Appendix 33

Meadowbank and Whale Tail Blast Monitoring Program Version 10

Meadowbank & Whale Tail Mines

Blast Monitoring Program

Prepared by:

Agnico Eagle Mines Limited – Meadowbank Complex

Version 10

December 2024: EXECUTIVE SUMMARY

The Guidelines for the Use of Explosives In or Near Canadian Waters (Wright and Hopky, 1998) as modified by the DFO for use in the North mention the following requirements that are applicable to the Meadowbank Complex:

- No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (IPC) (i.e., overpressure) greater than 100 kPa in the swim bladder of a fish.

- No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity (PPV) greater than 13 mm/sec in a spawning bed during the period of egg incubation.

As a result of testing and monitoring in the NWT that indicates the limit of 100 kPa was not protective to fish, DFO has recommended to Agnico Eagle to use 50 kPa as the threshold for instantaneous pressure change.

Every blast is monitored with an Instantel Minimate or Micromate Blaster to ensure that vibrations generated by blasting are less than 13 mm/sec and the overpressure is under 50 kPa. The blasts were monitored from three locations at the Meadowbank site; one station is located near the northern end of Portage Pit, the second near the south end of Portage Pit and the other one at the north of Vault Pit.

For the Whale Tail site, the blasts are monitored from three possible locations. The following table summarizes their use and status.

Station	Pit	Status	Period
Nemo Lake	IVR	Active	August 2020 – Present
Nemo Lake 2	IVR	Active	May 2022 – Present
Kangislulik Station	Whale Tail	Inactive	Before June 2019
Kangislulik Station 2	Whale Tail	Inactive	June 2019 – October 2022
Kangislulik Station 3	Whale Tail	Active	October 2022 – ***Upon approval of this document***
Kangislulik Station 4	Whale Tail	Active	***From the approval of this document*** – Present

In May 2022, an additional station called Nemo Lake 2 was installed to create redundancy within our measurements to validate the accuracy of our seismographs, this station’s readings are not reported to the DFO as this is an internal process. On November 6, 2024, a new monitoring station (**Kangislulik Station 4**) was installed with permanent equipment and connectivity capabilities. This new station will allow Agnico Eagle to remotely collect vibration and air pressure data. Upon reception of the approval from DFO, Kangislulik Station 3 will be decommissioned and only Kangislulik Station 4 would be used to monitor Whale Tail Pit mining activities.

Furthermore, independent blast monitoring plans will be established for blasts that are outside of the limits of the current plan, if any.

The results of blast monitoring are systematically analyzed by the Engineering department within the 24 hours following the blasting operation. The blast monitoring results are interpreted, and a blast mitigation plan is implemented immediately if the vibrations or the overpressure exceed the guidelines. A retro analysis is conducted to determine what caused the higher-than-expected results.

The following factors are considered in controlling vibration intensity and overpressure while using an electronic initiation system:

- confinement of the charges;
- coupling of the explosives charges to the rock affects how much energy is transferred to the rock;
- spatial (geometric) distribution of the explosives affects the character and intensity of the ground vibrations;
- charge weight per delay (2ms intervals); and
- blast direction.

Additional practices and considerations have been implemented to underground blasting operations to ensure regulatory compliance.

- New optimized vibration simulation model; and
- New optimized timing between charges.

With the use of electronic initiation systems, blasting practices and designs are now highly controlled and predictable, allowing for better results and maintained regulatory compliance.

The blast monitoring reports are systematically archived, and any relevant information is entered into a database. The blast monitoring data will be submitted for regulatory review annually in the Meadowbank Complex Annual Report.

IMPLEMENTATION SCHEDULE

This Plan is implemented immediately (December 2024), upon approval by DFO.

DISTRIBUTION LIST

Agnico Eagle – Environment and Critical Infrastructures Superintendent
Agnico Eagle – Environment General Supervisor
Agnico Eagle – Environmental Coordinators
Agnico Eagle – Engineering Superintendent
Agnico Eagle – Engineering General Supervisor
Agnico Eagle – Engineering Coordinators

Version	Date	Section	Revision
1	May 2010	All Section	Comprehensive plan for Meadowbank Project
2	March 2017	All Section	Update of the original plan
3	March 2019	All Section	Implementation of Whale Tail project monitoring
4	March 2020	All Section	Update of Whale Tail project monitoring and correction of overpressure measurement
5	September 2020	All Section	Update of Whale Tail project monitoring to include IVR Pit
6	March 2021	All Section	Update of Whale Tail project monitoring to update monitoring stations
7	January 2022	All Section	Update of Whale Tail project monitoring to update monitoring stations and Underground program
8	March 2023	3.2 and 3.4	Added installation of geophone details and maps to reflect updated positions of seismograph
9	February 2024	All Section	Implementation of EIS, and general update to seismographic installations
9_rev1	March 2024	All Section	Update to lake names and monitoring stations
10	December 2024	Executive summary Section 3.2 and 3.4 Section 5	Addition of new Kangislulik Station 4 information and Underground blast optimization New sections – Addition of information for permanent blast monitoring station Addition of new Kangislulik Station 4 information and Figure 15 updated

Produced by: Engineering Department

Approved by: Christian Tremblay Digitally signed by Christian Tremblay Date: 2024.12.02 17:36:46 -06'00'
Christian Tremblay
Engineering General Supervisor

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Agnico Eagle Mines Limited – Meadowbank Complex originally developed this Blasting Monitoring Program for the control of blasting vibrations at the Portage, Goose and Vault Pit in accordance with Condition 85 of Project Certificate No.004 issued by the Nunavut Impact Review Board (NIRB). This monitoring program was also updated to include blasting activities at Whale Tail Mine in accordance with Condition 22 of NIRB Project Certificate No.008.

Agnico Eagle had developed a detailed blasting program to minimize the effects of blasting on fish and fish habitat, water quality, and wildlife and terrestrial VECs. The Blasting Program has been developed in consultation with the Fisheries and Oceans Canada (DFO) and the Government of Nunavut (GN), and shall:

a) Comply with the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998) as modified by the DFO for use in the north;
b) Adhere to the guidance provided in the Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies, NWT 2000-2002 (Cott and Hanna, 2005);
c) Include a monitoring and mitigation plan to be developed in consultation with the DFO and obtain DFO approval of the blasting program prior to the commencement of blasting;
d) Restrict blasting when migrating caribou, or sensitive local carnivores or birds may be negatively affected; and
e) Minimize the use of ammonium nitrate to reduce the effects of blasting on receiving water quality.

The Blasting Monitoring Program will continue to be implemented during the operation of the Meadowbank and Whale Tail Mines.

