A COMPETENT PERSONS REPORT ON THE KAGEM EMERALD MINE, ZAMBIA, 2017

Prepared For

Pallinghurst Resources Limited

Report Prepared by

srk consulting

SRK Consulting (UK) Limited
UK7367

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EXECUTIVE SUMMARY
A COMPETENT PERSONS REPORT ON THE KAGEM EMERALD MINE, ZAMBIA, 2017

1 INTRODUCTION

SRK Consulting (UK) Limited (SRK) is an associate company of the international group holding company, SRK Global Limited (the SRK Group). SRK has been commissioned by Pallinghurst Resources Ltd ("Pallinghurst"), hereinafter also referred to as the "Company" or the "Client" to undertake an update of the Competent Persons Reports (CPRs) for the assets of Gemfields Plc ("Gemfields") that SRK authored in 2015. Gemfields is now a 100% subsidiary of Pallinghurst. This CPR is on the Kagem Emerald and Beryl Mine ("Kagem", the "Mine" or the "Kagem Mine") in Zambia. Kagem Mining Ltd is the project operator and is 75% owned by Gemfields.

SRK has been requested by Pallinghurst to base the CPR on the Kagem life of mine plan ("LoMp") reviewed and adjusted by SRK where appropriate. This CPR has been prepared to support the reporting and sign off by SRK of Mineral Resources and Mineral Reserve estimates for the Kagem Mine in accordance with the SAMREC Code.

The Lead Competent Person (CP) with overall responsibility for this CPR is Mr Mike Beare CEng BEng ACSM MIMMM, a Corporate Consultant (Mining Engineering) with SRK. Mr Beare has 23 years' experience in the mining industry and has been extensively involved in the reporting of Mineral Reserves on various diamond and gemstone projects during his career to date. The CP confirms that this Executive Summary is a true reflection of the full CPR.

2 PROJECT DESCRIPTION

The Kagem Mine comprises the current operating Chama open pit mine and the bulk sampling pits at Libwente and Fibolele. The Chama open pit produces emerald and beryl bearing ore for processing at the processing plant. Existing surface infrastructure at the Mine area includes:

- access roads;
- operational wash plant
- operational emerald sorting house;
- mine camp, accommodation and offices; and
- equipment maintenance facilities and stores.

The existing workforce consists of approximately 652 personnel including technical and operational employees.

The Mine is situated in the Ndola Rural District, Copperbelt Province, Zambia, approximately 260 km north of Lusaka, the capital city of Zambia as presented in Figure ES 1 and Figure ES 2. Located at latitude 13°04'S and longitude 28°08'E at an elevation of 1,200 m above mean sea level ("amsl"), the site is some 31 km south-southwest of the Copperbelt town of Kitwe and the licence is bisected by the administrative boundary between Ndola Rural District and Luanshya District. The site is accessed along a combination of national (10 km south of Kitwe to Fisenge along the M4) and local (22 km) southwest towards the settlement of Sempala, a total travelled distance of 32 km. Sempala has a population of some 1,225 within a 7 km radius and is located in the northernmost corner of the licence area, and is situated in the GMT +2 time zone.

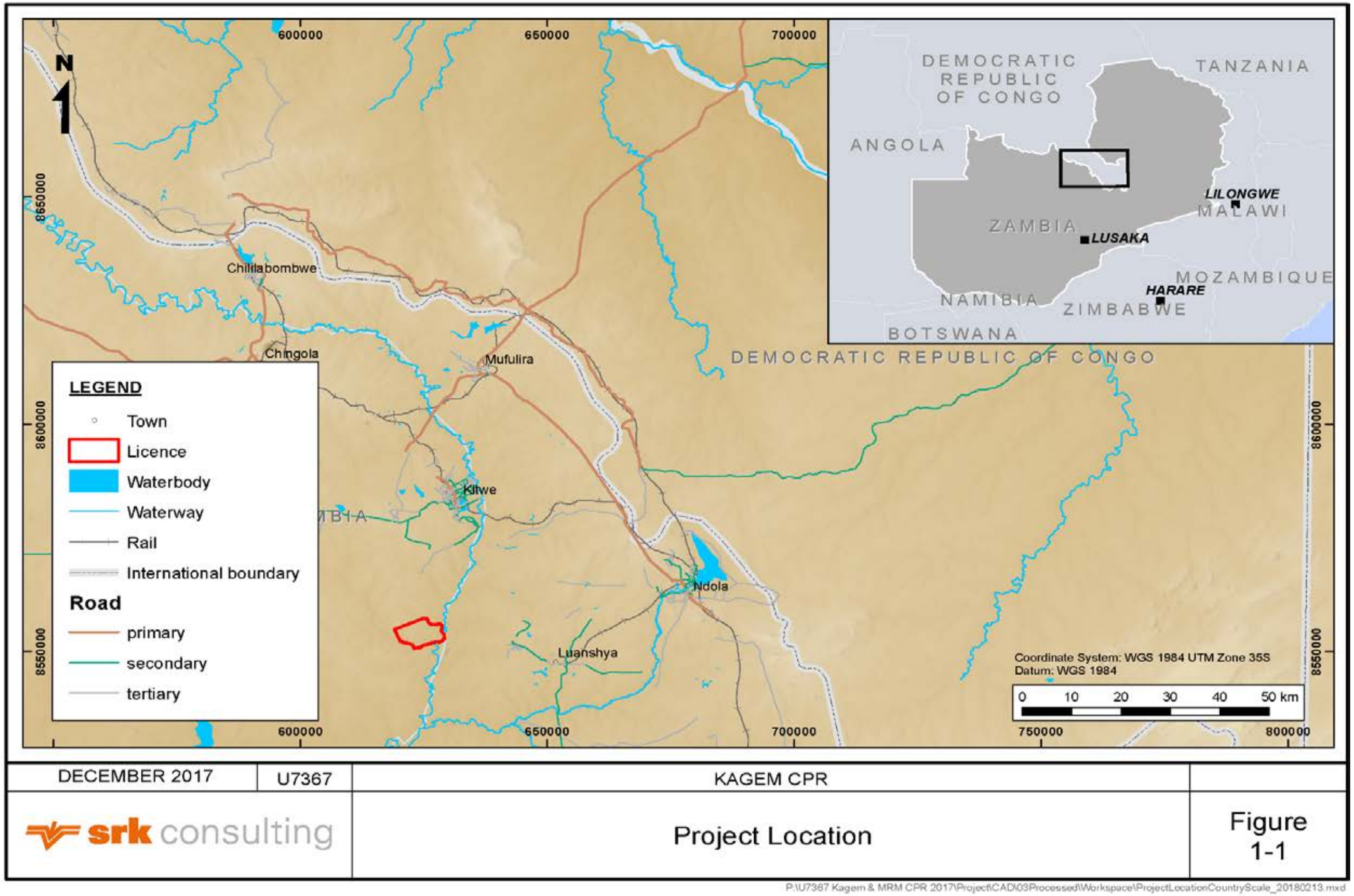

Figure ES 1: Project Location

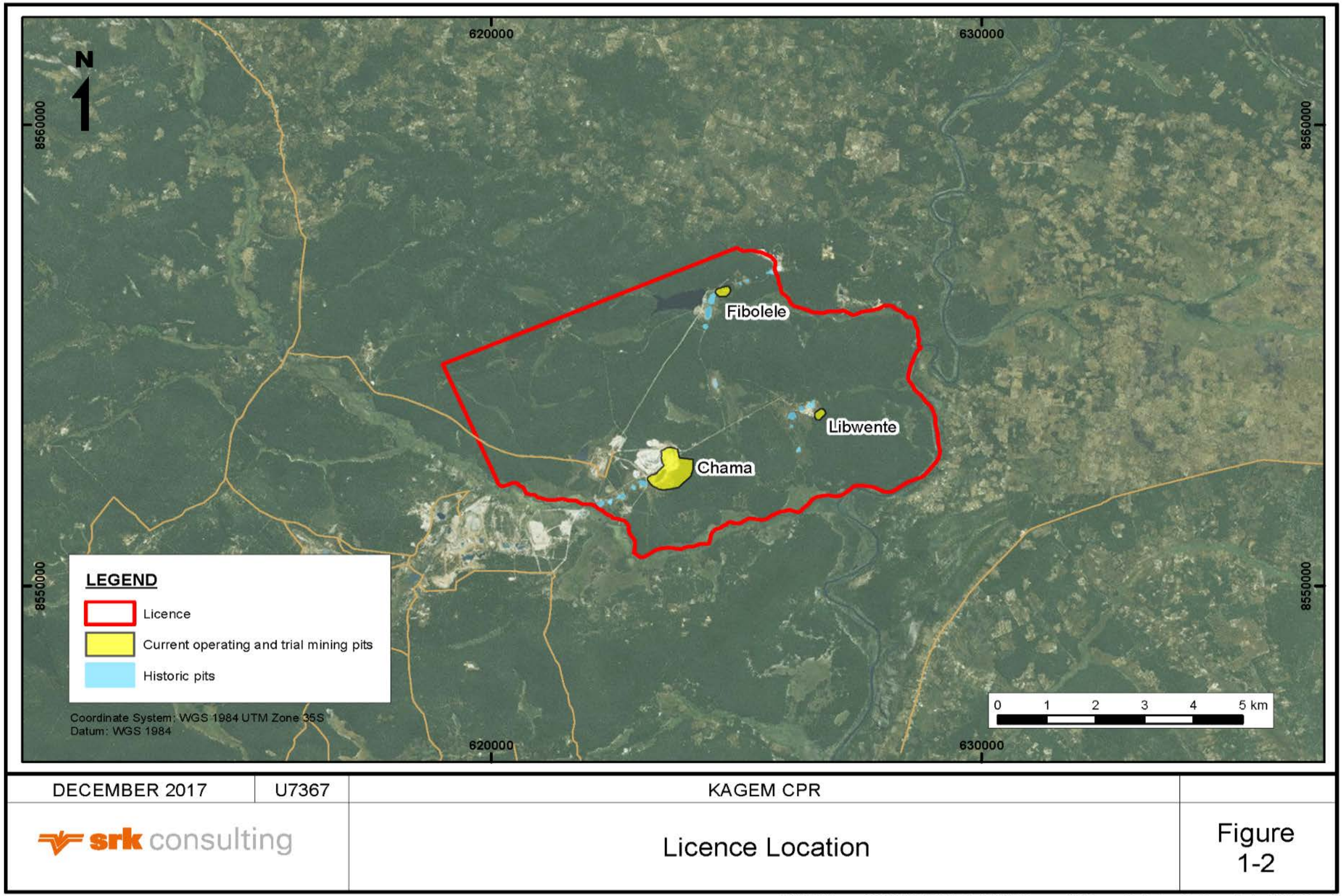

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Figure ES 2: Licence Location

3 GEOLOGY

3.1 Deposit Geology and Mineralisation

The Kagem Mine, which comprises three separate deposits, namely Chama, Libwente and Fibolele is situated in the Ndola Rural Emerald Restricted Area (NRERA) within the Kafubu area of the Copperbelt Province of Zambia. The currently defined emerald and beryl deposits of the Mine are hosted by talc-magnetite schists (“TMS”) of the Muva Supergroup. Broadly, the stratigraphy of the Chama deposit can be described (from bottom to top) in terms of footwall mica schist, overlain by TMS, amphibolite (“AMP”) and quartz-mica schist of the Muva Supergroup. The whole sequence is intruded by steeply dipping discordant and locally concordant quartz-feldspar pegmatite (“PEG”) dykes and quartz-tourmaline veins. Although there are local differences in the average thickness of individual units, the stratigraphic sequences at both Fibolele and Libwente are largely similar to that described for Chama. That said, some key distinctions exist, most notably at Fibolele, where the AMP horizon in the hangingwall of the TMS unit is absent.

The Chama, Libwente and Fibolele deposits form part of a semi-regional scale tight-isoclinal fold system, which trends northeast or east-northeast, ranging in dip from near flat-lying to up to 60° to the southeast or south-southeast, and is locally offset by a series of predominantly north-northwest striking structures. The suite of PEG dykes and quartz-tourmaline veins that intrude the stratigraphic succession throughout the Kagem deposits occupy a range of trends, both concordant and discordant to the local stratigraphy. At Chama, the majority of discordant dykes strike north or north-northwest, dipping at around 50° to 75° towards east-northeast. The discordant dykes and veins at Libwente and Fibolele occupy the same trend set, striking north-northwest, but with a steeper, typically sub-vertical dip.

Emerald and beryl mineralisation in the Kafubu area, including the Kagem deposits, belongs to a group referred to as “schist-hosted emeralds”, relating to the interaction of Be-bearing fluids relating to pegmatoid dykes or granitic rocks, with Cr-rich mafic and ultramafic schists or weakly metamorphosed ultramafic rocks. At the Mine, emerald and beryl mineralisation is hosted by the ultramafic TMS unit, with three main styles of mineralisation recognised:

- discordant reaction zone (RZ) material adjacent to the PEG and quartz-tourmaline vein contacts;
- concordant RZ material concentrated along the footwall and rarely the hangingwall contacts of the TMS unit; and
- discordant RZs hosted by brittle structures within the TMS unit distal to the PEG and quartz-tourmaline veins.

3.2 Data Quantity and Quality

The main exploration methods being employed at the Kagem Mine include diamond drilling, and bulk sampling from trial pits, most of which has been undertaken since 1998. This key data is supplemented by geological mapping of the main operating open pit at Chama and the trial mining pits at Fibolele and Libwente, in addition to some airborne geophysical survey maps. Diamond drilling is primarily aimed at determining the nature and geometry of the TMS units and PEG dykes / quartz-tourmaline veins. The main exploration tool used to determine emerald grade and quality is through current open-pit mining operations at Chama, and trial mining at Fibolele and Libwente. The grade of each deposit is determined through recovered emerald quantity and quality data from the sort house. The approximate exploration expenditure completed to date is given in Table ES 1.

Table ES 1: Approximate Exploration Expenditure to June 2017 (Source: Kagem)

Item	Cost (USD)
Drilling (Diamond)	2,436,220
Geophysics Surveys (Airborne and Ground Based)	7,151
Core Photography	1,000
Handheld XRF/ LIBS and other core analysis (as applicable)	62,265
Consultancy (e.g. thin sections, geophysics, optical sorting etc)	132,000
Total	**2,638,636**

The CP has not been supplied with any specific exploration programmes for the three deposits which form the focus of the Kagem Mine. Any further drilling is likely to be operational in nature, and provided for in the sustaining capital provision, and / or operating costs. Furthermore, The CP has not been supplied with any anticipated greenfield exploration programmes which fall outside the confines of the Kagem Mine.

Drilling to date, across the three deposit areas in question (Chama, Fibolele and Libwente), comprises a total of 707 drillholes for a total meterage of 67,457.60 m. This includes 348 holes for 35,771 m at Chama, 117 holes for 9,875 m at Fibolele and 242 holes for 21,810 m at Libwente. All drillholes are diamond core holes.

Grade and quality data for Chama comes from production data derived from the open-pit mining operation, which has been Gemfields main operational focus since acquiring the Kagem licence in 2008. Available production data for Fibolele comes from a single main bulk sampling pit, which has been in operation since August 2012, and from which, to date more than 2,000,000 tonnes of material has been removed. Two bulk sampling pits are currently in operation in the Libwente deposit area: Libwente South and Ishuko. Of the two currently operating pits, production data is only presently available for Libwente South, from which more than 1,350,000 tonnes of material has been removed since July 2014. At the time of writing, the Ishuko pit is still at the waste stripping stage.

Gemfields has put in place a logical logging and data capture procedure for diamond drilling, to guide the on-site staff through the technical process. This aims to ensure a consistent methodology for the process of capturing data throughout the drilling campaign to allow for subsequent meaningful analysis. All logging is carried out by Gemfields geologists, and the CP considers the methodologies in place to be consistent with normal industry practice for this commodity type. That being said,the CP has made a number of recommendations to Gemfields to improve the logging process going forward.

The CP completed a brief review of the drillhole databases for the respective deposits and summary logging of a series of drillholes during the most recent site visit completed in June 2015. The CP's review suggests that the geological information being recorded by Gemfields geologists is of a good quality, lithological identifications are consistent and downhole contact depths have been captured to an appropriate level of accuracy. That being said, the CP notes that there is a degree of inconsistency between the logging of the older, pre-2008 holes and more recent drilling with the latter being carried out to a superior standard compared to what was applied in the past.

3.3 Mineral Resources

Mineral Resource models were constructed, estimated and classified independently for the Chama, Fibolele and Libwente areas. All geological modelling was undertaken in ARANZ Leapfrog Geo software, with grade and tonnage estimates being completed in either GEMS or Datamine, as relevant.

3.3.1 Geological Modelling

A similar geological modelling process was conducted for each of the Chama, Fibolele and Libwente deposits, as described below:

1. construction of a TMS model, through sectional polyline interpretations of the TMS footwall and hangingwall. TMS and RZ logging codes were used as an explicit control on the TMS model geometry, with downhole Niton XRF chromium grades used to refine the contact surfaces where appropriate.
2. development of a discordant PEG model. At Fibolele and Libwente this was completed through a manual process of creating interval selections of PEG / quartz-tourmaline vein intersections considered to form part of individual dykes or veins, and subsequent modelling using the Leapfrog vein tool. At Chama, the discordant PEG model was generated using a Leapfrog indicator interpolation of all discordant PEG intersections, applying a trend guided by a series of surfaces based on downhole PEG trends and geological mapping within the open pit. The discordant PEG models were cut from the TMS solids.
3. two RZ domains were constructed: one to define the TMS footwall RZ (concordant), and another based on areas where the PEG model is in contact with the TMS model (discordant).

To define the basis for the footwall RZ model, all logged RZ intervals at the base of the TMS solid volumes were manually selected and assigned a footwall RZ code. RZ hangingwall surfaces were then generated from the hangingwall points of the footwall RZ interval selection, using the TMS footwall surface as a framework to guide the trend of the model. The Fibolele concordant RZ model comprises solid volumes at both the footwall and hangingwall of the TMS unit, whilst the Chama and Libwente concordant RZ models only comprise a footwall volume.

The discordant RZ models were created as a buffer around the discordant PEG models and within the TMS unit. The discordant RZ thickness was adjusted on a deposit basis in order for the ratio of combined concordant and discordant RZ volume relative to modelled TMS volume above the most recent pit survey wireframes to reflect the RZ to TMS ratio in the Gemfields production analysis for each pit to date.

3.3.2 Grade and Tonnage Estimation

The CP used a block model to quantify the volume, tonnage, and grade of the modelled RZs. The volumes of the discordant and concordant RZs were defined from the geological model. The tonnage was estimated using an average density value of 2.85 g/cm^3. The anticipated grade of emerald and beryl and their relative importance, is based on the extrapolation of the recovery of these minerals from the tonnage of RZ processed during the period covered by the historical mining production statistics. The minimum size (bottom cut-off) of stone which can be recovered from the wash plant is 3 mm. Accordingly, given the complexity associated with the estimation of individual RZ tonnage as well as the concentration of emerald and beryl within such RZs, the CP has based the current Mineral Resource estimate on what is effectively a large-scale bulk sample combined with the geological interpretation of the TMS, PEG and RZ lithological units as described above.

3.3.3 Mineral Resource Classification

The CP notes that the exploration and production activities completed by Gemfields have significantly improved the geological knowledge and understanding of the deposits; however, the derivation of Mineral Resources is largely dependent on the availability of the results of bulk samples or equivalent such as historical production statistics. This provides the confidence in the grade of the individual deposit, and therefore the contained gemstones in the estimate.

In order to develop a classification scheme for the Mineral Resources at Kagem, the CP has taken the following factors into account:

- quantity and quality of the underlying data, the level of geological understanding for each deposit, and across the property as a whole;
- confidence in the geological continuity of the TMS, PEGs, and RZ;
- confidence in the grades, as derived from the production/bulk sampling, and the understanding of the grade variation at a given production scale;
- the stage of development for each deposit (such as exploration, production, care and maintenance, etc.); and
- the perceived level of risk associated with deviations from the assumptions made.

3.3.4 Mineral Resource Statement

The Mineral Resource Statements for Chama, Fibolele and Libwente are included in Table ES 2:. The Competent Person with overall responsibility for reporting of the Mineral Resource is Dr Lucy Roberts, MAusIMM (CP), a Principal Consultant (Resource Geology) with SRK. Dr Roberts has the relevant experience in reporting Mineral Resources on various coloured gemstone projects. The CP considers that the Mineral Resource Statements, as presented in Table ES 1 are reported in accordance with the SAMREC Code (2016).

In reporting the Mineral Resources for the Kagem area, the CP notes the following:

- Mineral Resources are quoted at appropriate economic cut-off grades which satisfy the requirement of ‘potentially economically mineable’ for open-pit mining; furthermore, the commodity prices incorporated into the cut-off grade calculations for derivation of optimised shells are USD3.90 /ct which is an average price for all carats.

- The average value of the beryl and emerald, as reported in the Mineral Resource Statement is USD4.56 /ct. The value of the different product splits, are as follows:
  - Premium Emerald and Emerald – USD15.66 /ct; and
  - Beryl (Beryl 1 and Beryl 2) - USD0.07 /ct.
- Mineral Resources are quoted with a bottom cut-off size of 3mm, which is consistent with what can be recovered in the plant, and picked by hand from the belts.
- in addition, the CP has also completed a pit optimisation exercise which quantifies the amount of material which is likely to be mined using open pit methods. The optimised pits were derived using the same input parameters as those in the mining study (Section 7), but with a commodity price which reflects an optimistic view. In the case of the Kagem Mine deposits, a price of USD3.90 /ct was applied;
- all Mineral Resources are quoted at 100%, and derivation of attributable Mineral Resources would necessitate application of the Company's 75% equity interest; and
- all total grades quoted reflect beryl and emerald combined, expressed as carats per tonne. For the Measured and Indicated Mineral Resources, the product splits are consistent used for those forecasted in the TEM. "PE&E" is Premium Emerald and Emerald combined, and "Beryl" is Beryl-1 and Beryl-2 combined. One carat is defined as 0.2 g. Conversely, this equates to a conversion factor of 5 carats per gram.

As at 31 December 2017, the CP notes that the Chama beryl and emerald deposit has Measured Mineral Resources, of 700 kt of RZ material, grading at 283 ct/t B&E, and an Indicated Mineral Resource of 3,700 kt of RZ material, grading at 304 ct/t B&E. There are no Inferred Mineral Resources reported at Chama, as mineralisation with lower confidence occurs below the reporting shell used to define the Mineral Resources. At Fibolele, the declared Mineral Resources comprise 140 kt of RZ material, grading at 119 ct/t B&E, classified as Indicated, and 1,420 kt of RZ material, grading at 119 ct/t B&E, classified as Inferred Mineral Resources. At Libwente, the Inferred Mineral Resources consist of 200 kt of RZ material, grading at 46 ct/t B&E. Fibolele and Libwente are considered satellite deposits to the main Chama operation.

Table ES 2: Mineral Resource Statements, as of 31 December 2017, for the Chama, Fibolele and Libwente Beryl and Emerald Deposits

Deposit	Classification	Tonnage (kt)	PE+E Grade (ct/t)	Beryl Grade (ct/t)	B+E Grade (ct/t)	Contained Carats (ct ,000)
Chama	Measured Mineral Resources	700	83	200	283	198,000
	Indicated Mineral Resources	3,700	89	215	304	1,124,000
	Inferred Mineral Resources	-	-	-	-	-
	Measured + Indicated	**4,400**	**88**	**213**	**300**	**1,322,000**
Fibolele	Measured Mineral Resources	-	-	-	-	-
	Indicated Mineral Resources	140	25	94	119	16,500
	Inferred Mineral Resources	1,420	0	0	119	169,400
	Measured + Indicated	**140**	**25**	**94**	**119**	**16,500**
Libwente	Measured Mineral Resources	-	-	-	-	
	Indicated Mineral Resources	-	-	-	-	-
	Inferred Mineral Resources	200	-	-	46	9,100
	Measured + Indicated	**-**	-	-	**-**	**-**
Total	Measured Mineral Resources	700	83	200	283	198,000
	Indicated Mineral Resources	3,840	87	210	297	1,140,500
	Inferred Mineral Resources	1,620	-	-	110	178,500
	Measured + Indicated	**4,540**	**86**	**209**	**295**	**1,338,500**

4 GEOTECHNICAL STUDIES

The purpose of the geotechnical study is to assess the engineering characteristics of the rock mass that will form the highwall of the Chama Pit and use this information to carry out kinematic and rock mass stability analyses to develop overall slope design parameters for the ultimate pit that satisfy specific stability and failure probability criteria.

The data used for this study has been gathered from the following sources:

1. a pit slope stability study carried out by African Mining Consultants (AMC) in 2008;
2. an underground scoping study carried out by SRK in 2008;
3. a programme of laboratory testing carried out to support the AMC and SRK 2008 studies;
4. an underground feasibility study carried out by SRK in 2012; and
5. a geotechnical site visit carried out in June 2015 which included detailed pit inspections, the collection of discontinuity data for existing pit wall exposure and geotechnical logging of a selection of cored resource boreholes.

The main lithological units that form the current Chama Pit are:

- weathered quartz mica schist ("QMS" or "MS");
- fresh QMS;
- AMP; and
- TMS.

The fresh rock masses are generally strong to very strong and contain widely spaced joints. The mica schist has a dominant foliation discontinuity that dips into the pit wall. These lithologies are classified a fair to good rock masses. Sub-vertical, east-west striking PEGs (PEG) occur throughout the rock mass. Thin, sheared RZs within which the gemstones are found occur at the base of the TMS (concordant RZs) or at the contact between the TMS and the PEG intrusions (discordant RZs). The PEGs weather rapidly on exposure. The PEG and RZs are classified as good to poor rock masses depending on degree of weathering and shearing respectively.

The current pit wall is over 115 m high at an angle of between 50 and 53°. The current design slope formed of 10 m high benches, battered at 75° with a 3 m wide berm in fresh rock below 1170m RL and 10 m high benches, battered at 70° with a 4m wide berm in the weathered rock above this RL. This results in an overall slope angle of 58°. There are currently no stability problems in the active pit; however, a groundwater seepage line is visible at about 60 m below the pit crest.

Kinematic analyses were undertaken to determine the optimum bench configuration. Based on the joint sets identified by pit mapping the analysis confirmed that there was limited potential for joint controlled instability and a 3 m wide catch berm was adequate to retain any block failure volumes that may become detached from the bench faces.

Finite element modelling was undertaken to determine the stability of the overall highwall. Sensitivity analyses were undertaken with respect to overall slope angle, overall slope height and inferred ground water condition. Probability of failure (P(f)) was calculated using the bivariate point estimate method. This considered the potential variability of the rock mass conditions one standard deviation above and below the average rock mass conditions. Based on internationally accepted slope design acceptance criteria the CP defined minimum acceptance criteria of factor of safety (FoS) of 1.3 and P(f) of 15% for operational slopes (that is incremental cut back slopes) and FoS of 1.6 and P(f) of 8% for final closure slopes.

The results of the sensitivity analyses were synthesised to produce a slope height:slope angle chart that satisfied both operational and closure slope stability acceptance criteria. This graph is presented as Figure ES 3 and represents an un-drained slope condition.

The modelling carried out indicated that the Pushback 5 design slope, at an overall height of 150 m and overall angle of 58°, is slightly steeper than the design recommendation. However the achieved angles of the interim slopes are generally slightly flatter than designed, particularly when incorporating the hangingwall ramp and therefore conform to the design recommendation. The CP notes that all future interim slopes and final slope should be laid out to the design recommendations presented in Figure ES 3.

The modelling indicated that the stability of the overall slopes was very sensitive to the location of the phreatic surface. The analyses carried out were based on a phreatic surface being located just behind the pit wall at the point where surface seepage was noted. When the phreatic surface was placed 20 to 30m behind the slope, the FoS of the slope increased by between 30 and 50%.

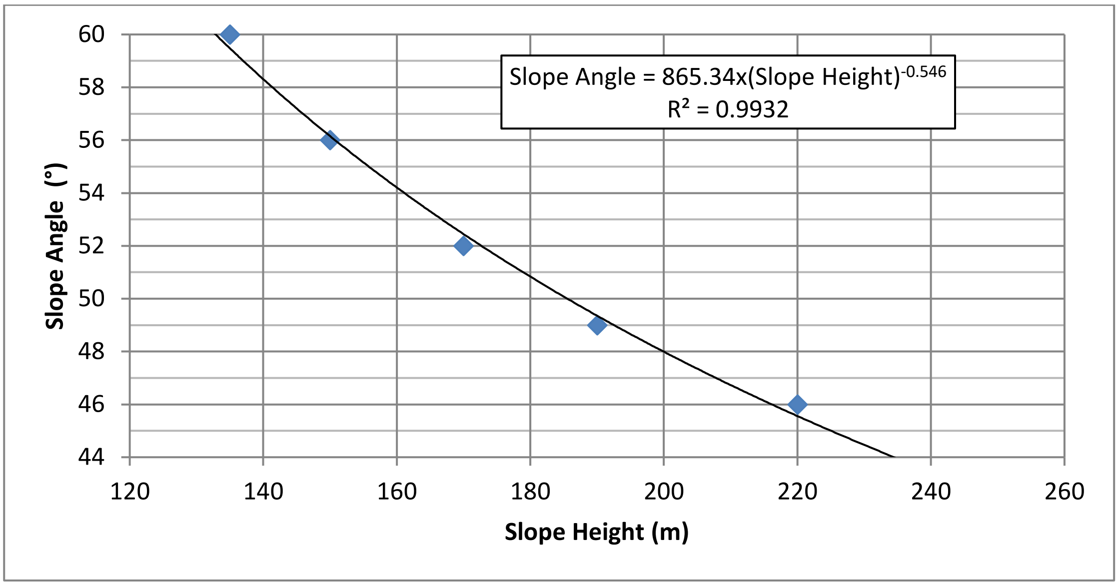

Figure ES 3: Slope Design Chart for Chama Pit

Pit optimisation runs were carried out using a 46° overall slope initially which was considered to be the limiting slope angle related to maximum slope height and closure requirements. Geotechnical verification analyses were then carried out on the ultimate pit design and the overall slope angle adjusted to conform to the closure slope stability acceptance criteria. The final slope design utilised an overall angle of 51° comprising 10 m high benches, battered at 75° in the fresh rock with a 5.5 m wide berm.

5 MINING

5.1 Current Operation

The mining operations at Kagem comprise a number of historically mined open-pits as well as the current open-pit operations situated mainly in the Chama Pit area and the bulk sampling operations at the Libwente and Fibolele areas. The mining method comprises conventional open-pit operations: drill and blast, excavate and load and haul to in-pit backfill, waste rock dump locations and the various ex-pit stockpiles and a stockpile at the wash plant facility. Mining is undertaken by a combination of Kagem owned in-house fleet and contractor mining fleets. The upper 20-30 m of weathered material is free dig with the remainder of the waste rock requires drilling and blasting.

Based on recent production data (Jan 2017 – Dec 2017), Kagem currently extracts total rock at an annualised rate of 9.8 Mtpa from the Chama Pit, with mined RZ mineralisation contributing 120 ktpa of ore. The associated average stripping ratio is estimated at 91 t_{waste}:t_{ore}. Bulk sampling scale operations have been undertaken at the Fibolele and Libwente areas in the past but the present focus is on ore production from the Chama pit. To date, a total of 70.9 Mt of material has been mined from Chama, producing 834 kt of ore. At present, all ore excavation and haulage is undertaken by a Kagem operated fleet which consists mainly of 30 t articulated dump trucks supported by medium sized backhoe excavators and bull dozers.

5.2 Future Operations

In its LoMp, the Kagem operation at the Chama Pit is planning to ramp up ore production from 120 ktpa in the current year to 130 ktpa over a 4-year period. The Fibolele pit will be mined intermittently to cover shortfalls in carat production at the Chama pit. The principal strategic targets for the Chama Pit comprise mining a number of additional cutbacks up to a practical and economic open pit limit, to provide a significant mine life and improve the confidence in the mineralisation along strike of the orebody in lower strip ratio zones.

The principle targets for Fibolele are to expand ore production to 30 ktpa which will be included as ore feed to the Kagem Mine wash plant. This production will focus on the Indicated region of the deposit, whilst additional exploration is completed on the deeper parts. Mining at Fibolele will be undertaken by the Kagem in-house fleet.

The CP considers this to be achievable and appropriate for the orebodies as currently defined.

All mining will be undertaken in-house at a rate of approximately 11.0 Mtpa of rock at the Chama Pit, ramping up to 11.5 MTpa. The current mining fleet is appropriate for the mining requirements for the first 9 years, after which increased haulage distances require additional trucks.

5.3 Modifying Factors

The CP has estimated the planned and operational mining dilution and ore recovery based on the current operating practice at the Kagem Mine and historic reconciliation data.

The estimated modifying factors are summarised below:

- planned dilution and ore losses estimated to be 0%;
- the RZs are quite continuous and generally do not contain internal waste;
- this allows the waste to be planned distinctly separate from the ore; and
- all RZs that are encountered are planned to be mined.
- operational RZ dilution estimated to be 15%, based on the following historic tonnage reconciliation:
- historic reconciliation shows that the diluted RZ ore is consistently approximately 11-12% of the TMS by tonnage;
- the 2015 SRK Chama Resource Model in situ tonnages show the RZ to be 9.5% of the TMS by tonnage;
- a 15% dilution increases the 2015 Resource Model in situ tonnages (9.5% of TMS) to close to the historic diluted RZ to TMS proportions of 11-12%;
- operational mining loss is 0%; and
- no RZ is left behind in the pit, and is easily identifiable by the production geologists and equipment operators.

5.4 Mineral Reserves

The CP has estimated Mineral Reserves in accordance with the SAMREC Code. These are presented in Table ES 3. As at 31 December 2017, the CP notes that the Kagem emerald and beryl deposit has Mineral Reserves, as presented in accordance with the SAMREC Code consisting of 3,354 kt of RZ material grading at 256 ct/t emerald at Chama Pit, and 144 kt of RZ material grading at 103 ct/t emerald at Fibolele Pit. Based on an average long term price of USD3.30 /ct the corresponding average operating cut-off grade is estimated at 120.0 ct/t_{ore}.

Table ES 3: Kagem Mineral Reserve Statement, as at 31 December 2017, for the Kagem Emerald and Beryl Deposits

Classification	Mineralisation Type	Tonnage (kt_{dry})	PE+E Grade (ct/t)	Beryl Grade (ct/t)	B+E Grade (ct/t)	Contained Carats (kct)
Proved						
Chama	RZ	749	73	176	249	186,615
Fibolele	RZ	0	0	0	0	0
Total Proved	RZ	749	73	176	249	186,615
Probable						
Chama	RZ	2,604	75	181	256	671,629
Fibolele	RZ	144	22	81	103	14,888
Total Probable	RZ	2,748	72	176	250	686,517
Proved & Probable						
Chama	RZ	3,354	75	181	256	858,244
Fibolele	RZ	144	22	81	103	14,888
Total Proved & Probable	RZ	3,498	73	177	250	873,132

The average value of the beryl and emerald, as reported in the Mineral Reserve Statement is USD4.56 /ct. The value of the different product splits, are as follows:

- Premium Emerald and Emerald – USD15.66 /ct; and
- Beryl (Beryl 1 and Beryl 2) - USD0.07 /ct.

The Competent Person ("CP") with overall responsibility for reporting of Mineral Reserves is Mr Mike Beare CEng BEng ACSM MIMMM, a Corporate Consultant (Mining Engineering) with SRK. Mr Beare has 26 years' experience in the mining industry and has been extensively involved in the reporting of Mineral Reserves on various diamond and gemstone projects during his career to date.

6 PROCESSING

The washing plant at the Kagem Mine consists of a series of comminution, screening, washing and sorting facilities which are located close to the current mining activities in the Fwaya-Fwaya area. The plant currently in operation was commissioned in 2006 and has an operating capacity of approximately 330 ktpa of ore.

Ore is fed into the feed bin using an excavator or small wheel loader. The bin has a grizzly that removes +300 mm material, which is stored to the north of the RoM pad. A further grizzly allows -100 mm material to by-pass the primary (jaw) crusher. At the double deck vibrating screen, the +60 mm oversize material is directed to the secondary crusher operating in open circuit.

The double deck screen operates wet, and the -3 mm fines from the double deck vibrating screen (approximately 35% of the feed mass) are directed to the fines storage area in the valley to the west of the plant. The product from the double deck screen (+3 mm, -60 mm) is fed to a triple deck screen that separates the material into three product streams for hand picking: +3 mm -6 mm, +6 mm -30 mm and +30 mm -60 mm. Each stream is directed to individual picking belts; the +30 mm is split to feed two belts. The prospective emerald and beryl stones are picked off the belt by hand and dropped in a drop safe type box similar to that used at the mining faces. The nominal capacity of the washing plant is 70 tph.

The washing plant products, together with the high quality product directly recovered from the Mine, are sent to the secure sort house facility. The prospective beryl and emerald gemstones are sorted and graded using manual methods. The sorting house is a high security area and access is controlled. The drop-type safe type boxes from the Mine and the plant are weighed, with all material being monitored on a mass-balance type recording system from this point onwards, they are then opened and emeralds are picked out from the remaining material which is then washed and tumbled. Products from this material are also picked and the fines and waste separated. Where necessary, the product is chipped to grade the gemstone and further lightly tumbled and cleaned. The product gemstones from this process are sized into six size classes, then sorted in to the following categories: premium emerald; (standard) emerald; beryl-1; and beryl-2. The two emerald products are further graded, then these and the beryl-1 product are dried, dressed with oil, weighed, catalogued and stored for evaluation and subsequent export to Lusaka (or otherwise) for auction.

Kagem has doubled the potential capacity of the wash plant, by duplicating the picking belts. The circuit upstream of the picking belts has been assessed as being capable of handling the additional capacity, although conveyor 3 is upgraded with a wider belt and larger motor, and the raw water supply line has been upgraded.

This upgrade has sufficient capacity at the Kagem wash plant to handle the on-going production from the Chama pit (approximately 100-120 ktpa), the projected production from the re-start of the Mbuva-Chibolele pits (also approximately 100-120 ktpa), as well as the various bulk sampling operations at Fibolele and others. The maximum capacity of the upgraded plant is expected to be 330 ktpa. This expansion will require the addition of 90 operational and supervisory staff. The budgeted cost for this expansion was USD1.02 M.

Kagem is also considering installing an additional primary crusher that will be capable of handling the largest size rocks produced by the mining operation, i.e. up to 700 mm. This crusher will handle both on-going production, as well as being able to process the stockpiled oversize (+300 -700 mm) material over time.

7 INFRASTRUCTURE

The Mine is well served with infrastructure. The site is accessed by good quality gravel roads which connect to the main highway. Power is sourced from the national transmission grid to transformers at the camp and wash plant. Backup diesel generators are used when the fixed connection is interrupted to ensure operations remain unaffected. Process and non-potable water at the Mine is sourced from river water, and potable water is provided by treated ground water.

8 ENVIRONMENTAL AND SOCIAL

The description of the environmental and social elements of the project are based on a site visit in 2015 and a subsequent review of updated Environmental Impact Assessment documentation and permits. The CP have reviewed the available documentation to assess compliance of Kagem with applicable Zambian environmental and social legislation, performance relative to good international industry practice, including the SAMESG Guideline, appropriateness of existing management systems and CSR activities, environmental and social issues, risks and liabilities and appropriateness of closure planning and cost estimates. The review also provided recommendations for improvement to existing management measures.

The Mine is located in a relatively remote, and thus less disturbed, part of the Zambian Copperbelt with miombo woodland, dambos and perennial rivers. The closest village is Pirala, situated about 5 km south of the original Mine. Immediately north of the Fibolele Pit is the village of Sempala. This appears to be associated with the Grizzley Mine on the northern border of the Kagem Concession. There are no settlements within the concession area itself, although some level of sporadic illegal mining activities and charcoal burning are taking place.

According to the annual audits required to be undertaken on behalf of the Zambia Environmental Management Agency (“ZEMA”) and the Mineral Safety Department (“MSD”), the Company’s operation is in compliance with the requirements of Zambian environmental legislation and existing licence conditions. Kagem submitted an application to ZEMA, for environmental clearance to expand the Fibolele exploration pit from bulk sampling to a larger scale open pit in 2016. The subsequent EIS was approved in November 2016.

Kagem is in the process of standardising its environmental management system and developing site specific management measures in line with Gemfields corporate requirements, which are reasonably well aligned with good international industry practice (“GIIP”). In support of this, it is expanding its human resources to proactively address environmental and social management. This process is being driven by the Group Sustainability Manager at Gemfields. Whilst more could still be done, most of the potential environmental and social impacts and current EMP non-compliances evident at the site can be reduced to acceptable levels through management measures that are not difficult to implement and are known to be reliable.

In addition to getting the systems and plans in place as outlined above, key factors to be addressed going forward include:

- Systematically implement the requirements of the ‘new’ EMP that was approved as part of the EIS in 2016; this will need to be cognisant of the twenty six conditions attached to the EIA approval;
- formalising stakeholder engagement and community development initiatives and ensuring corporate social investment focuses on sustainable outcomes;
- ensuring compliance with EMP conditions;
- improving the understanding of surface and groundwater regimes in the area by expanding the parameters monitored, increasing the number of sampling sites and undertaking a hydrogeological assessment;
- incorporating the voluntary principles into Kagem’s security policies, procedures and contracts and implementing these at Kagem’s operations; and

- developing an end of life of mine closure plan and cost estimate in addition to the current financial assurance closure cost estimate using appropriate rates and in accordance with GIIP.

Environmental and social risks identified for the Mine include:

- delays or disruption to mining activities by ZEMA caused by non-conformances to the EMP or permit conditions. This is, however, considered unlikely as the Mine is demonstrating it is undertaking measures to ensure on-going improvement; and
- potential reputational risks associated if the voluntary principles are not properly incorporated into policies, contracts and practices.

In the CP's view, these risks are manageable if the appropriate and timeous action is taken and will bring the operation into general conformance with GIIP.

In consideration of all legal aspects relating to the Mine, the CP has placed reliance on the representations by the Company and Kagem that the following are correct as at 31st July 2017:

- the Directors of the Company and Kagem are not aware of any legal proceedings that may have an influence on the rights to explore or mine for gemstones;
- that the Company and their subsidiaries are the legal owners of all mineral and surface rights relating to the Mine; and
- no significant legal issue exists which would affect the likely viability of the Mine and/or on the estimation and classification of the Mineral Resources and Mineral Reserves as reported herein.

9 RISKS AND OPPORTUNITIES

Kagem is subject to certain inherent risks and opportunities, which apply to some degree to all participants of the international mining industry. These include:

- Commodity Price Fluctuations;
- Foreign Exchange and CPI Risk;
- Country Risk;
- Legislative Risk;
- Mineral Reserve Estimation Risk;
- Water Management Risk;
- Environmental and Social Risks; and
- Economic Performance Risk.

The principal opportunities with respect to Kagem are largely constrained to:

- Mineral Resource;
- Mineral Reserves; and
- Plant Throughput.

The risk and opportunity assessment undertaken for Kagem and specifically the current LoMp and accompanying Mineral Reserves, indicates that there are opportunities to substantially increase the current Mineral Resource through further exploration. The principal risks which require management to mitigate their negative impacts are as follows:

- **legislative and permitting risk:** Kagem should maintain the current good relations with government to ensure permits are approved in a timely manner and to lobby for no negative changes to the mining fiscal regime or export regulations;
- **Mineral reserve estimation risk:** the expected variation in mined grade from month to month requires some buffering between production and sales activities. Kagem has a significant quantity of rough gemstones in a secure storage facility on surface equivalent to approximately one year's production to meet this objective. The CP considers this to be adequate, but has also recommended that mining blocks are delineated with further sampling prior to mining to predict future production more accurately:
- **water management:** hydrogeological investigations are required to assess long-term water requirements and careful day-to-day management is necessary to ensure that zero discharge of silty water to the environment is maintained; and
- **environmental and social risks:** Kagem has made significant efforts to maintain good relations in the local communities through a number of social initiatives. The CP considers that the approach being applied is appropriate but needs to be maintained and enhanced through to be effective in the medium to long term.

10 FINANCIAL

For the economic analysis, the CV has constructed an independent technical economic model ("TEM") for the Mine. This economic analysis has been undertaken in accordance with the SAMVAL code to determine the "Intrinsic Value" of the Kagem Mine Mineral Reserves as part of this CPR and is not a market valuation of the Company. This CPR has been prepared to support the reporting and sign-off by SRK's CP's of Mineral Resources and Mineral Reserve estimates for the Mine in accordance with the SAMREC Code as requested by the Client. The Client requires the CPR at the request of the JSE following the recent acquisition of Gemfields.

The valuation date of this TEM is 31 December 2017 to align with reporting date of the Mineral Reserves. Further as this is economic analysis is estimating the "Intrinsic Value" value of the Mines Mineral Reserves the valuation has been prepared and presented on a 100% basis for the Mine and does not reflect the value attributable to Pallinghurst. Again, it is noted that the Mine is effectively 75% owned by Gemfields which in turn is 100% owned by Pallinghurst.

The SRK team has considered a base case scenario initially targeting 120 ktpa building up to 130 ktpa in year 4 from Chama Pit Production of 30 ktpa from Fibolele Pit is scheduled to supplement periods of low grade mining from the Chama Pit in 2030 with the remainder scheduled after the depletion of Chama pit. The life of Chama pit is 27 years, with Fibolele contributing in 5 years, depleting in the year 2047.

The Base Case reflects production, capital and operating expenditures and revenues from 31 December 2017 through to 2047 on an annual basis. Total ore treated over the LoM amounts to 3.4 Mt at an average grade of 256 ct/t from Chama pit and 0.14 Mt at an average grade of 103 ct/t from Fibolele pit.

The TEM is based on the production schedule derived by the SRK team with adjustments based on the respective CP's views on the forecast capital and operating costs. In addition, the TEM:

- based on an income approach with discounted cash flow analysis undertaken on estimated future cash flows;
  - the CP notes that a market approach was not considered due to the lack of similar comparable market transactions to allow a comparative valuation;
  - As Kagem is an operating concern that has generated significant positive cashflows a cost to date approach was also not considered;
- is expressed in real terms; this means un-inflated United States Dollars (USD) with no allowances for inflation on capital or operating costs, inputs or revenues, real terms escalation will be considered where appropriate;
- is presented at December 2017 money terms for Net Present Value ("NPV") calculation purposes;
- applies a Base Case discount rate of 10%;
  - The CP considers a 10% discount rate to be appropriate for this type of mine within the jurisdiction it is operating. NPV values are also presented at 8% and 12% discount rates;
- is based on historical commodity prices achieved at auctions by Gemfields;
- is expressed in post-tax and pre-financing terms and assumes 100% equity;
- a base Corporate tax rate of 30 %, as per the standard GoZ corporate tax rate for mining operations, has been used; and
- royalties are included at 6% of revenue as per the standard GoZ royalty rate for gemstone mining.

In respect of the commodity price, the CP has not undertaken a detailed price analysis, but in discussion with Gemfields has relied on the historical auction results in this regard. The average price achieved at the high quality auctions for the period 2015 to 2017 has been USD64.63/ct. All premium emeralds and 18% of emeralds are sold at the high quality auction. The average price achieved at the low quality auctions for the same period has been USD4.19/ct for the lower quality emeralds (82%). Note that Beryl products are not sold at these auctions. Price forecast for Beryl I, based on historical direct sales, is USD0.11/ct and the estimate for the Beryl II product is 0.006/ct as estimated by Gemfields. The CP consider the premium emerald and emerald product forecasts based on historical average prices achieved to be acceptable for these products. With forecast revenue from Beryl products amounting to 1% of LoM revenue the CP considers there to be negligible risk from Gemfields beryl price forecasts and consider them acceptable.

The LoMp assumes that overall ore production from all sources will be 3,498 kt. Over the life of mine based on the current Measured and Indicated Resource, it is planned to produce 0.889 Mct, and will generate USD4,049 M in gross revenue.

Operating costs have been based on the Client's historical costs in the 2017 year. Average total operating costs are estimated at USD339.16 /t treated, with total operating costs amounting to USD1,186 M over the LoM.

Total capital expenditure is estimated to be USD216 M over the LoM. Capital for engineering and mining has been estimated at USD109 M. Sustaining capital for the on-going operations is estimated at USD87 M. Closure costs of USD20 M are included.

Figure ES 4 provides an analysis of project cashflow over the life of mine. Table ES 4 provides a summary of the key financial parameters from the TEM.

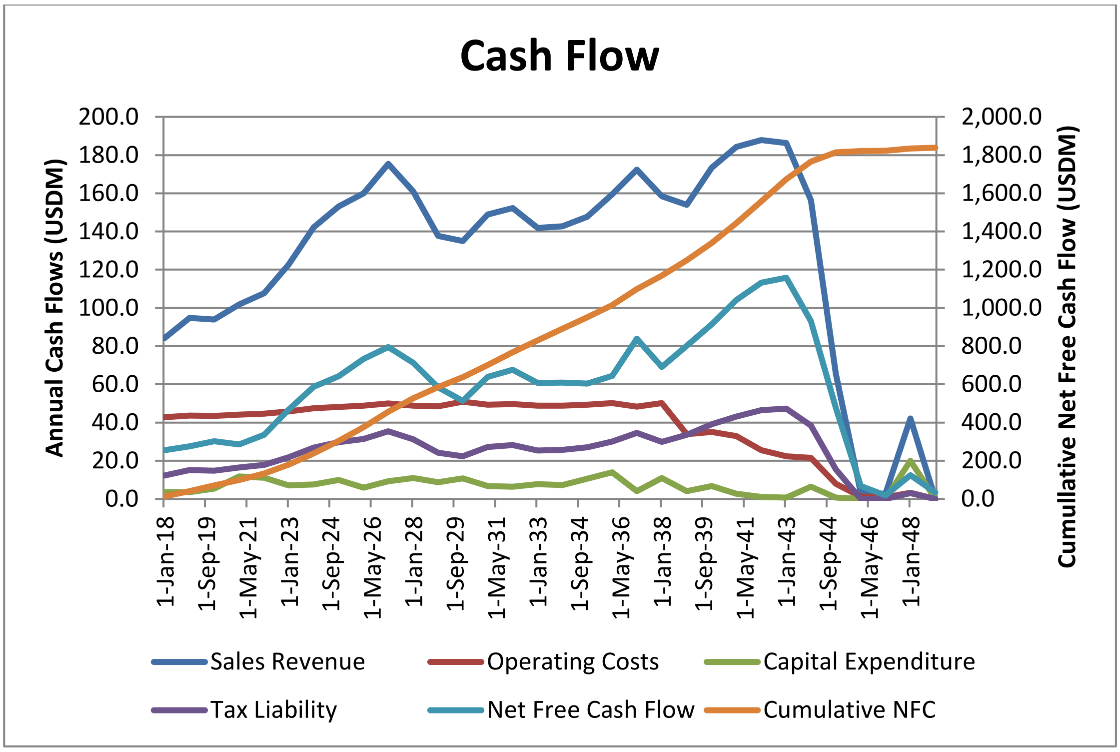

Figure ES 4: Net Cash Flow Base Case

Table ES 4: Summary of LoM Financial Parameters Base Case

		Total LoM
Sales Revenue	(USDM)	4,049
Operating Costs	(USDM)	1,186
Operating Profit - EBITDA	**(USDM)**	**2,862**
Tax Liability	(USDM)	794
Capital Expenditure	(USDM)	216
Net Free Cash Flow	**(USDM)**	**1,850**
Total Waste Mined	(kt)	257,946
Total Ore Mined	(kt)	3,498
S/R	(t:t)	73.75
Total Ore Treated	(kt)	3,498
Grade	(ct/t)	249.6
Contained ct	(kct)	873,131
Stock Inventory	(kct)	15,566
Total Sales	(kct)	888,698
Mining and production costs	(USD/t Treated)	225.10
Administrative expenses	(USD/t Treated)	24.35
Management and auction fees	(USD/t Treated)	20.26
Mineral royalties and production taxes	(USD/t Treated)	69.45
Total Operating Costs	(USD/t Treated)	339.16
Revenue	(USD/ct)	4.56
Operating Costs	(USD/ct)	1.33
Operating Profit	**(USD/ct)**	**3.22**

NPVs of the cash flows are shown in Table ES 5 using discount rates from zero to 15% in a post-tax context. The CP notes that at 10% discount rate the post-tax NPV is USD528 M. As there are no initial negative cash flows, an Internal Rate of Return (IRR) cannot be determined. The NPV is also shown at the 75% ownership level of the Client.

