Review of Jagersfontein Pit Stability and Backfilling Options

Report Prepared for

Jagersfontein Developments

Report Number 445072/2

Report Prepared by

srk consulting

May 2012

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Executive Summary

Jagersfontein Developments requested SRK Consulting to investigate the Jagersfontein Open Pit stability and the likely break back rates as well as the implications for the backfilling of the open pit using tailings and slimes from the nearby mining operations.

Jagersfontein Developments are the owners of the Jagersfontein Open Pit and the nearby diamond processing facility extracting diamonds from the various dumps around Jagersfontein and are also responsible for the Jagersfontein Open Pit stability and its possible and potential impact on the communities of Jagersfontein, some of which live within 80m to 100m from the current pit rim location.

Since the open pit mining operations ceased in the 1970's, there has been ongoing reports from the community of continuing break back of the very steep side slopes of the open pit. The current mine manager Mr J Pretorius on 30 March 2012 reported during the site visit that in the previous year 2011 during the periods of heavy rain there were many reports from the community of Jagersfontein of noise from the open pit when break back of the pit side walls takes place.

As Jagersfontein open pit is the oldest diamond mine open pit in South Africa, from a heritage point of view if the state of this open pit is to be changed, submissions have to be made to the Heritage Committee for approvals before any engineering related activities can be implemented.

Jagersfontein Developments as the owners of the Jagersfontein Open Pit have to quantify their risk profile with regard to the Jagersfontein Open Pit. In order to achieve this requirement, an investigation is required to assess the open pit stability and possible make safe solutions.

It is our opinion that when the risks of the three very significant factors (ongoing pit rim break back, ongoing vibrations related to blocks falling in the open pit and preventing public / people access to the open pit) are quantified and considered by the owner of the Jagersfontein open pit, unless there is a very substantial income from another source (such as a National or World Heritage Organization, or National Government or from the public wishing to visit and see this site), the intuitive decision has to be to backfill the open pit so that all three the above risks can be mitigated, as soon as possible. During the time of the back filling of the open pit, the risks will reduce with time until the pit is fully filled and the liabilities of these three risks are reduced to acceptable levels. It is essential that the open pit is filled as far as possible so that the requirements of limiting access to the public can be met.

The following conclusions can be derived from this study.

- The site visit indicated that the 250m deep pit is showing signs of ongoing break back of the side slopes.
- Review of the Jagersfontein open pit site conditions indicates that there will be ongoing break back of the side slopes of the open pit for a considerable period of time. A number of properties and structures are located within the zone of influence of break back.
- It is impractical and extremely costly to stabilize the pit side slopes. Therefore there are two resulting scenarios.
    1. Peg the proposed break back area on the ground, allowing for the break back zone of influence and then construct a suitable fence around this zone of break back of the open pit. This fenced facility will then have to be maintained in this condition in perpetuity, limiting access to people to this area. The property and other liabilities will have to be resolved between the owners of the open pit and the community, also noting that the

community was aware of the open pit, when the residential developments took place in this area, as the open pit presence precedes the community.

2. Backfill the open pit with the slimes and tailings derived from the current mining endeavours and then close this facility to suit the various Heritage Committee requirements.

The following recommendations are made:

- Suitable information has been provided in this report for Jagersfontein Developments to quantify their risk profile.
- The implications and liabilities of the various time frames for the different options have to be considered by Jagersfontein Developments, the Jagersfontein Community, the Heritage committee and other stakeholders.

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Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by Jagersfontein Developments. The opinions in this Report are provided in response to a specific request from Jagersfontein Developments to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

List of Abbreviations

Abbreviation	Description
RoR	Rate of rise
FoS	Factor of safety
hr	hour

1 Introduction and Scope of Report

Jagersfontein Developments requested SRK Consulting to investigate the Jagersfontein Open Pit stability and the likely break back rates as well as the implications for the backfilling of the open pit using tailings and slimes from the nearby mining operations.

2 Background and Brief

2.1 Background of the project

Jagersfontein Developments are the owners of the Jagersfontein Open Pit and the nearby diamond processing facility extracting diamonds from the various dumps around Jagersfontein and are also responsible for the Jagersfontein Open Pit stability and its possible and potential impact on the communities of Jagersfontein, some of which live within 80m to 100m from the current pit rim location.

Since the open pit mining operations ceased in the 1970’s, there has been ongoing reports from the community of continuing break back of the very steep side slopes of the open pit. The current mine manager Mr J Pretorius on 30 March 2012 reported during the site visit that in the previous year 2011 during the periods of heavy rain there were many reports from the community of Jagersfontein of noise from the open pit when break back of the pit side walls takes place.

As Jagersfontein open pit is the oldest diamond mine open pit in South Africa, from a heritage point of view, if the state of this open pit is to be changed, submissions have to be made to the Heritage Committee for approvals before any engineering related activities can be implemented.

2.2 Nature of the brief

Jagersfontein Developments as the owners of the Jagersfontein Open Pit have to quantify their risk profile with regard to the Jagersfontein Open Pit. In order to achieve this requirement, an investigation is required to assess the open pit stability and possible make safe solutions.

The scope of work has to address the following objectives so that the submission to the Jagersfontein Heritage Committee can be made:

- Present at a high level the implications the scenario of not backfilling the pit: i.e. the implication of the “do nothing” scenario. This scenario should address the likely pit break-back scenarios with time using the experience gained at other open pit operations.
- Present at a high level the implications of the scenario of backfilling the pit with tailings and slimes from the retreatment process. This scenario needs to highlight the main issues which will occur during backfilling, as well as comment on the post pit filling issues related to long term consolidation settlements of the backfilled material as well as pit rim stability.

When the above information is available to Jagersfontein Developments, then they can plan what work is required to mitigate risk.

3 Proposed scope of work

The following scope of work was proposed to meet the above-mentioned objectives.

- This study should be a scoping level study to define the principles of the two basic scenarios and the critical success factors.

- A two day site visit by two senior staff members which will include:
  - a review of the development around the pit within the possible break-back zone of more than 200m.
  - a review of cracks and any other movements that have occurred around the pit: this will include review of available monitoring records
  - a review of the pit stability and the break-back that has occurred from the existing mine records;
  - a review of the pit geology and structural geology
  - a review of the proposed materials to be used to back fill the pit
  - a review of the proposed methods of the pit backfilling
  - A review of ground water conditions using available information of the mine.
  - A review of the geochemistry of the tailings and the slimes, using information provided by the mine.
- An assessment of the current pit slope stability using available information and site information and observations and evaluation of likely break-back scenarios including extent and timing. The focus of this activity will be the likely long term break-back scenarios. This will include some recommendations related to safety measures.
- An assessment of proposed pit backfill procedures in terms of impact on pit slope stability, stability of the placed slimes and stability of the placed tailings, preliminary assessment of long term consolidation behaviour and implications for closure. The minimum depth of backfilling of the pit will also be indicated. This will include some recommendations related to safety measures.
- A deliverable in the form of a report detailing the following:
  - Site visit observations.
  - Evaluation of the scenario of not back filling the pit.
  - Evaluation of the scenario of backfilling the pit with slimes and tailings.

The client should then use this project scoping report to make an assessment of which scenario is preferred so that in the next project phases, the focus can be on defining the details of this scenario.

4 Site visit

4.1 Background information on Jagersfontein pit

The location of the Jagersfontein open pit in relation to the town of Jagersfontein is shown in Figure 4-1. A basic cross-section though the open pit is shown in Figure 4-2 and a coloured cross section in Figure 4-3. A geohydrological interpretation is shown in Figure 4-4.

The open pit is about 250m deep and is then underlain by underground mine development as shown in Figure 4-2 and in Figure 4-3.

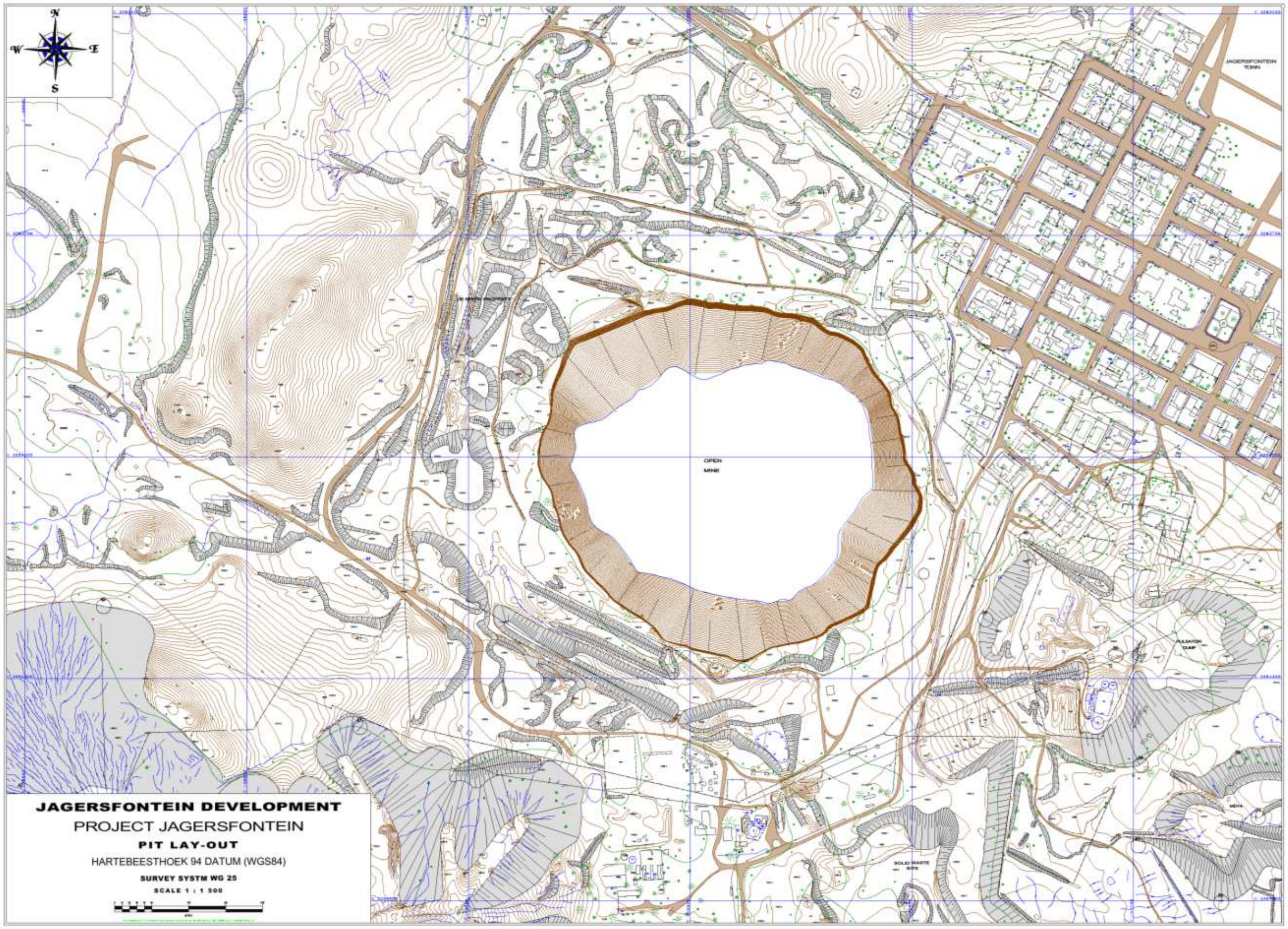

Figure 4-1 : Location of the Jagersfontein Open Pit

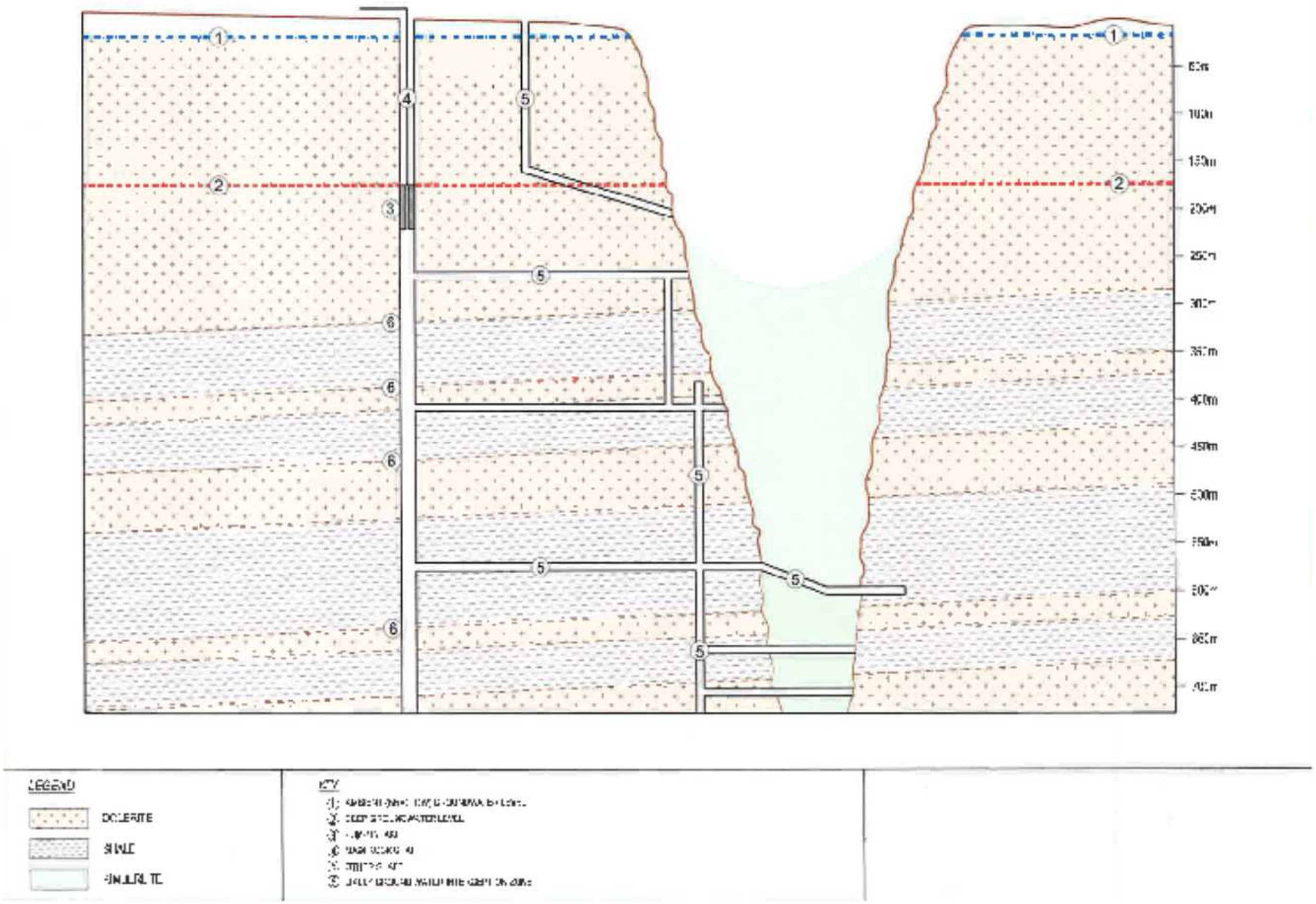

Figure 4-2 : Cross section through open pit

Figure 4-3 : Coloured cross-section of open pit

Figure 32. Geohydrological profile of the Jagersfontein Mine (After DeBeers Ltd. 1969 modified)

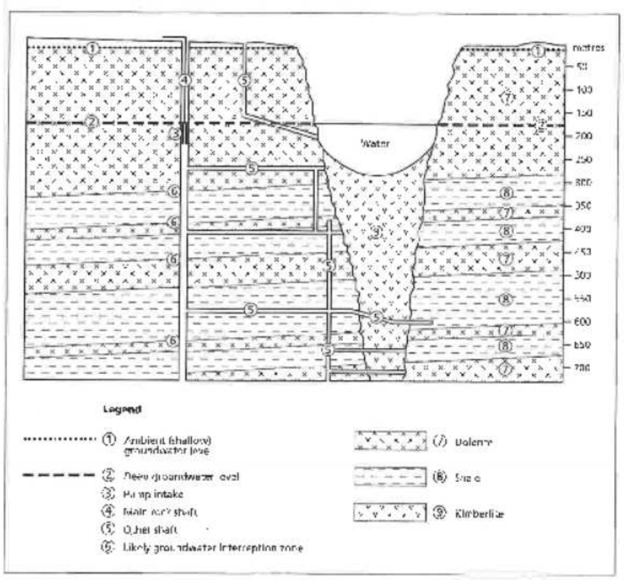

Figure 4-4 : Geohydrological model after De Beers 1969

4.2 Geology

The geology of the region can be described as follows. The Jagersfontein kimberlite pipe intrudes through the Karoo Supergroup sediments and the dolerite intrusive sill complexes. The stratigraphy, Figure 4-5 and regional map Geological Survey; Figure 4-6, show how the local hills preserve the remnants of the dolerites. The outcrop of dolerites indicates the NW-SE striking structure, which appears to be a common structural trend in the region. This feature is clearly observed in the pit as a NW-SE trending fault. The structural trend is known to influence kimberlite emplacement.