2. Blasting standard and criteria

The effects of blasting are typically assessed in terms of Peak Particle Velocity (PPV). The US Bureau of Mines has established that the peak particle velocity is related to the scaled distance by the following relationship:

$$PPV = k * (R/W^{0.5})^{-b}$$

Where:

PPV = Peak Particle Velocity, mm/s

R = Distance from blast to point of concern, m

W = Charge weight per delay, kg

k = confinement factor – specific to site

b = site factor

This formula can be used to estimate PPV and determine if the PPV will surpass the given limits before the blast occurs.

The pressure in water has a direct relationship with the peak particle velocity for the longitudinal or shock wave as it travels from the substrate (in our case permafrost) of water body to the water (Wright and Hopky, 1998). The formulas that described this relationship are found in the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998):

Equation (A)

Equation (A) describes the transfer of shock pressure from the substrate to the water.

$$P_W = \frac{2\left(\frac{Z_W}{Z_R}\right)P_R}{1+\left(\frac{Z_W}{Z_R}\right)}$$

Where:

P_W = pressure (kPa) in water

P_R = pressure (kPa) in substrate

Z_W = acoustic impedance of water

Z_R = acoustic impedance of substrate

Equation (B)

Equation (B) describes the relationship between acoustic impedance and the density and velocity of the medium through which the compressional wave travels.

$$\frac{Z_W}{Z_R} = \frac{D_W\ C_W}{D_R\ C_R}$$

Where:

D_W = density of water = 1 g•cm^{-3}

D_R = density of the substrate in g•cm^{-3}

C_W = compressional wave velocity in water = 146,300 cm•s^{-1}

C_R = compressional wave velocity in substrate in cm•s^{-1}

The following values are used for D_R and C_R for various substrates:

Substrate	D_R (g•cm^{-3})	C_R (cm•s^{-1})
Rock	2.64	457,200
Frozen Soil	1.92	304,800
Ice	0.98	304,800
Saturated soil	2.08	146,300
Unsaturated soil	1.92	45,700

At both Meadowbank and Whale Tail Mines, Agnico Eagle can consider the substrate to be frozen soil as the ground around the lakes is permafrost. So, Agnico Eagle is using 1.92 g•cm^{-3} as D_R and 304,800 cm•s^{-1} as C_R.

Equation (C)

Equation (C) describes the relationship between the peak particle velocity (V_R) and the pressure, density and compressional wave velocity in the substrate.

$$V_R = \frac{2P_R}{D_R\ C_R}$$

For Meadowbank and Whale Tail Mines, assuming that D_R =1.92 g•cm^{-3} and C_R = 304,800 cm•s^{-1} we can combine all the equations A, B and C to find the relationship between V_R, peak particle velocity in mm•s^{-1} and P_W, pressure (kPa) in water.

$$\frac{Z_W}{Z_R} = \frac{D_W\ C_W}{D_R\ C_R} = \frac{1\ g/cm^3 \cdot 146{,}300\ cm/s}{1.92\ \ g/cm^3 \cdot 304{,}800\ cm/s} = 0.25$$

$$P_W = \frac{2\left(\frac{Z_W}{Z_R}\right) P_R}{1 + (\frac{Z_W}{Z_R})} = \frac{2(0.25)P_R}{1 + (0.25)} = 0.4P_R$$

$$V_R = \frac{2P_R}{D_R\ C_R} \rightarrow P_R = \frac{V_R D_R C_R}{2}$$

$$P_W = 0.4P_R = \ 0.4\frac{V_R D_R C_R}{2}$$

$$= 0.4\frac{V_R \cdot 1.92\ \ g/cm^3 \cdot 304{,}800\ cm/s}{2} \cdot \frac{1\ cm/s}{10\ mm/s} \cdot \frac{1\ kPa}{10{,}000\ g \cdot cm/s^2}$$

$$P_W = 1.1704V_R$$

Where:

V_R = Peak Particle Velocity in mm•s^{-1}

P_W = Pressure in water in kPa

This last relationship is applied to the peak particle velocity (PPV) result of a blast to obtain the overpressure or instantaneous pressure change (IPC).

The Guidelines for the Use of Explosives In or Near Canadian Waters (Wright and Hopky, 1998) as modified by the DFO for use in the North, mention the following requirements that are applicable to the Meadowbank Complex:

- No explosive is detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swim bladder of a fish.
- No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than 13 mm/sec in a spawning bed during the period of egg incubation.

As a result of testing and monitoring in the NWT that indicates the limit of 100 kPa was not protective to fish, the DFO has recommended to Agnico Eagle to use 50 kPa as the threshold for instantaneous pressure change.

To keep PPV under the 13 mm/sec guideline, Wright and Hopky (1998) suggests the setback distances shown in Table 1. It also should be noted that Wright and Hopky (1998) state the following: “The detonation of explosives in or near water produces post-detonation compressive shock wave characterized by a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure.”

This statement is important for realizing that the important wave for reporting purposes is peak particle velocity for the compressive shock wave which is also referred to as the longitudinal wave.

Table 1 : Set back distance (m) from center of detonation of a confined explosive to spawning habitat to achieve 13mm/sec guideline criteria for all types of substrates (Wright and Hopkins,1998)

	Weight of Explosive Charges (kg)						
	0.5	1	5	10	25	50	100
Setback distance (m)	10.7	15.1	33.7	47.8	75.5	106.7	150.9

Concerning the instantaneous pressure change (i.e., overpressure), Wright and Hopky (1998) suggest the following setback distances to keep it under the 100 kPa guideline.

Table 2 : Set back distance (m) from center of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrate

Substrate Type	Weight of Explosive Charges (kg)							
	0.5	1	2	5	10	25	50	100
Rock	3.6	5.0	7.1	11.0	15.9	25.0	35.6	50.3
Sfrozen Soil	3.3	4.7	6.5	10.4	14.7	23.2	32.9	46.5
Ice	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Saturated Soil	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Rock	2.0	2.9	4.1	6.5	9.2	14.5	20.5	29.0

The Meadowbank Engineering team is also referring to the vibration and overpressure historical data to assess certain blast patterns closer to lakes. Over ten (10) years of historical data are archived in the Meadowbank database, and they are often used as case study for delicate blasting operations.

3. Blast monitoring plan

3.1. Portable blast monitoring equipment

Every blast is monitored to ensure that vibrations generated by blasting are less than 13 mm/sec and the overpressure is under 50 kPa. The portable instrument used for blast monitoring is an Instantel Minimate Blaster which is fully compliant with the international Society of Explosives and Engineers performance specification for blasting seismographs (Instantel, 2005).