Table ES 5: NPV Profile Base Case

	Discount Rate	NPV USDM (100%)	NPV USDM (75%)
Net Present Value	8.0%	645	484
	10.0%	528	396
	12.0%	441	331

The Mine's NPV is most sensitive to revenue (grade or commodity price). The Mine has lower sensitivity to operating costs and capital. The revenue, operating and capital cost sensitivity of NPV is illustrated in Table ES 6.

Table ES 6: Base Case Dual Sensitivity Analysis for NPV at 10%

NPV 10% (USDM)		REVENUE SENSITIVITY				
		-20%	-10%	0%	10%	20%
OPEX SENSITIVITY	-20%	420	506	592	678	764
	-10%	390	475	560	645	730
	0%	360	444	528	612	697
	10%	331	413	496	579	663
	20%	301	383	465	547	629

NPV 10% (USDM)		REVENUE SENSITIVITY				
		-20%	-10%	0%	10%	20%
CAPEX SENSITIVITY	-20%	375	459	543	627	712
	-10%	368	451	535	620	704
	0%	360	444	528	612	697
	10%	353	436	520	605	689
	20%	345	429	512	597	682

NPV 10% (USDM)		OPEX SENSITIVITY				
		-20%	-10%	0%	10%	20%
CAPEX SENSITIVITY	-20%	607	575	543	511	480
	-10%	600	567	535	504	473
	0%	592	560	528	496	465
	10%	585	552	520	489	457
	20%	577	545	512	481	450

The Competent Valuator (“CV”) for this valuation is Mr Keith Joslin BEng ACSM MSAIMM, an Independent Consultant with SRK. Mr Joslin has 30 years’ experience in the mining industry and has been involved in the valuation of mineral assets across many commodities during his career to date.

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A COMPETENT PERSONS REPORT ON THE KAGEM EMERALD MINE, ZAMBIA, 2017

1 INTRODUCTION

1.1 Background

SRK Consulting (UK) Limited ("SRK") is an associate company of the international group holding company, SRK Global Limited ("the SRK Group"). SRK has been commissioned by Pallinghurst Resources Ltd ("Pallinghurst"), hereinafter also referred to as the "Company" or the "Client" to undertake an update of the Competent Persons Reports ("CPRs") for the assets of Gemfields Plc ("Gemfields") that SRK authored in 2015. Gemfields is now a 100% subsidiary of Pallinghurst. This CPR is on the Kagem Emerald Mine ("Kagem", the "Mine" or the "Kagem Mine") in Zambia. Kagem Mining Ltd is the project operator and is 75% owned by Gemfields.

SRK has been requested by Pallinghurst to base the CPR on the Kagem life of mine plan ("LoMp") reviewed and adjusted by SRK where appropriate. This CPR has been prepared to support the reporting and sign off by SRK of Mineral Resources and Mineral Reserve estimates for the Kagem Mine in accordance with the SAMREC Code. SRK has previously undertaken four significant mandates involving the Mine as follows:

- CPR for Gemfields (UK) Ltd in 2008 to list on the AIM market of the London Stock Exchange;
- Scoping Study in 2008 for an underground mining operation;
- Feasibility Study in 2012 for an underground mining operation; and
- CPR for Gemfields (UK) Ltd in 2015 to support the reporting of Mineral Resources and Ore Reserve estimates.

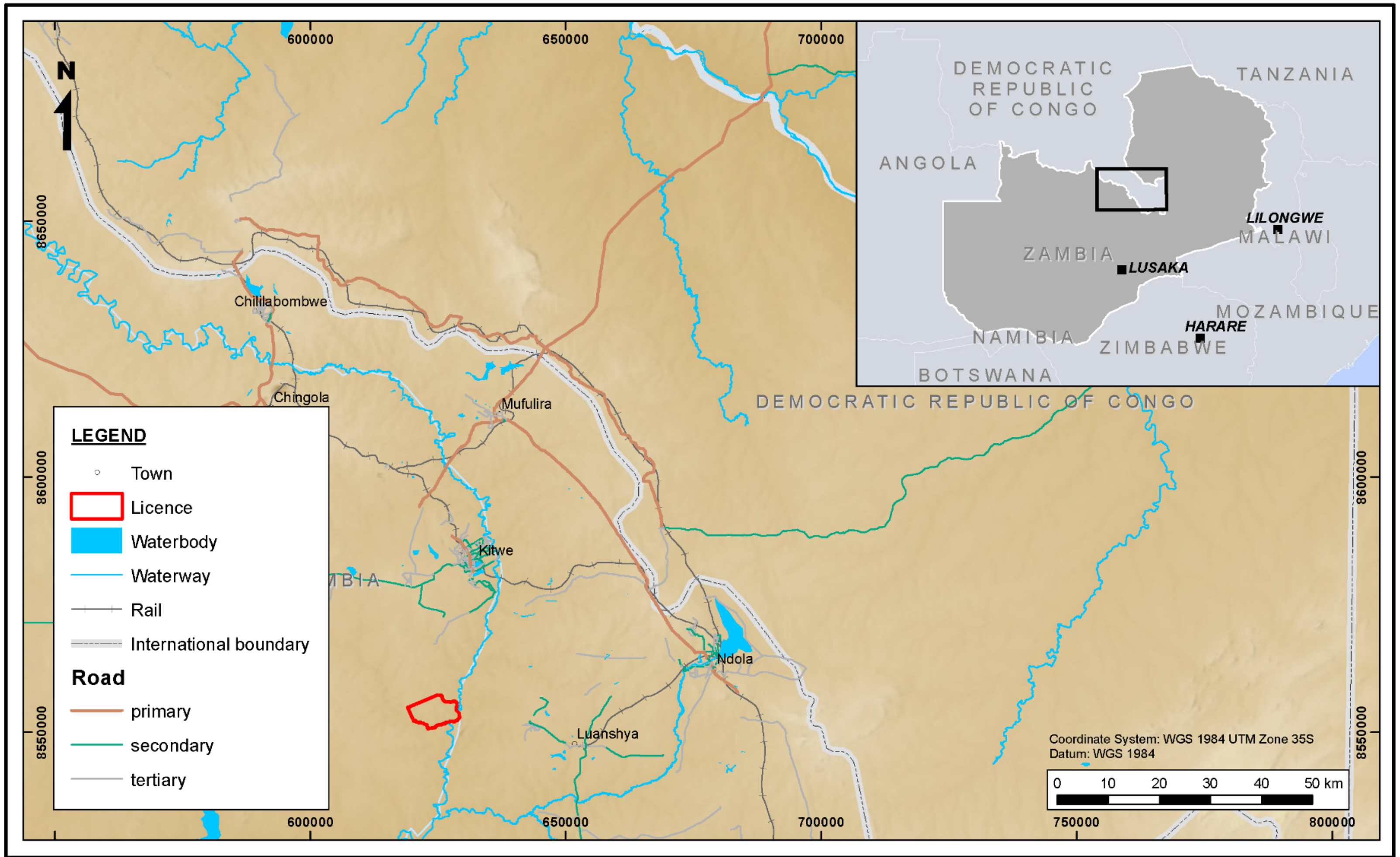
The Lead Competent Person (CP) with overall responsibility for this CPR is Mr Mike Beare CEng BEng ACSM MIMMM, a Corporate Consultant (Mining Engineering) with SRK. Mr Beare has 23 years' experience in the mining industry and has been extensively involved in the reporting of Ore Reserves on various diamond and gemstone projects during his career to date. The CP confirms that this Executive Summary is a true reflection of the full CPR.

1.2 Project Description

1.2.1 Location and Access

The Mine is situated in the Ndola Rural District, Copperbelt Province, Zambia, approximately 260 km north of Lusaka, the capital city of Zambia as presented in Figure 1-1 and Figure 1-2.

Located at latitude 13°04'S and longitude 28°08'E at an elevation of 1,200 m above mean sea level ("amsl"), the site is some 31 km south-southwest of the Copperbelt town of Kitwe and the licence is bisected by the administrative boundary between Ndola Rural District and Luanshya District. The site is accessed along a combination of national (10 km south of Kitwe to Fisenge along the M4) and local (22 km) southwest towards the settlement of Sempala, a total travelled distance of 32 km. Sempala has a population of some 1,225 within a 7 km radius and is located in the northernmost corner of the licence area, and is situated in the GMT +2 time zone.



DECEMBER 2017	U7367	KAGEM CPR	
srk consulting		Project Location	Figure 1-1

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Figure 1-1: Project Location

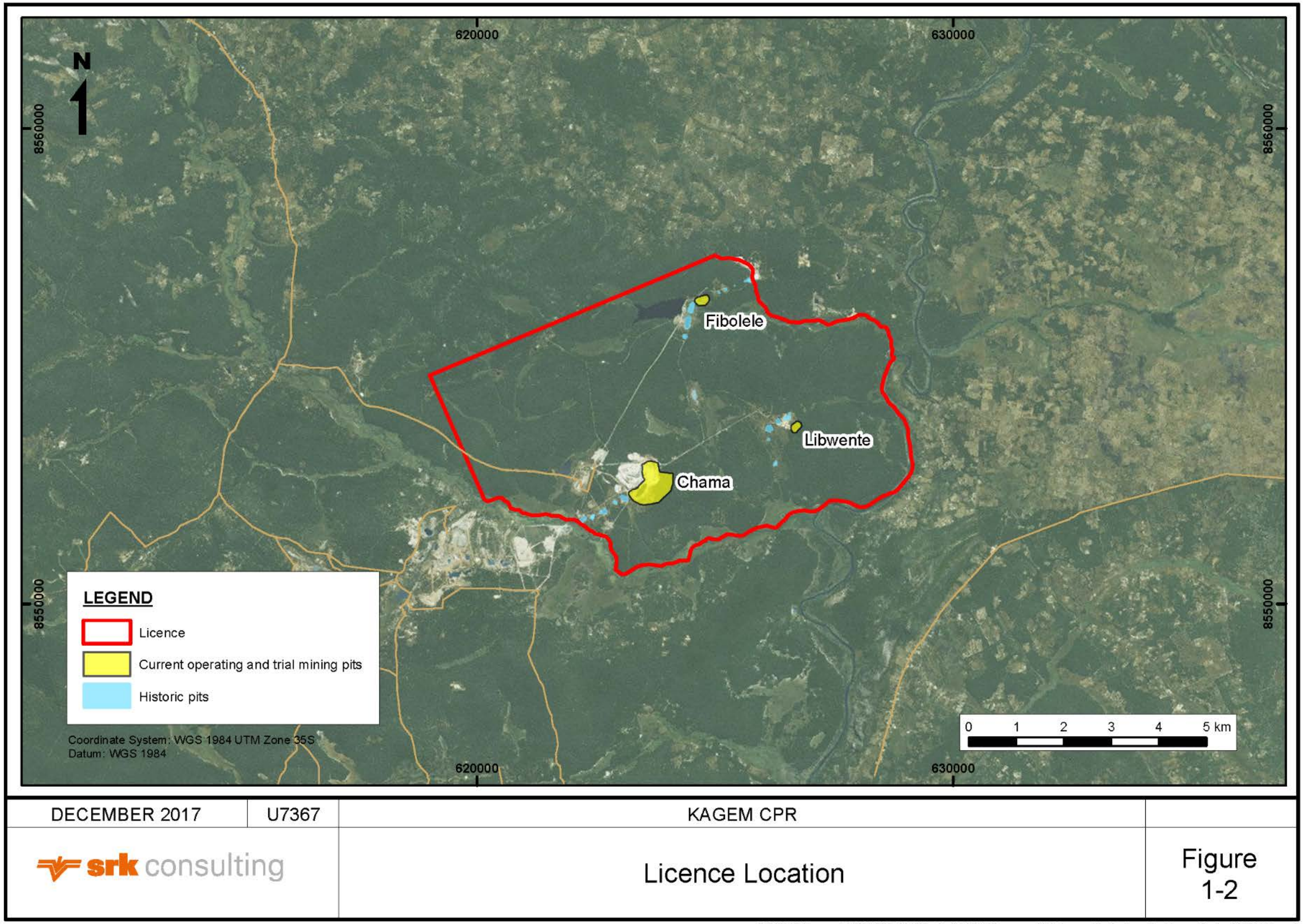

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Figure 1-2: **Licence Location**

1.2.2 Topography

Much of this ecoregion is flat or rolling, with local areas of higher relief. The Mine site, however, is fairly flat, gently sloping towards the Kafubu stream in the south. The Kafubu stream forms the southern boundary of the permit area and lies in a wide valley. The biome is Tropical and Subtropical Grasslands, Savannas and Shrublands. The vegetation is dominated by the Central Zambezian Miombo Woodlands which is a densely forested ecoregion that covers much of Central and East Africa. Trees grow to heights of 15 m to 20 m, rising over a broadleaf shrub understory with grassland underneath.

Animal life is limited by the disturbed nature of the area, with small mammals occurring in the less disturbed areas. Numerous insects, birds and reptiles occur. The aquatic environment is relatively undisturbed and fishing is common.

The site is located in the catchment of the Kafue river and is drained by the Kafubu which drains into the Kafue. The Kafubu stream, which has its origin some 50 km to the northwest of the permit area, forms the southern boundary. It drains into the Kafue which is a major river and provides water to much of Zambia, including the city of Lusaka. The Kafue river forms the eastern boundary and flows approximately 6.5 km to the east of the project area. Abandoned pits readily fill with water indicating a relatively shallow groundwater table between 8 m and 10 m below the surface.

1.2.3 Climate

The climate is classed as temperate humid. The dry season may be as long as 7 months, and 95% of the annual rainfall occurs from November to March, which is the region's summer. The mean annual evapotranspiration is 1,419 mm with monthly values ranging from 90 mm to 165 mm. The mean monthly temperatures range from 16.1°C in June to 23.8°C in October. The monthly temperatures range from a minimum of 6.1°C in July to a maximum of 32.1°C in October. Wind speeds range between 0.7 m/s to 1.5 m/s and are predominantly from the southeast, east and northeast.

1.2.4 Site Description

The Kagem Mine comprises the current operating Chama open pit mine and the bulk sampling pits at Libwente and Fibolele. The Chama open pit produces emerald and beryl bearing ore for processing at the processing plant. Existing surface infrastructure at the Mine area includes:

- access roads;
- operational wash plant
- operational emerald sorting house;
- mine camp, accommodation and offices; and
- equipment maintenance facilities and stores.

The existing workforce consists of approximately 652 personnel including technical and operational employees Figure 1-3 shows the Kagem Mine site layout and location of the operations.

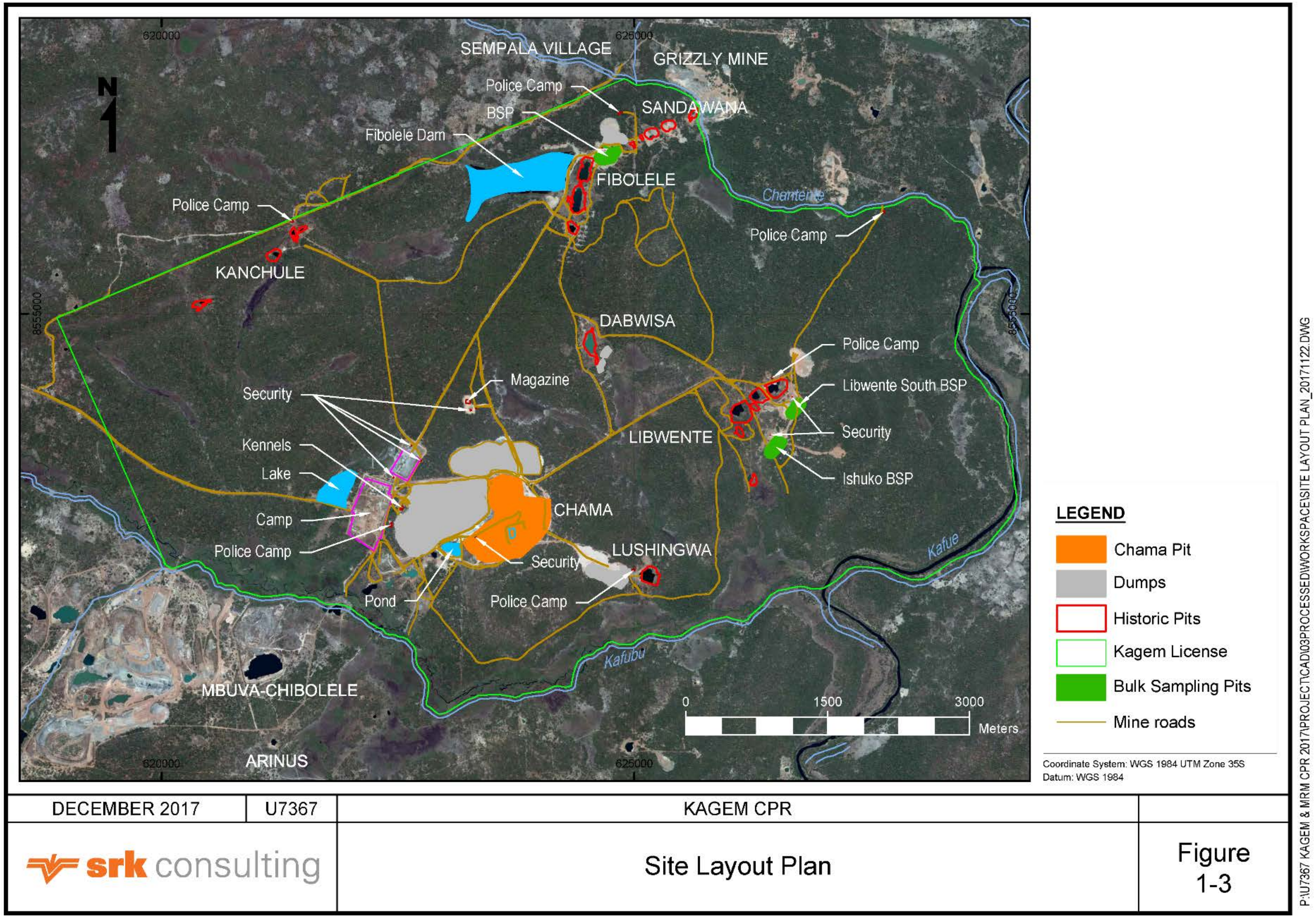

Figure 1-3: **Site Layout Plan**

1.2.5 Mining Operations

Waste mining in the Chama Pit comprises conventional open pit drill-blast-load-haul methods. Waste rock is dumped at either ex-pit or in-pit locations depending on material type and haul distance. The steeply dipping reaction zones are mined using manual intensive methods using picks and shovels with the assistance of hydraulic excavators under close supervision and only under daylight hours.

All large and high quality coloured gemstones are hand sorted at the mining face and are placed in a drop safe type container that is numbered, tagged and closed with security controlled locks. The remaining reaction zone ("RZ") material is loaded into trucks and transported directly to the processing facility. The open-pit is currently 110 m deep, with ore haul roads placed in the footwall of the talc-magnetite schist ("TMS"), given the relatively shallow dip of 14°. Waste haul roads are located on the hanging wall side of the pit. The upper 15 m to 20 m of overburden is free-digging whilst all other waste, including internal TMS waste, is drilled and blasted.

1.2.6 Processing Plants

The processing plant processes RZ material mined directly from the open-pit. The processing facilities comprise a simple series of comminution, screening, washing and sorting facilities which are located close to the current mining activities in the Chama pit area. Waste material from the washing plant, comprising the coarse (-3 mm) discard is discharged from the process plants and tailings in slurry form from the settling ponds.

All product is essentially hand sorted in a secure sort house facility where gemstones are upgraded using manual methods to produce emerald (subdivided into premium emerald and emerald) and beryl (subdivided into beryl-1, beryl-2, specimen and fines categories). These are then dried, dressed with oil, weighed and catalogued, and stored for evaluation and subsequent export for auction.

1.2.7 History

Kagem ML was incorporated in 1984 as a joint venture between the Reserved Mineral Corporation (55% - liquidated in 1996) and Hagura Mining Limited (45%). The GoZ assumed management control of Kagem in 1990; however, after experiencing operational and financial difficulties and 12 months of frozen production, Hagura UK regained management control in July 1996. In Sept 2001, Hagura signed an agreement with Government of Republic of Zambia("GRZ") to purchase 42% of its 55% Share. In June 2005, GRZ entered into a supplemental agreement, whereby Hagura would increase its stake to 75%. In October 2007, a portfolio company of Pallinghurst acquired Hagura, which owned and still owns 75% of Kagem. An expansion and redevelopment plan for Kagem was immediately put in place. To implement this plan, Kagem entered into a management agreement on 8 November 2007 whereby Gemfields was asked to spearhead Kagem's redevelopment plan and expansion. On 8 June 2008, a transaction was completed whereby Gemfields plc became the owner of Hagura, meaning that it effectively held a 75% interest in Kagem. Gemfields directly manage the Mine. Hagura, essentially a shell company, do not receive any management fees or payments. The Gemfields organogram is presented in Figure 1-4. Pallinghurst acquired 100% of Gemfields in 2017.

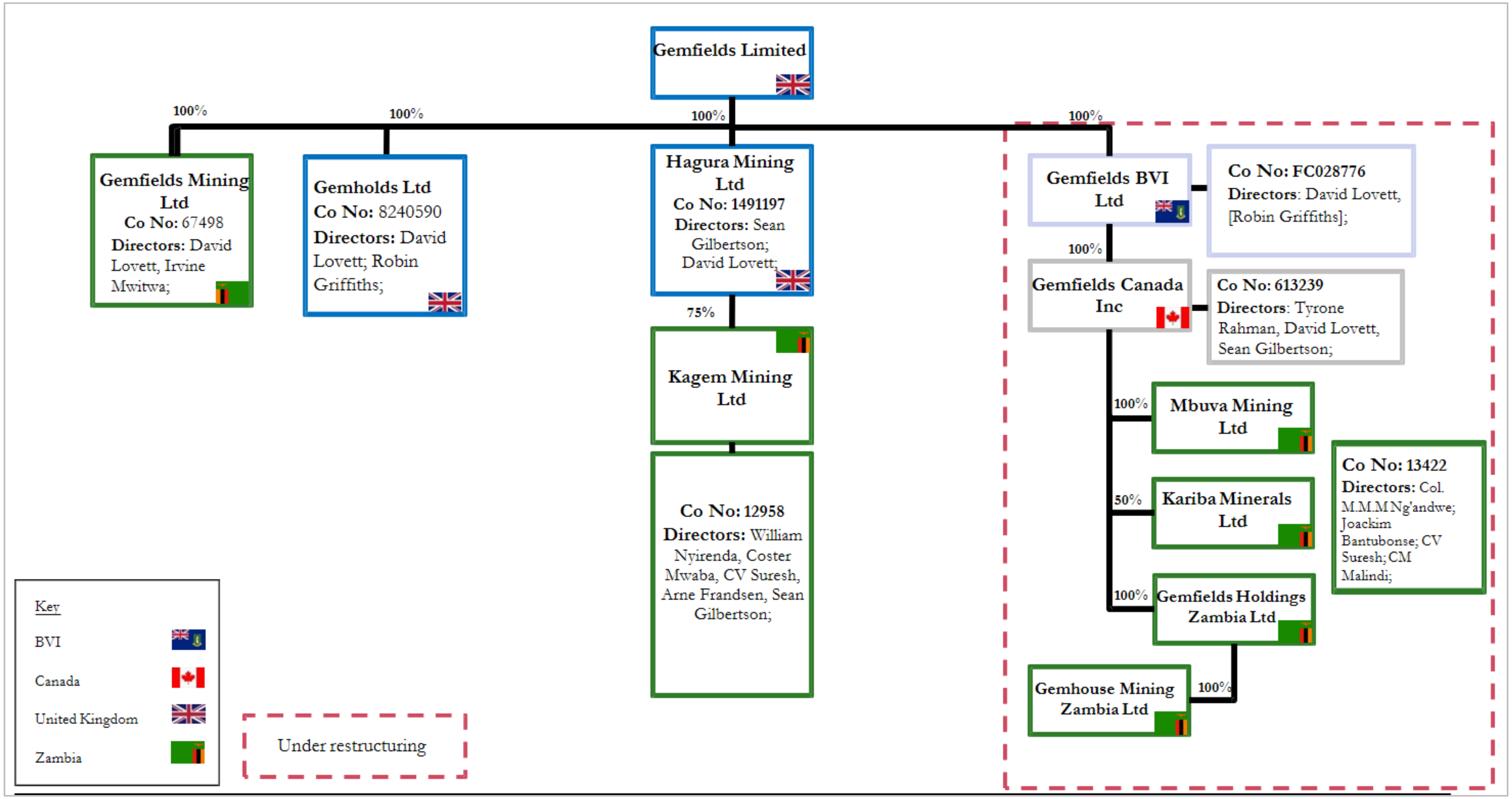

Figure 1-4: **Gemfields Organogram**

1.3 Requirement, Structure and Reporting Standard

1.3.1 Requirement

This CPR has been prepared to support the reporting of Mineral Resources and Mineral Reserve estimates in accordance with SAMREC.

1.3.2 Structure

The asset comprises the Kagem Mine and the associated licences. Accordingly, this CPR has been structured on a discipline basis where technical sections comprise: Geology; Mineral Resources; Mining Engineering; Mineral Reserves; Mineral Processing; Infrastructure; Environment and Social; Commodity Prices and Macro-Economics; Technical-Economic Parameters; Risks and Opportunities; Financial Analysis; and Conclusions and Recommendations.

1.3.3 Compliance

In this CPR, the standard adopted for the reporting of the Mineral Resources and Mineral Reserve statements is that defined by the terms and definitions given in the SAMREC Code. The SAMREC Code is a recognised reporting code and is acceptable to the Johannesburg Stock Exchange (“JSE”). This CPR has also been prepared to comply with the requirements of Section 12 of the JSE listing requirements. The standard adopted for the economic analysis is the SAMVAL Code.

This CPR has been prepared under the direction of the Competent Persons as defined by the SAMREC Code, who assume overall professional responsibility for the Mineral Resource and Mineral Reserve statements as presented herein.

Notwithstanding the above, the CP notes the following:

- where any information in the CPR has been sourced from a third party, such information has been accurately reproduced and no facts have been omitted which would render the reproduced information inaccurate or misleading;
- drafts of the CPR were provided to Gemfields and the Company for the purpose of confirming both the accuracy of factual information and the reasonableness of assumptions relied upon in this CPR;
- the CP notes that gemstone deposits, owing to the distribution of economic concentrations of the mineral in question, are notoriously difficult to sample, estimate and classify as their spatial location, morphology, and grade are highly variable and their exact location very difficult to predict. Current drilling techniques cannot provide sufficient or relevant data to enable direct estimation of mineralisation or grade; and
- accordingly, drilling as currently employed can only provide information to determine the continuity of the host geology and controls on mineralisation. Derivation of Mineral Resources is largely dependent on the availability of the results of bulk samples or equivalent such as production statistics. All the above uncertainties, and the use of extrapolated grade and geological information require that normally only an Indicated Mineral Resource category would be assigned. Gemfields have consistently collected high quality data and relevant information over a prolonged period of time, which has led to an increase in the confidence in the understanding of the geological and grade continuity, and so has enabled the classification of a Measured Mineral Resource.

1.4 Effective Date and Base Technical Information

The report date of this CPR is deemed to be March 2018 with the Mineral Resources and Mineral Reserves estimated at 31 December 2017 the effective date.

1.5 Verification, Validation and Reliance

This CPR is dependent upon technical, financial and legal input. In respect of the technical information provided, this has been taken in good faith by the CP, and other than where expressly stated, this has not all been independently verified. The CP has, however, conducted a detailed review and assessment of all material technical issues likely to influence the value of the Project, which has included the following:

- the historical work at the Mine noted in Section 1.1;
- inspection visits to the Project in July 2015;
- discussion and enquiry following access to key project technical, head office and managerial personnel from May through August 2015 and September to November 2017;
- an examination of historical information for the Mine;
- generation and reporting of a SAMREC compliant Mineral Resource and Mineral Reserve statements; and
- a review and, where considered appropriate by the CP, modification of the latest LoMp for the Mine as part of the 2017 CPR.

The CP has also assumed certain macro-economic parameters and commodity prices and relied on these as inputs to determine the potential economic viability of the stated Mineral Resources.

Where fundamental base data in support of the Mineral Resource statements has been provided (geological information, assay information, exploration programmes) for the purposes of review, the CP has performed all necessary validation and verification procedures deemed appropriate in order to place an appropriate level of reliance on such information.

1.5.1 Technical Reliance

The CP places reliance on the Company and their respective technical representatives that all technical information provided to the CP, as of 31st December 2017, is accurate. The technical representative for the Company's Mineral Resources is Mr Anirudh Sharma. Mr Sharma is the Kagem General Manager for the Company and is responsible for all technical matters in respect of this CPR at the Company and has 16 years' experience in the exploration and mining industry.

1.5.2 Financial Reliance

In consideration of all financial aspects relating to the Mine, the CP has placed reliance on the Company and Kagem that the following information as they may relate to the Mine and the Company is appropriate as at 31st July 2017:

- operating expenditures as included in Kagem's financial reports;
- equipment capital prices as included in Kagem's internal plans; and
- all statutory and regulatory payments as may be necessary to execute the LoMp.

The financial information referred to above has been prepared under the direction of Mr David Lovett, Chartered Accountant (ICAEW), on behalf of the Board of Directors of the Company. Mr Lovett is the Chief Financial Officer of Gemfields and has 12 years' experience in financial operations and management.

1.5.3 Legal Reliance

In consideration of all legal aspects relating to the Mine, the CP has placed reliance on the representations by the Company and Kagem that the following are correct as at 31st July 2017:

- the Directors of the Company and Kagem are not aware of any legal proceedings that may have an influence on the rights to explore or mine for gemstones;
- that the Company and their subsidiaries are the legal owners of all mineral and surface rights relating to the Mine; and
- no significant legal issue exists which would affect the likely viability of the Mine and/or on the estimation and classification of the Mineral Resources and Mineral Reserves as reported herein.

The details of mining and environmental licenses are presented in Table 1-1

Table 1-1: Mining and Environmental Licenses

Document Type	License No.; Serial No.	Approval	
Type, date - subject		**Authority**	**Validity Period**
Large Scale Gemstone Mining License for an area over 40.5 square kilometer	14105-HQ-LGML	Director Mines, Ministry of Mines and Minerals Development, Government of Zambia.	27 April 2010 - 26 April 2020
Approval and conditions of the Environmental Impact Statement, 2016	ZEMA/EA/EIS/506	ZEMA	11 November 2016 (Note - this is the date of issuance of the Approval and it remains valid for as long as the mine is in operation)
Environmental Licenses			
The mine has three environmental licences in terms of the Environmental Management Act No. 12 of 2011 and Environmental Management (Licensing) Regulations (SI 112 of 2013).			
Waste Management License, 2017 (For operation of waste disposal sites and transportation of general and industrial waste)	NDL/WM/00515/Z09/2014; 00125	ZEMA	1 January 2017 – 31 December 2019
Hazardous Waste Management License, 2017 (For generation, transportation and storage of hazardous waste including used oil, waste batteries, waste oil filters and waste fluorescent tubes only and operation of Lunshingwa overburden dump (53C) only and operation of Fwayafwaya Waste Rock Dump only)	NDL/LHWM/00515/Z09/2014; 000118	ZEMA	1 January 2017 – 31 December 2019
Emissions License, 2017 (For emission or discharge of pollutants/contaminants into the environment for the Healthcare Waste Incinerator Stack) and for effluent discharge of water from the pits.	NDL/EMM/00515/Z09/214; 000066	ZEMA	1 January 2017 – 31 December 2019

1.6 Limitations, Reliance on Information, Declaration, Consent and Copyright

1.6.1 Limitations

The CP is responsible for this CPR and declares that all reasonable care to ensure that the information contained in this report, is to the best of the CP's knowledge having made all reasonable enquiries, in accordance with the facts and contains no omission likely to affect its import.

The CP does not assume any responsibility and will not accept any liability to any other person for any loss suffered by any such other person as a result of, arising out of, or in connection with this CPR or statements contained therein.

The Company and Kagem have confirmed in writing to the CP that to their knowledge the information provided by them (when provided) was complete and not incorrect or misleading in any material respect. The CP has no reason to believe that any material facts have been withheld. Further, the Company and Kagem have confirmed in writing to the CP that they believe they have provided all material information.

The achievability of the LoMp and associated expenditure programme is neither warranted nor guaranteed by the CP. The LoMp and expenditure programme as presented and discussed herein has been proposed by the Company's management, and adjusted where appropriate by the CP, and cannot be assured. The LoMp and expenditure programme are necessarily based on technical and economic assumptions, many of which are beyond the control of the Company and Kagem. Future cash flows derived from such forecasts are inherently uncertain and accordingly actual results may be significantly more or less favourable.

1.6.2 Reliance on Information

The CP believes that its opinion must be considered as a whole and that selecting portions of the analysis or factors considered by it, without considering all factors and analysis together, could create a misleading view of the process underlying the opinions presented in the CPR. The preparation of a CPR is a complex process and does not lend itself to partial analysis or summary.

The CP's opinion in respect of the Mineral Resources and Mineral Reserves declared and the LoMp is effective at 1st September 2017 and is based on information provided by the Company and Kagem throughout the course of the CP's investigations, which in turn reflect various technical-economic conditions prevailing at the date of this report. Further, the CP has no obligation or undertaking to advise any person of any change in circumstances which comes to its attention after the date of this CPR or to review, revise or update the CPR or opinion.

1.6.3 Declaration

SRK will receive a fee for the preparation of this report in accordance with normal professional consulting practice. This fee is not contingent on the outcome of the CPR and SRK will receive no other benefit for the preparation of this report. SRK does not have any pecuniary or other interests that could reasonably be regarded as capable of affecting its ability to provide an unbiased opinion in relation to the Mineral Resources or Mineral Reserve.

Neither SRK, the Competent Persons, nor any of the directors of SRK, have at the date of this report, nor have had within the previous two years, any shareholding or other interest in the Company or Kagem. Consequently, SRK, the Competent Persons and the directors of SRK consider themselves to be independent of the Company and Kagem.

This CPR includes technical information, which requires subsequent calculations to derive subtotals, totals and weighted averages. Such calculations may involve a degree of rounding and consequently introduce an error. Where such errors occur, the CP does not consider them to be material.

1.6.4 Consent

Neither the whole nor any part of this report nor any reference thereto may be included in any other document without the prior written consent of SRK as to the form and context in which it appears.

1.6.5 Copyright

Copyright of all text and other matter in this document, including the manner of presentation, is the exclusive property of SRK. It is an offence to publish this document or any part of the document under a different cover, or to reproduce and/or use, without written consent, any technical procedure and/or technique contained in this document. The intellectual property reflected in the contents resides with SRK and shall not be used for any activity that does not involve SRK, without the written consent of SRK.

1.7 Qualifications of Consultants

The SRK Group comprises over 1,300 staff, offering expertise in a wide range of resource engineering disciplines with 49 offices located on six continents. The SRK Group's independence is ensured by the fact that it holds no equity in any project. This permits the SRK Group to provide its clients with conflict-free and objective recommendations on crucial judgement issues. The SRK Group has a demonstrated track record in undertaking independent assessments of resources and reserves, project evaluations and audits, Mineral Experts' Reports, Competent Persons' Reports, Mineral Resource and Mineral Reserve Compliance Audits, Independent Valuation Reports and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies and financial institutions worldwide. The SRK Group has also worked with a large number of major international mining companies and their projects, providing mining industry consultancy service inputs. SRK also has specific experience in commissions of this nature.

This CPR has been prepared based on a technical and economic review by a team of 8 consultants sourced from the SRK Group's offices in the United Kingdom over a four-month period. These consultants are specialists in the fields of geology, resource and reserve estimation and classification, open-pit mining, mineral processing, tailings management, infrastructure, environmental management and mineral economics.

The individuals who have provided input to this CPR, and are listed below, have extensive experience in gemstones and the mining industry and are members in good standing of appropriate professional institutions. Certificates of CP's and key technical staff are provided in Appendix C.

- Michael Beare, CEng, MIMMM ACSM BEng (Lead CP and CP on Mineral Reserves) (Section 1, 8, 10 and 11);
- Onno ten Brinke, MAusIMM, BEng, (Section 6);
- Dr Lucy Roberts, MAusIMM, PhD (CP Mineral Resources), (Section 2, 3 and 4);
- James Haythornthwaite MSc, BSc, FGS (g Section 2, 3 and 4);
- Neil Marshall, CEng, MIMMM, MSc, BSc (Section 5)
- John Willis, CEng, MIMMM, PhD (Section 7);
- John Merry MPhil, BSc, AIEMA (Section 9); and
- Keith Joslin, MSAIMM ACSM BEng (Hons) (Section 12).

In order to prepare this CPR, the following site visits were undertaken in addition to historical visits on a number of previous mandates:

- 5th – 15th June 2015: Lucy Roberts and James Haythornthwaite visited site to work on the geological model and to advise on data collection for Resource and Reserve estimation; and
- 22nd June – 26th June 2015: Fraser McQueen, Neil Marshall, Rowena Smuts and John Willis visited site to review the mining, environmental and processing disciplines respectively. The aim of the visit was to collect project information and data, make a visual assessment and understand the current mining and processing operations for the purposes of providing guidance on environmental and social management for the Mine.

A site visit was not undertaken in 2017 as SRK was informed by Gemfields management they considered there to be no material change since the last site visit and instructed SRK that it was a simple matter of depletion.

The Competent Person who has reviewed the Mineral Resources as reported by SRK is Dr Lucy Roberts. The Competent Person responsible for reporting Mineral Reserves is Michael Beare who also takes overall responsibility for the CPR. SRK notes that Mike Beare has visited Kagem on two previous occasions, in 2008 for a scoping study and in 2012 for an underground study.

2 GEOLOGY

2.1 Introduction

This section details the geology of the Kagem deposit. This forms the basis of the declaration of Mineral Resources, which is further described in Section 4.

2.2 Regional Geology

The Kagem Mine is located in the Kafubu area of the Copperbelt Province of Zambia, at the centre of the transcontinental Pan-African belts in central-southern Africa, between the Kalahari Craton to the south and the Congo Craton to the north. The oldest units of the Kafubu area comprise Palaeoproterozoic granites, amphibolite (“AMP”) gneisses and quartz-biotite schists of the Lufubu Basement Complex, exposed in structurally elevated basement domes (Hickman, 1973). The contact between this basement sequence and the overlying Mesoproterozoic (Daly and Unrug, 1983) Muva Supergroup is defined by a distinct angular unconformity, marked by a regional ridge of basal quartzites (Seifert et al, 2004). The Kagem Mine location is shown within the context of the regional geology of Zambia in Figure 2-1. A simplified geology sketch map of the Kafubu emerald area.is shown in Figure 2-2., and is reproduced from Zwaan et al (2005) and modified after Hickman (1973) and Sliwa and Nguluwe (1984) Kafubu.

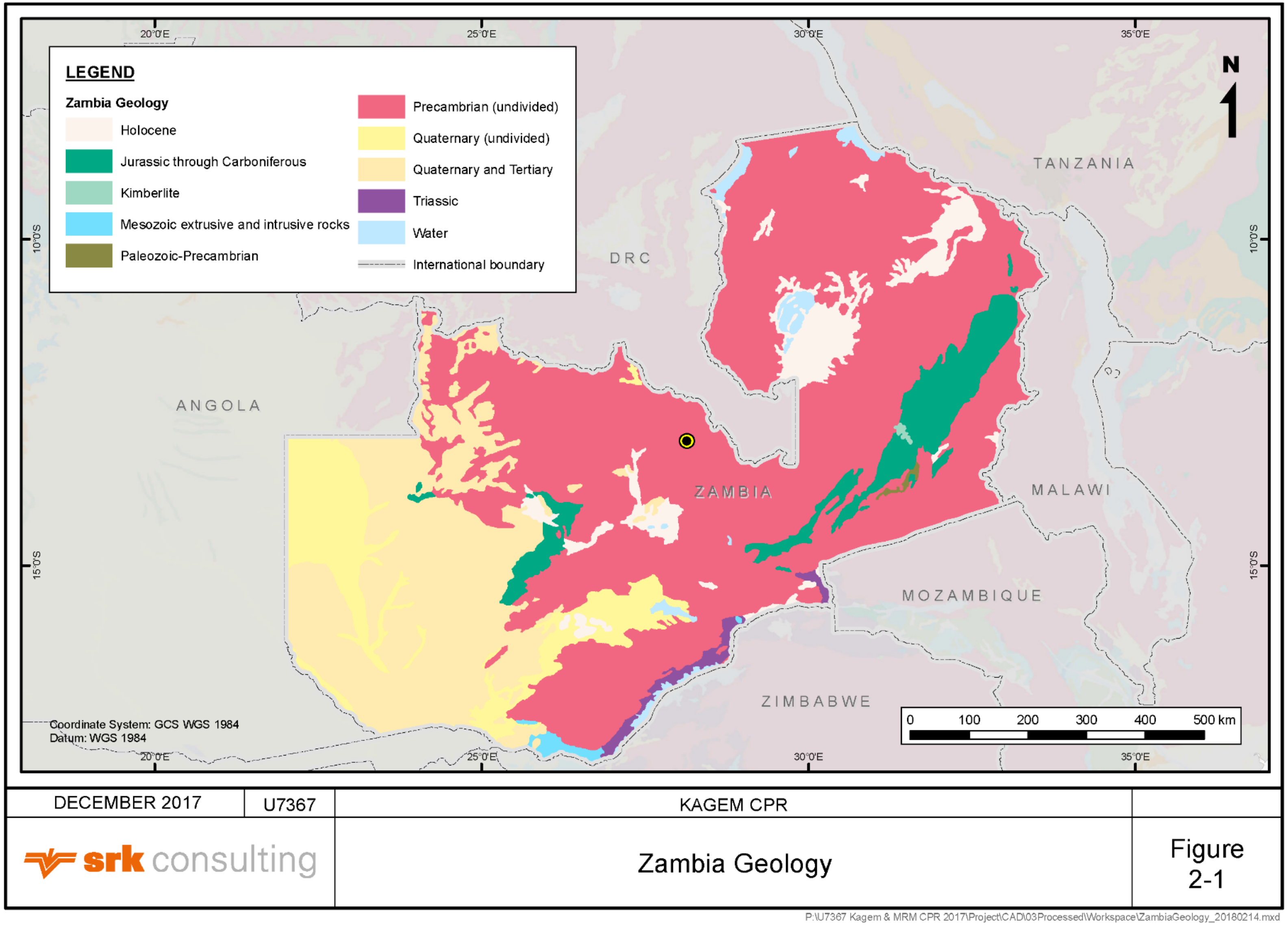

Figure 2-1: Kagem Project Location within the Context of the Regional Geology of Zambia

The Muva Supergroup comprises fine grained quartz-mica schists, medium-coarse grained sugary and friable metaquartzites, and sub-concordant bodies of amphibolitic and ultramafic schists derived from komatiitic sills (Hickman, 1973). The ultramafics, which host the emerald and beryl deposits in the Kafubu area, vary in thickness from 20 m to 140 m and have been altered by metamorphism and hydrothermal activity to talc-chlorite-tremolite ± magnetite schist (locally referred to as TMS) or talc-biotite schist ("TBS"). The AMPs have also suffered varying degrees of alteration to biotite–actinolite schists.

The youngest stratigraphic unit of the Kafubu area is the Neoproterozoic Katanga Supergroup, host to the stratiform copper-cobalt deposits of the Central Afrcian Copperbelt in Zambia and the DRC. The Katanga Supergroup consists of a 5 to 10 km thick sequence that, from bottom to top, is divided into siliclastic and dolomitic conglomerates, sandstones and shales of the Roan Group, carbonates and carbon-rich shales of the Nguba Group the youngest, uppermost Kundelungu Group including glacial metasediments and a cap carbonate (Caitleux et al, 2005). The contact between the Katanga Supergroup and the underlying Muva Supergroup appears to be conformable, although isolated areas of discordance suggest that the Muva was deformed prior to deposition of the Katanga units (Hickman, 1973).

The units of the Kafubu area are affected by three main orogenic events: the Ubendian, Irumide and Lufilian (Pan-African) orogenies (Tembo et al, 2000). The earliest of these, the Ubendian orogeny, dates at c. 1.8 Ba and thus only affects the rocks of the Palaeoproterozoic basement complex. Ubendian deformation is poorly preserved in the Lufubu Complex due to overprinting by later events. The Irumide orogeny occurred between 1.05 Ga and 1.00 Ga (de Waele et al, 2009), affecting rocks of the basement complex and the Muva Supergroup. The Lufilian was part of the wider Pan-African orogeny, which involved crustal shortening between the Kalahari and Congo Cratons of up to 150 km between 590 and 512 Ma. This compression deformed the Katanga Supergroup into a fold and thrust belt, the Lufilian Arc. The Lufilian orogeny at c. 550 Ma is responsible for the present structural configuration of the Kafubu area and may be broadly described in terms of four deformation phases (Hickman, 1973), which largely overprinted structures relating to earlier deformation events. Of these, the D_3 event, which resulted in extensive isoclinal-open folding, is interpreted to be responsible for axial planar faulting accompanied by pegmatite ("PEG") intrusions, which commonly cut the Kafubu stratigraphic sequence. Throughout the Kafubu area steeply dipping PEG dykes and quartz tourmaline veins typically trend north to south or northwest to southeast. These are accompanied by shallow dipping to flat lying PEGs and quartz-tourmaline veins of variable strike.

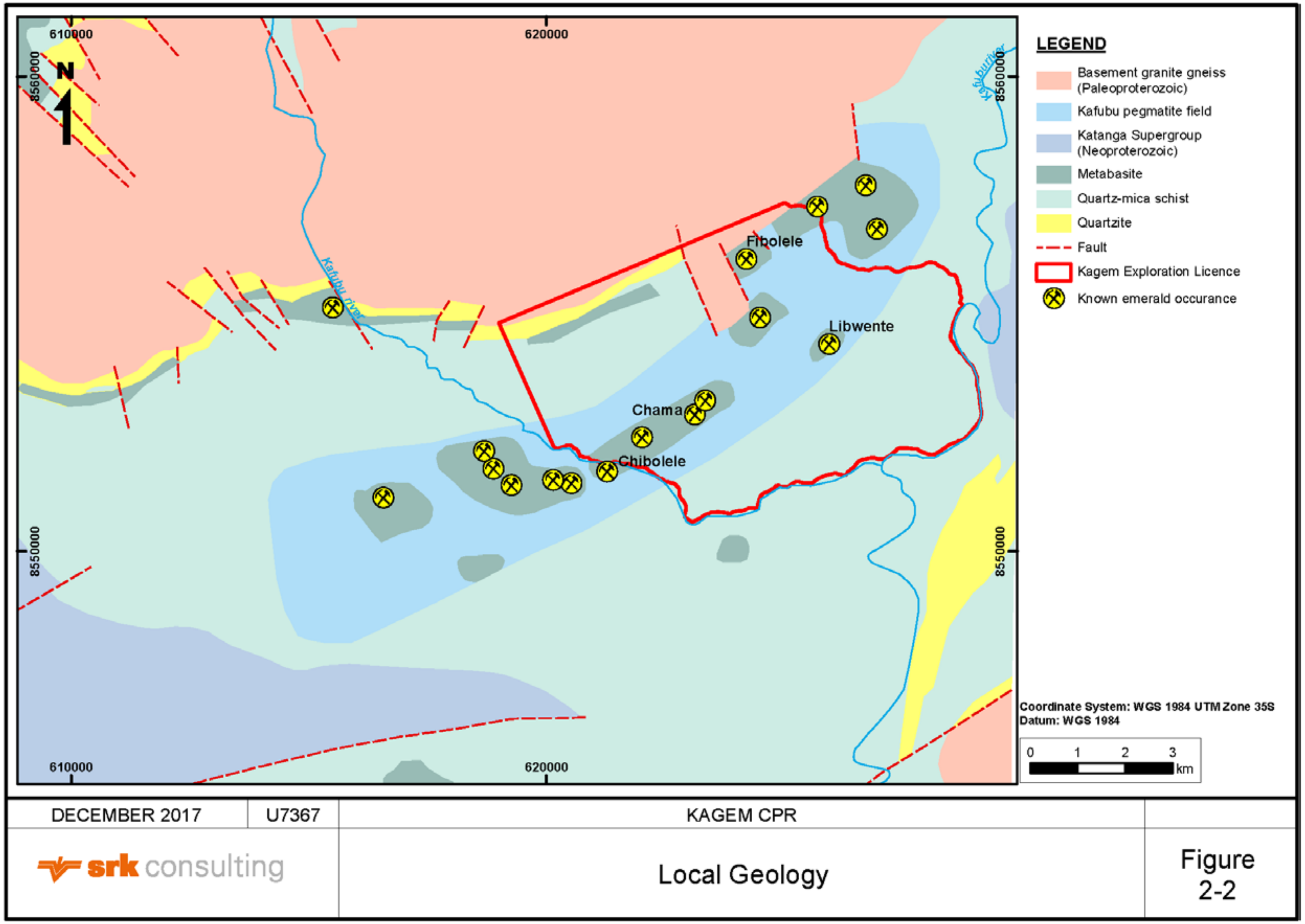

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Figure 2-2: A Simplified Geology Sketch Map of the Kafubu Emerald Area.

2.3 Deposit Geology

2.3.1 Stratigraphy

The currently defined emerald and beryl deposits of the Mine are hosted by TMS of the Muva Supergroup. The stratigraphy of the main Chama deposit (from bottom to top) is defined by footwall mica schist, followed by talc-magnetite schist, AMP and quartz-mica schist of the Muva Supergroup and a thin top soil of approximately 3- m (Figure 2-5). The whole sequence is intruded by concordant and steeply dipping discordant quartz-feldspar PEG dykes and quartz-tourmaline veins.

The upper portion of the stratigraphic sequence is usually characterised by at least 200 m of hangingwall quartz-mica schist ("QMS"), dominated by quartz, with variable quantities of muscovite, biotite or phlogopite, albite and chlorite (Figure 2-3a). At Chama, this meta-sedimentary unit often defines a strain gradient from massive, low strain, quartz-rich QMS, to high strain, strongly foliated or sheared, biotite and chlorite rich QMS (Figure 2-3b) near the transitional footwall contact with the AMP unit below.

Representative examples of the following key lithologies are given in Figure 2-3:

a) hangingwall quartz-mica schist;

b) high strain, strongly sheared quartz-mica schist with quartz sigmoid structures, at the footwall of the quartz-mica schist unit adjacent to the AMP contact;

c) high strain AMP at the hangingwall of the AMP unit; and

d) massive AMP.

Figure 2-3: Kagem Mine Mica-schist and AMP Lithologies

The AMP horizon may be described in terms of two distinct units: a dark, hornblende-rich AMP with lesser actinolite, quartz, feldspar, biotite and tourmaline, or its' alteration equivalent green tremolite-actinolite schist with chlorite, biotite and tourmaline ± epidote and talc. At Chama, this AMP unit generally ranges in thickness from 0 to 30 m, but is most commonly in the range of 8 m to 15 m. Field and drill core observations suggest that the AMP is usually more banded and foliated than the relatively massive talc-magnetite schist. The highest degree of strain appears to be preferentially partitioned into the upper portion of the unit, which is often more intensely foliated and epidote-rich (Figure 2-3c). The contact between the AMP and the underlying talc-magnetite schist is transitional, over which interstitial quartz disappears, and talc and disseminated tourmaline become increasingly common (Figure 2-4a). Magnetite is also present in increasing quantities, but is very fine grained and its existence is only detectable by an increase in Cr content from AMP values of 200 ppm to 300 ppm to values in excess of 700 ppm in the talc-magnetite schist.

The TMS unit (Figure 2-4b) itself contains highly variable quantities of talc, tremolite, actinolite, biotite, magnetite and tourmaline; the latter may be disseminated in quartz veins or as tourmalinite bands. Magnetite occurs as very fine grained disseminations, usually not visible in hand samples, but identified through elemental analyses and magnetic susceptibility tests. Carbonate alteration of the TMS unit is relatively common, often manifest as pseudomorphs of mica agglomerates. At Chama, the TMS unit ranges from 0 to 60 m in thickness, with an average thickness of approximately 18 m. Current interpretations suggest that the TMS and overlying AMP unit were originally intruded into the Muva Supergroup as a single differentiated komatiite sill.

