

Node	Drawing	Description
	Figure 1 : Stage 1 General Layout	Dam - Civils
1		Western Embankment
2		Northern Embankment
3		Eastern Embankment
4		Screening Bund, Catchment Drain and Road Cutting
5		Seepage Collection Drain, including Collection Pond and Return Pipe
6		Runoff Collection Bypass Drain
7		Spillway Northern Site

HAZOP Record Sheet

Project: Rosebery Future TSF

Date: 15th April 2015

Section: 1

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
1.01	1	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam	Overflow of Western Embankment to township. Inundation of surrounding area.	Spillway designed for PMF rainfall event and relocated downstream of TasWater offtake location. Screening bund and catchment drain to direct	Ensure procedures are developed and followed to ensure minimum levels are maintained in the Dam during winter months.
1.02	1	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam	Dam Failure	Spillway designed for PMF rainfall event. Screening bund and catchment drain	Procedures will be developed for inspections of freeboard (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual
1.03	1	Flow	Decant blockage or failure	Overflow of Western Embankment to township. Inundation of surrounding area. Dam failure	Spillway designed for PMF rainfall event. Screening bund and catchment drain to direct flows into Stitt River downstream of spillway.	Instrumentation will be installed on decant pipe - return to ETP
1.04	1	Level	Runoff collection drain failure	Overflow of Western Embankment to township. Inundation of surrounding area. Dam failure	Collection drain design. Spillway design for PMF rainfall event assuming drain has failed	Procedures for inspections (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual. Preventative maintenance
1.05	1	Pressure	Hydrostatic pressures	Excessive seepage	Cut-off wall and embankment lining system as described in DPEMP	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to be installed to monitor on crest and downstream. Periodic review of data.

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Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
1.06	1	Control	water/tailings overtopping wall wall failure	settlement or movement of the wall	Installation of movement monuments	Operational procedures for survey and periodic review of data by dam engineer monthly/annually
1.07	1	Control	water/tailings overtopping wall wall failure	Seepage	Ongoing seepage water quality and flows monitored	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to monitor on crest and downstream. Periodic review of data.
1.08	1	Flow	Tailings pipeline failure or spigot failure	Erosion of crest leading to failure	Flow monitors and automated cut-off installed in pipeline. Conditions of embankment regularly assessed for erosive impacts.	Maintenance and inspection program to be developed Operational procedures followed. Selection and number of joining mechanism for tailings pipeline
1.09	1	Load	Seismic load	Dam failure	Designed for ANCOLD requirements 1 in 10,000	Survey to be performed after seismic event. Include seismic inspection in operational manual. Identify trigger level for seismic events.
1.1	2	Damage	Wild life, boats moving pipes, etc.	Damage to liner	Liner selection - compatible with environment	Operational procedures and selection of liner that is easy to repair. Consider fencing for liner protection
1.11	2	Damage	Bacterial degradation	Damage to liner	Liner selection - compatible with environment	Check compatibility during selection process

HAZOP Record Sheet

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Date: 15th April 2015

Section: 2

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
2.01	2	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam	Overflow of Northern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Spillway designed for PMF rainfall event.	Ensure procedures are developed and followed to ensure minimum levels are maintained in the Dam during winter months. MMG 's emergency response procedures developed in conjunction with TasWater during Stitt River offtake use.
2.02	2	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam	Dam Failure	Spillway designed for PMF rainfall event.	Procedures for inspections of freeboard (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual
2.03	2	Flow	Decant blockage or failure	Overflow of Northern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Spillway designed for PMF rainfall event.	Instrumentation on decant pipe - return to ETP
2.04	2	Level	Runoff collection drain failure	Overflow of Northern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Collection drain design Spillway design for PMF rainfall event assuming drain has failed.	Procedures for inspections (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual. Preventative maintenance
2.05	2	Pressure	Hydrostatic pressures	Excessive seepage	Cut-off wall and embankment lining Seepage collection drain and pump back system	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to monitor on crest and downstream. Periodic review of data. Further investigation into impacts and management of seepage
2.06	2	Control	water/tailings overtopping wall wall failure	settlement or movement of the wall	Installation of movement monuments	Operational procedures for survey and periodic review of data

