



Evaluation of noise and particulate matter
emissions associated with aggregate
operations in the Fraser Valley Regional
District

**Prepared in
confidence for:** Fraser Valley Regional District
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Attention: Mike Neil

Executive Summary

Noise and particulate matter monitoring was conducted over three days in July 2022 with the intent of characterizing emissions associated with commercial aggregate operations. The present evaluation aimed to collect initial baseline data by completing brief monitoring events at a number of properties. Monitoring was prioritized along property boundaries of aggregate operations that bordered with neighbouring residence or potentially affected stakeholders. Some aggregate operations were not active during the evaluation period. At these locations background data was collected. Given the challenges associated with identifying the source of particulate matter or noise at a given location, background data at these locations will be helpful for comparison with future data collected when the operations are active.

Particulate matter monitoring results suggest conditions evaluated during the present evaluation were not in exceedance of air quality standards. Noise monitoring results suggested that the conditions evaluated during the present evaluation did not create an exceedance of the Bylaw limits. Data from the present evaluation can be used to direct future monitoring efforts.

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Introduction

The Fraser Valley Regional District (FVRD) has adopted [BYLAW No. 1181, 2014](#) to regulate commercial gravel operations in the electoral areas of the Regional District. The bylaw defines areas within the FVRD where commercial aggregate operations may operate upon obtaining a permit, and subject to requirements and restrictions. Within the areas designated as 'Community Areas' in the bylaw, commercial aggregate operations must operate in accordance with the defined noise and dust limits.

A number of activities at commercial aggregate operations can create dust and/or noise emissions. Dust and noise generating activities related to pits and quarries can include drilling, blasting, crushing, screening, conveying, hauling, and the loading and unloading of stockpiles. Fugitive emissions from the stockpiles may themselves contribute to the amount of airborne particulate generated at an aggregate operation. Community sources of dust and noise may also contribute to emissions within the FVRD.

The present evaluation was undertaken to better understand the dust and noise generated at commercial aggregate operations in Community Areas. In order to obtain a preliminary indication of which properties may generate emissions near the bylaw limits, baseline measurements were collected at priority locations.

When evaluating dust and noise concentrations in community areas, results can be influenced by multiple sources. Noise sources may include road, rail, and air traffic, other manmade sources, as well as noise created by animals (e.g., birds, dogs) or wind currents. A vegetative cover of trees and shrubs could be found along many of the property boundaries under consideration for this evaluation. Wind currents rustling branches and leaves can contribute to overall noise in the community and may influence property line monitoring events. Particulate matter can be produced from burning materials (e.g., residential fire places, burning of vegetative matter or backyard burning, and wild fires), road dust, construction, and/or agricultural activities. In addition to man-made sources, natural sources of dust within a community can include particles derived from wind-suspended sea salt and natural weathering of minerals and soils. Other industrial facilities within a community may also generate noise and airborne particulate matter.

Dust generated from mining activities consists of variable particle size fractions, including those with an aerodynamic diameter of 10 µm or less (PM₁₀) and particulates with an aerodynamic diameter of 2.5 µm or less (PM_{2.5}). These size fractions are a focus for health-based standards because they represent size fractions that may penetrate the lungs. For these size fractions, ambient air quality standards have been adopted by the BC Provincial government. The standards, referred to as Air Quality Objectives (AQO), are non-statutory limits used to guide air-management decisions, such as decisions on environmental impact assessments

and authorizations, airshed planning efforts and regulatory development. They also guide decisions on whether or not to issue an air quality advisory. These air quality metrics have been referenced herein for interest, in addition to the total suspended particulate metric referenced in the Bylaw. A summary of these standards is presented in Table 1.

Table 1. Summary of Noise and Dust Standards

Air Quality Standards		
Criteria	Level	Averaging Period
B.C. Provincial Ambient Air Quality Criteria for PM _{2.5}	25 µg/m ³	24-hour average; Achievement based on annual 98th percentile value
B.C. Provincial Ambient Air Quality Criteria for PM _{2.5}	8 µg/m ³	Annual
B.C. Provincial Ambient Air Quality Criteria for PM ₁₀	50 µg/m ³	24-hour average
FVRD Bylaw limit for Total Suspended Particulate Matter (TSP)	120 µg/m ³	24-hour average
Noise Standard		
Criteria	Equivalent continuous sound pressure level	Integrating Period
FVRD Bylaw limit for decibels on an A-weighted scale	60 dB (A)	60 minutes

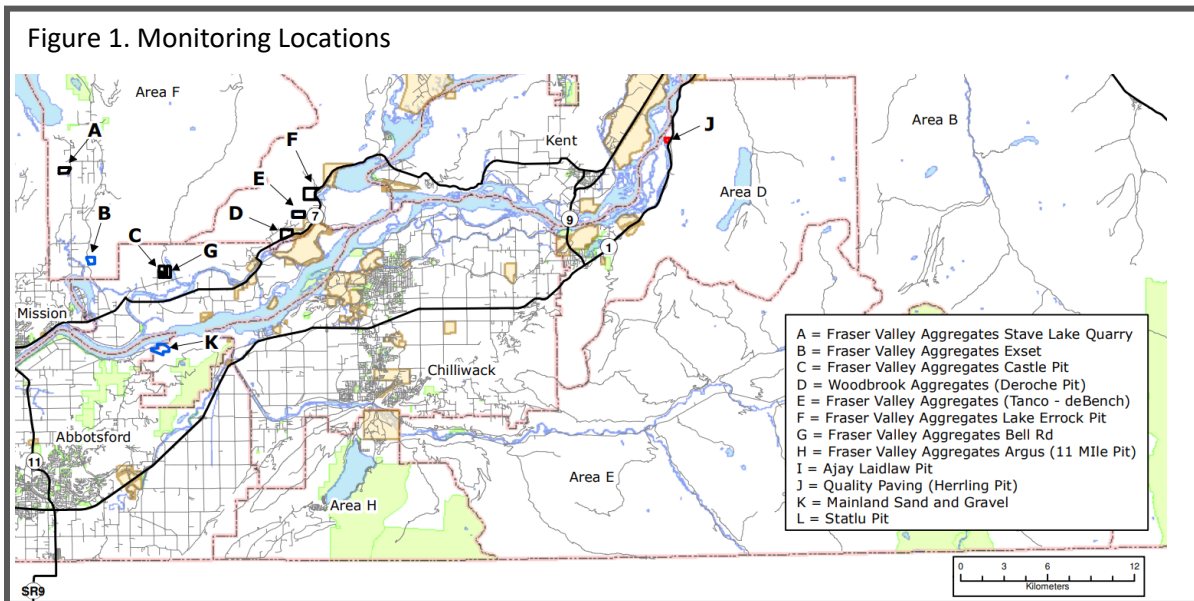
Data Collection

For the purposes of acquiring initial baseline data, one-hour intervals were targeted for dust and noise measurements. Dust standards referenced are based on a 24-hour averaging period. Particulate matter concentrations are likely to vary over a 24-hour monitoring period. Where the location may be affected by industrial activity, it is reasonable to expect a possible elevation in airborne particulate matter concentration during the period when dust generating activities are occurring, and the period immediately after they cease to occur. Thus, to gauge priorities for follow up monitoring, an initial one-hour interval was targeted during the operating hours when industrial activity was occurring at the selected sites. For locations that were found to be non-operational, a background one-hour sample was targeted.

Monitoring was conducted on July 20th, 21st, and 22nd. Measurements were collected along property boundaries at five locations where commercial aggregate operations occur, and at one community location. In general, locations were chosen along the

boundaries of the mine properties which bordered with other community infrastructure or potentially affected residents.

An overview showing the properties where monitoring occurred is shown in Figure 1. Monitoring occurred at locations A, C/G, D, E and F. Monitoring was also conducted at Dewdney Regional Park across the Fraser River from location K. A description of each of the locations is further provided in the section below.



