PERFORMANCE OF WASTE ROCK COVERS – RUM JUNGLE

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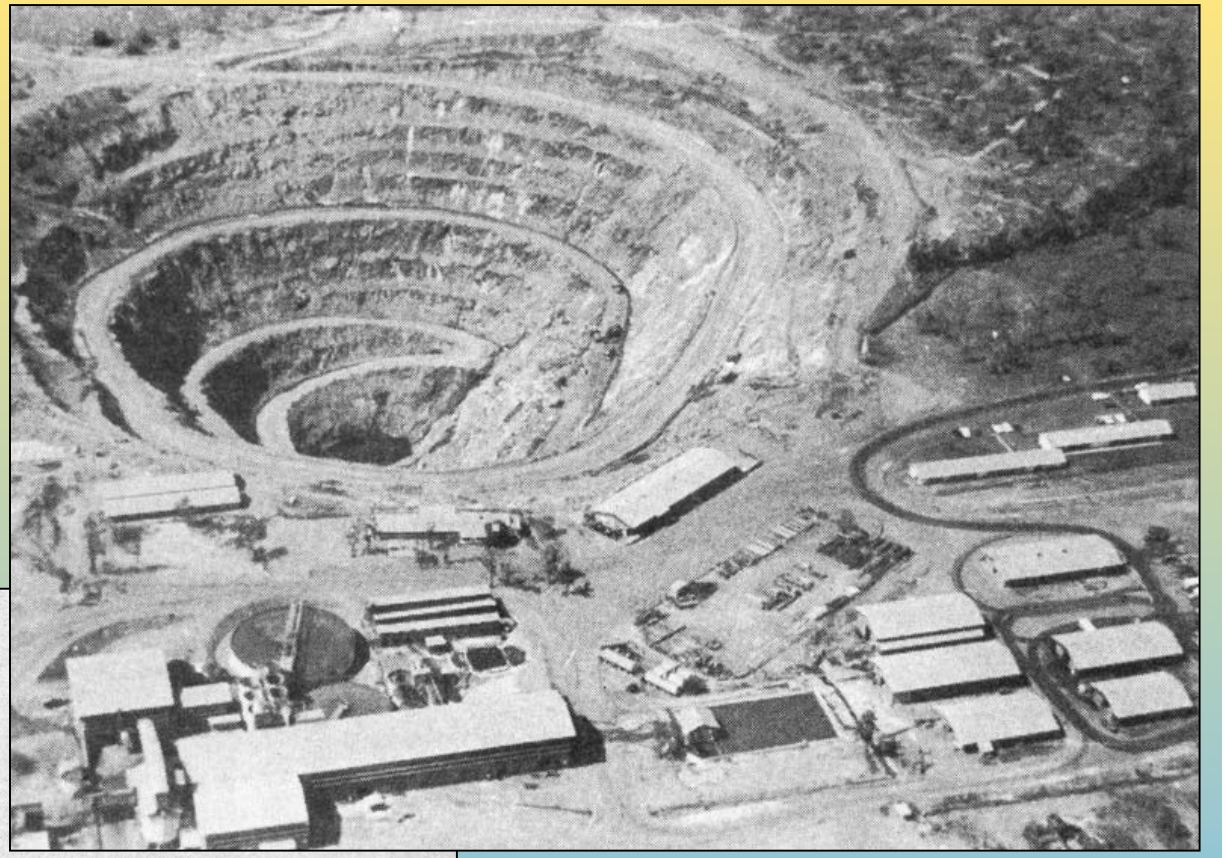
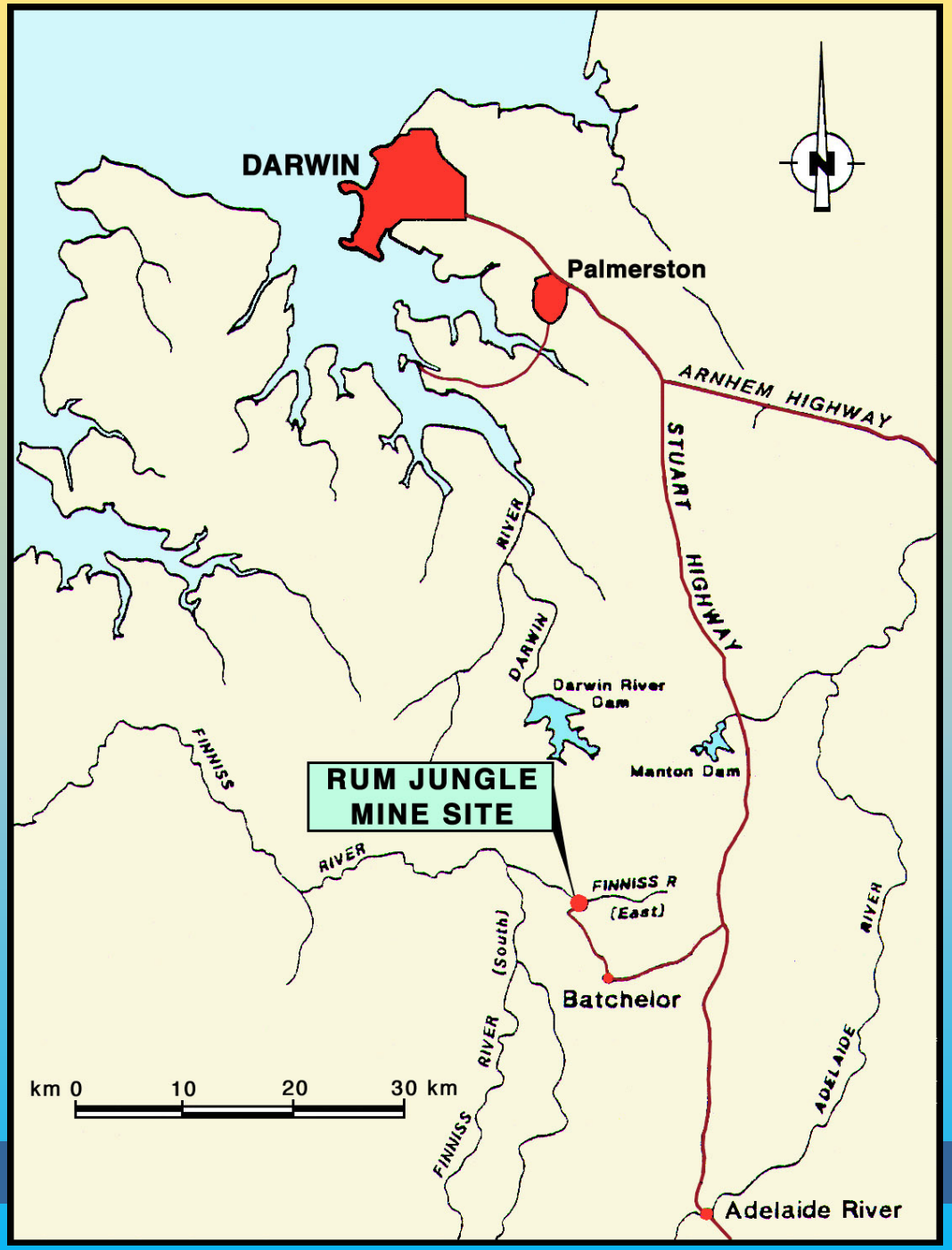
Mining Activities at Rum Jungle



