

# Kevin Rosengren & Associates Pty. Ltd.

## CONSULTING MINING ENGINEERS

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February 28, 2011  
30028

Oceana Gold (NZ) Limited  
Golden Point Road  
**MACRAES FLAT 9483**  
**NEW ZEALAND**

Attention: **Mr Marty Hughes**

Dear Sirs,

### **MACRAES GOLD MINE - FOOTWALL FAULT PEER REVIEW OF PSM REPORT**

This report presents a peer review of the Pells Sullivan Meynink (PSM) report (Ref. 1) concerning likely ground movement on the Footwall Fault, resulting from proposed cut-backs of the Round Hill and Southern open pits. The review is based on information in the PSM report (Ref. 1), together with our knowledge of the area and other information provided by Oceana Gold (NZ) Limited (OceanaGold).

In this report, locations and directions are based on the Mine Grid which is oriented 45° west of True North.

#### **1. BACKGROUND INFORMATION**

Gold mineralisation in the Macraes Flat area occurs within the Hyde Macraes Shear Zone (HMSZ), within the Otago Schist. This shear zone has a known strike length of 30km, is approximately 100m thick and dips at around 15° to the east (Ref. 2). The upper and lower limits of the HMSZ are sharply defined by the Hangingwall Shear and the Footwall Fault, respectively.

The highest grade gold mineralisation occurs in the upper part of the HMSZ, immediately below the Hangingwall Shear, and gold grade decreases towards the base of the zone. Open pit mining has generally extracted the upper half of the HMSZ, while the Frasers underground mine is extracting the uppermost 10-15m of the HMSZ.

With the increasing gold price, there is now an incentive to extract the lower part of the HMSZ. OceanaGold are currently investigating the feasibility of deepening and cutting back the eastern walls of the existing and now partly filled open pits in the northern mine area, including the Golden Point, Round Hill and Southern open pits.

A constraining factor on this proposal is that it is well known that open pit mining mobilises movement on the Footwall Fault. In the northern mine area, this movement has caused significant displacement of the Macraes processing plant which is located east of the surface outcrop of the Footwall Fault (Fig. 2). Mining of the Frasers open pit has also caused damage to the upper part of the Frasers underground decline which is located in the HMSZ above the Footwall Fault. Currently, substantial ground movement is being caused by mining of the Frasers South pit, although there is no significant infrastructure in this area.

The extent of the proposed northern area cut-back is shown on plan in Fig. 1. It is proposed that the existing Mixed Tailings Impoundment (MTI) will be decommissioned and partially dewatered reclaimed tailings from the Southern Pit cut-back will be drystacked on top of the MTI. A set of cross-sections through the northern mine area is shown on Figs. 3 to 9.

If there were no restraints, the pit cut-back would extend further to the north, to include the Golden Point open pit. However, because of concerns about the influence of such mining on the stability of the processing plant, the northern limit of mining has been specified by a "PSM Line" at approximately 15250N (Ref. 1), (Figs. 1 and 2).

The objective of the PSM report (Ref. 1) is to assess the influence of the proposed mining on the west wall area and the stability of the processing plant. This report presents a peer review, or second opinion, on the PSM report.

## **2. PREVIOUS EXPERIENCE**

### **2.1 Round Hill - Golden Point Open Pits**

Open pit mining at Macraes commenced in 1991 at the Round Hill open pit. Movement of the west wall of this open pit was noticed in 1995 and a monitoring program was established and a depressurisation program instituted. The mining rate was varied to ensure that the west wall movement rate did not exceed 2mm/day and the pit was completed successfully in July, 1998, with backfilling also commencing in July, 1998.

Mining then progressed to the north into the Golden Point area. Depressurisation and stop-start mining was also adopted and, during 2000, the west wall movement rate was maintained at around 4mm/day. During the mining of Golden Point Stage 3, the movement rate reached 7mm/day. Mining at Golden Point was completed in June, 2002, and backfilling was carried out to stabilise the area.

Two small open pits were mined during 2003 and 2004, as follows (Fig. 2):

- Round Hill Extension (= North-West) pit, immediately north-east of the plant site, between April 2003 and October, 2004
- ROM Pad pit, a very small open pit, located 150m south-east of the plant site, between March and May, 2003.

Four survey pillars were established in the plant site area in 2000 (Fig. 2). Monitoring of pillars A and D commenced on July 7, 2000 and of pillars E and G on November 2, 2000. Results of this monitoring are summarised on Fig. 10. All four pillars showed similar movements with a total horizontal movement of around 4m to the north-east, and a settlement of around 1m. A fault scarp with a vertical displacement of 1.1m, developed along the rear of the plant site (Fig. 2, Plate 1).

The bulk of the movement occurred between March 2001 and June 2002, during the mining of Stage 3 of the Golden Point open pit, at a remarkably constant rate of 8mm/day, determined by the stop/start mining sequence. Movements effectively ceased as soon as mining was completed. There was additional small movement in the second half of 2004, corresponding to the mining of the Round Hill Extension pit. There have been steady small movements since that time.

The directions of movement of the three pillars are shown on Fig. 10. The directions are consistently to the north-east, on bearings between 037° and 050°. Some northerly component of movement would be expected because the Golden Point pit is located north of the plant site. In addition, the dip direction (075°) of the Footwall Fault in this area is slightly north of east.

However, the much larger northerly components actually recorded are unexpected and, in our opinion, are not readily explainable. It has been suggested that they have been caused by the fact that the Footwall Fault outcrops in Deepdell Creek, 900m to the north (Fig. 1). In view of this large separation, we find this explanation difficult to accept.

The movement experienced by the plant site during this period (4m horizontal, 1m vertical) is large and it is surprising that the plant did not suffer significant damage. Presumably, the whole plant

site moved as a block, down the Footwall Fault, and suffered minimal differential movement. Regular surveys are carried out to check on differential movements within the plant site.

The movements caused by the mining of the Round Hill Extension open pit are shown on the monitoring record on Fig. 10. Although only relatively small, this pit was mined close to the subcrop of the Footwall Fault and to within 20m of the fault. The movements occurred towards the end of the mining period because this represents the closest proximity to the Footwall Fault.

## **2.2 Frasers and Frasers South Pits**

The Frasers and Frasers South open pits are located at the south end of the mine, south of the Macraes Fault Zone. This is a major transverse fault zone, with a downthrow of some 100m to the south. These pits are 3 to 4.5km south of the plant site will have no influence on its stability. However they have the same stratigraphic relationship to the Footwall Fault and their behaviour has direct relevance to the proposed northern pits.

The locations of the pits, which are contiguous, are shown on Fig. 11. A typical cross-section through each pit is shown on Fig 12. The Frasers open pit has a depth of 230m and is currently inactive. However a major cutback of the east wall is planned (Fig. 12). The Frasers South pit is currently active and is the major production centre for the mine.

The Innes Mills pits are located north of the Macraes Fault Zone pillar. A cutback of these pits may also be undertaken, depending on economic conditions at the time. These pits are completely backfilled, which will have an adverse effect on the stripping ratio of a cutback.

### **2.2.1 Frasers Pit**

Mining of Frasers pit has generated movement on the Footwall Fault, causing deterioration of the west wall of the pit. It has also caused dislocation of the Macraes-Dunback Road, north of the open pit, which requires regular repairs to maintain operation. However, there is no major infrastructure in the footwall area, except the underground mine office and workshops, located immediately north of the pit (Fig. 11).

The degree of footwall movement is less than that would be expected from mining such a large void. In our opinion, this is the result of the pit having a relatively small strike length when it was being mined (compare Round Hill open pit). Footwall movements in the Frasers South area are certainly much larger, with the increase in strike length (refer below). Again, this mirrors the

situation of mining of Golden Point open pit (refer above).

Movement on the Footwall Fault has also caused damage to the Frasers underground mine access decline which is located behind the north wall of Frasers pit, in the east-west pillar between the backfilled Innes-Mills pits and the Frasers pit (Fig. 11). In late 2007 (Ref. 3), it was noted that significant deterioration of the upper part of the decline was occurring. This was shown by cracking and spalling of shotcrete and slabbing of the decline walls. It was concluded that this deterioration was being caused by mining in the adjacent Frasers pit, with two related mechanisms as follows:

- (i) reduction in north-south confinement of the pillar hosting the decline, causing north-south expansion of the pillar;
- (ii) east-west compression of the pillar by drag of the adjacent material moving down the Footwall Fault, as a result of the Frasers pit mining.

The degree of decline deterioration was dependent on the location and depth of mining in Frasers pit and effectively ceased when mining transferred to the Frasers South pit. It is anticipated that the deterioration will re-occur when mining resumes in Frasers pit. We understand that there is a proposal to re-locate the upper part of the decline prior to that time.

It is anticipated that ground movements generated by a Frasers pit cutback will be much larger than the original movements because the southern abutment of the original pit has been removed by mining of the Frasers South pit.

### **2.2.2 Frasers South Pit**

Frasers South pit is currently in production and is generating major ground movements in the footwall area, as the result of slip down the Footwall Fault. Examples of these movements are shown on Plates 2 and 3 and locations of major cracking are shown on Fig. 11. The western cracks are located around 150m east of the inferred subcrop line of the Footwall Fault, although this is not defined by the current fault model. There has also been significant floor heave and thrusting in the pit floor (Plate 4).

An extensive movement monitoring program is being carried out. The movement history of three stations located on the crest of the west wall (Fig. 11) is shown on Fig. 13. Over a 14 month period, ending December, 1010, these stations show horizontal movements of 15m to 18m, and subsidence of 6m to 8.8m. Note that there is a small progressive increase in the movements, from

south to north. Station FR521 shows the smallest movement because it is closest to the south wall (abutment) of the pit. Station FR524 shows the largest movement because it is closest to the existing large void of Frasers pit.

There was a sudden increase in movements, of 4m horizontal and 1.5m vertical, in late May, 2010 (Fig. 13). This followed heavy rainfall of 250mm, over a five day period from May 27, which was rated as a 1 in 30 year event.

The directions of movement are shown on Fig. 13b. Prior to the heavy rainfall event, the bearing of the movement direction was 080° to 083°. Following the heavy rainfall event, movements of stations FR522 and FR524 deviated to a bearing of 073°. These movement directions are consistent with the dip direction of the Footwall Fault, taking into account the existing large void of the Frasers open pit. The northerly component of movement is significantly less than that for the plant site pillars during the mining of the Golden Point open pit (refer above).

In our opinion, the Frasers South open pit is a prototype for the likely footwall movements to be expected from mining in the northern mine area, particularly close to the Footwall Fault.

### **3. MECHANISM OF MOVEMENTS**

In our opinion, the mechanism of movement is quite simple, that is, block sliding down an inclined plane. The Footwall Fault is quite planar and dips fairly uniformly at around 15° to the east. The fault plane has experienced movement over geological time and its residual shear strength is estimated to be  $\Phi_r=9^\circ$  (Ref. 1). If unrestrained, any block on this plane will slip down the plane. This mechanism will be aggravated by any groundwater pressures in the fault zone (refer Section 5 below).

