Mitigation of Abandoned Mine Entries at Swanbank Enterprise Development, Ipswich, Australia

10th Interstate Technical Group on Abandoned Underground Mines Workshop Harrisonburg, VA

• David L Knott, PE, Coffey, 19 Warabrook Boulevard, Warabrook NSW, Australia 2304; David.Knott@coffey.com 61-2-4016-2300

• Ken Grubb, RPEQ; Owner, Moreton Geotechnical Services Pty Ltd, PO Box 915, Ipswich QLD, Australia 4305; mgs@gil.com.au 61-7- 3294- 6988

• Hugh Taylor, Registered Surveyor, Mining A & SSE; Owner; Taylor Mining Services Pty Ltd, PO Box 4065, Raceview QLD, Australia 4305; hugh-taylor@bigpond.com 61-7- 3816-2311

• John Deans, Development Manager; Investa Property Group, Level 13, 241 Adelaide Street, Brisbane QLD, Australia 4000; jdeans@investa.com.au 61-7-3837- 0713

• Matthew Sadler; Project Engineering Geologist; Coffey, 47 Doggett Street, Newstead, QLD Australia 4006; Matthew.Sadler@coffey.com 61-7-3608-2500
Site Location

- Brisbane
- Ipswich
- Newcastle
- Sydney
Introduction
- The purpose of the project was to stabilize abandoned coal mine entries at three mines to allow redevelopment of the site.

- The entries consisted of cut and cover Armco Steel Arch sections connecting to tunnels in rock or coal, tunnels excavated in rock, and a shaft. The entries were constructed between about 1900 and the 1996.

- Storage areas for materials were planned over the entries.

- No investigation was performed.
Swanbank Enterprise Park is strategically located adjacent to the Ripley Valley, the fastest growing metropolitan region in Australia, with an estimated future population of 120,000. The development is just 28kms from Brisbane and 10 minutes from Ipswich. Proximity to this burgeoning growth corridor provides an outstanding resource from which skilled workers can be drawn.

Swanbank Enterprise Park is a green 5436 ac (2,200ha) master planned estate with 741ac (300ha) of prime industrial land available for the development of major industry. Swanbank will be the largest industrial estate in South East Queensland, meticulously master planned, not just for efficiency, but also for environmental sustainability. 3459ac (1,400ha) have been set-aside as conservation and buffer areas.

Swanbank is perfectly positioned to integrate seamlessly with one of Australia's fastest growing regions. Outstanding cooperation with local government planning ensures efficient approval processes. Built around an existing power station, this master planned estate will deliver far more than economical energy: with the Cunningham Highway to the North and the Centenary Highway to the South, access couldn't be easier. Markets, ports, raw materials and skilled workers are all within easy reach.
# Triassic Age Ipswich Coal Measures Stratigraphy

<table>
<thead>
<tr>
<th>Blackstone Formation</th>
<th>Tivoli Form</th>
<th>Not to scale</th>
<th>Seam Name</th>
<th>Seam Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thomas/New Found Out</td>
<td>26.2-29.6 ft. (8-9m) Splits in places.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aberdare</td>
<td>22.11-26.2 ft. (7-8m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bluff</td>
<td>Up to 29.6 ft. (9m) Splits in places.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Four Foot</td>
<td>2 Splits 8.2 ft. (2.5m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bergin</td>
<td>13.1-16.4 ft. (4-5m) Splits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Striped Bacon</td>
<td>8.2 ft. (2.5m) Consistent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rob Roy</td>
<td>6.6 ft. (2m) Tops 8.2 Ft. (2.5m) Bottoms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lindsay’s Hard</td>
<td>6.6 ft. (2m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cochrane Ritchie</td>
<td>8.2 Ft. (2.5m) 3.3-49.2 ft. (1-15m) Interburden</td>
</tr>
</tbody>
</table>

Aberdare “Aspro” No. 4

Rhondda No. 5

New Hill
Overview of Disturbance Locations

Taylor Mining Services Pty Ltd
Rhondda No. 5 Colliery
Entry Tunnels
Disturbances 11, 13, and 15
Rhondda No. 5 Colliery