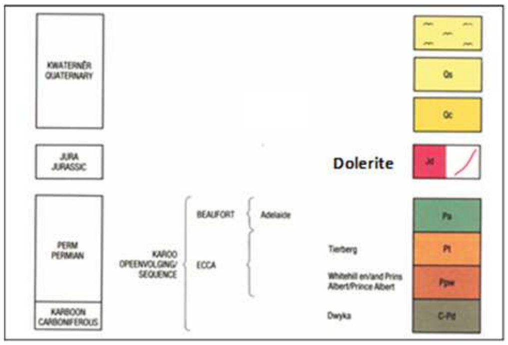

Figure 4-5 : Stratigraphy from Map 2924 Koffiefontein (1:250000 Geological Series, Geological Survey)

Figure 4-6 : Regional geological map including Jagersfontein

A geological section of Jagersfontein Mine, Figure 4-7, shows that the local country rock geology consists of Karoo shales intruded by dolerite sills. The rock exposures in the pit comprise predominantly dolerite.

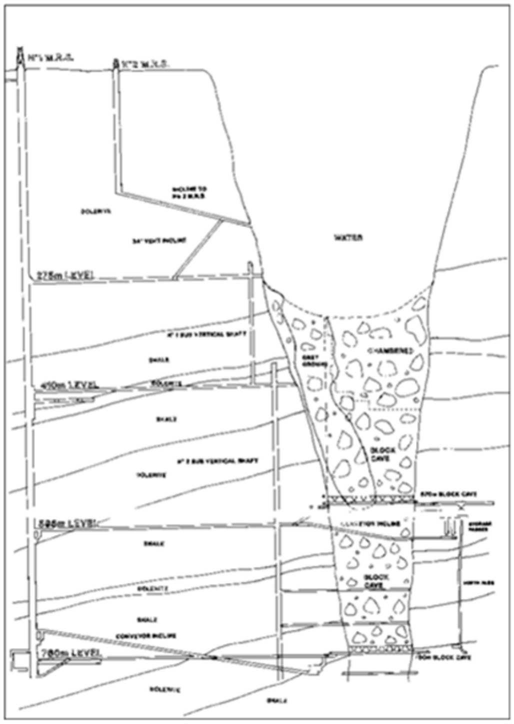

Figure 4-7 : NW-SE geological section through Jagersfontein Mine

4.3 Site visit of 30 March 2012

The Mine Manager Mr J Pretorius accompanied Dr G Howell and Mr A Meintjes of SRK on the site visit.

The following site observations were made:

- The rainfall was heavy during the day of 30 March 2012.
- The open pit located just south of the main part of town with some structures between 80m and 100m from the open pit.
- There is no walk down access into the pit.
- The area is underlain by shales and sandstone from the Ecca Series of the Karoo Supergroup. At Jagersfontein it is significantly intruded by a series of dolerite sills. The upper sill is of significant thickness and allowed the pit to be developed with very steep side slopes of an average of about 72 degrees over an upper open pit height of about 180m. It should be noted that there are significant variations in the pit side slope angles (Figure 4-1): the north-eastern side of the pit have very steep side slopes (about 80 degrees) whilst the north-western side have flatter side slopes of about 63 degrees. The steepness of the slopes is related to the quality of the bedrock in that location.
- When the floor of the open pit is considered, it can be seen that there are abundant boulders which have fallen from the upper slopes, indicating the presence of active geological process, tending to flatten the slopes.

- Most of the upper slopes comprise dolerite. This is underlain by shale. The shale dips to the south.
- There is a fault passing from north-west to south east. There is another fault almost orthogonal to this fault passing from south-west to north-east through the open pit.
- The orientations of the joint sets in the dolerite vary from place to place in the open pit. On the north-eastern side of the pit the joints move in and out of the open pit face up to about 60 to 70 degrees. Generally the dolerite is quite massive with joint sets on the southern side with spacing between 10m and 30m. On the north eastern side the joint spacings may be about 10m or less. On the western side of the open pit there are a number of joints sites allowing toppling failures to take place.
- The presence of the faults changes the jointing from place to place.
- From the viewing platform on the north-eastern side of the pit the predominantly vertical joints sets can be observed. There are numerous examples where these joints are open, clearly as a result of movement which will influence the development of break back. On the northern side, approximately 5 to 10m back from the face, open joints were observed, indicating that further development of break back in this area.
- In the north west area, the presence of the fault is indicated by highly weathered materials which have manifested in a steep scree slope. Closer inspection of this area shows that the weathered materials are deeply incised by erosion gullies which have left promontories (or islands and peninsulas) of potentially unstable materials. Whilst these areas on remote from the town and are not likely to affect the risk to the town itself, they are nevertheless important to the stability of the rim during backfilling operations.
- The north-eastern and eastern slopes are adversely affected by the fault/dyke (apparently kimberlite) on this face. This feature is clearly identifiable in the face of the pit as well as on the surface where a local area of break back is seen. Since this material is weathered and will be unstable with time in its own right, the contingent effect will be the removal of support from the surrounding stronger dolerite sill material and preferential failure in this area.
- On the north-eastern wall, a localised adversely dipping joint set (dipping about 40-60º into the pit) and the surface weathered zone indicates that sliding failure of the rock mass in this area is possible. This feature is probably the reason for the sharp 'corner' on the eastern side.
- Numerous examples of old hoisting equipment and concrete installations are visible on the eastern side of the pit. All have been undermined to greater or lesser degree (eg Figure 4.9) thus indicating the active nature of the break back process.
- The water in the shaft on the south side of the open pit is about 290m to 300m below ground surface. The shaft is 760m deep. It should be noted that the shaft head gear located currently on the northern side of the open pit was moved from the south shaft to its new location.
- The water extracted at this location is used for the mine activities as well as the water supply to the town.
- This head gear location is close to the view point of the north which has been closed to visitors as it is understood that an engineer has indicated that this structure is no longer safe as a view point access.
- During the site visit, there were two occasions when noise was heard from the pit side slopes when large rock boulders broke loose and fell to the bottom of the open pit. This is ongoing

evidence related to ongoing active geological processes attempting to flatten the open pit side slopes in the longer term, by the pit slope break back phenomenon.

- The concrete base of the outlook on the northern side of the open pit refers. The rock below the base has completely collapsed into the pit. This outlook position would not have been constructed like this and originally would have been about 10m from the edge of the pit on a high ground position.

Figure 4-8 : Condition of the outlook position

Figure 4-9 : Old undermined installations

- There are “islands” of slope material about to fall into the open pit.

Figure 4-10 : Block of material about to fall into the pit

- At numerous places there is evidence of break back in process from the presence of cracks between 5m and 10m from the open pit edge. It means that the pit side wall material had already failed and is waiting to fall into the open pit.

Figure 4-11 : Numerous cracks at a distance of between 5m and 10m from the edge of open pit

- In the north-eastern sector of the open pit there were instances that the joint dip angles in the dolerite seem to be about 40 degrees as shown below.

Figure 4-12 : Flatter joint dip angles in dolerite

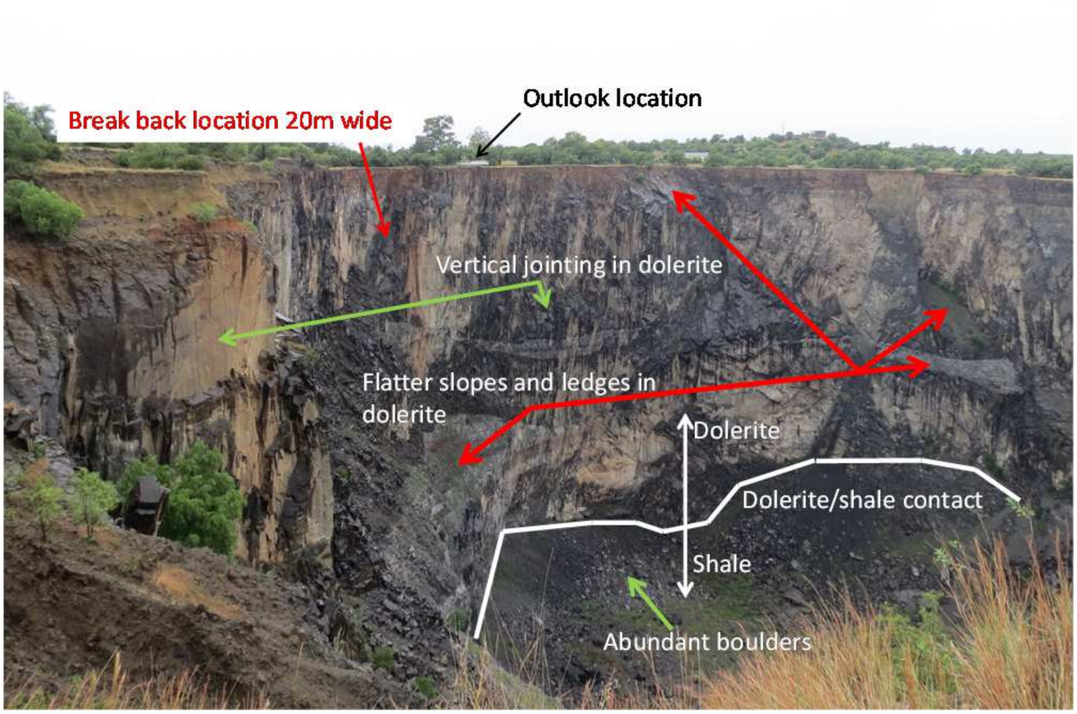

Figure 4-13 : Variability in open pit side slopes to the north

Figure 4-14 : Very consistent high wall rock conditions close to the outlook location

- It is reported that there is no water standing in the bottom of the open pit. This means that the bottom of the open pit is fractured enough and is continuously draining into the underground workings from where the water is then extracted to be used for the mining operations and water supply to the Jagersfontein community.
- It seems as if the break back increments are between 5m to 10m and up to 20m. This means that the walls of the open pit may seem very stable, but when for example the 5m break back limit is reached, 5m could break back in one increment over a short period of time.
- The current mining activities are undertaken in a neat manner indicating that the process is well managed and planned. The Mine Manager reports that they have an approach methology of re-mining to remine from several dumps at any one time to ensure that the target grade feed to the process plant is near constant and so that the recovery can be as high as possible. It is planned to process nearly all the orebody dumps.
- There are 15 dumps which can be remined. The oldest dumps are the richest orebodies and as the dumps become more recent the orebody diamond content decreases.

It was not possible to obtain the De Beers monitoring results of the actual pit break back rates in time for this report.

4.4 Experience from other diamond open pits

Active geological processes in a mining setting mean the following:

- When an open pit is excavated during mining steeper than the surrounding slopes in the vicinity, then, from an active geological processes point of view, the rock and soil will continue to fail until stable slopes develop in geological time.

- This is normal mass wasting processes which occur everywhere in nature and will also occur at Jagersfontein pit where the open pit slopes with an average slope of about 72 degrees will tend to flatten to the long term stable slopes in time to come.

These active geological processes also occur at every other open pit on earth. Two relevant examples refer.

- De Beers pit in Kimberley. The main Johannesburg Cape Town Railway line passes about 30m from the crest of the open pit on the southern side of the open pit. Professor JE Jennings was involved in the 1970's to install a series of long anchors into the slope with shotcrete and grout to stabilise the slope of the open pit on the side the railway line. This was quite successful but was also subsequently supplemented by spraying a skin of shotcrete onto the shale slopes so that these slopes do not weather as fast as when they are exposed to the forces of climate. About 10 or so years ago, tailings and slimes was started to be placed into this open pit to back fill this pit to enhance pit side wall stability and to stabilise the pit in long term when it was recognised by De Beers that the anchor support will have a finite design and operational life and the next set of remedial measures could be significantly more expensive to install to maintain the stability of the railway line.
- Kimberley pit in Kimberley. This pit is normally referred to as the "Big Hole" and the museum and major tourist attractions are located at this pit on the western side of this pit in Kimberley. Bultfontein Road is located on the opposite side of the pit on the same side as Stockdale House. The City Council of Kimberley have closed Bultfontein Road a few years ago when they assessed that their risk was too high related to safety of the public so close to the Kimberley open pit.

There are some significant differences between the Jagersfontein Open Pit side wall geology and the Kimberley and the De Beers Pit side wall geology:

- In the case of the Kimberley and De Beers Open Pits, the side wall geology comprises an upper horizon of dolerite at surface about 20 to 30m thick and this is underlain by various types of shales.
- In the case of the Jagersfontein Open Pit, most of the upper 200m or so of the side wall geology comprise very good quality dolerite for the most part, underlain by shales and then further sills of dolerite.

There are three basic risk related problems with open pits which Jagersfontein Developments have to consider.

- An open pit will with time break back and the increased pit rim will affect property and structures close to the open pit. This means that with time some of the property within the break back zone of the open pit will or could fall into the open pit. This ongoing process has to be carefully managed to ensure that the liabilities to all parties are understood by all parties. The break back zone has to include an allowance for a safety risk zone as well, which in the case for Jagersfontein could be up to 100m wide.
- Every time that there is a significant break back event, there will be vibration type shock waves associated with the event (as have been reported to date by the Community to the Mine). It is possible, that these shock waves could behave similar to very small earthquake tremors and could cause damage to poorly constructed houses and structures close to the open pit, within the zone of influence of the vibration event. It is very difficult to manage this risk as there will always be complaints which the owners of the open pit will have to investigate and make an assessment whether or not the claim is justified or not. Suitable arrays of seismometers will be required to measure each event and the location and extent of each event as part of the

evaluation of the relevance or not of claims. This could be a very costly activity and will require considerable management effort.

- The last but not the least risk problem is providing a no access boundary so that no person of the public can fall into the very deep open pit with very steep side slopes. This also has to be suicide proof boundary to limit and prevent future claims.

If the open pit is left as is, then in geological time (which could extend for many hundreds and even thousands of years), the open pit side walls will break back on an ongoing basis, albeit with time that the rate of break back will decrease, but the above three risk factors to the owners of the open pit and the community will remain. The risks will remain, unless the open pit is completely backfilled or from an engineering behavioural point of view is sufficiently backfilled.

It is our opinion that when the risks of these three very significant factors are quantified and considered by the owner of the Jagersfontein open pit, unless there is a very substantial income from another source (such as a National or World Heritage Organization, or National Government or from the public wishing to visit and see this site), the intuitive decision has to be to backfill the open pit so that all three the above risks can be mitigated, as soon as possible. During the time of the back filling of the open pit, the risks will reduce with time until the pit is fully filled and the liabilities of these three risks are reduced to acceptable levels. It is essential that the open pit is filled as far as possible so that the requirements of the last bullet above can be met.

What also should be understood by all stakeholder parties that there is a timing problem related to backfilling of the pit, as the following factors also have to be considered in the evaluation of this backfilling project:

- The open pit volume has to be compared with the sources of available backfilling material to be filled into the pit by the owner whilst they are busy covering the costs of the backfilling operation. If the decision is left too late by the consenting authorities and NGOs then the pit may only partially be backfilled, which is not meeting the end objectives.
- If the owners of the open pit are unsure whether or not they will obtain backfilling permission in time, they may actually incur too much capital costs in building new slimes and tailings disposal facilities and then it may be too costly later to backfill the pit.

Both these above factors have to be considered during the planning of the way forward with the various mining operations currently been planned on site.

5 Assessment of the break back scenarios

5.1 Background

The lack of accurate historical information such as slope monitoring data, and good quality rock mass ratings, makes the definitive analysis of break back scenarios very difficult. In June 2008, Messrs Barnett and Terbrugge (SRK Project 391907 Potential Break-Back Assessment for Jagersfontein Pit, South Africa for De Beers Consolidated Mines) reported extensively on the break back scenarios. This section therefore contains a précis of this work moderated by the observations made by Messrs Meintjes and Howell in the site inspection of 30 March 2012. Sections in parenthesis (") represent sections taken verbatim from this report.

"Two empirical approaches can be considered. The first approach is to try determining rates of break-back at different positions in the pit, and then predicting width of break-back when the rate reduces to zero. This approach is limited by the small number of data points (three dates with data since mining stopped) available to develop a mathematical best-fit function describing the rate. In reality the break-back may be strongly episodic over several decades and a temporary hang-up may severely skew the predicted rate. The benefit of this approach is that it caters for local variation in geology, such as structural controls on failure."