Our concept of the mechanism of failure is shown diagrammatically on Fig. 14, in four stages as follows:

- (i) Stage 1 - no mining - block above fault is compressed by incipient slip down the fault but equilibrium is maintained. This situation has existed for at least recent geological time.
- (ii) Stage 2 - shallow pit mined - pillar between pit floor and fault is compressed and deforms and the western block will show small movement down the fault.
- (iii) Stage 3 - deep pit mined - pillar between pit floor and fault becomes slender, more highly

compressed, may buckle or suffer shear failure (Plate 4) - western block experiences large movement (Plates 2 and 3).

- (iv) Stage 4 - pit mined through to fault - no resistance to sliding - western block suffers complete failure.

Note that Fig. 14 shows a two dimensional slice without side restraint and applies strictly to a pit with significant strike length. The lateral restraint is the reason why the Round Hill pit caused such minor movement, even though it was mined relatively close to the Footwall Fault (Figs. 6, 7). As discussed above, in our opinion, the increase in strike length of mining is also the reason why such large movements are being experienced at Frasers South.

It should also be noted that it is planned that both Frasers and Frasers South open pits will be mined down to the Footwall Fault (Fig. 12). This will be equivalent to Stage 4 of Fig. 14 and will generate large scale movements in the footwall area. This may be quite acceptable provided that there is no essential infrastructure located in this area.

#### **4. SUMMARY OF PSM REPORT**

The PSM report contains most of the discussion given above and is, in fact, the source of much of the information. Its objective is to predict the movements likely to be generated by the proposed Round Hill - Southern pit cutbacks.

The report approaches the problem from four directions, as follows:

- comparison with previous movements attributable to mining of Round Hill and Golden Point open pits
- comparison with current movements being experienced as a result of mining Frasers and Frasers South open pits
- earth pressure calculations
- numerical modelling - Phase<sup>2</sup>, FLAC3D, Abaqus.

These approaches are discussed briefly below.

##### **4.1 Comparison with Round Hill - Golden Point Open Pits**

An evaluation of this data (summarised above) concludes that substantial movement will be experienced at the plant site if the proposed mining proceeds over the full strike length between

Golden Point and Southern open pits. This movement could be reduced to manageable levels by:

- reducing depth of mining to RL350, or
- restricting mining south of the PSM line (Figs. 1 and 2).

The second option has been adopted by OceanaGold for ongoing mine design studies.

#### **4.2 Comparison with Frasers-Frasers South Open Pits**

An analysis of the footwall movements in the Frasers/Frasers South area since January, 2010 shows that, while substantial movements have occurred opposite the active mining area at Frasers South, much smaller movements, of the order of 10%, have been observed opposite the dormant Frasers pit. This data has been used to determine the proposed PSM line for the Round Hill - Southern cut-back (Figs. 1 and 2).

#### **4.3 Earth Pressure Calculation**

We have not checked or confirmed these rather complex calculations which attempt to quantify the sliding block concept shown on Fig. 14. The analysis concludes that the minimum offset distance between the pit floor and the Footwall Fault should be 25m.

Comments in this conclusion are as follows:

- (i) This offset distance will still allow significant movement to occur by compression of the 25m thick pillar beneath the open pit. For example, the 4m(H)/1m(V) movements of the plant site occurred with a much larger pillar thickness below the Golden Point pit (Figs. 8 and 10).
- (ii) The behaviour of the 25m thick pillar will be very dependent on the down dip length of the pillar. The longer the pillar, the more slender it becomes and the higher probability it has of suffering buckling or shear failure. For example, the current Round Hill cut-back proposal has 500m long pillars between 15100N and 15300N (refer Figs. 6 and 7). These pillars have slenderness ratios of 20:1 to 25:1 and will have minimal passive earth pressure resistance, even with the minimum pillar thickness of 25m.

#### **4.4 Numerical Modelling**

We have not checked or confirmed the numerical modelling and simply summarise the results, as follows:



#### **4.4.1 2D Modelling - Phase<sup>2</sup>**

Two sections were analysed at 15177N and 15403N, respectively. The results confirm that mining below RL350 will re-initiate the movements and that such movements could be relatively higher than those observed in the past. Predicted movements are between 2.5m and greater than 10m at the MTI, and up to 2.5m at the plant site.

#### **4.4.2 3D Modelling - FLAC3D**

It was concluded that the FLAC3D modelling could not produce a reliable solution.

#### **4.4.3 3D Modelling - Abaqus**

The model was calibrated using the previous Round Hill - Golden Point data and was used to predict displacement rates for the proposed future mining. The analysis indicates that, with a northern mining limit at the PSM line and a minimum 25m thick pillar below the pit floor, the movement at the plant site will be of the order of 1.5m, and opposite the active mining area, will be of the order of 4m. If the northern mining limit was removed, the movement at the plant site would be of the order of 4m.

### **5. GROUNDWATER**

Groundwater pressures in the Footwall Fault surface will significantly reduce its already low shear resistance and aggravate any movements which may occur. It is understood that considerable effort went into depressurising the fault in the previous Round Hill-Golden Point operation, including horizontal drain holes from the west wall of the Round Hill pit and pumping wells located in the north-eastern corner of the MTI. Four of these pumping wells continue to operate at the present time, at a cumulative rate of around 10L/s. Cessation of pumping results in a rapid rise in water level in a nearby standpipe and an increase in the movement rate, measured by an inclinometer in the plant site (Ref. 4)

The cross-sections (Figs. 4 to 6) show that the Footwall Fault continues beneath the MTI, south of 15200N. With movements of several metres predicted in this area, there will be substantial cracking of the base of the MTI, with direct connection to the Footwall Fault. It is planned that the MTI will be decommissioned but, if it is not completely dewatered, it will provide a source of constant recharge to the fault, which will potentially generate even larger movements.

OceanaGold's tailings consultants (Ref. 5) have advised that, after decommissioning, the MTI will remain saturated and that the phreatic surface will drop at only 1 to 2m/year. Since the thickness of saturated tailings in the valley where the Footwall Fault subcrops is up to 80m, saturated tailings will be located above the Footwall Fault for many years, and certainly well in excess of the life of the proposed northern pit cutbacks.

In our opinion, the issue of water pressures in the Footwall Fault, generated by the saturated tailings in the MTI undercut by the Footwall Fault, is of major importance and could lead to much larger ground movements than those currently predicted. It is recommended that a detailed study of the matter, including measures which can be taken to reduce the influence of the tailings, be undertaken before the proposed cutback of the northern pits commences.

## **6. DISCUSSION**

We are in general agreement with the content and conclusions of the PSM report. However, we are inclined to place more faith in the fairly extensive body of experience at the mine than the various modelling techniques, because of the numerous assumptions which must be made in these models, and the very extensive database available on previous movements.

The simple mechanism of the movements (Fig. 14), and the past experience, indicate that any open pit mining at Macraes will generate movement on the Footwall Fault. The magnitude of the movement will be:

- proportional to the volume of material removed (buttress reduction) at any location
- inversely proportional to the thickness and geometry of the pillar between the pit floor and the Footwall Fault.

For the proposed cutback operation, the situation is summarised diagrammatically on Fig. 15 which shows, for 50m spaced cross-sections:

- buttress reduction ( $B = \text{m}^3$  removed per metre strike length)
- minimum pillar thickness (T)
- buttress reduction ratio ( $BR = B/T$ ), which is an index of the likely magnitude of the ground movements.

Fig. 15 shows that BR value is low south of 14850N, indicating that footwall ground movements in this area will be relatively small. However, the value is high between 15000N and 15300N, indicating that ground movements in this area will be large. In this area, the Footwall Fault

outcrops beneath the MTI (refer above).

In our opinion, the movements are likely to be relatively greater than those which have occurred previously because of:

- the existing strike length of excavation
- the greater volume of proposed excavation
- the influence of water pressure in the fault, generated by saturated tailings in the MTI
- the recent history of slip on the Footwall Fault
- the current experience of mining at Frasers South (up to 18m horizontal and 8m vertical).

For these reasons, we believe that the movements predicted by the PSM report represent a lower estimate.

The only situation where significant movements will not occur is a pit with short strike length which provides sufficient end-restraint to minimise the footwall movement, for example, the original Round Hill pit. At the other extreme, an elongated pit which extracts the full depth to the Footwall Fault will potentially generate large scale footwall failure (refer Fig. 14).

For this reason, the proposal to limit the northern extent of mining, to protect the plant site is a sound approach. Whether the PSM line is an adequate limit is another question. The cross-section at 15300N (Fig. 7), beyond this nominal limit and at the southern limit of the plant site, shows that there is substantial buttress reduction ( $80,000\text{m}^3/\text{m}$  strike length) and a relatively high buttress reduction ratio (4000m) on this section. Furthermore, the floor pillar has a minimum thickness of 25m and a slenderness ratio of 17 to 1. We would not be confident that this mining will have minimal impact on the plant site.

We believe that there will never be certainty in detail about what will happen at the plant site should mining proceed. For this reason, the preferred strategy will be:

- (i) Establish a comprehensive monitoring system in the area west of mining.
- (ii) Establish the maximum feasible depressurisation system for the Footwall Fault, with particular reference to the eastern edge of the MTI which is underlain by the Footwall Fault.
- (iii) Commence mining at the south end of the reserve block and progress to the north - this will require a modification of the mining method and sequence, to terrace or haulback mining.
- (iv) Use the results from the monitoring system to control the advance rate of mining and to determine the actual northern limit of mining (refer Section 11.1 of Ref. 1).

In relation to monitoring, it should be noted that the trigger levels on movement rate, proposed by PSM (Ref. 1) will have minimal, if any, influence the total movement at the conclusion of mining. We fully support the concept of trigger levels, to control the rate of movement, because:

- it will provide time to take evasive/remedial action, for example repairing broken pipes, etc, and mining can cease until the appropriate action is taken
- it will reduce the risk of catastrophic failure occurring, because movement rates will increase markedly before such failure occurs.

However, the final movement will be determined by the final pit geometry after mining, particularly the thickness and slenderness of the final pillar between the pit floor and the Footwall Fault (Fig. 14)

In the light of the fact that the processing plant has already survived 4m of horizontal movement and 1m of subsidence, consideration should also be given to "movement proofing" the processing plant. In concept, this would involve:

- isolating the various major items of plant on their own raft foundations
- connecting the major items of plant by "flexible" connections.

This may allow mining to proceed some distance further north and so recover additional gold reserves. It is recommended that this concept be reviewed by a structural engineer with experience in subsidence.

## 7. CLOSURE

We trust that this report is adequate for your immediate requirements. Please contact us should you require any further information or clarification.