The basal contact of the TMS is relatively sharp, being underlain by a typically strongly foliated quartz-muscovite schist or quartz-sericite-biotite (phlogopite) schist. This felsic schist, is up to at least 120 m thick, and forms part of a wider group of gneisses, AMPs, and kyanite-bearing schists in the wider Mine area.

Characteristic examples of the following lithologies are given in Figure 2-4:

a) tourmaline rich AMP near the talc-magnetite schist contact;

b) talc-magnetite schist;

c) PEG with feldspar and muscovite; and

d) a quartz-tourmaline vein with massive tourmaline accumulations at the base.

Figure 2-4: Kagem Mine AMP, TMS, PEG and Quartz-tourmaline Vein Lithologies

The entire stratigraphic sequence described above is intruded by a suite of PEG dykes (Figure 2-4c) and quartz-tourmaline veins (Figure 2-4d), both concordant to the host rock contacts, and as steeply dipping discordant bodies. The mineralogy of the PEG dykes is dominated by quartz and feldspar with lesser muscovite and minor garnet, tourmaline and beryl. They are usually highly friable and kaolinised near surface. Quartz-tourmaline veins are characterised by increased tourmaline content and decreased feldspar input relative to the coarse grained, and usually wider, PEG dykes. Tourmaline crystals are often observed to radiate from the vein contacts inwards. Cross-cutting relationships between the PEG dykes and quartz-tourmaline veins imply multiple phases of intrusion, but it is broadly considered most likely that the two vein sets were intruded synchronously as part of the same broad intrusive event.

Although there are local differences in the average thickness of individual units, the stratigraphic sequences at both Fibolele and Libwente are largely similar to that described for Chama above. That said, some key distinctions exist, most notably at Fibolele, where the AMP horizon in the hangingwall of the TMS unit is absent.

Although the general stratigraphic sequence at Libwente is similar to that observed at Chama, the distribution of the ultramafic schists is more irregular, with at least two distinct TMS bands, and additional minor satellite bodies with AMP in the hangingwall, footwall or both. It is considered that this is most likely a function of multiple phases of magma emplacement and differentiation in the mafic sill protolith, coupled with localised shearing in the area of the Libwente deposit.

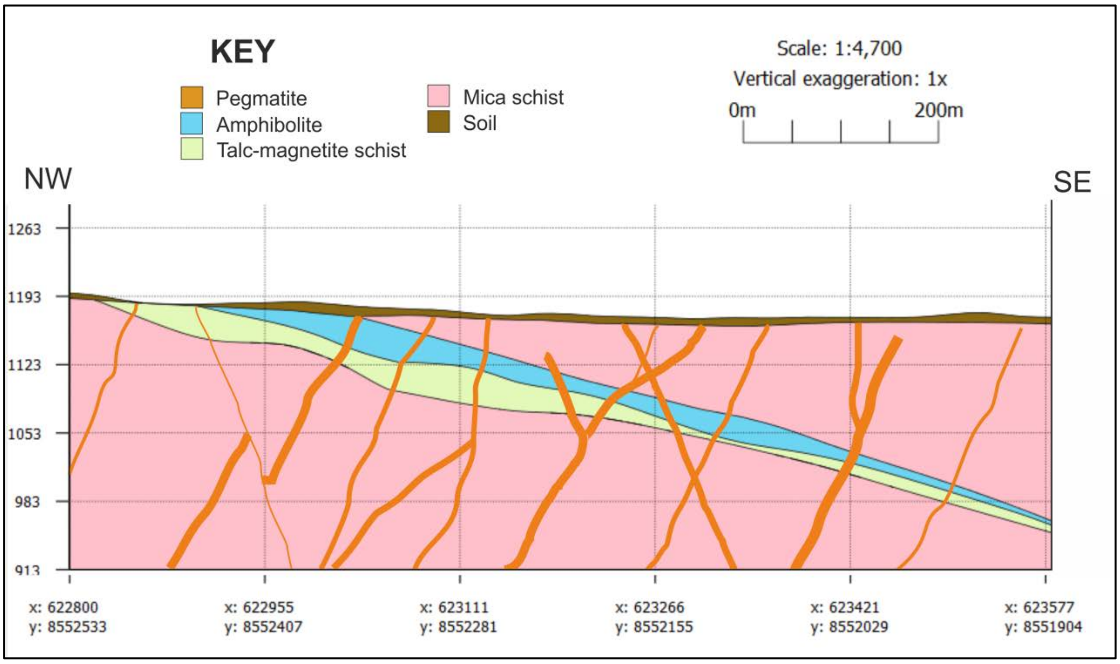


Figure 2-5: Schematic Northwest to Southeast Cross Section through the Chama Deposit Displaying the Mica-schist, AMP, TMS Stratigraphy and Intruding PEGs

2.3.2 Structure

The most historically significant and productive TMS belt of the Ndola Rural Emerald Restricted Area ("NRERA") in central Zambia, is the Pirala Fwaya-Fwaya Belt, which extends roughly 8 km ENE and includes both the Chama and Libwente deposits, in addition to Gemfields' Chibolele deposit. This belt forms part of a semi-regional scale tight-isoclinal fold system which trends east-northeast and is locally offset by a series of predominantly north-northwest striking structures. Interpretation of airborne magnetic survey imagery, suggests that the Pirala Fwaya-Fwaya Belt, host to Libwente and Chama, defines a single limb in the south of this fold system, with Fibolele to the north.

At the deposit-scale, the dip and strike of the TMS unit and associated stratigraphy is relatively variable. At Chama, the TMS horizon strikes at roughly 60°, dipping shallowly (10 to 25°) to the south-southeast, and rotating to a more north-easterly strike towards the northeast. Libwente trends broadly east-northeast, dipping very shallowly (<10°) towards the south-southeast in the southeast of the deposit area and to the north-northwest in the northwest of the deposit. The Fibolele stratigraphy is characterised by a broadly north-northeast trend, which rotates to an east-northeast strike towards the north-north-eastern part of the deposit. The dip of the TMS unit at Fibolele is steeper than that described at Chama and Libwente, typically being in the order of 20 to 35° towards the southeast, but can be up to 60° locally. Drilling to date suggests that the dip of the TMS at Fibolele becomes shallower with depth. The TMS is deformed by north to north-northwest trending late folding in the area of the current bulk sampling operation.

The suite of PEG dykes and quartz-tourmaline veins that intrude the stratigraphic succession throughout the Kagem deposits occupy a range of trends, both concordant and discordant to the local stratigraphy. At Chama, the majority of discordant dykes have a N-S to NNW-SSE strike and the dips vary between 50° and 70° towards the E-NE. The discordant dykes and veins at Libwente and Fibolele occupy the same trend set, striking north-northwest, but with a steeper, typically sub-vertical dip. A second, less abundant set of east-west trending, sub-vertically dipping PEG dykes is evident throughout the Kagem licence. In addition, low to moderately dipping PEG dykes are also evident throughout the Kagem Mine area. The PEG dykes and associated quartz-tourmaline veins, which date to around 500 Ma, are parallel to locally developed axial planar cleavage relating to late stage north-south trending folds, such as those observed at Fibolele, and pervasive north to north-northwest trending structures which locally offset the TMS unit.

In addition to the north to north-northwest trending structures which appear to offset the TMS unit at the deposit-scale, it is thought that the stratigraphy may be locally offset by a series of layer sub-parallel post-mineralisation southwest to west-southwest trending shears. This is most evident at Libwente, where there is significant discontinuity in the local stratigraphy, often over relatively short lateral distances.

A review of the drillhole logging conducted by the CP whilst on site in June 2015, suggests that some of the drillhole intersections originally logged as quartz-mica schist may be more accurately described as a highly sheared or mylonitised rock with significant silica influx and overprint. A visual assessment of the spatial distribution of the Libwente QMS intersections highlighted more than one group of QMS intervals that do not conform to the typical stratigraphic sequence, and can be connected along a planar southwest or west-southwest trend. It is loosely hypothesized that these planar QMS trends may in fact represent silica-rich shear zones, which locally offset the TMS unit. This is supported by apparent lateral offsets of the TMS unit, which coincide with the planar “QMS” interval trends, in addition to west-southwest trending discrete, though often cryptic, lineaments in the airborne magnetic signature in the Libwente area.

At present there is insufficient understanding of these structures to incorporate the modelled shear surfaces as explicit domain boundaries in the resource modelling process. The CP strongly recommends that Gemfields commission a structural review of the Libwente deposit to better understand the local discontinuities in the Libwente stratigraphy and the structural controls on the TMS geometry in this area.

2.4 Mineralisation

Emerald and beryl mineralisation in the Kafubu area, including the Kagem deposits, belongs to a group referred to as ‘schist-hosted emeralds’, in which emeralds occur predominantly in phlogopite or other types of schists. The origin of schist-hosted emerald and beryl deposits is controversial, but is known to require specific geological conditions in which beryllium bearing fluids interact with chromium bearing host rocks. The most established model for emerald and beryl mineralisation in the Kafubu area involves the interaction of Be-bearing fluids relating to pegmatoid dykes or granitic rocks, with Cr-rich mafic and ultramafic schists or un-metamorphosed ultramafic rocks (Lams et al, 1996, Barton and Young, 2002). Other models for schist-hosted emerald and beryl mineralisation (Grundmann and Morteani, 1989, Nwe and Grundmann, 1990) propose syn- to post-tectonic growth of beryl in metasomatised ultramafic rock adjacent to Be-bearing PEGs during regional metamorphism.

At the Mine, emerald and beryl mineralisation is hosted by an ultramafic talc-magnetite schist unit, which has an elevated average chromium content of approximately 2,120 ppm. Three main styles of mineralisation are recognised within the TMS unit:

- discordant RZ material adjacent to the PEG and quartz-tourmaline vein contacts;
- concordant RZ material concentrated along the footwall and occasionally the hangingwall contacts of the TMS unit (Figure 2-6d); and
- discordant RZs hosted by brittle structures within the TMS unit distal to the PEG and quartz-tourmaline veins.

Typical examples of RZ material, both in drill core and in the open pit environment are given in Figure 2-6, as follows:

a) tourmaline-rich RZ in drill core;

b) mineralised RZ material in drill core;

c) a loose boulder in the Chama Pit containing a quartz-tourmaline vein with RZ material at both the footwall and hangingwall contacts; and

d) concordant footwall RZ in the Chama Pit.

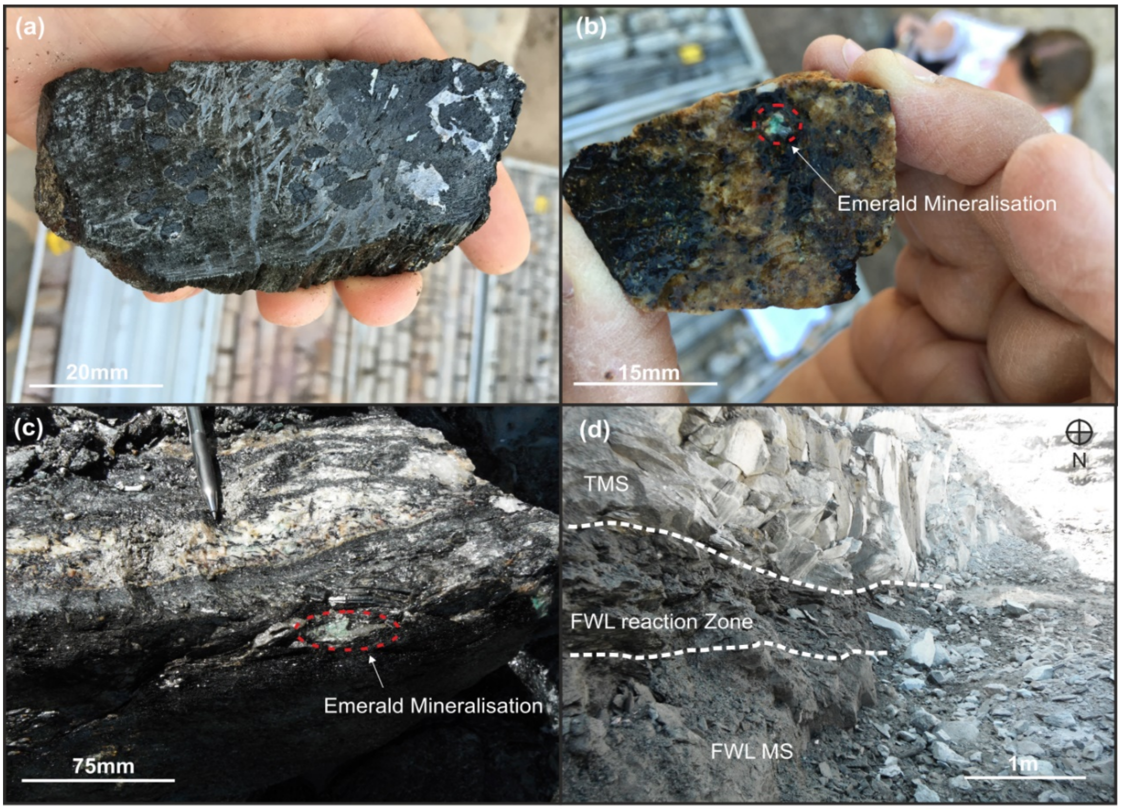
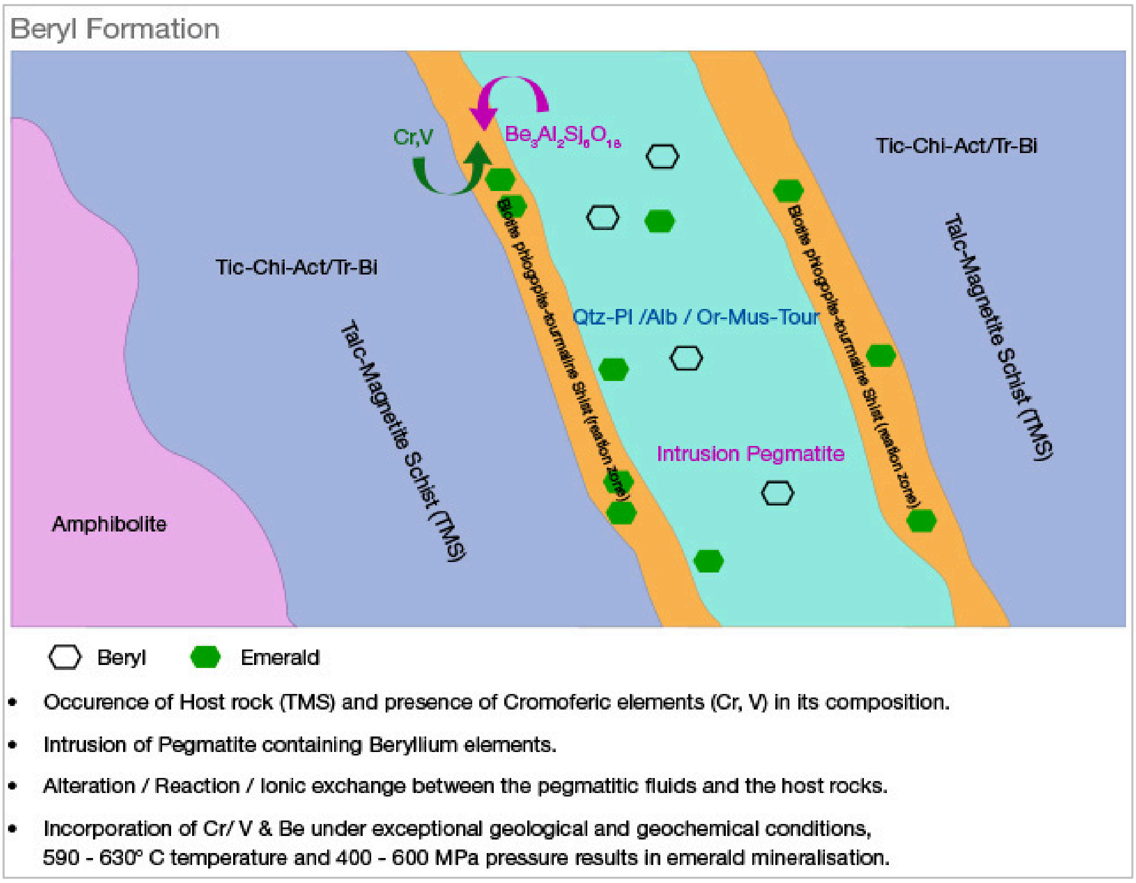


Figure 2-6: Reaction Zone Material at the Kagem Mine

Both the concordant and discordant RZs are laterally discontinuous and vary in thickness from a few centimetres to more than 2 m. All three styles of RZ are mineralogically similar, being composed of phlogopite-biotite-tourmaline aggregates (Figure 2-6a), which are highly soft and friable, providing a protective buffer ideal for the preservation of beryl and emerald crystals. The RZs typically contain beryl mineralisation, of which a variable fraction may be emerald, depending on the chemistry of the TMS. Chemical analyses of phlogopite-rich RZs from emerald and beryl deposits throughout the Kafubu area by Seifert et al (2004), indicate that the transformation of ultramafic units into phlogopite schist involves a major influx of K, Al, F, Li and Rb, localised enrichment of Be, dilution of Cr and Ni, and removal of Ca and Si.

Within the context of the proposed models for schist-hosted emerald and beryl mineralisation within the wider Kafubu area, emerald formation at Kagem is considered to be the result of the interaction of a Be-rich fluid relating to the PEG dykes and quartz-tourmaline veins, with the TMS unit to form the discordant and concordant RZs adjacent to the PEG and quartz-tourmaline vein contacts (Figure 2-7). This fluid also utilised fluid pathways along the TMS footwall and hangingwall contacts and internal brittle structures to form the footwall concordant RZ where there is no footwall PEG, and discordant RZs hosted by brittle structures inside the TMS unit.



- Occurence of Host rock (TMS) and presence of Cromoferic elements (Cr, V) in its composition.
- Intrusion of Pegmatite containing Beryllium elements.
- Alteration / Reaction / Ionic exchange between the pegmatitic fluids and the host rocks.
- Incorporation of Cr/ V & Be under exceptional geological and geochemical conditions, 590 - 630° C temperature and 400 - 600 MPa pressure results in emerald mineralisation.

Figure 2-7: Schematic Representation of the Metasomatic RZ between the PEG and TMS Units, Host to Emerald and Beryl Mineralisation. Source: Gemfields internal presentation

Where concordant and discordant RZs intersect, tri-junctions are formed, which typically produce wider zones of RZ material, with improved quality and quantity of emerald and beryl mineralisation.

Emeralds are a member of the beryl group of minerals which have the chemical formula $Be_3Al_2(SiO_3)_6$ and which show a strong prismatic habit and an imperfect (0001) cleavage perpendicular to the long axis of the crystal (basal pinacoid). They have a hardness of 7.5 to 8.0 and a specific gravity of 2.65 to 2.80. Emerald is the deep green translucent variety of beryl and results from the substitution of Cr, ferrous iron, and in some cases, traces of V, for Al in the crystal lattice.

Kafubu area beryls are typically white to yellowish to bluish white (Figure 2-8), while the emeralds have a moderate to strong green colouration (Figure 2-8) due to low to moderate levels of Cr_2O_3 in the range 0.11 wt% to 0.77 wt% (Seifert et al, 2004). Typical compositional ranges reported by Seifert et al (2004) for beryl and emerald, are listed in Table 2-1. The Kafubu emeralds are characterised by a wide range of trace element contents, typically with moderate levels of Mg and Na, and a moderate to high Fe content (Zwaan et al, 2005). The gemstones have enriched trace element levels, most notably of Cs and Li, but also of K, Rb, Ti, Sc, Mn, Ni and Zn (Saeseaw et al, 2014). Vanadium content is low (Zwaan et al, 2005).

Table 2-1: Key Element Composition Ranges for the Kafubu Emeralds (from Seifert et al, 2004)

Oxide	Compositional Range	
	From (%)	To (%)
SiO_2	64.05	66.23
Cr_2O_3	0.11	0.77
Al_2O_3	13.96	15.37
FeO	0.76	1.88
MgO	1.55	2.64
Na_2O	1.72	2.22
BeO	13.36	13.83

The Kafubu emeralds have relatively high specific gravity (2.69 – 2.77) and refractive index values, especially relatively to emeralds from Colombia (Zwaan et al, 2005). Beryl and emerald mineralisation in the Kafubu area typically forms as subhedral to euhedral hexagonal crystals that often grow in aggregates of multiple gemstones. Step-growth crystal surfaces are common (Seifert et al, 2004). Individual crystals can vary in size from <1mm to >10cm in diameter. The Kafubu beryl and emeralds are variably included, most commonly containing multiphase liquid and gas inclusions mostly of rectangular shape, or less commonly with an irregular outline (Saeseaw et al, 2014). Solid inclusions are relatively common; most typically comprising platy, subhedral to euhderal phlogopite (Seifert et al, 2004), as well as rod-like actinolite or tremolite (Milisenda et al, 1999), pyrolusite, tourmaline, chlorite, feldspar, fluoropatite, magnetite, hematite, rutile and quartz amongst others.

In addition to the phlogopite schist (RZ) mineralisation, the PEG dykes, and particularly the quartz-tourmaline veins at Kagem also contain variable quantities of beryl and emeralds (Figure 2-8d). The emeralds found within the quartz-tourmaline veins typically exhibit a bluish colour and strong habit, and are usually more transparent than the phlogopite schist emeralds. The phlogopite schist emeralds are also typically more included than those in the quartz-tourmaline veins. Despite this, the emeralds contained within the phlogopite schist are, on average, considered to be of a higher quality than those found within the quartz-tourmaline veins. This is primarily because of the greener colour of the phlogopite schist emeralds. The blue colour and increased transparency of the quartz-tourmaline emeralds is attributed to increased Fe content in the beryl crystal lattice.

Images of emerald and beryl mineralisation at the Kagem Mine are displayed in Figure 2-8, as follows:

a) stones recovered from RZ material at the Chama Pit, increasing in quality from low quality beryl on the left, to high quality emerald on the right;

b) a high quality premium emerald;

c) high quality green-ish (left) and blue-ish (right) emeralds; and

d) beryl mineralisation in a quartz-tourmaline vein.

Figure 2-8: Emerald and Beryl Mineralisation at the Kagem Mine

3 DATA QUANTITY AND QUALITY

3.1 Exploration

The main exploration methods being employed at the Kagem Mine include diamond drilling, and bulk sampling from trial pits, most of which has been undertaken since 1998. This key data is supplemented by geological mapping of the main operating open pit at Chama and the trial mining pits at Fibolele and Libwente, in addition to some airborne geophysical survey maps.

Diamond drilling is primarily aimed at determining the nature and geometry of the talc-magnetite schist units and PEG dykes / quartz-tourmaline veins at Chama, Fibolele and Libwente. Additional diamond drilling within the Kagem Mine area has been focussed on identifying and defining additional exploration targets outside of the main deposit areas. The main exploration tool used to determine emerald grade and quality is through current open-pit mining operations at Chama, and trial mining at Fibolele and Libwente. The grade of each deposit is determined through recovered emerald quantity and quality data obtained from the sort house. The approximate exploration expenditure completed to date is given in Table 3-1.

Table 3-1: Approximate Exploration Expenditure to June 2017 (Source: Kagem)

Item	Cost (USD)
Drilling (Diamond)	2,436,220
Geophysics Surveys (Airborne and Ground Based)	7,151
Core Photography	1,000
Handheld XRF/ LIBS and other core analysis (as applicable)	62,265
Consultancy (e.g. thin sections, geophysics, optical sorting etc)	132,000
Total	**2,638,636**

The CP has not been supplied with any specific exploration programmes for the three deposits which form the focus of the Kagem Mine. Any further drilling is likely to be operational in nature, and provided for in the sustaining capital provision, and / or operating costs. Furthermore, the CP has not been supplied with any anticipated greenfield exploration programmes which fall outside the confines of the Kagem Mine.

3.2 Licensed Area

Kagem was incorporated in 1984 as a joint venture between the Reserved Mineral Corporation (55% - liquidated in 1996) and Hagura Mining Limited (45%). In July 1996, Hagura took over the management of Kagem. In Sept 2001, Hagura signed an agreement with Government of Republic of Zambia(“GRZ”) to purchase 42% of its 55% Share. In June 2005, GRZ entered into a supplemental agreement, whereby Hagura would increase its stake to 75%. In October 2007, a portfolio company of Pallinghurst acquired Hagura, which owned and still owns 75% of Kagem. An expansion and redevelopment plan for Kagem was immediately put in place. To implement this plan, Kagem entered into a management agreement on 8 November 2007 whereby Gemfields was asked to spearhead Kagem’s redevelopment plan and expansion. On 8 June 2008, a transaction was completed whereby Gemfields plc became the owner of Hagura, meaning that it effectively held a 75% interest in Kagem. The GRZ renewed the Large scale Gemstone License in favour of Kagem Mining Limited (75% owned by Gemfields, now a portfolio company of Pallinghurst and 25% owned by the GRZ) vide License no 14105HQ-LGML for an area over 40.5 square kilometer on 27th April 2010 for a period of 10 years valid up to 26th April, 2020. A plan of the concession area is provided in Figure 1-2.

3.3 Topography

The highest resolution pre-mining topographic data available for the Kagem Mine area is regional airborne barometric sensing data, at a resolution of 10mX by 10mY. To ensure consistency between the topographic survey and the resource model presented in this report, this surface was projected onto the drillhole collar points, which were surveyed using either total station or differential GPS, and are known to have more accurate elevation values than the topographic survey points. This was achieved through an intelligent interpolation process in ARANZ Leapfrog software, resulting in a topographic surface which honours the more accurate elevation of the collar survey points, whilst retaining the geometry of the original topographic survey between drillholes. Figure 3-1 shows an oblique view (31° towards 342°) of the adjusted pre-mining Kagem topography surface, snapped to collar points (displayed in black) and coloured by elevation (displayed at 3 times vertical exaggeration).

3.4 Geophysical Surveys

3.4.1 Airborne Geophysics

Semi-regional airborne geophysical data was captured by New Resolution Geophysics ("NRG") across much of the NRERA area in 2006. Gemfields re-commissioned NRG to conduct more detailed geophysical data capture within the Kagem licence area in 2008. The licence-scale survey was conducted on a section spacing of 40 m, with point spacing on-section at 1 to 2 m. The licence-scale data was interpreted by Vishnu Geophysics to produce a series of geophysical survey maps, including: total magnetic intensity ("TMI"), TMI analytic signal ("TMI AS"), TMI first and second derivatives, apparent susceptibility, calculated digital terrain model, potassium, thorium and uranium amongst others. The 2006 semi-regional geophysical data was interpreted by NRG, Vishnu Geophysics and Tect Geological Consulting to produce TMI, TMI AS, TMI derivatives, Euler 3D and geological interpretation maps.

3.4.2 Ground Geophysics

Ground geophysical data was collected in-house by Gemfields geologists during the first two quarters of 2015, at a 20 m section spacing and 1 m point spacing on section, in targeted areas of the Kagem licence. Vishnu Geophysics was contracted to complete interpretation of the ground geophysics data, which is on-going at the time of writing.

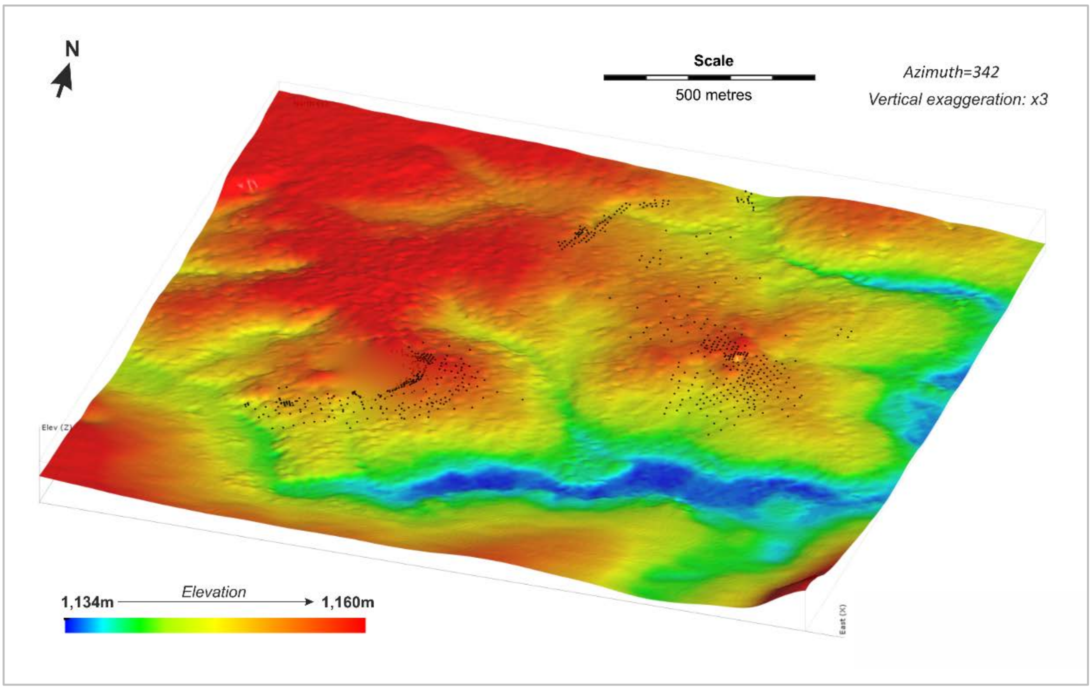


Figure 3-1: Adjusted Pre-Mining Kagem Topography Surface

3.5 Drilling

3.5.1 Summary of the Drill Programme

For the purposes of this study, Gemfields has supplied the CP with a drillhole database for the Chama, Fibolele and Libwente deposits. Other exploration prospects within the Kagem Mine licence area have not been reviewed by the CP, and are excluded from this mandate.

Drilling to date across the three deposit areas in question, (Chama, Fibolele and Libwente) comprises a total of 707 drillholes for a total meterage of 67,457.60 m. This includes 348 holes for 35,771 m at Chama, 117 holes for 9,875 m at Fibolele and 242 holes for 21,810 m at Libwente. All drillholes are diamond core holes.

Figure 3-2 shows the pre- and post-2008 Chama collars overlain on the most recent detailed Kagem satellite imagery. Drilling at Chama is on a variably spaced grid broadly defined by close spaced drilling of approximately 25 x 25 m in a northeast trending arc around the surface expression of the TMS unit, with drill spacing decreasing down-dip. Drill spacing down-dip is highly variable, but can be loosely described in terms of a 100 x 200 m grid, decreasing to approximately 50 x 50 m in places. The majority of holes at the Chama deposit have been drilled perpendicular to the TMS unit, at an average dip of 70° to the northwest and west. A small number of holes have been drilled to assess the distribution and continuity of PEG veining at the Chama deposit. These holes have been drilled at approximately 55° towards the west-southwest on a rough 200 x 200 m grid.

Figure 3-3 shows the Fibolele collars overlain on the most recent detailed Kagem satellite imagery. Fibolele is drilled on 50 m sections (Figure 3-3), with an on-section collar spacing of 50 m. Most sections comprise two or three holes. Infill drilling has been completed in a small area in the south of the deposit on a 25 x 25 m grid. The majority of holes are drilled perpendicular to the TMS unit dipping at an average dip of 70° towards the west and west-northwest, rotating to a north-northwest azimuth in the north, to reflect the change in strike of the target TMS. A total of 15 additional holes have been completed to date targeting the TMS in an area approximately 600 m northeast of the main Fibolele deposit, locally known as Sandwana. Some 20 vertically dipping exploration holes have also been completed on a relatively sporadic grid in the area between Fibolele and Libwente.

Figure 3-4 shows the Libwente collars overlain on the most recent detailed Kagem satellite imagery. Drilling at Libwente has been completed on a variable grid of 100 x 100 m, 100 x 50 m, or 50 x 50 m, decreasing to 25 x 25 m in places. Collar spacing decreases to roughly 200 x 100 m in the north-western part of the deposit. Almost all of the Libwente holes are drilled vertically to target the shallow dipping TMS unit.

All diamond drilling carried out after January 2011 has been completed in-house by two Gemfields owned Longyear LF 1000 D rigs. Most holes start at HQ core diameter, switching to NQ diameter core once into competent rock. The majority of holes extend approximately 20 m beyond the TMS unit into footwall mica schist before being terminated.

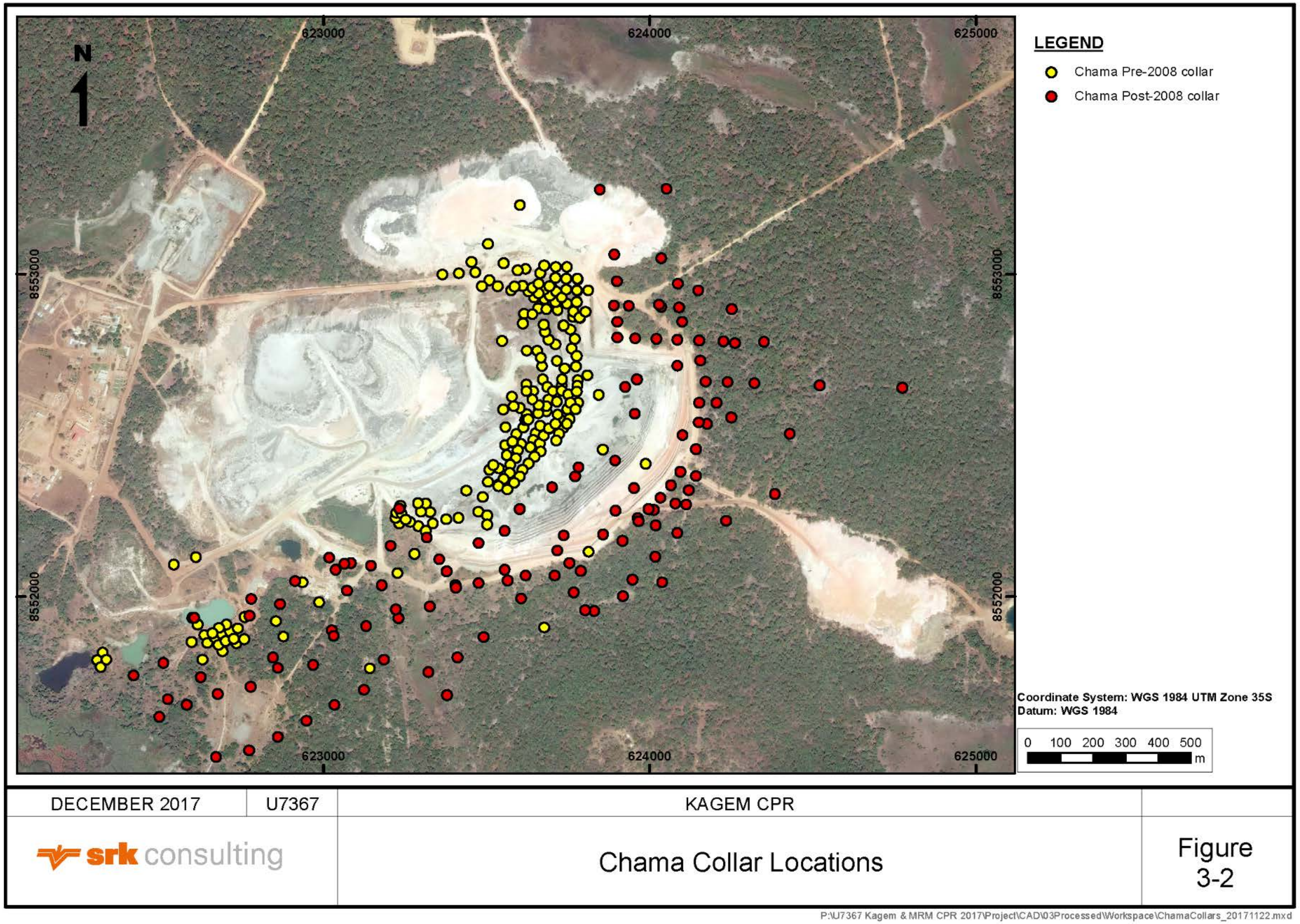


Figure 3-2: Chama Collar Locations

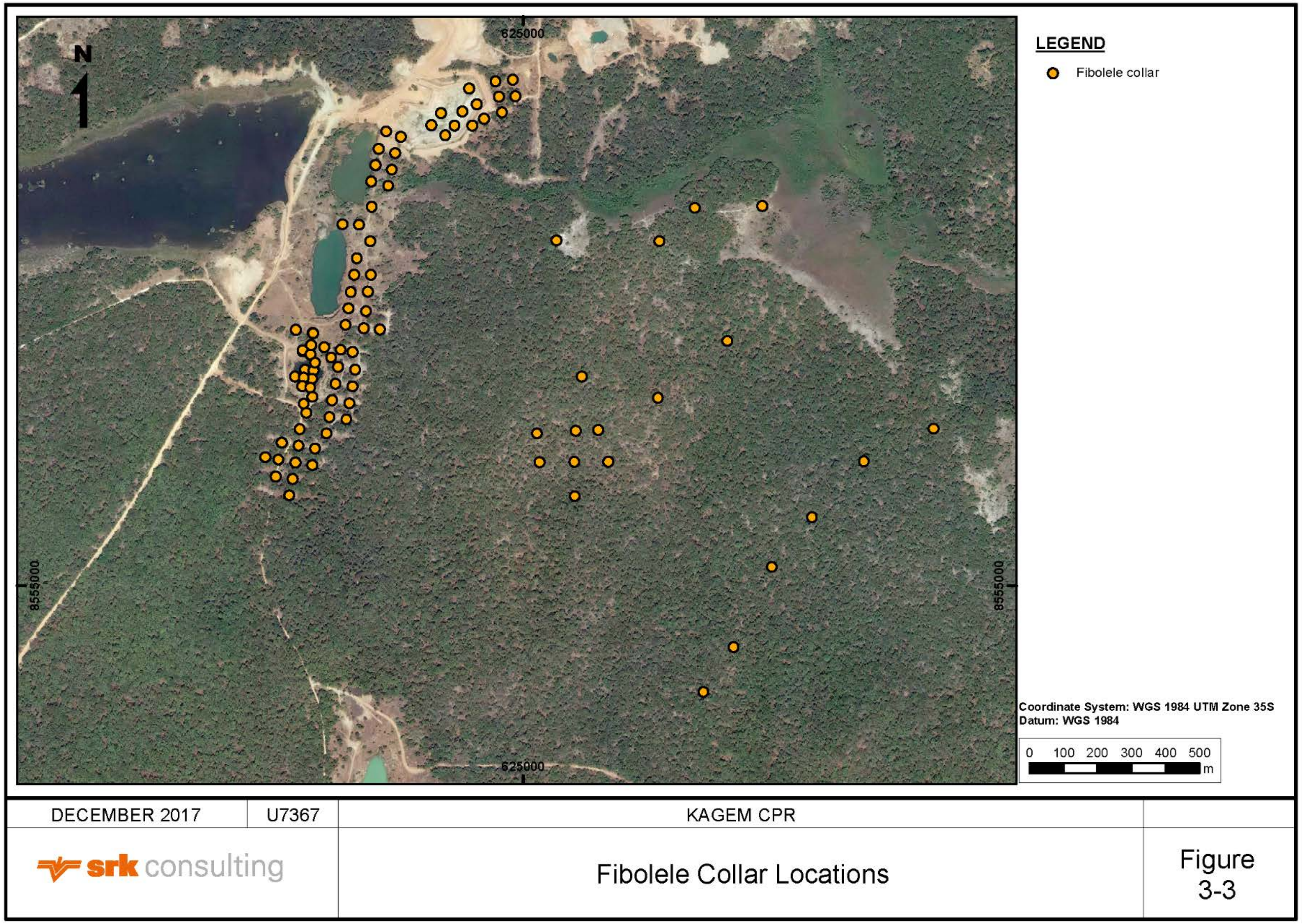


Figure 3-3: **Fibolele Collar Locations**

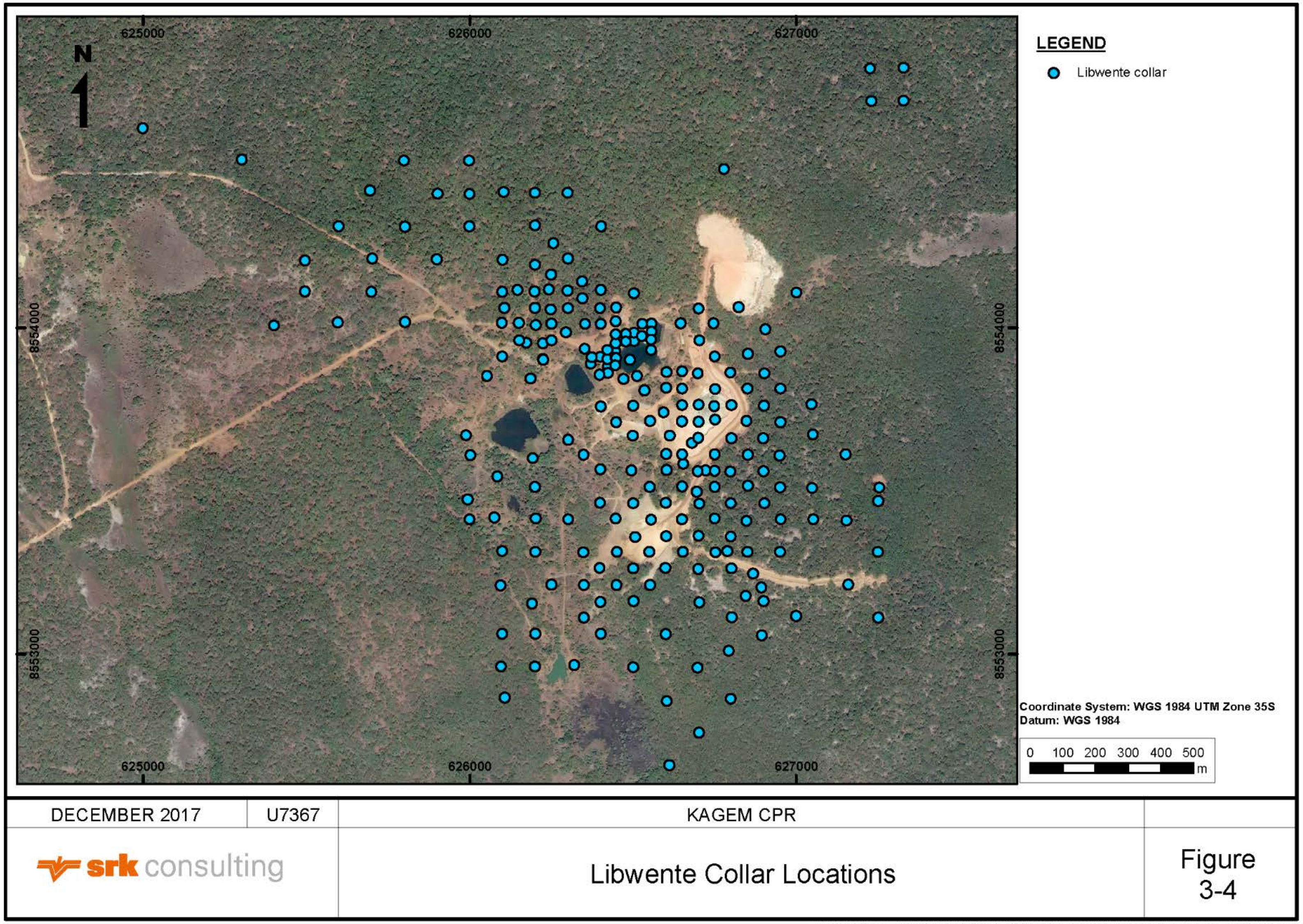


Figure 3-4: Libwente Collar Locations

3.5.2 Collar Surveys

The majority of diamond drillhole collars throughout the Kagem Mine licence were surveyed using total station theodolite. The remaining, most recent, collars have been surveyed using differential GPS.

3.5.3 Downhole Surveys and Core Orientation

Downhole survey data exists for a total of 246 holes throughout the Kagem Mine licence, which represents roughly 35% of the total number of holes drilled. On a deposit basis, the percentage of holes for which downhole surveying has been completed is equal to approximately 33% at Chama, 70% at Fibolele and 20% at Libwente. The holes are surveyed using a REFLEX EZ-Com 2.0.0 tool, at average downhole intervals of approximately 12 m at Chama, Fibolele, and Libwente. None of the holes has been structurally oriented.

3.5.4 Logging and Sampling Procedures

Gemfields has put in place a logical logging and data capture procedure for diamond drilling, to guide the on-site staff through the technical process. This aims to ensure a consistent methodology for the process of capturing data throughout the drilling campaign to allow for subsequent meaningful analysis. All logging is carried out by Gemfields geologists, and the CP considers the methodologies in place to be consistent with normal industry practice for this commodity type. That being said, the CP has made a number of recommendations to Gemfields to improve the logging process going forward, in order to ensure that the most relevant data is captured in a consistent and user-friendly format.

The current procedures for core handling, transportation, logging and sampling are:

1. once removed from the ground, the core is placed into metal core boxes, and length tags inserted at the end of each run. The depth of each run is also marked on the inside of the core box at the position at which the tag is inserted in case any length tags are lost during transportation of the core to the core drill core yard. It is the drillers responsibility to ensure that core in the boxes is in the correct order;
2. after drilling, the core boxes are picked up from the drill site by drilling personnel and taken directly to the drill core storage facilities at camp. The core boxes are stacked and clamped before loading to minimise any disturbance and breakage caused during transportation;
3. upon receipt at the drill core yard, the core boxes are checked to ensure that the depth tags are still in place, and then stacked as per the index catalogue in the core yard;
4. prior to logging, the core boxes are laid out on logging tables and checked to ensure that the core is continuous and in the right order in each box. The core boxes are then cleaned to remove any extraneous contaminants such as drill mud or grease;
5. basic geotechnical data including recovery and rock quality designation (“RQD”) is recorded by a geologist. RQD is defined as the core recovery percentage, only incorporating pieces of solid core >10 cm in length measured along the centre line of the core;
6. after recording core recovery, the core boxes and lids are clearly labelled with “from” and “to” depths;

7. geological data is recorded in a detailed log spread sheet designed to capture key geological information for each interval. This includes rock type, grain size, texture, degree of weathering, colour, intrusive features (such as veining) and major, minor and accessory minerals. A 5 cm minimum logging width applies to ensure that the RZ material, which has an average downhole interval length of approximately 1 m, and is often at the <10 cm scale, is appropriately accounted for in the drillhole database;
8. handheld Niton XRF analysis is completed from 3 m above the hangingwall of the logged TMS unit to 3 m below the footwall of the TMS. A Niton reading is typically taken every 0.33 m, or at 1 m intervals in places;
9. after geological logging and Niton XRF analysis has been completed, sample positions are marked to conform with changes in lithology / alteration. Sample numbers corresponding to pre-printed sample tags are written on the inside of the core boxes. Sampling is undertaken for the TMS unit, in addition to the immediate hangingwall and footwall formations, and the standard sample length is 1 m;
10. the core axis is marked by red pencil down the centre of the core, and the boxes containing core to be sampled are moved to the cutting area;
11. the core is cut using 'Corster' diamond saw blade cutters;
12. half core from one side of the cut line is placed into plastic sample bags for each interval. The sample bags are labelled with sample numbers on the outside and sample tags inserted inside. The boxes from which samples have been taken are then marked with red paint marker as "SAMP";
13. standards are weighed and inserted every 10th sample. Gemfields hold samples for PEG, TMS, mica schist and AMP, generated from Kagem drill core;
14. the sample bags are closed and secured and then places into large sacks. The sacks are labelled with the sample range and company name, and a laboratory instruction sheet included for each batch; and
15. the drill core boxes are returned to the core storage facility at the core yard, and re-stacked as per the core yard index catalogue.

3.5.5 Sample Preparation and Analyses

It is not possible to obtain an accurate emerald carat per tonne assay values from HQ or NQ size core samples. Gemfields has instead conducted geochemical assaying of the drill core, for a suite of elements, which can be used to assist in interpreting the geometry of the TMS unit and RZ host to the emerald and beryl mineralisation. The bulk of geochemical assay data for the Kagem Mine is supplied by handheld Niton XRF analysis, with laboratory assays employed as a validation of the Niton data in selected drillholes. Gemfields has provided the CP with assay data for a total of 715 samples across 72 drillholes. More detail on the quantity and spatial distribution of the laboratory assay samples is given in Section 3.5.7.

Samples are sent for crushing, pulverisation and analysis to either the Alfred H Knight laboratory in Kitwe, Zambia ("AHK"), Shiva Analyticals in Bangalore, India ("Shiva"), or the SGS laboratory in Kalalushi, Zambia ("SGS"). The certification for each laboratory, as at the time of the assaying being completed was as follows:

- The AHK commercial laboratory and sample preparation facility is ISO/IEC 17025:2005* and ISO 9001:2008 compliant. It is a "UKAS" accredited testing laboratory.

- The Shiva loboratory has been assessed and accredited with standard ISO/IEC 17025:2005. The accreditation certificate is awarded by National Accreditation Board for Testing and calibration Laboratories (NABL), which is an autonomous body under the Department of Science and Technology, for the Government of India.

The SGS geochemical laboratory is accredited to the ISO/IEC 17025 standard. The accreditation program is monitored by the South African Development Community Accreditation Service (SADCAS).

For each drillhole sample batch, Quality Assurance and Quality control (“QAQC”) samples in the form of an internal blank and internal duplicate are added to monitor analytical precision and potential contamination. The internal blanks were obtained from quartz samples from the Chama Pit that have been crushed, pulped and thoroughly homogenized at the AHK laboratory. External blank, duplicate and standard standards are also inserted at SGS.

The Company’s exploration manager is charged with the responsibility of ensuring that all quality control procedures are followed and the results regularly reviewed.

3.5.6 Data Received

The CP was provided with the following list of documents and files to assist with the Mineral Resource Estimate:

- drillhole data:
  - diamond drillhole data for 707 holes including collar and survey files and detailed geological and basic geotechnical logging data;
  - handheld Niton XRF analysis for a suite of 12 elements for 136 holes at Chama and Libwente, and single element (Cr) Niton analysis for 42 holes at Fibolele; and
  - laboratory assay data for a total of 715 samples from the selected sampled holes at Chama, Fibolele and Libwente, in Excel format.
- in situ and drill core density testwork results;
- monthly pit survey wireframes up to May 2015 for the Chama, Fibolele and Libwente deposits in Surpac format;
- detailed monthly (when available) open-pit geology maps for the Chama, Fibolele, Libwente, Ishuko and Sandwana pits in both JPG image format and ArcGIS format;
- detailed production data for the Chama, Fibolele and Libwente operations, including mined tonnes by rock type, RZ tonnes, stripping ratio and run of mine (“RoM”) from both the Mine and the plant, all on a month-by-month basis;
- underground working survey strings in Surpac string format;
- detailed underground geological mapping sections and plans in both JPG image format and Surpac string format;
- semi-regional magnetic and radiometric geophysics interpretation maps;
- licence scale airborne geophysical survey maps including TMI, TMI AS, TMI first and second derivatives and apparent susceptibility and radiometric interpretation maps for potassium, thorium and uranium;
- ground geophysics magnetic and radiometric data interpretation maps for the Ishuko pit area;

- airborne licence-wide 10 x 10 m topography survey data in point format;
- high resolution geo-referenced satellite imagery for the Kagem licence area;
- exploration plan maps including surface geology interpretations for the Chama, Fibolele and Libwente deposits;
- Kagem Mine licence boundary string (in .dxf format) and associated documentation;
- core photographs for a total of 58 holes throughout the Chama (16 holes), Fibolele (33 holes) and Libwente (9 holes) deposits; and
- in-house Surpac wireframes for the Chama TMS unit.

