

E.3 Challenging the Myths of Mine Site Rehabilitation

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Challenging the Myths of Mine Site Rehabilitation



- My current projects include:
 - Inpit co-disposal, store & release PAF waste rock dump cover and tailings storage closure at *Kidston* Gold Mines, North Queensland.
 - Risk assessment and cost-effectiveness applied to open cut coal mine *spill rehabilitation* in the Bowen Basin Coalfields, central Queensland.
 - Long-term seepage and runoff from WMC's *tailings storage facilities* in the Kalgoorlie region, Western Australia.

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Challenging the Myths of Mine Site Rehabilitation



- My background:
 - *Geotechnical Engineer* with over 20 years experience.
 - 18 years at The University of Queensland.
 - Main research, consulting and teaching interests are in *applying geotechnical engineering* to the disposal and rehabilitation of mining and mineral processing wastes.

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Challenging the Myths of Mine Site Rehabilitation



- New projects include:
 - *Waste rock dump characterisation* under INAP.
 - *Co-disposed* tailings and waste rock covers for PAF waste rock dumps, for Cadia, NSW.
 - *Mitigating* mine site *erosion* in a wet tropical climate for Placerdome.

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Challenging the Myths of Mine Site Rehabilitation



- My contributions have included:
 - Physical and numerical *modelling* of the beaching, hydraulic sorting, sedimentation, consolidation, desiccation and loading of *tailings*.
 - Promotion of the *co-disposal* of coarse mine wastes and tailings, including pumped co-disposal.
 - Procedures for safely and cost-effectively *covering tailings*.
 - Conception of the *"store & release" soil cover system* for PAF waste rock dumps.
 - Application of *risk assessment* to mine site closure.

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Mine site rehabilitation vs Nature vs "Development"



- In nature, *"sharp relief"* predominates and we revere it!
- Why must mined land be *"smoothed"*?
- Is *"greening"* achievable or sustainable?
- Is *agricultural land use* achievable or sustainable?
- *Excessive costs discourage rehabilitation*.
- Do we expect similar standards for all *development*?

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Sharp relief in nature



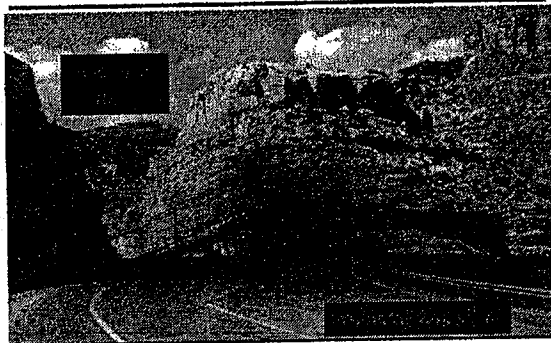
Pick the "Natural" from the "Constructed"



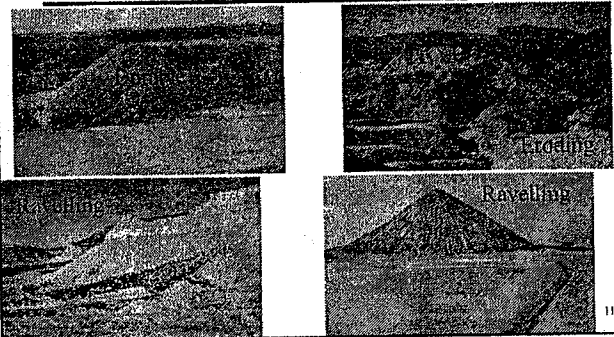
- "Waste rock dumps".
- "Strip mining".
- Reshaped slopes.
- Erosion.
- Creeks and diversions.
- "Post-mining" land uses.

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Mountainous highway



"Waste rock dumps"



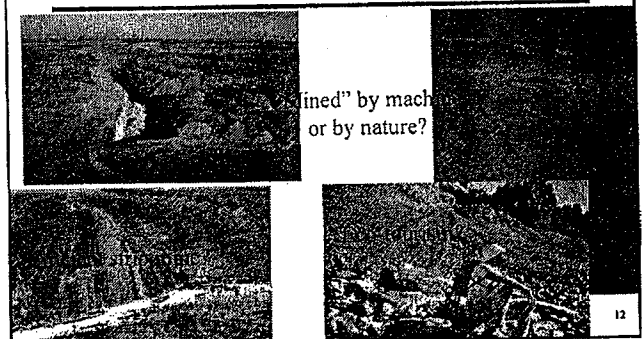
Mining land use in Australia in perspective