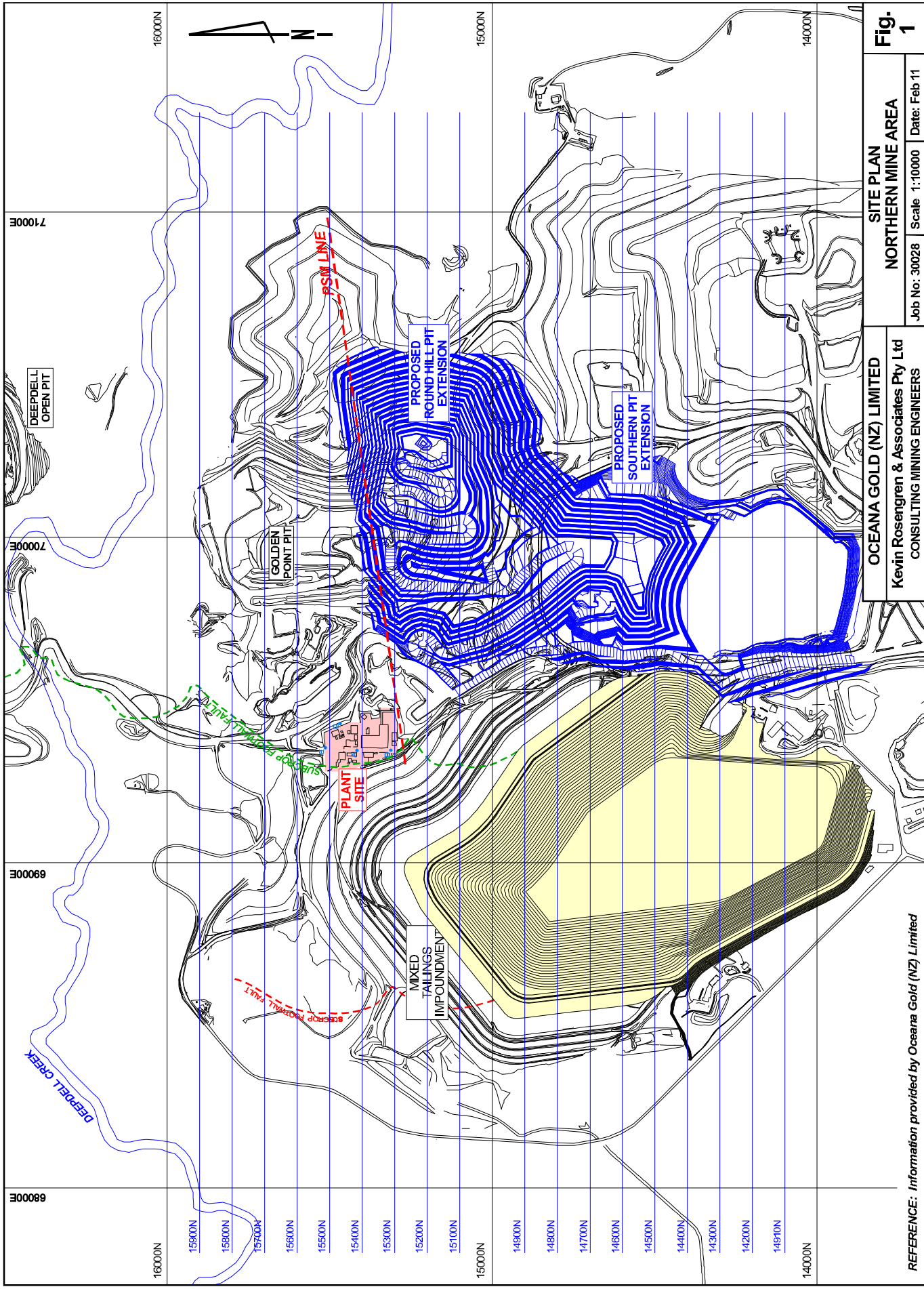
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per: K J Rosengren

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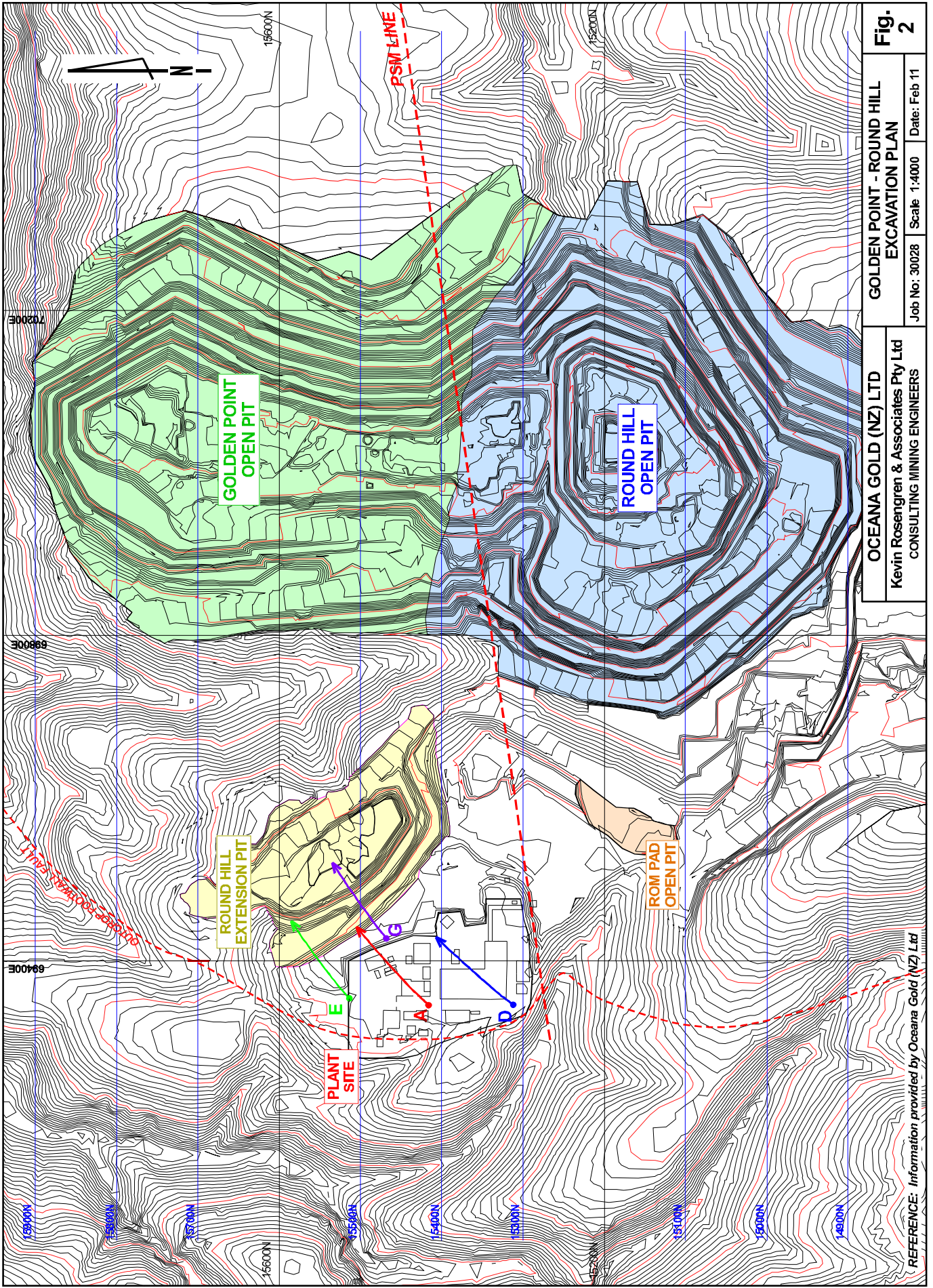


**Fig. 1**

<b>SITE PLAN</b>	
<b>NORTHERN MINE AREA</b>	
Job No: 30028	Scale 1:10000
Date: Feb 11	

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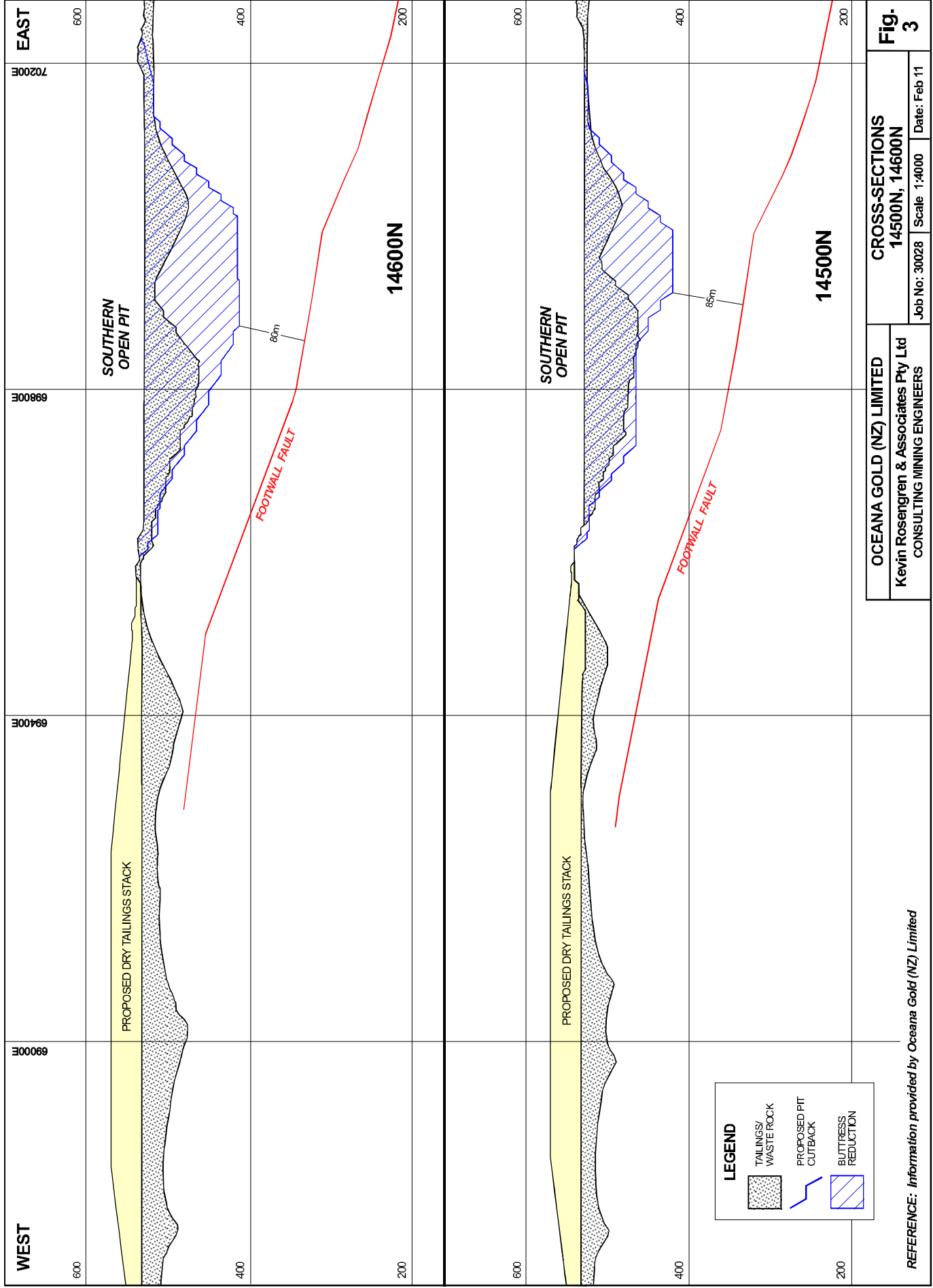


