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Report on
Desk Study of Mine Subsidence Risk

Proposed Commercial Development
4B South Street, Bennetts Green

Prepared for
SPG Investments Pty Ltd

Project 49710.03
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Desk Study of Mine Subsidence Risk
Proposed Commercial Development
4B South Street, Bennetts Green

1. Introduction

This report presents the results of a desk study to assess the mine subsidence risk in connection with a proposed commercial development at 4B South Street, Bennetts Green. The investigation was commissioned by Matthew Skerrett of Blueprint Group Australia Pty Ltd acting on behalf of SPG Investments Pty Ltd.

The proposed development of the site is shown on the attached Overall Site Plan, Drawing No. ATP-200 dated 22 May 2017 (supplied by client) and will include:

- Lot 1 – Bunnings Building;
- Lots 2 and 3 – Bulky Goods and Commercial shops.

Douglas Partners Pty Ltd (DP) has previously undertaken a desk study of mine subsidence risk for Lot 1, in April 2012 and a revised assessment in December 2017 (Refs 1 and 2). This report presents additional analysis which encompasses Lots 1 to 3 (i.e. the full site of proposed development).

The proposed development site is located within the proclaimed Lake Macquarie Mine Subsidence District, and therefore the development is subject to the approval of Subsidence Advisory NSW (SA NSW, previously Mine Subsidence Board). It is anticipated that consultations with the SA NSW will be required in conjunction with the development approval process.

A desk study was undertaken to comment on the stability of the mine workings beneath the proposed development area for Lots 1 to 3 and also to provide comments on the likely surface subsidence parameters which would result from the 'worst credible case' future mine subsidence.

No subsurface investigation was undertaken for the mine subsidence assessment.

2. Scope of Work

The scope of work comprised:

- A review of the plans of the mine workings, which are documented on record traces (RTs) held by the NSW Department of Primary Industries – Minerals (DPI – Minerals);
- Review of the DPI – Minerals' online data base "DIGS" for relevant information;
- Review of other historical documents and data from Douglas Partners files;
- Analysis of the stability of pillars under the site and within and immediately surrounding the "angle of draw" of the workings;
- Comment on the pillar stability and the likelihood of mine subsidence affecting the site; and
- Estimation of surface subsidence parameters for use in preliminary design of the development.

The “angle of draw” described above represents the horizontal extent at ground surface level beyond the limit of mine workings which would likely be affected by subsidence due to collapse of the workings. The angle of draw is typically 26° off upward vertical, so that the horizontal extent at ground level beyond the limit of mine workings is about one-half of the depth to the floor of the workings.

3. Data Review

3.1 Extent of Mining

3.1.1 General

Enquiries made with the then NSW Mine Subsidence Board (MSB) (now known as Subsidence Advisory NSW (SANSW)) as part of the initial assessment (Ref 1) indicate that the site has been undermined by abandoned coal mine workings in both the Dudley Seam and the Victoria Tunnel Seam. These seams were worked by the Lambton ‘B’ (previously, Durham) Colliery at depths beneath the development site of the order of 145 m to 175 m and 125 m to 135 m, respectively.

Scanned images of the RTs of these abandoned mines were obtained from the DPI – Minerals. The images were georeferenced to the modern surface cadastre provided by the Department of Lands. Drawing 1 and Drawing 2 in Appendix C show the approximate Lot boundaries relative to the workings in the Dudley Seam and the Victoria Tunnel Seam, respectively.

3.1.2 Record Trace – Victoria Tunnel Seam

The Victoria Tunnel (VT) Seam workings of the Lambton B Colliery are recorded on RT 403. Reference to the RT indicates that the workings are typically of the bord and pillar type. Dates on the RT indicate that mining near the site likely took place in the early 1960s.

RT 403 indicates that areas of first workings by bord and pillar methods in the VT Seam underlie Lots 2 and 3, but do not underlie Lot 1.

Workings in the VT Seam which are nearest to Lot 1 are of the order of 20 m to 30 m to the east through north-east.

The nearest areas of partial (first workings) and full pillar extraction are between 60 m and 140 m to the east of Lot 1. As indicated on Drawing 2, areas of pillar extraction do not encroach the angle of draw limit of the workings which would likely impact the footprint of Lots 1 to 3 in terms of mine subsidence.

The RT also indicates that a dyke, noted as some 5.9 m (19 feet, 6 inches) thick near the western extent of the workings, was encountered in an approximately south-east to north-west orientation. The RT shows no workings in the Victoria Tunnel Seam on the south-west side of this dyke.

Georeferencing of the Victoria Tunnel Seam workings relative to the surface cadastre and proposed development areas of the site indicates the following (refer to Drawing 2):

- No mine workings in the Victoria Tunnel Seam are present beneath Lot 1;
- Bord and pillar type first workings are present beneath the areas of proposed development on proposed Lots 2 and 3.

3.1.3 Record Trace – Dudley Seam

The Dudley Seam workings of the Lambton 'B' Colliery are recorded on RT 691. Reference to the RT indicates that the workings are typically bord and pillar type with secondary extraction by pillar removal in certain areas.

Drawing 1 in Appendix C relates the layout of the workings to the footprint of Lots 1 to 3.

Dates on the RT indicate that mining beneath the overall development site likely took place in the mid-1970s to early 1980s. Depths to the floor of the workings are of the order of 160 m to 172 m beneath Lot 1, and of the order of 155 m to 170 m across Lots 2 and 3.

The RT shows a dyke with a south-east to north-west orientation beneath the central portion of the development site. The dyke was also encountered in the overlying Victoria Tunnel Seam workings (refer Section 3.1.2 above).

Overlaying RT 691 (Dudley Seam) with RT 403 (Victoria Tunnel Seam) shows that the position and orientation of the dyke is the same in each seam. On this basis, the dyke was probably sub-vertical.

3.2 Historical Data

The historical data which was reviewed for the purpose of the desk study included:

- Annual reports of the Department of Mines of NSW obtained from the DPI – Minerals' online DIGS database;
- Information on Lake Macquarie City Council's (LMCC) website; and
- Previous study of actual subsidence due to mining in the Dudley Seam by Lambton Colliery, including mining beneath the subject site (Ref 5).

3.2.1 Annual Reports, DIGs Database and LMCC

From this review, it is noted that the Scottish Australian Mining Company acquired a leasehold for the Durham Colliery at Redhead prior to 1876 during which year sinking of the first shaft was in progress. Work on the colliery was sporadic until 1888 when the Borehole Seam was reached.

In 1898 the name of the colliery was changed to Lambton No 2, known as Lambton 'B'. In 1932, the Lambton 'B' Colliery was purchased by the BHP Co Ltd.

There were two shafts at the pit top facilities at Redhead, one downcast and one upcast, and a surface drift working three seams:

- Victoria Tunnel Seam;
- Dudley Seam; and
- Borehole Seam.

A cross-measure drift provided for the transfer of mined coal from an interseam bin above the Dudley Seam workings up into the Victoria Tunnel Seam from where it was transferred to the pit top by means of the surface drift.

RT 691 shows that an upcast shaft (No 3 Shaft) was constructed in 1972 to a depth of about 169.5 m (556 feet) at a location approximately 1 km east of the proposed development site. The timing of its construction relative to the surrounding Dudley Seam workings indicates that the shaft was sunk for the purpose of ventilating the mine.

Workings within the Borehole Seam extend offshore from Redhead several kilometres. Workings within the Victoria Tunnel Seam and the Dudley Seam extend west to Gateshead and Windale. The northern extent of the mining lease adjoined the Dudley (previously South Burwood) Colliery, Burwood Colliery and Waratah Colliery holdings along an east-west boundary between Dudley Road and Warners Bay Road. The southern extent of the lease adjoined the John Darling Colliery holding.

The Lambton 'B' Colliery ceased mining operations in 1992.

3.2.2 Previous Study (Ref 5)

The study presented survey monitoring data to assess the actual surface subsidence due to mining within the Dudley Seam by Lambton Colliery.

The study notes that Lambton Colliery initially mined the Dudley Seam by first workings of bord and pillar methods, without pillar extraction. Experiences at the adjoining Burwood Colliery with the success of the 'panel and pillar' mining system, led to alternate mining layouts whereby panels of second workings (full pillar extraction) were mined, separated by relatively large, intact pillars. This technique was employed beneath the subject site, with the panel beneath Lot 1 denoted "6 NW", and the panel beneath Lots 2 and 3 denoted "4 NW" and "4NW Left" as indicated on Figure 1 below.

The study presents data in relation to panels "6 NW" and "4 NW" which is relevant to the current assessment. A summary of relevant information is presented below:

<u>Panel "6 NW"</u>

- Dates of extraction – June 1980 to November 1981;
- Panel width 82 m;
- Panel Length 200 m;
- Average depth of cover – approximately 170 m;
- Seam height – 1.7 m;
- Height of pillars – 1.7 m; and

- Maximum recorded subsidence post mining – approximately 180 mm (January 1982).

<u>Panel "4 NW"</u>

- Dates of extraction – July 1978 to September 1979;
- Panel width 58 m;
- Panel Length 250 m;
- Average depth of cover – approximately 165 m;
- Seam height – 1.6 m to 1.8 m;
- Height of pillars – 1.6 m; and
- Maximum recorded subsidence post mining – approximately 60 mm (November 1983).

The mine subsidence survey monitoring points from Ref 5 relative to the approximate site location and underlying workings are presented in Figure 1 below.

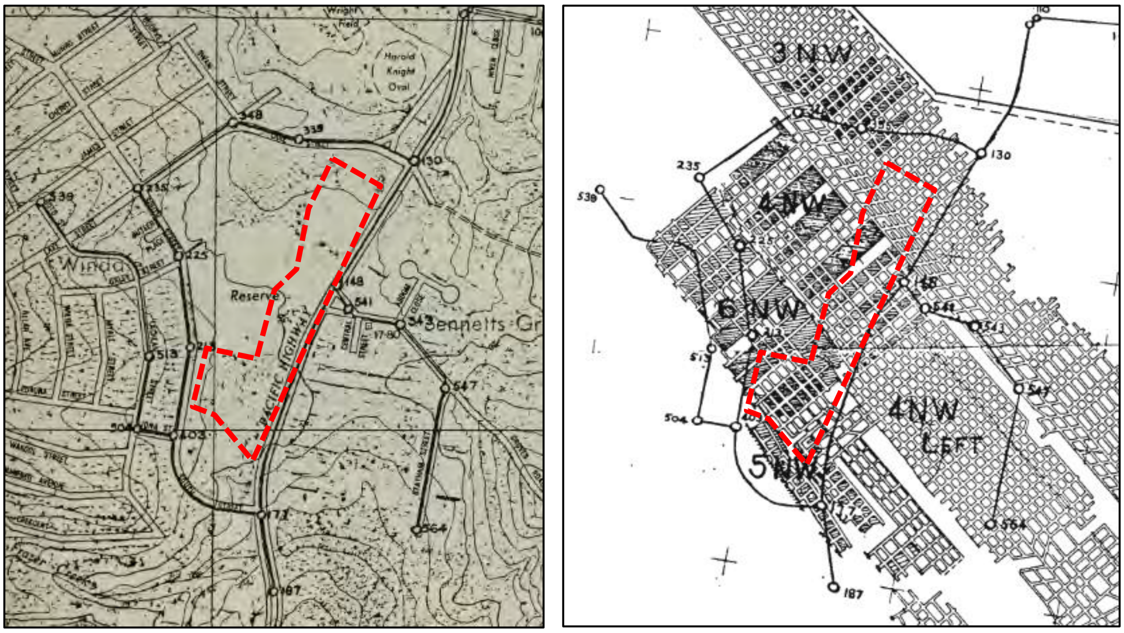

Figure 1: Extract from Ref 5 showing mine subsidence survey points around "The Site" (red dashed line) together with the underlying workings relative to the site

3.3 Working Section and Seam Thickness

The following sections outline the information obtained for each seam.

3.3.1 Victoria Tunnel Seam

Table 1 below gives a summary of data available on the DPI – Minerals' online DIGS database.

Table 1: Summary of Available Colliery Bore Data for the Victoria Tunnel Seam [1]

Bore Identifier (Date)	Approximate Distance of Bore from Building Site	Thickness of VT Seam	Thickness of Working Section of VT Seam [2]
BHP Lambton DDH 18 (1970)	Less than 100 m south	3.03 m (10')	1.6 m (5' 3 ")
Old Redhead DDH 2, ("Bennett's Bore", 1886)	Approx 250 m east	3.61 m (10' 10")	Not indicated 2.1 m ? (7') ?
BHP Windale DDH 3 (1957)	Approx. 100 m west	1.62 m (5' 3¾")	Not indicated 1.6 m ?
BHP Windale DDH 4 (1960)	Approx 500 m south-west	1.45 m (4' 9")	Not indicated
South Redhead DDH 1 (1889)	Approx 900 m south-east	1.47 m (4' 10")	Not indicated
Durham Colliery No 1 Pit DDH (1888)	Approx 2.1 km east	4.13 m (13' 6½")	Not indicated 1.73 m ? (5' 8") ?

Notes to Table 1:

(1) Source: DIGS online database

(2) The working section of the Victoria Tunnel Seam is equivalent to the height of the mine roof above the base of the seam

Figure 2 below is an archival image of workings in the Victoria Tunnel Seam at Burwood Colliery, which borders Lambton 'B' Colliery to the north. The photograph gives a depiction of working section height in the Victoria Tunnel Seam at Burwood Colliery. Based on the height of the men in the photograph, the height of this working section was probably of the order of 1.8 m.

Figure 2: Workings in Victoria Tunnel Seam, Burwood Colliery (source: LMCC online archives)

A section is included on RT 403 (sheet 11) which shows the thickness of the Victoria Tunnel Seam as 2.50 m (8 feet, 2½ inches) at the downcast shaft of Lambton 'B' Pit. Sheet 1 of RT 403 shows the working section as 1.75 m (5 feet, 9 inches).

Data from Ref 1 indicated overall thicknesses and inferred working sections for the following collieries in the Victoria Tunnel Seam:

- John Darling Colliery;
    - Overall seam thickness 2.16 m (85 inches);
    - Working roof 2.01 m (79 inches) above base of seam.
- Lambton ('B') Colliery;
    - Overall seam thickness 2.90 m (114 inches);
    - Working roof 2.39 m (94 inches) above base of seam.
- Burwood Colliery;
    - Overall seam thickness 2.79 m (109¾ inches); and
    - Working roof 2.19 m (86¼ inches) above base of seam.

The sampling locations for these data were not provided in Ref 1.

Based on the above, the seam thickness and working section which has been adopted for analysis of the VT Seam underlying the site is 3.03 m and 2.39 m, respectively.

3.3.2 Dudley Seam

A section is included on RT 691 which shows the thickness of the Dudley Seam as some 2.3 m (7 feet, 8 inches) at an undisclosed location. The section also shows the working floor as some 1.8 m (6 feet) below the roof of the seam at this location.

From other information on the RT, it is probable that the section was made at the downcast shaft of Lambton 'B' Pit.

In addition, data from a 1963 CSIRO report titled "Petrographic Data on some New South Wales Coals" by G H Taylor (Ref 2) indicate an overall thickness of 1.93 m (76 inches) for the Dudley Seam in workings of the Burwood Colliery, which borders the northern extent of the Lambton 'B' Colliery lease. The sampling locations for these data were not provided in Ref 2.

Table 2 below gives a summary of data available on the DPI – Minerals' online DIGS database.

Table 2: Summary of Available Colliery Bore Data for the Dudley Seam [1]

Bore Identifier (Date)	Approximate Distance of Bore from Building Site	Thickness of Dudley Seam	Thickness of Working Section of Dudley Seam [2]
BHP Lambton DDH 18 (1970)	Less than 100 m south	3.05 m (10')	1.6 m (5' 3 ")
Old Redhead DDH 2, ("Bennett's Bore", 1886)	Approx 250 m east	3.61 m (10' 10")	Not indicated 2.1 m ? (7') ?
BHP Windale DDH 3 (1957)	Approx. 100 m west	1.62 m (5' 3¾")	Not indicated 1.6 m ?
BHP Windale DDH 4 (1960)	Approx 500 m south-west	1.45 m (4' 9")	Not indicated
BHP Windale DDH 2 (1960)	Approx 800 m west	1.24 m (4' 1")	Not indicated
South Redhead DDH 1 (1889)	Approx 900 m south-east	1.47 m (4' 10")	Not indicated
BHP Windale DDH 1 (1960)	Approx 1.3 km north	1.42 m (4' 8")	Not indicated
Durham Colliery No 1 Pit DDH (1888)	Approx 2.1 km east	2.16 m (7' 1")	Not indicated 1.73 m ? (5' 8") ?
BHP Burwood Dudley DDH 4 (1964)	Approx 4 km north-east	2.30 m (7' 6½")	Not indicated 1.92 m (6' 3½")

Notes to Table 2:

(1) Source: DIGS online database

(2) Thickness of the working section of the Dudley Seam is the depth of the working floor below the top of the seam

In addition to the above data, a previous study of subsidence due to Dudley Seam mining by Lambton Colliery (Ref 5) as summarised in Section 3.2.2 presents data relating to the "6 NW" mining panel, which is shown to underlie the subject site. The study reports that in the "6 NW" panel, the Dudley Seam height was 1.7 m, and the height of pillars was 1.7 m, indicating that the full seam was mined.

4. Analysis of Mine Void Stability

4.1 Pillar Stability

4.1.1 General

The analysis of pillar stability beneath and surrounding the footprint of Lots 1 to 3 was undertaken using the UNSW Pillar Stability Formula (Ref 4) to estimate a factor of safety (FoS) for each coal pillar of interest in a representative panel of mine voids beneath the proposed development area.

4.1.2 Victoria Tunnel Seam

The pillar stability analysis for the VT Seam workings was undertaken for 108 pillars within and adjacent to the projected angle of draw relative to the site boundary of Lots 1 to 3.

Based on Douglas Partners' review of RT 403 and the available historical data, it is considered that Lot 1 would be almost entirely outside the angle of draw of the Victoria Tunnel Seam workings to the east and north and mining within this seam would not likely affect the proposed development area of Lot 1.

The pillars which were indexed for use in the analysis are shown on Drawing 2 in Appendix C. All pillar dimensions were measured from RT 403.

Based on a review of the available data as described above, a seam thickness of 3.03 m and working section of 2.39 m has been adopted for the analysis of pillar stability in the VT Seam workings beneath the site. It is considered that this represents a reasonable estimate of the seam thickness and working section beneath the site.

Given that the data review indicated the lower portion of the VT Seam was mined by Lambton 'B' Colliery, a sensitivity analysis was undertaken whereby the pillar height section was increased to the full seam thickness, to simulate 'top coal' having fallen from the roof post-mining (i.e. 'loss of top').

The results of these analyses are given as Tables V and V1 attached to the report in Appendix B, and are presented graphically in Drawings 3 and 4, Appendix C.

A summary is given in Table 1 below.

Table 3: Summary of Pillar Stability Analysis – VT Seam

Table No:	V	V1
Full Seam Thickness (m)	3.03	3.03
Pillar Height Section (m)	2.39	3.03
Working Section (m)	2.39	2.39
Pillar Dimensions	RT403	RT403
Min. W:H Ratio	2.3	1.8
Max W:H Ratio	24.1	19.0
Max FoS	50.08	27.96
Min FoS	1.16	0.95
Panel FoS	8.55 (4.35 if Pillar 45 is not considered)	5.4 (3.1 if Pillar 45 is not considered)

Notes to Table 3: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

From Table 1 above, and the attached analysis, the following is noted:

- For the scenario whereby the pillar height section is equal to the working section of 2.39 m:
    - All but six of the 108 pillars analysed have factors of safety (FoS) of greater than 2.1, indicating that they are likely to be long term stable;

- o Of the six pillars with FoS<2.1, only one of these pillars (Pillar 13), has a factor of safety of less than 1.6, indicating a probability of failure of greater than 1 in 1000 of this individual pillar;
- o The overall panel factor of safety of the VT Seam pillars subject to analysis is 8.55, or 4.35 if the influence of the very large pillar, Pillar 45, is ignored. This indicates that the panel of workings is long term stable overall, with a probability of failure of less than 1 in 1,000,000.

- For the scenario whereby the pillar height section is equal to the full seam thickness of 3.03 m:
  - o 18 of the 108 pillars analysed have FOS<2.1, and five of these pillar have FoS<1.6;
  - o Pillar 13 has a factor of safety of 0.95 m under this scenario, indicating that it would be likely to have crushed;
  - o The overall panel factor of safety is 5.4, or 3.1 if the influence of Pillar 45 is ignored. This indicates that the panel of workings would be long term stable overall, with the load from any localised failed pillars able to be readily accommodated by adjacent, larger pillars within the panel.

Based on the above, the workings in the VT Seam are considered long term stable and therefore subsidence associated with pillar failure in the VT Seam has not been further assessed.

4.1.3 Dudley Seam

The pillar stability analysis for the Dudley Seam workings was undertaken for a total of 192 pillars within, and adjacent to, the projected angle of draw relative to the boundaries of Lots 1 to 3. The pillars which were indexed for use in the analysis are shown on Drawing 1 in Appendix C. All pillar dimensions were measured from RT 691.

Due to mapped second workings (full pillar extraction) beneath the site, resulting abutment loads were applied to selected pillars.

Based on a review of the available data as described above, a seam thickness of 1.7 m and working section of 1.7 m has been assumed for the analysis of pillar stability in the Dudley Seam workings beneath the site. It is considered that this represents a reasonable estimate of the seam thickness and working section beneath the site, and is consistent with the data presented in Ref 5.

The sensitivity of pillar stability to working section height was also assessed. The sensitivity analysis used a seam thickness of 2.0 m, which is the largest seam thickness reported in the Ref 5 study in the vicinity of the site. The working section was again taken as equal to the full seam thickness for the sensitivity analysis. It is considered this would likely represent an over-estimate of the seam thickness and working section beneath the site.

For the purpose of analysis, the pillars subject to assessment were separated into eight panels, denoted Panels A to H, as shown in Drawing 1, Appendix C.

The results of these analyses are given as Tables A to H and A1 to H1 attached to the report in Appendix B, and are presented graphically in Drawings 5 and 6, Appendix C.

A summary is given in Tables 4 to 11 below.

Table 4: Summary of Pillar Stability Analysis – Dudley Seam – Panel A

Table No:	A	A1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	9.7	8.3
Max W:H Ratio	17.6	15.0
Max FoS	5.2	3.56
Min FoS	1.78	1.35
Panel FoS	4.10	2.85

Notes to Table 4: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 5: Summary of Pillar Stability Analysis – Dudley Seam – Panel B

Table No:	B	B1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	9.7	8.3
Max W:H Ratio	11.2	9.5
Max FoS	2.41	1.77
Min FoS	1.11	0.84
Panel FoS	1.71	1.28

Notes to Table 5: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 6: Summary of Pillar Stability Analysis – Dudley Seam – Panel C

Table No:	C	C1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	4.1	3.5
Max W:H Ratio	28.2	24.0
Max FoS	30.9	20.54
Min FoS	0.79	0.66
Panel FoS	10.85 (3.55 if Pillar H is not considered)	7.42 (2.65 if Pillar H is not considered)

Notes to Table 6: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 7: Summary of Pillar Stability Analysis – Dudley Seam – Panel D

Table No:	D	D1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	4.1	3.5
Max W:H Ratio	12.4	10.6
Max FoS	7.65	5.65
Min FoS	1.02	0.86
Panel FoS	4.53	3.41

Notes to Table 7: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 8: Summary of Pillar Stability Analysis – Dudley Seam – Panel E

Table No:	E	E1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	10.3	8.8
Max W:H Ratio	12.5	10.6
Max FoS	3.49	2.6
Min FoS	1.30	0.97
Panel FoS	2.38	1.73

Notes to Table 8: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 9: Summary of Pillar Stability Analysis – Dudley Seam – Panel F

Table No:	F	F1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	9.6	8.2
Max W:H Ratio	15.7	13.4
Max FoS	8.72	6.06
Min FoS	0.84	0.61
Panel FoS	3.41 (1.61 if Pillar 114 is not considered)	2.43 (1.21 if Pillar 114 is not considered)

Notes to Table 9: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 10: Summary of Pillar Stability Analysis – Dudley Seam – Panel G

Table No:	G	G1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	7.2	6.2
Max W:H Ratio	12.6	10.8
Max FoS	1.55	1.11
Min FoS	0.23	0.19
Panel FoS	1.06	0.77

Notes to Table 10: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

Table 11: Summary of Pillar Stability Analysis – Dudley Seam – Panel H

Table No:	H	H1
Full Seam Thickness (m)	1.7	2.0
Pillar Height Section (m)	1.7	2.0
Working Section (m)	1.7	2.0
Pillar Dimensions	RT691	RT691
Min. W:H Ratio	7.6	6.5
Max W:H Ratio	12.4	10.6
Max FoS	3.94	2.89
Min FoS	0.32	0.25
Panel FoS	1.52	1.13

Notes to Table 11: Panel Factor of Safety (FoS) is total strength of pillars (kN) / total load on pillars (kN)

From Tables 4 to 11 above, and the attached analysis, the following is noted:

- Panel A
  - For a working height of 1.7 m, the pillars with the greatest risk of failure are Pillars A1 to A3, which have a factor of safety of 1.78, equating to a probability of failure of less than 1 in 10,000. The overall panel factor of safety is 4.1, indicating that the panel would be long term stable (probability of failure of less than 1 in 1,000,000);
  - For a working height of 2 m, the individual factors of safety for pillars A1 to A3 reduce to 1.35, indicating the pillars are marginally stable. The panel factor of safety reduces to 2.85 under this scenario, indicating that the probability of failure of the overall panel remains greater than 1 in 1,000,000.