The Minimate Blaster has three main parts: a monitor, a standard transducer (geophone) and a microphone (Figure 1). The monitor contains the battery and electronic components of the instrument. It also checks the two sensors to be sure that they work properly. The transducer measures ground vibration with a mechanism called a geophone.

Figure 1 : Instantel Minimate Blaster Unit

The transducer has three geophones that measure the ground vibrations in terms of particle velocity. They measure transverse, vertical and longitudinal ground vibrations (Figure 2). Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a back and forth motion progressing outward from the event site (Instantel, 2016). Longitudinal waves are commonly referred to as shock or compressional waves.

The microphone measures the PSP (Peak Sound Pressure) also referred as to the PAO (Peak Air Overpressure). The instrument checks the entire event waveform and displays the largest sound pressure in Pa unit.

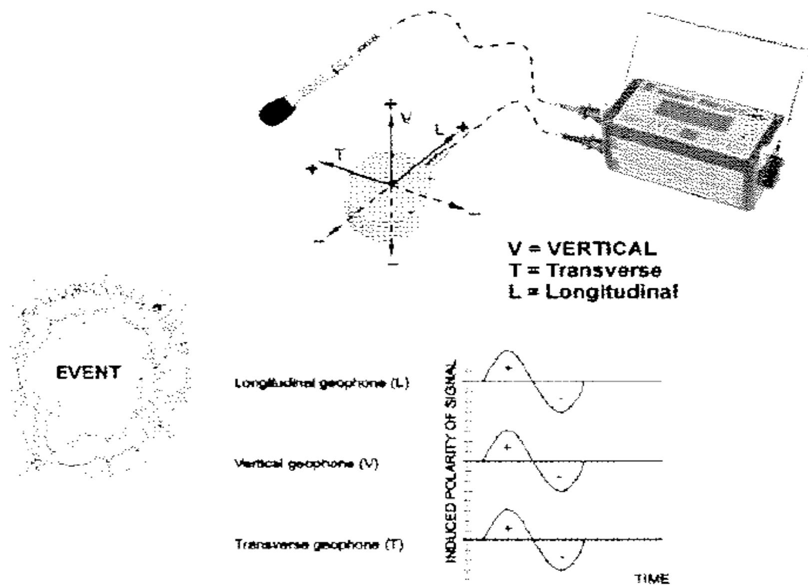

Figure 2: Sensor Orientation (Instantel, 2016)

The Minimate Blaster (Instantel) calculates the PPV of each wave-type. For measuring compressive or shock waves the longitudinal wave is the reportable value.

The vector sum is also calculated by doing a sum of all wave types. The vector sum is the PVS (Peak Vector Sum) and it is calculated as follows:

$$PVS = \sqrt{(T^2 + V^2 + L^2)}$$

Where:

T = particle velocity along the transverse plane

V = particle velocity along the vertical plane

L = particle velocity along the longitudinal plane

3.2. Permanent blast monitoring station equipment

For permanent station, the instrument used for blast monitoring is the IMS xES (engineering seismograph). It is a low power advanced vibration monitoring station designed to be rapidly deployed for permanent installations. Versatile sensor inputs enable monitoring of a wide selection of sensors including geophones, accelerometers, broadband seismometers, strong motion sensors and microphones (IMS, s.d.).

For use in blast or other vibration monitoring applications, the IMS triaxial vibration monitoring sensor is calibrated using the back-to-back method as described in ISO 16063-21 and can provide a response according to ISEE (2017) or DIN 45669-1 (2019) standards when used with the xES engineering seismograph. The auxiliary port enables simultaneous monitoring of linear microphones or other sensors.

The xES can be used in standalone mode where data is retrieved and reported offline or can operate in online mode where alarms can be triggered in real time and event reports issued in seconds.

The system has a microphone interface for air overpressure for air blast monitoring, with an unweighted (linear) response, a maximum of 150 dB SPL, and an ISEE (2017) response. It includes a 5m cable and 3 inch windscreen.

IMS's calibration procedures ensure measurement traceability to the international System of Units (SI) via national metrology institutes.

Figure 3: The xES – Portable seismic monitoring station (IMS, n.d.)

Figure 4: The IMS triaxial vibration monitoring sensor - geophone (IMS, n.d.)

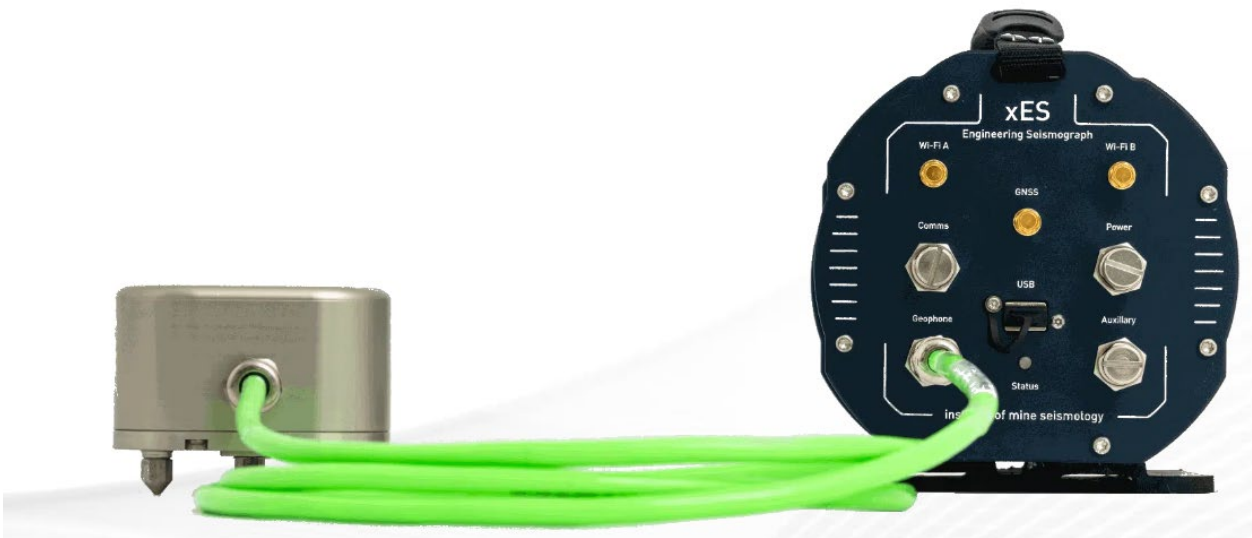

Figure 5: The xES connected to the geophone (IMS, n.d.)

