



# Mine Rehabilitation Options & Scenarios for the Latrobe Valley



Ted Waghone

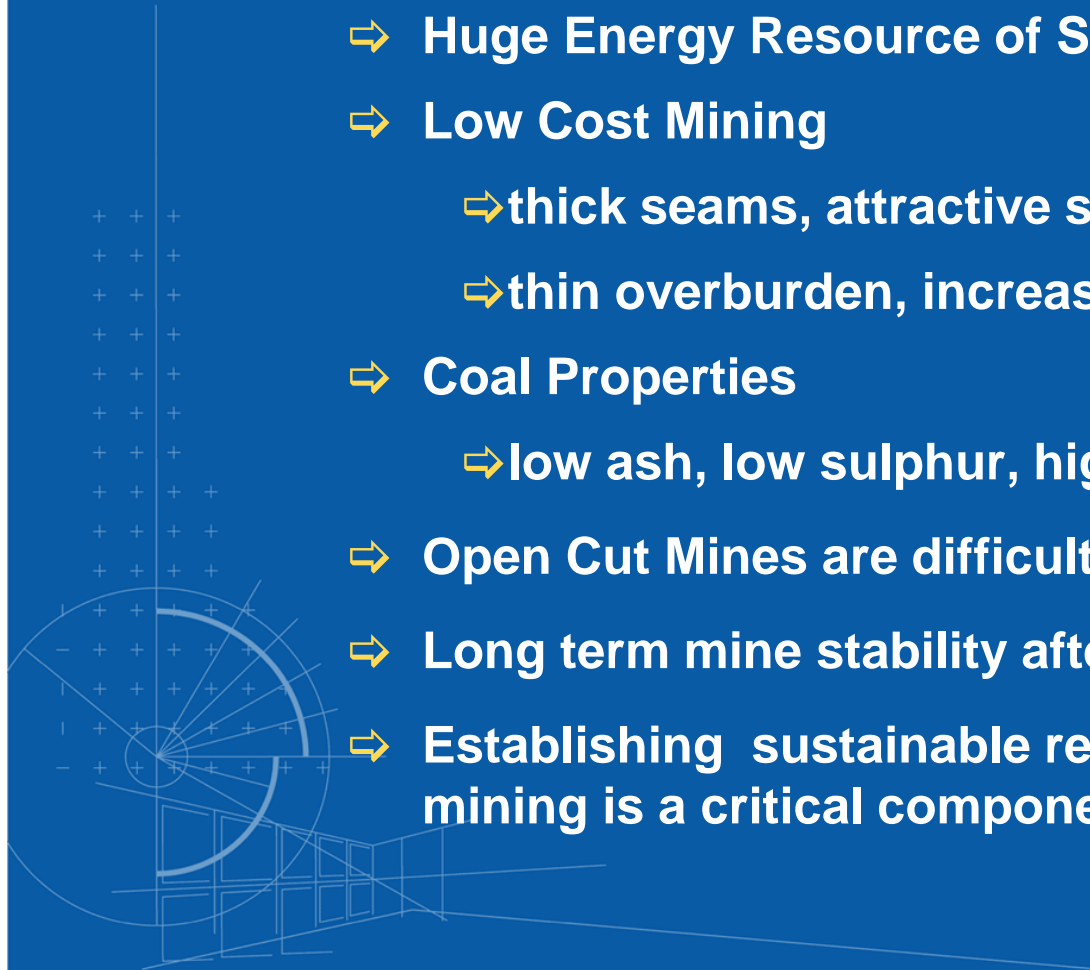
GHD Australia





# LV Coal Resource

- ⇒ **Huge Energy Resource of State significance**
- ⇒ **Low Cost Mining**
  - ⇒ **thick seams, attractive strip ratios**
  - ⇒ **thin overburden, increasing interseams**
- ⇒ **Coal Properties**
  - ⇒ **low ash, low sulphur, high moisture**
- ⇒ **Open Cut Mines are difficult to fill and rehabilitate**
- ⇒ **Long term mine stability after closure an issue**
- ⇒ **Establishing sustainable rehabilitation options for mining is a critical component of coal mining**





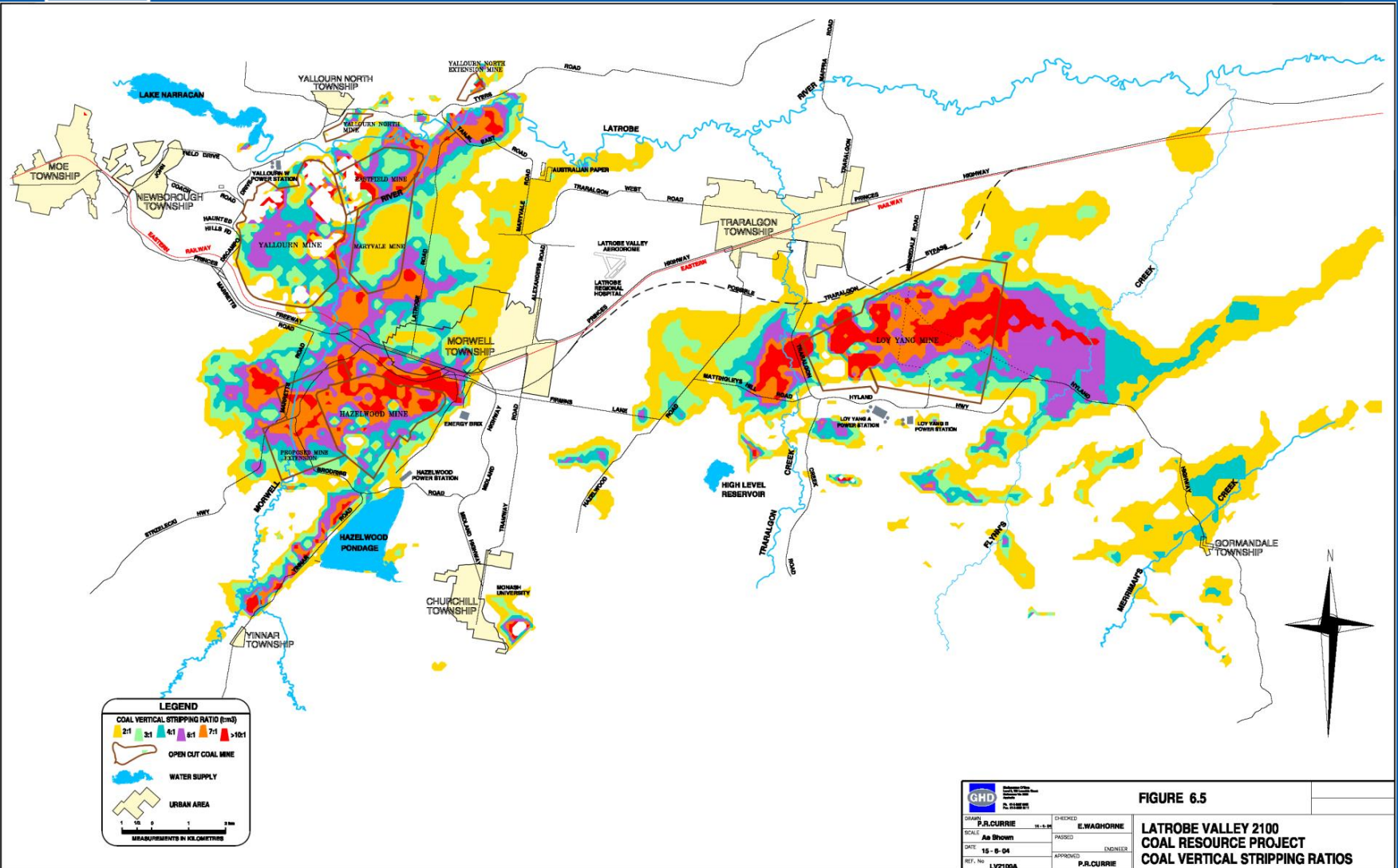
# Three Current Mines





# Potential New Mines

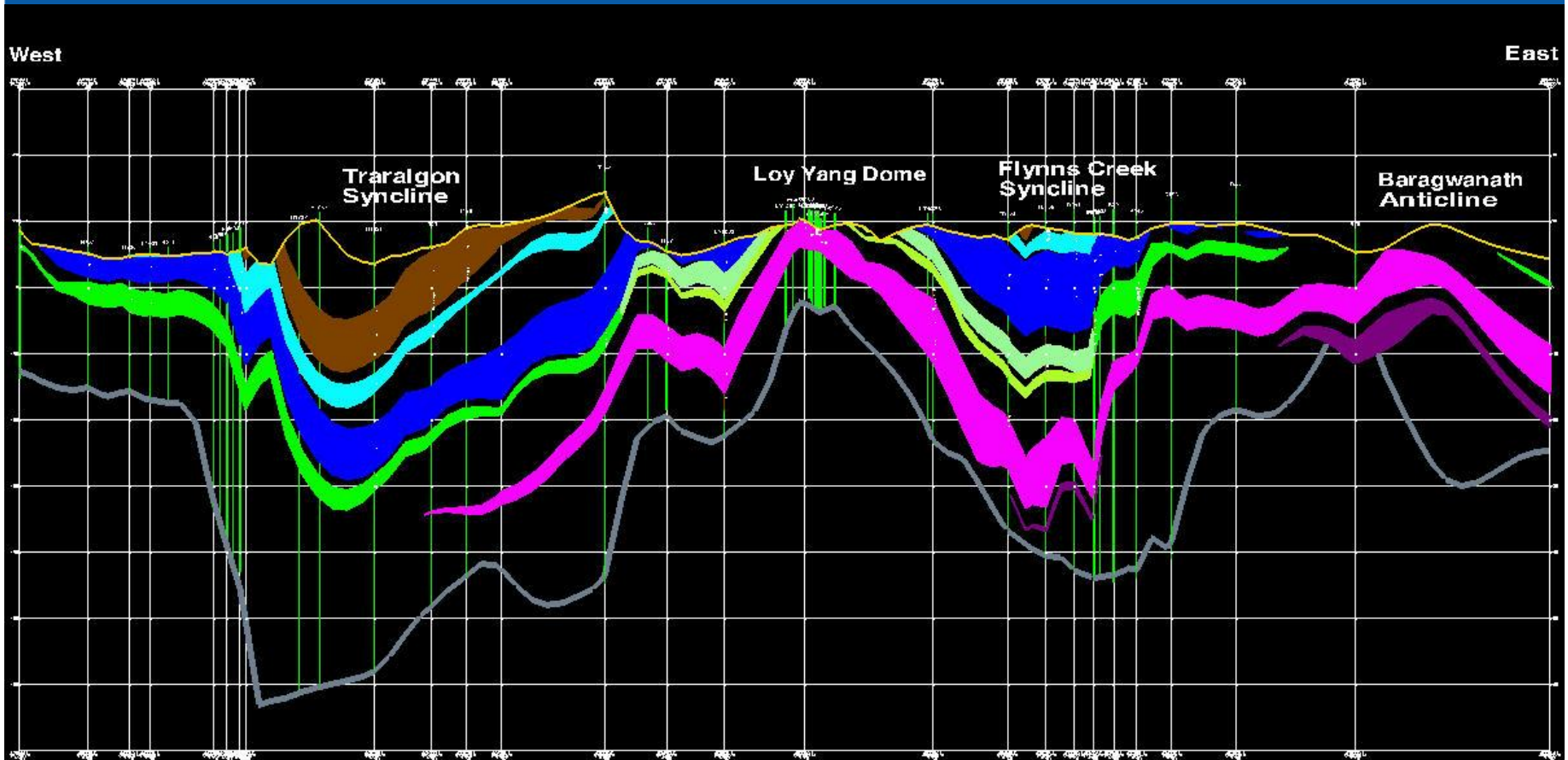
(based on Stripping Ratios)





