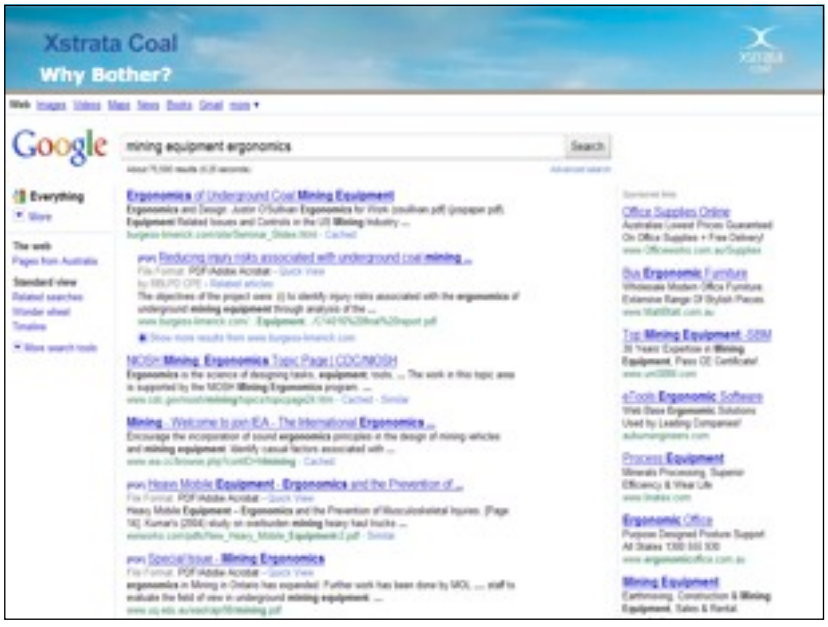
Xstrata Coal



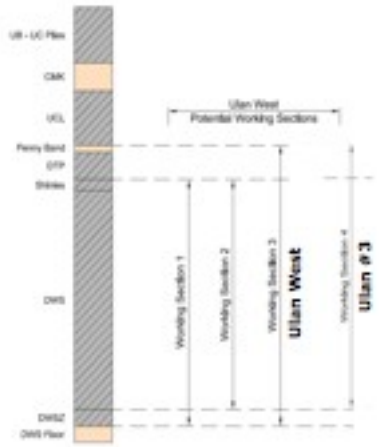
Project Overview

- Xstrata Coal NSW – 90% JV
- Approximately 45km NNE of Mudgee in Central West NSW

- Immediately West of current Ulan Underground

- LW1 = 5800m length
- LW1 = 9.9Mt ROM
- LW6 = 6100m length
- LW6 = 10.4Mt ROM
- Approx 62km total development before first LW coal
- First Development panel (TG1) contains approx 15,500m driveage
- 400m wide LW at 4500tph nameplate
- Four Continuous Miners (three units)
- Mains along strike

- 3m working section (2.8-3.2m)
- 5.4m wide headings
- Penny Band horizon
- Coal 35-40Mpa
- Typically 6 x 1.8m bolts per metre
- LW Strata Control 110t/m²



Ergonomics Through Procurement

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What's the Big Deal?

- So why the push for Ensuring "Safe Design" Through Procurement?
- Isn't it as simple as going to your favourite OEM and saying "I want ....."?
- Or is it as easy as "we'll go off the same spec that 'xyz mine' just did"?
- Yes we can!
- We decided to go back to the start and invent a 'new' wheel
- Work through a pre-defined risk-based process
- Engage experts in chosen fields (Risk Engineering, Ergonomists, OEM's, Engineers, Operators, ACARP etc)
- Traditional approach are the "nuts and bolts" – what about the mine itself?
- Longwall Recovery and Box Cut as the examples....

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Risk Process

- A review of 15 recently completed mining projects – addressing their risk management activities – highlighted:
  - Studies conducted too late – and then had to develop work around plans for design introduced issues
  - Studies produced too much – and the project team were defeated by the sheer volume of action items:
    - *"We did what we could"*
    - *"We're not sure if we covered off on the most important improvements"*
  - A lot of really good information prepared – but the operations guys never look at it.

SPSolutions

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Risk Process

Overview of Process

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Risk Process

- Consolidate all losses and issues into a single Incident Type

Strata	Traffic	Caught In / Struck by	Explosion
Falls from Height	Fire / Spon Com	Dropped Loads	Inrush
Electric Shock	Confined Space	Structural Failure	Spills / DG
OOS / Strains	Business	Off site impact	Environment