Background

• Three Armco steel arch cut and cover tunnels to the Bergins Seam;

• Mined 1976 to 1998;

• Tunnels sealed at end of mining by puncturing the Armco Section and placing a clay plug in the tunnel;

• Two of the entries were covered with coal waste.
Existing Conditions
Rhondda No. 5 Colliery

Plan View of Disturbances
Rhondda No. 5 Colliery

Original Man & Supply Tunnel Profile

Tunnel Grade 1 - 40 (44.02') approx.
Armco Section
Grouted
Approximate Grout
Bergins Seam Mined

Datum RL 131.2 ft. (40m)

Proposed Surface
RL 179.5 ft. (54.7m)

Surface Level - February, 2012

Surface 2011

Original Surface

RL 152.6 ft. (46.5m)

27 ft. (8.16m)

21.4 ft. (6.5m)

31.2 ft. (9.5m)

8.2 ft. (2.5m)

Approximate Excavated Area - February, 2012

Tunnel sealed with earth / clay fill by excavator ripping a hole into the top of the Armco Arch

Taylor Mining Services Pty Ltd
Rhondda No. 5 Colliery

Disturbance D13 - Entrance to Belt Tunnel
Rhondda No. 5 Colliery

Mitigation
Rhondda No. 5 Colliery

Disturbance Mitigation Procedure:

• Drill grout holes into the tunnel and create a grout barrier to lessen the potential for the escape of mine gases and mine water;

• Grout upslope section of tunnel above barrier;

• Over-excavate entry and backfill with compacted material.
Plan View of Disturbances
Sinkhole Development During Drilling of 1st Grout Hole
Rhondda No. 5 Colliery

Sinkhole views
Rhondda No. 5 Colliery

Sinkhole Test Pit
Rhondda No. 5 Colliery

Original Man & Supply Tunnel Profile

Tunnel sealed with earth/clay fill by excavator ripping a hole into the top of the Armco Arch

Approximate Excavated Area - February, 2012

Datum RL 131.2 ft. (40m)

Surface Level - February, 2012

Surface 2011

Original Surface

Proposed Surface RL 179.5 ft. (54.7m)

27 ft. (8.16m)

RL 152.6 ft. (46.5m)

Tunnel Grade 1 - 40° (14.02') approx.

Armco Section

Grouted Tunnel Section

Approximate Grout

Bergins Seam Mined

R15B3

R15B1A

R15B3A

15H3BH

15CH65BH

Borehole Locations

Taylor Mining Services Pty Ltd
Sinkhole Test Pit con’t

- Dug down to about 20ft (6m), just above arch, and could not dig deeper;
- Sinkhole may have been caused by disturbing backfill along the outsides of the arch or piping may have been occurring on the outside of the arch and the piping area collapsed.
Rhondda No. 5 Colliery

Drilling resumed with Atlas Copco L8 Rig over the portion of tunnel in rock, but stopped drilling since holes wouldn’t stay open in the refuse material and rig could not install casing.
Hutte Rig drilled remainder of grout holes in Rhondda area since it could install casing.
Rhondda No. 5 Colliery

View looking upslope in Belt Tunnel (D13) before grouting

Timber Roof Beams

Remains of Conveyor Belt

Timber Props
Steel tremie pipe being lowered into hole prior to grout injection
Rhondda No. 5 Colliery

- Mixer
- Cement storage hopper
- Fly Ash stockpile
- Batch Plant

Taylor Mining Services Pty Ltd
Rhondda No. 5 Colliery

Note Lumps

Swanbank Pond Ash

Close-up
## Rhondda No. 5 Colliery

<table>
<thead>
<tr>
<th>MIX</th>
<th>POND ASH (kg)</th>
<th>CRUSHER DUST (kg)</th>
<th>CEMENT (kg)</th>
<th>WATER (l)</th>
<th>FLOWABILITY</th>
<th>STRENGTH (MPa) [psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier</td>
<td>382</td>
<td>1117</td>
<td>127</td>
<td>385</td>
<td>Slump 55-65mm (2 – 2.5in)</td>
<td>1.3 [189] 3.8 [551]</td>
</tr>
<tr>
<td>Infill 1</td>
<td>897</td>
<td>0</td>
<td>87</td>
<td>555</td>
<td>Flow Trough 230mm</td>
<td>0.95 [138] 2.2 [319]</td>
</tr>
<tr>
<td>Infill 2</td>
<td>322</td>
<td>941</td>
<td>175</td>
<td>453</td>
<td>Flow Trough 320mm</td>
<td>3.55 [515] 8.4 [1218]</td>
</tr>
</tbody>
</table>

