

GEMCO MINE SITE TAILINGS FACILITY RISK

Risk Assessment Findings (GISTM Requirement 15.1 B3)

A failure modes and effects analysis (FMEA), dam break assessment (DBA) and quantitative risk assessment (QRA) were completed for each of the tailings storage facilities (TSFs) at Groote Eylandt Mining Company (GEMCO).

The FMEA informed the most probable failure mode scenarios for the GEMCO TSFs, following multi-disciplinary workshops and a semi quantitative risk assessment. The following failure modes were carried forward to the QRA:

- Static slope instability;
- Seismic slope instability;
- Overtopping;
- Geotechnical piping; and
- Failure of buried structure.

Dam break assessments were then conducted, generally using a two-phase approach in determining possible runout, following a loss of containment. Specifically, the modelling considers both the water contained within the TSF at the time of failure and the probable tailings outflows that would subsequently occur following the triggering event.

The probability of failure occurring was then assessed by either the fault tree or event tree methodologies, during the QRA.

Credible Flow Failure Risk Assessment Outcomes (GISTM Requirement 15.1 B4)

In line with international practice, DBAs were conducted for two broad scenarios:

- A rainy day/flood day scenario, or overtopping scenario, which may cause the erosion of the supporting embankment and may also result in the release of a large volume of supernatant water. This water would entrain some tailings as it erodes the embankment and would behave as a non-Newtonian fluid. Thus, the erosion of the supporting embankment could result in either a flow slide (if the tailings liquefy), or a slump (if the tailings fail due to its residual shear strength without liquefying). The solids concentration of the liquefied tailings is likely to be reduced by dilution with the overtopping flood water; and
- A sunny day scenario, which refers to a situation where the cause of removal of the supporting embankment would be by any mechanism other than overtopping erosion. Within this scenario, either a slump or flow slide may occur.

Table 1 summarises the impact assessments, environmental and human exposure, and vulnerability to tailings facility credible flow failure scenarios for each TSF.

TSF	Credible Flow Failure Scenario	Assessment Outcomes	Environmental and Human Exposure
TSF 5	Flow slide failure on the north embankment following the initiating faults of foundation failure and tailings liquefaction.	Flood inundation mapping shows that the sediment laden water and tailings released from the north embankment failure would flow off the GEMCO mining lease to the north and northwest of TSF 5 and release into the Angurugu River. Release of tailings are limited in extent and remain in close proximity to the breach location. Sediment laden water is expected to travel further and affect both the Angurugu River Delta area, and near shore coastal environment downstream of the breach.	<p>The potential for human exposure is limited to within the operation.</p> <p>Due to location of the TSF, tailings are likely to reach the Angurugu River resulting in a medium to long term impact on the flood plain and aquatic environment.</p> <p>Release of sediment laden water expected to have a short to medium term impact on terrestrial vegetation and short term die back of aquatic vegetation. This includes mapped vegetation communities and areas of cultural value within the Angurugu River floodplain.</p>
TSF 6	Flow slide failure on the south embankment following the initiating faults of foundation failure and tailings liquefaction.	<p>Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease to the west from a TSF 6 southern embankment failure.</p> <p>Any release of tailings would be contained within the GEMCO mining lease. Sediment laden water is expected to travel further downstream of the breach.</p>	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p> <p>Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation to the west of TSF 6. This includes mapped vegetation communities and areas of cultural value within the coastal environment.</p>
TSF 7	Flow slide failure on the south embankment following the initiating faults of foundation failure and tailings	Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease to the west from a TSF 7 south embankment	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p>

TSF	Credible Flow Failure Scenario	Assessment Outcomes	Environmental and Human Exposure
	liquefaction.	failure. Tailings would be contained within the GEMCO mining lease. Sediment laden water is expected to travel further downstream of the breach	Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation to the west of TSF 7. This includes mapped vegetation communities and areas of cultural value within the coastal environment.
TSF 8	Internal flow slide failure on the northwest embankment following the initiating faults of foundation failure and liquefaction.	Failure inundation mapping shows that sediment laden surface water and liquefied sand tailings would be contained within the GEMCO mining lease.	The potential for human exposure is limited to within the operation. There is no off-site impact to wildlife, water sources and plants from released tailings.
TSF 10	Flow slide failure on north embankment following the initiating faults of internal erosion.	Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease with tailings contained within the within the GEMCO mining lease.	The potential for human exposure is limited to within the operation. There is no off-site impact to wildlife, water sources and plants from released tailings. Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation to the west of TSF 10. This includes mapped vegetation communities and areas of cultural value within the coastal environment.
TSF 11	Flow slide failure at north embankment following the initiating faults of overtopping and slope instability.	Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease to the north with tailings contained within the GEMCO mining lease.	The potential for human exposure includes operational personnel and one property within the Angurugu community from flooding of the Angurugu River. The depth of flooding at the property is expected to be less than 300mm in depth. There is no off-site impact to wildlife, water sources and plants from released tailings, however two cultural sites of significant value to the east of TSF 11 would be inundated by tailings. Medium to long term impacts on the vegetation, fire regime and cultural values of these sites is considered.

TSF	Credible Flow Failure Scenario	Assessment Outcomes	Environmental and Human Exposure
			Release of sediment laden water is expected to have a short to medium term amenity impact on terrestrial vegetation to the west and north of TSF 11. This includes mapped vegetation communities and areas of cultural value within Angurugu River flood plain.
TSF 13	Flow slide failure at the west embankment following initiating faults of slope instability and overtopping.	Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease to the west from a TSF 13 west embankment failure with tailings contained within the GEMCO mining lease.	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p> <p>Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation and areas of cultural value within the coastal environment.</p>
TSF 15	Flow slide failure on north embankment following the initiating faults of piping failure with pond level at spillway crest.	Flood inundation mapping shows that sediment laden s water would flow off the GEMCO mining lease to the west from a TSF 15 north embankment failure with tailings contained within the GEMCO mining lease.	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p> <p>Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation and areas of cultural value within the coastal environment.</p>
TSF 18	Flow slide failure on west embankment following the initiating faults of overtopping and embankment failure.	Flood inundation mapping shows that sediment laden water would flow off the GEMCO mining lease to the west from a TSF 18 west embankment failure with tailings contained within the GEMCO mining lease.	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p> <p>Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation and areas of cultural value within the coastal environment.</p>
TSF 20	Flow slide failure on west embankment following liquefaction under static conditions.	Flood inundation mapping shows that sediment laden supernatant water would flow off the GEMCO mining lease to the west from a TSF 20	<p>The potential for human exposure is limited to within the operation.</p> <p>There is no off-site impact to wildlife, water sources and plants from released tailings.</p>

TSF	Credible Flow Failure Scenario	Assessment Outcomes	Environmental and Human Exposure
		west embankment failure with tailings contained within the GEMCO mining lease.	Release of sediment laden water is expected to have a short to medium term impact on terrestrial vegetation and areas of cultural value within the coastal environment.

Table 1: Credible Flow Failure Risk Assessment Outcomes

Review of the credible failure modes and potential causes indicate that the risks are well understood and managed with appropriate controls. The risk assessment outcomes have been agreed and reviewed with the Engineer of Record (EoR) and Independent Technical Review Board (ITRB).