GEOTECHNICAL ASSESSMENT OF

GOLDEN PIKE CUTBACK

for

KCGM PTY LTD

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1.0 INTRODUCTION

At the request of Mr Gary Lye of KCGM Pty Ltd (KCGM), BFP Consultants Pty Ltd (BFP) has reviewed the proposed pit wall design for the Golden Pike Cutback at KCGM's Super Pit in Kalgoorlie. This report also assesses the implications of the Golden Pike Cutback in relation to Department of Industry and Resources (DoIR) pit abandonment guidelines (Reference 1 and Appendix A).

The cutback will be undertaken on the west wall of the proposed final pit between 48200 mN and 49500 mN (Figure 1). The west wall in this area extends to a proposed final pit depth of 600 metres.

All orientations in this report, unless otherwise noted are quoted with respect to mine grid north which is 38.3º west of magnetic north.

2.0 SCOPE

The scope for this study is as follows:

- Review the proposed slope design for the Golden Pike Cutback area,
- Confirm the overall slope stability and the possible slope controlling mechanisms for the Golden Pike cutback, and
- Consider DoIR guidelines in relation to mine abandonment, and identify the appropriate distance from the crest that should be maintained to accommodate any potential long-term pit slope deterioration.

The following was undertaken in this study:

- Examination of geotechnical data from 41 oriented diamond drillholes and 4 non-oriented diamond drillholes (Tables 1 and 2),
- Examination of KCGM face mapping data from the current pit,
- A review of design and review reports (References 2 to 6),
- A review of the Vulcan 3D model of stratigraphic surfaces and major structures, and
- A review of the available geotechnical testing database.

3.0 BACKGROUND

The KCGM Super Pit has been mined for approximately 14 years. Over this time pit walls have generally performed well, with geotechnical studies not identifying any overall controlling mechanism of failure. This has particularly been the case for the west wall. Overall slope stability has been controlled by the stability of individual mining faces, the local influence of underground workings and the requirement to maintain safe operating conditions on the pit floor. Pit wall designs have also been refined through field trials, resulting in a "performance based design approach".

Due to the proximity of the Kalgoorlie-Boulder township, the government has imposed a 400 metre safety exclusion zone (SEZ) around the open pit (Figure 2). The projected location of the abandonment/noise reduction bund is also shown in this figure. The SEZ zone was originally intended to prevent the likelihood of any injury or damage caused by fly-rock associated with blasting in the pit. Details of the SEZ are contained in Appendix B.

4.0 GEOLOGY

The Golden Pike Cutback follows an ore zone which develops along the Golden Pike Fault (Figure 1). The geology in the vicinity of the cutback consists of a sequence of dolerites, basalts, shales, sandstones, siltstones and porphyries dipping steeply to the west.

The majority of the cutback area will be mined in the Golden Mile Dolerite (GMD), with the Williamstown Dolerite (WD) to the west of the Golden Pike Fault, as shown in Figure 1. The Black Flag Bed (BFB) shale sequence is confined to the GMD.

The BFB unit is approximately 20 to 30 metres thick and is underlain by a further sequence of GMD to the base of the existing pit.

The Paringa Basalt (PB) is found north of 49100 mN in the cutback. The Vulcan 3D model of this unit is highly convoluted , reflecting the experience in the pit.

There is currently no exposure of WD in the Super Pit. The nearest exposures of this material are at the Union Club Pit at Mt Percy, approximately 5 kilometres to the north of the proposed Golden Pike cutback. However, five drill holes in the cutback and one just south of the cutback intersect WD..

5.0 ENGINEERING GEOLOGY

The engineering geology in the proposed cutback area is characterised by weathering (extremely to highly weathered) extending to a depth of approximately 50 metres, followed by moderately weathered rock to a depth of approximately 70 metres, where slightly weathered to fresh rock is encountered. Although WD and the GMD will predominantly be exposed in this weathered zone, Paringa Basalt and Black Flag Beds will also be exposed in the north of the cutback.

There is no rock strength data available for WD, but observations from core photographs indicate a medium to strong rock when fresh.

Rock strength data for the GMD indicates that the dolerite is very strong, with an average UCS, calculated from point load data, of 145 MPa for samples in fresh rock to a depth of 600 metres.

BFB rock strength data indicates that it is a moderate to strong rock, with a Point Load Strength Index of 3.8 MPa. No UCS equivalent has been determined as all tests were diametral.

Rock strength data for the PB indicates that the basalt is strong to very strong, with an average UCS, calculated from point load data, of 105 MPa for samples in fresh rock to a depth of 600 metres.

6.0 STRUCTURAL GEOLOGY

A number of faults are interpreted in the proposed cutback area (Figure 1).

The approximate orientations of these structures are as follows:

- Golden Pike Fault dips at 70º towards 293º.
- Drysdale and Drysdale Interpreted Faults dip at 85º towards 288º.
- Golden Mile Fault dips at 90º towards 276º north of 48350 mN, and 85º towards 260º south of 48350 mN.

KCGM advise that the Golden Pike Fault (GPF) is an “open” structure.

In the cutback area the fault is intersected by five drillholes (CSGD014, CSGD015, ENGD043, ENGD045A and HMGD028). In CSGD014 and CSGD015, the fault is located near zones of high FF and low RQD, with logged fault widths of 1.7 – 3.2 m. In ENGD043 the fault was recorded having a width of 0.1 m. With the exception of ENGD045A, no core photographs for these holes were made available by KCGM to allow visual inspection of the GPF.

The modelled GPF intercepts the holes EWGD045A and HMGD028 in the weathered zone. ENGD045A was logged by BFP from core photographs, although identification of the fault was difficult due to the presence of a number of weathered and broken zones and the interpreted narrow width of the fault. A core loss of 4-8 m was recorded in HMGD028 in the area of the fault. In viewing these results, BFP concur with KCGM's view that the GPF is an "open" structure.

The Drysdale Fault (Figure 1) and the newest interpretation of the Drysdale Fault are intercepted by 20 drill holes (CTGD030, CTGD044, CTGD046, HMGD023, HMGD024, HMGD031, HMGD032, HMGD022, HMGD028, HMGD029, HMGD030, ENGD020, CSGD014, ENGD043, ENGD053, ENGD030, ENGD044, ENGD058, GGGD052 and GGGD009). Only 5 of these intercepts were located near zones of high FF and low RQD that would indicate an open structure. Although KCGM pit mapping indicates the Drysdale Fault is an open structure, BFP’s inspection of core photos suggests that the fault is variably open and a healed structure.

The Golden Mile Fault (GMF) (Figure 1) intercepts 20 drillholes (CTGD030, CTGD046, HMGD023, HMGD024, HMGD031, HMGD032, HMGD015, HMGD022, HMGD028, HMGD029, HMGD030, ENGD020, CSGD014, ENGD043, ENGD053, ENGD030, ENGD045B, GGGD006, GGGD052 and GGGD009). Again only 5 of these intercepts were located near zones of high FF and low RQD, and were located in the vicinity of the BFB/GMD contact. It is therefore BFP’s view that the GMF is a healed structure.

7.0 DRILL CORE AND TRAVERSE MAPPING DATA

The geotechnical data for 45 drillholes were examined. Only three of the holes intersected the WD. The location of the drillhole collars is shown in Figure 6 with a list of drillhole survey data provided in Table 1. The data consisted of:

- Defect data,

- RQD,
- Fracture frequency,
- Lithology and oxidation, and
- Core photographs

A summary of the data made available to BFP by KCGM is provided in Table 2.

Core photographs were made available for ten drillholes in the cutback area and only one of these intersected the WD (ENGD045A). Two drillholes, ENGD045A and ENGD040 were logged by BFP from core photos in the area of concern, as BFP were not provided with geotechnical log data for these drill holes. The resultant geotechnical logs for these two holes are presented in Appendix C. Where drill hole RQD data was not provided, RQD values were determined from fracture frequency data using the Priest/Hudson correlation (Reference 7). Other photos were used to fill in gaps and discrepancies in the data.

A spot audit of drillhole data was carried out by BFP using core photos. The audit shows that the majority of logging carried out by KCGM, apart from a few problems outlined below, was within acceptable error margins.

Histograms of RQD and fracture frequency are plotted on the drill hole traces in Figures 3 to 5 and Appendix E.

Some holes had gaps in fracture frequency data. High RQD's would be expected if these gaps indicated zero fractures per metre. However, in drill holes where RQD data was available adjacent to these gaps, low and high RQD's were recorded. It should therefore not immediately be assumed that gaps in fracture frequency or RQD data on the drillhole traces indicate zones of good rock or poor rock respectively.

The locations of the geotechnical mapping traverses undertaken by KCGM are shown in Figure 6. Mapping data has been used to assess discontinuity sets in the GMD and BFB, to obtain information on discontinuity characteristics.

Overall, RQD and fracture frequency data shows that the majority of the Golden Pike cutback is in competent rock, with lesser zones of fractured/weak rock present in all units. Analysis indicates that there are no new large-scale open structures, and that zones of weakness are localised.

8.0 ROCK MASS CLASSIFICATION

A rock mass classification has been undertaken using the RMR system (Reference 8) to allow an assessment of the likely pit wall slope geometry using a method developed by Haines and Terbrugge (Reference 9).

For the purpose of classification the GMD unit was divided into "GMD west of BFB" and "GMD east of BFB". WD, PB and GMD west of BFB occurr in the weathered zone in the west wall of the design.

Table 3 summarises the rock mass classification parameters used in the analysis, and presents the resulting RMR values.

The classification is based on five parameters, covering:

- Rock strength,
- RQD,
- Joint spacing,
- Joint conditions, and
- Joint water.

Rock strength test results were available for the fresh GMD, BFB and PB. It has been assumed that WD has similar strength to GMD.

An assessment of the strength of WD in the weathered horizons has been based on Reference 10, prepared by KCGM, which states that at the Union Club Pit, *"WTD is competent almost to the surface – rock is oxidised but retains significant strength".* This observation, and a review of the available core photographs from holes intersecting WD indicate a strength of 70% of the fresh material is appropriate.

The RQD parameter was obtained from length- weight averaging the borehole data for each of the units to a depth of 600 metres, between 48200 mN and 49500 mN.

As the fracture frequency in the borehole data is already length weighted, as confirmed by the core photo audit, the joint spacing parameters were obtained from straight averaging this data to a depth of 600 m, between 48200 mN and 49500 mN.

Areas of known stoping were removed from the data sets for both of these parameters. To determine the impact, the RQD data for the GGGD series of boreholes in the GMD east of BFB were averaged, with the stope areas retained. The result was an RQD of 94%, as opposed to 96% from the RMR results.

The joint condition parameters were obtained from the face mapping in fresh GMD and BFB rock. Defects in the GMD west of BFB were slickensided, with a thickness of greater than 5mm. The mixture of chlorite, calcite and quartz carbonate infills was classified as 53% soft material and 47% hard material. For the BFB and GMD east of BFB, the majority of defects were smooth and had a thickness of greater than 5 mm. The majority of BFB infill consisted of soft material.Mapping of major structures in the PB on the west wall has been conducted. Pit exposures indicate the PB is highly foliated, and particularly schistose in the weathered section of the western wall (Reference 11)

KCGM advise (Reference 11) that the average defect length of shears and veins on the western wall is greater than 30 m, and 5 to10 m on prominent joint planes. BFP adopted a value of 15 to 20 m for the rock mass classification, and assumed that these parameters would be similar in WD as for GMD west of BFB.

Current pit slopes are dry and it is assumed that similar conditions will occur in the cutback.

The rockmass rating determined that the weathered material was "Fair Rock", while the classification in the fresh material was "Good Rock".

9.0 STEREOGRAPHIC ANALYSIS

A stereographic analysis has been undertaken for the oriented data to obtain a discontinuity design set for pit wall stability analysis. This data was sourced from drill hole logs and traverse mapping (except for WD and PB). There are currently no exposures of WD in the Super Pit.

