GYRV Mine
Stage 2 Water Distribution System

Key project drivers

- Provide additional infrastructure to distribute water around the site – integrated water management
- Minimise waste of water
- Reduce water truck corrosion issues
- Limit deterioration of existing mine infrastructure (WF points)

Additional Water Infrastructure

Existing Water Fill

Existing Water Fill

Existing Water Fill

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Key scope items

- 1500ML water supply dam – utilise existing pit (700ML)
- 4 new water fill points
- Transfer capacity between four site storages – pipelines & pump stations
- Upgrade existing water fill point
- Electrical MCC's, control systems - in-truck detectors and wireless LAN integrated control.

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H13 Water Supply Dam – Purpose

- Temporary storage of water
  - collected and pumped from other areas of the site
  - supply two water fill points
- Store water collected across the site to reduce the risk of discharge of poor quality water captured from the mine site.
- On average at FSL only every four or five years.
- When full preferentially used to supply the RS3 storage and to supply the two water fill points WF10 and WF14.
- Typically operated within the 700ML capacity provided by the existing pit excavation – limit evaporation.

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H13 Concept Design

- Utilise existing mine void
- Zoned earthfill embankment to provide required capacity – maximum of 8m high.
- Saddle dams – typically 3m high
- Excavation up to 6m to the north eastern area of the existing pit.
  - allows potential runoff to enter the pit void
  - provides additional ponded area - minimises embankment height.
- A spillway to the north west of the ponded area that discharges to "Lake Anderson".

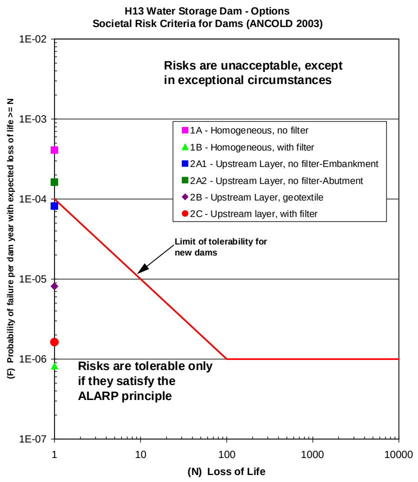
H13 Design Criteria

- Designed in general accordance with ANCOLD Guidelines:
- Meet the ANCOLD Societal Risk Guidelines, in particular with respect to piping risk.
- Designing the embankment to satisfy ANCOLD guidelines for overall stability.
- Designing the spillway to safely pass the design flood.
- Designing the storage to withstand the Maximum Design Earthquake (MDE) without uncontrolled release of the reservoir.

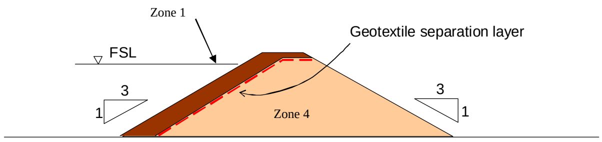
Key Design Challenges

- Construction materials – optimise available materials (mine spoil)
- Abutments – dumped mine spoil
- Seepage and piping through the abutments.
- Settlement of the spoil and the impacts this could have on the performance of the embankment.
- Storage efficiency – significant evaporation at FSL
- Cost effective

Piping Risk Assessment



H13 Embankment Section

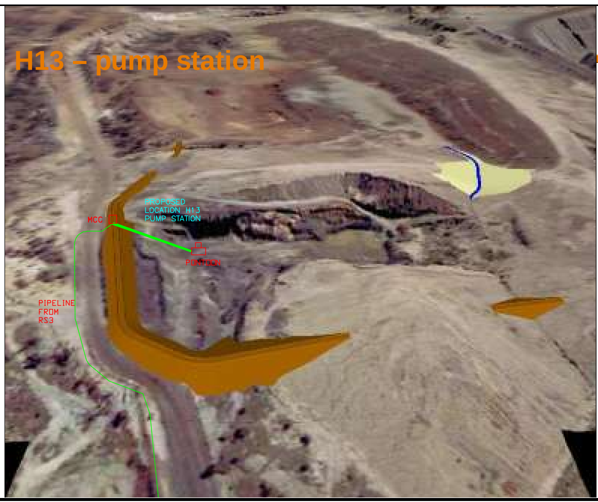


Zone 1 -Low permeability clay – select mine spoil
- Compact in 200 mm layers – 98% STD
- Max particle size 100 mm
- 4 m minimum width – for constructability