3.5.7 Quality Assurance and Quality Control - Assays

The bulk of geochemical assay data for the Kagem Mine is supplied by handheld Niton XRF analysis, with laboratory assays employed as a validation of the Niton data in selected drillholes. Gemfields has provided the CP with laboratory assay data for a total of 715 samples from the selected sampled holes at Chama, Fibolele and Libwente. This includes assay data produced by AHK, Shiva, and SGS. The majority of downhole assay data provided incorporates the TMS unit and a few metres of the footwall and hangingwall waste rock. The laboratories used for analysis are as follows:

- AHK – Alfred H Knight, Kitwe, Zambia;
- Shiva – Shiva Analyticals (India) Private Ltd, Bangalore, India; and
- SGS – SGS Inspection Services, Kalulushi, Zambia

The Shiva laboratory data includes analysis for a suite of 59 elements for a total of 83 samples from 9 drillholes, including three holes each at Chama, Fibolele, and Libwente. The AHK database includes a total of 160 samples analysed for Cr and V, from a total of 7 drillholes, all at Chama. The SGS dataset is the most comprehensive, including data for 472 samples analysed for a suite of 36 elements across 56 holes, including 15 holes at Chama, 15 holes at Fibolele and 26 holes at Libwente. The SGS data set also incorporates a total of 39 QAQC samples, including internal blanks, internal duplicates, external blanks, external standards and external duplicates, as documented in Table 3-2.

Table 3-2: SGS QAQC Laboratory Assays by QAQC Type and Deposit

QAQC type	*Number of Analyses*		
	Chama	**Fibolele**	**Libwente**
Internal Blank	6	5	11
Internal Duplicate	6	4	10
External Blank	7	6	26
External Standard	13	12	48
External Duplicate	7	6	25

Laboratory assay data has not been used as an explicit control in the resource modelling process for this study. For this reason, it has not been considered necessary to complete a detailed analysis of the laboratory assay QAQC data provided at this time. The limited QAQC analysis conducted by the CP as part of the underground FS at Kagem in 2012, coupled with the present analysis of the ICP-MS analysis in two additional laboratories suggests a relatively strong performance of the limited QAQC sample database.

The CP considers that that the frequency of QAQC sample insertion is appropriate for the current QAQC checks, and the level of resource classification in this report; however, it is noted that the supplied data is relatively limited. Based on QAQC analysis, the CP is satisfied that the quality control procedures indicate no overall bias in the sample preparation and ICP-MS procedure.

In general, it is the opinion of the CP that the results of the limited number of QAQC analysis display a reasonably good correlation to the original assays and are acceptable. That being said, it is recommended that more stringent compilation and records of QAQC procedures are kept in the future for historical review of data. It is considered possible that with a more comprehensive QAQC program, and assay database size in general, the assay data could be incorporated as an additional control in the resource modelling process, helping to improve overall resource confidence.

3.5.8 QAQC Niton

Gemfields has provided the CP with handheld Niton XRF data for a total of 7,088 samples from a 178 holes across Chama, Fibolele and Libwente. This includes analyses for 22 holes at Chama (approximately 6% of the Chama holes), 41 holes at Fibolele (approximately 35% of the Fibolele holes) and 115 holes at Libwente (approximately 48% of the Libwente holes). The Niton XRF data covers a suite of 12 elements at Chama and Libwente, and one element (Cr) at Fibolele. Niton analysis is typically completed from 3 m above the hangingwall of the logged TMS unit to 3 m below the footwall of the TMS. The majority of Niton intervals are 0.33 m in length, or alternatively 1 m in places.

As a validation check, the CP has completed a high level comparison analysis of the Niton XRF data against the laboratory assays. Weighted average Cr values within the TMS unit for the Niton XRF data, in addition to the laboratory assays from SGS, AHK and Shiva are presented in Table 3-3.

Table 3-3: Weighted Average Cr Values with in the TMS Unit for the Niton and Laboratory Assay Data Sets

Data set	Weighted average TMS Cr value (ppm)	Total length of TMS core analysed (m)
Niton	2,058	112.76
SGS	1,737	2,257.81
AHK	2,664	273.26
Shiva	2,761	26.92

Direct comparison of Niton XRF Cr grades and SGS Cr grades where down-hole crossover between the two data sets exists is presented in Figure 3-5. Similar analysis comparing the Niton XRF grades with Shiva Cr grades is presented in Figure 3-6. No cross-over exists between the Niton XRF and AHK assays. The standard laboratory assay sample length is 1 m, whilst the standard Niton interval length is 0.33 m. For this reason, the Niton XRF grades directly compared with individual SGS and Shiva laboratory assays are length weighted averages of all the Niton samples that cross over with individual laboratory assay sample intervals.

Figure 3-5 demonstrates a large discrepancy between the Niton XRF Cr values and the SGS Cr assays, with a correlation coefficient of about 0.49. This indicates a relative lack of precision in the Niton analysis, the SGS laboratory analysis, or both. In addition, other than core with very low Niton Cr values of <300 ppm, the handheld Niton typically returns higher Cr values than the SGS laboratory data. This is also evident from the weighted average Cr value in the TMS unit from the SGS assays which, at 1,737 ppm, is 321 ppm less than the weighted average value from the Niton data set.

Comparison of the Niton XRF and Shiva laboratory Cr data, also indicates a relatively poor correlation, with a correlation coefficient of about 0.55. Figure 3-6 also highlights that the Niton Cr values are typically higher than the Shiva assay Cr values, although the average Cr value within the TMS is higher for the Shiva assays than the Niton data, resulting from the effect of 1 or 2 anomalous values on the relatively small amount of data from the Shiva laboratory available for comparison.

Although based on a relatively small assay dataset, the results of the QAQC analysis suggest that there is possibly a significant degree of imprecision associated with the handheld Niton XRF Cr values, and that this data should be used with caution when used to assist in geological or resource modelling. The QAQC review also indicates that the Niton XRF may be slightly over-estimating the Cr content. Although a concern, this does not have a significant impact on the resource modelling process, as the average Cr values of the various rock types and derived cut-off values used to adjust the resource model are based on Niton data alone.

At this stage, it is unclear whether the discrepancies between the laboratory assay data and the handheld Niton data are a result of imprecision in the Niton data, the laboratory data, or a combination of both. In addition, the differences in sample length (Niton, 33 cm, and SGS, 1m), may also be introducing a level of exaggeration. Review of limited laboratory QAQC samples (Section 3.5.7) suggests a reasonable precision in the laboratory assay analysis; however, the CP recommends that Gemfields substantially adds to the laboratory assay QAQC data set, in order that a more detailed QAQC of the laboratory assays may be undertaken. This should go a long way to determining the cause of the discrepancies between the Niton and laboratory analyses.

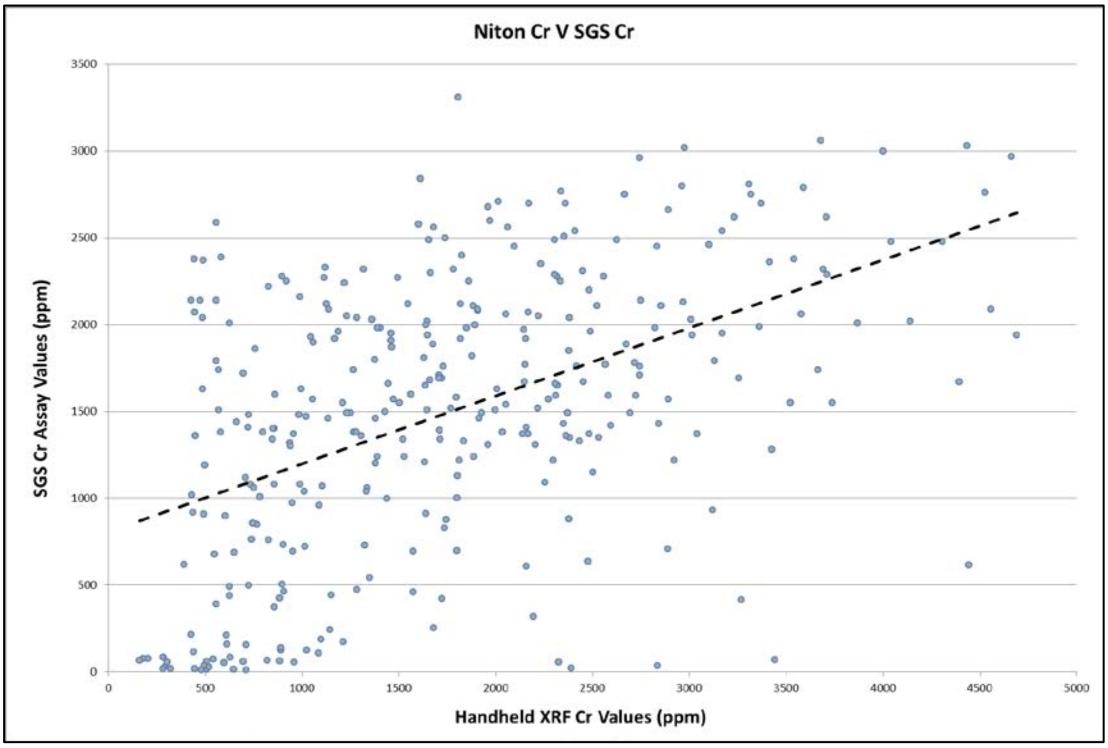


Figure 3-5: **Direct Comparison of SGS Laboratory Cr Assays and Niton XRF Cr Values**

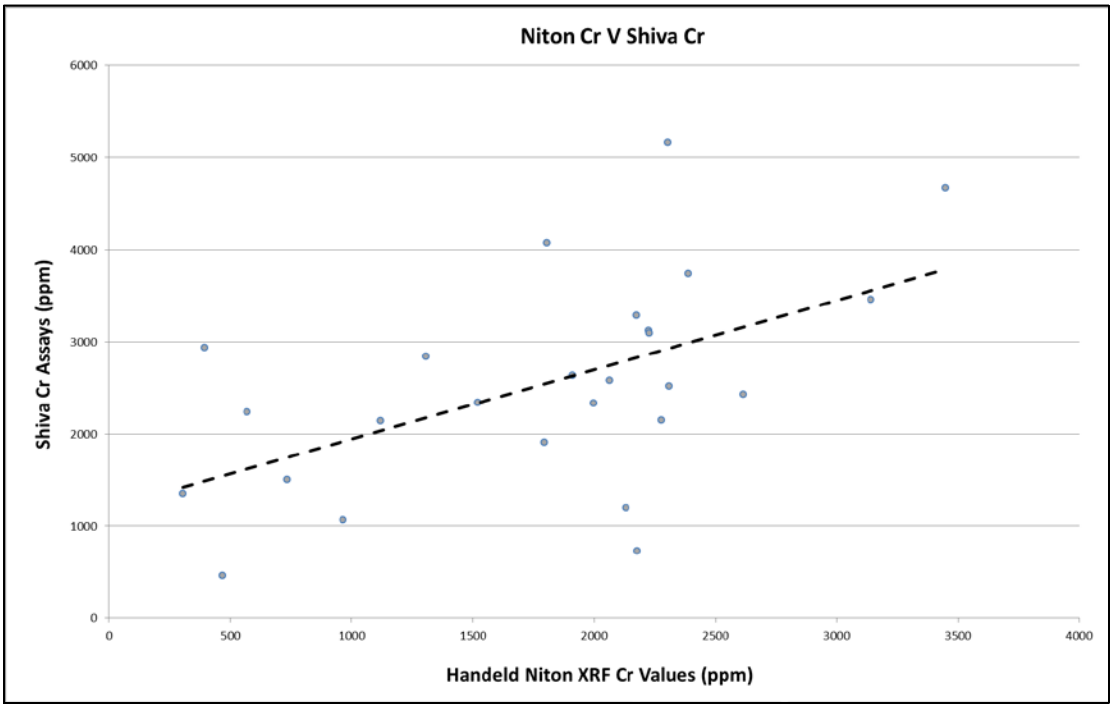


Figure 3-6: **Direct Comparison of Shiva Laboratory Cr Assays and Niton XRF Cr Values**

3.5.9 Lithological Logging Validation

The CP completed a brief review of the drillhole databases for the respective deposits and summary logging of a series of drillholes during the most recent site visit completed in June 2015. The CP's review suggests that the geological information being recorded by Gemfields geologists is of a good quality, lithological identifications are consistent and downhole contact depths have been captured to an appropriate level of accuracy.

That being said, the CP notes that there is a degree of inconsistency between the logging of the older, pre-2008 holes and more recent drilling. Most notably, the logged RZ thickness in the post-2008 holes is 0.76 m, approximately 67% that in the pre-2008 holes, of 1.14 m. This is considered to be a function of an improved understanding of the nature of the RZ material over time, rather than any geological difference in RZ thickness in the older drilling relative to the more recent drillholes. In general, the logging and nomenclature used during logging is generally consistent between the pre- and post-2008 holes.

As a form of validation of the lithological logging, and to identify any potential relationships between rock type and geochemical signature that may assist in the resource modelling process, the CP completed a high level analysis of the Niton XRF data with the lithological logging. Average Niton XRF values for the suite of 12 elements analysed split by lithology are presented in Table 3-4.

Table 3-4: Average Niton XRF Grades for the Chama, Fibolele and Libwente Deposits, Split by Lithology

	Average Niton XRF grade (ppm)											
Lith	Zn	Mn	Sr	Ca	Ti	Fe	Rb	V	Cr	Nb	K	Cu
AMP	1,306	910	423	29,984	1,918	60,438	118	294	1,075	38	7,399	72
MS	626	493	385	20,301	2,076	47,734	154	270	510	41	11,766	24
TMS	1,208	964	135	22,570	1,402	69,459	96	236	2,125	34	5,710	64
RZ	5,443	1,128	201	17,966	1,802	65,325	530	255	914	59	17,354	71
PEG	1,871	802	221	26,364	1,228	31,900	157	222	797	47	8,568	69
QT	3,854	866	294	19,202	1,957	50,851	220	248	880	59	12,934	38

On this basis, the most notable geochemical differentiator between the AMP and TMS units is a significant increase in Cr content within the TMS, from an average of 1,075 ppm in the logged AMP unit, to an average of 2,125 ppm within the TMS (Figure 3-7). Visual analysis of the Cr grades alongside the downhole lithological logging indicates a sharp increase in Cr grade at the TMS – AMP contact, rather than a gradational change. This increase in chromium content within the TMS unit is considered most likely to be a result of differentiation of chromium within the original komatiite melt into the lower, more ultramafic protolith to the TMS unit, and explains why emerald and beryl mineralisation is only associated with the TMS, and not also the adjacent AMP unit. The contact between the TMS and AMP units is also marked by a pronounced decrease in strontium content from an average of 423 ppm within the AMP, to 135 ppm within the TMS unit (Figure 3-7).

Key geochemical differentiators between the TMS unit and the RZ material are a marked increase in both rubidium and potassium content within the RZ, relating to the influx of K and Rb during the transformation of metabasic rock into phlogopite. Average Rb content in the TMS unit is 96 ppm, which compares to an average Rb content of 530 ppm in the RZ material, whilst average K in the TMS of 5,710 ppm compares to an average RZ K grade of 17,354 ppm (Figure 3-7). RZ material is also characterised by a pronounced increase in zinc grade, from an average of 1,208 ppm within the TMS unit, to 5,443 ppm in the RZ material (Figure 3-7), probably relating to increased tourmaline content within the RZ.

Notably none of the key lithologies, including TMS and RZ material, shows any great variation in vanadium content (Figure 3-7), which suggests that vanadium does not have a significant role to play in the formation of emerald and beryl mineralisation within the tested Kagem deposits.

The CP notes that although this high level review of the Niton XRF data offers a useful insight into the geochemical characteristics of the key lithological units at the Kagem Mine, clearly more detailed data and analysis is required to derive any firm conclusions on the chemical composition of the local units (and particularly RZ material) that can be used as an explicit control for resource modelling. That being said, taking geological continuity into consideration, the CP has carefully utilised certain aspects of the Niton XRF data to assist in constructing the resource model where possible (see Section 4.2.1). The Niton XRF grades are not used directly for the estimation of Mineral Resources, but are used to provide further comfort regarding the lithological logging completed to date.

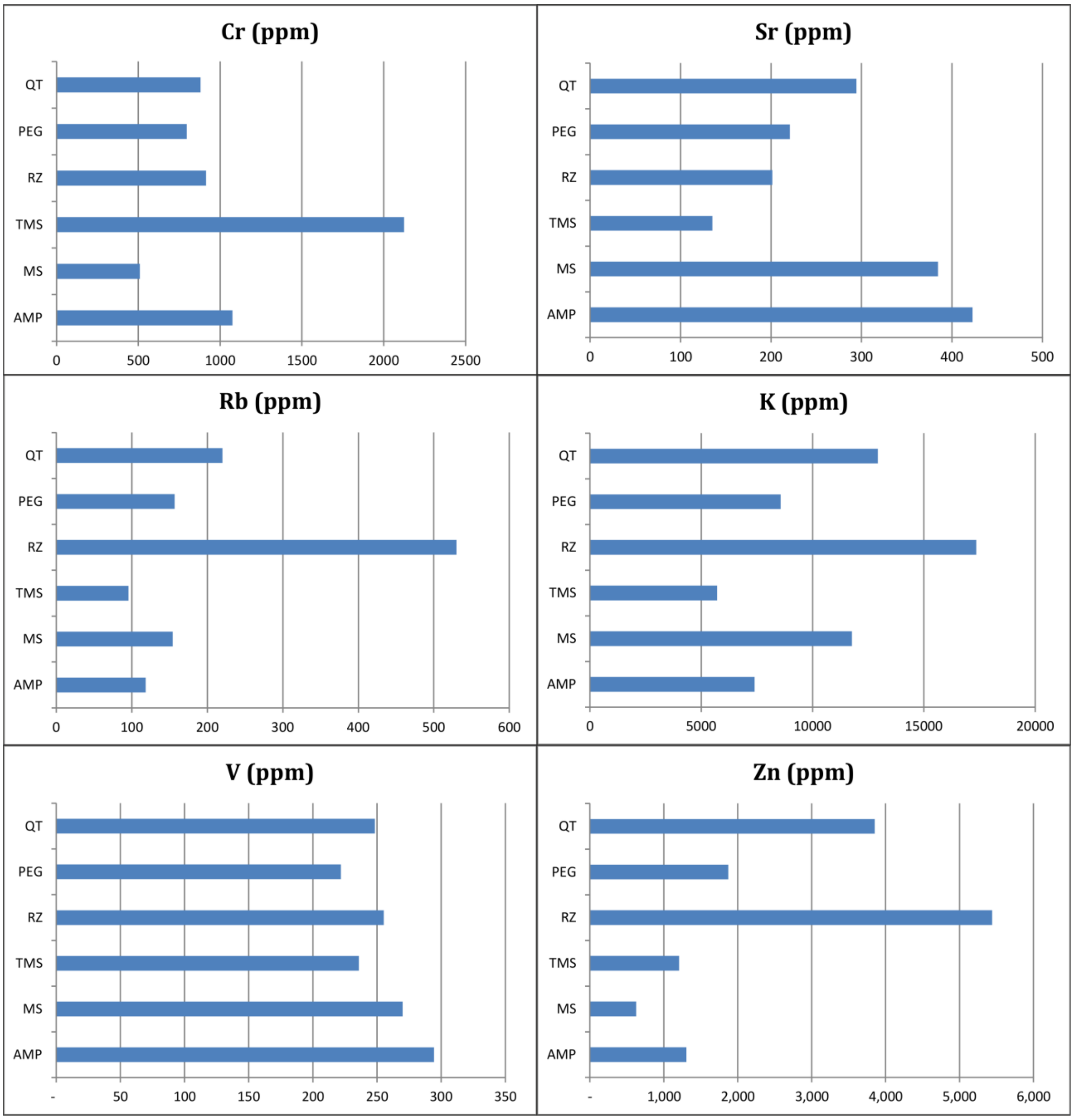


Figure 3-7: Average Niton XRF Values for Selected Key Elements Split by Lithology

3.5.10 Core recovery

Core recoveries have been recorded for all new drillholes. Core recoveries in available drillhole data average 80.8%. Recovery in the PEG ranges from 5 to 100% and averages at 82.5%, whilst recovery in the TMS is more consistent, ranging from 8.4% to 100% and averaging at 91.1%. Good core recovery in the PEGs and TMS intersections is particularly important.

Core recovery was not routinely recorded in the pre-2008 drilling campaigns. Where available, excepting expected low recoveries in the soil horizon, average values range from 57.6% to 98.5% with the latter value being in the TMS unit and the former in kaolinised PEG areas. Reduced recovery in the PEGs is a concern as it renders thickness measurements, and assessment as to whether PEGs are conformable or discordant, more difficult.

3.6 Density

Historically, specific gravity measurements were only available from a 2009 Rocklab report from AMC. Subsequent to the underground Feasibility Study in 2012, Gemfields undertook density testwork from both in situ and core sources. In addition, Gemfields also benchmarked the density testwork results against the production records derived from the Mine. This is a significant improvement on the data available historically, and has improved confidence in the tonnage estimates.

All of the density values used to define the tonnage estimates were determined using a standard emersion technique. Each sample was weighed in air, and in water, and the density determined. If the sample was friable, then the sample was wrapped in plastic before being weighed. The density values and number of samples per lithology are detailed in Table 3-5.

Table 3-5: Density Values Derived from Testwork and Production Records, as Applied for Tonnage Estimation

Lithology	Number of Samples	Density (g/cm^3)
TMS	19	2.85
PEG / QT Veins	14	2.60
RZ	19	2.85
Undifferentiated waste, including AMP	35	2.40
Weathered waste rock to a depth of 1,160mRL	7	2.20

3.7 Pit Mapping

The on-site geologists complete detailed pit mapping of the operating open pits (namely Chama, Fibolele, Libwente South and Ishuko) on a regular on-going basis. The data from this mapping is regularly imported into ArcGIS software and incorporated with pre-existing mapping data to produce an updated digital geological map of each pit on a monthly basis. Figure 3-8 shows a detailed geological map of the Chama open pit completed by Kagem geologists, sourced from the Gemfields mapping library. The geological pit maps are generated at a scale of 1:1,000 at Chama (production contacts are mapped at a scale of 1:200) and Libwente, and 1:500 at Fibolele. Units incorporated into the final maps include mica schist, AMP, talc-magnetite schist, transitional talc-magnetite schist, footwall mica schist, PEG, quartz-tourmaline veins and RZ. In addition to the current operating pits, Kagem has also partially de-watered and mapped the two Sandwana pits in the far north of the Fibolele deposit area. Here, mapping is based on a combination of observations made directly from the exposed pit, and the extrapolation of logged TMS in the drill database to surface in areas of the pit that are still flooded. The Sandwana pits are mapped at a scale of 1:800.

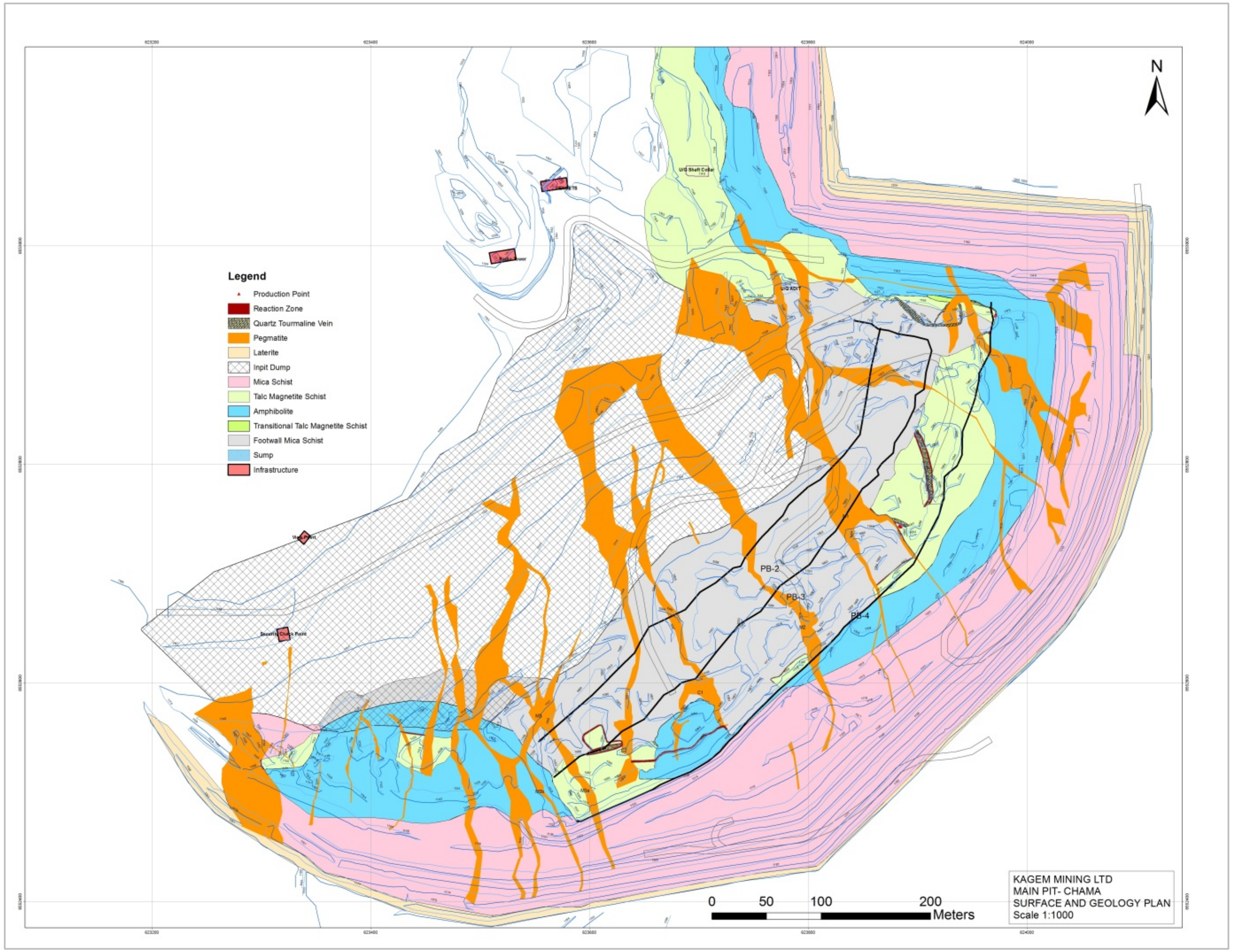


Figure 3-8: Detailed Geological Map of the Chama Open Pit Completed by Kagem Geologists. Source: Gemfields Mapping Library

3.8 Bulk Sampling and Production Data

The main exploration tool used to determine emerald and beryl grade and quality at the Fibolele and Libwente deposits is through bulk sampling from trial mining pits. Grade and quality data for Chama comes from production data the open-pit mining operation, which has been Gemfields main operations focus since acquiring the Kagem licence in 2008. The areas which have been mined, either historically by third parties, or by Gemfields, are illustrated in Figure 3-9.

Available production data for Fibolele comes from a single main bulk sampling pit, which has been in operation since August 2012, and from which, to date more than 2,000,000 tonnes of material has been removed. At least 9 historic bulk sampling pits of variable size border the main Fibolele pit to the north and south; however, no production analysis is available for these. Most are currently flooded, although the two Sandwana pits in the far north of the Fibolele deposit area have recently been partially de-watered and mapped.

Two bulk sampling pits are currently in operation in the Libwente deposit area: Libwente South and Ishuko. At least five historic trial mining pits exist in the area surrounding the two currently operating pits, however, as at Fibolele, these are mostly flooded and have no associated production data. Of the two currently operating pits, production data is only presently available for Libwente South, from which more than 1,350,000 tonnes of material has been removed since July 2014. At the time of writing, the Ishuko pit is still at the waste stripping stage.

The material recovered from the bulk sampling pits at Fibolele and Libwente and the open pit mining operation at Chama is passed through a wash plant to isolate the gemstones, and subsequently sorted by hand to provide emerald grade and quality values for each pit. The minimum size (bottom cut-off) of stone which can be recovered from the wash plant is 3 mm. Upon receipt at the sort house, the mined material is passed through a tumbler and screens in order to remove any clay material prior to sorting. Any schist or other waste rock still attached to the gemstones is then removed, either by using pliers to remove the host rock in a process known as “cobbing” (Figure 3-10), or by cleaning with a hand-held drill for some of the higher quality gemstones (Figure 3-11).

After cleaning, the gemstones are sorted by hand into 4 broad quality designations, before being further subdivided (resulting in a total of 181 quality splits) as outlined below:

- **Premium Emerald:** emeralds of a very pleasant green or blue-green colour with a secondary hue of yellow or blue and a medium to dark tone. Saturation is vivid to medium, with even colouring throughout, and very good clarity with very few minor inclusions, such as insignificant fractures. The Premium Emerald gemstones have a bright vitreous lustre and high brilliance, especially when polished, and good to excellent competency with very high carat yield once cut.

  The Premium Emerald gemstones are divided into green and blue-green fractions and then further subdivided into various quality designations (A-E). These are then split into 6 size categories resulting in a total of 60 Premium grades.

- **Emerald:** the Emerald split designation represents a wide range of emerald qualities. Emerald grade gemstones retain a green or blue-green colour with a secondary hue of green or blue and a light to medium tone. Clarity is variable, ranging from transparent to highly included or opaque. Yield after cutting is also variable, from very low to moderate.

  Similar to the Premium Emerald designation, the Emerald gemstones are divided into green and blue-green fractions and then further subdivided into various quality designations (F-M for green stones and Fc-Nc for blue-green gemstones). These are then split into a number of size categories resulting in a total of 118 Emerald grades.

- **Beryl-1:** gemstones of a bluish colour that range in clarity from translucent to opaque and are generally highly included, giving a low recovery in the cut. The Beryl-1 gemstones are divided into two sizes: -16mm and +16mm.
- **Beryl-2:** greyish or brownish gemstones with no lustre or transparency resulting in a very low yield. The Beryl-2 grade gemstones are not subject to any further sorting.

Gemfields holds three reference sets, which define each quality designation and are held at the sort house at the Kagem Mine, in London and in India. The reference sets were built from production at various locations throughout the main Chama open-pit over a number of years. The use of these reference sets helps to ensure consistent grading of the emerald gemstones over time and as production moves forwards.

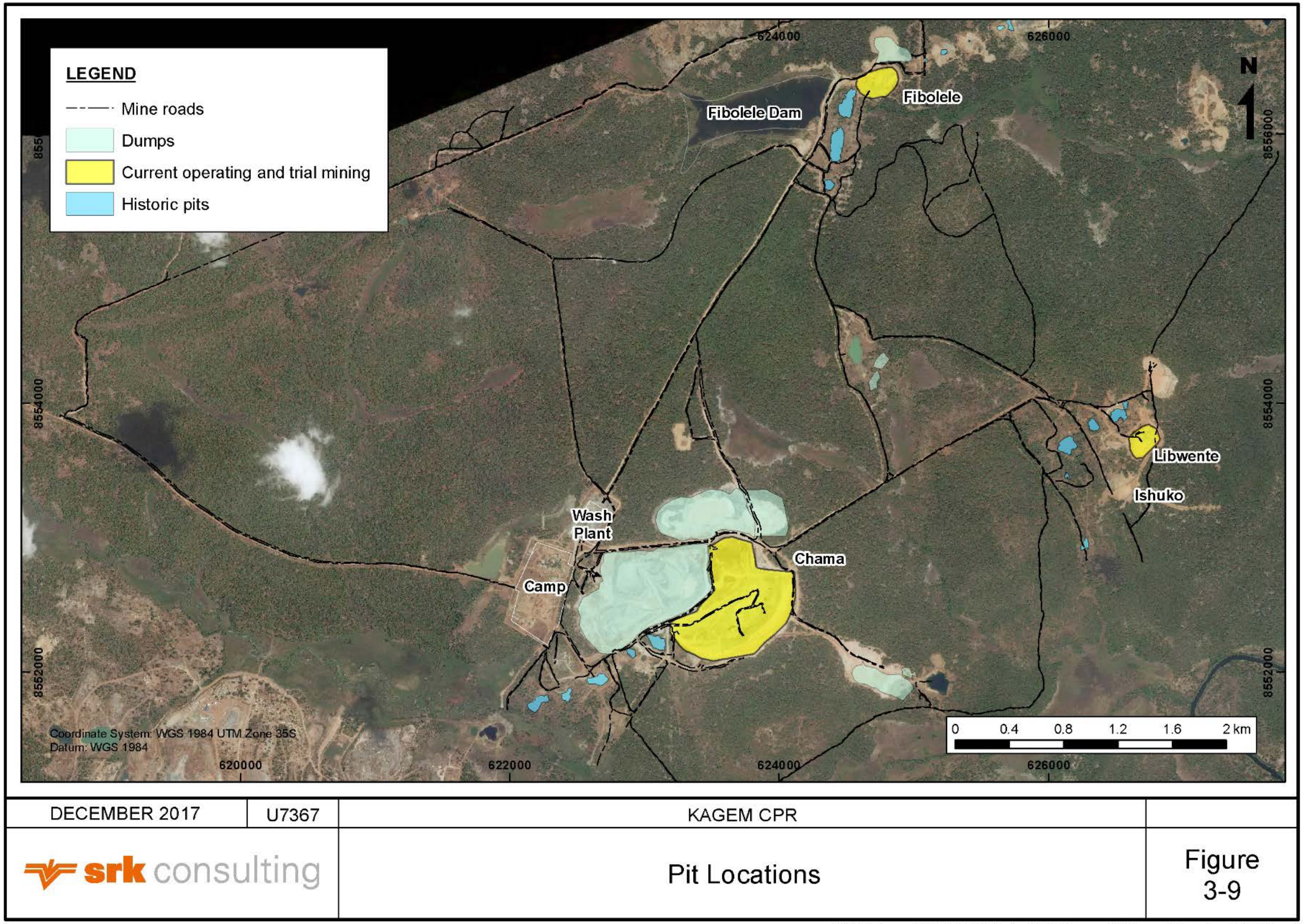


Figure 3-9: Location of Operating and Historic Pits at Chama, Fibolele and Libwente

Figure 3-10: **Kagem Sort House Worker "Cobbing" Host Rock from Emerald Gemstones**

Figure 3-11: **Kagem Sort House Worker Removing Waste Material from a High Quality Emerald**

4 MINERAL RESOURCES

4.1 Introduction

Resource models were constructed, estimated and classified independently for the Chama, Fibolele and Libwente areas, using all available data. The following section describes the modelling methodology applied. All geological modelling was undertaken in ARANZ Leapfrog Geo software, with grade and tonnage estimates being completed in either GEMS or Datamine as stated.

4.2 Chama Geological Modelling

4.2.1 TMS model

A talc-magnetite schist model (including RZ material) for the Chama deposit was constructed in Leapfrog Geo through sectional polyline interpretations of the TMS footwall and hangingwall. The footwall and hangingwall strings were snapped to drillhole contacts, using the TMS, TBS and RZ logging codes as an explicit control on the model. A 3D TMS solid was then generated below the hangingwall and above the footwall surfaces. The model was subsequently checked against downhole XRF chromium grades, and the contact surfaces modified where appropriate to reflect the chromium distribution. Considering the average downhole XRF grade of the TMS material documented in Section 3.5.9, this typically involved adjusting the TMS model to incorporate external material grading at >1,500 ppm Cr adjacent to the modelled TMS contact, or conversely the removal of internal material <1,500 ppm Cr in the contact zone.

4.2.2 Pegmatite model

As the local stratigraphy is intruded by both concordant and discordant pegmatitic dykes, it was necessary to divide the logged PEG intervals into concordant and discordant PEG groups for modelling purposes. This was achieved by visual assessment of all downhole PEG, QV, QF, QT and TOUR intervals in 3D space, looking down-dip, parallel to the TMS model. Manual selections were then created for any logged PEGs forming consistent trends in PEG intervals of similar thickness parallel to the TMS unit. Figure 4-1 shows the concordant dyke selections in the Chama pit area, with key dyke selections labelled and shown relative to a NE-SW section of the TMS model (in green). A total of 37 discrete concordant PEG bodies were identified (the most prominent of which being a relatively continuous PEG dyke at the FWL of the TMS unit) and ranked according to confidence in geological continuity (Table 4-1). The confidence in the geological continuity was based on the number of holes intersected, and the degree to which intersections could be correlated between drillholes. This confidence was purely used to aid coding of the drillholes in defining the pegmatite models.

Table 4-1: Confidence Ranking for the Chama Concordant PEG Dyke Units Identified through Visual Assessment and Interval Selection

Dyke No.	Confidence Ranking	Number of holes intersected	Average thickness per hole (m)	Dyke No.	Confidence Ranking	Number of holes intersected	Average thickness per hole (m)
98	1	4	0.93	26	20	16	2.04
99	2	201	2.26	14B	21	9	2.87
23	3	5	4.32	16	22	11	4.84
6	4	7	4.51	18	23	9	6.13
4	5	8	5.13	27	24	7	4.21
22	6	8	5.74	17	25	9	1.04
7	7	17	1.44	9	26	9	3.22
8	8	8	4.16	24	27	11	2.57
29	9	10	2.11	25	28	5	1.57
34	10	8	3.52	32	29	11	6.08
2B	11	15	2.80	13	30	10	3.15
14	12	6	4.98	10	31	14	1.67
20	13	8	4.68	11	32	13	4.14
3	14	9	3.56	31	33	13	3.46
5	15	9	3.89	19	34	18	3.81
35	16	6	3.31	15	35	12	4.43
33	17	10	1.75	21	36	19	3.78
12	18	6	0.96	30	37	10	2.72
28	19	10	4.82	-	-	-	-

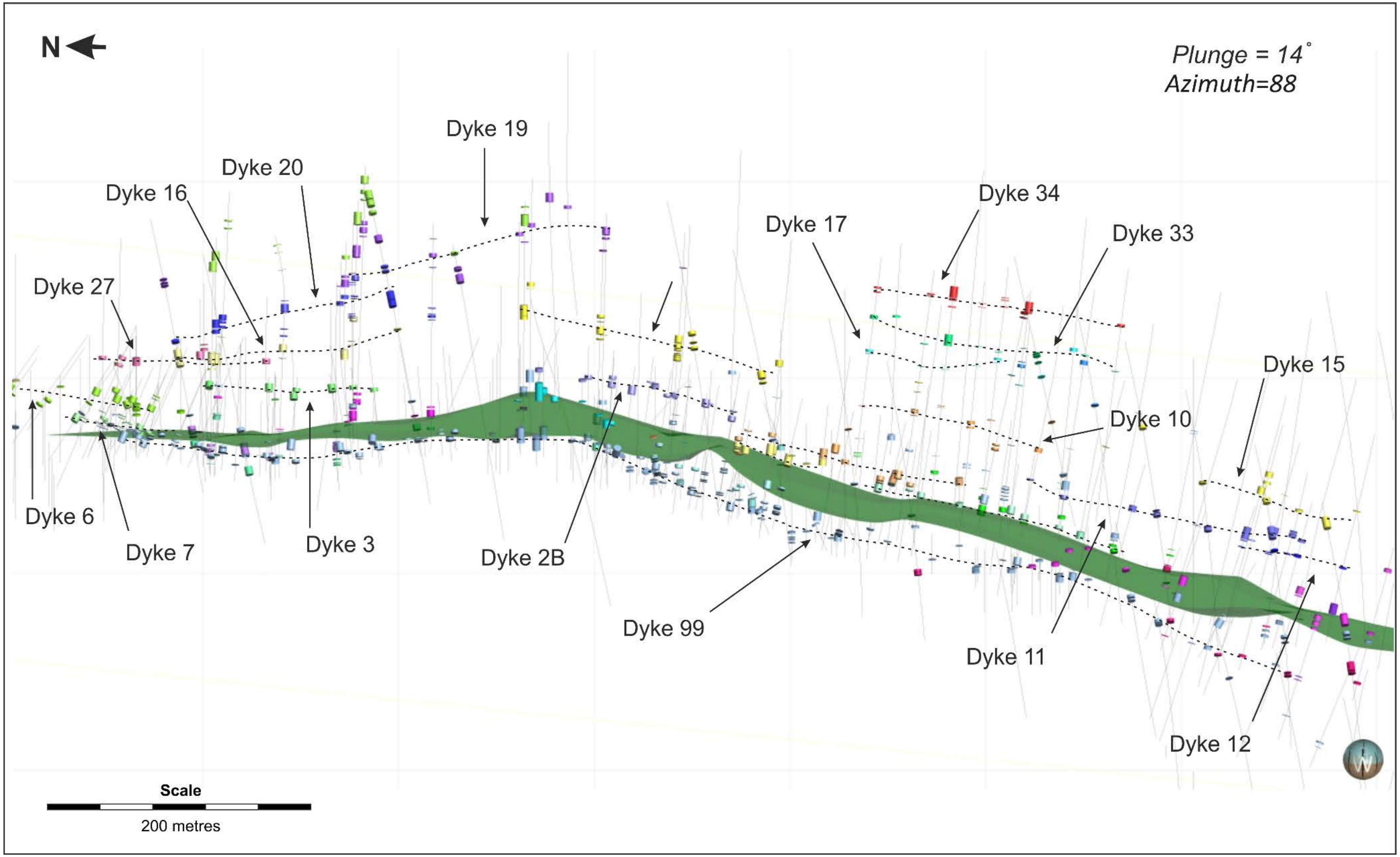


Figure 4-1: Key Concordant Dyke Interval Selections at Chama. The drillhole intersections are coloured by the individual pegmatite dyke.

After completing the concordant PEG interval selection, all remaining PEG, QV, QT, QF and TOUR intersections were coded as discordant PEG intervals. A discordant PEG model was then generated using a Leapfrog Geo indicator interpolation. The Leapfrog indicator interpolation uses a radial basis function, similar to dual Kriging, to define a volume that encloses values likely to be above a given cut-off. In this instance, all discordant PEG intervals were assigned a value of 1, and all other intervals (including the concordant PEG interval selections) assigned a value of 0.01. The PEG model is based on a cut-off iso-value of 0.5.

Figure 4-2 shows the PEG trend surfaces (in grey) based on the discordant PEG selections and PEGs (in orange) mapped in the open pit (shown behind the slice plane). The indicator interpolation was guided by a structural trend, which defines a search anisotropy that varies in direction according to a series of defined surfaces. The structural trend applied in this instance was defined by surfaces generated on the basis of mapped PEGs in the Chama open pit, and outside of the pit by visual trends in the downhole discordant PEG intervals. This allowed the interpolation honour the multiple discordant PEG trends observed and recorded in the Chama Pit. In order to fully encapsulate the mapped PEGs in the Chama Pit into the PEG model, the indicator interpolation was edited using contour polylines digitised along the centre of the mapped PEGs in the open-pit map. These contour polylines are assigned a value of 1, and added to the downhole data used to derive the indicator interpolant. In this sense, the mapped PEGs are not only used as a trend to guide the interpolation, but also as an explicit control on the model geometry.

The resulting PEG model was domained within the modelled TMS volume and subsequently used to cut the TMS to produce a post-PEG TMS model. Figure 4-3 shows the Chama PEG model domained within the TMS model, relative to the downhole discordant PEG intersections and pit mapping.

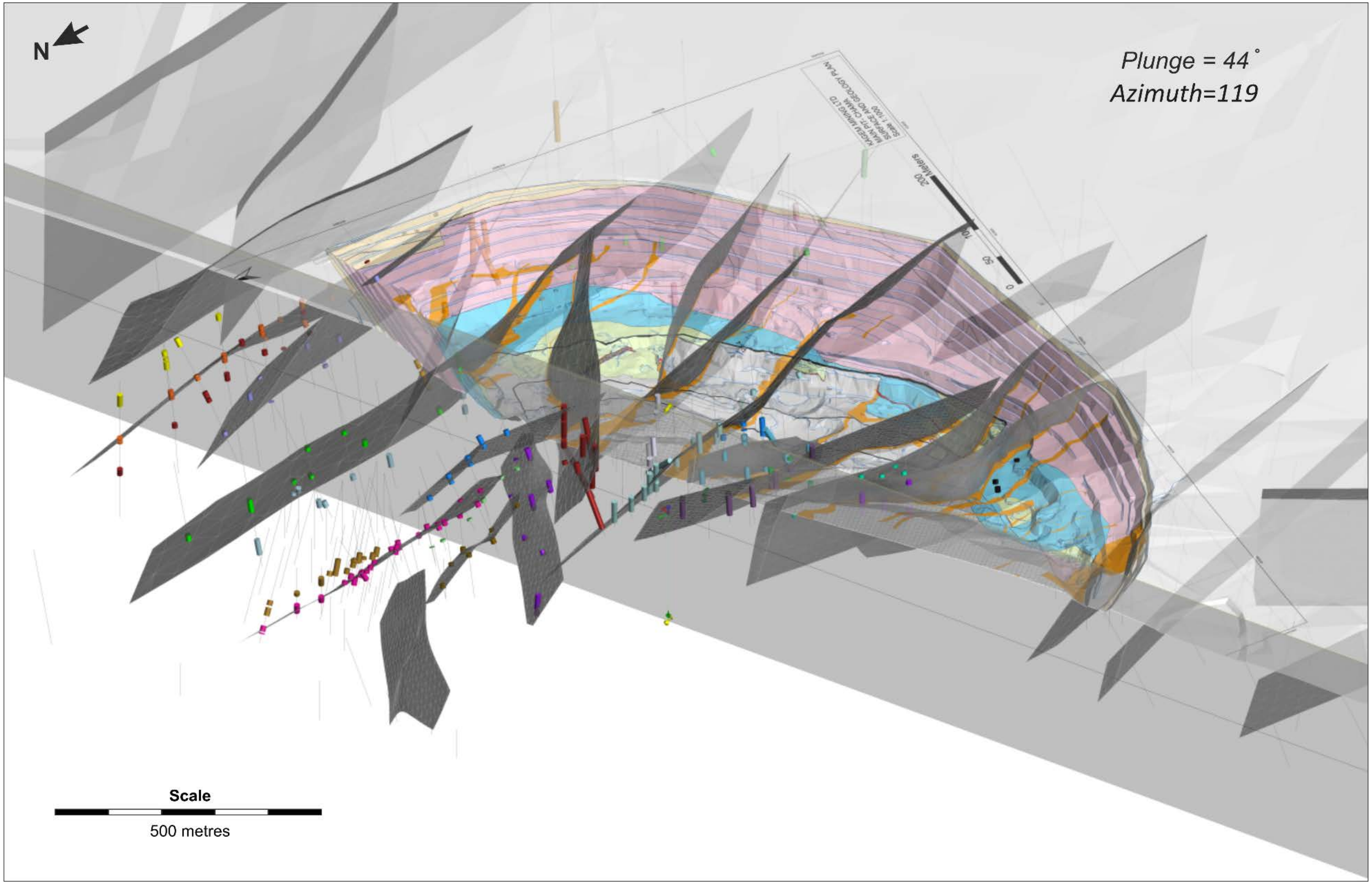


Figure 4-2: Discordant PEG Selections and Trends in the Chama Pit Area. (see Figure 3-8 for legend)

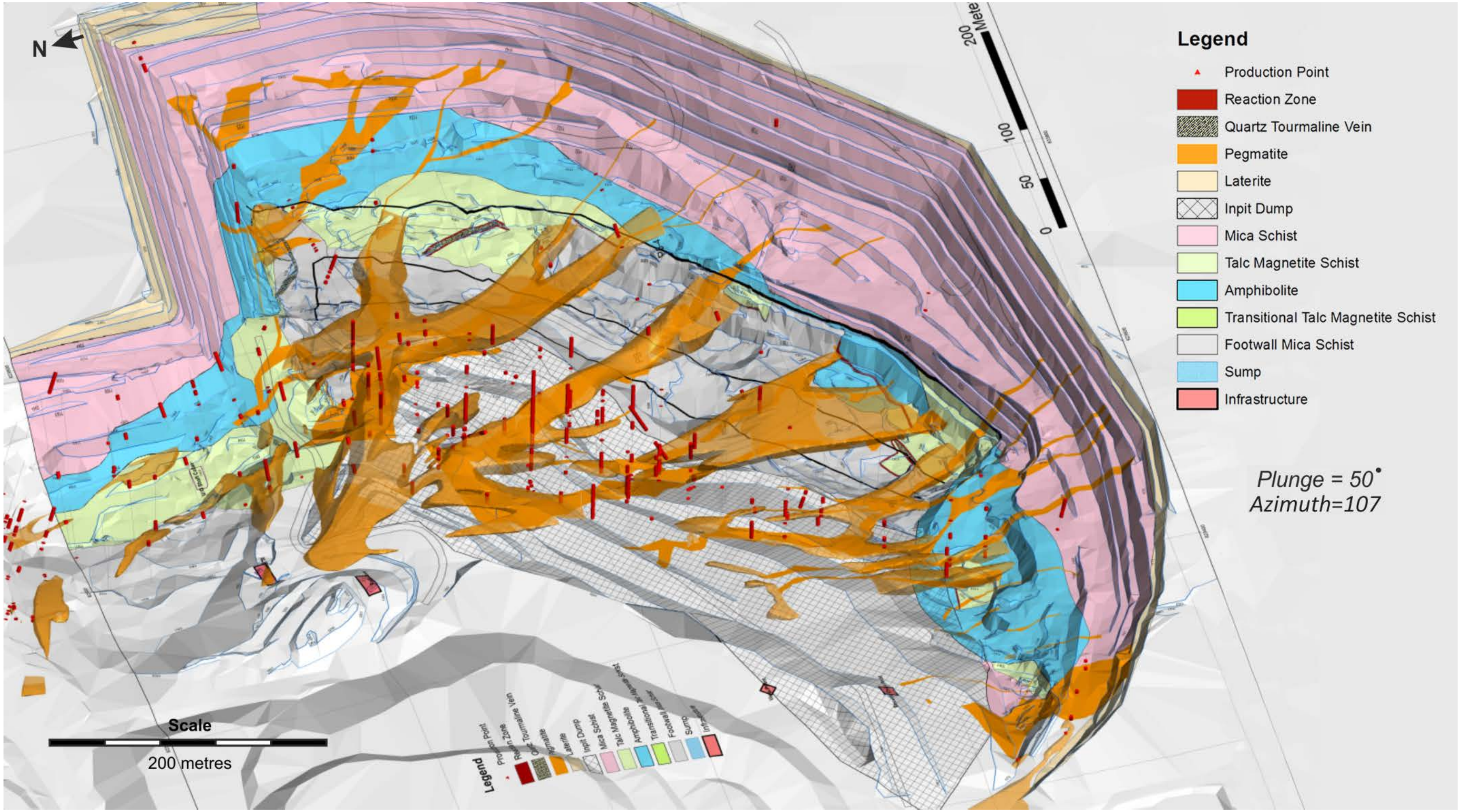


Figure 4-3: Chama PEG Model

4.2.3 Reaction zone model

Three main styles of mineralisation are recognised within the TMS unit, namely concordant RZs along the footwall (and occasionally the hangingwall) of the TMS, discordant RZs at the contacts between PEG dykes / QT veins and the TMS unit, and along brittle structures within the TMS. High level analysis of the downhole logging indicates that approximately 90% of the logged RZ material is located either on the TMS footwall (and occasionally hangingwall) contacts, or is in contact with a PEG dyke or quartz-tourmaline vein. For this reason, and to avoid over-complication of the RZ resource model, two RZ domains were constructed: one to define the TMS footwall RZ; and another based on areas where the PEG model is in contact with the TMS model.

Footwall RZ:

To define the basis for the footwall RZ model, all logged RZ (RZ and BPS) intervals at the base of the Chama TMS model were manually selected and assigned a footwall RZ code. This was supplemented by CBS, BS and QT intervals at the base of the TMS model where RZ is not logged, but where adjacent drillholes all include logged footwall RZ.

Analysis of downhole Niton XRF data (Section 3.5.9) indicates a significant spike in average rubidium grade within core logged as RZ. Therefore, where available, the downhole Niton rubidium grades were checked against the footwall RZ interval selection, which was edited to include Rubidium spikes >300 ppm at the TMS footwall where no RZ is logged, but adjacent drillholes include logged footwall RZ. In such instances, the downhole log was edited to include a footwall RZ interval of the average thickness (0.81 m) of the intersections in the footwall RZ interval selection.

Comparison of the average footwall RZ thickness (0.81 m) in holes drilled after 2008, with those drilled before this date (1.58 m) indicates that the logged footwall RZ thickness in the earlier holes is on average approximately 1.95 times the average thickness logged in more recent drilling programmes. This is considered to be a reflection of an improved understanding of the deposit, and specifically the nature and characteristics of the RZ material, by the on-site geology team with time, rather than any actual difference in RZ thickness in the older drilling relative to the more recent drillholes. For this reason, the footwall RZ interval selections in the pre-2008 drillholes were altered to reflect the average thickness (0.81 m) of the footwall RZ material in the post-2008 drillholes.