The majority of the pit wall exposure will be within GMD, although 16% of the pit wall exposure will be within WD. For the weathered pit walls, 57% will be in the WD, with the balance predominantly in GMD.

Discontinuity patterns for the rock masses have been interpreted from both pit mapping and core logging, with due consideration given to drillhole azimuth bias and pit mapping sampling bias. Stereographic projections for each of the rock types and data sources are presented in Appendix D, while Table 4 lists the interpreted discontinuity sets and resulting interpreted design orientations. The stereographic projections show Terzaghi-corrected contours of the data, with an approximation of the "blind zone" resulting from drill hole azimuth bias. The interpreted "design" discontinuity patterns are summarised on the compilation stereographic projection shown in Figure 7.

Six discontinuity sets are interpreted for the WD, GMD and BFB rock masses, with a seventh for the PB rockmass. The discontinuity pattern is dominated by north-northwest to north-northeast striking sub-vertical discontinuities (sets 4 and 2) and by low angle dipping structures, with dips less than 25º to 30º and variable dip direction (set 6). A further sub-vertical discontinuity set (set 1) is interpreted to strike approximately east – west. There are two moderate-dipping sets; discontinuity set 3, which dips at a moderate angle toward the west, and discontinuity set 5, which dips at a moderate angle toward the southwest. Set 7 is only associated with PB, and dips at a moderate angle to the south east.

10.0 SEISMICITY

KCGM has experienced both mining-induced and natural seismic events. The effect of seismic loads on pit slope stability can be addressed using pseudo-static loading or by examining dynamic stability. There are few examples of pit slope failures in hard rock that can be attributed solely to the effects of seismicity. Most seismically induced failures occur in highly to extremely weathered materials, or silts, which liquefy during an event. Natural seismic events have very long wave lengths, much greater than the size of the pit wall. Hence experience has confirmed that such events have little impact on hard rock slopes.

Blasting in the intermediate field (approximately 500 metres) would be more likely to shake loose blocks from individual batters.

11.0 WILLIAMSTOWN DOLERITE EXPOSURES NORTH OF KALGOORLIE

The nearest exposure of the WD is at the Union Club Pit, approximately 5 kilometres to the north of the proposed cutback. On KCGM's advice, a brief assessment of the geotechnical conditions and pit wall performance of the WD at this pit (Reference 12) has been made in an attempt to correlate its performance with the proposed Golden Pike cutback.

The WD at the Union Club Pit is exposed in the south wall of the pit and is highly to moderately weathered to a depth of approximately 60 metres. The total pit wall depth in this area is 105 metres, with a pit wall geometry as follows:

- Batter angle 61.5º
- Berm width 10 m
- Batter height 20 m
- Inter-ramp slope angle 44º

The pit was mined from 1987 to 1991 and has undergone survey, groundwater and visual monitoring since the completion of mining. To date no instability issues have been reported in the WD. While KCGM has identified some major structures in the south wall, the orientation of the structures is such that they do not affect stability of the pit wall.

Minor structures have been assessed to have trace lengths of less than 5 metres, and have orientations as shown on the stereographic projection presented in Figure 8. A comparison of these orientations with those recorded in the WD in the region of the Golden Pike cutback indicates that there is good correlation between the two data sources, and emphasises the significance of design discontinuity sets 1, 4 and 6.

No kinematic failure mechanisms were identified in the WD in the Union Club Pit. KCGM undertook circular failure stability analyses in the weathered WD, and derived a factor of safety of 1.08.

The parameters used were representative of lower bound results (i.e. at limit equilibrium). Based on 10 years experience, it appears that these results are too low, as no failures have taken place in that time.

In summary, it is concluded that the geotechnical rockmass conditions at the Union Club Pit are similar to those at the proposed Golden Pike cutback. It is therefore interpreted that the pit wall geometry adopted at Union Club would, as a guide, be successful at Golden Pike.

12.0 ABANDONMENT BUND

Using the DoIR guidelines (Reference1) in relation to mine abandonment, BFP have determined that the Golden Pike cutback area would require an abandonment bund 86 m from the pit crest, to potentially accommodate any potential long term slope deterioration (Figure 2).

13.0 ASSESSMENT OF KINEMATIC FAILURE POTENTIAL FOR GOLDEN PIKE CUTBACK

The design discontinuity set interpretation has been used to assess kinematic failure potential (KFP) for the cutback, which will have final walls that dip toward the east, south-southeast and northeast. An assessment of KFP with identified mechanisms is presented as a rosette of slope dip and slope dip direction on Figure 9. The dominant slope dip directions are shown on the figure. The assessment can be summarised as follows:

East Dipping Slopes

Cutback slopes with easterly dip directions are interpreted to have no kinematic failure potential. However, mapping within GMD and drill core logging within WD and GMD show a small cluster of veins and fewer number of faults or shears with moderate dips (30º to 40º) toward the northeast to east-northeast (identified as “set 10” on the design stereographic projection). In drill hole data these features are however healed. These sets also appear to relate to the lode system shown in Figure 10.

Southeast Dipping Slopes

Cutback slopes which dip toward the southeast have a KFP of wedge failure on sets 10 and 5. This wedge has a low angle of intersection, and batter scale failure of this type has been observed in the present pit. The failures are typically very low volume and unlikely to control slope angles.

Drill core logging within PB show a small number of shears with moderate dip (55º to 60º) towards the southeast (identified as "set 7" on the design stereographic projection). These shears are only likely to cause low volume batter scale failures, and are therefore also unlikely to control slope angles.

North-Northeast Dipping Slopes

Cutback slopes which dip toward the north-northeast have a KFP of planar failure on a shallower dipping (55º) cluster (set 11) of discontinuity set 1.

The interpreted stability rosette shows that for inter-ramp slope angles less than 65º there are no kinematic failures governing the slope angle for the pit wall orientations, except for the north-northeast dipping slope, where the inter-ramp slope angle should not exceed 55º. Localised batter failure should be anticipated for batter angles in excess of 55º within this slope.

14.0 REVIEW OF GOLDEN PIKE CUTBACK DESIGN

At KCGM the major controls on slope stability, to date, have been related to structure and orientation/location of old workings. Groundwater has not presented a stability problem due to the drainage effect of the workings, although there are pockets of perched water. The pit design in the GMD is based predominantly on experience, as the effect of structural controls on the existing west wall has been minimal.

The present design comprises:

Oxide/weathered zone

- Batter angle 50º
- Berm width 10 m
- Batter height 20 m
- Interramp slope angle 40.5º

Transition/fresh zone

- Batter angle 75º
- Berm width 10 m
- Batter height 30 m
- Interramp slope angle 63.9º

The proposed depth of the cutback is 600 m.

To the west of the Golden Pike Fault, there is a limited history of underground mining, so a phreatic surface could be intersected in the cutback area. The oxide design is more conservative than was used previously at the Union Club Pit (Reference 11). (i.e. IRSA –

Golden Pike = 40.5º, IRSA – Union Club = 44º). Hence Kalgoorlie experience would confirm that the design is stable.

The results of the rock mass classification have been plotted on a stability chart, shown in Figure 11. The GMD has a design slope exposure of greater than 300 m, therefore the data was not plotted on the stability chart in Figure 11. The positions indicate that the possibility of an overall failure in both the weathered and fresh rocks is low.

The presence of BFBs in the wall should not signify any major stability issues, due to the limited thickness of this unit. While toppling may be a local issue, this is unlikely to influence the overall slope. Recent KCGM microseismic results (J. Jiang personal communication) indicate that this unit may be susceptible to flexure however, and microseismic monitoring is recommended.

A review of the rock mass failure mechanisms and kinematic failure mechanisms confirm that this design, when combined with experience at KCGM, is conservative and has low risk of instability.

Taking into account these results, BFP found that the Noise Abatement Bund had negligible influence on overall pit slope stability.

15.0 ADDITIONAL OBSERVATIONS

Figure 10 shows the Golden Pike lode on cross section 48900 mN. It appears that the development shown (shaft, level development and stoping) has not yet been digitised into Vulcan, and should be undertaken if not already done.

16.0 TASKS OUTSTANDING

The following work should be undertaken for the West Wall appraisal:

- Obtain discontinuity infill data for design discontinuity sets,
- Examine existing west wall pit slopes, and determine the presence, continuity and geotechnical properties of discontinuity set 11,
- Sample and test WD for rock strength, especially shear strength of any low angle defects,
- Review BFB for strength anisotropy,
- Review slope monitoring data (prism movements),
- Review material properties of the Golden Pike Fault, and if possible obtain samples for testing,
- Carry out stress analysis to ascertain the influence of extensional strain and the likely generation of new (i.e. unmapped) structures that could influence stability (e.g. in BFB),
- Examine groundwater conditions to the west of the Golden Mile Fault,

- Undertake further strength testing to establish valid Point Load correlations in the other units, and
- Assess blasting procedures in the proposed Golden Pike Cutback area.

17.0 CONCLUSIONS

The geotechnical assessment of the Golden Pike cutback undertaken in this report has been based on:

- A review of available data,
- A review of experience in the WD,
- Examination of seismicity issues,
- Examination of kinematic and rock mass stability, and
- Correlations with existing experience.

It is concluded that for cutback pit slopes with east and southeast dip directions the proposed pit design conforms with KCGM experience and may be considered conservative. However, for cutback slopes with north-northeast pit slope dip directions inter-ramp slope angles of up to 55º would be acceptable, recognizing that localized batter scale slope instability may occur.

The stability of the oxide wall is not compromised by the presence of the Noise Abatement Bund.

Although there are outstanding issues (summarised in Section 16) that should be resolved to confirm that these conclusions remains correct, these issues are considered unlikely to change the general design parameters.

Yours faithfully
BFP CONSULTANTS PTY LTD

Phil Dight
Partner and
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REFERENCES

1. Guidelines on the Safety Bund Walls around Abandoned Open Pits. Mining Engineering Division, Department of Mines Western Australia, January 1991.

2. Review of Fimiston Operations, SRK Report, 1995

3. Geotechnical Status Report, Oroya Cutback - KCGM, April 2001.

4. Drysdale Geotechnical Report, Bilki, F., July 1992.

5. Pit Slope Stability Review - Nov. 2001. Golder Associates Ltd., Letter Report, February 7 2002.

6. Geotechnical Data for KCGM., J. Jiang, September 2003. [Letter Report]

7. Priest, S. D., Hudson, J. A., 1981, Estimation of Discontinuity Spacing and Trace Length using Scanline Surveys, Int. J. Rock Mech, Min. Sci Geomech. Abstr., Vol 8 pp 183 to 197, Printed in Great Britain., Pergamon Press Ltd.

8. Hoek, E., Kaiser, P.K., Bawden, W.F., 1995, Support of Underground Excavations in Hard Rock, A. A. Balkema, Rotterdam / Brookfield.

9. Haines, A., Terbrugge, P.J., 1990, Preliminary Estimations of Rock Slope Stability Using Rock Mass Classification Systems.

10. Email from G Lye to P. Dight, PowerPoint Presentation at Union Club Pit, 18 November 2003.

11. Email from K Sonnekus to P.Dight, Geotechnical Comments on BFP Report “Geotechnical Assessment of Golden Pike Cutback”, 16 February 2004.