To the extent feasible, monitoring locations were selected to minimize the effects of local sources that may generate dust or noise immediately adjacent to the monitor. Monitors were mounted in protective enclosures, with the sampling inlet height approximately 1.5 meters above base of the tripod.

In general, monitoring locations should be located away from structures such as trees and buildings. For the present evaluation, locations along property boundaries were prioritized. A vegetative cover along the property boundary at some of the selected monitoring locations was observed. Trees may have a blocking affect on noise/dust propagation. It was assumed that if applicable, neighbouring properties would benefit from this blocking effect and conditions observed at the monitors would reflect the property line conditions.

➤ Noise

Noise measurements were collected using a Quest SoundPro DL-2 sound level meter. A Quest QC-10 sound level meter calibrator was used at the start of each monitoring period to calibrate the sound level meter, and at the end of each monitoring period to confirm the performance of the instrument. All pre- and post-

measurements were within one decibel (dB). The sound level meter was set with a 3 dB exchange rate, a slow time constant and to an A-weighted scale.

➤ **Particulate Matter**

Particulate matter monitoring was conducted using a TSI DustTrak™ aerosol monitor to simultaneously measure both mass and size fraction of suspended particles. The DustTrak uses a light-scattering laser photometer to determine mass concentration in real time. The instrument had current laboratory certification and had been calibrated against a gravimetric reference using the respirable fraction of standard ISO 12103-1, A1 test dust. Flow rate calibrations were conducted prior to use of the equipment each day of monitoring. A user calibration factor of 1 was used for size calibration. A photometric calibration of 0.38 was used, as per manufacturer recommendations for fugitive emissions monitoring applications. A zero calibration was performed at the monitoring location prior to each monitoring event.

The TSI DustTrak DRX (model 8533) was selected for use due to its portability, commercial availability, and capacity to rely on a direct current power supply for monitoring in remote locations. It also features the ability to evaluate different size fractions of particulate material concurrently (total particulate matter, PM₁₀ and PM_{2.5}). The DustTrak DRX has a detection range up to 150 mg/m³, and captures particles up to 15 µm in size.

➤ **Weather**

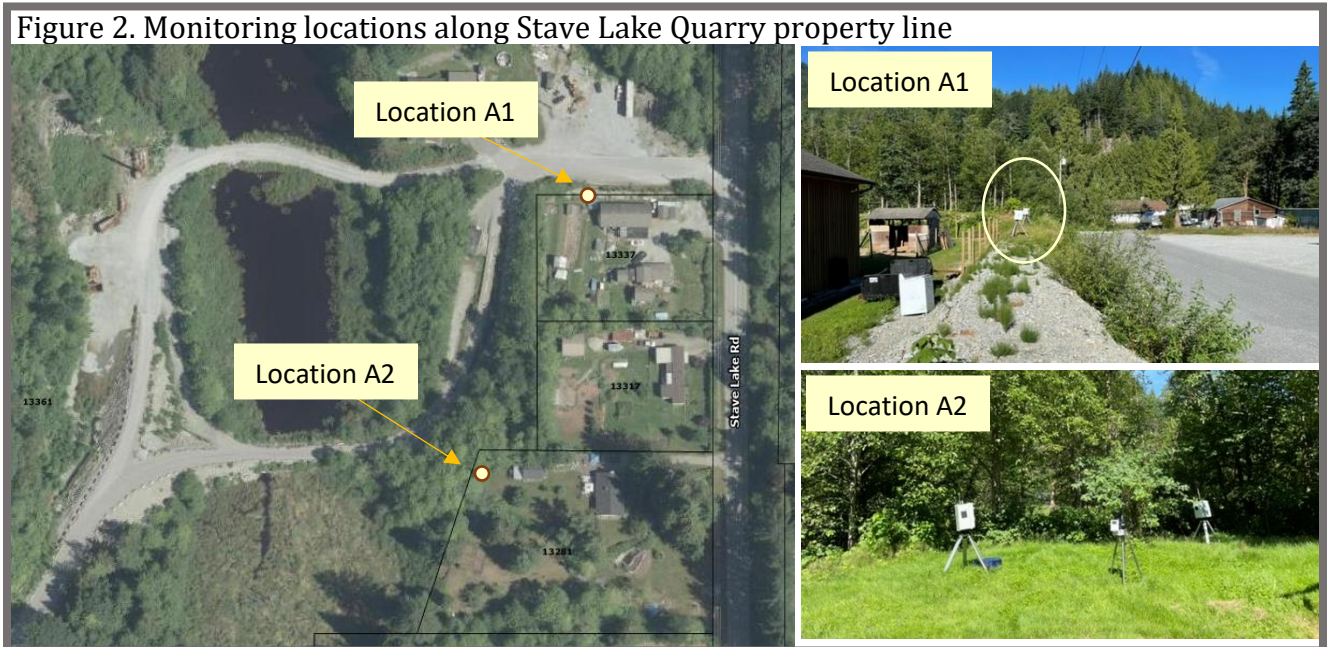
Information on temperature, relative humidity, and wind at the time of monitoring was collected using a Davis Vantage Pro weather station at each monitoring location. A 30-minute average reading was taken during each monitoring event. Precipitation was not observed during any of the monitoring events. On July 20th, temperatures during monitoring ranged from 21^oC to 27^oC, relative humidity ranged from 59% to 72%, and wind speeds ranged from 0.4 to 1.3 m/s. On July 21st temperatures during monitoring ranged from 22^oC to 33^oC, relative humidity ranged from 46% to 70%, and wind speeds ranged from 0.4 to 0.9 m/s. On July 22nd, temperatures during monitoring ranged from 17^oC to 20^oC, relative humidity ranged from 67% to 78%, and wind speeds ranged from 1.3 to 1.8 m/s. July 20 and July 21st conditions were clear. On July 22nd the morning was initially slightly overcast and cleared up by midday.

Findings

The details of the monitoring and the results are presented below for each location.

➤ Stave Lake

Monitoring was conducted at two locations along the property boundary of Stave Lake Quarry on the morning of July 21st. The monitoring locations are shown in Figure 2 below.



Noise monitoring at location A1 was conducted over 66 minutes, and air quality monitoring was conducted over 70 minutes. Noise monitoring at location A2 was conducted over 62 minutes and air quality monitoring was conducted over 68 minutes. The monitoring results are shown in Table 2 below.

During the monitoring event at location A1, three trucks for hauling material entered the quarry and 4 trucks hauling material left. One of the trucks remained parked at the laydown area near the entrance to the quarry for 13 minutes. Other noise sources observed during the monitoring event included intermittent construction noise (saw, hammering) at the neighbour's property, vehicle traffic on stave lake road, a helicopter that passed nearby, animals (dog barking, birds), the arrival of a pump truck to the residence at location A1, and a light vehicle that entered the laydown area at the entrance to the quarry.

At location A2, the testing was done during a period when very little traffic was observed on the mine road adjacent to the property. One light vehicle was observed

descending the road during the monitoring period. The noise monitoring results from location A2 reflect background community noise, which included sounds such as intermittent construction noise from the neighbouring property, intermittent bird and animal sounds, and the sound of wind disturbing tree leaves.

Table 2. Monitoring results at Stave Lake Quarry

	Noise		Particulate Matter		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)
Location A1	59 dB(A)	60 dB(A) L_{eq} (1 hour)	TSP: 3.69	Total Suspended Particulate Matter (TSP) over an average period of 24 hours may not exceed 120 $\mu\text{g}/\text{m}^3$	Temp: 24
			PM ₁₀ : 3.64		RH: 58
			PM _{2.5} : 2.26		Wind speed: 0.4
Location A2	44 dB(A)	60 dB(A) L_{eq} (1 hour)	TSP: 5.22	Total Suspended Particulate Matter (TSP) over an average period of 24 hours may not exceed 120 $\mu\text{g}/\text{m}^3$	Temp: 26
			PM ₁₀ : 5.13		RH: 56
			PM _{2.5} : 3.59		Wind speed: 0.9

Residents reported that the volume of traffic entering and exiting the quarry during the monitoring period was much less than has been observed in the past. The noise of vehicle traffic entering and exiting the quarry has been raised previously as a concern for adjacent property owners.

