

MERG Report 2000-4 – Adit Ice Plug Prevention

W.D. Mann Consulting

Non-technical Summary

Many mine tunnels (or adits) in the Yukon have water flowing from them in the winter, which freezes and builds up ice like a road glacier. If ice completely blocks the adit, it can dam water behind it, filling the mine. Eventually the ice dam fails, releasing the water suddenly, as a flood. If a large flood of water is suddenly released from a mine, property can be damaged and public safety can be jeopardized. Water in some mines is contaminated; a sudden release can result in a toxic surge downstream. The majority of Yukon adits do not form ice plug dams.

The Onek and No Cash mines in the Keno Hill area have had adit ice plug floods, or outbursts large enough to wash out the Silver Trail Highway. The Onek portal is located at the edge of Keno City, and produced flooding of some residential property during an outburst in May 1997. The Tom mine near Macmillan Pass experienced an ice plug blowout following an attempt to temporarily seal the mine portals (entrances) with waste rock. Acid rock drainage is produced from the Tom adit, so an ice dam outburst may impact the downstream environment. The largest Yukon adit ice plug outburst occurred at the abandoned Mt. Skukum gold mine in October 1991. A large volume of water was released suddenly producing a torrent, which washed away the portal doors and much of the waste rock at the portal. This outburst continued down Butte Creek, and was powerful enough to lift the ice off the Wheaton River for several kilometres downstream. Ice plug outbursts occur in other parts of the world, but no documentation in scientific or technical literature was found.

Certain factors are important for ice plug formation. Adit ice plugs form in mines that have a gentle uphill slope from the portal, produce water through the winter and are located in moderately cold regions, usually within the discontinuous permafrost zone. In Yukon, these mines tend to occur at higher elevations, and on north-facing slopes. Circulation of cold air through the mine promotes ice formation. Small exploration adits, which have minimal water storage capacity, are of little concern for ice plug outbursts; potential impact increases with an increase in mine size and water pressure.

There are two types of adit ice plugs. Long ice plugs form where cold air circulation freezes long portions of adits. Ice plugs over 200 metres long have been found in the Yukon. Water release from long ice plugs tends to increase gradually. Short ice plugs form where there is little air circulation. They are approximately two to ten metres long, and form at the portal. Failure of short ice plugs can be sudden and can release catastrophic floods where water pressure is high.

Adit ice plug damming can be permanently prevented by construction of a concrete plug in the adit. This solution is expensive, and is an obstacle to future access for mine exploration. Simpler preventive measures include sealing mine openings to reduce air circulation, while allowing adequate drainage from the portal. Heat tracing of drainage pipes may be used where a power supply is available. Use of insulated pipes for mine water drainage may be adequate to maintain flow through the winter. It is important to consider the potential for adit ice plug damming when a mine is abandoned. When planning a mine it may be possible to reduce or eliminate the risk of adit ice plug formation by modifying the design of the mine.