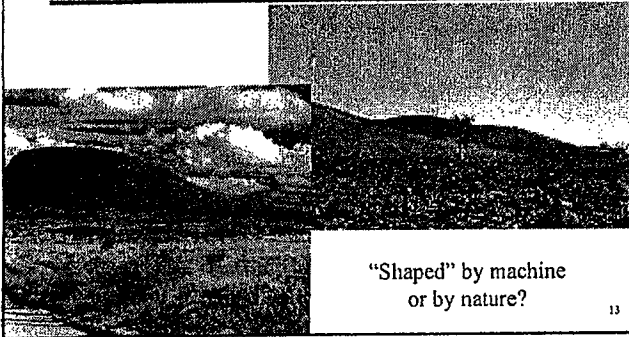
- In 200 years, *mining has disturbed* < 0.03% of Australia's 750 Mha land mass.
- *Agriculture* and forestry impact 66% (grazing 54%, cropping 6% and forestry 6%).
- Other land uses include 5% dedicated to conservation, urbanisation 1.2% and deserts, etc. 28%.

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"Strip mining"



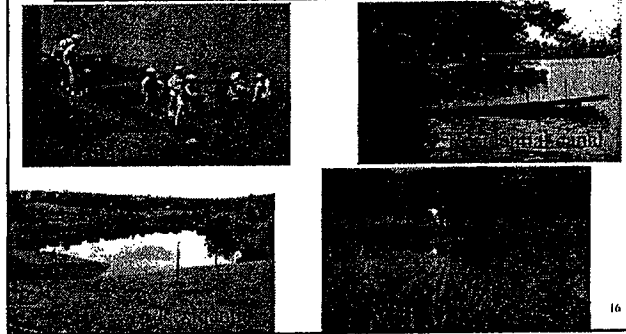
Reshaped slopes



"Shaped" by machine
or by nature?

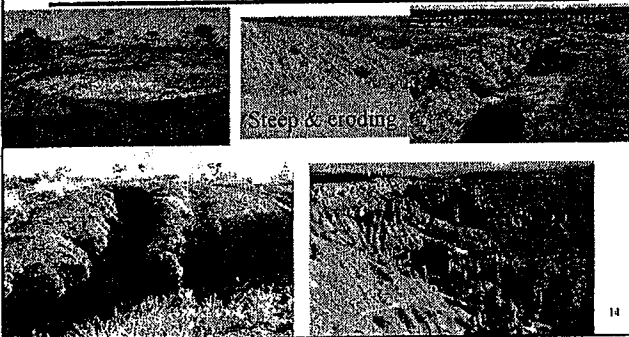
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"Post-mining" land uses



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Erosion



Steep & eroding

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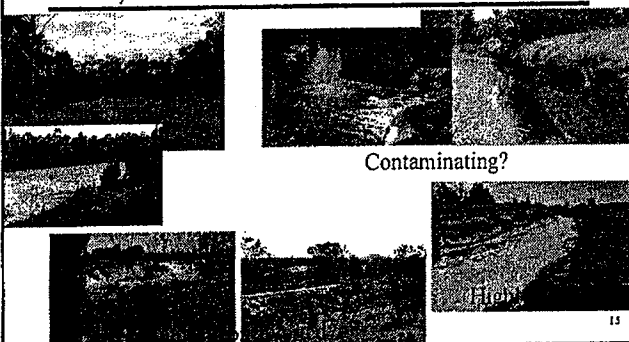
Australian regulation of mining



- Historically, the regulation of mining and mineral processing in Australia has generally been directed by a *grazing post-mining land use*.
- Any *bond* was based on the value of the land for the pre-existing land use at the time the mining lease was granted, e.g. \$A 125/ha in 1975 for central Queensland grazing land (now worth \$A 500/ha).

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Creeks and diversions



Contaminating?

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Developments during the 1990s



- The *key guidelines became*:
 1. Achievement of an acceptable post-disturbance land use capability (usually grazing).
 2. Achievement of a stable post-disturbance landform.
 3. Preservation of downstream water quality.