The results did not indicate the quarry was in exceedance of the bylaw requirements at the time of monitoring. Sound pressure energy recorded at Location A1 when trucks for hauling material entered or exited the quarry had the potential to momentarily exceed the 60 dB (A) threshold. With increased traffic, noise levels at the property boundary would likely be greater than what was observed during this monitoring event.

➤ Dewdney Park

Dewdney Park is situated across the Fraser River from Mainland Sand and Gravel, a large aggregate operation that climbs up from the banks of the Fraser and faces out across the river. The park is approximately 1 km away from the aggregate operation. The park was closed to all vehicle traffic at the time of the monitoring events. Pedestrians were able to walk down from the parking area to the edge of the river. Monitoring took place midday on July 20th for noise, on the evening of July 21st

for dust and noise, and midday on July 22nd for dust and noise. The monitoring locations are shown in Figure 3 below.



Noise monitoring was conducted over 64 minutes on July 20th, over 32 minutes on July 21st, and over 33 minutes on July 22nd. Air quality monitoring was conducted over 61 minutes on July 21st and 36 minutes on July 22nd. The monitoring events on July 20th and 22nd began midday during pit operating hours. The monitoring event on July 21st occurred between 8:08 and 9:09 pm, when the aggregate operation was not believed to be running. The monitoring results are shown in Table 3 below.

There were no notable dust generating sources at Dewdney Park during the monitoring events on July 21st and 22nd. The gate to the park remained closed, which prohibited vehicle traffic from frequenting the open gravel parking area that makes up most of the park. One person walked quickly from the car park area outside the park gate to the water's edge and promptly returned during the monitoring event on July 21st. On July 22nd one person entered the park on foot, stopped at the picnic bench and returned to the car park area outside the gate over approximately 10 minutes.

Dominant noise sources during monitoring events at Dewdney Park included birds and the wind rustling tree branches. During the monitoring event on July 20th two people carried boats down to the water's edge from the car park area outside the gate and paddled out into the river. Two people talked amongst themselves and walked to the picnic table where they stayed for approx. 20 minutes. Two people talked amongst themselves and walked through the park briefly to observe invasive plant species. On two additional occasions a person entered the park from the car park area outside the gate and departed. A motor boat passed briefly and a plane could be heard passing overhead.

Table 3. Monitoring results at Dewdney Park

	Noise		Particulate Matter		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)
July 20 th (12:02 pm – 1:07pm)	48 dB (A)	60 dB(A) L_{eq} (1 hour); measured at property boundary	(not evaluated)	Total Suspended Particulate (TSP) over an average of 24 hours may not exceed 120 $\mu\text{g}/\text{m}^3$; measured at property boundary	Temp: 26 RH: 60 Wind speed: 1.1
July 21 st (8:08 pm – 9:09 pm)	45 dB (A)		TSP: 5.52 PM ₁₀ : 5.43 PM _{2.5} : 3.38		Temp: 22 RH: 70 Wind speed: 0.9
July 22 nd (12:01 pm – 12:41 pm)	50 dB(A)		TSP: 7.33 PM ₁₀ : 6.61 PM _{2.5} : 4.25		Temp: 20 RH: 67 Wind speed: 1.8

Monitoring results collected during the operating hours of Mainland Sand and Gravel (July 20th and 22nd) appear slightly higher, but similar to those collected during non-operating hours (July 21st). During the midday monitoring events (July 20th and 22nd) the park saw slightly more activity, wind speed was slightly higher, and background noises from wildlife (e.g., birds) and man-made sources (e.g., boats, planes, nearby vehicle traffic) were more apparent. From this data, we cannot be confident that the higher results observed during the midday monitoring events can be attributed to the aggregate operation.

➤ **Castle Pit**

Monitoring was conducted near the entrance to castle pit along Norrish Creek Forest Service Road on the morning of July 20th and 22nd. The monitoring location is shown in Figure 4 below.

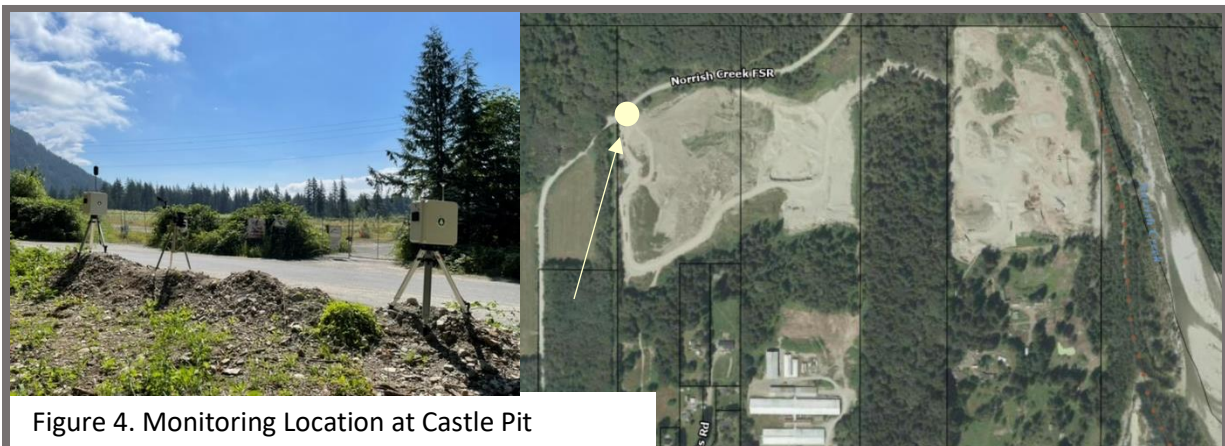


Figure 4. Monitoring Location at Castle Pit

Locations C (Castle Pit) and G (Bell Road) identified in Figure 1 were not operating at the time of the monitoring events. Monitoring results reflect background conditions.

Noise monitoring was conducted over 63 minutes on July 20th, and over 68 minutes on July 22nd. Air quality monitoring was conducted over 82 minutes on July 22nd. The monitoring event on July 20th began at 9:26 am. The monitoring event on July 22nd began at 10:24 am. The monitoring results are shown in Table 4 below.

Monitoring equipment was set up along a berm at the side of the road. The road immediately adjacent to the monitoring location was paved. Shortly after the gate and entrance to Castle Pit, the pavement runs out and the road turns to gravel.

Five vehicles passed on the road adjacent to the monitoring equipment during the monitoring period on July 20th. In addition, one motorcycle approached the gate the entrance to the pit and turned back. On July 22nd, six vehicles passed during the monitoring period.