"The second approach would be to estimate a rock mass rating (RMR) and determine an expected break-back slope angle from empirical charts. This approach is risky, since rock mass properties are assumed and inaccuracies in the empirical charts are accepted. The method also assumes a homogenous rock mass (i.e. no local structural control). The benefit of the method is that it provides a target pit limit based on the inherent strength of the rock mass."

"It was decided to combine the two approaches, therefore incorporating the rock mass strength generally across the pit, but also modifying the expected break-back locally because of expected structural controls."

These methods represented the best estimate of the break back process and therefore are substantially more accurate then anecdotal evidence (such as the undermining of installations) acquired during our recent site visit.

5.2 RMR Break-Back Angles

"In order to look at slope angles an estimate of the pit bottom is required. The best data available is from two cross-sections of the pit. The first shows the pit base schematically at around 300 m depth, Figure 4.3, and the second is a prediction made in 1962 of the expected position of the pit base in 1970, Figure 5.1, just prior to the date of mine closure. The prediction shows a convex basal shape close to 1000 feet (305 m) deep. The two data sources agree closely, and since there is a pipe contact outline for the 305 m depth, this outline was taken to be the pit basal depth and shape." [Figure numbers underlined indicate figures in this report]

"Note that one of the documents supplied by DBCM shows a map" [not available for this report] "in which expected break-back limits are shown. One of the limits is calculated from an assumed 70^{o} angle from the 305 m contact. Other limits are calculated from deeper contacts. We suggest that the 305 m contact is the most logical depth to use."

"Visual inspection of the basalt near the lookout bridge suggests that the jointing is penetrative with trace lengths typically greater than 5 m. The joint spacing appears to be greater than 2 m. The RMR fracture frequency rating is therefore around 31. The dolerites dominate the pit, and outcrops of shale do not appear to be strongly weathered. The sediments appear resistant to weathering and may have been thermally altered by the dolerite sills. Note that this observation suggests that comparisons with the Kimberley or Bultfontein pits are not valid, where the shale weathering dominates the break-back. The rock mass strength is rated as 20 (extremely strong rock). The joints appear to be smooth planar in large-scale geometry. No infill or signs of joint controlled weathering was observed from a distance. A joint condition rating of 22 is used. The total RMR is 73. Adjustments for weathering and stress are more difficult to estimate, but a MRMR between 60 and 70 is probably appropriate. The empirically derived slope angle is 65° (Laubscher, 1991). The resulting rock mass break-back limit is shown in Figure 5.5~~Figure 5.5~~. "

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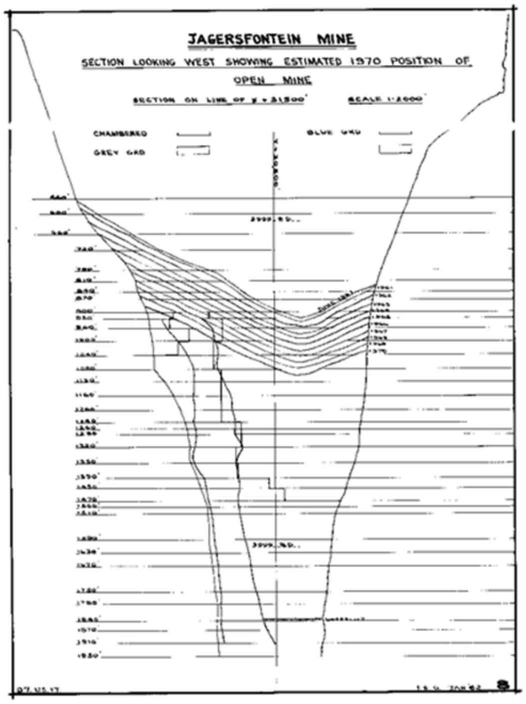

Figure 5.1: NW-SE cross-section through Jagersfontein pipe showing the expected draw-down of the pit bottom due to block mining.

This information gives an excellent assessment of the strength of the rockmass surrounding the pit. Weathering of the upper strata as well as the exposed faces can be expected to occur during the current working phase and with (geological) time. Therefore a conservative approach is indicated.

5.3 Rate of Break-Back

For the purpose of analysis the following methodology was used:

"The pit was subdivided in 8 section lines as represented in Figure 5.2~~Figure 5.2~~. The break-back for each time period (1936-1946, 1946-1971, 1971-1998 and 1998-2008) along each section line was calculated in linear metres. The results are graphically illustrated for each section line in Figure 5.3."

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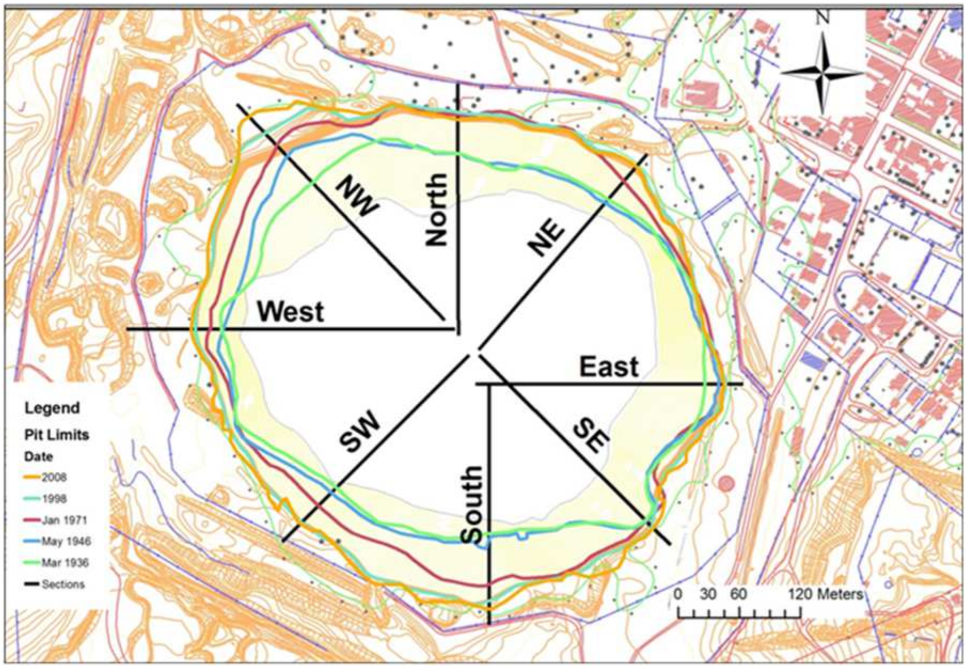

Figure 5.2: Plan showing the sections used to calculated local break-back rates

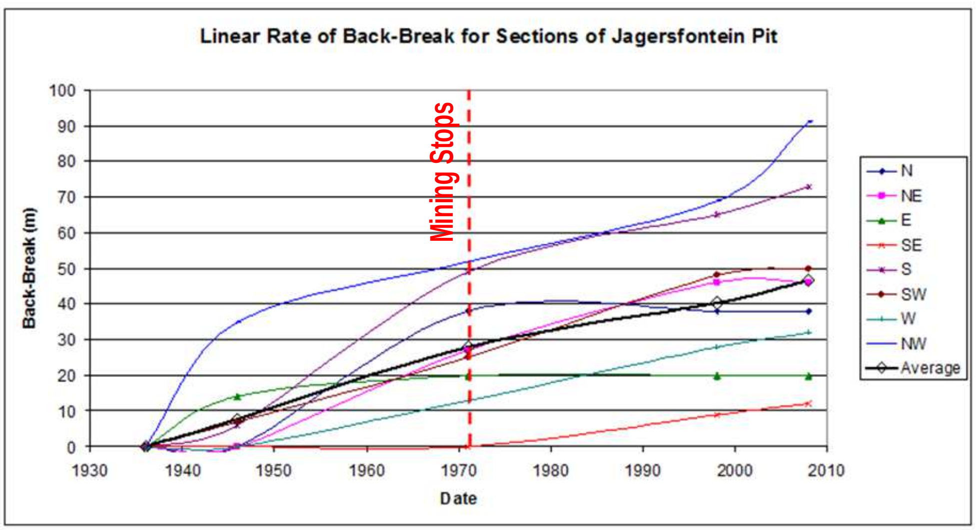

Figure 5.3: Graphical representation of break-back in different parts of the pit

"A best-fit 2nd order polynomial curve was fitted to the 5 data points for each section line Figure 5.4. The point where the fitted polynomial curve becomes horizontal represents a zero break-back rate and the final limit. Note that some of the section lines appear to already be at the final break-back limit (based on the data only). Some curves were only fitted with the post-mining data points, simply because the curves fitted to all points produced unrealistic results. The final break-back limit was then plotted on the plans and a rate controlled limit line constructed. The rate controlled limit line was made to follow the shape of the previous measured limit lines, thereby creating a realistic limit. The limit line was also modified to account for mapped local structural features, such as the dykes and also the wedge on the western side of the pit. However, the limit rounds-off sharp geometries and removes buttresses. The plausible structure and rate controlled break-back line is shown in Figure 5.5."

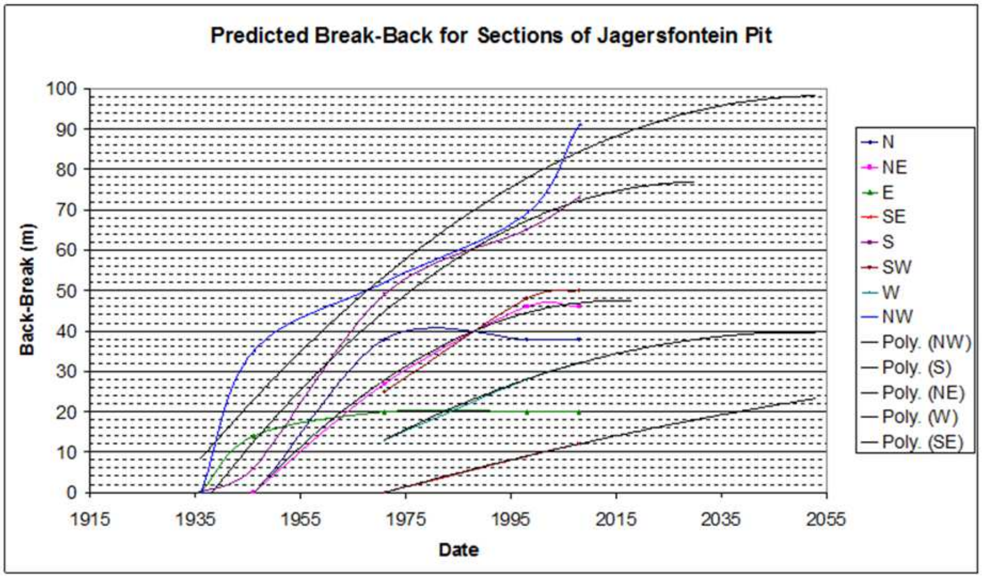

Figure 5.4: Predicted break-back based on best-fit polynomial functions. Interpolated lines are labelled Poly.

5.4 Ultimate Break-Back Limit

"The rock mass 65 degree limit and the structure-controlled limit are then merged into a final break-back limit. The outer, more conservative line was taken at each point around the pit. This final limit is illustrated in Figure 5.5~~Figure 5.5~~. It therefore caters for the jointed rock mass strength, as well as possible local structure-controlled failures. The mapped cracks are considered to outline the most hazardous areas over the next decade. Based on the rates of break-back, the structure limit most likely provides an indication of the break-back within the next 45 years. Erosion will continue to cause small-scale toppling in the pit and a final pit limit will be achieved over the next few hundred years."

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Figure 5.5 clearly indicates the ultimate zone of back break from this analysis. Break back rates of between 0.2m/yr and 1.0m/yr are demonstrated with an average of 0.67m/yr (47m/70yrs). It should be noted, however, that the town properties affected by this analysis are in no immediate danger, but with time (next 50 years) will increasingly be susceptible. An exclusion zone, of the order of 100m, for access is therefore indicated and should be maintained.

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From an engineering design point of view, the ultimate zone of break back only takes account of the known structural geological and geological factors, but does not account of other possible impacts such as a major earthquake somewhere in RSA. It is recommended that if the open pit is not backfilled at an additional exclusion zone be defined to take account of these other possible design factors which will include *force majeure* conditions.

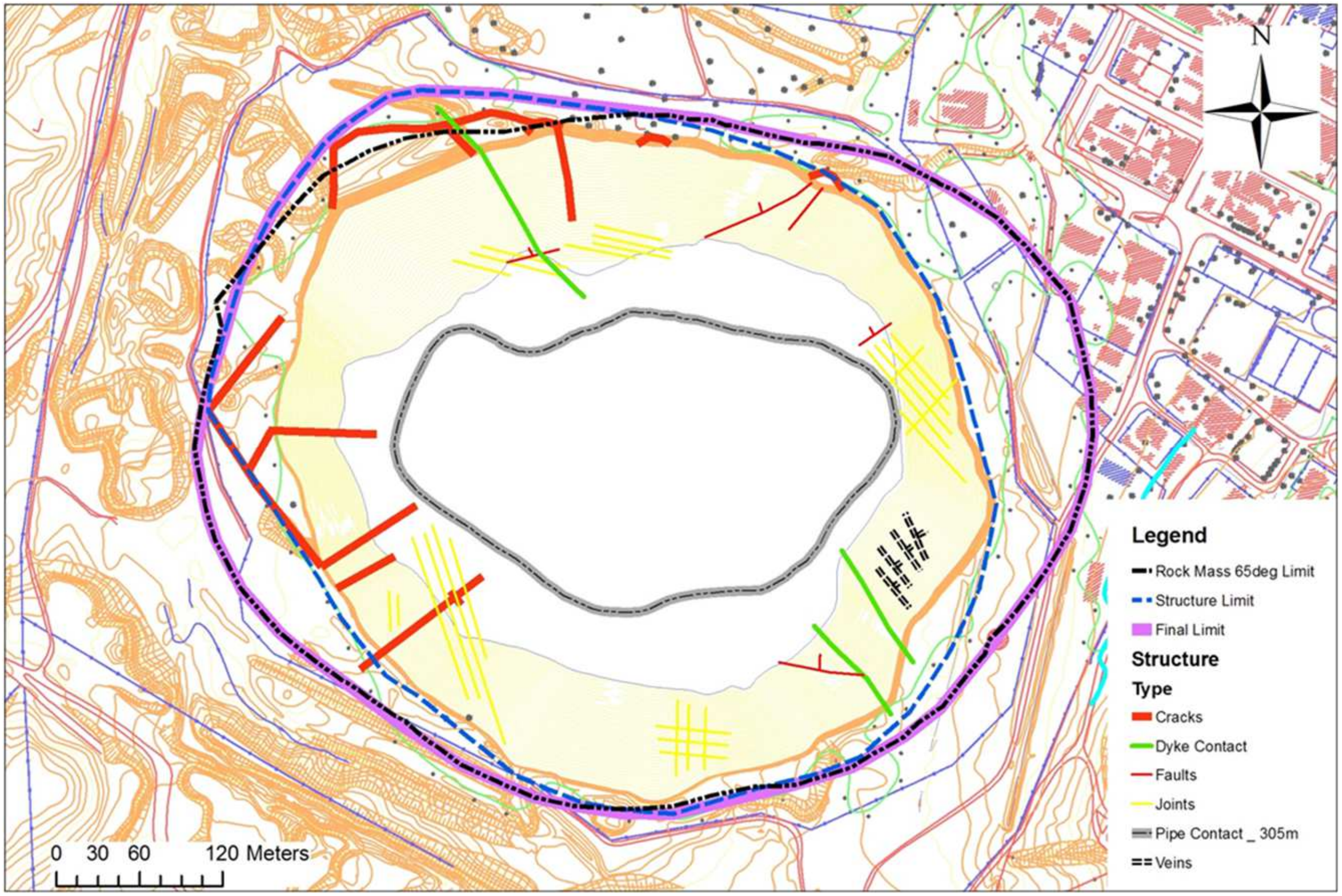


Figure 5.5: Plan showing the final expected break-back limit for the Jagersfontein Pit. Highest risk areas are within areas bounded by the red cracks.

6 Assessment of the pit back filling scenarios

6.1 Review of pit geometry

The mine provided a contour plan of the open pit and also an assessment of the open pit volumes. The contour plan was used to undertake a review of the pit volumes to ensure that there was no basic volume assessment problem in the data provided by the mine. The following comments refer to Figure 6-1.

- The surveyor volume calculations extend to a depth of 254m. The volume calculations by the surveyor are shown as the "Surveyor" line. The surveyor volume calculated for the open pit is about 32 million m^3.
- The open pit survey provided to SRK only extends to a depth of 185m. The volume estimate of SRK is shown as the "Contours" line. The volume estimate of SRK was adjusted to the Surveyor line by adding the volume difference to the top of the open pit volume calculated. It can be seen that there is good correspondence.