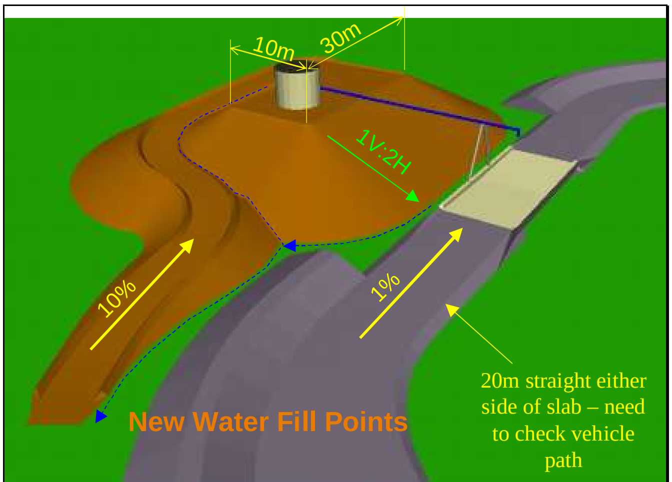
Zone 4 -Mine overburden – sourced from waste dumps
- Compact in 400 mm layers – 95% STD
- Max. particle size 200 mm

Geotextile – non-woven

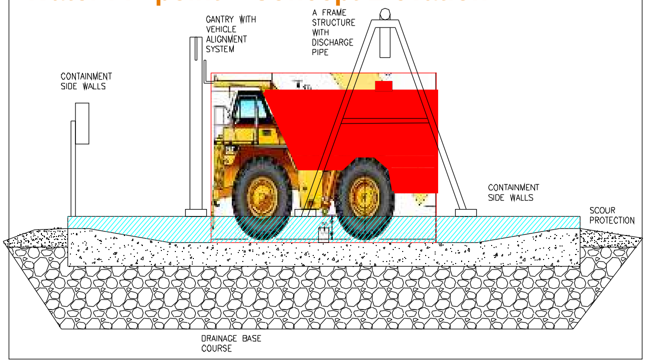
H13 – pump station



New Water Fill Points



Water Fill point – Concept Elevation



WF Electrical Controls

- Main control system
  - located in the local MCC
  - controls the tank fill and truck fill process - log and transmit data.
- Level control within the trucks (2 sensors) and control consoles provided.
- In-cab console –
  - "Start" and "Reset" buttons as well as LED's
  - link to the Modular Mining system in each BMA water truck.
  - The system is to be robust and strongly resistant to water, dust and vibration impacts.

Pipe Transfer System

- Thermapipe - welded with flanges only where required.
- Air valves at high points, road crossings and at least every 800m.
- Drain/scour valves at obvious low points and water courses for pipe-line draining purposes.
- Flotation rings will be provided on pipe discharges to enable the discharge to be viewed.
- Control valves to be electrically actuated butterfly valves.

