

DeBench Pit – Mission Ridge Aggregates # 1610395
Occupational Silica and Noise Monitoring
June 26th, 2012

s.22

Ministry of Energy and Mines

The objective of this assessment was to determine occupational silica (rock dust) and noise exposure at DeBench Pit on June 26, 2012. A noise survey of the mine site was done around equipment and in areas with higher sound levels. Results were compared to Ministry of Energy and Mines (MEM) Health Safety and Reclamation Code (HSRC) requirements.

Respirable Crystalline Silica (Quartz)

Silica is the basic component of sand and rock, and the most abundant type of crystalline silica is quartz. Mining activities such as crushing, loading, hauling, dumping rock, dry sweeping or pressurized air blowing, and drilling may be at risk of exposure to silica dust. Silicosis is a disease caused by the prolonged breathing of crystalline silica dust. Fine particles deposited in the lungs cause thickening and scarring of the lung tissue. The HSRC for Mines in BC has an occupational exposure limit of 0.1 milligrams per cubic metre (mg/m^3), which is the maximum amount of crystalline silica to which workers may be exposed during an eight-hour work shift. There are however current exposure guidelines adopted by ACGIH® and WorkSafe BC which use an exposure limit of $0.025 \text{ mg}/\text{m}^3$ (8-hour TWA), which is a more conservative and up to date indicator for crystalline silica. Crystalline silica is also classified as a human carcinogen, and exposures must be kept as low as reasonably achievable.

Method

Personal exposure monitoring for crystalline silica was performed by measuring the respirable fraction of dust in an employees breathing zone for the duration of a full-shift. Sampling was performed using a Nylon Cyclone and filter cassette assembly, which is connected to a personal sampling pump that draws air through the sampling head at 1.7 L/min. The filter cassette was then analyzed using gravimetric analysis to determine the respirable particulate concentration and using x-ray diffraction for respirable quartz concentration. Employees were interviewed at the end of shift to characterize their daily tasks, equipment used, dust sources, respiratory protection use, and controls in place to reduce dust exposure.

Results

Employee's exposures to respirable crystalline silica (quartz) were below the HSRC for Mines 8-hour TWA Limit of 0.10 mg/m³. Sampling results indicate that 1 out of 4 employees exposures were greater than the guideline adopted by ACGIH® and Worksafe BC of 0.025 mg/m³, therefore caution should be taken in regards to employees silica exposure risk. Employees exposure to respirable total dust were also below the HSRC for Mines 8-hour TWA Limit of 3.0 mg/m³. Refer to Table 1 below for a summary of the personal sampling results.

Table 1: Summary of Employee Exposure to Respirable Dust

Mine Name: DeBench - Mission Ridge Aggregates		Date: 26-June-12		Weather: Cloudy, light rain, damp ground Temp: 15°C		
Employee Name	Occupation	Work area	Run Time (min)	Respirable Dust		Task Description
				Total (mg/m ³)	Quartz (mg/m ³)	
s.22		Crusher plant	513	0.26	0.05	Most of day spent in close proximity to crusher plant, grease jaw, shovelling, survey crusher plant, shovelled out screendeck, fit/squeeze into small spaces, repair V-belt 2hrs (crush plant not in operation). Start/shutdown crusher plant.
		Operate loader Cat 988B, loading trucks	438	0.04	< 0.01	Operated loader 9hrs, loading haul trucks (lots, continuously filling trucks throughout day); Loader old, window open, no AC, no radio
		Operate Loader Cat 988F, feeding crusher plant	562	0.19	0.02	Operated loader 7hrs, feeding crusher plant, Fix V-belt, dig out conveyor, replace v-belt, 2hrs; Loader good condition, window/doors closed, AC, radio moderate
		Operate excavator Link-belt 460Lx	568	0.15	< 0.01	Operate excavator 9hrs, moving top soil and loose aggregate on top bench; Excavator good condition, window/door closed, AC, no radio

Note: result < 0.01 mg/m³ indicates the presence of quartz below the detectable limit of <0.01 mg.