12. Geotechnical Status Report - South Wall Mystery and Union Club Pits - Mt Percy Mine, G. N. Lye, 19 December 1996.

TABLES

Table 1 – Summary of Drillhole Survey Data

Borehole ID	E	N	RL	Dip Range Top (º)	Dip Range Bottom (º)	Azimuth (º)	Pre-collar (m)
CSGD014	18771.09	48590.26	-55.99	-49	-32	83	96.1
CSGD015	18770.65	48590.21	-55.95	-59	-59	83	95.9
CTGD027	18692.45	48170.53	-53.11	-50	-29	84	-
CTGD030	18743	48296.06	-57.12	-58	-45	91	150.5
CTGD040	18689.25	48169.99	-53.19	-55	-34	84	-
CTGD044	18744.48	48294.73	-57.16	-56	-45	90	75.9
CTGD046	18744.58	48294.61	-57.02	-50	-44	91	76.2
ENGD020	18869.87	48540.11	-43.75	-57	-46	86	268.1
ENGD030	18902.81	48889.8	-54.27	-61	-56	90	306
ENGD031	18976.32	48887.95	-52.19	-59	-50	90	331
ENGD040	19017.91	48948.98	-52.4	-51	-46	90	190
ENGD043	18838.58	48649.3	-54.29	-65	-43	87	69.2
ENGD044	19024.29	48949.39	-52.32	-44	-38	90	100
ENGD045A	18977.59	48888.81	-50.6	-45	-34	90	71.8
ENGD045B	18977.59	48888.81	-50.6	-45	-42	90	251.3
ENGD053	18943.38	48710.08	-49.65	-52	-45	90	56.1
ENGD058	19024.39	48949.1	-52.28	-50	-50	90	66
GGGD009	19001.01	49098.14	-53.38	-62	-51	89	229
GGGD014	19098.36	49262.11	-53.7	-58	-48	90	271
GGGD017	19163.82	49368.64	-53.86	-68	-59	90	207
GGGD024	19078.81	49038.1	-51.31	-55	-52	90	354
GGGD026	19075.78	49038.03	-51.26	-58	-55	90	180
GGGD030	19151.79	49252.09	-52.13	-58	-49	90	59
GGGD032A	19230.18	49369.85	-52.65	-56	-44	88	73.9
GGGD044	19082.66	49127.53	-51.99	-56	-46	91	51.5
GGGD045	19069.25	48993.13	-51.4	-55	-37.5	87	-
GGGD048	19130.55	49189.78	-51.88	-57	-54	91	45.1
GGGD051	19130.8	49190.28	-51.93	-56	-49	91	45.7
GGGD052	19095.2	49067.85	-51.16	-55	-44.5	87	51.5
HMGD015	18915.9	48410	-71.04	-59	-51	90	150.8
HMGD022	18847.08	48412.85	-55.95	-58	-51	91	53.5
HMGD023	18849.28	48352.5	-54.8	-58	-45	91	38.4
HMGD024	18847.23	48352.34	-55	-60	-51	87	28.5
HMGD028	18847.99	48487.24	-55.05	-57	-50	88	61.5
HMGD029	18862.27	48489.6	-55.06	-55	-	87	81
HMGD030	18850.26	48488.95	-55.14	-55	-	87	75.8
HMGD031	18849.43	48352.41	-54.82	-50	-41	87	28
HMGD032	18760.7	48351.39	-56.48	-56	-32	90	86.8
HRD0035	18679.84	48199.64	-54.16	-49.5	-51	95	-
NKGD019	19221.75	49369.85	-52.57	-63	-54	87	159
NKGD023	19231.05	49371.33	-52.46	-52	-47	90	67.15
NKGD024	19192.31	49310.12	-52.36	-55	-48	89	-
NKGD025	19191.1	49310.19	-52.31	-58	-56	90	71.8

Table 2 – Summary of Geotechnical Drillhole Logging and Photography

ID	RQD	FF	Defect	Photo	Lithology and Oxidation	Data for				
						WD	GMD West	GMD East	BFB	PB
CSGD014	Y	Y					Y	Y	Y	
CSGD015	Y	Y					Y			
CTGD027			Y				Y			
CTGD030	Y	Y	Y				Y	Y	Y	
CTGD040			Y				Y			
CTGD044	Y	Y	Y				Y			
CTGD046	Y	Y	Y				Y	Y	Y	
ENGD020	Y	Y	Y				Y	Y	Y	
ENGD030		Y	Y		Y		Y	Y	Y	Y
ENGD031		Y	Y		Y		Y	Y	Y	Y
ENGD040	Y	Y	Y	Y	Y		Y	Y	Y	Y
ENGD043	Y	Y	Y		Y	Y	Y	Y	Y	Y
ENGD044		Y	Y	Y	Y		Y	Y	Y	Y
ENGD045A	Y	Y	Y	Y	Y	Y	Y	Y	Y	
ENGD045B		Y	Y		Y		Y	Y	Y	Y
ENGD053		Y	Y		Y		Y	Y	Y	
ENGD058		Y	Y		Y		Y	Y	Y	
GGGD009	Y	Y	Y		Y		Y	Y	Y	Y
GGGD014	Y	Y	Y		Y			Y		Y
GGGD017			Y		Y		Y	Y	Y	Y
GGGD024	Y	Y	Y		Y			Y		Y
GGGD026	Y	Y	Y	Y	Y			Y		Y
GGGD030	Y	Y	Y	Y	Y		Y	Y	Y	Y
GGGD032A	Y	Y	Y		Y			Y		Y
GGGD044	Y	Y	Y	Y	Y		Y	Y	Y	Y
GGGD045			Y					Y		
GGGD048	Y	Y	Y	Y	Y		Y	Y	Y	Y
GGGD051	Y	Y	Y	Y	Y		Y	Y	Y	Y
GGGD052	Y	Y	Y		Y		Y	Y	Y	
HMGD015	Y	Y	Y					Y		
HMGD022	Y	Y	Y				Y	Y	Y	
HMGD023	Y	Y	Y				Y	Y	Y	
HMGD024	Y	Y	Y				Y	Y	Y	
HMGD028	Y	Y	Y				Y	Y	Y	
HMGD029	Y	Y					Y	Y	Y	
HMGD030	Y	Y					Y	Y	Y	
HMGD031	Y	Y	Y				Y	Y	Y	
HMGD032	Y	Y	Y				Y	Y	Y	
HRDO035			Y			Y	Y			
NKGD019	Y	Y	Y		Y			Y		Y
NKGD023	Y	Y	Y		Y			Y		Y
NKGD024			Y					Y		
NKGD025	Y	Y	Y	Y	Y			Y	Y	Y

LEGEND:

WD: Williamstown Dolerite
GMD: Golden Mile Dolerite
PB: Paringa Basalt
BFB: Black Flag Beds
RQD: Rock Quality Designation
FF: Fractures Frequency

Table 3 Rock Mass Rating (RMR) System (after Bieniawski, 1989)

Parameter	**Rock Mass**						
	WD		**GMD (west of BFB)**		**BFB**	**GMD (east of BFB)**	**PB**
	Weathered	Fresh	Weathered	Fresh	Fresh	Fresh	Fresh
1.0 Strength UCS							
UCS (MPa)	70% of Fr	As for GMD	25-50	80 - 171		80 - 171	67-182
Average (MPa)	96.6	138		138	PI=3.84	138	107
Rating	**7**	**12**	**4**	**12**	**7**	**12**	**12**
2.0 RQD							
Ave %	72	93	86	95	92	96	98
Rating	**13**	**20**	**17**	**20**	**20**	**20**	**20**
3.0 Joint Spacing							
Fpm	7.6	4.1	3.5	3.2	3.7	1.7	1.4
Spacing(mm)	132	213	287	310	270	596	737
Rating	**8**	**10**	**10**	**10**	**10**	**10**	**15**
4.0 Joint Condition							
4.1 Persistence	15-20	15-20	15-20	15-20	15-20	15-20	15-20
Rating	**1**	**1**	**1**	**1**	**1**	**1**	**1**
4.2 Aperture(mm)	>5mm	>5mm	>5mm	>5mm	>5mm	>5mm	1-5mm
Rating	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Table 3 Rock Mass Rating (RMR) System (after Bieniawski, 1989) - (Continued)

Parameter	**Rock Mass**						
	WD		**GMD (west of BFB)**		**BFB**	**GMD (east of BFB)**	**PB**
	Weathered	Fresh	Weathered	Fresh	Fresh	Fresh	Fresh
4.3 Roughness	Slick	Slick	Slick	Slick	Smooth	Smooth	Smooth
Rating	**0**	**0**	**0**	**0**	**3**	**3**	**3**
4.4 Infill	CH Soft(>5mm)	CH Soft(>5mm)	CH Soft(>5mm)	CH Soft(>5mm)	GR/SE/CH Soft(>5mm)	Soft/Hard >5mm	Hard <5mm
Rating	**0**	**0**	**0**	**0**	**0**	**1**	**4**
4.5 Weathering	Weathered	Fresh	Weathered	Fresh	Fresh	Fresh	Fresh
Rating	**3**	**6**	**3**	**6**	**6**	**6**	**6**
5.0 Groundwater							
Assume	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Rating	**15**	**15**	**15**	**15**	**15**	**15**	**15**
∑ RMR (UNADJUSTED)	**47**	**62**	**58**	**64**	**62**	**68**	**77**
	Fair Rock	Good Rock	Fair Rock	Good Rock	Good Rock	Good Rock	Good Rock

LEGEND:

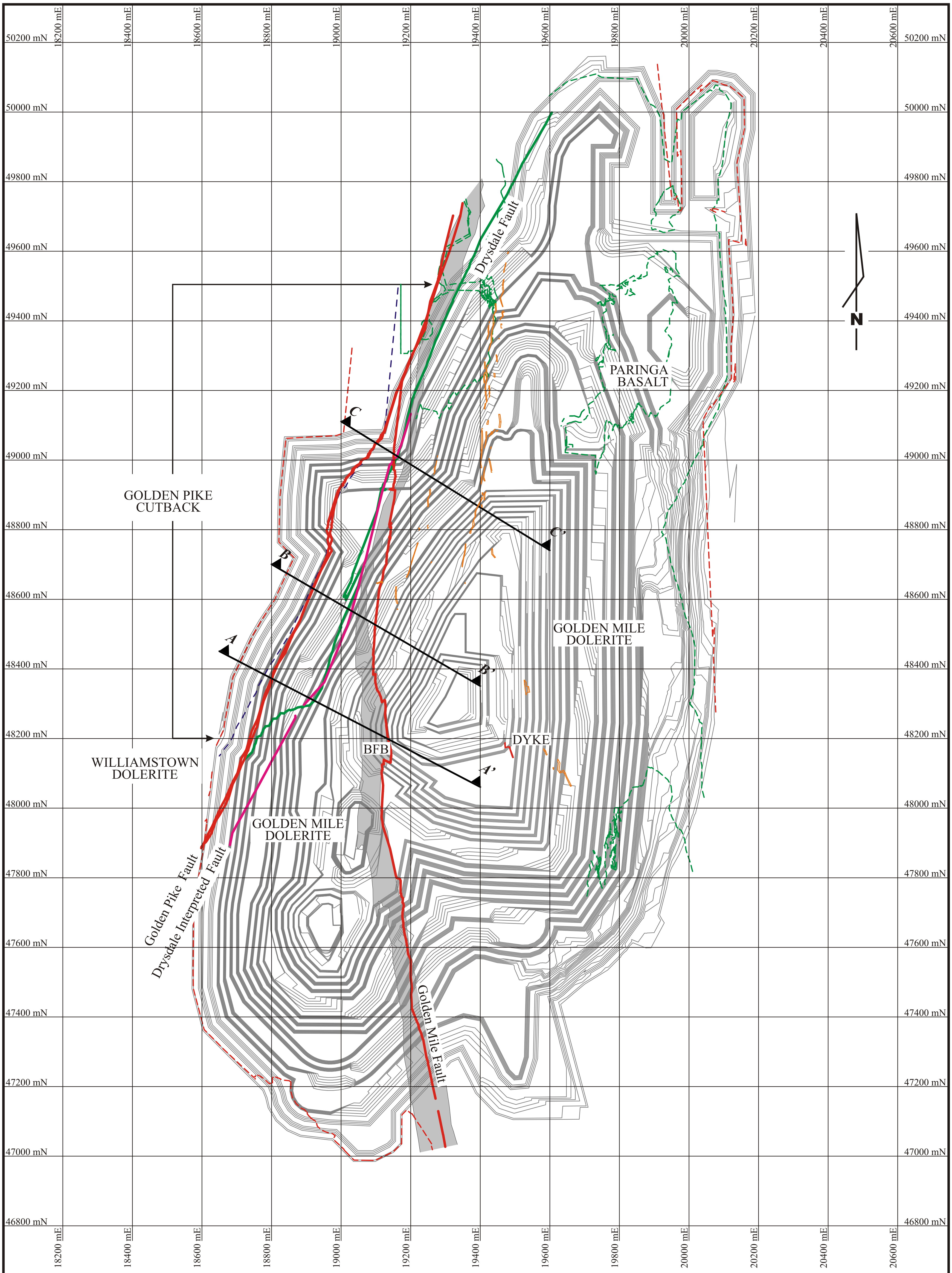
WD: Williamstown Dolerite
GMD: Golden Mile Dolerite
PB: Paringa Basalt
BFB: Black Flag Beds
RMR: Rock Mass Rating