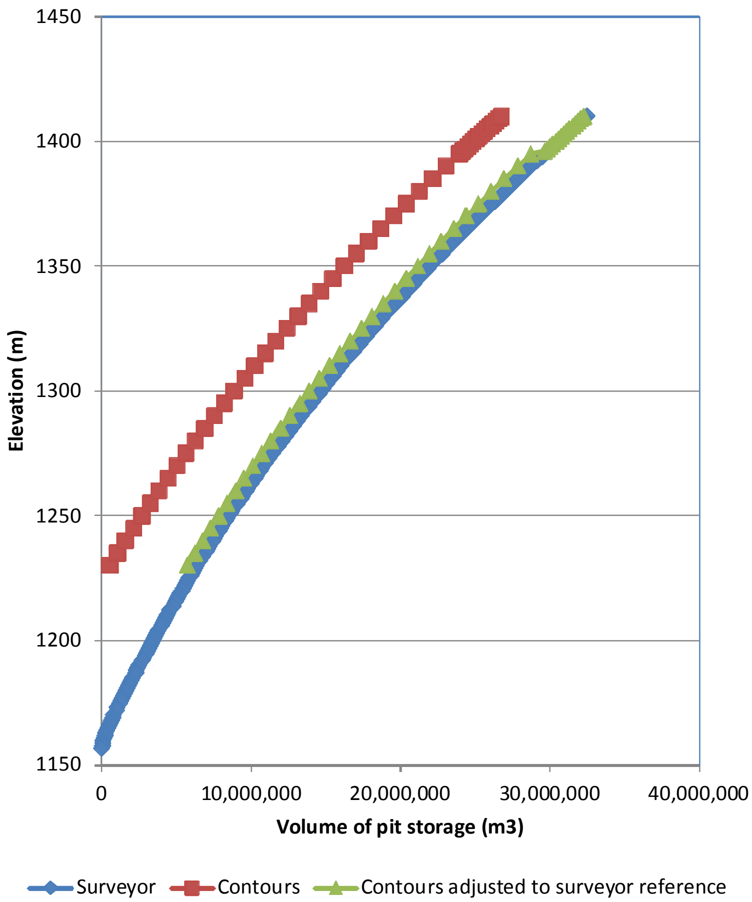


Figure 6-1 : Pit volumes

The following comments relate to the interpretation of the volume assessment of the open pit survey (Figure 6-2).

- The top elevation of the open pit is not level and therefore as a tailings and slimes storage facility the pit can be filled until the first obstacle is encountered at the lowest crest level. The lowest crest level is on the south-western side of the open pit at elevation 1400m. This location is close to the grid position X 3 294 300 and Y -40 500, using the Southern Hemisphere - Degrees - WGS84 - LO23. This is a tailings and slimes storage volume of about 30.5 million m^3.
- Between elevations 1400m and 1404m it is not too difficult to provide a suitable containment wall for tailings. This allows an additional storage of 0.745 million m^3 or a total of 31.3 million m^3.
- Between elevations 1404m and 1410m (the top level of the open pit), considerable effort is required to provide containment walls. This allows an additional storage of 1.1 million m^3 or a total of 32.5 million m^3.

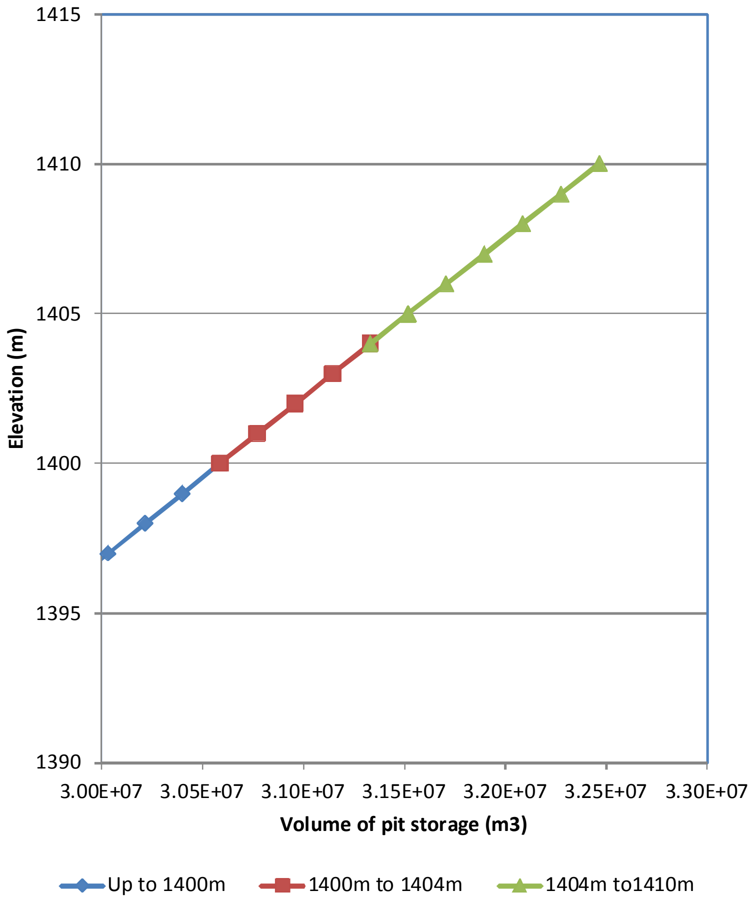


Figure 6-2 : Incremental storage volume in open pit

The mining of the open pit comprised two components.

- The Kimberlite orebody which in terms of the current understanding comprises about 52 million tons.

- Waste material in the form of soil and rock. If a reasonable assessment is made of the in situ density of the open pit before mining commenced an average value of at least 2.5t/m^3 could be selected. This means that in terms of waste material mined there could be about 26 million tons available for usage, if required.

6.2 Proposed rates of backfilling of the open pit

The dumps to be mined and processed contain about 52 million tons, which can be used for the pit backfilling.

The following mining details were provided by the mine.

- Tailings production. The tailings particles are smaller than 6mm diameter. The production rate is 150t/hr. 2019: production rate for Tailings is now 550t/hr
- Slimes production. The slimes particles are smaller than 0.8mm down to clay sizes. The slimes density produced in the high rate thickener is 1.5 t/m^3. The current production rate is 120 to 140 m^3/hr, but it is planned in future to produce only 70 m^3/hr to 80 m^3/hr of slimes. The reason for this change in production is that it is planned to de-grid sand from the tailings and provide that to the community as a sand commercial source at about 100t/hr. Slimes production is now up to 250m3/h
- The top-up water requirements are 100 to 120m^3/hr.
- The dumps resource comprises about 52 million tons, with about 34 million tons in the MTD facility and 18 million tons in the old array of dumps. The dry density of the old dumps typically varies between 1.8 and 2 t/m^3. The specific gravity, SG of the dump materials varies between 2.7 and 2.8. Now 36Mt
- The process plant runs at about 80% plant utilization, 24 hours per day and seven days per week.

In order make an assessment of possible slimes slurry properties, the following Table 6-1 refers.

- If the slurry density of the slimes is 1.5t/m^3, then the dry density of the slimes is about 0.79t/m^3.
- The initial estimated dry density of the consolidated slimes during the pilling of the open pit is 1t/m^3. This means that the water liberated during this process is about 15.96m^3/hr.
- The longer term consolidated density of the slimes is estimated to be about 1.3t/m^3. The longer term settlement post closure of the slimes in the open pit will be as a result of the difference between 1t/m^3 and 1.3t/m^3.

Table 6-1 : Basic slimes slurry properties

SG of water	1	1	1	1	1	1	1
Slurry density	**1.35**	**1.4**	**1.45**	**1.5**	**1.55**	**1.635**	**1.83**
SG of solids	2.75	2.75	2.75	2.75	2.75	2.75	2.75
%Solids	41	45	49	52	56	61	71
Volumetric water content Vw/Vt	20	23	26	29	31	36	47
Unit volume of solids	1	1	1	1	1	1	1
Unit volume of water	4.00	3.38	2.89	2.50	2.18	1.76	1.11
Unit total volume	5.00	4.38	3.89	3.50	3.18	2.76	2.11
Mass of solids for unit volume of solids	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Mass of water	4.00	3.38	2.89	2.50	2.18	1.76	1.11
Total mass of slurry	6.75	6.13	5.64	5.25	4.93	4.51	3.86
Mass of solids/ton of solids	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total mass of slurry /ton of solids	2.45	2.23	2.05	1.91	1.79	1.64	1.40
mass of water /ton of solids	1.45	1.23	1.05	0.91	0.79	0.64	0.40
Mass of dry tailings pumped into tailings dam (tons) per hr	59	59	59	59	59	59	59
Mass of water pumped (tons) per hr	**86**	**72**	**62**	**54**	**47**	**38**	**24**
Total mass of slurry (tons/hr)	145	131	121	113	106	97	83
Volume of solids (m^3)	21	21	21	21	21	21	21
Volume of water (m^3)	86	72	62	54	47	38	24
Volume of slurry (m^3)	107	94	83	75	68	59	45
dry density	0.55	0.63	0.71	0.79	0.86	1.00	1.30
void ratio	4.000	3.375	2.889	2.500	2.182	1.756	1.108
Slurry water content	145.45	122.73	105.05	90.91	79.34	63.85	40.31

The information from Table 6-1 and the mining production information provided by the mine can be used to estimate the following tailings and slimes properties (Table 6-2), so that the longer term tailings and the slimes deposition can be evaluated.

Table 6-2 : Longer term slimes and tailings basic volumetric properties

Tailings production	150	t/hr
Slimes production	75	m^3/hr
Slimes density	1.5	t/m^3
Slimes production	59	t/hr
Plant utilization	80	%
Tailings production	2880	t/day
Slimes production	1132.8	t/day
Total production	4012.8	t/day
tailings dry density	2	t/m^3
Slimes dry density	1	t/m^3
Volume of tailings	1440	m^3/day
Volume of slimes	1132.8	m^3/day
Total volume	2572.8	m^3/day
Average dry density	1.560	t/m^3

The average dry density between the slimes and the tailings to be placed in the open pit can be used to make an assessment of the average stage capacity curve for filling the open pit (Figure 6-3). The data on which this stage capacity curve is based is presented in Appendix A. The following comments apply:

- The time period for filling the open pit facility is about 34 years as proposed by the Mine (Table 6-2). If the plant utilization improves to more than 80% then the project time will correspondingly decrease. With new production rates, time left to fill pit is about 7 years
- The rate of rise at filling of the open pit say to an elevation of 1400m is very high for this type of slimes at about 5.1m/year. This means that very little consolidation of the slimes will take place during the time of filling of the open pit. Impoundment walls will be required to manage the slimes impoundment.

In order to make an assessment of the implications if the longer term reduction in slimes handling does not take place, the following table of mining production rates was prepared (Table 6-3). It can be seen that the average dry density has decreased due to the higher ratio of slimes in the production cycle. This average dry density of 1.424 t/m^3 and the associated combined production rate of 4838 m^3/day of slimes and tailings were used to prepare the relevant stage capacity curve as shown in Figure 6-4. The following comments apply:

- The time period for filling the open pit facility is about 25 years as proposed by the Mine (Table 6-2). If the plant utilization improves to more than 80% then the project time will correspondingly decrease.
- The rate of rise at filling of the open pit say to an elevation of 1400m is very high for this type of slimes at about 6.7 m/year. This means that very little consolidation of the slimes will take place during the time of filling of the open pit. Impoundment walls will be required to manage the slimes impoundment.

Table 6-3 : Higher slimes production rate

Tailings production	150	t/hr
Slimes production	130	m^3/hr
Slimes density	1.5	t/m^3
Slimes production	102	t/hr
Plant utilization	80	%
Tailings production	2880	t/day
Slimes production	1958.4	t/day
Total production	4838.4	t/day
tailings dry density	2	t/m^3
Slimes dry density	1	t/m^3
Volume of tailings	1440	m^3/day
Volume of slimes	1958.4	m^3/day
Total volume	3398.4	m^3/day
Average dry density	1.424	t/m^3

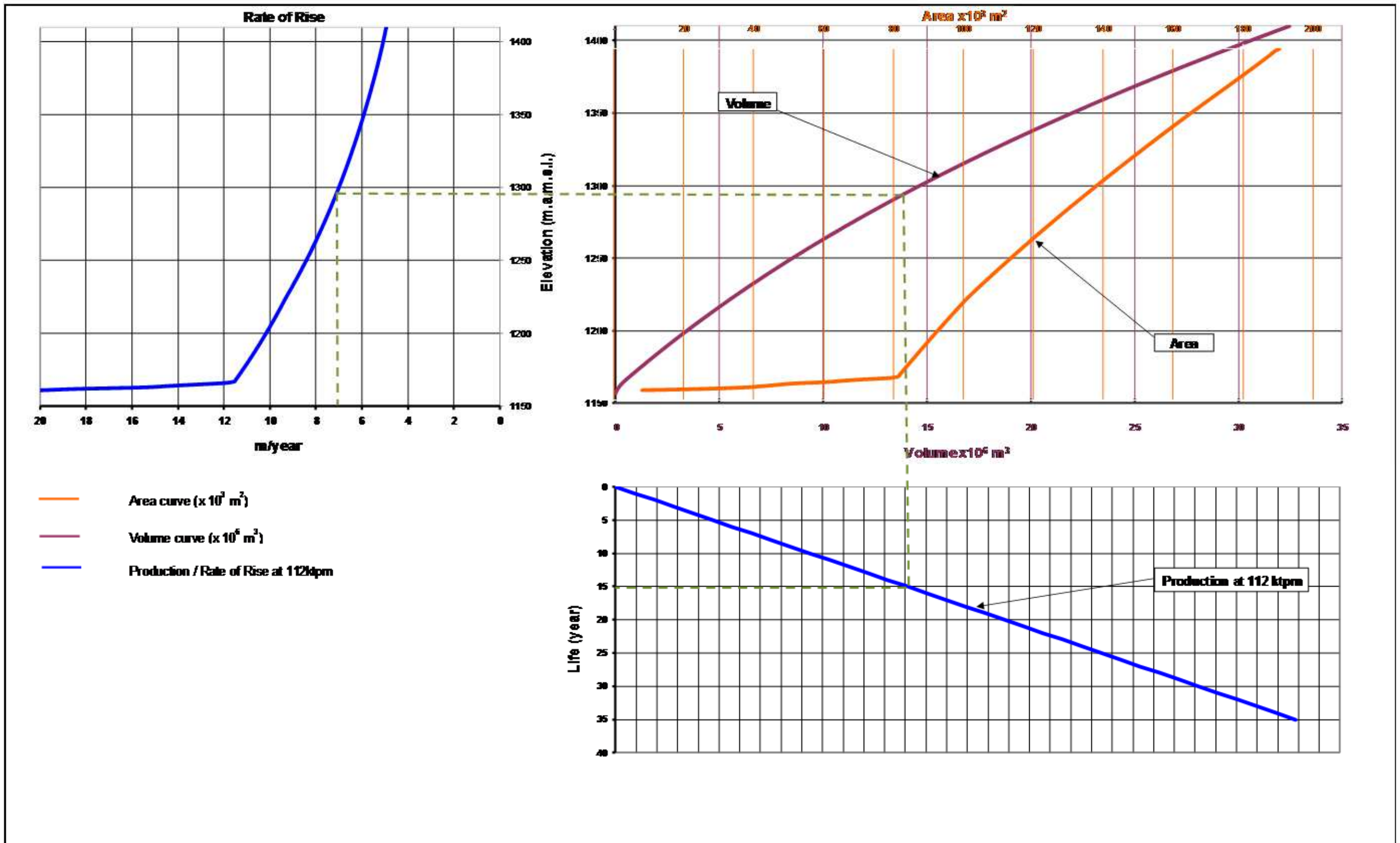
6.3 Proposed deposition into the open pit

The tailings and slimes deposition into the open pit has to consider the following factors.

- The current water supply to the Jagersfontein Mine relies on pump out from the open pit via the shaft.
- The deposition into the open pit has to be planned to enhance the stability of the pit side slopes.

The following activities will have to be undertaken.