Discussion

Considering crystalline silica is a carcinogen, it is important to minimize exposure to rock dust (crystalline silica, quartz) during every job task. Job tasks should be carried out in a manner that considers minimizing dust exposure. Applying water during dry, hot, dusty conditions will help suppress the dust, this is especially important in areas with high activity (main roads) and where employees are working. There are endless options for water systems used to suppress dust, such as field sprinklers, long range hose (fire hose), water truck or filling loader bucket with water, that may be used in the mining industry. It is also possible to prevent the dust from becoming a problem through applying a dust suppression chemical spray. Vehicle cabs are effective at reducing dust exposure, however it is important that cabs are regularly maintained and have working A/C, good seals, cab pressurization, and doors/windows closed. Although the results of this assessment demonstrated levels below the occupational exposure limits, as required by the HSRC it is necessary to conduct further sampling to verify the on-going effectiveness of the implemented controls including, during dry, sunny weather conditions, or if there are significant changes to the work environment, equipment, processes and/or worker activities.



Noise Exposure

Noise is a serious hazard in many workplaces. Over time, if exposure to noise from machinery, processes, and equipment is not properly eliminated or controlled, it may cause permanent hearing loss in workers. Exposure to high levels of noise in the workplace, may also create physical and psychological stress, reduce productivity, interfere with communication, and contribute to accidents and injuries by making it difficult to hear moving equipment, other workers, and warning signals. The maximum permissible noise exposure limits refer to sound pressure levels and durations of exposure that represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech. The HSRC for mines occupational noise limit for an 8 hour shift is 85 dBA, and 84 dBA for a 10 hour shift (HSRC Part 2: Table 2-2).

Methods

Personal exposure monitoring for noise was performed using personal noise dosimeters, in which the microphone was placed in the workers hearing zone and worn for the duration of a full shift. Personal noise exposure was measured using Larson Davis Spark Model 705+ and 706 dosimeters. Sound level measurements on the mine site were conducted using a Larson Davis Model 831 Sound Level Meter. Equipment was calibrated prior to starting the sample and after stopping the sample. Employees were interviewed at the end of shift to characterize their daily tasks, equipment used, noise sources, hearing protection use, and controls in place to reduce noise exposure.

Results

Sampling results indicate that 2 out of 4 employees have exposure levels that exceed the maximum permissible noise exposure for unprotected ears on a daily basis as set out in the HSRC. Refer to Table 2 below for a summary of the personal sampling results. *Definitions:* Sample result in Laeq is the equivalent steady sound level of a noise energy-averaged over the sampling period. Noise dose is a value relative to 100% (of an “acceptable” amount of noise; a dose >100% exceeds the

5

permissible limits) for the work shift (10-hours). Lex is the sound level, energy-averaged over the shift length of 10 hours (this value is compared to the HSRC noise limit).

Table 2: Summary of Employee Exposures to Noise

Mine Name: DeBench - Mission Ridge Aggregates		Date: 26-June-12		Weather: Cloudy, light rain, damp ground Temp: 15°C				Job description
Employee Name	Occupation	Work area	Run Time (h:min)	Sample Result Laeq, T (dBA)	Dose (%)	Lex (dBA)	HSRC for Mines Occupational Noise Limit	
s.22		Crusher plant	9:18	94	1020	94	84 dBA 10-hr TWA	Most of day spent in close proximity to crusher plant, grease jaw, shovelling, survey crusher plant, shovelled out screendeck, fit/squeeze into small spaces, repair V-belt 2hrs (crush plant not in operation). Start/shutdown crusher plant.
		Operate loader Cat 988B, loading trucks	9:24	83	71	83		Operated loader 9hrs, loading haul trucks (lots, continuously filling trucks throughout day); Loader old, window open, no AC, no radio
		Operate Loader Cat 988F, feeding crusher plant	9:15	87	202	87		Operated loader 7hrs, feeding crusher plant, Fix V-belt, dig out conveyor, replace v-belt, 2hrs; Loader good condition, window/doors closed, AC, radio moderate
		Operate excavator Link-belt 460Lx	9:21	81	42	80		Operate excavator 9hrs, moving top soil and loose aggregate on top bench; Excavator good condition, window/door closed, AC, no radio

NOTES:

BOLDED sample results represent values over the TWA Limit
dBA = Decibels in the A weighted scale

Discussion

Employees may be at risk of overexposure to noise, however, workers may be protected with the use of their hearing protection devices. Employees with exposures that exceed the permissible noise limit should wear their hearing protection for the entire duration of the shift. At DeBench Pit employees on average wore hearing protection 100 percent of the shift. It is also important to minimize the frequency at which hearing protection is removed throughout the day. Sources of noise that may have contributed to overexposure includes:

- Working in close proximity to crusher plant or other equipment
- Operating older equipment (with poor acoustic conditions, no A/C, poor seals around doors/windows, rattling and squeaking parts)
- Operating equipment with door/window open
- Operating equipment with loud stereo and communication radio

Noise conditions on the site were assessed using a sound level meter and detailed field notes/representation of the sound level are included in the appendix of this report. Sound level around the crusher plant was very high and ranged from 67-95 dBA. Some locations with increased sound pressure level (>85 dBA) are hazardous to unprotected ears, and may be hazardous within a distance of 25 meters from the equipment.