UCS: Unconfined Compressive Strength (MPa)
PI: Point Load Strength Index (MPa)
RQD: Rock Quality Designation
Fpm: Fractures per metre

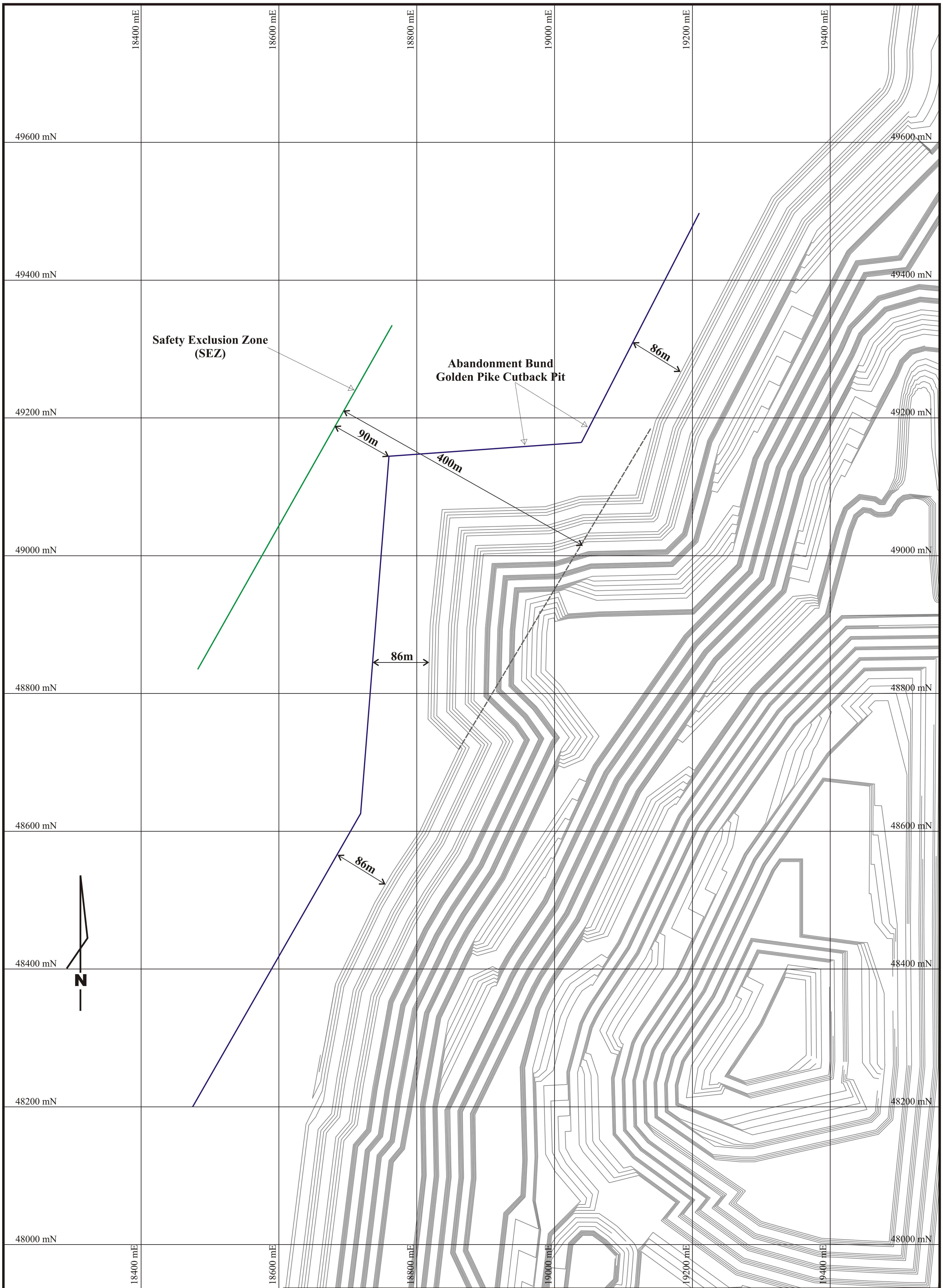
Table 4 - Discontinuity Set Orientations for the Golden Pike Cutback

Discontinuity Set #	Orientation (wrt mine grid)	
	Dip	Dip Direction
1	77º	006º
11	56º	006º
2	68º	290º
3	48º	272º
4	81º	272º
41	84º	068º
5	63º	221º
6	13º	291º
7	58º	120º
10	36º	068º

FIGURES



CLIENT	PLAN GOLDEN PIKE CUTBACK			
KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD GOLDEN PIKE CUTBACK BFP Geotechnical, Mining and Geological Consultants	DATE JAN 2004	SCALE 1:10000	JOB No 1803035	Fig 1



CLIENT

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

GOLDEN PIKE CUTBACK

BFP Geotechnical, Mining and Geological Consultants

SEZ AND MINE ABANDONMENT EXCLUSION ZONE

DATE	SCALE	JOB No	
JAN 2004	1:5000	1803035	Fig **2**

users\1803035_0221\jan2004reportfig2.pdf

CLIENT

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

GOLDEN PIKE CUTBACK

BFP Geotechnical, Mining and Geological Consultants

SECTION A - A'

DATE	SCALE	JOB No	
JAN 2003	1:1250	1803035	Fig 3

CLIENT KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

KCGM SITE VISIT

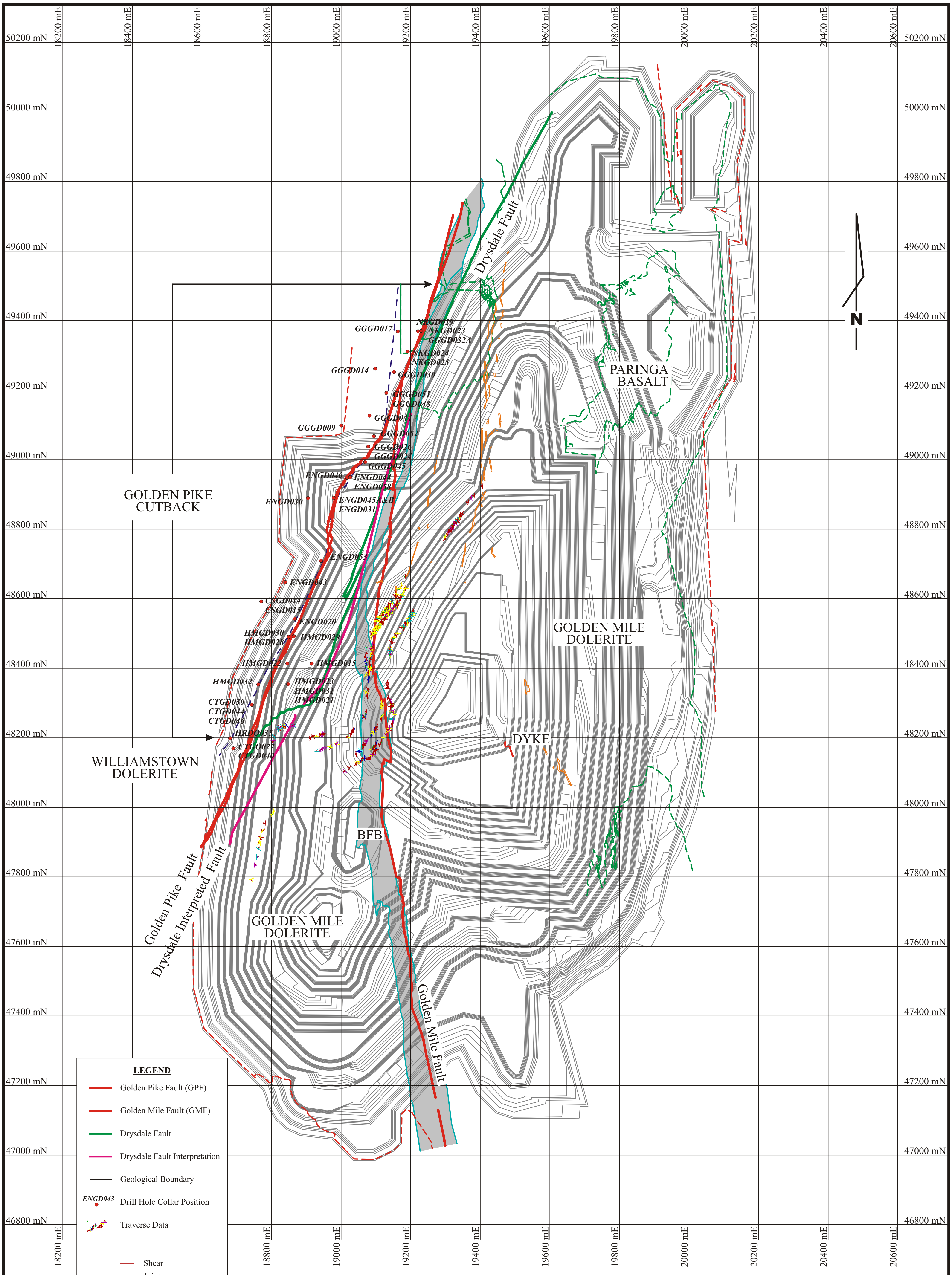
BFP Geotechnical, Mining and Geological Consultants

SECTION B - B'

DATE	SCALE	JOB No	
JAN 2004	1:1250	1803035	Fig 00

CLIENT KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD	SECTION C - C'			
GOLDEN PIKE CUTBACK BFP Geotechnical, Mining and Geological Consultants	DATE JAN 2004	SCALE 1:1250	JOB No 1803035	Fig 5

Users\1803035_0221jan2004\reportfig5.pdf



For further detail refer to drawing E28 (Appendix E)