- The tailings will have to be placed using a conveyor type system from the southern side (Figure 6-5) of the open pit. It is essential that the tailings deposition occurs before any slimes is placed in the open pit.
- The tailings deposition from the southern side of the open pit will have to continue until a wedge is formed at least 100m wide and 20m high. This is a preliminary assessment and has to be updated as part of the detailed design process when the full water consumption of both the mine and the Jagersfontein community has been checked.
- The tailings deposition always has to stay ahead of the slimes production in terms of height within the open pit. This will always allow the tailings to act as a filter connecting the surface of the slimes, to the tailings and then to the porous base of the open pit, allowing filtration of water to continue to service the pumps in the extraction shaft.
- As the lowest crest elevation is on the south western side of the open pit, it is proposed that the slimes delivery location be placed on the eastern side of the open pit (Figure 6-5). This will allow surface water to always flow towards the tailings from the current locations where surface water flows into the pit from the western side of the open pit.



srk consulting	Jagersfontein Pit STAGE CAPACITY CURVE	Project No. 445072	Figure No. 6.3

Figure 6-3 : Stage capacity curve for the longer term slimes and tailings disposal

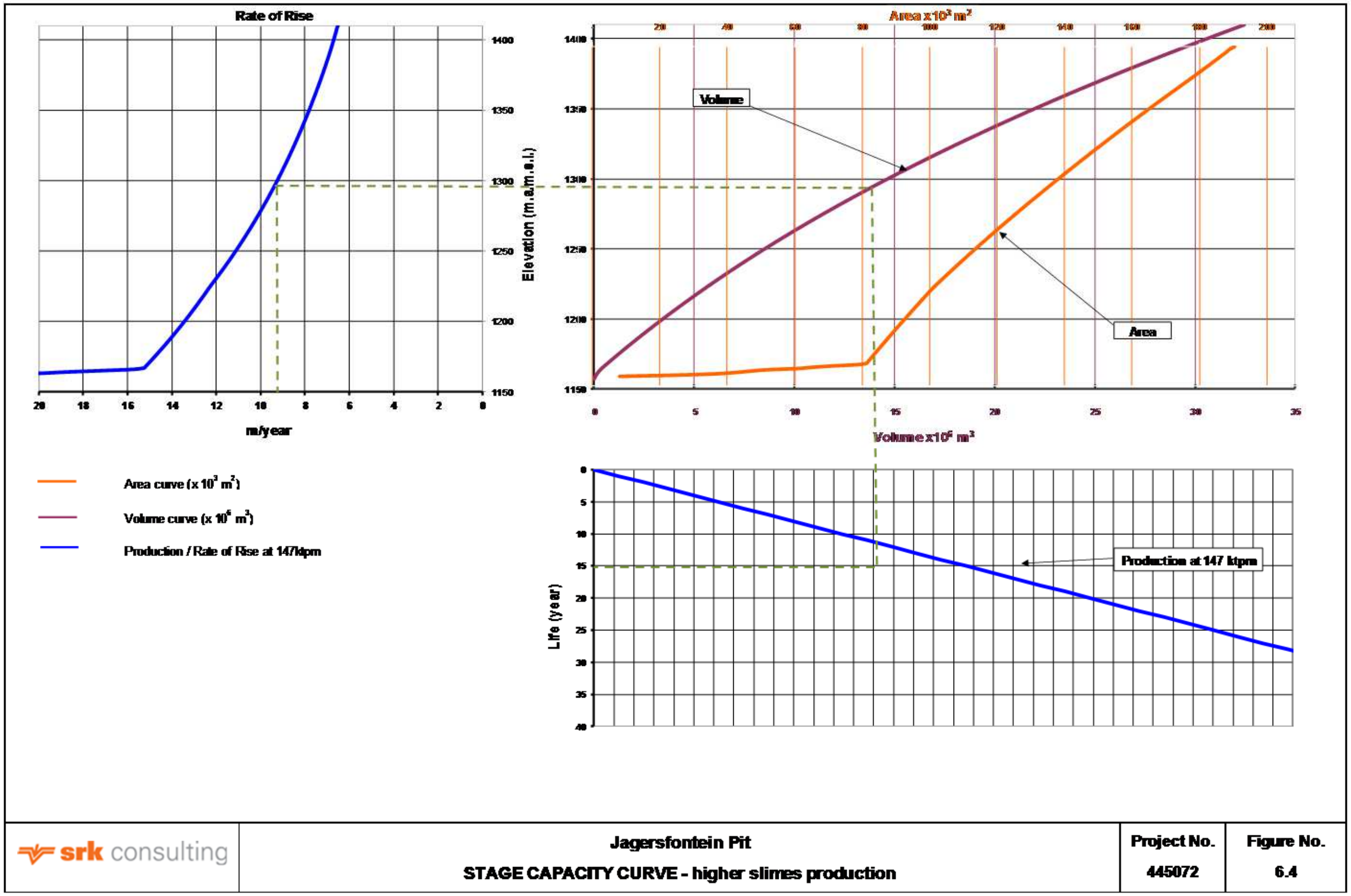


Figure 6-4 : Stage capacity curve for the higher rate slimes and tailings disposal

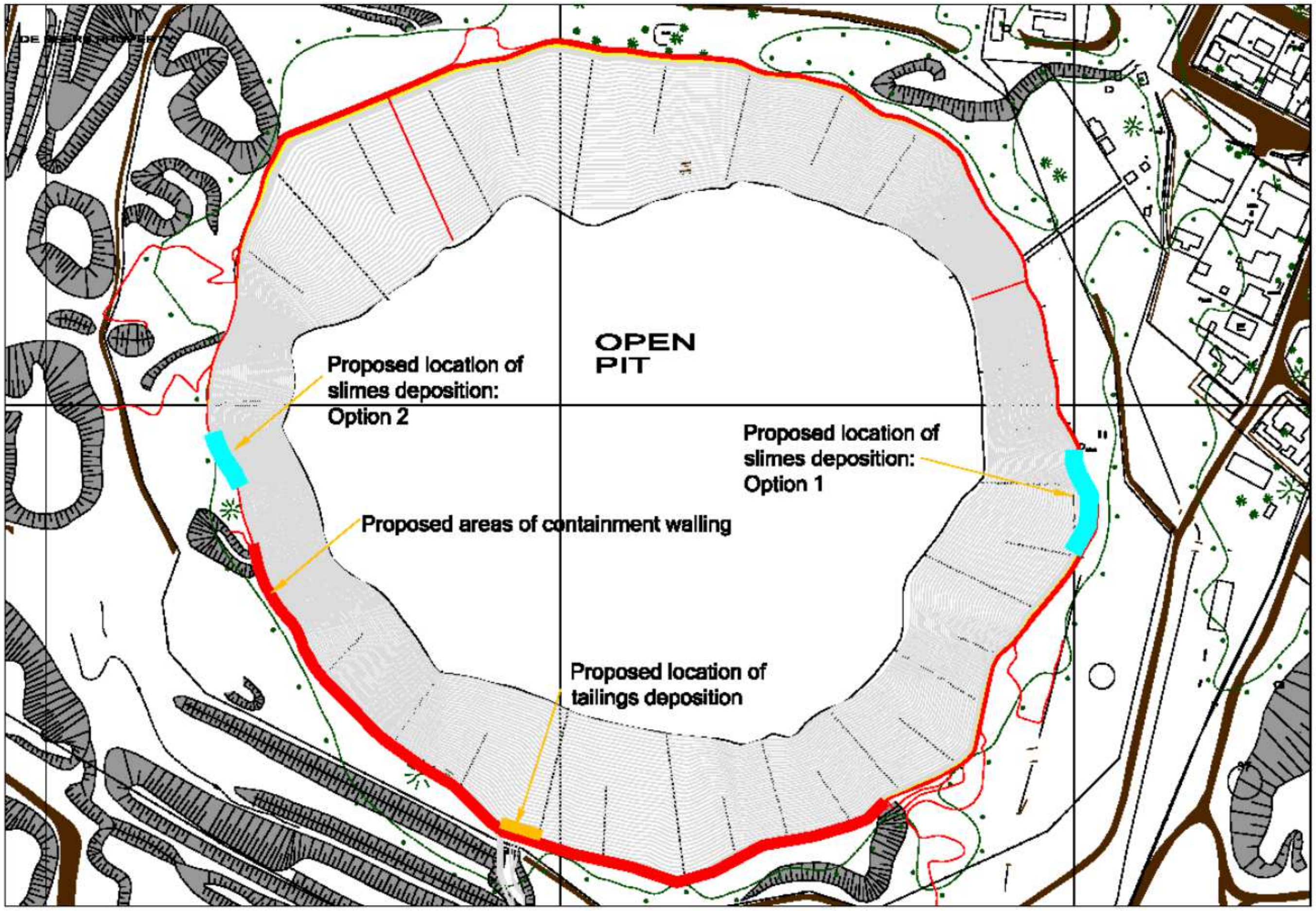


Figure 6-5 : Proposed tailings and slimes deposition locations

- Even if the slimes deposition point was placed on the western side of the open pit (Figure 6-5), it should be possible to still allow decant of water to take place towards the tailings stack location. The reason for this is that the slope of the slimes surface is likely to be no more than about 2 degrees. Much more careful slimes deposition will be required during the later years shortly before complete filling of the open pit to manage surface water.
- A water use licence will have to be obtained for this mining operation for the backfilling of the open pit.
- Although the Jagersfontein community water supply is currently been taken from the open pit via the mine pumping system, it is considered essential that the Kalkfontein water scheme to supply water to the Jagersfontein community be expedited and commissioned as soon as possible, preferably even before the backfilling of the open pit commences. There are two key considerations, the first is the water quality of the water in the open pit which will be further affected by the mining operations at least from a turbidity point of view and the second is that the community should not have to rely on the open pit which will also tend to behave as a sink to provide for their water supply. Water supply from the Kalkfontein water scheme should be used to provide for the Jagersfontein community.

6.3.1 Deposition management considerations

Once the “water” filter has been developed on the southern side by ongoing deposition of the tailings at this location, to ensure water available during the backfilling of the open pit, consideration will have to be given to move a portion of the tailings deposition further around the pit edge so that the closure of the open pit can be planned. The first location that requires protection is the area where the lowest crest elevation occurs, so that a slimes impoundment wall can be constructed at this location.

The tailings deposition has to be planned to ensure that there is no ongoing down-drag of the pit side slopes by the tailings deposition.

6.3.2 Water management considerations

Whilst the open pit is only partially filled with slimes and tailings, storm water management is not a serious constraint, but when the open pit is almost filled this will require very detailed management. Furthermore, the tailings and slimes deposition will have to be managed to also ensure that the water accumulating on the upper surface of the slimes can always be decanted. There will always be an ongoing management requirement to ensure that the slimes and tailings deposition is integrated with the water management plan.

6.3.3 Pit side slope stability considerations

The pit side slope stability is a function of the square of the height. Therefore the following relationship depicts the reduction in risk with elevation as the pit is filled (Figure 6-6 and Figure 6-7). The comparison reference is that it is 100% certain that pit side wall instability will occur at the current height with no backfilling of the pit. Furthermore, when the open pit is completely filled, the risk will be close to 0%, for pit side wall instability, if reasonable practice is followed during open pit filling.

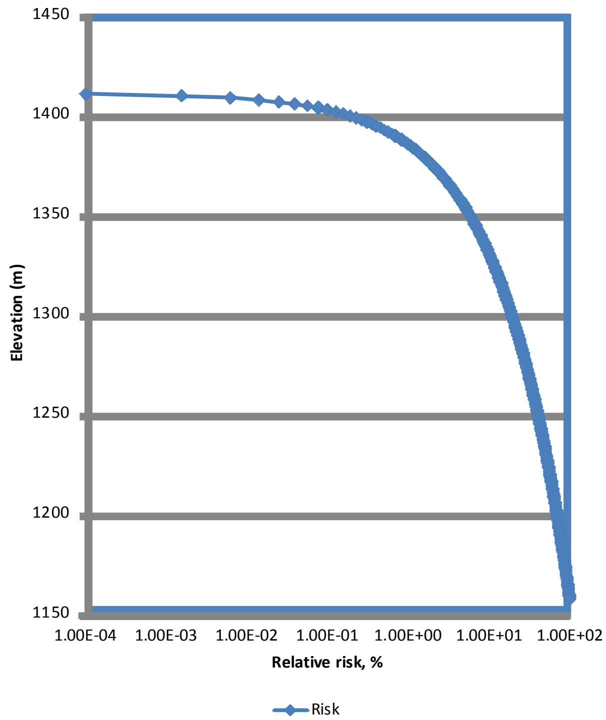


Figure 6-6 : Risk as a function of filling of the pit (log scale)

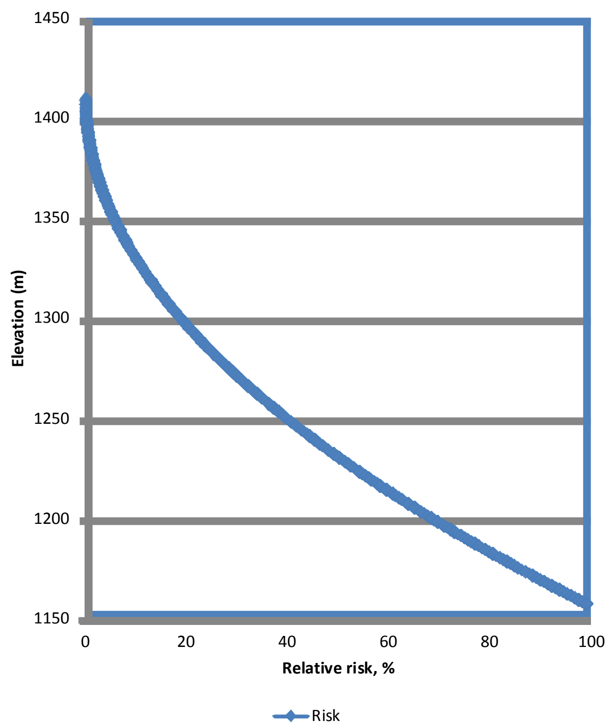


Figure 6-7 : Risk as a function of filling of the pit (normal scale)

6.4 Behaviour of the open pit after filling

6.4.1 Likely properties of the slimes and the tailings

From previous similar studies and from the literature, typical properties for the slimes and the tailings will be provided.

The properties of the slimes can be summarized as follows:

- Cone resistance = 1 MPa
- Coefficient of consolidation, Cv = 40 m^2/yr
- Stiffness E = 2.5 MPa
- Undrained shear strength = 10 to 70 kPa
- Dry density = 1000 kg/m^3
- Void ratio = 1.5
- Dry density after consolidation = 1.3 t/m^3
- Allowable bearing capacity = 20 to 100 kPa

The properties of the tailings can be summarized as follows:

- Dry density = 2000 kg/m^3
- Void ratio = 0.33
- Little or no consolidation is expected

6.4.2 Slope stability of the open pit side slopes

The following parameters were selected to be used in a slope stability assessment (Table 6-4). These parameters are based on typical parameters for the rock mass forming the open pit side slope and for the slimes.

Table 6-4 : Shear strength parameters

Property	Rock mass properties dominated by dolerite	Slimes
Unit Weight [kN/m3]	26	15
Cohesion [kPa]	600	0
Friction Angle [deg]	40	30

Two analyses were undertaken:

- The open pit slope stability to assess the current condition and also to confirm that the parameters selected for the rock mass are reasonable and represent the current condition (Figure 6-8).
- The second analysis was to show the impact of filling the pit with slimes (Figure 6-9).