3.3. Portable blast monitoring station installation

The transducer is installed on a hard surface, which in this case is rock. A 3/8-inch bolt is anchored in the rock (Figure 6) and the transducer is tightened with a nut and a wrench to ensure proper contact with the floor (Figure 7). The arrow on the top of the standard transducer must be pointed in the direction of the event to ensure the geophone sensors, located inside the standard transducer, remain in their natural axis (Instantel, 2016). The trigger level of the instrument is set to 1 mm/s and the transducer will start recording an event automatically when the ground vibrations are greater than or equal to 1.5 mm/s. The instrument is protected with a box and the microphone is oriented in the direction of the blast.

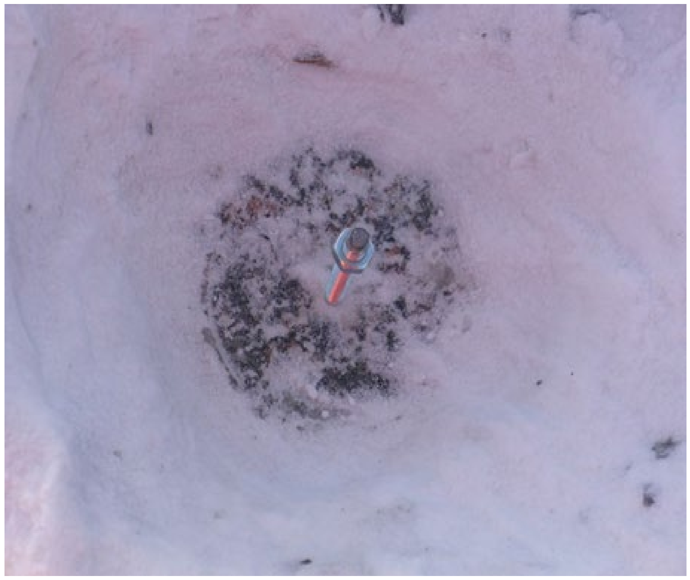

Figure 6: 3/8-inch bolt anchored in the rock

Figure 7: Transducer tightened with a nut

Figure 8: Final Set-up with the microphone in the direction of the blast

Figure 9: General view of portable monitoring station

3.4. Permanent blast monitoring station installation

The permanent station is installed as per supplier (IMS) recommendations. The wiring schematics and general installation figures are presented below.

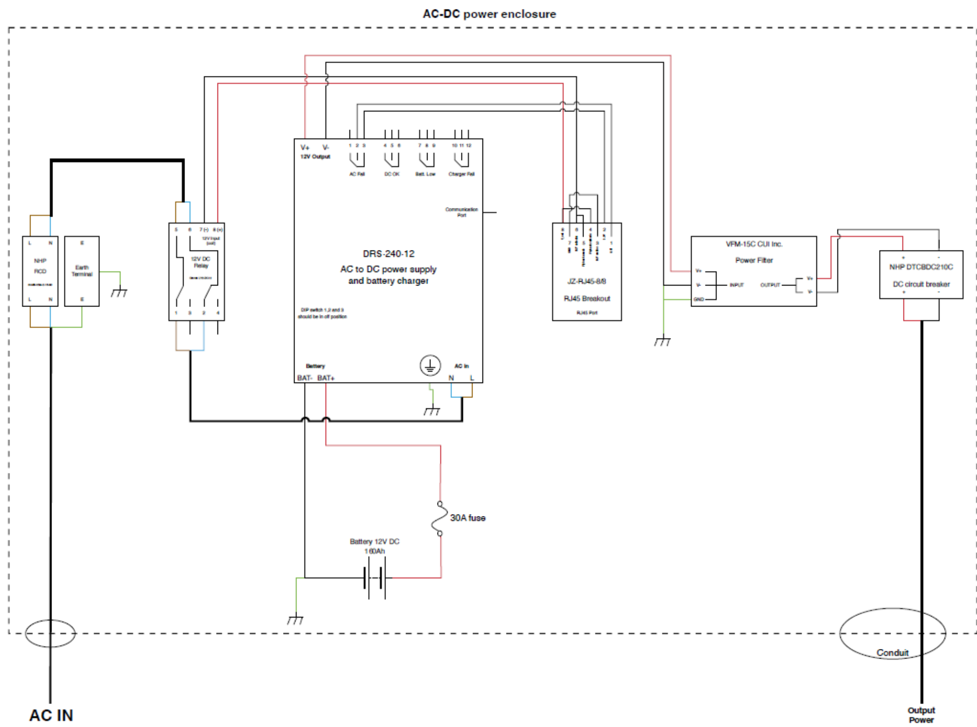

Figure 10: AC-DC Power enclosure

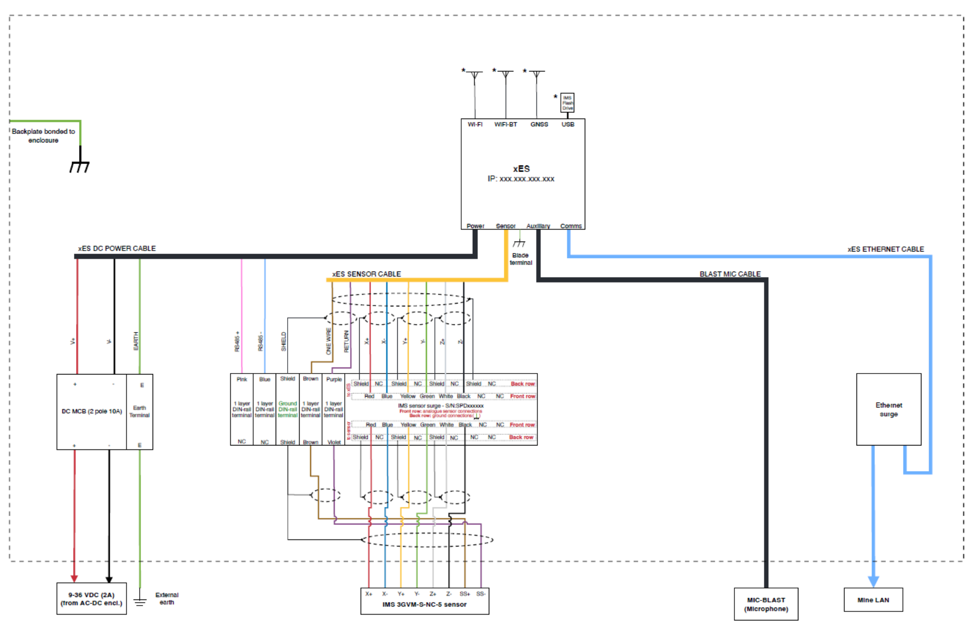

Figure 11 : xESM-M Enclosure (xES with Microphone Interface on Auxillary Port)

Figure 12 : Permanent blast monitoring installation

4. Blast monitoring stations at Meadowbank

The blasts are monitored from three different locations. The locations were chosen to have the optimal distance between the blasts and the water (fish habitat). One station is located near the northern end of Portage pit and the other near the south end of Portage pit (Figure 13). The third station is located completely at the northern end of the Vault Pit (Figure 14).