### Proposed Grout Mix Components and Properties
Rhondda No. 5 Colliery

Infill Grout in Hopper
(25 – 35 Sec Flow Cone)

Slump Test on Barrier Grout (6 in slump)

Grout Consistency
Rhondda No. 5 Colliery

Grout being fed into agitator truck from batch plant
Grout being fed from agitator truck to concrete pump for pumping to grout hole
Formation of grout barrier in progress – Conveyor Support being enveloped in grout
Grout in contact with roof

Grout barrier

Barrier nearing completion
Rhondda No. 5 Colliery

Bag

Bag over other hole to check for pressure from grout

Gauge at injection hole to check pressure build-up
Rhondda No. 5 Colliery

UPVC tremie pipe for injection of grout in breach in Armco Section upslope of barrier in Belt Tunnel (D13)
Rhondda No. 5 Colliery

Over - excavation of old Man & Supply Tunnel (D15) to remove Armco section, showing the original breach looking downslope
Rhondda No. 5 Colliery

New breach and previous collapse in Old Man & Supply Tunnel (D15) looking downslope
Excavation filled with grout at New Man & Supply Tunnel (D11)
## Rhondda No. 5 Colliery

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Armco Section of Tunnel</th>
<th>Portion of Tunnel in Rock</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length¹ (m)</td>
<td>Cross-sectional area (m²)</td>
<td>Length² (m)</td>
<td>Cross-sectional area (m²)</td>
<td>Theoretical Volume of Tunnel to be Grouted (m³)</td>
<td>Total Theoretical Volume of Tunnel (m³)</td>
<td>Volume of Grout injected (m³)</td>
<td>Percentage of Tunnel filled based on Grout Take vs. Theoretical Volume³</td>
</tr>
<tr>
<td>New Man &amp; Supply (D11)</td>
<td>19</td>
<td>11.3</td>
<td>214</td>
<td>18.3</td>
<td>382</td>
<td>596</td>
<td>543</td>
<td>91%</td>
</tr>
<tr>
<td>Belt (D13)</td>
<td>22</td>
<td>11.3</td>
<td>248</td>
<td>16.3</td>
<td>293</td>
<td>541</td>
<td>963</td>
<td>178%</td>
</tr>
<tr>
<td>Old Man &amp; Supply (D15)</td>
<td>24</td>
<td>11.3</td>
<td>271</td>
<td>16.3</td>
<td>227</td>
<td>498</td>
<td>395</td>
<td>79%</td>
</tr>
</tbody>
</table>

1 – Length downslope of breach and start of rock tunnel,  
2 – Length from Armco Section to plug, cross cuts not included  
3 – Contribution from barrier grout and debris in the tunnel ignored

### Grouting Quantities for the Rhondda area
New Hill Colliery
Entry Tunnels and Air Shaft Disturbances  D1, D2, and D3
New Hill Colliery

Background

• Two Armco steel arch cut and cover tunnels connecting to rock tunnels to access the Cochrane Seam;

• One air shaft;

• Mined 1996 to 1998;

• Armco arch tunnels sealed at end of mining by removing the upper portion of the Armco arch tunnel and installing a plate;

• Airshaft filled with coal waste and covered with clay cap;

• Area regraded;

• Area to be filled and used for material storage.
New Hill Colliery

Tunnels
New Hill Colliery

Existing Conditions
New Hill Colliery

Excavation for Armco Tunnel Installation and Air Shaft location
New Hill Colliery