Stage 2 Water Distribution System Delivers:

- Key part of site Integrated Water Management system
- Provides water supply to the north of the site – collected mine water – runoff/TSF's
- Provides buffer storage capacity in high rainfall events to reduce the risk of discharge from the site outside EA
- Efficient use of mine water – reduces demand on outside supply
- Reduces waste of water at WF points

Goonyella Riverside Mine
Concept For Isaac River Diversion

CQMRG 27-28 July 2006

Presentation Overview

- Context of Potential Stream Diversions For Mine Expansion
- Review of Previous Isaac Diversion
- Design Strategy
- Hydraulic Assessments
- Conclusions

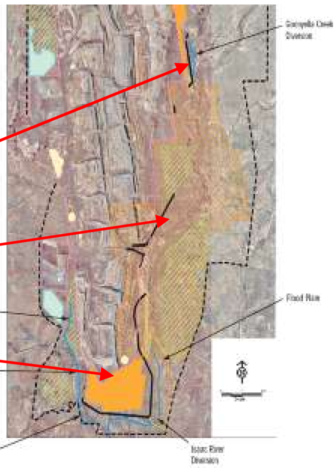
Background

- Proposed Mine Expansion
- EIS
- Investigations of potential stream diversions
- Approvals to be obtained for stream diversions
- Design subject to refinement

- **Proposed Diversions are not definite at this stage**

Mine Expansion

- Extend Mine Lease
- Extension of Northern Pits
- Underground Mine
- Railway Pit (South)



Diversions Design Approach

- Integrated analysis & assessment between EIS and PFS
- ACARP & NRMW stream diversion guidelines
- Site specific investigations and analyses
- Lessons from previous diversions (Isaac River ~1986)

Previous Isaac Diversion

- Original Isaac River Alignment
- Isaac River diverted in 1980's
  - Flood levee bank close to channel
  - Design bed width (40m) too small
- Constructed before ACARP and NRMW guidelines for Best Practice

Bed Widening and Stabilisation

- Diversion unstable until mid 1990's
  - Flood damage in 1991
- Rehabilitation in mid 1990's
  - Timber groynes

Previous Isaac Diversion - Assessment

- Positive – Natural Resilience
  - Riparian Colonisation
  - Bank condition 1995
  - Positive – Bed evolution
  - Natural replenishment of sandy bed and benches
- Negative – Bank erosion
  - Risk from exposed erodible soils

Natural Channels

- Isaac River – "*Incised* " Channel

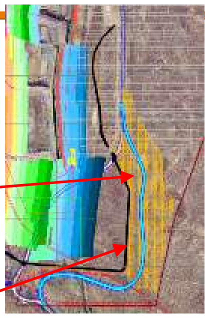
- Fisher Ck, Platypus Ck, Goonyella Ck

Design Strategy

- Facilitate coal access with stable and sustainable diversion
- Design Strategy included:
  - diversion alignment
  - grade and geometry
  - Rehabilitation
  - Rehabilitation Timing
  - Hydraulic modelling

Diversion Alignment

- Permanent river diversion
- Maintain length of channel or increase
- Provide floodplain capacity – large flood events
- Channel meandering and buffer
- 500 year ARI Immunity For Mine Height and Position of Levee Banks
- Tributary junctions on outside bends



Diversion Design – Grade & Section

- Grade to match bed levels upstream & downstream
- Channel Size & Geometry
  - Similar to natural channel upstream & downstream
- Channel width and depth for hydraulic performance
  - Length and bed gradient
  - Bank-full flow capacity
  - Flow velocity and stream power

Diversion – Bank Rehabilitation

- Riparian bank vegetation
- Bio-engineered capping
  - Tree seed topsoil
  - Revegetation substrate
  - Weathered rock
- Timber groynes
- Establishment period for Isaac Diversion
  - Existing channel will be retained for 5 years
  - Allow diversion to hold water but not pass floods
  - Change-over channel after 5 years

Diversion – Bed Rehabilitation

- Restore sand cover across bed

- In-channel sand benches
  ~ 1 to 2m above bed
  - Formation enhanced by timber groynes

- Replace large woody debris
  Sand + LWDs to recreate natural channel substrate

Concept Isaac River Diversion

- Alignment constrained Lease Boundary
- Current concept option will increase length
- Benefit from relocation of previous levee bank
- Create Floodplain 700 - 1000m wide
- Floodplain width and levee bank position is key factor for extent of open cut pits