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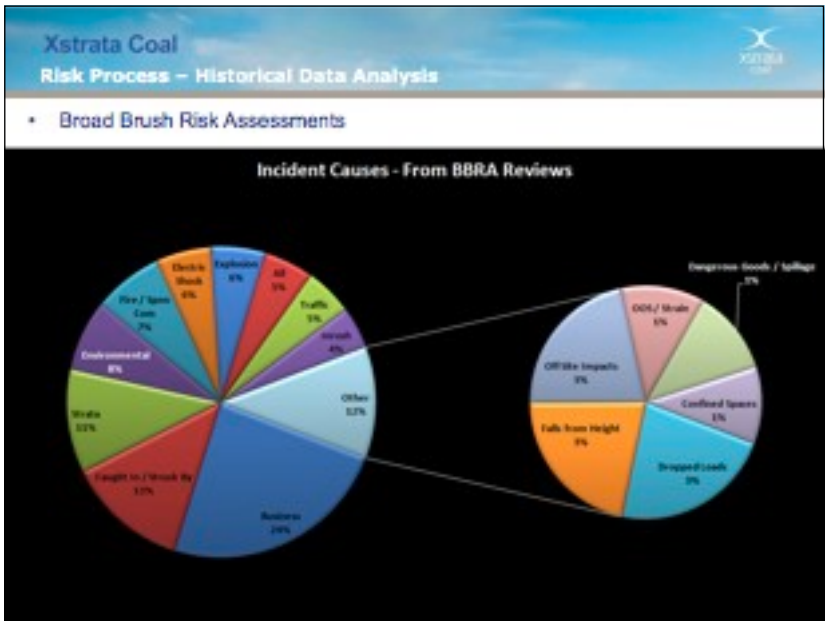
Risk Process – Historical Data Analysis

- Broad Brush Risk Assessments



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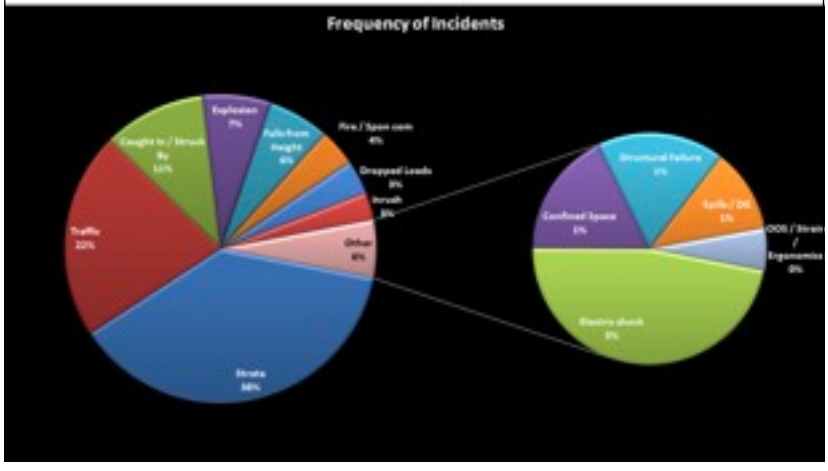
Risk Process – Historical Data Analysis

- Fatality Database – 1,311 deaths



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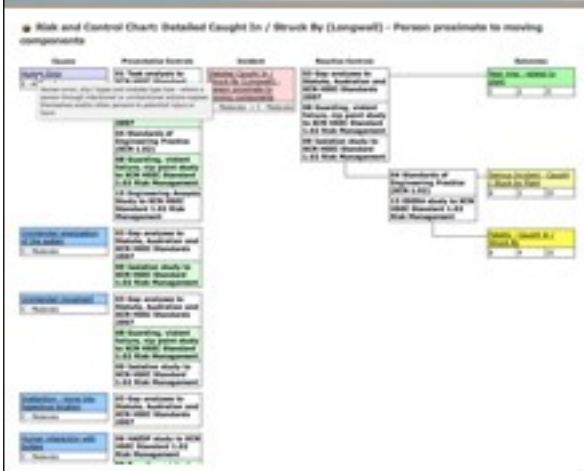
Risk Process – Typical Outputs



- Risk and Control Chart for Caught in / Struck by in the Development work package
- RCCs were generated for each incident type for the project
- For individual work package areas these are "focussed" on those incident types of most significance

SPSolutions

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Risk Process – HAZID Workshop

- Development HAZID
- Gather the most experienced people we could find from a wide-cast net
  - ACARP Roadway Development Task Group Member
  - Previous General Manager of XCN
  - Current operations engineers
  - Geotech Consultants
  - OEM representatives
  - Development superintendent
  - Mechanical engineers
  - Electrical engineers
  - Mining engineers
  - People with 'hands-on' operator and development panel supervisory experience

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Risk Process – HAZID Workshop

- Presentations of scope, aims and objectives of the session
- Brain dump of biggest issues facing development
  - What are the biggest areas of concern (along lines of loss types)
- Brain writing (what are the biggest issues for each loss type)
- Reassemble group and compare
- List all issues raised and place on a wall
- Vote on each person's "Top 10" most critical factors
- Issues from top four or five loss types were then embedded into the design process (by way of tender spec)

- Tender Preparation (Contractor)
  - Contractor to provide details on the consultative process will ensure the equipment designs achieve control and the hazards identified through Human Factor Engineering/Ergonomic principles
- Tender Evaluation and Short-Listing
- Pre-Contract Award Risk Assessment
- Contract Consolidation and Award
- Design Documentation
- Equipment Manufacture
- Operational Risk Assessment

- Purpose of the Pre-Contract Risk Assessment, is to check that all the identified risks can be adequately controlled in relation to the contractor's:
  - Designs and Design Documentation (emphasis on Ergonomics and SIL's)
  - Proposed software capability and functionality
  - Fabrication and factory testing
  - Transportation of equipment to site
  - Installation, commissioning and testing procedures
  - Ongoing operation and maintenance of the equipment

An Ergonomic Mine Plan?