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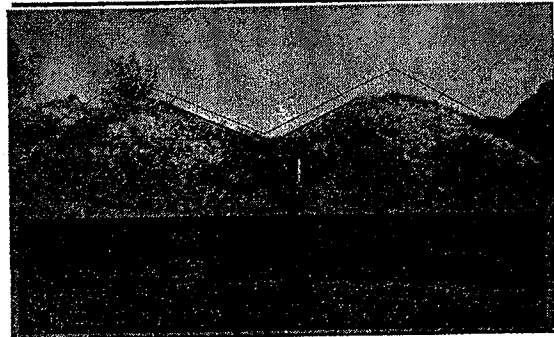
Current developments



- Mining applications must be *inclusive of all Stakeholders*.
- A *risk-based* approach is preferred.
- Increasingly, *Closure Plans* are required prior to start up.
- Future legislation should be *outcome-based rather than prescriptive*.

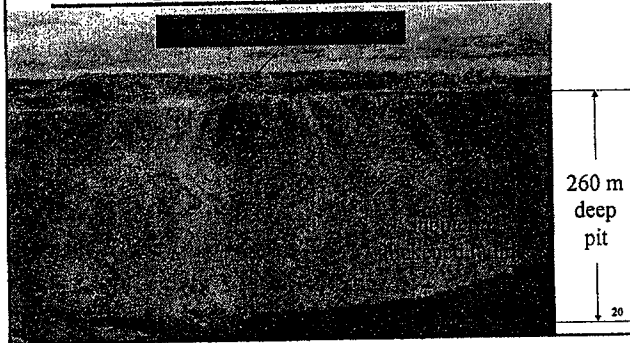
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Even clayey spoil can remain at angle of repose



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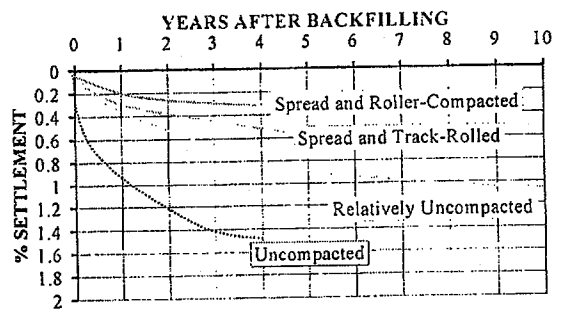
Geotechnically stable angle of repose dump slopes, e.g.



260 m
deep
pit

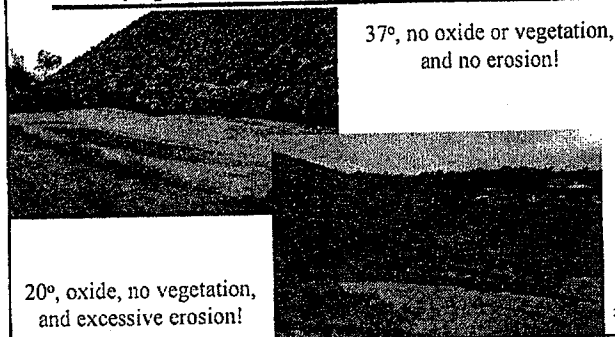
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Measured spoil settlements



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Reduced erosion on angle of repose dump slopes, e.g.

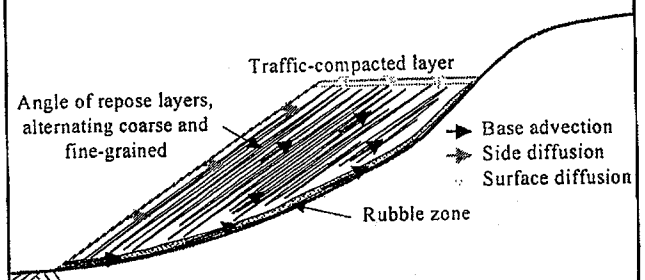


37°, no oxide or vegetation,
and no erosion!

20°, oxide, no vegetation,
and excessive erosion!