A RZ hangingwall surface was generated from the hangingwall points of the footwall RZ interval selection, using the TMS footwall surface as a framework to guide the trend of the model. A 3D solid was then generated below the modelled RZ hangingwall surface and below the TMS footwall surface to define a footwall RZ volume. Figure 4-4 shows a plan view looking up at the base of the Chama footwall RZ (in red) and TMS unit (in green), both cut by the PEG model. The model was manipulated to pinch pit to a zero thickness at holes with no RZ at the TMS footwall (excluding where the TMS footwall is marked by discordant PEG).

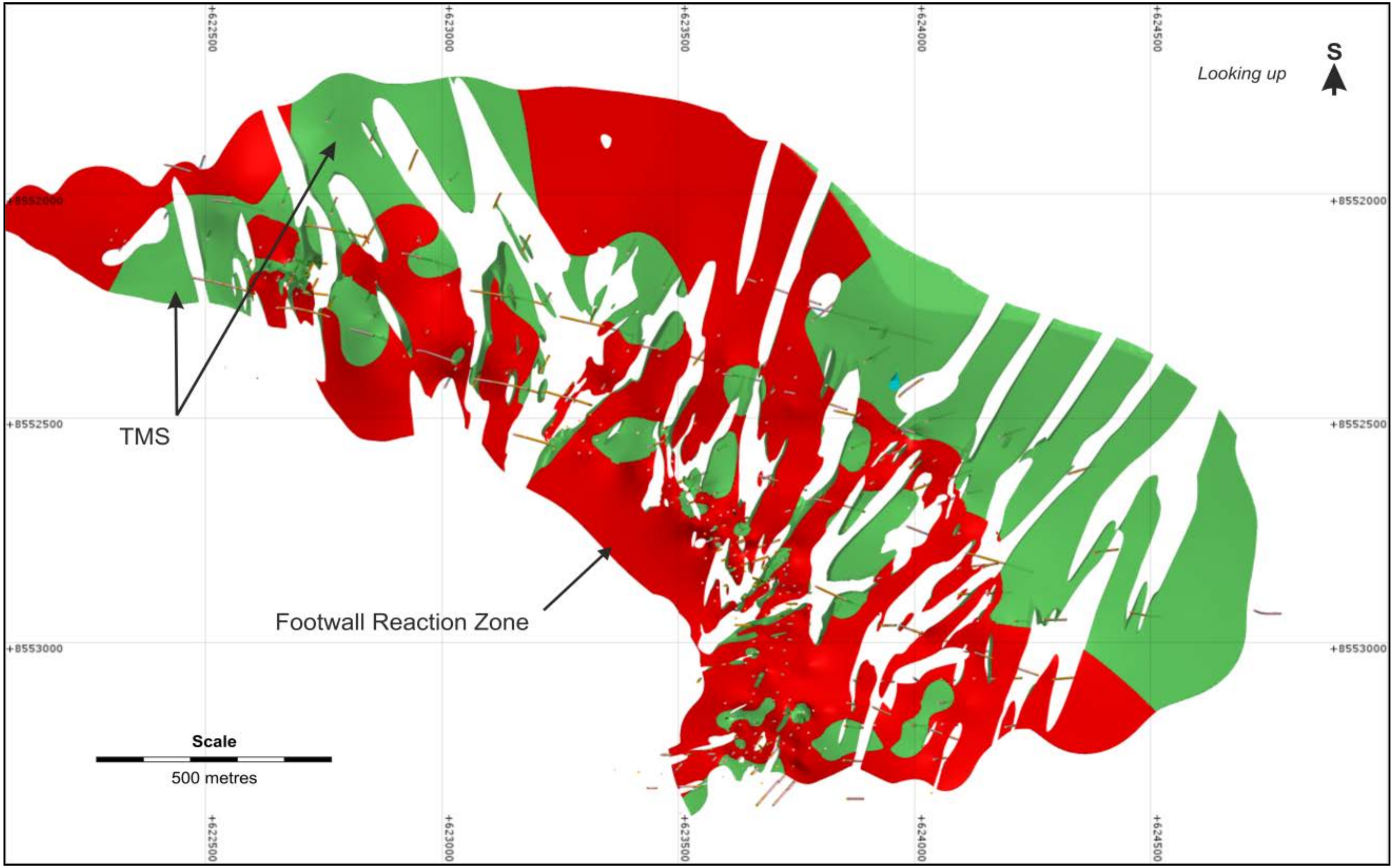


Figure 4-4: **Chama Footwall RZ and TMS Models**

Discordant RZ:

Gemfields' production analysis data from the Chama Pit to date indicates that RZ material is equal to 12.9% of the tonnage of the mined waste TMS. To reflect this, but also to account for dilution of the RZ material during the mining process, the CP generated a combined RZ model equating to 10.5% of the modelled waste TMS above the May 2015 pit survey wireframe. Above this pit survey wireframe, the modelled footwall RZ volume equates to 3.4% of the total modelled waste TMS volume. A discordant RZ model was generated to account for the remaining 7.1% (as a proportion of the modelled waste TMS) of RZ material. The ratio of reaction zone to waste has been defined from the production achieved to date. The proportion remains relatively consistent over time, and is associated with the number of pegmatites within the TMS unit.

The discordant RZ model was created by re-running the PEG indicator interpolation (see Section 4.2.2) at a series of cut-off iso-values. The resulting iso-surfaces were cut within the TMS unit and outside of the PEG model, to generate a "skin" around the outside of the PEG. This was repeated at various cut-off values until, through an iterative process, a cut-off value was established which resulted in a PEG "skin" volume equal to 7.1% of the waste TMS model volume above the pit survey wireframe (resulting in a combined concordant and discordant RZ volume equating to 10.5% of the TMS waste above the open pit wireframe). The final indicator interpolation cut-off iso-value is 0.43, which compares to a cut-off of 0.5 used to generate the PEG model. The geological model completed for Chama is illustrated in Figure 4-5 and Figure 4-6.

Figure 4-5 shows a plan view of the Chama footwall RZ, discordant RZ, TMS unit, and PEG domained within the TMS unit model. Figure 4-6 shows the Chama PEG model relative to the TMS model, with enlarged views of the PEG and discordant RZ model in the open pit area (a), and the PEG and discordant RZ models in detail (b).

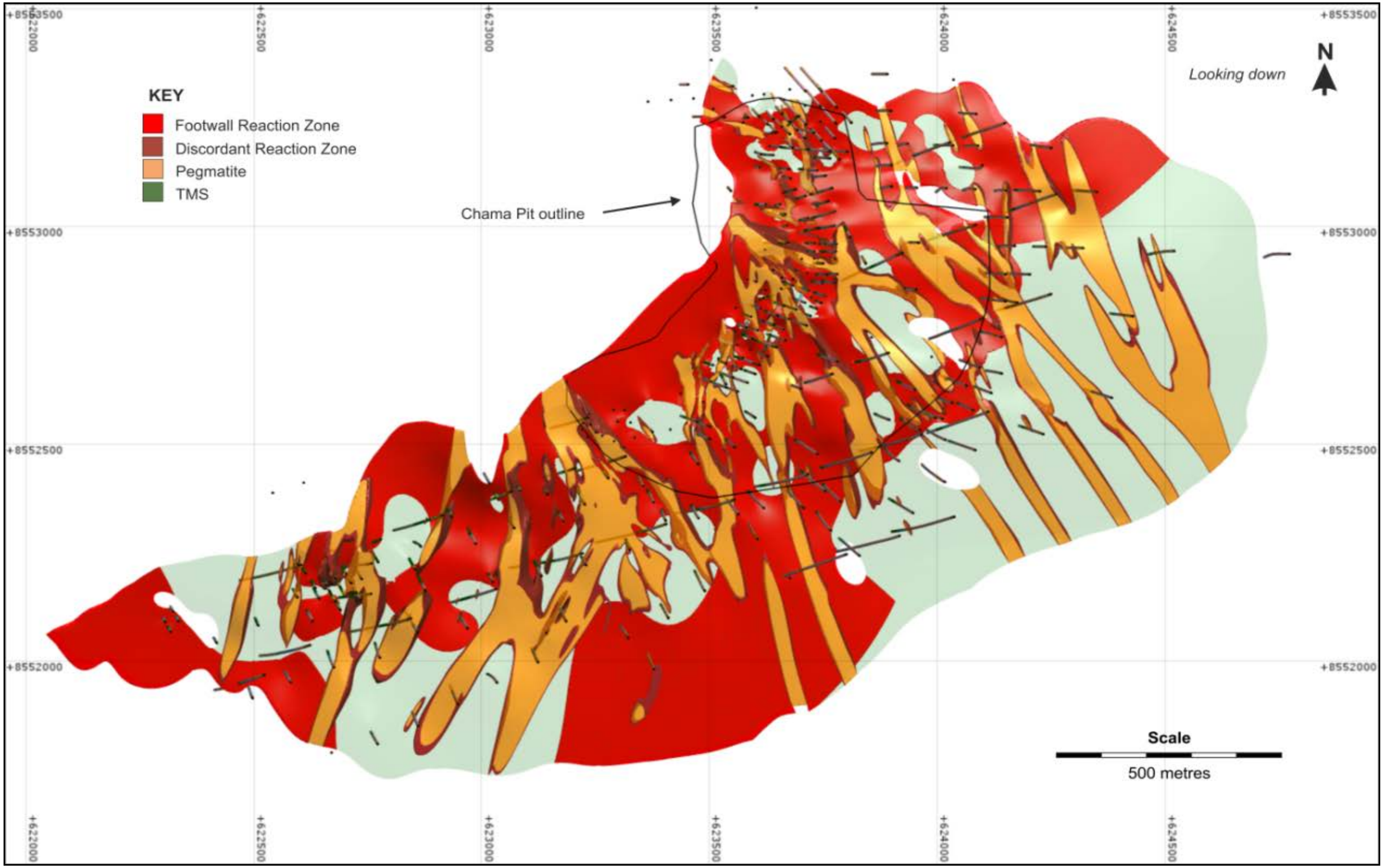


Figure 4-5: Chama TMS, PEG and RZ Models

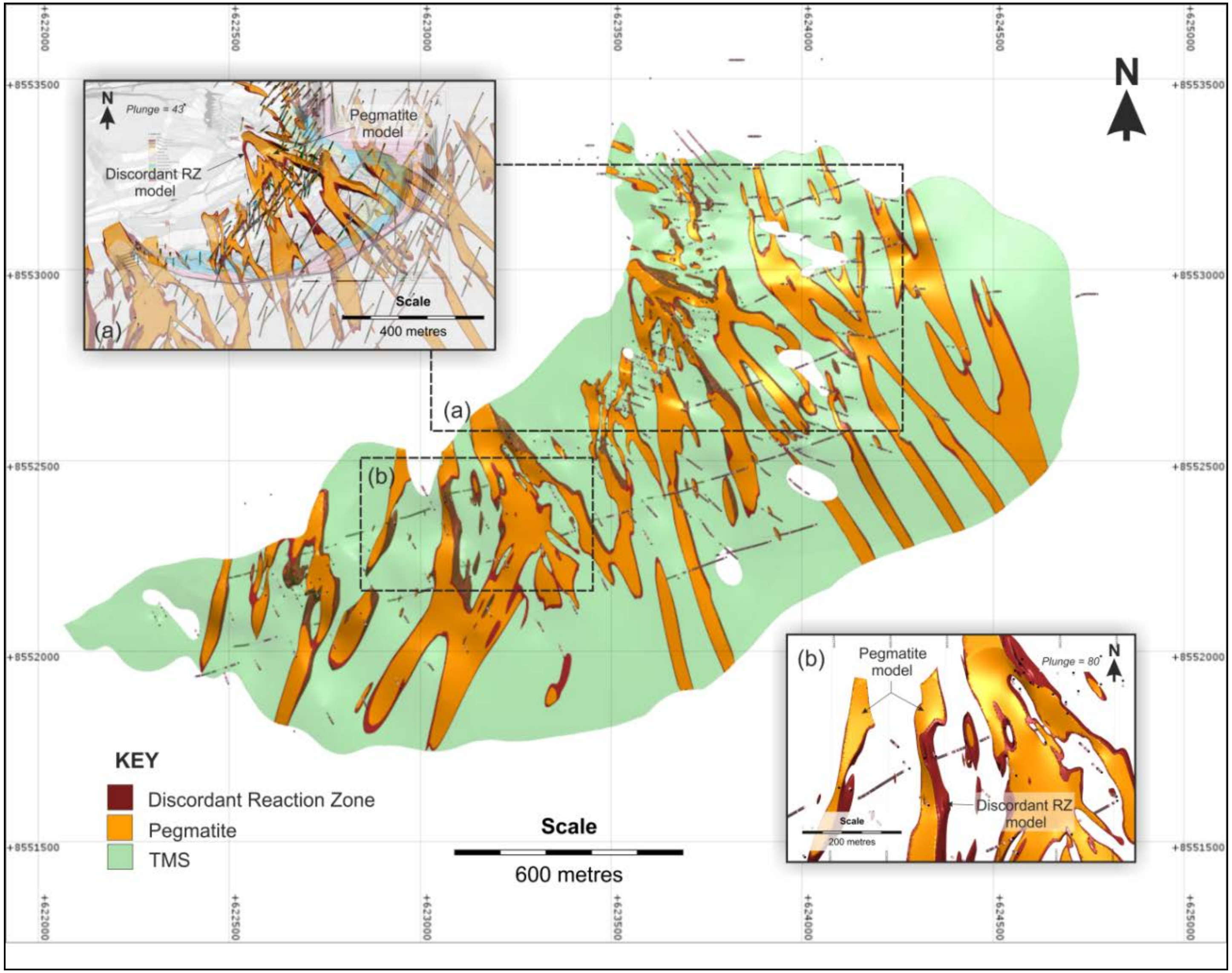


Figure 4-6: **Chama TMS, PEG and Discordant RZ Models**

4.3 Chama Grade and Tonnage Estimation

The RZ model, whether discordant and related to the modelled PEGs, or the footwall RZ, were used as the basis for the grade and tonnage estimation. The CP used a block model to quantify the volume, tonnage, and grade of the modelled RZs, as this could also be used as a basis for the subsequent mine planning exercise. The block model used is defined in Table 4-2.

Table 4-2: Chama: Block Model Parameters

Coordinate	Minimum	Maximum	Block Size (m)	Number of Blocks
X	**621,500**	**625,500**	**20**	200
Y	**8,551,250**	**8,553,850**	**20**	130
Z	**800**	**1275**	**5**	95

The volumes of the discordant and concordant RZs were defined from the geological model. The tonnage was estimated using an average density value of 2.85 g/cm^3 (Section 3.6).

The CP has assumed that all emerald and beryl mineralisation is hosted by the modelled RZs, although the CP notes that the model has been adjusted to reflect the historical production. Geologically, beryl and emerald mineralisation is associated with the cross cutting pegmatite features, which have been modelled from the drilling. The tonnage estimate is based on a model of the volume of RZs which reflects the historical production, giving confidence that the geological model is a good representation of the in-situ mineralisation. Historical information for this has been taken from data recorded for financial years 2008 to 2016, the data for which can be seen in Table 4-3. The data is reported using the Gemfields financial year, which is from 30 June to 1 July. The grade estimates are expressed as beryl and emerald combined ("B&E"), as this reflects the mine planning, and data captured historically by the mine. PE&E refers to Premium Emerald+Emerald only, i.e. excluding Beryl-1 and Beryl-2.

Table 4-3: Chama: Historical Production Data

Statistic	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average or Total
Mining											
RZ	(kt)	80	61	64	100	84	67	98	96	91	741
Waste TMS	(kt)	726	585	483	534	981	616	679	980	1,362	6,945
Waste non-TMS	(kt)	3,269	1,940	2,939	7,768	8,122	5,708	10,060	8,819	8,245	56,871
Total Rock	(kt)	4,076	2,586	3,485	8,402	9,187	6,391	10,837	9,894	9,698	64,557
RZ:WST TMS%	(%)	11	10	13	19	9	11	14	10	7	11
Gemstones Recovered											
Premium Emerald	(kg)	135	52	161	43	32	20	23	22	6	494
Emerald	(kg)	1,148	524	1,701	983	1,628	1,347	1,279	1,773	833	11,217
Beryl-1	(kg)	4,322	1,916	2,930	1,837	2,594	1,568	2,000	2,151	1,359	20,677
Beryl-2	(kg)	1,294	953	1,798	1,335	1,591	1,073	1,838	1,470	1,209	12,562
PE&E	(kct)	6,418	2,882	9,312	5,130	8,299	6,835	6,513	8,975	4,193	58,554
B&E	(kct)	34,498	17,228	32,952	20,986	29,225	20,039	25,703	27,084	17,033	224,747
Grade											
PE&E	(g/t)	16	9	29	10	20	21	13	19	9	16
B&E	(g/t)	86	56	103	42	69	60	53	57	37	61
PE&E	(ct/t)	80	47	145	52	98	102	67	94	46	79
B&E	(ct/t)	430	282	513	211	347	300	264	283	187	303
PE&E:B&E %	(%)	19%	17%	28%	25%	28%	34%	25%	33%	25%	26%
Rolling B&E Grade	(ct/t)	430	366	412	346	346	335	322	320	303	-

The anticipated grade of emerald and beryl and their relative importance, is based on the extrapolation of the recovery of these minerals from the tonnage of RZ processed during the period covered by the historical mining production statistics. The variation in ratio between beryl and emerald is shown in Table 4-3 and Table 4-4. This includes mineral obtained from in-pit chiselling as well as that obtained from the processing plant. Due to the nature of the mining method used, emerald and beryl brakage is not considered to be a concern, as the larger stones are recovered from the pit directly.

Given the complexity associated with estimate of individual RZ tonnage as well as the concentration of emerald and beryl within such RZs, the CP has based the current Mineral Resource estimate on what are effectively large-scale bulk samples combined with the geological interpretation of the TMS, PEG and RZ lithological units as described above.

The Company has collected production data on a sector basis, which indicates the difference in grade distribution within the pit. The CP has used the gathered production data to predict how the grade is likely to vary in the future. Direct estimates of grade or quality cannot be determined, but the logical gathering of detailed production data provides a sound basis for future trends. The sectors used to gather the production data are shown in Figure 4-7.

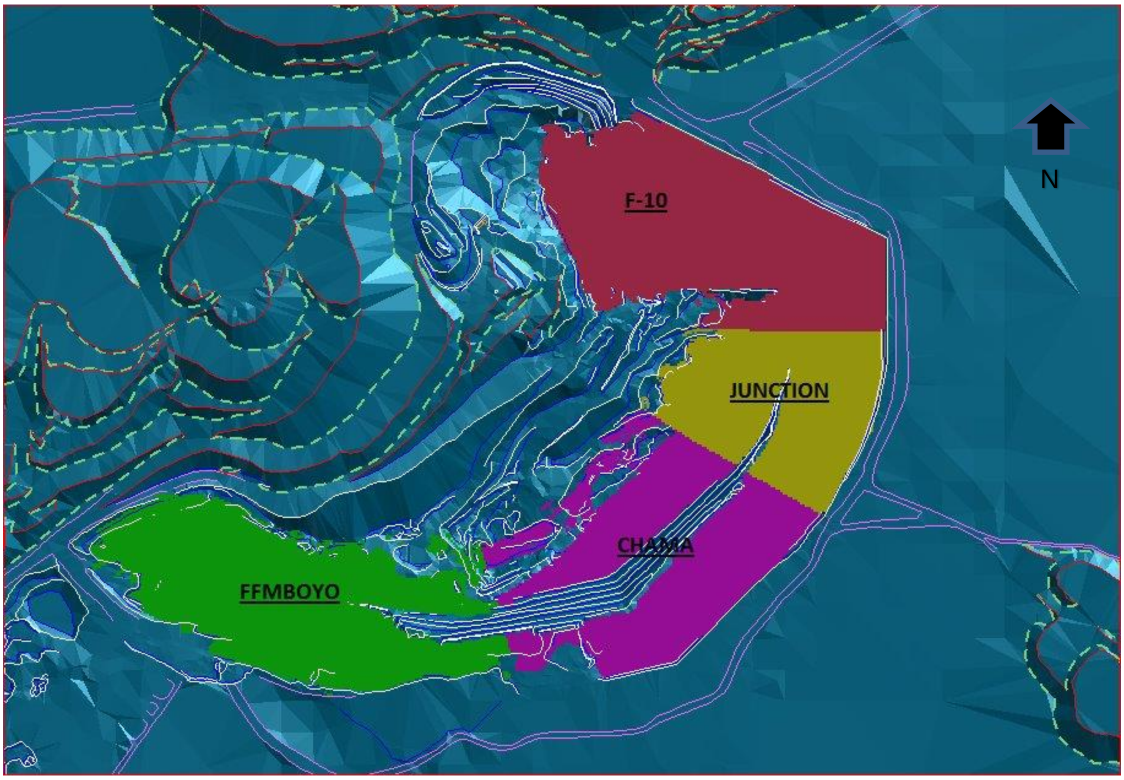


Figure 4-7: Production sectors within the Chama pit

The grade distribution from the production zones, as collected since 2012 on a yearly basis, is summarised in Table 4-4, and illustrated in Figure 4-8. Over time, the B+E grade has varied significantly, but for the F10, Junction, and Chama sectors, the grade has steadily decreased. Mboyanga has only recently started to be a focus of production, and recovered grades to date are low. However, Gemfields considers that this is a largely a function of operational factors, and as more PEG contact zones are uncovered, the recovered grade is likely to increase.

Table 4-4: Chama: Historical Production Data – Grade by Sector

	Unit		2012				2013				2014				2015				2016				2017
		Total	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
RZ Tonnage																							
F10	(kt)	375	22.7	7.9	3.2	17.4	13.2	8.7	10.3	16.1	17.3	14.9	21.1	31.7	23.8	22.6	19.3	27.6	26.5	17.9	10.5	18.6	23.3
Junction	(kt)	81	6.1	10.5	16.2	2.8	2.1	3.1	5.8	5.2	8.3	7.3	3.7	0.5	0.6	0.3	0.2			2.2	1.3	2.3	2.1
Chama	(kt)	24		1.5	2.8	0.8	4.3	4.3	2.6				0.2	2.1	1.2							0.6	3.8
FF - Mboyanga	(kt)	12																		2.3	4.3	4.8	1.1
Total	(kt)	492	28.8	20.0	22.2	21.0	19.6	16.1	18.7	21.4	25.6	22.2	25.0	34.3	25.6	22.9	19.5	27.6	26.5	22.4	16.1	26.3	30.3
RZ B+E Grade																							
F10	(c/t)	245	262	276	242	371	301	210	148	285	211	185	379	228	262	283	347	250	212	199	280	121	98
Junction	(c/t)	289	308	347	280	575	335	260	213	318	232	233	421	272	315	346	388	320	321	211	323	204	100
Chama	(c/t)	356	610	472	312	618	406	282	288	410	354	357	680	365	382	360	340	340	340	269	329	632	289
FF - Mboyanga	(c/t)	92																		68	102	75	176
Total		254	272	328	279	408	328	239	188	293	218	201	388	237	269	284	347	250	212	186	236	131	125

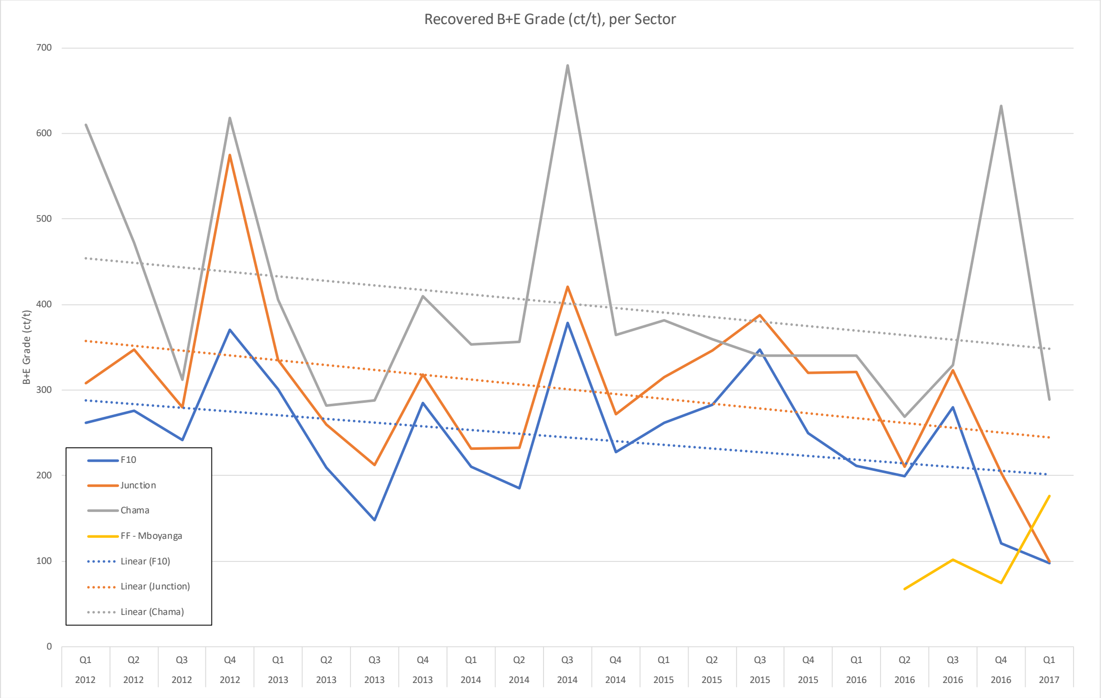


Figure 4-8: Variability of Production Grade from sectors within the Chama pit, on a Quarterly Basis

In order to account for anticipated dilution when mining the RZ material, the CP has calculated a recovered grade. Gemfields reports that approximately 15% dilution is planned, and this is reflected in the recovered grades applied to the RZ model. The grades determined for each sector are illustrated in Table 4-5.

The recovered grade of B&E has shown to be relatively consistent, although slowly decreasing with time. The production data gathered to date (Table 4-3) notes that the ratio between Premium Emerald+Emerald and total gemstones recovered remains relatively constant, between 19% in 2008, with a maximum of 34% in 2013. Since then, the ratio is approximately 25%. This indicates that the variability of the proportion of Premium Emerald+Emerald recovered over time is relatively stable, indicating that it is unlikely to change as production continues. This provides a significant measure of comfort for predicting both the overall grade of the E&B, and the proportion of the Premium Emerald+Emerald.

The grade distribution (carat content) within Chama is well understood. The presence of emerald and beryl is largely related to metasomatism and alteration, the degree of crystallisation at the TMS / PEG contact, the degree of deformation at the TMS / PEG contact, and the presence of quartz-tourmaline veining. All of these aspects control the degree to which the biotite phlogopite schists are developed, and so the presence of emerald and beryl crystals. These factors are known to vary along the strike length of the area currently in production. These factors have also been to observe along the dip extend of the TMS unit. Where a contact is exposed, which is considered to be well defined, the E&B grade can be as high as 450 ct/t, whereas in less well-defined areas, the grade can decrease to 100 ct/t. These grade variations are reflected in the sector and factored grade approach used to define the Mineral Resources.

Within a contact, the proportion of emerald to beryl can also vary, but typically, the grade (carats per tonne) is generally consistent. The sizes of individual stones recovered can also vary, with occasional very large stones (e.g. 8kg) have been recovered during the hand chiselling. The size of the stone is thought to be related to the fluid trap where the crystal starts to grow, and with subsequent deformation. For all recovered grades presented, the minimum crystal size regarded is 3 mm. Stones of a smaller size are recovered, but these are not included in any grades stated, or production reported. To date, Gemfields report that approximately 42 million carats of fines (i.e. less than 3mm) have been recovered.

Although the factors which influence both the grade and size distribution of the recovered stones are known, the E&B grade is typically consistent within the sectors described. Furthermore, the grades recovered have shown good reconciliation for what was predicted previously. This provides a good degree of comfort for the anticipated grade of E&B in both the declared Mineral Resources, and the subsequent mine planning exercises.

The CP has applied a factor which reflects the decreasing grade in the F10, Junction, and Chama sectors. In FF-Mboyanga, the grade is currently rising. A factor has been applied to the FF-Mboyanga area to reflect this. In the deeper parts of the FF-Mboyanga sector, the CP has applied the historically achieved average for the life of mine to date, while allowing for a factor that demonstrates that grade is decreasing over time.

Table 4-5: Chama: Derivation of Grade for sectors

Statistic	Unit	Value
F10		
Average production B&E grade	(ct/t)	245
Factor applied to average grade to reflect decreasing grade	(%)	9%
Factored production grade	(ct/t)	223
Anticipated dilution	(%)	15%
B&E grade	(ct/t)	260
Junction		
Average production B&E grade	(ct/t)	289
Factor applied to average grade to reflect decreasing grade	(%)	9%
Factored production grade	(ct/t)	263
Anticipated dilution	(%)	15%
B&E grade	(ct/t)	300
Chama		
Average production B&E grade	(ct/t)	356
Factor applied to average grade to reflect decreasing grade	(%)	9%
Factored production grade	(ct/t)	324
Anticipated dilution	(%)	15%
B&E grade	(ct/t)	370
FF - Mboyanga (1)		
Average production B&E grade	(ct/t)	92
Factor applied to average grade to reflect increasing grade	(%)	18%
Factored production grade	(ct/t)	108
Anticipated dilution	(%)	15%
B&E grade	(ct/t)	124.2
FF - Mboyanga (2)		
Average production B&E grade (life of mine)	(ct/t)	326
Factor applied to average grade to reflect decreasing grade	(%)	9%
Factored production grade	(ct/t)	300
Anticipated dilution	(%)	15%
B&E grade	(ct/t)	345

The B&E grade shown in Table 4-5 was used coded into the block model, and also forms the basis of the Mineral Resource estimate. As production grades are recorded by Kagem as a combination of beryl and emerald, the CP has used the same approach for the predicted grade, and so has not differentiated between beryl and emerald in either the Mineral Resource Statement, or the block model. The CP and Gemfields both consider this to be a suitable method for reporting the predicted grades of the mineralisation as the E&B grade reflects the overall mineralising system, and reflects the in-situ nature of the gemstone deposits.

4.4 Fibolele Geological Modelling

The controls on emerald and beryl mineralisation at the Chama, Fibolele and Libwente deposits are largely the same, and for this reason a similar modelling approach was taken for all three deposits. This section includes a description of the methodology as applied to the Fibolele deposit.

4.4.1 TMS model

Similar to the Chama modelling, the Fibolele talc-magnetite schist model was constructed through sectional polyline interpretations of the hangingwall and footwall, using the TMS, TBS and RZ logging codes as an explicit control on model geometry. A 3D TMS solid was then generated below the hangingwall and above the footwall surfaces. The model was checked against downhole XRF chromium grades, and modified to remove any material <1,500 ppm Cr and incorporate any material >1,500 ppm Cr at the TMS contact.

In addition to the main Fibolele TMS unit, an additional TMS body, potentially representing continuation of the Fibolele TMS trend was modelled based on a total of 11 drillholes (five with TMS intersections), and pit mapping of two historic pits in the Sandwana area, extending approximately 800 m ENE of the main Fibolele Pit.

4.4.2 Quartz-Tourmaline vein model

Consistent with the other deposits, and most notably Chama, Fibolele is characterised by both concordant and discordant vein populations. At Fibolele, the majority of these intrusions are logged as quartz-tourmaline veins, being characterised by increased tourmaline content, and decreased feldspar input relative to the coarser PEGs intersected at the other deposits at the Kagem Mine. These quartz-tourmaline veins are also generally narrower than the Chama PEGs.

Visual analysis of logged vein intervals at Fibolele in 3D, suggests that the most prominent and continuous concordant quartz-tourmaline veins are intruded along the immediate hangingwall and footwall of the TMS unit. An interval selection was generated for both the hangingwall and footwall veins (Table 4-6), based on all QT, TOUR, QV, PEG and QF intervals at the TMS contacts.

Table 4-6: Number of Intervals and Average Thickness of the Fibolele Concordant Veins

Vein	Number of holes intersected	Average thickness per hole (m)	% of TMS holes with vein at contact
TMS FWL Vein	34	0.62	47%
TMS HWL Vein	18	0.95	25%

After completing the concordant vein interval selection, all remaining vein intersections were coded as discordant. These were then modelled manually, using the Leapfrog vein modelling tool. A total of 25 discrete discordant QT veins were modelled at the Fibolele deposit (Table 4-7). The modelled veins are mostly sub-vertical, striking broadly N-S, consistent with the trend of the veins mapped in the open pit, and also with limited surface structural data collected by the CP on-site. The most recent version of the Fibolele open pit geology map was also used as an explicit control on the discordant QT vein model where appropriate. Veins mapped in the open pit between drill sections where no drilling data is available were modelled based on mapping alone. Figure 4-9 shows the Fibolele TMS (in green) and quartz-tourmaline vein (in orange) models shown relative to the Fibolele Pit survey wireframe.

Table 4-7: Dip, Azimuth and Basis for Modelling the Fibolele Discordant QT Veins

Vein	Average Dip (°)	Average Dip Azimuth (°)	Basis for Modeling	Vein	Average Dip (°)	Average Dip Azimuth (°)	Basis for Modeling
QT1	85	83	Drill Data	QT14	85	85	Drill Data
QT2	82	82	Drill Data	QT15	85	87	Drill Data
QT3	89	262	Drill Data	QT16	85	85	Drill Data
QT4	66	261	Drill Data	QT17	85	82	Drill Data
QT5	82	251	Drill Data	QT18	80	282	Pit Mapping & Drill Data
QT6	87	252	Drill Data	QT19	67	281	Drill Data
QT7	84	157	Pit Mapping & Drill Data	QT20	66	275	Drill Data
QT8	86	158	Drill Data	QT21	84	290	Drill Data
QT9	81	280	Pit Mapping & Drill Data	QT22	64	263	Pit Mapping & Drill Data
QT10	77	244	Drill Data	QT23	81	269	Pit Mapping
QT11	88	289	Pit Mapping & Drill Data	QT24	82	293	Pit Mapping
QT12	80	79	Drill Data	QT25	81	256	Pit Mapping
QT13	87	86	Drill Data	-	-	-	-

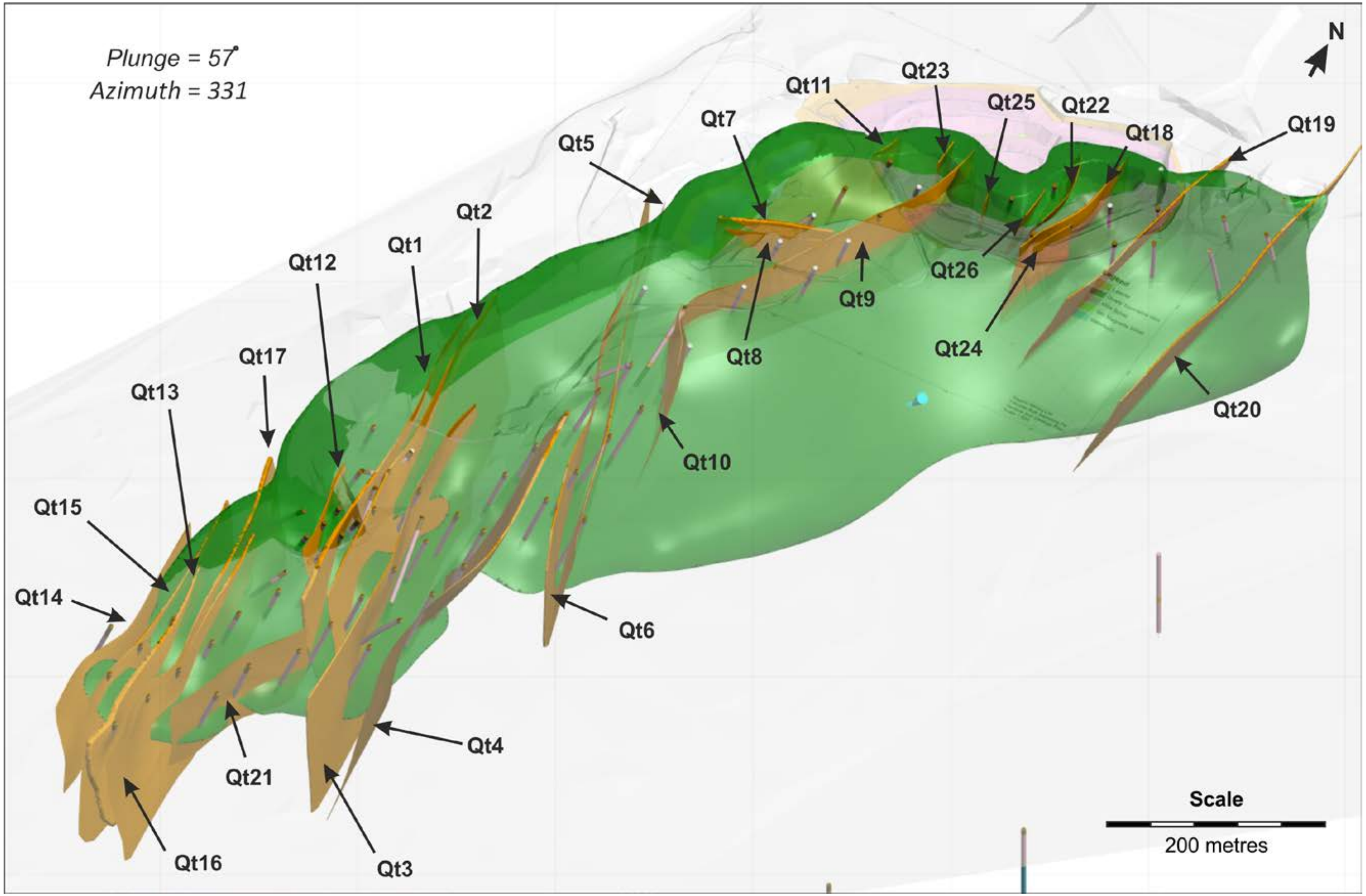


Figure 4-9: Fibolele TMS and Quartz-Tourmaline Vein Models

4.4.3 Reaction zone model

Footwall and hangingwall RZs:

Both the footwall and hangingwall TMS contacts at Fibolele are marked by discontinuous horizons of RZ material. The footwall RZ is intersected by 42 holes, whilst the hangingwall RZ is intersected by 28 holes, which represents 57% and 39% respectively of the total number of holes that intersect the main Fibolele TMS unit.

Both the footwall and hangingwall RZ models are based on RZ and BPS intervals at the TMS contacts. This was supplemented by CBS, BS and QT intervals where RZ is not logged, but where adjacent drillholes all include logged RZ at the TMS footwall or hangingwall respectively.

Figure 4-10 shows a plan view of the hangingwall RZ (top image) and upwards facing plan view of the footwall RZ (bottom image) shown relative to the TMS unit (in green) and cut by the modelled QT veins. The footwall RZ model was generated by running a surface interpolation on the footwall RZ hangingwall points, using the modelled TMS footwall as a trend surface to guide the interpolation. A solid wireframe was then generated below the RZ surface and above the TMS footwall surface. The model was manipulated to pinch out to a zero thickness at holes with no RZ at the TMS footwall. This process was repeated for the hangingwall RZ model.

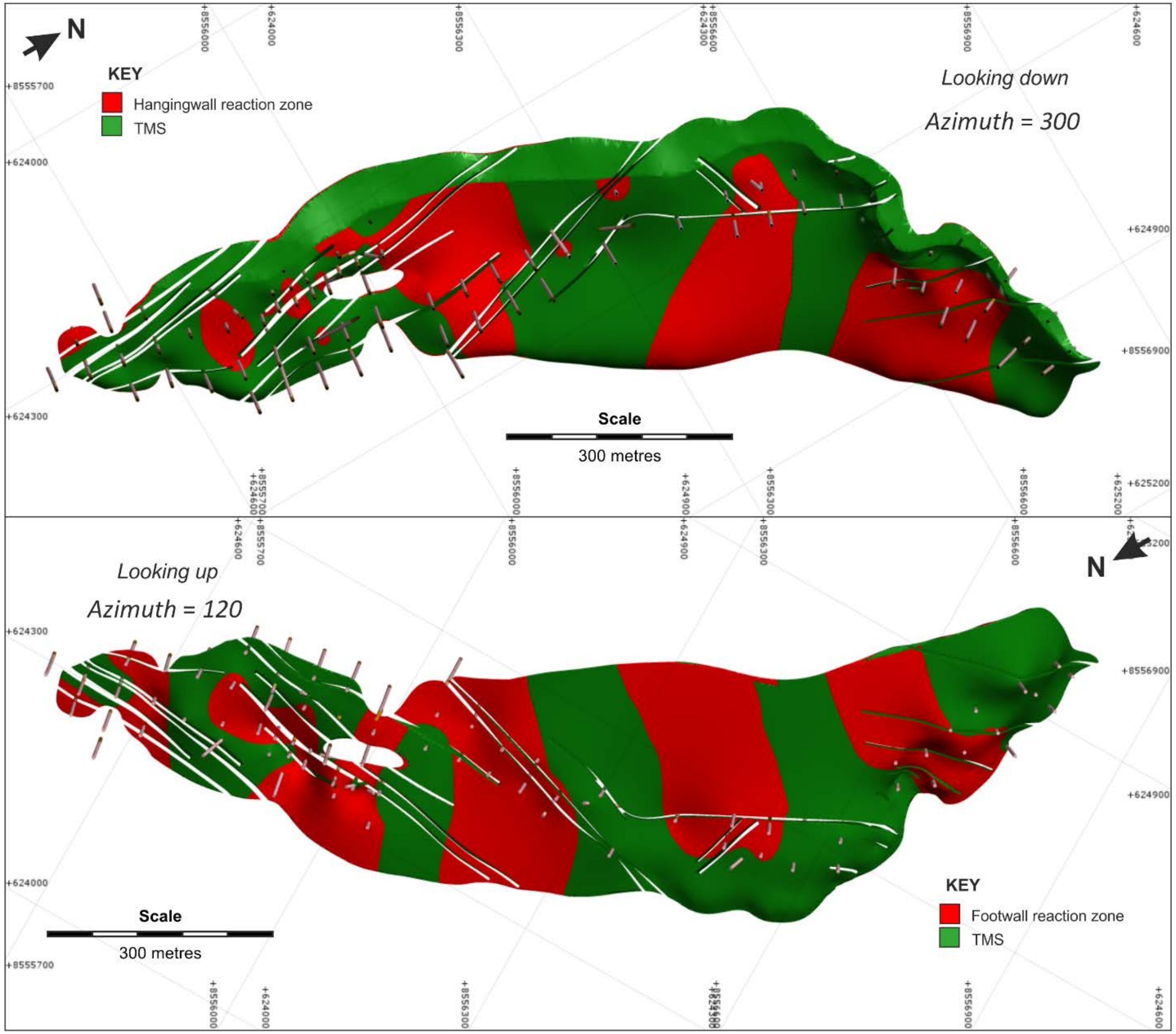


Figure 4-10: Fibolele Hangingwall and Footwall RZ Models

Discordant RZ:

To date, RZ material equates to 8.1% of the waste TMS removed from the Fibolele Pit, according to Gemfields production analysis. Comparison of the modelled footwall and hangingwall RZ volumes with the modelled waste TMS volume above the most recent pit survey wireframe indicates that, above the pit, the footwall and hangingwall RZ models are equal to 1.56% and 0.44% of the waste TMS model volume respectively. A discordant RZ model was generated to account for the remaining RZ material, at a ratio of 5.87% relative to the modelled waste TMS above the open pit wireframe.

Figure 4-11 shows the Fibolele concordant and discordant RZ models displayed alongside the modelled QT veins and TMS unit. The discordant RZ model was generated by running a series of distance buffers and various distances around the quartz-tourmaline vein model. These were then cut outside the quartz-tourmaline model and inside the TMS model to generate a “skin” around the veins at various thickness values. These “skin” wireframes were then evaluated above the pit to calculate volume. This iterative process was repeated until a vein buffer distance (1.715 m) was established which resulted in a vein “skin” volume equal to 5.87% of the waste TMS model volume above the pit survey wireframe.

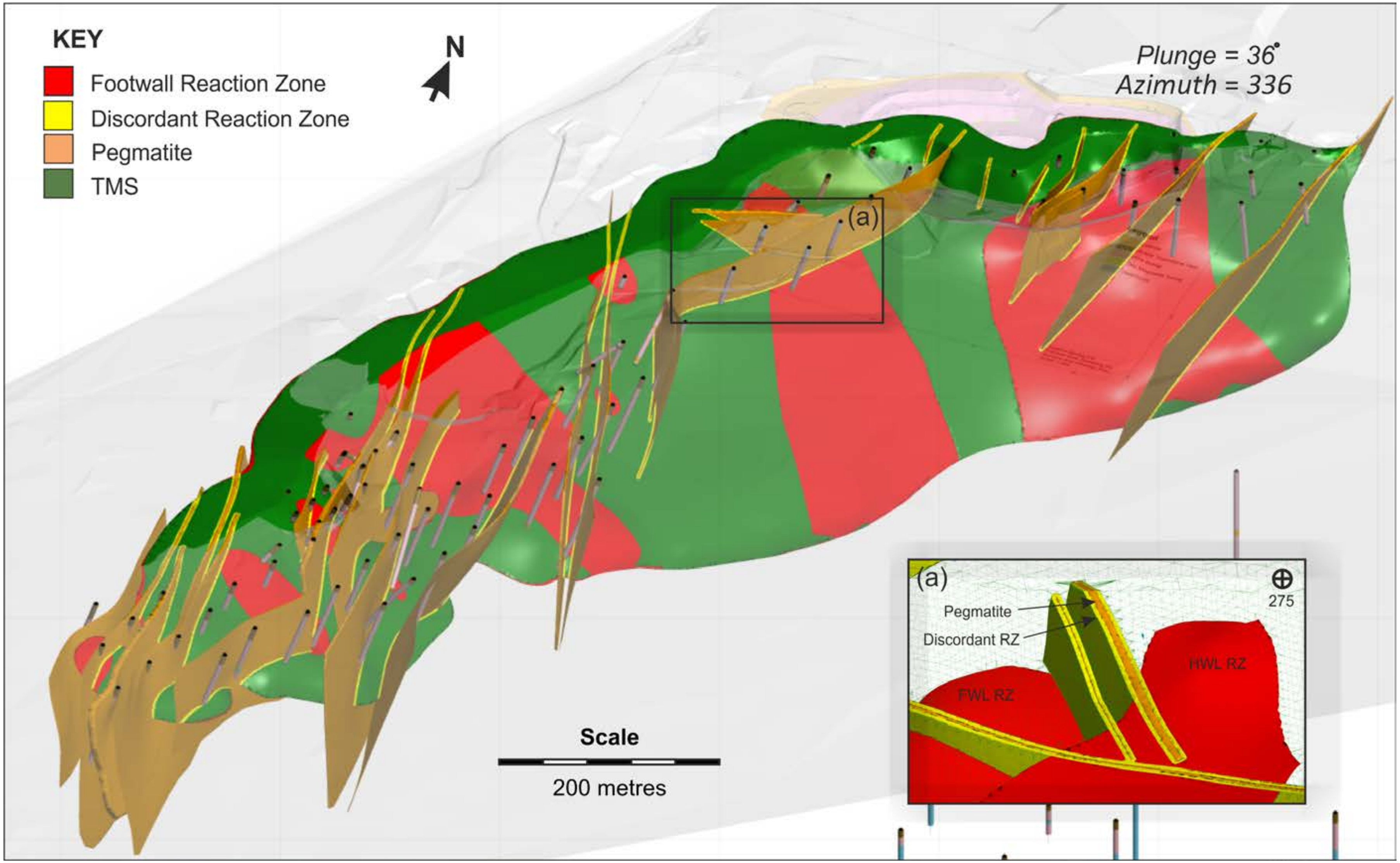


Figure 4-11: Fibolele TMS, Quartz-Tourmaline Vein and Concordant and Discordant RZ Models

4.5 Fibolele Grade and Tonnage Estimation

As with Chama, the CP has produced a block model, based on the modelled RZs. The block model was used in the subsequent pit optimisation exercise. The block model parameters are included in Table 4-8. As with Chama, the density value applied was 2.85 g/cm^3 (Section 3.6).

Table 4-8: Fibolele: Block Model Parameters

Coordinate	Minimum	Maximum	Block Size (m)	Number of Blocks
X	623,500	625,500	20	100
Y	8,555,000	8,557,260	20	113
Z	900	1,250	5	70

The CP has assumed that all B&E mineralisation is hosted by the modelled RZs. As at Chama, the amount of RZ in the geological model reflects the amount of RZ recorded during the bulk sampling operation. The bulk sampling production data is summarised in Table 4-9. Bulk sampling at Fibolele was conducted in three phases, with Phase 1 between August 2012 and July 2013, Phase 2 between October 2013 and November 2014, and finally, Phase 3 between December 2014 and June 2015. Due to the nature of the mining method used, emerald and beryl breakage is not considered to be a concern, as the larger stones are recovered from the pit directly

Table 4-9: Fibolele: Bulk Sampling Production Data

Statistic	Unit	Phase 1	Phase 2	Phase 3	Ph1+Ph2	All
Mining						
RZ	(kt)	15.1	10.7	4.2	25.8	30.0
Waste TMS	(kt)	184.5	138.8	45.3	323.2	368.5
Waste non-TMS	(kt)	249.8	603.9	781.2	853.7	1,634.9
Total Rock	(kt)	449.4	753.3	830.7	1,202.7	2,033.4
RZ:WST TMS%	(%)	8.2%	7.7%	9.2%	8.0%	8.1%
Gemstones Recovered						
Premium Emerald	(kg)	0.15	0.07	0.04	0.21	0.25
Emerald	(kg)	44.9	79.1	12.7	124.0	136.8
Beryl-1	(kg)	65.4	160.9	30.7	226.3	257.0
Beryl-2	(kg)	55.3	126.3	33.1	181.7	214.7
Premium Emerald + Emerald	(kg)	45.1	79.2	12.8	124.2	137.0
B&E	(kg)	165.8	366.3	76.6	532.1	608.7
Premium Emerald + Emerald	(kct)	225	396	64	621	685
B&E	(kct)	829	1,832	383	2,661	3,044
Grade						
Premium Emerald + Emerald	(g/t)	3.0	7.4	3.1	4.8	4.6
B&E	(g/t)	11.0	34.4	18.3	20.6	20.3
Premium Emerald + Emerald	(ct/t)	15	37	15	24	23
B&E	(ct/t)	55	172	92	104	102

The recovered grade at Fibolele is based on both the in-pit recovery, and from the wash plant. In order to account for anticipated dilution when mining the RZ material, the CP has calculated a recovered grade. The CP has assumed a dilution factor of 15%, which is consistent with that anticipated by Gemfields at Chama. The derivation of the modelled grade is shown in Table 4-10. Due to some operational considerations, Gemfields requested the CP to use production data from Phase 1 and Phase 2 only to derive the B&E grade as operation issues during Phase 3 mean that the data recovered was not as reliable as that gathered in Phases 1 and 2.

Table 4-10: Fibolele: Derivation of Modelled Grade

Statistic	Unit	Value
Average production B&E grade	(Ct/t)	104
Anticipated dilution	(%)	15%
B&E grade	(Ct/t)	119

The B&E grade shown in Table 4-10 was used coded into the block model, and also forms the basis of the Mineral Resource estimate. As production grades are recorded by Gemfields as a combination of beryl and emerald, the CP has used the same approach for the predicted grade, and so has not differentiated between beryl and emerald in either the Mineral Resource Statement, or the block model.

4.6 Libwente Geological Modelling

4.6.1 TMS model

A TMS model (including RZ material), comprising four, apparently stratigraphically distinct horizons, was constructed for the Libwente deposit, using Leapfrog Geo software. Figure 4-12 shows a plan view of the Libwente modelled TMS units with drillhole locations indicated in black. Footwall and hangingwall contact points were extracted from drillhole contacts using the TMS, TBS and RZ logging codes and then used to construct bounding footwall and hangingwall surfaces. A 3D TMS solid, for each horizon, was then generated below the hangingwall and above the footwall surfaces. Figure 4-13 shows a long section (2x vertical exaggeration) of the Libwente modelled TMS units looking southwest (azimuth 235) with drillholes coloured by intersected TMS units.

The model was subsequently checked against downhole XRF chromium grades (where available), and the contact surfaces were modified where appropriate to reflect the chromium distribution. Considering the average downhole XRF grade of the TMS material documented in Section 3.5.9, this typically involved adjusting the TMS model to incorporate external material grading at >1,500 ppm Cr adjacent to the modelled TMS contact, or conversely the removal of internal material <1,500 ppm Cr in the contact zone.

