TECHNICAL MEMORANDUM

DATE	17th March 2023	21467213.CO4.11.B.0
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DTSF QUALITATIVE FLOOD RISK ASSESSMENT

1.0 INTRODUCTION

Nalunaq A/S ("Nalunaq") has engaged WSP (UK) Ltd ("WSP") to qualitatively assess the potential consequences of a hypothetical failure of the proposed Dry Stack Tailings Storage Facility (DTSF). The analysis has considered potential failure modes that are physically possible and credible, assessing how these may materially affect the receiving environment of the Kirkespir River valley (and fjord).

This technical memorandum provides a Potential Failure Modes Assessment (PFMA) for the proposed Nalunaq DTSF and the qualitative impact of the selected failure mode.

It is noted that this analysis is intended to provide an enhanced understanding of what the consequences could be if a failure of the DTSF was to occur. The analysis does not consider the probability of failure, which may be very small (e.g. noting that the system has been hydraulically designed to withstand a Probable Maximum Flood (PMF) with an indicative likelihood of 0.0001% (1 in 10,000) in any year).

1.1 Disclaimer

DTSF failure and related inundation studies are based on hypothetical scenarios. They are performed to inform consequence classification and/or as input to emergency plans that would be enacted in the occurrence of a DTSF breach event. A DTSF breach and inundation study does not constitute, nor imply, a DTSF Safety Review and specifically does not imply any likelihood of failure. Rather, it assumes that a breach is initiated irrespective of likelihood and assumes hypothetical credible failure modes based on assumed site conditions and historic system failures at other locations.

2.0 DAM BREAK SCENARIO

Seven different potential failure modes have been identified in Potential Failure Modes Analysis for the Nalunaq Mine DTSF (Golder 2023):

- Static Slope Instability
- Seismic Event Leading to Liquefaction of the DTSF Foundation
- Seismic Event Leading to Liquefaction of the Tailings

- Internal Erosion / Piping
- Erosion by Surface Runoff
- River Erosion

The current technical memorandum will focus on qualitatively analysing the consequences of a failure due to the erosion of the DTSF perimeter by surface runoff, including both heavy rainfall (pluvial runoff) and extreme river flow (fluvial flooding). This has been selected as it is expected to represent the “worst-case scenario” for the Kirkespir River valley (and downstream fjord).

As outlined above, the failure will be qualitatively assessed under two (2) climatic scenarios:

- Sunny Day Scenario – triggered by heavy rainfall, where it has been assumed that the background hydrological conditions within the Kirkespir River is the Mean Annual Discharge (MAD);
- Rainy Day Scenario – triggered by high energy flow conditions, where flow in the Kirkespir River is the Probable Maximum Flood (PMF).

The flooding conditions within the Kirkespir River have been assessed in the Flood Risk Assessment (Golder 2022) for reference purposes.

3.0 DAM BREAK VOLUMES

Studies by Blight and Fourie (Blight and Fourie, 2003) indicate that post-failure surface slopes in tailings impoundments typically range between 2° to 4° (3.5% to 7%). Whilst the Nalunaq DTSF will be a dry-stack arrangement, this has been adopted as a “worst case” scenario for analysis purposes. The post-failure angle is a function of the residual strength of the tailings, which can be evaluated from site investigations like in-situ Cone Penetration Test (CPT), in-situ shear vane test and laboratory tailings testing. In absence of site specific data, a tailings failure slope of 5% was adopted for the assessment, which is considered to represent a ‘worst-case’ scenario.

The volume of the tailings failure cone was calculated from cross sections of the dam and the tailings profiles using AutoCAD.

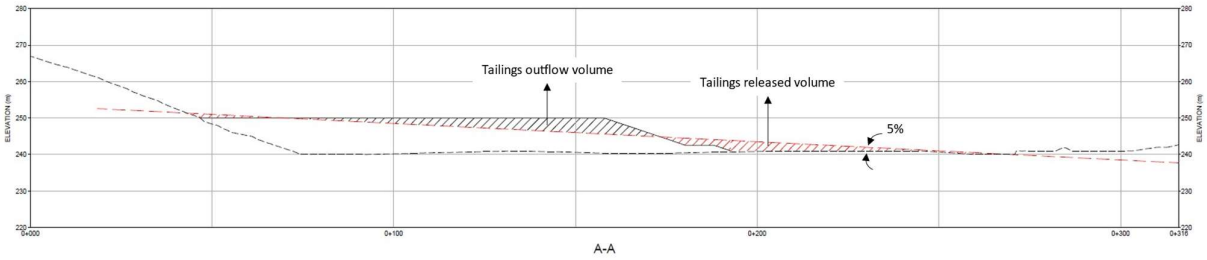

Figure 1 : Tailings outflow and released volume – DTSF section

Based on the assumption above, the volume of tailings released has estimated to be approximately 100,000 m^3.