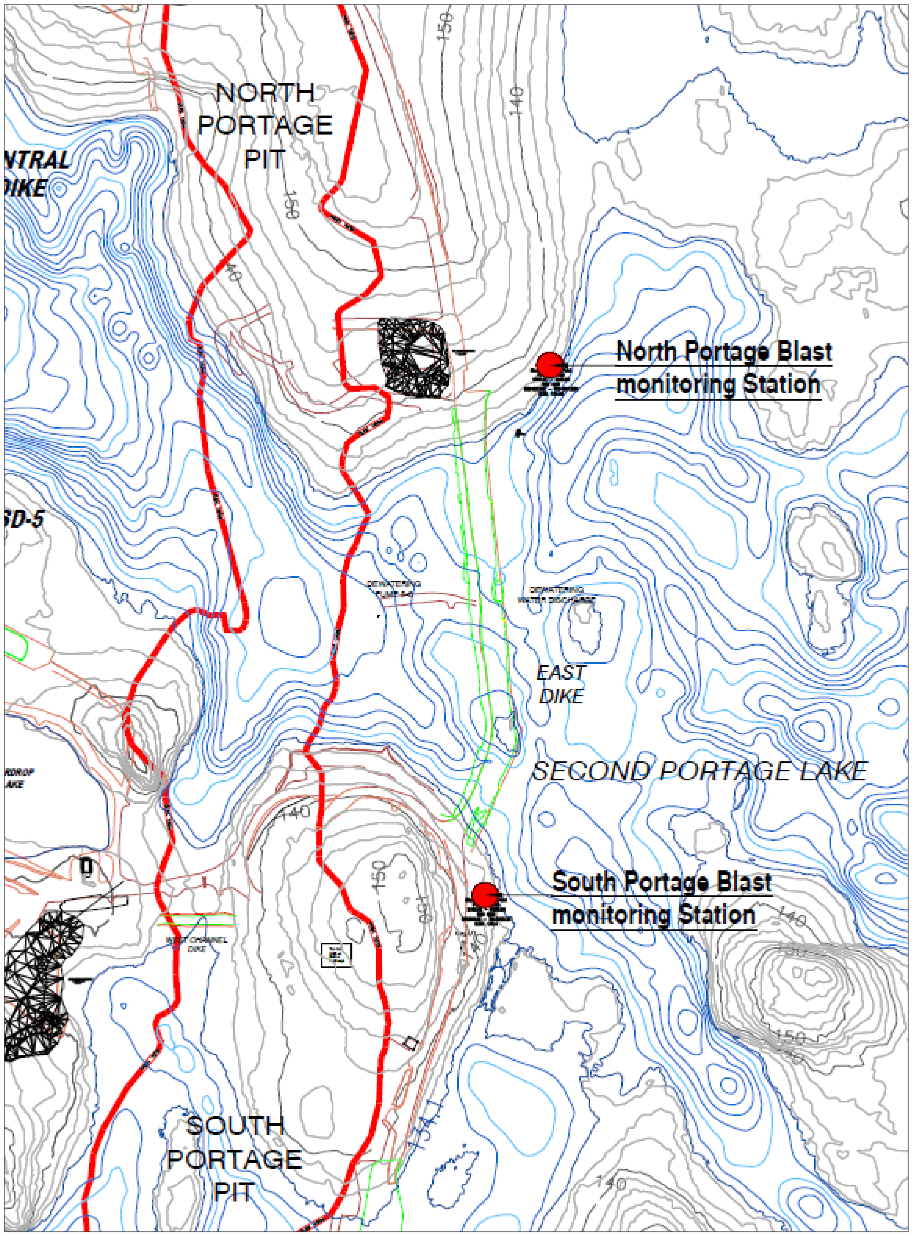

Figure 13: Localizations of the two blast monitoring stations at Portage Pit

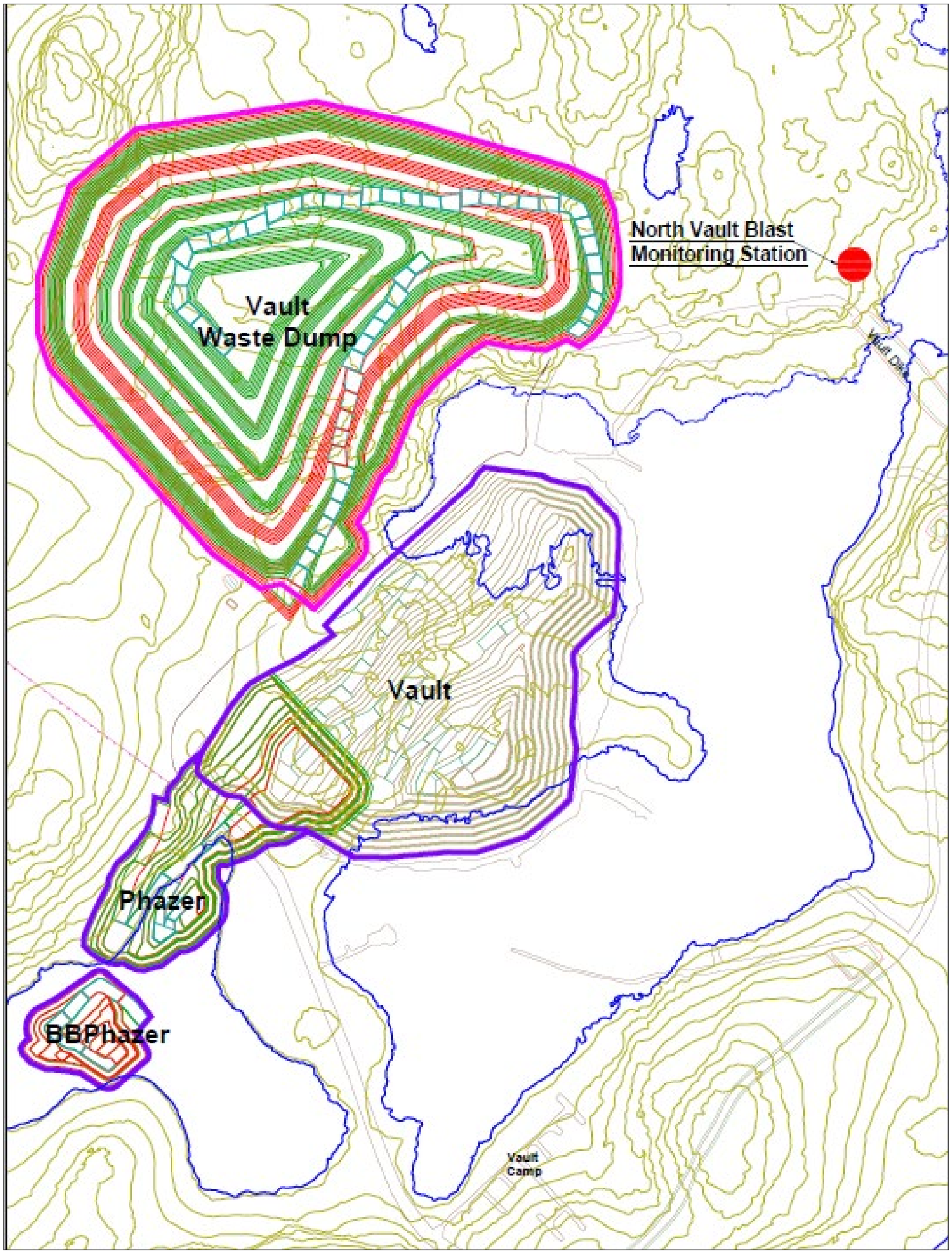

Figure 14: Localization of the blast monitoring station at Vault pit

5. Blast monitoring stations at Whale Tail

During 2019, the blasts of Whale Tail Pit were monitored from Kangislulik Station until June 25th, 2019. A new monitoring station, named Kangislulik Station 2, was implemented closer to the Kangislulik Lake and from June 26th, 2019 monitoring was done from that station.

Since October 13th, 2022, Whale Tail Pit blasts were recorded using Kangislulik Station 3. On November 6th, 2024, a new monitoring station (**Kangislulik Station 4**) was installed with permanent equipment and connectivity capabilities. This new station will allow Agnico Eagle to remotely collect vibration and air pressure data. Upon reception of the approval from DFO, Kangislulik Station 3 will be decommissioned and only Kangislulik Station 4 would be used to monitor Whale Tail Pit mining activities.