CLIENT

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

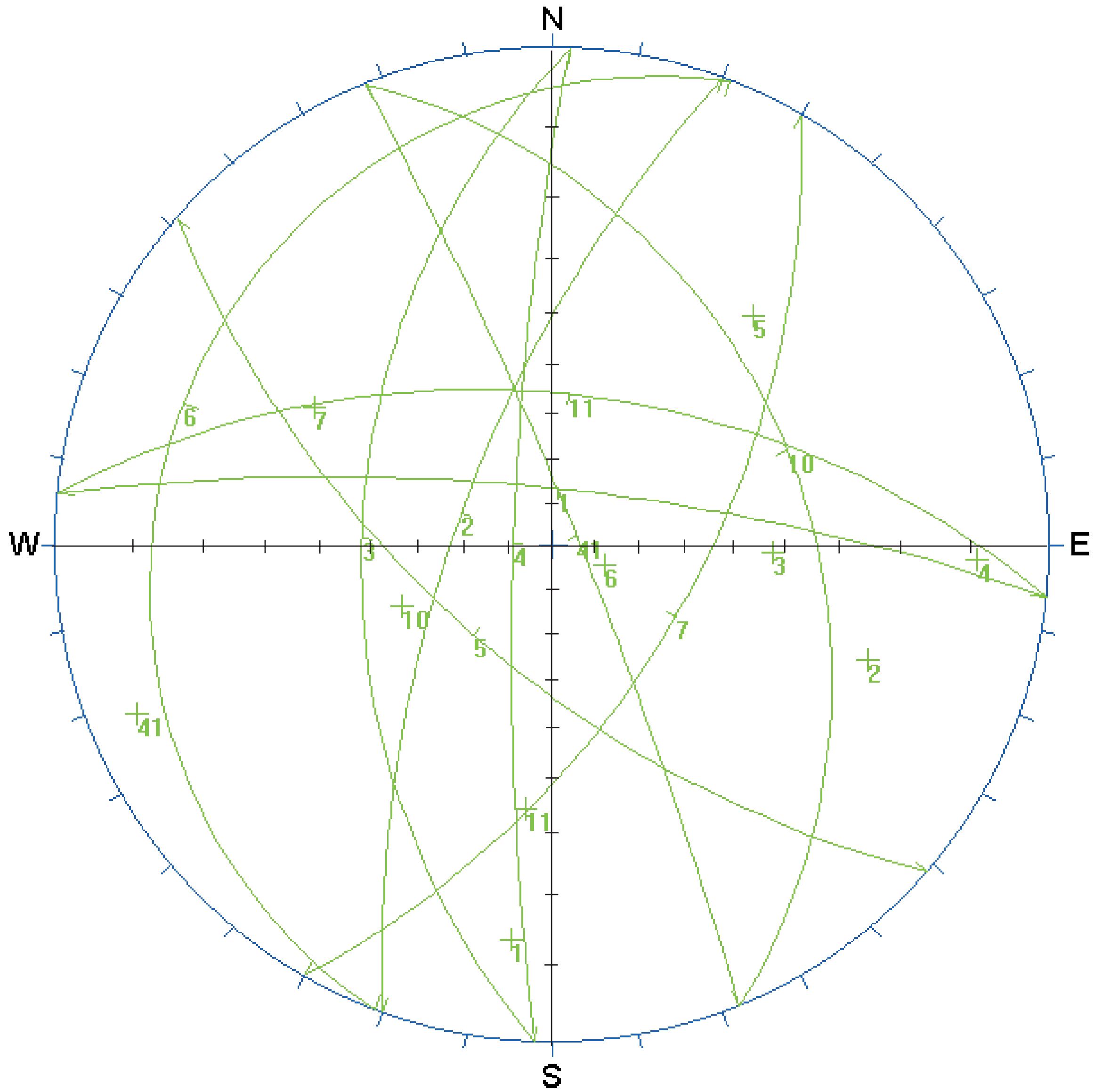
KCGM SITE VISIT

BFP Geotechnical, Mining and Geological Consultants

LOCATION OF MAPPING AND MAJOR LITHOLOGICAL BOUNDARIES

DATE	SCALE	JOB No	
JAN 2004	1:10000	1803035	Fig 6

Users\1803035_0221\jan2004reportfig6.pdf



ORIENTATIONS	
ID	DIP/DIRECTION
1	77/006
11	56/006
2	68/290
3	48/272
4	81/272
41	84/068
5	63/221
6	13/291
7	58/120
10	36/068

Equal Angle
Lower Hemisphere

CLIENT

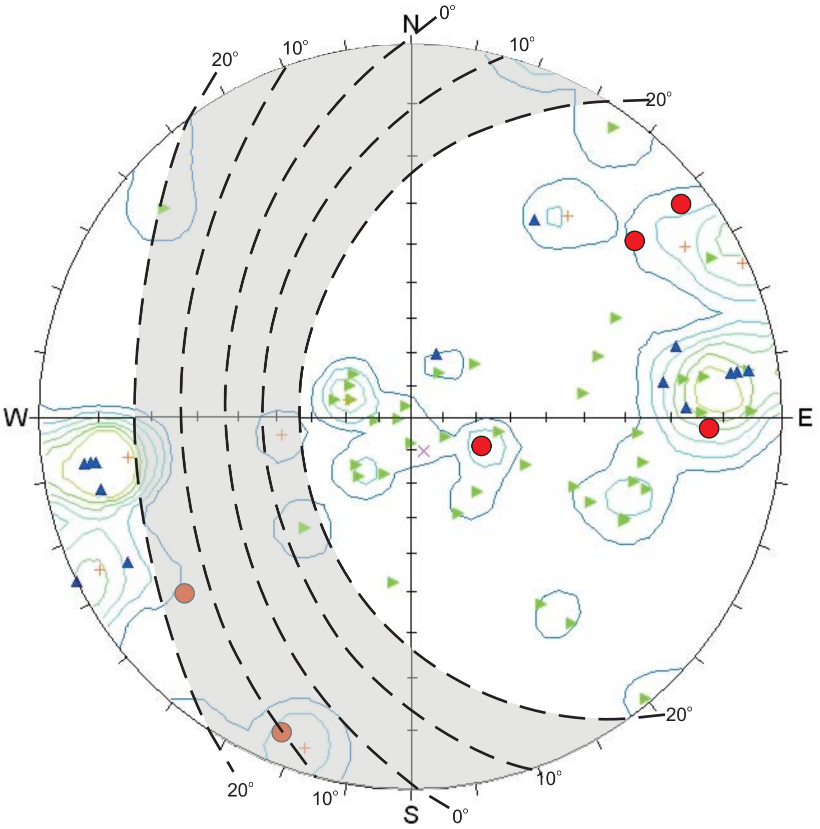
KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

GOLDEN PIKE CUTBACK

BFP Geotechnical, Mining and Geological Consultants

DESIGN DISCONTINUITY SET ORIENTATIONS

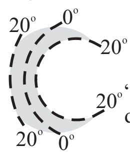
DATE	SCALE	JOB No	
JAN 2004	NTS	1803035	Fig 7



TYPE

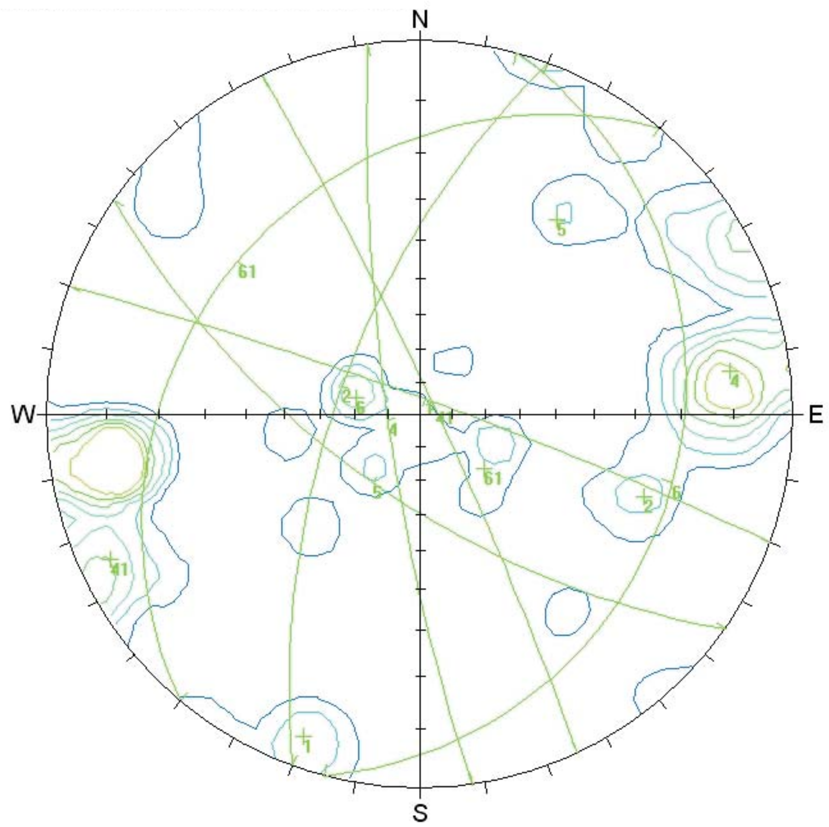
●	Union Club Pit Planes	(6)
▲	Foliation	(16)
▶	Joint	(44)
+	Shear	(10)
×	Vein	(1)

Alpha Angles



"Blind zone" caused by drill hole azimuth bias

Equal Angle
Lower Hemisphere
77 Poles
77 Entries



ORIENTATIONS

ID	DIP/DIRECTION
1	85/020
2	65/290
4	80/262
41	85/065
5	65/215
6	20/105
61	25/310

Equal Angle
Lower Hemisphere
77 Poles
77 Entries

CLIENT

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

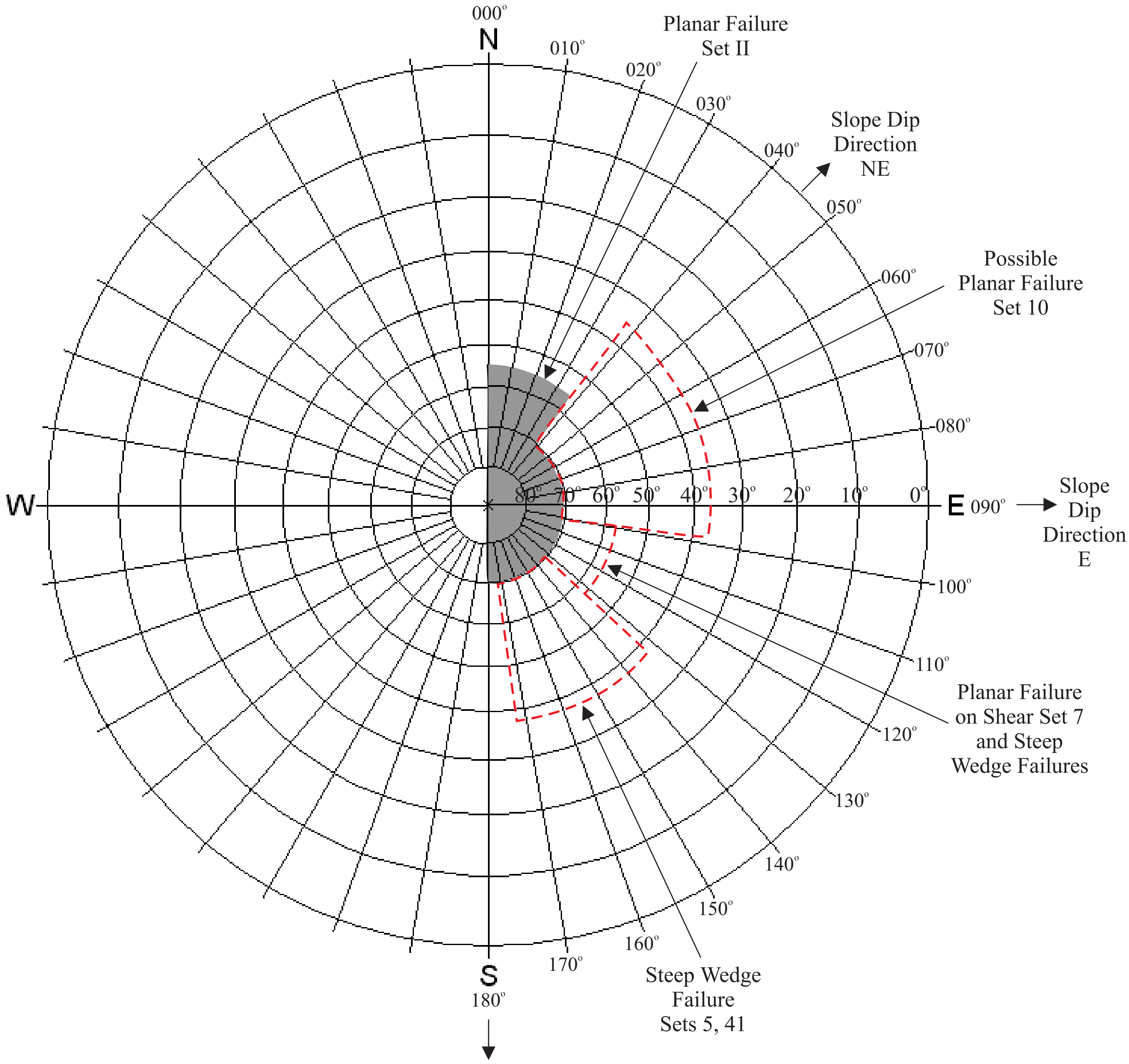
GOLDEN PIKE CUTBACK

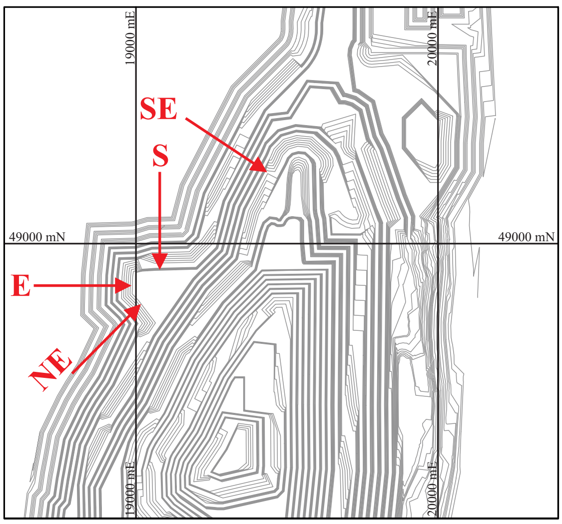
BFP Geotechnical, Mining and Geological Consultants