Finally, the TMS units were further constrained by surface mapping information from the 8 pits located in the deposit area. In all cases, where TMS exposures were mapped in the pits, the hangingwall and/or footwall surfaces of the appropriate TMS horizon are locally constrained by this information.

In most cases, the drilled TMS intersections appear to correlate well for the individual TMS horizons, particularly for the TMS1 and TMS2 units. But, for the TMS3 and TMS4 units there is less continuity and the resulting model for these are more irregular. Also, several TMS intersections could not be included in the models as they did not form any continuous zone. The apparent low continuity, in some of the areas of the deposit, may be exacerbated by the presence of faulting. It is suspected that the deposit may be affected by northeast trending, post-mineralization age, faulting. Since the dip of the TMS units in the Libwente deposit are very shallow (generally less than 10º), significant lateral offsets of the TMS units (in the order of tens of metres) could be manifested by even small (sub-metre or metre scale) fault offsets.

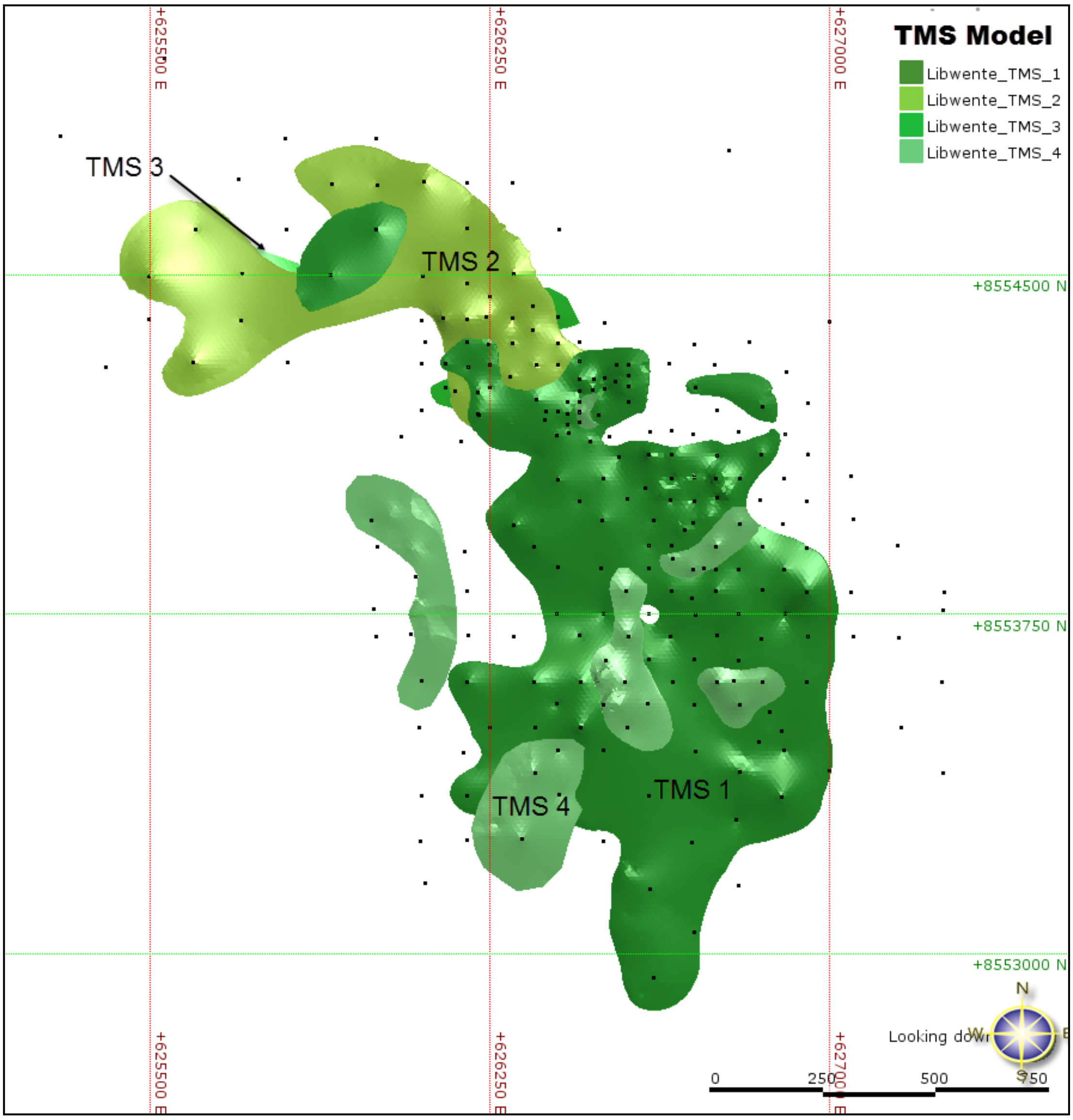


Figure 4-12: Plan View of the Modelled TMS Units at Libwente

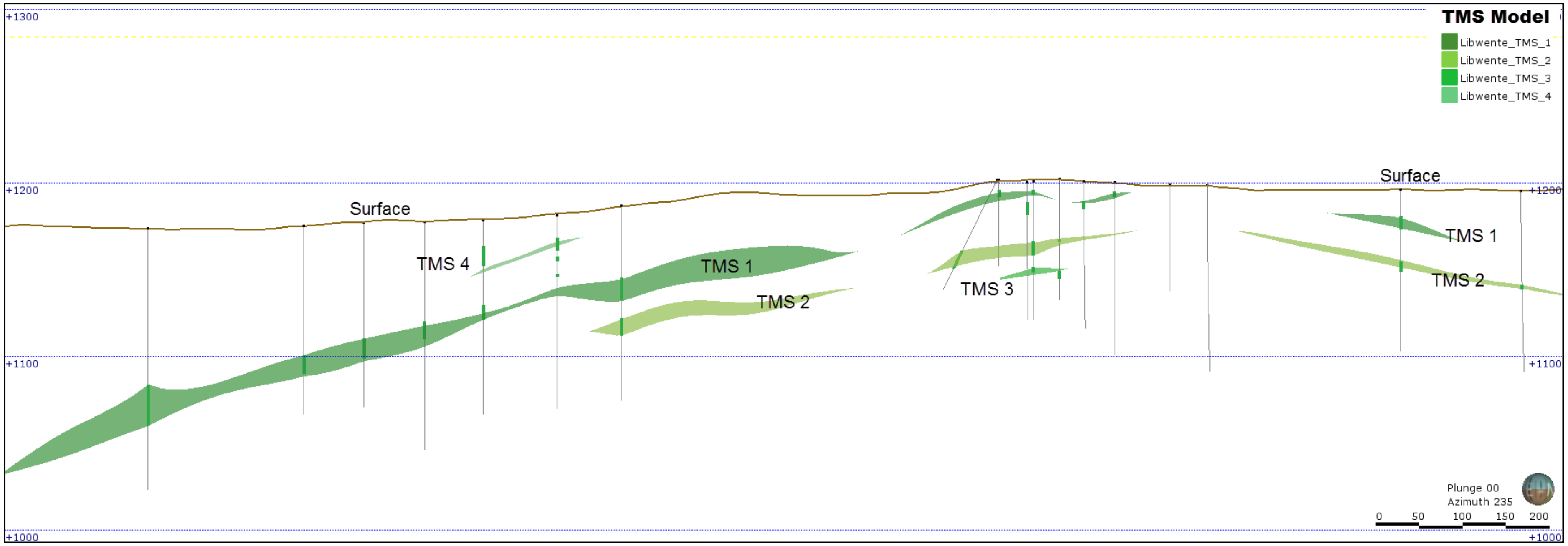


Figure 4-13: Southwest Facing Long Section of the Modelled Libwente TMS Units

4.6.2 Pegmatite Model

As the local stratigraphy is intruded by both concordant and discordant pegmatititic dykes, it was necessary to divide the logged PEG intervals into concordant and discordant PEG groups for modelling purposes. This was achieved by visual assessment of all downhole PEG, QV, QF, QT and TOUR intervals in 3D space, looking down-dip, parallel to the TMS model. Manual interval selections were then created for any logged PEGs forming consistent trends in PEG intervals of similar thickness parallel to the TMS horizons. A total of 8 discrete concordant PEG bodies were identified (the most prominent of which being a relatively continuous PEG dyke at the footwall of the TMS1 unit) and a concordant PEG model was then generated using the Leapfrog Geo 'Vein System' modeller (Figure 4-14). The 'Vein System' modeller uses the identified intervals to define the hangingwall and footwall points of each individual vein which are used to model surfaces for each. These surfaces are then constrained by the lateral extent of the intersections to create the final model volumes.

After completing the concordant PEG interval selection, all remaining PEG, QV, QT, QF and TOUR intersections were considered to be potential discordant PEG intervals. Manual interval selections were then created for any logged PEGs forming consistent trends at similar orientations to those mapped in the 8 pit exposures in the deposit area, with the focus on including PEG intervals of >5 m (as these intersections are most likely to be sub-vertical, discordant PEGs). Some 28 discordant PEG bodies were identified in this manner and a discordant PEG model was then generated using the Leapfrog Geo Vein System modeller. Figure 4-14 shows a plan view of the Libwente modelled PEGs with the TMS units with drillhole locations indicated in black.

The discordant vein models were further constrained by surface mapping information from the 8 pits located in the deposit area. In all cases, where PEG exposures were mapped in the pits, the hangingwall and/or footwall surfaces of the appropriate PEG model are locally constrained by this information.

The resulting PEG model (Figure 4-15) was constrained within the modelled TMS volume and subsequently used to cut the TMS, to produce a post-PEG TMS model volume.

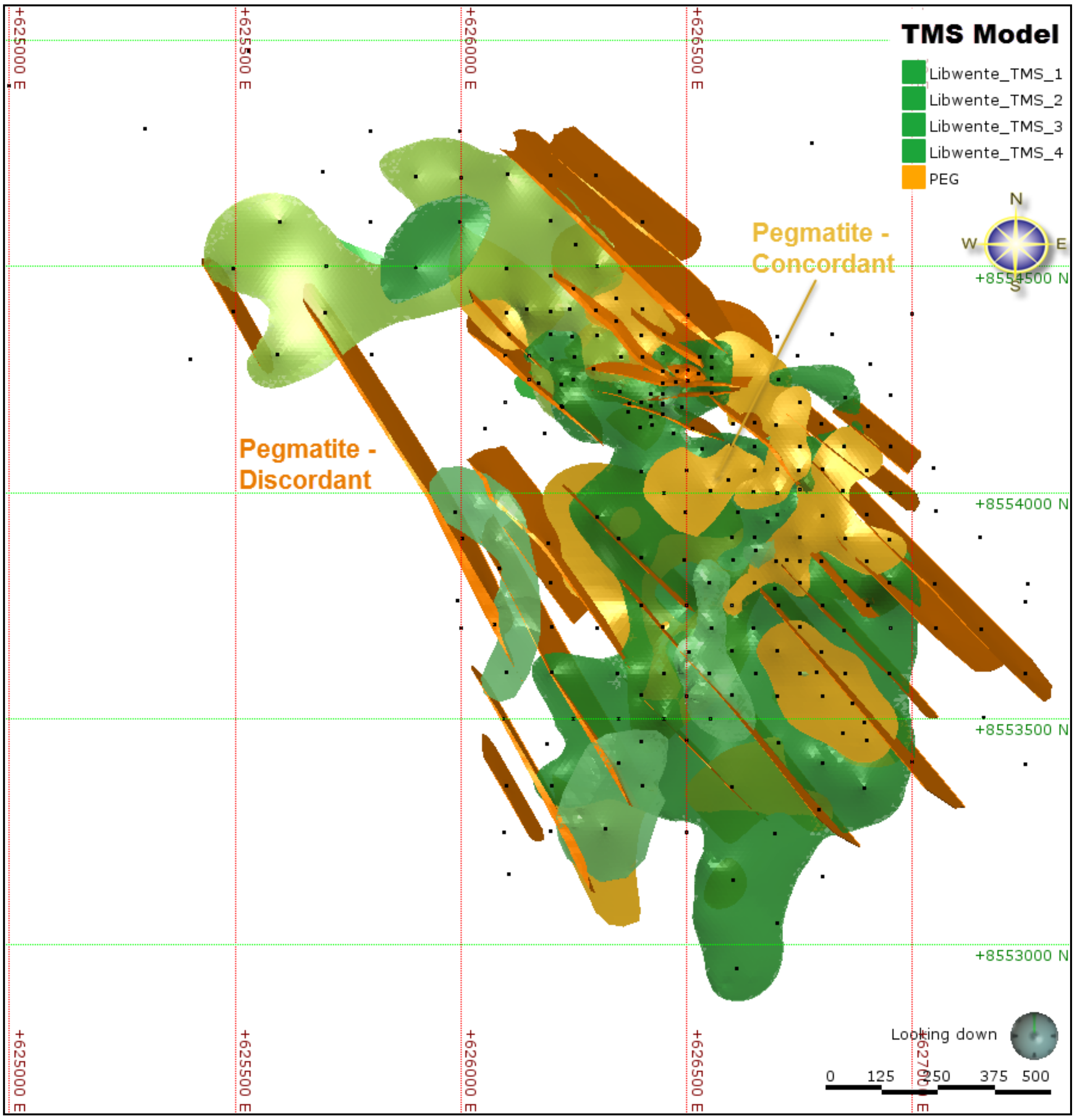


Figure 4-14: Plan View of the Libwente Modelled PEGs with the TMS Units

4.6.3 Reaction Zone Model

Gemfields production analysis data from the Libwente Pit to date indicates that RZ material is equal to 4.5% of the tonnage of the mined waste TMS. To reflect this, but also to account for dilution of the RZ material during the mining process, the CP generated a RZ model, based on a 1.18 m offset contact zone between modelled PEGs (discordant and concordant) and the TMS equating to 4.0% of the modelled waste TMS above the most recent (May 2015) pit survey wireframe. Above this pit survey wireframe, the modelled concordant RZ volume equates to 2.3% of the waste TMS volume, while the discordant RZ model equates to 1.7%.

With the 1.18 m offset RZ applied to the entire Libwente model, the total RZ volume comprises 3.6% of the modelled waste TMS. Figure 4-15 shows a plan view of the Libwente modelled RZ and PEGs within the TMS units with drillhole locations indicated in black.

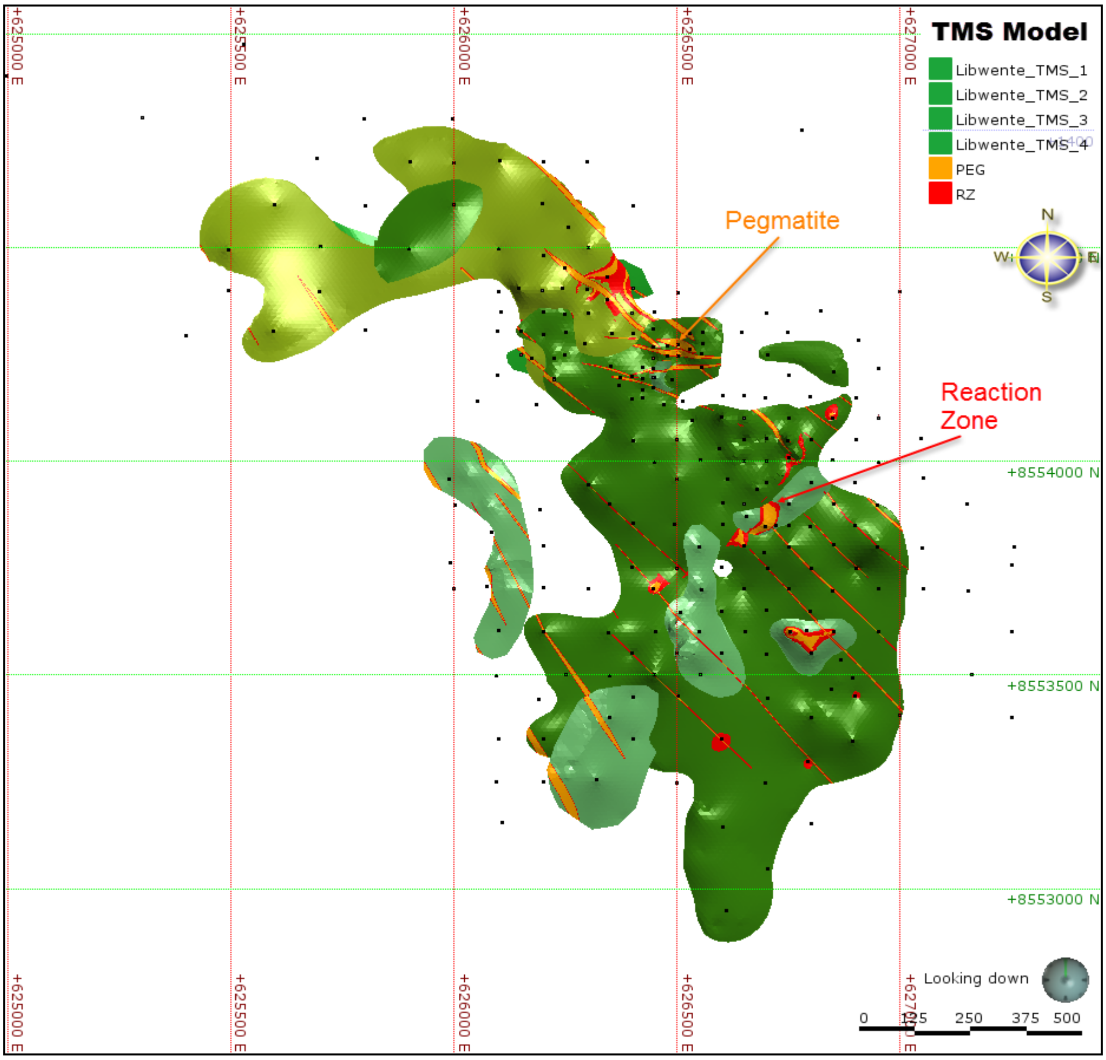


Figure 4-15: Plan View of the Libwente Modelled RZ and PEGs within the TMS Units

4.7 Libwente Grade and Tonnage Estimation

As with Chama and Fibolele, the CP has produced a block model, which is based on the modelled RZs. The block model was used in the subsequent pit optimisation exercise. The block model parameters are included in Table 4-11. As with the other deposits, the density value applied was 2.85 g/cm^3 (Section 3.6).

Table 4-11: Libwente: Block Model Parameters

Coordinate	Minimum	Maximum	Block Size (m)	Number of Blocks
X	625,000	628,000	20	150
Y	8,552,000	8,556,000	20	200
Z	800	1,275	5	95

The CP has assumed that all B&E mineralisation is hosted by the modelled RZs. As with the other deposits, the amount of RZ in the geological model reflects the amount of RZ recorded during the bulk sampling operation. The bulk sampling production data is summarised in Table 4-12. Bulk sampling at Libwente has been continuous since July 2014. The production data is split into calendar year, with the most recent data collected in June 2015. Due to the nature of the mining method used, emerald and beryl breakage is not considered to be a concern, as the larger stones are recovered from the pit directly.

Table 4-12: Libwente: Bulk Sampling Production Data

Statistic	Unit	2014	2015	Total
Mining				
RZ	(kt)	1.5	2.9	4.3
Waste TMS	(kt)	22	73	95.4
Waste non-TMS	(kt)	821	435	1,256.0
Total Rock	(kt)	844	512	1,355.8
RZ:WST TMS%	(%)	7%	4%	5%
Gemstones Recovered				
Premium Emerald	(kg)	0.00	0.03	0.0
Emerald	(kg)	0.94	5.03	6.0
Beryl-1	(kg)	2.71	8.75	11.5
Beryl-2	(kg)	5.22	9.45	14.7
Premium Emerald + Emerald	(kg)	0.94	23.25	6.00
B&E	(kg)	8.87	23.25	32.12
Premium Emerald + Emerald	(kct)	5	116	30
B&E	(kct)	44	116	161
Grade				
Premium Emerald + Emerald	(g/t)	0.6	8.1	1.4
B&E	(g/t)	6.0	8.1	7.4
Premium Emerald + Emerald	(ct/t)	3	41	7
B&E	(ct/t)	30	41	37

As at the other deposits, the recovered grade at Libwente is based on both the in-pit recovery, and from the wash plant. In order to account for anticipated dilution when mining the RZ material, the CP has calculated a recovered grade. the CP has assumed a dilution factor of 15%, which is consistent with that anticipated by Gemfields at Chama. The derivation of the B&E grade is shown in Table 4-13.

Table 4-13: Fibolele: Derivation of Grade

Statistic	Unit	Value
Average production B&E grade	(Ct/t)	37
Anticipated dilution	(%)	15%
B&E grade	(Ct/t)	46

The B&E grade shown in Table 4-13 was used coded into the block model, and also forms the basis of the Mineral Resource estimate. As production grades are recorded by Gemfields as a combination of beryl and emerald, the CP has used the same approach for the predicted grade, and so has not differentiated between beryl and emerald in either the Mineral Resource Statement or the block model.

4.8 Mineral Resource Classification

4.8.1 Introduction

The CP notes that the exploration and production activities completed by Gemfields since the underground feasibility study have significantly improved the geological knowledge and understanding of the deposits; however, the derivation of Mineral Resources is largely dependent on the availability of the results of bulk samples or equivalent such as historical production statistics, as gathered and supplied by the mine. This provides the confidence in the grade of the individual deposit, and therefore the contained gemstones in the estimate.

This section describes the data analysis and considerations taken into account by the CP when deriving the classification of the Mineral Resources at each of the deposits.

4.8.2 Reporting Code Definitions

The following is taken from the SAMREC Code (2016), for reference:

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An Inferred Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve.

It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

An 'Inferred Diamond Resource' is that part of a Diamond Resource for which quantity, grade and average diamond value are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply, but not verify, geological and grade continuity.

An Inferred Diamond Resource has a lower level of confidence than that applying to an Indicated Diamond Resource and must not be converted to a Diamond Reserve. It is reasonably expected that the majority of Inferred Diamond Resources could be upgraded to Indicated Diamond Resources with continued exploration.

Where the Mineral Resource being reported is predominantly an Inferred Mineral Resource, sufficient supporting information must be provided to enable the reader to evaluate and assess the risk associated with the reported Mineral Resource.

An Inferred Mineral Resource can be based on interpolation between widely spaced data where there is reason to expect geological continuity of mineralisation. The extent of extrapolation outside of the nominal drill or sampling grid spacing must be justified. The report must contain sufficient information to inform the reader of:

- the maximum distance that the Mineral Resource is extrapolated beyond the sample points;
- the proportion of the Mineral Resource that is based on extrapolated data;
- the basis on which the Mineral Resource is extrapolated to these limits; and
- a diagrammatic representation of the Inferred Mineral Resource showing clearly the extrapolated part of the estimated Resource.

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An 'Indicated Diamond Resource' is that part of a Diamond Resource for which quantity, grade, or value, density, shape and physical characteristics of the deposit are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade continuity between points of observation.

An Indicated Diamond Resource has a lower level of confidence than that applying to a Measured Diamond Resource and may only be converted to a Probable Diamond Reserve.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve. An Indicated Mineral Resource has a higher level of confidence than that applying to an Inferred Mineral Resource.

A deposit or part of a deposit may be classified as an Indicated Mineral Resource when the nature, quality, amount and distribution of data are such as to allow the Competent Person determining the Mineral Resource to confidently interpret the geological framework and to assume physical and grade continuity of Mineralisation. Confidence in the estimate is sufficient to allow the appropriate application of technical and economic parameters to prepare incremental mine plans and production schedules and to enable an evaluation of economic viability. Overall confidence in the estimates is high, while local confidence is reasonable. The Competent Person should recognise the importance of the Indicated Mineral Resource category in the advancement of the feasibility of the project.

An Indicated Mineral Resource estimate should be of sufficient quality to support detailed technical and economic studies leading to Probable Mineral Reserves which can serve as the basis for development decisions. It is imperative that data exists in the area of the Indicated Mineral Resource.

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proved Mineral Reserve or to a Probable Mineral Reserve.

A 'Measured Diamond Resource' is that part of a Diamond Resource for which quantity, grade or value, density, shape, and physical characteristics of the deposit are estimated with sufficient confidence to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade continuity between points of observation.

A Measured Diamond Resource has a higher level of confidence than that applying to either an Indicated Diamond Resource or an Inferred Diamond Resource. It may be converted to a Proved Diamond Reserve or to a Probable Diamond Reserve.

A Measured Mineral Resource requires that the nature, quality, amount and distribution of data are such as to leave the Competent Person with no reasonable doubt that the tonnage and grade of the Mineralisation can be estimated to within close limits and any variation within these limits would not materially affect the economics of extraction. This category requires a high level of confidence in, and understanding of, the geology and the controls on mineralisation.

A Measured Mineral Resource estimate should be of sufficient quality to support detailed technical and economic studies leading to Mineral Reserves which can serve as the basis for major development decisions.

Mineral Resource classification is a matter for skilled judgement and a Competent Person should take into account those items in Table 1 that relate to confidence in Mineral Resource estimation.

In many cases it will be understood that overall tonnages, densities, shapes, physical characteristics, grades or qualities and mineral contents can be estimated with higher levels of confidence, and local tonnages, densities, shapes, physical characteristics, grades or qualities and mineral contents can be estimated only with lower levels of confidence, insufficient for detailed mine planning.

The Competent Person should take into consideration issues of the style of mineralisation and cut-off grade when assessing geological and grade continuity for the purposes of classifying the Mineral Resource. Cut-off grades chosen for the estimation should be realistic in relation to the style of mineralisation and the anticipated mining and metallurgical development options.

4.8.3 Classification strategy and assumptions

The CP has made a series of assumptions with the mineralising system at all of the deposits. The CP has assumed that characteristics of the TMS unit remain constant to extents of the modelled unit with no changes in geology or mineralogy. Similarly, it is assumed that there is no changing in the mineralising system with depth and no change due to weathering with depth. The PEGs were modelled using a combination of the regional scale interpretation, in-pit mapping, and available drillhole intersections. The RZs were modelled either directly (footwall / hangingwall) or from the intersection of the modelled PEGs with the TMS unit. In the case of the discordant zones, the morphology of the RZs was derived from the modelled PEGs, with the assumed thicknesses based on the percentage of RZ mined, in relation to the TMS.

Grade data is sourced from historical production data so no direct grade estimate can be undertaken. Grade estimates are therefore entirely dependent on historical data for validation. The actual historical RZ grade has been applied on a sectional basis to the RZ in the model. The RZ tonnage per block varies locally according to the CP's wireframe models. The level to which the grade is extrapolated is related to the way that the data is gathered and assigned to the geological model. The degree of extrapolation is tightly controlled by referencing geological model and subsequent tonnage estimate to the production achieved since mining commenced.

In order to develop a classification scheme for the Mineral Resources at Kagem, the CP has taken the following factors into account. These factors were refined into guidelines for each Mineral Resource classification:

1. quantity and quality of the underlying data, the level of geological understanding for each deposit, and across the property as a whole;
2. confidence in the geological continuity of the TMS, PEGs and RZ;
3. confidence in the grades, as derived from the production/bulk sampling and the understanding of the grade variation at a given production scale;
4. the stage of development for each deposit (such as exploration, production, care and maintenance, etc.); and
5. the perceived level of risk associated with deviations from the assumptions made in defining and classifying the Mineral Resources. In particular, the CP notes that the definition of a Measured or Indicated Mineral Resource specifically requires there to be sufficient confidence for the subsequent application of modifying factors, and so the risk in classifying as such needs to be understood.

4.8.4 Classification guidelines

In order to classify the Mineral Resources at Kagem, the CP has used the following broad guidelines:

Measured Mineral Resources

1. extremely high quality mapping of all available outcrop, along with drilling, logging, sampling and analysis of all available drillhole data. Excellent understanding of the location of the TMS, the spatial distribution of RZs within the TMS, and of the orientation of PEGs. Drillhole spacing and orientation is sufficient to accurately predict the TMS, PEGs, and RZs where relevant. Drillhole spacing in the zone defined as Measured Mineral Resources at Chama varies between approximately 20m to 80m, depending on the orientation of the drillholes. Some drillholes are targeted at intersectiong the TMS, and some at intersectiong the PEG, and so the orientations vary. In adition to the drilling, the geological models are supported by detailed geological mapping of all available outcrop. Development and demonstration of suitability through testing of a conceptual mineralising model which underpins the ability to predict the location, geometry and tenor of the RZs;

2. a high degree of confidence in the continuity of the TMS, PEGs, discordant and footwall and hangingwall RZs. Individual PEGs can be easily traced between multiple drillholes, indicating a high degree of confidence of the discordant RZs, which are dependent on the PEG locations. The footwall and hangingwall RZs should be easily traced between drillholes, with consistency in the geometry and spatial location. The confidence in the geological and grade continuity is based extrapolation of the knowledge of the deposit from known areas, to unknown areas, with a maximum distance based on the length down-dip that mineralisation has already been exposed, and successfully mined. The distance of extrapolation is based on the amount of material already mined from the individual deposit, as well as incorporating other factors (for example, grade continuity, modelling approach, etc.). The level of extrapolation was derived for each deposit individually. At Chama, the maximum extrapolation distance of 150m, although some areas are less, in region of 30 to 50m. This extrapolation distance compares to the down-dip extension already exposed during mining of approximately 400m. In addition, all geological modelling must reflect the trends observed in the geological mapping, including the scale, morphology, and location of the PEGs and RZs;
3. high degree of confidence in the global grade of the RZs. This is demonstrated through the ability to predict, plan, and reconcile grade estimates to within 15% error, at a 90% confidence limit on an annual basis. This needs to be consistent over a prolonged period of time, analogous to the anticipated mine plan. This provides a level of understanding as to the level of variability in the grade estimates, and how these are likely to change in the short term, as required for short term mine planning;
4. the project needs to be at an advanced stage of development, with appropriate production procedures in place for the deposit in question. The stage of development of the project needs to be accounted for, as this determines the level of confidence in the data available to support the Mineral Resource estimate and subsequent classification. The procedures need to be shown to be suitable and to be gathering the relevant information over a reasonable period of time. A high confidence that all conditions necessary to form beryl and emeralds during the mineralising process were present, achieved by extrapolating confidence a relatively short distance from the known emerald bearing parts of the deposit (that is, the mine workings); and
5. The CP considers that in order for a Mineral Resource to be classified as Measured, the economic viability of the project also needs to be highly insensitive to changing parameters, such as selling price, grade, strip ratio, and as such, supports the application of any subsequent modifying factors, for the definition of a Mineral Reserve.

Indicated Mineral Resources

1. high quality mapping, drilling, logging, sampling and analysis of available drillhole data. Understanding of the location of the TMS, the spatial distribution of RZs within the TMS, and of the orientation of PEGs. Drillhole spacing and orientation is sufficient to accurately predict the TMS, PEGs, and RZs were relevant. Drillhole spacing in the area defined as Indicated Mineral Resources at Chama is between approximately 50m increasing to a maximum of 100m;

2. a high to reasonable degree of confidence in the continuity of the TMS, PEGs, discordant and footwall/hangingwall RZs. Individual PEGs can be easily traced between drillholes, indicating a high to reasonable degree of confidence of the discordant RZs, which are dependent on the PEG locations. The footwall and hangingwall RZs should be easily traced between drillholes, with consistency in the geometry and spatial location. In addition, all geological modelling must reflect the trends observed in the geological mapping, including the scale, morphology, and location of the PEGs and RZs. This differes from a Measured Mineral Resource as there is less confidence in the geological, grade, and quality continuity, as defined by a more distant extrapolation of data from known areas to unknown. Indicated Mineral Resources are either defined as being beyond the area defined as Measured Indicated Mineral Resources (in the case of Chama) or in well drilled and defined areas (as found in Fibolele);
3. high to reasonable degree of confidence in the grade of the RZs. This is demonstrated through the ability to predict, plan, and reconcile grade estimates to within 15% error, at a 90% confidence limit on an annual basis. This provides a level of understanding as to the level of variability in the grade estimates, and how these are likely to change in the short to medium term, as required for medium to long term mine planning. The CP considers that the grade and quality of the deposit is generally well understood, and so notes that there is only a minor difference between defining Measured and Indicated Mineral Resources for this point alone;
4. the project needs to be at an advanced stage of development, with appropriate production procedures in place for the deposit in question. The stage of development of the project needs to be accounted for, as this determines the level of confidence in the data available to support the Mineral Resource estimate and subsequent classification. The procedures need to be shown to be suitable and to be gathering the relevant information over a reasonable period of time; and
5. The CP considers that in order for a Mineral Resource to be classified as Indicated, the economic viability of the project also needs to be highly insensitive to changing parameters, such as selling price, grade, strip ratio, and as such, supports the application of any subsequent modifying factors, for the definition of a Mineral Reserve.

Inferred Mineral Resources

1. high quality mapping, drilling, logging, sampling and analysis of available drillhole data. Understanding of the location of the TMS, the spatial distribution of RZs within the TMS, and of the orientation of PEGs. Drillhole spacing and orientation is sufficient to infer the spatial location of the TMS, PEGs, and RZs were relevant;
2. a reasonable to low degree of confidence in the continuity of the TMS, PEGs, discordant and footwall/hangingwall RZs. Individual PEGs can be inferred between drillholes, indicating a reasonable to low degree of confidence of the discordant RZs, which are dependent on the PEG locations. The footwall and hangingwall RZs should be inferred to occur between drillholes;
3. reasonable to low degree of confidence in the grade of the RZs. There is a high degree of uncertainty regarding the ability to predict, plan, and reconcile the grade; and

4. the project needs to be at an advanced stage of development, with appropriate production procedures in place for the deposit in question. Alternatively, the deposit should have been subjected to a systematic and tightly controlled period of bulk sampling. The methods and data gathered need to be shown to be suitable for the deposit in question.

When classifying the individual deposits within Kagem, these broad criteria will be considered as a whole. The classification applied to the block model for the deposits, in relation to the pit shells used for Mineral Resource reporting (see Section 4.9), are uillustrated in Figure 4-16 to Figure 4-18. For all figures, Measured Mineral Resoruces are coloured red, Indicated Mineral Resources, coloured green, and Inferred Mineral Resources, coloured blue. Material which has been modelled, but falls outside of the reported Mineral Resources, are coloured grey. The figures also show the drillholes used to define the geological models, as reported previously.

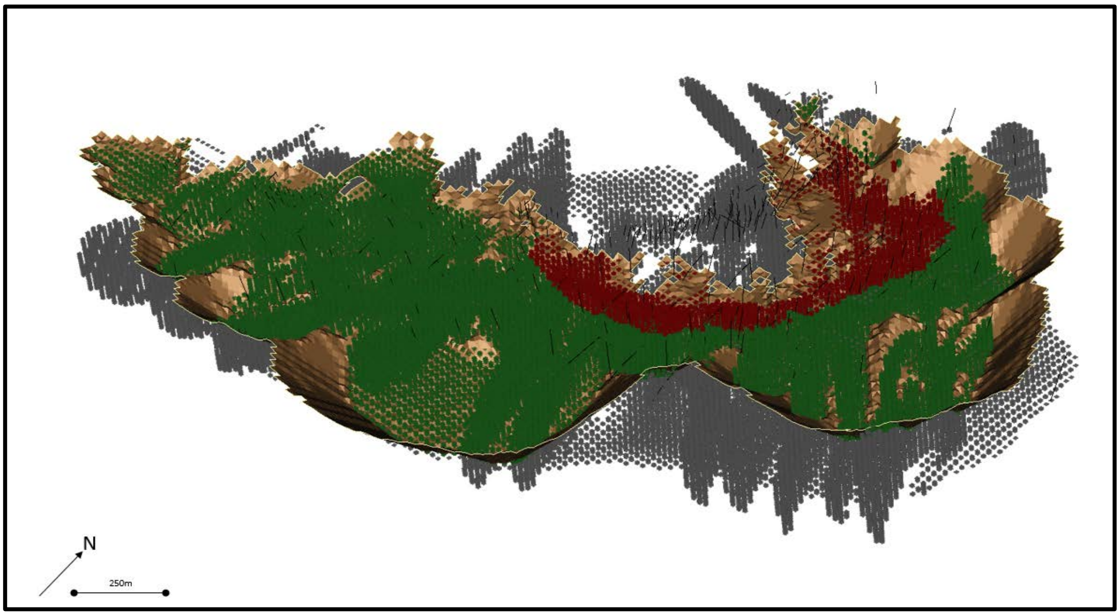


Figure 4-16: Mineral Resource classification at Chama, shown in relation to resource shell used to limit Mineral Resource reporting

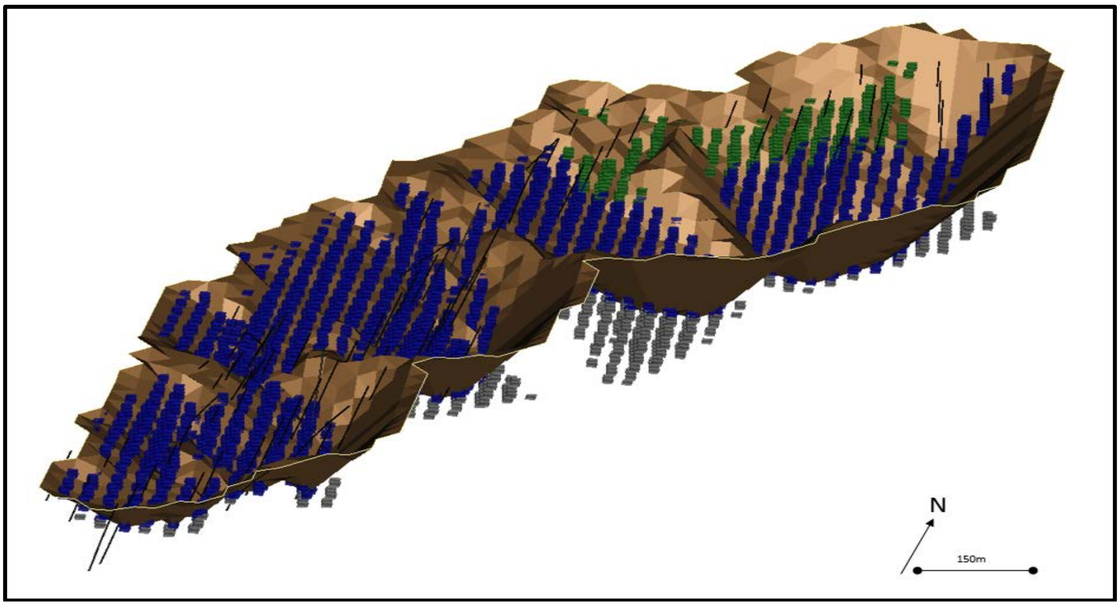


Figure 4-17: Mineral Resource classification at Fibolele, shown in relation to resource shell used to limit Mineral Resource reporting

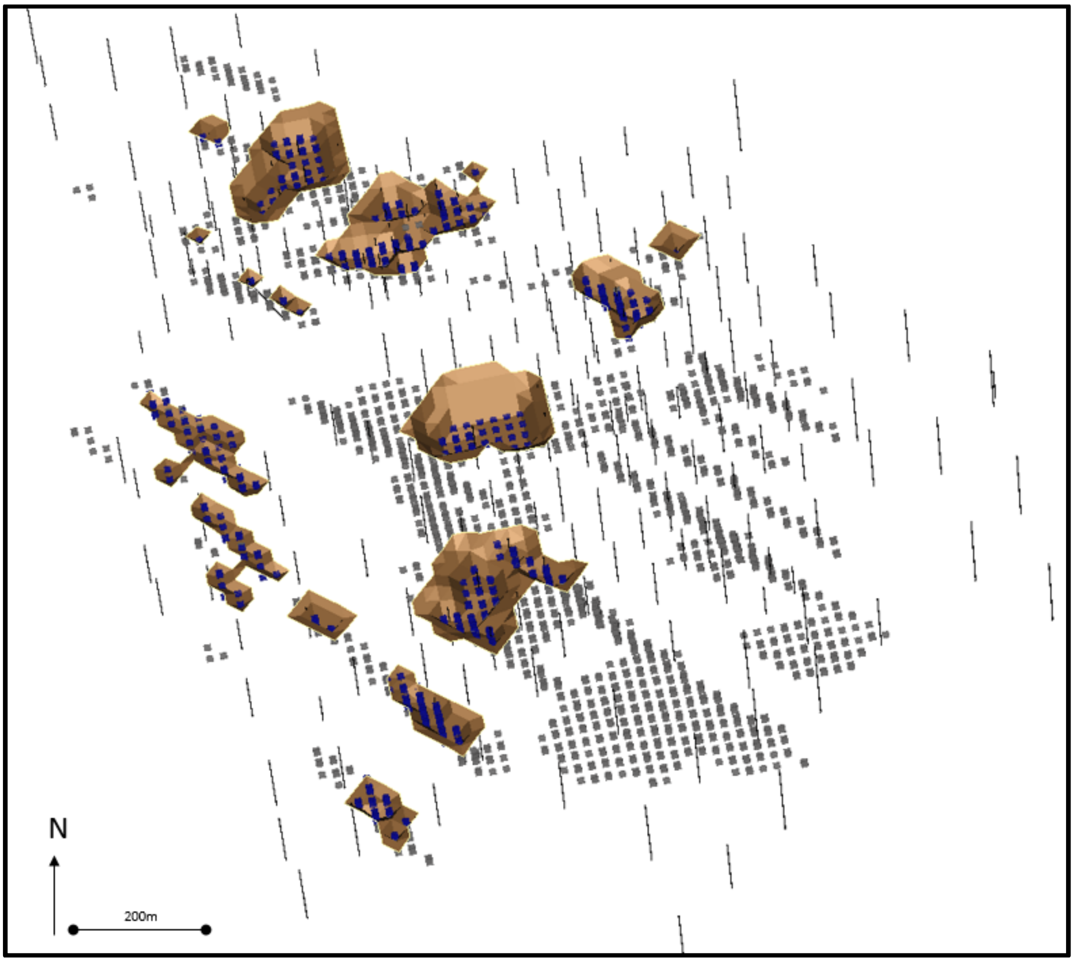


Figure 4-18: **Mineral Resource classification at Libwente, shown in relation to resource shell used to limit Mineral Resource reporting**

4.9 Mineral Resource Reporting

In order to derive the proportions of the modelled deposits which fulfil the "…reasonable prospects for eventual economic extraction" criteria required for reporting Mineral Resources in accordance with the SAMREC Code (2016), the CP has completed a pit optimisation exercise.

The optimised pits were based on the same parameters used for the mining study, except with a 30% mark up on the anticipated price, to reflect an optimistic view. The pit shells were derived from the block models discussed previously, and the classification coded into the block model. The resultant shells were used to report the tonnage and grade for each deposit. In the case of the Kagem Mine deposits, a price of USD3.90 /ct was applied.

The CP has been provided copies of written approval of the large-scale gemstone mining licence currently in place at the Kagem Mine, and is valid for 10 years commencing on 27th April 2010. All reported resources are contained within the extent of the Kagem Licence boundary. In addition, copies of the current operating permits and annual area charge invoices were provided to, and reviewed by the CP.

4.10 Comparison with Previous Mineral Resource estimates

The previous Mineral Resource estimate for the Kagem Mine was declared as of 31 May 2015. This estimate also covered the Chama, Fibolele and Libwente deposits. At that time, no Exploration Targets were specifically declared. The Mineral Resource Statement, as of 31 May 2015 is given in Table 4-14.

Table 4-14: Mineral Resource Statements, as of 31 May 2015, for the Chama, Fibolele and Libwente Beryl and Emerald Deposits

Deposit	Classification	Tonnage (kt)	B+E Grade (ct/t)	Contained Carats (ct ,000)
Chama	Measured Mineral Resources	800	345	290,000
	Indicated Mineral Resources	3,800	345	1,310,000
	Inferred Mineral Resources			
	Measured + Indicated	**4,600**	**345**	**1,600,000**
Fibolele	Measured Mineral Resources	-	-	-
	Indicated Mineral Resources	170	119	20,300
	Inferred Mineral Resources	1,450	119	172,100
	Measured + Indicated	**170**	**119**	**20,300**
Libwente	Measured Mineral Resources	-	-	-
	Indicated Mineral Resources	-	-	-
	Inferred Mineral Resources	200	46	9,100
	Measured + Indicated	**-**	**-**	**-**
Total	Measured Mineral Resources	800	345	290,000
	Indicated Mineral Resources	3,970	335	1,330,300
	Inferred Mineral Resources	1,650	110	181,200

Since the completion of the previous Mineral Resource estimate, the following aspects have influenced the changes reported:

- Production from Chama and Fibolele. No production has been completed at Libwente
- No change to the underlying geological model
- A decrease in the B&E grade at Chama, related to production achieved since 2015.

4.11 Mineral Resource Statements

The Mineral Resource Statements for Chama, Fibolele and Libwente are included in Table 4-15. The Competent Person with overall responsibility for reporting of the Mineral Resource is Dr Lucy Roberts, MAusIMM (CP), a Principal Consultant (Resource Geology) with SRK. Dr Roberts has the relevant experience in reporting Mineral Resources on various coloured gemstone projects. The CP considers that the Mineral Resource Statements, as presented in Table 4-15 are reported in accordance with the SAMREC Code (2016).

In reporting the Mineral Resources for the Kagem area, the CP notes the following:

- Mineral Resources are quoted at appropriate economic cut-off grades which satisfy the requirement of 'potentially economically mineable' for open-pit mining; furthermore, the commodity prices incorporated into the cut-off grade calculations for derivation of optimised shells are USD3.90 /ct which is an average price for all carats.
- The average value of the beryl and emerald, as reported in the Mineral Resource Statement is USD4.56 /ct. The value of the different product splits, are as follows:
  - Premium Emerald and Emerald – USD15.66 /ct; and
  - Beryl (Beryl 1 and Beryl 2) - USD0.07 /ct;
- Mineral Resources are quoted with a bottom cut-off size of 3mm, which is consistent with what can be recovered in the plant, and picked by hand from the belts.
- in addition, the CP has also completed a pit optimisation exercise which quantifies the amount of material which is likely to be mined using open pit methods. The optimised pits were derived using the same input parameters as those in the mining study (Section 7), but with a commodity price which reflects an optimistic view. In the case of the Kagem Mine deposits, a price of USD3.90 /ct was applied;
- all Mineral Resources are quoted at 100%, and derivation of attributable Mineral Resources would necessitate application of the Company's 75% equity interest; and
- all total grades quoted reflect beryl and emerald combined, expressed as carats per tonne. For the Measured and Indicated Mineral Resources, the product splits are consistent used for those forecasted in the TEM. "PE&E" is Premium Emerald and Emerald combined, and "Beryl" is Beryl-1 and Beryl-2 combined. One carat is defined as 0.2 g. Conversely, this equates to a conversion factor of 5 carats per gram.

As at 31 December 2017, the CP notes that the Chama beryl and emerald deposit has Measured Mineral Resources, of 700 kt of RZ material, grading at 283 ct/t B&E, and an Indicated Mineral Resource of 3,700 kt of RZ material, grading at 304 ct/t B&E. There are no Inferred Mineral Resources reported at Chama, as mineralisation with lower confidence occurs below the reporting shell used to define the Mineral Resources. At Fibolele, the declared Mineral Resources comprise 140 kt of RZ material, grading at 119 ct/t B&E, classified as Indicated, and 1,420 kt of RZ material, grading at 119 ct/t B&E, classified as Inferred Mineral Resources. At Libwente, the Inferred Mineral Resources consist of 200 kt of RZ material, grading at 46 ct/t B&E.

Table 4-15: Mineral Resource Statements, as of 31 December 2017, for the Chama, Fibolele and Libwente Beryl and Emerald Deposits

Deposit	Classification	Tonnage (kt)	PE+E Grade (ct/t)	Beryl Grade (ct/t)	B+E Grade (ct/t)	Contained Carats (ct ,000)
Chama	Measured Mineral Resources	700	83	200	283	198,000
	Indicated Mineral Resources	3,700	89	215	304	1,124,000
	Inferred Mineral Resources	-	-	-	-	-
	Measured + Indicated	**4,400**	**88**	**213**	**300**	**1,322,000**
Fibolele	Measured Mineral Resources	-	-	-	-	-
	Indicated Mineral Resources	140	25	94	119	16,500
	Inferred Mineral Resources	1,420	0	0	119	169,400
	Measured + Indicated	**140**	**25**	**94**	**119**	**16,500**
Libwente	Measured Mineral Resources	-	-	-	-	
	Indicated Mineral Resources	-	-	-	-	-
	Inferred Mineral Resources	200	-	-	46	9,100
	Measured + Indicated	**-**	-	-	**-**	**-**
Total	Measured Mineral Resources	700	83	200	283	198,000
	Indicated Mineral Resources	3,840	87	210	297	1,140,500
	Inferred Mineral Resources	1,620	-	-	110	178,500
	Measured + Indicated	**4,540**	**86**	**209**	**295**	**1,338,500**

The geographical locations of the respective deposits included in the Mineral Resource Statement are indicated in Figure 1-2 and Figure 1-3.

Fibolele and Libwente are considered satellite deposits to the main Chama operation.

4.12 Conclusions

The CP has generated a Mineral Resource estimate for the Chama, Libwente and Fibolele deposits of the Kagem Mine, using all available and valid data as at 31 December 2017.

It is the opinion of Dr Lucy Roberts, MAusIMM (CP), that adequate work has been undertaken at the Project to report Measured, Indicated and Inferred Mineral Resources in accordance with the SAMREC Code (2016). The open pit mining, trial mining, drilling, sampling, logging and other data gathering methods used by Gemfields are appropriate and have yielded suitable data for use in the subsequent geological and grade modelling.

In total, as at 31 December 2017, the CP notes that the Chama beryl and emerald deposit has Measured Mineral Resources, of 700 kt of RZ material, grading at 283 ct/t B&E, and an Indicated Mineral Resource of 3,700 kt of RZ material, grading at 304 ct/t B&E. At Fibolele, the declared Mineral Resources comprise 140 kt of RZ material, grading at 119 ct/t B&E, classified as Indicated, and 1,420 kt of RZ material, grading at 119 ct/t B&E, classified as Inferred Mineral Resources. At Libwente, the Inferred Mineral Resources consist of 200 kt of RZ material, grading at 46 ct/t B&E.

The Mineral Resource Statement generated by the CP is constrained within an optimised shell representing a metal price of USD3.90/ct. This represents the material which the CP considers has reasonable prospect for eventual economic extraction.

4.13 Recommendations

The CP recommends the following, in order to provide data that will assist in improving the geological understanding and confidence in any future MRE updates:

- complete a programme of drilling at both Libwente and Fibolele perpendicular to the main PEG / quartz-tourmaline vein trend to target the felsic intrusives. Targeted PEG / QT vein drilling is of equal importance to drilling focussed on the TMS unit, as the felsic intrusives are known to be a key control on the discordant RZ geometries;
- complete additional drilling at Fibolele to test the down-dip extent of the TMS unit in the central and northern areas of the currently defined TMS model, where little drillhole data is available at depth;
- routinely complete downhole surveying on all future diamond drillholes;
- structurally orientate any future diamond drillholes to allow for the capture of key downhole structural data to provide a more robust basis for the interpretation of the TMS unit, and particularly the PEGs and quartz-tourmaline veins, which are of variable orientation;
- once sufficient oriented diamond drilling has been completed, commission a structural geology review, with particular emphasis on the Libwente deposit, which at present is the least well understood and potentially most structurally complex of the three main Kagem deposits;
- routinely take thickness measurements and structural readings from all PEG dykes and quartz-tourmaline veins as part of the existing open pit mapping procedure;
- where possible, de-water and conduct geological mapping of historic pits;
- complete Niton XRF analysis on the entire length of drillholes, rather than just the TMS unit and 3 m into the hangingwall and footwall waste. This is essentially “free” data which, when coupled with sound geological logging and understanding, can help to provide a highly roust basis for geological interpretations;
- where and when possible, complete handheld Niton XRF analysis along the entire length of historic holes to add to the Niton database;
- routinely complete core photography on all new drillholes. Photographs should be taken as soon as the drill core arrives at the core facility, with depth markers clearly displayed. The core should be photographed wet and dry, ideally using a purpose built frame that allows a constant angle and distance from the camera;

- lithological logging data should be input into a fixed data input system that only allows the input of the agreed upon codes into the logging database. This should avoid the input of erroneous codes into the drillhole database and negate the need for time consuming database clean-up prior to use for modelling or analysis purposes; and
- there is currently a degree of discrepancy between the geo-location of the open pit survey wireframes and the geo-referenced satellite imagery. This should be checked and rectified as soon as possible to ensure the spatial consistency and accuracy of all data sources.

