



Our reference: J13-131 - CL1

04 February 2014

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Attention: James Thomas

SPITZ LAND: UNDERMINING DESK STUDY

As requested we have conducted a desk study of available information to assess the risk of subsidence that may occur on the above property due to mining operations that have occurred on and below the site. The following report details the work done, presents the results and gives our analysis, conclusions and recommendations.

1. INTRODUCTION

The objectives of the investigation were to establish the risk of subsidence developing related to undermining in the area. The undermining is associated with DRD Gold, who are the present mineral rights holders.

The site is located on the Remainder of Portion 14 of Roodepoort 2371Q and is bounded by low cost housing and Randfontein Road in the north and open land in the south, west and east. Most of the property is vacant.

2. INVESTIGATION PROCEDURE

A meeting with, the Environmental Manager, Mr Neville Lane, from DRD Gold was conducted and portions of mining plans at a scale of 1:1000 were obtained from him. These copies of old hand drawn survey plans and a detailed discussion of the area with Mr Lane form the basis of the Undermining Plan attached to this report. Contours of the depth to the reef below surface are plotted onto the Undermining Plan (J13-131/1) attached.

3. SITE GEOLOGY

The general area is underlain by sedimentary rocks of the Witwatersrand Supergroup and it is in these strata that gold is found. There are a few north-west striking faults that run through the area.

4. GEOTECHNICAL ASSESSMENT

Following the guidelines proposed by Stacey and Bakker (Ref.1), the following factors should be considered when determining the potential for developing over undermined ground:

- Dip of Reefs
- Stoping width
- Extent of mining
- Number of reefs mined
- Separation of reef
- Competence of rocks
- Support
- Time elapsed since mining

Based on the outcome of the analysis criteria can be provided for the design of structures which would enable the area to be safely and economically developed.

Stacey and Bakker recommend dividing undermined ground into the following zones:

- Outcrop Zone. This zone extends from 3 m on the footwall side of the stope to points where the depth of mining, measured vertically, is 25 m.
- Shallow Zone. This zone extends from the outcrop zone where the mining depth, measured vertically is 25 m, to points where the depth, measured vertically is 200 m.
- Deep zone. This zone includes all areas where the mining depth, measured vertically, is greater than 200 m.
- Special zones. All ground within 5 m of the perimeters of shafts and winzes, including the openings themselves and within 5 m of significant dyke or fault contacts, and the dykes themselves, might be included in special zones.

Following the methodology proposed by Stacey and Bakker the factors mentioned above are analysed as follows:

- Dip of Reefs - The dip of the reef in this area is approximately 37°. This is fairly steep and any material that has collapsed from the hanging wall will tend to ravel down the stopes, especially if water flows into the workings. This means that where the stopes are fairly shallow and the hanging wall is incompetent there is a fair chance of sinkholes developing.
- Stoping width – The Main Reef and the South Reef were mined separately and the stopes are a maximum of 2,0 m high.

- Extent of mining – Most of site has been undermined as shown on the Undermining Plan (J13-131/1) attached. Limited areas, where igneous intrusives had disrupted the strata were left unmined.
- Number of reefs mined – The Main Reef and South Reef were mined under this site. The Bird Reef was mined to a limited extent both underground and open cast in the region of the Mona Liza Adit, shown on the Undermining Plan (J13-131/1).
- Separation of reef – The Main Reef and South Reef are between 50 m and 100 m apart.
- Competence of rocks – This factor would require drilling to give an indication of weathering and strength. Typically unweathered hard rock is found at depths of approximately 30 m below surface.
- Support – No or limited support would have been provided except in the shafts. Wooden support was used in the old mines and this has generally disintegrated and no longer functions.
- Time elapsed since mining – Mining ceased in this in 2001.

5. CONCLUSION AND RECOMMENDATIONS

Based on the above analysis, it is concluded that the bulk of the site falls into the Deep Zone defined by Stacey and Bakker, as shown on the Undermining Plan (J13-131/1) attached. According to Mr Lane of DRD Gold the area south of Randfontein Road has been undermined at depths greater than 240 m. Based on available information it appears that no Shallow Zone is present on this site.

Although there is, strictly speaking, no Outcrop Zone as defined by Stacey and Bakker, the rocks overlying the shallow mined areas are not considered to be competent and there is thus considered to be a fair chance that sinkholes could develop in these areas. This zone includes:

- All areas where mining has taken place at depths of less than 30 m, essentially the area around the Mona Liza Adit,
- All shafts that have been identified on the plan and the areas surrounding them for a distance of 5 m, this includes Shaft 4, 4A and Old Princess Shaft.

5.1 Outcrop Zone

This zone encompasses those areas in which there is some potential for sinkholes to develop and includes the shafts on this site as well as the area around the Mona Liza Adit. No development should take place in this zone and it should be reserved for open parkland. Any sinkholes which do develop in these areas should be immediately cordoned off and the advice of a competent person sought on the measures to be taken with respect to remediation.

Further work in these areas is required to more precisely define boundaries, particularly in the area around the Mona Liza Adit, if development close to these areas is envisaged.

5.2 Deep Zone

This zone includes any areas where the undermining is deeper than 200 m depth or where no undermining has taken place. There are no restrictions on development in this zone.