**Fig. 2**

**GOLDEN POINT - ROUND HILL  
EXCAVATION PLAN**  
Job No: 30028 Scale 1:4000 Date: Feb 11

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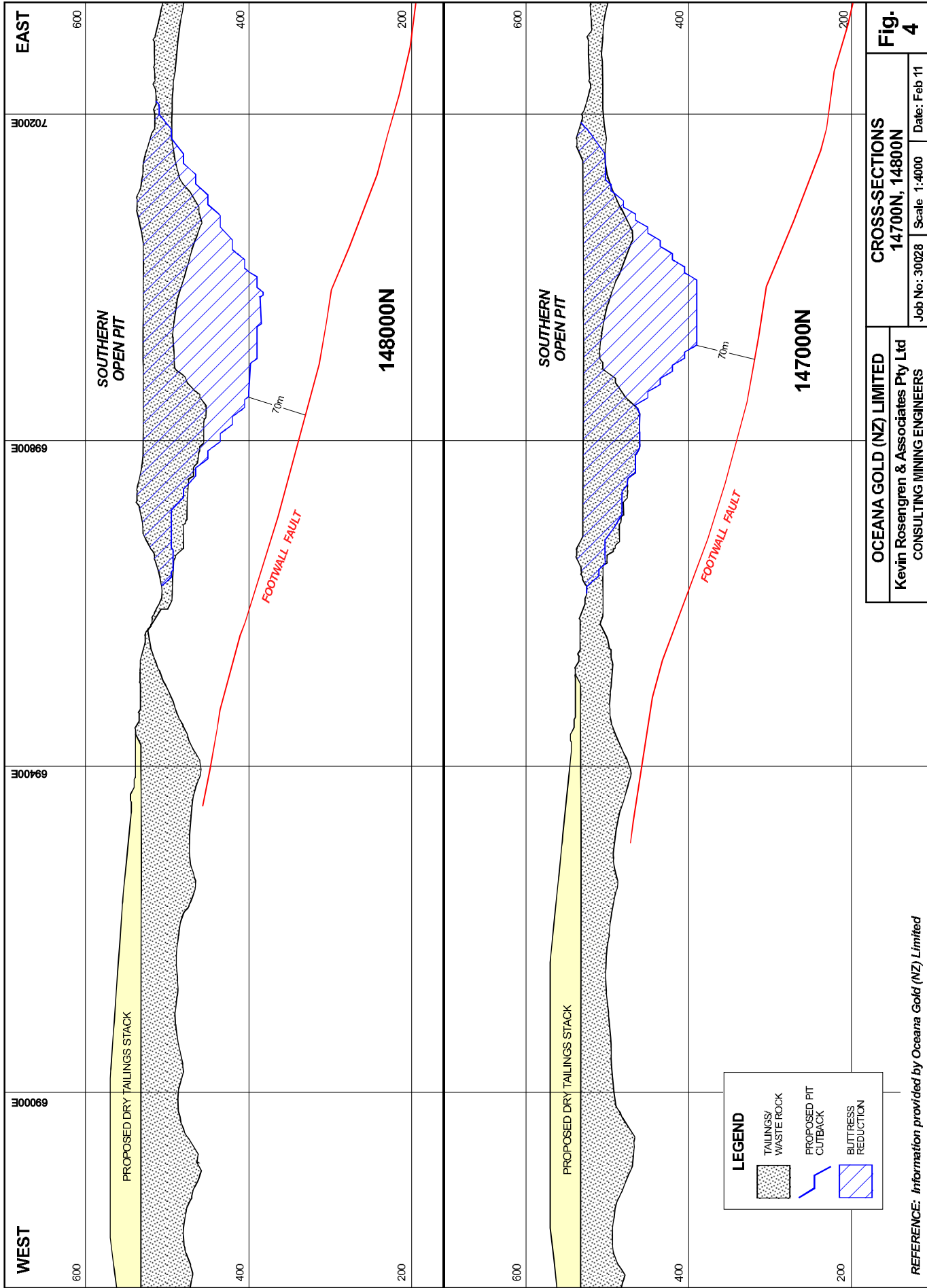
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**Fig. 3**  
**CROSS-SECTIONS**  
**14500N, 14600N**  
 Job No: 30028 Scale 1:4000 Date: Feb 11  
**OCEANA GOLD (NZ) LIMITED**  
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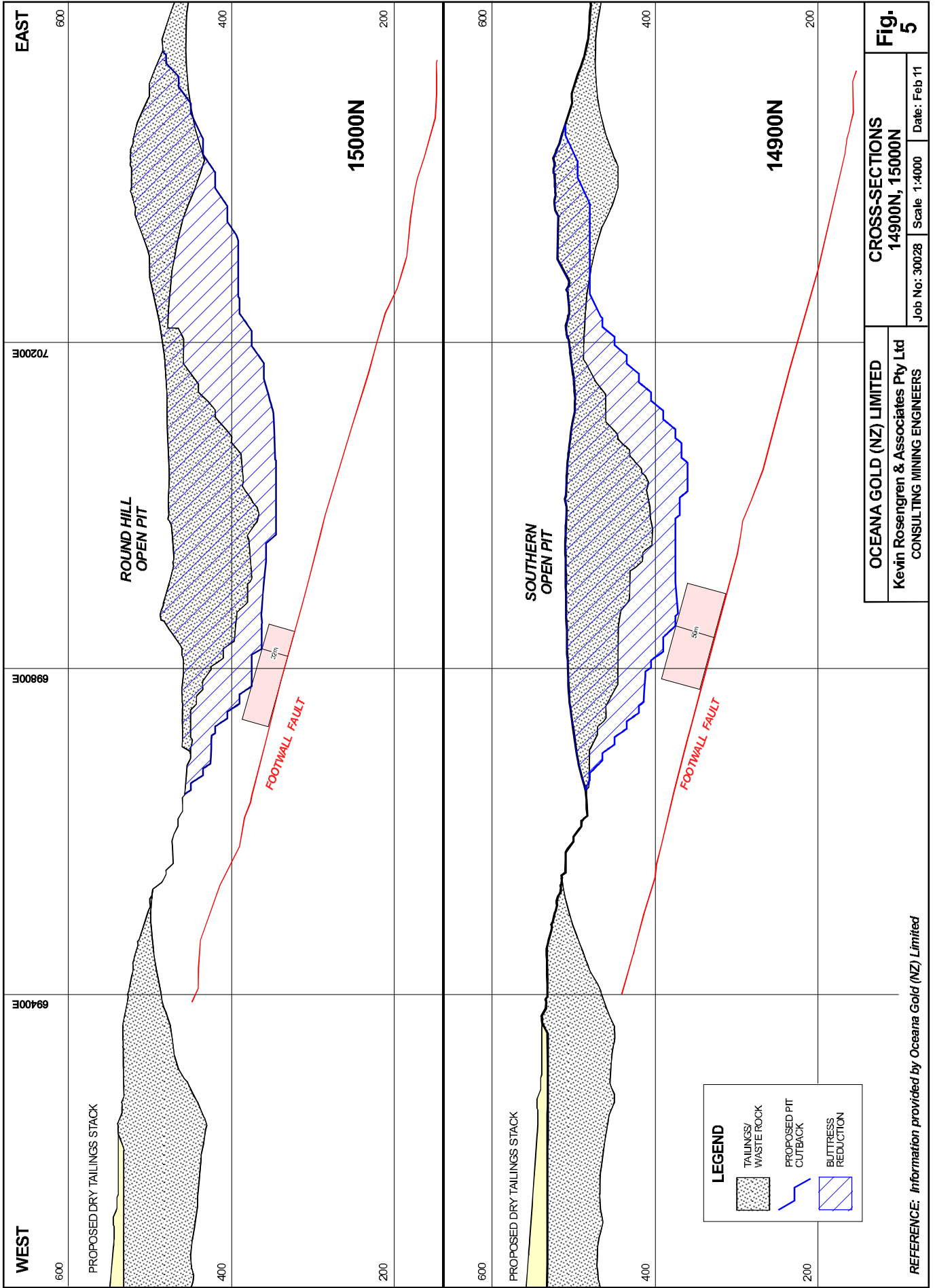


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CROSS-SECTIONS  
 147000N, 148000N  
 Job No: 30028 Scale 1:4000 Date: Feb 11