Table 4. Monitoring results at Castle Pit

	Noise		Particulate Matter		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)
July 20 th (9:26 am – 10:32 am)	46 dB (A)	60 dB(A) L_{eq} (1 hour)	(not evaluated)	TSP over 24 hours may not exceed 120 $\mu\text{g}/\text{m}^3$	Temp: 22
July 22 nd (10:24 am – 11:46 am)	50 dB(A)		TSP: 5.16		RH: 69
			PM ₁₀ : 5.07		Wind speed: 0.4
		PM _{2.5} : 4.20	Temp: 21		
			RH: 67		
			Wind speed: 1.8		

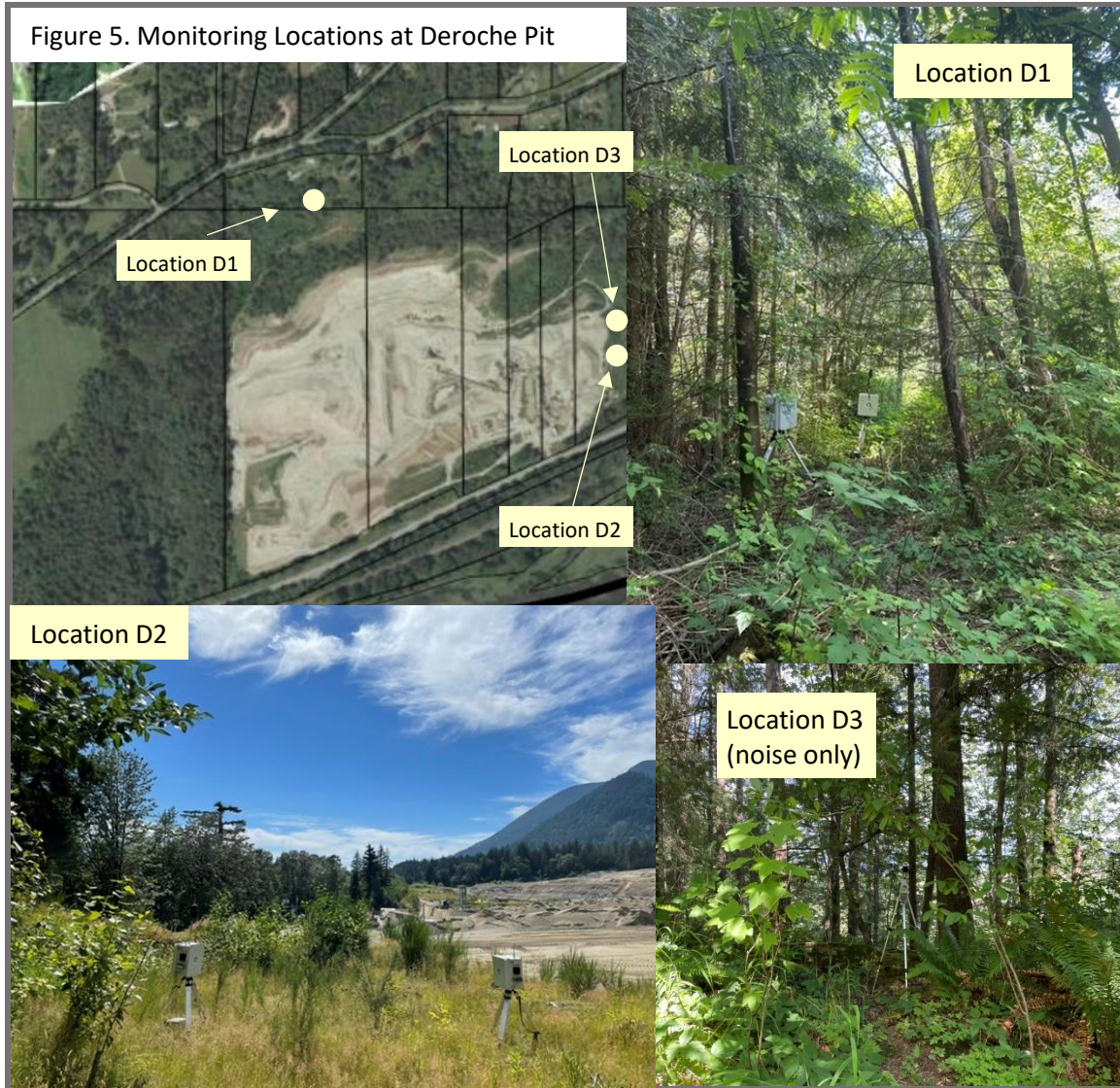
➤ Deroche Pit

Monitoring was conducted at three locations along the property boundary of Deroche Pit on the afternoon of July 21st. Air quality monitoring was conducted at two locations and noise monitoring was conducted at three locations. The monitoring locations are shown in Figure 5 below.

Along the east side of the property, two monitoring locations were selected for the evaluation of noise: D2 and D3 (as illustrated in Figure 5 below). Location D2 was located inside the berm on the mine property. Location D3 was located just outside the mine property, approx. 15 feet from markings along a berm that appeared to

mark the property line. These locations were in close proximity, but situated on either side of a berm that marked the property boundary.

Air quality measurements were collected at locations D1 and D2.



On the afternoon of July 21st, it was reported that pit activities were typical of an operating day. Three crushers and two wash plants were running. Production activities continued until the end of shift. By 5 pm activities were shut down for the day.

Noise monitoring was conducted over 72 minutes at Location D1, over 64 minutes at location D2 and over 103 minutes at location D3. Air quality monitoring was conducted over 70 minutes at location D1 and over 62 minutes at location D2. The monitoring event at Location D1 began at 13:26 pm. The monitoring event at Location D2 began at 3:24 pm, and at D3 the monitoring event began at 3:49 pm.

The monitoring event at Location D3 was extended to allow for a comparison of the noise level during operation with the noise level after operations had finished for the day. The monitoring results are shown in Table 5 below.

A slight breeze created movement of the vegetation along the property boundary which contributed to noise levels. Noise monitoring locations along the east side of the property (locations D2 and D3) appeared to be affected by traffic noise from Lougheed Highway.

Table 5. Monitoring results at Deroche Pit

	Noise		Particulate Matter		Weather	
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)	
Location D1 (1:26 pm – 2:39 pm)	47 dB (A)	60 dB(A) L_{eq} (1 hour)	TSP: 4.84	Total Suspended Particulate (TSP) over an average of 24 hours may not exceed 120 $\mu\text{g}/\text{m}^3$	Temp: 27	
			PM ₁₀ : 4.79			RH: 61
			PM _{2.5} : 3.00			Wind speed: 0.4
Location D2 (3:24 pm – 4:29 pm)	61 dB (A)		TSP: 6.92			Temp: 30
		PM ₁₀ : 6.77		RH: 46		
		PM _{2.5} : 3.18		Wind speed: 0.9		
Location D3 (3:49 pm – 5:00 pm)	60 dB(A)		(Not evaluated)		(Given proximity to D2, assumed to be as per conditions recorded at D2)	
Location D3 (5:00 pm – 5:32 pm)	60 dB (A)					

Results of the noise monitoring at Deroche Pit indicate that noise levels along the east side of the property may meet or exceed the 60 dB(A) criteria. Results indicate that the contribution of pit noise at these locations was not significant. The sound level meter that recorded noise levels just outside the mine property boundary showed an L_{eq} of 60 dB(A) during pit operations, as well as after pit operations had ceased.

➤ **Ohman Road pit**

Monitoring was conducted near the entrance to Tanco – deBench pit along Ohman Road on July 21st. The pit was not operating on July 20th or July 21st. Background measurements were targeted at this location. The monitoring location is shown in Figure 6 below.



Figure 6. Monitoring Location at Ohman Road

Noise monitoring was conducted over 71 minutes. Air quality monitoring was conducted over 76 minutes. Air quality monitoring began at 5:50 pm and noise monitoring began at 5:55 pm. The monitoring results are shown in Table 6 below.