- Panel B
  - For a working height of 1.7 m, the pillars with the greatest risk of failure are Pillars D and E, which have a factor of safety of 1.3 and 1.11 respectively. The overall panel factor of safety is 1.71, indicating a probability of overall panel failure of less than 1 in 10,000;
  - For a working height of 2 m, the individual factors of safety for Pillars D and E are less than 1, indicating that they would likely have crushed. Pillars F1 and F2 have factors of safety of 1.35 and 1.37 respectively, while the panel factor of safety reduces to 1.28 under this scenario, indicating marginal overall stability of the panel.
- Panel C
  - For a working height of 1.7 m, the pillars with the greatest risk of failure are Pillars M1 and M2, which have factors of safety of 0.79 and 1.73 respectively, while the remaining pillars in the panel have factors of safety of greater than 2.1. The overall panel factor of safety is 10.85, or 3.55 if Pillar H, which is a very large pillar located in the northern part of the panel, is removed from the analysis. The analysis suggests that the panel is likely to be long term stable overall, apart from Pillar M1, which would likely have crushed;
  - For a working height of 2 m, pillar M1 has a factor of safety of 0.66, indicating that it would likely have crushed, while pillars M2 to P have factors of safety ranging from 1.44 to 2.05. Remaining pillars have factors of safety greater than 2.1. The overall panel factor of safety is 7.42, or 2.65 if Pillar H is removed from the analysis, indicating that the panel is likely to be long term stable overall.
- Panel D
  - For a working height of 1.7 m, the pillars with the greatest risk of failure are Pillars 19, 92, 95 to 100 and 102, which have a factor of safety of less than 1.6, equating to a probability of failure of greater than 1 in 1,000. The overall panel factor of safety is 4.53, indicating that the panel would be long term stable (probability of failure of less than 1 in 1,000,000);
  - For a working height of 2 m, Pillar 102 has a factor of safety of 0.86, indicating it would likely have crushed. The panel factor of safety reduces to 3.41 under this scenario, indicating that the probability of failure of the overall panel remains greater than 1 in 1,000,000.
- Panel E
  - For a working height of 1.7 m, the pillars with the greatest risk of failure are Pillars 104 and 105, which have a factor of safety of 1.3, indicating marginal stability. The overall panel factor of safety is 2.38, indicating that the panel in stable overall, with a probability of failure of less than 1 in 1,000,000;
  - For a working height of 2.0 m, Pillars 104 and 105 have factors of safety of 0.97, indicating that they are likely to have failed. The overall panel factor of safety reduces to 1.73 under this scenario, indicating that the panel has an overall probability of failure of about 1 in 10,000).
- Panel F
  - For working heights of both 1.7 m and 2.0 m, the analysis indicates that pillars 115 to 117 are likely to have failed, with FoS<1 under both scenarios. Pillars 114 and 118 are likely to be long term stable, with analysis indicating probabilities of failure of less than 1 in 1,000,000.

- Panel G
    - o For a working height of 1.7 m, the panel factor of safety is 1.06, indicating overall marginal stability of the panel. All pillars have FoS<1.6, with 11 of the 19 pillars exhibiting FoS<1;
    - o For a working height of 2 m, 16 of the 19 pillars have factors of safety equal to or less than 1, and the panel factor of safety is 0.77, indicating that the panel is likely to have crushed under this scenario.
- Panel H
    - o For a working height of 1.7 m, 15 of the 27 pillars in the panel have FoS<1.6, and 2 of these have FoS<1, indicating that they are likely to have failed. The overall panel factor of safety is 1.52, indicating that the probability of failure of the panel is less than 1 in 100.
    - o For a working height of 2.0 m, 21 of the 27 pillars in the panel have FoS<1.6, and 10 of these have FoS<1. The overall panel factor of safety is 1.13, indicating marginal overall stability of the panel (overall probability of failure of greater than 1 in 10);

From the above, it can be seen that the analysis is sensitive to the actual worked section within the Dudley Seam. The analysis indicates that, depending on the actual worked section, Panels B, F, G and H are a credible risk of failure, whilst failure of other, localised, pillars is also likely. The analysis indicates that Panels A, C and D are likely to be long term stable overall, while Panel E may also be long term stable, depending on the actual worked seam section.

4.2 Subsidence Prediction

4.2.1 Actual Subsidence – Dudley Seam

The study described in Section 3.2.2 (Ref 5) presents the results of survey monitoring of mine subsidence in the “6 NW” and “4 NW” panels, which underlie the subject site, both during and at the completion of mining. Of these two panels, the magnitude of observed subsidence was greatest for the “6 NW” panel. Further details are provided below.

The survey alignment for “6 NW” panel was along South Street, immediately adjacent to the subject site, and covered a distance of approximately 400 m. The alignment which was surveyed spans a number of panels of second workings (full pillar extraction) and intermediate chain pillars, including the areas represented by Panels A and B (refer Drawing 1).

The data indicates that the maximum subsidence following mining was approximately 180 mm over the surveyed alignment of the “6 NW” panel. Based on the data presented, the subsidence over this panel appeared to be substantially complete by January 1982, less than one year following the completion of mining within the panel.

The maximum reported ‘slope change’ (i.e. tilt) along the survey alignment on South Street during the survey period was 0.14%, or 1.4 mm/m.

4.2.2 Subsidence Parameters – Dudley Seam

The actual subsidence over bord and pillar workings varies with the size and location of the pillars, pillar extraction areas and any unmined areas. However, values of possible subsidence can be estimated by the use of the Newcastle Coalfields Longwall Guidelines (Ref 4) and reducing height of the working section to account for the average extraction ratio of the panel.

In this instance, subsidence parameters have been back calculated using the known value of maximum measured subsidence previously measured at the site. Given the mining geometry beneath and adjacent to the site, the maximum subsidence which has already occurred in the vicinity of the site would not be expected to be exceeded due to any potential future crush of pillars which remain in place.

A maximum subsidence value (S_{max}) of 200 mm was adopted for the purpose of analysis.

The resulting values of strains, tilt and curvature are considered to be limiting values for the available mine data as described in this report. For this reason, the values are denoted 'worst credible' subsidence parameters.

Estimates of 'worst credible' subsidence parameters were undertaken for the case of S_{max} = 200 mm, and a working section of 1.7 m at 170 m depth (Lot 1) and 150 m depth (Lots 2 and 3), using the methods outlined in Ref 4; the results are presented in Table 7.

Table 7: Worst Credible Subsidence Parameters

	Lot 1	Lots 2 and 3
Working Section	1.7 m	
Maximum Surface Subsidence (m)	0.2	
Maximum Tensile Strain (mm/m)	0.5	
Maximum Compressive Strain (mm/m)	0.7	0.8
Maximum Tilt (mm/m)	2.1	2.4
Minimum Radius of Curvature (km)	13 km	12 km

4.3 Conclusion and Recommendations

Based on the review of available information, and the results of the pillar stability analysis and risk assessment, it is DP's opinion that:

- The risk of future mine subsidence affecting the subject site due to workings within the VT Seam is barely credible;

- There is some risk of future mine subsidence affecting the subject site due to failure of pillars within the Dudley Seam workings.

It is considered good practice to accommodate the 'worst credible' effects of mine subsidence in the event that a pillar failure may occur in the future.

It is therefore recommended that the proposed development should be designed to accommodate the mine subsidence parameters presented in Table 7.

5. References

1. Douglas Partners Pty Ltd, "Report on Desk Study of Mine Subsidence Risk, Proposed Masters Home Improvement Development, Pacific Highway, Windale", Project No. 49710.01 dated April 2012.
2. Taylor, G H, "Petrographic Data on some New South Wales Coals", Commonwealth Scientific and Industrial Research Organisation miscellaneous report 242, November 1963.
3. Galvin, J M, Hebblewhite B K, Salamon M D G and Lin B B, "Establishing the Strength of Rectangular and Irregular Pillars", Final Report for ACARP Project C5024, 1998.
4. Holla, L, "Mining subsidence in New South Wales – 2. Surface subsidence prediction in the Newcastle Coalfield", Department of Mineral Resources, ISBN 0 7305 1522 2 (Volume 2, January 1987).
5. William Arthur Kapp PhD thesis (1984) "Mine subsidence and strata control in the Newcastle district on the northern coalfield New South Wales Study 8, Use of the panel and pillar system to control subsidence in residential and light industrial areas", Department of Civil and Mining Engineering.

6. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 4B South Street, Bennetts Green in accordance with DP's email proposal dated 24 November 2017 and email acceptance received from Mr Matthew Skerrett of Blueprint dated 24 November 2017 acting on behalf of SPG Investments Pty Ltd. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of SPG Investments Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DP's advice is based upon the conditions inferred as part of this desk study investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site and by mining conditions beneath the site.

The data on which the mine subsidence assessment is based includes mine plans previously obtained by DP from the NSW Department of Industry. The mine plans, however, were prepared by third parties and not by the Department, nor by the NSW Government nor by DP. These organisations were not responsible for preparation of the mine plans and provide no warranty that the data are complete, current or accurate in the depiction of the mine workings.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Table A – Pillar Stability Analysis, Panel A – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table B – Pillar Stability Analysis, Panel B – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table C – Pillar Stability Analysis, Panel C – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table D – Pillar Stability Analysis, Panel D – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table E – Pillar Stability Analysis, Panel E – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table F – Pillar Stability Analysis, Panel F – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table G – Pillar Stability Analysis, Panel G – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table H – Pillar Stability Analysis, Panel H – Measured Pillar Dimensions – Pillar Height = Working Section = 1.7 m
Table A1 – Pillar Stability Analysis, Panel A – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table B1 – Pillar Stability Analysis, Panel B – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table C1 – Pillar Stability Analysis, Panel C – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table D1 – Pillar Stability Analysis, Panel D – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table E1 – Pillar Stability Analysis, Panel E – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table F1 – Pillar Stability Analysis, Panel F – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table G1 – Pillar Stability Analysis, Panel G – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table H1 – Pillar Stability Analysis, Panel H – Measured Pillar Dimensions – Pillar Height = Working Section = 2.0 m
Table V – Pillar Stability Analysis, VT Seam – Measured Pillar Dimensions – Pillar Height = Working Section 2.39 m
Table V1 – Pillar Stability Analysis, VT Seam - Measured Pillar Dimensions Working Section 2.39 m, Pillar Height = 3.03 m

Table A - Pillar Stability Analysis, Panel A - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
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Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	24/11/17
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT		

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
A1-A3	Full abut loads	170.0	1.7	1.7	1.7	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	9.7	1.320	1.320	6.64	3506	A		7241.9		20.36	36.17	19100	1.78	1.6E-04
B	Full abut loads	172.0	1.7	1.7	1.7	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	17.6	1.032	1.032	5.96	5724	A		11622.2		18.07	93.96	90206	5.20	6.3E-26
C	Full abut loads	174.0	1.7	1.7	1.7	25	18.5	33.0	90.0	5.0	5.5	32.5	610.5	904.8	10.9	1.282	1.282	6.45	3936	A		5864.6		16.05	42.60	26008	2.65	5.2E-10
W1	Full/70% abut loads	168.0	1.7	1.7	1.7	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	17.6	1.032	1.032	5.82	5591	A		14992.4		21.44	93.96	90206	4.38	8.2E-21
W2	Full/30% abut loads	167.0	1.7	1.7	1.7	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	17.6	1.032	1.032	5.79	5558	A		12991.7		19.32	93.96	90206	4.86	8.1E-24
												Total	4018.5	5723.5														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered (refer to text)

Panel Extraction Ratio 0.30

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS	
	Max	5.20	
	Min	1.78	
	Mean	3.78	
Panel Factor of safety Based on Tributary load			
Total Pillar Load		77028.26	MN
Total Pilla Capacity		315725.04	MN
Panel FoS		4.10	

Table B - Pillar Stability Analysis, Panel B - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

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Mine Workings - RT691 - Dudley Seam
Client: SPG Investments Pty Ltd
Project: Proposed Commercial Development
Date: 24/11/17
Location: 4B South Street, Bennetts Green
Sheet: 1
Project No: 49710.01
Analysis Assumptions: Pillar dimensions from RT

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Probability of Failure
D	Full/70% abut loads	169.0	1.7	1.7	1.7	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	9.7	1.320	1.320	6.60	3486	A		11253.8		27.92	36.17	19100	1.30	4.8E-02
E	Full/70% abut loads	170.0	1.7	1.7	1.7	25	16.5	29.5	90.0	5.5	5.5	36.8	486.8	770.0	9.7	1.283	1.283	6.72	3273	A		12395.3		32.19	35.65	17355	1.11	2.9E-01
F1	Full abut loads	170.5	1.7	1.7	1.7	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	9.7	1.320	1.320	6.66	3517	A		7178.3		20.26	36.17	19100	1.79	1.4E-04
F2	Full abut loads	171.0	1.7	1.7	1.7	25	16.5	32.0	90.0	4.5	5.5	33.0	528.0	787.5	9.7	1.320	1.320	6.38	3367	A		7178.3		19.97	36.17	19100	1.81	9.6E-05
G1	Full abut loads	171.5	1.7	1.7	1.7	25	19.0	32.0	90.0	4.5	5.5	31.0	608.0	881.3	11.2	1.255	1.255	6.21	3778	A		8229.4		19.75	44.04	26776	2.23	2.3E-07
G2	Full abut loads	172.0	1.7	1.7	1.7	25	19.0	32.0	90.0	4.5	5.5	31.0	608.0	881.3	11.2	1.255	1.255	6.23	3789	A		7332.3		18.29	44.04	26776	2.41	1.8E-08
												Total	3286.8	4970.0														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5 Pillar Height should be the same as the working section unless roof collapse is being considered

Summary		FoS
	Max	2.41
	Min	1.11
	Mean	1.77

Panel Extraction Ratio 0.34

Panel Factor of safety Based on Tributary load

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Total Pillar Load	74776.38	MN
Total Pilla Capacity	128207.00	MN
Panel FoS	1.71	

Table C - Pillar Stability Analysis, Panel C - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 24/11/17
Sheet: 1

Douglas Partners
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Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
H	Full abut loads	161.5	1.7	1.7	1.7	25	48.0	76.0	90.0	5.5	5.5	16.3	3648.0	4360.3	28.2	1.226	1.226	4.83	17605	A		15440.1		9.06	279.91	1021107	30.90	1.5E-186
J1	30%/70% abut loads	164.0	1.7	1.7	1.7	25	17.0	34.0	90.0	5.5	5.5	35.0	578.0	888.8	10.0	1.333	1.333	6.30	3644	A		3111.5		11.69	38.04	21986	3.25	9.1E-14
J2	30%/70% abut loads	164.0	1.7	1.7	1.7	25	17.0	34.0	90.0	5.5	5.5	35.0	578.0	888.8	10.0	1.333	1.333	6.30	3644	A		3663.8		12.64	38.04	21986	3.01	3.1E-12
K	70% abut load	164.5	1.7	1.7	1.7	25	17.5	30.5	90.0	4.5	5.5	32.6	533.8	792.0	10.3	1.271	1.271	6.10	3257	A		2443.2		10.68	38.82	20718	3.63	3.8E-16
L	70% abut load	165.0	1.7	1.7	1.7	25	18.0	30.0	90.0	4.5	5.5	32.4	540.0	798.8	10.6	1.250	1.250	6.10	3295	A		2681.3		11.07	40.24	21731	3.64	3.8E-16
M1	Full abut load	170.0	1.7	1.7	1.7	25	7.0	31.0	90.0	4.5	5.0	47.6	217.0	414.0	4.1	1.632	1.200	8.11	1760	A		2711.2		20.60	16.30	3538	0.79	1.0E+00
M2	70% abut load (M1)	171.5	1.7	1.7	1.7	25	7.0	31.0	90.0	4.5	5.0	47.6	217.0	414.0	4.1	1.632	1.200	8.18	1775	A		267.8		9.41	16.30	3538	1.73	3.0E-04
N	70% abut load	168.0	1.7	1.7	1.7	25	19.5	19.0	90.0	4.5	5.5	37.0	370.5	588.0	11.5	0.987	0.987	6.67	2470	A		2921.9		14.55	40.70	15079	2.80	6.6E-11
P	70%/70% abut loads	169.0	1.7	1.7	1.7	25	18.0	45.0	90.0	4.5	5.5	28.7	810.0	1136.3	10.6	1.429	1.429	5.93	4801	A		11013.2		19.52	43.08	34893	2.21	3.2E-07
Q	30%/30% abut loads	168.0	1.7	1.7	1.7	25	20.0	30.0	90.0	4.5	5.5	31.0	600.0	869.8	11.8	1.200	1.200	6.09	3653	A		1947.6		9.33	46.95	28169	5.03	7.3E-25
R	No abut load	169.0	1.7	1.7	1.7	25	22.0	25.5	90.0	6.0	5.5	35.4	561.0	868.0	12.9	1.074	1.074	6.54	3667						52.51	29459	8.03	1.2E-43
S	70%/30% abut loads	162.0	1.7	1.7	1.7	25	19.5	39.0	74.0	5.5	5.5	31.6	760.5	1112.5	11.5	1.316	1.316	5.92	4506	A		3811.4		10.94	47.12	35838	4.31	2.3E-20
T	70%/30% abut loads	162.0	1.7	1.7	1.7	25	15.5	39.0	74.0	5.5	5.5	35.3	604.5	934.5	9.1	1.415	1.415	6.26	3785	A		2606.3		10.57	34.25	20707	3.24	1.1E-13
U	30% abut load	165.0	1.7	1.7	1.7	25	13.0	70.0	90.0	5.5	5.5	34.8	910.0	1396.8	7.6	1.687	1.687	6.33	5762	A		3351.6		10.01	29.98	27279	2.99	3.9E-12
V	No abut load	168.0	1.7	1.7	1.7	25	22.0	31.0	90.0	5.0	6.0	31.7	682.0	999.0	12.9	1.170	1.170	6.15	4196						54.86	37414	8.92	3.7E-49
												Total	11610.3	16461.3														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.29

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	30.90
	Min	0.79
	Mean	5.63

Panel Factor of safety Based on Tributary load

Total Pillar Load	123787.88	MN
Total Pilla Capacity	1343441.79	MN
Panel FoS	10.85	

