



**Kalgoorlie Consolidated Gold Mines Pty Ltd**

**Submission to the  
Minister for State Development**

**On the  
Final Report of the  
Independent Review of a Proposal  
to Raise the Fimiston I Tailings Dam  
at Kalgoorlie**

**10 November 2004**

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## Executive Summary

Kalgoorlie Consolidated Gold Mines (KCGM) has before the Minister a proposal to increase the height of the Fimiston I Tailings Storage Facility and welcomes the opportunity to address the issues raised in the independent review (Thompson Brett Report).

Our submission offers the government realistic and workable solutions that provide reassurance that the Fimiston Tailings Storage Facilities (TSF) are being managed in a safe and environmentally responsible manner, without adversely impacting on the amenity or welfare of the community or neighbours.

The Thompson Brett Report fails to differentiate between current practice in the management of the TSFs and the historical impacts. In some cases these extend back to well before KCGM and other prospecting leaseholders took up ground in the area.

There are no stability problems with the Fimiston I TSF or the proposed increase in height. Since the release of the Thompson Brett Report, KCGM has commissioned consultant geotechnical engineers who have completed all of the studies recommended by the reviewers. These studies, as flagged by the report, confirm that the current operating practices and stability criteria used in the design of the TSFs will meet the more stringent ANCOLD guidelines.

KCGM believes that seepage from the TSFs is not currently having any adverse environmental impact and that the management and testing regime is more than adequate. Despite this KCGM would be prepared to work with the DoE to undertake additional testing, as discussed in the report, to better understand the impact of seepage on the surrounding area.

There are no adverse impacts on the Beneficial Use of groundwater in the area. KCGM acknowledges that there is low level seepage of saline water into already residual-saline groundwater. However, there is no groundwater resource in the area that can be utilized for any practical use other than by the mining industry. Salinity levels will not pose a risk to other industry users. Traces of cyanide species are minor and do not constitute a risk to surface water environments or to the general public.

Seepage rates will not increase as the TSF is raised and the report acknowledges this. Groundwater levels are being managed to ensure that vegetation is not being impacted. As agreed with DoE this is to a depth of 4-6 m below ground surface which ensures saline water will not contact the root zone of vegetation. These levels are being monitored and managed, and will continue to be so after the closure of the facility. Photographic monitoring reported to the DoE confirms that vegetation is being protected.

On closing the facility groundwater levels will decline and KCGM will ensure that a safe and stable structure will be incorporated into the overall landform.

The Thompson Brett Report used an approximation when estimating the quoted areas influenced by seepage from the TSF. The Thompson Brett Report does not clearly explain that water table rises detected over larger areas may have been caused by displaced groundwater, nor that the water table in these areas is being competently managed. In these larger areas the monitoring data does not show a seepage influence on groundwater chemistry.

KCGM believes that its proposed management plan and response to the issues should provide the Government with the necessary confidence to approve the Fimiston I TSF to be raised in a staged manner to a height of 40m above ground surface. That staging will occur with comprehensive checks through existing powers the State Government has to control the activity.

## Structure of this Submission

This submission by KCGM addresses the recommendations and issues raised in the Final Report of Thompson & Brett Consulting Engineers Pty Ltd to the Minister for State Development on the Independent Review of the Fimiston I Tailings Storage Facility (TSF). In this submission the report is referred to as the “Thompson Brett Report”.

KCGM has structured its submission to address matters raised in the Thompson Brett Report by offering a way forward for each matter that is in turn supported by further information and comments. The matters addressed include:

- Recommendations (Section 9 of the Thompson Brett Report);
- Proposed Management and Monitoring (Section 8); and
- Other Issues raised in the body of the Thompson Brett Report including:
  - Protecting of Vegetation;
  - Management of Seepage and Contamination; and
  - Closure Planning.

## Overview of Desired Outcomes

KCGM believes this submission offers the state government some realistic and workable solutions and provides reassurance that the Fimiston TSFs are being managed in a safe and environmentally responsible manner, without adversely impacting on the amenity or welfare of the community or neighbours.

KCGM believes that its proposed way forward and commentary should be adopted by the State Government to allow the Fimiston I TSF to be raised in a staged manner to a height of 40m above ground surface. That staging will occur with comprehensive checks through existing powers the State Government has to control the TSF height increase or to stop it at any time.

KCGM believes through this submission that it can provide both at this point in time, and during the future operation of the TSF, checks and balances which exceed standards required by the Government of similar TSF operations elsewhere in the State. By meeting these standards KCGM will adequately meet the safety, environmental and community expectations for the operation of the Fimiston I TSF.

KCGM believes through the details of its submission and its proposed way forward that the State Government can expect it to meet the requirements and recommendations of the Thompson Brett Report. This will allow the proposal to be assessed and approved under the Works Approval and Licensing provisions of Part V of the Environmental Protection Act.

KCGM believes the Appeals Convenor should take due consideration of the Appeals put forward and prescribe expectations of KCGM as necessary, but allow this staged approval to proceed under the control of Part V of the EP Act. This action would be consistent with the level of assessment set by the Environmental Protection Authority.

## Recommendations

Section 9 of the Thompson Brett Report details eight Recommendations. The following table summarises the view, way forward and comments of KCGM on each of these recommendations. The table is followed by a more complete treatise of each recommendation.

### KCGM Assessment Summary of Thompson Brett Recommendations

Thomson Brett	KCGM		
Recommendation	View	Way Forward	Comment
1. Define Beneficial Use of groundwater.	Supported  Achievable under Part V of EP Act	State Government role.  Set Beneficial Use (B/U) as "mining" in KCGM Part V Licence and refer this to existing DoE-Water Quality Protection Guidelines.  Current B/U –"Mining" is satisfactory to protect environment and stakeholders.  DoE Policy Division could review Water Quality Protection Guidelines specifically B/U as Mining for saline groundwater areas of Goldfields.  Normally policy reflected by updating Licence Conditions as changes occur.  Policy revision would be a lengthy process.	Staged raising can be approved and regulated or stopped through licence conditions.  Current groundwater management near Fimiston TSFs commended by DoE reflecting compliance.  Failure to approve staged raising of TSF which complies with Environmental Licence Conditions may deny Licensee Fair Trading and competitiveness if forced to await B/U review.  A more restrictive groundwater B/U criteria on the Licence for the Fimiston TSF would have to be applied by DoE to many other Goldfields premises.  Elsewhere govt allows saline to hypersaline water resources to be "mined" cf. sustainable yield, reflecting current and foreseeable use mainly in mining.  Fimiston groundwater unlikely in the future to flow into sensitive surface water ecosystems or be accessible to the public for recreational or potable uses.  The potential for flow of groundwaters from KCGM leases with a seepage quality signature from nearby the Fimiston TSF will not impact on the ability of other lessees to undertake exploration or mining activity.  Vegetation protected near by TSF water balance and production bores to keep saline groundwater below regulated depth.
2. Conduct studies to improve seepage collection.	Supported  Achievable under Part V of EP Act	KCGM will liaise with DoE Hydrogeologists and undertake agreed and practicable changes.  Any such study may be undertaken through Licence Conditions applied to a stage raising of the TSF.	No salinity or WADCN levels contravene the B/U of mining for this groundwater.  Vegetation in the area is protected by the groundwater management guideline which KCGM reports against and takes action to control water table levels to the satisfaction of the DoE.  Detailed photographic transects show the condition of vegetation around the Fimiston TSF is not in decline. These records are reported to DoE and DoIR.