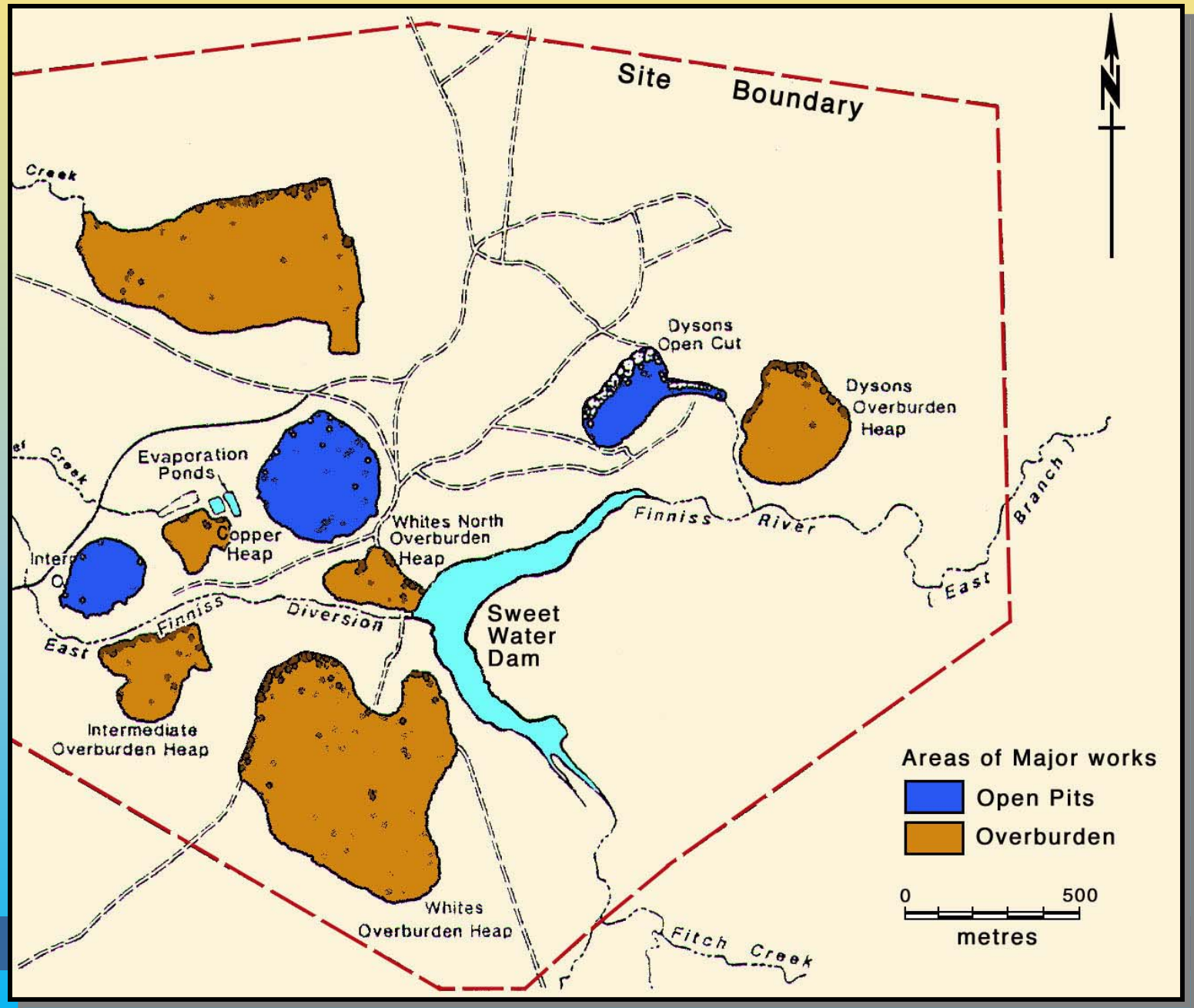
Location map for the Rum Jungle minesite