HAZOP Record Sheet

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Date: 15th April 2015

Section: 2

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
2.07	2	Control	water/tailings overtopping wall wall failure	Seepage	Ongoing seepage water quality and flows monitored	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to monitor on crest and downstream. Periodic review of data.
2.08	2	Flow	Tailings pipeline failure or spigot failure	Erosion of crest leading to failure	Flow monitors and automated cut-off installed in pipeline. Conditions of embankment regularly assessed for erosive impacts.	Maintenance and inspection program. Consider flow monitoring on offtake. Operational procedures followed. Selection and number of joining mechanism for tailings pipeline
2.09	2	Load	seismic load	Dam failure	Designed for ANCOLD requirements 1 in 10,000	Survey to be performed after seismic event. Include seismic inspection in operational manual. Identify trigger level for seismic events.
2.1	2	Damage	Wild life, boats moving pipes, etc.	Damage to liner	Liner selection - compatible with environment	Operational procedures and selection of liner that is easy to repair. Consider fencing or liner protection
2.11	2	Damage	Bacterial degradation	Damage to liner	Liner selection - compatible with environment	Check compatibility during selection process
2.12	2	Load	Vegetation clearance, access for construction, any other use of buttresses	Failure or damage to buttresses	Restrict access to LV only on buttresses.	Check/confirm capacity during design stage. Make sure buttress are designed to be accessible. Possibly ramp middle tier buttress down on south eastern side to natural ground for access. Extra stability analysis. Maintain existing access tracks to Stitt River.

HAZOP Record Sheet

Project: Rosebery Future TSF

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Section: 3

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
3.01	3	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam required for sub-aqueous tailings deposition	Overflow of Eastern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Spillway designed for PMF rainfall event.	Ensure procedures are developed and followed to ensure minimum levels are maintained in the Dam during winter months. MMG 's emergency response procedures developed in conjunction with TasWater during Stitt River offtake use.
3.02	3	Flow	High flow of water to Dam due to extreme weather event and already high levels in Dam	Dam Failure	Spillway designed for PMF rainfall event.	Procedures for inspections of freeboard (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual
3.03	3	Flow	Decant blockage or failure	Overflow of Eastern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Spillway designed for PMF rainfall event.	Instrumentation on decant pipe - return to ETP
3.04	3	Level	Runoff collection drain failure	Overflow of Eastern Embankment to Stitt River. Inundation of surrounding area. Contamination of town water supply	Collection drain design Spillway design for PMF rainfall event assuming drain has failed	Procedures for inspections (to be approved by dams engineer and conducted by appropriately trained people) that reflect ops manual. Preventative maintenance

HAZOP Record Sheet

Project: Rosebery Future TSF

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Section: 3

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
3.05	3	Pressure	Hydrostatic pressures	Excessive seepage Ground water contamination - shallow ground water	Embankment lining. Some areas requiring rock grouting to reduce seepage. Seepage collection drain and pump back system.	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to monitor on crest and downstream. Periodic review of data. Investigate best way to manage seepage issues in south eastern area of embankment during closure 2023 onwards.
3.06	3	Control	water/tailings overtopping wall wall failure	Settlement or movement of the wall	Installation of movement monuments	Operational procedures for survey and periodic review of data Cater design to build in additional settlement allowance
3.07	3	Control	water/tailings overtopping wall wall failure	Seepage	Ongoing seepage water quality and flows monitored	Installation of v-notch in drains - continual monitoring of flow/quality. Piezometers to monitor on crest and downstream. Periodic review of data.
3.08	3	Flow	Tailings pipeline failure or spigot failure	Erosion of crest leading to failure	Flow monitors and automated cut-off installed in pipeline. Conditions of embankment regularly assessed for erosive impacts.	Maintenance and inspection program. Consider flow monitoring on offtake. Operational procedures followed. Selection and number of joining mechanism for tailings pipeline

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Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
3.09	3	Load	Seismic load	Dam failure	Designed for ANCOLD requirements 1 in 10,000	Survey to be performed after seismic event. Include seismic inspection in operational manual. Identify trigger level for seismic events.
3.1	3	Damage	Wild life, boats moving pipes, etc.	Damage to liner	Liner selection - compatible with environment	Operational procedures and selection of liner that is easy to repair. Consider fencing or liner protection
3.11	3	Damage	Bacterial degradation	Damage to liner	Liner selection - compatible with environment	Check compatibility during selection process
3.12	3	Load	Overloading of crest	Localised damage	Limit access to LV only. Appropriate signage and induction information	Restrict access to excessive point loads. Specify loads allowed on crest during life of dam. Additional stability analysis if required.
3.13	3	Load	Puncture of liner, reduced load on liner	Release of hydrostatic pressure resulting in spillage	Limit access and appropriate barriers and bunding to sensitive/critical areas	Restrict workings and access on eastern embankment Example - barricading, hazard board, zoning
3.14	3	Location	Damage to embankment toe	Flooding of Stitt River	Engineered to withstand erosion and geotechnical impacts	Include all areas to regular and frequent civil engineering surveys.