Thomson Brett	KCGM		
Recommendation	View	Way Forward	Comment
3. Flood Capacity	Supported  Achievable under Part V of EP Act	A review of the flood capacity has been completed and is capable of holding PMF event. The likelihood of the Fimiston I TSF overtopping is considered to be negligible.	It is anticipated that the Probable Maximum Precipitation (PMP) event in Kalgoorlie is likely to arise from a cyclonic event, which is unlikely to persist for longer than 12 hours (i.e. the 12-hour duration for the PMP is probably the most appropriate selection and is less volume than the 36 hour event)
4. Piping Protection	Supported  Achievable under Part V of EP Act	The need to provide a level of piping protection has been reviewed.	It is concluded that due to the outer embankment being constructed of compacted, homogenised and fine grained tailings combined with the relatively short duration storage of water following a PMF event, that the potential for piping failure is negligible.
5. Piezometric Conditions	Supported  Achievable under Part V of EP Act	Stability calculations have been completed based on undrained strength. The results from this conclude that the factor of safety (FoS) is satisfactory under PMF conditions.	The strength profiles were derived from a piezoprobe investigation undertaken in September 2004 at the Fimiston I TSF The analyses used a phreatic surface location estimated to be the result of water storage on the TSF surface for an extended time following a PMF event. The condition used is considered to be the maximum possible elevation of the phreatic surface during either normal operation, following extreme events or after closure.
6. Stability Analysis	Supported  Achievable under Part V of EP Act	Stability analyses have been completed and confirm the embankment remained stable with a FoS equal to or greater than 1.5 for static and 1.0 for pseudo static under the above conditions.	These studies were completed in terms of effective stress for pore pressures up to the PMF condition and in terms of total stress taking account of the previously measured undrained strengths. These studies also took into account extreme earthquake loading (MCE) determined from a site-specific study.
7. Interim Raise Preliminary Studies	Supported  Achievable under Part V of EP Act	Studies completed since the Thomson Brett site visit and close out meeting satisfy the three dot points of this recommendation. The detail for these is available under previous recommendations.	The embankment is stable in terms of effective stress under a PMF piezometric condition. This is discussed above under recommendation five.  The embankment is stable in terms of total stress using data from a site specific seismic study. This is discussed above under recommendation six.  An inspection of the TSF was carried out as part of the annual operational audit on 1 September 2004 by Golder Associate which confirms that these operating procedures are being complied with.
8. Fimiston II TSF Review	Qualified Support  Achievable under Part V of EP Act	KCGM to engage geotechnical consultants to undertake same Fimiston I review for approval to raise Fimiston II when needed.	Groundwater review would only repeat assessment already done by Thomson and Brett Report which looked at whole borefield. Their report looked at flow patterns areas influenced for both TSFs.

## R1 Define Beneficial Use of Groundwater

**Recommendation 1** *The environmental values and beneficial uses of groundwater in the area should be established and the desired target of groundwater control should be determined as policy.*

### Way Forward

This recommendation is supported.

KCGM believes this is a role for the State Government in particular the Department of Environment (DoE).

KCGM believes the Beneficial Use (B/U) of the groundwaters around its Fimiston TSFs should be defined as for "Mining" in the Fimiston - EP Act Licence Conditions. These conditions should refer to the existing DoE - Water Quality Protection Guidelines which already prescribe the B/U of the saline groundwater areas of Goldfields as being Mining.

This could be undertaken as an immediate measure to provide clearer bounds of environmental protection to all parties. At the same time it would be consistent with allowing a staged rise of Fimiston I TSF without the need to wait for an industry or region wide review of the Water Quality Protection Guidelines No. 1 Water Quality Management in Mining and Mineral Processing: An Overview, 2000 (<http://www.wrc.wa.gov.au/protect/policy/guidelines.htm>).

Licence Condition W2 entitled "HOLDING FACILITIES – CONTAMINATED MATTER" of Licence Number 6420/9 (File Number L137/88) for the Fimiston TSF states:

#### HOLDING FACILITIES - CONTAMINATED MATTER

W2 The licensee shall manage the storage of all matter containing saline or alkaline constituents within holding facilities in a manner, which prevents pollution.

*Pollution is defined in the Environmental Protection Act 1986 and includes, but is not limited to, the constituents of tailings storage facilities damaging vegetation or lowering the environmental value of surface waters or underground waters.*

For the purpose of meeting Recommendation 1 of the Thompson Brett Report the underlined sentence could be added to this licence condition as shown in the following:

W2 "The Licensee shall manage the storage of all matter containing saline and alkaline constituents within holding facilities in a manner which prevents pollution.

*Pollution is defined in the Environmental Protection Act 1986 and includes, but is not limited to, the constituents of tailings storage facilities damaging vegetation or lowering the environmental value of surface or underground waters. For this condition the environmental value of surface or underground waters surrounding the Fimiston tailings storage facilities shall be defined as a Beneficial Use of Mining in accordance with the DoE - Water Quality Protection Guidelines.*"



It may be appropriate for the DoE Policy Division to review these Water Quality Protection Guidelines.

KCGM understands the current B/U – Mining is satisfactory to protect the environment and stakeholders.

The environment of natural vegetation around the Fimiston TSFs is also protected from the saline groundwaters by a groundwater management guideline. The DoE requires KCGM to follow this guideline and install production bores in areas should the saline water table rise to within a depth of 4 – 6 m below ground surface. KCGM reports to the DoE against this guideline on a quarterly basis. In fact along the Fimiston floodway between the TSFs the water table is deeper than 4 - 6 m below ground surface.

#### Further Information / Comments

With regard to the prescription of the Beneficial Use (B/U) of groundwater around the Fimiston TSFs the Thompson Brett Report states:

*“The current level of contamination does not appear to affect the Beneficial Use of the groundwater for mining process water but the potential impact on future beneficial uses is one of the important grounds of appeal. The issue of environmental values and appropriate Beneficial Use for groundwater is critical and needs to be addressed to give the proponents a quantified target for compliance and to determine the level of seepage control that is appropriate. The extent of works required to control the impacts could then be engineered by KCGM.”*

KCGM understands in the context of the National Water Quality Management Strategy to which the State Government aspires as a matter of policy that the term B/U be used in regulation taking account of sustainability, existing circumstances, practicability and an inherent precautionary principle protecting potential future users or dependencies.