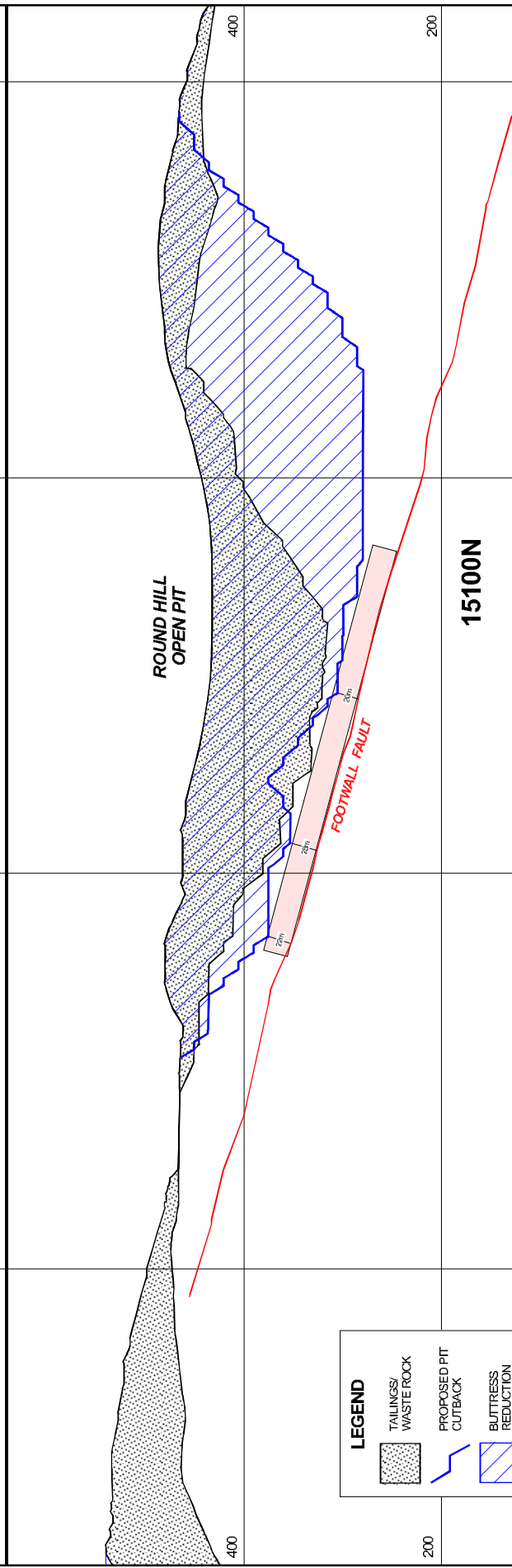
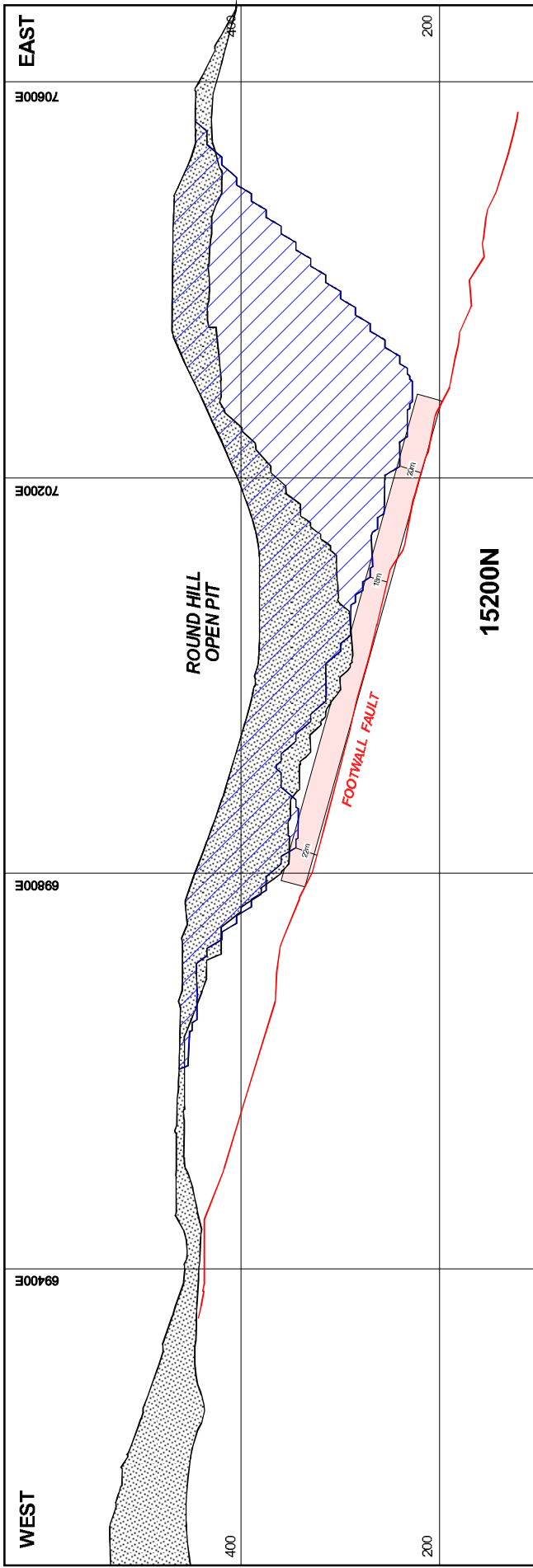
Fig-  
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
**Fig. 5**  
**CROSS-SECTIONS**  
**14900N, 15000N**  
 Job No: 30028 Scale 1:4000 Date: Feb 11

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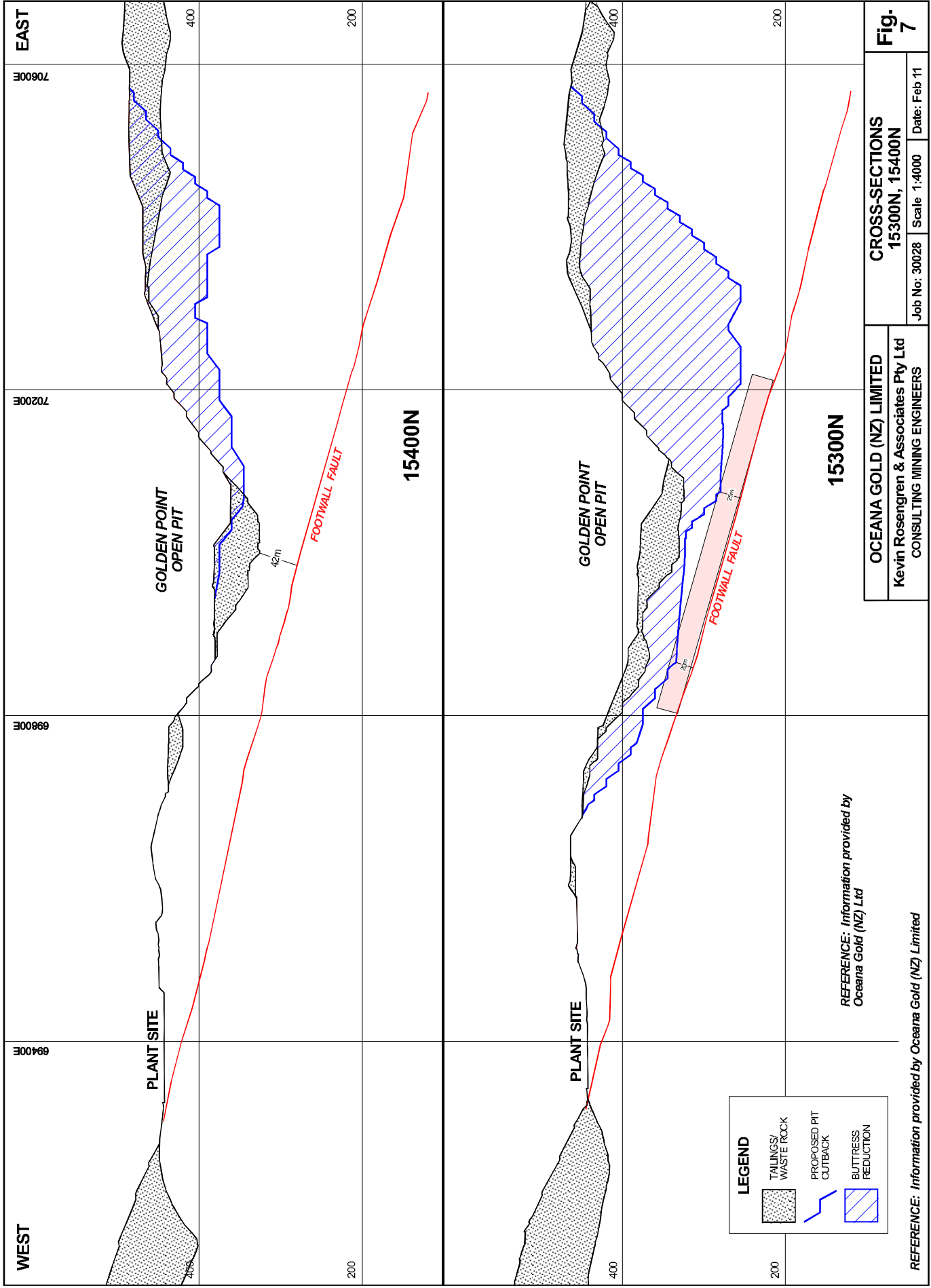


**LEGEND**

-  TAILINGS/WASTE ROCK
-  PROPOSED PIT CUTBACK
-  BUTTRESS REDUCTION

<b>OCEANA GOLD (NZ) LIMITED</b> Kevin Rosengren & Associates Pty Ltd CONSULTING MINING ENGINEERS	<b>CROSS-SECTIONS</b> 15100N, 15200N		<b>Fig-6</b>
	Job No: 30028	Scale 1:4000	