The monitoring station, named Nemo Station, was implemented close by Nemo Lake and starting from August 31st, 2020, marking the first IVR Pit blast date, monitoring is done from that station. In May 2022, an additional station called Nemo Station 2 was installed to create a redundancy within our measurements to validate the accuracy of our seismographs, this station's reading is not reported to the DFO as this is an internal process.

These locations were chosen to have the optimal distances between the Surface and Underground blasts and the respective Kangislulik Lake and Nemo Lake fish habitats.

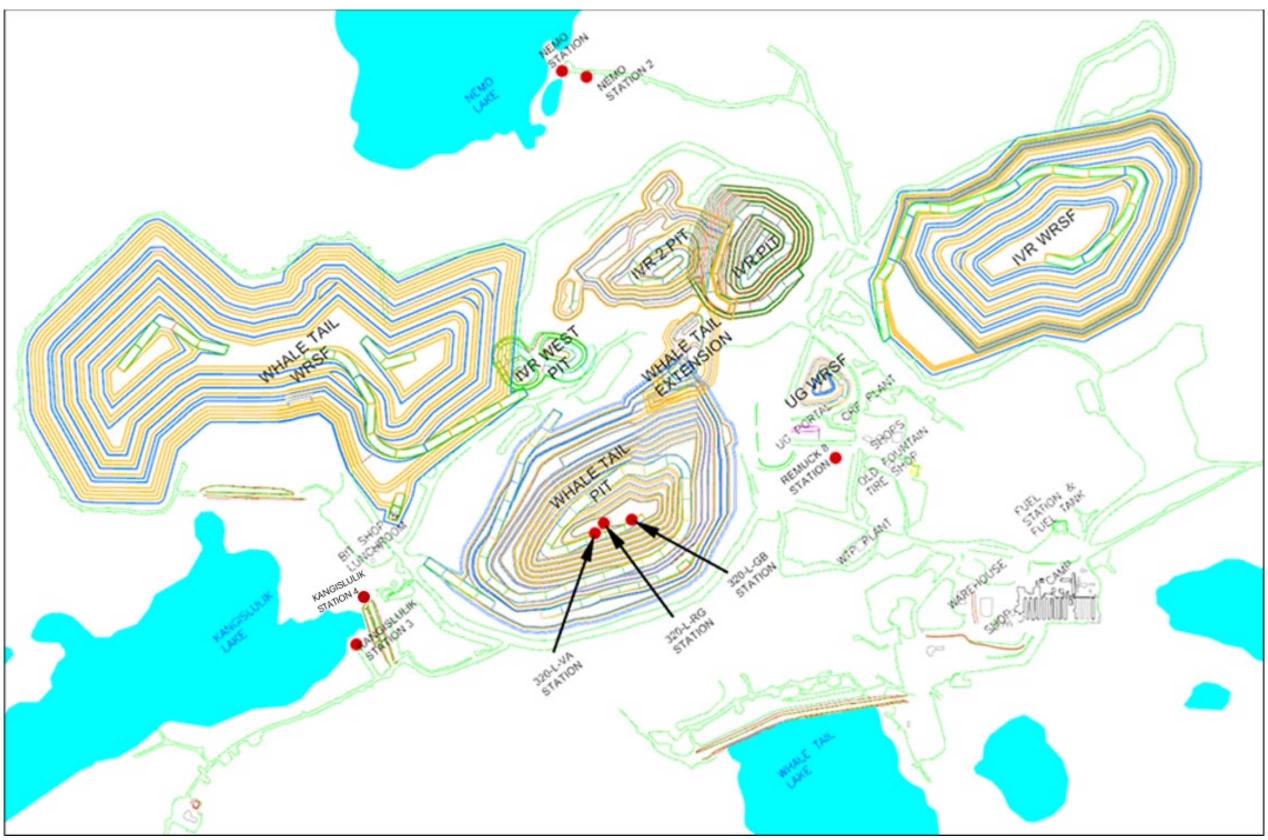

Figure 15: Localization of the blast monitoring stations at Whale Tail Site

As illustrated in Figure 16, the possible fish spawning areas are located West of Mammoth Dike.

Since these areas are further away from blasting activities than the blast monitoring stations, we can assume that if we respect the 13mm/s threshold at these measuring points, the vibrations will be lower towards the fish spawning areas.