# Potential Deeper Mines

(West – East Long Section)





# DPI Project Scope

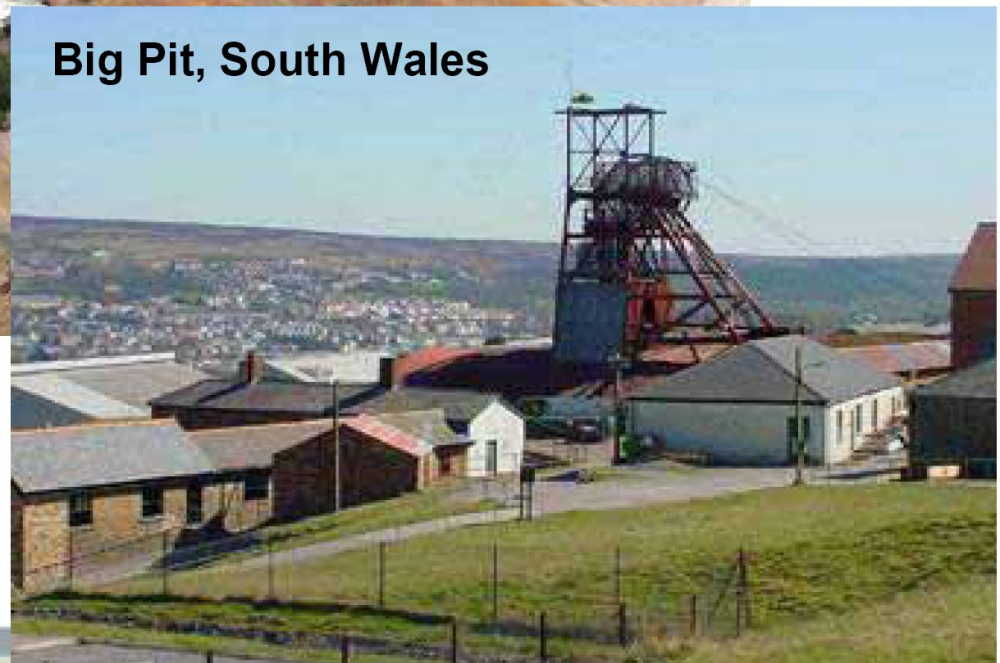
- ⇒ Analyse rehabilitation strategies of current mines
- ⇒ Assess rehabilitation issues for future mines including mines that will be deeper and those which merge into super pits
- ⇒ Identify environmental issues for mine rehabilitation
- ⇒ Identify mine rehabilitation options
- ⇒ Recommend role of government to implement rehabilitation options
- ⇒ Carry out stakeholder consultation



**SD06: OPERATING FOR ENDURING VALUE**

Caroline Digby

## No shortage of mining heritage







## Fundamental Principles for the Mining Sector (Berlin Guidelines 1991, revised 2000)

Governments, mining companies and the minerals industries should as a minimum:

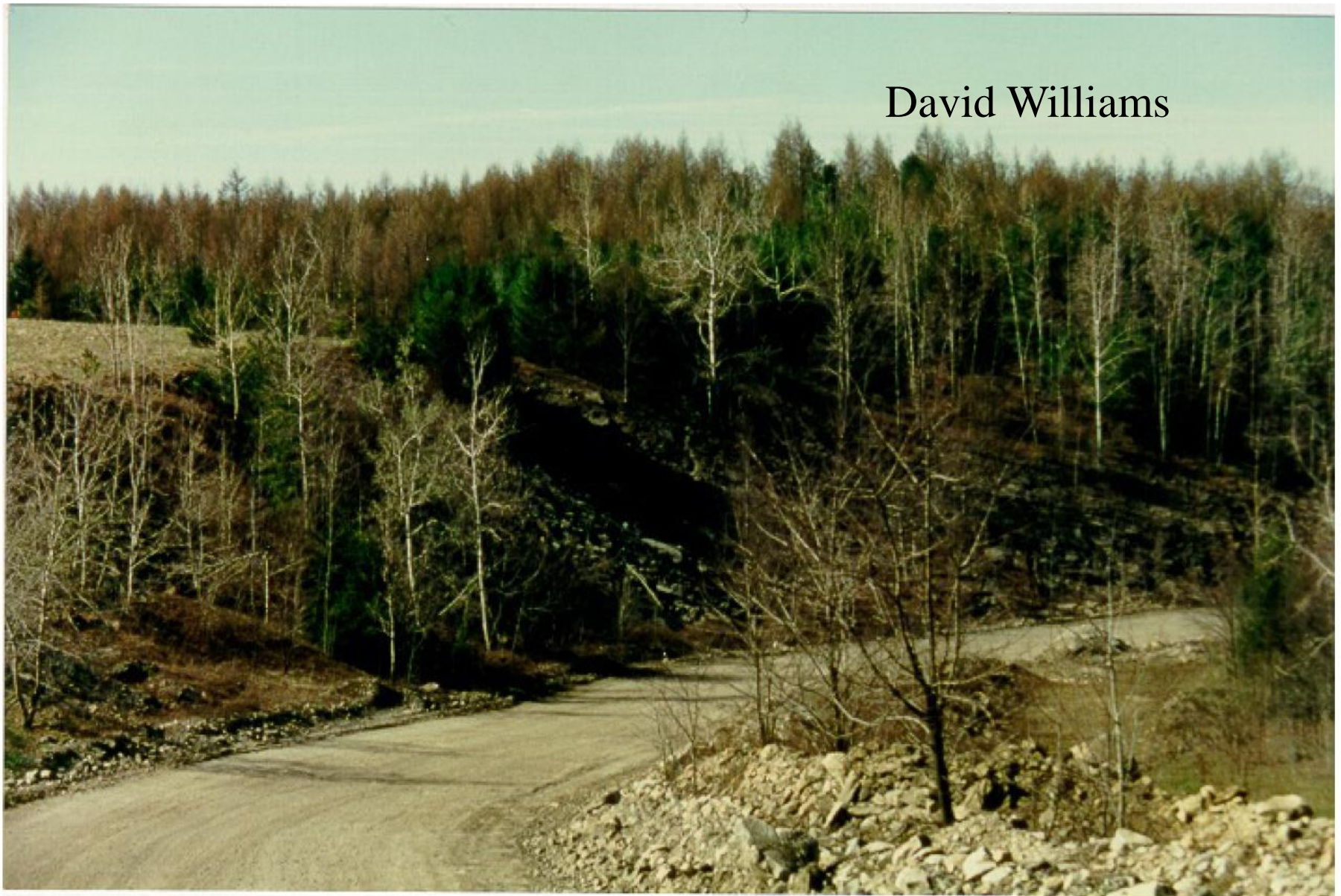
1. Recognize environmental management as a high priority, notably during the licencing process and through the development and implementation of environmental management systems. These should include early and comprehensive environmental impact assessments, pollution control and other preventive and mitigative measures, monitoring and auditing activities, and emergency response procedures.
2. Recognize the importance of socio-economic impact assessments and social planning in mining operations. Social-economic impacts should be taken into account at the earliest stages of project development. Gender issues should also be considered at a policy and project level.
3. Establish environmental accountability in industry and government at the highest management and policy-making levels.
4. Encourage employees at all levels to recognize their responsibility for environmental management and ensure that adequate resources, staff and requisite training are available to implement environmental plans.
5. Ensure the participation of and dialogue with the affected community and other directly interested parties on the environmental and social aspects of all phases of mining activities and include the full participation of women and other marginalized groups.
6. Adopt best practices to minimize environmental degradation, notably in the absence of specific environmental regulations.
7. Adopt environmentally sound technologies in all phases of mining activities and increase the emphasis on the transfer of appropriate technologies that mitigate environmental impacts, including those from small-scale mining operations.



# BHP Definition of Rehabilitation

The return of disturbed areas to a safe, stable, productive and self-sustaining condition, consistent with the agreed end land uses.