KCGM believes it would be unduly restrictive and over precautionary to prescribe the B/U around the Fimiston TSFs or elsewhere with saline to hypersaline groundwaters of the WA Goldfields to a classification other than “Mining”.

The B/U of Mining for saline to hypersaline groundwaters of the WA Goldfields has already been agreed by WA Water agencies and prescribed in the DoE – Water Quality Protection Guidelines.

The relevance of this document is as follows:

*“The objective of these guidelines is to provide information to the Commission and other government agency staff, mining personnel, environmental consultants and regulatory agencies, on water related issues that need to be considered during project development and management of mining and mineral processing activities”. (WQPG S1.2 P1)*

KCGM understands that elsewhere in the Goldfields where palaeochannel aquifers are accessed for hypersaline groundwater resources the DoE permits the sustainable yield to be exceeded and effectively “mining” of the groundwater to occur.

Near the Fimiston TSFs there are neither palaeochannel aquifers nor substantive groundwater resources. In relative terms the groundwater quantities present near these TSF are minor or residual in quantification. KCGM through expert hydrogeological advice and extensive drilling records contends the conceptual model of a palaeogeographic groundwater and drainage system put forward in the Thompson Brett Report does not properly reflect the groundwater conditions of the area. Rather the groundwater layers tend to follow the modern topography on which the TSFs are located.

Beyond closure of these TSFs groundwater levels and pumping rates will decline substantially, a point acknowledged by the Thompson Brett Report. This is moving even further from any notion that a groundwater resource of any significance exists and requires future protection within a B/U category other than Mining.

Throughout the Goldfields saline to hypersaline groundwaters are useful in mining irrespective of salinity or trace levels of CN species. Groundwaters near the Fimiston TSFs are used by KCGM in mineral processing. These waters do not or are unlikely in the future to flow into sensitive-surface-water ecosystems or be accessible to the public for recreational or potable uses. Again KCGM finds that the Thompson Brett Report has erred by comparing the intermittent quality of residual waters in perimeter seepage-trenches to recreational water quality criteria. These trenches lie within the confines of a fenced mining operation.

The Thompson Brett Report did not acknowledge the WADCN levels in water in these trenches is less than the level prescribed in the International Cyanide Code for the protection of animal life at TSFs. Beyond closure these trenches could be filled to further head off any environmental or community exposures. KCGM could also review the practicality of backfilling some trenches or part thereof during the operation phase of the Fimiston I TSF as part of a review of seepage collection effectiveness (Thompson Brett Report – Recommendation 2).

The potential for flow of groundwaters from KCGM leases with a seepage quality signature from nearby the Fimiston TSF will not impact on the ability of other leasees to undertake exploration or mining activity. KCGM has undertaken exploration activity in this area and shown no effects on occupational health of personnel monitoring groundwater or drilling. Monitoring records confirm negligible cyanide levels in groundwater there which do not present an occupation health hazard.

A more restrictive groundwater B/U criteria on the Licence for the Fimiston TSF would have to be applied by DoE to many other Goldfields premises. This impost may not be sustainable for the mining industry and no apparent environmental or community benefit is foreseen.

KCGM understands that DoE or EPA Policy revision would be a lengthy process.

Normally policies or guidelines are reflected in Licence Conditions, of which there are numerous WA precedents, including Goldfields Sulphur Dioxide Environmental Protection Policy. KCGM believes the staged raising of the Fimiston TSF could be approved and regulated or even halted at a ceiling level through licence conditions.

Current groundwater management by KCGM around the Fimiston TSFs has been commended by DoE, reflecting compliance with existing environmental regulation.

In a letter to KCGM reviewing its groundwater management activities and reports dated 29 May 2003, Wayne Astill for DoE Director Rob Atkins wrote:

*“.....KCGM have demonstrated excellent management of TSF water recovery. The DEP commends KCGM on their pro-active approach to groundwater management and anticipates positive outcomes of this initiative to continue.”*

Again in a letter to KCGM reviewing its groundwater management activities and reports dated 25 March 2004, Sarah Williams, Natural Resource Management Officer wrote:

**MONITORING REPORT: Kalgoorlie Consolidated Gold Mine Eastern borefield**

Thank you for the monitoring report for the eastern borefield covered by groundwater licence 66252(3). The report has been reviewed and the following points are noted:

- Abstraction was 2,749,000kl (86%) within the allocation limit;
- Water levels have remained stable during the review period.
- The background salinity of natural groundwater is 20000mg/L and it is evident that seepage from the TSF with higher salt concentration is mixing with natural water. This increase in salinity has not decreased the usefulness of the resource.
- A considerable amount of seepage finds its way into the groundwater system but it is probably unrealistic to expect 100% seepage recovery from Fimiston I and II bores or any other TSF. This seepage and the resulting increase in salinity have not adversely affected the health of vegetation in the area.
- The groundwater recovery via trenches and eastern borefield operation appears to be working at an optimum levels.

Please ensure compliance with the operating strategy in 2002.

The report is of a very good standard, data presentation is very professional and the report complies with the guidelines.

Other environmental management issues in WA may also be instructive to government in its endorsement of a B/U – Mining for the groundwaters around the Fimiston TSFs. As already stated KCGM believes that the currently measured levels of salinity change or WADCN levels being detected are not adversely impacting on the environment or other leaseholders in the area.

In other parts of the Goldfields-wheatbelt areas regional clearing cultivation has caused salinity effects on soil with environmental and agricultural impacts on freehold neighbours. Above coastal aquifers containing potable and marginal groundwaters, horticulture can impact on wetlands and the utility of the groundwater to other potential users. Both of these issues are often unconstrained.

Groundwater around the Fimiston TSF is managed through licence conditions and management by KCGM. The Fimiston TSFs are not impacting on the surface environment (vegetation). There are also no adverse consequences on other parties if salinity changes within the B/U Mining extend across mining or prospecting lease boundaries. Somewhat higher salinities near the TSF boundaries may be migrating from the TSF perimeter but this is being attenuated by flow towards production bores and dispersion within saline groundwater throughflow.

KCGM believes on the matter of B/U of groundwater near the Fimiston TSFs that it is performing acceptably against government requirements. KCGM is concerned that the timing of approval of the proposed (staged) raise of the TSF under Part V of the EP Act might be rejected or held up awaiting a B/U policy review by Government. Accordingly a failure to approve a staged raising of TSF which is currently in compliance with Environmental Licence Conditions may deny it fair trading and competitiveness within state and national comparisons

Finally it is disappointing that with all of this information available including DoE policies and correspondence that the Thompson Brett Report concluded that B/U was poorly defined or not applied in the DoE regulation of the Fimiston TSFs.

