ELIZABETH MINE SUPERFUND SITE
PHASE 2 REMEDIAL ACTION
LORD BROOK SOURCE AREAS
BLASTING FACT SHEET
REV01 JUNE 19, 2018

At the Elizabeth Mine Superfund Site, the exposed bedrock slope/face along the west side of the South Open Cut Pit Lake has experienced two significant rock slides since the mine closed. Smaller rock slides/failures continue to occur without warning so it is not safe for anyone to enter the pit lake. Therefore, blasting activities will be performed to stabilize the exposed bedrock slope/face along the west side of the pit lake. Blasting operations are used to remove rock/ledge that cannot be removed by other means, breaking the rock/ledge into smaller pieces that can then be handled by construction equipment. Blasting operations do create ground and air vibrations that can be felt in surrounding areas. Site monitoring will be performed to document the ground vibrations. Seismographs will be used to monitoring the ground vibrations to confirm that the blasting is within the project requirements. There will be individuals establishing and monitoring an "all clear" blast zone to prevent access into the active blasting area.

A Blasting Plan was developed for the Elizabeth Mine project. As part of the plan, the area was evaluated to determine if there were any structures within a ¼-mile (1,320-foot) radius of the blast area. Structures within this distance should have pre-blast and post-blast surveys. No structures are located within the 1,320-foot radius. The closest residential structure is about 1,700 feet from the blast area. Given the distance between the blast area and the closest structured, it is unlikely that any structural damage will occur.

Groundwater sampling will be performed prior to and following the blasting to confirm that there have been no impacts to groundwater as a result of the blasting. The site has adequate groundwater monitoring wells to assess the potential impacts to groundwater.

Nobis Engineering, Inc. is the prime contractor providing remedial construction services on-site under contract with the United States Army Corps of Engineers (USACE). Blasting specialists Maine Drilling & Blasting will be performing blasting activities in the South Open Cut area on-site. Northwoods Excavating will be sizing, handling, and placing blast rock in the South Open Cut pit lake.

Attached is additional information and some of the most common questions about blasting.

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1. WHY DOES MY HOUSE SHAKE DURING BLASTING?

During blasting, energy waves are transmitted through the ground as vibrations, and through the air as overpressure or air blast. While some of the energy from a blast is used to break rock, the remaining energy will travel from the blast site in the form of ground and airwaves. Each of these can cause your house to vibrate or shake. Humans are very sensitive to all vibrations. It is possible that you will feel or hear your house shake from the blasting, even at very low levels. Ground vibration is measured in inches per second (in/s), and air blast is measured in decibels (dB). Vibration effects on structures can be caused by both ground vibration energy and air blasts. In order to prevent damage to buildings and property, the United States Army Corps of Engineers (USACE) has set Standards for allowable ground vibrations and air blasts from blasting that are at or below federal government and industry standards.

2. WHAT IS THE STANDARD FOR ALLOWABLE GROUND VIBRATION FROM BLASTING?

The Standard for allowable ground vibrations from blasting for homes is based on the frequency of the blast wave, measured in Hertz (Hz). In North America, safe vibration standards are based on scientific studies conducted by the U.S. Bureau of Mines (USBM). These studies recommend ground and air vibration limits based on scaled distance, peak particle velocity, air pressure and frequency. Meeting these standards will prevent even cosmetic cracking in structures. On the other hand, slightly exceeding these conservative standards will not necessarily harm a structure. Structures located more than 1,320-feet from the blast are rarely affected by blasting activities.

For ground vibrations, the Standard is a function of frequency and peak particle velocity. At low frequencies (below 40 Hz), the limit is 0.5 inches per second (in./sec.). At high frequencies (above 40 Hz), the limit is up to 2.0 in./sec.

A blasting seismograph is one tool that can be used to document compliance with these standards

3. WHAT ARE THE STANDARDS FOR ALLOWABLE AIR BLASTS?

The Standard for allowable air blasts measured at the nearest above ground structure, or 1,320-feet from the blast zone (whichever is closer) is 0.014 pounds per square inch (psi) (133 decibels (dB)).