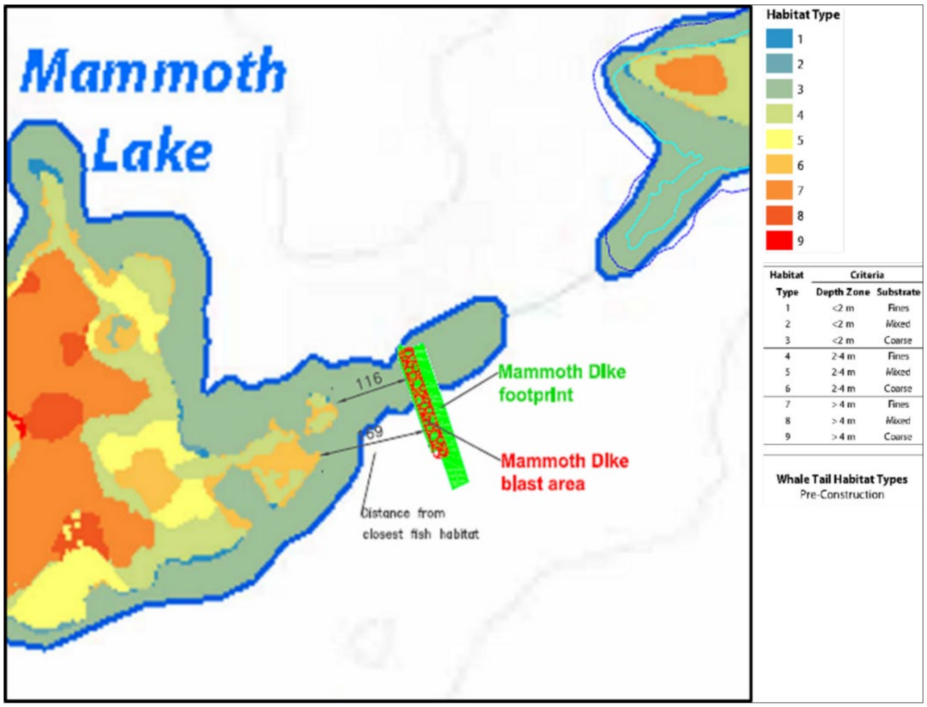

Figure 16: Fish Habitat Types for Kangislulik Lake

6. Underground monitoring

Additional monitoring stations were installed in the Underground mine, they are as follows: one at the main refuge station (Remuck 8) in the Whale Tail underground development ramp and 3 stations on the 320 level (320-L-VA-1, 320-L-RG-2 and 320-L-GB-3) as illustrated in Figure 17. As underground development progressed, two more stations have been added to levels 260 (260-D-EB-02) and 290 (290-L-LA-01). These stations are used to monitor vibration effects of surface blasting on underground infrastructure. It is not used to monitor impact on fish habitats.

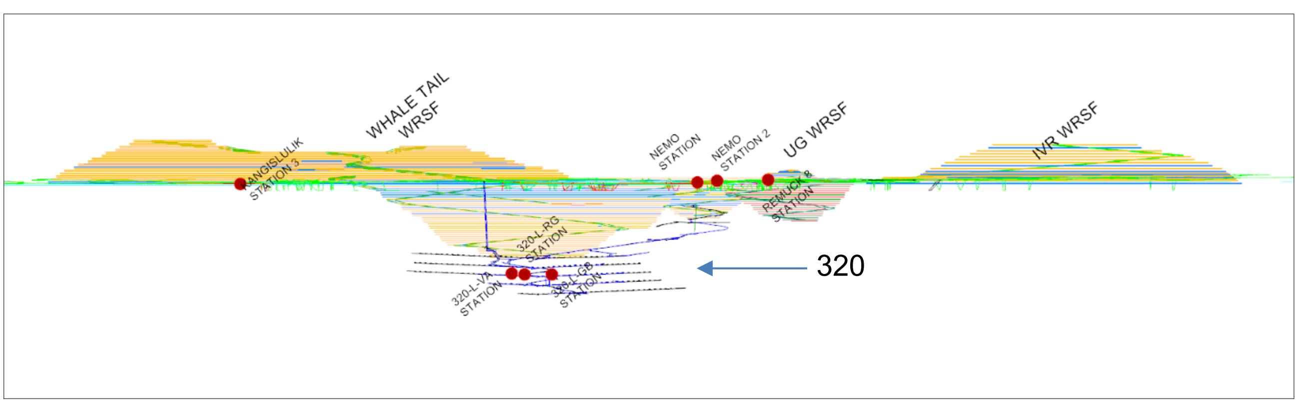

Figure 17: Localization of the blast monitoring stations at Whale Tail Site 320 Level

7. Blast monitoring report

After each blast, the results are stored in a database and the report saved in the library for future reference. The blast monitoring results are interpreted, and a blast mitigation plan is implemented immediately if the vibrations or the overpressure exceed the permitted limit (see section 3). If vibrations or overpressures exceed the permitting limit, Agnico Eagle will advise DFO of any exceedance in a delay of 72h. The data will also be submitted to DFO, GN, NIRB, Environment and Climate Change Canada, and the Nunavut Water Board annually in the Meadowbank Complex Annual Report.