Man & Supply Tunnel and Pit Head at closure – Aug 1997

Courtesy Bob Bitmead/ Alan Brims
New Hill Colliery

Man and Supply Tunnel Profile

Legend:
- Excavated and Backfilled Section
- Around Armco Section During Construction
- Where Armco was Removed at Mine Closure

Datum RL 0m

Scale - Metres

Scale - Feet
New Hill Colliery

Man & Supply Tunnel
Cross Section through the Tunnel Section of the Mine Tunnel

Belt Tunnel
Cross Section through the Tunnel Roadway in the Coal Seam

Man & Supply and Belt Tunnel Armco Section

Typical Tunnel Cross Section
New Hill Colliery

Tunnel Mitigation
New Hill Colliery

Man and Supply Tunnel Profile

Taylor Mining Services Pty Ltd

MORETON GEOTECHNICAL SERVICES

Swanbank Enterprise Park

coffey geotechnics
SPECIALISTS MANAGING THE EARTH
New Hill Colliery

Sinkhole over Belt Tunnel – May 2008
Approx. Dia = 26ft (8m) and Depth = 20ft (6m)
Backfilled sinkhole area at Belt Tunnel prior to drilling
New Hill Colliery

Tunnel Location Procedure

- Survey two points on alignment based on mine map;

- Locate tunnel by excavating test pits to top of arch on alignment down slope of entrance;

- Survey centerline of exposed arch;

- Adjust alignment;

- Drill grout holes.
New Hill Colliery

Survey Stake on Tunnel Centerline Down Slope from Entrance

Survey Stake on Tunnel Centerline near Entrance
New Hill Colliery

Test Pit to Locate Tunnel Excavated Perpendicular to Tunnel Axis

Surveyed Tunnel Centerline Near Upper End of Tunnel
New Hill Colliery

Poor Backfill
Exposing upslope Corrugation in top of Armco section
New Hill Colliery

Armco Arch Section Uncovered
New Hill Colliery

Arch CL within 1m of Survey Location

Taylor Mining Services Pty Ltd
New Hill Colliery

Grout Hole Drilling for Tunnels
New Hill Colliery

Overview of drilling area
New Hill Colliery

Fitting on cap

Gas sampling at grout hole

Filled bag
New Hill Colliery

Tent for borehole camera viewing
Man & Supply Tunnel (D1) – View looking up slope in rock tunnel from NH1B1

Note: Mesh roof support
New Hill Colliery

View from borehole camera looking upslope at material from sinkhole in rock tunnel portion of Belt Tunnel
# New Hill Colliery

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>HOLE</th>
<th>DATE DRILLED</th>
<th>SOIL OVERBURDEN DEPTH (m)</th>
<th>DEPTH TO TOP OF VOID (m)</th>
<th>DEPTH TO BOTTOM OF VOID (m)</th>
<th>VOID HEIGHT (m)</th>
<th>HOLE DEPTH (m)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hill 1</td>
<td>NH1-I2</td>
<td>26/04/2012</td>
<td>5</td>
<td>14</td>
<td>18</td>
<td>4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-V1</td>
<td>26/04/2012</td>
<td>7</td>
<td>28</td>
<td>31</td>
<td>3</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-B4</td>
<td>23/04/2012</td>
<td>2.5</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-B5</td>
<td>23/04/2012</td>
<td>3</td>
<td>9</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-I2</td>
<td>20/04/2012</td>
<td>11</td>
<td>22.5</td>
<td>26</td>
<td>3.5</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-I1</td>
<td>19/04/2012</td>
<td>2.6</td>
<td>25</td>
<td>28.5</td>
<td>3.5</td>
<td>28.5</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B4</td>
<td>4/04/2012</td>
<td>3.42</td>
<td>31.2</td>
<td>34.65</td>
<td>3.45</td>
<td>34.65</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B5</td>
<td>2/04/2012</td>
<td>9</td>
<td>31</td>
<td>34.5</td>
<td>3.5</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-I1</td>
<td>29/03/2012</td>
<td>2.6</td>
<td>25.03</td>
<td>28.56</td>
<td>3.53</td>
<td>28.56</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-I1</td>
<td>28/03/2012</td>
<td>2.88</td>
<td>22.12</td>
<td>25.98</td>
<td>3.86</td>
<td>25.98</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B4</td>
<td>26/03/2012</td>
<td>3.42</td>
<td>31.2</td>
<td>34.65</td>
<td>3.45</td>
<td>34.65</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B3</td>
<td>19/03/2012</td>
<td>4.4</td>
<td>33.31</td>
<td>34.31</td>
<td>1</td>
<td>34.31</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-B2</td>
<td>29/02/2012</td>
<td>1.77</td>
<td>26.03</td>
<td>29.13</td>
<td>3.1</td>
<td>29.13</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-B3</td>
<td>29/02/2012</td>
<td>0.8</td>
<td>25.66</td>
<td>29.05</td>
<td>3.39</td>
<td>29.05</td>
<td></td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B1</td>
<td>29/02/2012</td>
<td>2.51</td>
<td>0</td>
<td>36</td>
<td></td>
<td></td>
<td>Hole aborted at 36m due to missing tunnel</td>
</tr>
<tr>
<td>New Hill 2</td>
<td>NH2-B2</td>
<td>29/02/2012</td>
<td>1.51</td>
<td>29.35</td>
<td>31.85</td>
<td>2.5</td>
<td>31.85</td>
<td></td>
</tr>
<tr>
<td>New Hill 1</td>
<td>NH1-B1</td>
<td>28/02/2012</td>
<td>1</td>
<td>24.93</td>
<td>28.36</td>
<td>3.43</td>
<td>28.36</td>
<td></td>
</tr>
</tbody>
</table>

