Ambient Noise Study Extension
NE BC Heavily Traveled Roadways
Highway 97
John Hart Highway
Highway 2
Highway 49

Prepared for:
BC Oil and Gas Research and Innovation Society

Prepared by:
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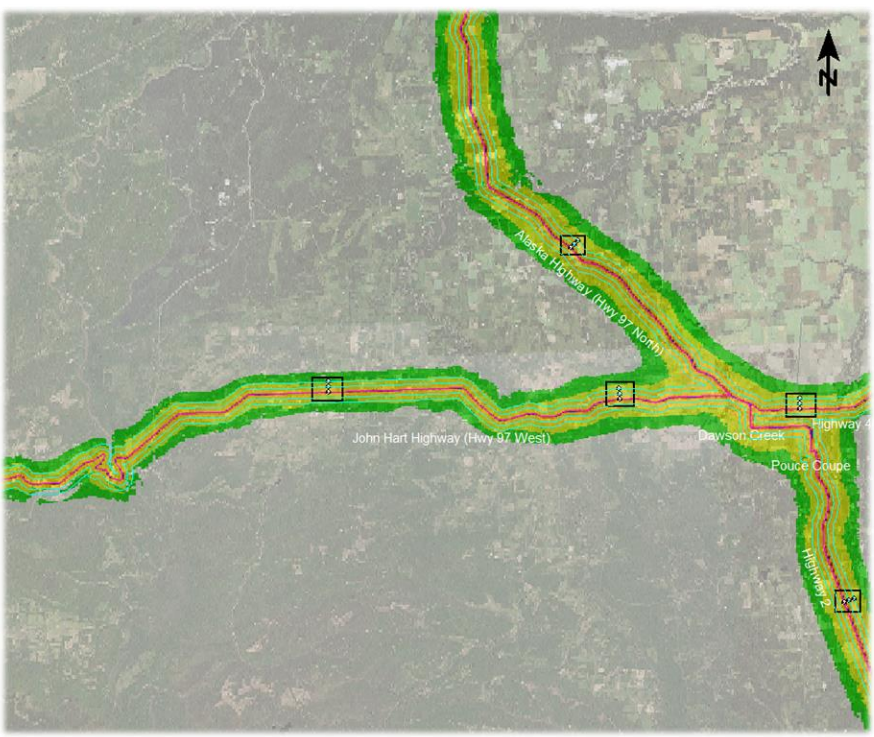
2021-04-01
Document ID: 005452-NIA-005



Acknowledgements

Patching Associates Acoustical Engineering Ltd. (PAAE) is grateful for the contribution of the BC Oil and Gas Research and Innovation Society (BC OGRIS) for funding this research project extension. We also appreciate the discussions, input, support, and feedback provided during the project by the BC Oil and Gas Commission (BCOGC). Finally, the noise modeling was only possible because of the data and support provided by the BC Ministry of Transportation and Infrastructure, this data was leveraged to create insights beyond its typical use and our work was better because the data was available.

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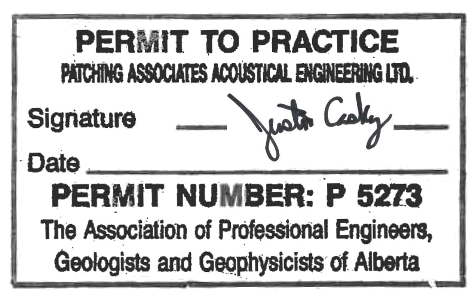
 PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA J. CASKEY # 47011	 PERMIT TO PRACTICE PATCHING ASSOCIATES ACOUSTICAL ENGINEERING LTD. Signature Date PERMIT NUMBER: P 5273 The Association of Professional Engineers, Geologists and Geophysicists of Alberta
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Executive Summary

BC Oil and Gas Research and Innovation Society (BC OGRIS, the client) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct an ambient noise study for NE BC Heavily Traveled Roadways, located near Dawson Creek, British Columbia.

Previous BC OGRIS project, (PAAE Document ID: 005452-CSS-001) competed in 2019/2020, established a validated method to assess ambient noise levels near the Alaska Highway through the Farmington Development Area. This previous project relied on noise monitoring to validate an effective method to model sound levels from the Alaska Highway and focused on a 42 km section through the Farmington Development Area. The project provided data to inform revisions to the BC OGC Noise Control Guideline as well as site-specific data to optimize noise mitigation measures for well sites near the Alaska Highway.

This study aims to apply the learnings from the 2019/2020 study to other roadways where development is ongoing or expected. These previous learnings include establishing a validated method to model noise emissions from highways with publicly available traffic volume data. Using this established method, the data and insight was extended from the 42 km of roadways in the Farmington Development Area to approximately 130 km without additional monitoring.

The purpose of the sound study is to quantify the current (2019/2020) ambient sound levels near the heavily traveled roadways, which will provide data for consideration in a review of current noise regulations and associated permissible sound levels in B.C., and provide more targeted and specific information to optimize noise mitigation planning. This report outlines the initial modeling results for heavily traveled roadways in Northeastern British Columbia. To achieve this purpose, several sections of heavy travelled highways were selected and modeled to establish a reliable method for predicting ambient sound levels from traffic. Several reference locations were selected in detail and results are presented in this report.

Table: Predicted sound level Results

Receiver	BC OGC Current Assumed BSL (ASL) (dBA)		Receiver Location	Summer		Winter		Long Term prevailing wind conditions	
	Daytime	Nighttime		Daytime SPL (dBA)	Nighttime SPL (dBA)	Daytime SPL (dBA)	Nighttime SPL (dBA)	Daytime SPL (dBA)	Nighttime SPL (dBA)
Receiver Locations (Category 3)	60.0 (55.0)	50.0 (45.0)	R15m Hwy2	67.1	61.3	65.8	60.0	66.4	60.6
			R15m Hwy49	63.6	58.3	63.5	58.3	63.6	58.4
			R15m Hwy97	66.8	60.9	65.8	59.7	66.6	60.5
			R15m JH Hwy	65.1	59.4	65.1	59.3	65.1	59.4
			R15m JH Hwy W	63.0	56.9	62.9	56.9	63.0	56.9
Receiver Locations (Category 2/3)	60.0 (55.0)	50.0 (45.0)	R30m Hwy2	63.4	57.6	62.1	56.3	62.7	56.9
			R30m Hwy49	59.6	54.4	59.5	54.3	59.7	54.4
			R30m Hwy97	62.6	56.7	61.6	55.5	62.4	56.3
			R30m JH Hwy	61.5	55.8	61.4	55.7	61.5	55.8
			R30m JH Hwy W	58.1	52.1	58.0	52.0	58.1	52.1
Receiver Locations (Category 1/2)	55.0 (50.0)	45.0 (40.0)	R500m Hwy2	41.3	35.5	38.7	32.9	41.0	35.2
			R500m Hwy49	41.9	36.5	41.0	35.7	42.4	36.9
			R500m Hwy97	42.8	36.9	40.9	34.7	43.0	36.9
			R500m JH Hwy	42.4	36.7	41.1	35.4	42.7	37.0
			R500m JH Hwy W	39.1	33.2	38.7	32.8	39.4	33.6
Receiver Locations (Category 1)	50.0 (45.0)	40.0 (35.0)	R1000m Hwy2	36.6	30.7	33.5	27.6	36.5	30.7
			R1000m Hwy49	36.1	30.7	34.4	28.9	36.7	31.2
			R1000m Hwy97	36.9	31.0	34.7	28.6	37.1	31.0
			R1000m JH Hwy	32.1	26.4	30.7	25.0	32.5	26.8
			R1000m JH Hwy W	27.2	21.3	26.8	20.9	27.3	21.4

The key findings and recommendations of the ambient noise study results are the following:

- The results of the noise prediction show that the acoustic environment near the highways were **highly impacted by transportation noise** in all the three typical modeled weather conditions.
- **Category 3 Receivers (<30m):** The sound levels are higher than the BSL at the reference receivers, located at 15m and 30m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment is dominated by the highway traffic and applying A2 adjustments is appropriate for these locations.
- **Category 2 Receivers (<500m):** Sound Levels from highways dominate the ambient sound levels within 500 meters (Category 2) and this would extend past 500m in some areas. Recommend applying A2 adjustment based on modeling results herein when designing noise mitigation, this recommendation extends to receivers in Category 1.
- **Category 1 Receivers (>500m):** The results indicate that the sound levels are lower than the BC OGC BSL at the reference receivers, located at 500m and 1000m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment was impacted by the highway traffic but may not be dominated by the highway traffic, especially the receivers approaching 1000m away. At these distances other non-highway noise sources would begin to dominate the ambient acoustic environment, typically these levels are assumed to be 35 dBA.
- For all categories, the **local topography** near the highway affects sound levels from traffic noise. This means that ambient sound levels can not be generalized. Patching Associates recommends using specific noise model results (sound contours) for A2 adjustments, as opposed to generic categories. Patching Associates recommend providing open access to these noise modeling results in electronic format for efficient use in planning by multiple operators.
- **Wind direction** will affect ambient sound level propagation from each highway at receivers in Category 1 and 2. Prevailing winds should be considered when establishing A2 ambient adjustment. Patching Associates recommend using long term prevailing wind noise contour calculations to establish A2 ambient adjustment. Operators may apply other wind condition scenarios to specific operations to assess risk or set A2 adjustments.
- **Background non-highway** sound levels are not included in the noise model contours and are expected to dominate the sound environment under some wind conditions for residences in Category 1 and 2. Recommend including background non-highway ambient sound levels (35 dBA unless otherwise established) when traffic noise model predicts levels between 30 and 40 dBA at receivers.
- The noise model prediction for the study area should be used for noise mitigation planning when receivers are within 1000m of the heavy travelled highways. Patching Associates recommend this prediction method should be validated annually, especially for the receivers located more than 500 m away, which will also minimize the prediction error from the traffic volume assumption for truck percentage, day-night traffic pattern, and travelling speed.

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Acronyms

Acronym	Description
AADT	Average Annual Daily Traffic
AB	Alberta
AER	Alberta Energy Regulator
ASL	Ambient Sound Level
BSL	Basic Sound Level
dB	Decibel
dBA	A-Weighted Decibel
dBC	C-Weighted Decibel
dBZ	Z-Weighted Decibel or Linear Decibel
CSL	Comprehensive Sound Level
DIL	Dynamic Insertion Loss
ISO	International Organization for Standardization
L_{eq}	Energy Equivalent Sound Level
LFN	Low Frequency Noise
LSD	Legal Subdivision
NIA	Noise Impact Assessment
NC	Noise Control
NR	Noise Reduction
PSL	Permissible Sound Level
PWL	Sound Power Level
SPL	Sound Pressure Level
TL	Transmission Loss
UTM	Universal Transverse Mercator
TNM	Federal Highway Administration's Traffic Noise Model

Introduction

BC Oil and Gas Research and Innovation Society (BC OGRIS, the client) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct an ambient noise study for NE BC Heavily Traveled Roadways, located near Dawson Creek, British Columbia.

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This study aims to apply the learnings from the 2019/2020 study to other roadways where development is ongoing or expected. These previous learnings include establishing a validated method to model noise emissions from highways with publicly available traffic volume data. Using this established method, the data and insight was extended from the 42 km of roadways in the Farmington Development Area to approximately 130 km without additional monitoring.

The purpose of the sound study is to quantify the current (2019/2020) ambient sound levels near the heavily traveled roadways, which will provide data for consideration in a review of current noise regulations and associated permissible sound levels in B.C., and provide more targeted and specific information to optimize noise mitigation planning. This report outlines the initial modeling results for heavily traveled roadways in Northeastern British Columbia. To achieve this purpose, several sections of heavy travelled highways were selected and modeled to establish a reliable method for predicting ambient sound levels from traffic.

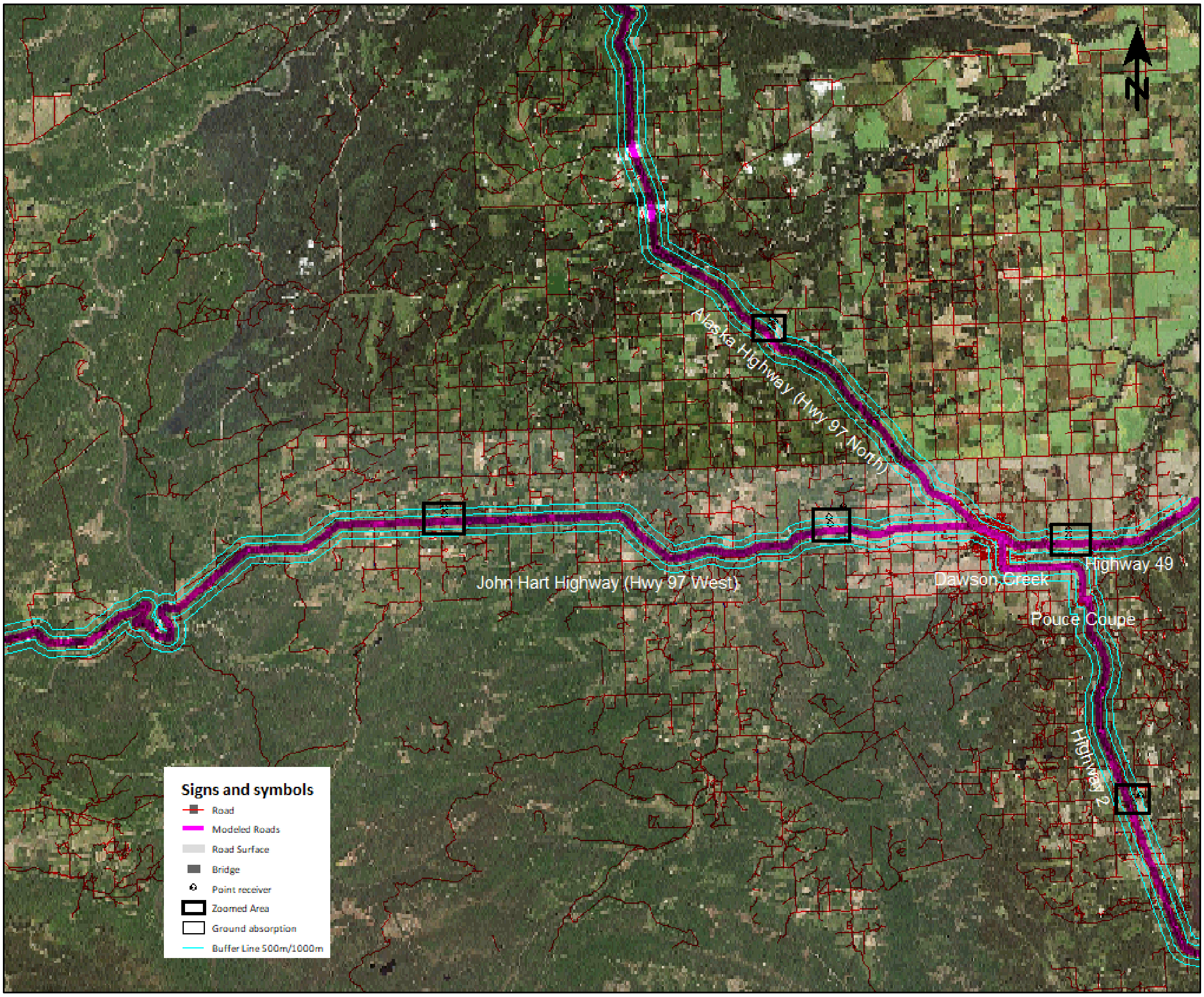
Study Area

The extended Farmington Development Area, affected by heavily traveled roadways, is the northeast area of British Columbia, located near Dawson Creek. The terrain cover is mainly rolling farmland with patches of tree. There are four heavily traveled highways involved in this area:

- Alaska Highway (97 North) Peace River (South of Tylor), BC to Dawson Creek, BC
- John Hart Highway (97 West) Dawson Creek to East of Chetwynd, BC
- Highway 49 Dawson Creek, BC to Alberta Border
- Highway 2 Dawson Creek, BC to Alberta Border

The four reference locations, located 15m, 30m 500m, and 1000m away, were selected to demonstrate the noise emission from each highway with consistent traffic situation, shown as zoomed areas in Figure 1.