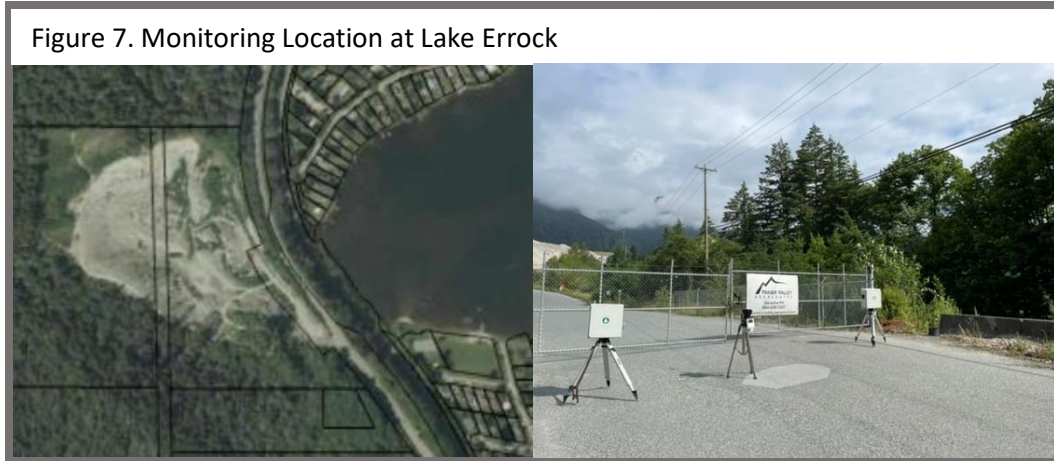
Monitoring equipment was set up to the side of the main entrance at the edge of the road. The road adjacent to the monitoring location was paved. No vehicle traffic was observed during the monitoring period.

Table 6. Monitoring results at Ohman Road

	Noise		Particulate Matter		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)
July 21 st (5:55 pm – 7:06 pm)	46 dB(A)	60 dB(A) L_{eq} (1 hour)	TSP: 3.92	120 $\mu\text{g}/\text{m}^3$ TSP over 24-hours	Temp: 27
			PM ₁₀ : 3.79		RH: 50
			PM _{2.5} : 2.00		Wind speed: 0.9

➤ **Lake Errock Pit**

Monitoring was conducted near the entrance to Lake Errock pit on July 22nd. The pit was not operating on July 20th, July 21st, or 22nd. Background measurements were targeted at this location. The monitoring location is shown in Figure 7 below.



Noise monitoring and air quality monitoring were conducted over 71 minutes. Air quality monitoring began at 8:42 am and noise monitoring began at 8:40 am. The monitoring results are shown in Table 7 below.

Monitoring equipment was set up in front of the main entrance. Monitoring results were influenced by the traffic from Lougheed Highway, which runs along the east property line and adjacent to the monitoring location at the pit entrance.

Table 7. Monitoring results at Lake Errock Pit

	Noise		Particulate Matter		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Measured Particulate Matter ($\mu\text{g}/\text{m}^3$)	Bylaw Limit	Temp ($^{\circ}\text{C}$); Relative Humidity (RH) (%); Wind Speed (m/s)
July 22 nd (8:40 am – 9:53 am)	75 dB(A)	60 dB(A) L_{eq} (1 hour)	TSP: 5.56	120 $\mu\text{g}/\text{m}^3$ TSP over 24-hours	Temp: 17
			PM ₁₀ : 5.52		RH: 78
			PM _{2.5} : 4.56		Wind speed: 1.3

Conclusion

Air quality monitoring was conducted along the property line at two active aggregate operations. Particulate matter monitoring results suggest conditions evaluated during the present evaluation were not in exceedance of air quality standards.

BC Provincial Air Quality Objectives for particulate matter are established for comparison with data collected over long durations. Although the total number of samples was small in relation to data collected over longer periods, and the averaging period was only one hour, the initial results from this evaluation did not observe concentrations that approached the criterion values targeted in the Air Quality Objectives.

Particulate matter concentrations associated with aggregate operations are expected to increase during daytime hours when dust generating activities occur. Thus, it can be hypothesized that for affected locations, concentrations of particulate matter during nighttime hours will decrease. It follows that the overall 24-hour averages may be slightly less than what was observed during the short term one-hour averaging periods collected in the present evaluation. Results fell well below the annual average target value of $8 \mu\text{g}/\text{m}^3$.

Particulate matter concentrations are expected to vary over time. Seasonal changes in weather and rainfall patterns may affect fugitive dust emissions. This collection of baseline monitoring data was target for the summer season, during conditions that are likely to be drier and warmer.

Monitoring for total suspended particulate targets collection of all particles that are suspended in air. Particle size plays an important role in dictating a particle's ability to remain suspended. In practice, particles above $40 \mu\text{m}$ do not remain suspended in air for long. Due to inherent limitations in the collection and measurement technique of sampling instruments, sampling efficiency at larger particle sizes can be limited. In general, large particles are sampled less efficiently due to inertial losses and gravitational settling. Above 10 microns, sampling efficiency drops off very rapidly for many instruments. In the present evaluation, a real-time monitor, the TSI Dusttrak, is used to evaluate total suspended particles. If desired, for a more accurate evaluation of total suspended particulate, the United States Environmental Protection Agency's reference method for the determination of suspended particulate matter in the atmosphere (High-Volume Method) can be used. The High-Volume Method collects particles on a filter. A direct power source is generally desirable.

Noise monitoring was conducted along the property line at two active aggregate operations. Noise monitoring results suggested that the conditions evaluated during the present evaluation did not create an exceedance of the Bylaw limit.

At Stave Lake, from a noise perspective, vehicle traffic presented the greatest concern to local residents. Limited traffic was observed during the monitoring period. With additional traffic, it is expected that noise levels along the property boundary may increase. Additional monitoring during a busier time may be helpful to further evaluate ongoing compliance with the Bylaw limits. It is recommended that the volume of vehicle traffic be taken into consideration for future evaluations. Per Bylaw section 51, the Bylaw noise limits do not apply to the noise that may be generated by the movement of trucks entering or exiting a parcel in the approved area of access to and egress from the permit area.

At Deroche Pit, although it was observed that the noise level over one hour at the property boundary may exceed 60 dB(A) between the hours of 7:00 am and 7:00 pm, results indicate that the noise related to aggregate removal or processing did not exceed 60 dB(A). Results indicated that the contribution of pit noise at the property boundary was below the criteria outlined in the Bylaw.

Results from background noise monitoring events demonstrate Bylaw limits at a property boundary may be exceeded in the absence of activity at the aggregate operation and hence highlight the importance of a careful monitoring strategy.

At some of the locations targeted for initial data collection, the aggregate operations were not active at the time of the evaluation. It is recommended that an initial data collection event be considered for these properties at a time when they are active. Background data at these locations was collected to compare future results that may be collected when the operations are active.

Data collected at operating locations was believed to be representative of the conditions present at the time of monitoring. To confirm the findings reflect ongoing operating conditions, it is recommended that the evaluation is repeated. Further, should conditions change, or the level of activity at the aggregate operation change, monitoring should be repeated.

Limitations and use of report

This review has been prepared in accordance with the scope of the contracted services, and with generally accepted monitoring standards and practices. Aclaran Solutions makes no express or implied warranties. Aclaran Solutions disclaims responsibility for any damages or losses (including, without limitation, financial loss, damages for loss in business projects, loss of profits or other consequential losses) due to use of this report.

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Closure

This report represents the best judgement of the author, based on the information acquired at the time of the review. If you have any questions or require further information, please contact the signatory.

Yours truly,

Aclaran Solutions

Prepared by:



Carina Doyle, M.Sc., CIH



Evaluation of noise emissions associated with aggregate operations in the Fraser Valley Regional District

**Prepared in
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Executive Summary

Noise monitoring was conducted over two days in August 2023 with the intent of characterizing noise associated with commercial aggregate operations. The present evaluation aimed to collect one hour monitoring events at a number of properties. Monitoring was prioritized along property boundaries of aggregate operations at locations that bordered with neighbouring residence or potentially affected stakeholders. Five properties were evaluated; three of which were either closed or non-operational at the time of the evaluation, one was down for a blast event, and one was operating.

At locations that were not active during the evaluation period, background data was collected. Given the complexity associated with identifying the source of noise at a given location, background data at these locations will be helpful for comparison with future data collected when the operations are active.