Table D - Pillar Stability Analysis, Panel D - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Power Law Probability of Failure
1	Panel D	142.0	1.7	1.7	1.7	25	18.3	18.9	90.0	6.1	5.6	42.1	345.9	597.8	10.8	1.016	1.016	6.14	2122	A		3805.3		17.14	37.18	12861	2.17	5.5E-07
2	Panel D	142.0	1.7	1.7	1.7	25	18.3	18.3	90.0	6.1	5.6	42.6	334.9	583.2	10.8	1.000	1.000	6.18	2070	A		671.5		8.19	36.88	12351	4.50	1.4E-21
3	Panel D	142.0	1.7	1.7	1.7	25	18.3	18.6	90.0	6.1	5.6	42.4	340.4	590.5	10.8	1.008	1.008	6.16	2096						37.03	12606	6.01	5.2E-31
4	Panel D	141.0	1.7	1.7	1.7	25	18.8	26.4	90.0	6.1	6.1	38.7	496.3	809.3	11.1	1.168	1.168	5.75	2853						41.72	20707	7.26	8.6E-39
5	Panel D	142.0	1.7	1.7	1.7	25	18.9	18.9	90.0	6.3	6.1	43.3	357.2	630.0	11.1	1.000	1.000	6.26	2237						38.88	13889	6.21	3.1E-32
6	Panel D	141.0	1.7	1.7	1.7	25	19.2	21.7	90.0	6.0	6.0	40.3	416.6	698.0	11.3	1.061	1.061	5.91	2461						41.14	17141	6.97	5.8E-37
7	Panel D	141.0	1.7	1.7	1.7	25	15.6	19.2	90.0	6.0	6.4	45.8	299.5	553.0	9.2	1.103	1.103	6.51	1949						30.45	9120	4.68	1.1E-22
8	Panel D	142.0	1.7	1.7	1.7	25	11.5	20.6	90.0	6.0	6.0	49.1	236.9	465.5	6.8	1.283	1.283	6.98	1653						22.96	5439	3.29	5.4E-14
9	Panel D	142.0	1.7	1.7	1.7	25	10.1	16.3	90.0	6.0	5.9	53.9	164.6	357.4	5.9	1.235	1.230	7.71	1269						20.14	3315	2.61	9.4E-10
10	Panel D	141.0	1.7	1.7	1.7	25	9.9	13.3	90.0	6.0	5.9	56.9	131.7	305.3	5.8	1.147	1.137	8.17	1076						19.07	2511	2.33	5.2E-08
11	Panel D	140.0	1.7	1.7	1.7	25	9.9	18.7	90.0	6.2	6.6	54.6	185.1	407.3	5.8	1.308	1.287	7.70	1426						20.31	3760	2.64	6.6E-10
12	Panel D	142.0	1.7	1.7	1.7	25	18.7	23.5	74.0	6.0	6.3	40.3	439.5	736.1	11.0	1.094	1.094	5.95	2613						40.00	17578	6.73	1.8E-35
13	Panel D	141.0	1.7	1.7	1.7	25	18.6	24.7	74.0	6.0	6.3	39.8	459.4	762.6	10.9	1.121	1.121	5.85	2688						40.15	18446	6.86	2.6E-36
14	Panel D	141.0	1.7	1.7	1.7	25	19.2	25.5	90.0	5.9	6.0	38.1	489.6	790.7	11.3	1.141	1.141	5.69	2787						42.69	20902	7.50	2.7E-40
15	Panel D	142.0	1.7	1.7	1.7	25	18.5	28.2	90.0	6.2	6.2	38.6	521.7	849.7	10.9	1.208	1.208	5.78	3016						41.33	21562	7.15	4.2E-38
16	Panel D	141.0	1.7	1.7	1.7	25	9.0	18.1	90.0	6.3	6.4	56.5	162.9	374.9	5.3	1.336	1.248	8.11	1321						18.80	3062	2.32	6.6E-08
17	king section unless ro	141.0	1.7	1.7	1.7	25	18.7	19.2	90.0	6.0	6.0	42.3	359.0	622.4	11.0	1.013	1.013	6.11	2194						38.46	13809	6.29	9.2E-33
18	Panel D	142.0	1.7	1.7	1.7	25	18.8	31.2	90.0	6.4	5.8	37.1	586.6	932.4	11.1	1.248	1.248	5.64	3310						43.15	25312	7.65	3.2E-41
19	Panel D	142.0	1.7	1.7	1.7	25	7.2	18.4	90.0	6.4	5.9	59.9	132.5	330.5	4.2	1.438	1.161	8.86	1173						16.27	2155	1.84	6.6E-05
20	Panel D	142.0	1.7	1.7	1.7	25	18.4	18.6	90.0	6.1	6.0	43.2	342.2	602.7	10.8	1.005	1.005	6.25	2140	A		1573.3		10.85	37.31	12769	3.44	6.4E-15
21	Panel D	142.0	1.7	1.7	1.7	25	18.3	18.7	90.0	6.2	6.0	43.5	342.2	605.2	10.8	1.011	1.011	6.28	2148	A		674.3		8.25	37.08	12690	4.50	1.6E-21
22	Panel D	142.0	1.7	1.7	1.7	25	18.4	19.0	90.0	6.0	6.3	43.4	349.6	617.3	10.8	1.016	1.016	6.27	2191						37.51	13114	5.98	8.0E-31
23	Panel D	142.0	1.7	1.7	1.7	25	16.0	18.2	74.0	6.3	6.1	46.3	291.2	541.9	9.4	1.045	1.045	6.61	1924						30.70	8939	4.65	1.8E-22
24	Panel D	142.0	1.7	1.7	1.7	25	18.5	19.2	74.0	6.3	6.1	43.4	355.2	627.4	10.9	0.999	0.999	6.27	2227						37.52	13326	5.98	8.1E-31
25	Panel D	142.0	1.7	1.7	1.7	25	18.1	18.9	90.0	6.2	6.2	43.9	342.1	609.9	10.6	1.022	1.022	6.33	2165						36.63	12531	5.79	1.3E-29
26	Panel D	142.0	1.7	1.7	1.7	25	18.8	18.8	90.0	6.3	6.1	43.4	353.4	625.0	11.1	1.000	1.000	6.28	2219						38.54	13622	6.14	8.5E-32
27	Panel D	142.0	1.7	1.7	1.7	25	17.6	44.0	90.0	6.3	6.2	35.5	774.4	1199.8	10.4	1.429	1.429	5.50	4259						41.57	32193	7.56	1.2E-40
28	Panel D	143.0	1.7	1.7	1.7	25	18.4	19.0	90.0	5.9	6.0	42.5	349.6	607.5	10.8	1.016	1.016	6.21	2172	A		1582.5		10.74	37.51	13114	3.49	2.9E-15
29	Panel D	143.0	1.7	1.7	1.7	25	19.0	19.2	90.0	5.9	6.1	42.1	364.8	630.0	11.2	1.005	1.005	6.17	2252	A		695.0		8.08	39.33	14347	4.87	7.5E-24
30	Panel D	143.0	1.7	1.7	1.7	25	18.9	19.1	90.0	6.3	6.0	42.9	361.0	632.5	11.1	1.005	1.005	6.26	2261						38.99	14074	6.22	2.5E-32
31	Panel D	143.0	1.7	1.7	1.7	25	16.1	18.9	90.0	6.5	6.2	46.4	304.3	567.3	9.5	1.080	1.080	6.66	2028						31.50	9587	4.73	5.7E-23
32	Panel D	143.0	1.7	1.7	1.7	25	18.6	18.9	90.0	6.2	6.1	43.3	351.5	620.0	10.9	1.008	1.008	6.31	2217						38.02	13367	6.03	4.1E-31
33	Panel D	143.0	1.7	1.7	1.7	25	18.1	18.7	90.0	6.4	6.0	44.1	338.5	605.2	10.6	1.016	1.016	6.39	2163						36.53	12366	5.72	3.8E-29
34	Panel D	143.0	1.7	1.7	1.7	25	19.1	19.0	90.0	6.2	6.2	43.1	362.9	637.6	11.2	0.997	0.997	6.28	2279						39.52	14340	6.29	9.5E-33
35	Panel D	145.0	1.7	1.7	1.7	25	18.5	18.8	74.0	6.2	6.2	43.7	347.8	617.5	10.9	0.988	0.988	6.44	2238						37.31	12978	5.80	1.2E-29
36	Panel D	144.0	1.7	1.7	1.7	25	18.1	20.3	74.0	6.3	6.1	43.0	367.4	644.2	10.6	1.038	1.038	6.31	2319						36.92	13566	5.85	5.5E-30
37	Panel D	145.0	1.7	1.7	1.7	25	18.2	18.6	90.0	6.3	6.1	44.1	338.5	605.2	10.7	1.011	1.011	6.48	2194						36.76	12443	5.67	7.1E-29
38	Panel D	145.0	1.7	1.7	1.7	25	18.3	18.9	90.0	6.1	5.9	42.8	345.9	605.1	10.8	1.016	1.016	6.34	2194	A		1633.8		11.07	37.18	12861	3.36	2.0E-14
39	Panel D	145.0	1.7	1.7	1.7	25	18.6	19.0	90.0	6.0	5.9	42.3	353.4	612.5	10.9	1.011	1.011	6.28	2220	A		705.9		8.28	38.08	13456	4.60	3.7E-22
40	Panel D	145.0	1.7	1.7	1.7	25	18.6	18.9	90.0	6.0	6.4	43.5	351.5	622.4	10.9	1.008	1.008	6.42	2256						38.02	13367	5.92	1.9E-30
41	Panel D	145.0	1.7	1.7	1.7	25	16.3	18.2	90.0	6.3	6.2	46.2	296.7	551.4	9.6	1.055	1.055	6.74	1999						31.70	9404	4.70	7.9E-23
42	Panel D	145.0	1.7	1.7	1.7	25	18.2	18.5	90.0	6.1	6.0	43.4	336.7	595.4	10.7	1.008	1.008	6.41	2158						36.71	12360	5.73	3.2E-29
43	Panel D	145.0	1.7	1.7	1.7	25	18.5	19.0	90.0	6.1	6.0	42.8	351.5	615.0	10.9	1.013	1.013	6.34	2229						37.79	13284	5.96	1.1E-30
44	Panel D	145.0	1.7	1.7	1.7	25	18.6	19.2	90.0	6.1	6.0	42.6	357.1	622.4	10.9	1.016	1.016	6.32	2256						38.18	13633	6.04	3.4E-31
45	Panel D	145.0	1.7	1.7	1.7	25	18.6	19.2	90.0	6.1	6.0	42.6	357.1	622.4	10.9	1.016	1.016	6.32	2256						38.18	13633	6.04	3.4E-31
46	Panel D	145.0	1.7	1.7	1.7	25	18.6	18.7	74.0	6.2	6.0	43.2	347.8	612.6	10.9	0.983	0.983	6.38	2221						37.54	13057	5.88	3.6E-30
47	Panel D	145.0	1.7	1.7	1.7	25	18.4	20.8	74.0	6.3	6.1	42.4	382.7	664.4	10.8	1.042	1.042	6.29	2409						37.99	14539	6.04	3.8E-31
48	Panel D	145.0	1.7	1.7	1.7	25	18.5	18.5	90.0	6.4	6.2	44.4	342.3	615.0	10.9	1.000	1.000	6.51	2229						37.54	12847	5.76	1.9E-29
49	Panel D	146.0	1.7	1.7	1.7	25	16.5	18.5	90.0	6.2	6.0	45.1	305.3	556.2	9.7	1.057	1.057	6.65	2030	A		1541.0		11.70	32.31	9861	2.76	1.1E-10
50	Panel D	146.0	1.7	1.7	1.7	25	16.5	18.6	90.0	6.2	6.2	45.5	306.9	563.0	9.7	1.060	1.060	6.70	2055	A		1541.0		11.72	32.35	9928	2.76	1.1E-10
51	Panel D	146.0	1.7	1.7	1.7	25	16.4	18.2	90.0	6.0	6.1	45.2	298.5	544.3	9.6	1.052	1.052	6.66	1987	A		651.7		8.84	31.94	9533	3.61	5.3E-16
52	Panel D	146.0	1.7	1.7	1.7	25	16.6	19.2	90.0	6.0	6.1	44.3	318.7	571.8	9.8	1.073	1.073	6.55	2087						32.84	10467	5.02	9.0E-25
53	Panel D	146.0	1.7	1.7	1.7	25	16.7	18.8	90.0	5.9	6.1	44.2	314.0	562.7	9.8	1.059	1.059	6.54	2054						32.92	10337	5.03	7.0E-25
54	Panel D	146.0	1.7	1.7	1.7	25	16.8	17.6	90.0	5.7	6.3	45.0	295.7	537.8	9.9	1.023	1.023	6.64	1963						32.64	9652	4.92	3.7E-24
55	Panel D	146.0	1.7	1.7	1.7	25	16.7	18.5	90.0	5.8	6.1	44.2	309.0	553.5	9.8	1.051	1.051	6.54	2020						32.80	10133	5.02	9.0E-25
56	Panel D	146.0	1.7	1.7	1.7	25	16.7	18.7	74.0	6.0	6.2	44.7	312.3	565.2	9.8	1.037	1.037	6.61	2063						32.57	10171	4.93	3.1E-24
57	Panel D	146.0	1.7	1.7	1.7	25	16.6	18.4	74.0	6.0	6.2	45.1	305.4	556.0	9.8	1.032	1.032	6.64	2029						32.20	9834	4.85	1.0E-23
58	Panel D	146.0	1.7	1.7	1.7	25	17.3	18.1	90.0	5.9	6.2	44.5	313.1	563.8	10.2	1.023	1.023	6.57	2058						34.13	10687	5.19	7.0E-26
59	Panel D	146.0	1.7	1.7	1.7	25	17.6	19.6	90.0	5.8	6.2	42.9	345.0	603.7	10.4	1.054	1.054	6.39	2204						35.60	12279	5.57	3.0E-28
60	Panel D	146.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.40	2154						36.04	12128	5.63	1.3E-28
61	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183	A		708.5		8.59	36.04	12128	4.19	1.2E-19
62	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183	A		708.5		8.59	36.04	12128	4.19	1.2E-19
63	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
64	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
65	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
66	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
67	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	74.0	5.8	6.1	43.0	336.5	590.1	10.5	1.005	1.005	6.49	2183						35.68	12008	5.50	8.5E-28
68	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	74.0	5.8	6.1	43.0	336.5	590.1	10.5	1.005	1.005	6.49	2183						35.68	12008	5.50	8.5E-28
69	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
70	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
71	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
72	Panel D	148.0	1.7	1.7	1.7	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	10.5	1.025	1.025	6.49	2183						36.04	12128	5.55	3.9E-28
73	Panel D	148.0	1.7	1.7	1.7	25	16.9	17.6	90.0	5.9	6.1	45.0	297.4	540.4	9.9	1.020	1.020	6.72	1999						32.89	9782	4.89	5.3E-24
74	Panel D	151.0	1.7	1.7	1.7	25	18.5	29.9	90.0	6.2	6.6	38.6	553.2	901.6	10.9	1.236	1.236	6.15	3403						41.81	23129	6.80	6.7E-36
75	Panel D	151.0	1.7	1.7	1.7	25	9.0	28.5	90.0	5.8	6.4	50.3	256.5	516.5	5.3	1.520	1.377	7.60	1950						19.77	5070	2.60	1.1E-09
76	Panel D	151.0	1.7	1.7	1.7	25	8.3	29.6	90.0	6.0	6.2	52.0	245.7	511.9	4.9	1.562	1.323	7.87	1933						18.69	4592	2.38	2.8E-08
77	Panel D	151.0	1.7	1.7	1.7	25	8.5	30.2	90.0	5.7	6.3	50.5	256.7	518.3	5.0	1.561	1.346	7.62	1957						19.08	4899	2.50	4.5E-09
78	Panel D	151.0	1.7	1.7	1.7	25	8.5	30.0	90.0	6.1	6.0	51.5	255.0	525.6	5.0	1.558	1.344	7.78	1984						19.07	4864	2.45	9.6E-09
79	Panel D	151.0	1.7	1.7	1.7	25	8.7	28.9	74.0	6.0	6.0	51.0	251.4	513.0	5.1	1.523	1.346	7.70	1937						19.17	4820	2.49	5.6E-09
80	Panel D	151.0	1.7	1.7	1.7	25	8.3	29.0	74.0	5.7	6.5	51.6	240.7	497.0	4.9	1.541	1.312	7.79	1876						18.61	4480	2.39	2.4E-08
81	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943						19.03	4707	2.42	1.5E-08
82	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943						19.03	4707	2.42	1.5E-08
83	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943						19.03	4707	2.42	1.5E-08
84	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943						19.03	4707	2.42	1.5E-08
85	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943	A		451.3		9.68	19.03	4707	1.97	1.0E-05
86	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943	A		451.3		9.68	19.03	4707	1.97	1.0E-05
87	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943			0.0			19.03	4707	2.42	1.5E-08
88	Panel D	151.0	1.7	1.7	1.7	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	5.0	1.548	1.338	7.86	1943			0.0			19.03	4707	2.42	1.5E-08
89	Panel D	153.0	1.7	1.7	1.7	25	21.1	27.8	90.0	6.4	6.7	38.2	586.6	948.8	12.4	1.137	1.137	6.19	3629	A		878.6		7.68	50.16	29422	6.53	3.2E-34
90	Panel D	154.0	1.7	1.7	1.7	25	21.1	28.1	74.0	6.4	6.5	37.7	592.9	951.5	12.4	1.123	1.123	6.18	3663	A		890.2		7.68	49.84	29551	6.49	5.5E-34
91	Panel D	153.0	1.7	1.7	1.7	25	8.2	30.4	74.0	6.2	6.5	53.1	249.3	531.4	4.8	1.562	1.311	8.15	2032			0.0			18.49	4610	2.27	1.3E-07
92	Panel D	153.0	1.7	1.7	1.7	25	6.9	30.4	90.0	6.2	6.5	56.6	209.8	483.4	4.1	1.630	1.188	8.81	1849	A		418.6		10.81	16.10	3378	1.49	5.3E-03
93	Panel D	153.0	1.7	1.7	1.7	25	16.6	30.0	90.0	6.5	6.2	40.4	498.0	836.2	9.8	1.288	1.288	6.42	3199	A		1722.1		9.88	36.05	17951	3.65	3.2E-16
94	Panel D	153.0	1.7	1.7	1.7	25	17.0	28.4	90.0	6.2	6.3	40.0	482.8	805.0	10.0	1.251	1.251	6.38	3079	A		1729.6		9.96	36.82	17778	3.70	1.6E-16
95	Panel D	153.0	1.7	1.7	1.7	25	8.2	28.6	90.0	6.0	6.5	52.9	234.5	498.4	4.8	1.554	1.307	8.13	1906	A		1058.6		12.64	18.46	4330	1.46	7.4E-03
96	Panel D	153.0	1.7	1.7	1.7	25	8.0	28.6	90.0	6.0	6.5	53.4	228.8	491.4	4.7	1.563	1.289	8.22	1880	A		447.3		10.17	18.10	4142	1.78	1.5E-04
97	Panel D	153.0	1.7	1.7	1.7	25	8.0	29.6	90.0	6.3	6.4	54.0	236.8	514.8	4.7	1.574	1.294	8.32	1969	A		1066.1		12.82	18.14	4296	1.42	1.2E-02
98	Panel D	153.0	1.7	1.7	1.7	25	8.0	29.6	90.0	6.3	6.4	54.0	236.8	514.8	4.7	1.574	1.294	8.32	1969	A		456.9		10.24	18.14	4296	1.77	1.7E-04
99	Panel D	153.0	1.7	1.7	1.7	25	8.1	29.2	74.0	6.1	6.3	53.1	236.5	504.1	4.8	1.552	1.295	8.15	1928	A		1058.6		12.63	18.26	4319	1.45	8.8E-03
100	Panel D	153.0	1.7	1.7	1.7	25	7.9	29.2	74.0	6.1	6.3	53.6	230.7	497.0	4.6	1.561	1.277	8.24	1901	A		447.3		10.18	17.90	4129	1.76	2.1E-04
101	Panel D	153.0	1.7	1.7	1.7	25	9.0	28.9	90.0	6.2	6.5	51.7	260.1	538.1	5.3	1.525	1.381	7.91	2058						19.79	5148	2.50	4.7E-09
102	Panel D	153.0	1.7	1.7	1.7	25	7.0	17.1	90.0	6.1	6.1	60.6	119.7	303.9	4.1	1.419	1.139	9.71	1162	A		697.6		15.54	15.88	1901	1.02	4.5E-01
												Total	#REF!	#REF!														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio #REF!

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	7.65
	Min	1.02
	Mean	4.46

Panel Factor of safety Based on Tributary load

Total Pillar Load	250120.20	MN
Total Pilla Capacity	1133176.95	MN
Panel FoS	4.53	

Table E - Pillar Stability Analysis, Panel E- Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
103	Panel E	154.0	1.7	1.7	1.7	25	17.9	47.5	90.0	6.2	6.2	34.3	850.3	1294.2	10.5	1.453	1.453	5.86	4983	A		5520.7		12.35	43.06	36614	3.49	3.3E-15
104	Panel E	154.0	1.7	1.7	1.7	25	17.5	21.2	90.0	6.2	6.6	43.7	371.0	658.9	10.3	1.096	1.096	6.84	2537	A		7755.8		27.74	35.99	13351	1.30	4.8E-02
105	Panel E	154.0	1.7	1.7	1.7	25	17.5	21.2	90.0	6.2	6.6	43.7	371.0	658.9	10.3	1.096	1.096	6.84	2537	A		7755.8		27.74	35.99	13351	1.30	4.8E-02
106	Panel E	154.0	1.7	1.7	1.7	25	20.9	29.5	90.0	6.2	6.4	36.6	616.6	972.9	12.3	1.171	1.171	6.08	3746	A		8868.5		20.46	50.06	30864	2.45	1.0E-08
107	Panel E	154.0	1.7	1.7	1.7	25	20.9	29.5	90.0	6.2	6.4	36.6	616.6	972.9	12.3	1.171	1.171	6.08	3746	A		8868.5		20.46	50.06	30864	2.45	1.0E-08
108	Panel E	154.0	1.7	1.7	1.7	25	21.2	29.6	90.0	6.2	6.1	35.8	627.5	978.2	12.5	1.165	1.165	6.00	3766	A		8966.7		20.29	51.22	32143	2.52	3.3E-09
109	Panel E	154.0	1.7	1.7	1.7	25	21.2	29.6	90.0	6.2	6.1	35.8	627.5	978.2	12.5	1.165	1.165	6.00	3766	A		8966.7		20.29	51.22	32143	2.52	3.3E-09
110	Panel E	155.0	1.7	1.7	1.7	25	21.0	30.2	90.0	6.1	6.2	35.7	634.2	986.4	12.4	1.180	1.180	6.03	3822	A		8926.1		20.10	50.68	32142	2.52	3.5E-09
111	Panel E	155.0	1.7	1.7	1.7	25	21.0	30.2	74.0	6.1	6.2	35.7	634.2	986.4	12.4	1.161	1.161	6.03	3822	A		8926.1		20.10	50.26	31875	2.50	4.7E-09
112	Panel E	155.0	1.7	1.7	1.7	25	20.8	30.3	74.0	6.1	5.5	34.6	630.2	963.0	12.2	1.167	1.167	5.92	3732	A		8860.2		19.98	49.55	31230	2.48	6.3E-09
113	Panel E	155.0	1.7	1.7	1.7	25	20.5	30.3	90.0	6.1	5.5	34.8	621.2	952.3	12.1	1.193	1.193	5.94	3690	A		8761.4		20.05	48.85	30346	2.44	1.2E-08
												Total	6600.2	10402.2														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5. Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.37

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	3.49
	Min	1.30
	Mean	2.36

Panel Factor of safety Based on Tributary load

Total Pillar Load	132322.01	MN
Total Pilla Capacity	314922.87	MN
Panel FoS	2.38	

Table F - Pillar Stability Analysis, Panel F - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details: Width Wp (m)	Pillar Details: Length Lp (m)	Pillar Details: Internal Angle (°)	Roadway Details: Wr (m)	Roadway Details: Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law: Strength (MPa)	Power Law: "Ultimate" Load MN	Power Law: FoS	Power Law: Probability of Failure
114	Panel F	155.0	1.7	1.7	1.7	25	26.7	106.8	90.0	0.1	5.9	5.6	2851.6	3020.4	15.7	1.600	1.600	4.10	11704	A		18693.0		10.66	92.97	265104	8.72	6.2E-48
115	Panel F	160.0	1.7	1.7	1.7	25	20.4	20.9	90.0	5.6	6.0	39.0	426.4	699.4	12.0	1.012	1.012	6.56	2798	A		18720.0		50.47	44.54	18992	0.88	7.7E-01
116	Panel F	162.0	1.7	1.7	1.7	25	20.2	20.9	90.0	5.6	6.0	39.2	422.2	694.0	11.9	1.017	1.017	6.66	2811	A		18808.2		51.21	43.90	18533	0.86	8.3E-01
117	Panel F	163.0	1.7	1.7	1.7	25	20.1	20.9	90.0	5.6	6.0	39.2	420.1	691.3	11.8	1.020	1.020	6.71	2817	A		18851.0		51.58	43.58	18306	0.84	8.6E-01
118	Panel F	163.0	1.7	1.7	1.7	25	16.4	130.3	90.0	3.0	5.8	19.1	2136.9	2640.3	9.6	1.776	1.776	5.03	10759	A		14229.9		11.69	41.72	89151	3.57	1.0E-15
												Total	6257.1	7745.5														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered (refer to text)

Panel Extraction Ratio 0.19

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS	
	Max	8.72	
	Min	0.84	
	Mean	2.97	
Panel Factor of safety Based on Tributary load			
Total Pillar Load		120190.88	MN
Total Pilla Capacity		410086.27	MN
Panel FoS		3.41	

Table G - Pillar Stability Analysis, Panel G - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
119	Panel G	153.0	1.7	1.7	1.7	25	16.2	20.8	90.0	6.1	6.1	43.8	337.0	599.9	9.5	1.124	1.124	6.81	2295	A		15353.6		52.37	32.45	10934	0.62	1.5E+00
120	Panel G	153.0	1.7	1.7	1.7	25	21.0	31.2	90.0	6.2	5.7	34.7	655.2	1003.7	12.4	1.195	1.195	5.86	3839	A		18727.2		34.44	51.02	33432	1.48	5.9E-03
121	Panel G	154.0	1.7	1.7	1.7	25	20.9	30.0	90.0	6.4	6.2	36.6	627.0	988.3	12.3	1.179	1.179	6.07	3805	A		18918.9		36.24	50.24	31498	1.39	1.7E-02
122	Panel G	155.0	1.7	1.7	1.7	25	21.1	29.6	74.0	6.2	6.5	36.6	624.6	985.5	12.4	1.148	1.148	6.11	3819	A		19041.8		36.60	50.41	31487	1.38	1.9E-02
123	Panel G	156.0	1.7	1.7	1.7	25	21.2	29.3	74.0	6.2	6.2	36.1	621.2	972.7	12.5	1.141	1.141	6.11	3794	A		19234.8		37.07	50.68	31478	1.37	2.2E-02
124	Panel G	158.0	1.7	1.7	1.7	25	20.0	20.8	90.0	5.9	6.4	40.9	416.0	704.5	11.8	1.020	1.020	6.69	2783	A		18414.9		50.96	43.21	17974	0.85	8.6E-01
125	Panel G	160.0	1.7	1.7	1.7	25	20.0	21.1	90.0	6.0	6.2	40.5	422.0	709.8	11.8	1.027	1.027	6.73	2839	A		18720.0		51.09	43.36	18298	0.85	8.5E-01
126	Panel G	161.0	1.7	1.7	1.7	25	19.6	21.0	90.0	6.0	6.3	41.1	411.6	698.9	11.5	1.034	1.034	6.83	2813	A		18547.2		51.90	42.05	17307	0.81	9.5E-01
127	Panel G	162.0	1.7	1.7	1.7	25	16.7	21.3	90.0	3.0	6.1	34.1	355.7	539.8	9.8	1.121	1.121	6.15	2186	A		14361.3		46.52	33.89	12056	0.73	1.2E+00
128	Panel G	163.0	1.7	1.7	1.7	25	16.9	20.8	90.0	3.1	6.2	34.9	351.5	540.0	9.9	1.103	1.103	6.26	2201	A		14670.0		47.99	34.23	12032	0.71	1.2E+00
129	Panel G	152.0	1.7	1.7	1.7	25	15.9	21.1	90.0	6.2	6.2	44.4	335.5	603.3	9.4	1.141	1.141	6.83	2293	A		15116.4		51.89	31.81	10673	0.61	1.5E+00
130	Panel G	152.0	1.7	1.7	1.7	25	21.5	30.9	90.0	6.0	5.8	34.2	664.4	1009.3	12.6	1.179	1.179	5.77	3835	A		18810.0		34.09	52.85	35109	1.55	2.7E-03
131	Panel G	153.0	1.7	1.7	1.7	25	21.0	30.1	90.0	6.3	6.0	35.9	632.1	985.5	12.4	1.178	1.178	5.96	3770	A		18796.1		35.70	50.65	32014	1.42	1.2E-02
132	Panel G	155.0	1.7	1.7	1.7	25	21.0	29.8	74.0	6.2	6.4	36.4	625.8	984.6	12.4	1.154	1.154	6.10	3815	A		18972.0		36.41	50.12	31363	1.38	1.9E-02
133	Panel G	156.0	1.7	1.7	1.7	25	21.0	29.4	74.0	6.4	6.1	36.5	617.4	972.7	12.4	1.147	1.147	6.14	3794	A		19234.8		37.30	49.97	30851	1.34	2.9E-02
134	Panel G	157.0	1.7	1.7	1.7	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	12.4	0.978	0.978	6.55	2765	A		19287.5		52.24	46.06	19443	0.88	7.7E-01
135	king section unless ro	158.0	1.7	1.7	1.7	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	12.4	0.978	0.978	6.59	2782	A		19410.3		52.58	46.06	19443	0.88	7.8E-01
136	Panel G	159.0	1.7	1.7	1.7	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	12.4	0.978	0.978	6.63	2800	A		19533.2		52.91	46.06	19443	0.87	8.0E-01
137	Panel G	160.0	1.7	1.7	1.7	25	12.3	12.3	90.0	5.8	6.0	54.3	151.3	331.2	7.2	1.000	1.000	8.76	1325	A		13032.0		94.90	21.62	3270	0.23	3.0E+00
												Total	9114.4	14742.7														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.38

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	1.55
	Min	0.23
	Mean	1.02

Panel Factor of safety Based on Tributary load

Total Pillar Load	395731.90	MN
Total Pilla Capacity	418104.37	MN
Panel FoS	1.06	

Table H - Pillar Stability Analysis, Panel H - Measured Pillar Dimensions - Pillar Height = Working Section = 1.7 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT		

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Probability of Failure
138	Panel H	160.0	1.7	1.7	1.7	25	14.3	14.3	90.0	6.4	6.4	52.3	204.5	428.5	8.4	1.000	1.000	8.38	1714	A		14904.0		81.27	25.76	5268	0.32	2.6E+00
139	Panel H	153.0	1.7	1.7	1.7	25	21.1	21.1	90.0	5.9	5.7	38.5	445.2	723.6	12.4	1.000	1.000	6.22	2768	A		13942.1		37.53	46.98	20916	1.25	8.0E-02
140	Panel H	153.0	1.7	1.7	1.7	25	20.9	20.9	90.0	5.9	5.7	38.7	436.8	712.9	12.3	1.000	1.000	6.24	2727	A		13838.9		37.92	46.19	20178	1.22	1.0E-01
141	Panel H	155.0	1.7	1.7	1.7	25	20.9	20.9	90.0	5.9	5.7	38.7	436.8	712.9	12.3	1.000	1.000	6.32	2762	A		14019.8		38.42	46.19	20178	1.20	1.3E-01
142	Panel H	155.0	1.7	1.7	1.7	25	20.7	29.0	90.0	6.1	6.2	36.4	600.3	943.4	12.2	1.167	1.167	6.09	3656	A		14019.8		29.44	49.14	29499	1.67	7.4E-04
143	Panel H	157.0	1.7	1.7	1.7	25	20.2	20.7	74.0	6.2	6.1	40.9	418.1	707.5	11.9	0.992	0.992	6.64	2777	A		13988.7		40.10	43.35	18128	1.08	3.4E-01
144	Panel H	157.0	1.7	1.7	1.7	25	20.2	20.7	74.0	6.2	6.1	40.9	418.1	707.5	11.9	0.992	0.992	6.64	2777	A		13988.7		40.10	43.35	18128	1.08	3.4E-01
145	Panel H	158.0	1.7	1.7	1.7	25	19.6	20.7	90.0	5.8	6.4	41.1	405.7	688.3	11.5	1.027	1.027	6.70	2719	A		13544.6		40.09	41.90	17000	1.05	4.1E-01
146	Panel H	159.0	1.7	1.7	1.7	25	16.8	20.9	90.0	6.1	6.2	43.4	351.1	620.6	9.9	1.109	1.109	7.03	2467	A		12288.7		42.02	34.01	11940	0.81	9.6E-01
147	Panel H	159.0	1.7	1.7	1.7	25	16.6	38.9	90.0	5.7	3.2	31.2	645.7	938.8	9.8	1.402	1.402	5.78	3732	A		11966.7		24.31	37.64	24308	1.55	2.7E-03
148	Panel H	160.0	1.7	1.7	1.7	25	15.2	30.8	90.0	3.2	3.0	24.7	468.2	621.9	8.9	1.339	1.339	5.31	2488	A		9936.0		26.54	32.42	15176	1.22	9.8E-02
149	Panel H	160.0	1.7	1.7	1.7	25	13.9	15.4	90.0	6.0	6.0	49.7	214.1	425.9	8.2	1.051	1.051	7.96	1703	A		1910.4		16.88	25.50	5458	1.51	4.2E-03
150	Panel H	159.0	1.7	1.7	1.7	25	13.0	19.5	90.0	5.8	6.2	47.5	253.5	483.2	7.6	1.200	1.200	7.58	1921	A		4184.9		24.08	25.20	6388	1.05	4.0E-01
151	Panel H	159.0	1.7	1.7	1.7	25	16.2	26.7	90.0	3.1	6.2	31.9	432.5	635.0	9.5	1.245	1.245	5.84	2524	A		1841.2		10.09	34.18	14783	3.39	1.4E-14
152	Panel H	159.0	1.7	1.7	1.7	25	16.2	26.7	90.0	6.1	6.2	41.0	432.5	733.7	9.5	1.245	1.245	6.74	2916	A		2127.4		11.66	34.18	14783	2.93	9.6E-12
153	Panel H	159.0	1.7	1.7	1.7	25	16.2	26.7	90.0	6.2	6.2	41.3	432.5	737.0	9.5	1.245	1.245	6.77	2929	A		2137.0		11.71	34.18	14783	2.92	1.2E-11
154	king section unless ro	159.0	1.7	1.7	1.7	25	19.3	26.9	90.0	5.9	6.3	37.9	519.2	836.6	11.4	1.165	1.165	6.41	3326	A		2404.1		11.04	43.52	22593	3.94	4.5E-18
155	Panel H	157.0	1.7	1.7	1.7	25	19.4	26.9	74.0	5.9	6.3	37.9	521.9	840.0	11.4	1.143	1.143	6.32	3297	A		6355.4		18.50	43.48	22688	2.35	4.1E-08
156	Panel H	157.0	1.7	1.7	1.7	25	20.0	26.5	74.0	5.7	6.2	36.9	530.0	840.4	11.8	1.120	1.120	6.22	3299	A		6455.8		18.40	45.33	24027	2.46	8.1E-09
157	Panel H	157.0	1.7	1.7	1.7	25	16.5	26.7	90.0	6.3	6.3	41.4	440.6	752.4	9.7	1.236	1.236	6.70	2953	A		5727.4		19.70	34.99	15414	1.78	1.6E-04
158	Panel H	159.0	1.7	1.7	1.7	25	16.5	21.3	90.0	3.1	6.1	34.6	351.5	537.0	9.7	1.127	1.127	6.07	2135	A		4363.0		18.49	33.38	11731	1.81	1.0E-04
159	Panel H	159.0	1.7	1.7	1.7	25	16.2	21.0	90.0	6.2	6.4	44.6	340.2	613.8	9.5	1.129	1.129	7.17	2440	A		4986.2		21.83	32.52	11063	1.49	5.3E-03
160	Panel H	158.0	1.7	1.7	1.7	25	16.5	21.2	90.0	6.1	6.5	44.1	349.8	626.0	9.7	1.125	1.125	7.07	2473	A		4999.1		21.36	33.34	11663	1.56	2.4E-03
161	Panel H	158.0	1.7	1.7	1.7	25	20.0	21.0	90.0	6.0	6.2	40.6	420.0	707.2	11.8	1.024	1.024	6.65	2793	A		5751.2		20.34	43.31	18190	2.13	9.9E-07
162	Panel H	158.0	1.7	1.7	1.7	25	19.8	20.8	90.0	6.2	6.3	41.5	411.8	704.6	11.6	1.025	1.025	6.76	2783	A		5751.2		20.72	42.57	17534	2.05	2.9E-06
163	Panel H	157.0	1.7	1.7	1.7	25	19.8	20.8	90.0	6.1	6.1	40.9	411.8	696.7	11.6	1.025	1.025	6.64	2735	A		5692.8		20.46	42.57	17534	2.08	2.0E-06
164	Panel H	157.0	1.7	1.7	1.7	25	16.2	21.1	90.0	6.3	6.0	43.9	341.8	609.8	9.5	1.131	1.131	7.00	2393	A		4945.5		21.47	32.55	11127	1.52	3.9E-03
												Total	11234.4	18585.0														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.40