Recommendations

A hearing conservation program with all its elements is necessary when workers are exposed to noise at or above the maximum permissible noise exposure limit. A hearing conservation program is a systematic multi-element plan designed to protect workers' hearing, it should include the following elements (ranked in order of importance):

1. Engineering and administrative noise control
 - Engineering noise-control measures should be implemented to reduce worker noise exposures to below regulated limits, and to promote acoustical conditions consistent with worker safety, comfort and efficiency
 - Administrative noise-control measures comprise purchasing quieter equipment (replace obsolete equipment with quieter models), and the reassignment of work tasks to reduce the time spent in noisy work positions.
2. Worker education
 - Workers, supervisors and management must be educated about noise.
 - Promote an understanding of noise in the workplace, the associated risk of hearing loss, the company hearing conservation program, and the responsibilities of all involved in implementing it.
 - Information on the performance, use and limitations of hearing protectors must be included.
 - Education should be updated periodically.
3. Hearing protection
 - If engineering and administrative controls are not adequate, hearing protection may be necessary.

- The protection required by each worker must be carefully assessed.
 - All employees should be trained on the fit, care and use of the hearing protection, as well as be informed of the importance in wearing the hearing protectors in the work place. (It is especially important to train employees on proper fit of hearing protection. Hearing protection has a noise reduction rating (NRR) that applies only when properly fitted (ex. Ear plugs fully inserted into ear canal), and therefore without the proper fit we are unable to ensure our ears are being protected against high noise levels.)
4. Audiometric monitoring
- Measurement of worker hearing thresholds at commencement of, and at regular intervals (eg annually) during, employment as well as before a worker is assigned to a noisy workplace.
 - Results of audiometric monitoring must be discussed with the employee.
5. (Sound survey has been generally covered from this assessment, therefore this is ranked as a lower priority) Sound survey: comprehensive survey of the noise exposures of workers and of workplace noise levels.
- Determine risky job categories, which workers require protection and the amount of protection.
 - Identify areas where noise levels may result in speech communication problems, danger due to inaudibility or warning signals, etc.
 - Identify dominant sources and determine the acoustical characteristics of the noise in preparation for engineering controls.
 - Sound surveys should be repeated periodically (eg annually) or whenever changes to the workplace suggest engineering and administrative controls and hearing protection requirements should be reviewed.

If noise exposure levels are not reduced the employer must provide hearing protectors to affected employees that meet the requirements set out in HSRC (Part2- Table2-3, see below). Hazard sound areas should be identified using warning signs and should be located at conspicuous locations within the work place.

Areas in the work place that are sources of employee exposure should be designated “Hearing Protection Zone”, in which employers require worker compliance of hearing protector use. As required by the HSRC, conduct further sampling to verify the on-going effectiveness of the implemented controls including, during varied seasonal conditions, or if there are significant changes to the work environment, equipment, processes and/or worker activities.

Table 2-3

Maximum Equivalent Noise Level, dBA	Required Rating of Hearing Protector	
	Class A, B or C †	NRR ‡
Leq less than 85 dBA	None required	None required
Leq up to 89 dBA	Class C	up to 16
Leq up to 95 dBA	Class B	at least 17
Leq up to 105 dBA	Class A	at least 24
Leq up to 110 dBA	Class A plug plus Class A or B muff	At least 24 plug ins At least 17 muff
Leq more than 100 dBA	As above, with limited exposure	As above, with limited exposure

† Canadian Standards Association standard Z94.2-94.

‡ Noise Reduction Rating (NRR) subject to Canadian Standards Association standard Z94.2-94 frequency requirements.