For the benefit of readers of this submission KCGM understands that the salinities assigned to various potential Beneficial Uses of water resources in WA are as follows:

### Water Quality Classification

	mg/L TDS	Potential Use
	<500	Domestic
	500-1000	
	1000-3000	Irrigation
	3000-7000	Cattle
	7000-14000	Sheep
	14,000-35,000	Industrial
	>35,000	Mining

The following salinities are noteworthy in comparison of Beneficial Uses of groundwaters:

- Salt concentration of Rainwater is 5-20mg/L.
- The salinity of Seawater is about 35,000 mg/L.
- Natural groundwater around Kalgoorlie has salinity between 20,000 - 40,000 mg/L.
- The groundwater pumped from bores in palaeochannel aquifers has a salinity range of about 60,000 to 250,000 mg/L.

## R2 Conduct Studies to Improve Seepage Collection

*Recommendation 2 Subject to the outcome of item 1, appropriate studies should be carried out to allow improved collection of the seepage from the TSF with the aim of reducing the impacts on the environment as required.*

### Way Forward

KCGM will liaise with DoE Hydrogeologists and undertake agreed and practicable studies to improve seepage collection or demonstrate acceptable environmental risk management for B/U – Mining and prevailing groundwater quality in area.

Any such study may be undertaken through Licence Conditions applied to a staged raising of the TSF, consistent with approval of the proposal under Part V of the EP Act. KCGM could also review the practicability of backfilling these trenches or part thereof during the operation phase of the Fimiston I TSF.

### Further Information / Comments

The Thompson Brett Report showed no new monitoring data. The information is already known to the DoE.

No salinity or WADCN levels contravene the groundwater B/U - Mining for the groundwaters.

Vegetation in the area is protected by the groundwater management guideline which KCGM reports against and takes action to control water table levels to the satisfaction of the DoE.

Detailed photographic transects submitted in routine reports to DoE show the condition of vegetation around the Fimiston TSF is not in decline

### R3 Flood Capacity

*Recommendation 3 A review of the flood capacity of the TSF should be completed.*

#### Way Forward

This recommendation is supported.

Golder Associates have completed a review of the flood capacity of the combined cells of the Fimiston I TSF. The facility has been calculated as being capable of holding a 36 hour Probable Maximum Flood (PMF). It is anticipated that the Probable Maximum Precipitation (PMP) event in Kalgoorlie is likely to arise from a cyclonic event, which is unlikely to persist for longer than 12 hours (i.e. the 12-hour duration for the PMP is probably the most appropriate selection), the likelihood of the Fimiston I TSF overtopping is considered to be negligible.

#### Further Information / Comments

The PMF can be estimated for an infinite number of recurrence intervals of the PMP, e.g. the 6-hour PMP, the 24-hour PMP, the 48-hour PMP etc.

Hydrological analyses have been undertaken to provide estimates of the PMP for a variety of recurrence intervals. The annual exceedance probability (AEP) for the PMP was set at 1:1,000,000 in accordance with Australian Rainfall and Runoff Compendium.

To supplement the above analyses, PMP estimates for several durations were made using formulae from the Generalised Tropical Storm Method (GTSM) 5. The calculated values were increased by 10% to provide conservative estimates of the PMP. Table 2 below summarises the rainfall events and depths.

**Table 2: Rainfall Depths for PMP Events at Fimiston I**

Event Duration	Rainfall Depth (mm)	Average Rainfall Intensity (mm/hr)
6-hour	670	112
12-hour	713	59
24-hour	1,004	42
48-hour	1,329	28
72-hour	1,578*	22
96-hour	1,874	20

The results of the hydrological analysis indicate that the Fimiston I TSF will be capable of retaining at least a 36-hour PMP throughout all stages of operation without overtopping. Given that the PMP in Kalgoorlie is likely to arise from a cyclonic event, which is unlikely to persist for longer than 12 hours (i.e. the 12-hour duration for the PMP is probably the most appropriate selection), the likelihood of the Fimiston I TSF overtopping is considered to be negligible.

## R4 Piping Protection

*Recommendation 4 A review of the need to provide a level of piping protection should be completed.*

### Way Forward

This recommendation is supported.

Golder Associates has reviewed the need to provide a level of piping protection specific to ensuring the embankment can contain a PMF event. It is concluded that due to the outer embankment being constructed of compacted, homogenised and fine grained tailings combined with the relatively short duration storage of water following an extreme rainfall event (up to and including the PMF), the potential for piping failure is negligible.

### Further Information / Comments

Piping failure can occur through soils as a result of sustained passage of seepage water. In sands and silts, piping is more likely to be the result of the physical action of water seeping through the material and causing tunnel erosion. As the tailings in Fimiston I comprise mainly silt particles (and the clay fraction is actually a milled rock flour, rather than natural clay particles), the potential for piping failure is likely to be controlled by the material's resistance to erosion when seepage water flows through it.

There is currently no sign of seepage emerging from the face of the TSF. Piping through the tailings is therefore only likely to arise as a consequence of sustained pond encroachment close to the outer crest of the TSF. It is not implausible that, under those conditions, water from the pond could enter desiccation cracks close to the perimeter and flow towards the outer face via preferential seepage pathways (potentially formed from segregation of the tailings after deposition). Such preferential pathways could arise from an improbable, but not inconceivable continuity of sand lenses.

To minimise the potential for this mechanism propagating into piping erosion failure, the outer perimeter embankment is formed from a mechanically mixed (and hence "homogenised") tailings, which is compacted (for a minimum width of 5 m) to at least 95% Standard Maximum Dry Density. The potential for water to seep through this material under a transient condition where the pond is close to the outer face (presumably arising from an extreme rainfall event similar to the Probable Maximum Precipitation) is controlled by the permeability of the compacted fill.

Assuming a conservatively high permeability of  $10^{-6}$  m/s and a hydraulic gradient of 0.1, it would require over two years for seepage water originating from the (larger than normal) pond to emerge on the outer face of the embankment. Piping erosion would then only occur if the embankment fill were sufficiently erodible, or the flow velocity were sufficiently high to allow mobilisation of solids from the face as a result of such seepage. It is not considered plausible for such a condition to arise, as a flow velocity of approximately 100 times that estimated above would be needed to transport solids from the face. The likelihood of piping erosion occurring under the prevailing (and anticipated future) configuration of the Fimiston I TSF is therefore judged to be negligible.

## R5 Piezometric Conditions

*Recommendation 5 Investigations of the piezometric conditions and the undrained strength of the TSF are required both during normal operating conditions, during extreme events and during operation and closure conditions.*

### Way Forward

This recommendation is supported.