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	3.94
	Min	0.32
	Mean	1.76

Panel Factor of safety Based on Tributary load

Total Pillar Load	289275.83	MN
Total Pilla Capacity	440476.71	MN
Panel FoS	1.52	

Table A1 - Pillar Stability Analysis, Panel A - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 24/11/17
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details: Width Wp (m)	Pillar Details: Length Lp (m)	Pillar Details: Internal Angle (°)	Roadway Details: Wr (m)	Roadway Details: Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier: Θ_0	Width Modifier: Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law: Strength (MPa)	Power Law: "Ultimate" Load MN	Power Law: FoS	Power Law: Probability of Failure
A1-A3	Full abut loads	170.0	2.0	2.0	2.0	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	8.3	1.320	1.320	6.64	3506	A		7241.9		20.36	27.44	14490	1.35	2.7E-02
B	Full abut loads	172.0	2.0	2.0	2.0	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	15.0	1.032	1.032	5.96	5724	A		11622.2		18.07	64.40	61824	3.56	1.1E-15
C	Full abut loads	174.0	2.0	2.0	2.0	25	18.5	33.0	90.0	5.0	5.5	32.5	610.5	904.8	9.3	1.282	1.282	6.45	3936	A		5864.6		16.05	31.50	19230	1.96	1.1E-05
W1	Full/70% abut loads	168.0	2.0	2.0	2.0	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	15.0	1.032	1.032	5.82	5591	A		14992.4		21.44	64.40	61824	3.00	3.4E-12
W2	Full/30% abut loads	167.0	2.0	2.0	2.0	25	30.0	32.0	90.0	5.5	5.5	27.9	960.0	1331.3	15.0	1.032	1.032	5.79	5558	A		12991.7		19.32	64.40	61824	3.33	3.0E-14
												Total	4018.5	5723.5														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5 Pillar Height should be the same as the working section unless roof collapse is being considered (refer to text)

Panel Extraction Ratio 0.30

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	3.56
	Min	1.35
	Mean	2.64

Panel Factor of safety Based on Tributary load

Total Pillar Load	77028.26	MN
Total Pilla Capacity	219193.09	MN
Panel FoS	2.85	

Table B1 - Pillar Stability Analysis, Panel B - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 24/11/17
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Probability of Failure
D	Full/70% abut loads	169.0	2.0	2.0	2.0	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	8.3	1.320	1.320	6.60	3486	A		11253.8		27.92	27.44	14490	0.98	5.4E-01
E	Full/70% abut loads	170.0	2.0	2.0	2.0	25	16.5	29.5	90.0	5.5	5.5	36.8	486.8	770.0	8.3	1.283	1.283	6.72	3273	A		12395.3		32.19	27.05	13165	0.84	8.8E-01
F1	Full abut loads	170.5	2.0	2.0	2.0	25	16.5	32.0	90.0	5.5	5.5	36.0	528.0	825.0	8.3	1.320	1.320	6.66	3517	A		7178.3		20.26	27.44	14490	1.35	2.5E-02
F2	Full abut loads	171.0	2.0	2.0	2.0	25	16.5	32.0	90.0	4.5	5.5	33.0	528.0	787.5	8.3	1.320	1.320	6.38	3367	A		7178.3		19.97	27.44	14490	1.37	2.0E-02
G1	Full abut loads	171.5	2.0	2.0	2.0	25	19.0	32.0	90.0	4.5	5.5	31.0	608.0	881.3	9.5	1.255	1.255	6.21	3778	A		8229.4		19.75	32.38	19688	1.64	1.1E-03
G2	Full abut loads	172.0	2.0	2.0	2.0	25	19.0	32.0	90.0	4.5	5.5	31.0	608.0	881.3	9.5	1.255	1.255	6.23	3789	A		7332.3		18.29	32.38	19688	1.77	1.7E-04
												Total	3286.8	4970.0														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5. Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.34

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS	
	Max	1.77	
	Min	0.84	
	Mean	1.33	
Panel Factor of safety Based on Tributary load			
Total Pillar Load		74776.38	MN
Total Pilla Capacity		96009.26	MN
Panel FoS		1.28	

Table C1 - Pillar Stability Analysis, Panel C - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 24/11/17
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details: Width Wp (m)	Pillar Details: Length Lp (m)	Pillar Details: Internal Angle (°)	Roadway Details: Wr (m)	Roadway Details: Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3
H	Full abut loads	161.5	2.0	2.0	2.0	25	48.0	76.0	90.0	5.5	5.5	16.3	3648.0	4360.3
J1	30%/70% abut loads	164.0	2.0	2.0	2.0	25	17.0	34.0	90.0	5.5	5.5	35.0	578.0	888.8
J2	30%/70% abut loads	164.0	2.0	2.0	2.0	25	17.0	34.0	90.0	5.5	5.5	35.0	578.0	888.8
K	70% abut load	164.5	2.0	2.0	2.0	25	17.5	30.5	90.0	4.5	5.5	32.6	533.8	792.0
L	70% abut load	165.0	2.0	2.0	2.0	25	18.0	30.0	90.0	4.5	5.5	32.4	540.0	798.8
M1	Full abut load	170.0	2.0	2.0	2.0	25	7.0	31.0	90.0	4.5	5.0	47.6	217.0	414.0
M2	70% abut load (M1)	171.5	2.0	2.0	2.0	25	7.0	31.0	90.0	4.5	5.0	47.6	217.0	414.0
N	70% abut load	168.0	2.0	2.0	2.0	25	19.5	19.0	90.0	4.5	5.5	37.0	370.5	588.0
P	70%/70% abut loads	169.0	2.0	2.0	2.0	25	18.0	45.0	90.0	4.5	5.5	28.7	810.0	1136.3
Q	30%/30% abut loads	168.0	2.0	2.0	2.0	25	20.0	30.0	90.0	4.5	5.5	31.0	600.0	869.8
R	No abut load	169.0	2.0	2.0	2.0	25	22.0	25.5	90.0	6.0	5.5	35.4	561.0	868.0
S	70%/30% abut loads	162.0	2.0	2.0	2.0	25	19.5	39.0	74.0	5.5	5.5	31.6	760.5	1112.5
T	70%/30% abut loads	162.0	2.0	2.0	2.0	25	15.5	39.0	74.0	5.5	5.5	35.3	604.5	934.5
U	30% abut load	165.0	2.0	2.0	2.0	25	13.0	70.0	90.0	5.5	5.5	34.8	910.0	1396.8
V	No abut load	168.0	2.0	2.0	2.0	25	22.0	31.0	90.0	5.0	6.0	31.7	682.0	999.0
												Total	11610.3	16461.3

Pillar Id:	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law: Strength (MPa)	Power Law: "Ultimate" Load MN	Power Law: FoS	Probability of Failure
H	24.0	1.226	1.226	4.83	17605	A		15440.1		9.06	186.02	678601	20.54	9.0E-122
J1	8.5	1.333	1.333	6.30	3644	A		3111.5		11.69	28.66	16563	2.45	9.5E-09
J2	8.5	1.333	1.333	6.30	3644	A		3663.8		12.64	28.66	16563	2.27	1.4E-07
K	8.8	1.271	1.271	6.10	3257	A		2443.2		10.68	29.05	15506	2.72	2.0E-10
L	9.0	1.250	1.250	6.10	3295	A		2681.3		11.07	29.93	16163	2.70	2.5E-10
M1	3.5	1.632	1.085	8.11	1760	A		2711.2		20.60	13.51	2932	0.66	1.4E+00
M2	3.5	1.632	1.085	8.18	1775	A		267.8		9.41	13.51	2932	1.44	9.9E-03
N	9.8	0.987	0.987	6.67	2470	A		2921.9		14.55	29.77	11028	2.05	3.3E-06
P	9.0	1.429	1.429	5.93	4801	A		11013.2		19.52	32.04	25953	1.64	1.1E-03
Q	10.0	1.200	1.200	6.09	3653	A		1947.6		9.33	34.16	20499	3.66	2.7E-16
R	11.0	1.074	1.074	6.54	3667						37.55	21064	5.74	2.5E-29
S	9.8	1.316	1.316	5.92	4506	A		3811.4		10.94	34.47	26211	3.15	4.0E-13
T	7.8	1.415	1.415	6.26	3785	A		2606.3		10.57	26.38	15945	2.49	5.1E-09
U	6.5	1.687	1.687	6.33	5762	A		3351.6		10.01	24.12	21950	2.41	1.8E-08
V	11.0	1.170	1.170	6.15	4196						39.23	26752	6.38	2.8E-33

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.29

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	20.54
	Min	0.66
	Mean	4.02

Panel Factor of safety Based on Tributary load

Total Pillar Load	123787.88	MN
Total Pilla Capacity	918663.49	MN

Panel FoS 7.42

Table D1 - Pillar Stability Analysis, Panel D - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT		

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m³)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m³	Total Area m³	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
1	Panel D	142.0	2.0	2.0	2.0	25	18.3	18.9	90.0	6.1	5.6	42.1	345.9	597.8	9.2	1.016	1.016	6.14	2122	A		3805.3		17.14	27.56	9531	1.61	1.4E-03
2	Panel D	142.0	2.0	2.0	2.0	25	18.3	18.3	90.0	6.1	5.6	42.6	334.9	583.2	9.2	1.000	1.000	6.18	2070	A		671.5		8.19	27.33	9154	3.34	2.7E-14
3	Panel D	142.0	2.0	2.0	2.0	25	18.3	18.6	90.0	6.1	5.6	42.4	340.4	590.5	9.2	1.008	1.008	6.16	2096						27.45	9342	4.46	2.8E-21
4	Panel D	141.0	2.0	2.0	2.0	25	18.8	26.4	90.0	6.1	6.1	38.7	496.3	809.3	9.4	1.168	1.168	5.75	2853						30.74	15259	5.35	7.4E-27
5	Panel D	142.0	2.0	2.0	2.0	25	18.9	18.9	90.0	6.3	6.1	43.3	357.2	630.0	9.5	1.000	1.000	6.26	2237						28.62	10223	4.57	5.4E-22
6	Panel D	141.0	2.0	2.0	2.0	25	19.2	21.7	90.0	6.0	6.0	40.3	416.6	698.0	9.6	1.061	1.061	5.91	2461						30.18	12576	5.11	2.3E-25
7	Panel D	141.0	2.0	2.0	2.0	25	15.6	19.2	90.0	6.0	6.4	45.8	299.5	553.0	7.8	1.103	1.103	6.51	1949						23.41	7011	3.60	6.6E-16
8	Panel D	142.0	2.0	2.0	2.0	25	11.5	20.6	90.0	6.0	6.0	49.1	236.9	465.5	5.8	1.283	1.257	6.98	1653						18.85	4465	2.70	2.6E-10
9	Panel D	142.0	2.0	2.0	2.0	25	10.1	16.3	90.0	6.0	5.9	53.9	164.6	357.4	5.1	1.235	1.155	7.71	1269						16.69	2747	2.17	5.9E-07
10	Panel D	141.0	2.0	2.0	2.0	25	9.9	13.3	90.0	6.0	5.9	56.9	131.7	305.3	5.0	1.147	1.093	8.17	1076						16.18	2131	1.98	8.4E-06
11	Panel D	140.0	2.0	2.0	2.0	25	9.9	18.7	90.0	6.2	6.6	54.6	185.1	407.3	5.0	1.308	1.190	7.70	1426						16.91	3130	2.20	3.8E-07
12	Panel D	142.0	2.0	2.0	2.0	25	18.7	23.5	74.0	6.0	6.3	40.3	439.5	736.1	9.4	1.094	1.094	5.95	2613						29.51	12968	4.96	1.9E-24
13	Panel D	141.0	2.0	2.0	2.0	25	18.6	24.7	74.0	6.0	6.3	39.8	459.4	762.6	9.3	1.121	1.121	5.85	2688						29.65	13623	5.07	4.2E-25
14	Panel D	141.0	2.0	2.0	2.0	25	19.2	25.5	90.0	5.9	6.0	38.1	489.6	790.7	9.6	1.141	1.141	5.69	2787						31.32	15335	5.50	8.2E-28
15	Panel D	142.0	2.0	2.0	2.0	25	18.5	28.2	90.0	6.2	6.2	38.6	521.7	849.7	9.3	1.208	1.208	5.78	3016						30.56	15943	5.29	1.8E-26
16	Panel D	141.0	2.0	2.0	2.0	25	9.0	18.1	90.0	6.3	6.4	56.5	162.9	374.9	4.5	1.336	1.156	8.11	1321						15.86	2584	1.96	1.2E-05
17	king section unless roo	141.0	2.0	2.0	2.0	25	18.7	19.2	90.0	6.0	6.0	42.3	359.0	622.4	9.4	1.013	1.013	6.11	2194						28.37	10187	4.64	1.9E-22
18	Panel D	142.0	2.0	2.0	2.0	25	18.8	31.2	90.0	6.4	5.8	37.1	586.6	932.4	9.4	1.248	1.248	5.64	3310						31.80	18652	5.63	1.2E-28
19	Panel D	142.0	2.0	2.0	2.0	25	7.2	18.4	90.0	6.4	5.9	59.9	132.5	330.5	3.6	1.438	1.075	8.86	1173						13.64	1808	1.54	3.0E-03
20	Panel D	142.0	2.0	2.0	2.0	25	18.4	18.6	90.0	6.1	6.0	43.2	342.2	602.7	9.2	1.005	1.005	6.25	2140	A		1573.3		10.85	27.62	9453	2.55	2.5E-09
21	Panel D	142.0	2.0	2.0	2.0	25	18.3	18.7	90.0	6.2	6.0	43.5	342.2	605.2	9.2	1.011	1.011	6.28	2148	A		674.3		8.25	27.48	9405	3.33	3.0E-14
22	Panel D	142.0	2.0	2.0	2.0	25	18.4	19.0	90.0	6.0	6.3	43.4	349.6	617.3	9.2	1.016	1.016	6.27	2191						27.77	9708	4.43	4.1E-21
23	Panel D	142.0	2.0	2.0	2.0	25	16.0	18.2	74.0	6.3	6.1	46.3	291.2	541.9	8.0	1.045	1.045	6.61	1924						23.46	6831	3.55	1.3E-15
24	Panel D	142.0	2.0	2.0	2.0	25	18.5	19.2	74.0	6.3	6.1	43.4	355.2	627.4	9.3	0.999	0.999	6.27	2227						27.74	9853	4.42	4.5E-21
25	Panel D	142.0	2.0	2.0	2.0	25	18.1	18.9	90.0	6.2	6.2	43.9	342.1	609.9	9.1	1.022	1.022	6.33	2165						27.21	9309	4.30	2.7E-20
26	Panel D	142.0	2.0	2.0	2.0	25	18.8	18.8	90.0	6.3	6.1	43.4	353.4	625.0	9.4	1.000	1.000	6.28	2219						28.40	10038	4.52	1.1E-21
27	Panel D	142.0	2.0	2.0	2.0	25	17.6	44.0	90.0	6.3	6.2	35.5	774.4	1199.8	8.8	1.429	1.429	5.50	4259						31.07	24064	5.65	9.8E-29
28	Panel D	143.0	2.0	2.0	2.0	25	18.4	19.0	90.0	5.9	6.0	42.5	349.6	607.5	9.2	1.016	1.016	6.21	2172	A		1582.5		10.74	27.77	9708	2.59	1.4E-09
29	Panel D	143.0	2.0	2.0	2.0	25	19.0	19.2	90.0	5.9	6.1	42.1	364.8	630.0	9.5	1.005	1.005	6.17	2252	A		695.0		8.08	28.92	10549	3.58	8.5E-16
30	Panel D	143.0	2.0	2.0	2.0	25	18.9	19.1	90.0	6.3	6.0	42.9	361.0	632.5	9.5	1.005	1.005	6.26	2261						28.70	10359	4.58	4.7E-22
31	Panel D	143.0	2.0	2.0	2.0	25	16.1	18.9	90.0	6.5	6.2	46.4	304.3	567.3	8.1	1.080	1.080	6.66	2028						24.04	7315	3.61	5.7E-16
32	Panel D	143.0	2.0	2.0	2.0	25	18.6	18.9	90.0	6.2	6.1	43.3	351.5	620.0	9.3	1.008	1.008	6.31	2217						28.08	9872	4.45	2.9E-21
33	Panel D	143.0	2.0	2.0	2.0	25	18.1	18.7	90.0	6.4	6.0	44.1	338.5	605.2	9.1	1.016	1.016	6.39	2163						27.14	9186	4.25	5.8E-20
34	Panel D	143.0	2.0	2.0	2.0	25	19.1	19.0	90.0	6.2	6.2	43.1	362.9	637.6	9.6	0.997	0.997	6.28	2279						29.02	10532	4.62	2.6E-22
35	Panel D	145.0	2.0	2.0	2.0	25	18.5	18.8	74.0	6.2	6.2	43.7	347.8	617.5	9.3	0.988	0.988	6.44	2238						27.59	9596	4.29	3.2E-20
36	Panel D	144.0	2.0	2.0	2.0	25	18.1	20.3	74.0	6.3	6.1	43.0	367.4	644.2	9.1	1.038	1.038	6.31	2319						27.43	10078	4.35	1.4E-20
37	Panel D	145.0	2.0	2.0	2.0	25	18.2	18.6	90.0	6.3	6.1	44.1	338.5	605.2	9.1	1.011	1.011	6.48	2194						27.27	9233	4.21	9.9E-20
38	Panel D	145.0	2.0	2.0	2.0	25	18.3	18.9	90.0	6.1	5.9	42.8	345.9	605.1	9.2	1.016	1.016	6.34	2194	A		1633.8		11.07	27.56	9531	2.49	5.5E-09
39	Panel D	145.0	2.0	2.0	2.0	25	18.6	19.0	90.0	6.0	5.9	42.3	353.4	612.5	9.3	1.011	1.011	6.28	2220	A		705.9		8.28	28.12	9938	3.40	1.2E-14
40	Panel D	145.0	2.0	2.0	2.0	25	18.6	18.9	90.0	6.0	6.4	43.5	351.5	622.4	9.3	1.008	1.008	6.42	2256						28.08	9872	4.38	9.0E-21
41	Panel D	145.0	2.0	2.0	2.0	25	16.3	18.2	90.0	6.3	6.2	46.2	296.7	551.4	8.2	1.055	1.055	6.74	1999						24.12	7154	3.58	8.6E-16
42	Panel D	145.0	2.0	2.0	2.0	25	18.2	18.5	90.0	6.1	6.0	43.4	336.7	595.4	9.1	1.008	1.008	6.41	2158						27.24	9171	4.25	5.5E-20
43	Panel D	145.0	2.0	2.0	2.0	25	18.5	19.0	90.0	6.1	6.0	42.8	351.5	615.0	9.3	1.013	1.013	6.34	2229						27.94	9822	4.41	5.8E-21
44	Panel D	145.0	2.0	2.0	2.0	25	18.6	19.2	90.0	6.1	6.0	42.6	357.1	622.4	9.3	1.016	1.016	6.32	2256						28.19	10069	4.46	2.6E-21
45	Panel D	145.0	2.0	2.0	2.0	25	18.6	19.2	90.0	6.1	6.0	42.6	357.1	622.4	9.3	1.016	1.016	6.32	2256						28.19	10069	4.46	2.6E-21
46	Panel D	145.0	2.0	2.0	2.0	25	18.6	18.7	74.0	6.2	6.0	43.2	347.8	612.6	9.3	0.983	0.983	6.38	2221						27.72	9643	4.34	1.4E-20
47	Panel D	145.0	2.0	2.0	2.0	25	18.4	20.8	74.0	6.3	6.1	42.4	382.7	664.4	9.2	1.042	1.042	6.29	2409						28.12	10763	4.47	2.4E-21
48	Panel D	145.0	2.0	2.0	2.0	25	18.5	18.5	90.0	6.4	6.2	44.4	342.3	615.0	9.3	1.000	1.000	6.51	2229						27.76	9499	4.26	4.7E-20
49	Panel D	146.0	2.0	2.0	2.0	25	16.5	18.5	90.0	6.2	6.0	45.1	305.3	556.2	8.3	1.057	1.057	6.65	2030	A		1541.0		11.70	24.51	7481	2.09	1.6E-06
50	Panel D	146.0	2.0	2.0	2.0	25	16.5	18.6	90.0	6.2	6.2	45.5	306.9	563.0	8.3	1.060	1.060	6.70	2055	A		1541.0		11.72	24.54	7531	2.09	1.6E-06
51	Panel D	146.0	2.0	2.0	2.0	25	16.4	18.2	90.0	6.0	6.1	45.2	298.5	544.3	8.2	1.052	1.052	6.66	1987	A		651.7		8.84	24.26	7242	2.74	1.4E-10
52	Panel D	146.0	2.0	2.0	2.0	25	16.6	19.2	90.0	6.0	6.1	44.3	318.7	571.8	8.3	1.073	1.073	6.55	2087						24.88	7929	3.80	3.6E-17
53	Panel D	146.0	2.0	2.0	2.0	25	16.7	18.8	90.0	5.9	6.1	44.2	314.0	562.7	8.4	1.059	1.059	6.54	2054						24.91	7820	3.81	3.2E-17
54	Panel D	146.0	2.0	2.0	2.0	25	16.8	17.6	90.0	5.7	6.3	45.0	295.7	537.8	8.4	1.023	1.023	6.64	1963						24.66	7291	3.71	1.2E-16
55	Panel D	146.0	2.0	2.0	2.0	25	16.7	18.5	90.0	5.8	6.1	44.2	309.0	553.5	8.4	1.051	1.051	6.54	2020						24.81	7665	3.79	3.9E-17
56	Panel D	146.0	2.0	2.0	2.0	25	16.7	18.7	74.0	6.0	6.2	44.7	312.3	565.2	8.4	1.037	1.037	6.61	2063						24.64	7694	3.73	9.8E-17
57	Panel D	146.0	2.0	2.0	2.0	25	16.6	18.4	74.0	6.0	6.2	45.1	305.4	556.0	8.3	1.032	1.032	6.64	2029						24.39	7450	3.67	2.3E-16
58	Panel D	146.0	2.0	2.0	2.0	25	17.3	18.1	90.0	5.9	6.2	44.5	313.1	563.8	8.7	1.023	1.023	6.57	2058						25.61	8019	3.90	8.8E-18
59	Panel D	146.0	2.0	2.0	2.0	25	17.6	19.6	90.0	5.8	6.2	42.9	345.0	603.7	8.8	1.054	1.054	6.39	2204						26.61	9179	4.17	1.9E-19
60	Panel D	146.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.40	2154						26.84	9031	4.19	1.2E-19
61	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183	A		708.5		8.59	26.84	9031	3.12	6.1E-13
62	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183	A		708.5		8.59	26.84	9031	3.12	6.1E-13
63	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
64	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
65	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
66	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
67	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	74.0	5.8	6.1	43.0	336.5	590.1	9.0	1.005	1.005	6.49	2183						26.57	8942	4.10	5.1E-19
68	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	74.0	5.8	6.1	43.0	336.5	590.1	9.0	1.005	1.005	6.49	2183						26.57	8942	4.10	5.1E-19
69	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
70	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
71	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
72	Panel D	148.0	2.0	2.0	2.0	25	17.9	18.8	90.0	5.8	6.1	43.0	336.5	590.1	9.0	1.025	1.025	6.49	2183						26.84	9031	4.14	2.8E-19
73	Panel D	148.0	2.0	2.0	2.0	25	16.9	17.6	90.0	5.9	6.1	45.0	297.4	540.4	8.5	1.020	1.020	6.72	1999						24.81	7380	3.69	1.7E-16
74	Panel D	151.0	2.0	2.0	2.0	25	18.5	29.9	90.0	6.2	6.6	38.6	553.2	901.6	9.3	1.236	1.236	6.15	3403						30.92	17102	5.02	7.9E-25
75	Panel D	151.0	2.0	2.0	2.0	25	9.0	28.5	90.0	5.8	6.4	50.3	256.5	516.5	4.5	1.520	1.233	7.60	1950						16.39	4205	2.16	6.7E-07
76	Panel D	151.0	2.0	2.0	2.0	25	8.3	29.6	90.0	6.0	6.2	52.0	245.7	511.9	4.2	1.562	1.186	7.87	1933						15.43	3790	1.96	1.1E-05
77	Panel D	151.0	2.0	2.0	2.0	25	8.5	30.2	90.0	5.7	6.3	50.5	256.7	518.3	4.3	1.561	1.204	7.62	1957						15.73	4038	2.06	2.5E-06
78	Panel D	151.0	2.0	2.0	2.0	25	8.5	30.0	90.0	6.1	6.0	51.5	255.0	525.6	4.3	1.558	1.203	7.78	1984						15.72	4010	2.02	4.7E-06
79	Panel D	151.0	2.0	2.0	2.0	25	8.7	28.9	74.0	6.0	6.0	51.0	251.4	513.0	4.4	1.523	1.208	7.70	1937						15.95	4010	2.07	2.3E-06
80	Panel D	151.0	2.0	2.0	2.0	25	8.3	29.0	74.0	5.7	6.5	51.6	240.7	497.0	4.2	1.541	1.180	7.79	1876						15.38	3703	1.97	9.2E-06
81	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943						15.70	3884	2.00	6.4E-06
82	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943						15.70	3884	2.00	6.4E-06
83	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943						15.70	3884	2.00	6.4E-06
84	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943						15.70	3884	2.00	6.4E-06
85	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943	A		451.3		9.68	15.70	3884	1.62	1.2E-03
86	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943	A		451.3		9.68	15.70	3884	1.62	1.2E-03
87	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943			0.0			15.70	3884	2.00	6.4E-06
88	Panel D	151.0	2.0	2.0	2.0	25	8.5	29.1	90.0	6.0	6.4	51.9	247.4	514.8	4.3	1.548	1.200	7.86	1943			0.0			15.70	3884	2.00	6.4E-06
89	Panel D	153.0	2.0	2.0	2.0	25	21.1	27.8	90.0	6.4	6.7	38.2	586.6	948.8	10.6	1.137	1.137	6.19	3629	A		878.6		7.68	36.13	21195	4.70	8.2E-23
90	Panel D	154.0	2.0	2.0	2.0	25	21.1	28.1	74.0	6.4	6.5	37.7	592.9	951.5	10.6	1.123	1.123	6.18	3663	A		890.2		7.68	35.90	21287	4.67	1.2E-22
91	Panel D	153.0	2.0	2.0	2.0	25	8.2	30.4	74.0	6.2	6.5	53.1	249.3	531.4	4.1	1.562	1.178	8.15	2032						15.27	3807	1.87	3.9E-05
92	Panel D	153.0	2.0	2.0	2.0	25	6.9	30.4	90.0	6.2	6.5	56.6	209.8	483.4	3.5	1.630	1.076	8.81	1849	A		418.6		10.81	13.36	2802	1.24	9.6E-02
93	Panel D	153.0	2.0	2.0	2.0	25	16.6	30.0	90.0	6.5	6.2	40.4	498.0	836.2	8.3	1.288	1.288	6.42	3199	A		1722.1		9.88	27.31	13599	2.76	1.1E-10
94	Panel D	153.0	2.0	2.0	2.0	25	17.0	28.4	90.0	6.2	6.3	40.0	482.8	805.0	8.5	1.251	1.251	6.38	3079	A		1729.6		9.96	27.74	13393	2.79	7.8E-11
95	Panel D	153.0	2.0	2.0	2.0	25	8.2	28.6	90.0	6.0	6.5	52.9	234.5	498.4	4.1	1.554	1.176	8.13	1906	A		1058.6		12.64	15.26	3578	1.21	1.2E-01
96	Panel D	153.0	2.0	2.0	2.0	25	8.0	28.6	90.0	6.0	6.5	53.4	228.8	491.4	4.0	1.563	1.160	8.22	1880	A		447.3		10.17	14.97	3425	1.47	6.5E-03
97	Panel D	153.0	2.0	2.0	2.0	25	8.0	29.6	90.0	6.3	6.4	54.0	236.8	514.8	4.0	1.574	1.163	8.32	1969	A		1066.1		12.82	14.99	3549	1.17	1.8E-01
98	Panel D	153.0	2.0	2.0	2.0	25	8.0	29.6	90.0	6.3	6.4	54.0	236.8	514.8	4.0	1.574	1.163	8.32	1969	A		456.9		10.24	14.99	3549	1.46	7.2E-03
99	Panel D	153.0	2.0	2.0	2.0	25	8.1	29.2	74.0	6.1	6.3	53.1	236.5	504.1	4.1	1.552	1.166	8.15	1928	A		1058.6		12.63	15.10	3572	1.20	1.4E-01
100	Panel D	153.0	2.0	2.0	2.0	25	7.9	29.2	74.0	6.1	6.3	53.6	230.7	497.0	4.0	1.561	1.151	8.24	1901	A		447.3		10.18	14.81	3417	1.46	7.9E-03
101	Panel D	153.0	2.0	2.0	2.0	25	9.0	28.9	90.0	6.2	6.5	51.7	260.1	538.1	4.5	1.525	1.235	7.91	2058						16.41	4268	2.07	2.2E-06
102	Panel D	153.0	2.0	2.0	2.0	25	7.0	17.1	90.0	6.1	6.1	60.6	119.7	303.9	3.5	1.419	1.060	9.71	1162	A		697.6		15.54	13.35	1598	0.86	8.3E-01
												Total	#REF!	#REF!														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebblewhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio #REF!

