



DHI SOLUTION

FLOOD MANAGEMENT AT MINE SITES

Reducing the risk to operations and production

Most mine operations are susceptible to flooding – ranging from high rainfall to catastrophic flooding. The exact nature of potential disruption depends on the mine location, mine type, and access routes for logistics and transport. Mines located in dry regions may be particularly susceptible to an underestimation of the risk.

The changing landscape at most mines means that mine operations must continually re-assess their risk and exposure to flood-related impacts and damage. Many mine sites are located in remote areas with poor records of rainfall and stream flow, thereby increasing the uncertainty of the calculated flood risk.



*Partially flooded mine pit
– Photo credits shutter-
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Mining activities by their very nature have a large topographic footprint and will invariably have significant interaction with the local drainage system. Mine developments will often require diversions of creeks and rivers. Mines are also likely to increase flood risks in surrounding areas due to floodplain storage lost resulting from flood mitigation measures for the mine.

The consequences of a low likelihood flood inundation event can be catastrophic for the mining operations and the mine viability. The floodwaters can also become contaminated with minerals, salts and suspended sediments. They cannot be pumped out due to contamination risk in the neighboring environment, which can lead to suspension of the mine operations.

SUMMARY

CLIENT

- Mine Operators
- Mining consultants and contractors

CHALLENGE

- Inadequate rainfall & stream flow records
- Lack of installed flow and rain gauges
- Continually changing landscape
- Settlement of ground surface and levees
- Operational constraints from flooding
- Climate change risk of flooding

SOLUTION

- Experienced flood hydrology modeling and mitigation
- Application of hydrodynamic flood modeling in combination with real-time flood information managements systems

VALUE

- Reliable flood information for mine planning
- Minimized risk of flood-constrained operations
- Maximized mine production
- Reduced risk from inundations



Aerial view over flood – Photo credits shutterstock © Miks

It is critical to have a reliable estimate of flood levels for the specification of flood protection structures such as levees and dams. Levees are often considered in the context of addressing the risk from flooding. However, the consequences of levee failure during a food are often not addressed properly. Levees are also susceptible to significant settlement on mine sites which increase flood risks over time.

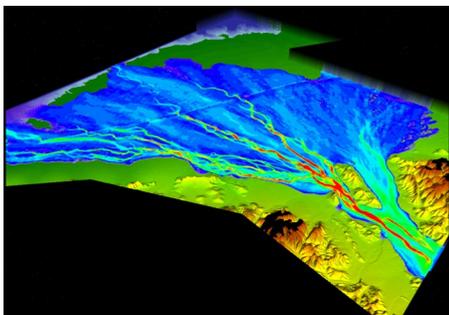
Flooding can result in the suspension of operations due to:

- erosion and poor road conditions
- water build-up at working faces and in mining areas
- inadequate on-site storage and the inability to discharge accumulated runoff to surface water
- damage to infrastructure, such as road, rail and conveyor systems
- catastrophic inundation from surrounding rivers due to levee failure.

Each of these will have different design criteria, costs, and failure modes.

At DHI, we provide services to manage flood risks reliably, including :

- Groundwater and surface water interaction modeling
- Flood hydrodynamic modeling
- Flood watering and forecasting systems
- Climate change impacts and adaptations



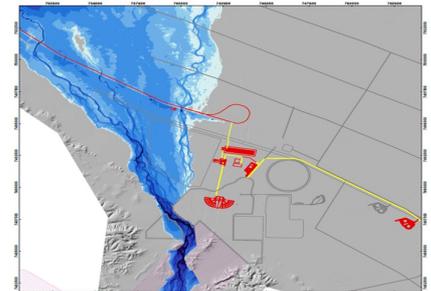
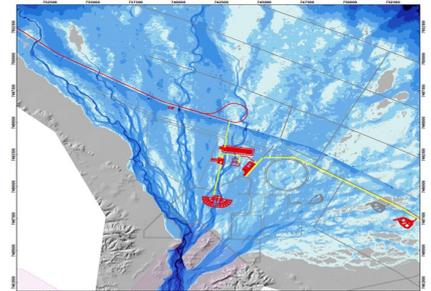
Visualisation of two dimensional flooding in a future mine area

TWO DIMENSIONAL HYDRODYNAMIC FLOOD MODELLING

We develop two dimensional models of existing and future topographic conditions over the life of the mine plan. The models are used to assess the flooding likelihood and consequence over time. The mine plan is a critical component of the flood analysis process. As the mine plan changes with time, the flood risks will also change. There are significant opportunities to manage flooding issues as the mine develops over time. The spoil and overburden dump areas can be designed to be compatible with flood and drainage management goals.

FLOOD FORECASTING SYSTEMS

Flood forecasting systems can be a useful tool for mine managers. Extreme rainfall events can cause river and stream rises. These prevent the movement of labor and equipment around the mine site for a considerable time, which in turn leads to lost production. By providing mine managers with early warning systems, the mine manager can make decisions in a timely way to



limit the loss of production. An early warning system is developed by combining flood modeling tools with real-time data from Local Area Weather Radars (LAWRs). The information is combined automatically in a Decision Support System (DSS) to provide warnings of potential river and stream rises in local drainage systems.

CLIMATE CHANGE

Climate changes may alter the flood risk of a mine as time passes, particularly as mines operate over time scales spanning decades. Climate change impacts may be significant and need to be considered when developing the mine and building flood protection. We can assess climate changes on rainfall characteristics, the hydrological regime of the mine and sea level rise for mines located in coastal areas. This information can be used to assess future risks. These risks can then be mitigated over the life of the mine plan. They also can provide the ability to defer flood-related capital expenditure whilst not increasing the flood risk.

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