**Figure 10** Reforested near angle of repose overburden slopes in Pennsylvania

C-16-11-US

David Williams



**Figure 11** Stepped coal mine waste dump slopes in Witbank Coalfields, South Africa



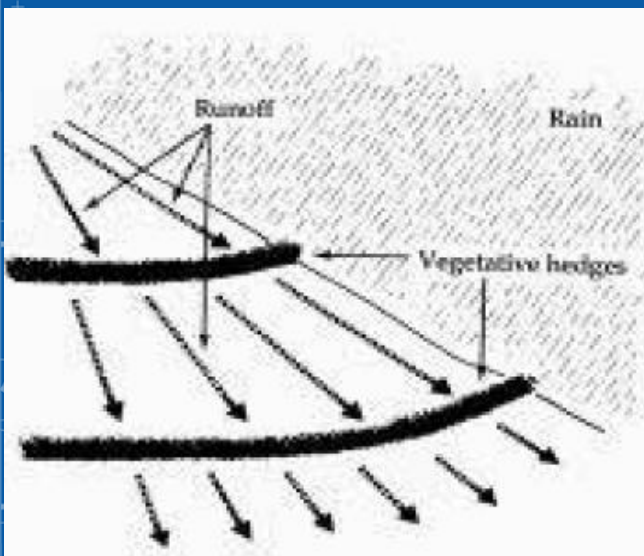
Markkleeberg

Zöbiger

Absetzer 993



## Vertiver Grass





# Latrobe Valley example





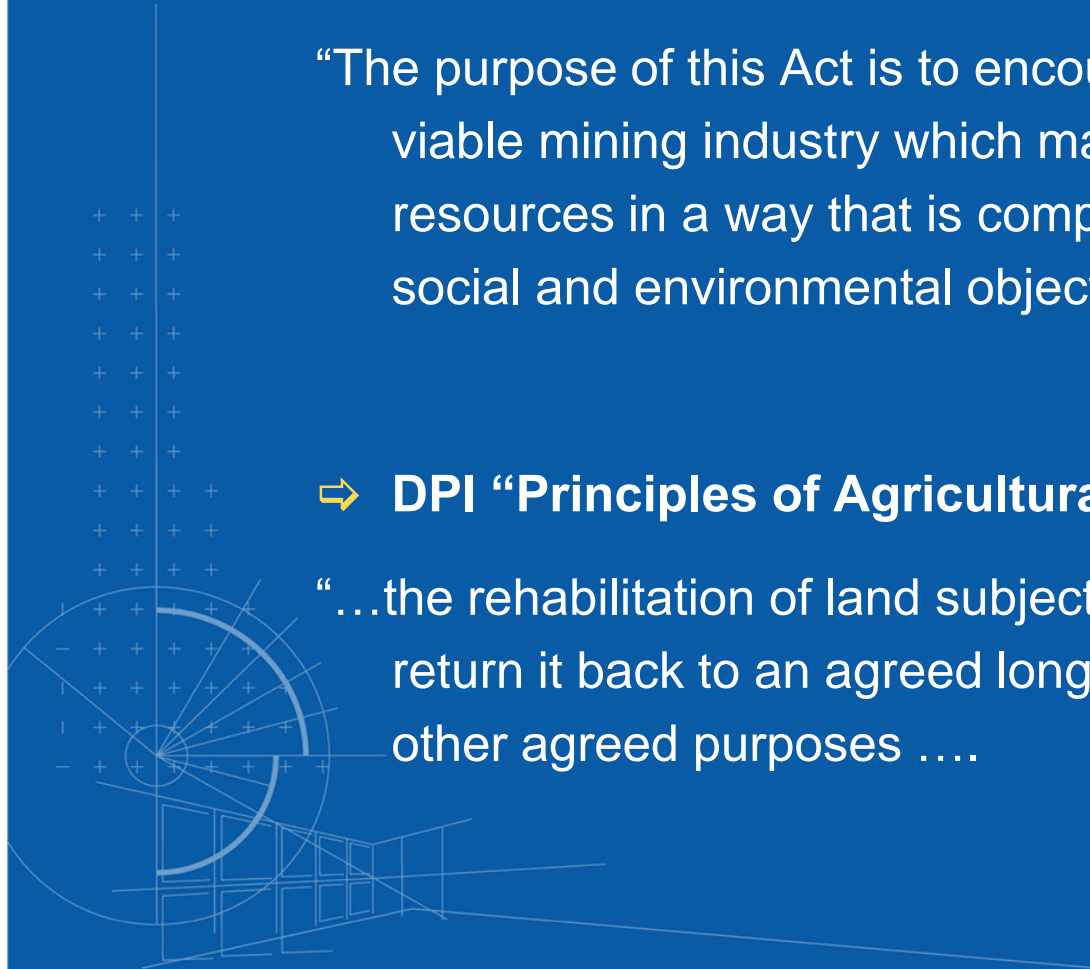
# Principles for Rehabilitation

## ⇒ The Mineral Resources (Sustainable Development) Act

“The purpose of this Act is to encourage an economically viable mining industry which makes the best use of mineral resources in a way that is compatible with the economic, social and environmental objectives of the State.”

## ⇒ DPI “Principles of Agricultural Land Subject to Mining”

“...the rehabilitation of land subject to mining would be to return it back to an agreed long term sustainable use for other agreed purposes ....”







# Rehabilitation – Part of Sustainable Mining Practices

## Selected MCA Enduring Value Principles

- ⇒ 2. Sustainable development part of decision making
- ⇒ 4. Risk strategies based on valid data & sound science
- ⇒ 6. Seek continual improved environmental performance
- ⇒ 7. Contribute to conservation of biodiversity & integrated approaches to land use planning
- ⇒ 10. Engage, communicate and report with stakeholders

Beyond the benefits of mining, appropriate rehabilitation is one way Latrobe Valley mining companies can leave a lasting and sustainable legacy.



# Strategic Framework For Mine Closure

Aus & NZ Minerals & Energy Council & MCA

- ⇒ Stakeholder engagement
- ⇒ Planning
- ⇒ Financial Provision
- ⇒ Implementation
- ⇒ Standards
- ⇒ Relinquishment





# Loy Yang





# Determining a Rehabilitation Strategy for Latrobe Valley Mines

- ⇒ Latrobe Valley Mines have such long lives and as the community preferences change with time it is difficult to finalise the End Use during initial design stages
- ⇒ Most critical in the planning of a new mine is that the Land Form of the mine can be made stable and sustainable with reasonable resource allocation
  - ⇒ Stability of the Base of Mine and Batters
  - ⇒ Fire risk in exposed batters
  - ⇒ Reasonable use of coal, water, cost resources
  - ⇒ Low on-going maintenance costs
- ⇒ End Use definition can be a separate and individual mine activity involving local communities, assessment against environmental standards ... can be done later



# Step 1. Defining Land Form

## Gate 1

- ⇒ Mine Stability
- ⇒ Sustainability

## Gate 2

- ⇒ Resource Use

## Prime Check Points

- ⇒ Base of Mine Heave
- ⇒ Mine Batter Failure
- ⇒ Fire risk in exposed coal

## Prime Check Points

- ⇒ Coal
- ⇒ Surface & U/G water
- ⇒ Capital costs
- ⇒ Maintenance Costs





# Step 2. End Use Definition

## Gate 3

⇒ Environmental

- ⇒ Air
- ⇒ Noise
- ⇒ Water quality
- ⇒ Flora
- ⇒ Fauna
- ⇒ Net gain

⇒ Gate 4

⇒ Community/Other

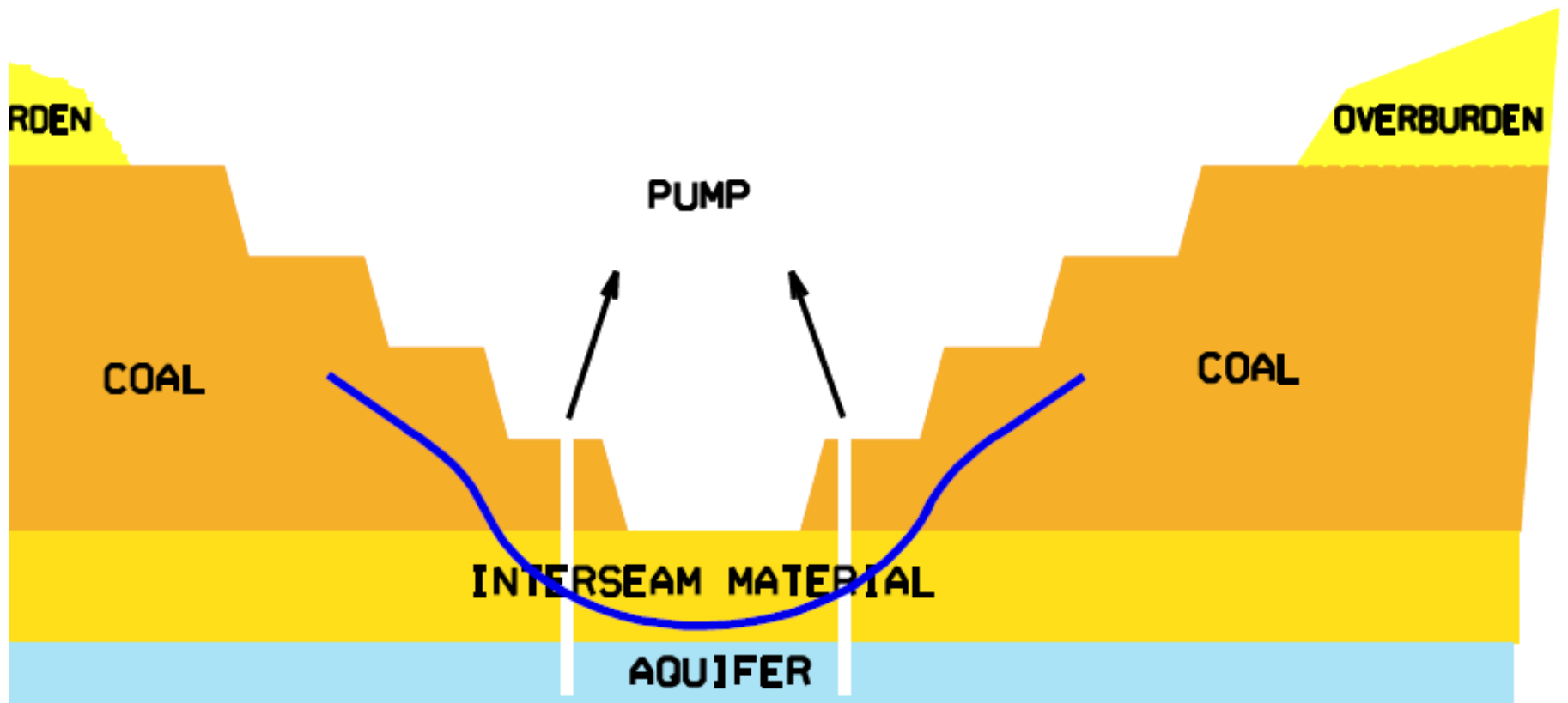
- ⇒ Public safety
- ⇒ Community wishes
- ⇒ Heritage
- ⇒ Visual
- ⇒ Access
- ⇒ Progressive rehabilitation