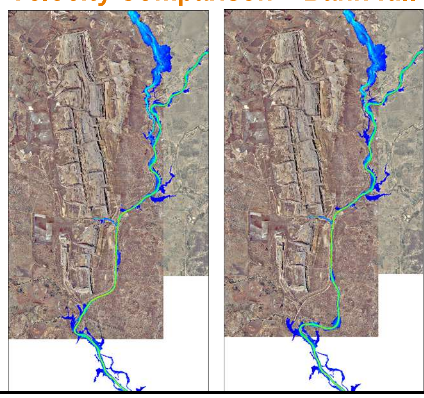
Hydraulic Assessment of Floods

- Flood Hydrology – Probability of Peak Flood Flows
  - Flood frequency analysis
  - 2 year (small) to 500 year (extreme) floods
- Isaac River hydraulic models
  - Detailed photogrammetric survey
  - Cooperation from Anglo Coal
  - Modeled area upstream & downstream
  - One-dimensional model of in-channel floods
  - Two-dimensional model of larger floods
  - Calibrated to NRMW gauge data – historical floods

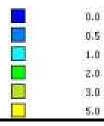
Key Hydraulic Parameters For Erosion

- Channel Flood Velocity – flow speed
- Channel Stream power – work done by river flow

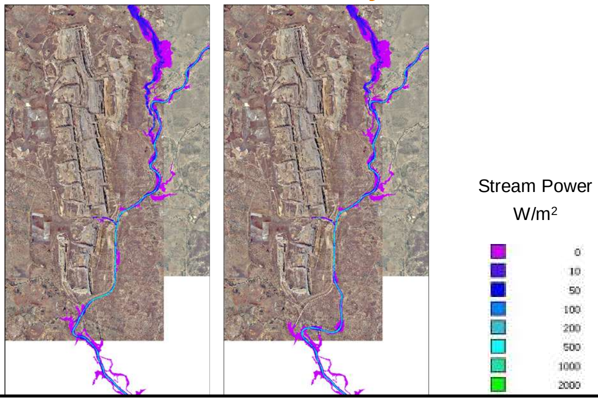
Velocity Comparison – Bank-full 20year Flood