WILLIAMSTOWN DOLERITE DISCONTINUITY PATTERNS

DATE	SCALE	JOB No	
JAN 2004	NTS	1803035	Fig **8**

Users\1803035_0221jan2004reportfig8.pdf



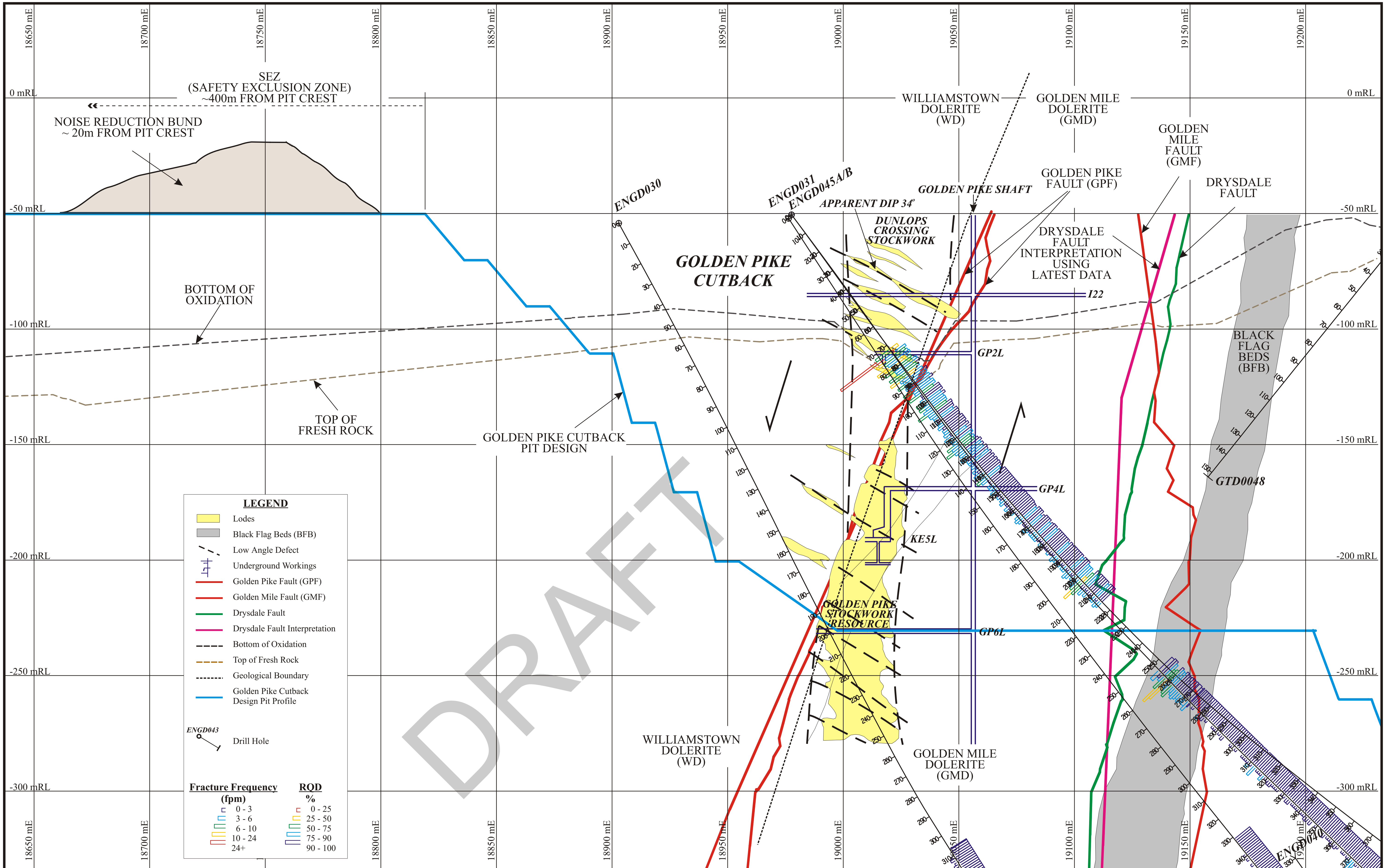


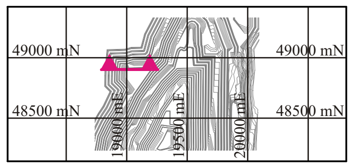
ORIENTATIONS

ID	DIP/DIRECTION
1	77/006
11	56/006
2	68/290
3	48/272
4	81/272
41	84/068
5	63/221
6	13/291
7	58/120
10	36/068

CLIENT	KINEMATIC STABILITY ROSETTE			
KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD GOLDEN PIKE CUTBACK	DATE JAN 2004	SCALE NTS	JOB No 1803035	Fig 9

BFP Geotechnical, Mining and Geological Consultants





CLIENT

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

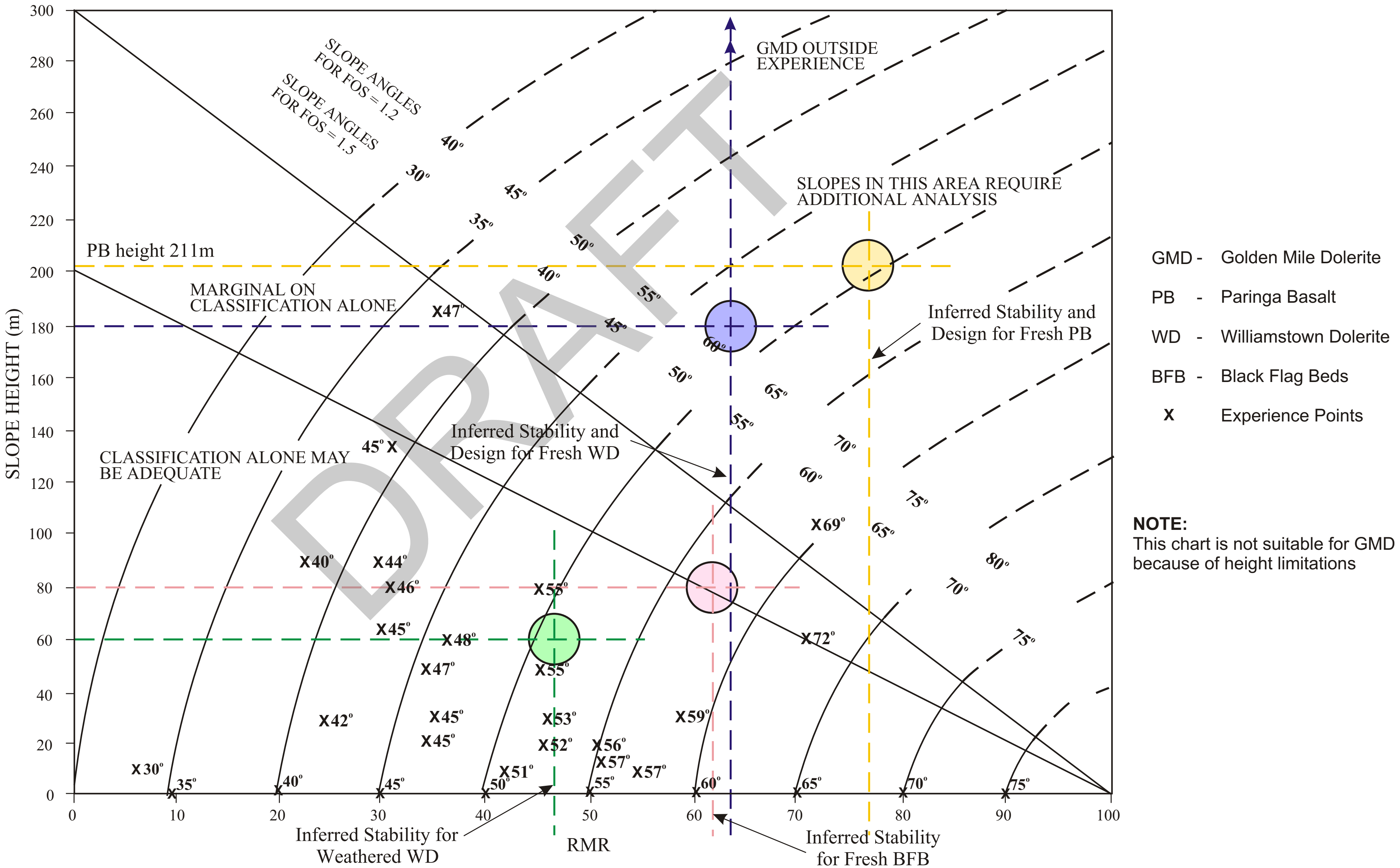
GOLDEN PIKE CUTBACK

BFP Geotechnical, Mining and Geological Consultants

CROSS SECTION 48900 mN

DATE	SCALE	JOB No	
JAN 2004	1:1500	1803035	Fig 10

DESIGN CHART TO DETERMINE SLOPE ANGLE USING RMR CLASSIFICATION DATA



SOURCE: Haines, A., Terbrugge, P.J. 1990
" Preliminary Estimation of Rock Slope Stability
Using Rockmass Classification Systems" ISRM.

CLIENT
KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

GOLDEN PIKE CUTBACK

BFP Geotechnical, Mining and Geological Consultants

HAINES AND TERBRUGGE SLOPE ANGLE FROM RMR

DATE	SCALE	JOB No	
JAN 2004	AS SHOWN	1803035	Fig **11**

users\1803035_0221\jan2004reportfig11.pdf

APPENDIX A

DoIR Pit Abandonment Guidelines

1.6 Current Guidelines for Pit Abandonment

In January 1991 DME released its "Guidelines on Safety Bund Walls around Abandoned Open Pits. This document is still valid and its intent is to define the criteria for establishing a 'safety zone' around open pits at the end of mining. The recommendations have been based on field investigations of failures and tension cracks around pit edges in operating and abandoned open pit gold mines in Western Australia.

It is noted that the guidelines apply to open pits that exceed 5 metres depth and have wall angles steeper than 25°, see Figure 1. The DME stresses the guidelines do not address safety exclusion zones for active mining operations. The document does, however, recognise the area most prone to instability is the weathered zone. The implication is deeper-seated failures tend to be rare and localised, and have usually occurred within the operating life of the mine. In this situation specific geotechnical studies would have been required in order to define a safe boundary for abandonment.