# Step 1 Defining the Land Form

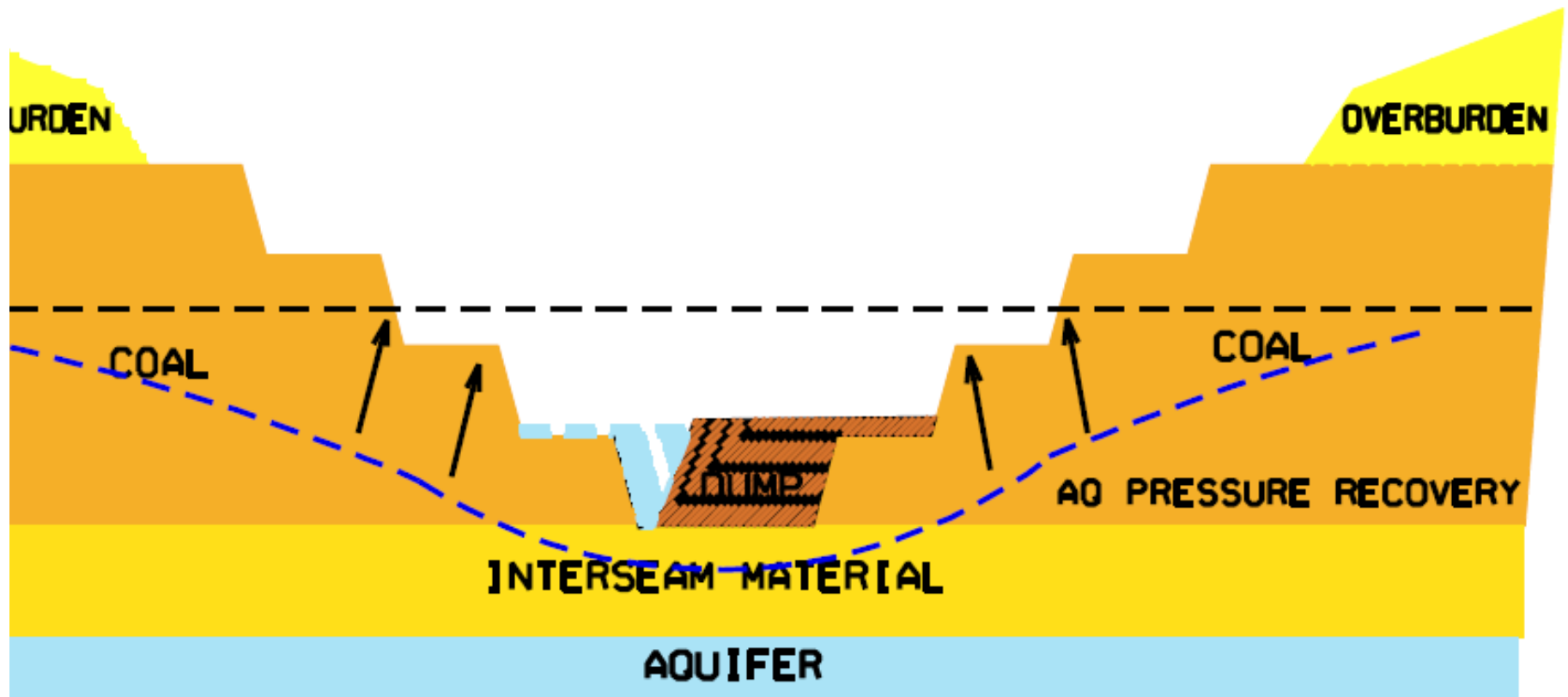
(Base of Mine Operating Mode: Stability from Heave)





# Step 1 Defining the Land Form

(Base of Mine Rehabilitation Mode: Stability from Heave)

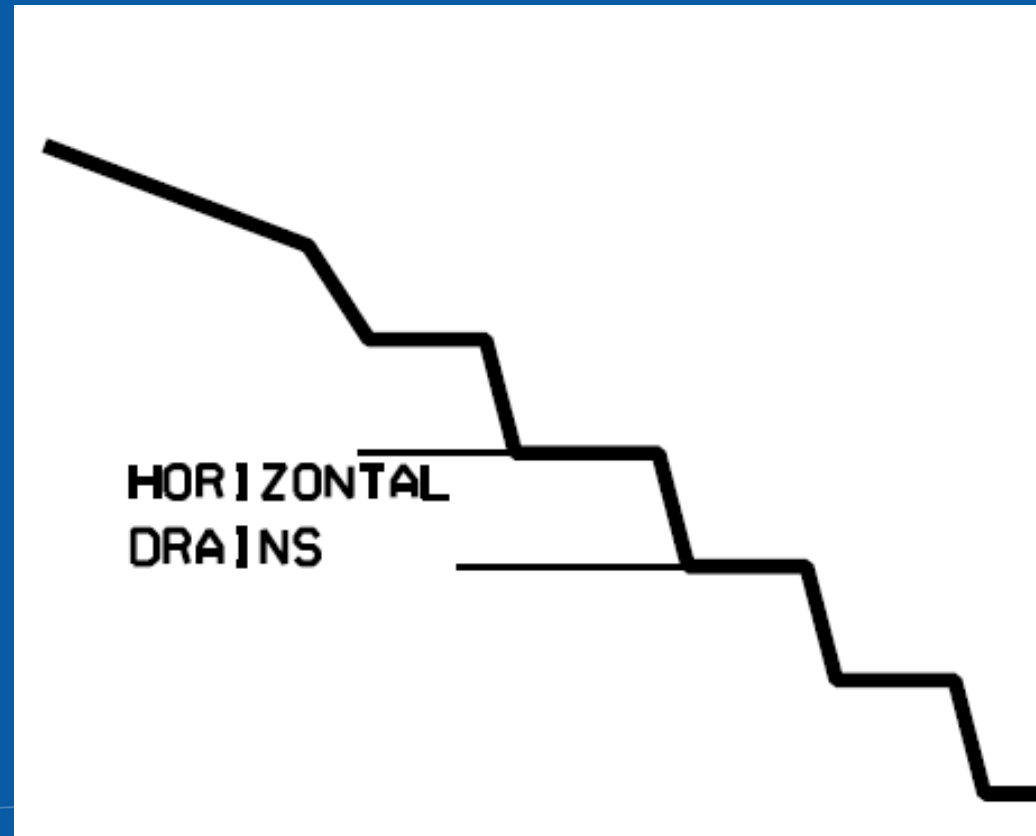






# Step 1 Defining the Land Form

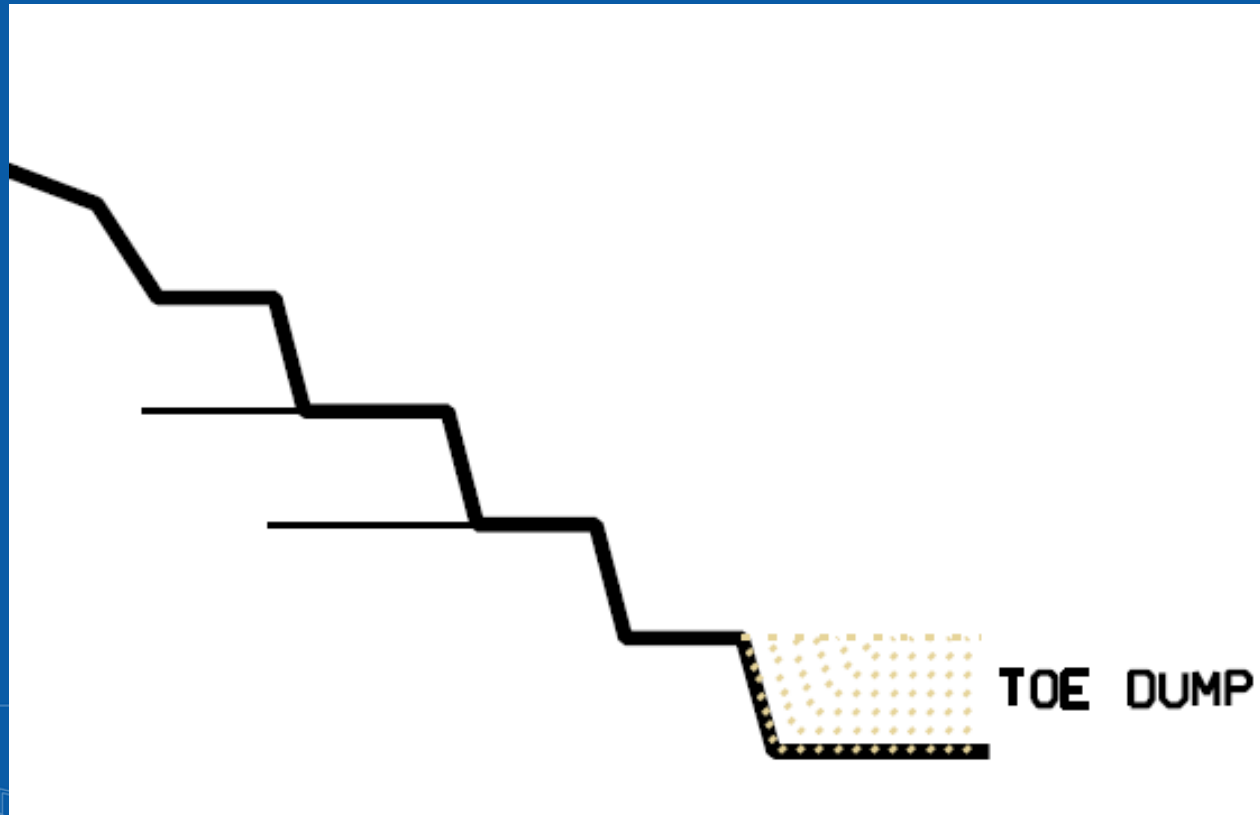
(Mine Operations Batter Stability from Movement)