Figure 1: Study Area Map



Noise Criteria

Noise for energy related facilities is regulated through the BC OGC Noise Control Guideline (the Guideline). The Guideline sets the Permissible Sound Level (PSL), which is the limit that the Sound Pressure Level (SPL) emanating from the facilities in the study area plus the Ambient Sound Level (ASL) may not exceed over a specified period, as measured at specific locations of interest (the receivers). These allowable limits are dependent on the population density, proximity to heavily traveled transportation routes (motor vehicles, rail and aircraft) and other specified adjustments. The SPL is the sound level received at a specific location. The ASL is the average background sound level not attributable to energy industry facilities. The ASL is assumed to be 5 dBA below the PSL, as prescribed by the Guideline. The receivers are located at the residences existing within 1500 m of the subject facility, or else at the study area boundary.

The ambient sound level (ASL) is the average sound environment in a given area without contribution from any energy-related industry. This project aims to collect data for consideration in a review of noise regulations and associated permissible sound levels in B.C. Current regulations are based on research conducted in Alberta several decades ago that relied on approximate and simplified categories to establish permissible sound levels and compliance criteria for oil and gas activities.

The four reference locations, located 15m, 30m 500m, and 1000m away from each highway with consistent traffic situation have been selected to cover the nearby areas along the highway to get representative conditions in this area, and classified as each of the Categories for the Basic and Ambient Noise Levels definition, See Appendix B for the BSL and PSL calculations based on the Guideline.

Environmental noise level is typically not steady and continuous, but constantly varies over time. To account for the time-varying nature of environmental noise, a single number descriptor known as the energy equivalent sound level (L_{eq}) is used. The L_{eq} value, expressed in dBA, is the A-weighted equivalent-continuous sound level for the complete period of interest that has the same acoustic energy as the actual varying sound levels over the same time period. The use of this index permits the description of a varying sound level environment as a single number. As the L_{eq} is an “average” level, the measured sound level may exceed the criterion level for a short period, provided that the duration is limited. The L_{eq} value considers both the sound level and the length of time that the sound level occurs.

Methodology

This study setup a procedure to predict of road traffic noise based on road traffic parameters, receiver description and topographical features, which will be used to assess the noise impact from existing roadways on planned residential land uses, to assess the noise impact of roadway projects, and to establish the ambient noise level criterion for the purposes of approval of new noise sources and for complaint investigation.

The prediction method is based on an assumption that a roadway may be represented by a series of straight line sections (segments). For each road section, vehicles are classified into one of three acoustic source groups: automobiles, medium trucks, and heavy trucks. The model is based on determination of the reference sound level which is a function of the reference energy mean emission levels for these three categories of vehicles and the average speed of traffic flow. This procedure also assumed typical traffic and noise propagation conditions which are consistent during the assessed periods. General procedure:

1) Road Segment Selection

Divide the roadways into segments such that the variation of noise within the segment is small.

2) Basic Noise Level Calculation

Calculate the basic noise level at a reference distance of 15m away from the center of the nearside roadway for each segment. The traffic noise levels were predicted using the Federal Highway Administration's Traffic Noise Model (FHWA TNM) 2.5 module in SoundPlan [Version 8.2]. The modeling parameters are shown in the Noise Prediction section of the report. The traffic flow to be used in the calculation of this study were obtained from the traffic count data available on from the BC traffic count program, see Appendix C for more details.

3) Noise Propagation Prediction

Assess for each segment with the noise level at the reception points, considering distance attenuation and screening of the source line. The line source of traffic noise is taken to be a line 0.5m above the road surface and 3.7m in from the road edge.

4) Site Layout Consideration as Needed

Correct the noise level at the expected receiver locations, for some specific areas if needed, to consider site layout features including reflections from buildings and facades, and the size of the source segment and terrain information. Such details were neglected in this study due to large area, but could be included if needed and such detailed information is available.

5) Noise level prediction and noise map calculation - Combine contributions from all segments

Combine the contributions from all road segments to give the predicted noise level at the receiver locations and the area for the whole road scheme.

Model input

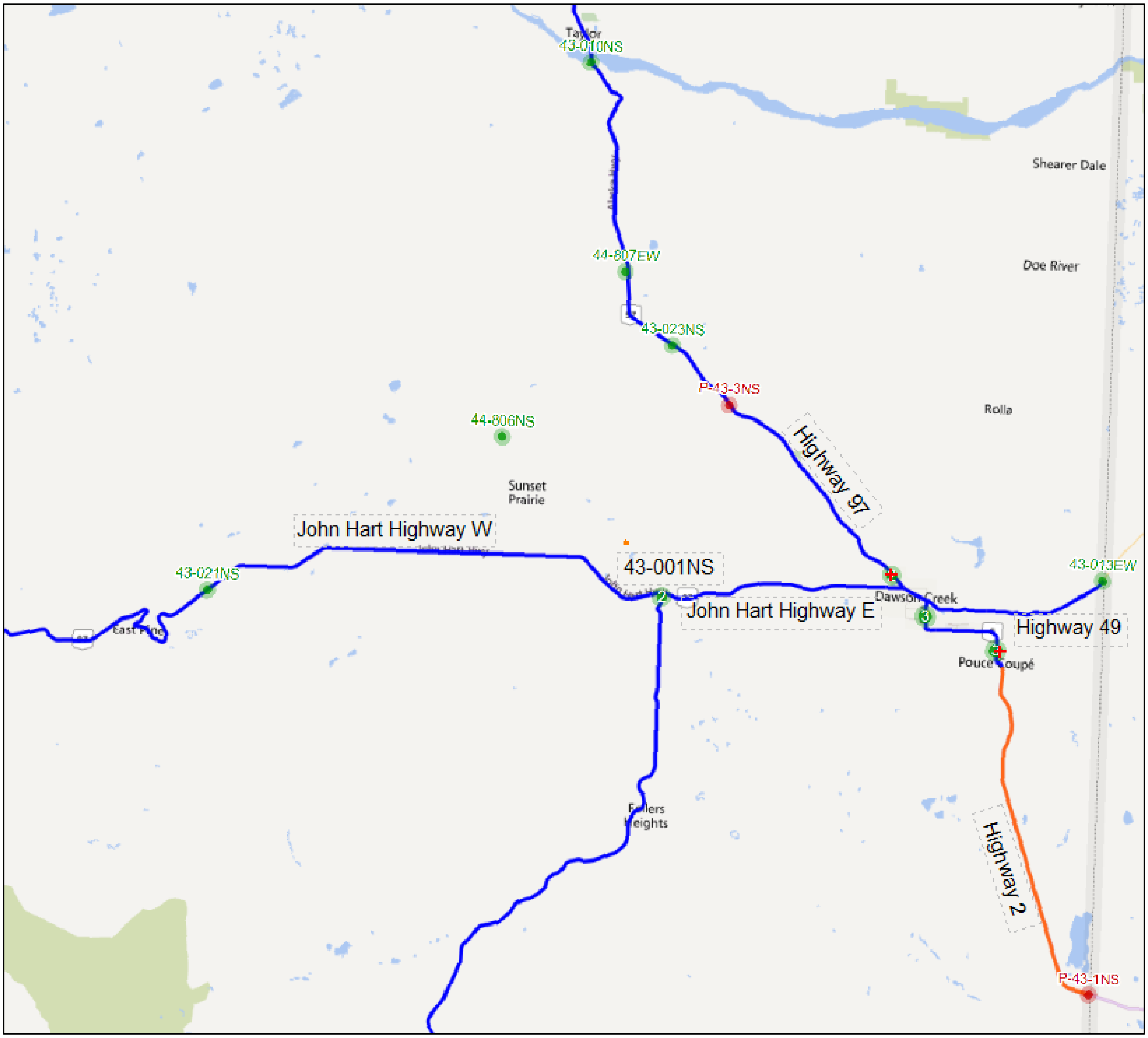
In this study area, four road segments were selected based on the consistent traffic pattern, traffic pattern in each segment assumed to be represented by the traffic count location, shown as Figure 2 and Table 1 based on the most recent traffic count available.

Table 1: Roadway Segment Traffic Information*

Road Segment	Corresponding Traffic Count Location (Site Name)	AADT/SADT/WADT	Traffic Volume Daytime/Nighttime (% of ADT)	Truck %	Truck Ratio (M/H)	Post Speed (kph)
Alaska Highway (Hwy 97 North) – Peace River, BC to Pouce Coupe, BC	Farmington - P-43-3NS, Alaska Highway	5172/5533/4470 (2019)	86.6/13.4	29.2	1/2	100
Highway 2 - Pouce Coupe, BC to Alberta Border	Tupper - P-43-1NS, Dawson Creek - Tupper	3791/4401/3296 (2018)	86.6/13.4	32.2	1/3	100
John Hart Highway East (Hwy 97 West) - Dawson Creek to Heritage Highway (Hwy 52)	Kiskatinaw River Bridge - 43-001NS, John Hart - Peace River	3182/3182/- (2017)	86.0/14.0	-	-	100
John Hart Highway West (Hwy97 West) – Heritage Highway (Hwy 52) to Chetwynd, BC	Chetwynd - 43-021NS, John Hart - Peace River	1916/1916/- (2017)	88.0/12.0	-	-	100
Highway 49 - Dawson Creek, BC to Alberta Border	Spirit River Highway - 43-013EW, Dawson Creek - Spirit River	2790/2790/- (2017)	84.0/16.0	-	-	90

Note: Data collected from BC The Ministry of Transportation and Infrastructure's Traffic Data Program Online

Figure 2: Area Traffic Map*



Note: Data comes from BC The Ministry of Transportation and Infrastructure's Traffic Data Program Online

All the highway segments were modelled as one lane in each direction. If the truck information is not available for some of the road segments, truck percentage was assumed as 30%, and the truck ratio (M/H) 1:2 (Medium truck/heavy truck). The nighttime traffic volumes in this area approximately 12-16% of the average daily traffic volume as per the traffic count data available, Nighttime traffic volume as 15% of the ADT was assumed in this study.

Noise Predictions

In the extended area of Farmington Development Area, several highways including Alaska Highway (Highway 97 north), John Hart Highway (Hwy 97 West), Highway 2 and Highway 49, are the major noise sources. To assess the potential impact from the traffic noise from these highways to the ambient noise, noise prediction model was built in this area.

The physical layout near these highways were obtained from, aerial photos, and topographical maps obtained from Natural Resources Canada. Sound power levels of these highways were determined as per the daytime and nighttime hourly traffic volume in the area at the corresponding traffic counting locations. Sound propagation calculations were then undertaken to predict the sound pressure level that will exist at the selected reference receiver locations. All calculations were undertaken in octave bands.

The noise modeling was conducted using the noise modeling software package SoundPLAN 8.2 incorporated the FHWA TNM 2.5 module based on the traffic volumes, grades of roads, speeds, and land topography. SoundPLAN is an advanced noise propagation model that considers geometric spreading, atmospheric sound absorption, ground impedance effects, site topography and geometry, vegetation, and environmental conditions. The calculations performed in SoundPLAN were conducted in accordance with ISO 9613. The ground cover was modeled as mixed ground with the consideration of ground covered by grass, trees or other vegetation.

The SoundPLAN implementation of TNM v2.5 has two modes, the default mode is the compatibility mode where the algorithm of TNM v2.5 is implemented in its original form, and the other is an updated TNM v2.5 mode where modifications have been applied to improve the accuracy of the original algorithm. The latter mode was used in this analysis.

Traffic data (See Appendix C) provided by the BC Ministry of Transportation and Infrastructure gave the classifications of truck percentages for some of the highways with most recent 10-year traffic data summary at the permanent traffic count sites.

The modeled speeds were based on posted speeds of the roads in this study area, which is 100 kph except the Highway 49, which is 90 kph.

Table 2 lists the major parameters used in the noise model. These parameters follow accepted acoustical engineering methodologies. The modeled conditions produce results representative of meteorological conditions favouring sound propagation (e.g., downwind or mild temperature inversion conditions), as prescribed by the Guideline. This environmental condition modeled represents “close-to-worst-case” sound propagation conditions as per ISO 9613-2. The long-term prevailing wind conditions considering yearly average traffic were also considered in this noise study.

Table 2: Modeling Parameters

Parameter	Value	Description
Modeling software	SoundPLAN 8.2	An advanced noise propagation model that considers geometric spreading, atmospheric sound absorption, ground impedance effects, site topography and geometry, vegetation and environmental conditions. The SoundPLAN model calculates the contribution level of each noise source at the receiver location in octave bands as well as calculating the overall facility sound level.
Standard followed	ISO 9613	As recommended in the Guideline. Specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The published accuracy for this standard is ±3 dBA between 100 m to 1000 m. Accuracy levels beyond 1000 m are not published.
Wind Condition	ISO 9613 Standard Condition: 1 – 5 m/s Downwind	ISO 9613 uses a slight downwind condition from each noise source to each receiver. Wind speed is measured at a height of 3 m to 11 m above ground and covers the acceptable range specified in the Guideline.
	Long Term Wind Condition	Modeled as per the long term prevailing wind conditions in the study area, 3-years historical hourly weather data (from 2017 – 2020) collected from Environment Canada database at Dawson Creek airport.
Ground Factor	0.0 for water bodies and roads 0.6 everywhere else	The ground factor G is a property of the ground material, with value ranging from 0 to 1. The typical values below were determined from several standards and guidelines, including ISO 9613, Commission Directive EU 2015/996, and Nord 2000. G = 0.0 is suitable for asphalt, concrete, pavement, water G = 0.3 is suitable for compacted dense ground, gravel road, hard soil G = 0.6 is suitable for sand, compacted field and gravel, roadside dirt G = 0.8 is suitable for cultivated land, such as farm land G = 1.0 is suitable for uncultivated land, such as forest floor and loose ground For residential properties, the ground factor was determined from the proportion of the above typical values, based on satellite images.
Order of Reflection	3	The model calculates reflection effects from the reflective surfaces included in the model.
Foliage	excluded	Currently not included in this study to enhance the calculation speed, if for local area, can be modeled as ground absorption 0.8, based on conservative considerations due to the presence of human dwelling residences in the study area.
Temperature	10ºC (Summertime, Long Term) -20ºC (Wintertime)	Represents typical nighttime temperature.
Relative Humidity	80% (Summertime, Long Term) 50% (Wintertime)	Represents typical nighttime relative humidity.
Topography	Included	Topographical data obtained from Natural Resources Canada. Resolution of 5 m.