Golder Associates has completed a series of stability calculations based on undrained strength using the strength profiles from a piezoprobe investigation completed in September 2004 at the Fimiston I TSF. The results from this conclude that the factor of safety (FoS) is satisfactory under conditions of PMF.

### Further Information / Comments

The analyses used a phreatic surface location estimated to be the result of water storage on the TSF surface for an extended time following a PMF event. The condition used is considered to be the maximum possible elevation of the phreatic surface during either normal operation, following extreme events or after closure.

## R6 Stability Analysis

*Recommendation 6 Further engineering analysis of the stability should be carried out in terms of effective stress with a range of pore pressures and in terms of total stress taking account of the previously measured undrained strengths. This work should take into account extreme earthquake loading determined from a site-specific study.*

### Way Forward

This recommendation is supported.

Stability analyses have been completed in terms of effective stress for pore pressures up to the PMF condition and in terms of total stress taking account of the previously measured undrained strengths. These studies also took into account maximum credible earthquake (MCE) loading determined from a site-specific study.

The results of the studies were that the embankment remained stable with a FoS equal to or greater than 1.5 for static and 1.0 for pseudo static under the above conditions.

### Further Information / Comments

Effective stress stability analyses have been carried out using static loading conditions under both the "operating condition" and the "PMF piezometric condition".

Under static loading, there is no change in the slope factor of safety after raising the TSF, or following a raise of the phreatic surface as the critical failure surfaces remain in the lower benches / starter embankment.



The operating base earthquake (OBE) and maximum credible earthquake (MCE) peak ground accelerations have been based on the results of a site specific seismic hazard study. The results from this study have been used in revised stability analysis. The acceleration coefficient for the OBE is the same as adopted in the NOI of 0.07g and an acceleration of 0.14g has been used as the MCE.

A Total Stress (undrained) stability analysis was completed for the facility at three representative sections (A, B and C) using the information from both the Site Specific Earthquake Study and the most recent piezocone data. The results are tabulated below.

### Results of Total Stress (Undrained) Slope Stability Analyses

Section	Minimum Factor of Safety Under MCE (0.14g) Loading		
	Current Height	After 2 m Raise	After 10 m Raise
A	1.38	1.36	1.20
B	1.24	1.17	1.05
C	1.45	1.39	1.10

The above results indicate that the factor of safety of the outer slope of Fimiston I TSF will remain above unity under the anticipated loading of the Maximum Credible Earthquake.

### Liquefaction Potential

The liquefaction potential of the tailings (the process by which the strength of a material is reduced due to earthquake shaking or rapid loading) has been assessed in this study.

Evaluation of the tailings liquefaction resistance has been made according to accepted practices of geotechnical engineering. The calculations have been conducted using a 'worst case' scenario of a loading similar to the Maximum Credible Earthquake (MCE).

The factor of safety against liquefaction was calculated by dividing the Cyclic Resistance Ratio (CRR) by the Cyclic Stress Ratio (CSR) at each point in the soil column. The CRR is highly dependent on the type of behaviour the tailings is likely to exhibit, and hence there is a variation in the factor of safety against liquefaction as the fines content increases. A correction has been made to relate the factors of safety for a clean sand (<5% fines) to a sand with about 35% fines. The tailings in Fimiston I TSF are generally of much higher fines content and hence this correction is very conservative. Liquefaction is considered highly unlikely in soils of greater than 35% fines.

The sand / silty sand zones in the upper portions of the TSF display drained characteristics (i.e. are partially saturated) and hence the potential for liquefaction is negligible. In the saturated, less consolidated zones encountered deeper in the profiles, the tailings is generally classified as clayey and is considered too fine-grained to liquefy. The factor of safety against liquefaction under MCE loading (0.14g) has been estimated according to accepted empirical methods for each piezoprobe profile.

The minimum factor of safety against liquefaction under MCE loading for each piezoprobe test recently conducted in Fimiston I is presented in the Table below.

#### **Minimum Factor of Safety against Liquefaction under MCE Loading**

<b>Probe Number</b>	<b>Minimum Factor of Safety</b>
P1U	1.30
P2U	0.97
P3U	1.49
P4U	1.18
P5U	1.10
P6U	1.30
P7U	1.32

It is evident from the above table that the factor of safety against liquefaction falls just below unity over a limited depth in the saturated zone of the profile at one location (P2U). P2U is, however, situated near the centre of the Fimiston I TSF, and has a fines content of between 50% and 80%. Therefore, the potential for liquefaction to occur is judged to be minimal due to the high fines content of the material. If the fines content were assumed to be 35%, the acceleration at which the factor of safety against liquefaction falls below unity is estimated to be 0.135g for a magnitude 7.5 earthquake event (i.e. greater than the estimated MCE). It is also noteworthy that, if liquefaction was to occur, the thickness of the layer in which it occurs is less than 0.5 m and is unlikely to affect the stability of the perimeter embankment. Moreover, the zones of material that may potentially liquefy are within 7 m of the surface and will achieve greater consolidation and strength in the near future.

It is therefore considered unlikely that liquefaction of the tailings stored in the Fimiston I TSF will occur, and even if it did, the likelihood of material escaping from the confines of the stable perimeter embankments is considered to be negligible.

## R7 Interim Raise Preliminary Studies

*Recommendation 7 After completion of the studies it is judged likely that the rise should be approved, possibly subject to new conditions relating to groundwater protection and stabilisation works. However this may take some time to complete. It would be reasonable to carry out an interim raise provided a limited, preliminary study could demonstrate that:*

- The embankment is stable in terms of effective stress under a PMF piezometric condition*
- The embankment is stable in terms of total stress using undrained strength measurements for a range of seismic loadings*
- That existing operating procedures as outlined in the NOI are being complied with.*

### Way Forward

This recommendation is supported.

Studies completed since the Thompson Brett site visit and close out meeting satisfy the three dot points of this recommendation. The detail for these is available under previous recommendations. Specifically:

- The embankment is stable in terms of effective stress under a PMF piezometric condition. An effective stress analysis was conducted using the maximum pore pressures considered possible following a PMF event. This is discussed above under recommendation five.
- The embankment is stable in terms of total stress for a range of seismic loadings. A site specific seismic study was completed enabling the MCE to be incorporated in the analyses. This is discussed above under recommendation six.
- A summary of the existing operating procedures are shown below. An inspection of the TSF was carried out as part of the annual operational audit on 1 September 2004 by Golder Associates. They confirm that these operating procedures are being complied with.