Ambient Air Quality – PM10

Particulate matter is the term for solid or liquid particles in the air. Smaller particles are of special interest and importance, as they are likely responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract. PM-10 includes particles with a diameter of 10 micrometers or less (one-seventh the width of human hair). The BC Air Quality Standard for PM-10 is $50 \mu\text{g}/\text{m}^3$ (daily average 24-hour sample). The equipment used in this assessment included a Harvard Impactor, filter and environmental pump with a continuous flow rate of 4.0 L/min. The results indicate PM-10 exposures are lower than the ambient air quality guideline for a 24-hour period of $50 \mu\text{g}/\text{m}^3$, see Table 3 for detailed results.



Table 3: Summary of Ambient Air Quality PM10

Mine Name: DeBench - Mission Ridge Aggregates Ltd.			Date: 26-June-12		Weather: Cloudy, light rain, damp ground Temp: 15°C	
Sample Location	Sampling Time (min)	Sample Volume (m ³)	Concentration (µg/m ³)	Air Quality Objective 24-hour	Comments	Activity
Tree Line Perimeter (downwind) , aprox 150m from crusher plant	1440	6.01	20.42	50 µg/m ³	Monitor placed on large rock, far end of mine footprint	Normal operating day, 4 employees, heavy haul truck traffic, visible dust generated from haul trucks entering and exiting mine, no water or dust suppression methods used
Mine Entrance Perimeter , aprox 30m, 100m to nearest residential area	1440	6.21	27.97		Monitor placed in grass field, 20m from mine entrance, heavy traffic flow haul trucks	

Dust suppression methods should be utilized during dry, hot, windy conditions and when noticeable dust is being generated continuously by mining activities.

Dust suppression methods (a few examples):

- Water truck on main roads
- Water sprinklers on conveyors and crusher plants
- Filling loader bucket with water
- Fire hose
- Tire wash at scale house
- Chemical dust suppression spray

Conclusion

Thank you for your participation in this assessment, please share report with all employees.