Mine design that drives the desired behaviour

(Mine design that makes the correct decision/behaviour the easiest option)

- Past projects in industry have suffered from:
  - Grand ideas that were not well thought through
  - Plans based on poor assumptions
  - Targets that were not achievable or realistic (give them the number they want)
  - Plans developed not practical in their implementation
  - No real contingency or 'back-up' plan
  - Lack of detail
  - Planning system not challenged or scrutinised
  - No change-management and recording of the reasoning of decisions made
  - No learning from past mistakes
  - Little in the way of benchmarking other similar operations
  - Focus on the gear (the fun stuff)
  - Not stopping to challenge and ask "how are <u>people</u> going to achieve this?"

- Large-scale mine is hard to plan as a whole
- How to keep a broad-scale approach and still capture the detail?
- MADA (Mining Area Design Assessment)
  - Break the 'mine' into discreet areas and work on each individually
    - *Box Cut*
    - *Portals*
    - *LW Changeout Area*
    - *Typical Mains Panel*
    - *Mains/Gateroad Interaction*
    - *Typical Gateroad Panel*
    - *Conveyor Tripper Drive Installation*
    - *LW Installation Face (no panel inbye)*
    - *LW Installation Face (with LW panel inbye)*
    - *Main Shaft bottom*
    - *North-West to West Mains Turn*
  - Then piece together for how they relate to one another and 'fit' – how does one factor in a given area affect another factor in a neighbouring area?

- **Factors to consider in each MADA**
  - Purpose
    - *why do we need this area?*
    - *what are we trying to achieve?*
  - Customer
    - *what does the end user need?*
  - Geology
    - *what do we need to consider in our design?*
  - Geotech
    - *what design considerations do we need to give given the needs and geology?*
  - Dimensions and Layout
    - *does the layout reflect the most effective use of real estate?*
    - *is all anticipated equipment able to use this area unimpeded?*
    - *can the equipment we have create this design efficiently and safely?*

- **Factors to consider in each MADA (cont)…**
  - Safety
    - *what other considerations need to be accounted for in the design/layout (egress, fire-fighting, personal protection, guarding, working at heights etc)?*
  - Ergonomics
    - *what ergonomic considerations have been made in the design of the work area?*
    - *is the area designed to provide the best chance for people to work safely, comfortably and productively?*
  - Ventilation
    - *can this layout be ventilated according to design guidelines and limitations?*
    - *should the operational requirements of the area change, can ventilation be changed to accommodate?*
    - *is the ventilation proposed for the area reasonable (pressure, quantity, velocity etc)*

- **Factors to consider in each MADA (cont)…**
  - Sequencing
    - *what is the most practical and efficient sequencing of machinery and other resources in developing this area?*
  - Scheduling
    - *given the geology expected and resulting geotechnical infrastructure to be installed, considering the layout, dimensions, layout, ventilation while developing, and sequencing, what is the most appropriate rate to assign to each item of plant and activity in the formation of and other resultant uses of this area?*
    - *can this be refined through better planning?*
    - *how do the assumptions made, factors considered and rates assigned compare with previous experience or comparable data at other operations?*
    - *is the result defendable?*
  - Budget
    - *what will this area cost*
    - *are there any areas where cost efficiencies can be provided?*

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MADA – Mining Area Design Assessment

- Challenge Test for each decision:
  - Is it Safe?
  - Is it Legal?
  - Is it Logical?
- Piece the composite parts together and assess the interaction between each area
- Mind Map tool

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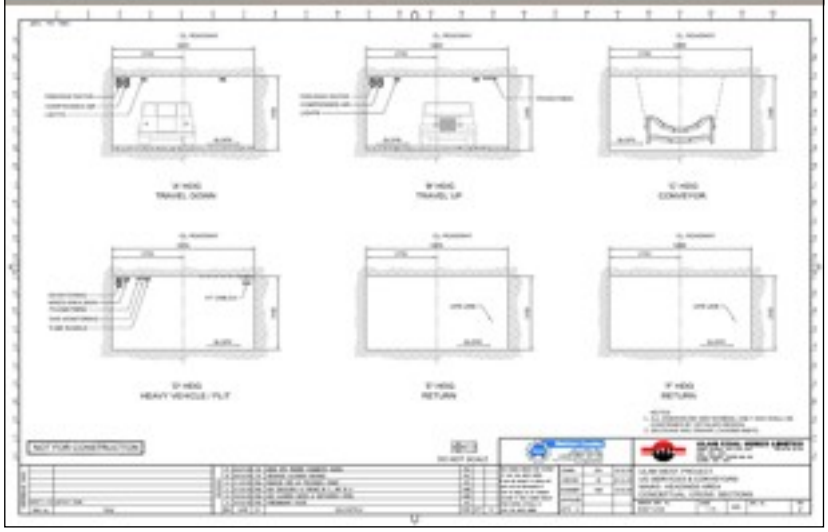
MADA – Detailed Mine Planning Area (Mains)