### Further Information / Comments

The operating procedures for the Fimiston I TSF as outlined in the addendum to the NOI are as follows:

- Tailings slurry is pumped from the mill to Fimiston I via a 450 mm HDPE PE100 delivery pipeline;
- A 400 mm HDPE pipeline, located around the perimeter of the combined TSF distributes the tailings to the active area of tailings discharge;
- Tailings are discharged into the storage from multiple spigots tapped into the distribution pipeline on the perimeter of the TSF;
- The area of active discharge is systematically rotated around the TSF by progressively opening and closing spigots as the deposition points are cycled around the TSF for the purpose of maintaining a uniform beach and the supernatant water pond around the decant;
- A tailings layer thickness of approximately 200 mm will be deposited during each discharge rotation around the TSF; and

- Return water flow into the decant will be regulated through the placement or removal of collars around the central slotted riser in the centre of the decant tower.

## **R8 Fimiston II TSF Review**

*Recommendation 8 The condition and performance of Fimiston 2 should be subject to a similar review of geotechnical and hydrogeological performance as both structures impact similarly on the environment of the area of interest.*

### **Way Forward**

This recommendation is supported with qualification.

KCGM has already engaged expert Geotechnical Engineers to review for the Fimiston II the same criteria recommended by the Thompson Brett report for Fimiston I. It is noted that these criteria already exceed the normal expectation of DoIR for this type and setting of TSF.

Changes recommended for the groundwater monitoring programme will apply to the network of bores that surround both Fimiston TSFs.

### **Further Information / Comments**

There is no need to conduct further review of the Fimiston II TSF operation. As stated above the geotechnical review matters required of Fimiston I by the Thompson Brett Report and are already in progress. The completion of these studies for Fimiston I have already been shown to be complied with geotechnically showing that on those criteria the proposal is technically sound for a staged approval and raising of the TSF. The completion of these works has been described above for Recommendations 2 to 7 inclusive. Finally the geographic setting and design similarities for the two TSFs provide further reassurance.

The scope of work undertaken by Thompson and Brett with regard to groundwater management and environmental protection allowed them to review all aspects of groundwater management for the network of bores and management performance. On these matters the reviewers referred throughout to combined influences of the TSFs in the area. The recommendations apply to both TSFs and the way the area should be protected. Finally allegations of impact by other parties had to be dealt with seeing the combined interaction of the TSFs as it was not possible to isolate just the Fimiston I TSF. They even republished contour plans of groundwater quality and water table depths from “self monitoring” data and overlaid their own flow nets for both TSFs. Another government sponsored review looks entirely superfluous.

## Proposed Management and Monitoring

Section 8 of the Thompson Brett Report proposes six management and monitoring initiatives. The following table summarises the view, way forward and comments of KCGM on each of these initiatives. The table is followed by a more complete treatise of each initiative.

KCGM supports all of these proposed revisions to its management and monitoring programme with qualification. All proposed changes can be implemented through changes to Licence Conditions.

### KCGM Assessment Summary of Thompson Brett Proposed Management and Monitoring

Proposed by Thompson Brett	KCGM		
	View	Way Forward	Comment
(i) Monitoring Groundwater under Nearby Waste Rock Dumps	Supported  Achievable under Part V of EP Act	KCGM to liaise with consultant and DoE Hydrogeologists	Some bores are already in these areas. More important to monitor flow past TSF and monitor at edge of waste rock dumps.
(ii) Additional Monitor Bores to North of TSF	Supported  Achievable under Part V of EP Act	KCGM will take advice from consultant and DoE Hydrogeologists to construct and monitor additional bores in these areas where practicable and necessary.	Groundwater levels in this area are well below any trigger value that warrants groundwater recovery to protect vegetation.
(iii) Revise Groundwater Monitoring Frequency and Attributes	Supported  Achievable under Part V of EP Act	KCGM will take advice from consultant and DoE Hydrogeologists to revise groundwater monitoring programme. This can be reflected in a licence condition amendment.	The Environmental Value and Beneficial Use of the groundwater near the TSF is already established as for Mining and no change is needed.
(iv) Try Real-time Monitoring of Water Table Levels	Supported  Achievable under Part V of EP Act	KCGM is prepared to trial available and practicable technology through consultation and advice from consultant and DoE Hydrogeologists.	Water table levels are known to respond to many different factors.  Water table levels may fluctuate in response to TSF operation but changes in groundwater quality may not occur at the same location.
(v) Look for Metastable CN species	Supported  Achievable under Part V of EP Act	KCGM will take advice from its consultant geochemists and DoE Hydrogeologists to review the cyanide speciation of groundwaters near its Fimiston TSFs.	This proposal is highly precautionary. Several of these CN species may be reflected in CN-total analyses. These species are likely to be less than the WADCN assays reported which are already low and less than those assigned to protect higher B/U groundwaters.
(vi) Additional Monitors for Pore Pressures in TSF Profile	Supported  Achievable under Part V of EP Act	A series of piezometers will be constructed in the TSF embankment to varying depths.	Piezocene results from the most recent testwork (throughout the vertical profile of the TSF) show the basal monitors are sufficient.  However, KCGM is prepared to undertake this precautionary assessment for completeness.

## **PMM (i) Monitoring Groundwater under Nearby Waste Rock Dumps**

*Proposal (i) The groundwater monitoring does not provide a full picture of the development of seepage to the west and south of the TSF and additional bores would be necessary to achieve this, accepting that the bores would be difficult and expensive to install due to the presence of waste rock dumps in the area..*

### **Way Forward**

KCGM supports this proposal.

KCGM will take advice from its consultant and DoE Hydrogeologists to construct and monitor additional bores in these areas where practicable and necessary.

### **Further Information / Comments**

West of the Fimiston I TSF the aquifer and most probably the coincident surface catchment boundary is approached and one or two bores may be needed there.

South of the Fimiston I TSF extensive waste rock dumps exist on KCGM tenements. No beneficial use of the groundwater beneath those dumps need be defined. Drilling through these stockpiled materials may be difficult. More relevant might be the monitoring of groundwater flow from near Fimiston I and beyond the toe of these waste rock dumps. Monitor and production bores exist there but several more can be installed if needed. This can be required of KCGM by DoE in response to performance reviews of these bores. This is a regulatory provision of Part V of the EP Act.

## **PMM (ii) Additional Monitor Bores to North of TSF**

*Proposal (ii) The condition of the natural groundwater system is unclear as even the most northerly current bores appear to have been possibly affected by seepage. Some additional bores are required further to the north to assess groundwater quality in areas that have not been affected by seepage.*

### **Way Forward**

KCGM supports this proposal.

KCGM will take advice from its consultant and DoE Hydrogeologists to construct and monitor additional bores in these areas where practicable and necessary.

### **Further Information / Comments**

Groundwater levels in this area are well below any trigger value that warrants groundwater recovery to protect vegetation.

KCGM believe that the most northerly monitoring bores should indicate groundwater that has not been affected by seepage. A signature of seepage chemistry is limited to several hundred metres from the TSF at most. Standing water levels in the most northerly groundwater bores may have responded to displacement of groundwater elsewhere by seepage. Furthermore monitoring data from these bores does not reflect a signature of seepage water.