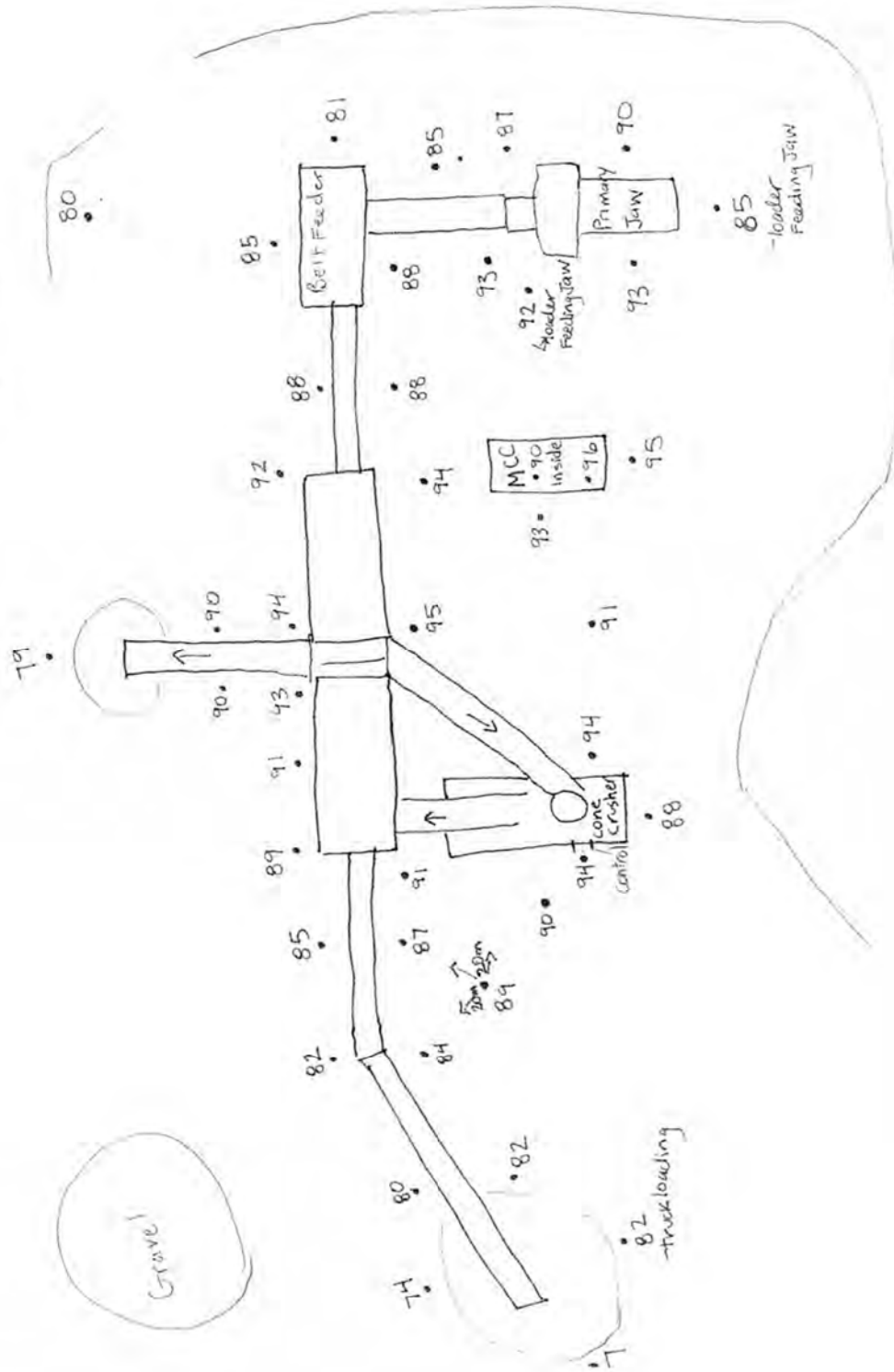
Sincerely,

s.22

Ministry of Energy and Mines

Appendix: Field Drawings/Notes of Area Sound Level Measurements

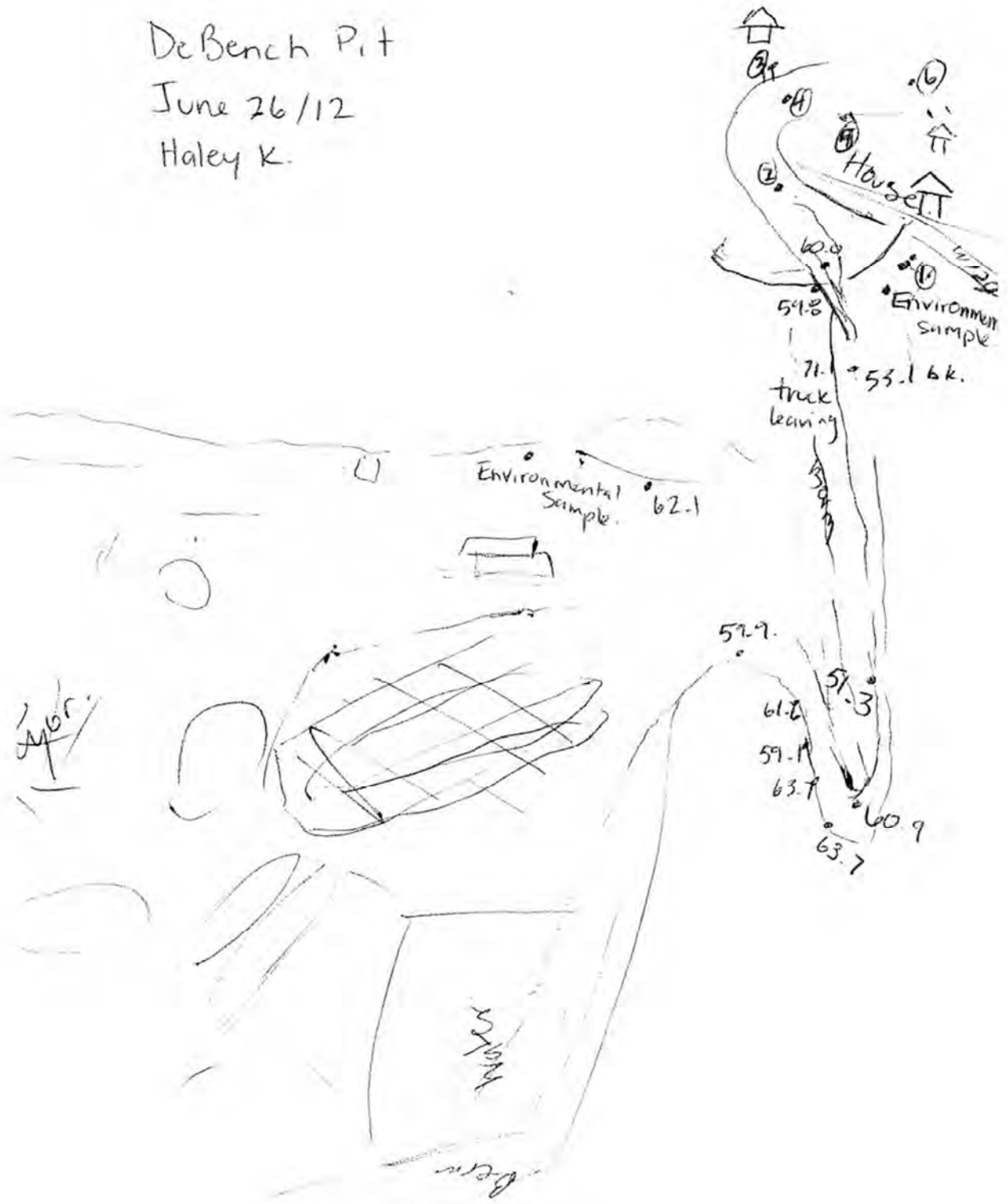
Crush Plant - DeBench Pit - Mission Ridge Aggregates