Table 3 shows the predicted sound level results for the four selected reference locations, which impacted by the nearby highways.

Table 3: Predicted sound level Results

Receiver	BC OGC Current Assumed BSL (ASL) (dBA)		Receiver Location	Summer		Winter		Long Term prevailing wind conditions	
	Daytime	Nighttime		Daytime SPL (dBA)	Nighttime SPL (dBA)	Daytime SPL (dBA)	Nighttime SPL (dBA)	Daytime SPL (dBA)	Nighttime SPL (dBA)
Receiver Locations (Category 3)	60.0 (55.0)	50.0 (45.0)	R15m Hwy2	67.1	61.3	65.8	60.0	66.4	60.6
			R15m Hwy49	63.6	58.3	63.5	58.3	63.6	58.4
			R15m Hwy97	66.8	60.9	65.8	59.7	66.6	60.5
			R15m JH Hwy	65.1	59.4	65.1	59.3	65.1	59.4
			R15m JH Hwy W	63.0	56.9	62.9	56.9	63.0	56.9
Receiver Locations (Category 2/3)	60.0 (55.0)	50.0 (45.0)	R30m Hwy2	63.4	57.6	62.1	56.3	62.7	56.9
			R30m Hwy49	59.6	54.4	59.5	54.3	59.7	54.4
			R30m Hwy97	62.6	56.7	61.6	55.5	62.4	56.3
			R30m JH Hwy	61.5	55.8	61.4	55.7	61.5	55.8
			R30m JH Hwy W	58.1	52.1	58.0	52.0	58.1	52.1
Receiver Locations (Category 1/2)	55.0 (50.0)	45.0 (40.0)	R500m Hwy2	41.3	35.5	38.7	32.9	41.0	35.2
			R500m Hwy49	41.9	36.5	41.0	35.7	42.4	36.9
			R500m Hwy97	42.8	36.9	40.9	34.7	43.0	36.9
			R500m JH Hwy	42.4	36.7	41.1	35.4	42.7	37.0
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Receiver Locations (Category 1)	50.0 (45.0)	40.0 (35.0)	R1000m Hwy2	36.6	30.7	33.5	27.6	36.5	30.7
			R1000m Hwy49	36.1	30.7	34.4	28.9	36.7	31.2
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- The predicted sound level results indicate that the sound levels are higher than the BSL at the reference receivers, located at 15m and 30m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment was dominated by the highway traffic..

- The. sound levels are lower than the BC OGC BSL at the reference receivers, located at 500m and 1000m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment was impacted by the highway traffic but may not be dominated by the highway traffic, especially the receivers approaching1000 m away. At these distances other non-highway noise sources would begin to dominate the ambient acoustic environment, typically these levels are assumed to be 35 dBA.

- The predicted results could be affected by the following factors:

  - The noise emission model was built as per the average traffic volume and traffic classifications at the traffic count location, which may not represent the actual fluctuation of the traffic noise.
  - The truck percentage and classifications were assumed the same pattern during daytime and nighttime period, in the actual situation there will be more trucks and different traffic pattern during the nighttime, which may under-predict the noise emission from highway during nighttime period.
  - The results were based on averaged wind conditions, actual wind conditions will vary, affecting sound levels. .
  - The predicted noise level only considers the noise emission from the highway traffic, which means the prediction only applies the traffic dominated situation, which means this noise model prediction for the study area should be used for noise mitigation planning when receivers are within 1000m of the heavy travelled highways. Patching Associates recommend this prediction method should be validated annually, especially for the receivers located more than 500 m away, which will also minimize the prediction error from the traffic volume assumption for truck percentage, day-night traffic pattern, and travelling speed
  - Non-highway ambient sound levels are not included in this study or the noise model contours and are expected to dominate the sound environment under some wind conditions for residences in Category 1 and 2. Recommend including background non-highway ambient sound levels (35 dBA unless otherwise established) when traffic noise model predicts levels between 30 and 40 dBA at receivers.

The results of the noise modeling were also converted into a noise map of the extended area. The noise prediction results indicate that there will be significant noise impacts on the nearby area along the modeled heavy travelled highways in the study area.

The figures in Appendix D depict the daytime and nighttime predicted sound levels from the heavy travelled highways in the study area in different weather conditions (summertime, wintertime and long term prevailing wind conditions) excluding the ambient sound levels (ASL).

- Figures D1/2 were based on ISO standard wind condition, summertime, daytime/nighttime.

- Figures D3/4 were based on ISO standard wind condition, wintertime, daytime/nighttime.

- Figures D5/6 were based on based on long term prevailing wind condition, daytime/nighttime.

Limitations

This traffic noise modeling procedure is not applicable in situations where the existing acoustical environment is not dominated by an existing highway traffic noise source. Highway traffic noise models are not capable of accurately determining existing noise levels where highway traffic noise is not the dominant contributing acoustical characteristic. Generally, the procedure is intended for sites that are currently influenced by highway traffic noise. In areas dominated by background (non-roadway) noise sources, monitored (rather than modeled) noise levels should be used to determine existing noise levels, thereby accurately representing the existing noise environment. Professional judgment shall be used when selecting sites for determining the ambient noise levels in such areas.

In order to verify the accuracy of the noise model used to predict existing noise levels, existing noise levels monitored in the field should be compared with the noise level predictions for the traffic conditions observed during the monitoring period.

Conclusion

BC Oil and Gas Research and Innovation Society (BC OGRIS, the client) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct an ambient noise study for NE BC Heavily Traveled Roadways, located near Dawson Creek, British Columbia.

The purpose of the sound study is to quantify the current (2019/2020) ambient sound levels near the heavily traveled roadways in northeast B.C., which will provide data for consideration in a review of current noise regulations and associated permissible sound levels, and provide more targeted and specific information to optimize noise mitigation planning. This report outlines the initial modeling results for heavily traveled roadways in Northeastern British Columbia. To achieve this purpose, several sections of heavy travelled highways were selected and modeled to establish a reliable method for predicting ambient sound levels from traffic. Several reference locations were selected in detail and results are presented in this report.

The key findings and recommendations of the ambient noise study results are the following:

- The results of the noise prediction show that the acoustic environment near the highways were **highly impacted by transportation noise** in all the three typical modeled weather conditions.
- **Category 3 Receivers (<30m):** The sound levels are higher than the BSL at the reference receivers, located at 15m and 30m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment is dominated by the highway traffic and applying A2 adjustments is appropriate for these locations.
- **Category 2 Receivers (<500m):** Sound Levels from highways dominate the ambient sound levels within 500 meters (Category 2) and this would extend past 500m in some areas. Recommend applying A2 adjustment based on modeling results herein when designing noise mitigation, this recommendation extends to receivers in Category 1.
- **Category 1 Receivers (>500m):** The results indicate that the sound levels are lower than the BC OGC BSL at the reference receivers, located at 500m and 1000m from the highway in all the three typical modeled weather conditions, which means that the acoustic environment was impacted by the highway traffic but may not be dominated by the highway traffic, especially the receivers approaching1000m away. At these distances other non-highway noise sources would begin to dominate the ambient acoustic environment, typically these levels are assumed to be 35 dBA.
- For all categories the **local topography** near the highway affects sound levels from traffic noise. This means that ambient sound levels can not be generalized. Patching Associates recommends using specific noise model results (sound contours) for A2 adjustments, as opposed to generic categories. Recommend providing open access to these noise modeling results in electronic format for efficient use in planning by multiple operators.
- **Wind direction** will affect ambient sound level propagation from each highway at receivers in Category 1 and 2. Prevailing winds should be considered when establishing A2 ambient adjustment. Recommend

using long term prevailing wind noise contour calculations to establish A2 ambient adjustment. Operators may apply other wind condition scenarios to specific operations to assess risk or set A2 adjustments.

- Background non-highway sound levels are not included in the noise model contours and are expected to dominate the sound environment under some wind conditions for residences in Category 1 and 2. Recommend including background non-highway ambient sound levels (35 dBA unless otherwise established) when traffic noise model predicts levels between 30 and 40 dBA at receivers.
- The noise model prediction for the study area should be used for noise mitigation planning when receivers are within 1000m of the heavy travelled highways. Patching Associates recommend this prediction method should be validated annually, especially for the receivers located more than 500 m away, which will also minimize the prediction error from the traffic volume assumption for truck percentage, day-night traffic pattern, and travelling speed.

References

Alberta Utilities Commission (AUC) Rule 012: Noise Control (AUC 2013).

British Columbia Oil and Gas Commission (BC OGC) *British Columbia Noise Control Best Practices Guideline*. 2009. British Columbia, Canada.

International Organization for Standardization (ISO). 1993. *Standard 9613-1, Acoustics – Attenuation of Sound during Propagation Outdoors – Part 1: Calculation of Absorption of Sound by the Atmosphere*, Geneva Switzerland.

International Organization for Standardization (ISO) 1996. *Standard 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation*, Geneva Switzerland.

Natural Resources Canada: www.nrcan.gc.ca

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APPENDIX A

Technical Details Regarding
Sound Measurement and Analysis

Technical Details

Sound is the phenomena of vibrations transmitted through air, or other medium such as water or a building structure. The range of pressure amplitudes, intensities, and frequencies of the sound energy is very wide, and many specialized fields have developed using different ranges of these variables, such as room acoustics and medical ultrasound.

Due to the wide range of intensities, which are perceived as sound, standard engineering units become inconvenient. Sound levels are commonly measured on a logarithmic scale, with the level (in decibels, or dB) being proportional to ten times the common logarithm of the sound energy or intensity. Normal human hearing covers a range of about twelve to fourteen orders of magnitude in energy, from the threshold of hearing to the threshold of pain. On the decibel scale, the threshold of hearing is set as zero, written as 0 dB, while the threshold of pain varies between 120 to 140 dB. The most usual measure of sound is the sound pressure level (SPL), with 0 dB SPL set at 2.0 X 10^{-5} N/m^2 (also written 20 μPa), which corresponds to a sound intensity of 10^{-12} Watts/m^2 (or 1 picoWatt/m^2, written 1 pW/m^2).

Normal human hearing spans a frequency range from about 20 Hertz (Hz, or cycles per second) to about 20,000 Hz (written 20 kHz). However, the sensitivity of human hearing is not the same at all frequencies. To accommodate the variation in sensitivity, various frequency-weighting scales have been developed. The most common is the A-weighting scale, which is based on the sensitivity of human hearing at moderate levels; this scale reflects the low sensitivity to sounds of very high or very low frequencies. Sound levels measured on the A-weighted scale are written in A-weighted decibels, commonly shown as dBA or dB(A).

Human hearing becomes more sensitive to lower frequency sounds as the level of the sound increases. For this purpose, the C-weighing scale was developed to assess reaction to higher levels sounds. Although the C-weighting scale, or the sound level in dBC, is seldom used on its own, the levels in dBC and dBA are often used together to assess the significance of the low-frequency components of sound. In some cases, a limit is placed on the dBC level at a location in order to limit the amount of low-frequency noise.

When sound is measured using the A-weighting scale, the reading is often called the "Noise level", to confirm that human sensitivity and reactions are being addressed. A table of some common noise sources and their associated noise levels are shown in the table below.

When the A-weighting scale is not used, the measurement is said to have a "linear" weighting, or to be unweighted, and may be called a "linear" level. As the linear reading is an accurate measurement of the physical (sound) pressure, the term "Sound Pressure Level", or SPL, is usually (but not universally) reserved for unweighted measurements.

Noise is usually defined as "unwanted sound", which indicates that it is not just the physical sound that is important, but also the human reaction to the sound that leads to the perception of sound as noise. It implies a judgment of the quality or quantity of sound experienced. As a human reaction to sound is involved, noise levels are usually given in A-weighted decibels (dBA). However, use of the C-weighting scale, usually in combination with the dBA level, is becoming more common as well. An alternate definition of noise is "sound made by somebody else", which emphasizes that the ability to control the level of the sound alters the perception of noise.

Table A1: Noise Levels of Familiar Sources

Source Or Environment	Noise Level (dBA)
High Pressure Steam Venting To Atmosphere (3 m)	121
Steam Boiler (2 m)	90-95
Drilling Rig (10 m)	80-90
Pneumatic Drill (15 m)	85
Pump Jack (10 m)	68-72
Truck (15 m)	65-70
Business Office	65
Conversational Speech (1 m)	60
Light Auto Traffic (30 m)	50
Living Room	40
Library	35
Soft Whisper (5 m)	20-35

The single number A-weighted level is often inadequate for engineering purposes, although it does supply a good estimate of people's reaction to a noise environment. As noise sources, control measures, and materials differ in the frequency dependence of their noise responses or production, sound is measured with a narrower frequency bandwidth; the specific methodology varies with the application. For most work, the acoustic frequency range is divided into frequency bands where the center frequency of each band is twice the frequency of the next lower band; these are called "Octave" bands, as their frequency relation is called an "Octave" in music, where the field of acoustics has its roots. For more detailed work, the octave bands, and certain standard octave and 1/3 octave bands have been specified by international agreements.

Where the noise at the receiver is steady, it is easy to assess the noise level. However, both the production of noise at the source and the transmission of noise can vary with time; most noise levels are not constant, either because of the motion of the noise source (as in traffic noise), because the noise source itself varies, or because the transmission of sound to the receiver location is not steady as over long distances. This is almost always the case for environmental noise studies. Several single number descriptors have been developed and are used to assess noise in these conditions.

The most common is the measurement of the "equivalent continuous" sound level, or L_{eq}, which is the level of a hypothetical source of a constant level which would give the same total sound energy as is measured during the sampling period. This is the "energy" average noise level. Typical sampling periods are one hour, nighttime (9 hours) or one day (24 hours); the sampling period used must be reported when using this unit.

The greatest value of the L_{eq} is that the contributions of different sources to the total noise level can be assessed, or in a case where a new noise source is to be added to an existing environment, the total noise level from new and old sources can be easily calculated. It is also sensitive to short term high noise levels.

Statistical noise levels are sometimes used to assess an unsteady noise environment. They indicate the levels that are exceeded a fixed percentage of the measurement time period measured. For example, the 10th percentile level, written L_{10}, is the levels exceeded 10% of the time; this level is a good measure of frequent noisy occurrences such as steady road traffic. The 90% level, L_{90}, is the level exceeded 90% of the time, and is the background level, or noise floor. A steady noise source will modify the background level, while an intermittent noise source such as road or rail traffic will affect the short-term levels only.

One disadvantage with the L_{eq} measure, when used alone, is that nearby loud sources (e.g. dogs barking, or birds singing) can confuse the assessment of the situation when it is the noise from a distant plant that is the concern. For this reason, the equivalent level and the statistical levels can be used together to better understand the noise environment. One such indication is the difference between the L_{eq} and the L_{90} levels. A large difference between the L_{eq} and L_{90}, greater than 10 dB, indicates the intrusion of short-term noise events on the general background level. A small difference, less than 5 dB, indicates a very steady noise environment. If the L_{eq} value exceeds the L_{10} value this indicates the presence of significant short-term loud events.