## **PMM (iii) Revise Groundwater Monitoring Frequency and Attributes**

### **Proposal (iii)**

- The current groundwater quality monitoring program comprises*
- o Monthly recording of production volumes/bore*
  - o Monthly pH and EC from production bores*
  - o Groundwater levels in monitor bores quarterly*
  - o 6 monthly pH and EC from monitor bores*
  - o Annual water quality testing (pH, EC, TDS and cyanide (total, free and WAD)) from production and monitoring bores*
  - o Major component analysis from a group of 10 bores every 3 years*
- The level of water quality testing in particular appears low and contrasts with the recommended levels of Guideline No 5 (Water and Rivers, 2000), which recommends a minimum three-monthly cycle. The frequency of monitoring should be reviewed once environmental values are determined and the required level of groundwater control is established. The cost of monitoring will be influenced by the large number of bores involved and this could be rationalised by determining a limited number of designated monitor bores which are monitored more frequently. A recommended realistic program might be based on half a dozen key bores subject to monthly sampling and testing.*

*The choice of parameters to be analysed should be determined from the assessment of environmental values.*

### **Way Forward**

KCGM supports this proposal.

KCGM will take advice from its consultant and DoE Hydrogeologists to revise the parameters and frequency on the groundwater monitoring programme. This can be reflected in a licence condition amendment.

### **Further Information / Comments**

KCGM responded to Recommendation 1 of the Thompson Brett Report that the Environmental Value and Beneficial Use of the groundwater near the TSF is already established as for Mining and no change is needed to this setting. However, KCGM is prepared to review the monitoring schedule in consultation with the DoE.

## **PMM (iv) Try Real-time Monitoring of Water Table Levels**

*Proposal (iv) Groundwater quality monitoring demonstrates generally low levels of cyanide but some high levels have been noted, particularly in the Fimiston 1 trench. The potential for local spikes of seepage flow and higher contamination levels during discharge of tailings at various locations around the perimeter may not have been appreciated and the current monitoring would not pick this up. Real time monitoring of water levels in several piezometers and perimeter monitoring bores would not be expensive and could give important information on this issue.*

### **Way Forward**

KCGM supports this proposal.

KCGM is prepared to trial available and practicable technology in a select number of monitoring bores to look for fluctuations in water-table levels through consultation and advice from its consultant and DoE Hydrogeologists.

### **Further Information / Comments**

Water table levels are known to respond to at least, rainfall recharge, groundwater abstraction, influence from human activity or structures and even barometric pressure.

Whilst some water-table levels may fluctuate in response to TSF operation this potentiometric pressure is unlikely to coincide with pronounced changes in groundwater quality as changes in dispersion rates of seepage at the same location will be very slow in relative terms. If water-table fluctuations suggest pronounced impact from cyclical deposition of tailings then KCGM is prepared to investigate more frequent groundwater sampling. This may only be needed for a few “sentinel bore locations”.

To confirm that the current level of monitoring is sufficient to pick up potential for spikes during the discharge of tailings, piezometers could be monitored for real time water levels.

The current level of monitoring of groundwater levels indicates that ground water levels do respond to the tailings deposition cycle. However, the effect is typically limited to bores located near the TSF embankment. The deposition cycle is between six and nine months. During this time between six and nine ground water level readings would be taken. This is usually sufficient to indicate a trend.



## **PMM (v) Look for Metastable CN species**

*Proposal (v) The low levels of cyanide make indication of the level of contamination and movement of seepage products difficult to determine. Monitoring for cyanide related compounds such as chloramine, cyanogen or thiocyanate may be worthwhile.*

### Way Forward

KCGM supports this proposal.

KCGM will take advice from its consultant geochemists and DoE Hydrogeologists to review the cyanide speciation of groundwaters near its Fimiston TSFs.

### Further Information / Comments

This proposal from the Thompson Brett Report is highly precautionary and somewhat arbitrary. Several of these CN species are metastable and may be reflected in CN-total analyses or other more practicable assays. Regardless these species are likely to be less than the WADCN assays reported which are already low and less than those assigned to protect higher B/U groundwaters.

## **PMM (vi) Additional Monitors for Pore Pressures in TSF Profile**

*Proposal (vi) The current piezometers potentially give a misleading indication of pore pressures within the TSF due to their location near the base of the tailings. Additional piezometers higher in the tailings would be necessary to give a full picture of performance.*

### Way Forward

KCGM supports this proposal.

To confirm that the current installation practice of constructing piezometers to within 2m of the base of the TSF is satisfactory a series of piezometers will be constructed in the embankment to varying depths. KCGM will take advice of its consultant and DoIR geotechnical engineers on this matter.

### Further Information / Comments

An examination of the piezocone results from the most recent testwork (throughout the vertical profile of the TSF) shows no evidence to support the proposition that misleading pore pressure readings are occurring from the current piezometer installations. However, KCGM is prepared to undertake this precautionary assessment for completeness.

## Other Issues

### Protection of Vegetation

#### Way Forward

KCGM will continue to manage groundwater levels (in accordance with the management guideline) to minimise any potential impact on vegetation and undertake an annual assessment of vegetation around the TSFs.

KCGM will work closely with the DoE to confirm that the vegetation and groundwater monitoring programmes demonstrate acceptable environmental management to reduce the risk of impacting on vegetation health near the TSFs.

Vegetation monitoring is prescribed in licence conditions under Part V of the EP Act and may be modified from time to time as required.

#### Further Information / Comments

It is important to note that the Thompson Brett Report refers to vegetation impacts that occurred historically (before KCGM formed) and that although the impact can be assumed to be associated with elevated groundwater levels, it is not possible to prove the cause of death. However it is recognised by the Thompson Brett Report that any potential threat to vegetation has now been controlled by reducing groundwater levels.

Vegetation near the TSFs has suffered no long-term impact from the historically shallow groundwater. Vegetation is thriving in areas of the floodway where some five years ago it was around two metres below ground surface.



Rehabilitation at “Neve’s Farm” located on the Floodway.  
As can be seen from these photographs vegetation is thriving  
in the floodway area on which the Optimum Leases are located.

KCGM worked with the DoE to establish an appropriate goal for groundwater depth to reduce the risk of groundwater levels impacting on vegetation health. Based on information regarding tree root systems and that the biomass is concentrated in the upper 1m of the soil profile in semi-arid regions (as noted in the Thompson Brett Report), a goal of 4m below ground surface was committed to by KCGM for groundwater management.

In 2001 KCGM developed a groundwater management guideline to use as a planning tool and to demonstrate that the company has a consistent and methodical approach to the installation of groundwater control systems around its tailings storages. The outcome envisaged is to achieve a depth to groundwater below ground surface (BGS) of at least 4m in all locations.