RUM JUNGLE MINE

- Mined for uranium and copper 1952-1971
- Three open-cut mines on site
- Other small mines within 10 km
- Four waste rock dumps
- Three open pits
- TSF
- Heap leach piles
- Acid dam

RUM JUNGLE MINESITE PRIOR TO REHABILITATION



WHITE'S OVERBURDEN HEAP

- 7.1 mt ; 26.4 ha ; 4 x 10^6 m^3
- Consists of shales and slates with minor dolomite
- Main sulfide is pyrite
- IOR = 1.3 x 10^{-8} kg $(O_2)m^{-3}$ s^{-1}
- Left for 26-30 years prior to covering

REHABILITATION

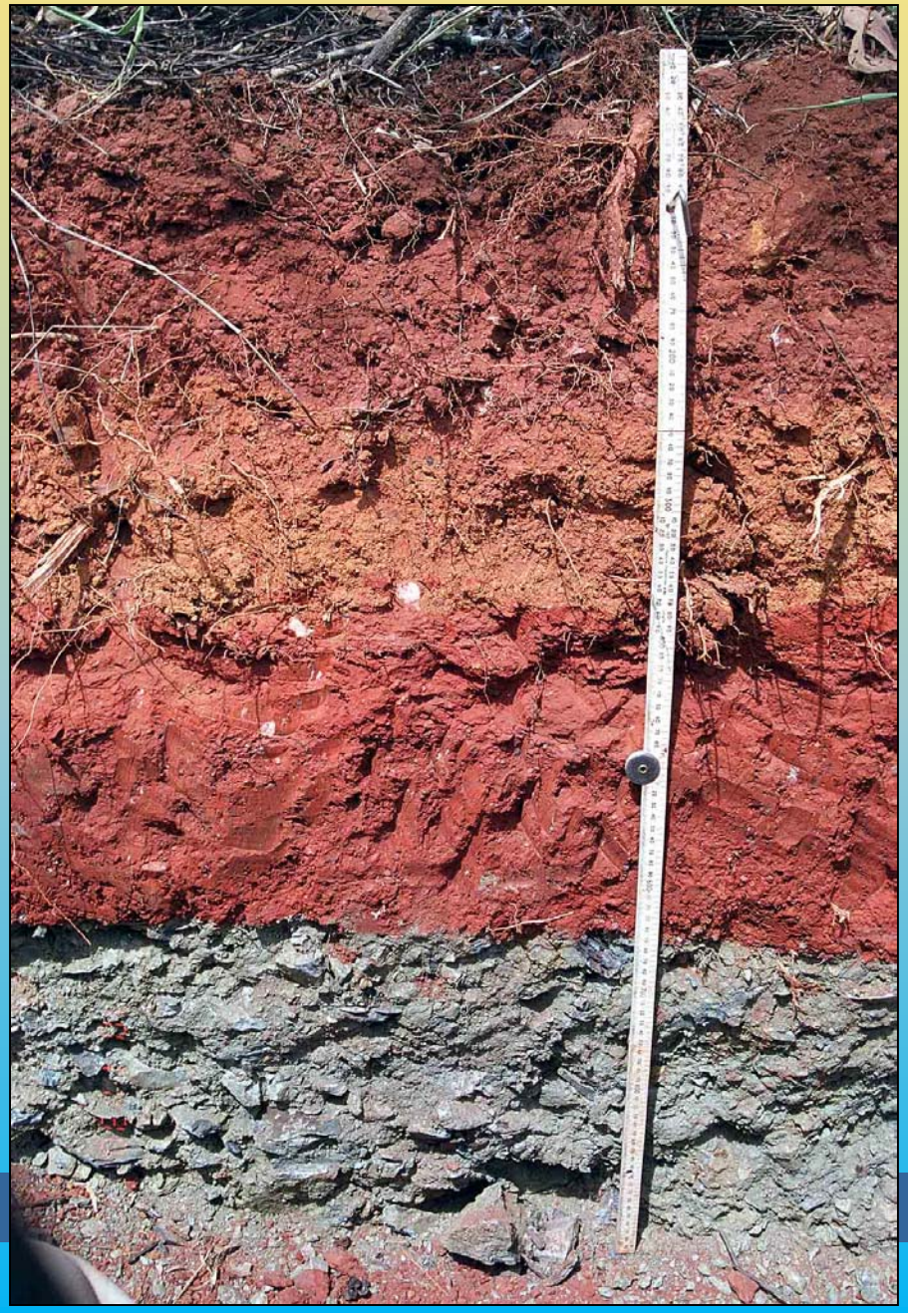
- **Reshaping**

REHABILITATION

- **Drainage**

REHABILITATION

- Covers



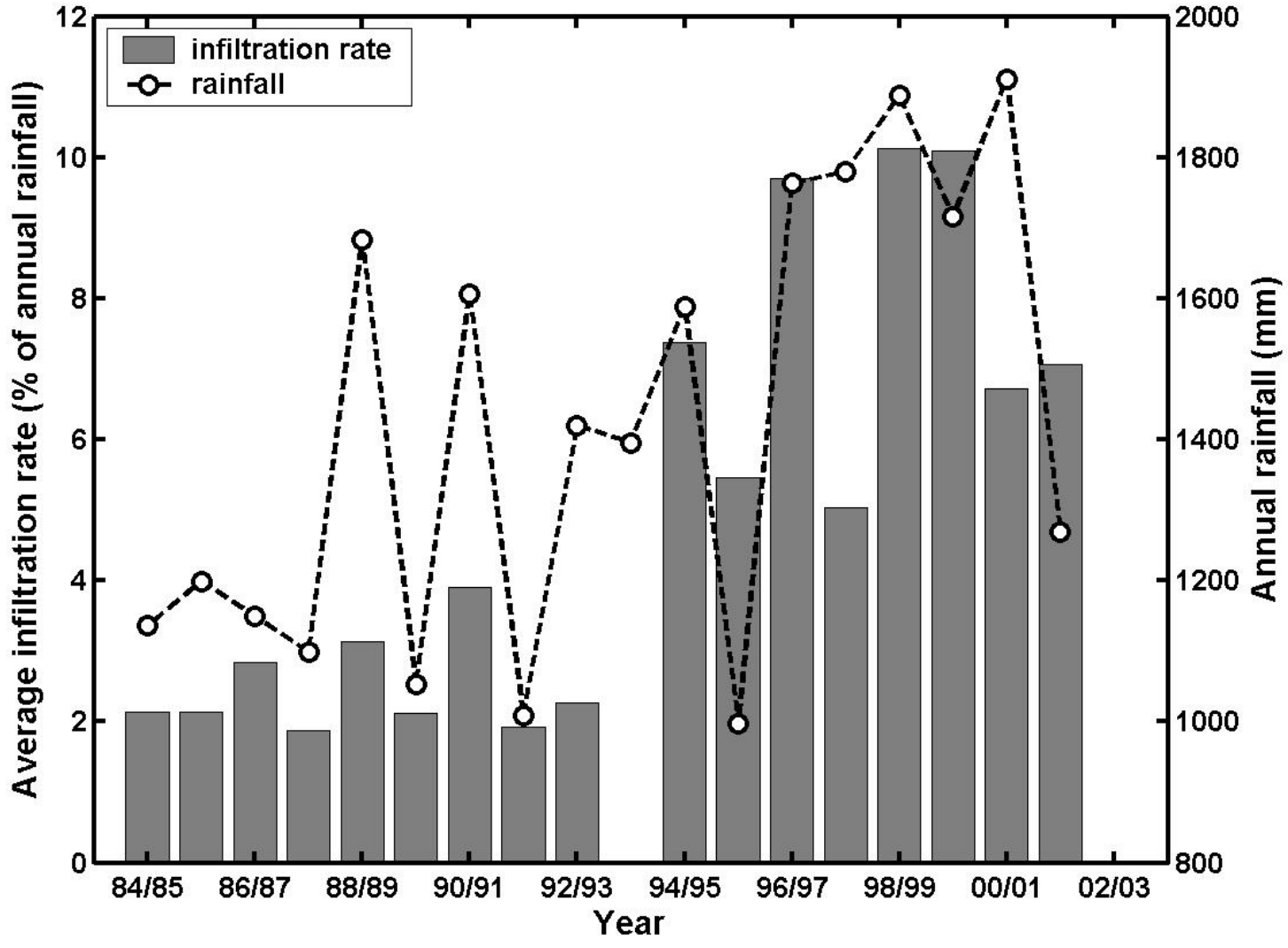
REHABILITATION

- **Revegetation**

MONITORING

- Instrumentation
- Water quality in Finniss River
- Water infiltration rate
- Oxidation rates
- Vegetation
- Erosion
- Weeds
- Wildfires

WATER INFILTRATION



CSIRO / ANSTO RESEARCH

To ascertain what factors led to a deterioration in performance of the cover on White's overburden heap