# Step 1 Defining the Land Form

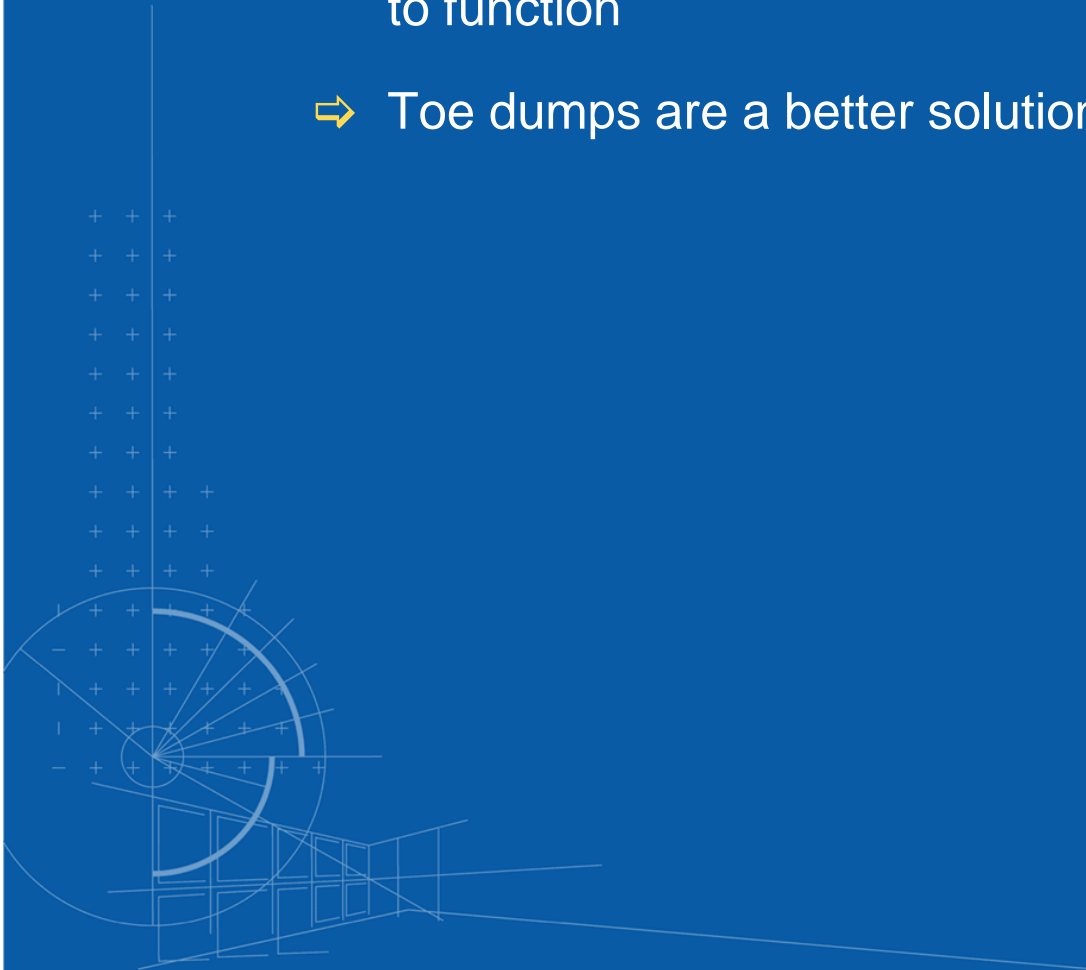
(Mine Rehab Batter Stability from Movement)





## (Mine Batter Stability from Movement)

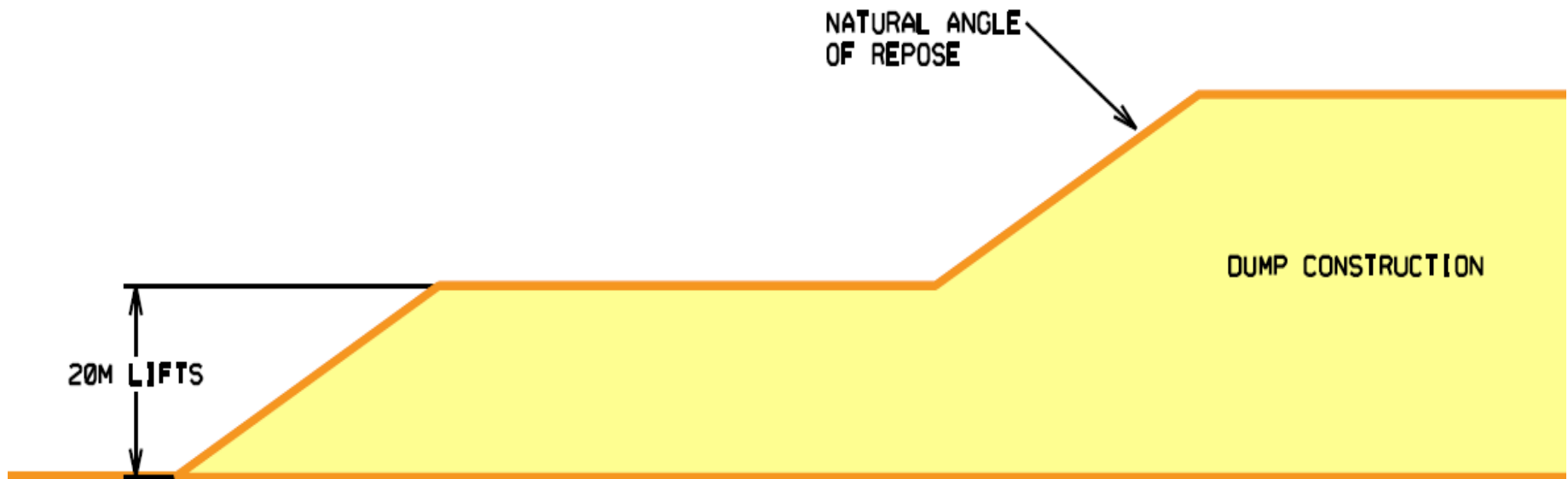
- ⇒ For long term how do we ensure horizontal drains continue to function
- ⇒ Toe dumps are a better solution





# Step 1: Defining the Land Form

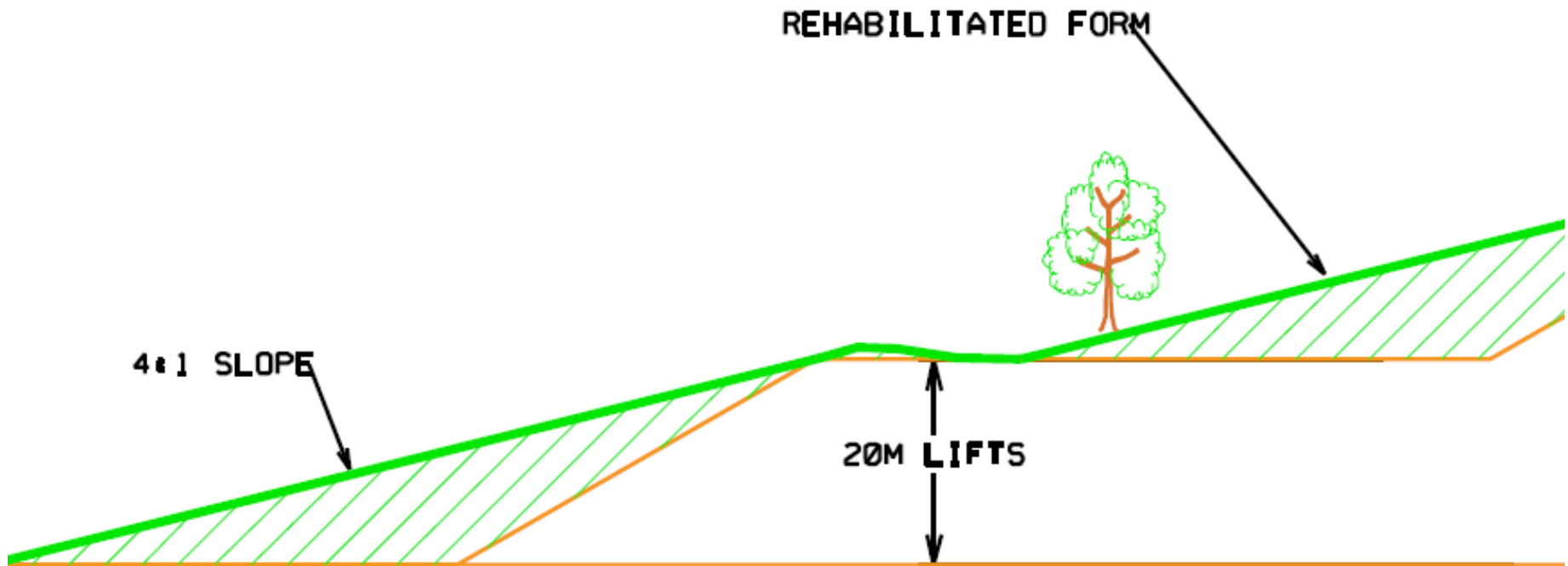
(Overburden Dump - as constructed)





# Step. 1: Defining the Land

(Dump Rehabilitation – flatten batters and drainage)





## (Dump Rehabilitation – flatten batters and drainage)

- ⇒ Flatten batters: 4:1 or 5:1 seem to be accepted
- ⇒ Top soil accepted practice
- ⇒ Drainage each level used to manage drainage and prevent scour on faces