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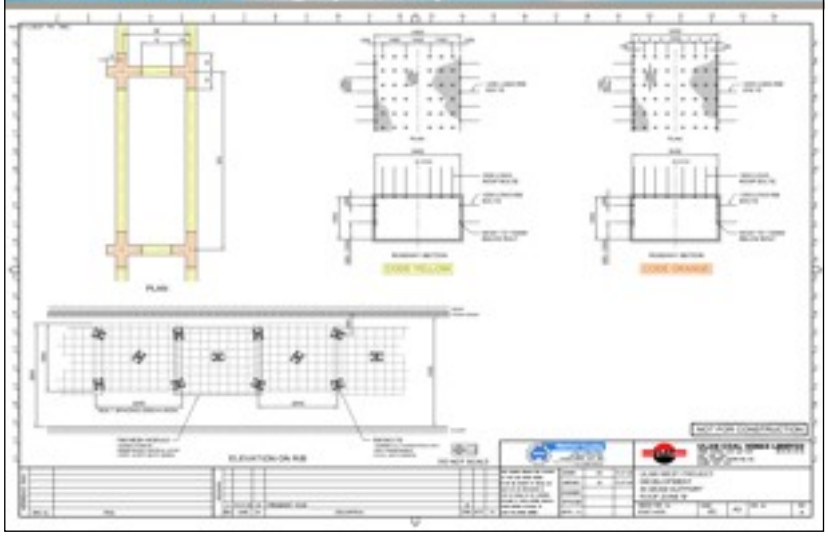
MADA – Detailed Design (Geotech)



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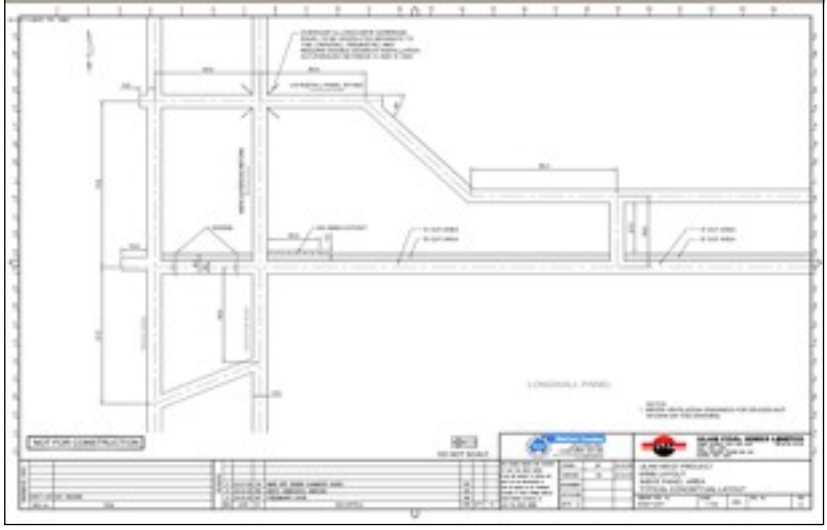
MADA – Detailed Design (Ventilation)



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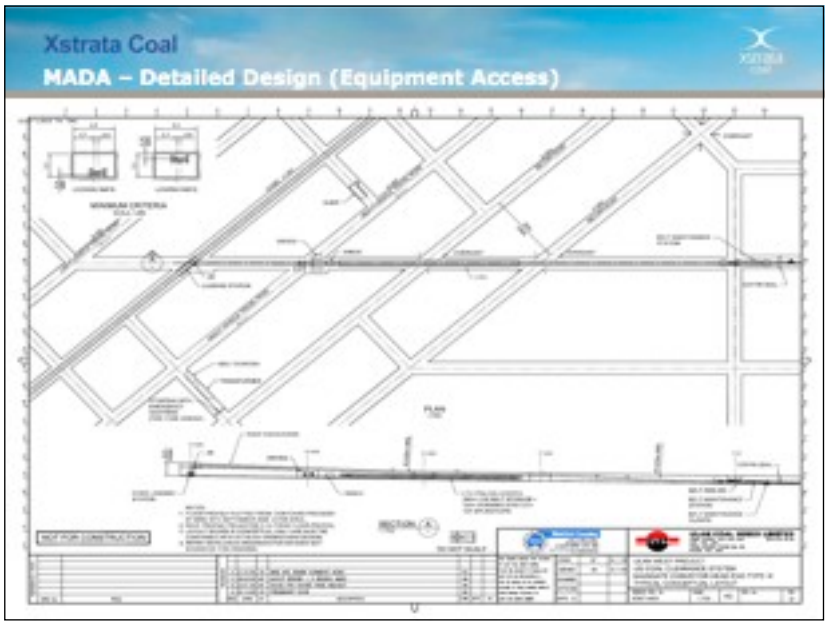
MADA – Detailed Design (Equipment Access)