FoS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	5.65
	Min	0.86
	Mean	3.37

Panel Factor of safety Based on Tributary load

Total Pillar Load	250120.20	MN
Total Pilla Capacity	852169.56	MN
Panel FoS	3.41	

Table E1 - Pillar Stability Analysis, Panel E - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners Geotechnics · Environment · Groundwater

Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT		

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m³)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m²	Total Area m²	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
103	Panel E	154.0	2.0	2.0	2.0	25	17.9	47.5	90.0	6.2	6.2	34.3	850.3	1294.2	9.0	1.453	1.453	5.86	4983	A		5520.7		12.35	32.07	27266	2.60	1.2E-09
104	Panel E	154.0	2.0	2.0	2.0	25	17.5	21.2	90.0	6.2	6.6	43.7	371.0	658.9	8.8	1.096	1.096	6.84	2537	A		7755.8		27.74	26.93	9993	0.97	5.6E-01
105	Panel E	154.0	2.0	2.0	2.0	25	17.5	21.2	90.0	6.2	6.6	43.7	371.0	658.9	8.8	1.096	1.096	6.84	2537	A		7755.8		27.74	26.93	9993	0.97	5.6E-01
106	Panel E	154.0	2.0	2.0	2.0	25	20.9	29.5	90.0	6.2	6.4	36.6	616.6	972.9	10.5	1.171	1.171	6.08	3746	A		8868.5		20.46	36.12	22272	1.77	1.8E-04
107	Panel E	154.0	2.0	2.0	2.0	25	20.9	29.5	90.0	6.2	6.4	36.6	616.6	972.9	10.5	1.171	1.171	6.08	3746	A		8868.5		20.46	36.12	22272	1.77	1.8E-04
108	Panel E	154.0	2.0	2.0	2.0	25	21.2	29.6	90.0	6.2	6.1	35.8	627.5	978.2	10.6	1.165	1.165	6.00	3766	A		8966.7		20.29	36.87	23134	1.82	8.8E-05
109	Panel E	154.0	2.0	2.0	2.0	25	21.2	29.6	90.0	6.2	6.1	35.8	627.5	978.2	10.6	1.165	1.165	6.00	3766	A		8966.7		20.29	36.87	23134	1.82	8.8E-05
110	Panel E	155.0	2.0	2.0	2.0	25	21.0	30.2	90.0	6.1	6.2	35.7	634.2	986.4	10.5	1.180	1.180	6.03	3822	A		8926.1		20.10	36.54	23174	1.82	8.7E-05
111	Panel E	155.0	2.0	2.0	2.0	25	21.0	30.2	74.0	6.1	6.2	35.7	634.2	986.4	10.5	1.161	1.161	6.03	3822	A		8926.1		20.10	36.24	22981	1.80	1.1E-04
112	Panel E	155.0	2.0	2.0	2.0	25	20.8	30.3	74.0	6.1	5.5	34.6	630.2	963.0	10.4	1.167	1.167	5.92	3732	A		8860.2		19.98	35.79	22557	1.79	1.3E-04
113	Panel E	155.0	2.0	2.0	2.0	25	20.5	30.3	90.0	6.1	5.5	34.8	621.2	952.3	10.3	1.193	1.193	5.94	3690	A		8761.4		20.05	35.38	21978	1.77	1.9E-04
												Total	6600.2	10402.2														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in “Prefailure Pillar Yielding”, by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5 Pillar Height should be the same as the working section unless roof collapse is being considered

Summary	FoS
Max	2.60
Min	0.97
Mean	1.72

Panel Factor of safety Based on Tributary load

Panel Extraction Ratio 0.37

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Total Pillar Load	132322.01	MN
Total Pilla Capacity	228754.54	MN
Panel FoS	1.73	

Table F1 - Pillar Stability Analysis, Panel F - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT	**Project No:**	49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m^3	Total Area m^3	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Power Law Probability of Failure
114	Panel F	155.0	2.0	2.0	2.0	25	26.7	106.8	90.0	0.1	5.9	5.6	2851.6	3020.4	13.4	1.600	1.600	4.10	11704	A		18693.0		10.66	64.57	184138	6.06	2.8E-31
115	Panel F	160.0	2.0	2.0	2.0	25	20.4	20.9	90.0	5.6	6.0	39.0	426.4	699.4	10.2	1.012	1.012	6.56	2798	A		18720.0		50.47	32.29	13768	0.64	1.4E+00
116	Panel F	162.0	2.0	2.0	2.0	25	20.2	20.9	90.0	5.6	6.0	39.2	422.2	694.0	10.1	1.017	1.017	6.66	2811	A		18808.2		51.21	31.88	13460	0.62	1.5E+00
117	Panel F	163.0	2.0	2.0	2.0	25	20.1	20.9	90.0	5.6	6.0	39.2	420.1	691.3	10.1	1.020	1.020	6.71	2817	A		18851.0		51.58	31.68	13309	0.61	1.5E+00
118	Panel F	163.0	2.0	2.0	2.0	25	16.4	130.3	90.0	3.0	5.8	19.1	2136.9	2640.3	8.2	1.776	1.776	5.03	10759	A		14229.9		11.69	31.69	67728	2.71	2.3E-10
												Total	6257.1	7745.5														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered (refer to text)

Panel Extraction Ratio 0.19

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	6.06
	Min	0.61
	Mean	2.13

Panel Factor of safety Based on Tributary load

Total Pillar Load	120190.88	MN
Total Pilla Capacity	292402.34	MN
Panel FoS	2.43	

Table G1 - Pillar Stability Analysis, Panel G - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT691 - Dudley Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
119	Panel G	153.0	2.0	2.0	2.0	25	16.2	20.8	90.0	6.1	6.1	43.8	337.0	599.9	8.1	1.124	1.124	6.81	2295	A		15353.6		52.37	24.72	8331	0.47	2.0E+00
120	Panel G	153.0	2.0	2.0	2.0	25	21.0	31.2	90.0	6.2	5.7	34.7	655.2	1003.7	10.5	1.195	1.195	5.86	3839	A		18727.2		34.44	36.79	24104	1.07	3.6E-01
121	Panel G	154.0	2.0	2.0	2.0	25	20.9	30.0	90.0	6.4	6.2	36.6	627.0	988.3	10.5	1.179	1.179	6.07	3805	A		18918.9		36.24	36.25	22730	1.00	5.0E-01
122	Panel G	155.0	2.0	2.0	2.0	25	21.1	29.6	74.0	6.2	6.5	36.6	624.6	985.5	10.6	1.148	1.148	6.11	3819	A		19041.8		36.60	36.32	22682	0.99	5.2E-01
123	Panel G	156.0	2.0	2.0	2.0	25	21.2	29.3	74.0	6.2	6.2	36.1	621.2	972.7	10.6	1.141	1.141	6.11	3794	A		19234.8		37.07	36.47	22656	0.98	5.3E-01
124	Panel G	158.0	2.0	2.0	2.0	25	20.0	20.8	90.0	5.9	6.4	40.9	416.0	704.5	10.0	1.020	1.020	6.69	2783	A		18414.9		50.96	31.44	13080	0.62	1.5E+00
125	Panel G	160.0	2.0	2.0	2.0	25	20.0	21.1	90.0	6.0	6.2	40.5	422.0	709.8	10.0	1.027	1.027	6.73	2839	A		18720.0		51.09	31.55	13316	0.62	1.5E+00
126	Panel G	161.0	2.0	2.0	2.0	25	19.6	21.0	90.0	6.0	6.3	41.1	411.6	698.9	9.8	1.034	1.034	6.83	2813	A		18547.2		51.90	30.72	12645	0.59	1.6E+00
127	Panel G	162.0	2.0	2.0	2.0	25	16.7	21.3	90.0	3.0	6.1	34.1	355.7	539.8	8.4	1.121	1.121	6.15	2186	A		14361.3		46.52	25.64	9120	0.55	1.7E+00
128	Panel G	163.0	2.0	2.0	2.0	25	16.9	20.8	90.0	3.1	6.2	34.9	351.5	540.0	8.5	1.103	1.103	6.26	2201	A		14670.0		47.99	25.82	9077	0.54	1.8E+00
129	Panel G	152.0	2.0	2.0	2.0	25	15.9	21.1	90.0	6.2	6.2	44.4	335.5	603.3	8.0	1.141	1.141	6.83	2293	A		15116.4		51.89	24.35	8168	0.47	2.0E+00
130	Panel G	152.0	2.0	2.0	2.0	25	21.5	30.9	90.0	6.0	5.8	34.2	664.4	1009.3	10.8	1.179	1.179	5.77	3835	A		18810.0		34.09	37.94	25205	1.11	2.8E-01
131	Panel G	153.0	2.0	2.0	2.0	25	21.0	30.1	90.0	6.3	6.0	35.9	632.1	985.5	10.5	1.178	1.178	5.96	3770	A		18796.1		35.70	36.52	23082	1.02	4.5E-01
132	Panel G	155.0	2.0	2.0	2.0	25	21.0	29.8	74.0	6.2	6.4	36.4	625.8	984.6	10.5	1.154	1.154	6.10	3815	A		18972.0		36.41	36.13	22612	0.99	5.2E-01
133	Panel G	156.0	2.0	2.0	2.0	25	21.0	29.4	74.0	6.4	6.1	36.5	617.4	972.7	10.5	1.147	1.147	6.14	3794	A		19234.8		37.30	36.03	22243	0.97	5.7E-01
134	Panel G	157.0	2.0	2.0	2.0	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	10.5	0.978	0.978	6.55	2765	A		19287.5		52.24	33.21	14018	0.64	1.5E+00
135	king section unless ro	158.0	2.0	2.0	2.0	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	10.5	0.978	0.978	6.59	2782	A		19410.3		52.58	33.21	14018	0.63	1.5E+00
136	Panel G	159.0	2.0	2.0	2.0	25	21.0	20.1	90.0	6.3	5.7	40.1	422.1	704.3	10.5	0.978	0.978	6.63	2800	A		19533.2		52.91	33.21	14018	0.63	1.5E+00
137	Panel G	160.0	2.0	2.0	2.0	25	12.3	12.3	90.0	5.8	6.0	54.3	151.3	331.2	6.2	1.000	1.000	8.76	1325	A		13032.0		94.90	17.64	2668	0.19	3.2E+00
												Total	9114.4	14742.7														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.38

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	1.11
	Min	0.19
	Mean	0.74

Panel Factor of safety Based on Tributary load

Total Pillar Load	395731.90	MN
Total Pilla Capacity	303772.74	MN
Panel FoS	0.77	

Table H1 - Pillar Stability Analysis, Panel H - Measured Pillar Dimensions - Pillar Height = Working Section = 2.0 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings -	RT691 - Dudley Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT		

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m^3)	Pillar Details Width Wp (m)	Length Lp (m)	Internal Angle (°)	Roadway Details Wr (m)	Lr (m)	Extract. Ratio (%)	Pillar Area m^2	Total Area m^2	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	"Ultimate" Load MN	FoS	Probability of Failure
138	Panel H	160.0	2.0	2.0	2.0	25	14.3	14.3	90.0	6.4	6.4	52.3	204.5	428.5	7.2	1.000	1.000	8.38	1714	A		14904.0		81.27	20.24	4138	0.25	2.9E+00
139	Panel H	153.0	2.0	2.0	2.0	25	21.1	21.1	90.0	5.9	5.7	38.5	445.2	723.6	10.6	1.000	1.000	6.22	2768	A		13942.1		37.53	33.84	15067	0.90	7.2E-01
140	Panel H	153.0	2.0	2.0	2.0	25	20.9	20.9	90.0	5.9	5.7	38.7	436.8	712.9	10.5	1.000	1.000	6.24	2727	A		13838.9		37.92	33.33	14561	0.88	7.8E-01
141	Panel H	155.0	2.0	2.0	2.0	25	20.9	20.9	90.0	5.9	5.7	38.7	436.8	712.9	10.5	1.000	1.000	6.32	2762	A		14019.8		38.42	33.33	14561	0.87	8.1E-01
142	Panel H	155.0	2.0	2.0	2.0	25	20.7	29.0	90.0	6.1	6.2	36.4	600.3	943.4	10.4	1.167	1.167	6.09	3656	A		14019.8		29.44	35.52	21325	1.21	1.2E-01
143	Panel H	157.0	2.0	2.0	2.0	25	20.2	20.7	74.0	6.2	6.1	40.9	418.1	707.5	10.1	0.992	0.992	6.64	2777	A		13988.7		40.10	31.49	13166	0.79	1.0E+00
144	Panel H	157.0	2.0	2.0	2.0	25	20.2	20.7	74.0	6.2	6.1	40.9	418.1	707.5	10.1	0.992	0.992	6.64	2777	A		13988.7		40.10	31.49	13166	0.79	1.0E+00
145	Panel H	158.0	2.0	2.0	2.0	25	19.6	20.7	90.0	5.8	6.4	41.1	405.7	688.3	9.8	1.027	1.027	6.70	2719	A		13544.6		40.09	30.61	12420	0.76	1.1E+00
146	Panel H	159.0	2.0	2.0	2.0	25	16.8	20.9	90.0	6.1	6.2	43.4	351.1	620.6	8.4	1.109	1.109	7.03	2467	A		12288.7		42.02	25.69	9020	0.61	1.5E+00
147	Panel H	159.0	2.0	2.0	2.0	25	16.6	38.9	90.0	5.7	3.2	31.2	645.7	938.8	8.3	1.402	1.402	5.78	3732	A		11966.7		24.31	28.52	18415	1.17	1.7E-01
148	Panel H	160.0	2.0	2.0	2.0	25	15.2	30.8	90.0	3.2	3.0	24.7	468.2	621.9	7.6	1.339	1.339	5.31	2488	A		9936.0		26.54	25.08	11742	0.95	6.2E-01
149	Panel H	160.0	2.0	2.0	2.0	25	13.9	15.4	90.0	6.0	6.0	49.7	214.1	425.9	7.0	1.051	1.051	7.96	1703	A		1910.4		16.88	20.17	4318	1.19	1.4E-01
150	Panel H	159.0	2.0	2.0	2.0	25	13.0	19.5	90.0	5.8	6.2	47.5	253.5	483.2	6.5	1.200	1.200	7.58	1921	A		4184.9		24.08	20.28	5140	0.84	8.7E-01
151	Panel H	159.0	2.0	2.0	2.0	25	16.2	26.7	90.0	3.1	6.2	31.9	432.5	635.0	8.1	1.245	1.245	5.84	2524	A		1841.2		10.09	26.04	11263	2.58	1.5E-09
152	Panel H	159.0	2.0	2.0	2.0	25	16.2	26.7	90.0	6.1	6.2	41.0	432.5	733.7	8.1	1.245	1.245	6.74	2916	A		2127.4		11.66	26.04	11263	2.23	2.2E-07
153	Panel H	159.0	2.0	2.0	2.0	25	16.2	26.7	90.0	6.2	6.2	41.3	432.5	737.0	8.1	1.245	1.245	6.77	2929	A		2137.0		11.71	26.04	11263	2.22	2.6E-07
154	king section unless ro	159.0	2.0	2.0	2.0	25	19.3	26.9	90.0	5.9	6.3	37.9	519.2	836.6	9.7	1.165	1.165	6.41	3326	A		2404.1		11.04	31.89	16558	2.89	1.7E-11
155	Panel H	157.0	2.0	2.0	2.0	25	19.4	26.9	74.0	5.9	6.3	37.9	521.9	840.0	9.7	1.143	1.143	6.32	3297	A		6355.4		18.50	31.83	16611	1.72	3.5E-04
156	Panel H	157.0	2.0	2.0	2.0	25	20.0	26.5	74.0	5.7	6.2	36.9	530.0	840.4	10.0	1.120	1.120	6.22	3299	A		6455.8		18.40	32.99	17484	1.79	1.3E-04
157	Panel H	157.0	2.0	2.0	2.0	25	16.5	26.7	90.0	6.3	6.3	41.4	440.6	752.4	8.3	1.236	1.236	6.70	2953	A		5727.4		19.70	26.54	11693	1.35	2.7E-02
158	Panel H	159.0	2.0	2.0	2.0	25	16.5	21.3	90.0	3.1	6.1	34.6	351.5	537.0	8.3	1.127	1.127	6.07	2135	A		4363.0		18.49	25.32	8899	1.37	2.1E-02
159	Panel H	159.0	2.0	2.0	2.0	25	16.2	21.0	90.0	6.2	6.4	44.6	340.2	613.8	8.1	1.129	1.129	7.17	2440	A		4986.2		21.83	24.78	8429	1.14	2.4E-01
160	Panel H	158.0	2.0	2.0	2.0	25	16.5	21.2	90.0	6.1	6.5	44.1	349.8	626.0	8.3	1.125	1.125	7.07	2473	A		4999.1		21.36	25.29	8848	1.18	1.6E-01
161	Panel H	158.0	2.0	2.0	2.0	25	20.0	21.0	90.0	6.0	6.2	40.6	420.0	707.2	10.0	1.024	1.024	6.65	2793	A		5751.2		20.34	31.52	13237	1.55	2.7E-03
162	Panel H	158.0	2.0	2.0	2.0	25	19.8	20.8	90.0	6.2	6.3	41.5	411.8	704.6	9.9	1.025	1.025	6.76	2783	A		5751.2		20.72	31.04	12785	1.50	4.9E-03
163	Panel H	157.0	2.0	2.0	2.0	25	19.8	20.8	90.0	6.1	6.1	40.9	411.8	696.7	9.9	1.025	1.025	6.64	2735	A		5692.8		20.46	31.04	12785	1.52	3.9E-03
164	Panel H	157.0	2.0	2.0	2.0	25	16.2	21.1	90.0	6.3	6.0	43.9	341.8	609.8	8.1	1.131	1.131	7.00	2393	A		4945.5		21.47	24.80	8478	1.16	2.0E-01
												Total	11234.4	18585.0														

Summary		FoS
	Max	2.89
	Min	0.25
	Mean	1.31

Panel Extraction Ratio 0.40

Panel Factor of safety Based on Tributary load

Total Pillar Load	289275.83	MN
Total Pilla Capacity	326635.78	MN
Panel FoS	1.13	

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.
5. Pillar Height should be the same as the working section unless roof collapse is being considered

Table V - Pillar Stability Analysis, VT Seam - Measured Pillar Dimensions - Pillar Height = Working Section 2.39 m