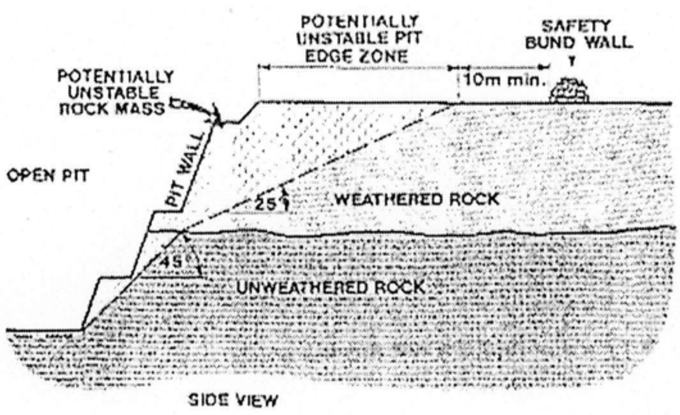


Figure 1 Guideline for calculating a geotechnical 'safety zone' around an abandoned pit with walls excavated in weathered and unweathered rock.

Applying the Guidelines to the West Wall excavated with an overall slope of 45° and an average 60 metres depth of weathering results in a bund wall/fence line being some 78 metres from the pit crest, regardless of the overall slope height.

APPENDIX B

SEZ History

1. CURRENT SEZ SITUATION

1.1 What is the SEZ?

The government imposed a 400-metre safety exclusion zone (SEZ) around our open pit operations at Fimiston to prevent the likelihood of any injury or damage caused by fly-rock from any blasting within the pit. The SEZ commences from the pit perimeter and radiates out 400 metres. No permanent residential dwellings were to remain however commercial and industrial properties could stay within this zone provided they were vacant at the time of any blasting occurring.

The imposition of this SEZ has necessitated an ongoing property acquisition programme by KCGM. Apart from two light industrial sites, all property within the 1992 SEZ has been acquired by KCGM and either demolished or leased.

The 1992 version of the SEZ was made public and included in the City of Kalgoorlie-Boulder's town planning scheme. The DME was advised of small changes to the outline in 1994, but no public declarations have been made since 1992.

It is important to investigate whether the SEZ has ever been legally established as a fixed line on the ground. Rather, the intention appears to be that the Fimiston open pit must maintain a 400-metre safety zone around its operations at all times. As a consequence the outer limit of the SEZ can be expected to advance with time. The onus is on KCGM to manage the acquisition of property within the zone at each stage and ensure periodic inclusion of the zone in the City of Kalgoorlie-Boulder's town planning scheme.

1.2 Background

24 October 1991

Minister for the Environment, Bob Pierce, established conditions for 'Fimiston Project Stage II - Mine and Waste Dumps' in response to a mining proposal provided by KCGM:

"Subject to these conditions (referring to the commitments made in the Consultative Environmental Review), the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by proponents to the Environmental Protection Authority with the proposal. Where in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on advice of the Environmental Protection Authority, is not substantial, those changes may be effected."

There is no reference to the SEZ in this document. The announcement of the SEZ appears to have come from the DME almost 12 months later. It does appear, however, from the Environment Ministers perspective that KCGM could be restricted to the latest submitted and approved long-term mine plan.

2 September 1992

In a letter from Jim Torlach (State Mining Engineer) to Ian Burston (CEO KCGM) notification was given that a 400 metre SEZ would be applied to the 'Super Pit(s)'. It stated:

"This will require that the distance from the perimeter of any section of the open pit (or pits) where blasting operations are taking place at or adjacent to that perimeter, to any occupied dwelling, will be maintained at 400m."

The linkage of the SEZ to blasting practices and fly rock was highlighted:

"The basis of the 400 metre distance is determined by the potential for fly-rock from blasting, as a lesser distance would have sufficed to provide- security from future subsidence of the final pit wall perimeters."

"As the pit perimeter in any locality advances, it will be the responsibility of the company to take the appropriate action to maintain this safety zone, and ensure that no persons are within the area during blasting operations at or near the relevant perimeter zones."

1 October 1992

Jim Torlach responds to a request for clarification of the SEZ by Ian Burston. In this letter it is reinforced that fly-rock is the issue:

"The Safety Exclusion Zone was determined on the basis of fly-rock potential deriving from the primary production blasting ... "

The 400 metres are to be measured in plan from the area of blasting. Significantly it is implied that as the pit increases in depth and the production area moves further away from the community then the SEZ could close in on the pit perimeter:

"As the Safety Exclusion Zone is measured in Plan, effectively from the line or the outermost blastholes, it would reach its greatest width from the pit perimeter when the line of blast holes is at or near the surface and closely adjacent to the perimeter."

There is hope for reducing the safe distance from controlled blasting in the weathered zone:

"Smaller scale primary blasting or 'shake-tip' shots fired to allow ripping and scraping of overburden or weathered rocks would obviously be subject to lesser separation distances from dwelling, although the normal stringent controls on the executions of such blasting would apply."

The Golden Mile Mining Development Planning Committee - 1992

The Golden Mile Mining Development Planning Committee (GMMDPC) was chaired by the Jim Torlach (State Mining Engineer) and had representatives from the DME, the EPA, The Department of State Development, the Department of Conservation and Land Management, the Goldfields Esperance Development Authority, the City of Kalgoorlie-Boulder, KCGM and Kaltails. The GMMDPC was established to address the issues confronting mining companies and the community as a result of large-scale mining in the near vicinity of Kalgoorlie-Boulder.

Three documents have been released into the public arena:

- The Golden Mile Environmental Strategy" in January 1988;
- A second document in July 1989 detailed mining activities and infrastructure developments;
- The final publication from the GMMDPC came in and was aimed at alerting the community of the social aspects associated with the large scale/long term mining activity. For the first time details of the Safety Exclusion Zone were made public.

The 1992 document provided a map of the 'Ultimate 500 metre Pit crest' and an 'approximate position of the Safety Exclusion Zone'. There were no coordinates on the map but the outlines were spliced onto an aerial photograph so that the position of the SEZ with respect to community infrastructure could be appreciated. Public safety was cited as the reason for the SEZ with fly-rock and pit wall subsidence noted as the issues. It was noted that the SEZ was a DME recommendation, which was endorsed by State Cabinet in December 1991. Significantly it was stated:

"The SEZ has been defined to address the unique conditions at the Fimiston Open pit and will extend 400 metres from the boundary of any active pit excavation involving primary blasting at or near that boundary. In line with a cabinet decision any residential properties occurring within the SEZ are to be purchased by KCGM, who may enter into arrangements with the occupants of those premises, allowing residents to remain living in the area subject to strict adherence to safety requirements to ensure nobody is injured during blasting activity. In addition all properties likely to be affected by future pit wall subsidence will be vacated and removed."

The City of Kalgoorlie-Boulder was to review is town planning and establish a special zoning to cover the SEZ. Development of residential properties in the SEZ was to be prohibited. DOLA would not release any further land within the zone nor convert to freehold any existing alienated blocks within the SEZ.

October 1992

KCGM distributed a 1:2000 plan showing the SEZ in relation to the DOLA Kalgoorlie townsite plan, to DME, DOLA and the City of Kalgoorlie-Boulder.

February 1993

Ian Burston wrote to the Minister for Lands and Mines, the Won S.G.E. Cash, addressing confusion expressed by several residents over the position of the SEZ. Plans showing the SEZ with the standard Australian Map Grid were included.

March 1993

Sly and Weigall provided KCGM with a legal opinion on the claims of the 'Hainault Road Residents' who resided outside the 400 metre SEZ but claimed they were being adversely affected by the mining activity. Noise, dust and vibration were cited by the residents as being the main issues. On the noise and dust issue the legal opinion stated that residents could mount a claim for nuisance under the Common Law. They could also have mounted a claim under the Mining Act 1978 if it could be shown that the mining activity caused 'injury or depreciation' to property.

April 1997

The SEZ is addressed in the Government Gazette, Western Australia. The objective of the SEZ is defined as:
"(a) To provide a buffer between the Super Pit Gold Mine and the urban area in order to maintain the safety, health and welfare of the surrounding residents and the population in general.
(b) To allow for the continuing development and operation of the Super Pit Gold Mine with minimum impact upon the amenity of the adjoining urban and residential areas."

It is significant that the City of Kalgoorlie-Boulder supports the SEZ concept and encourages KCGM to purchase land in the zone. It will also only consider applications for planning approval over properties in the zone, made by KCGM.

In regard to General Development in the SEZ:

"Where buildings, residences, or land uses located within the SEZ are considered to be at risk from hazards associated with mining activity, such buildings, residences or land uses shall be removed and/or relocated to the satisfaction of the Council. The costs .....shall be met by KCGM."

"Non-residential uses may be approved by the Council provided that the purpose, safety and amenity of the Zone shall not be compromised."

April 1997

Gary Lye contacted the DME to ascertain what was the scientific basis for the SEZ, i.e. were there any technical reports to support 400 metres.

Mr. Hugh Jones, DME's Assistant Director Research and Technical Services, confirmed in a letter dated 29 April 1997, that the basis for establishing 400 metres as the width of the Safety Exclusion Zone (SEZ) was the potential for fly rock from blasting.

Mr. Jones notes that the determination of the SEZ was first described in a letter dated 2 September 1992, from the State Mining Engineer to KCGM's CEO. In this letter it was stated that the SEZ: *"... distance is determined by the potential for fly rock from blasting, as a lesser distance would have sufficed to provide security from future subsidence of the final pit wall perimeters"*.

There are no DME Geotechnical reports or data pertaining to the SEZ. It is understood that one of the DME's geotechnical officers visited KCGM for discussions on the stability of a final west wall pit slope. He apparently concluded a distance somewhat less than 400 metres would have been sufficient if slope instability was the paramount issue.

It is believed an empirical approach was used to assess the safe horizontal distance from blasting. The State Mining Engineer apparently reviewed all DME records with respect to fly rock incidents and determined 400 metres as the safe limit.

KCGM has been passively acquiring properties within the SEZ since 1992.