For most noise measurement, instruments are adjusted so that the time response of the instrument is similar to the response of the human ear; this is the “Fast” setting. Measurement with the “Fast” setting therefore assesses the sound environment according to the way humans would hear it and react to it. Where the noise level varies substantially and an average level is wanted without the complexity of and L_{eq} or statistical measurement, the “Slow” setting is used on the sound level meter. The “Slow” setting is also typically used in industrial settings where hearing damage is a concern. Where the noise level changes very rapidly, for example due to impacts or detonations, the “Fast” and “Slow” settings do not respond quickly enough to assess the maximum levels, and the “Impulse” meter setting us used.

The Sound Power Level (abbreviated L_w, SWL or PWL) is the decibel equivalent of the total energy emitted from a source in the form of noise. The reference level for the sound power is 10^{-12} Watts, or 1 picoWatt (abbreviated pW). The sound power level is given by:

$$L_w, \text{SWL}, \text{PWL} = 10 \times \log_{10} (\text{Emitted Power} / 1 \text{ pW}) \text{ dB}$$

Therefore, a source emitting 1 Watt of power in the form of sound would have a sound power level of 120 dB. Sound power levels can be expressed in terms of frequency bands, an overall linear-weighted level or A-weighted, as is the case for sound pressure levels. However, sound power levels are inherent to the source of noise, whereas the sound pressure level is dependant on the source, but also on the distance from the source and other environmental factors.

Note that according to the acoustical literature (E.g. Noise Control Engineering from Bies and Hanson), the subjective effect of changes in SPL is as follows:

- A 3 dB change is “just perceptible”.
- A 5 dB change is “clearly noticeable”.
- A 10 dB change is “twice as loud or half as loud”.
- A 20 dB change is “much louder or much quieter”.

Table A2: Glossary

Term	Description
Average Annual Daily Traffic (AADT)	The total volume of vehicle traffic of a highway or road for a year divided by 365 days.
Alberta Energy Regulator (AER)	The Alberta Energy Regulator ensures the safe, efficient, orderly, and environmentally responsible development of hydrocarbon resources over their entire life cycle. This includes allocating and conserving water resources, managing public lands, and protecting the environment while providing economic benefits for all Albertans.
Ambient sound level (ASL)	The sound pressure level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ASL does not include any energy-related industrial component and must be measured without it. The ASL is assumed to be 5 dBA below the determined PSL as per Rule 012.
A-weighted sound level (dBA)	The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies.
Bands (full octave or 1/3 octave)	A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it. The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency.
Cumulative SPL	The cumulative sound pressure level from the facilities and the ambient sound level.
Comprehensive Sound Level (CSL)	The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The CSL does include industrial components and must be measured with them, but it should exclude abnormal noise events. The CSL is used to determine whether a facility is in compliance with the Directive.
Cumulative noise level	The sound level that is the total contribution of all industrial noise sources (existing and proposed) from EUB-regulated facilities at the receptor.
C-weighted sound level (dBC)	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.
Daytime	Defined as the hours from 07:00 to 22:00.
Deferred facility	Facilities constructed and in operation prior to October 1988. These facilities do not have to demonstrate compliance in the absence of a complaint. This does not exempt them from the requirements but does recognize that they were potentially designed without the same considerations for noise as facilities approved after the date when the first comprehensive noise control directive (ID 88-1) was published and put into effect.
Directive 038: Noise Control	Directive 038: Noise Control states the requirements for noise control as they apply to all operations and facilities under the jurisdiction of the Alberta Energy and Utilities Board (EUB). The directive also provides background information and describes an approach to deal with noise problems. This directive is the fifth edition, superseding Interim Directive (ID) 99-8.
Energy equivalent sound level (Leq)	The average weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. The time interval used should be specified in brackets following the Leq—e.g., Leq (9) is a 9-hour Leq. If a sound level is constant over the measurement period, the Leq will equal the constant sound level.
Emergency	An unplanned event requiring immediate action to prevent loss of life or property. Events occurring more than four times a year are not considered unplanned.
Facility SPL	The overall sound pressure level from all the facilities in the study area

Table A2: Glossary

Term	Description
Heavily Travelled Road	Generally includes highways and any other road where the average traffic count is at least 10 vehicles/hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern. The AER will use the 10 vehicles/hour criterion to determine whether highways qualify as heavily travelled during the nighttime period.
Low Frequency Noise (LFN)	Where a clear tone is present below and including 250Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.
Nighttime	Defined as the hours from 22:00 to 07:00.
Noise	Generally associated with the unwanted portion of sound.
Noise Impact Assessment (NIA)	An NIA identifies the expected sound level emanating from a facility as measured 15 m from the nearest or most impacted permanently or seasonally occupied dwelling. It also identifies what the permissible sound level is and how it was calculated.
Permanent facility	A facility that is in operation for more than two months.
Permissible Sound Level (SPL)	The maximum SPL that a facility must not exceed at receivers located within 1500 m from the subject facility fence line. The PSL for each receiver is determined as per section 2.1 of the Directive.
Receiver	The location of the residences existing in the NIA study area for which the SPL is determined. In the event that there are no residences existing in the study area, then hypothetical receivers are included at 1500 m from the subject facility fence line.
Representative conditions	Those conditions typical for an area and/or the nature of a complaint. For ASLs, these are conditions that portray the typical activities for the area, not the quietest time. For CSLs, these do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated. Sound levels must be taken only when representative conditions exist; this may necessitate a survey of extensive duration (two or more consecutive nights).
Sound Power Level (PWL)	The sound level emitted. The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level is given by: $PWL = 10 \times LOG_{10}\left(\frac{Sound\ as\ Power}{W_0}\right)$ Where $W_0 = 10^{-12}$ watts (or 1 pW)
Sound Pressure Level (SPL)	The sound level received. The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. The sound pressure level is given by: $SPL = 10 \times LOG_{10}\left(\frac{Sound\ as\ Pressure}{P_0}\right)$ Where $P_0 = 2 \times 10^{-5}$ Pa (or 20 μPa)
Subject facility	The energy industry facility which is the object of the NIA.
Temporary facility	Any facility that will be in operation less than 60 days.
Tonal component	A pronounced peak clearly obvious within the sound level spectrum.
Federal Highway Administration's Traffic Noise Model (FHWA TNM)	A methodology comprised of acoustic algorithms and computer architecture, for noise prediction, and barrier analysis and design.
Heavy Trucks	All cargo vehicles with three or more axles -- generally with gross vehicle weight more than 12,000 kg (26,400 lb).
Medium Trucks	All cargo vehicles with two axles and six tires -- generally with gross vehicle weight between 4,500 kg (9,900 lb) and 12,000 kg (26,400 lb).

Appendix B: Permissible Sound Level Determination

BC OGC Noise Control Guideline: Permissible Sound Level Determination
Receiver Locations, 15m and 30m from the Roadway

Basic Nighttime Sound Level

Proximity to Transportation	Dwelling Unit Density per ¼ Section of Land			Nighttime	Daytime
	1 - 8 Dwellings	9 - 160 Dwellings	>160 Dwellings		
Category 1	40	43	46		
Category 2	45	48	51		
Category 3	50	53	56	50	50
Daytime Adjustment				N/A	10
Basic Sound Levels				40	60

Class A Adjustments

Class	Reason for Adjustment	Value (dBA L_{eq})	Nighttime	Daytime
A1	Seasonal Adjustment (Wintertime Operation)	+5	N/A	N/A
A2	Ambient Monitoring Adjustment	-10 to +10	N/A	N/A
	Class Adjustment = Sum of A1 and A2 (as applicable), but not to exceed a maximum of 10 dBA L_{eq}			
Total Class A Adjustments			0	0

Class B Adjustments

Class	Duration of Activity	Value (dBA L_{eq})	Nighttime	Daytime
B1	1 day	+15		
B2	7 days	+10		
B3	< or = to 60 days	+5		
B4	> 60 days	0	0	0
Class B Adjustment = one only of B1, B2, B3 or B4				
Class B Adjustment			0	0

	Nighttime	Daytime
PERMISSIBLE SOUND LEVEL (dBA)	50	60

Category 1: Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 2: Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 3: Dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.

BC OGC Noise Control Guideline: Permissible Sound Level Determination
Receiver Locations, 500m from the Roadway

Basic Nighttime Sound Level

Proximity to Transportation	Dwelling Unit Density per ¼ Section of Land: 1 - 8 Dwellings	9 - 160 Dwellings	>160 Dwellings	Nighttime	Daytime
Category 1	40	43	46		
Category 2	45	48	51	45	45
Category 3	50	53	56		
Daytime Adjustment				N/A	10
Basic Sound Levels				45	55

Class A Adjustments

Class	Reason for Adjustment	Value (dBA L_{eq})	Nighttime	Daytime
A1	Seasonal Adjustment (Wintertime Operation)	+5	N/A	N/A
A2	Ambient Monitoring Adjustment	-10 to +10	N/A	N/A
	Class Adjustment = Sum of A1 and A2 (as applicable), but not to exceed a maximum of 10 dBA L_{eq}			
	Total Class A Adjustments		0	0

Class B Adjustments

Class	Duration of Activity	Value (dBA L_{eq})	Nighttime	Daytime
B1	1 day	+15		
B2	7 days	+10		
B3	< or = to 60 days	+5		
B4	> 60 days	0	0	0
	Class B Adjustment = one only of B1, B2, B3 or B4			
	Class B Adjustment		0	0

	Nighttime	Daytime
PERMISSIBLE SOUND LEVEL (dBA)	**45**	**55**

Category 1: Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 2: Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 3: Dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.

BC OGC Noise Control Guideline: Permissible Sound Level Determination
Receiver Locations, 1000m from the Roadway

Basic Nighttime Sound Level

Proximity to Transportation	Dwelling Unit Density per ¼ Section of Land		
	1 - 8 Dwellings	9 - 160 Dwellings	>160 Dwellings
Category 1	40	43	46
Category 2	45	48	51
Category 3	50	53	56

	Nighttime	Daytime
Basic Nighttime Sound Level	40	40
Daytime Adjustment	N/A	10
Basic Sound Levels	40	50

Class A Adjustments

Class	Reason for Adjustment	Value (dBA L_{eq})	Nighttime	Daytime
A1	Seasonal Adjustment (Wintertime Operation)	+5	N/A	N/A
A2	Ambient Monitoring Adjustment	-10 to +10	N/A	N/A
	Class Adjustment = Sum of A1 and A2 (as applicable), but not to exceed a maximum of 10 dBA L_{eq}			

	Nighttime	Daytime
Total Class A Adjustments	0	0

Class B Adjustments

Class	Duration of Activity	Value (dBA L_{eq})	Nighttime	Daytime
B1	1 day	+15		
B2	7 days	+10		
B3	< or = to 60 days	+5		
B4	> 60 days	0	0	0
Class B Adjustment = one only of B1, B2, B3 or B4				

	Nighttime	Daytime
Class B Adjustment	0	0
PERMISSIBLE SOUND LEVEL (dBA)	**40**	**50**

Category 1: Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 2: Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 3: Dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.

APPENDIX C

Traffic Count data

Traffic Data

10 Year Annual Summary for 2019

TM Site ID: **P-43-3NS**

TM Site Name: **Farmington - P-43-3NS, Alaska Highway**

Location: Route 97, 0.2 km north of Road 237, Dawson Creek

Posted Speed: **100 kph**

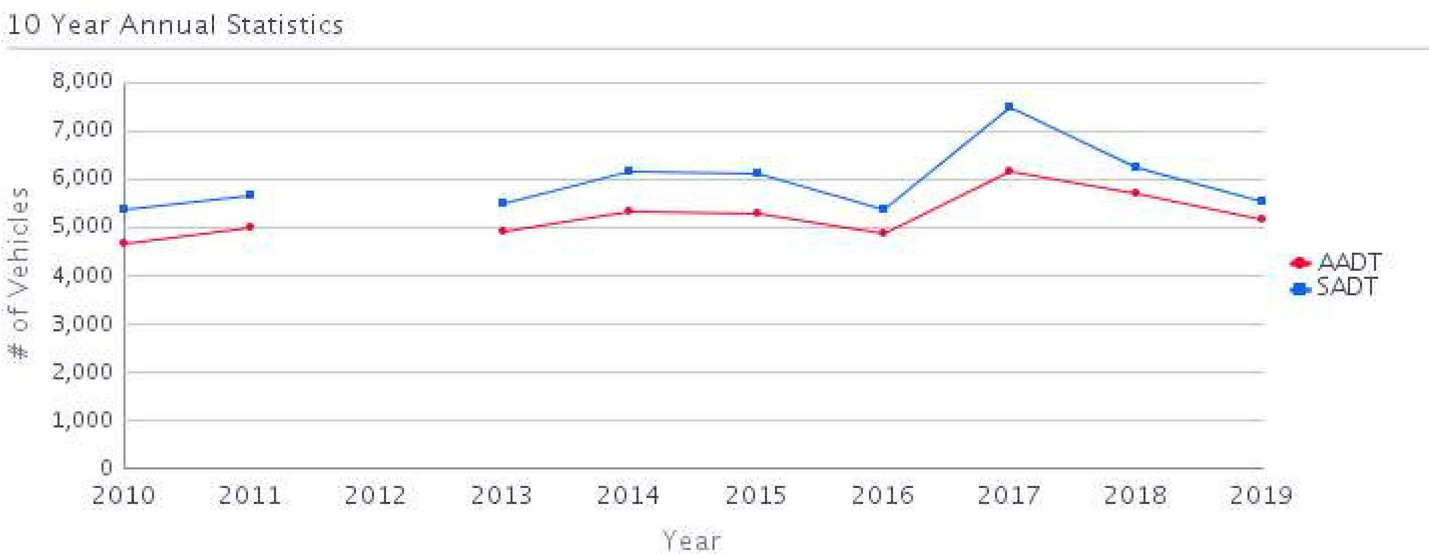
Report Run on: Thursday September 10 2020 11:43 AM

Traffic Data in this report

- AADT — **Annual Average Daily Traffic**: A calculated daily estimate of the number of vehicles passing this site.
- SADT — **Summer Average Daily Traffic** (for the months of July and August)
- Class — **Vehicle Length**: Types of vehicles traveling through this site.