REFERENCE: Information provided by Oceana Gold (NZ) Limited

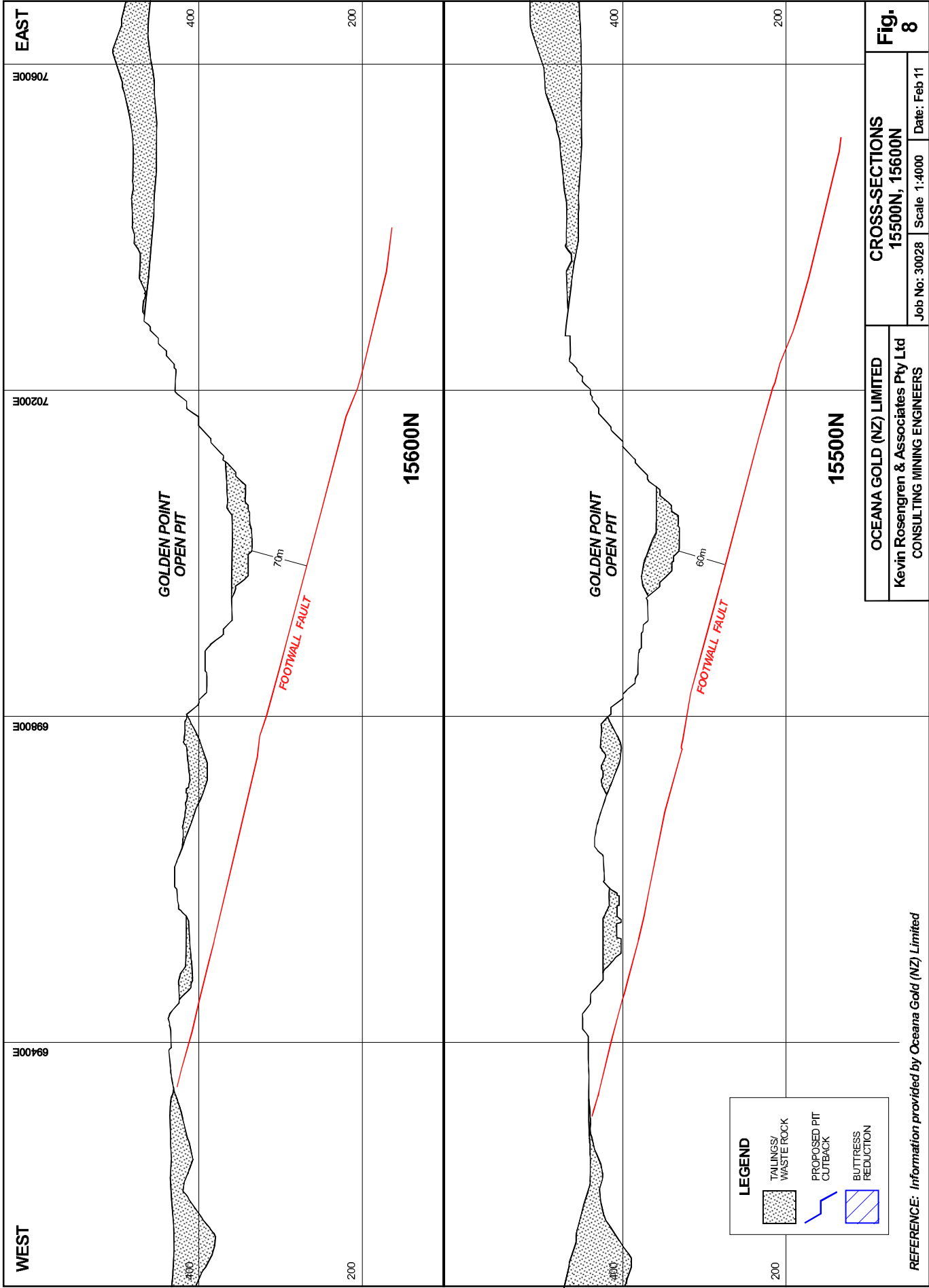


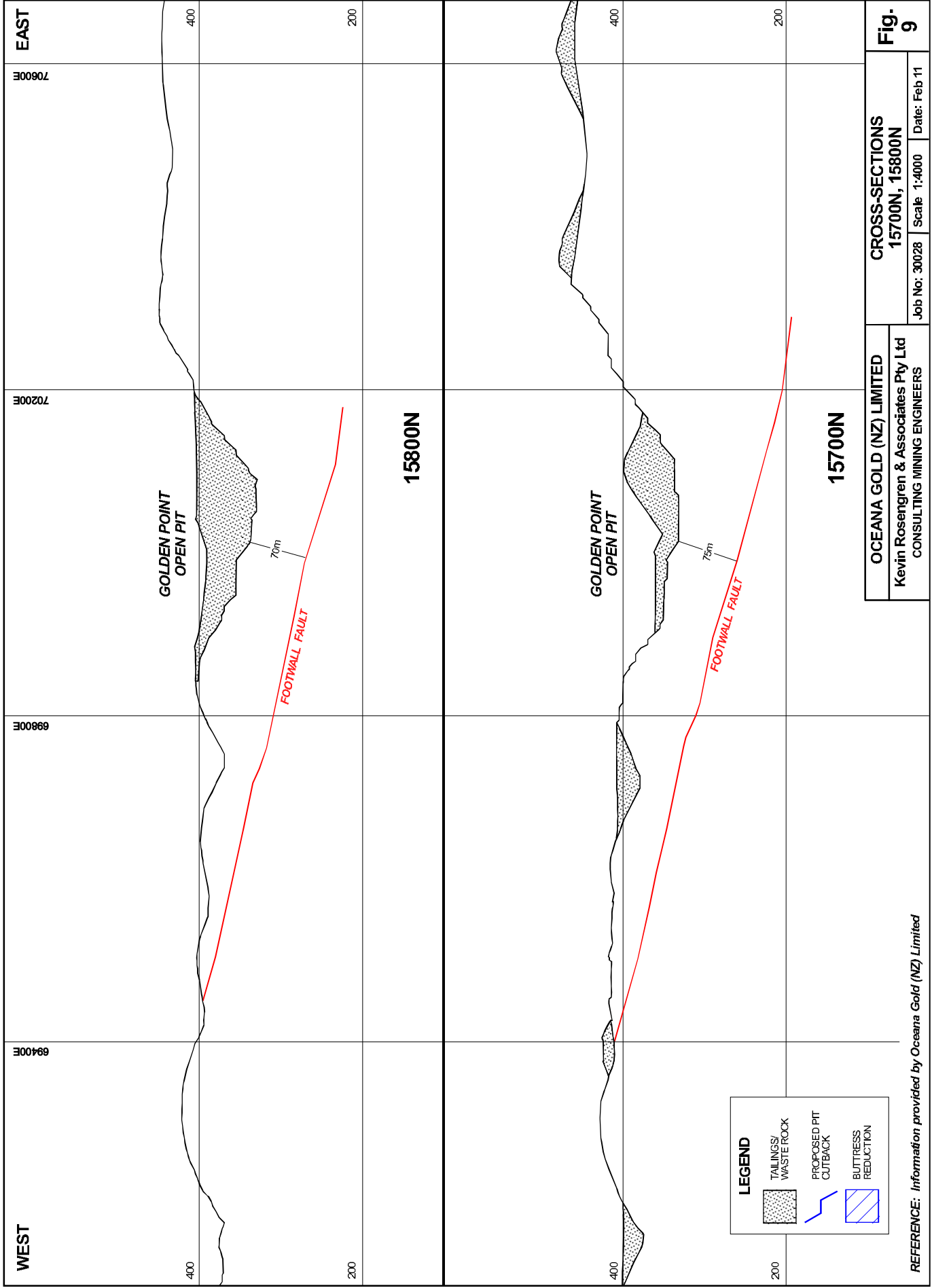
**Fig. 7**

**CROSS-SECTIONS 15300N, 15400N**

Job No: 30028 Scale 1:4000 Date: Feb 11

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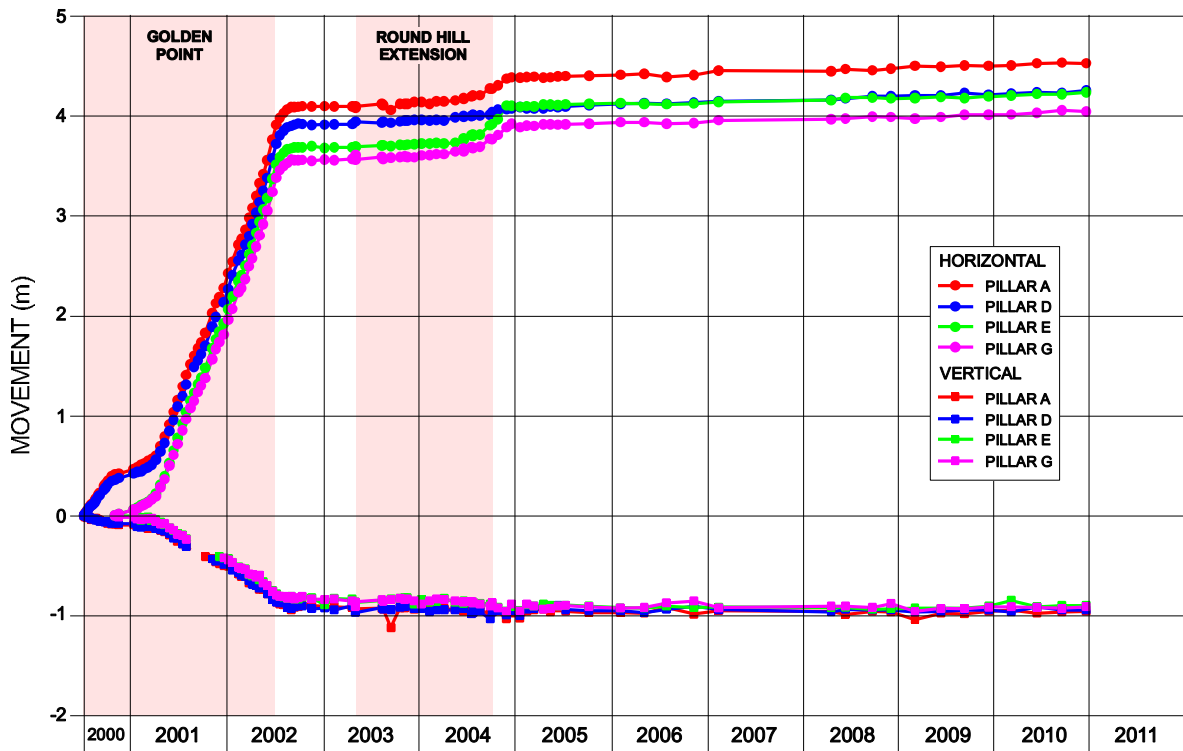
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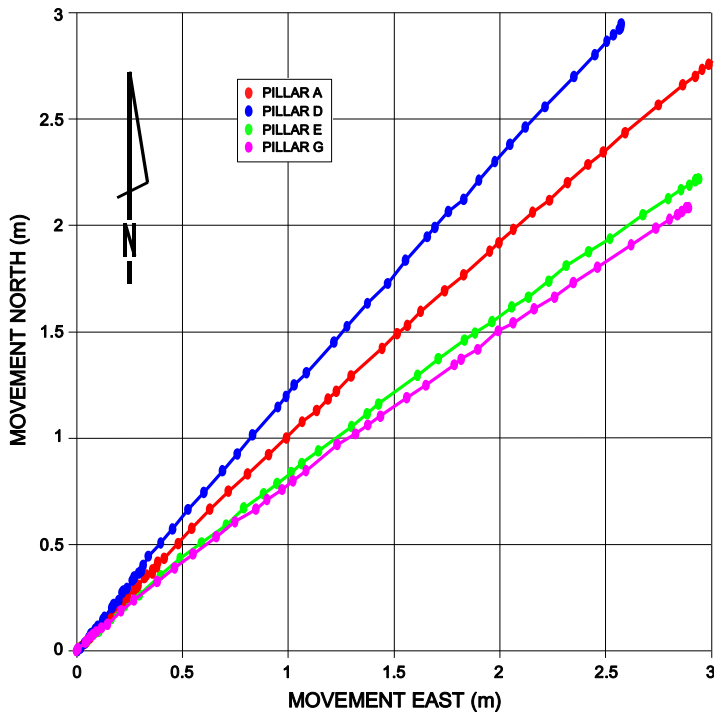
**CROSS-SECTIONS**  
 15700N, 15800N