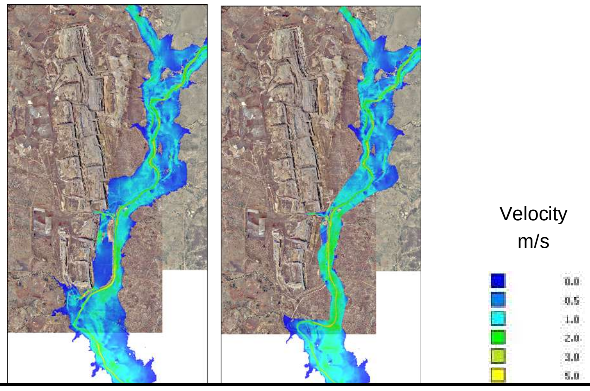
Velocity
m/s



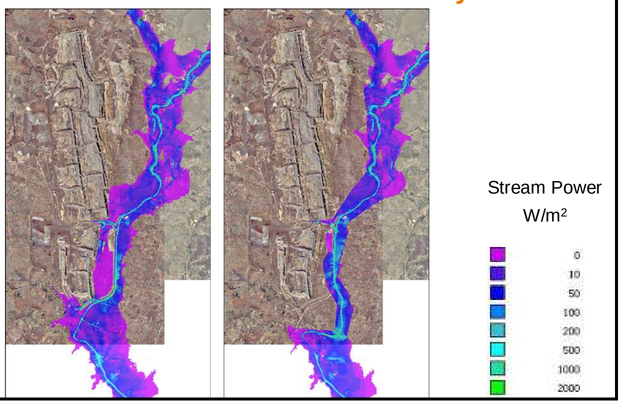
Stream Power – Bank-full 20year Flood



Velocity – Extreme Flood 500year



Stream Power – Extreme Flood 500year



Isaac River Diversion Conclusions

- Design to replicate natural river channel geometry
  - Alignment (length and meandering)
  - Channel size and floodplain corridor
- Stream power and velocity consistent with existing river
- Diversion can be designed to be morphologically stable
- Revegetation of channel banks is very important
  - Cover for erodible soils
  - 5-year establishment before channel change-over
- Reinstate and replenish sandy bed
- Monitoring and Maintenance Plan to be implemented

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GYRV Mine
Riverside Rejects Dump
Concept Design

URS BMA

URS BMA

Background

- Commenced in 1983 - 125 hectares
- Approximately 55 hectares previously capped and revegetated - majority in 1995 - remainder in 2003.
- Additional 45 hectares to be rehabed in 2005/2006
- 25 hectares of the reject dump will remain active.

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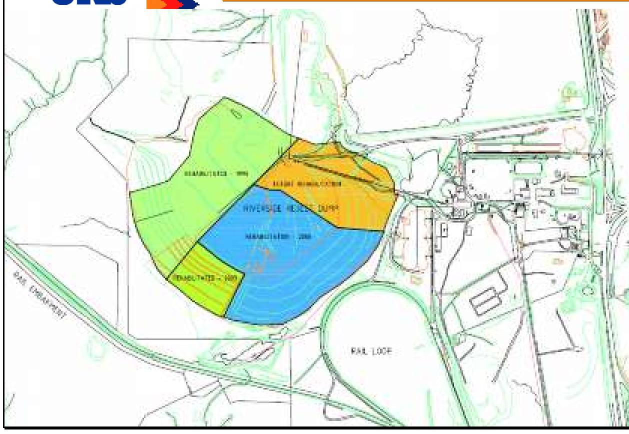
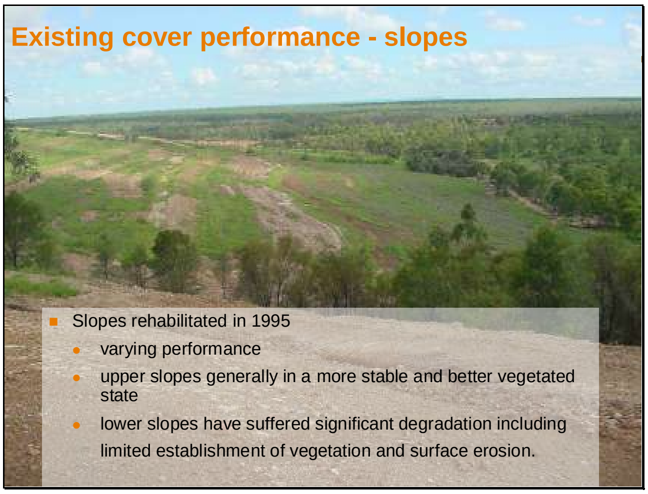


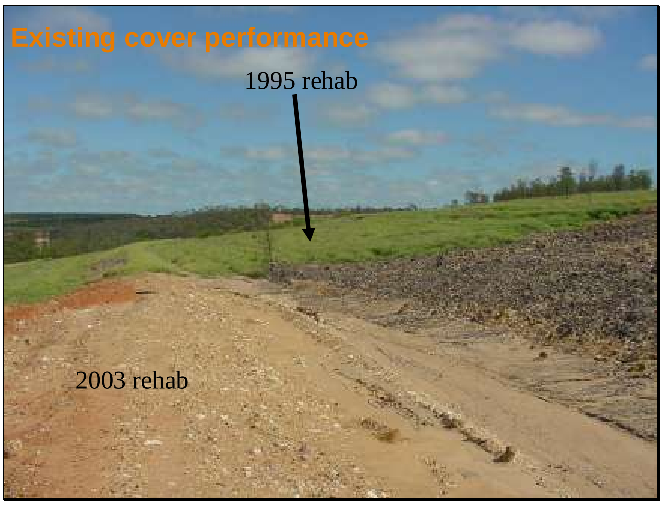
Existing cover performance - crest

- Crest area rehabilitated in 1995
  - performing satisfactorily, with a well-established grass cover
  - localised stands of trees across the cover in a poor condition