Douglas Partners Geotechnics · Environment · Groundwater

Mine Workings -	RT403 - VT Seam	**Client:**	SPG Investments Pty Ltd
Project:	Proposed Commercial Development	**Date:**	28/2/18
Location:	4B South Street, Bennetts Green	**Sheet:**	1
Analysis Assumptions:	Pillar dimensions from RT	**Project No:**	49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m³)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m³	Total Area m³	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Power Law Probability of Failure
1	VT Seam	145.0	3.03	2.39	2.39	25	10.0	31.0	90.0	6.6	5.7	49.1	310.0	609.2	4.2	1.512	1.177	7.12	2208						14.55	4510	2.04	3.5E-06
2	VT Seam	145.0	3.03	2.39	2.39	25	10.7	27.4	90.0	7.2	3.1	46.3	293.2	546.0	4.5	1.438	1.196	6.75	1979						15.18	4450	2.25	1.8E-07
3	VT Seam	142.0	3.03	2.39	2.39	25	11.2	34.1	90.0	7.2	2.7	43.6	381.9	677.1	4.7	1.506	1.259	6.29	2404						15.95	6090	2.53	2.9E-09
4	VT Seam	142.0	3.03	2.39	2.39	25	15.2	18.0	90.0	6.6	5.4	46.4	273.6	510.1	6.4	1.084	1.084	6.62	1811						17.82	4874	2.69	3.0E-10
5	VT Seam	142.0	3.03	2.39	2.39	25	12.2	42.1	90.0	6.4	6.6	43.3	513.6	905.8	5.1	1.551	1.360	6.26	3216						17.20	8835	2.75	1.3E-10
6	VT Seam	141.0	3.03	2.39	2.39	25	8.5	31.1	90.0	6.4	5.9	52.0	264.4	551.3	3.6	1.571	1.087	7.35	1943						12.86	3399	1.75	2.3E-04
7	VT Seam	140.0	3.03	2.39	2.39	25	13.4	31.1	90.0	6.0	6.4	42.7	416.7	727.5	5.6	1.398	1.338	6.11	2546						18.03	7516	2.95	7.1E-12
8	VT Seam	140.0	3.03	2.39	2.39	25	11.6	36.5	90.0	6.5	6.2	45.2	423.4	772.9	4.9	1.518	1.294	6.39	2705						16.47	6972	2.58	1.6E-09
9	VT Seam	140.0	3.03	2.39	2.39	25	12.7	16.6	90.0	6.4	6.5	52.2	210.8	441.2	5.3	1.133	1.101	7.32	1544						15.79	3330	2.16	6.7E-07
10	VT Seam	140.0	3.03	2.39	2.39	25	16.1	31.9	90.0	5.9	7.1	40.1	513.6	858.0	6.7	1.329	1.329	5.85	3003						20.81	10686	3.56	1.2E-15
11	VT Seam	138.0	3.03	2.39	2.39	25	9.9	17.1	90.0	6.3	6.8	56.3	169.3	387.2	4.1	1.267	1.094	7.89	1336						13.94	2360	1.77	1.8E-04
12	VT Seam	137.0	3.03	2.39	2.39	25	9.5	22.7	74.0	5.8	6.7	52.1	215.7	449.8	4.0	1.393	1.114	7.14	1541						13.78	2971	1.93	1.8E-05
13	VT Seam	136.0	3.03	2.39	2.39	25	5.5	31.4	74.0	5.9	6.4	59.9	172.7	430.9	2.3	1.692	1.000	8.48	1465						9.87	1704	1.16	1.9E-01
14	VT Seam	137.0	3.03	2.39	2.39	25	22.9	32.0	90.0	3.0	6.0	25.5	732.8	984.2	9.6	1.166	1.166	4.60	3371						29.78	21820	6.47	7.0E-34
15	VT Seam	138.0	3.03	2.39	2.39	25	21.5	30.5	90.0	5.2	6.5	33.6	655.8	987.9	9.0	1.173	1.173	5.20	3408						27.31	17906	5.25	2.9E-26
16	VT Seam	138.0	3.03	2.39	2.39	25	14.3	26.7	90.0	6.8	6.0	44.7	381.8	690.0	6.0	1.302	1.301	6.23	2380						18.61	7107	2.99	4.4E-12
17	king section unless ro	137.0	3.03	2.39	2.39	25	14.8	16.1	90.0	6.9	5.6	49.4	238.3	470.9	6.2	1.042	1.042	6.77	1613						17.08	4069	2.52	3.4E-09
18	VT Seam	137.0	3.03	2.39	2.39	25	11.8	24.4	90.0	6.8	6.4	49.7	287.9	572.9	4.9	1.348	1.213	6.81	1962						16.07	4627	2.36	3.7E-08
19	VT Seam	135.0	3.03	2.39	2.39	25	16.3	38.0	90.0	6.0	6.6	37.7	619.4	994.6	6.8	1.400	1.400	5.42	3357						21.61	13387	3.99	2.4E-18
20	VT Seam	134.0	3.03	2.39	2.39	25	8.8	16.6	90.0	6.5	5.9	57.6	146.1	344.3	3.7	1.307	1.063	7.89	1153						12.94	1890	1.64	1.1E-03
21	VT Seam	135.0	3.03	2.39	2.39	25	15.7	28.7	90.0	5.6	6.2	39.4	450.6	743.4	6.6	1.293	1.293	5.57	2509						20.05	9032	3.60	6.3E-16
22	VT Seam	135.0	3.03	2.39	2.39	25	37.8	50.0	90.0	5.7	5.7	22.0	1890.0	2423.0	15.8	1.139	1.139	4.33	8177						70.83	133868	16.37	9.7E-96
23	VT Seam	133.0	3.03	2.39	2.39	25	14.6	54.6	74.0	5.6	5.8	34.7	797.2	1220.1	6.1	1.565	1.565	5.09	4057						20.79	16569	4.08	5.9E-19
24	VT Seam	134.0	3.03	2.39	2.39	25	17.8	34.6	74.0	5.7	6.3	35.9	615.9	961.2	7.4	1.303	1.303	5.23	3220						22.80	14043	4.36	1.1E-20
25	VT Seam	135.0	3.03	2.39	2.39	25	18.7	33.6	90.0	5.6	6.3	35.2	628.3	969.6	7.8	1.285	1.285	5.21	3272						23.94	15043	4.60	3.7E-22
26	VT Seam	132.0	3.03	2.39	2.39	25	10.8	33.6	90.0	5.7	2.8	39.6	362.9	600.6	4.5	1.514	1.233	5.46	1982						15.49	5622	2.84	3.7E-11
27	VT Seam	132.0	3.03	2.39	2.39	25	14.4	38.0	90.0	5.4	6.0	37.2	547.2	871.2	6.0	1.450	1.450	5.25	2875						19.78	10825	3.77	5.9E-17
28	VT Seam	136.0	3.03	2.39	2.39	25	14.2	36.1	90.0	5.4	6.0	37.9	512.6	825.2	5.9	1.435	1.425	5.47	2806						19.40	9946	3.55	1.4E-15
29	VT Seam	135.0	3.03	2.39	2.39	25	12.7	36.3	90.0	5.5	5.5	39.4	461.0	760.8	5.3	1.482	1.354	5.57	2568						17.55	8091	3.15	4.0E-13
30	VT Seam	134.0	3.03	2.39	2.39	25	12.7	35.5	90.0	5.5	5.5	39.6	450.9	746.2	5.3	1.473	1.348	5.54	2500						17.51	7895	3.16	3.7E-13
31	VT Seam	133.0	3.03	2.39	2.39	25	13.2	39.3	90.0	5.6	5.6	38.5	518.8	844.1	5.5	1.497	1.404	5.41	2807						18.31	9496	3.38	1.4E-14
32	VT Seam	133.0	3.03	2.39	2.39	25	13.0	37.0	90.0	5.6	5.6	39.3	481.0	792.4	5.4	1.480	1.375	5.48	2635						17.94	8630	3.28	6.7E-14
33	VT Seam	132.0	3.03	2.39	2.39	25	13.0	38.2	90.0	5.6	5.6	39.0	496.6	814.7	5.4	1.492	1.385	5.41	2688						18.00	8940	3.33	3.3E-14
34	VT Seam	133.0	3.03	2.39	2.39	25	13.6	37.8	90.0	5.6	5.1	37.6	514.1	823.7	5.7	1.471	1.413	5.33	2739						18.73	9630	3.52	2.1E-15
35	VT Seam	133.0	3.03	2.39	2.39	25	13.6	37.4	74.0	5.5	6.1	38.8	508.6	830.9	5.7	1.451	1.396	5.43	2763						18.62	9470	3.43	7.5E-15
36	VT Seam	134.0	3.03	2.39	2.39	25	14.4	37.6	74.0	5.6	5.8	37.6	541.4	868.0	6.0	1.430	1.430	5.37	2908						19.64	10635	3.66	2.8E-16
37	VT Seam	133.0	3.03	2.39	2.39	25	13.8	21.6	90.0	5.4	5.8	43.3	298.1	526.1	5.8	1.220	1.202	5.87	1749						17.42	5194	2.97	5.5E-12
38	VT Seam	133.0	3.03	2.39	2.39	25	14.6	32.5	90.0	5.5	5.2	37.4	474.5	757.8	6.1	1.380	1.380	5.31	2520						19.50	9251	3.67	2.3E-16
39	VT Seam	132.0	3.03	2.39	2.39	25	14.5	26.8	90.0	5.7	5.8	41.0	388.6	658.5	6.1	1.298	1.298	5.59	2173						18.79	7303	3.36	2.0E-14
40	VT Seam	132.0	3.03	2.39	2.39	25	13.1	37.0	90.0	6.1	6.1	41.4	484.7	827.5	5.5	1.477	1.381	5.63	2731						18.06	8755	3.21	1.8E-13
41	VT Seam	132.0	3.03	2.39	2.39	25	12.9	41.9	90.0	6.0	5.5	39.7	540.5	895.9	5.4	1.529	1.404	5.47	2956						18.05	9754	3.30	4.8E-14
42	VT Seam	132.0	3.03	2.39	2.39	25	12.3	34.2	90.0	5.2	5.2	39.0	420.7	689.5	5.1	1.471	1.318	5.41	2275						17.00	7151	3.14	4.5E-13
43	VT Seam	132.0	3.03	2.39	2.39	25	15.0	26.6	90.0	5.1	5.2	37.6	399.0	639.2	6.3	1.279	1.279	5.29	2109						19.17	7647	3.63	4.4E-16
44	VT Seam	132.0	3.03	2.39	2.39	25	17.8	36.7	90.0	5.9	5.8	35.1	653.3	1007.3	7.4	1.347	1.347	5.09	3324						23.19	15150	4.56	6.5E-22
45	VT Seam	132.0	3.03	2.39	2.39	25	57.5	139.5	90.0	5.9	5.8	12.9	8021.3	9212.0	24.1	1.416	1.416	3.79	30400						189.80	1522466	50.08	2.0E-306
46	VT Seam	130.0	3.03	2.39	2.39	25	14.2	36.8	74.0	5.5	5.7	37.6	522.6	837.3	5.9	1.427	1.417	5.21	2721						19.35	10109	3.72	1.2E-16
47	VT Seam	129.0	3.03	2.39	2.39	25	16.9	24.9	74.0	5.6	6.1	39.7	420.8	697.5	7.1	1.172	1.172	5.35	2249						20.46	8609	3.83	2.4E-17
48	VT Seam	133.0	3.03	2.39	2.39	25	13.6	134.0	90.0	6.2	3.3	33.0	1822.4	2718.5	5.7	1.816	1.707	4.96	9039						20.63	37592	4.16	2.0E-19
49	VT Seam	133.0	3.03	2.39	2.39	25	12.8	42.0	90.0	6.3	5.3	40.5	537.6	903.4	5.4	1.533	1.398	5.59	3004						17.92	9636	3.21	1.8E-13
50	VT Seam	132.0	3.03	2.39	2.39	25	15.1	28.6	90.0	6.0	6.2	41.2	431.9	734.3	6.3	1.309	1.309	5.61	2423						19.50	8422	3.48	3.8E-15
51	VT Seam	132.0	3.03	2.39	2.39	25	16.6	40.2	90.0	6.0	6.1	36.2	667.3	1046.4	6.9	1.415	1.415	5.17	3453						22.12	14764	4.28	3.8E-20
52	VT Seam	132.0	3.03	2.39	2.39	25	11.3	24.8	90.0	5.3	5.9	45.0	280.2	509.6	4.7	1.374	1.201	6.00	1682						15.64	4383	2.61	1.0E-09
53	VT Seam	132.0	3.03	2.39	2.39	25	12.1	32.3	90.0	5.7	5.9	42.5	390.8	680.0	5.1	1.455	1.294	5.74	2244						16.70	6525	2.91	1.3E-11
54	VT Seam	132.0	3.03	2.39	2.39	25	14.8	35.7	90.0	5.7	6.0	38.2	528.4	854.9	6.2	1.414	1.414	5.34	2821						19.95	10542	3.74	8.8E-17
55	VT Seam	131.0	3.03	2.39	2.39	25	11.0	36.2	90.0	5.9	3.1	40.0	398.2	664.2	4.6	1.534	1.257	5.46	2175						15.79	6287	2.89	1.7E-11
56	VT Seam	130.0	3.03	2.39	2.39	25	14.8	30.0	74.0	6.2	3.3	36.5	444.0	699.3	6.2	1.322	1.322	5.12	2273						19.28	8560	3.77	5.8E-17
57	VT Seam	130.0	3.03	2.39	2.39	25	14.9	32.7	74.0	5.5	6.0	38.3	487.2	789.5	6.2	1.357	1.357	5.27	2566						19.65	9572	3.73	9.7E-17
58	VT Seam	130.0	3.03	2.39	2.39	25	14.5	40.4	90.0	5.4	5.9	36.4	585.8	921.4	6.1	1.472	1.472	5.11	2994						20.04	11738	3.92	6.3E-18
59	VT Seam	128.0	3.03	2.39	2.39	25	9.4	25.6	90.0	6.1	2.8	45.3	240.6	440.2	3.9	1.463	1.126	5.85	1409						13.78	3315	2.35	3.9E-08
60	VT Seam	129.0	3.03	2.39	2.39	25	13.4	33.3	90.0	6.0	6.3	41.9	446.2	768.2	5.6	1.426	1.361	5.55	2478						18.20	8119	3.28	6.6E-14
61	VT Seam	130.0	3.03	2.39	2.39	25	13.3	38.6	90.0	6.1	6.1	40.8	513.4	867.2	5.6	1.487	1.404	5.49	2818						18.40	9444	3.35	2.3E-14
62	VT Seam	129.0	3.03	2.39	2.39	25	16.1	105.0	90.0	6.4	2.6	30.2	1690.5	2421.0	6.7	1.734	1.734	4.62	7808						23.83	40281	5.16	1.1E-25
63	VT Seam	127.0	3.03	2.39	2.39	25	12.6	38.2	90.0	5.2	5.6	38.3	481.3	779.6	5.3	1.504	1.362	5.14	2475						17.52	8434	3.41	1.0E-14
64	VT Seam	126.0	3.03	2.39	2.39	25	13.0	33.8	90.0	5.3	4.8	37.8	439.4	706.4	5.4	1.444	1.349	5.06	2225						17.76	7804	3.51	2.4E-15
65	VT Seam	127.0	3.03	2.39	2.39	25	14.0	36.2	90.0	5.1	5.2	35.9	506.8	790.7	5.9	1.442	1.417	4.95	2511						19.15	9703	3.86	1.4E-17
66	VT Seam	127.0	3.03	2.39	2.39	25	12.2	31.6	90.0	6.1	6.6	44.9	385.5	699.1	5.1	1.443	1.293	5.76	2220						16.76	6463	2.91	1.3E-11
67	VT Seam	127.0	3.03	2.39	2.39	25	15.0	31.6	74.0	5.5	5.6	37.8	474.0	762.6	6.3	1.339	1.339	5.11	2421						19.62	9300	3.84	2.0E-17
68	VT Seam	127.0	3.03	2.39	2.39	25	11.6	31.3	74.0	6.6	5.7	46.1	363.1	673.4	4.9	1.443	1.255	5.89	2138						16.21	5885	2.75	1.3E-10
69	VT Seam	126.0	3.03	2.39	2.39	25	13.2	36.1	90.0	5.5	5.0	38.0	476.5	768.6	5.5	1.465	1.378	5.08	2421						18.13	8641	3.57	9.9E-16
70	VT Seam	126.0	3.03	2.39	2.39	25	13.3	35.8	90.0	5.4	5.0	37.6	476.1	763.0	5.6	1.458	1.381	5.05	2403						18.24	8684	3.61	5.2E-16
71	VT Seam	126.0	3.03	2.39	2.39	25	13.4	30.3	90.0	6.0	5.1	40.9	406.0	686.8	5.6	1.387	1.329	5.33	2163						17.97	7297	3.37	1.7E-14
72	VT Seam	126.0	3.03	2.39	2.39	25	13.4	36.2	90.0	5.7	6.5	40.5	485.1	815.6	5.6	1.460	1.389	5.30	2569						18.38	8918	3.47	4.0E-15
73	VT Seam	127.0	3.03	2.39	2.39	25	13.5	35.9	90.0	6.0	6.4	41.2	484.7	824.9	5.6	1.453	1.391	5.40	2619						18.49	8961	3.42	8.2E-15
74	VT Seam	127.0	3.03	2.39	2.39	25	13.5	48.2	90.0	6.3	5.6	38.9	650.7	1065.2	5.6	1.562	1.483	5.20	3382						19.10	12429	3.67	2.2E-16
75	VT Seam	127.0	3.03	2.39	2.39	25	13.7	37.2	90.0	6.6	5.6	41.3	509.6	868.8	5.7	1.462	1.413	5.41	2759						18.83	9594	3.48	3.7E-15
76	VT Seam	127.0	3.03	2.39	2.39	25	13.6	44.8	90.0	5.6	6.8	38.5	609.3	990.7	5.7	1.534	1.468	5.16	3146						19.10	11636	3.70	1.5E-16
77	VT Seam	127.0	3.03	2.39	2.39	25	13.4	35.2	90.0	5.9	6.3	41.1	471.7	801.0	5.6	1.449	1.380	5.39	2543						18.32	8642	3.40	1.2E-14
78	VT Seam	126.0	3.03	2.39	2.39	25	12.0	44.0	90.0	6.0	3.6	38.4	528.0	856.8	5.0	1.571	1.356	5.11	2699						17.03	8989	3.33	3.0E-14
79	VT Seam	126.0	3.03	2.39	2.39	25	11.8	34.1	74.0	6.4	6.8	45.9	402.4	744.4	4.9	1.471	1.283	5.83	2345						16.54	6654	2.84	3.7E-11
80	VT Seam	125.0	3.03	2.39	2.39	25	9.6	35.4	74.0	6.7	7.1	50.9	339.8	692.8	4.0	1.560	1.163	6.37	2165						14.16	4811	2.22	2.6E-07
81	VT Seam	125.0	3.03	2.39	2.39	25	9.9	33.4	90.0	7.0	7.0	51.6	330.7	682.8	4.1	1.543	1.179	6.45	2134						14.49	4790	2.25	1.9E-07
82	VT Seam	124.0	3.03	2.39	2.39	25	11.8	35.6	90.0	6.7	7.0	46.7	420.1	788.1	4.9	1.502	1.300	5.82	2443						16.65	6996	2.86	2.5E-11
83	VT Seam	123.0	3.03	2.39	2.39	25	14.8	35.1	90.0	6.6	7.3	42.7	519.5	907.4	6.2	1.407	1.407	5.37	2790						19.90	10339	3.71	1.4E-16
84	VT Seam	122.0	3.03	2.39	2.39	25	15.7	35.5	90.0	7.1	7.5	43.2	557.4	980.4	6.6	1.387	1.387	5.37	2990						20.78	11579	3.87	1.3E-17
85	VT Seam	121.0	3.03	2.39	2.39	25	16.0	25.0	90.0	6.9	3.8	39.3	400.0	659.5	6.7	1.220	1.220	4.99	1995						19.80	7919	3.97	3.1E-18
86	VT Seam	121.0	3.03	2.39	2.39	25	15.0	33.3	90.0	6.9	7.5	44.1	499.5	893.5	6.3	1.379	1.379	5.41	2703						19.92	9948	3.68	2.0E-16
87	VT Seam	122.0	3.03	2.39	2.39	25	15.4	33.3	90.0	7.3	7.5	44.6	512.8	926.2	6.4	1.368	1.368	5.51	2825						20.28	10400	3.68	2.0E-16
88	VT Seam	123.0	3.03	2.39	2.39	25	15.4	33.3	90.0	7.2	7.5	44.4	512.8	922.1	6.4	1.368	1.368	5.53	2835						20.28	10400	3.67	2.4E-16
89	VT Seam	124.0	3.03	2.39	2.39	25	11.6	34.3	90.0	6.4	6.7	46.1	397.9	738.0	4.9	1.495	1.282	5.75	2288						16.39	6520	2.85	3.1E-11
90	VT Seam	125.0	3.03	2.39	2.39	25	13.7	23.8	74.0	5.7	5.7	43.0	326.1	572.3	5.7	1.251	1.226	5.48	1788						17.51	5710	3.19	2.2E-13
91	VT Seam	121.0	3.03	2.39	2.39	25	14.7	31.8	74.0	6.8	7.4	44.5	467.5	842.8	6.2	1.351	1.351	5.45	2549						19.39	9062	3.55	1.2E-15
92	VT Seam	122.0	3.03	2.39	2.39	25	15.1	31.8	90.0	6.4	7.4	43.0	480.2	842.8	6.3	1.356	1.356	5.35	2571						19.86	9535	3.71	1.3E-16
93	VT Seam	123.0	3.03	2.39	2.39	25	15.8	31.8	90.0	6.6	7.4	42.8	502.4	878.1	6.6	1.336	1.336	5.37	2700						20.50	10301	3.82	2.9E-17
94	VT Seam	124.0	3.03	2.39	2.39	25	28.2	36.3	90.0	6.2	6.0	29.7	1023.7	1455.1	11.8	1.126	1.126	4.41	4511						40.81	41780	9.26	2.6E-51
95	VT Seam	125.0	3.03	2.39	2.39	25	13.3	37.7	90.0	5.4	5.7	38.2	501.4	811.6	5.6	1.478	1.397	5.06	2536						18.35	9199	3.63	4.3E-16
96	VT Seam	121.0	3.03	2.39	2.39	25	14.4	33.1	90.0	6.7	6.3	42.7	476.6	831.3	6.0	1.394	1.394	5.28	2515						19.38	9240	3.67	2.2E-16
97	VT Seam	122.0	3.03	2.39	2.39	25	14.7	36.1	90.0	6.3	6.3	40.4	530.7	890.4	6.2	1.421	1.421	5.12	2716						19.90	10559	3.89	1.0E-17
98	VT Seam	123.0	3.03	2.39	2.39	25	15.9	36.1	90.0	6.4	6.3	39.3	574.0	945.5	6.7	1.388	1.388	5.07	2907						21.03	12070	4.15	2.3E-19
99	VT Seam	121.0	3.03	2.39	2.39	25	13.6	35.4	74.0	5.8	5.8	39.8	481.4	799.3	5.7	1.429	1.377	5.02	2418						18.49	8900	3.68	2.0E-16
100	VT Seam	120.0	3.03	2.39	2.39	25	14.2	33.5	74.0	6.4	2.8	36.4	475.7	747.8	5.9	1.388	1.379	4.72	2243						19.08	9076	4.05	1.0E-18
101	VT Seam	121.0	3.03	2.39	2.39	25	14.3	35.4	90.0	6.3	5.8	40.4	506.2	848.7	6.0	1.425	1.422	5.07	2567						19.48	9861	3.84	2.0E-17
102	VT Seam	121.0	3.03	2.39	2.39	25	14.2	34.5	90.0	6.6	3.0	37.2	489.9	780.0	5.9	1.417	1.407	4.82	2360						19.28	9443	4.00	1.9E-18
103	VT Seam	122.0	3.03	2.39	2.39	25	17.2	35.4	90.0	6.6	5.8	37.9	608.9	980.6	7.2	1.346	1.346	4.91	2991						22.35	13610	4.55	7.2E-22
104	VT Seam	122.0	3.03	2.39	2.39	25	17.4	35.4	90.0	6.8	7.0	40.0	616.0	1026.1	7.3	1.341	1.341	5.08	3130						22.58	13909	4.44	3.3E-21
105	VT Seam	124.0	3.03	2.39	2.39	25	29.0	74.8	90.0	5.6	5.9	22.3	2169.2	2792.2	12.1	1.441	1.441	3.99	8656						48.61	105435	12.18	1.5E-69
106	VT Seam	125.0	3.03	2.39	2.39	25	13.8	46.8	90.0	5.7	6.2	37.5	645.8	1033.5	5.8	1.545	1.495	5.00	3230						19.47	12576	3.89	9.2E-18
107	VT Seam	125.0	3.03	2.39	2.39	25	22.7	73.0	90.0	6.8	6.2	29.1	1657.1	2336.4	9.5	1.526	1.526	4.41	7301						33.72	55877	7.65	3.0E-41
108	VT Seam	124.0	3.03	2.39	2.39	25	17.6	37.7	90.0	6.8	6.3	38.2	663.5	1073.6	7.4	1.363	1.363	5.02	3328						23.05	15297	4.60	3.8E-22
												Total	64923.4	102049.1														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.36

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS	
	Max	50.08	
	Min	1.16	
	Mean	4.13	
Panel Factor of safety Based on Tributary load			
Total Pillar Load		331066.77	MN
Total Pilla Capacity		2829990.44	MN
Panel FoS		8.55	

Table V1 - Pillar Stability Analysis, VT Seam - Measured Pillar Dimensions - Working Section 2.39 m, Pillar Height = 3.03 m

Douglas Partners
Geotechnics · Environment · Groundwater

Mine Workings - RT403 - VT Seam
Project: Proposed Commercial Development
Location: 4B South Street, Bennetts Green
Analysis Assumptions: Pillar dimensions from RT