Average Daily Traffic Volumes

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AADT	4,687	4,992		4,917	5,351	5,311	4,882	6,163	5,724	5,172
SADT	5,386	5,685		5,507	6,170	6,111	5,389	7,491	6,235	5,533



Traffic Data

10 Year Annual Summary for 2019

TM Site ID: **P-43-3NS**

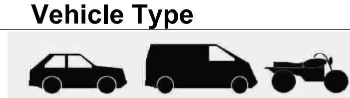
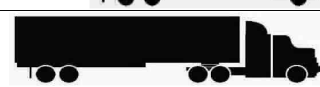
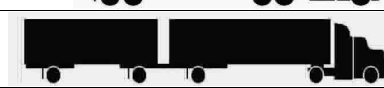
TM Site Name: **Farmington - P-43-3NS, Alaska Highway**

Location: Route 97, 0.2 km north of Road 237, Dawson Creek

Posted Speed: **100 kph**

Report Run on: Thursday September 10 2020 11:43 AM

10 Year Annual Average Daily Length Distribution Summary for 2019

Length	Vehicle Type	Road	% of Roadway	% Pos	% Neg
0 - 6 metres		33,519	71	51	49
6 - 12.5 metres		4,493	9	52	48
12.5 - 22.5 metres		6,272	13	50	50
22.5 - 35 metres		3,023	6	46	54
35 - 999 metres		30	<1	58	42

Disclaimer information and the most current traffic data may be found at: http://www.th.gov.bc.ca/trafficData

Traffic Data

10 Year Annual Summary for 2019

TM Site ID: **P-43-1NS**

TM Site Name: **Tupper - P-43-1NS, Dawson Creek - Tupper**

Location: Route 2, just north of the BC / AB border, Tupper

Posted Speed: **100 kph**

Report Run on: Thursday September 10 2020 10:43 AM

Traffic Data in this report

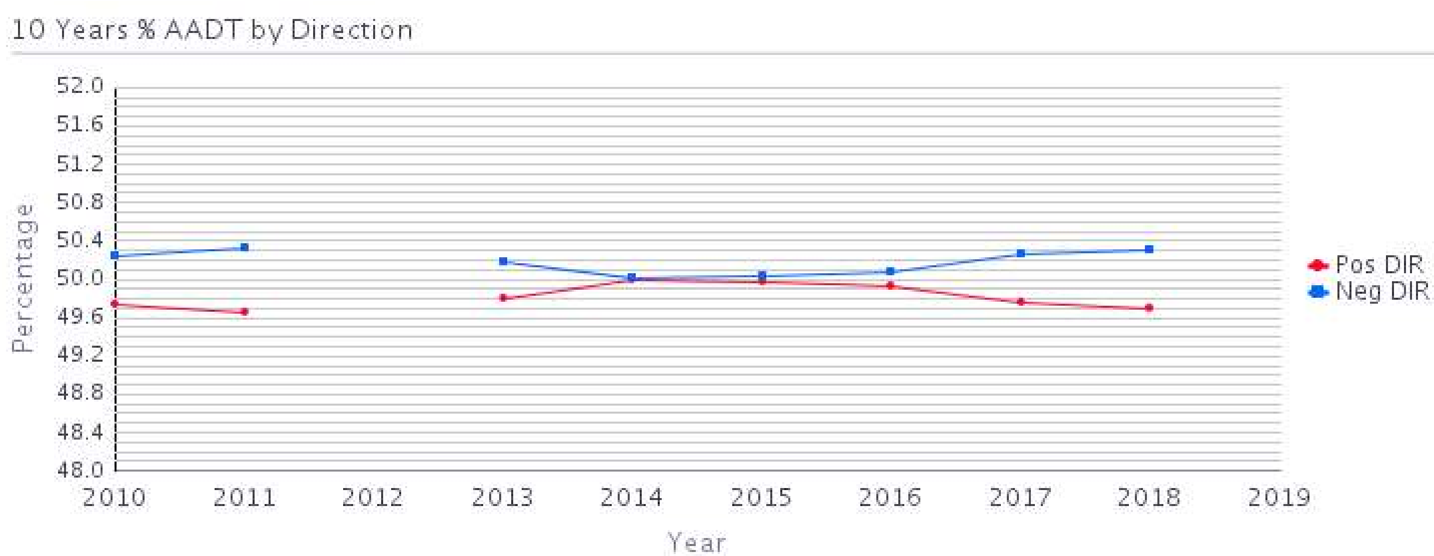
AADT — **Annual Average Daily Traffic**
A calculated daily estimate of the number of vehicles passing this site.

SADT — **Summer Average Daily Traffic**
(for the months of July and August)

Class — **Vehicle Length**
Types of vehicles traveling through this site.

Average Daily Traffic Volumes

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AADT	3,984	4,100		3,775	4,049	3,806	3,523	4,116	3,791	
SADT	4,626	4,764	4,397	4,285	4,683	4,410	3,934	5,110	4,401	



Traffic Data

10 Year Annual Summary for 2019

TM Site ID: **P-43-1NS**

TM Site Name: **Tupper - P-43-1NS, Dawson Creek - Tupper**

Location: Route 2, just north of the BC / AB border, Tupper

Posted Speed: **100 kph**

Report Run on: Thursday September 10 2020 10:43 AM

10 Year Annual Average Daily Length Distribution Summary for 2019

Length	Vehicle Type	Road	% of Roadway	% Pos	% Neg
0 - 6 metres		21,112	68	50	50
6 - 12.5 metres		2,595	8	50	50
12.5 - 22.5 metres		4,588	15	53	47
22.5 - 35 metres		2,832	9	47	53
35 - 999 metres		17	<1	69	31

Traffic Data

10 Year Annual Summary for 2019

Ministry of Transportation and Infrastructure

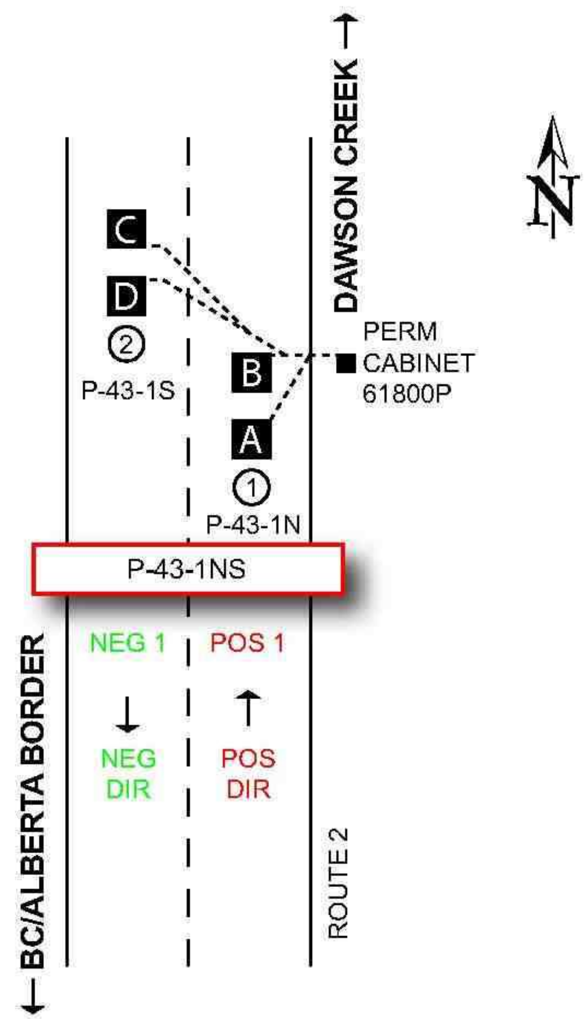
TM Site: **Description:**

P-43-1NS ROUTE 2, JUST NORTH OF THE BC/ALBERTA BOUNDARY, TUPPER

Station: 61800P
Name: TUPPER
Survey: 6180

- Short Count Post
- Loops
- Cabinet
- Junction Box
- TRADAS Traffic Measurement Site
- Channels
- Detectors

PHOTOLOG
YEAR: -
HIGHWAY: -
IMAGE NUMBER: -
SHOWS LOOPS: YES NO ✓



NOT TO SCALE

Highway Planning Branch
TRANHighway Planning@gov.bc.ca

Revised Date: December / 2004
Version 2-A

Traffic Data

10 Year Annual Summary for 2019

TM Site ID: **43-013EW**

TM Site Name: **Spirit River Highway - 43-013EW, Dawson Creek - Spirit River**

Location: Route 49, 15.5 km east of Route 2, east of Dawson Creek

Posted Speed: **90 kph**

Report Run on: Thursday September 10 2020 10:36 AM

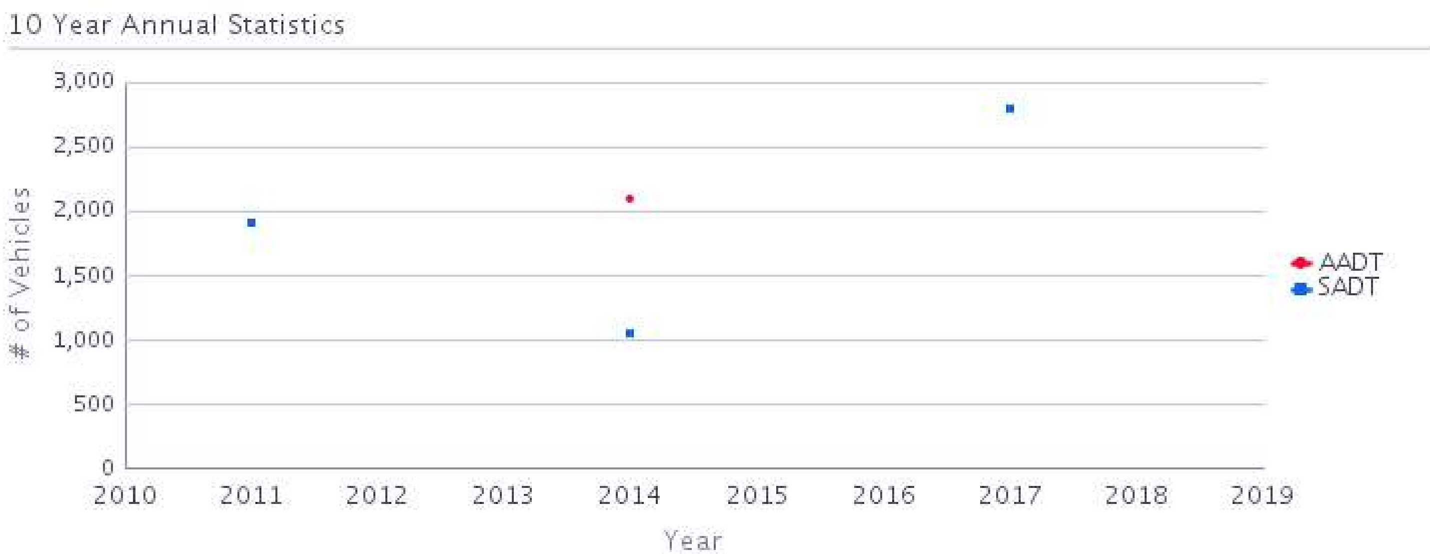
Traffic Data in this report

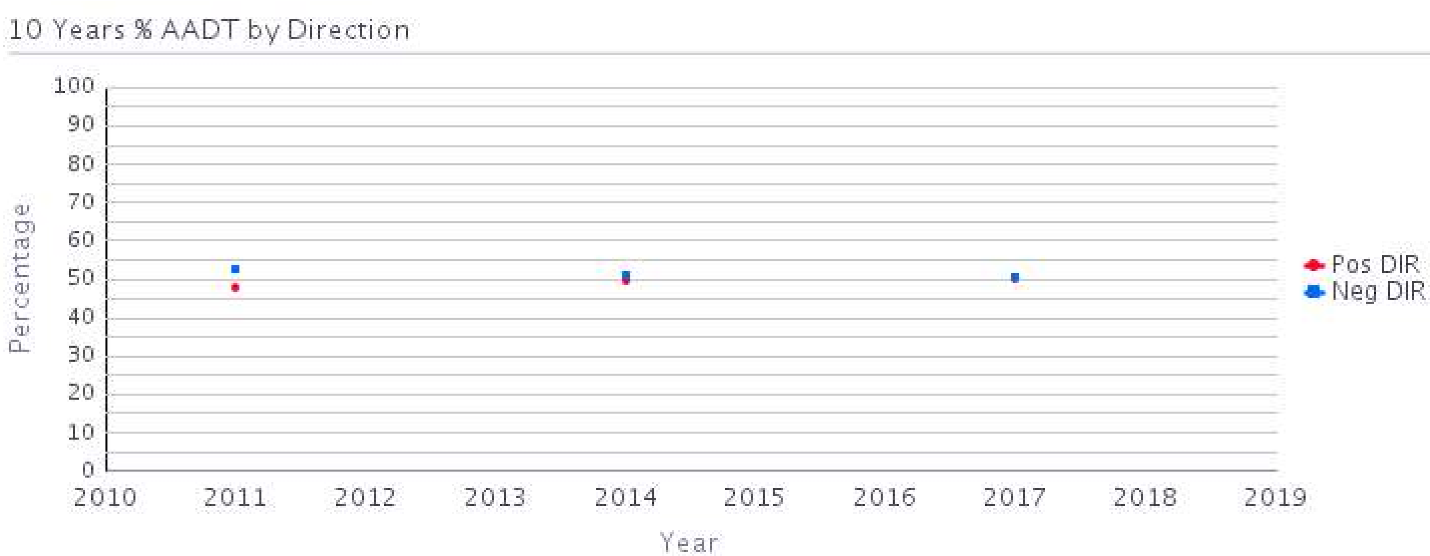
AADT **Annual Average Daily Traffic**
A calculated daily estimate of the number of vehicles passing this site.