- **Field observations**
- **Field tests**
- **Laboratory tests / analyses**

End of 'wet' season – April 2002
End of 'dry' season – October 2002

CSIRO / ANSTO RESEARCH

Field tests

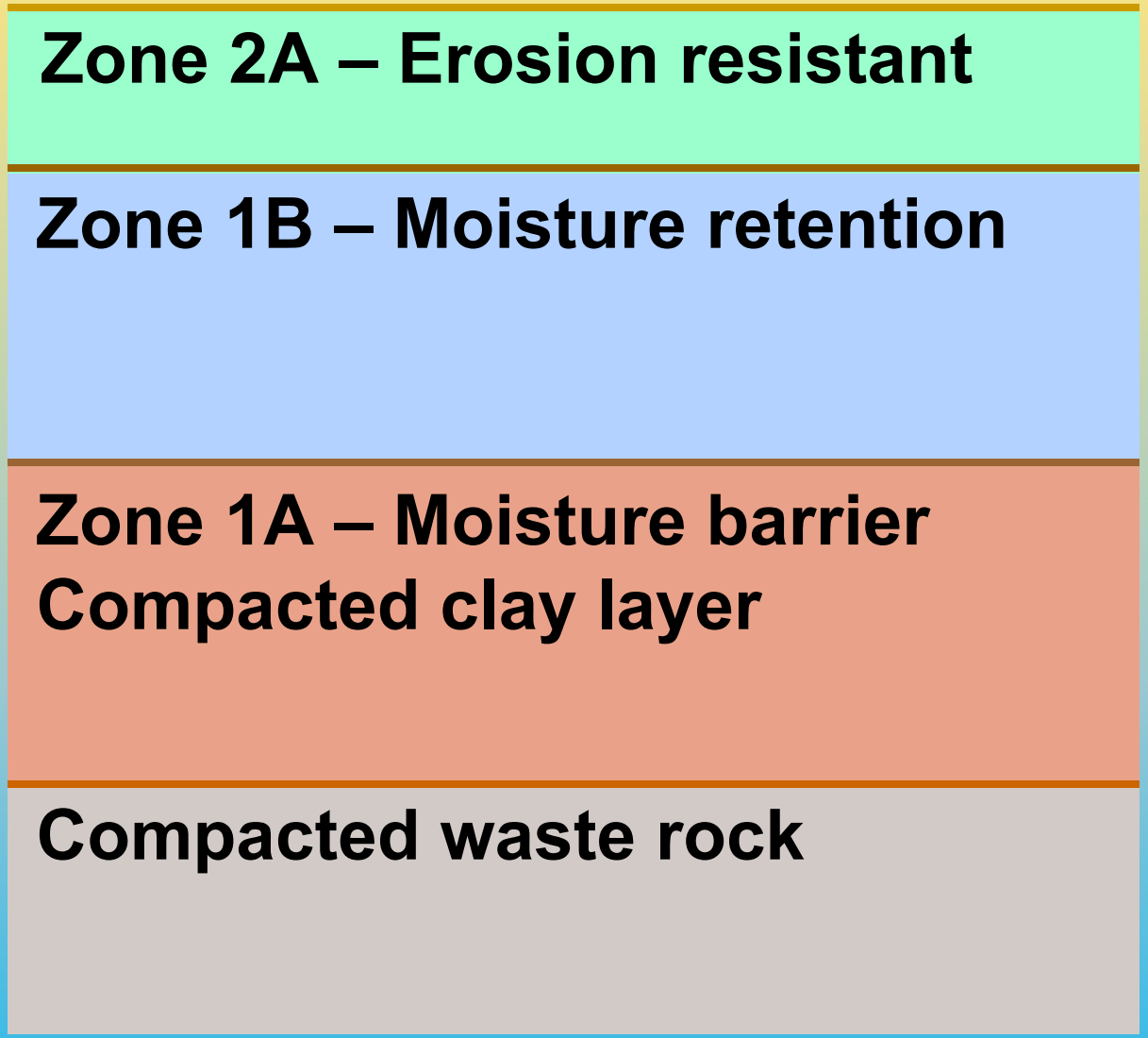
RESULTS

- **Vegetation**
- **Cover characteristics**
  - **surface: litter, cryptogams, stoniness, macropores, micro-relief, termite mounds, erosion**
  - **profile: thickness, layer properties, depth distribution of roots, infiltration, oxygen flux**
- **Laboratory testing**
  - **moisture content, particle density, bulk densities, void ratio, saturation, dispersivity, liquid and plastic limits, shrinkage, particle size analysis**
- **Laboratory analyses**
  - **mineralogy, composition, leachate composition**

DISCUSSION

Design :

- Low permeability to reduce infiltration to <5% incident rainfall
- Well drained with no ponding
- Erosion resistant
- Minimum thickness compatible with performance objectives
- Simple construction using local materials


Zone 2A – Erosion resistant
150 mm
Zone 1B – Moisture retention
300 mm
Zone 1A – Moisture barrier
Compacted clay layer
300 mm
Compacted waste rock

Construction / Materials

- Water-shedding / erosion prevention features satisfactory
- Zone 2A much thinner than specified
- Some materials fell outside specified designed limits
- Insufficient material meeting specifications
- Tests indicated Zone 1A material would shrink during ‘dry’ season

Physical / chemical changes

- Minimal erosion or slumping
- Bare patches have been acid burned (pH=3.7)
- Pedological changes