Client: SPG Investments Pty Ltd
Date: 28/2/18
Sheet: 1

Project No: 49710.01

Pillar Id:	Comment	Depth D (m)	Seam Thickness (m)	Working Section H (m)	Pillar Height Section H (m)	Unit Weigth γ (kN/m³)	Pillar Details Width Wp (m)	Pillar Details Length Lp (m)	Pillar Details Internal Angle (°)	Roadway Details Wr (m)	Roadway Details Lr (m)	Extract. Ratio (%)	Pillar Area m³	Total Area m³	Width/ Height Ratio Wp/H	Width Modifier Θ_0	Width Modifier Θ	Pillar Stress (Tributary) (MPa)	Pillar Load (Tributary) MN	Abut (A) Yield (Y) (?)	Shed Load MN	Load Received MN	Pillar Stress ("Yield") (MPa)	Pillar Stress ("Abut") (MPa)	Power Law Strength (MPa)	Power Law "Ultimate" Load MN	Power Law FoS	Power Law Probability of Failure
1	VT Seam	145.0	3.03	2.39	3.03	25	10.0	31.0	90.0	6.6	5.7	49.1	310.0	609.2	3.3	1.512	1.042	7.12	2208						11.20	3472	1.57	2.1E-03
2	VT Seam	145.0	3.03	2.39	3.03	25	10.7	27.4	90.0	7.2	3.1	46.3	293.2	546.0	3.5	1.438	1.066	6.75	1979						11.73	3439	1.74	2.8E-04
3	VT Seam	142.0	3.03	2.39	3.03	25	11.2	34.1	90.0	7.2	2.7	43.6	381.9	677.1	3.7	1.506	1.100	6.29	2404						12.20	4658	1.94	1.5E-05
4	VT Seam	142.0	3.03	2.39	3.03	25	15.2	18.0	90.0	6.6	5.4	46.4	273.6	510.1	5.0	1.084	1.056	6.62	1811						13.85	3790	2.09	1.7E-06
5	VT Seam	142.0	3.03	2.39	3.03	25	12.2	42.1	90.0	6.4	6.6	43.3	513.6	905.8	4.0	1.551	1.162	6.26	3216						13.10	6730	2.09	1.7E-06
6	VT Seam	141.0	3.03	2.39	3.03	25	8.5	31.1	90.0	6.4	5.9	52.0	264.4	551.3	2.8	1.571	1.000	7.35	1943						10.09	2669	1.37	2.0E-02
7	VT Seam	140.0	3.03	2.39	3.03	25	13.4	31.1	90.0	6.0	6.4	42.7	416.7	727.5	4.4	1.398	1.172	6.11	2546						13.81	5754	2.26	1.5E-07
8	VT Seam	140.0	3.03	2.39	3.03	25	11.6	36.5	90.0	6.5	6.2	45.2	423.4	772.9	3.8	1.518	1.122	6.39	2705						12.55	5312	1.96	1.1E-05
9	VT Seam	140.0	3.03	2.39	3.03	25	12.7	16.6	90.0	6.4	6.5	52.2	210.8	441.2	4.2	1.133	1.051	7.32	1544						12.71	2679	1.73	2.9E-04
10	VT Seam	140.0	3.03	2.39	3.03	25	16.1	31.9	90.0	5.9	7.1	40.1	513.6	858.0	5.3	1.329	1.245	5.85	3003						15.55	7986	2.66	4.8E-10
11	VT Seam	138.0	3.03	2.39	3.03	25	9.9	17.1	90.0	6.3	6.8	56.3	169.3	387.2	3.3	1.267	1.021	7.89	1336						11.03	1867	1.40	1.5E-02
12	VT Seam	137.0	3.03	2.39	3.03	25	9.5	22.7	74.0	5.8	6.7	52.1	215.7	449.8	3.1	1.393	1.015	7.14	1541						10.77	2322	1.51	4.4E-03
13	VT Seam	136.0	3.03	2.39	3.03	25	5.5	31.4	74.0	5.9	6.4	59.9	172.7	430.9	1.8	1.692	1.000	8.48	1465						8.08	1396	0.95	6.0E-01
14	VT Seam	137.0	3.03	2.39	3.03	25	22.9	32.0	90.0	3.0	6.0	25.5	732.8	984.2	7.6	1.166	1.166	4.60	3371						20.25	14838	4.40	6.2E-21
15	VT Seam	138.0	3.03	2.39	3.03	25	21.5	30.5	90.0	5.2	6.5	33.6	655.8	987.9	7.1	1.173	1.173	5.20	3408						18.99	12454	3.65	2.9E-16
16	VT Seam	138.0	3.03	2.39	3.03	25	14.3	26.7	90.0	6.8	6.0	44.7	381.8	690.0	4.7	1.302	1.164	6.23	2380						14.22	5429	2.28	1.1E-07
17	king section unless ro	137.0	3.03	2.39	3.03	25	14.8	16.1	90.0	6.9	5.6	49.4	238.3	470.9	4.9	1.042	1.026	6.77	1613						13.57	3234	2.01	5.9E-06
18	VT Seam	137.0	3.03	2.39	3.03	25	11.8	24.4	90.0	6.8	6.4	49.7	287.9	572.9	3.9	1.348	1.093	6.81	1962						12.49	3595	1.83	7.1E-05
19	VT Seam	135.0	3.03	2.39	3.03	25	16.3	38.0	90.0	6.0	6.6	37.7	619.4	994.6	5.4	1.400	1.306	5.42	3357						16.05	9939	2.96	6.2E-12
20	VT Seam	134.0	3.03	2.39	3.03	25	8.8	16.6	90.0	6.5	5.9	57.6	146.1	344.3	2.9	1.307	1.000	7.89	1153						10.27	1501	1.30	4.5E-02
21	VT Seam	135.0	3.03	2.39	3.03	25	15.7	28.7	90.0	5.6	6.2	39.4	450.6	743.4	5.2	1.293	1.205	5.57	2509						15.08	6793	2.71	2.4E-10
22	VT Seam	135.0	3.03	2.39	3.03	25	37.8	50.0	90.0	5.7	5.7	22.0	1890.0	2423.0	12.5	1.139	1.139	4.33	8177						41.86	79123	9.68	6.7E-54
23	VT Seam	133.0	3.03	2.39	3.03	25	14.6	54.6	74.0	5.6	5.8	34.7	797.2	1220.1	4.8	1.565	1.312	5.09	4057						15.28	12178	3.00	3.5E-12
24	VT Seam	134.0	3.03	2.39	3.03	25	17.8	34.6	74.0	5.7	6.3	35.9	615.9	961.2	5.9	1.303	1.288	5.23	3220						16.90	10408	3.23	1.3E-13
25	VT Seam	135.0	3.03	2.39	3.03	25	18.7	33.6	90.0	5.6	6.3	35.2	628.3	969.6	6.2	1.285	1.285	5.21	3272						17.52	11011	3.36	1.9E-14
26	VT Seam	132.0	3.03	2.39	3.03	25	10.8	33.6	90.0	5.7	2.8	39.6	362.9	600.6	3.6	1.514	1.081	5.46	1982						11.87	4307	2.17	5.2E-07
27	VT Seam	132.0	3.03	2.39	3.03	25	14.4	38.0	90.0	5.4	6.0	37.2	547.2	871.2	4.8	1.450	1.243	5.25	2875						14.76	8074	2.81	5.6E-11
28	VT Seam	136.0	3.03	2.39	3.03	25	14.2	36.1	90.0	5.4	6.0	37.9	512.6	825.2	4.7	1.435	1.225	5.47	2806						14.55	7457	2.66	4.9E-10
29	VT Seam	135.0	3.03	2.39	3.03	25	12.7	36.3	90.0	5.5	5.5	39.4	461.0	760.8	4.2	1.482	1.169	5.57	2568						13.42	6185	2.41	1.8E-08
30	VT Seam	134.0	3.03	2.39	3.03	25	12.7	35.5	90.0	5.5	5.5	39.6	450.9	746.2	4.2	1.473	1.166	5.54	2500						13.40	6041	2.42	1.6E-08
31	VT Seam	133.0	3.03	2.39	3.03	25	13.2	39.3	90.0	5.6	5.6	38.5	518.8	844.1	4.4	1.497	1.200	5.41	2807						13.87	7194	2.56	1.9E-09
32	VT Seam	133.0	3.03	2.39	3.03	25	13.0	37.0	90.0	5.6	5.6	39.3	481.0	792.4	4.3	1.480	1.184	5.48	2635						13.66	6572	2.49	5.1E-09
33	VT Seam	132.0	3.03	2.39	3.03	25	13.0	38.2	90.0	5.6	5.6	39.0	496.6	814.7	4.3	1.492	1.188	5.41	2688						13.69	6797	2.53	3.2E-09
34	VT Seam	133.0	3.03	2.39	3.03	25	13.6	37.8	90.0	5.6	5.1	37.6	514.1	823.7	4.5	1.471	1.211	5.33	2739						14.14	7271	2.66	5.1E-10
35	VT Seam	133.0	3.03	2.39	3.03	25	13.6	37.4	74.0	5.5	6.1	38.8	508.6	830.9	4.5	1.451	1.203	5.43	2763						14.10	7170	2.60	1.2E-09
36	VT Seam	134.0	3.03	2.39	3.03	25	14.4	37.6	74.0	5.6	5.8	37.6	541.4	868.0	4.8	1.430	1.232	5.37	2908						14.69	7956	2.74	1.6E-10
37	VT Seam	133.0	3.03	2.39	3.03	25	13.8	21.6	90.0	5.4	5.8	43.3	298.1	526.1	4.6	1.220	1.109	5.87	1749						13.62	4061	2.32	6.2E-08
38	VT Seam	133.0	3.03	2.39	3.03	25	14.6	32.5	90.0	5.5	5.2	37.4	474.5	757.8	4.8	1.380	1.216	5.31	2520						14.69	6973	2.77	1.0E-10
39	VT Seam	132.0	3.03	2.39	3.03	25	14.5	26.8	90.0	5.7	5.8	41.0	388.6	658.5	4.8	1.298	1.168	5.59	2173						14.35	5575	2.57	1.8E-09
40	VT Seam	132.0	3.03	2.39	3.03	25	13.1	37.0	90.0	6.1	6.1	41.4	484.7	827.5	4.3	1.477	1.188	5.63	2731						13.74	6660	2.44	1.1E-08
41	VT Seam	132.0	3.03	2.39	3.03	25	12.9	41.9	90.0	6.0	5.5	39.7	540.5	895.9	4.3	1.529	1.195	5.47	2956						13.67	7391	2.50	4.7E-09
42	VT Seam	132.0	3.03	2.39	3.03	25	12.3	34.2	90.0	5.2	5.2	39.0	420.7	689.5	4.1	1.471	1.146	5.41	2275						13.07	5496	2.42	1.6E-08
43	VT Seam	132.0	3.03	2.39	3.03	25	15.0	26.6	90.0	5.1	5.2	37.6	399.0	639.2	5.0	1.279	1.173	5.29	2109						14.63	5838	2.77	1.0E-10
44	VT Seam	132.0	3.03	2.39	3.03	25	17.8	36.7	90.0	5.9	5.8	35.1	653.3	1007.3	5.9	1.347	1.330	5.09	3324						17.18	11220	3.38	1.6E-14
46	VT Seam	130.0	3.03	2.39	3.03	25	14.2	36.8	74.0	5.5	5.7	37.6	522.6	837.3	4.7	1.427	1.221	5.21	2721						14.52	7589	2.79	7.4E-11
47	VT Seam	129.0	3.03	2.39	3.03	25	16.9	24.9	74.0	5.6	6.1	39.7	420.8	697.5	5.6	1.172	1.146	5.35	2249						15.36	6464	2.87	2.2E-11
48	VT Seam	133.0	3.03	2.39	3.03	25	13.6	134.0	90.0	6.2	3.3	33.0	1822.4	2718.5	4.5	1.816	1.344	4.96	9039						14.92	27188	3.01	3.2E-12
49	VT Seam	133.0	3.03	2.39	3.03	25	12.8	42.0	90.0	6.3	5.3	40.5	537.6	903.4	4.2	1.533	1.190	5.59	3004						13.59	7309	2.43	1.2E-08
50	VT Seam	132.0	3.03	2.39	3.03	25	15.1	28.6	90.0	6.0	6.2	41.2	431.9	734.3	5.0	1.309	1.195	5.61	2423						14.82	6399	2.64	6.2E-10
51	VT Seam	132.0	3.03	2.39	3.03	25	16.6	40.2	90.0	6.0	6.1	36.2	667.3	1046.4	5.5	1.415	1.333	5.17	3453						16.40	10942	3.17	3.1E-13
52	VT Seam	132.0	3.03	2.39	3.03	25	11.3	24.8	90.0	5.3	5.9	45.0	280.2	509.6	3.7	1.374	1.080	6.00	1682						12.14	3402	2.02	4.5E-06
53	VT Seam	132.0	3.03	2.39	3.03	25	12.1	32.3	90.0	5.7	5.9	42.5	390.8	680.0	4.0	1.455	1.132	5.74	2244						12.88	5033	2.24	1.9E-07
54	VT Seam	132.0	3.03	2.39	3.03	25	14.8	35.7	90.0	5.7	6.0	38.2	528.4	854.9	4.9	1.414	1.243	5.34	2821						14.97	7907	2.80	6.1E-11
55	VT Seam	131.0	3.03	2.39	3.03	25	11.0	36.2	90.0	5.9	3.1	40.0	398.2	664.2	3.6	1.534	1.094	5.46	2175						12.05	4800	2.21	3.2E-07
56	VT Seam	130.0	3.03	2.39	3.03	25	14.8	30.0	74.0	6.2	3.3	36.5	444.0	699.3	4.9	1.322	1.191	5.12	2273						14.65	6503	2.86	2.6E-11
57	VT Seam	130.0	3.03	2.39	3.03	25	14.9	32.7	74.0	5.5	6.0	38.3	487.2	789.5	4.9	1.357	1.215	5.27	2566						14.85	7233	2.82	4.8E-11
58	VT Seam	130.0	3.03	2.39	3.03	25	14.5	40.4	90.0	5.4	5.9	36.4	585.8	921.4	4.8	1.472	1.259	5.11	2994						14.90	8731	2.92	1.2E-11
59	VT Seam	128.0	3.03	2.39	3.03	25	9.4	25.6	90.0	6.1	2.8	45.3	240.6	440.2	3.1	1.463	1.013	5.85	1409						10.70	2574	1.83	7.6E-05
60	VT Seam	129.0	3.03	2.39	3.03	25	13.4	33.3	90.0	6.0	6.3	41.9	446.2	768.2	4.4	1.426	1.183	5.55	2478						13.87	6191	2.50	4.8E-09
61	VT Seam	130.0	3.03	2.39	3.03	25	13.3	38.6	90.0	6.1	6.1	40.8	513.4	867.2	4.4	1.487	1.202	5.49	2818						13.93	7152	2.54	2.8E-09
62	VT Seam	129.0	3.03	2.39	3.03	25	16.1	105.0	90.0	6.4	2.6	30.2	1690.5	2421.0	5.3	1.734	1.529	4.62	7808						17.26	29186	3.74	8.7E-17
63	VT Seam	127.0	3.03	2.39	3.03	25	12.6	38.2	90.0	5.2	5.6	38.3	481.3	779.6	4.2	1.504	1.171	5.14	2475						13.37	6436	2.60	1.1E-09
64	VT Seam	126.0	3.03	2.39	3.03	25	13.0	33.8	90.0	5.3	4.8	37.8	439.4	706.4	4.3	1.444	1.171	5.06	2225						13.59	5972	2.68	3.4E-10
65	VT Seam	127.0	3.03	2.39	3.03	25	14.0	36.2	90.0	5.1	5.2	35.9	506.8	790.7	4.6	1.442	1.219	4.95	2511						14.40	7299	2.91	1.4E-11
66	VT Seam	127.0	3.03	2.39	3.03	25	12.2	31.6	90.0	6.1	6.6	44.9	385.5	699.1	4.0	1.443	1.134	5.76	2220						12.94	4988	2.25	1.8E-07
67	VT Seam	127.0	3.03	2.39	3.03	25	15.0	31.6	74.0	5.5	5.6	37.8	474.0	762.6	5.0	1.339	1.209	5.11	2421						14.86	7042	2.91	1.3E-11
68	VT Seam	127.0	3.03	2.39	3.03	25	11.6	31.3	74.0	6.6	5.7	46.1	363.1	673.4	3.8	1.443	1.107	5.89	2138						12.46	4523	2.12	1.2E-06
69	VT Seam	126.0	3.03	2.39	3.03	25	13.2	36.1	90.0	5.5	5.0	38.0	476.5	768.6	4.4	1.465	1.188	5.08	2421						13.80	6575	2.72	2.1E-10
70	VT Seam	126.0	3.03	2.39	3.03	25	13.3	35.8	90.0	5.4	5.0	37.6	476.1	763.0	4.4	1.458	1.191	5.05	2403						13.87	6602	2.75	1.4E-10
71	VT Seam	126.0	3.03	2.39	3.03	25	13.4	30.3	90.0	6.0	5.1	40.9	406.0	686.8	4.4	1.387	1.168	5.33	2163						13.78	5595	2.59	1.4E-09
72	VT Seam	126.0	3.03	2.39	3.03	25	13.4	36.2	90.0	5.7	6.5	40.5	485.1	815.6	4.4	1.460	1.196	5.30	2569						13.95	6768	2.63	6.9E-10
73	VT Seam	127.0	3.03	2.39	3.03	25	13.5	35.9	90.0	6.0	6.4	41.2	484.7	824.9	4.5	1.453	1.199	5.40	2619						14.02	6795	2.59	1.2E-09
74	VT Seam	127.0	3.03	2.39	3.03	25	13.5	48.2	90.0	6.3	5.6	38.9	650.7	1065.2	4.5	1.562	1.242	5.20	3382						14.27	9287	2.75	1.4E-10
75	VT Seam	127.0	3.03	2.39	3.03	25	13.7	37.2	90.0	6.6	5.6	41.3	509.6	868.8	4.5	1.462	1.212	5.41	2759						14.21	7240	2.62	7.9E-10
76	VT Seam	127.0	3.03	2.39	3.03	25	13.6	44.8	90.0	5.6	6.8	38.5	609.3	990.7	4.5	1.534	1.237	5.16	3146						14.30	8711	2.77	9.9E-11
77	VT Seam	127.0	3.03	2.39	3.03	25	13.4	35.2	90.0	5.9	6.3	41.1	471.7	801.0	4.4	1.449	1.192	5.39	2543						13.93	6569	2.58	1.4E-09
78	VT Seam	126.0	3.03	2.39	3.03	25	12.0	44.0	90.0	6.0	3.6	38.4	528.0	856.8	4.0	1.571	1.156	5.11	2699						12.96	6842	2.53	2.9E-09
79	VT Seam	126.0	3.03	2.39	3.03	25	11.8	34.1	74.0	6.4	6.8	45.9	402.4	744.4	3.9	1.471	1.122	5.83	2345						12.65	5092	2.17	5.4E-07
80	VT Seam	125.0	3.03	2.39	3.03	25	9.6	35.4	74.0	6.7	7.1	50.9	339.8	692.8	3.2	1.560	1.025	6.37	2165						10.88	3697	1.71	4.2E-04
81	VT Seam	125.0	3.03	2.39	3.03	25	9.9	33.4	90.0	7.0	7.0	51.6	330.7	682.8	3.3	1.543	1.039	6.45	2134						11.13	3680	1.72	3.3E-04
82	VT Seam	124.0	3.03	2.39	3.03	25	11.8	35.6	90.0	6.7	7.0	46.7	420.1	788.1	3.9	1.502	1.129	5.82	2443						12.69	5333	2.18	4.6E-07
83	VT Seam	123.0	3.03	2.39	3.03	25	14.8	35.1	90.0	6.6	7.3	42.7	519.5	907.4	4.9	1.407	1.239	5.37	2790						14.94	7762	2.78	8.2E-11
84	VT Seam	122.0	3.03	2.39	3.03	25	15.7	35.5	90.0	7.1	7.5	43.2	557.4	980.4	5.2	1.387	1.268	5.37	2990						15.47	8624	2.88	1.9E-11
85	VT Seam	121.0	3.03	2.39	3.03	25	16.0	25.0	90.0	6.9	3.8	39.3	400.0	659.5	5.3	1.220	1.163	4.99	1995						14.96	5984	3.00	3.6E-12
86	VT Seam	121.0	3.03	2.39	3.03	25	15.0	33.3	90.0	6.9	7.5	44.1	499.5	893.5	5.0	1.379	1.232	5.41	2703						15.00	7494	2.77	9.4E-11
87	VT Seam	122.0	3.03	2.39	3.03	25	15.4	33.3	90.0	7.3	7.5	44.6	512.8	926.2	5.1	1.368	1.243	5.51	2825						15.15	7771	2.75	1.3E-10
88	VT Seam	123.0	3.03	2.39	3.03	25	15.4	33.3	90.0	7.2	7.5	44.4	512.8	922.1	5.1	1.368	1.243	5.53	2835						15.15	7771	2.74	1.5E-10
89	VT Seam	124.0	3.03	2.39	3.03	25	11.6	34.3	90.0	6.4	6.7	46.1	397.9	738.0	3.8	1.495	1.117	5.75	2288						12.52	4981	2.18	4.9E-07
90	VT Seam	125.0	3.03	2.39	3.03	25	13.7	23.8	74.0	5.7	5.7	43.0	326.1	572.3	4.5	1.251	1.120	5.48	1788						13.64	4449	2.49	5.7E-09
91	VT Seam	121.0	3.03	2.39	3.03	25	14.7	31.8	74.0	6.8	7.4	44.5	467.5	842.8	4.9	1.351	1.204	5.45	2549						14.67	6859	2.69	3.1E-10
92	VT Seam	122.0	3.03	2.39	3.03	25	15.1	31.8	90.0	6.4	7.4	43.0	480.2	842.8	5.0	1.356	1.223	5.35	2571						15.00	7201	2.80	6.2E-11
93	VT Seam	123.0	3.03	2.39	3.03	25	15.8	31.8	90.0	6.6	7.4	42.8	502.4	878.1	5.2	1.336	1.239	5.37	2700						15.34	7707	2.85	2.9E-11
94	VT Seam	124.0	3.03	2.39	3.03	25	28.2	36.3	90.0	6.2	6.0	29.7	1023.7	1455.1	9.3	1.126	1.126	4.41	4511						25.93	26544	5.88	3.3E-30
95	VT Seam	125.0	3.03	2.39	3.03	25	13.3	37.7	90.0	5.4	5.7	38.2	501.4	811.6	4.4	1.478	1.199	5.06	2536						13.91	6975	2.75	1.3E-10
96	VT Seam	121.0	3.03	2.39	3.03	25	14.4	33.1	90.0	6.7	6.3	42.7	476.6	831.3	4.8	1.394	1.214	5.28	2515						14.58	6950	2.76	1.1E-10
97	VT Seam	122.0	3.03	2.39	3.03	25	14.7	36.1	90.0	6.3	6.3	40.4	530.7	890.4	4.9	1.421	1.242	5.12	2716						14.91	7912	2.91	1.2E-11
98	VT Seam	123.0	3.03	2.39	3.03	25	15.9	36.1	90.0	6.4	6.3	39.3	574.0	945.5	5.2	1.388	1.279	5.07	2907						15.65	8982	3.09	9.9E-13
99	VT Seam	121.0	3.03	2.39	3.03	25	13.6	35.4	74.0	5.8	5.8	39.8	481.4	799.3	4.5	1.429	1.194	5.02	2418						14.04	6760	2.80	6.7E-11
100	VT Seam	120.0	3.03	2.39	3.03	25	14.2	33.5	74.0	6.4	2.8	36.4	475.7	747.8	4.7	1.388	1.202	4.72	2243						14.41	6853	3.06	1.6E-12
101	VT Seam	121.0	3.03	2.39	3.03	25	14.3	35.4	90.0	6.3	5.8	40.4	506.2	848.7	4.7	1.425	1.225	5.07	2567						14.60	7389	2.88	2.1E-11
102	VT Seam	121.0	3.03	2.39	3.03	25	14.2	34.5	90.0	6.6	3.0	37.2	489.9	780.0	4.7	1.417	1.216	4.82	2360						14.49	7100	3.01	3.1E-12
103	VT Seam	122.0	3.03	2.39	3.03	25	17.2	35.4	90.0	6.6	5.8	37.9	608.9	980.6	5.7	1.346	1.304	4.91	2991						16.59	10104	3.38	1.5E-14
104	VT Seam	122.0	3.03	2.39	3.03	25	17.4	35.4	90.0	6.8	7.0	40.0	616.0	1026.1	5.7	1.341	1.308	5.08	3130						16.75	10319	3.30	4.9E-14
105	VT Seam	124.0	3.03	2.39	3.03	25	29.0	74.8	90.0	5.6	5.9	22.3	2169.2	2792.2	9.6	1.441	1.441	3.99	8656						30.63	66441	7.68	2.1E-41
106	VT Seam	125.0	3.03	2.39	3.03	25	13.8	46.8	90.0	5.7	6.2	37.5	645.8	1033.5	4.6	1.545	1.253	5.00	3230						14.50	9364	2.90	1.5E-11
107	VT Seam	125.0	3.03	2.39	3.03	25	22.7	73.0	90.0	6.8	6.2	29.1	1657.1	2336.4	7.5	1.526	1.526	4.41	7301						23.00	38115	5.22	4.7E-26
108	VT Seam	124.0	3.03	2.39	3.03	25	17.6	37.7	90.0	6.8	6.3	38.2	663.5	1073.6	5.8	1.363	1.337	5.02	3328						17.08	11333	3.41	1.0E-14
												Total	56902.1	92837.1														

Notes:

1. Pillar stability analysis based on the methods of Galvin, Hebbelwhite, Salamon and Lin (1998) UNSW Mining Research Centre Report RR3/98.
2. Relationship between Factor of Safety (FoS) and probability of coal pillar failure is based on interpolation and extrapolation of data in the above publication. It should be noted that the probability of failure does not extend beyond a FoS of 2.11 (equivalent to a probability of failure of 1 in 1,000,000) in the above and therefore probabilities of failure for FoSs above this are an extrapolation based on a curve of best fit for data for FoSs of 2.11 and less
3. Load on weaker pillars reduced by 30% as discussed in "Prefailure Pillar Yielding", by Agapto and Goodrich (2002) Load transferred to adjacent pillars.
4. Extraction ratio is relative to working section not full seam height.

5 Pillar Height should be the same as the working section unless roof collapse is being considered

Panel Extraction Ratio 0.39

FOS≤1
1<FOS≤1.6
1.6<FOS≤2.1

Summary		FoS
	Max	9.68
	Min	0.95
	Mean	2.74

Panel Factor of safety Based on Tributary load

Total Pillar Load	300667.10	MN
Total Pilla Capacity	938203.62	MN
Panel FoS	3.12	

Appendix C

Drawing 1 – Site Position Relative to Abandoned Workings, Lambton 'B' Colliery, Dudley Seam (RT 691)

Drawing 2 – Site Position Relative to Abandoned Workings, Lambton 'B' Colliery, Victoria Tunnel Seam (RT 403)

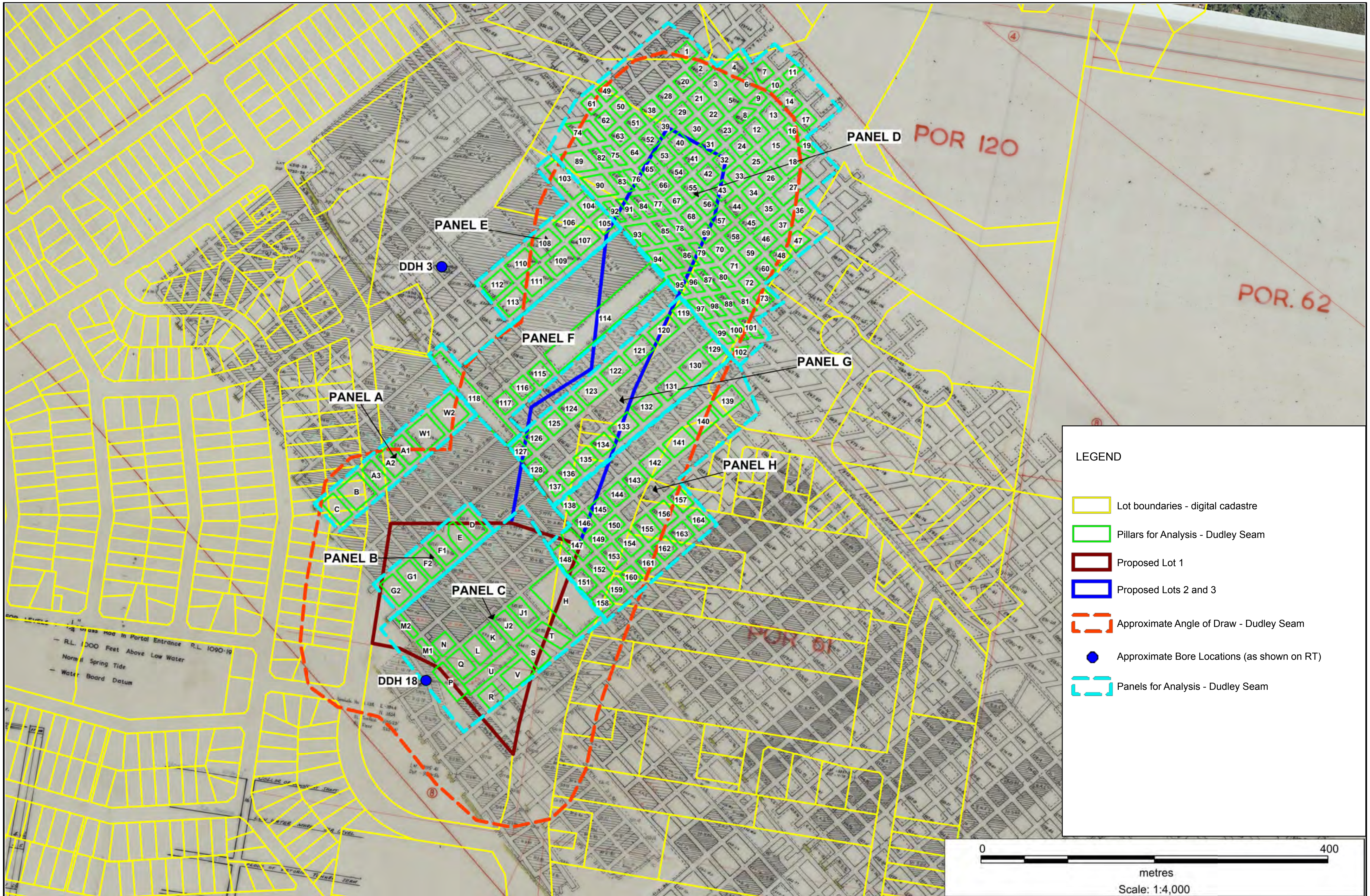
Drawing 3 – Calculated Pillar Factors of Safety – Working Section 1.7 m, Lambton 'B' Colliery, Dudley Seam Workings

Drawing 4 – Calculated Pillar Factors of Safety – Working Section 2.0 m, Lambton 'B' Colliery, Dudley Seam Workings

Drawing 5 – Calculated Pillar Factors of Safety – Pillar Height Section = 2.39 m, Lambton 'B' Colliery, VT Seam Workings