- Measurement taken 5 m from noise source (unless otherwise indicated) A-weighted sound pressure level (dBA)

Haley K.
June 26/12

DeBench Pit
 June 26/12
 Haley K.



MINE NAME DeBorch Pit MINE NUMBER Mission Ridge Aggregates
 DATE June 26/12
 WEATHER CONDITIONS Cloudy, partial showers (5min)

LOCATION	EQUIPMENT / NOISE SOURCE	TIME	SOUND LEVEL (dBA)	COMMENTS
Outside scale house.	Background.	11:10	64.3	generator 10m away crusher plant 100m away
Corner of pit. approx 50 m.	Background loud separating crusher plant + truck	2:07	62.1	
Pit berm Env. Sampler	80m from CP		61.7	truck on scale (40m away)
20m from berm			59.1	
40m from berm	60m		61.6	
Close to Scale (80m from crusher plant)			62.2	loader filling truck.
20m away Scale.	80m crush plant		66.8	Loader moving in area truck on scale
50m away Scale	50m crush plant		65.6	
25m from crush plant			66.0	

SOUND LEVEL METER Larson Davis Model 831 S/N 00015641

CALIBRATED June 26/12

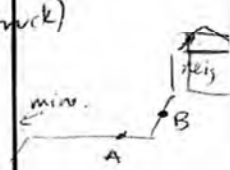
SAMPLED BY Halley K

MINE NAME DeBench Pit MINE NUMBER Mission Ridge Aggregates

DATE June 26/12

WEATHER CONDITIONS Light rain, cloudy - mild wind.

	LOCATION	EQUIPMENT / NOISE SOURCE	TIME	SOUND LEVEL (dBA)	COMMENTS
①	Entrance of Pit - by neighbour Fence approx 10m	truck - double leaving pit.	10:18	62.5	Average of background noise + truck leaving mine -
		background		67.8 67.3 55.3	up to 70 - entering pit (single truck) - without truck noise
	On neighbour berm 2m Fence	background		58.2	- w/out truck.
③	Second house at driveway gate	truck leaving pit.	10:38	69.4 avg. max 71.8	- dog across street
		Background		42.5	
④	Roadside. Down slope 20m (second driveway)	Background		43.7	
⑤	43346 (house) driveway	Background		40.5 45.3	on driveway (15m) on roadside
		truck entering (15m away)		67.7	hear sound of gravel dumped into truck - Backup alarm
⑥	43422 (house) road side.	background		43.2	Continuous quiet shake of screener/crusher
		truck leaving		70.9	louder with muffler of engine slowing down
②	Top of road entrance	Background		56.2	Continuous - loud sound crusher/screener.



SOUND LEVEL METER Larson Davis Model 831 S/N 0001564

CALIBRATED June 26/12

SAMPLED BY Haley K.

DATE June 26/12
 MINE NAME De Bench Pit
 SOUND LEVEL METER Larsen Davis M831
 S/N 0001564
 CALIBRATION June 26/12
 SAMPLED BY HK

LOW IDLE

63.7 dBA

HIGH IDLE

73.4 dBA



LEFT SIDE

RIGHT SIDE

LOW IDLE

77.2 dBA

HIGH IDLE

84.9 dBA



LOW IDLE

80.6 dBA

HIGH IDLE

87.3 dBA



INSIDE CAB

LOW IDLE

72.0 dBA

HIGH IDLE

80.7 dBA

LOW IDLE

78.7 dBA

HIGH IDLE

85.6 dBA



LOW IDLE

84.7 dBA

HIGH IDLE

93.3 dBA



LOW IDLE

84.2 dBA

HIGH IDLE

91.2 dBA



engine cover missing

year (1990)
 EQUIPMENT TYPE Cat 988B
 EQUIPMENT CONDITIONS older

☒ WINDOWS / DOORS OPEN / CLOSED
☒ SEALS ☐ PRESSURIZATION or AC
☒ RADIOS (LOW MOD HIGH)
 HOURS OPERATED PER DAY all day

COMMENTS 81.0 moving back + forth
loading bucket.