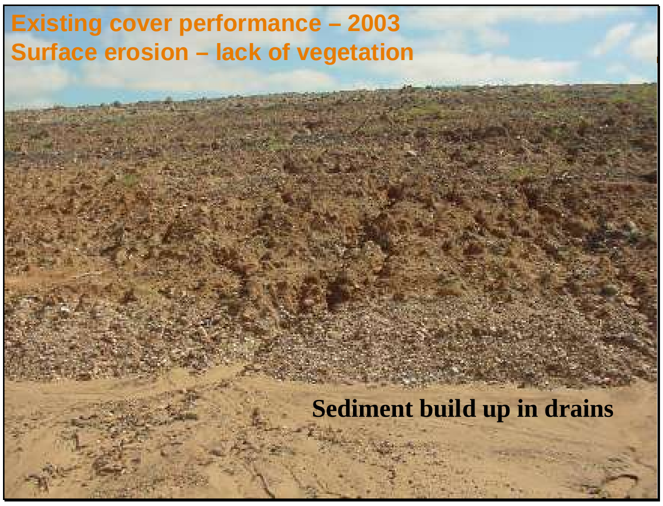
Existing cover performance - slopes



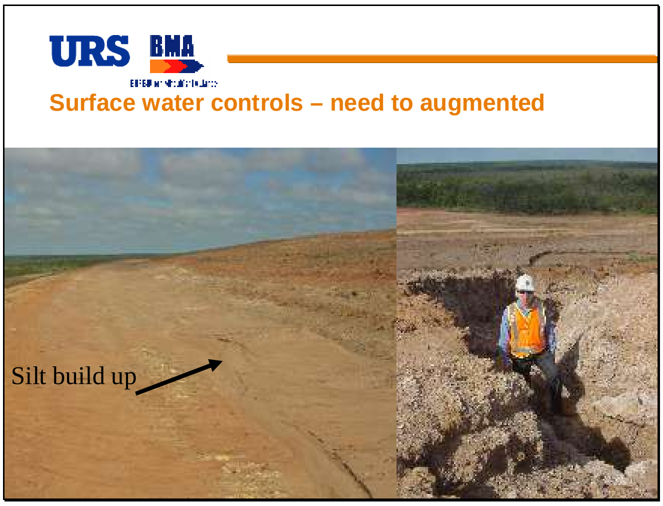
- Slopes rehabilitated in 1995
  - varying performance
  - upper slopes generally in a more stable and better vegetated state
  - lower slopes have suffered significant degradation including limited establishment of vegetation and surface erosion.


Existing cover performance
1995 rehab
2003 rehab


Existing cover performance - slopes
Slopes rehabilitated in 2003
generally performed poorly with little surface vegetation, evidence of drain failure and surface erosion across the slope profile.
Controls implemented during construction were inadequate
thickness of the constructed cap
construction of the drainage features.