5 GEOTECHNICAL STUDIES

5.1 General

The purpose of the geotechnical study is to assess the engineering characteristics of the rock mass that will form the highwall of the Chama Pit and use this information to carry out kinematic and rock mass stability analyses to develop overall slope design parameters for the ultimate pit that satisfy specific stability and failure probability criteria. the CP considers that the quantum of geotechnical data collected and the analyses undertaken are appropriate for the definition of slope angles to a feasibility study level of accuracy. The data used for this study has been gathered from the following sources:

1. pit slope stability study carried out by African Mining Consultants (“AMC”) in 2008;
2. underground scoping study carried out by SRK in 2008;
3. programme of laboratory testing carried out to support the AMC and SRK 2008 studies
4. underground feasibility study carried out by SRK in 2013; and
5. geotechnical site visit carried out in June 2015 which included detailed pit inspections, the collection of discontinuity data for existing pit wall exposure and geotechnical logging of a selection of cored resource boreholes.

As the pit walls are currently located in rock masses with the same geotechnical characteristics as those described and tested in 2008, geotechnical characterisation for this study was based on a synthesis of the historical geotechnical data in addition to data collected in 2015.

5.2 Geotechnical Characterisation

5.2.1 Pit Lithology

The main lithological units that form the current Chama Pit are:

- weathered quartz mica schist (“QMS” or “MS”);
- fresh QMS;
- AMP; and
- TMS.

These units as exposed in the current pit highwall are shown in Figure 5-1 Sub-vertical, east-west striking PEG intrusions are visible as lighter coloured lithologies in the highwall. Thin, sheared RZs within which the gemstones are found occur at the base of the TMS (concordant RZs) or at the contact between the TMS and the PEG intrusions (discordant RZs).

5.2.2 Geotechnical Logging

Kagem has carried out a comprehensive geological drilling programme to define a gemstone resource eastwards, down dip of the current Chama Pit. Geological and RQD logging was available for all boreholes (687 in total) through the simplified geology files which provided the basis for developing a geotechnical waste model. Whilst face mapping provided geotechnical context for the rock mass currently exposed in the Chama Pit, the CP selected 10 resource boreholes that had been drilled behind the current Pushback 4 pit to provide geotechnical characterisation data for future mining stages. The 10 boreholes, totalling over 1,600 m of core were logged on site by a Kagem intern with check photographic logging being done by the CP. Table 5-1 lists the holes logged whilst their location in relation to the current pit and future Pushback 5 pit is shown in Figure 5-2. Detailed geotechnical logs are presented in Appendix E.

Figure 5-1: Pit Highwall Showing Main Lithologies

Table 5-1: Geotechnical Logging Boreholes

Hole ID	From (m)	To (m)
ZD22	0	154.5
KD93	0	180.1
KD85	0	164.5
KD84	0	164.5
KD82	0	158.5
KD79	0	142.5
KD77	0	134.5
KD74	0	191.5
KD73	0	131.4
KD101	0	200.7

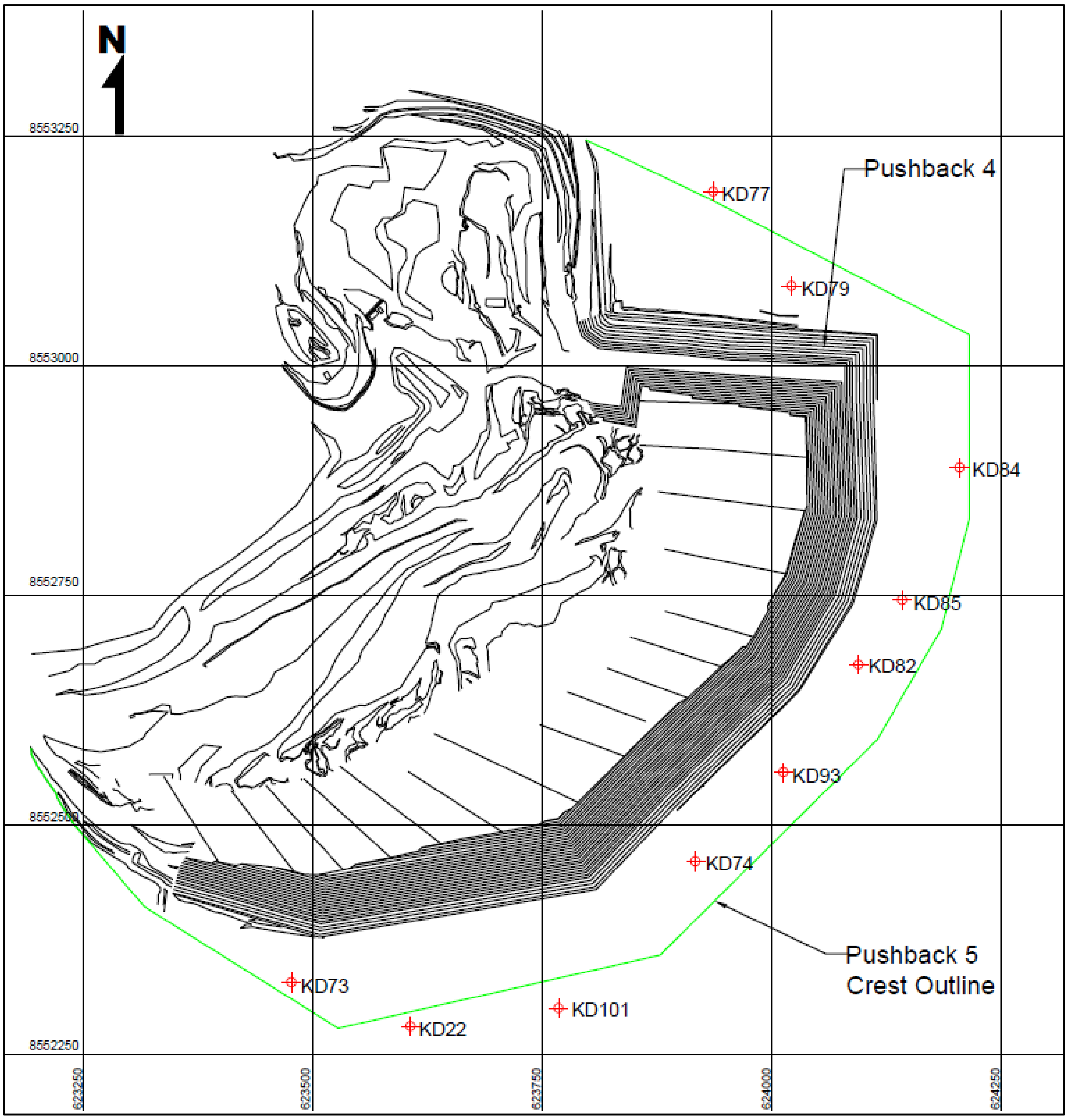


Figure 5-2: Location of the Geotechnically Logged Resource Boreholes

The geotechnical logging was undertaken on a domain basis which primarily used the lithology logs with structure, fracture frequency and alteration as additional parameters.

Table 5-2 shows the percentage of each domain logged in the 10 boreholes. This domaining forms the basis for the geotechnical waste model and subsequent finite element analysis ("FEA").

Table 5-2: Percentage of GT Domains Logged

Geotechnical Domain	Percentage Logged
Laterite	2%
MS	63%
AMPH	12%
TMS	4%
PEG	18%
RZ	1%

5.2.3 Structural Logging

Orientated core was not available from the geotechnical holes therefore kinematic analysis was based on pre-existing discontinuity data generated from face mapping and additional face mapping data collected in 2015.

5.2.4 Weathered Material

Weathered materials are described as those which are completely or heavily weathered host lithologies and logged as either soil (“SOIL”) or laterite (“LAT”). A reduction in weathering grade is expected within this zone from the surface from completely weathered (Depth: 0 to 10-20 m) through highly weathered (Depth: 20 to 30 m) into moderately then slightly weathered (Depth: 60 to 70 m), as shown in Figure 5-3.

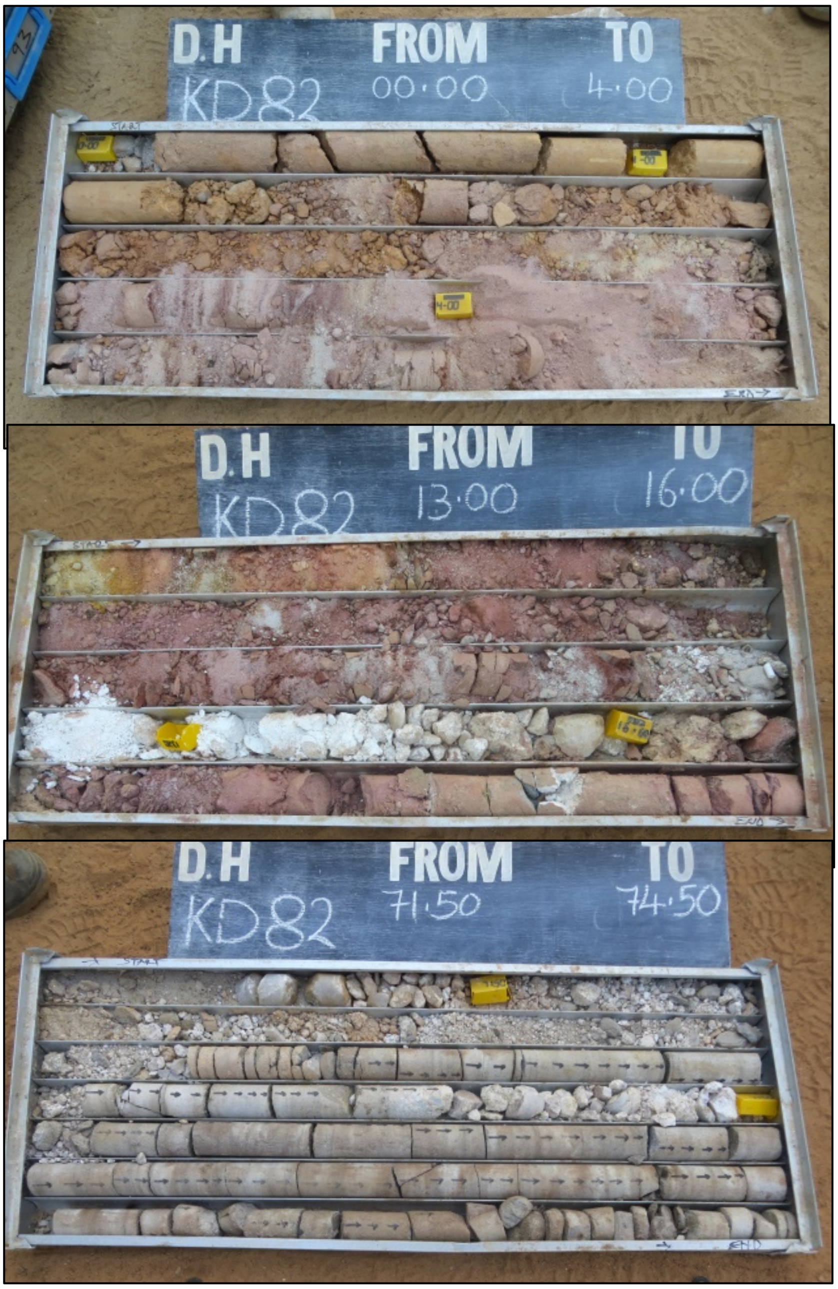


Figure 5-3: Weathered Material in KD82 (MS)

5.2.5 Mica Schist

The mica schist (“MS”) is the dominant waste materials at Kagem. The material is described as:

Strong to very strong, light green to green fine grained SCHIST. Material has a slight geological schistose fabric which does not significantly affect geotechnical properties. Discontinuities are straight to slightly undulating, planar smooth to undulating rough, stained in the upper zones (<100 m) and clean below. The rock is a dark grey, fine grained, moderately strong rock. It contains at least three moderately spaced joint sets of moderate persistence and a closely spaced foliation. The rock mass is generally blocky, slightly weathered and damp. The average rock mass rating of the MS is 50 characterising it as a fair quality rock mass.

Figure 5-4 presents representative examples of mica schist.

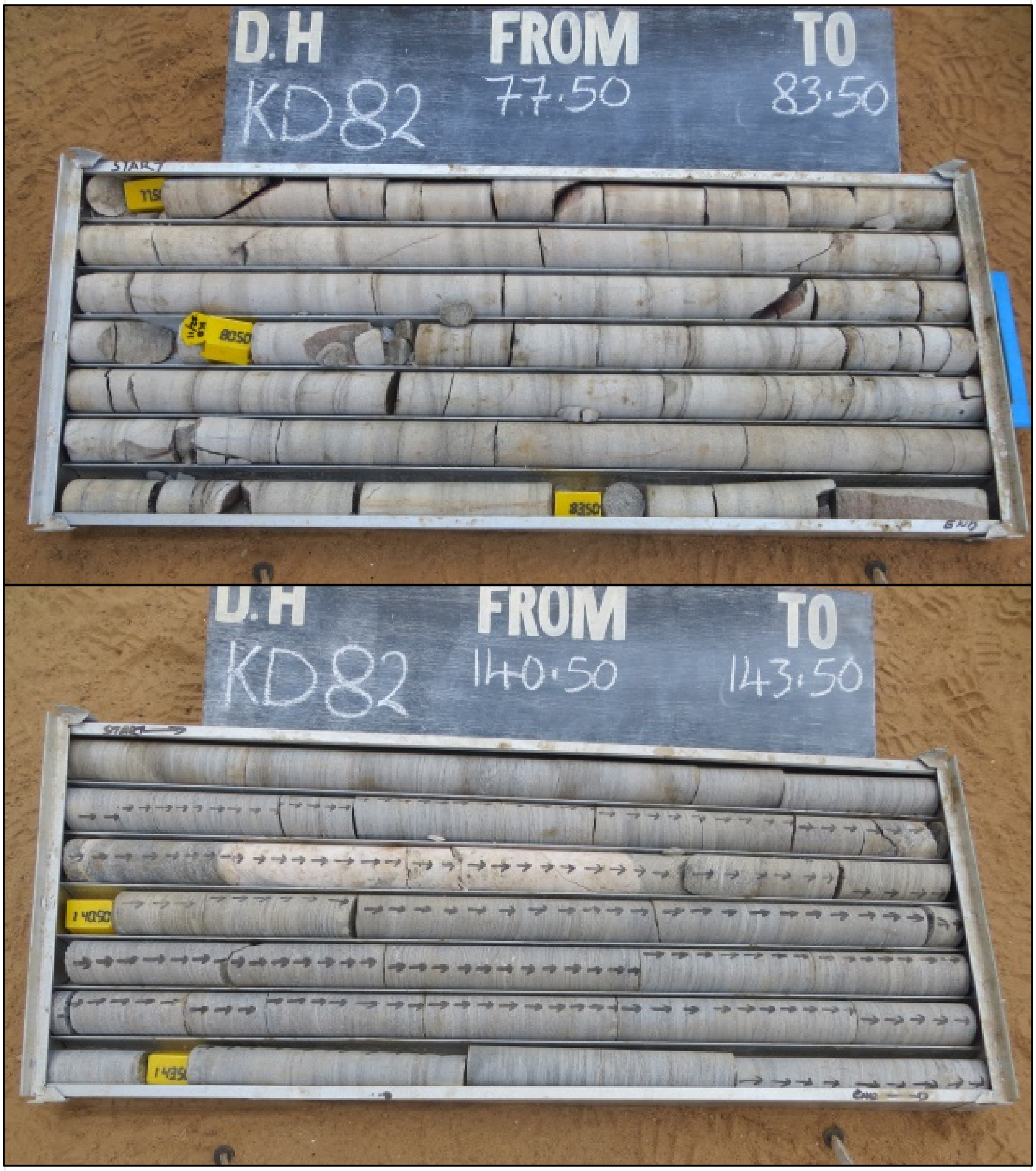


Figure 5-4: Core Logged as Mica Schist

5.2.6 Amphibolite

AMP is described as:

Strong to very strong green to dark grey fine grained AMP. Material is generally without internal fabric or structures. Discontinuities are straight to slightly undulating, planar smooth to undulating rough, stained in the upper zones and clean below.

The AMP contains at least three joint sets of moderate persistence together with a poorly developed foliation. The rock mass is generally blocky and competent and is fresh to slightly weathered and dry. Figure 5-5 shows photographs of core logged as AMP whilst Figure 5-6 shown an exposure of AMP within the pit highwall.

Figure 5-5: Core Logged as AMP

Figure 5-6: Hangingwall Exposure of AMP

5.2.7 Pegmatite (PEG, QF, QT, QV, TOURM, TOUR)

The PEG or associated quartz dominated lithologies are intrusive and associated with the main mineralisation and resource. These materials are described as:

Weak (highly weathered) to very strong (fresh) light cream course texture PEG. Material is phenocrystic in part, without internal fabric or structures. At least one discontinuity set, straight to slightly undulating, undulating rough to stepped rough, stained in the upper zones and clean below.

The PEG intrusions vary in dip from about 15° where they occur along the base of the TMS to sub-vertical where they cut through the TMS. The sub-vertical PEGs are orientated in an east-west direction and dip towards the north. The shape of the PEGs can be irregular and vary in thickness from centimetres to tens of metres. The PEGs carry significant quantities of groundwater. When exposed to the atmosphere they tend to degrade very rapidly through weathering or alteration which can heavily affect the integrity of the material causing a loss in drilling recovery as it becomes an unconsolidated sand.

Figure 5-7 shows core logged as PEG.

Figure 5-7: Borehole Core Logged as PEG (PEG)

5.2.8 TMS

The TMS is associated with the main mineralisation and resource, as shown as core in Figure 5-8 and TMS outcrop within the western end of the pit in Figure 5-9.

Figure 5-8: Borehole Core Logged as TMS

Figure 5-9: TMS at Base of Highwall

5.2.9 Reaction Zone

The RZs, which contain the emeralds, are located between the TMS and the PEG intrusions. The RZ along the base of the TMS is termed the Concordant RZ ("CRZ"). Those adjacent to the PEG intrusions that cross cut the TMS are termed the Discordant RZs ("DRZ"). The RZs are essentially weak metasomatic zones which vary in thickness from 1-2 cm to up to 2 m. The RZ is described as:

Very weak to weak, dark grey to black moderately to highly weathered (a product of alteration) highly foliated biotitic/phlogopitic RZ. Disintegrated rock mass, crushed to three to four discontinuity sets, tight to narrow spacing, low persistence, planar polished to smooth, straight to slightly undulating profile, soft fine infill to gouge in part.

The rock mass is closely foliated with foliation being highly contorted in places. The RZs are generally moderately to highly weathered and contain groundwater that probably originates from the PEGs. Figure 5-10 illustrates the concordant RZ at the footwall of the TMS.

Figure 5-10: CRZ on Footwall of TMS

5.2.10 Laboratory Testing

Laboratory testing was undertaken by RockLab (South Africa) in 2009 on rock samples to ascertain a series of parameters for numerical modelling as shown in Table 5-3, Table 5-4 and Table 5-5.

The CP considers that these tests represent the minimum number and variety of testing for analysis and geotechnical design for the current slope height. The laboratory data should be supplemented with additional field and laboratory testing to assess the potential variability in properties as the pit deepens.

Table 5-3: Summary of Density Testing Results

Material	Count	Average Density (g/cm³)
AMP	7	2.91
PEG	9	2.59
RZ	9	2.90
TMS	6	2.84

Table 5-4: Summary of Uniaxial Compressive Strength ("UCS") Results

Material	Count	Minimum UCS (MPa)	Maximum UCS (MPa)	Average UCS (MPa)	StdDev UCS (Mpa)
AMP	4	32.3	113.4	72.4	46.3
PEG	3	56.3	154.8	101.0	49.8
RZ	3	6.0	67.2	32.9	31.3
TMS	3	59.3	124.2	84.0	35.1

Table 5-5: Summary of Young's Modulus and Poisson's Ratio Results

Material	Count	Tangent Young's Modulus (GPa)	Secant Young's Modulus (GPa)	Tangent Poisson's Ratio	Secant Poisson's Ratio
RZ	3	13.8	17.1	0.4	0.3
TMS	3	44.5	51.4	0.3	0.2

5.2.11 Hydrogeological Conditions

It is the understanding of the CP that no hydrogeological testing has been undertaken at the Chama Pit either for dewatering or depressurisation of the pit slopes. The geotechnical analysis will therefore focus on the mechanical properties of the rock mass and infers a phreatic surface from observations made during the site visit. These observations noted seepage on the face occurring approximately 6 benches or 60m below the slope crest (Figure 5-11). A phreatic surface will therefore be created in the numerical modelling located 60m from the topographical surface and located close behind the face at this point and exiting at the toe of the slope.

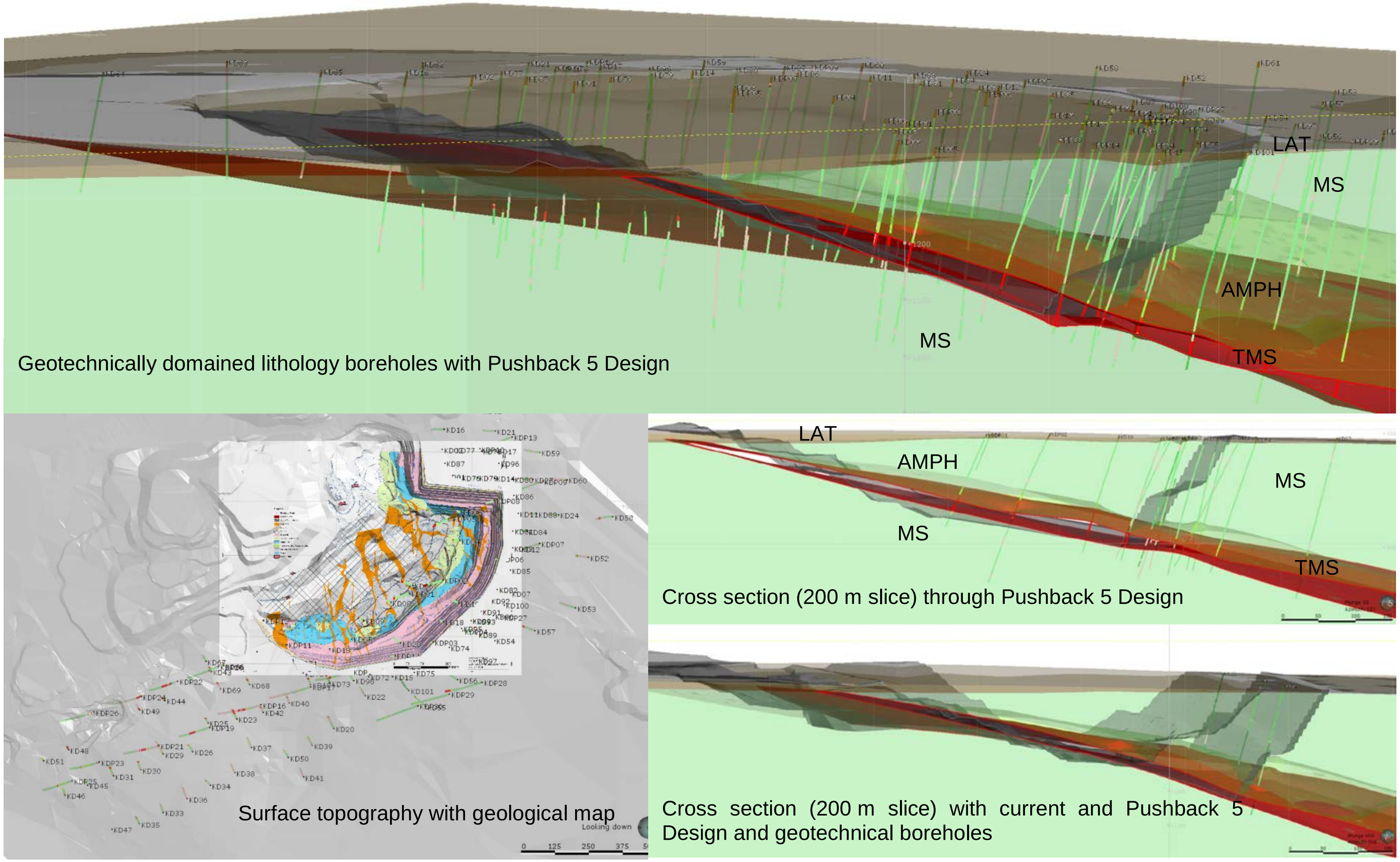
Figure 5-11: Site Photographs of Face Seepage (June 2015)

5.2.12 Geotechnical Waste Rock Mass Model

A geotechnical waste rock mass model was created from the geotechnical domained lithologies to enable kinematic assessment and rock mechanics modelling. The model was based on lithological logging as opposed to rock mass classification system due to the limited spatial coverage of the geotechnical boreholes or other geomechanical logging/mapping. This prevented the construction of a more detailed numerical model for Chama. If spatial coverage of geotechnical parameters increased a higher accuracy model could be developed for analysis.

Development of the waste rock model was undertaken in Leapfrog Geo based on the domaining in Table 5-1 and shown in Figure 5-12. PEGs were not geotechnically modelled as they run parallel to any cross sections cut through the pit model. In addition, the width and persistence of the PEGs it makes them extremely difficult to create numerical modelling domains. It was understood that the interaction of the TMS-PEG zones culminating in the RZ domains do possess a lower class rock mass zone than the MS, AMPH and TMS. The RZ was inferred in the modelling as a 2 m zone below the TMS as modelling based on the intercepts produced a non-geologically viable surface.

The rock mass classification is provided later in the report in Section 5.4.


Geotechnically domained lithology boreholes with Pushback 5 Design

Surface topography with geological map

Cross section (200 m slice) through Pushback 5 Design

Cross section (200 m slice) with current and Pushback 5 Design and geotechnical boreholes

Figure 5-12: Geotechnical Waste Rock Mass Model

5.3 Kinematic Analysis

Kinematic analysis determines the likelihood of planar, wedge and toppling instability on a bench scale to allow for the definition of bench-berm configurations that feed into inter-ramp and overall slope angles.

To undertake the kinematic analysis, discontinuity sets were defined on the basis of the discontinuity data collected from each of the field mapping campaigns and an assessment of the potential for planar, toppling and wedge failure made using stereographic software. Detailed berm width assessments were undertaken using the SBlock software to define appropriate batter and berm requirements.

5.3.1 Discontinuity Sets

Kinematic analysis was based on the field mapping of the bench faces undertaken over two separate mapping programmes. The number of discontinuity records totalled 162 poles. Due the limited volume of mapping data, however, it was not possible to accurately determine the presence of defined structural domains within the pit slopes and as a result, the pit slopes have been defined as being within a single structural domain. This methodology likely simplifies the rock mass structure. As a result, localised failures may occur when the bench faces are developed at orientations that adversely intersect the existing structure. To increase confidence in the kinematic analysis further pit mapping will be required as the pit develops.

Table 5-6: Main Joint Sets

ID	Dip (°)	Dip Direction (°)	Standard Deviation (°)	Lithology
J1	75	235	9	AMP
J2	51	330	19	AMP,TMS
J3	90	82	8	AMP,TMS
J4	90	1	8	MS, AMP,TMS
Fol	23	87	7	MS, AMP

Not all joint sets are present in all of the main hangingwall lithologies. Within the MS foliation is the dominant discontinuity whilst J1, J2 and J3 are missing. Within the AMP J1 is the dominant joint set whilst foliation is poorly developed and within the TMS, J2 is the dominant joint set whilst J1 and foliation are missing.

Spacing and persistence values for the discontinuities were taken from the field data and summarised in Table 5-7. This permitted the SBlock and Toppling analysis for failure volumes was based on the true spacing of discontinuities and their persistence.

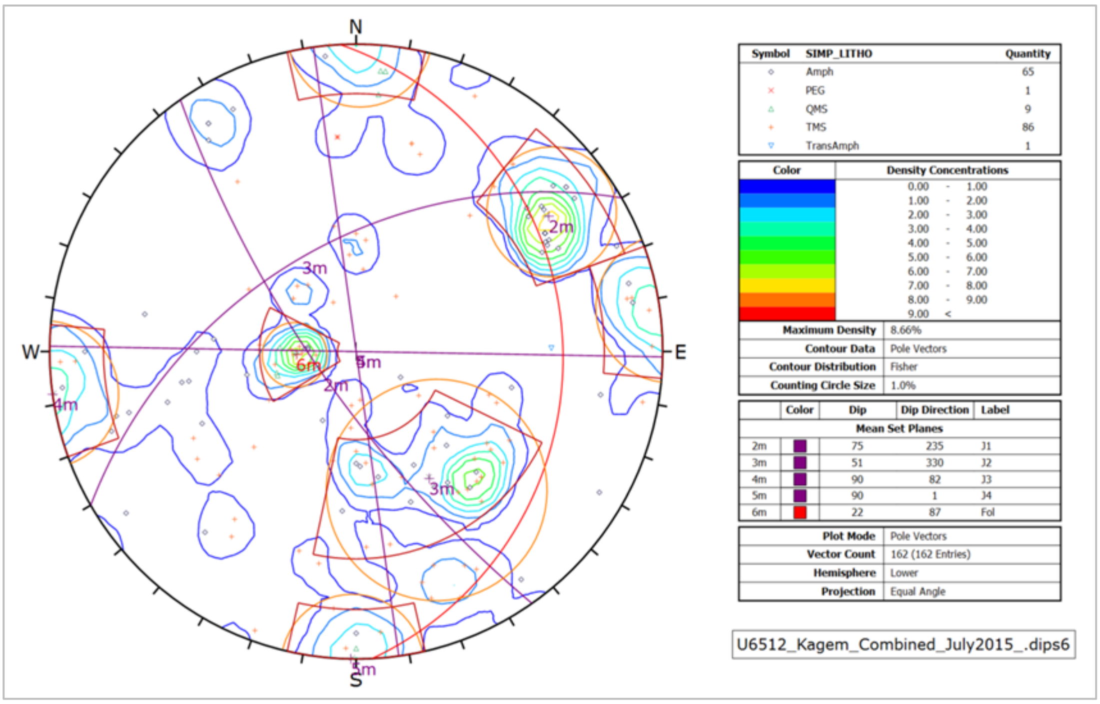


Figure 5-13: Chama Pit Major Discontinuity Sets

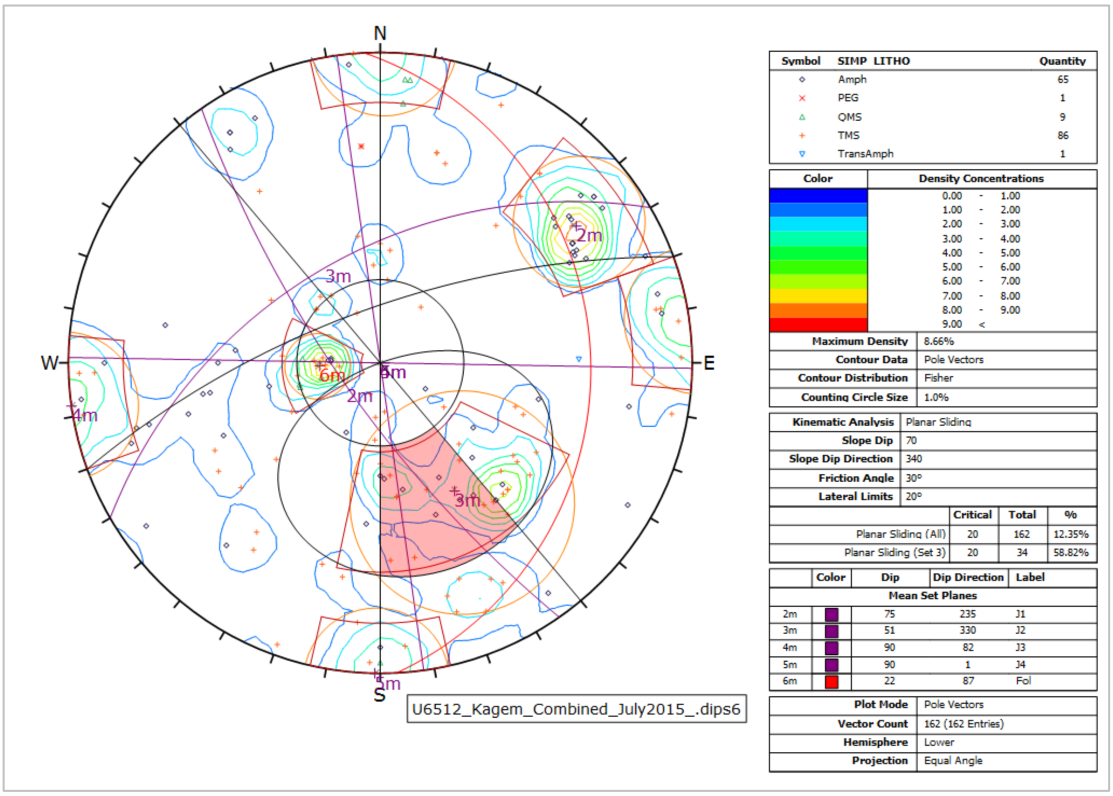
Table 5-7: Discontinuity Spacing and Persistence

Lithology	True Spacing (m)	Persistence (m)			
		1-3	3-10	10-20	>20
AMP	0.1-0.5			1	2
	0.5-1			4	
	1-2		1	17	
TMS	1		5		
	0.75-2	2	13	2	
	1-1.5		4	3	
	1-2		3		
	not recorded		3	10	2

5.3.2 Planar and Toppling Risk Analysis

Planar and toppling failure risks were assessed in Dips, Wedge instability was assessed in SBlock which is described in the following section. The stereonet presented in Figure 5-13 was used to carry out this assessment. Both 70° and 75° bench face angles were analysed and an estimated joint friction angle of 30° used.

Planar failure analysis is undertaken by employing a friction cone and a daylight envelope to test for combined frictional and kinematic scenarios where planar sliding is possible. Any poles falling within the envelope are kinematically free to slide, if frictionally unstable. Any pole falling outside of the frictional cone represents a plane that could slide if kinematically possible. The crescent shaped zone formed by the daylight envelope and the pole friction circle therefore encloses the region of planar sliding, where planes are free to slide both frictionally and kinematically. Figure 5-14 illustrates the planar failure assessment, for a slope direction of 340°. Approximately 59% of the joints belonging to joint set 3 are plotted in the instability region as described above, hence there a high planar failure risk along joint set 3.



Symbol	SIMP LITHO	Quantity
◇	Amph	65
×	PEG	1
△	QMS	9
+	TMS	86
▽	TransAmph	1

Color	Density Concentrations
🟦	0.00 - 1.00
🟦	1.00 - 2.00
🟦	2.00 - 3.00
🟩	3.00 - 4.00
🟩	4.00 - 5.00
🟩	5.00 - 6.00
🟩	6.00 - 7.00
🟨	7.00 - 8.00
🟧	8.00 - 9.00
🟥	9.00 <

Maximum Density	8.66%
Contour Data	Pole Vectors
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	70
Slope Dip Direction	340
Friction Angle	30°
Lateral Limits	20°

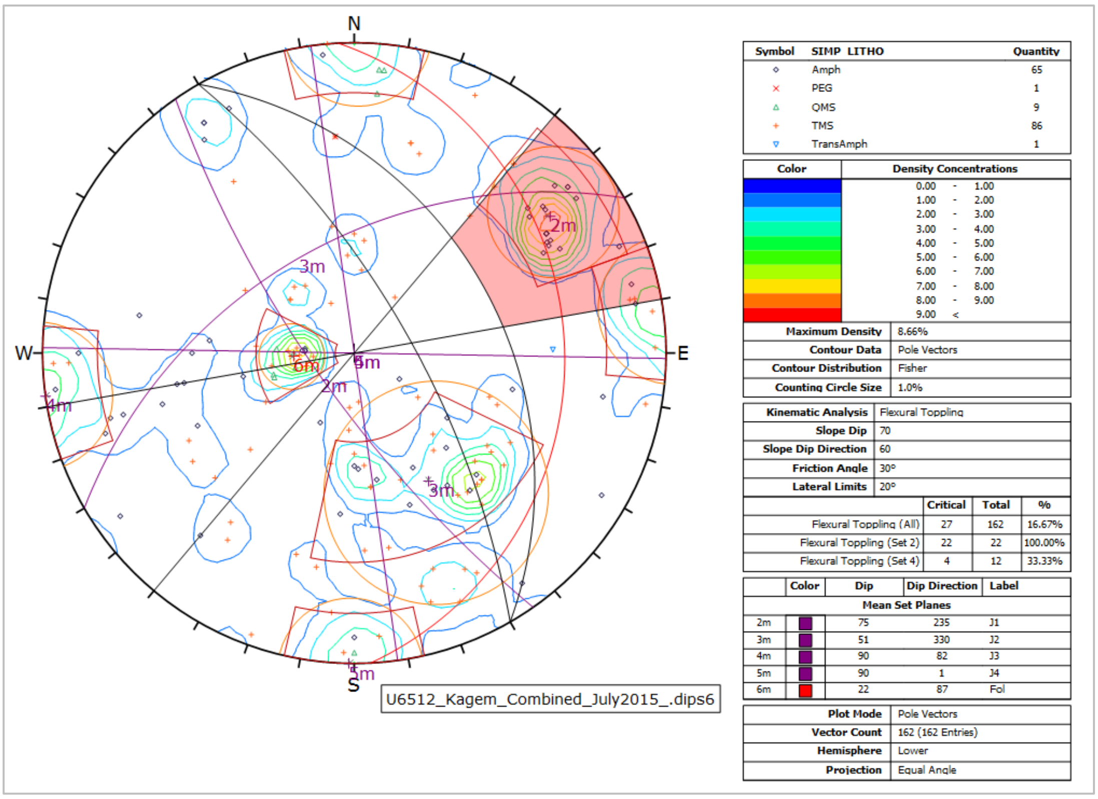
	Critical	Total	%
Planar Sliding (All)	20	162	12.35%
Planar Sliding (Set 3)	20	34	58.82%

	Color	Dip	Dip Direction	Label
Mean Set Planes				
2m	🟪	75	235	J1
3m	🟪	51	330	J2
4m	🟪	90	82	J3
5m	🟪	90	1	J4
6m	🟥	22	87	Fol

Plot Mode	Pole Vectors
Vector Count	162 (162 Entries)
Hemisphere	Lower
Projection	Equal Angle

Figure 5-14: Planar Failure Assessment

Toppling analysis involves plotting a plane, representing the bench face slope angle and a slip limit; the latter is defined as a plane with a dip direction parallel to the pit slope, and a dip equal to the bench face angle, minus the joint friction angle (for example, 70° (BFA) – 30° (friction angle) = 40° (slip limit)). The confined toppling region indicates where toppling failure is likely located. By comparing the number of joint and major structure poles within the confined zone with the total number of poles in the parent cluster, it is possible to determine the qualitative probability for toppling failure for a given pit slope orientation. Figure 5-15 illustrates the toppling risk associated with a slope dip direction of 060°. Most of the joints belonging to joint set 2 are plotted within the instability zone, hence the high risk for toppling failure for a 060° slope. Summaries of planar and toppling failure assessments are presented in Table 5-8 and Table 5-9.



Symbol	SIMP LITHO	Quantity
◇	Amph	65
×	PEG	1
△	QMS	9
+	TMS	86
▽	TransAmph	1

Color	Density Concentrations
🟦	0.00 - 1.00
🟦	1.00 - 2.00
🟦	2.00 - 3.00
🟩	3.00 - 4.00
🟩	4.00 - 5.00
🟩	5.00 - 6.00
🟩	6.00 - 7.00
🟨	7.00 - 8.00
🟧	8.00 - 9.00
🟥	9.00 <

Maximum Density	8.66%
Contour Data	Pole Vectors
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Toppling
Slope Dip	70
Slope Dip Direction	60
Friction Angle	30°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	27	162	16.67%
Flexural Toppling (Set 2)	22	22	100.00%
Flexural Toppling (Set 4)	4	12	33.33%

	Color	Dip	Dip Direction	Label
Mean Set Planes				
2m	🟪	75	235	J1
3m	🟪	51	330	J2
4m	🟪	90	82	J3
5m	🟪	90	1	J4
6m	🟥	22	87	Fol

Plot Mode	Pole Vectors
Vector Count	162 (162 Entries)
Hemisphere	Lower
Projection	Equal Angle

Figure 5-15: Toppling Failure Assessment

Table 5-8: Planar Failure Assessment Summary

	Face dip direction	**Joint Set 1**	**Joint Set 2**	**Joint Set 3**	**Joint Set 4**	**Foliation**
	Lithology	**AMP**	**AMP,TMS**	**AMP,TMS**	**MS, AMP,TMS**	**MS, AMP**
70° BFA	180	-	-	-	-	-
	200	-	-	-	-	-
	220	Very Low	-	-	-	-
	240	Very Low	-	-	-	-
	260	Very Low	-	-	-	-
	280	-	Very Low	-	-	-
	300	-	Moderate	-	-	-
	320	-	High	-	-	-
	340	-	High	-	-	-
	0	-	Moderate	-	-	-
	20	-	Very Low	-	-	-
	40	-	-	-	-	-
	60	-	-	-	-	Very Low
75° BFA	180	-	-	-	-	-
	200	Very Low	-	-	-	-
	220	Moderate	-	-	-	-
	240	High	-	-	-	-
	260	Low	-	-	-	-
	280	-	Very Low	-	-	-
	300	-	Moderate	-	-	-
	320	-	High	-	-	-
	340	-	High	-	-	-
	0	-	Moderate	-	-	-
	20	-	Very Low	-	-	-
	40	-	-	-	-	-
	60	-	-	-	-	Very Low

Note: The dominant joint set in each lithology is indicated in BOLD in the lithology row.

Table 5-9: Toppling Failure Assessment Summary

	Face dip direction	**Joint Set 1**	**Joint Set 2**	**Joint Set 3**	**Joint Set 4**	**Foliation**
	Lithology	**AMP**	**AMP,TMS**	**AMP,TMS**	**MS, AMP,TMS**	**MS, AMP**
70° BFA	180	-	Very Low	-	High	-
	200	-	Very Low	-	High	-
	220	-	-	-	-	-
	240	-	-	Very Low	-	-
	260	-	-	High	-	-
	280	-	-	Moderate	-	-
	300	-	-	-	-	-
	320	-	-	-	-	-
	340	-	-	-	Low	-
	0	-	-	-	High	-
	20	Very Low	-	-	Low	-
	40	Very High	-	-	-	-
	60	Very High	-	Moderate	-	-
75° BFA	180	-	Low	-	High	-
	200	-	Very Low	-	High	-
	220	-	-	-	-	-
	240	-	-	Very Low	-	-
	260	-	-	High	-	-
	280	-	-	Moderate	-	-
	300	-	-	-	-	-
	320	-	-	-	-	-
	340	-	-	-	Low	-
	0	-	-	-	High	-
	20	Very Low	-	-	Low	-
	40	Very High	-	-	-	-
	60	Very High	-	Low	-	-

Note: The dominant joint set in each lithology is indicated in BOLD in the lithology row.

The results of the kinematic analysis indicate that:

- For the mica schist where the dominant discontinuity set is foliation there is very little potential for planar failure and no potential for toppling failure;
- For the AMP where Joint Set 1 is the dominant joint set the potential for planar failure is generally very low to low. There is toppling failure potential for the slopes in the southern end of the pit;
- For the TMS where Joint Set 2 is the dominant joint set there is potential for planar failure whilst the potential for toppling is generally very low;
- For the minor joint sets, J3 and J4, there is no potential for planar failure whilst there is some potential for toppling failure; and
- There is greater potential for either planar or toppling failure when benches are cut at 75° rather than for those cut at 70°.

In relation to the current observed behaviour of the slopes, the Chama Pit analysis confirms the behaviour of the mica schist slope where little if no instability was noted. The AMP and TMS slopes are still in the process of being excavated and final slopes in these units have yet to be formed.

5.3.3 SBlock Analysis

SBlock was used to calculate failure volumes and depth of failures and also provides a probability of failure of planar and wedge failure. SBlock makes use of the keyblock method developed by Goodman & Shi (1985) to calculate the removability of blocks from a slope face. This allows blocks of any convex shape to be evaluated. SBlock can evaluate blocks with up to 8 facets. Once removability has been established, the program uses vector methods to determine the sliding direction, normal and shear forces on the sliding planes and the factor of safety ("FoS") of the block. A FoS of greater than 1.0 indicates a stable block. Sliding can occur along a single plane (planar failure) or along two planes (wedge failure) and sometimes along three planes. The program identifies blocks and finds whether they can slide out of the face and the associated sliding mode automatically. The program repeatedly selects joint surfaces from the provided joint statistics (collected during logging and face mapping) and tests whether a block is formed. This process is repeated ten times to acquire average values. The failure volume and other statistics are accumulated and a summary is provided at the end of each run. The program assumes that every joint truncates against another joint. The program uses trace length together with dip/dip direction. Joint spacing and trace length is assumed to follow a truncated negative exponential distribution. Joint orientation and strength properties are assumed to follow a normal distribution.

SBlock analysis was undertaken utilising the discontinuity data (Table 5-6) and spacing and persistence parameters (Table 5-7). Discontinuity strength parameters were estimated from literature sources, engineering judgement and experience. The initial values used in the SBlock analysis were c=0kPa, phi=30°. These values could be considered conservative in approach due to the lack of laboratory test data but were validated against site visit observations. A sensitivity analysis was undertaken with an increase in c and phi, c=25kPa, Phi=35° to account for potential rock bridges, roughness changes and orientation variance. The results of the analyses are presented in Figure 5-16 and Figure 5-17. The maximum bench width required is 2.7 m for a 70° bench face angle and 3.1 m for a 75° face angle in the slope sectors with a dip direction of 300°, that is north-west facing slopes. The case with higher joint shear strength gives minor failed block volumes.

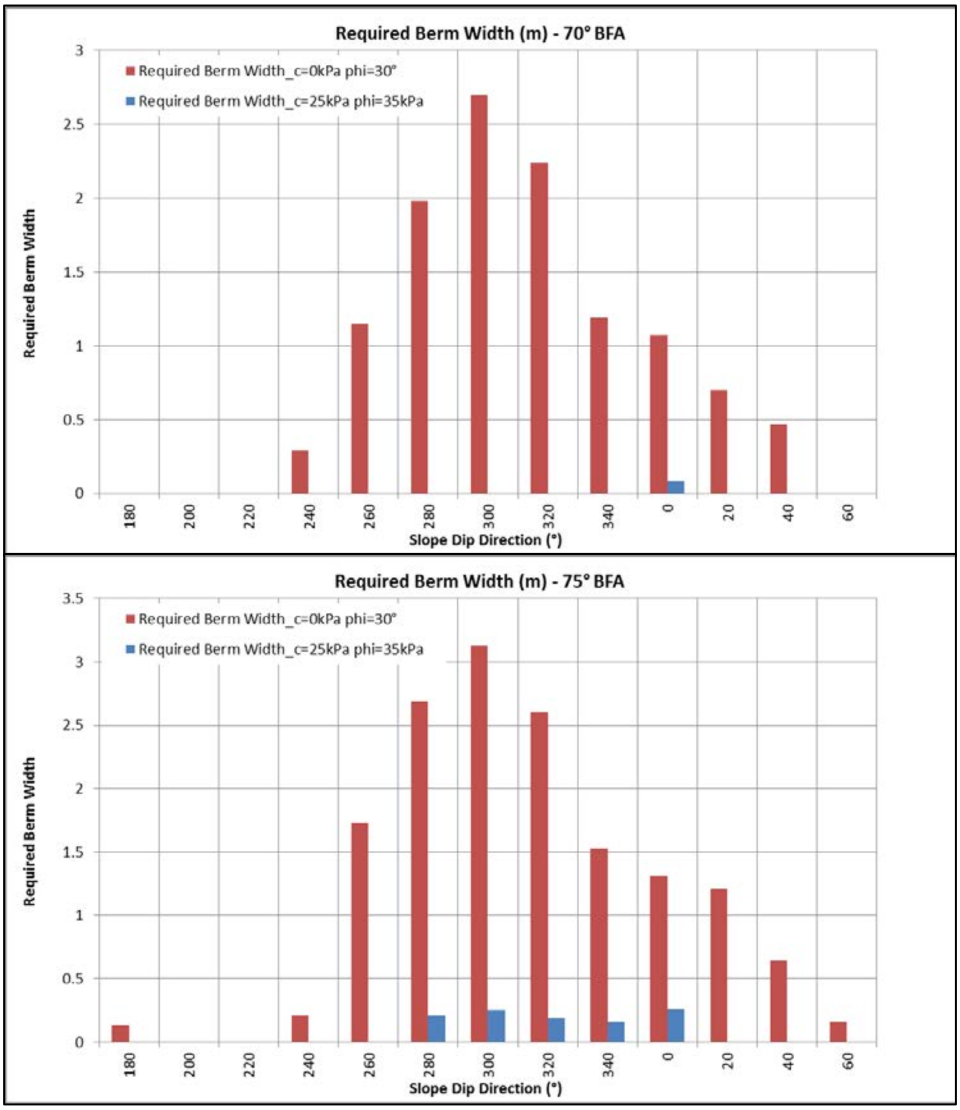


Figure 5-16: Minimum Required Berm Width per Slope Direction

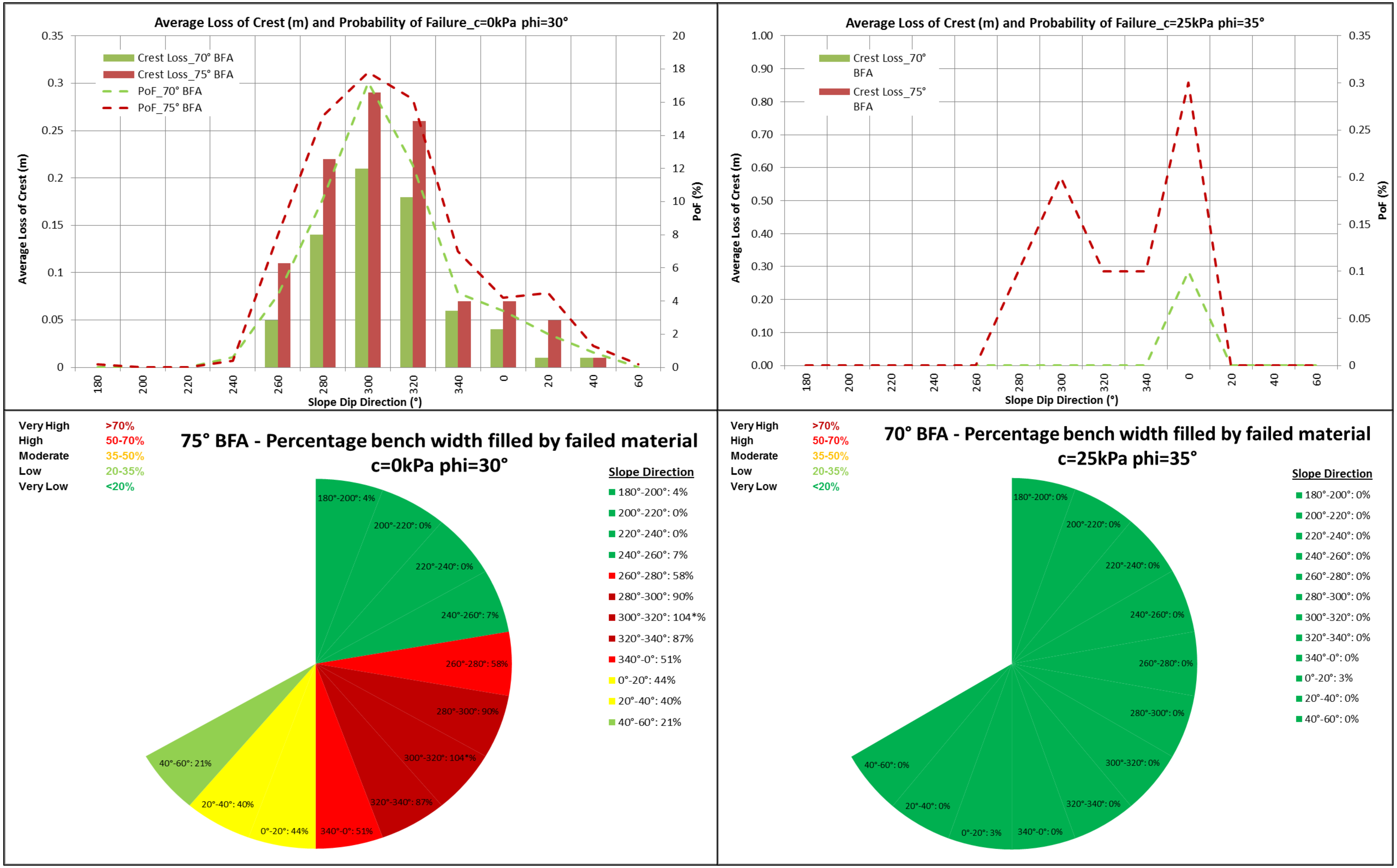


Figure 5-17: SBlock Analysis for Crest Loss, Probability of Failure and Berm Width for Changing Pit Face Direction

5.4 Rock Mass Analysis

5.4.1 Rock Mass Ratings

The main lithological domains that will influence the performance of the open pit are the TMS, MS/QMS, PEG, RZ and AMP. Each unit has been characterised with respect to Bieniawski's (RMR^{89})[1] and Hoek's Geological Strength Index (GSI^{13})[2]. The RMR^{89} requires the quantitative and qualitative evaluation of a number of geotechnical parameters that will control the engineering behaviour of the rock mass. These are:

- Intact rock strength (Rating Range: 0 – 15);
- Rock Quality Designation ("RQD") (Rating Range: 0 – 20);
- Joint spacing (Rating Range: 0 -20);
- Joint condition in terms of persistence, aperture, infill, roughness and weathering (Rating Range: 0 – 30); and
- Ground water condition (Rating Range: 0 – 15).