DATE June 26/12
MINE NAME DeBench Pit
SOUND LEVEL METER Larson Davis 031
S/N 0001564
CALIBRATION June 26/12
SAMPLED BY HK

LEFT SIDE

RIGHT SIDE

LOW IDLE
76.8 dBA

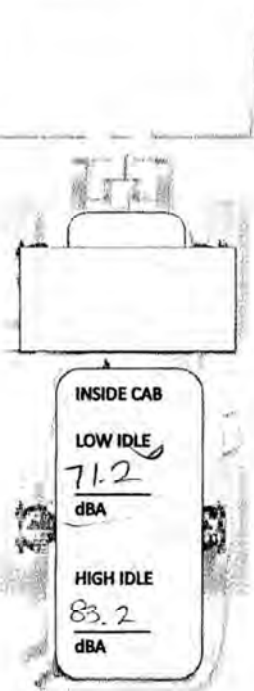
HIGH IDLE
84.2 dBA

LOW IDLE
90.1 dBA

HIGH IDLE
98 dBA

LOW IDLE
66.4 dBA

HIGH IDLE
71.6 dBA



LOW IDLE
77.4 dBA

HIGH IDLE
85.8 dBA

LOW IDLE
90.1 dBA

HIGH IDLE
98.1 dBA

LOW IDLE
81.8 dBA

HIGH IDLE
92.4 dBA

* High Idle bucket raised - 84.0

EQUIPMENT TYPE 988F

EQUIPMENT CONDITIONS 2001 year

☒ WINDOWS / DOORS OPEN / CLOSED
☐ SEALS ☒ PRESSURIZATION or AC
☐ RADIOS (LOW MOD HIGH)

HOURS OPERATED PER DAY _____

COMMENTS 85.1 Feeding ^{crusher} loader + loud music
79 - operating + filling loader

DATE June 26/12
 MINE NAME DeBench Pit
 SOUND LEVEL METER Larson Davis 831
 S/N 0001564
 CALIBRATION June 26/12
 SAMPLED BY Haley K.

LOW IDLE
65.7 dBA

HIGH IDLE
73.7 dBA

LEFT SIDE

RIGHT SIDE

LOW IDLE
66.0 dBA
 HIGH IDLE
74.5 dBA

LOW IDLE
71.9 dBA
 HIGH IDLE
82.0 dBA

LOW IDLE
68.7 dBA
 HIGH IDLE
80.3 dBA

LOW IDLE
70.8 dBA
 HIGH IDLE
81.8 dBA

INSIDE CAB

LOW IDLE
67.3 dBA

HIGH IDLE
77.6 dBA moving

LOW IDLE
68.9 dBA

HIGH IDLE
77.8 dBA

EQUIPMENT TYPE 160LY - Link belt.
 EQUIPMENT CONDITIONS New excavator.

☒ WINDOWS / DOORS OPEN / CLOSED
☒ SEALS ☐ PRESSURIZATION or AC
☒ RADIOS (LOW MOD HIGH)
 HOURS OPERATED PER DAY all day

COMMENTS _____

Table 1: Summary of
Employee Exposure to
Respirable Dust

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	Operate excavator Link-belt 460Lx		568	0.15	< 0.01	Operate excavator 9hrs, moving top soil and loose aggregate on top bench; Excavator good condition, window/door closed, AC, no radio

Table 2: Summary of Employee Exposures to Noise

Mine Name: DeBench - Mission Ridge Aggregates			Weather: Cloudy, light rain, damp ground Temp: 15°C			
Employee Name	Occupation	Work area	Date: 26-June-12		Run Time (h:min)	
			Sample Result Laeq, T (dBA)	Dose (%)	Lex (dBA)	HSRC for Mines Occupational Noise Limit
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	Mine Entrance Perimeter, aprox 30m,100m to nearest residential area	1440	6.21		27.97	