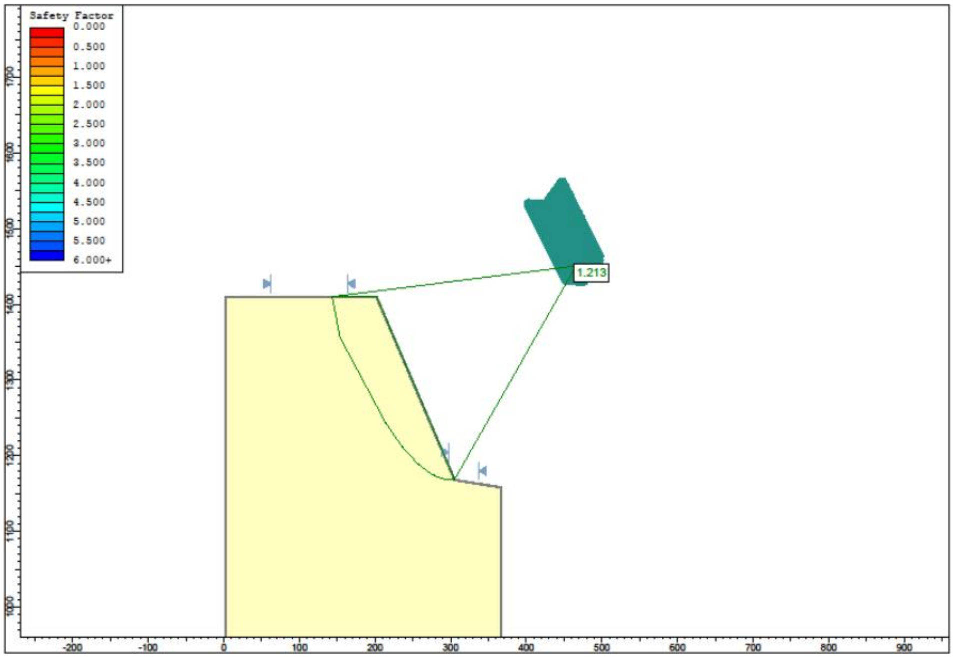


Figure 6-8 : Slope stability for current open pit

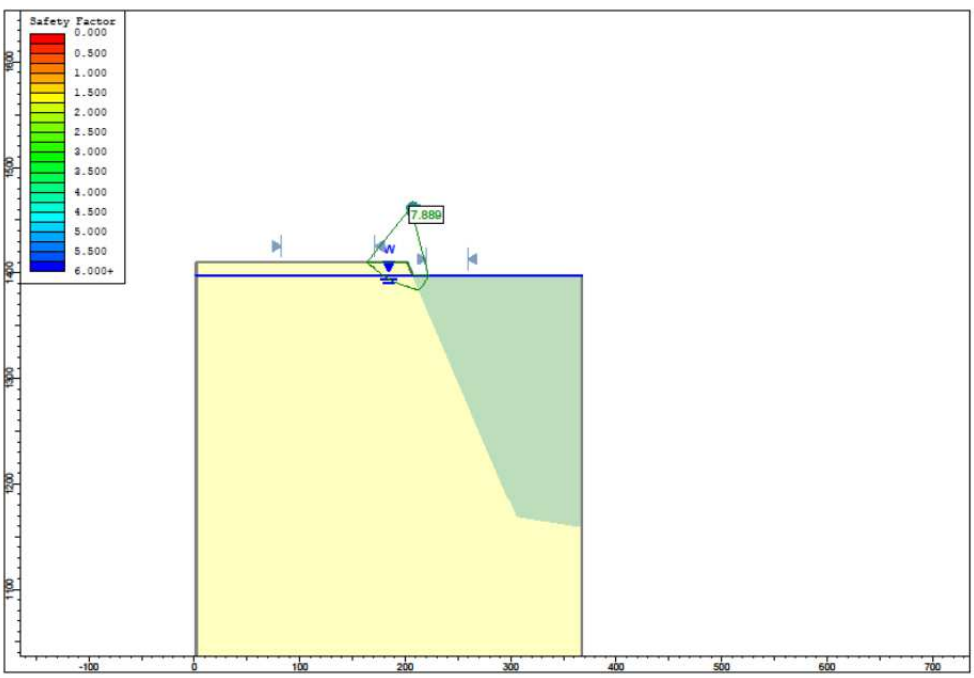


Figure 6-9 : Slope stability with pit filled with slimes

The results of the analyses are that the filling of the pit enhances the stability significantly and reduces the risk to the owner of the pit very significantly, as the factor of safety increased from 1.213 to more than 7.889. The risk of failure will change from about 1 in 1000 to 1 in less than 1 in million.

6.4.3 Long term settlement behaviour of the slimes

In the longer term there will be consolidation settlement of the slimes within the open pit. Consolidation settlement means that the clay quality slimes will tend to compress with time until its long term stability condition is reached. This means that water will be released with time from the pores of the clay quality slimes and this will allow the consolidation settlement under self-load to take place. It is very difficult to estimate what the actual settlement will be as this will also be a function of the exact method of backfilling of the pit and the impact of some coarser fraction (i.e. some sand) in the slimes can significantly alter the consolidation behaviour and therefore the time and magnitude of settlement. For the purposes of this project at this preliminary stage it is sufficient to indicate that the settlement could vary between about 30m and about 40m and the time for this settlement could vary between 200 years and 300 years.

This ongoing settlement should not be a concern as it is recommended that this area is not developed other than a park land until all the consolidation settlements have creased. If this open pit area is closed in a responsible manner a wetland type feature can be developed which will be of benefit to the community as this will attract much bird life, in addition to being an open space.

6.5 Closure consideration of the backfilled open pit

One of the major considerations related to backfilling of the pit, is that the various orebody dumps close to the town will be removed, processed and placed where they came from. This is a key environmental consideration. This will assist with the general clean-up of the area.

Partially filling of the open pit is not a practical option as there will be residual risks remaining as shown in Figure 6-6 and Figure 6-7.

If in discussions with the Heritage Committee it is decided that the open pit be filled and that the original outline of the pit be shown to future generations, this can be achieved in a number of ways.

- A small section of the pit rim high wall on the northern side can be retained say not more than 1m high.
- The balance of the perimeter can be denoted by a small wall say 1m high. An alternative structure could be a small berm wall, say 1m high.

This approach would imply that the footprint of the Jagersfontein open pit would be preserved as a “park” for the community. This would be a very reasonable choice as a future land use, specifically if Section 6.4 is considered.

There are two basic closure options:

- Allow the longer term consolidation settlement to take place and this will form a very beautiful park land area as water will accumulate in the lower lying areas attracting vegetation and birdlife in this wetland setting.
- Dome the open pit so that it always maintains a positive topography. In this scenario the open pit will not allow further infiltration of water and an alternative source of water for the Jagersfontein community will have to be found.

The following key elements have to be addressed during open pit closure.

- If it is decided to fill the open pit only to say to elevation 1404m, then the pit rim slope of the pit wherever it is higher than elevation 1404m, will have to be dressed to flatten these slopes by filling with soil or tailings to an inclination of not more than 18 degrees or 1 in 3 (h). The principles of this comment will apply to any final depth of backfilling of the open pit selected, unless people access can be prevented to the steep slopes area.
- Surface storm water in and around the open pit will have to be designed to cater for the backfilled pit.
- Consideration will have to be given to the longer term water supply to the community if this area is not well maintained as a park land and the community are allowed to pollute this area.

If the doming scenario is pursued, then the following aspects have to be considered.

- The tailings has to be used during the last five years or so to progressively place the tailings onto the slimes where possible, as this will significantly improve trafficability on top of the slimes.
- As the slimes is a low strength material, access of construction plant after filling of the pit will be difficult and may require some years before significant access may be possible, considering the low bearing capacity and the undrained shear strength of the slimes. This is why it is essential to consider all opportunities closer to the end of the backfilling project to enhance the slimes properties by placing tailings with the slimes.

6.5.1 Considerations for cover placement

The construction of a cover (doming) on weak compressible slimes often present a formidable challenge due to the low shear strength, poor trafficability, and high settlement of these unconsolidated slimes at the time of closure. The geotechnical properties of the slimes have to be well understood in order to select the best strategy for placing a cover onto the slimes.

The low permeability of the slimes results in very slow consolidation under self-weight. As a result excess pore pressures and settlement may occur for many tens of years after slimes placement. In addition, these extremely soft, compressible layers of clays generate high pore pressures when subjected to loading and behave as extremely weak, almost fluid, deposits. The poor consolidation properties of the slimes significantly complicate initial access and subsequent placement of a dry cover.

The slimes have an undrained shear strength of between 10 kPa and 70 kPa. Such low values are insufficient to support wheeled or tracked vehicles and conventional earthmoving and placement techniques for cover layer placement. This could even be worse when slimes with adverse properties are encountered.

The placement of a cover layer represents a significant load, which is initially born by the pore water as excess pore water pressure. During consolidation these excess pore pressures gradually dissipate thus transferring the stress of the new load to the soil skeleton, resulting in an increase in effective stress. In many instances a staged advancement of several thin cover layers is required, with provision to allow consolidation and strength gain at each stage, to avoid a rotational failure, slumping or a bearing capacity failure near the advancing edge of the cover.

Another problem during cover placement is the potential of sensitive behaviour of the slimes, i.e. a strength loss of the slimes due to a sudden or cyclic loading (e.g. movement of a dozer or installation of band drains). Here the soil structure is partially destroyed and some of the effective stress carried by the soil skeleton is transferred back to excess pore pressures. If a strength loss is observed in sensitive slimes during construction, cover placement may have to be interrupted to allow for dissipation of these new excess pore pressures. This can result in significant delays in the cover placement.

The large settlement of the fine slimes also raises geotechnical issues related to cover integrity and final surface shaping. The overall amount of settlement has a direct bearing on the amount of re-contouring required to achieve the desired final surface shape. In addition settlement is rarely uniform through the slimes owing to local differences in the slimes thickness and/or consolidation characteristics. The resulting differential settlement can significantly compromise the integrity of the cover, in particular, if a complex multi-layer cover is used. If significant differential settlement is anticipated, an interim cover may have to be placed to allow initial settlement.

6.5.2 Benefits of optimal usage of tailings to prepare for open pit closure

The volume of tailings for the proposed backfilling solution is expected to be about 25% more than the volume of slimes placed. This means that as part of the backfilling process, the tailings product closer to the upper levels of the tailings dam can progressively be used and mixed with the slimes and to improve the properties of the slimes whilst ensuring that the slimes containment walls are adequately provided.

7 Conclusions and Recommendations

7.1 Conclusions

The following conclusions can be derived from this study.

- The site visit indicated that the 250m deep pit is showing signs of ongoing break back of the side slopes.
- Review of the Jagersfontein open pit site conditions indicates that there will be ongoing break back of the side slopes of the open pit for a considerable period of time. A number of properties and structures are located within the zone of influence of break back.
- It is impractical and extremely costly to stabilize the pit side slopes. Therefore there are two resulting scenarios.
    1. Peg the proposed break back area on the ground, allowing for the break back zone of influence and then construct a suitable fence around this zone of break back of the open pit. This fenced facility will then have to be maintained in this condition in perpetuity, limiting access to people to this area. The property and other liabilities will have to be resolved between the owners of the open pit and the community, also noting that the community was aware of the open pit, when the residential developments took place in this area, as the open pit presence precedes the community.
    2. Backfill the open pit with the slimes and tailings derived from the current mining endeavours and then close this facility to suit the various Heritage Committee requirements.

7.2 Recommendations

The following recommendations are made:

- Suitable information has been provided in this report for Jagersfontein Developments to quantify their risk profile.

- The implications and liabilities of the various time frames for the different options have to be considered by Jagersfontein Developments, the Jagersfontein Community, the Heritage committee and other stakeholders.

Prepared by

HAC Meintjes Pr Eng

Reviewed by

Dr GC Howell Pr Eng

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Appendices

Appendix A: Stage capacity data

srk consulting	**CLIENT:**	Jagersfontein Development	**PROJECT No.:**	445072	
			SHEET No.:	2 of 3	
	PROJECT:	Jagersfontein Pit: lower slimes content	**DESIGNED:**	MEIN	
			TONNAGE:	122,056	
SRK Consulting JOHANNESBURG	**CHECKED:**		**DATE:**	19 April 2012	

PRODUCTION	122,056	t/month	DENSITY	1.56	$^t/_{m^3}$	PRODUCTION	939,072	$^{m3}/_{year}$

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1157	8.116	8.116		0	0.000	0.000		0.0
1158	25.816	25.816	1	1	0.026	0.026	36.38	0.0
1159	36.966	36.966	1	2	0.037	0.063	25.40	0.1
1160	42.575	42.575	1	3	0.043	0.105	22.06	0.1
1161	46.872	46.872	1	4	0.047	0.152	20.03	0.2
1162	51.436	51.436	1	5	0.051	0.204	18.26	0.2
1163	60.778	60.778	1	6	0.061	0.264	15.45	0.3
1164	65.427	65.427	1	7	0.065	0.330	14.35	0.4
1165	71.372	71.372	1	8	0.071	0.401	13.16	0.4
1166	78.555	78.555	1	9	0.079	0.480	11.95	0.5

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ^{6} m^3	SUM VOLUME x 10 ^{6} m^3	RATE of RISE $^m/_{yr}$	YEAR
1167	81.311	81.311	1	10	0.081	0.561	11.55	0.6
1168	81.646	81.646	1	11	0.082	0.643	11.50	0.7
1169	81.967	81.967	1	12	0.082	0.725	11.46	0.8
1170	82.291	82.291	1	13	0.082	0.807	11.41	0.9
1171	82.618	82.618	1	14	0.083	0.890	11.37	0.9
1172	82.941	82.941	1	15	0.083	0.973	11.32	1.0
1173	83.269	83.269	1	16	0.083	1.056	11.28	1.1
1174	83.595	83.595	1	17	0.084	1.139	11.23	1.2
1175	83.922	83.922	1	18	0.084	1.223	11.19	1.3
1176	84.251	84.251	1	19	0.084	1.308	11.15	1.4
1177	84.577	84.577	1	20	0.085	1.392	11.10	1.5
1178	84.909	84.909	1	21	0.085	1.477	11.06	1.6
1179	85.236	85.236	1	22	0.085	1.562	11.02	1.7
1180	85.567	85.567	1	23	0.086	1.648	10.97	1.8
1181	85.899	85.899	1	24	0.086	1.734	10.93	1.8
1182	86.227	86.227	1	25	0.086	1.820	10.89	1.9
1183	86.563	86.563	1	26	0.087	1.907	10.85	2.0
1184	86.893	86.893	1	27	0.087	1.993	10.81	2.1
1185	87.226	87.226	1	28	0.087	2.081	10.77	2.2
1186	87.562	87.562	1	29	0.088	2.168	10.72	2.3
1187	87.892	87.892	1	30	0.088	2.256	10.68	2.4
1188	88.230	88.230	1	31	0.088	2.344	10.64	2.5
1189	88.564	88.564	1	32	0.089	2.433	10.60	2.6

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1190	88.899	88.899	1	33	0.089	2.522	10.56	2.7
1191	89.238	89.238	1	34	0.089	2.611	10.52	2.8
1192	89.572	89.572	1	35	0.090	2.701	10.48	2.9
1193	89.912	89.912	1	36	0.090	2.791	10.44	3.0
1194	90.250	90.250	1	37	0.090	2.881	10.41	3.1
1195	90.588	90.588	1	38	0.091	2.971	10.37	3.2
1196	90.929	90.929	1	39	0.091	3.062	10.33	3.3
1197	91.266	91.266	1	40	0.091	3.154	10.29	3.4
1198	91.610	91.610	1	41	0.092	3.245	10.25	3.5
1199	91.949	91.949	1	42	0.092	3.337	10.21	3.6
1200	92.290	92.290	1	43	0.092	3.429	10.18	3.7
1201	92.637	92.637	1	44	0.093	3.522	10.14	3.8
1202	92.974	92.974	1	45	0.093	3.615	10.10	3.8
1203	93.322	93.322	1	46	0.093	3.708	10.06	3.9
1204	93.665	93.665	1	47	0.094	3.802	10.03	4.0
1205	94.007	94.007	1	48	0.094	3.896	9.99	4.1
1206	94.357	94.357	1	49	0.094	3.990	9.95	4.2
1207	94.699	94.699	1	50	0.095	4.085	9.92	4.4
1208	95.049	95.049	1	51	0.095	4.180	9.88	4.5
1209	95.394	95.394	1	52	0.095	4.276	9.84	4.6
1210	95.741	95.741	1	53	0.096	4.371	9.81	4.7
1211	96.093	96.093	1	54	0.096	4.467	9.77	4.8
1212	96.437	96.437	1	55	0.096	4.564	9.74	4.9

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m²	AVERAGE AREA x 1 000 m²	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ⁶ m³	SUM VOLUME x 10 ⁶ m³	RATE of RISE m/yr	YEAR
1213	96.792	96.792	1	56	0.097	4.661	9.70	5.0
1214	97.140	97.140	1	57	0.097	4.758	9.67	5.1
1215	97.489	97.489	1	58	0.097	4.855	9.63	5.2
1216	97.844	97.844	1	59	0.098	4.953	9.60	5.3
1217	98.191	98.191	1	60	0.098	5.051	9.56	5.4
1218	98.548	98.548	1	61	0.099	5.150	9.53	5.5
1219	98.900	98.900	1	62	0.099	5.249	9.50	5.6
1220	99.252	99.252	1	63	0.099	5.348	9.46	5.7
1221	99.609	99.609	1	64	0.100	5.448	9.43	5.8
1222	99.960	99.960	1	65	0.100	5.548	9.39	5.9
1223	100.320	100.320	1	66	0.100	5.648	9.36	6.0
1224	100.694	100.694	1	67	0.101	5.749	9.33	6.1
1225	101.081	101.081	1	68	0.101	5.850	9.29	6.2
1226	101.471	101.471	1	69	0.101	5.951	9.25	6.3
1227	101.865	101.865	1	70	0.102	6.053	9.22	6.4
1228	102.264	102.264	1	71	0.102	6.155	9.18	6.6
1229	102.667	102.667	1	72	0.103	6.258	9.15	6.7
1230	103.090	103.090	1	73	0.103	6.361	9.11	6.8
1231	103.504	103.504	1	74	0.104	6.465	9.07	6.9
1232	103.908	103.908	1	75	0.104	6.568	9.04	7.0
1233	104.311	104.311	1	76	0.104	6.673	9.00	7.1
1234	104.723	104.723	1	77	0.105	6.777	8.97	7.2
1235	105.140	105.140	1	78	0.105	6.883	8.93	7.3