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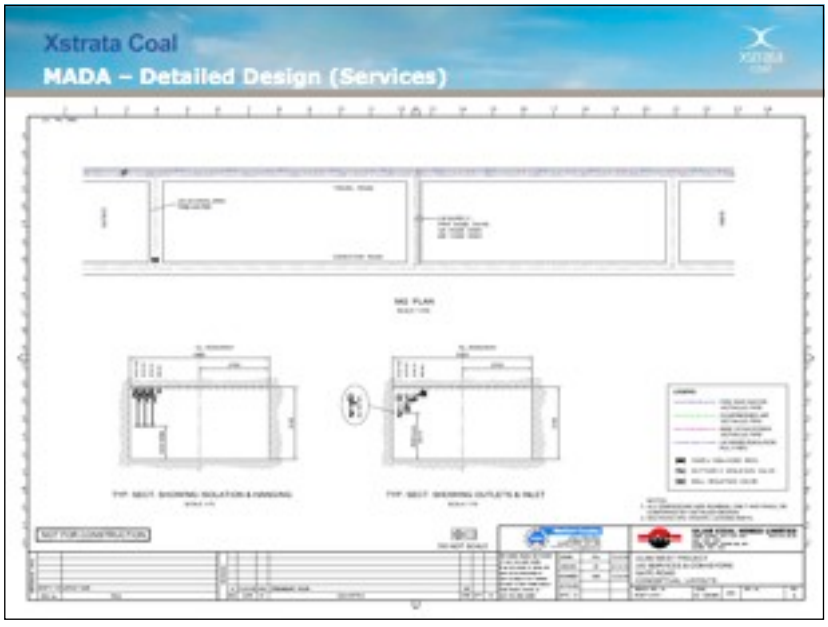
MADA – Detailed Design (Services)



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Ulan West Underground

Longwall Recovery

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Longwall Recovery Area

- Typically very busy area during changeout
- Focus on (but not limited to):
  - Pedestrian and Vehicle interaction
  - Vehicle and equipment interaction
  - Services
  - Efficient supply storage (bolts, chemicals, mesh etc)
  - Equipment parking (rapid face bolters, chock transporters, support recovery mules)
  - Longwall Hydraulics (monorail, pump station)
  - Water management
  - Conveyor interaction
  - Ventilation
- Utilised 3D and rendering features of AutoCAD

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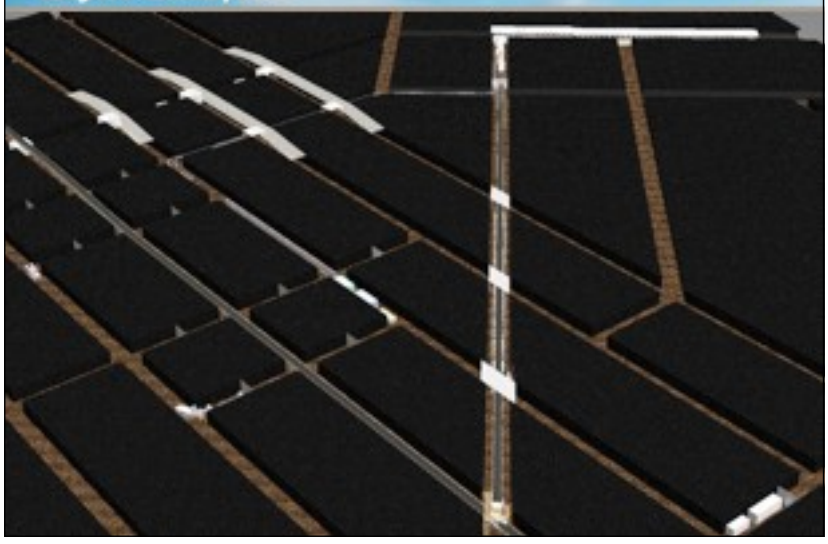
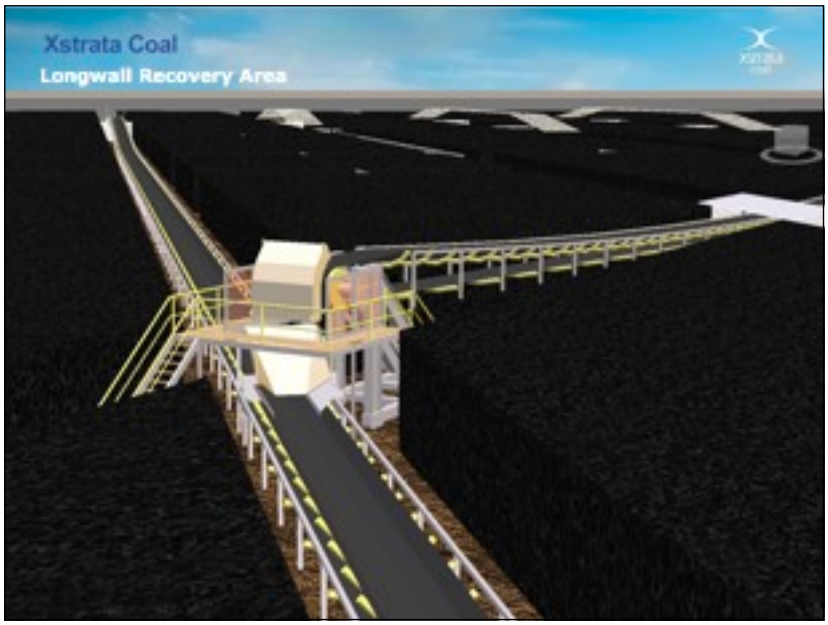
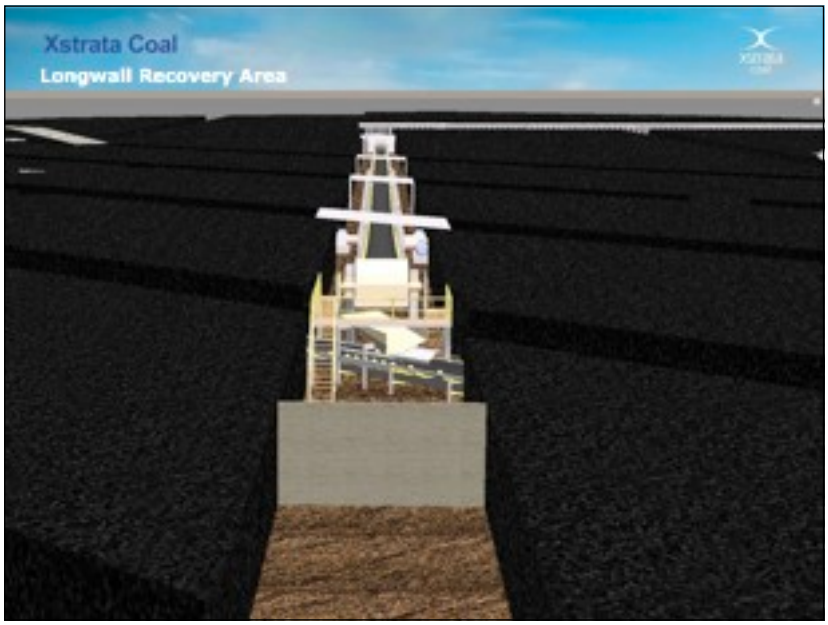
Longwall Recovery Area