SADT **Summer Average Daily Traffic**
(for the months of July and August)

Average Daily Traffic Volumes

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AADT		1,901			2,090			2,790		
SADT		1,901			1,045			2,790		





British Columbia — The Best Place on Earth | Ministry of Transportation and Infrastructure

Traffic Data

10 Year Annual Summary for 2019

TM Site ID:	**43-013EW**
TM Site Name:	**Spirit River Highway - 43-013EW, Dawson Creek - Spirit River**
Location:	Route 49, 15.5 km east of Route 2, east of Dawson Creek
Posted Speed:	**90 kph**
Report Run on:	Thursday September 10 2020 10:36 AM

British Columbia – The Best Place on Earth | Ministry of Transportation and Infrastructure

Traffic Data

10 Year Annual Summary for 2019

TM Site:	Description:
43-013EW	ROUTE 49, AT BC/ALBERTA BOUNDARY, 15.5 km EAST OF ROUTE 2 AND 7.2 km EAST OF BRIAR RIDGE ROAD, EAST OF DAWSON CREEK

Station: 59060S

Survey: 5906

▲ - Short Count Post

■ - Loops

■ - Junction Box

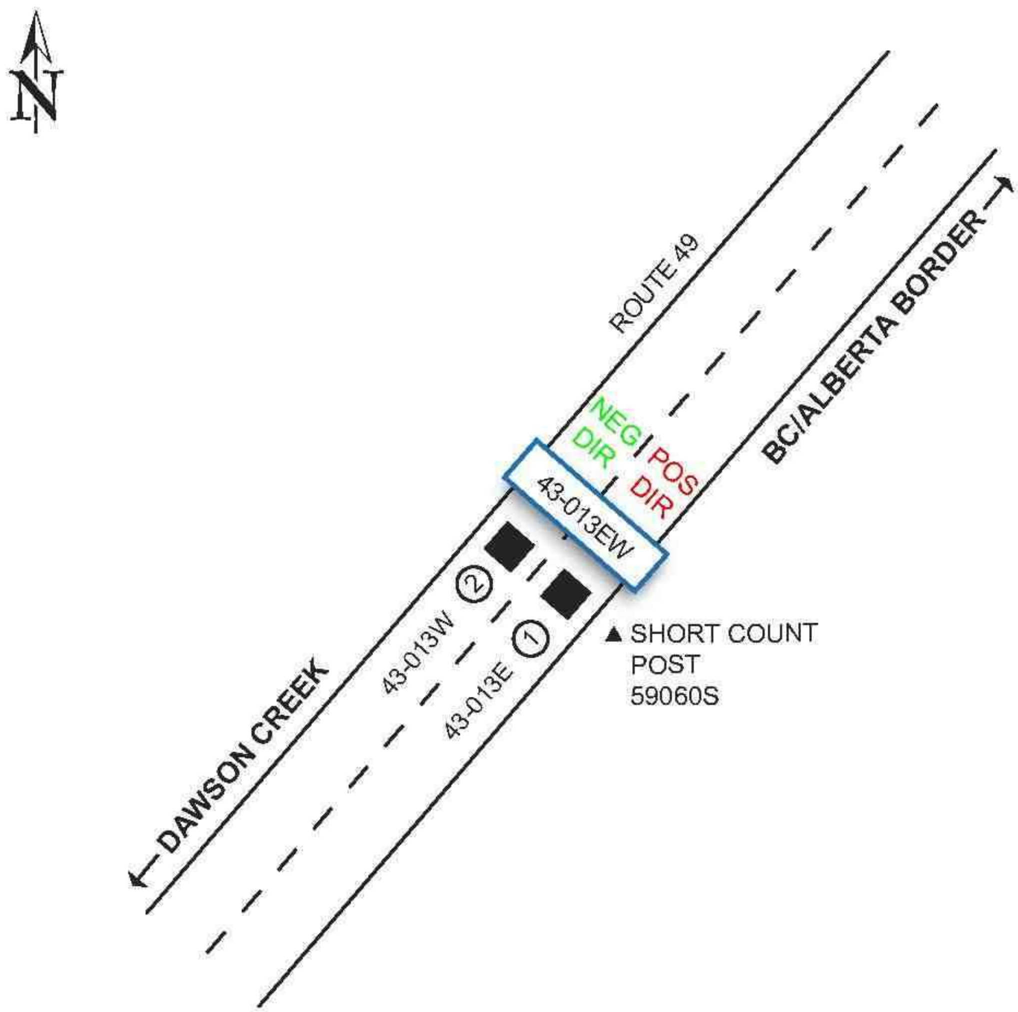
□ - TRADAS Traffic Measurement Site

(1) - Channels

A - Detectors

PHOTOLOG
YEAR: 2000
HIGHWAY: H49
IMAGE NUMBER: 45
SHOWS LOOPS: ☑ YES ☐ NO

GPS: N 55° 46'43.5" W 119° 59'57.10" ±200 metres



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Revised Date: May / 2006
Version 1-A

Traffic Data

10 Year Annual Summary for 2019

Ministry of Transportation and Infrastructure
BRITISH COLUMBIA
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Traffic Data in this report

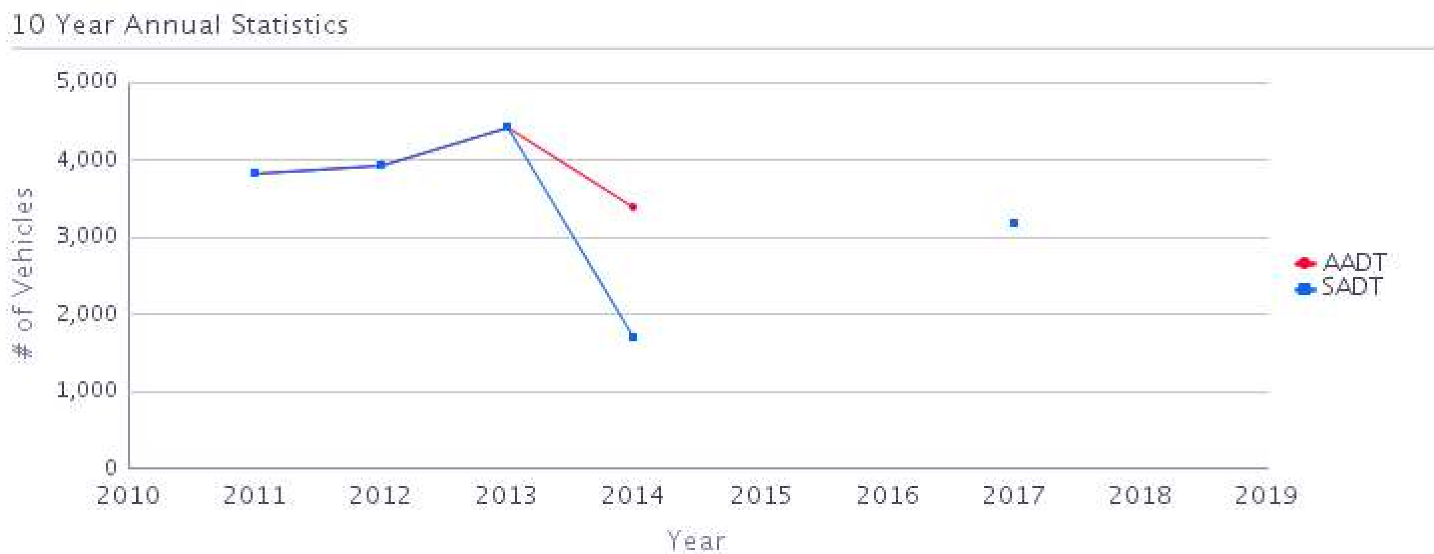
AADT — **Annual Average Daily Traffic**
A calculated daily estimate of the number of vehicles passing this site.

SADT — **Summer Average Daily Traffic**
(for the months of July and August)

TM Site ID:	**43-001NS**
TM Site Name:	**Kiskatinaw River Bridge - 43-001NS, John Hart - Peace River**
Location:	Route 97, 1.2 km north of Kiskatinaw River Bridge, south of Dawson Creek
Posted Speed:	**100 kph**
Report Run on:	Thursday September 10 2020 10:34 AM

Average Daily Traffic Volumes

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AADT		3,838	3,923	4,417	3,397			3,182		
SADT		3,838	3,923	4,417	1,698			3,182		



Traffic Data

10 Year Annual Summary for 2019

Ministry of Transportation and Infrastructure

TM Site ID:	**43-001NS**
TM Site Name:	**Kiskatinaw River Bridge - 43-001NS, John Hart - Peace River**
Location:	Route 97, 1.2 km north of Kiskatinaw River Bridge, south of Dawson Creek
Posted Speed:	**100 kph**
Report Run on:	Thursday September 10 2020 10:34 AM

Traffic Data

10 Year Annual Summary for 2019

British Columbia
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Ministry of Transportation and Infrastructure

TM Site ID: **43-021NS**

TM Site Name: **Chetwynd - 43-021NS, John Hart - Peace River**

Location: Route 97, 4.2 km south of Rice Road (Road 283), north of Chetwynd

Posted Speed: **100 kph**

Report Run on: Thursday September 10 2020 10:27 AM

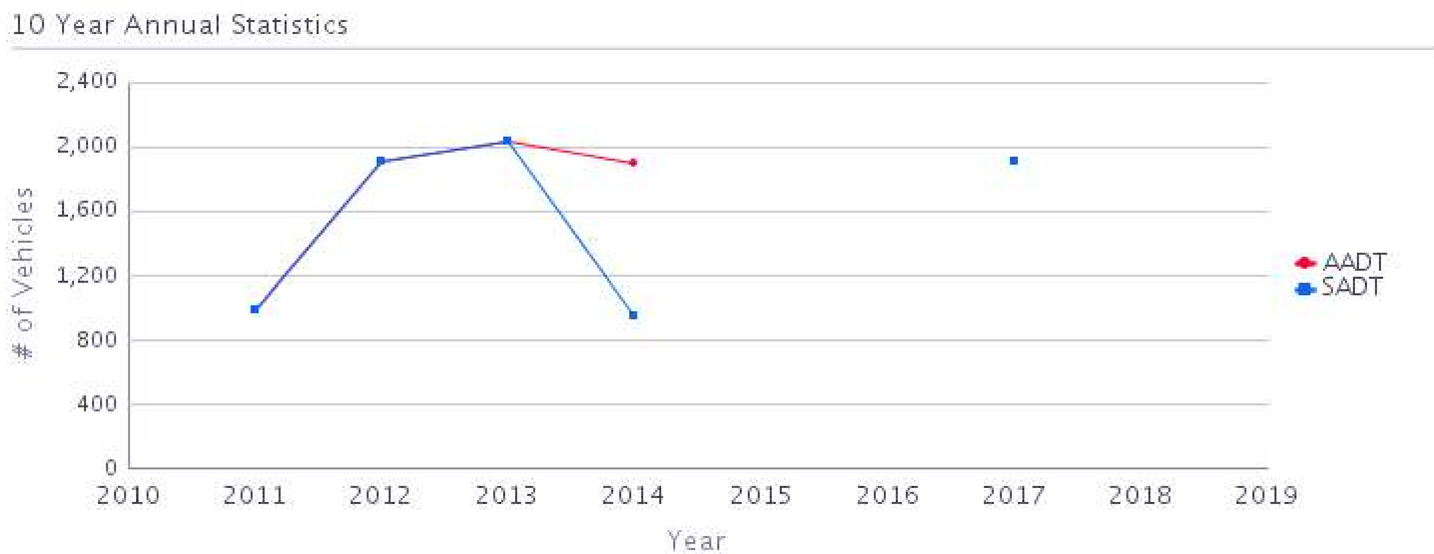
Traffic Data in this report

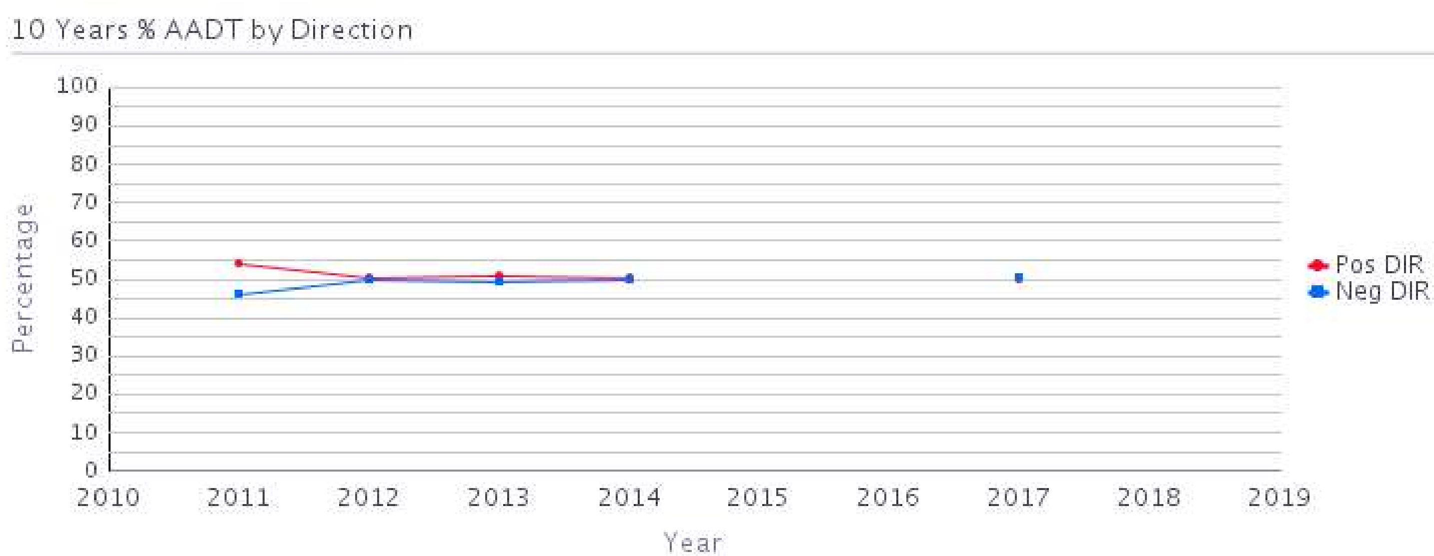
AADT **Annual Average Daily Traffic**
A calculated daily estimate of the number of vehicles passing this site.

SADT **Summer Average Daily Traffic**
(for the months of July and August)

Average Daily Traffic Volumes

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AADT		990	1,917	2,034	1,904			1,916		
SADT		990	1,917	2,034	952			1,916		





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Ministry of Transportation and Infrastructure

Traffic Data

10 Year Annual Summary for 2019

TM Site ID:	**43-021NS**
TM Site Name:	**Chetwynd - 43-021NS, John Hart - Peace River**
Location:	Route 97, 4.2 km south of Rice Road (Road 283), north of Chetwynd
Posted Speed:	**100 kph**
Report Run on:	Thursday September 10 2020 10:27 AM

Traffic Data

10 Year Annual Summary for 2019

TM Site:	Description:
43-021NS	ROUTE 97, 4.2 km SOUTH OF RICE ROAD (ROAD 283), APPROX. 41.6 km NORTH OF CHETWYND

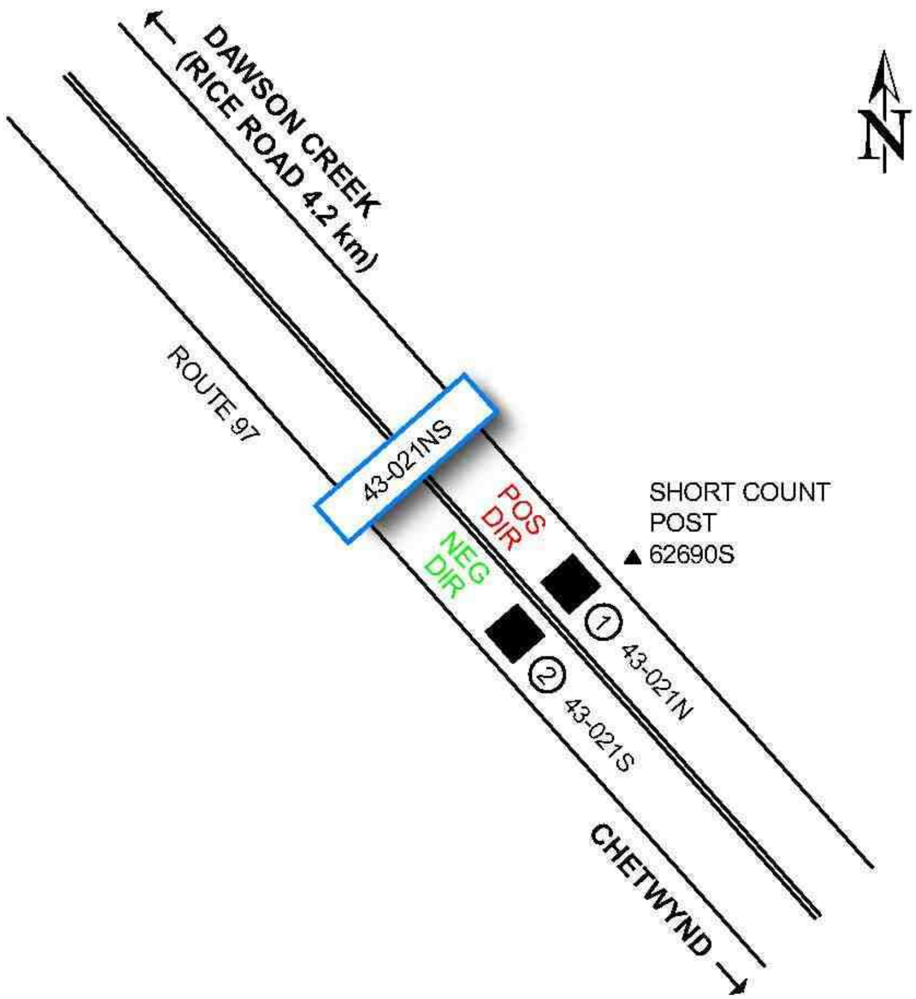
Station: 62690S

Survey: 6269

▲ - Short Count Post
■ - Loops
■ - Junction Box
☐ - TRADAS Traffic Measurement Site
(1) - Channels
A - Detectors