4.0 RESULTS

4.1 Sunny Day Scenario

For the Sunny Day Scenario it has been assumed that the background hydrological conditions for the downstream river network equates to the Mean Annual Discharge (MAD). Based on the assumption for the

selected failure scenario and the estimated tailings released volume, the majority of the released volume will deposit within the river floodplain, obstructing the river main channel. Projecting the volume of material expected to be lost from the DTSF in light of a failure (i.e. 100,000 m^3) into the river channel (using LiDAR) it is expected that the sludge plume will extend a distance of approximately 80m from the breached wall, causing an almost full blockage of the Kirkespir River valley.

Depending on the extent of the obstructed area two (2) scenarios can be identified:

- Assuming a “less worst case” and more likely scenario, tailings will partially obstruct the river channel and floodplain: this could lead to a limited amount of water accumulating upstream of the obstruction. The scenario could result with the river eroding the eastern portion of the tailings outflow, where the tailings have a reduced thickness, and transporting the material downstream.
- Assuming a “worst case” scenario and less likely, tailings will completely obstruct the river channel and floodplain: this could lead to a large volume of water accumulating upstream of the tailings obstruction, which would act like a dam. Water could keep accumulating upstream of this “dam” until the erosive processes create a breach into the obstruction, or the “dam” is overtopped.

In both circumstances, the rate at which the deposited tailings material in the river will be mobilised in the flow, and therefore transported downstream, will depend on the river regime.

The typical flow velocity is in the order of 2 m/s in the Mean Annual Discharge (MAD) event. Any blockage in the river will reduce the available flow area and increase the energy (and hence velocity) of the flow, progressively mobilising the material and washing it downstream. Under typical “sunny day” flow conditions however, flow conditions are relatively shallow and low energy. It is therefore expected that the tailings will settle out along the length of the river valley within a relatively short distance of the failed DTSF. Fines will also discolour the river flow and this will create a visible plume into the fjord.

It is noted that toxicity testing has been carried out to establish the potential toxicity of the tailings material (SGS 2021) to the natural environment. It is understood that the study concluded that, whilst there will be a short-term reduction in dissolved oxygen and increased turbidity, the tailings is not toxic to existing aquatic habitat.

Consequently, whilst there will be a significant visual impact, the net environmental harm is expected to be short-term and reversible.

Figure 2 : Projected tailings outflow area – Sunny day scenario

4.2 Rainy Day Scenario

For the Rainy Day Scenario it has been assumed that the Probable Maximum Flood (PMF) is occurring within the Kirkespir River, triggering the failure of the DTSF.

Key results for the Updated DTSF Flood Risk Assessment (Golder 2022) during a Probable Maximum Flood are a maximum flood depth of 3.0 m and a maximum flow velocity of 4.0 m/s for the proposed “updated” DTSF facility layout.

The high velocities and water depths would instantaneously erode the tailings outflow volume which, therefore, would not deposit within the floodplain. Tailings would be transported in the form of sediment load till the river outlet and into the fjord.

As noted above, the geochemical analysis has indicated that the tailings is not toxic to aquatic life. There will however be a short-term increase in turbidity and Total Suspended Solids (TSS), and a reduction in dissolved oxygen. The Kirkespir River flow will be visibly discoloured, and there will be a visible plume into the fjord. In light of the finite volume of the released material, it is expected that the tailings will disperse relatively rapidly into the fjord with limited material retained as deposited sediment in the Kirkespir River valley.

5.0 STUDY ASSUMPTIONS AND LIMITATIONS

The main assumptions and limitations of this DTSF failure qualitative assessment are outlined below:

- Being a qualitative assessment, the consequences of a DTSF failure have not been supported by a numerical model.
- Only one of the seven potential failure modes identified in the PFMA has been assessed in the current memo.

- No rheological data is currently available for the Nalunaq DTSF. Therefore, assumed tailings rheology / viscosity parameters have been applied for the purposes of this qualitative assessment.

6.0 REFERENCES

Blight and Fourie, 2003 – Blight, G.E. and Fourie, A.B., 2013. A Review of Catastrophic Flow Failures of Deposits of Mine Waste and Municipal Refuse, University of the Witwatersrand, Johannesburg, South Africa

Golder, 2022 - Nalunaq Gold Mine Flood Risk Assessment (Updated), April 2022, Report Number 21467213.CO4.5.B0

SGS, 2021 – The Environamental Characterization of Tailings from the Nalunaq Mine, March 2021

WSP (UK) Ltd