---

**Taylor Mining Services Pty Ltd**

---

**Drilling Summary**
New Hill Colliery

Belt Tunnel and Sinkhole Over-excavation after grouting
Exposed Armco section & steel cover plate installed at mine closure
Exposed Armco / rock tunnel interface in sinkhole over-excavation
New Hill Colliery

Close-up of rock tunnel roof at interface
Removal of uncontrolled fill in sinkhole over Belt Tunnel area

New Hill Colliery

Area with over – excavation of uncontrolled fill and compacted fill placement

Upslope Armco Section Over-Excavated & Backfilled with Compacted Fill

Steel Cover Plate

Rock Portion of tunnel
New Hill Colliery

Compacted backfilled sinkhole area
New Hill Air Shaft
Shaft was backfilled with coal waste at the end of mining;

There was a concern that the coal waste could migrate into the mine workings and result in a sinkhole;

Mitigation consisted of exposing shaft and capping with geotextile sandwich;

Area to be filled and used for material storage.
New Hill Colliery

Location of airshaft

Side of box cut for shaft

Approximate Location of shaft
New Hill Colliery

Section of shaft after mine closure
Exposed air shaft looking South
New Hill Shaft Capping Procedure

1. The ground around the shaft was raised to the top of the shaft collar level using compacted fill;

2. A trench was excavated around the outside perimeter of the shaft where it is in contact with the adjacent rock, to allow for the placement of a geosynthetic filter layer;

3. A concrete layer was placed on top of the metal lip, located on the top of the shaft, to lessen damage to the geosynthetic filter layer that would have occurred if it had been in contact with the sharp metal lip;

4. The pad at the level of the geosynthetic layer was prepared by compacting the existing soil material inside the shaft with a compactor attached to the end of an excavator arm;

5. An about 300mm thick layer of clayey sand with weathered sandstone gravel sized rock fragments fill was placed over the shaft and the surrounding area and compacted with a compactor attached to the end of an excavator arm;

6. The first layer of geotextile layer (Mirafi PET 800 woven polyester) with two overlapping sections, each 16m long and 5m wide, was laid over the shaft. The overlapping width of two geotextile layers is about 1m;

7. A layer of 100mm thick clayey sand fill was placed above the first geotextile layer and compacted using a sheet foot rollers attached the end of the excavator arm;

8. The second layer of a single geotextile strip (Mirafi PET 800, woven polyester), 16m in length and 5m in width) was placed centrally over the shaft, in the same direction as the first layer;

9. A layer of 100mm thick clayey sand fill was placed above the second geotextile layer and compacted using a sheet foot rollers attached the end of the excavator arm;