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Waste rock dump "reactors"



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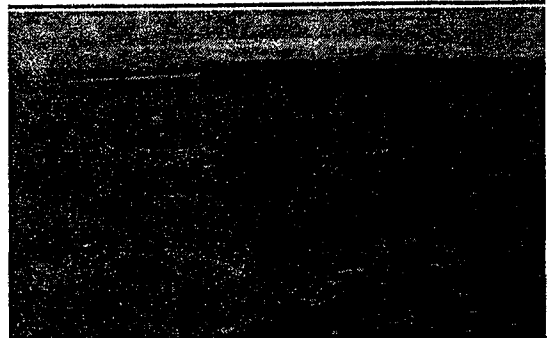
Structure of Kidston's waste rock dump



trafficked
layer

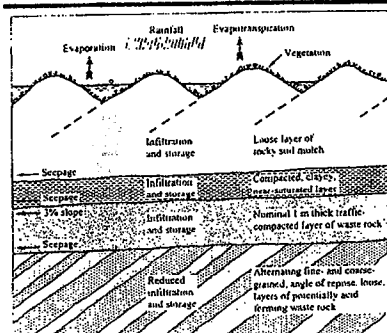
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Completed "Store & Release" cover



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"Store & Release" PAF waste rock cover



1.5 to 2 m
Rocky soil mulch

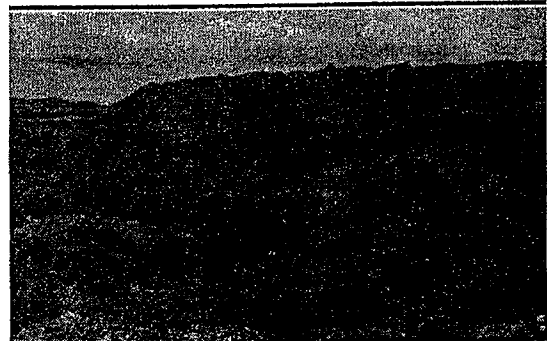
0.5 m comp. clay

1 m trafficked

Angle of repose
PAF waste rock

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Vegetated "Store & Release" cover



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Placing the cover



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Basic open strip coal mine rehabilitation options

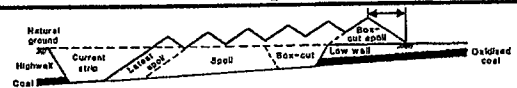


Figure 1 Saw-tooth dragline spoil pile profile at angle of repose (about 37 degrees)

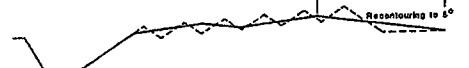


Figure 2 Mounded spoil pile profile at 8 degrees

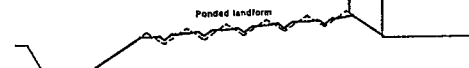
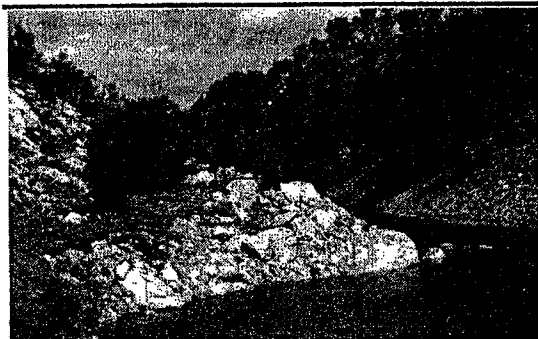


Figure 3 Ponded spoil pile profile

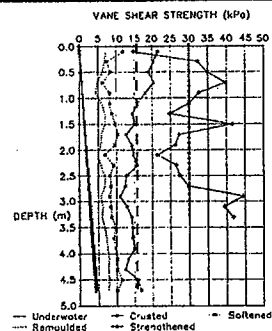
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1 - "Do nothing"



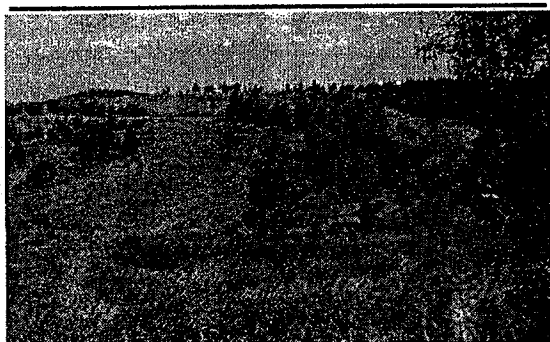
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Strength envelopes for coal tailings



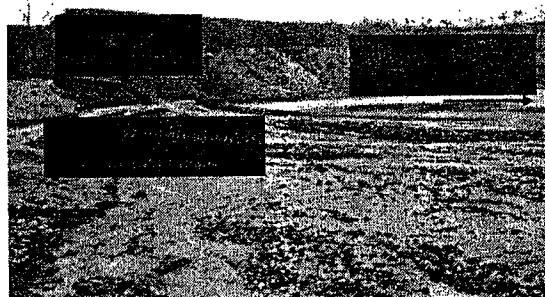
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2 - Mounding - "Fairways"