Existing cover performance – 2003
Surface erosion – lack of vegetation
Sediment build up in drains


Existing cover performance – 2003
Loss of topsoil – localised erosion

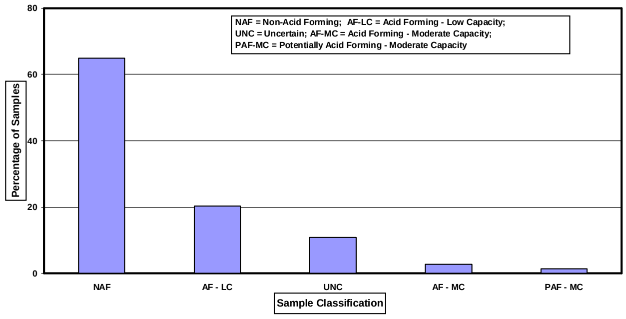

URS
BMA
Surface water controls – need to augmented
Silt build up


URS
BMA
1993 Cap – variable thickness

Geochemistry of rejects

- pH ranges from moderately acidic to slightly alkaline and the magnitude of the natural acidity/alkalinity are relatively small
- Some potential to generate acid if exposed to oxidising conditions - sulfide oxidation is occurring - significant acid buffering is also apparent
- PAF materials randomly dispersed within the rejects dump area
- Majority (65%) of the reject is non-acid forming

Geochemistry of rejects



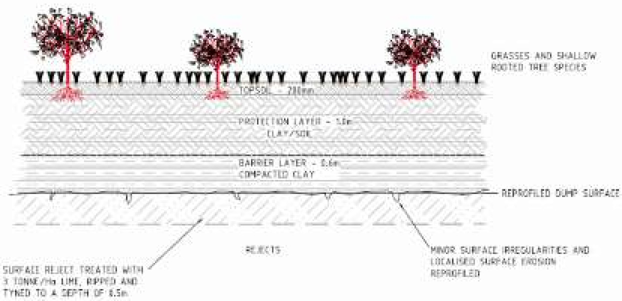
Geochemistry of rejects

- Under natural pH - soluble metals and sulfate in runoff and seepage from the reject material is unlikely to be of environmental concern - generally remain well within relevant Australian water quality guideline concentration limits.
- The natural salinity of the reject materials ranges from low to moderate and the risk of adverse effects to surface vegetation through capillary rise of salts and acid is expected to be low
- The concentration of metals in rejects is unlikely to present an environmental risk with respect to rehabilitation and revegetation

Rehabilitation concepts – new areas

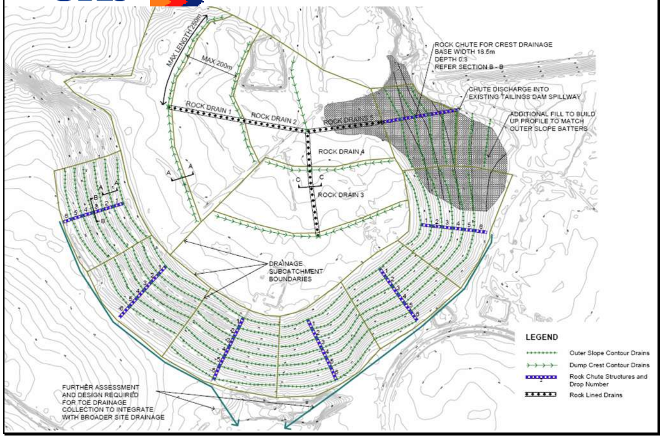
- Overall objectives
  - minimise infiltration into the rejects
  - to achieve successful revegetation
  - To achieve a stable landform
  - minimise the risks of significant ongoing maintenance during the establishment period.
- Spread lime across the surface
  - lower the acidity + increase pH of localised acidic areas.
- Construct a three-layered cover for the reject dump
  - to minimise infiltration into the reject
  - to limit the potential to generate acid from localised PAF materials contained within the reject dump.

Rehabilitation concepts – cover detail



Rehabilitation concepts – new areas

- Engineered surface water management system across the cover
  - to limit surface erosion
  - collect surface water and discharge in a controlled manner
  - contour drains - rock lined drainage channels and drop structures to discharge the collected surface water from the dump
- Revegetating with native grasses



Rehabilitation concepts – old rehab areas

- Poor performance of the existing rehabilitation works
- Does not comply with the EMOS/EA requirements and the concept cover design for the site
- Rehab as per new areas