10. The third layer of Mirafi PET 800 woven polyester geotextile layer with two overlapping sections in 16m long each was placed over the shaft. The direction of the geotextile sections are perpendicular (90°) to that of the first layer

11. A layer of 100mm thick clayey sand with some weathered sandstone rock fragments was placed and compacted over the geosynthetic material, using hand held compactor;

12. The fourth layer consisting of a single geotextile strip (Mirafi PET 800, woven polyester strip, 16m in length) was placed centrally over the shaft in the same direction as the third layer;

13. Additional fill was placed over the geotextile to bring the area to the final design grade.
Metal lip on top of shaft covered by concrete layer to reduce potential for ripping of geotextile
New Hill Colliery

First geotextile layer spread over shaft
New Hill Colliery

Compacted fill after the third geosynthetic layer
New Hill Shaft Capping - Residual Risks

The following risks have been identified as part of the design process:

1. Deflections leading to potentially large surface displacements:
   a. A geotextile will deflect when loaded;
   b. Additional layers of geotextile have been added so that the serviceability load is developed at smaller strains;

2. The land use of the shaft will be assumed as hardstand and no structures are to be constructed;

3. Future excavation, drilling or piling:
   a. The geotextile acts as a tension membrane. As such, any damage to the material has the capacity to induce a failure;
   b. Power lines currently exist above the shaft. No structure will be constructed under the power lines, which should preclude the potential for excavations and structures to be built in the area;
   c. This disturbance will be documented as a long term risk in the mining remediation report and should also be documented in any land agreements;

4. Ground level developments:
   a. The geotextile requires the weight of the overlying soil to generate adequate bonding between the soil and the fabric. Should the amount of soil be reduced, the bonding capacity between the soil and the geotextile is reduced and it could be pulled out;
   b. Additional bond length has been added to the textile to improve future flexibility for ground levels;
   c. A conservative design has been implemented whereby bond on only one side of the geotextile has been assumed.

5. Other constraints
   a. Gas from the mine may emanate from the shaft;
   b. Drainage should be diverted from the area;
   c. Potential for combustion in the coalstone.

Regular visual observations of the surface should be undertaken to assess if settlement and cracking are occurring. If settlement is occurring, the area should be re-levelled to improve drainage.
Aberdare No. 4 “Aspro Colliery”
Mine Entries
Disturbances 9 and 10
Aberdare No. 4 “Aspro” Colliery

Background

• Two rock tunnels used to access the Four Feet Seam;

• The mine operated between 1902 and 1913;

• Entries covered with coal waste at some time in the past;

• Area to be used for materials storage;

• Mitigation similar to other tunnels.
Main Tunnels Plan View
Aberdare No. 4 “Aspro” Colliery

Main Tunnel 1 Profile

Taylor Mining Services Pty Ltd

MORETON
GEO-TECHNICAL SERVICES
Swanbank Enterprise Park

coffey
gotechnics
SPECIAlISTS MANAGING THE EARTH
Aberdare No.4 “Aspro” Colliery

Tunnel Location by Test Pit Excavation
Aberdare No.4 “Aspro” Colliery

Caving of roof

Excavation at Tunnel 2
Caving encountered during excavation at Tunnel 1
Aberdare No.4 “Aspro” Colliery

Caving of roof

Excavation at Tunnel 1
Aberdare No.4 “Aspro” Colliery

Section of 4 ft Seam and upper split

Upper Split - Unmined poor coal and clay bands

Mined portion of seam
Aberdare No.4 “Aspro” Colliery

View of caved material that appears to have fallen in one block
Aberdare No.4 “Aspro” Colliery

Mitigation
Aberdare No.4 “Aspro” Colliery

Main Tunnels Plan View
Aberdare No.4 “Aspro” Colliery

Continuation of workings

Material collapsed due to drilling in another hole

Roof fall

Side view from barrier hole looking up slope in Tunnel 2
Aberdare No.4 “Aspro” Colliery