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Section: 4

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
4.01	4	Flow	Failure of screening bund before hit with water/tailings		Modelling of worst-case flow against proposed screening bund design. Geotechnical design approval of screening bund and appropriate diversion drain design/sizing	Confirm that the screening bund is placed on rock not the 1 Dam tailings
4.02	4	Flow	Mixing of contaminated and clean water	Contamination to Stitt River	Stormwater and diversion drains placed around project site to divert clean water directly to Stitt River before contact with Stitt.	
4.03	4	Location	Proximity of screening bund to road	Interaction with traffic Interaction with existing surfaces	All structures designed to relevant legislation and AustRoads Standards	Check screening bund complies with clearance zones and distances to the road.
4.04	4	Location	Proximity of screening bund and road cutting to road	Interaction with traffic Interaction with existing surfaces	All structures designed to relevant legislation and AustRoads Standards	Feedback from DPEMP and West Coast Council regarding need for barriers, traffic management plans
4.05	4	Safety	Proximity of screening bund and road cutting to road	Endangerment to public	All structures designed to relevant legislation and AustRoads Standards	Review position and extent of restricting public access along road cutting. Or make safe for public access Community engagement through forums to improve public access along road
4.06	4	Flow	Increased water runoff from screening bund	Poor drainage on road	All structures designed to relevant legislation and AustRoads Standards	Consider road drainage and stormwater management within the area. Is existing drainage system sufficient?

HAZOP Record Sheet

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Section: 5

Drawing: Figure 1 : Stage 1 General Layout

Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
5.01	5	Reactivity	Old seepage pathways	Contamination to Stitt River	Seepage collection drains and pond designed to intersect	Contain old seepage spills. Line seepage pond
5.02	5	Flow	Fallen trees Sediment build-up Vegetation growth	Blockage of drains	Maintenance of proximal vegetation to be routinely monitored and maintained as per Bobadil flume	Operational maintenance procedures.
5.03	5	Flow	Failure or damage to pumping system	Overflow of seepage into Stitt River Possible inability to pump seepage back into dam	Pressure deviations to be detected by sensors and automated standby pumping system.	Ensure contingency within design of seepage pond to allow for pump failure (24 /36 hours date guard). Consider size, location and pumping requirements for duty standby Consider location of pond for closure design
5.04	5	Safety	Unrestricted access	Injury to personnel	Fencing and access limited to authorised and inducted personnel	Fencing of seepage pond to restrict access
5.05	5	Damage	Vehicular or human impacts	Damage to the pond liner	Limit access to authorised and inducted personnel. Limit access to LV's where appropriate	Consider access ramp for cleaning of pond. Consider vegetation within pond.

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Section: 6

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Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
5.01	5	Reactivity/Location	Water becoming contaminated and discharged into Stitt River	Contaminated water discharging into the Stitt River	Design for high flows, no ground disturbance or vegetation clearance to occur up-gradient of bypass channel.	Bypass any degraded areas. Further investigation into this
5.02	5	Flow	Fallen trees Sediment build-up Vegetation growth	Blockage of drains	Bypass channel regularly inspected for blockages and vegetation clearance buffer to be maintained.	Operational maintenance procedures.
5.03	5	Flow	Channel overtopping	clean water ingress to site causing erosion.	Bypass channel regularly inspected for blockages and vegetation clearance buffer to be maintained.	Ensure drain size is suitable for catchment area and rainfall data. Reviewed by key site personnel

HAZOP Record Sheet

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Section: 7

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Action #	Node #	Deviation / Guide word	Possible Causes	Consequences	Existing safeguards	On-going Design and Operational Actions for Consideration
7.01	7	Flow	Under sized	Over topping of embankments	ANCOLD design criteria, Level indication (depth gauge at control point) on side to calculate volume of discharge	Design to guideline
7.02	7	Flow	Blockage or damage to spillway	Reduced capacity resulting in potential over flow of embankments	Regular inspections in place and procedures	Operational procedures and maintenance producers
7.03	7	Protection	Erosion of spillway	Unravelling	Concrete sill	Regular inspections in place and procedures
7.04	7	Location	Undersized or blockage	Any contamination directed t Stitt	Location of spillway selected as it is downstream of TasWater offtake	