In general the following measures should be adhered to on this site:

- No wet services should cross over mine workings and may not encroach within ten metres of the edge of the workings. Should this be a necessity then a competent person should be consulted to ensure that adequate measures are implemented to ensure strength and flexibility which will minimise the potential for the wet services to leak.
- All stormwater should be captured and led around and away from areas that are undermined close to surface, namely the Outcrop Zone areas. It is imperative that stormwater be prevented from entering mine workings.
- Stormwater should preferably be canalised on surface adjacent to roads rather than allowed to flow within buried pipes when crossing the Outcrop Zone.

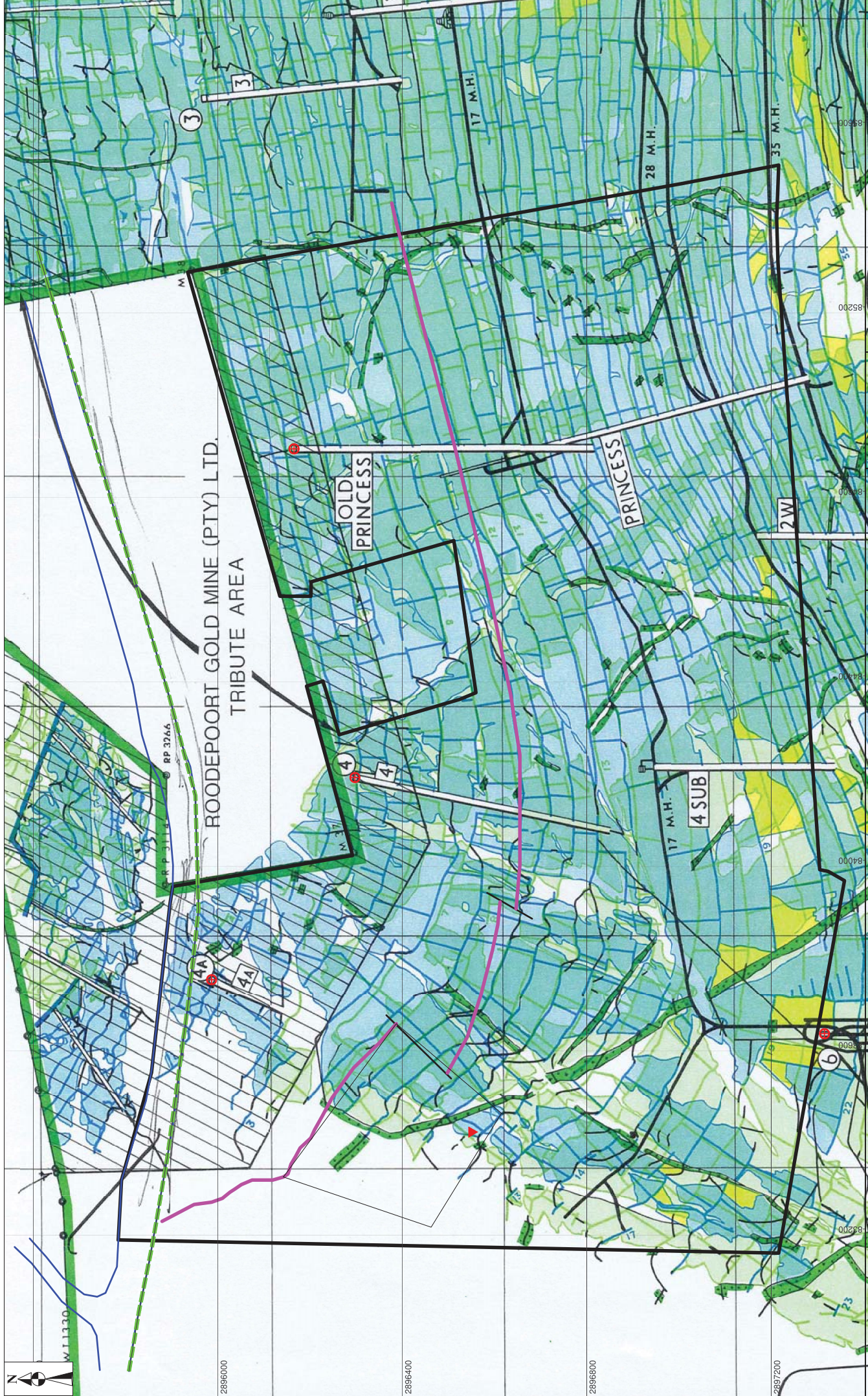
We trust that the above meets your requirements. Should you have any queries, please do not hesitate to contact the undersigned.

Yours faithfully



L R Richer Pr Sci Nat

Bear GeoConsultants (Pty) Ltd



- LEGEND**
- Faults
 - Randfontein Road
 - 240 m Depth of Undermining
 - Bird Reef Outcrop
 - Outcrop zone
 - ⊕ Shafts
 - ▼ Mona Liza Adit
 - Possible Opencast Mining Area

Scale 1:7500

0 30 120 180 240 300 m

Map Datum: WGS84 Lo27

CLIENT

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PROJECT

SPITZ LAND
UNDERMINING STUDY

UNDERMINING PLAN

DWG No.

J13-131/1