PHOTOLOG
YEAR: 2000
HIGHWAY: H97
IMAGE NUMBER: 33737
SHOWS LOOPS: ☐ YES ☑ NO

GPS: N 55° 44.935' **W** 121° 08.123' ± 200 metres



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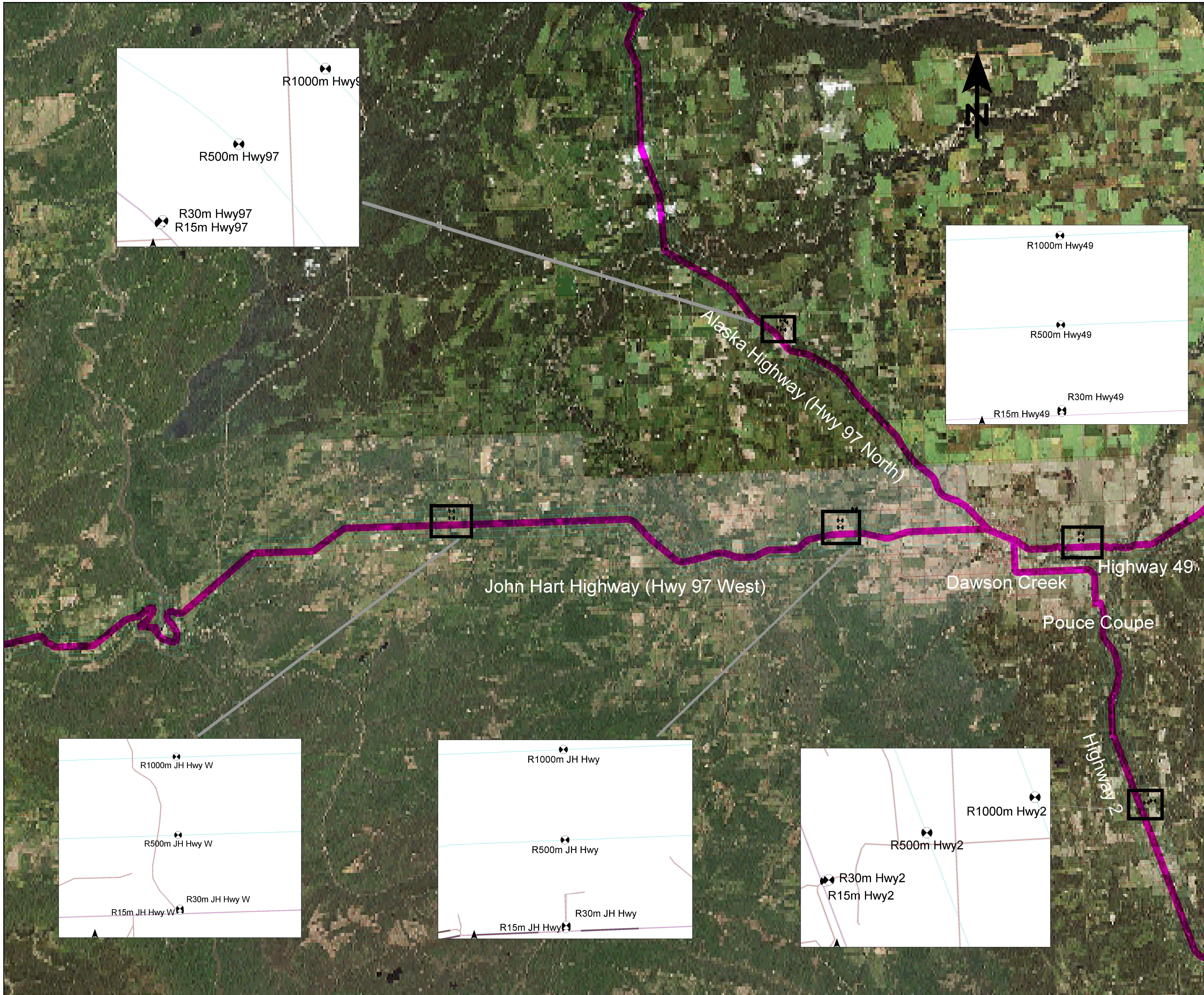
Revised Date: July / 2005
Version 2-A

APPENDIX D

Noise Maps for the NE BC Extended Area



Ambient Noise Study - BCOGRIS

Project:
FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D0
Study Area

BC Farmington extended Area
Surface Transportation Noise

Signs and symbols

- Road
- Modeled Roads
- Road Surface
- Bridge
- Point receiver
- Zoomed Area
- Ground absorption
- Buffer Line 500m/1000m

Length scale 1:260000

0 2000 4000 8000 12000 m

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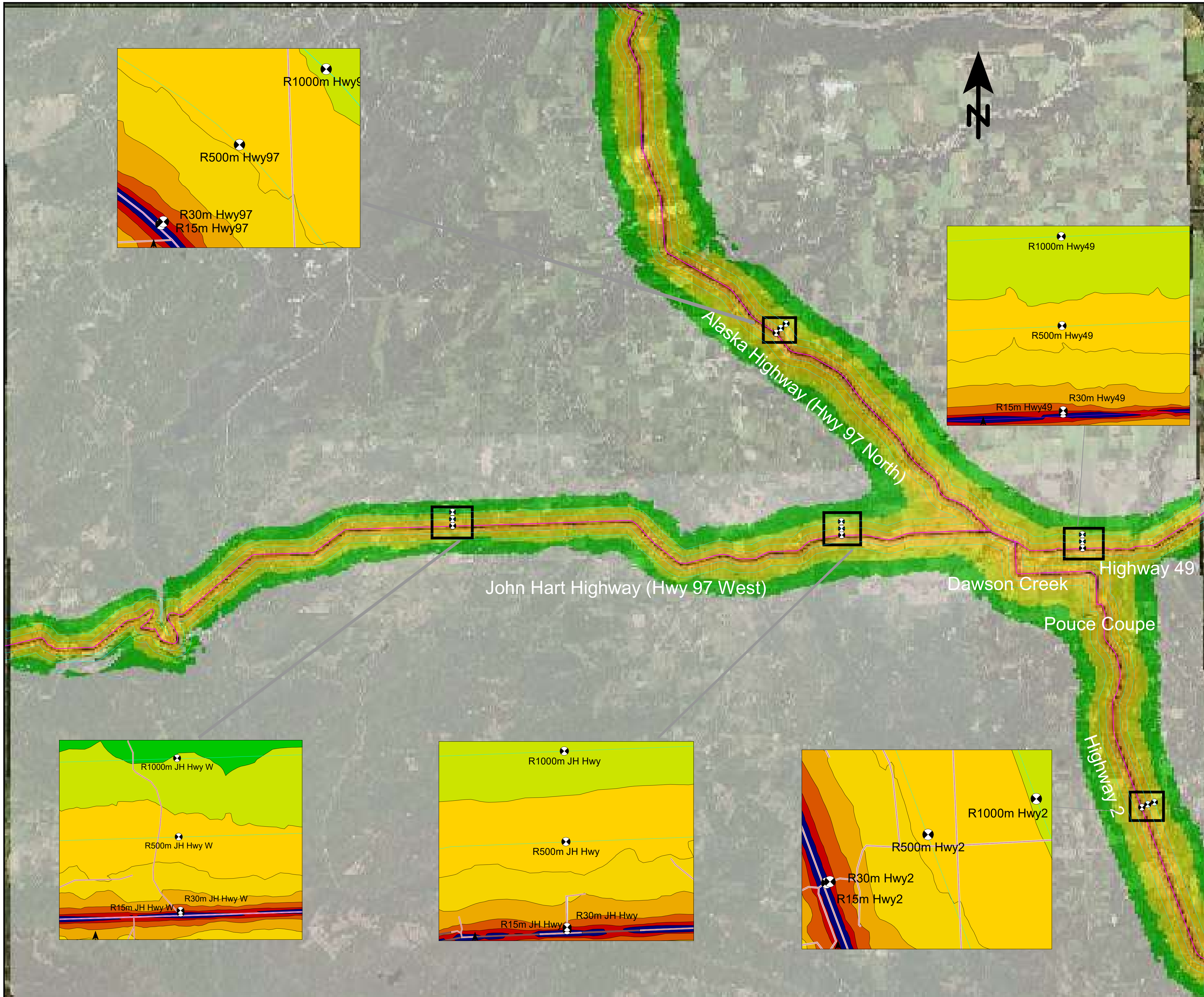
www.patchingassociates.com



Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D1
Predicted Sound Level Contours

Summer
Daytime Period
Downwind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

Sound level dB(A)
<= 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
> 65

Length scale 1:260000

0 2000 4000 8000 12000 m

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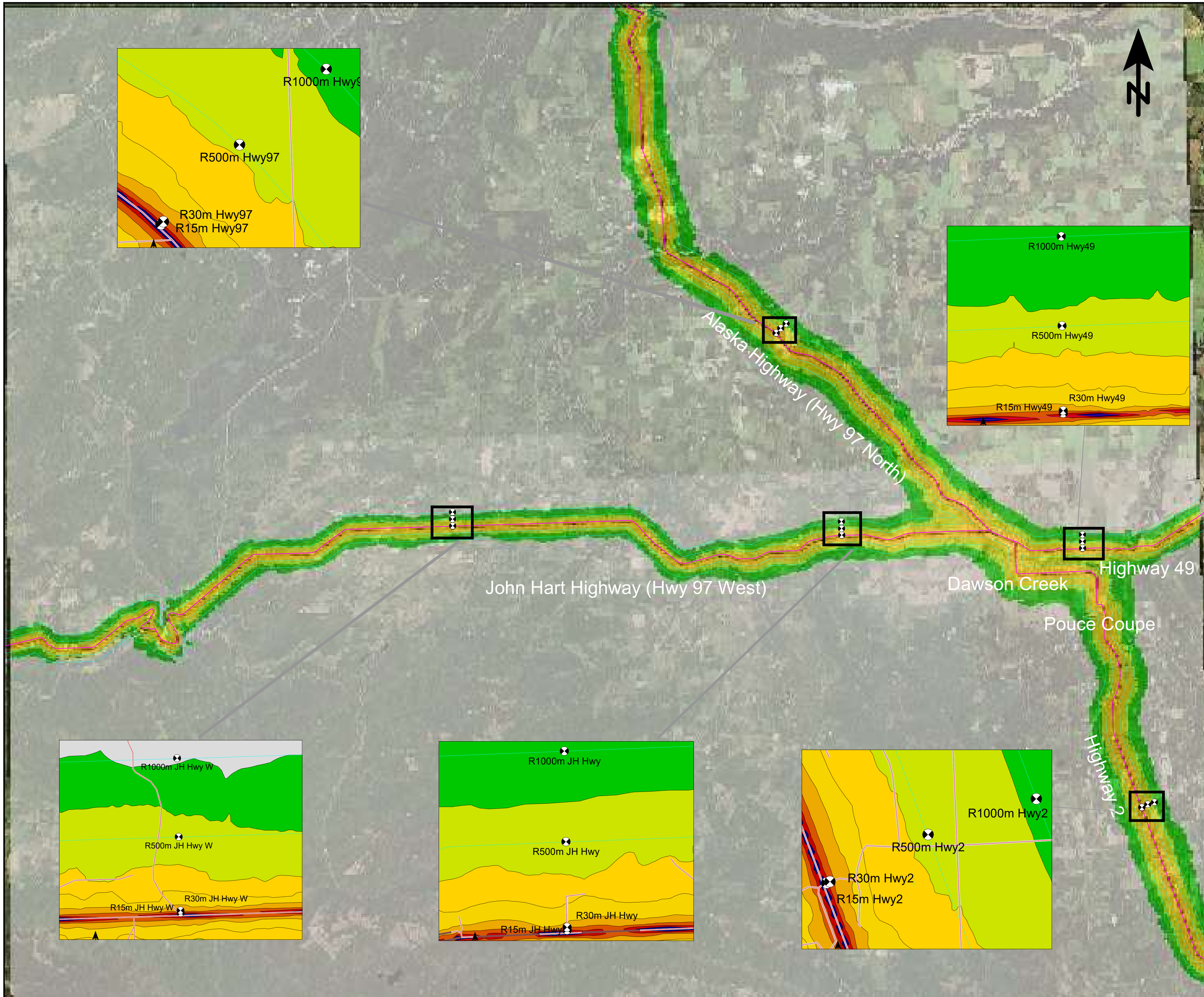

Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D2
Predicted Sound Level Contours

Summer
Nighttime Period
Downwind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

Sound Levels in dB(A)
<= 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
> 65