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1236	105.557	105.557	1	79	0.106	6.988	8.90	7.4
1237	105.975	105.975	1	80	0.106	7.094	8.86	7.6
1238	106.394	106.394	1	81	0.106	7.201	8.83	7.7
1239	106.812	106.812	1	82	0.107	7.307	8.79	7.8
1240	107.234	107.234	1	83	0.107	7.415	8.76	7.9
1241	107.652	107.652	1	84	0.108	7.522	8.72	8.0
1242	108.075	108.075	1	85	0.108	7.630	8.69	8.1
1243	108.497	108.497	1	86	0.108	7.739	8.66	8.2
1244	108.919	108.919	1	87	0.109	7.848	8.62	8.4
1245	109.345	109.345	1	88	0.109	7.957	8.59	8.5
1246	109.767	109.767	1	89	0.110	8.067	8.56	8.6
1247	110.195	110.195	1	90	0.110	8.177	8.52	8.7
1248	110.622	110.622	1	91	0.111	8.288	8.49	8.8
1249	111.048	111.048	1	92	0.111	8.399	8.46	8.9
1250	111.478	111.478	1	93	0.111	8.510	8.42	9.1
1251	111.907	111.907	1	94	0.112	8.622	8.39	9.2
1252	112.339	112.339	1	95	0.112	8.734	8.36	9.3
1253	112.770	112.770	1	96	0.113	8.847	8.33	9.4
1254	113.201	113.201	1	97	0.113	8.960	8.30	9.5
1255	113.634	113.634	1	98	0.114	9.074	8.26	9.7
1256	114.068	114.068	1	99	0.114	9.188	8.23	9.8
1257	114.503	114.503	1	100	0.115	9.303	8.20	9.9
1258	114.938	114.938	1	101	0.115	9.418	8.17	10.0

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1259	115.373	115.373	1	102	0.115	9.533	8.14	10.2
1260	115.813	115.813	1	103	0.116	9.649	8.11	10.3
1261	116.247	116.247	1	104	0.116	9.765	8.08	10.4
1262	116.688	116.688	1	105	0.117	9.882	8.05	10.5
1263	117.125	117.125	1	106	0.117	9.999	8.02	10.6
1264	117.569	117.569	1	107	0.118	10.116	7.99	10.8
1265	118.008	118.008	1	108	0.118	10.234	7.96	10.9
1266	118.454	118.454	1	109	0.118	10.353	7.93	11.0
1267	118.895	118.895	1	110	0.119	10.472	7.90	11.2
1268	119.339	119.339	1	111	0.119	10.591	7.87	11.3
1269	119.784	119.784	1	112	0.120	10.711	7.84	11.4
1270	120.227	120.227	1	113	0.120	10.831	7.81	11.5
1271	120.675	120.675	1	114	0.121	10.952	7.78	11.7
1272	121.119	121.119	1	115	0.121	11.073	7.75	11.8
1273	121.569	121.569	1	116	0.122	11.194	7.72	11.9
1274	122.019	122.019	1	117	0.122	11.316	7.70	12.1
1275	122.473	122.473	1	118	0.122	11.439	7.67	12.2
1276	122.926	122.926	1	119	0.123	11.562	7.64	12.3
1277	123.381	123.381	1	120	0.123	11.685	7.61	12.4
1278	123.839	123.839	1	121	0.124	11.809	7.58	12.6
1279	124.295	124.295	1	122	0.124	11.933	7.56	12.7
1280	124.752	124.752	1	123	0.125	12.058	7.53	12.8
1281	125.208	125.208	1	124	0.125	12.183	7.50	13.0

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1282	125.665	125.665	1	125	0.126	12.309	7.47	13.1
1283	126.122	126.122	1	126	0.126	12.435	7.45	13.2
1284	126.583	126.583	1	127	0.127	12.562	7.42	13.4
1285	127.043	127.043	1	128	0.127	12.689	7.39	13.5
1286	127.506	127.506	1	129	0.128	12.816	7.36	13.6
1287	127.968	127.968	1	130	0.128	12.944	7.34	13.8
1288	128.430	128.430	1	131	0.128	13.073	7.31	13.9
1289	128.894	128.894	1	132	0.129	13.202	7.29	14.1
1290	129.357	129.357	1	133	0.129	13.331	7.26	14.2
1291	129.825	129.825	1	134	0.130	13.461	7.23	14.3
1292	130.290	130.290	1	135	0.130	13.591	7.21	14.5
1293	130.760	130.760	1	136	0.131	13.722	7.18	14.6
1294	131.229	131.229	1	137	0.131	13.853	7.16	14.8
1295	131.702	131.702	1	138	0.132	13.985	7.13	14.9
1296	132.174	132.174	1	139	0.132	14.117	7.10	15.0
1297	132.651	132.651	1	140	0.133	14.250	7.08	15.2
1298	133.123	133.123	1	141	0.133	14.383	7.05	15.3
1299	133.598	133.598	1	142	0.134	14.516	7.03	15.5
1300	134.067	134.067	1	143	0.134	14.650	7.00	15.6
1301	134.542	134.542	1	144	0.135	14.785	6.98	15.7
1302	135.015	135.015	1	145	0.135	14.920	6.96	15.9
1303	135.490	135.490	1	146	0.135	15.055	6.93	16.0
1304	135.968	135.968	1	147	0.136	15.191	6.91	16.2

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1305	136.441	136.441	1	148	0.136	15.328	6.88	16.3
1306	136.923	136.923	1	149	0.137	15.465	6.86	16.5
1307	137.398	137.398	1	150	0.137	15.602	6.83	16.6
1308	137.880	137.880	1	151	0.138	15.740	6.81	16.8
1309	138.356	138.356	1	152	0.138	15.878	6.79	16.9
1310	138.838	138.838	1	153	0.139	16.017	6.76	17.1
1311	139.316	139.316	1	154	0.139	16.156	6.74	17.2
1312	139.797	139.797	1	155	0.140	16.296	6.72	17.4
1313	140.280	140.280	1	156	0.140	16.437	6.69	17.5
1314	140.763	140.763	1	157	0.141	16.577	6.67	17.7
1315	141.248	141.248	1	158	0.141	16.719	6.65	17.8
1316	141.733	141.733	1	159	0.142	16.860	6.63	18.0
1317	142.216	142.216	1	160	0.142	17.002	6.60	18.1
1318	142.701	142.701	1	161	0.143	17.145	6.58	18.3
1319	143.188	143.188	1	162	0.143	17.288	6.56	18.4
1320	143.675	143.675	1	163	0.144	17.432	6.54	18.6
1321	144.166	144.166	1	164	0.144	17.576	6.51	18.7
1322	144.654	144.654	1	165	0.145	17.721	6.49	18.9
1323	145.150	145.150	1	166	0.145	17.866	6.47	19.0
1324	145.639	145.639	1	167	0.146	18.012	6.45	19.2
1325	146.136	146.136	1	168	0.146	18.158	6.43	19.3
1326	146.626	146.626	1	169	0.147	18.304	6.40	19.5
1327	147.121	147.121	1	170	0.147	18.452	6.38	19.6

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1328	147.619	147.619	1	171	0.148	18.599	6.36	19.8
1329	148.113	148.113	1	172	0.148	18.747	6.34	20.0
1330	148.614	148.614	1	173	0.149	18.896	6.32	20.1
1331	149.111	149.111	1	174	0.149	19.045	6.30	20.3
1332	149.612	149.612	1	175	0.150	19.195	6.28	20.4
1333	150.109	150.109	1	176	0.150	19.345	6.26	20.6
1334	150.612	150.612	1	177	0.151	19.495	6.24	20.8
1335	151.110	151.110	1	178	0.151	19.646	6.21	20.9
1336	151.612	151.612	1	179	0.152	19.798	6.19	21.1
1337	152.115	152.115	1	180	0.152	19.950	6.17	21.2
1338	152.615	152.615	1	181	0.153	20.103	6.15	21.4
1339	153.119	153.119	1	182	0.153	20.256	6.13	21.6
1340	153.623	153.623	1	183	0.154	20.410	6.11	21.7
1341	154.124	154.124	1	184	0.154	20.564	6.09	21.9
1342	154.632	154.632	1	185	0.155	20.718	6.07	22.1
1343	155.136	155.136	1	186	0.155	20.873	6.05	22.2
1344	155.641	155.641	1	187	0.156	21.029	6.03	22.4
1345	156.150	156.150	1	188	0.156	21.185	6.01	22.6
1346	156.656	156.656	1	189	0.157	21.342	5.99	22.7
1347	157.168	157.168	1	190	0.157	21.499	5.97	22.9
1348	157.676	157.676	1	191	0.158	21.657	5.96	23.1
1349	158.190	158.190	1	192	0.158	21.815	5.94	23.2
1350	158.699	158.699	1	193	0.159	21.974	5.92	23.4

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ^{6} m^3	SUM VOLUME x 10 ^{6} m^3	RATE of RISE $^m/_{yr}$	YEAR
1351	159.214	159.214	1	194	0.159	22.133	5.90	23.6
1352	159.727	159.727	1	195	0.160	22.293	5.88	23.7
1353	160.242	160.242	1	196	0.160	22.453	5.86	23.9
1354	160.757	160.757	1	197	0.161	22.614	5.84	24.1
1355	161.275	161.275	1	198	0.161	22.775	5.82	24.3
1356	161.790	161.790	1	199	0.162	22.937	5.80	24.4
1357	162.309	162.309	1	200	0.162	23.099	5.79	24.6
1358	162.826	162.826	1	201	0.163	23.262	5.77	24.8
1359	163.345	163.345	1	202	0.163	23.425	5.75	24.9
1360	163.866	163.866	1	203	0.164	23.589	5.73	25.1
1361	164.386	164.386	1	204	0.164	23.753	5.71	25.3
1362	164.910	164.910	1	205	0.165	23.918	5.69	25.5
1363	165.433	165.433	1	206	0.165	24.084	5.68	25.6
1364	165.956	165.956	1	207	0.166	24.250	5.66	25.8
1365	166.483	166.483	1	208	0.166	24.416	5.64	26.0
1366	167.008	167.008	1	209	0.167	24.583	5.62	26.2
1367	167.536	167.536	1	210	0.168	24.751	5.61	26.4
1368	168.063	168.063	1	211	0.168	24.919	5.59	26.5
1369	168.594	168.594	1	212	0.169	25.087	5.57	26.7
1370	169.122	169.122	1	213	0.169	25.256	5.55	26.9
1371	169.654	169.654	1	214	0.170	25.426	5.54	27.1
1372	170.186	170.186	1	215	0.170	25.596	5.52	27.3
1373	170.719	170.719	1	216	0.171	25.767	5.50	27.4

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ^{6} m^3	SUM VOLUME x 10 ^{6} m^3	RATE of RISE $^m/_{yr}$	YEAR
1374	171.255	171.255	1	217	0.171	25.938	5.48	27.6
1375	171.789	171.789	1	218	0.172	26.110	5.47	27.8
1376	172.327	172.327	1	219	0.172	26.282	5.45	28.0
1377	172.861	172.861	1	220	0.173	26.455	5.43	28.2
1378	173.396	173.396	1	221	0.173	26.629	5.42	28.4
1379	173.929	173.929	1	222	0.174	26.803	5.40	28.5
1380	174.465	174.465	1	223	0.174	26.977	5.38	28.7
1381	174.999	174.999	1	224	0.175	27.152	5.37	28.9
1382	175.536	175.536	1	225	0.176	27.328	5.35	29.1
1383	176.069	176.069	1	226	0.176	27.504	5.33	29.3
1384	176.605	176.605	1	227	0.177	27.680	5.32	29.5
1385	177.133	177.133	1	228	0.177	27.857	5.30	29.7
1386	177.663	177.663	1	229	0.178	28.035	5.29	29.9
1387	178.190	178.190	1	230	0.178	28.213	5.27	30.0
1388	178.714	178.714	1	231	0.179	28.392	5.25	30.2
1389	179.245	179.245	1	232	0.179	28.571	5.24	30.4
1390	179.770	179.770	1	233	0.180	28.751	5.22	30.6
1391	180.303	180.303	1	234	0.180	28.931	5.21	30.8
1392	180.826	180.826	1	235	0.181	29.112	5.19	31.0
1393	181.354	181.354	1	236	0.181	29.293	5.18	31.2
1394	181.877	181.877	1	237	0.182	29.475	5.16	31.4
1395	182.402	182.402	1	238	0.182	29.658	5.15	31.6
1396	182.925	182.925	1	239	0.183	29.841	5.13	31.8

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE m/yr	YEAR
1397	183.444	183.444	1	240	0.183	30.024	5.12	32.0
1398	183.964	183.964	1	241	0.184	30.208	5.10	32.2
1399	184.478	184.478	1	242	0.184	30.393	5.09	32.4
1400	184.992	184.992	1	243	0.185	30.578	5.08	32.6
1401	185.500	185.500	1	244	0.185	30.763	5.06	32.8
1402	186.002	186.002	1	245	0.186	30.949	5.05	33.0
1403	186.497	186.497	1	246	0.186	31.136	5.04	33.2
1404	187.031	187.031	1	247	0.187	31.323	5.02	33.4
1405	187.561	187.561	1	248	0.188	31.510	5.01	33.6
1406	188.038	188.038	1	249	0.188	31.698	4.99	33.8
1407	188.479	188.479	1	250	0.188	31.887	4.98	34.0
1408	188.940	188.940	1	251	0.189	32.076	4.97	34.2
1409	189.572	189.572	1	252	0.190	32.265	4.95	34.4
1410	190.440	190.440	1	253	0.190	32.456	4.93	34.6

SRK Consulting JOHANNESBURG	CLIENT:	Jagersfontein Development	PROJECT No.:	445072
			SHEET No.:	2 of 3
	PROJECT:	Jagersfontein Pit: higher slimes content	DESIGNED:	MEIN
			TONNAGE:	147,168
	CHECKED:		DATE:	19 April 2012

PRODUCTION	147,168	t/month	DENSITY	1.42	$^{t}/_{m^3}$	PRODUCTION	1,240,416	$^{m3}/_{year}$

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^{m}/_{yr}$	YEAR
1157	8.116	8.116		0	0.000	0.000		0.0
1158	25.816	25.816	1	1	0.026	0.026	48.05	0.0
1159	36.966	36.966	1	2	0.037	0.063	33.56	0.1
1160	42.575	42.575	1	3	0.043	0.105	29.13	0.1
1161	46.872	46.872	1	4	0.047	0.152	26.46	0.1
1162	51.436	51.436	1	5	0.051	0.204	24.12	0.2
1163	60.778	60.778	1	6	0.061	0.264	20.41	0.2
1164	65.427	65.427	1	7	0.065	0.330	18.96	0.3
1165	71.372	71.372	1	8	0.071	0.401	17.38	0.3
1166	78.555	78.555	1	9	0.079	0.480	15.79	0.4
1167	81.311	81.311	1	10	0.081	0.561	15.26	0.5
1168	81.646	81.646	1	11	0.082	0.643	15.19	0.5

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1169	81.967	81.967	1	12	0.082	0.725	15.13	0.6
1170	82.291	82.291	1	13	0.082	0.807	15.07	0.7
1171	82.618	82.618	1	14	0.083	0.890	15.01	0.7
1172	82.941	82.941	1	15	0.083	0.973	14.96	0.8
1173	83.269	83.269	1	16	0.083	1.056	14.90	0.9
1174	83.595	83.595	1	17	0.084	1.139	14.84	0.9
1175	83.922	83.922	1	18	0.084	1.223	14.78	1.0
1176	84.251	84.251	1	19	0.084	1.308	14.72	1.1
1177	84.577	84.577	1	20	0.085	1.392	14.67	1.1
1178	84.909	84.909	1	21	0.085	1.477	14.61	1.2
1179	85.236	85.236	1	22	0.085	1.562	14.55	1.3
1180	85.567	85.567	1	23	0.086	1.648	14.50	1.3
1181	85.899	85.899	1	24	0.086	1.734	14.44	1.4
1182	86.227	86.227	1	25	0.086	1.820	14.39	1.5
1183	86.563	86.563	1	26	0.087	1.907	14.33	1.5
1184	86.893	86.893	1	27	0.087	1.993	14.28	1.6
1185	87.226	87.226	1	28	0.087	2.081	14.22	1.7
1186	87.562	87.562	1	29	0.088	2.168	14.17	1.7
1187	87.892	87.892	1	30	0.088	2.256	14.11	1.8
1188	88.230	88.230	1	31	0.088	2.344	14.06	1.9
1189	88.564	88.564	1	32	0.089	2.433	14.01	2.0
1190	88.899	88.899	1	33	0.089	2.522	13.95	2.0
1191	89.238	89.238	1	34	0.089	2.611	13.90	2.1