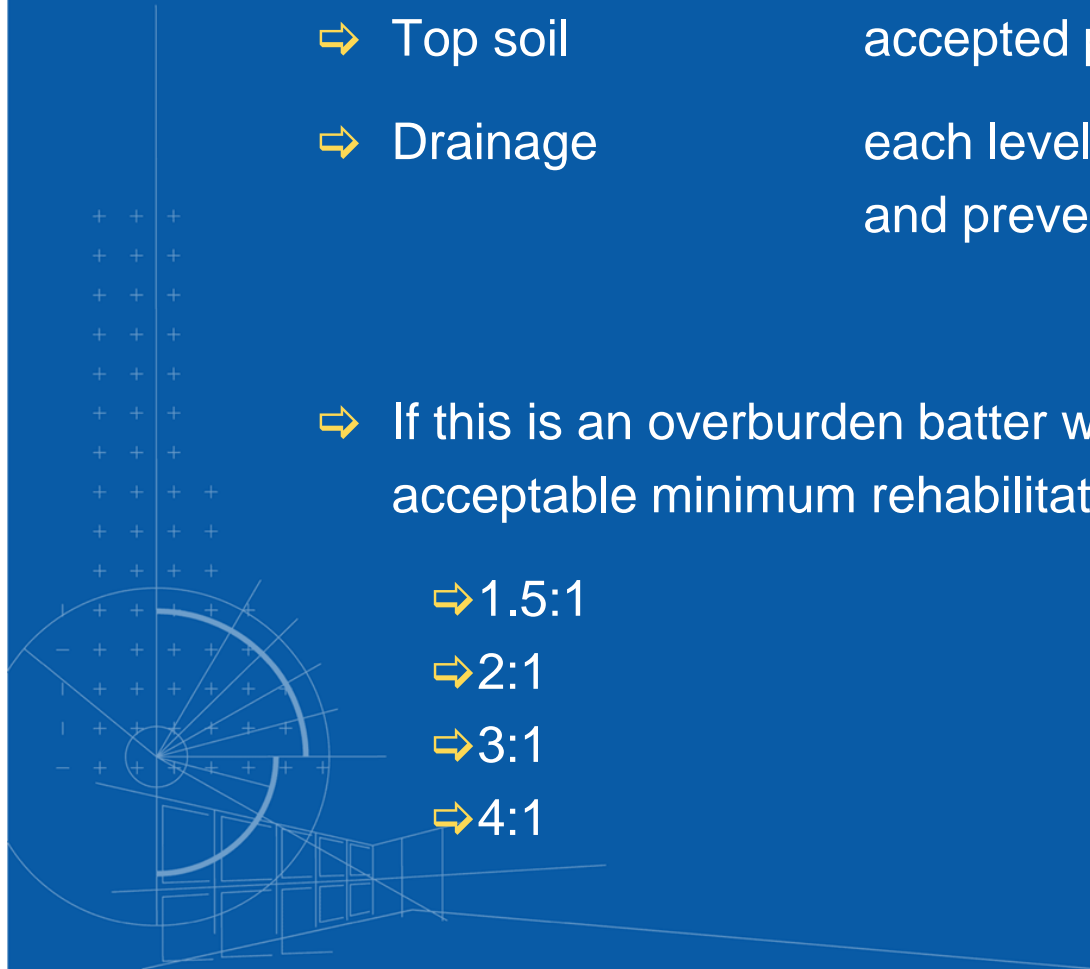
- ⇒ If this is an overburden batter within a mine what is the acceptable minimum rehabilitated slope

⇒ 1.5:1

⇒ 2:1

⇒ 3:1

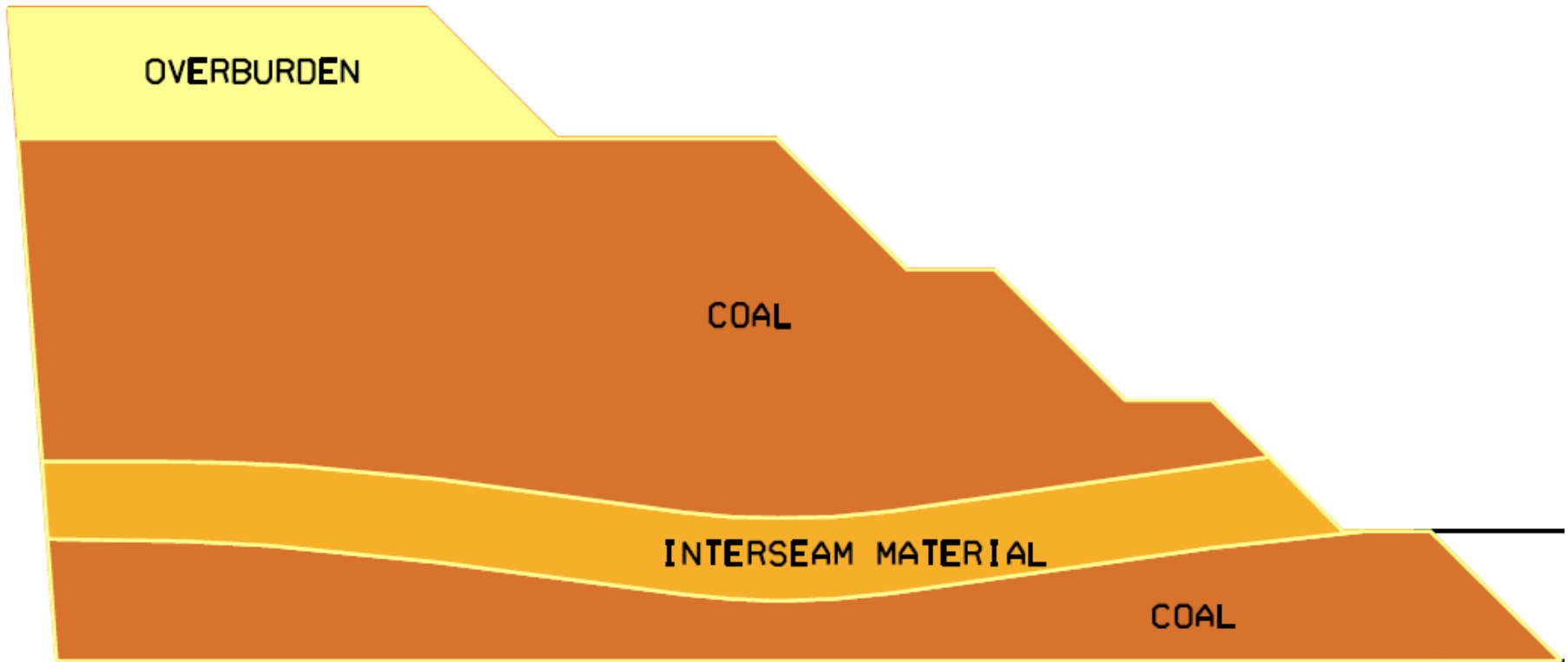
⇒ 4:1





# Step 1: Defining the Land Form

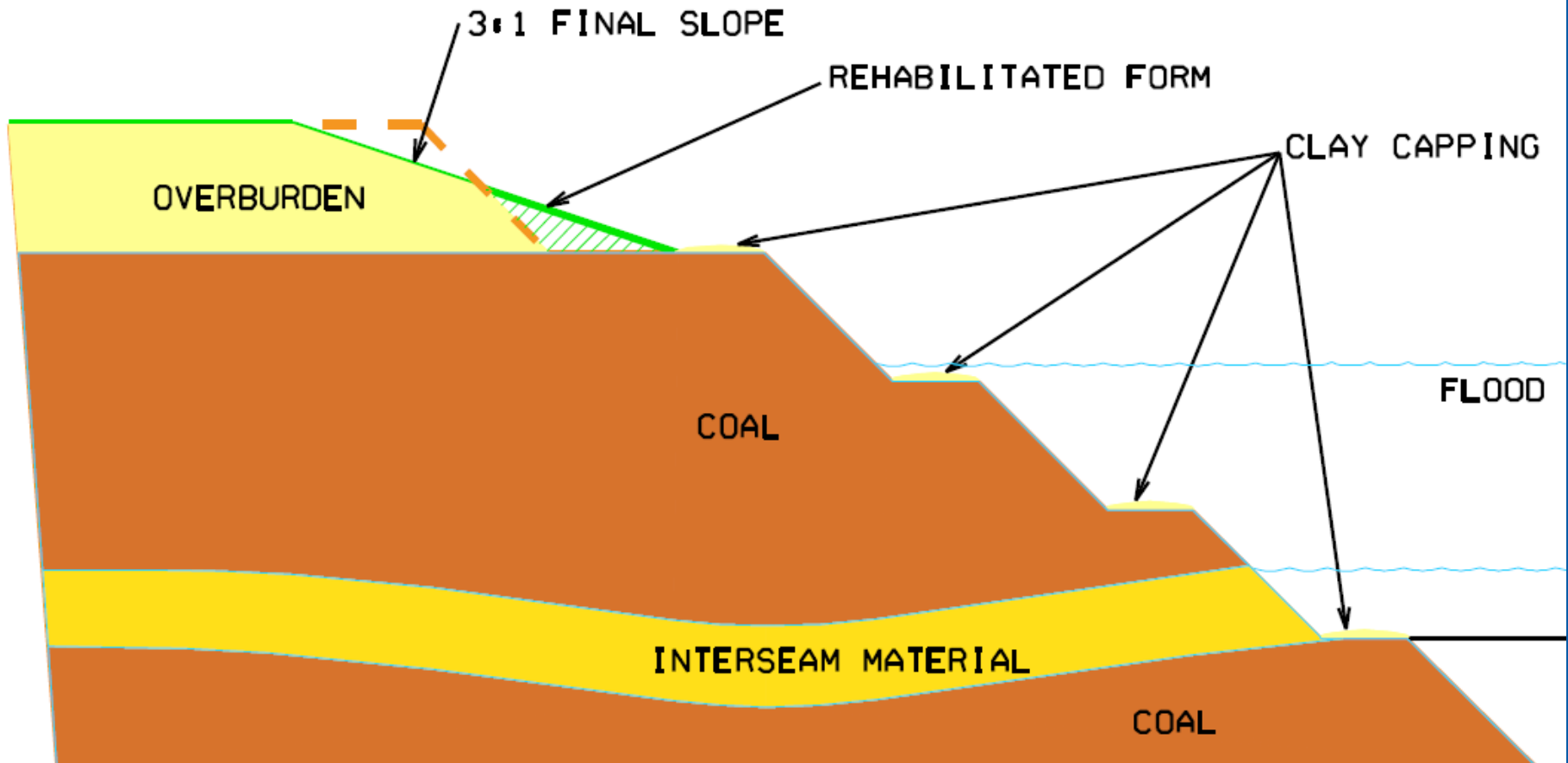
(Mine as completed)





# Step 1: Defining the Land Form

(Mine Rehabilitation - (steep coal batters, part flooding))