Monitoring results from the property that was operating indicated that an additional 62 dB(A) of noise was observed inside the berm along the property boundary during operation, when compared to background levels just prior to operation. Further evaluation is recommended to make an inference about the proportion of the additional noise that could be attributed to pit operation and how much additional noise attenuation is gained from the berm and vegetation along the property boundary. Data from the present evaluation can be used to direct future monitoring efforts.

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Introduction

The Fraser Valley Regional District (FVRD) has adopted [BYLAW No. 1181, 2014](#) to regulate commercial gravel operations in the electoral areas of the Regional District. The bylaw defines areas within the FVRD where commercial aggregate operations may operate upon obtaining a permit, and subject to requirements and restrictions. Within the areas designated as 'Community Areas' in the bylaw, commercial aggregate operations must operate in accordance with the defined noise and dust limits. The noise limit is shown in Table 1.

Table 1. Noise Standard

Criteria	Equivalent continuous sound pressure level	Integrating Period
FVRD Bylaw limit for decibels on an A-weighted scale	60 dB (A)	60 minutes

A number of activities at commercial aggregate operations can create noise emissions. Noise generating activities related to pits and quarries can include drilling, blasting, crushing, screening, conveying, hauling, and the loading and unloading of stockpiles. Community sources of noise may also contribute to emissions within the FVRD.

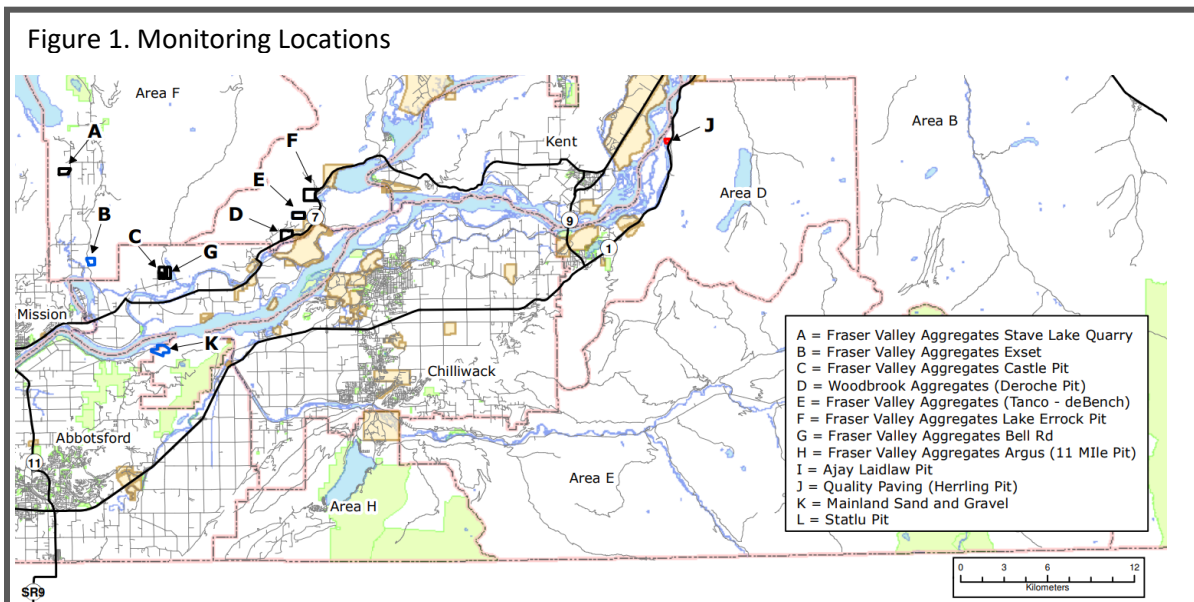
The present evaluation was undertaken to better understand the noise generated at commercial aggregate operations in Community Areas. In order to obtain a preliminary indication of which properties may generate emissions near the bylaw limits, baseline measurements at were collected at priority locations.

When evaluating noise concentrations in community areas, results can be influenced by multiple sources. Noise sources may include road, rail, and air traffic, other manmade sources, as well as noise created by animals (e.g., birds, dogs) or wind currents. A vegetative cover of trees and shrubs could be found along many of the property boundaries under consideration for this evaluation. Wind currents rustling branches and leaves can contribute to overall noise in the community and may influence property line monitoring events. Other industrial facilities within a community may also generate noise.

Data Collection

Monitoring was planned during operating hours of the aggregate operations, when industrial activity that may be noise generating occurs. One-hour measurement intervals were targeted at each monitoring location for ease of comparison with the bylaw limit. For locations that were found to be non-operational, a background one-hour sample was targeted.

Monitoring was conducted on August 22nd and 23rd, 2023. Measurements were collected along property boundaries at five aggregate operations. In general, wherever feasible, locations were chosen along the boundaries of the mine properties which bordered with other community infrastructure or potentially affected residents. An overview showing the properties where monitoring occurred is shown in Figure 1. Monitoring occurred at the locations labeled A, C/G, D, E and F in Figure 1. A description of each of the monitoring locations is further provided in the sections below.



Monitors were mounted in protective enclosures, with the sampling inlet height approximately 1.5 meters above base of the tripod. To the extent feasible, monitoring locations were selected to minimize the effects of local sources that may influence noise in the immediate vicinity of the monitor.

In general, monitoring locations should be located away from structures such as trees and buildings. For the present evaluation, locations along property boundaries were prioritized. A vegetative cover along the property boundary at some of the

selected monitoring locations was observed. Trees and vegetation may have a blocking affect on noise propagation. It was assumed that if applicable, neighbouring properties would benefit from this blocking effect and conditions observed at the monitors would reflect the property line conditions.

Measurements were collected using a Quest SoundPro DL-2 sound level meter. A Quest QC-10 sound level meter calibrator was used at the start of each monitoring period to calibrate the sound level meter, and at the end of each monitoring period to confirm the performance of the instrument. All pre- and post-measurements were within one decibel (dB). The sound level meter was set with a 3 dB exchange rate, a slow time constant and to an A-weighted scale.

➤ **Weather**

Information on temperature, relative humidity, and wind at the time of monitoring was collected using a Davis Vantage Pro weather station at each monitoring location. To determine wind speed, a 30-minute average reading was taken during each monitoring event. Conditions remained mostly clear with partly cloudy skies. Precipitation was not observed during the monitoring. On August 22nd, temperatures during monitoring ranged from 18^oC to 22^oC, relative humidity ranged from 39% to 58%, and wind speeds ranged from 0.9 to 1.8 m/s. On August 23rd, temperatures during monitoring ranged from 15^oC to 19^oC, relative humidity ranged from 68% to 85%, and wind speeds ranged from 0 to 0.9 m/s.

Findings

The details of the monitoring and the results are presented below for each location.

➤ Stave Lake

Monitoring was conducted at two locations along the property boundary of Stave Lake Quarry on the morning of August 22nd. The monitoring locations are shown in Figure 2 below. The monitoring results are shown in Table 2 below.



During the monitoring event at location A1, vehicle traffic into and out of the quarry was not observed. One light vehicle (pick-up truck) was parked at the laydown area near the entrance of the quarry and appeared to be manning the entrance for security purposes during a blast. One blast event occurred during the monitoring period. The noise level was observed to rise to 55 dBA at the time of the blast¹. No other industrial activity was observed (or could be heard) at the quarry.

Community noise sources were observed during the monitoring event, including vehicle traffic on stave lake road, air traffic that passed overhead, animals (dog barking, birds), and noise generated during yard maintenance activities. Of note, a significant noise source observed was the use of a lawn mower. The lawn mower was used to mow a grassy area on the back section of the property at A1. Results have been presented to show noise levels with, and without, the lawn mower.

¹ Note, measurement parameters were established for comparison with bylaw limits and not tailored to further evaluate noise and vibration from blasting.