Length scale 1:260000

0 2000 4000 8000 12000 m

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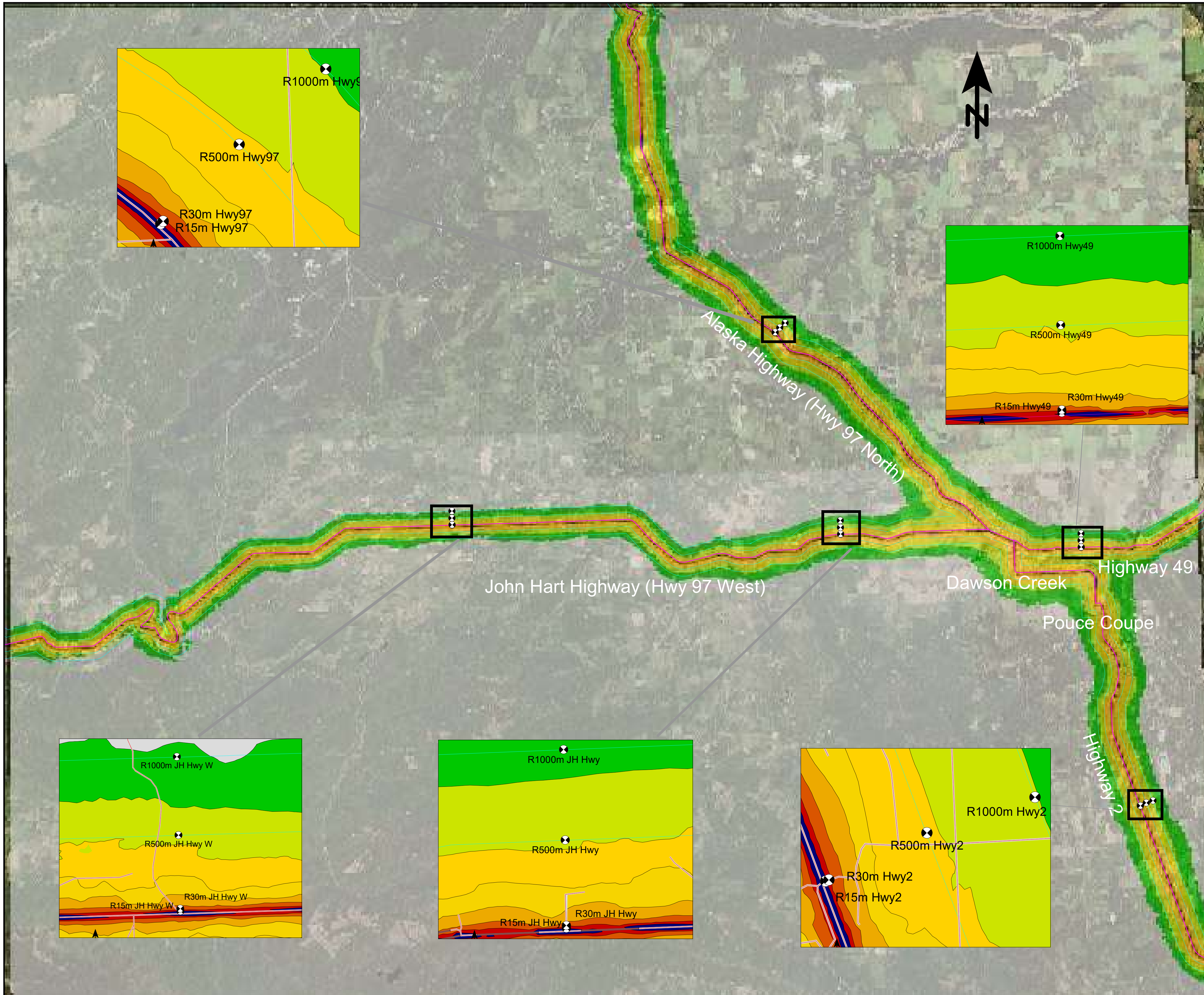

Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D3
Predicted Sound Level Contours

Winter
Daytime Period
Downwind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

	<= 30
	30 - 35
	35 - 40
	40 - 45
	45 - 50
	50 - 55
	55 - 60
	60 - 65
	> 65

Length scale 1:260000

0 2000 4000 8000 12000 m

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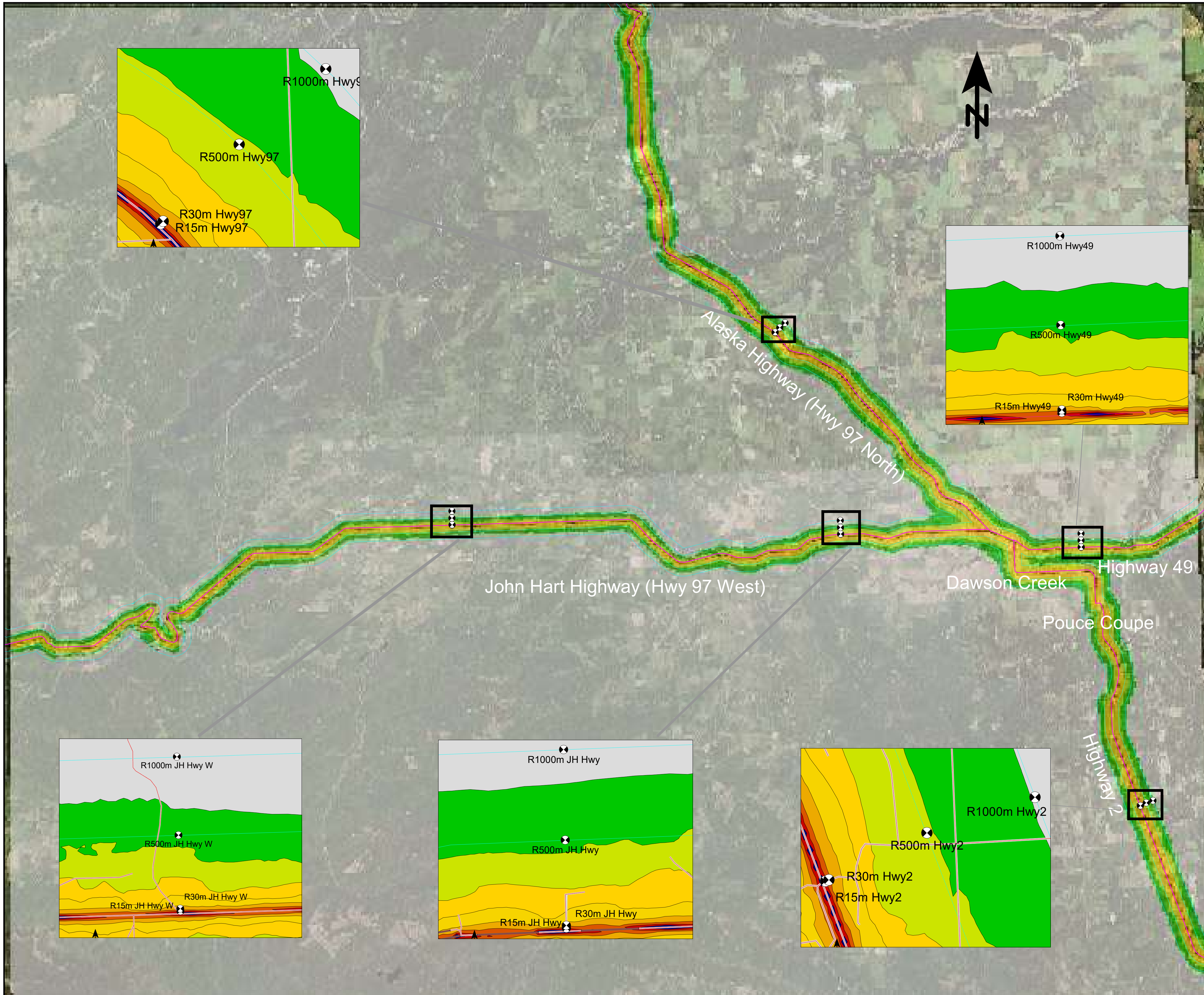

Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D4
Predicted Sound Level Contours

Winter
Nighttime Period
Downwind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

	<= 30
	30 - 35
	35 - 40
	40 - 45
	45 - 50
	50 - 55
	55 - 60
	60 - 65
	> 65

Length scale 1:260000

0 2000 4000 8000 12000 m

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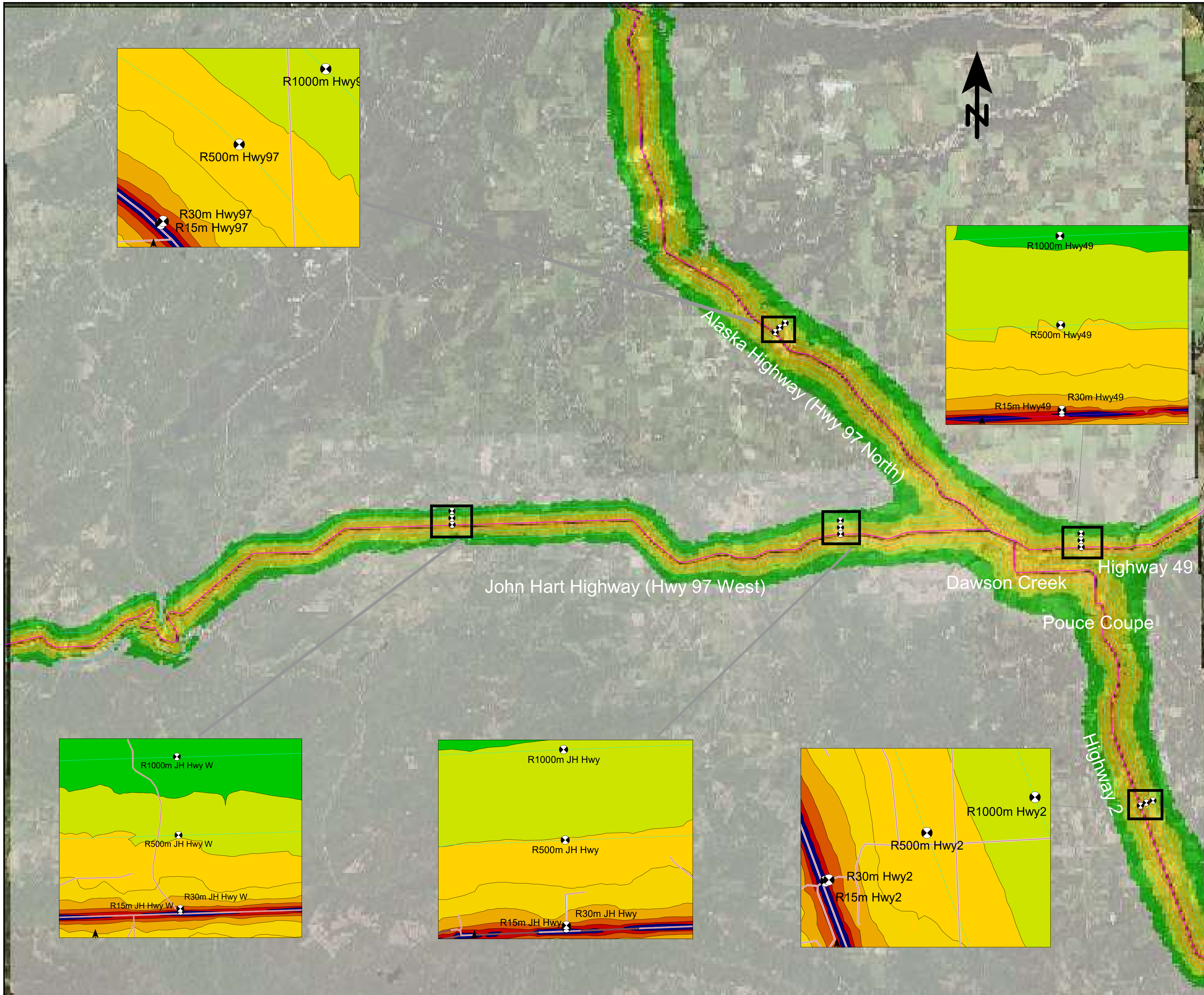

Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D5
Predicted Sound Level Contours

Yearly Average
Daytime Period
Long Term
Prevailing Wind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

<=	30
30 -	35
35 -	40
40 -	45
45 -	50
50 -	55
55 -	60
60 -	65
>	65

Length scale 1:260000

0 2000 4000 8000 12000 m

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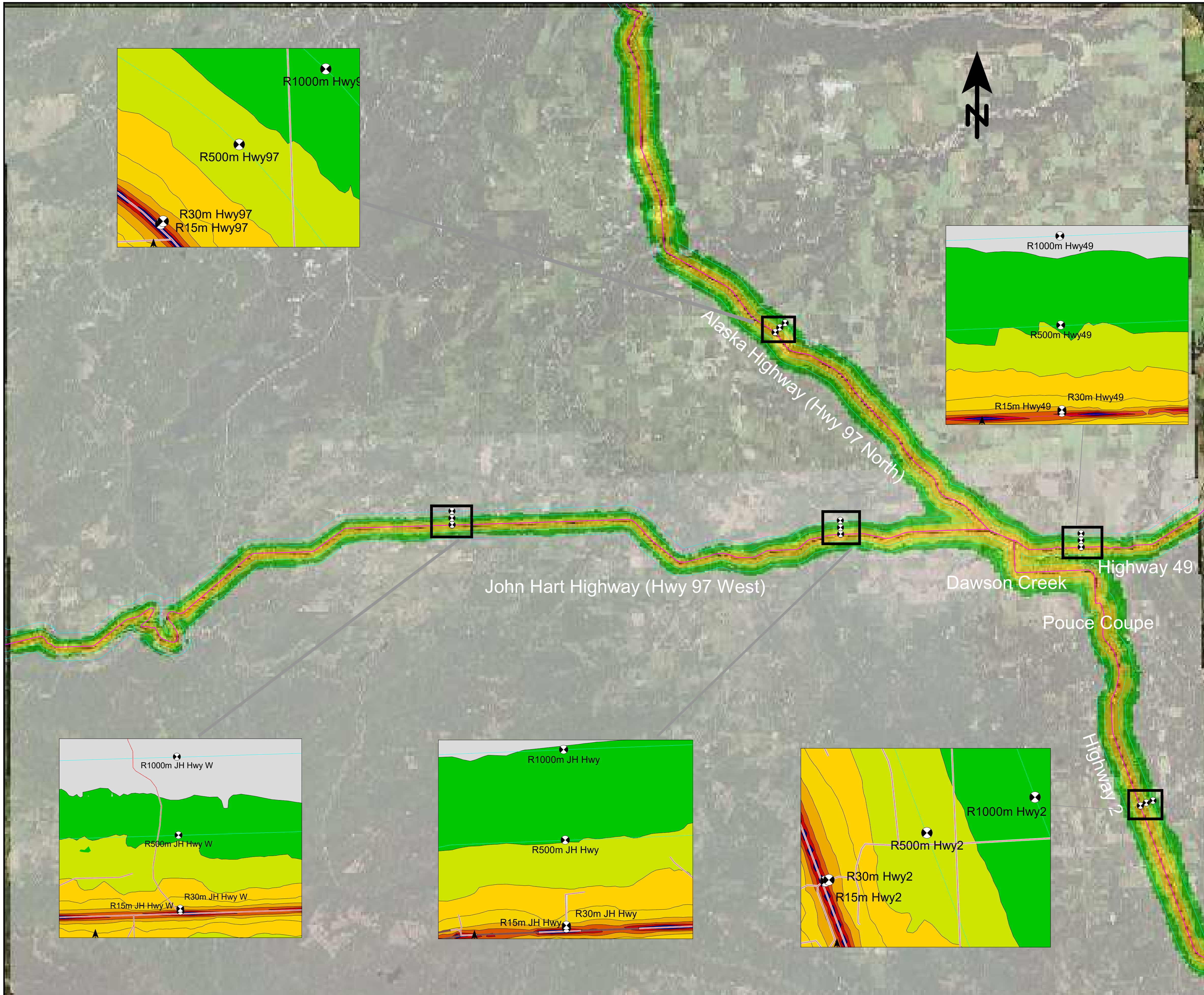

Ambient Noise Study - BCOGRIS

Project: FDA Extended Area

Heavily Traveled Roadways in Northeast BC

Customer: BCOGRIS
Project-No. 005452

Figure D6
Predicted Sound Level Contours

Yearly Average
Nighttime Period
Long Term
Prevailing Wind Conditions

BC Farmington extended Area
Surface Transportation Noise

Sound Levels
in dB(A)

<=	30
30 -	35
35 -	40
40 -	45
45 -	50
50 -	55
55 -	60
60 -	65
>	65

Length scale 1:260000

0 2000 4000 8000 12000 m

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