## (Mine Rehabilitation - (steep coal batters, part flooding)

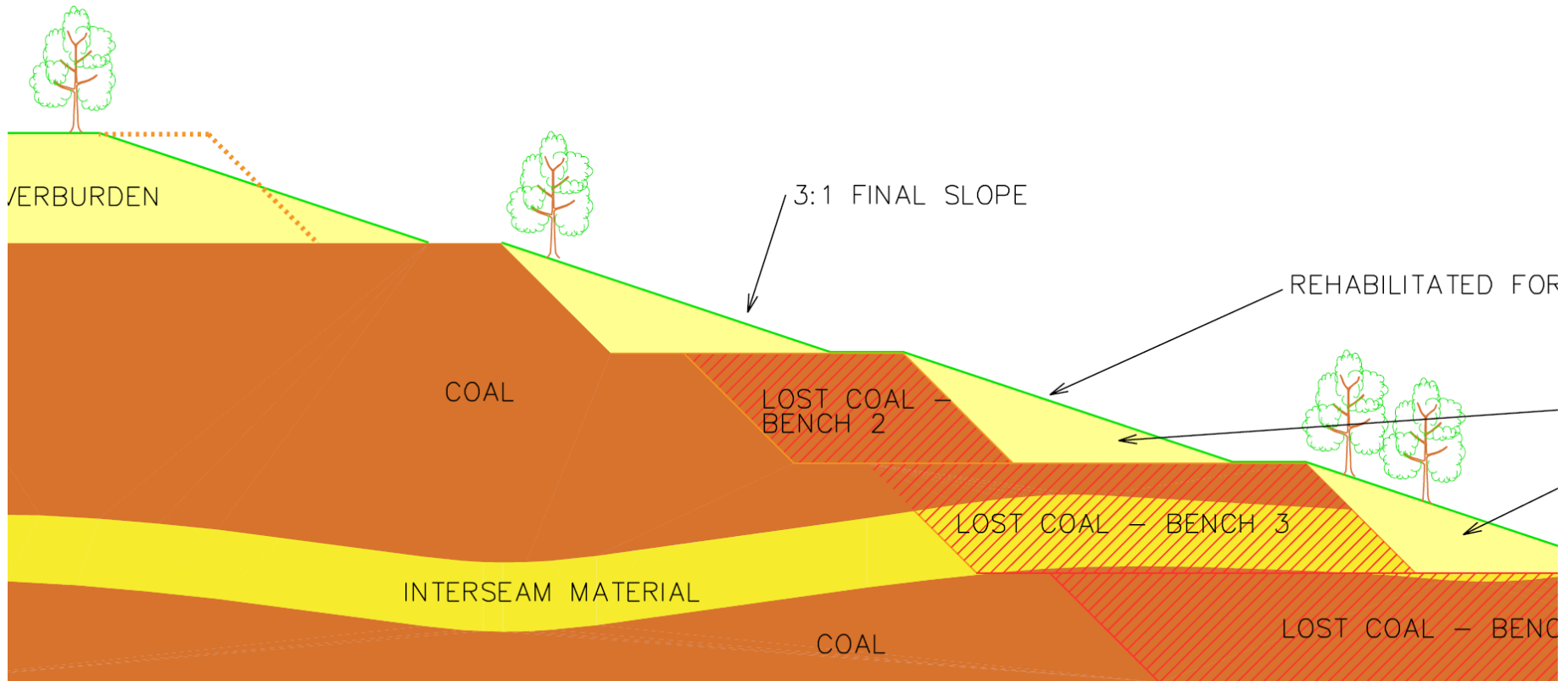
- ⇒ Coal batters are mined at about 45° slope. This is too steep to lay a thin overburden cover on, so assumed are left bare. Benches are clay covered.
- ⇒ Fire risk is a major problem with uncovered coal faces ?
- ⇒ Is this option acceptable in any situation ?
  - ⇒ Active mining area – yes, with managed precautions
  - ⇒ Final completed batter – no ?
  - ⇒ Interim batter when likely to be part of a super pit ?
  - ⇒ Below a planned flood water level ?
  - ⇒ Above a planned flood water level ?
  - ⇒ At planned flood water level ?
- ⇒ What is needed at exposed interseam areas





# Step 1: Defining the Land Form

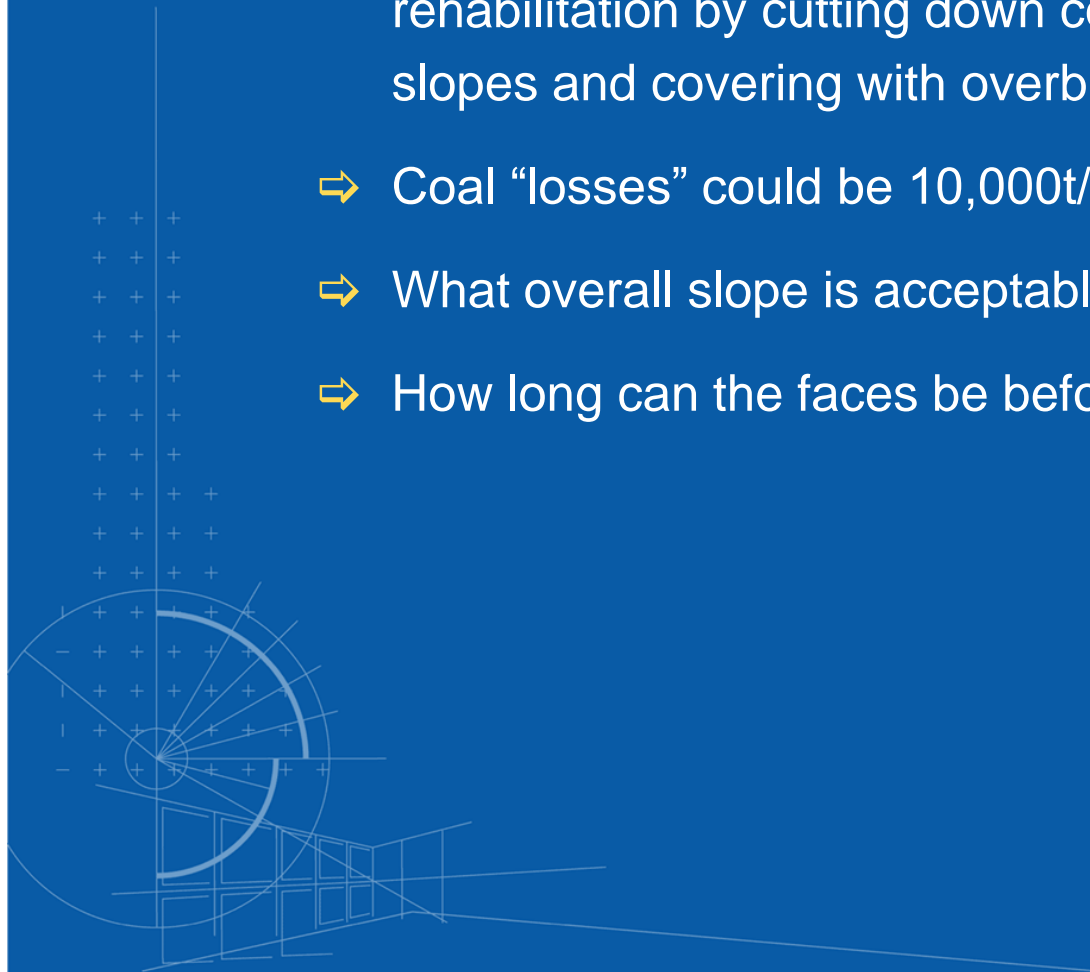
(Mine Rehabilitation - loss of coal)





## (Mine Rehabilitation - loss of coal)

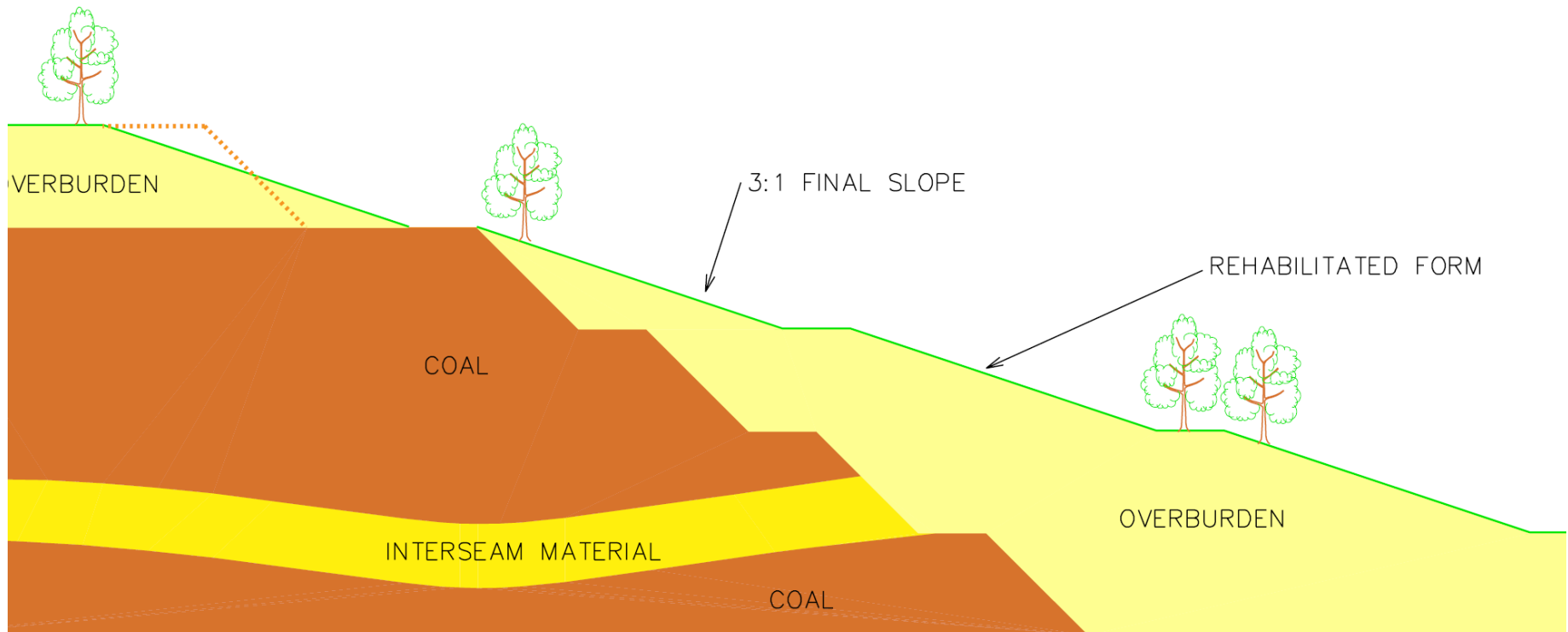
- ⇒ In this option the final coal faces are arranged to allow rehabilitation by cutting down coal faces to appropriate slopes and covering with overburden and topsoil.
- ⇒ Coal “losses” could be 10,000t/m batter length/100 m depth
- ⇒ What overall slope is acceptable ?
- ⇒ How long can the faces be before benches are required ?