Job No: 30028 Scale 1:4000 Date: Feb 11

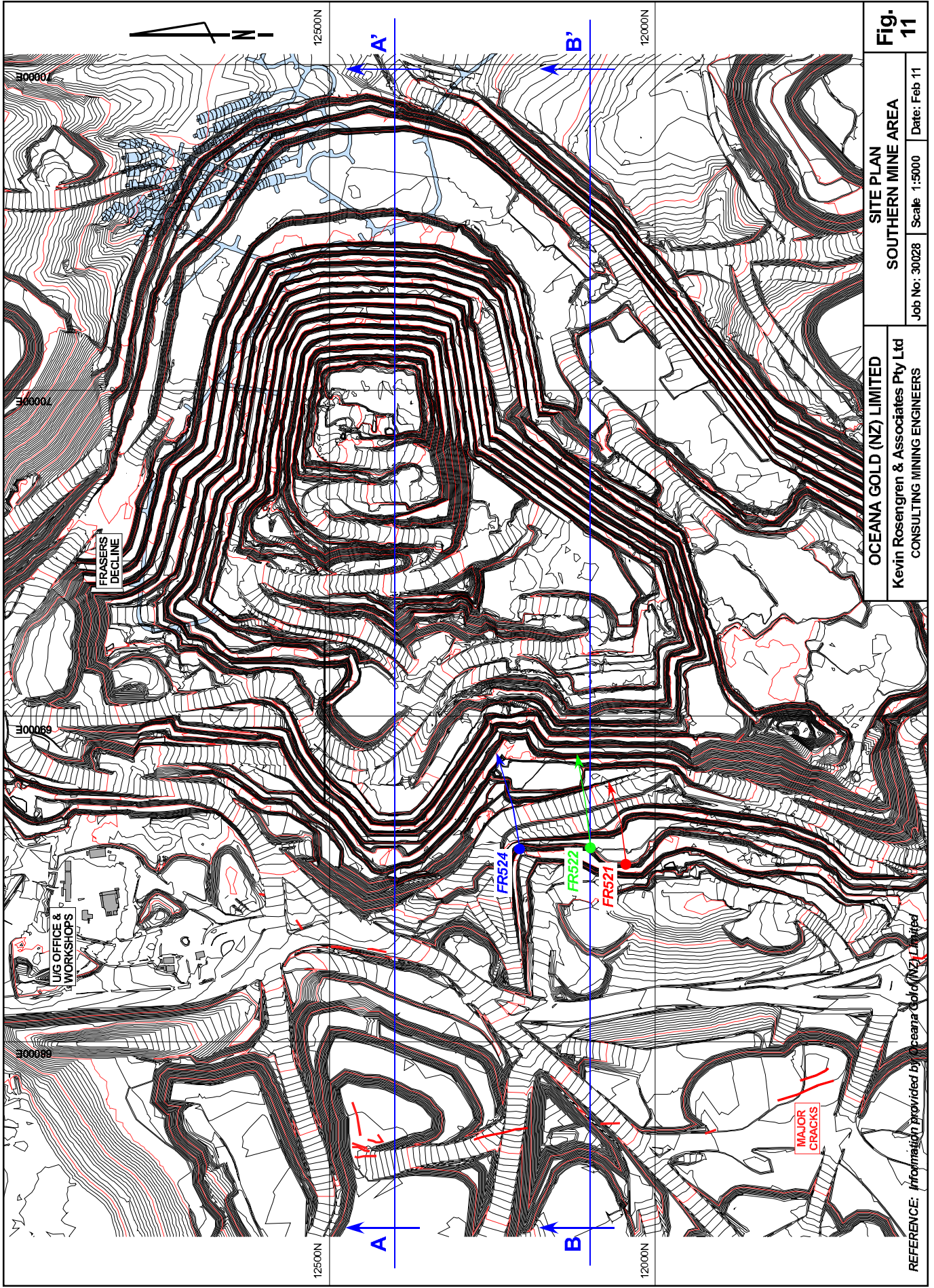
**Fig-9**



**(a) MOVEMENT MAGNITUDE  
(JULY, 2000 - SEPTEMBER, 2002)**



**(b) MOVEMENT DIRECTION  
(JULY, 2000 - SEPTEMBER, 2002)**



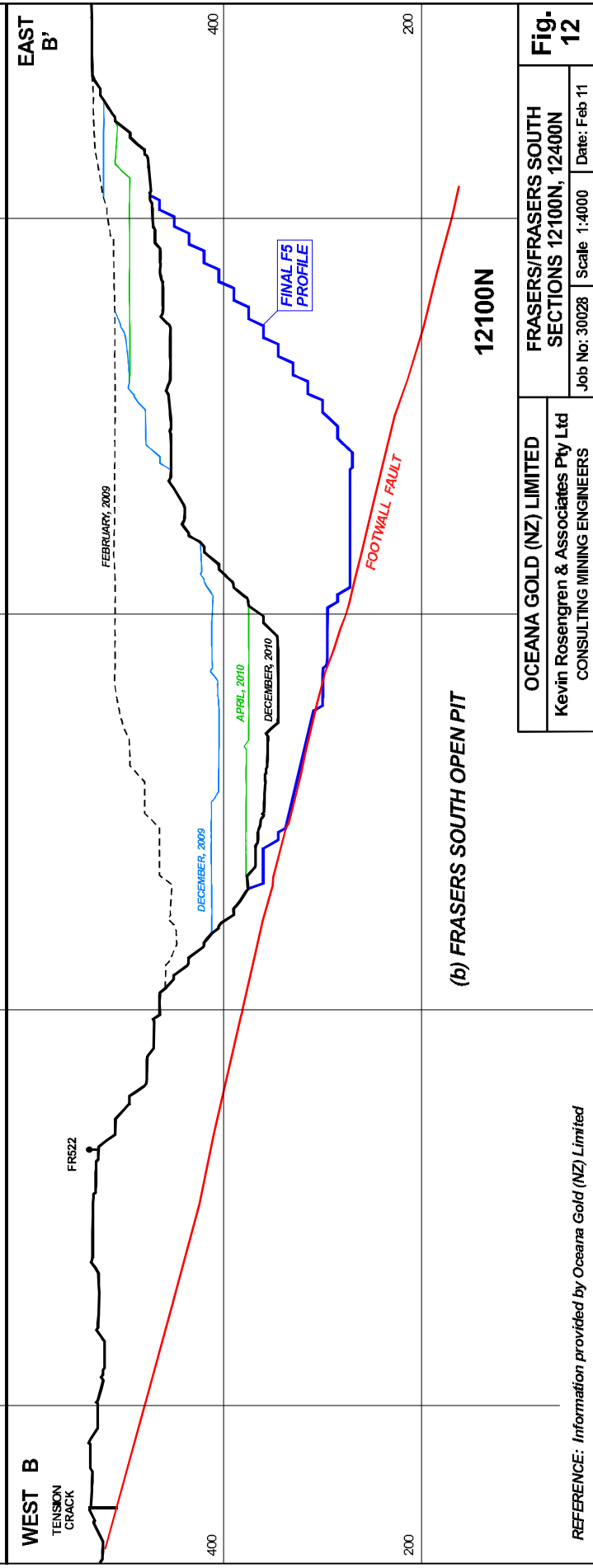
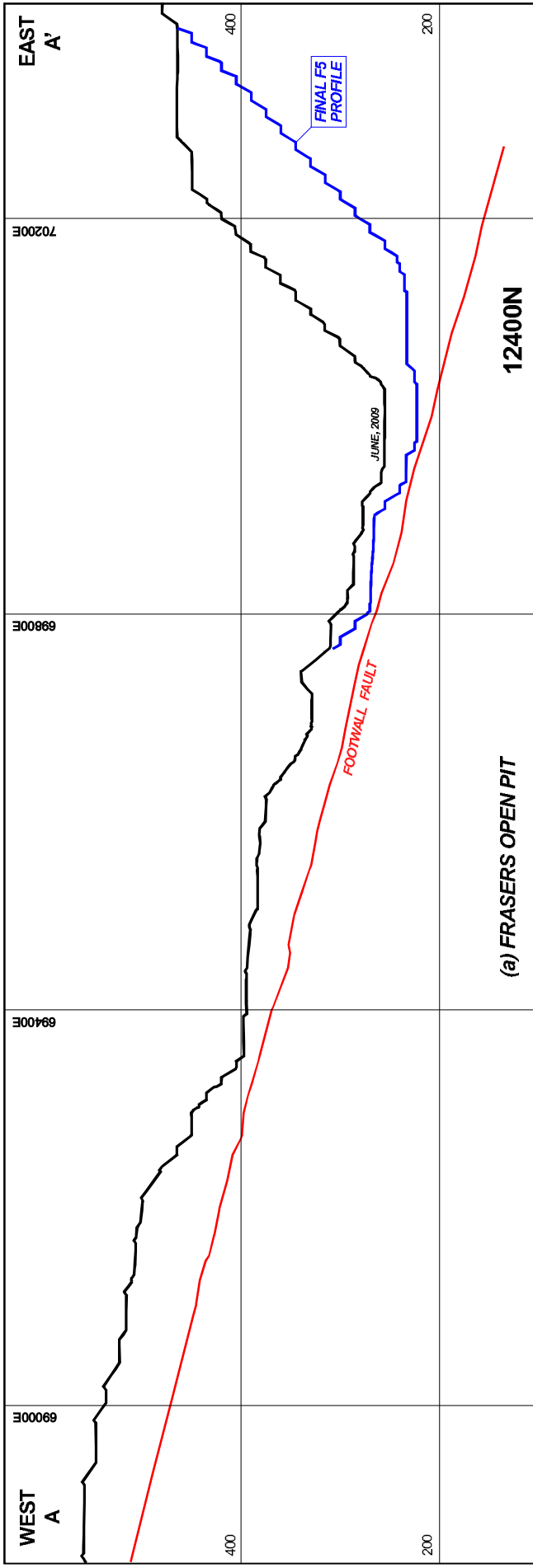
**Fig. 11**  
**SITE PLAN**  
**SOUTHERN MINE AREA**

**OCEANA GOLD (NZ) LIMITED**  
 Kevin Rosengren & Associates Pty Ltd  
 CONSULTING MINING ENGINEERS

Job No: 30028 Scale 1:5000 Date: Feb 11

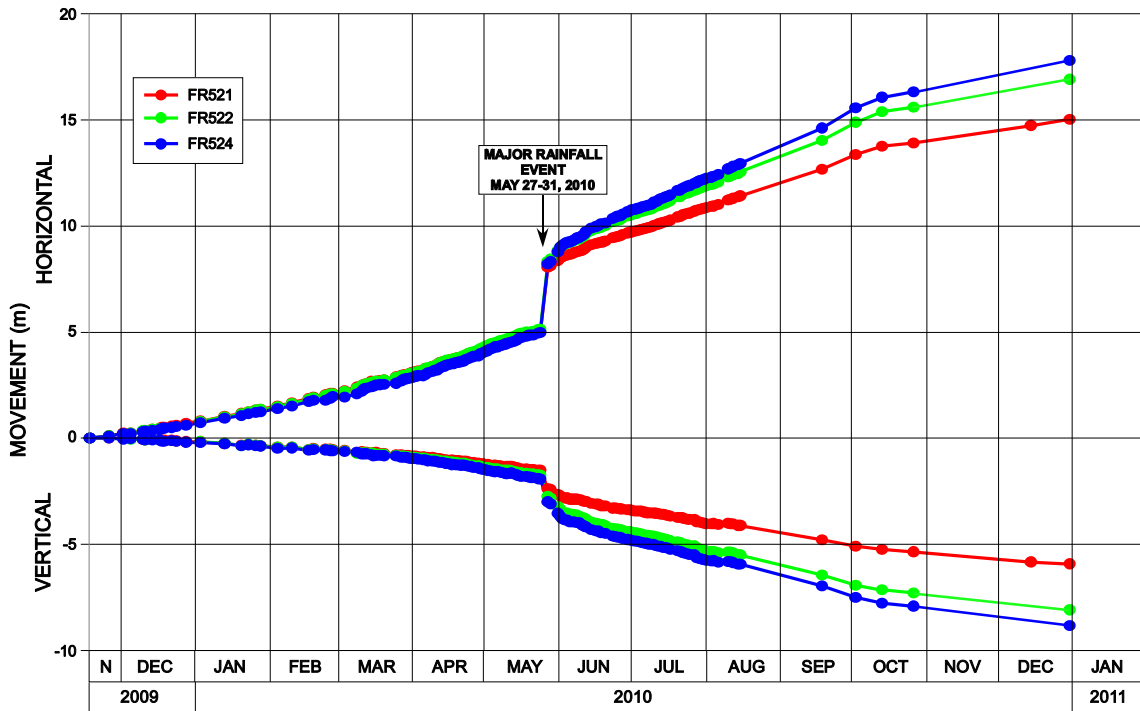
REFERENCE: Information provided by Oceana Gold (NZ) Limited