Xstrata Coal
Longwall Recovery Area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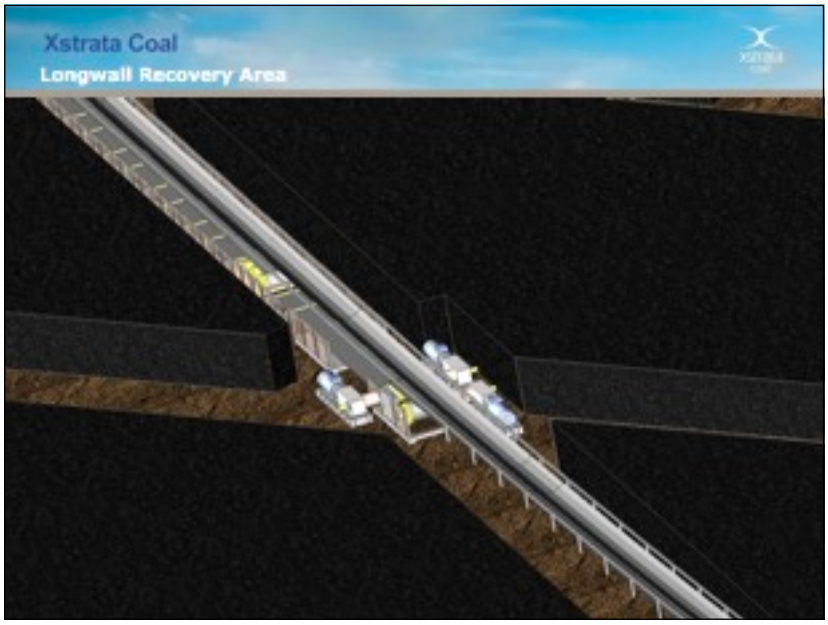
Longwall Recovery Area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Longwall Recovery Area

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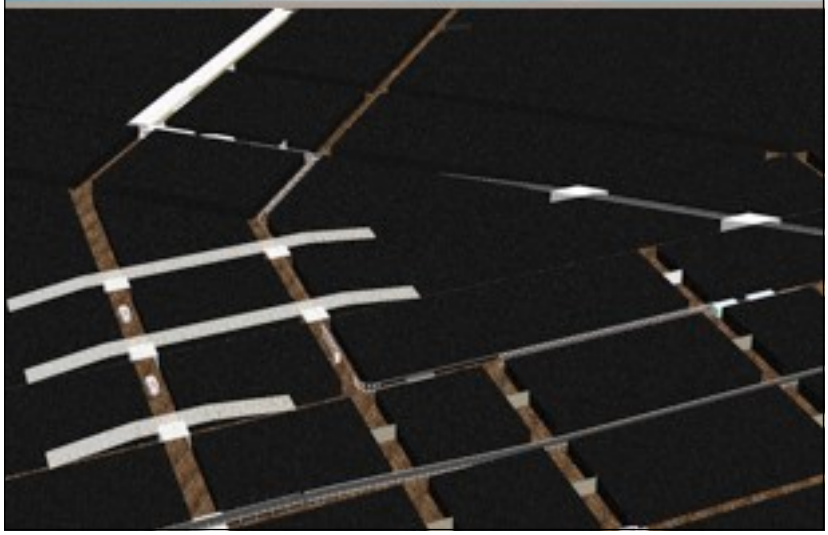
Longwall Recovery Area