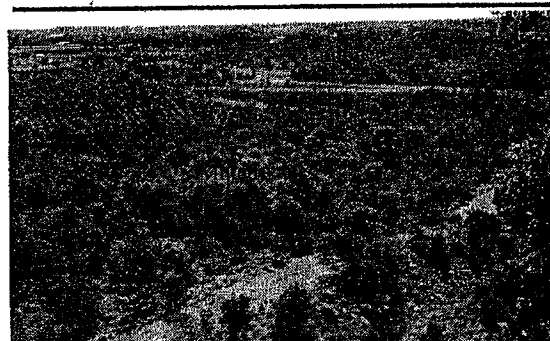
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Hydraulic capping



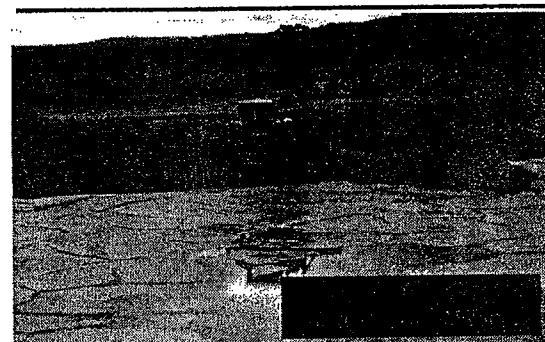
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3 - "Internally drained"