4. BUT IF THESE LIMITS ARE KEPT BELOW ALLOWABLE LIMITS, HOW COME I CAN STILL FEEL THE BLAST?

Human beings and some pets are extremely responsive to ground vibrations and air blast effects from blasting. The human body can feel vibration effects as low as 0.02 in/s, which is 25 times smaller than the lowest allowable ground vibration limit for homes. In addition, many structures have natural resonant frequencies within the same range of frequencies as the pressure wave from air blasts, which produces vibration effects normally associated with ground vibration only.

5. HOW DOES SOMEONE MEASURE THE ALLOWABLE GROUND VIBRATIONS AND AIR BLAST, AND WHERE ARE THEY MEASURED?

Ground vibrations and air blasts are measured with a device called a seismometer. These results are then plotted on a seismograph and the highest value of ground vibration, also known as the Peak Particle Velocity, or PPV, is obtained, as well as the peak air blast over-pressure. These results are then compared to the allowable limits to verify that the Contractor is in compliance. It is the Contractor's responsibility to ensure that he is within the allowable limits for ground vibration and air blast, however a USACE Construction Representative will review the data daily to confirm limits are not exceeded. The United States Environmental Protection Agency (EPA) and Vermont Department of Environmental Conservation (VTDEC) will also be providing oversight of these activities.

A seismometer is typically set up at the closest occupied structure to the blast location. Variations in geology and topography may also dictate placement of seismometers, as well as proximity to concentrated residential or commercial areas. It is impractical to set up seismometers at every occupied structure, so the structure closest to the blast is chosen to represent a concentrated area since ground vibrations and air blasts reduce in intensity as they travel further away from the blast site.

At the Elizabeth Mine blasting will be monitored at four (4) locations surrounding the work area using seismographs. (1) device will be located approximately 1,320-feet in each of the (4) principal geographic directions. The blasts are planned and designed to minimize ground vibrations and keep them far below required limits. The results collected by the monitoring devices will be reviewed by USACE to ensure compliance following each blast.

6. WHAT HAPPENS IF THE CONTRACTOR EXCEEDS THE ALLOWABLE GROUND VIBRATION OR AIR BLAST?

If the allowable ground vibration or air blast is exceeded at 1,320-feet from the blast zone (the ¼-mile radius), the Contractor is required to change the blasting methods to reduce these effects.

7. WHY DON'T YOU MONITOR THE VIBRATIONS INSIDE MY HOUSE?

Research has shown that it is more consistent to measure the ground waves entering the structure. Therefore, the seismograph sensor is attached to the ground outside at the compliance point which is a substantial distance closer to the blast area than any structures. By installing the sensors outside, the measured vibration levels can be compared with known safe limits, existing regulations or industry standards.

8. WHY DOES THE BLASTING SOUND LOUDER ON SOME DAYS THAN ON OTHERS?

Air blasts are unpredictable due to local weather conditions. Lower temperatures and pressures, along with cloud cover, tend to focus and intensify air blasts. This tends to make smaller blasts sound much larger.

9. COULD REPETITIVE BLASTING CAUSE DAMAGE TO MY FOUNDATION OR OTHER AREA OF MY HOME, EVEN IF THE VIBRATIONS ARE WITHIN ALLOWABLE LIMITS?

The foundation is the strongest part of a house. Vibration standards are designed to protect the weakest parts of the house, such as plaster and drywall. Ground vibrations strong enough to crack foundations consisting of concrete and masonry would far exceed the limits set by typical standards. In addition, the federal government has conducted studies where they have vibrated entire houses for several days. Their conclusions have shown that repetitive blasting kept below 0.75 in/s will not cause damage.