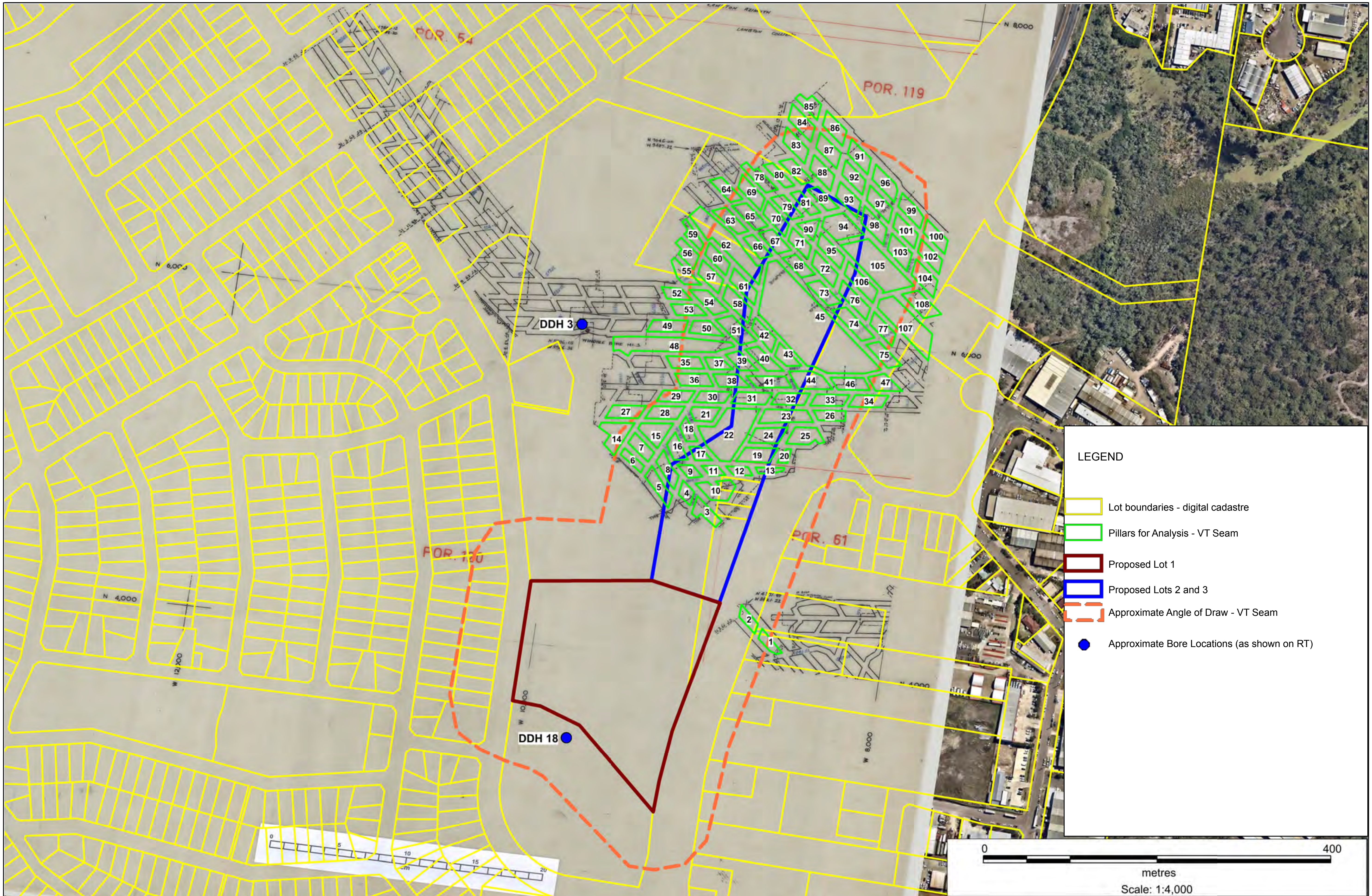
Drawing 6 – Calculated Pillar Factors of Safety – Pillar Height Section = 3.03 m, Lambton 'B' Colliery, VT Seam Workings

Overall Site Plan, Drawing No. ATP-200 (supplied by client)

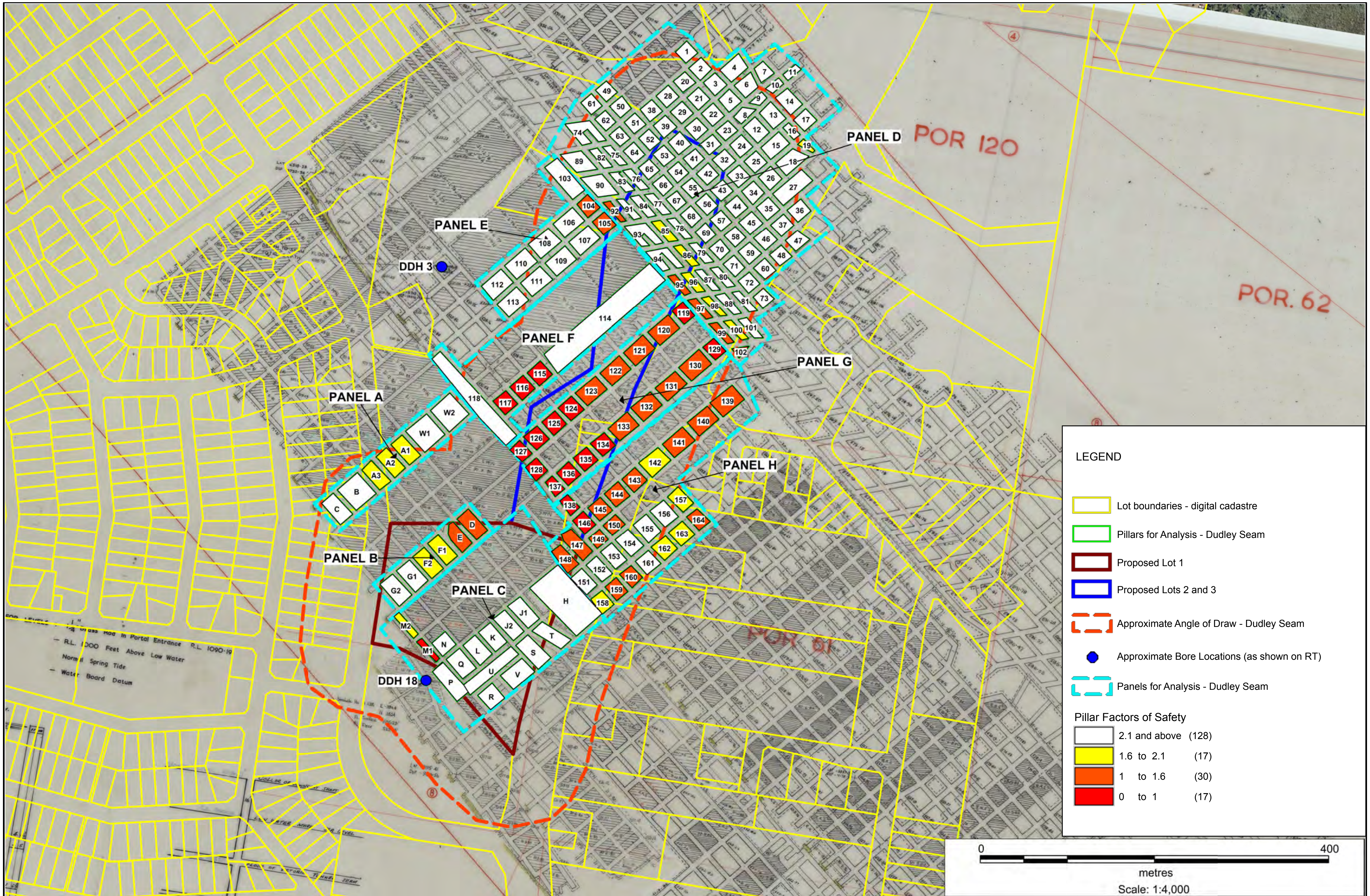


Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: SPG Investments Pty Ltd		TITLE: Site Position Relative to Abandoned Workings	PROJECT No: 49710.03
OFFICE: Newcastle	DRAWN BY: TAC	Lambton 'B' Colliery, Dudley Seam (RT691)	DRAWING No: 1
SCALE: As shown	DATE: 26.02.18	Proposed Commercial Development, 4B South Street, Bennetts Green	REVISION: 0

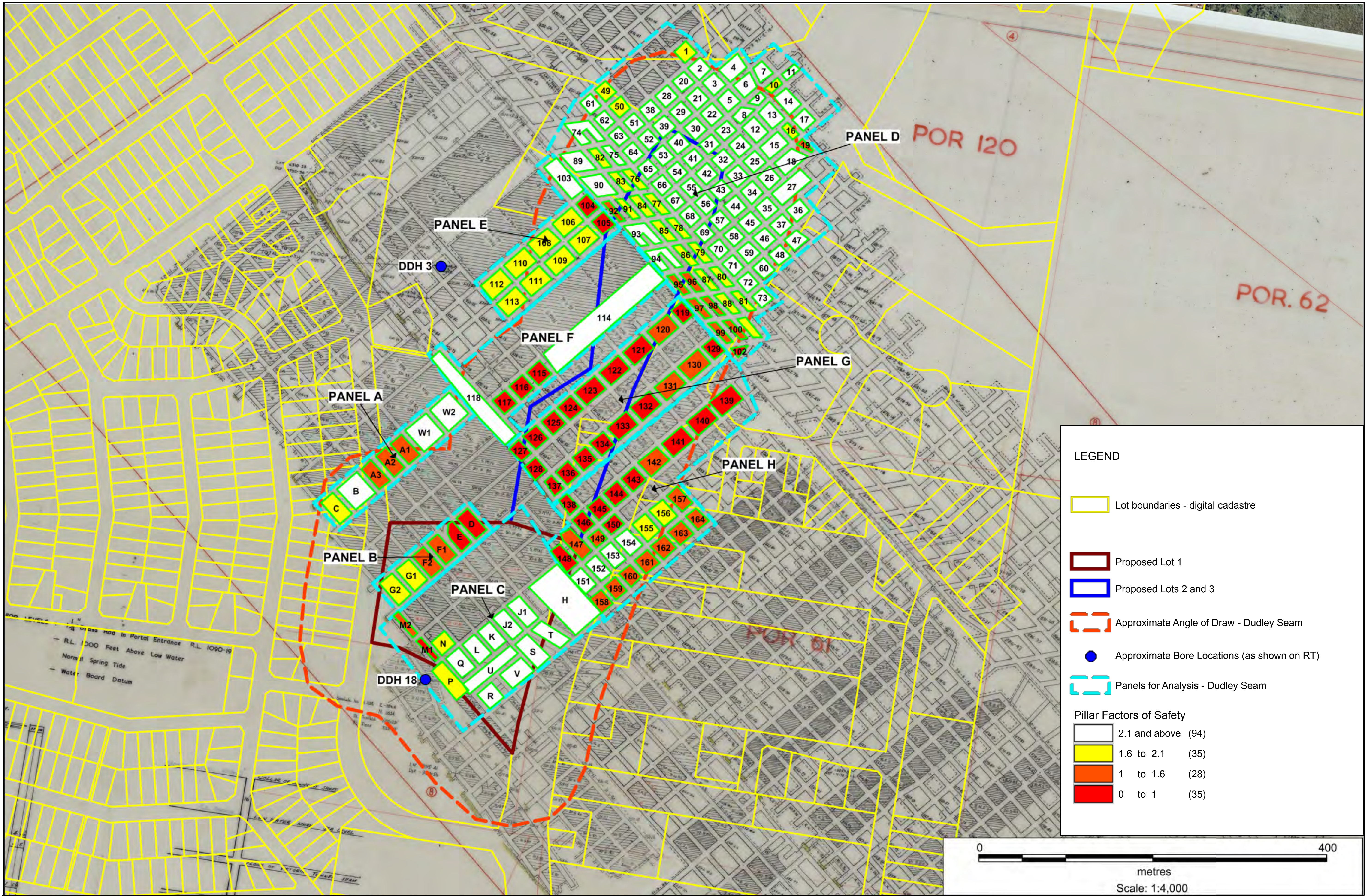


Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SPG Investments Pty Ltd	TITLE: **Site Position Relative to Abandoned Workings**	PROJECT No: 49710.03
	OFFICE: Newcastle / DRAWN BY: TAC	**Lambton 'B' Colliery, Victoria Tunnel Seam (RT403)**	DRAWING No: 2
	SCALE: As shown / DATE: 21.02.18	**Proposed Commercial Development, 4B South Street, Bennetts Green**	REVISION: 0

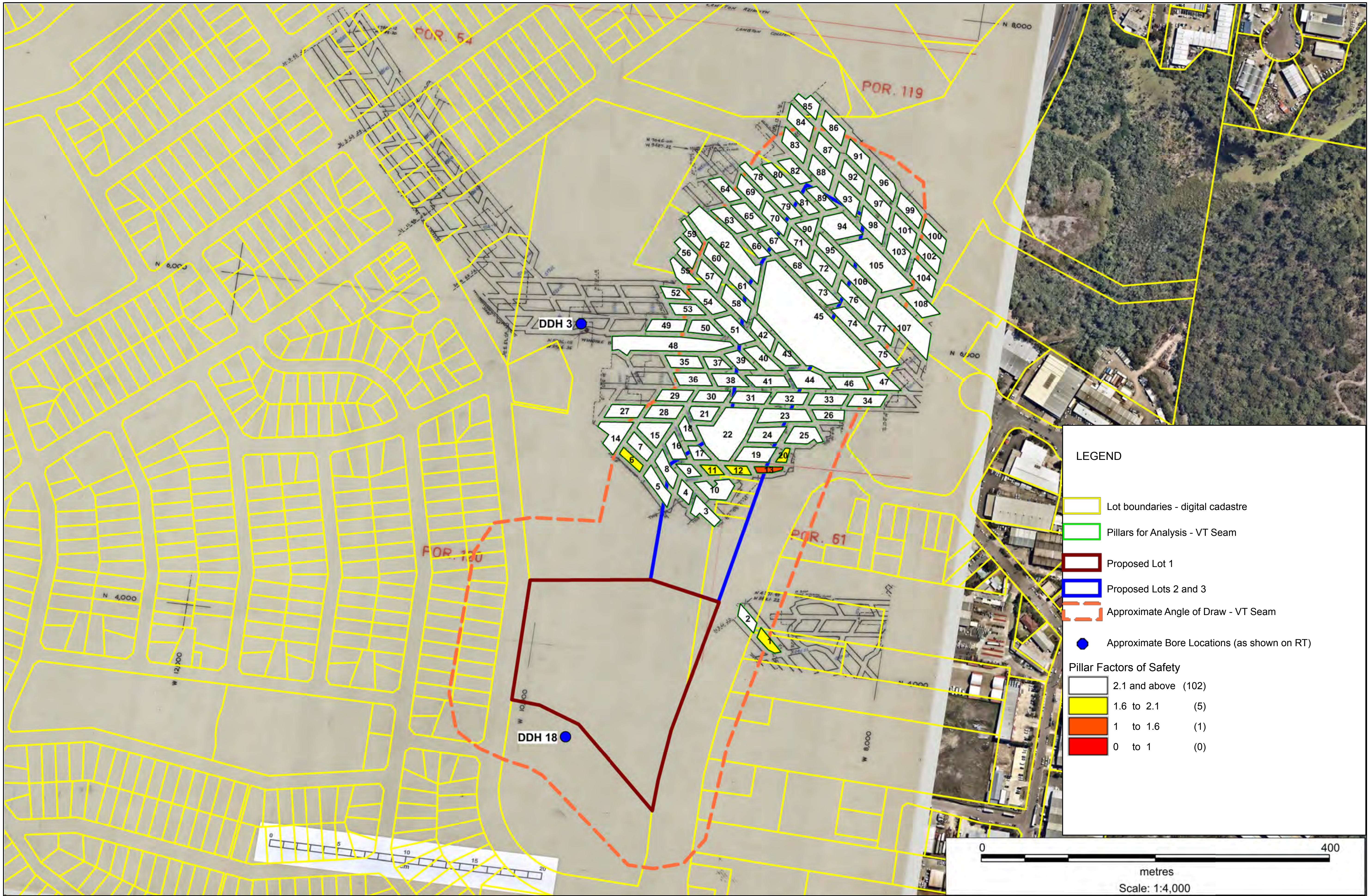


Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SPG Investments Pty Ltd	TITLE: **Calculated Pillar Factors of Safety - Working Section 1.7 m**	PROJECT No: 49710.03
	OFFICE: Newcastle — DRAWN BY: TAC	**Lambton 'B' Colliery, Dudley Seam (RT691)**	DRAWING No: 3
	SCALE: As shown — DATE: 1/3/18	**Proposed Commercial Development, 4B South Street, Bennetts Green**	REVISION: 0

MGA N



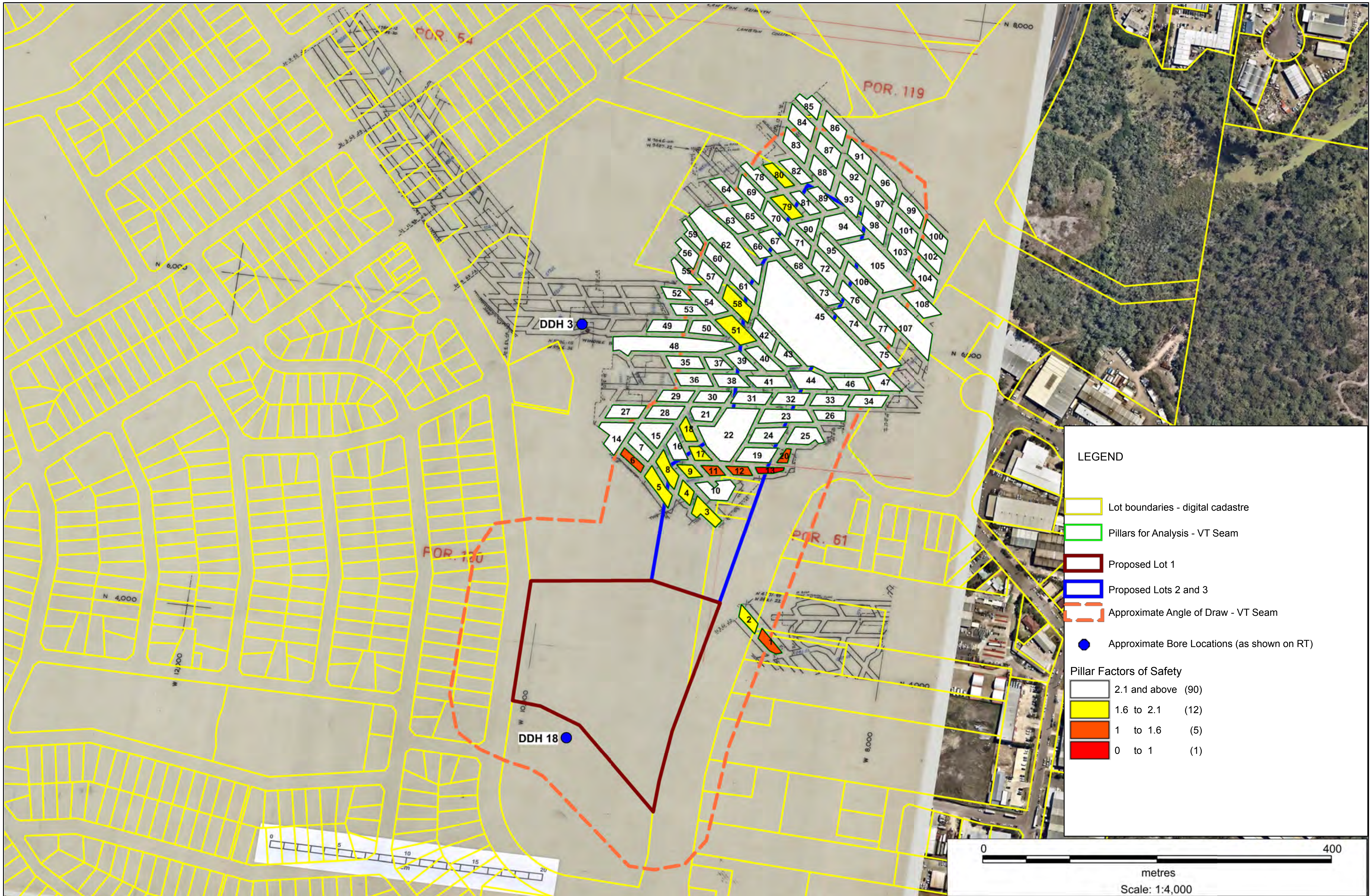
Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: SPG Investments Pty Ltd		TITLE: Calculated Pillar Factors of Safety - Working Section 2.0 m Lambton 'B' Colliery, Dudley Seam (RT691) Proposed Commercial Development, 4B South Street, Bennetts Green	N MGA	PROJECT No: 49710.03
	OFFICE: Newcastle	DRAWN BY: TAC			DRAWING No: 4
	SCALE: As shown	DATE: 1/3/18			REVISION: 0



Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: SPG Investments Pty Ltd		TITLE: Calculated Pillar Factors of Safety - Pillar Height Section = 2.39 m	PROJECT No: 49710.03
OFFICE: Newcastle	DRAWN BY: TAC	Lambton 'B' Colliery, Victoria Tunnel Seam (RT403)	DRAWING No: 5
SCALE: As shown	DATE: 1.3.18	Proposed Commercial Development, 4B South Street, Bennetts Green	REVISION: 0

MGA

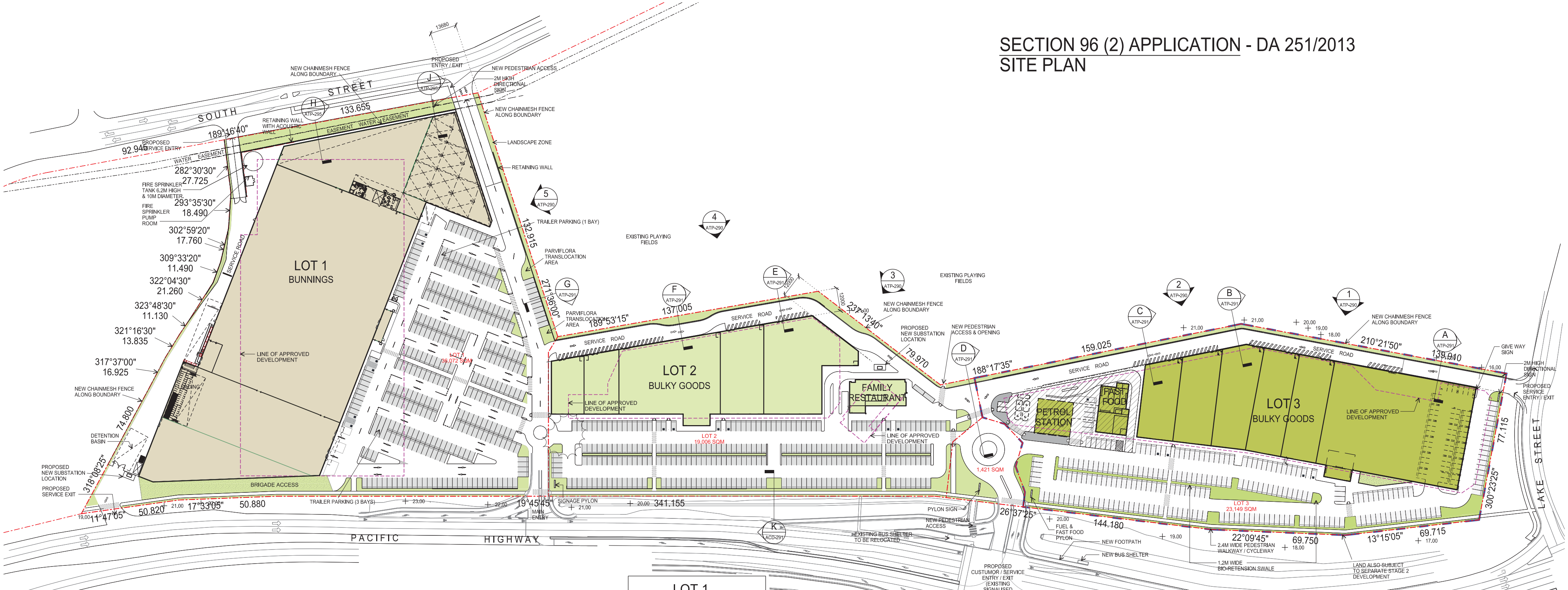


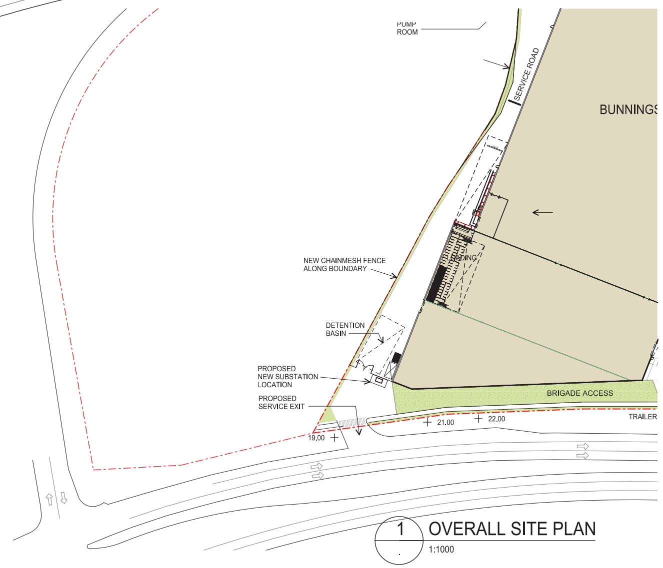
Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: SPG Investments Pty Ltd		TITLE: Calculated Pillar Factors of Safety - Pillar Height Section = 3.03 m Lambton 'B' Colliery, Victoria Tunnel Seam (RT403) Proposed Commercial Development, 4B South Street, Bennetts Green	PROJECT No: 49710.03
OFFICE: Newcastle	DRAWN BY: TAC		DRAWING No: 6
SCALE: As shown	DATE: 1.3.18		REVISION: 0

N
MGA

SECTION 96 (2) APPLICATION - DA 251/2013
SITE PLAN





1 OVERALL SITE PLAN
1:1000

LOT 1	
SITE AREA	36,072m²
HARDWARE GFA	16,806m²
SITE COVERAGE	46.59%
CARPARK SPACES	311
CARPARK RATIO	1:56
LOT 2	
SITE AREA	19,006m²
BULKY GOODS GFA	5,905m²
RESTAURANT GFA	508m²
SITE COVERAGE	33%
CARPARK SPACES	255
CARPARK RATIO	1:24
LOT 3	
SITE AREA	23,149m²
BULKY GOODS AREA	8,855m²
SITE COVERAGE	38.25%
CARPARK SPACES	274
CARPARK RATIO	1:38
LOT 4 (ROUNDABOUT) SITE AREA	1421m²
TOTAL SITE AREA	79,647m²

Note:
ALL AREAS NOTED ARE APROXIMATE ONLY.
ALSO SUBJECT TO FURTHER CONFIRMATION OF SITE BOUNDARIES

PROJECT
BENNETTS GREEN

PROJECT NUMBER	DATE	SCALE @ A1
316137	22/05/17	1:1000

STATUS
TOWN PLANNING
FOR INFORMATION

THE BUCHAN GROUP
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DRAWING TITLE
OVERALL SITE PLAN

DRAWING NUMBER
ATP-200

REVISION
P08

File Name: BG-TBG-ZA-00-DR-ATP-200