- Zone 2A has cloddy structure penetrated by roots and termite / ant galleries
- Zone 1A developed polygonal blocky structure with coarse material in voids
- Zoning of soluble elements suggests ‘biological pumping’

Biological changes :

- Root penetration into waste rock
- Termite / ant galleries
- Both have increased permeability
- Future biological development dependent on plant communities
- Native species adapted to prevailing conditions will replace agriculture species

Oxygen flux

- Cover reduces oxygen flux to 20% - 23% of exposed bare rock
- Reduction proportional to cover thickness
- Flux 4x higher at end of ‘dry’ season
- Difference due to moisture content

CONCLUSIONS :

- **Storage-release, water-shedding design appears appropriate**
- **Cover design based on material availability and cost not necessarily appropriate**
- **Adequate supervision and quality control essential during construction**
- **Monitoring instrumentation installed during construction necessary to determine performance**

CONCLUSIONS (cont.)

- Colonisation by termites (and ants) is inevitable
- Cover design must accommodate their impact on soil hydraulic properties
- Penetration by roots probably unavoidable – impact presently unquantifiable
- Oxygen flux limited by covers

RECOMMENDATIONS

- Detailed modelling using characteristics of available materials essential
- Make allowances for changes in permeability
- Comprehensive testing / analysis of potential cover materials
- To reduce long-term maintenance, cover should be planted to native flora
- Consideration of capillary break