10. WILL THE BLASTING VIBRATIONS DAMAGE MY WATER WELL/CISTERN/SEPTIC TANK?

Below-ground structures are confined in the ground and can only move as much as the ground itself moves. They respond less to the ground waves than a house or other buildings above ground. Therefore, standards that protect houses will also protect below-ground structures.

11. HOW LONG AFTER BLASTING CAN MY HOUSE BE AFFECTED?

Vibration energy is not stored in the house and has no potential to be cumulative. Each blast affects your home as a single event and rarely lasts for more than a few seconds. As ground and airwaves pass, the house will begin to vibrate. When the ground and airwaves end, the house will stop vibrating and there will be no further effect from the blast.

12. IF BLASTING IS NOT CAUSING DAMAGE TO MY HOUSE, THEN WHAT IS?

There are several other factors that have been proven to cause damage equivalent to vibrations, some man-made and some natural. Actions as simple as slamming a door can cause vibrations between 0.15 in/s and 1.9 in/s, whereas a moderate 20 mph wind can cause vibrations between 0.6 in/s and 2.6 in/s.

13. WHEN IS THE EARLIEST THE TEST BLAST MAY OCCUR?

Test blasting is scheduled to begin on Wednesday, June 27th.

14. HOW CAN THE TOWN AND RESIDENTS GET INFORMATION ABOUT THE BLASTING SCHEDULE?

EPA and USACE will coordinate with the Town to provide information about the blasting scheduled.

15. COULD BLASTING CAUSE A COLLAPSE IN THE UNDERGROUND MINE WORKINGS OR ADITS?

There are no known underground mine workings directly below the blasting. There is a cavity at the north end of the South Open Cut, and the North Open Cut and associated underground workings are in close proximity to the South Open Cut. The blasting will be performed above ground, within the exposed South Open Cut area, so no impacts to the underground workings are anticipated.

16. WHAT IS THE FURTHEST BLAST ROCKS COULD FLY?

The blasts will be laid out to limit rock movement and contain it to the pit lake area, to the extent practical. It is unlikely that blasted rock will travel more than 200-feet. To be safe, all site personnel will be removed from within 1,000-feet of each blast. In addition, personnel will be spread throughout a ~1,000-foot radius at blast time to ensure no one enters the blast area.

17. WHAT ABOUT GROUNDWATER CONTAMINATION?

The products that will be used at the Elizabeth Mine are specialty perchlorate free and packaged explosives. Each blast is designed to maximize detonation of the explosives, minimizing the potential for blasting residuals. The use of these products also minimizes the chances of any residual explosive product being left behind to enter the groundwater. There will be pre-blasting and post-blasting groundwater samples collected from the on-site monitoring wells in close proximity to the blasting.

18. IS IT SAFE FOR THE TRUCK WITH THE EXPLOSIVES TO DRIVE BY THE ELEMENTARY SCHOOL?

Yes, all of Maine Drilling & Blasting's delivery vehicles are approved by the Department of Transportation and the Bureau of Alcohol, Tobacco, Firearms, and Explosives for the transportation of explosives. These vehicles are kept locked or under direct supervision at all-times. The detonators and explosives are kept in separate storage areas on the transportation vehicles and the boxes that carry the explosives are built to withstand an internal explosion in the event of an accident.

19. ARE THERE ANY NOTIFICATION REQUIREMENTS ASSOCIATED WITH TRANSPORTING EXPLOSIVES THROUGH THE TOWNS?

No, Maine Drilling & Blasting is permitted to transport explosives throughout the State of Vermont. Explosives are transported through many local Towns every day as needed to support local, state, and private roadway and development projects. EPA and USACE will provide regular updates to the Selectboard (at least weekly) during blasting activities.

20. HOW LONG WILL THE BLASTING TAKE PLACE?

Blasting will occur over approximately 2-months, from the end of June through August 2018. In general, blasting will occur 1-2 times daily Monday through Friday.

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More information regarding the Elizabeth Mine Superfund Site can be found at the EPA website: www.epa.gov/superfund/elizmine.