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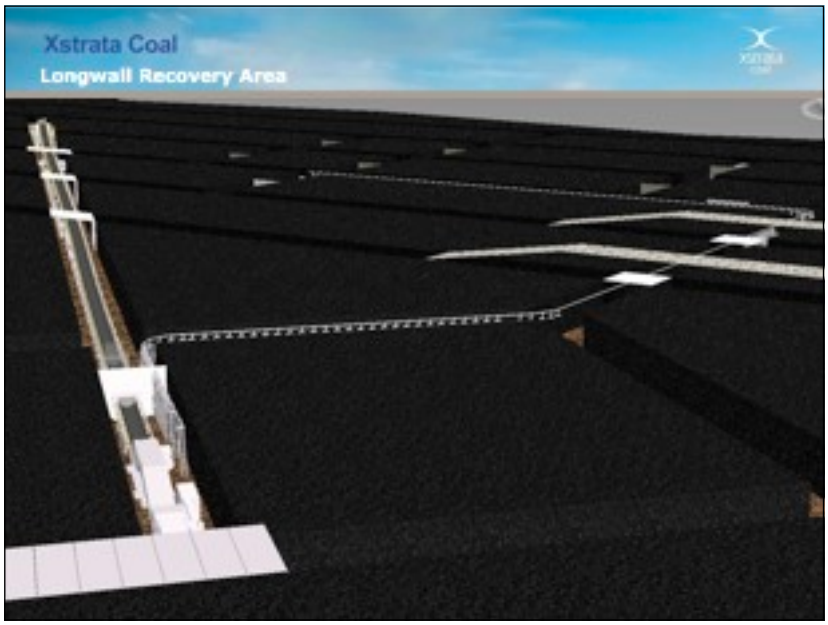
Longwall Recovery Area



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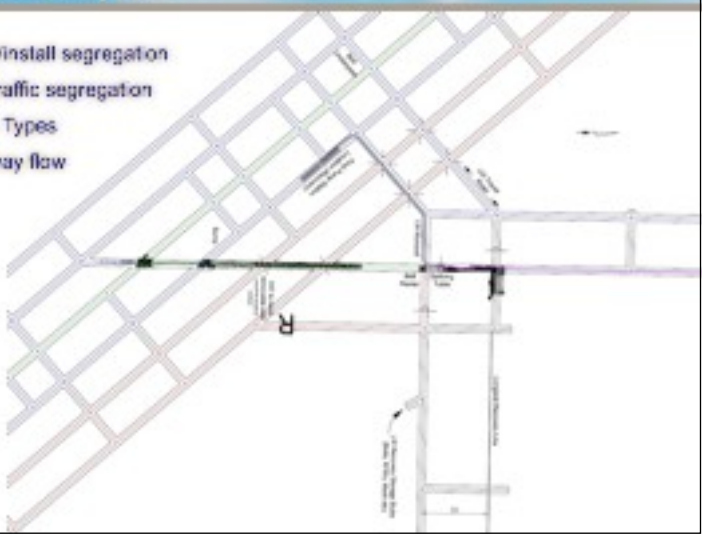
Longwall Recovery Area

- Traffic/install segregation
- Ped/Traffic segregation
- Traffic Types
- One-way flow



Box Cut

- Have an existing highwall, so why a box cut?
  - Reduced mains driveage (approx 8000m)
  - Allows longer lead times on development equipment and defers employment of crews
  - Allows increased pre-start training
  - Increased coal recovery (full seam vs roadways)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Ulan West Underground Access – Box Cut


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Ulan West Underground Access – Box Cut


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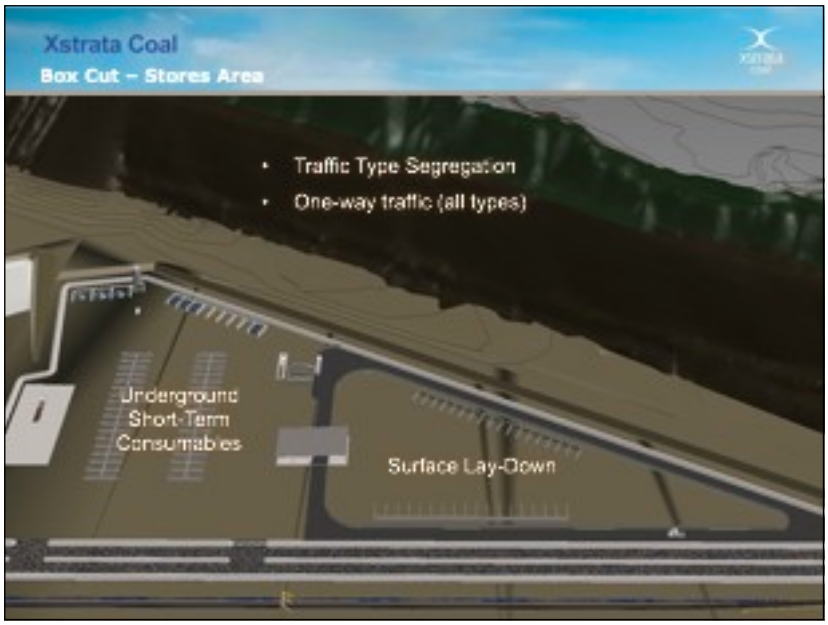
Box Cut – Conveyor and Traffic Ramp
• Traffic Type Segregation (UG and Road-Registered)
• One-way traffic for Underground Vehicles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Box Cut – Stores Area
Traffic Type Segregation
One-way traffic (all types)
Underground Short-Term Consumables
Surface Lay-Down