Down looking view showing roof fall in Tunnel 2
## Drilling Summary

**Aberdare No.4 “Aspro” Colliery**

<table>
<thead>
<tr>
<th>Hole</th>
<th>Date Drilled</th>
<th>Overburden Depth (m)</th>
<th>Depth to Top of Void (m)</th>
<th>Depth to Bottom of Void (m)</th>
<th>Void Height (m)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB10-V1</td>
<td>11/05/2012</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB10-V2</td>
<td>11/05/2012</td>
<td>1.44</td>
<td>8.27</td>
<td>10.79</td>
<td>2.52</td>
<td>Drilled into D10</td>
</tr>
<tr>
<td>AB10-V3</td>
<td>11/05/2012</td>
<td>0.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB10-V4</td>
<td>11/05/2012</td>
<td>1.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB10-V5</td>
<td>11/05/2012</td>
<td>1.22</td>
<td>8.61</td>
<td>9.44</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>AB10-B3</td>
<td>6/03/2012</td>
<td>2.3</td>
<td>10.31</td>
<td>15.4</td>
<td>5.09</td>
<td></td>
</tr>
<tr>
<td>AB9-B3</td>
<td>6/03/2012</td>
<td>3</td>
<td>8.49</td>
<td>15.81</td>
<td>7.32</td>
<td></td>
</tr>
<tr>
<td>AB10-B2</td>
<td>24/02/2012</td>
<td>1.9</td>
<td>9.12</td>
<td>12.75</td>
<td>3.63</td>
<td></td>
</tr>
<tr>
<td>AB10-B1</td>
<td>24/02/2012</td>
<td>1.77</td>
<td>9.92</td>
<td>13.71</td>
<td>3.79</td>
<td></td>
</tr>
<tr>
<td>AB9-B2</td>
<td>24/02/2012</td>
<td>2.23</td>
<td>9.03</td>
<td>12.62</td>
<td>3.59</td>
<td></td>
</tr>
<tr>
<td>AB9-B1</td>
<td>24/02/2012</td>
<td>2.84</td>
<td>9.79</td>
<td>13.84</td>
<td>4.05</td>
<td></td>
</tr>
</tbody>
</table>
Aberdare No.4 “Aspro” Colliery

Grout being pumped from agitator truck into grout hole through tremie pipe
Aberdare No. 4 “Aspro” Colliery

Grouting from the excavation in Tunnel 1
Aberdare No. 4 “Aspro” Colliery

Tunnel 2 after filling with grout
# Aberdare No. 4 “Aspro” Colliery

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Tunnel dimensions</th>
<th></th>
<th>Volume of Grout injected</th>
<th></th>
<th>Percentage of Tunnel filled based on Grout Take vs. Theoretical volume</th>
<th>Barrier Grout Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (m)</td>
<td>Cross-sectional area (m²)</td>
<td>Theoretical Volume (m³)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunnel 1 D10</td>
<td>18</td>
<td>5.4</td>
<td>134.7</td>
<td>101</td>
<td>75%</td>
<td>42</td>
</tr>
<tr>
<td>Tunnel 2 D9</td>
<td>22</td>
<td>5.4</td>
<td>157.5</td>
<td>186</td>
<td>118%</td>
<td>24</td>
</tr>
</tbody>
</table>

1 – Cross cut not included  
2 – Void height estimated as 1.2m  
3 – Contribution from barrier grout and debris in the tunnel ignored  
4 - Includes grout used to fill excavation

## Grouting Quantities
Aberdare No. 4 “Aspro” Colliery

Over – excavation and backfill of tunnel section upslope from grout barrier

Grout barrier
Conclusions

• A variety of methods may be needed to mitigate abandoned mine entries;

• The original construction of the entry and closure must also be considered as part of the mitigation design;

• The original closure may have been suitable for its purpose, but may not be adequate for redevelopment purposes;

• Impacts from mine gases and water must be considered;
Conclusions Continued

• Changes may need to be made during construction when the feature is exposed;

• Good coordination between the Owner, Contractor, and Engineer are needed to deal with changes;

• Sites with abandoned underground workings can be mitigated to allow redevelopment, thereby putting waste land to good use.
Box Flat Disaster

17 miners killed in gas explosion while fighting mine fire - July 31st, 1972
Questions

What happened?