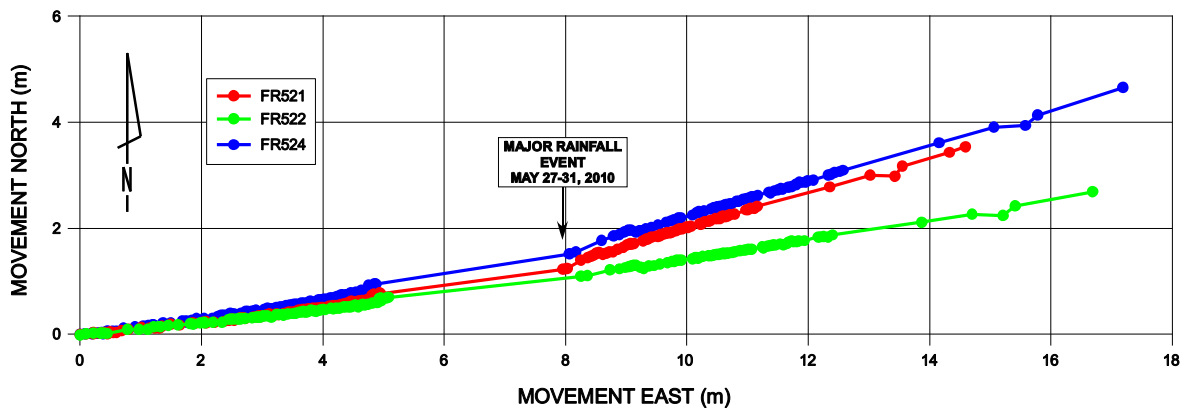


REFERENCE: Information provided by Oceana Gold (NZ) Limited

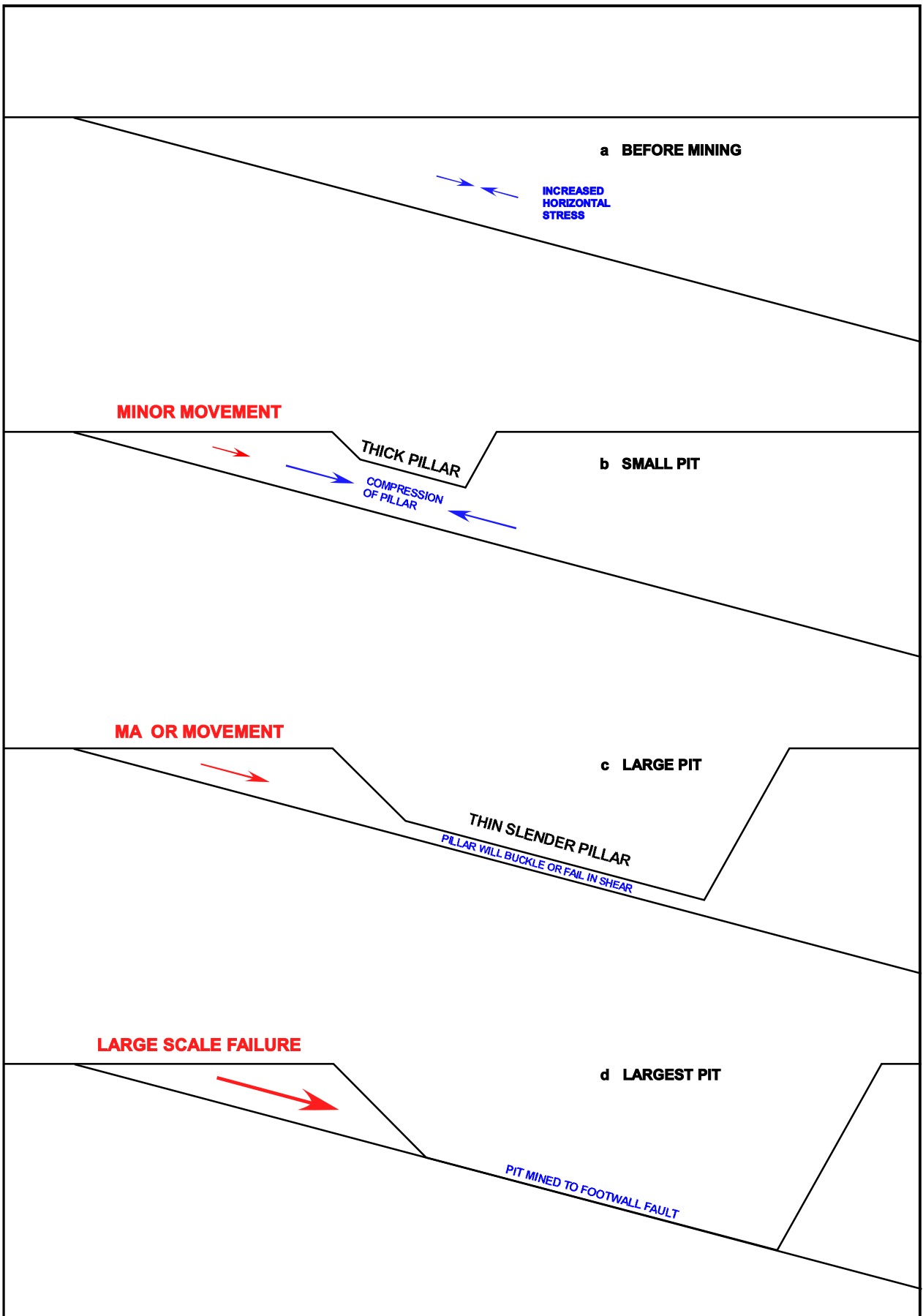
<b>OCEANA GOLD (NZ) LIMITED</b> Kevin Rosengren & Associates Pty Ltd CONSULTING MINING ENGINEERS	<b>FRASERS/FRASERS SOUTH</b> <b>SECTIONS 12100N, 12400N</b>	<b>Fig-12</b> Job No: 30028    Scale 1:4000    Date: Feb 11
	<b>FRASERS SOUTH OPEN PIT</b>	



(a) MOVEMENT MAGNITUDE  
(FROM NOVEMBER 17, 2009)



(b) MOVEMENT DIRECTION  
(NOVEMBER, 2009 - DECEMBER, 2010)



<b>OCEANA GOLD NZ LIMITED</b>	<b>MOVEMENT MECHANISM</b>		<b>Fig. 14</b>
Kevin Rosengren & Associates Pty Ltd CONSULTING MINING ENGINEERS	ob No 30028	Scale 1 2500	

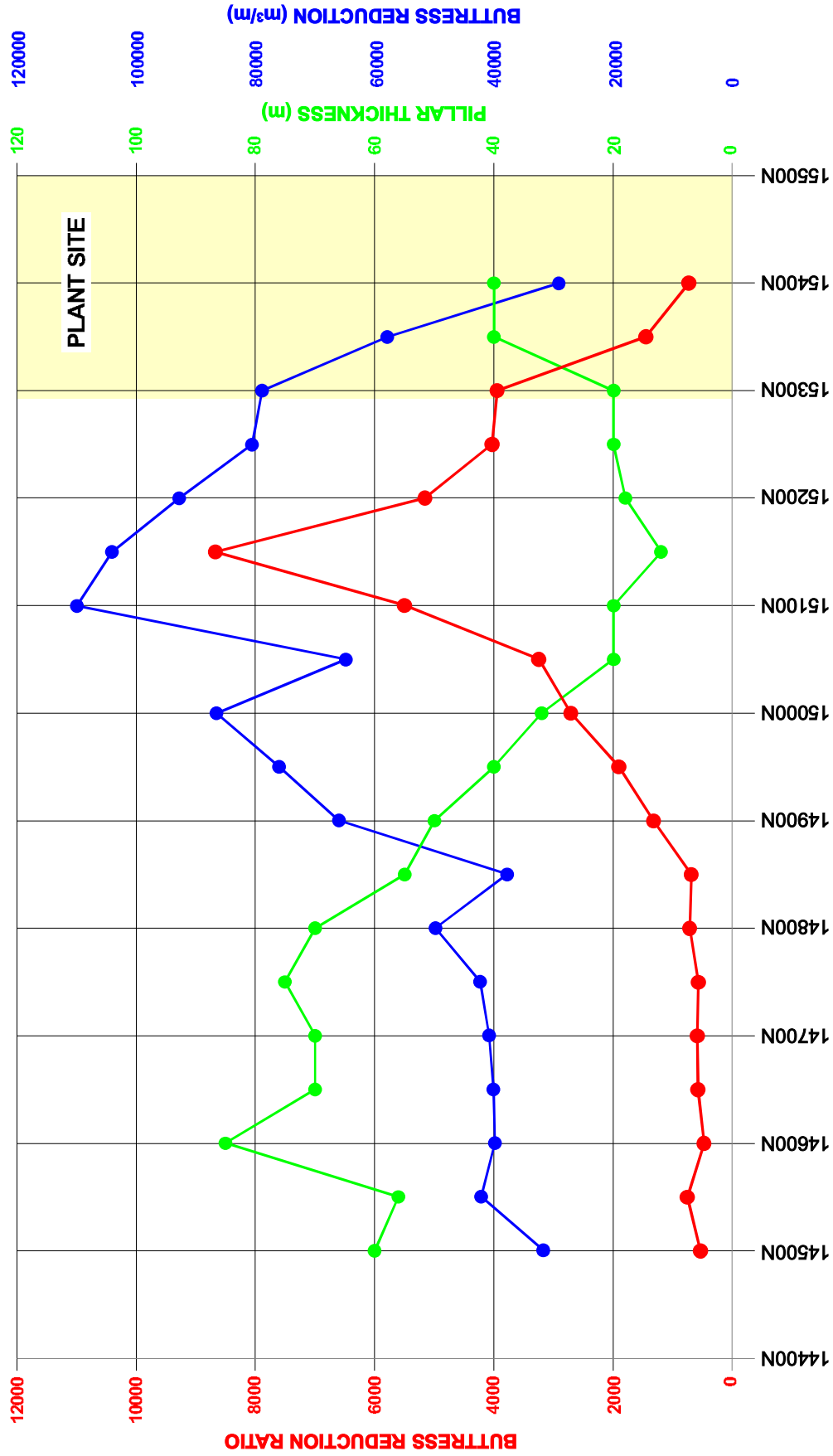


Fig. 15  
 BUTTRESS/PILLAR STATISTICS