Background noise levels during the monitoring period in the absence of the lawn mower were notable quieter at 47 dB(A), and rose to 64 dB(A) with the lawnmower, resulting in an average 1-hour L_{eq} of 61 dB(A).

At location A2, the testing was done during a period when very little traffic was observed on the mine road adjacent to the property. One light vehicle was observed descending the road during the monitoring period. The noise monitoring results from location A2 reflect background community noise, which included sounds such as intermittent bird and animal sounds, and the sound of wind disturbing tree leaves.

Table 2. Monitoring results at Stave Lake Quarry

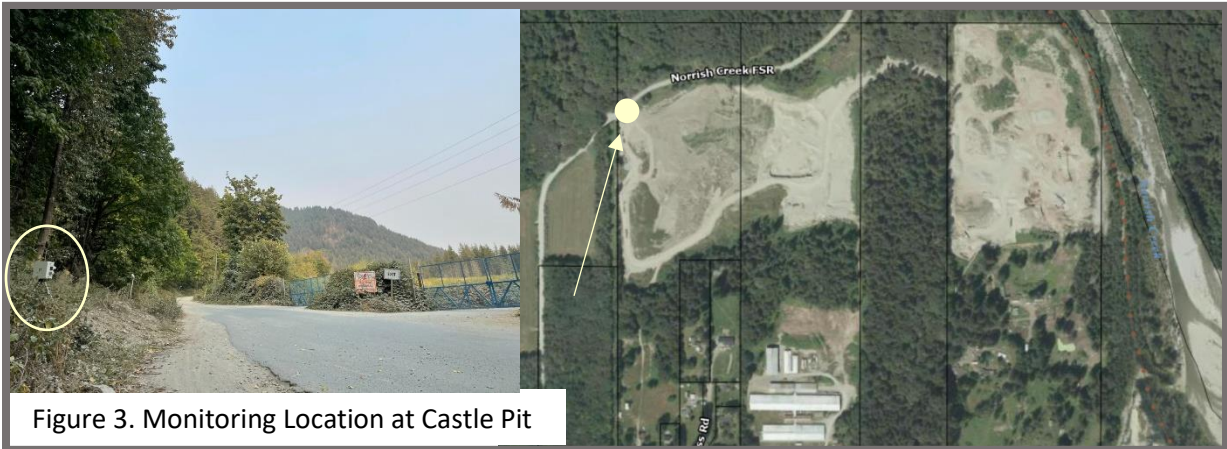
	Noise		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Temp (°C); Relative Humidity (RH) (%); Wind Speed (m/s)
Location A1	64 dB(A) during 30 min period with lawn mowing	60 dB(A) L_{eq} (1 hour)	Temp: 19
	47 dB(A) during 30 min period without lawn mowing		RH: 57 Wind speed: 0.4
Location A2	40 dB(A)		Temp: 18 RH: 58 Wind speed: 0.9

The noise of vehicle traffic entering and exiting the quarry has been raised previously as a concern for adjacent property owners. During the monitoring period, no trucks or heavy equipment was observed to enter the quarry. With increased traffic, noise levels at the property boundary would likely be greater than what was observed during this monitoring event.

The results did not indicate the quarry was in exceedance of the bylaw requirements at the time of monitoring.

➤ **Castle Pit**

Monitoring was conducted near the entrance to castle pit along Norrish Creek Forest Service Road during the early afternoon on August 22nd. The monitoring location is shown in Figure 3 below.



Locations C (Castle Pit) and G (Bell Road) identified in Figure 1 were not operating at the time of the monitoring events. The main gate remained closed, and no industrial activity associated with the pits was observed. The monitoring results reflect background conditions. Results are shown in Table 3 below.

Monitoring equipment was set up along a berm at the side of the road across from the entrance gate. The road immediately adjacent to the monitoring location was paved. Shortly after the gate and entrance to Castle Pit, the pavement runs out and the road turns to gravel.

Three vehicles passed on the road adjacent to the monitoring equipment during the monitoring period. In addition, one vehicle and one motorcycle (on separate occasions) came up the road to the gate at the entrance to the pit, adjacent to where the monitoring equipment was set up, and turned to go back down the road.

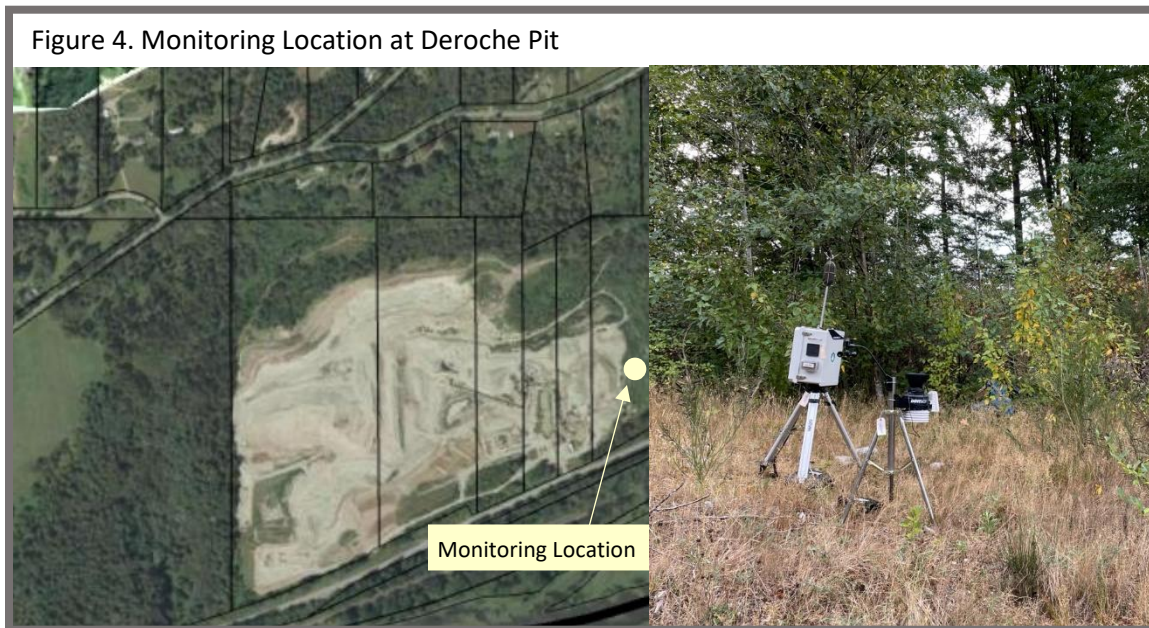
Table 3. Monitoring results at Castle Pit

	Noise		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Temp (°C); Relative Humidity (RH) (%); Wind Speed (m/s)
August 22 nd (1:37 pm – 2:38 pm)	46 dB(A)	60 dB(A) L_{eq} (1 hour)	Temp: 22 RH: 47 Wind speed: 1.3

➤ **Deroche Pit**

Monitoring was conducted at a location along the east side of the property boundary of Deroche Pit on the morning of August 23rd. A berm runs along the east side of the property at the property boundary. The monitoring location is shown in Figure 4 below. The location is inside the berm on the mine property.

It is acknowledged that the berm, along with the trees and vegetative cover, may provide a further reduction in noise levels at community locations adjacent to the mine property. During a previous monitoring event, monitoring locations were selected on either side of the berm in relation to the mine property and found to show comparable results.



Monitoring was conducted at the start of the shift, beginning at 7 am. It was reported that pit activities were typical of a routine operating day. With the exception of one wash plant, all other equipment was running. This included the crush plant, 3 loaders, an excavator, a wash plant, and the trucks.

On the morning of August 23rd, a short noise sample was collected prior to the commencement of operational activities at the pit in order to evaluate the background noise levels at the monitoring location. Monitoring of background noise began at 6:37 am. The monitoring results for the two monitoring events are shown in Table 4 below.