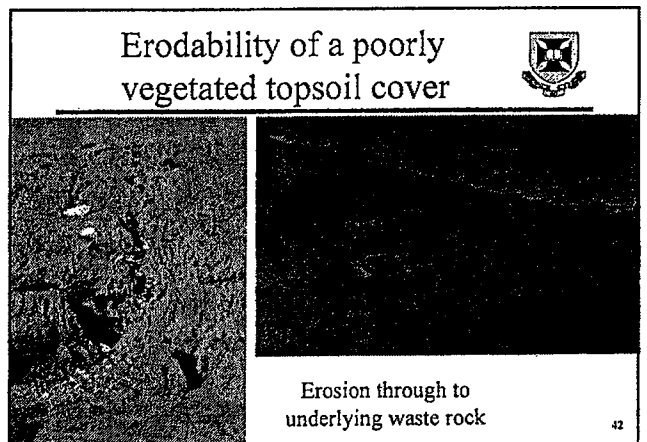
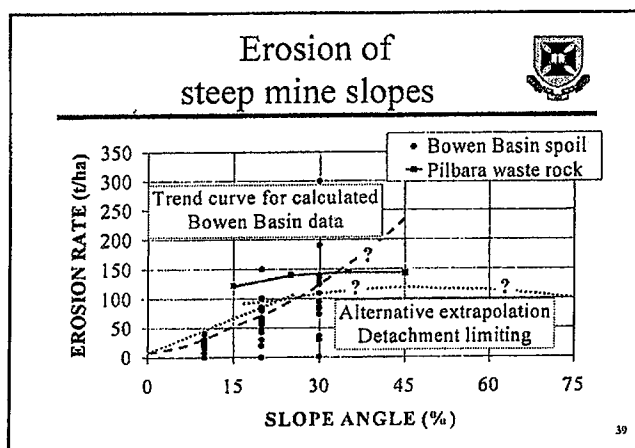
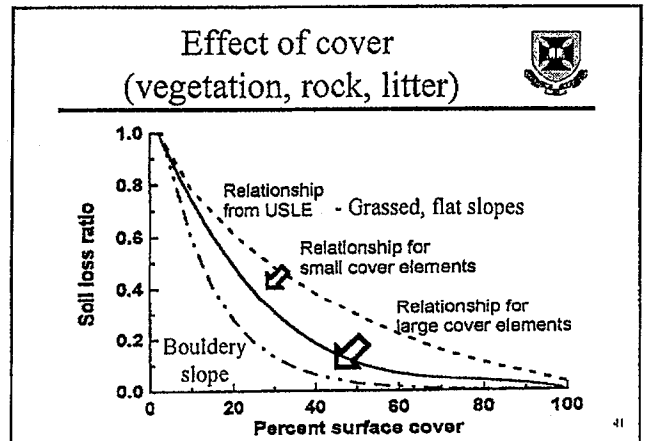
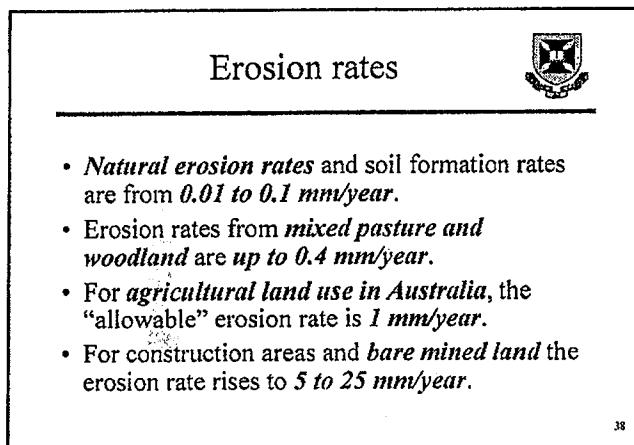
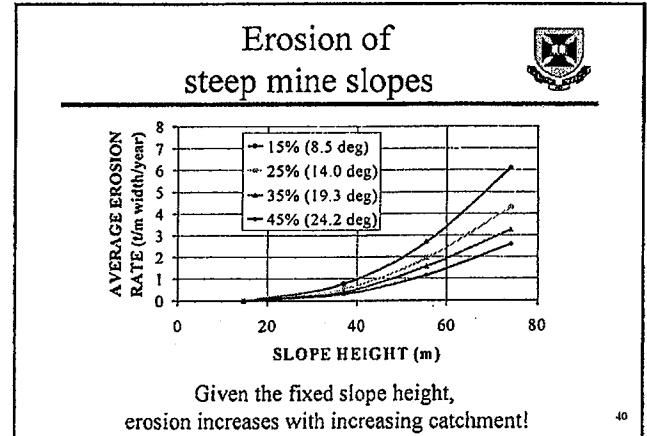
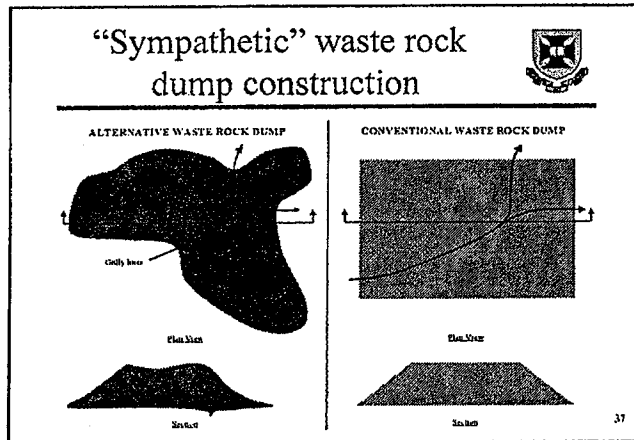


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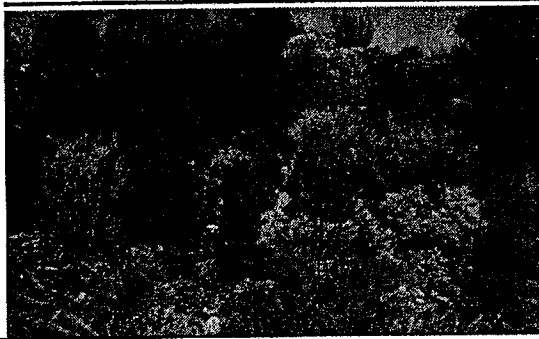
Placing cover



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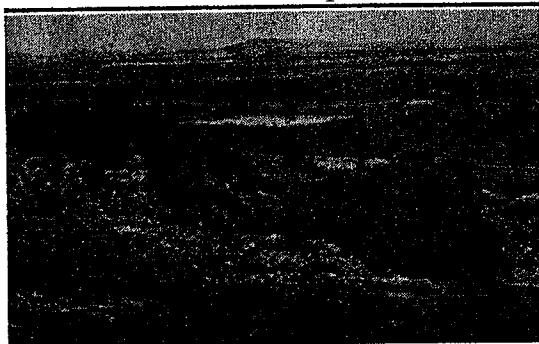


Natural semi-arid
cover on a slope



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Reconstructed semi-arid
cover on a slope



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