The criteria for the trigger of actions is based on the depth to groundwater BGS and its associated trend. The combined depth and trend status is then divided into the following four categories with actions assigned:

<b>Depth and Trend Status</b>	<b>Action</b>
Depth is shallower than 4 m and becoming more shallow.	Install bores within one Quarter.
Depth is shallower than 4 m and is stable or becoming deeper.	Monitor for a further quarter and if trend is stable install bores within two Quarters.
Depth is between 4m - 6m and becoming more shallow.	Install bores within two Quarters.
Depth is greater than 6m and becoming more shallow.	Estimate timing when depth will rise to 6m. Time the installation of a groundwater control system to ensure dewatering has commenced while the depth is greater than 6m.

The DoE requires KCGM to follow this guideline. A review of the groundwater status and trends is routinely undertaken and results provided to the DoE in the quarterly groundwater monitoring reports.

KCGM also undertakes annual photographic vegetation monitoring around the Fimiston I and Fimiston II TSFs to assess the health of the vegetation. This is in accordance with the Department of Environment (DoE) licence condition W12 for the Fimiston Plant and Tailings Disposal (L137/88).

#### VEGETATION MONITORING PROGRAMME

- W12(a) The licensee shall undertake a vegetation monitoring programme in the vicinity of Fimiston Tailings Storage Facilities (TSF) which shall include photographic monitoring of the vegetation along transects near Fimiston TSF (Attachment 2). The programme shall be in the following schedule:
- (i) transects shall link between monitor bores or identifiable field markers (Attachment 3);
  - (ii) photographs shall be taken at intervals to record key vegetation features along each transect;
  - (iii) photographs shall be taken annually in early spring, at a fixed focal length, and away from the facility to standardise the information gained; and
  - (iv) a professional photographer or technician skilled in plant identification and sampling shall be engaged in this work.
- W12(b) The licensee shall provide a report on the vegetation monitoring programme in the annual report required by condition G2. This report shall include a copy of the photographic record for that year and assessment of the vegetation by a suitably qualified professional.
- W12(c) The licensee shall engage a suitably qualified professional to undertake further biological monitoring as instructed by the Director.

The 17 photographic monitoring transects (See Figure below) were established in 1999 and include monitor bores or key vegetation features. A total of 32 photo points are used to record vegetation health near the Fimiston TSFs.



Photographic monitoring over the last 5 years has shown that the vegetation in the survey area is in good health and that localised areas of vegetation disturbance have occurred due to the installation of roads and pipeline corridors. All information is provided to the DoE and DoIR in the KCGM Annual Environment Report.

As noted previously current groundwater management by KCGM around the Fimiston TSFs has been commended by DoE, reflecting compliance with existing environmental regulation.

In a letter to KCGM reviewing its groundwater management activities and reports dated 29 May 2003, Wayne Astill for DoE Director Rob Atkins wrote:

*“.....KCGM have demonstrated excellent management of TSF water recovery. The DEP commends KCGM on their pro-active approach to groundwater management and anticipates positive outcomes of this initiative to continue.”*

Again in a letter to KCGM reviewing its groundwater management activities and reports dated 25 March 2004, Sarah Williams, Natural Resource Management Officer wrote:

*“This seepage and the resulting increase in salinity have not adversely affected the health of vegetation in the area.”*

## Management of Seepage and Contamination

### Way Forward

KCGM believes by continuing to manage groundwater levels (in accordance with the management guideline) that local groundwater flow patterns will help to influence the migration of any groundwater throughflow with a seepage signature and maintain compliance with its EP Act Licence.

KCGM believes that the Licence Condition W2 entitled “HOLDING FACILITIES – CONTAMINATED MATTER” of Licence Number 6420/9 (File Number L137/88) for the Fimiston TSF could be improved. Accordingly the following underlined sentence could be added to this condition:

W2 “The Licensee shall manage the storage of all matter containing saline and alkaline constituents within holding facilities in a manner which prevents pollution.

*Pollution is defined in the Environmental Protection Act 1986 and includes, but is not limited to, the constituents of tailings storage facilities damaging vegetation or lowering the environmental value of surface or underground waters. For this condition the environmental value of surface or underground waters surrounding the Fimiston tailings storage facilities shall be defined as a Beneficial Use of Mining in accordance with the DoE - Water Quality Protection Guidelines.”*

KCGM will liaise with DoE and DoIR to confirm both lease and licence conditions reflect the above intent to manage the potential influence of seepage on the Beneficial Use of groundwater near its Fimiston TSFs.

### Further Information / Comments

KCGM believes that current groundwater quality near its Fimiston TSFs shows the Beneficial Use of the groundwater is being protected. The DoE has acknowledged this through its commendations of groundwater management controls.

The quantities of groundwater around the TSFs are insubstantial by comparison with hypersaline groundwater resources elsewhere in the region. As such no resources will be adversely impacted by seepage dispersion locally near the TSFs either on the KCGM tenements or through migration across tenement boundaries.

Fimiston groundwaters are unlikely in the future to flow into sensitive-surface water ecosystems or be accessible to the public for recreational or potable uses. The potential for flow of groundwaters from KCGM leases with a seepage quality signature from nearby the Fimiston TSF will not impact on the ability of other lessees to undertake exploration or mining activity.

Vegetation is protected near the TSF by the water balance and production bores to keep saline groundwater below regulated depth. The Thompson Brett Report quoted large areas influenced by seepage from the TSF. KCGM has calculated that buffer areas around the TSFs of 300 m are sufficient to generate the areas quoted in their report for alleged seepage impact. Their estimating technique looks to be an approximation that does not take into account catchment and coincident aquifer boundaries or the negligible impact of including in that area, groundwater beneath waste rock dumps.

It is unfortunate that the Thompson Brett Report did not more clearly explain the influence of water table rises detected over larger areas. In these larger areas the monitoring data does not show a seepage influence on groundwater chemistry. Rather the water table may be responding to the displacement of groundwater beneath the TSFs by seepage. Regardless of that pressure change, the water-table levels discussed by Thompson Brett to the north of Bulong Road are much deeper than the recognised 4-6m depth range to protect vegetation.

## **Closure Planning**

### **Way Forward**

KCGM is able to integrate its TSF operating plan with post closure requirements to maintain the stability of the TSF post closure. The proposed raising of the TSF does not change the closure scenarios for the site.

### **Further Information / Comments**

Within a relatively short period after the closure of the TSF material towards the middle of will further consolidate. This will increase the effective holding capacity of runoff from storm of PMF flood events. Extensive waste rock dumps adjoin the TSF providing a ready source of rock to armour the embankments and cap the TSF in a manner that meets the requirements of DoIR to protect other land uses in the area.