Crushing & Conveying
A New Mining Technique for the Hunter

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Issues Facing Open Cut Mining in the Hunter
- Reducing productivity
- Deeper operations
- Environmental impacts
- Competing land use

Four issues are relevant to future mining method selection.

Reducing Productivity

This is a plot of productivity per employee for Hunter Valley mines from 1995 to 2009. Productivity gains in open cut mines by the end of the 20th century have largely been lost.

Reducing Productivity

- Dragline -45%
- Shovel -25%
- Pillar -10%
- Longwall 0%

This shows productivity by mine with Dragline operations in yellow, shovel/track in red, pillar mining in green and longwall in blue in 2000.
A comparison chart is given for 2008, with the red line indicating 35,000 t/mon-yr. Over 8 y dragline operation productivities have dropped by 45%, shovel/track operations by 25%, while underground productivities have only fallen slightly.
Deeper Operations

Marginal costs for deep mining with in-pit dumping are also high.

Increasing truck haulage costs are a major impediment to deeper open cut mining.

Environmental Impacts

The key environmental impacts are:

- Dust – coal mining is 34% of -10μm emissions for GMR
- Noise – a major concern for nearby residents
- Visibility – perceived business impacts and light pollution
- Aquifer Interference – impacts on irrigation & quality

Environmental Impacts

- Application of suppressants to haul roads (21%)
- Conversion of 50% of haul roads to conveyors (20%)
- Use larger capacity trucks (10%)
- Rapid rehabilitation of 80% of exposed areas (20%)

Competing Land Use

Existing coal leases are in grey; existing exploration licenses are in light blue; high potential green; exploration is light pink around Broke, Dorrigo and Wofly; potential green is light pink west of Scone. The Viticulture group Strategic Agricultural Land (maroon); The Esplanade group (dark blue); Biophysical SAL (green).

An existing lease is a valuable commodity.
Possible Solutions

- Underground Mining
- Crushing & Conveying of Waste
- Other Solutions (automation, dusticides, etc.)

Other solutions can also apply to the other two mining technique solutions and will not be discussed.

Underground Mining

**Advantages**
- Reduced dust emissions.
- Reduced noise emissions.
- Reduced visibility impact.
- Improving technology & productivity.
- Ability to select a target seam.

**Disadvantages**
- Larger area extent.
- Subsidence may be an issue.
- Inflexible requiring strict geological conditions.
- Poor overall resource recovery.
- Marketing & blending constraints.

Undoubtedly, underground mining will increase as a proportion of total mining in the Hunter. It is not universally applicable and may not be feasible or desirable in all areas.

Crushing & Conveying Systems

Mobile and semi-mobile crushers fed by shovels or trucks, respectively.
- Belt feeds, bridge conveyors or relocatable conveyors provide flexibility at the mining face.
- Shiftable conveyors are used for intermittent dig or dump face relocation.
- Conveyors form the heart of the system.
- Tripper and spreader for waste dumping.

Crushing & Conveying System Components

- Shoppee
- Belt Feeds
- Horizontal Conveyors
- Tripper & Spreader
- Dynamite

Limitations

- High initial capital outlay.
- Generally neutral with truck replacements.
- Reduced flexibility compared with truck & shovel.
  - Fully mobile systems have poor flexibility.
    - Shiftable or relocatable conveyors.
    - Horizontal benches and constrained geometry.
    - Buffered blasting to protect conveyors.
    - Greater technical risk due to complexity.
    - Relocation of semi-mobile crushers.
    - Rapid advance rate of mining faces.
    - Need to advance multiple benches.

Cost is less than double a similar shovel/truck system including ancillary equipment.
(System Cost: $150k for a system capable of 2,500tph excluding loaders & trucks)
Advantages

- Reduce operating costs.
  - Semi-mobile IPCC equal to shovel + 6 trucks.

- Reduce dust & noise emissions.
  - Sprays, covers, belt cleaners, dust suppression.
  - <25dBA noise suppression possible.

- Improve visual acuity.
  - Out of pit spoil can be dumped remotely.
  - Dumps created to final height by spreader allowing rapid rehabilitation.

Key Drivers for a Deep Open Cut Mine Plan

- Maximum haul distance around 1.5km.

- Dump pockets relocated every 10 to 20 years.

- Upper benches conveyed - lower benches in-pit hauls.

- Mobile equipment operates below topography.

- Surface equipment shielded from neighbours.

- Dumps created to allow rapid rehabilitation.

- Working faces as steep as possible.

Conclusion

- Changing conditions are forcing open cut mining deeper.

- New technology required to:
  - Allow continued economic operations.
  - Addresses environmental impacts.

- Underground mining is a possible solution:
  - Poor resource recovery.
  - Not universally applicable.

- Semi-mobile IPCC with conventional shovel/truck:
  - Low cost solution.
  - Better environmental outcomes.
  - Little technological risk.
  - Requires an innovative mine design.