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1192	89.572	89.572	1	35	0.090	2.701	13.85	2.2
1193	89.912	89.912	1	36	0.090	2.791	13.80	2.2
1194	90.250	90.250	1	37	0.090	2.881	13.74	2.3
1195	90.588	90.588	1	38	0.091	2.971	13.69	2.4
1196	90.929	90.929	1	39	0.091	3.062	13.64	2.5
1197	91.266	91.266	1	40	0.091	3.154	13.59	2.5
1198	91.610	91.610	1	41	0.092	3.245	13.54	2.6
1199	91.949	91.949	1	42	0.092	3.337	13.49	2.7
1200	92.290	92.290	1	43	0.092	3.429	13.44	2.8
1201	92.637	92.637	1	44	0.093	3.522	13.39	2.8
1202	92.974	92.974	1	45	0.093	3.615	13.34	2.9
1203	93.322	93.322	1	46	0.093	3.708	13.29	3.0
1204	93.665	93.665	1	47	0.094	3.802	13.24	3.1
1205	94.007	94.007	1	48	0.094	3.896	13.19	3.1
1206	94.357	94.357	1	49	0.094	3.990	13.15	3.2
1207	94.699	94.699	1	50	0.095	4.085	13.10	3.3
1208	95.049	95.049	1	51	0.095	4.180	13.05	3.4
1209	95.394	95.394	1	52	0.095	4.276	13.00	3.4
1210	95.741	95.741	1	53	0.096	4.371	12.96	3.5
1211	96.093	96.093	1	54	0.096	4.467	12.91	3.6
1212	96.437	96.437	1	55	0.096	4.564	12.86	3.7
1213	96.792	96.792	1	56	0.097	4.661	12.82	3.8
1214	97.140	97.140	1	57	0.097	4.758	12.77	3.8

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE m/yr	YEAR
1215	97.489	97.489	1	58	0.097	4.855	12.72	3.9
1216	97.844	97.844	1	59	0.098	4.953	12.68	4.0
1217	98.191	98.191	1	60	0.098	5.051	12.63	4.1
1218	98.548	98.548	1	61	0.099	5.150	12.59	4.2
1219	98.900	98.900	1	62	0.099	5.249	12.54	4.2
1220	99.252	99.252	1	63	0.099	5.348	12.50	4.3
1221	99.609	99.609	1	64	0.100	5.448	12.45	4.4
1222	99.960	99.960	1	65	0.100	5.548	12.41	4.5
1223	100.320	100.320	1	66	0.100	5.648	12.36	4.6
1224	100.694	100.694	1	67	0.101	5.749	12.32	4.6
1225	101.081	101.081	1	68	0.101	5.850	12.27	4.7
1226	101.471	101.471	1	69	0.101	5.951	12.22	4.8
1227	101.865	101.865	1	70	0.102	6.053	12.18	4.9
1228	102.264	102.264	1	71	0.102	6.155	12.13	5.0
1229	102.667	102.667	1	72	0.103	6.258	12.08	5.0
1230	103.090	103.090	1	73	0.103	6.361	12.03	5.1
1231	103.504	103.504	1	74	0.104	6.465	11.98	5.2
1232	103.908	103.908	1	75	0.104	6.568	11.94	5.3
1233	104.311	104.311	1	76	0.104	6.673	11.89	5.4
1234	104.723	104.723	1	77	0.105	6.777	11.84	5.5
1235	105.140	105.140	1	78	0.105	6.883	11.80	5.5
1236	105.557	105.557	1	79	0.106	6.988	11.75	5.6
1237	105.975	105.975	1	80	0.106	7.094	11.70	5.7

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ^{6} m^3	SUM VOLUME x 10 ^{6} m^3	RATE of RISE $^m/_{yr}$	YEAR
1238	106.394	106.394	1	81	0.106	7.201	11.66	5.8
1239	106.812	106.812	1	82	0.107	7.307	11.61	5.9
1240	107.234	107.234	1	83	0.107	7.415	11.57	6.0
1241	107.652	107.652	1	84	0.108	7.522	11.52	6.1
1242	108.075	108.075	1	85	0.108	7.630	11.48	6.2
1243	108.497	108.497	1	86	0.108	7.739	11.43	6.2
1244	108.919	108.919	1	87	0.109	7.848	11.39	6.3
1245	109.345	109.345	1	88	0.109	7.957	11.34	6.4
1246	109.767	109.767	1	89	0.110	8.067	11.30	6.5
1247	110.195	110.195	1	90	0.110	8.177	11.26	6.6
1248	110.622	110.622	1	91	0.111	8.288	11.21	6.7
1249	111.048	111.048	1	92	0.111	8.399	11.17	6.8
1250	111.478	111.478	1	93	0.111	8.510	11.13	6.9
1251	111.907	111.907	1	94	0.112	8.622	11.08	7.0
1252	112.339	112.339	1	95	0.112	8.734	11.04	7.0
1253	112.770	112.770	1	96	0.113	8.847	11.00	7.1
1254	113.201	113.201	1	97	0.113	8.960	10.96	7.2
1255	113.634	113.634	1	98	0.114	9.074	10.92	7.3
1256	114.068	114.068	1	99	0.114	9.188	10.87	7.4
1257	114.503	114.503	1	100	0.115	9.303	10.83	7.5
1258	114.938	114.938	1	101	0.115	9.418	10.79	7.6
1259	115.373	115.373	1	102	0.115	9.533	10.75	7.7
1260	115.813	115.813	1	103	0.116	9.649	10.71	7.8

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1261	116.247	116.247	1	104	0.116	9.765	10.67	7.9
1262	116.688	116.688	1	105	0.117	9.882	10.63	8.0
1263	117.125	117.125	1	106	0.117	9.999	10.59	8.1
1264	117.569	117.569	1	107	0.118	10.116	10.55	8.2
1265	118.008	118.008	1	108	0.118	10.234	10.51	8.3
1266	118.454	118.454	1	109	0.118	10.353	10.47	8.3
1267	118.895	118.895	1	110	0.119	10.472	10.43	8.4
1268	119.339	119.339	1	111	0.119	10.591	10.39	8.5
1269	119.784	119.784	1	112	0.120	10.711	10.36	8.6
1270	120.227	120.227	1	113	0.120	10.831	10.32	8.7
1271	120.675	120.675	1	114	0.121	10.952	10.28	8.8
1272	121.119	121.119	1	115	0.121	11.073	10.24	8.9
1273	121.569	121.569	1	116	0.122	11.194	10.20	9.0
1274	122.019	122.019	1	117	0.122	11.316	10.17	9.1
1275	122.473	122.473	1	118	0.122	11.439	10.13	9.2
1276	122.926	122.926	1	119	0.123	11.562	10.09	9.3
1277	123.381	123.381	1	120	0.123	11.685	10.05	9.4
1278	123.839	123.839	1	121	0.124	11.809	10.02	9.5
1279	124.295	124.295	1	122	0.124	11.933	9.98	9.6
1280	124.752	124.752	1	123	0.125	12.058	9.94	9.7
1281	125.208	125.208	1	124	0.125	12.183	9.91	9.8
1282	125.665	125.665	1	125	0.126	12.309	9.87	9.9
1283	126.122	126.122	1	126	0.126	12.435	9.84	10.0

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1284	126.583	126.583	1	127	0.127	12.562	9.80	10.1
1285	127.043	127.043	1	128	0.127	12.689	9.76	10.2
1286	127.506	127.506	1	129	0.128	12.816	9.73	10.3
1287	127.968	127.968	1	130	0.128	12.944	9.69	10.4
1288	128.430	128.430	1	131	0.128	13.073	9.66	10.5
1289	128.894	128.894	1	132	0.129	13.202	9.62	10.6
1290	129.357	129.357	1	133	0.129	13.331	9.59	10.7
1291	129.825	129.825	1	134	0.130	13.461	9.55	10.9
1292	130.290	130.290	1	135	0.130	13.591	9.52	11.0
1293	130.760	130.760	1	136	0.131	13.722	9.49	11.1
1294	131.229	131.229	1	137	0.131	13.853	9.45	11.2
1295	131.702	131.702	1	138	0.132	13.985	9.42	11.3
1296	132.174	132.174	1	139	0.132	14.117	9.38	11.4
1297	132.651	132.651	1	140	0.133	14.250	9.35	11.5
1298	133.123	133.123	1	141	0.133	14.383	9.32	11.6
1299	133.598	133.598	1	142	0.134	14.516	9.28	11.7
1300	134.067	134.067	1	143	0.134	14.650	9.25	11.8
1301	134.542	134.542	1	144	0.135	14.785	9.22	11.9
1302	135.015	135.015	1	145	0.135	14.920	9.19	12.0
1303	135.490	135.490	1	146	0.135	15.055	9.16	12.1
1304	135.968	135.968	1	147	0.136	15.191	9.12	12.2
1305	136.441	136.441	1	148	0.136	15.328	9.09	12.4
1306	136.923	136.923	1	149	0.137	15.465	9.06	12.5

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1307	137.398	137.398	1	150	0.137	15.602	9.03	12.6
1308	137.880	137.880	1	151	0.138	15.740	9.00	12.7
1309	138.356	138.356	1	152	0.138	15.878	8.97	12.8
1310	138.838	138.838	1	153	0.139	16.017	8.93	12.9
1311	139.316	139.316	1	154	0.139	16.156	8.90	13.0
1312	139.797	139.797	1	155	0.140	16.296	8.87	13.1
1313	140.280	140.280	1	156	0.140	16.437	8.84	13.3
1314	140.763	140.763	1	157	0.141	16.577	8.81	13.4
1315	141.248	141.248	1	158	0.141	16.719	8.78	13.5
1316	141.733	141.733	1	159	0.142	16.860	8.75	13.6
1317	142.216	142.216	1	160	0.142	17.002	8.72	13.7
1318	142.701	142.701	1	161	0.143	17.145	8.69	13.8
1319	143.188	143.188	1	162	0.143	17.288	8.66	13.9
1320	143.675	143.675	1	163	0.144	17.432	8.63	14.1
1321	144.166	144.166	1	164	0.144	17.576	8.60	14.2
1322	144.654	144.654	1	165	0.145	17.721	8.58	14.3
1323	145.150	145.150	1	166	0.145	17.866	8.55	14.4
1324	145.639	145.639	1	167	0.146	18.012	8.52	14.5
1325	146.136	146.136	1	168	0.146	18.158	8.49	14.6
1326	146.626	146.626	1	169	0.147	18.304	8.46	14.8
1327	147.121	147.121	1	170	0.147	18.452	8.43	14.9
1328	147.619	147.619	1	171	0.148	18.599	8.40	15.0
1329	148.113	148.113	1	172	0.148	18.747	8.37	15.1

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10 ^{6} m^3	SUM VOLUME x 10 ^{6} m^3	RATE of RISE $^m/_{yr}$	YEAR
1330	148.614	148.614	1	173	0.149	18.896	8.35	15.2
1331	149.111	149.111	1	174	0.149	19.045	8.32	15.4
1332	149.612	149.612	1	175	0.150	19.195	8.29	15.5
1333	150.109	150.109	1	176	0.150	19.345	8.26	15.6
1334	150.612	150.612	1	177	0.151	19.495	8.24	15.7
1335	151.110	151.110	1	178	0.151	19.646	8.21	15.8
1336	151.612	151.612	1	179	0.152	19.798	8.18	16.0
1337	152.115	152.115	1	180	0.152	19.950	8.15	16.1
1338	152.615	152.615	1	181	0.153	20.103	8.13	16.2
1339	153.119	153.119	1	182	0.153	20.256	8.10	16.3
1340	153.623	153.623	1	183	0.154	20.410	8.07	16.5
1341	154.124	154.124	1	184	0.154	20.564	8.05	16.6
1342	154.632	154.632	1	185	0.155	20.718	8.02	16.7
1343	155.136	155.136	1	186	0.155	20.873	8.00	16.8
1344	155.641	155.641	1	187	0.156	21.029	7.97	17.0
1345	156.150	156.150	1	188	0.156	21.185	7.94	17.1
1346	156.656	156.656	1	189	0.157	21.342	7.92	17.2
1347	157.168	157.168	1	190	0.157	21.499	7.89	17.3
1348	157.676	157.676	1	191	0.158	21.657	7.87	17.5
1349	158.190	158.190	1	192	0.158	21.815	7.84	17.6
1350	158.699	158.699	1	193	0.159	21.974	7.82	17.7
1351	159.214	159.214	1	194	0.159	22.133	7.79	17.8
1352	159.727	159.727	1	195	0.160	22.293	7.77	18.0

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1353	160.242	160.242	1	196	0.160	22.453	7.74	18.1
1354	160.757	160.757	1	197	0.161	22.614	7.72	18.2
1355	161.275	161.275	1	198	0.161	22.775	7.69	18.4
1356	161.790	161.790	1	199	0.162	22.937	7.67	18.5
1357	162.309	162.309	1	200	0.162	23.099	7.64	18.6
1358	162.826	162.826	1	201	0.163	23.262	7.62	18.8
1359	163.345	163.345	1	202	0.163	23.425	7.59	18.9
1360	163.866	163.866	1	203	0.164	23.589	7.57	19.0
1361	164.386	164.386	1	204	0.164	23.753	7.55	19.1
1362	164.910	164.910	1	205	0.165	23.918	7.52	19.3
1363	165.433	165.433	1	206	0.165	24.084	7.50	19.4
1364	165.956	165.956	1	207	0.166	24.250	7.47	19.5
1365	166.483	166.483	1	208	0.166	24.416	7.45	19.7
1366	167.008	167.008	1	209	0.167	24.583	7.43	19.8
1367	167.536	167.536	1	210	0.168	24.751	7.40	20.0
1368	168.063	168.063	1	211	0.168	24.919	7.38	20.1
1369	168.594	168.594	1	212	0.169	25.087	7.36	20.2
1370	169.122	169.122	1	213	0.169	25.256	7.33	20.4
1371	169.654	169.654	1	214	0.170	25.426	7.31	20.5
1372	170.186	170.186	1	215	0.170	25.596	7.29	20.6
1373	170.719	170.719	1	216	0.171	25.767	7.27	20.8
1374	171.255	171.255	1	217	0.171	25.938	7.24	20.9
1375	171.789	171.789	1	218	0.172	26.110	7.22	21.0

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE m/yr	YEAR
1376	172.327	172.327	1	219	0.172	26.282	7.20	21.2
1377	172.861	172.861	1	220	0.173	26.455	7.18	21.3
1378	173.396	173.396	1	221	0.173	26.629	7.15	21.5
1379	173.929	173.929	1	222	0.174	26.803	7.13	21.6
1380	174.465	174.465	1	223	0.174	26.977	7.11	21.7
1381	174.999	174.999	1	224	0.175	27.152	7.09	21.9
1382	175.536	175.536	1	225	0.176	27.328	7.07	22.0
1383	176.069	176.069	1	226	0.176	27.504	7.05	22.2
1384	176.605	176.605	1	227	0.177	27.680	7.02	22.3
1385	177.133	177.133	1	228	0.177	27.857	7.00	22.5
1386	177.663	177.663	1	229	0.178	28.035	6.98	22.6
1387	178.190	178.190	1	230	0.178	28.213	6.96	22.7
1388	178.714	178.714	1	231	0.179	28.392	6.94	22.9
1389	179.245	179.245	1	232	0.179	28.571	6.92	23.0
1390	179.770	179.770	1	233	0.180	28.751	6.90	23.2
1391	180.303	180.303	1	234	0.180	28.931	6.88	23.3
1392	180.826	180.826	1	235	0.181	29.112	6.86	23.5
1393	181.354	181.354	1	236	0.181	29.293	6.84	23.6
1394	181.877	181.877	1	237	0.182	29.475	6.82	23.8
1395	182.402	182.402	1	238	0.182	29.658	6.80	23.9
1396	182.925	182.925	1	239	0.183	29.841	6.78	24.1
1397	183.444	183.444	1	240	0.183	30.024	6.76	24.2
1398	183.964	183.964	1	241	0.184	30.208	6.74	24.4

CONTOUR VALUE m.a.m.s.l.	AREA x 1 000 m^2	AVERAGE AREA x 1 000 m^2	HEIGHT m	CUMULATIVE HEIGHT m	VOLUME x 10^6 m^3	SUM VOLUME x 10^6 m^3	RATE of RISE $^m/_{yr}$	YEAR
1399	184.478	184.478	1	242	0.184	30.393	6.72	24.5
1400	184.992	184.992	1	243	0.185	30.578	6.71	24.7
1401	185.500	185.500	1	244	0.185	30.763	6.69	24.8
1402	186.002	186.002	1	245	0.186	30.949	6.67	25.0
1403	186.497	186.497	1	246	0.186	31.136	6.65	25.1
1404	187.031	187.031	1	247	0.187	31.323	6.63	25.3
1405	187.561	187.561	1	248	0.188	31.510	6.61	25.4
1406	188.038	188.038	1	249	0.188	31.698	6.60	25.6
1407	188.479	188.479	1	250	0.188	31.887	6.58	25.7
1408	188.940	188.940	1	251	0.189	32.076	6.57	25.9
1409	189.572	189.572	1	252	0.190	32.265	6.54	26.0
1410	190.440	190.440	1	253	0.190	32.456	6.51	26.2

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