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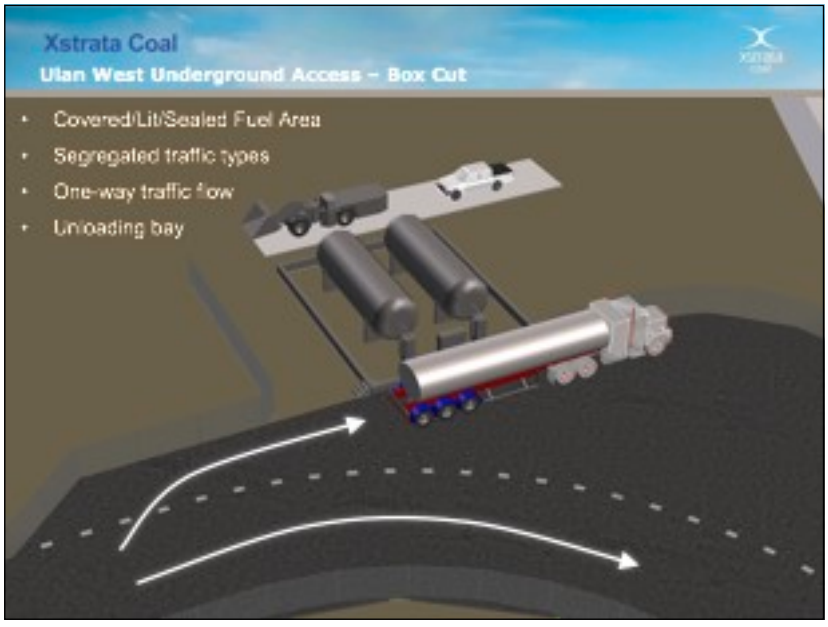
Ulan West Underground Access – Box Cut
Covered/Lit/Sealed Unloading/Loading Area
Periodic Consumables (right), short-term (left)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Ulan West Underground Access – Box Cut
Covered/Lit/Sealed Fuel Area
Segregated traffic types
One-way traffic flow
Unloading bay


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Ulan West Underground Access – Box Cut
• Visual Checks
• Traffic interaction
Unloading/Loading Area


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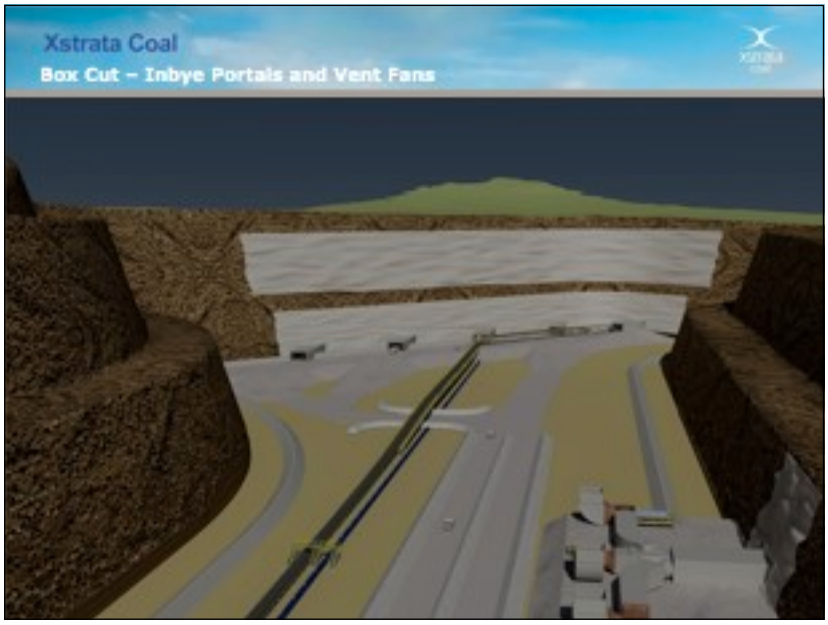
Box Cut – Inbye Portals and Vent Fans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Box Cut – Inbye Portals and Vent Fans

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Ulan West Underground - Summary

- Nearing end of Feasibility Phase (project not yet approved)
- Aim is to design and implement a 'big picture' mine
- Devil is in the detail
- Up to people to make it happen
- Need to give people the environment that is most conducive to their well-being
- The processes to create that environment are supported by correctly-designed and chosen equipment

"I don't care so much about shareholders. I care about my staff, who in turn look after my passengers and my passengers look after my shareholders".

Ralph Norris, former CEO Air New Zealand

Xstrata Coal

Level 38, The Gateway Building
1 Macquarie Place Sydney 2000

GPO Box R1543
Royal Exchange Sydney 1225

Telephone 02 9253 6700
Facsimile 02 9241 6888
xstrata.com