APPENDIX C

Geotechnical Logging from Core Photographs

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING &
GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
LOGGED BY: sc
CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD040	101.2	102.0	0.8			MD	Fr			0.65	81	4	5.00											
*	ENGD040	102.0	103.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	103.0	104.0	1			MD	Fr			0.92	92	4	4.00											
*	ENGD040	104.0	105.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	105.0	106.0	1			MD	Fr			1	100	3	3.00											
*	ENGD040	106.0	107.0	1			MD	Fr			0.92	92	6	6.00											
*	ENGD040	107.0	108.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	108.0	109.0	1			MD	Fr			1	100	0	0.00											
*	ENGD040	109.0	110.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	110.0	111.0	1			MD	Fr			0.92	92	3	3.00											
*	ENGD040	111.0	112.0	1			MD	Fr			1	100	3	3.00											
*	ENGD040	112.0	113.0	1			MD	Fr			0.89	89	5	5.00											
*	ENGD040	113.0	114.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	114.0	115.0	1			MD	Fr			1	100	3	3.00											
*	ENGD040	115.0	116.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	116.0	117.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	117.0	118.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	118.0	119.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	119.0	120.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	120.0	121.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	121.0	122.0	1			MD	Fr			0.79	79	6	6.00											
*	ENGD040	122.0	123.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	123.0	124.0	1			MD	Fr			0.95	95	5	5.00											
*	ENGD040	124.0	125.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	125.0	126.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	126.0	127.0	1			MD	Fr			0.82	82	4	4.00											
*	ENGD040	127.0	128.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	128.0	129.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	129.0	130.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	130.0	131.0	1			MD	Fr			0.87	87	5	5.00											
*	ENGD040	131.0	132.0	1			MD	Fr			0.92	92	4	4.00											
*	ENGD040	132.0	133.0	1			MD	Fr			0.84	84	6	6.00											
*	ENGD040	133.0	134.0	1			MD	Fr			1	100	3	3.00											
*	ENGD040	134.0	135.0	1			MD	Fr			0.9	90	5	5.00											
*	ENGD040	135.0	136.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	136.0	137.0	1			MD	Fr			1	100	4	4.00											
*	ENGD040	137.0	138.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	138.0	139.0	1			MD	Fr			0.96	96	4	4.00											
*	ENGD040	139.0	140.0	1			MD	Fr			1	100	3	3.00											
*	ENGD040	140.0	141.0	1			MD	Fr			1	100	2	2.00											

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING & GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
LOGGED BY: sc
CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD040	141.0	142.0	1			MD	Fr			0.89	89	5	5.00											
*	ENGD040	142.0	143.0	1			MD	Fr			0.59	59	6	6.00											
*	ENGD040	143.0	144.0	1			MD	Fr			0.7	70	8	8.00											
*	ENGD040	144.0	145.0	1			MD	Fr			0.69	69	5	5.00											
*	ENGD040	145.0	146.0	1			MD	Fr			0.79	79	5	5.00											
*	ENGD040	146.0	147.0	1			MD	Fr			1	100	2	2.00											
*	ENGD040	147.0	148.0	1			MD	Fr			0.83	83	5	5.00											
*	ENGD040	148.0	149.0	1			MD	Fr			1	100	1	1.00											
*	ENGD040	149.0	150.0	1			MD	Fr			0.55	55	5	5.00											
*	ENGD045A	71.8	73.0	1.2			MD	MW			0.57	47	10	8.33											
*	ENGD045A	73.0	74.0	1			MD	MW			0.09	9	30	30.00											
	ENGD045A	73.0	73.9												FZ										
*	ENGD045A	74.0	75.0	1			MD	MW			0.56	56	7	7.00											
*	ENGD045A	75.0	76.0	1			MD	MW			0.8	80	4	4.00											
*	ENGD045A	76.0	77.0	1			MD	MW			0.66	66	10	10.00											
	ENGD045A	76.9	77.0												FZ										
*	ENGD045A	77.0	78.0	1			MD	MW			0.7	70	7	7.00											
	ENGD045A	77.5	77.5												FZ										
*	ENGD045A	78.0	79.0	1			MD	MW			0.75	75	6	6.00											
*	ENGD045A	79.0	80.0	1			MD	MW			0.8	80	5	5.00											
*	ENGD045A	80.0	81.0	1			MD	MW			0.42	42	12	12.00											
	ENGD045A	80.9	81.0												FZ										
*	ENGD045A	81.0	82.0	1			MD	MW			0.75	75	6	6.00											
*	ENGD045A	82.0	83.0	1			MD	MW			0.69	69	10	10.00											
	ENGD045A	82.6	82.8												FZ										
*	ENGD045A	83.0	84.0	1			MD	MW			0.7	70	7	7.00											
	ENGD045A	83.7	83.9												FZ										
*	ENGD045A	84.0	85.0	1			MD	MW			0.6	60	9	9.00											
*	ENGD045A	85.0	86.0	1			MD	MW			0.89	89	4	4.00											
*	ENGD045A	86.0	87.0	1			MD	MW			0.93	93	4	4.00											
*	ENGD045A	87.0	88.0	1			MD	MW			0.65	65	9	9.00											
*	ENGD045A	88.0	89.0	1			MD	MW			0.75	75	7	7.00											
*	ENGD045A	89.0	90.0	1			MD	MW			0.45	45	10	10.00											
	ENGD045A	89.8	90.8												FZ										
*	ENGD045A	90.0	91.0	1			MD	MW			0.18	18	20	20.00											
*	ENGD045A	91.0	92.0	1			MD	SW			0.8	80	5	5.00											
*	ENGD045A	92.0	93.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	93.0	94.0	1			MD	Fr			0.89	89	8	8.00											
*	ENGD045A	94.0	95.0	1			MD	Fr			0.81	81	4	4.00											
*	ENGD045A	95.0	96.0	1			MD	Fr			0.89	89	5	5.00											

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING &
GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
LOGGED BY: sc
CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD045A	96.0	97.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	97.0	98.0	1			MD	Fr			0.75	75	8	8.00											
*	ENGD045A	98.0	99.0	1			MD	Fr			0.89	89	3	3.00											
*	ENGD045A	99.0	100.0	1			MD	Fr			0.89	89	3	3.00											
*	ENGD045A	100.0	101.0	1			MD	Fr			0.68	68	7	7.00											
*	ENGD045A	101.0	102.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	102.0	103.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	103.0	104.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	104.0	105.0	1			MD	Fr			0.81	81	6	6.00											
*	ENGD045A	105.0	106.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	106.0	107.0	1			MD	Fr			0.81	81	6	6.00											
*	ENGD045A	107.0	108.0	1			MD	Fr			0.85	85	3	3.00											
*	ENGD045A	108.0	109.0	1			MD	Fr			0.83	83	5	5.00											
*	ENGD045A	109.0	110.0	1			MD	Fr			0.72	72	9	9.00											
*	ENGD045A	110.0	111.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	111.0	112.0	1			MD	Fr			0.95	95	4	4.00											
*	ENGD045A	112.0	113.0	1			MD	Fr			0.93	93	3	3.00											
*	ENGD045A	113.0	114.0	1			MD	Fr			0.8	80	3	3.00											
*	ENGD045A	114.0	115.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	115.0	116.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	116.0	117.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	117.0	118.0	1			MD	Fr			0.9	90	4	4.00											
*	ENGD045A	118.0	119.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	119.0	120.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	120.0	121.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	121.0	122.0	1			MD	Fr			0.9	90	4	4.00											
*	ENGD045A	122.0	123.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	123.0	124.0	1			MD	Fr			0.75	75	5	5.00											
*	ENGD045A	124.0	125.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	125.0	126.0	1			MD	Fr			0.91	91	3	3.00											
*	ENGD045A	126.0	127.0	1			MD	Fr			0.89	89	3	3.00											
*	ENGD045A	127.0	128.0	1			MD	Fr			0.63	63	7	7.00											
*	ENGD045A	128.0	129.0	1			MD	Fr			0.8	80	5	5.00											
*	ENGD045A	129.0	130.0	1			MD	Fr			0.7	70	9	9.00											
*	ENGD045A	130.0	131.0	1			MD	Fr			0.9	90	5	5.00											
*	ENGD045A	131.0	132.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	132.0	133.0	1			MD	Fr			0.86	86	4	4.00											
*	ENGD045A	133.0	134.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	134.0	135.0	1			MD	Fr			0.82	82	5	5.00											
*	ENGD045A	135.0	136.0	1			MD	Fr			1	100	2	2.00											

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING &
GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
LOGGED BY: sc
CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD045A	136.0	137.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	137.0	138.0	1			MD	Fr			0.88	88	3	3.00											
*	ENGD045A	138.0	139.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	139.0	140.0	1			MD	Fr			0.9	90	3	3.00											
*	ENGD045A	140.0	141.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	141.0	142.0	1			MD	Fr			0.9	90	4	4.00											
*	ENGD045A	142.0	143.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	143.0	144.0	1			MD	Fr			0.95	95	5	5.00											
*	ENGD045A	144.0	145.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	145.0	146.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	146.0	147.0	1			MD	Fr			0.79	79	6	6.00											
*	ENGD045A	147.0	148.0	1			MD	Fr			0.9	90	4	4.00											
*	ENGD045A	148.0	149.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	149.0	150.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	150.0	151.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	151.0	152.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	152.0	153.0	1			MD	Fr			1	100	0	0.00											
*	ENGD045A	153.0	154.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	154.0	155.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	155.0	156.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	156.0	157.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	157.0	158.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	158.0	159.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	159.0	160.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	160.0	161.0	1			MD	Fr			0.9	90	2	2.00											
*	ENGD045A	161.0	162.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	162.0	163.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	163.0	164.0	1			MD	Fr			0.98	98	2	2.00											
*	ENGD045A	164.0	165.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	165.0	166.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	166.0	167.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	167.0	168.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	168.0	169.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	169.0	170.0	1			MD	Fr			0.92	92	4	4.00											
*	ENGD045A	170.0	171.0	1			MD	Fr			0.83	83	3	3.00											
*	ENGD045A	171.0	172.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	172.0	173.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	173.0	174.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	174.0	175.0	1			MD	Fr			0.75	75	4	4.00											
*	ENGD045A	175.0	176.0	1			MD	Fr			0.9	90	3	3.00											

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING & GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
LOGGED BY: sc
CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD045A	176.0	177.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	177.0	178.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	178.0	179.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	179.0	180.0	1			MD	Fr			0.85	85	3	3.00											
*	ENGD045A	180.0	181.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	181.0	182.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	182.0	183.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	183.0	184.0	1			MD	Fr			0.89	89	3	3.00											
*	ENGD045A	184.0	185.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	185.0	186.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	186.0	187.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	187.0	188.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	188.0	189.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	189.0	190.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	190.0	191.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	191.0	192.0	1			MD	Fr			0.85	85	4	4.00											
*	ENGD045A	192.0	193.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	193.0	194.0	1			MD	Fr			0.95	95	3	3.00											
*	ENGD045A	194.0	195.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	195.0	196.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	196.0	197.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	197.0	198.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	198.0	199.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	199.0	200.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	200.0	201.0	1			MD	Fr			0.88	88	5	5.00											
*	ENGD045A	201.0	202.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	202.0	203.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	203.0	204.0	1			MD	Fr			1	100	3	3.00											
*	ENGD045A	204.0	205.0	1			MD	Fr			0.86	86	5	5.00											
*	ENGD045A	205.0	206.0	1			MD	Fr			0.85	85	5	5.00											
*	ENGD045A	206.0	207.0	1			MD	Fr			0.86	86	6	6.00											
*	ENGD045A	207.0	208.0	1			MD	Fr			0.28	28	11	11.00											
*	ENGD045A	208.0	209.0	1			MD	Fr			0.7	70	7	7.00											
*	ENGD045A	209.0	210.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	210.0	211.0	1			MD	Fr			0.79	79	5	5.00											
*	ENGD045A	211.0	212.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	212.0	213.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	213.0	214.0	1			MD	Fr			1	100	2	2.00											
*	ENGD045A	214.0	215.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	215.0	216.0	1			MD	Fr			1	100	3	3.00											

GEOTECHNICAL CORE LOG

BFP
GEOTECHNICAL, MINING &
GEOLOGICAL CONSULTANTS

CLIENT: KCGM
PROJECT: Golden Pike Cutback
LOCATION: Fimiston Open Pits, Kalgoorlie
FILE NAME:CORE_PHOTO_LOGGING

JOB NO: 1803035
DATE: 1/12/03
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CORE SIZE:
ORIENT. LINE:

INTERVAL MARKER	BHID	FROM	TO	CORE LENGTH	REC LENGTH	CORE LOSS	ROCK TYPE	WEATH'G	ALTR'N	STRENGTH	RQD LENGTH	RQD %	NO OF DEFECTS	FRAC / m	DEFECT SETS**	TYPE	QTY / SET	ORIGIN	ALPHA	BETA	ROUGH	INFILL MIN	WIDTH mm	INFILL STR	COMMENTS
*	ENGD045A	216.0	217.0	1			MD	Fr			0.89	89	3	3.00											
*	ENGD045A	217.0	218.0	1			MD	Fr			1	100	1	1.00											
*	ENGD045A	218.0	219.0	1			MD	Fr			1	100	4	4.00											
*	ENGD045A	219.0	220.0	1			MD	Fr			1	100	3	3.00											

APPENDIX D

Stereographic Projections

LIST OF STEREOGRAPHIC PROJECTIONS

APPENDIX E

Cross Sections & Plan

(In Separate Folder)

LIST OF CROSS SECTIONS