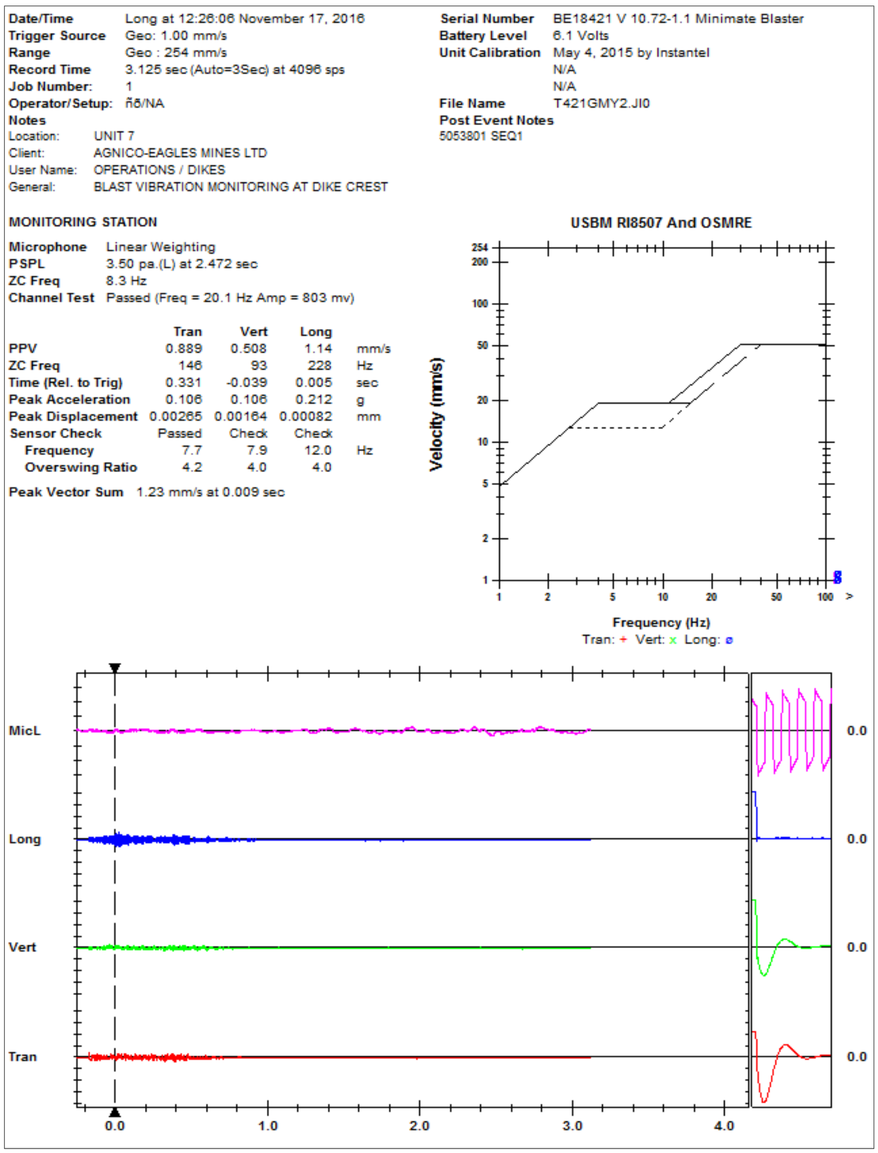

Figure 18: Example of the blast monitoring results

8. Blast monitoring outside areas covered

Agnico Eagle may execute construction projects, where blasting may be required, outside of the areas covered by this Blast Monitoring Program. In such cases, blast event vibrations and overpressures will be monitored following the guidelines of the program. Agnico Eagle will develop a suitable blast monitoring plan for each blasting activity that occurs outside the limits of the current plan. If vibrations or overpressures exceed the permitting limit during the egg incubation period, from August 15 to June 30, DFO will be notified.

9. Blast mitigation plan

This mitigation plan is specific to blasts in the open pits (Portage Pit, Vault Pit, BB Phaser Pit, Phaser Pit, Whale Tail Pit, IVR West Pit and IVR Pit). A Memo has been sent to Fisheries and Oceans Canada with its own specific mitigation plan relative to blasts for Whale Tail Dike, Mammoth Dike and Whale Tail South Channel excavation.

If the vibrations or the overpressure approach or exceed the permitted limit, it is possible to conduct a retro analysis and find the factors that may have caused higher than desired results. It is important to consider the main factors influencing blast vibration intensity and overpressure (Table 3) in order to prevent such results (ISEE, 1998).

Table 3: Main Factors Influencing Blast Vibration Intensity and Overpressure (ISEE, 1998)

Main Factors Influencing Blast Vibration Intensity
Maximum charge weight detonating at one time
True distance (distance the waves must travel)
Geological conditions
Confinement
Physical properties of the rock
Coupling
Spatial distribution
Detonator timing scatter
Time of energy release
Type of Explosive

Geological conditions and rock properties are site specific and cannot be changed but there are several controllable factors that may reduce blast vibration intensity. Agnico Eagle takes the following factors into consideration at Meadowbank Complex to reduce vibration intensity:

I. The confinement of the charges affects the vibration intensity. If a charge is deeply buried with no free face nearby, the rock is not displaced and more of the energy goes into seismic waves (ISEE, 1998). The engineering department carefully plans pre-shear blasting that may have excessive burden in the first row of holes.

II. The coupling of the explosives charges to the rock affects how much energy is transferred to the rock and hence the intensity of the vibrations. If smaller-diameter charges are placed in large-diameter holes, the charges are decoupled and less energy is transferred (ISEE, 1998). Using bulk products increases the coupling. In specific cases, like pre-splitting blasts, it is a better idea to use packaged products that have a small diameter.

III. The spatial (geometric) distribution of the explosives affects the character and intensity of the ground vibrations. A reduction in vibration is often found when there are many small charges per delay, widely distributed. There is a practical limit to the number of small charges that can reinforce each other, and the more there are, the less effective their reinforcement. A charge per delay composed of 100 charges of 1lb each will not generate the same intensity of vibration as a single charge of 100 lbs. (ISEE, 1998).

IV. The main factor that is used to prevent high intensity vibration is the charge weight per delay. A time envelop criterion (ranging from 8ms for non-electric initiation systems to 2ms for electronic initiation systems) can be applied to prevent delay times from overlapping or causing constructive reinforcement (addition) of two or more pulses (ISEE, 1998), which could cause higher vibrations. In every blast connection plan designed by the engineering department, this fact is taken into consideration. Timing can be designed to minimize the number of holes that overlap in a given time envelope.

V. The blasting direction of a blast pattern is another key element to minimize vibration once blasting besides areas close to lakes.

Mitigation techniques used to reduce overpressures are as follows:

I. Depth of burial affects overpressure. Improperly stemmed or insufficient collar will allow blast holes energy to be vented upwards. The quality of the stemming is also important: angular, coarse stemming material (3/4’’) is necessary to be efficient.

II. Avoid having insufficient burden on the first row of holes. This can cause air blast and generate fly rocks. Leaving muck piles from the previous blast in front of the free face (choke blasting) can reduce the intensity of a potentially generated air blast and minimize the chance of fly rocks.

III. Avoid placing charges in open seams, clay filled seams, and highly fractured zones where gases could be vented.

IV. Controlling the charge weight per delay especially for the pre-shear drilling. A limited number of kg per delay is in effect at Portage pit to avoid overpressure.

10. Conclusion

Blast monitoring process will continue to ensure that blast vibrations do not cause harm to aquatic life at Meadowbank and Whale Tail Mines. The results are used to find a more accurate confinement factor of the site. The data collected helps to correlate different factors that could influence vibration intensity and will be taken into consideration in the future to guarantee a constant improvement in controlling blast vibrations.

The full implementation of Electronic Initiation System detonators (EIS) for all blasts effective as of the 12th of November 2023 has allowed for millisecond precision and control when detonating individual drillholes in patterns. The added flexibility of specific timing possibilities reduces the risk of constructive overlapping shockwaves that could lead to vibration exceedances.

Agnico Eagle has, overall, successfully managed to keep the vibrations below the limit authorized. Agnico Eagle is committed to monitoring all blasts to fully comply with the regulation.

11. References

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