Table 4. Monitoring results at Deroche Pit

	Noise		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Temp (°C); Relative Humidity (RH) (%); Wind Speed (m/s)
August 23 rd (before pit operation)	62 dB (A)	60 dB(A) L_{eq} (1 hour)	Temp: 15
			RH: 79
			Wind speed: 0
August 23 rd (during pit operation)	65 dB (A)		Temp: 15
		RH: 85	
		Wind speed: 0	

Results of the noise monitoring at Deroche Pit indicate that noise levels along the east side of the property may exceed 60 dB(A). Results indicate that the 60 dB(A) threshold was exceeded prior to the commencement of operational activities at the pit. It has been observed previously that this monitoring location appears to be affected by traffic noise from Lougheed Highway, as well as noise generated by the movement of vegetation.

Results indicate that increased noise was observed during pit operation. During operating hours, the noise level at the monitoring location was approximately double the recorded background level, resulting in a 3 dB (A) increase. That is, the additional noise contribution observed during operating hours was 62 dB(A)². It may be erroneous to attribute this increase in noise solely to the operational activity of the pit. While the monitoring location was likely to have been impacted by pit operations, the contribution of other noise sources is also possible. For example, it is reasonable to consider that the noise contribution from Lougheed Highway at the monitoring location would increase with increased traffic. In general, it was observed that traffic increased during the day, compared to the traffic levels prior to 7 am.

Further evaluation that considers changes in the contribution of highway noise throughout the day may be helpful in determining the noise contribution of the aggregate operation at the property boundary location referenced in the present evaluation. Additional noise attenuation that may be realized from the berm and vegetation along the property boundary should also be considered when evaluating impact to community stakeholders.

² SPL (Sound Pressure Level (SPL)) = $10 \times \log \left(\sum_{i=1}^n 10^{\left(\frac{SPL_i}{10}\right)} \right)$

➤ **Ohman Road pit**

Monitoring was conducted near the entrance to Tanco – deBench pit along Ohman Road on the afternoon of August 22nd. The pit did not appear to be operating and the main gates remained closed. Background measurements were targeted at this location. The monitoring location is shown in Figure 5 below. Monitoring equipment was set up to the side of the main entrance at the edge of the road.



Figure 5. Monitoring Location at Ohman Road

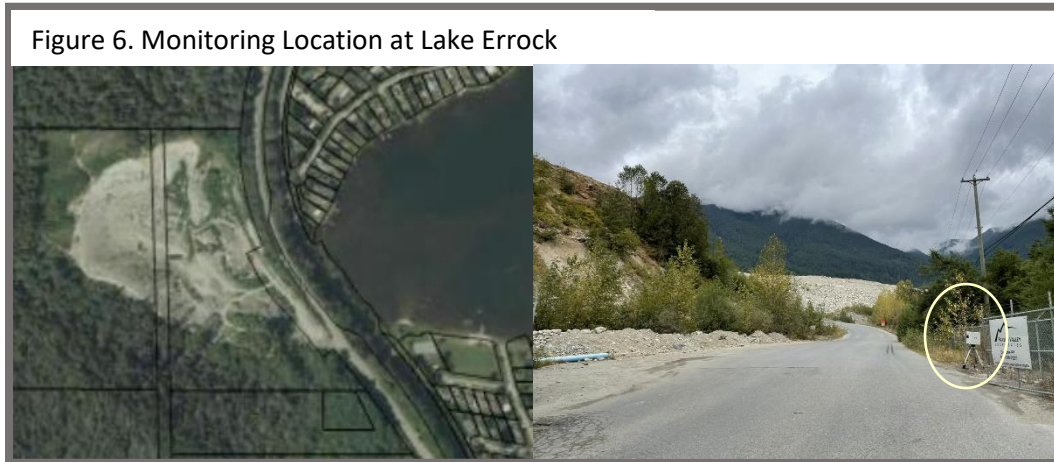
Monitoring began at 3:34 pm. During the monitoring period, one vehicle was observed on the road but turned prior to the end of the road and the gate where the monitor was set up. Other background noise sources included sound from air movement (leaves/vegetation moving in the wind), animals, and for short period of time distance music at a neighborhood house could be heard. The monitoring results are shown in Table 5 below.

Table 5. Monitoring results at Ohman Road

	Noise		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Temp (°C); Relative Humidity (RH) (%); Wind Speed (m/s)
August 22 nd	45 dB(A)	60 dB(A) Leq (1 hour)	Temp: 22
			RH: 39
			Wind speed: 1.8

➤ **Lake Errock Pit**

Monitoring was conducted near the entrance to Lake Errock pit on August 23rd. At the time of evaluation, the gate was open and the pit did not appear to be operating. An excavator was working along the south side of the property. There did not appear to be any additional industrial activity. The monitoring location is shown in Figure 6 below.



Noise monitoring was conducted between 9:35 am and 10:37 am. The monitoring results are shown in Table 6 below. Monitoring equipment was set up at the main entrance, just inside the gate, at the side of the road along the fence that runs along the property line. Monitoring results were influenced by the traffic from Lougheed Highway, which runs along the east property line and adjacent to the monitoring location at the pit entrance.

Table 6. Monitoring results at Lake Errock Pit

	Noise		Weather
	Measured Noise (decibels, A-weighted)	Bylaw Limit	Temp (°C); Relative Humidity (RH) (%); Wind Speed (m/s)
August 23 rd	62 dB(A)	60 dB(A) Leq (1 hour)	Temp: 18
			RH: 74
			Wind speed: 0.9

Industrial activity did not appear to contribute to the noise at the entrance gate. The results do not suggest the quarry was in exceedance of the bylaw requirements at the time of monitoring.

Conclusion

Noise monitoring was conducted along the property line at five different aggregate operations. The data collected was thought to be representative of the conditions present at the time of monitoring. Deroche pit was operational. The other operations were either down or closed and background data at these locations was collected for comparison with future results collected during routine operations. It is recommended that an initial data collection event be considered for these properties at a time when they are active.

The Stave Lake operation was down for a blast event at the time of monitoring. The blast event did not result in an exceedance of the Bylaw limit. As part of this process, access to site is blocked. Vehicle traffic remains the greatest concern to local residents. Traffic was not observed during the monitoring period. Additional monitoring during a busier time may be helpful to further evaluate noise impacts to community stakeholders and ongoing compliance with the Bylaw limits. It is recommended that the volume of vehicle traffic be taken this into consideration for future evaluations. Per Bylaw section 51, the Bylaw noise limits do not apply to the noise that may be generated by the movement of trucks entering or exiting a parcel in the approved area of access to, and egress from, the permit area.

At Deroche Pit, although it was observed that the noise level over one hour at the property boundary may exceed 60 dB(A) between the hours of 7:00 am and 7:00 pm, the noise related to aggregate removal or processing may not be in excess of 60 dB(A). An increase of 62 dB(A) above background was observed during operations at the monitoring location. Further evaluation should consider the proportional contribution of highway noise and/or other community sources during operating hours, as well as any additional attenuating effects that the berm and vegetation at the property boundary may have for community stakeholders.

Results from background noise monitoring events demonstrate Bylaw limits at a property boundary may be exceeded in the absence of activity at the aggregate operation and hence highlight the importance of a careful monitoring strategy.

For improved confidence that the findings of the present evaluation reflect ongoing operating conditions, it is recommended that the evaluation is repeated (i.e. one monitoring event reflects only the conditions at the time of monitoring). Further, should conditions change, or the level of activity at the aggregate operation change, additional monitoring may be warranted. This should be evaluated on a case-by-case basis.

Limitations and use of report

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Closure

This report represents the best judgement of the author, based on the information acquired at the time of the review. If you have any questions or require further information, please contact the signatory.

Yours truly,

Aclaran Solutions

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