# Step 1: Defining the Land Form

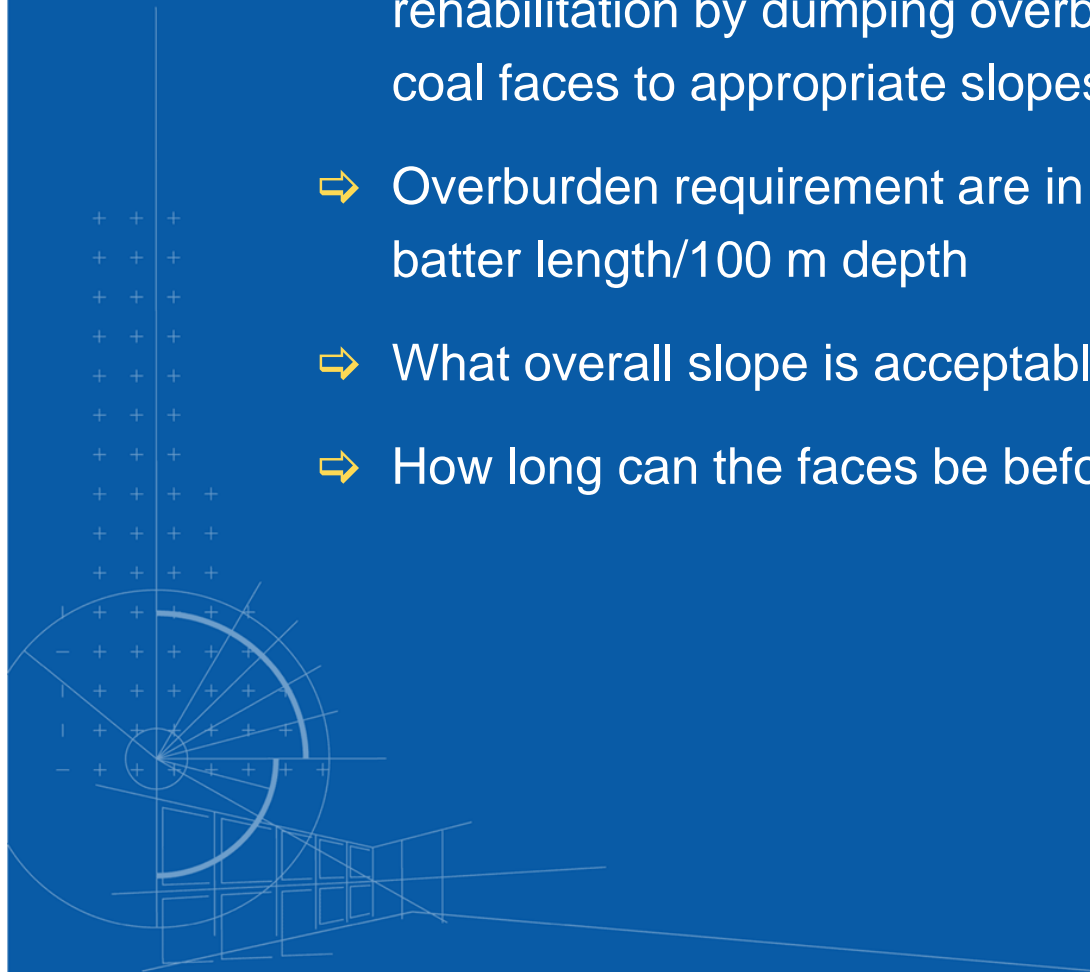
(Mine Rehabilitation with internal O/B Dump)





## (Mine Rehabilitation with internal O/B Dump)

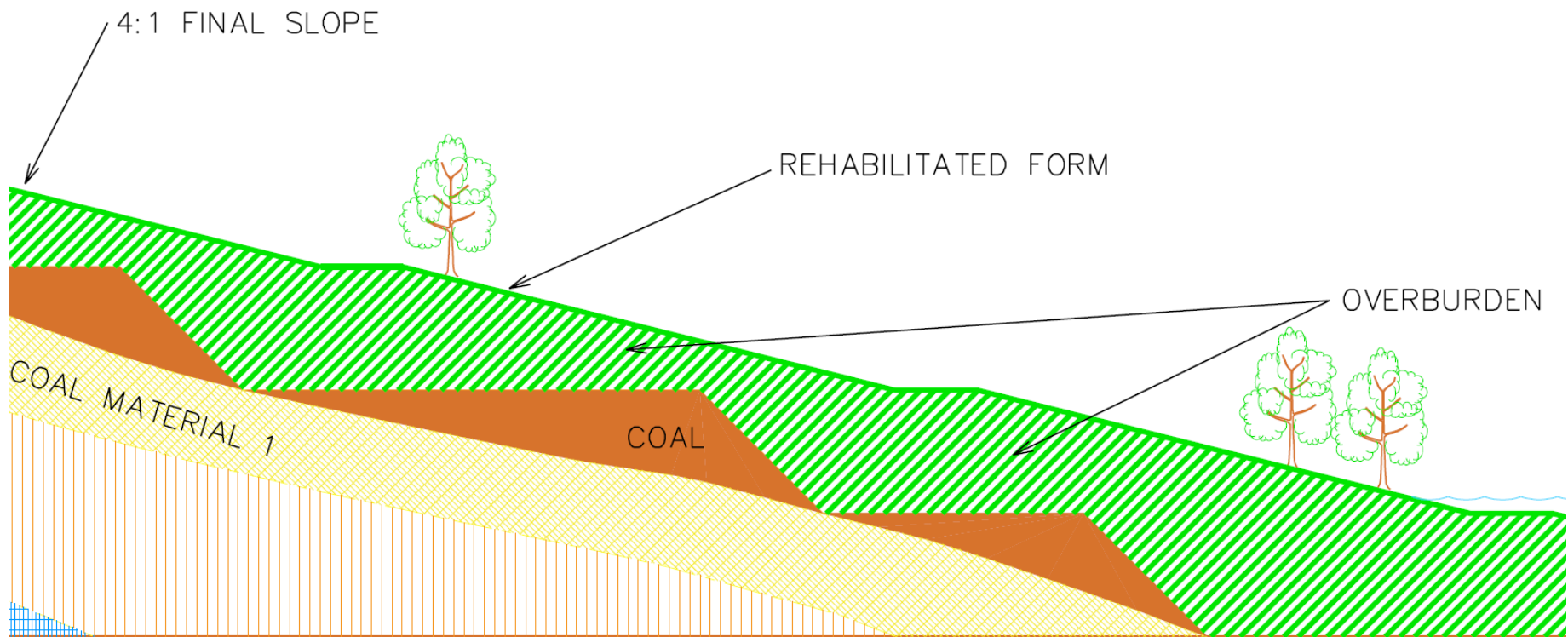
- ⇒ In this option the final coal faces are arranged to allow rehabilitation by dumping overburden against the finalised coal faces to appropriate slopes and covering with topsoil.
- ⇒ Overburden requirements are in the order of 10,000m<sup>3</sup>/m batter length/100 m depth
- ⇒ What overall slope is acceptable ?
- ⇒ How long can the faces be before benches are required ?





# Step 1: Defining the Land Form

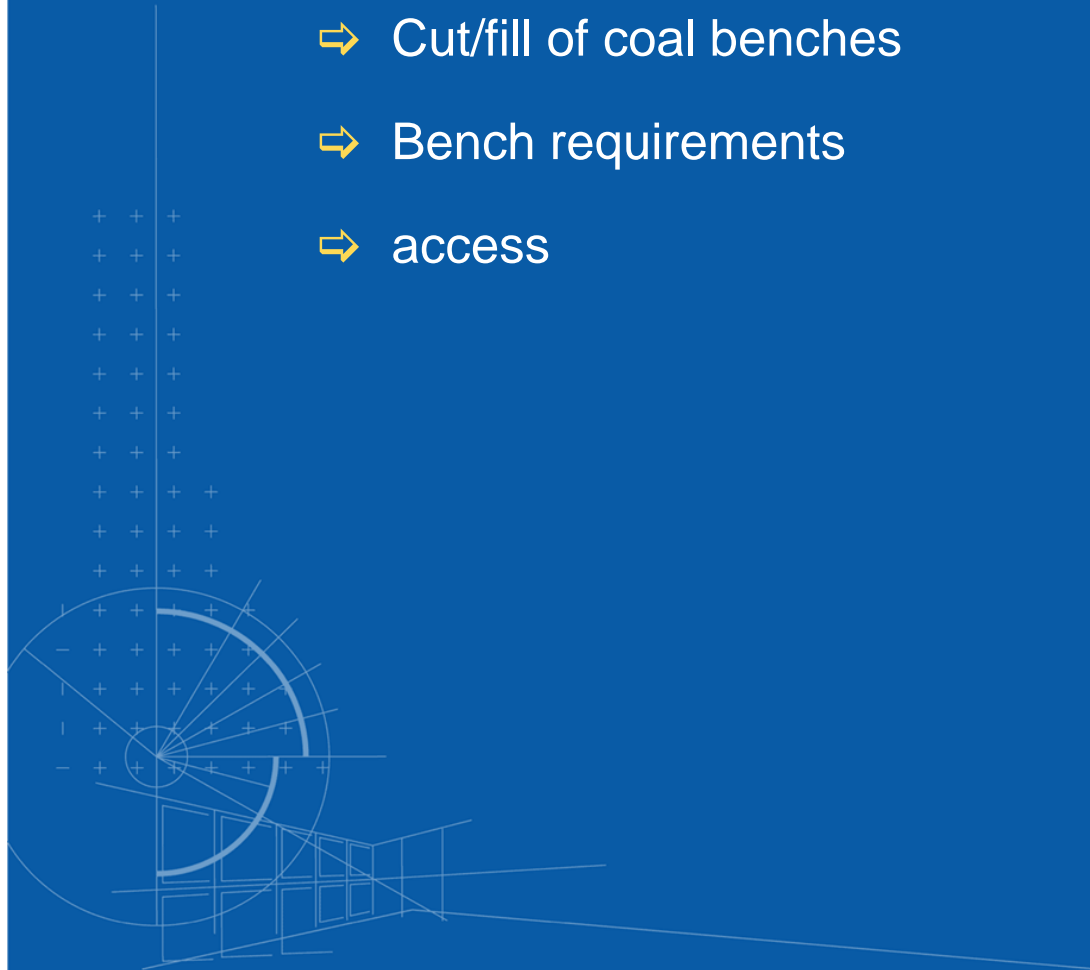
(Mine Rehabilitation – low wall)





## (Mine Rehabilitation – low wall)

- ⇒ Slope
- ⇒ Cut/fill of coal benches
- ⇒ Bench requirements
- ⇒ access





# Rehabilitation Framework

- Issue Framework for Discussion
- Workshop Example
- Outcomes of the Workshop