Each of these parameters is assigned a rating in the range given above and the sum of these parametric ratings is the RMR for the rock mass. This value will lie in the range 0 to 100. An RMR of 0 characterises a very poor rock mass, whilst an RMR of 100 characterises a very good rock mass. The GSI value is calculated through the RMR^{89} components of RQD which is divided by a constant (2) and joint condition parameters multiplied by a constant (1.5).

Rock Mass Rating values for the slightly weathered and fresh rock core of the 10 geotechnical boreholes were calculated. Moderately to completely weathered materials are considered to be soft rock or soil for which RMR values cannot be applied.

Previous studies have indicated the RMR values from mapping as those shown in Table 5-10 which were be compared with the geotechnical borehole logging. The relationships between the different photographed logged and field data parameters obtained during the June 2015 site visit can be seen in Table 5-11 and summarised graphically in Figure 5-18 and Figure 5-19.

These results show a relationship between depth and RMR^{89}/GSI^{13}; above 50 m depth values range between 30 to 50 from >50 m depth the values improve with average values above 50 which will form an additional domain for numerical modelling.

Table 5-10: Historical RMR Values from Mapping

Geotechnical Domain	RMR
MS	50
AMPH	65
TMS	65
PEG	65
RZ	30

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[1] *Bieniawski, Z. T. 1989.* Engineering rock mass classifications: a complete manual for engineers and geologists in mining, civil, and petroleum engineering*. Wiley-Interscience. pp. 40–47*

[2] *Hoek, E., Carter, T.G. and Diederichs, M.S. 2013. Quantification of the Geological Strength Index Chart. 47th US Rock Mechanics / Geomechanics Symposium, San Francisco, CA, USA.*

Table 5-11: Geotechnical Logging Parameters

Lithology	Interval length (m)	Average Strength (MPa)	Average RMR^{89} Strength Rating	Average RQD (%)	Average RMR^{89} Spacing Rating	Average RMR^{89} Persistence Value	Average RMR^{89} Roughness Value	Average RMR^{89} Aperture Value	Average RMR^{89} Infill Strength Value	Average RMR^{89} Joint Weathering Value	Average RMR^{89}	StDev RMR^{89}	Average GSI^{13}	StDev GSI^{13}
AMPH														
FR	178.06	71.2	7.0	95.8	8.7	4.0	2.5	2.2	5.9	5.8	70.1	3.8	69.7	4.3
SW	14.54	54.0	5.5	95.5	9.7	4.0	2.0	3.0	6.0	5.5	69.0	1.1	71.0	2.8
MS														
FR	228.97	69.0	6.8	91.3	9.0	4.0	2.4	2.5	5.8	5.8	68.7	6.2	69.1	6.7
SW	370.98	47.8	4.9	72.5	8.2	4.0	2.5	1.0	3.9	4.6	57.0	6.3	58.4	9.7
PEG														
FR	79.23	71.8	7.0	98.9	6.2	4.0	4.2	1.6	5.7	5.7	68.3	9.6	64.5	12.1
SW	48.07	48.1	5.0	55.6	6.0	4.0	4.6	1.2	4.5	4.7	54.8	10.9	50.6	17.5
RZ														
FR	8.8	63.4	6.3	92.7	8.0	4.0	3.8	1.3	6.0	5.6	61.3	9.7	57.7	17.6
TMS														
FR	65.9	61.0	6.1	85.1	9.7	4.0	3.7	1.4	6.0	5.8	67.9	8.2	66.9	8.6
SW	3.15	15.0	2.2	63.0	7.8	4.0	3.0	1.0	6.0	5.0	54.6		61.0	

FR = Fresh

SW = Slightly Weathered

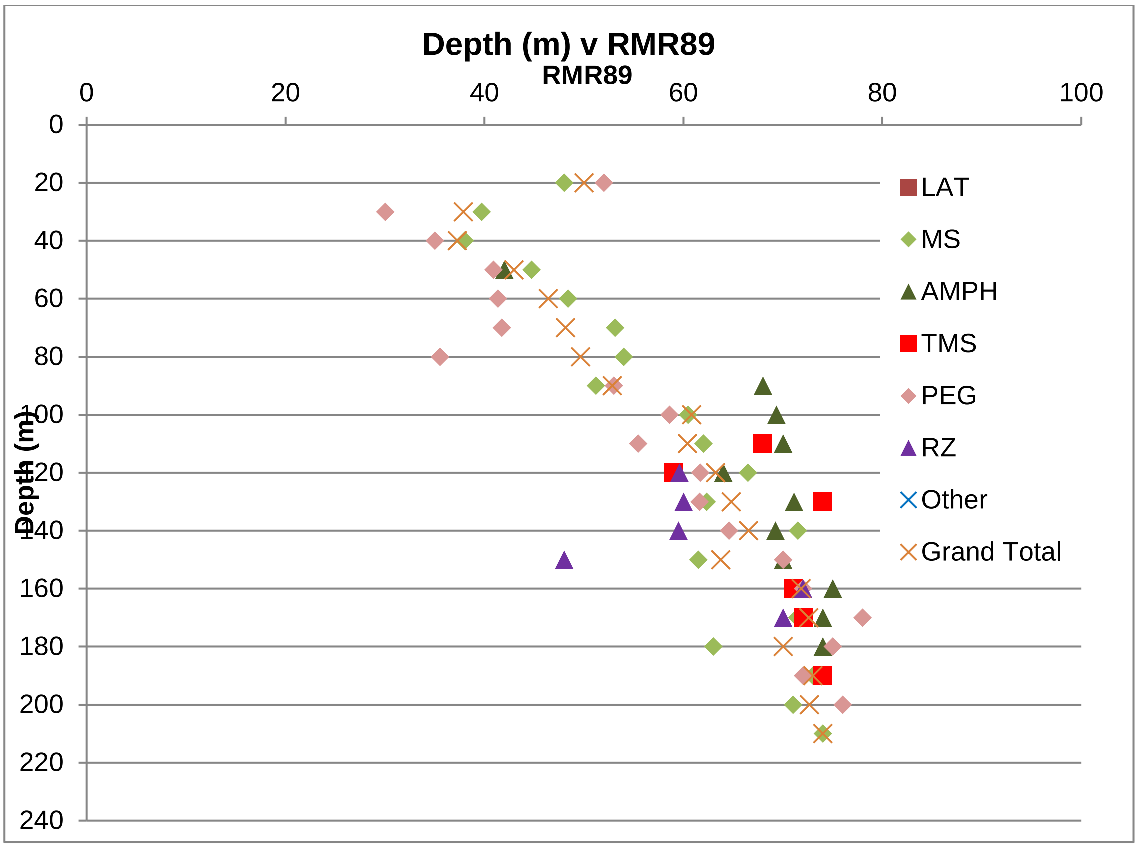


Figure 5-18: RMR^{89} v Depth (m)

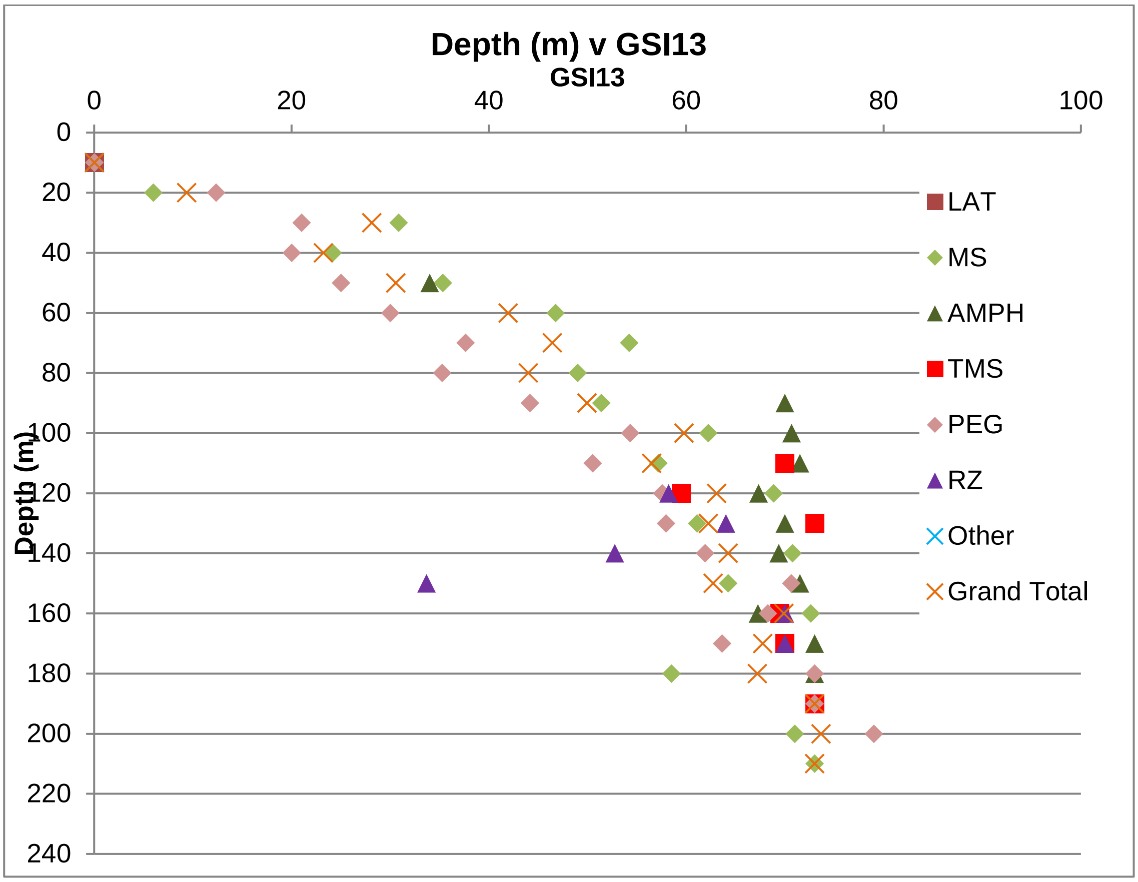


Figure 5-19: GSI13 v Depth (m)

5.4.2 Finite Element Modelling

Finite element modelling ("FEM") was undertaken to understand the rock mass instability mechanisms for the Chama Pit at Kagem. The photograph logging, field assessments, lithological domaining and laboratory testing data were collated along with literature and engineering experience to compile a table of modelling parameters, as shown in Table 5-12.

Characteristic GSI values for numerical modelling were based on the rock mass classification values shown in Table 5-11, but utilising a 1 standard deviation value below the mean value with an upper boundary of 50. These values are lower than previous assessment of the rock mass (Table 5-10) for initial conservatism in approach prior to slope sensitivity analysis and potential optimisation.

Numerical modelling was undertaken using the RocScience programme PHASE^2 using a Generalised Hoek-Brown constitutive model for the rock mass, with a "D" factor of 0.7, and a Mohr-Coulomb constitutive model for the soil/weathered materials. Note that the D factor or disturbance factor is used in the Hoek-Brown criterion to account for degradation in the rock mass due to excavation, stress release and weathering processes.

Four cross sections were cut through the geotechnical model, as shown in Figure 5-20, with Cross Section 4 illustrating the detail of the model construction.

Sensitivity analyses were undertaken by varying the input parameters, which were:

- change in the average UCS and GSI value by ±1 standard deviation to provide a probability of failure ("P(f)") calculated using the bivariate point estimate method;
- slope angles were varied between the current final Pushback 5 which is designed at an overall angle of 60° overall slope angle ("OSA") decreasing to 46° for potential closure slopes; and
- two phreatic surfaces, 6 m and 40 m from the face, were modelled on Cross Section 4 for two additional 100, 200 and 400 m pushbacks.

Table 5-12: Numerical Modelling Input Parameters

Domain	Constitutive Model	UCS MPa	UCS St Dev	GSI	GSI St Dev	Mi (from RocScience)	Young Modulus (Tangent) GPa	Poisson's Ratio (Tangent)	YM/PR Source
MS <50m	Gen. Hoek-Brown	45	7	35	10	26	20.15	0.198	Estimated
MS >50m	Gen. Hoek-Brown	72	11	50	10	26	20.15	0.198	Estimated
AMPH	Gen. Hoek-Brown	72	11	50	10	26	20.15	0.319	Estimated
TMS	Gen. Hoek-Brown	84	13	50	10	26	44.5	0.198	Lab Testing
RZ	Gen. Hoek-Brown	32	5	40	10	7	13.8	0.198	Lab Testing
SOIL	Mohr-Coulomb	C = 50kPa, φ = 35							
DUMP	Mohr-Coulomb	C = 0kPa, φ = 40							

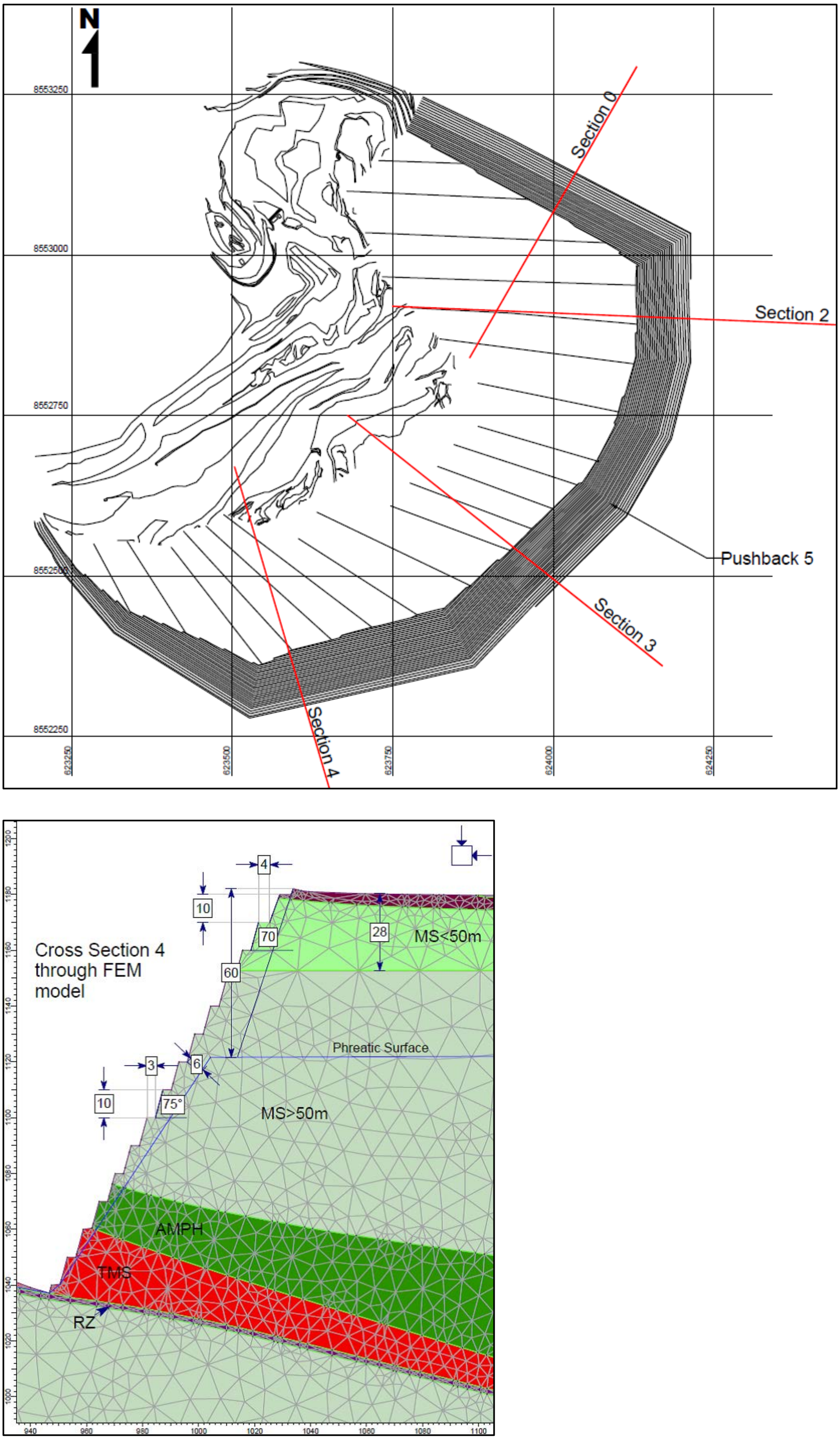


Figure 5-20: FEM Sections through Geotechnical Model

The results of the analyses are summarised and discussed below. Modelling output is presented in Appendix F.

For assessing slope stability, a number of criteria have been published, based on FoS and P(f). For the purpose of this study, the CP has chosen the following criteria to define stable slopes:

- Operating Slopes: FoS > 1.3 P(f) < 15%; and
- Closure Slopes: FoS >1.5 P(f) < 8%.

Table 5-13 presents the results of the FEM analyses of Pushback 5 which has been designed with a 60° overall slope angle to a maximum vertical height of around 150 m. As discussed in Section 5.2.11 a phreatic surface has been inserted into the model 60 m below ground surface at a distance of about 6m back from the slope face as shown in Figure 5-20. This phreatic surface has been estimated from observations of seepage on the slope face and on the pit floor.

Table 5-13: FEM Results Pushback 5

Section	Slope Height (m)	Slope Angle (°)	FoS	P(f)	Phreatic surface
Section 0	115	60	1.74	7%	6m
Section 2	130	60	1.13	29%	6m
Section 3	147	60	1.06	33%	6m
Section 4	144	60	1.12	29%	6m

The results indicate that whilst all of the slope cross sections analysed are stable, only the northern and southern slope profiles which form the flanks of the pit highwall meet the defined stability criteria for both FoS and P(f). The slope cross sections that form the main eastern highwall do not meet the stability criteria and, based on these results, the CP considers that the Pushback 5 design may be slightly too steep if the overall slope angle of 58° is achieved. This is discussed further in Section 5-5.

One of the main requirements of this study is to determine the ultimate pit footprint. Due to the dipping nature of the orebody as the pit is extended, particularly to the east and south, the vertical height of the highwall increases. As the vertical slope height is increased, it will be necessary to reduce the overall slope angle to maintain adequate slope stability. In order to determine the relationship between stable slope angle and vertical slope height, a number of additional analyses have been run on Cross Sections 3 and 4 where the TMS dips at 15°, by creating slopes located up to 400 m beyond the current Pushback 5 slope. (Note that the TMS is horizontal along Cross Sections 0 and 2.)

The results of these analyses are presented in Table 5-14 and show that:

- slopes cut at 60° are potentially unstable above a vertical height of 180 m;
- slopes lower than 180 m would need to be mined at between 55° and 60° to meet the stability criteria
- slopes between 180 m and 200 m would need to be mined at between 50° and 55° to meet the stability criteria; and
- slopes over 200 m would need to be mined at between 45° and 50° to meet the stability criteria.

Table 5-14: FEM Results Ultimate Pit Slopes

Section	Slope Height (m)	Slope Angle (°)	FoS	P(f)	Water surface
Section 3 – 100 m pushback	165	60	1.37	28%	6m
	165	55	1.39	17%	6m
Section 3 – 200 m pushback	190	60	0.85	66%	6m
	190	55	1.33	33%	6m
	190	50	1.39	12%	6m
Section 4 – 200 m pushback	184	60	1.08	53%	6m
	184	55	1.13	42%	6m
	184	50	1.63	3%	6m
Section 4 – 400 m pushback	220	60	0.61	80%	6m
	220	50	1.51	19%	6m
	220	45	1.84	4%	6m

Given that the groundwater location behind the slope is uncertain the assumed groundwater table was adjusted on the Cross Section 4 from 6 m behind the face, based on seepage observations, to 40 m behind the face. The results, which are presented in Table 5-15, indicate significant sensitivity of groundwater location to slope stability with improvements in FoS of from 11% to over 100%.

Table 5-15: FEM Results Groundwater Sensitivity Analysis

Section	Slope Height (m)	Slope Angle (°)	Water surface	FoS	P(f)	FoS Improvement
Section 4 – Pushback 5	144	60	6m	1.12	29%	53%
			40m	1.71	1%	
Section 4 – 200 m pushback	184	60	6m	1.08	53%	36%
			40m	1.47	1%	
Section 4 – 400 m pushback	220	60	6m	0.61	80%	126%
			40m	1.38	7%	
Section 4 – 400 m pushback	220	50	6m	1.51	19%	11%
			40m	1.67	1%	

5.5 Geotechnical Slope Design Criteria

5.5.1 Operational Design Criteria

The Chama pit stability analysis indicates that the stability of the slope is governed by the rock mass conditions rather than structural conditions. Although no major structures that could give rise to major slope instability were noted during the 2015 site visit, the potential for a large scale ramp or overall slope instability on unknown structures cannot be discounted.

For an operating slope, the normally accepted design criteria are FoS >1.3 and P(f) <15%. Stability analyses carried out on cross sections through the Pushback 5 slope configuration yield a minimum FoS of 1.1 and a P(f) of greater than 20%. The Pushback 5 design is therefore considered to require modification to ensure that design criteria are met.

When considering an optimised pit that extends further to the east than the current pit limit the dip of the TMS results in progressively higher pit walls which according to the results of the analyses requires the overall pit slope angle to be reduced. The stability analysis results shown in Tables 5-13 and 5-14 have therefore been synthesised to develop a slope angle : slope height design chart that can be used for pit optimisation and detailed engineering design. This is shown in Figure 5-21. The modelling carried out indicated that the Pushback 5 design slope, at an overall height of 150 m and overall angle of 58°, is slightly steeper than the design recommendation. However the achieved angles of the interim slopes are generally slightly flatter than designed, particularly when incorporating the hangingwall ramp and therefore conform to the design recommendation.

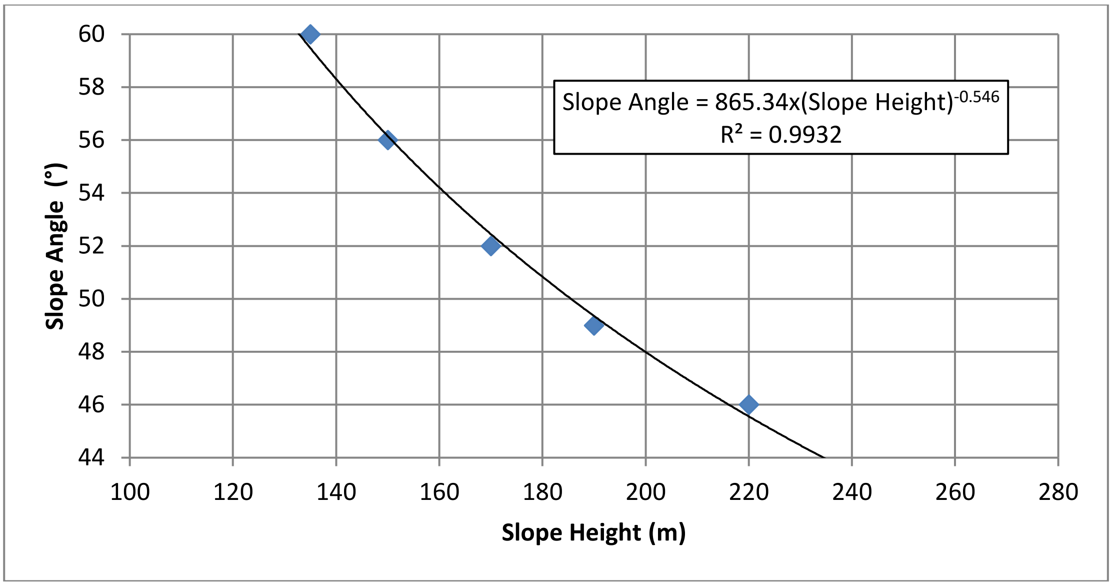
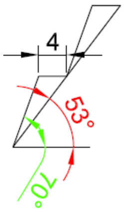
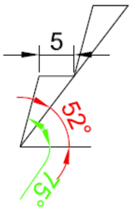
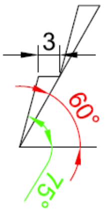
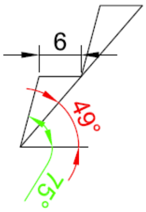
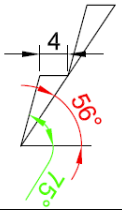
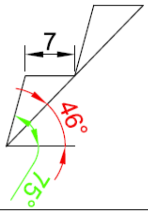


Figure 5-21: Inter-Ramp Slope Design Chart for FoS >1.3

Based on this chart the limiting slope angles are 60° for vertical slope heights of 130 m or lower and 46° for vertical slope heights of 220 m or higher. Between these limiting heights the graph or equation may be used to estimate slope angles for specific vertical slope heights.

The kinematic analyses have indicated that the berm width of 3 m currently being used for pit design is appropriate for the prevailing rock mass discontinuity conditions; however, because the stability of the slopes has been shown to be controlled by the rock mass rather than structure there will be a requirement to adjust the berm width to allow the slope angle to conform to the design slope angle requirement presented in Figure 5-21.

It will be difficult to design and mine a pit with continually varying slope angles so from a pragmatic and operational point of view bench : berm configurations have been developed for different slope height ranges based on the design chart. These are presented in Figure 5-22.

Weathered Rock Mass Inter Ramp Angle 53°		Fresh Rock Mass Slope Height 160m to 180m Inter Ramp Angle 52°	
Fresh Rock Mass Slope Height 130m to 140m Inter Ramp Angle 60°		Fresh Rock Mass Slope Height 180m to 200m Inter Ramp Angle 49°	
Fresh Rock Mass Slope Height 140m to 160m Inter Ramp Angle 56°		Fresh Rock Mass Slope Height > 200m and closure slopes at any height Inter Ramp Angle 46°	

Note: Bench height is 10 m

Figure 5-22: Bench Berm Configurations

The current pit design configuration has the weathered rock mass forming the top 30 m of the pit slope cut at 53°. This comprises a 10 m high bench cut at an angle of 70° with a berm width of 4 m. For the fresh rock slopes, which comprise 10 m high benches cut at a 75°, the berm width is increased by 1 m for every 20 m increase in vertical slope height, starting with a 3 m wide berm for a slope height in the range 130 m to 140 m and increasing to a 7 m wide berm for a slope height in excess of 200 m as shown in Figure 3-22. Note that when the slope height reaches and exceeds 160 m, the weathered rock mass slope should be cut at the same angle as the fresh rock slopes.

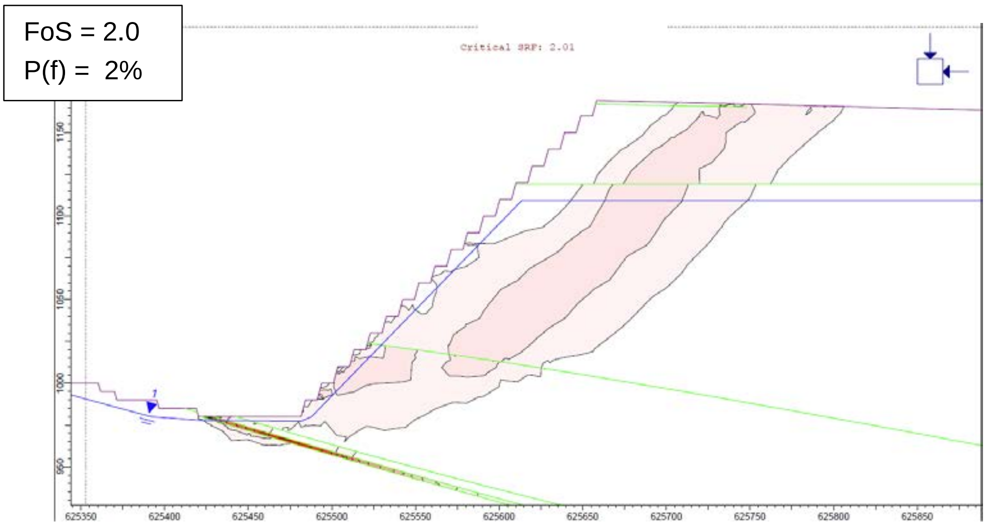
5.5.2 Closure Design Criteria

For the purpose of closure, the normally accepted design criteria are FoS >1.6 and P(f) <8%. A normal requirement for closure is to be able to access all benches for the purpose of rehabilitation. In relation to this requirement an inter-ramp slope angle for closure of 46°, comprising 7 m wide catch berms, is suggested, as shown in the bottom right hand cell of Figure 5-22.

5.6 Slope Verification Analyses

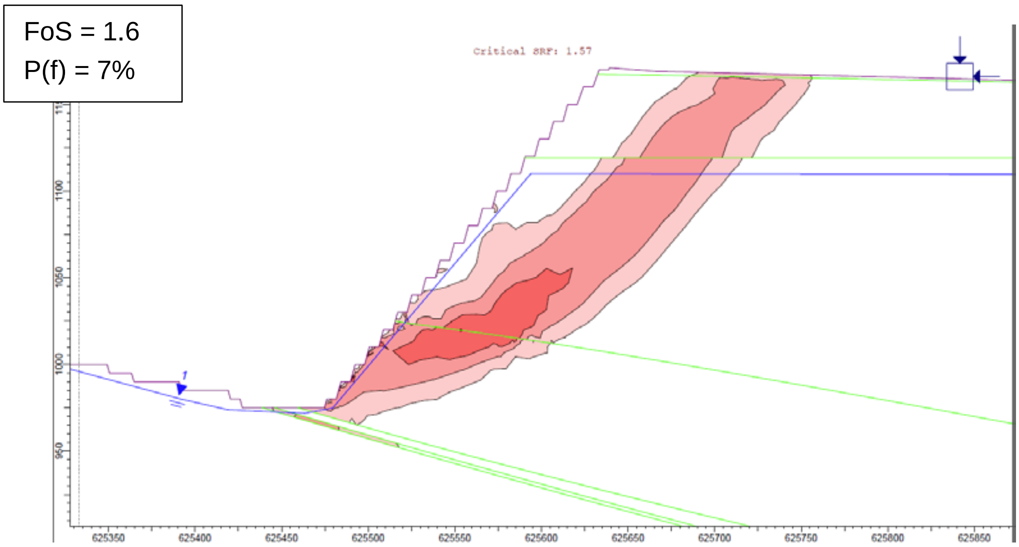
The approach used for the pit optimisation analysis was to determine the maximum economic open pit footprint based on the suggested overall closure slope angle of 46°. Once the optimised pit shell had been identified sensitivity analyses were carried out with respect to overall slope angle by increasing the overall angle from 46° to 50°. The results showed that the pit footprint was not sensitive to overall slope angle. On completion of the optimisation and sensitivity analyses an optimised engineered pit design was prepared. A finite element model was created through the highest part of the pit wall which was located in the south east sector of the pit. The pit slope height at this location is between 190 m and 195 m. The results of the verification analyses are presented in Figure 5-23.

Original Design – 46° Overall Slope Angle



FoS = 2.0
P(f) = 2%

Updated Design – 51° Overall Slope Angle



FoS = 1.6
P(f) = 7%

Figure 5-23: Verification Analyses of Engineered Pit Design

It can be seen that the 46° overall slope angle design produces an FoS and P(f) that exceeds the slope design criteria for closure slopes (FoS 1.6, P(f) 8%). By increasing the slope angle to 51°, achieved by reducing the berm width from 7 m to 5.5 m, the FoS reduces to 1.6 and the P(f) becomes 7%.

Based on this analysis, the final engineered pit has been designed using a 51° overall slope angle for all pit slope sectors. From the current interpretation of geotechnical conditions at the Chama Pit, this slope angle should provide appropriate security against large scale rock mass controlled pit instability. Note also that should the inferred phreatic surface be located further into the rock mass than shown in the analysis, the FoS will be higher.

That said, however, there is always some uncertainty regarding slope stability and usually some form of slope stability monitoring is carried out to provide early warning of the onset of potential instability. Methods of slope monitoring are discussed in the following section.

5.7 Slope Management Recommendations

5.7.1 Slope Stability Monitoring

The current state-of-art practice for open pit slopes is moving towards reliance on slope management, in which the monitoring of slope performance is used as a basis for modification of designs as the slopes are excavated. Tools and techniques for slope monitoring and management are well developed. In the context of slope management, a definition of failure becomes a critical issue. Many live with moving slopes, with very little impact on the efficiency or economics of the operation. Alternatively, even a relatively small failure in the wrong location can have a very serious impact even on a large operation. Understanding the significance of potential failures is critical, particularly in large open pit mines.

One of the threats in open pit mining is the potential for gradual deformation of a large slope to develop into a fast moving slide. This is a relatively poorly understood process as there are no reliable documented case histories, but it has to be considered a potential threat where large deforming slopes occur in an open pit mine. Numerical modelling of slopes for possible combinations of structural and rock mass failure, and comparison of the results of these models with observations and measurements of actual slope behaviour, is currently the most appropriate approach to understanding these types of failure mechanisms.

A significant factor in mitigating the risks of deforming slopes and the risks associated with slope instability in any open pit mining operation is an appropriate monitoring system that provides both early warning of the onset of instability and the progress of movement once it has started. Early warning becomes critical as the slope height increases, since remedial measures can take longer to develop. As such, the system must include both surveillance and tracking functions for both large scale and local failures, with rapid response in the latter case. The rapid response in terms of providing data efficiently and quickly is a key factor in ensuring the safety of operating crews.

Of the numerous slope stability monitoring devices available, the CP suggests that Kagem considers the following:

1. Survey Monitoring (using the Leica system); and

2. Radar Monitoring (using Ground Probe SSR or a similar type system).

5.7.2 Survey Monitoring

Many open pits around the world rely on quantitative methods to augment visual inspections for detecting large scale movements. The definition of 'large scale' varies depending upon the pit and the importance of the slope (for example, above a critical ramp, below a major facility, etc.), but slope movement involving a face length of 100 m of more is generally considered to be serious.

A survey monitoring system relies on the establishment of a high level pit wide survey monitoring network of base stations, transfer stations and survey monitoring points. A high level survey monitoring network allows the determination of high quality qualitative displacement data for points located around the pit (Read and Stacey 2009). The capabilities of the available prism monitoring system enable accurate monitoring of slope displacements over large distances, which in a large open pit is critical. This capability has not been surpassed by any other proven cost effective alternative monitoring technology.

This approach is adopted in the majority of large open pit mining operations (Table 5-16). In some cases, the survey prisms monitoring system is fully automated and linked to a dispatch system. The establishment of an appropriate displacement trigger level for various slope areas allows the implementation of an automatic alarm system through a control tower.

Table 5-16: Example of Quantitative Monitoring System Currently in use at other Large Open Pit Mining Operations

Mine	System	Equipment	Robotic/Manual	Comments
Chuquicamata	Surveying Inclinometers	Leica	Robotic – 6 stations	Approximately 550 prisms
Escondida	Surveying	Leica	Robotic – 2 stations	
Highland Copper Valley	Surveying Inclinometers	Leica	Robotic – 2 stations in each pit	
Kumtor	Surveying and TDR Inclinometers	Leica	Robotic – 2 stations	
Barrick Goldstrike	Surveying	Leica	Robotic – 3 stations	
Nchanga	Surveying	Leica	Manual	Approximately 150 prisms

Note: Data collected by SRK in 2004

The Leica system is available in manual and automated options. The manual system would have a lower initial cost, but would require additional staff to collect the data. With the automated unit, initial cost would be higher, but operating cost over time would not be as high.

5.7.3 Radar Monitoring

Slope Stability Radar ("SSR") is considered a critical management tool in areas of potential slope movement below which mining is being undertaken. It has the significant advantage that it is capable of monitoring displacement of a whole slope rather than just the locations at which prisms would be installed. There are numerous advantages associated with SSR over other monitoring systems, which include:

- improved production optimisation;
- increased production in geotechnical risk areas;
- reduction of post blast production delays; and
- improved management of wet weather production risk.

The system is mobile and can be moved to suit the changing slope geometry as the Mine develops. It does not require any special surveying or site preparation. Geo-referencing of each radar location combined with the appropriate software allows real time displacement/stability monitoring to be achieved. The current maximum range is approximately 2800 m. As the system does not require the installation of reflectors or instrumentation within or on the slopes, there is no need for mine personnel to access potentially hazardous locations for installation and maintenance of critical slope monitoring equipment.

5.7.4 Summary and Recommendations for Slope Monitoring

It will be critical that the slope monitoring strategy adopted for enabling the management of a design approach based upon 'controlled instability' is able to function well over a range of potential failure types. The selected combination if techniques, both observational and qualitative, must be able to handle all variations and combinations of potential failure size and rate.

Based on the experience and current levels of knowledge, the suitability of each of the monitoring techniques for varying failure sizes and rates are summarised in Table 5-17. It is noted that all the qualitative data acquisition systems do not have the capability of detecting rapid, small-scale surficial failures. For the detection of larger volumes in all areas of the open pit, a widespread survey prism network is currently considered to be the proven technique. By augmenting this system with other techniques such as radar, the management of potential instability in the operating areas of the pit is expected to be substantially enhanced.

Table 5-17: Summary of Monitoring Methods by Potential Failure Size and Implication

Block Size (m^3)	Speed of failure	Implications	Monitoring for detection	Typical remedial
1-10	Immediate	Rockfall – safety	Visual	Catchment
10-1000	Very rapid to rapid	Safety	Visual Radar	Catchment
1000-100,000	Rapid to slow	Operational	Visual Surveying Radar Seismic (?)	Manage Modify slope (step-out)
100,000-1,000,000	Moderate to slow	Operational/financial	Surveying Radar TDR/inclinometer Seismic	Manage Modify slope (step-out) Re-cut
> 1,000,000	Slow to moderate	Force majeure	Surveying TDR/inclinometer Seismic Radar	Modify slope (re-cut) Mine closure (>10 Mn^3) Manage

Note: Bolding denotes most common approach for given block size

The CP recommends Kagem considers using a Leica based survey system for the main component of the monitoring programme. This could start out as a manual system, but could be converted to an automated system with a number of prisms installed on the pit slopes faces; the requirement and extent of which would depend on the predicted risk. In addition, an SSR based system for monitoring slope performance near active production areas would be invaluable as a real time warning system for any potential instability.

5.7.5 Additional Data Collection Recommendations

In addition to the use of a survey system or SSR, the following is also required ensure appropriate pit slope management:

Structural Data Collection and Materials Testing

Detailed structural and geological mapping using regular line mapping or a remote mapping system will be required as benches are continually excavated. Further material strength testing should also be undertaken as mining advances. This early information will be used to calibrate the proposed slope designs based on 3D exposure and the structures and the rock mass.

Televiewer Logging

In relation to structural data collection given that Kagem has an active drilling programme consideration should be given to the use of televiewer logging for the collection of accurate spatially orientated data from borehole core. Televiewer tools (both acoustic “ATV” and optical “OTV”) provide rapid and accurate high resolution oriented images of the borehole walls and are generally used as a replacement for manual core orientation techniques. The processed ATV/OTV image logs are compared against the drill core to identify any natural, open or weakly cemented structures such as joints or faults. Fractures in the core are logged as open, natural joints if these are also found in the televiewer log. This method ensures that only natural discontinuities are logged and any artificial mechanical breaks caused by the drilling and handling of core are omitted. This approach is of particular importance as the number of discontinuities reduces the rock mass strength. The determination of suitable slope angles is directly related to the rock mass strength hence accounting for artificial joints in the rock mass characterisation is likely to reduce slope angles.

Hydrogeological Investigation and Monitoring

Given the sensitivity of slopes to variation in groundwater level it is important to understand the groundwater conditions around the pit through a programme of hydrogeological investigation and monitoring. If it is shown that pit economics is sensitive to slope angle then there may be merit in investigating in more detail the hydrogeological conditions of the deposit with a view to developing a better understanding of the impact of groundwater on slope stability.

6 OPEN PIT MINING

6.1 Introduction

The following section includes discussion and comment on the mining engineering related aspects of the Mine. Accordingly, focus is in respect of the historical mining operations, open-pit optimisation analysis; mining methods; mine design, production scheduling, equipment selection, operating expenditure and capital expenditure.

Historical sales, production and cost information as presented in this section are sourced from Gemfields and Kagem; this information is reported to assess the validity of the various technical aspects which support the LoMp developed for Kagem as part of this CPR.

For developing the LoMp, Kagem has indicated its intention to ramp up open pit production at the Chama Pit from the current production rate of 110 ktpa ore to an increased throughput rate of 130 ktpa ore over a 3-year period. The principal strategic targets for Chama comprise mining a number of additional cutbacks up to a practical and economic open pit limit, to provide a significant mine life and improve the confidence in the mineralisation along strike of the orebody in lower strip ratio zones.

A key issue facing the operation in recent years has been the increasing stripping ratio in the open pit. As part of the CPR, the CP's objectives have been to determine the viability of continuing the open pit operations and determine an appropriate life of mine plan for the Chama mine.

In addition, Kagem has indicated intention to expand the current Fibolele bulk sampling pit to a production rate of 30 ktpa ore, which will be included as ore feed to the Kagem Mine wash plant. This production will focus on the Indicated region of the deposit, whilst additional exploration is completed on the deeper parts. The Fibolele strategy has changed from straight production from year 1, to intermittent mining to supplement shortfalls in production from the Chama pit.

The CP notes that in 2012, an underground feasibility study was completed which supported the transition to an underground mine. Since that time policy decisions have been made to continue with the open pit operation.

6.2 Historical Mining Operating Statistics

6.2.1 Historic Production Statistics

Kagem has provided the historic mining production and processing physicals from July 2008 to December 2017 on a quarterly basis. Table 6-1 presents the historic open pit and underground total material movement, RoM ore tonnage from the Mine, sort house physicals, recovered gemstones and RZ grade.

The CP notes that there is a 289 kg (0.25 %) discrepancy between the RoM tonnages from the Chama Pit physicals and the sort house physicals, which is a large improvement over the discrepancy noted in the 2015 CPR. The CP does not consider the current discrepancy as a significant reconciliation issue for the CPR.

Table 6-1, Table 6-2 and Figure 6-1 shows the historic total material movements, RZ tonnage and grade, and open pit and underground RoM processing. Figure 6-2 shows the historic recovered gemstones for the open pit and underground mine, the proportion of recovered gemstones by product type, and a summary of the total recovered gemstones from the Chama Pit. The CP notes the periods are reported on Kagem's financial year, running from July through to June of each year. The key findings from the historic production data are summarised below and in Table 6-1:

- total of 45.4 Mt of rock has been mined from Chama (open pit and underground), at an average strip ratio of 80 to 1 (waste t :ore t;
- 560 kt of RZ has been mined from Q1 2008 to Q2 2015 at an average of 20 kt per quarter (minimum 10 kt per quarter, maximum 41 kt per quarter);
- the weighted mean grade of the RZ mined since Q1 2008 is 322 c/t (considering only premium emerald, emerald and beryl);

- when considering the historic production data from Q1 2008 to date, the rolling mean grade of the RZ ore has been gradually decreasing;
- the product types recovered from the ore are relatively consistent, and the following general trends can be noted:
  - a slight decrease in the proportion of recovered premium emeralds since Q1 2008, with the proportion remaining relatively stable from 2012 to date, at approximately 0.5% of total product;
  - a general increase in the proportion of recovered emerald can be seen since Q1 2010, and has remained relatively stable from 2012 to date, at approximately 28% of total product; and
  - the proportions of recovered beryl-1 and beryl-2 have remained relatively stable from 2012 to date, at approximately 41% and 30% respectively.
- Total recovered products since Q1 2008 of 466 kg premium emerald, 8,611 kg emerald, 17,166 kg beryl-1 and 9,882 kg of beryl-2.

Table 6-1: Kagem Historic Mining Production and Processing Physicals (2008 – 2012)

		Period	2008				2009				2010				2011				2012			
	Units	Total	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Chama Pit Mining Physicals																						
Total Material Movement	(kt)	**70,879**	1,758	1,016	783	519	540	668	646	733	843	725	663	1,254	1,995	2,024	1,611	2,771	2,527	2,065	2,169	2,425
Reaction Zone Ore	(kt)	**834**	21	19	18	22	16	13	13	19	19	14	10	21	23	15	21	41	29	16	19	20
Waste TMS	(kt)	**7,612**	299	236	78	113	164	117	131	174	145	122	120	96	78	42	146	268	202	219	281	277
Waste Non TMS	(kt)	**62,433**	1,437	761	687	384	360	538	502	540	679	589	533	1,137	1,895	1,967	1,444	2,463	2,296	1,830	1,869	2,127
Strip Ratio	$(t_{waste}:t_{ore})$	**84**	81	53	43	22	33	49	49	38	43	51	64	59	86	130	77	67	86	131	111	119
Total ROM Ore	(kg)	**275,128**	8,919	5,699	8,440	6,911	5,602	6,900	5,053	6,903	12,648	5,475	3,100	9,053	5,795	4,195	4,839	6,814	8,011	6,816	6,709	10,542
Washing Plant ROM	(kg)	**155,003**	3,303	2,171	3,456	3,381	2,885	3,157	2,490	3,177	5,567	3,570	1,566	5,121	4,173	2,778	2,183	3,747	5,342	4,749	4,158	5,130
Pit ROM	(kg)	**120,125**	5,616	3,529	4,984	3,530	2,717	3,743	2,564	3,726	7,081	1,905	1,534	3,932	1,621	1,417	2,656	3,067	2,669	2,067	2,551	5,413
Sort House Physicals																						
Processing of Open Pit ROM Ore																						
ROM Tonnage	(kg)	**119,836**	5,616	3,529	4,984	3,530	2,717	3,743	2,550	3,586	7,061	1,904	1,487	3,931	1,621	1,399	2,628	3,047	2,669	2,067	2,551	5,413
Total Recovered Gemstones	(kg)	**27,444**	1,369	707	1,862	711	494	879	460	932	2,066	673	390	1,128	356	319	653	866	722	599	658	1,077
Premium Emerald	(kg)	**297**	41	14	19	11	5	8	4	12	71	8	7	20	6	1	11	3	6	5	7	1
Emerald	(kg)	**6,139**	408	146	131	59	34	105	62	109	456	155	115	248	57	61	182	173	169	189	156	297
Beryl-I	(kg)	**10,533**	761	535	693	541	199	397	232	286	758	203	115	436	150	136	206	359	290	235	284	403
Beryl-II	(kg)	**6,258**	158	13	1,020	101	51	89	77	276	248	94	80	278	104	78	149	230	180	108	143	232
Specimen	(kg)	**664**					70	86	0	81	226	123	4	28	0		25					16
Fines	(kg)	**3,553**					135	195	84	167	308	90	70	117	37	42	79	100	77	61	69	127
WIP	(kg)																					
PE + Em + Be	(kg)	**23,227**	1,369	707	1,862	711	289	598	375	684	1,533	460	317	982	318	276	548	766	644	538	590	934
Gemstone Yeld	(%)	**23**	24	20	37	20	18	23	18	26	29	35	26	29	22	23	25	28	27	29	26	20
Total Recovered Products (Open Pit + Underground)																						
PE + Em	(carat)	**62,315,080**	3,227,610	1,215,980	1,227,485	746,200	405,126	827,759	553,282	1,095,254	4,016,313	1,873,161	1,180,376	2,241,303	808,681	914,078	1,645,765	1,761,145	2,159,305	2,011,355	1,610,055	2,517,635
PE + Em	(kg)	**12,463**	646	243	245	149	81	166	111	219	803	375	236	448	162	183	329	352	432	402	322	504
PE + Em + Be	(carat)	**238,662,425**	10,193,670	5,401,545	12,410,070	6,492,075	2,901,902	4,920,157	3,448,243	5,957,101	12,826,535	5,925,925	3,399,278	10,799,216	4,896,210	3,844,838	4,906,855	7,338,245	7,898,895	6,561,350	6,186,305	8,577,760
PE + Em + Be	(kg)	**47,732**	2,039	1,080	2,482	1,298	580	984	690	1,191	2,565	1,185	680	2,160	979	769	981	1,468	1,580	1,312	1,237	1,716
% PE + Em	(%)	**26**	32	23	10	11	14	17	16	18	31	32	35	21	17	24	34	24	27	31	26	29
Reaction Zone Mean Grade	(C/t)	**286**	475	289	696	291	182	365	269	315	671	421	334	517	215	249	237	181	272	420	319	424
Forward Rolling Mean Grade	(C/t)		321	315	316	302	303	307	305	306	306	289	284	283	269	273	274	277	291	294	285	282
Rolling Mean Grade	(C/t)		475	389	483	430	389	386	374	366	402	404	400	412	392	383	372	346	340	343	342	346
2008 Q3 - 2011 Q2	(C/t)		475	289	696	291	182	365	269	315	671	421	334	517								
2011 Q3 - 2015 Q2	(C/t)														215	249	237	181	272	420	319	424
Product Proportions																						
Total Recovered Product (PE + E + BE1 + BE2)	(%)	**100**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Premium Emerald	(%)	**1.1**	2.9	2.1	1.3	1.7	1.7	1.4	1.3	1.7	3.8	1.7	1.8	1.4	1.4	0.3	1.9	0.5	0.6	0.6	0.9	0.2
Emerald	(%)	**25.1**	28.8	20.4	8.6	9.8	12.3	15.4	14.8	16.7	27.5	29.9	32.9	19.3	15.2	23.4	31.6	23.5	26.7	30.0	25.1	29.2
Beryl-I	(%)	**45.4**	60.5	76.3	49.0	80.8	64.2	65.7	61.0	40.0	48.5	44.3	39.8	41.2	46.2	46.3	38.6	44.2	44.3	45.0	46.6	42.4
Beryl-II	(%)	**28.5**	7.8	1.2	41.1	7.7	21.8	17.5	23.0	41.6	20.2	24.1	25.5	38.0	37.3	29.9	27.8	31.8	28.4	24.4	27.3	28.3

Note: The results are reported for the financial years that start in July. Therefore, for example, calendar year 2017 is reported as Q3 and Q4 2016, and Q1 and Q2 2017.

Table 6-2: Kagem Historic Mining Production and Processing Physicals (2013 – 2017)

		Period	2013				2014				2015				2016				2017			
	Units	Total	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Chama Pit Mining Physicals																						
Total Material Movement	(kt)	**70,879**	1,874	1,732	852	2,369	2,686	3,208	3,205	2,756	3,125	2,071	2,160	2,539	2,511	2,270	1,809	3,107	2,645	2,225		
Reaction Zone Ore	(kt)	**834**	20	16	16	21	26	22	25	34	26	23	20	28	26	22	16	27	31	46		
Waste TMS	(kt)	**7,612**	146	183	134	190	171	193	214	154	181	306	197	295	327	320	317	397	344	234		
Waste Non TMS	(kt)	**62,433**	1,708	1,533	702	2,157	2,489	2,992	2,966	2,568	2,918	1,742	1,943	2,216	2,158	1,928	1,476	2,683	2,270	1,945		
Strip Ratio	(t_{waste}:t_{ore})	**84**	95	106	52	110	104	142	127	79	121	89	110	91	94	104	111	114	85	47		
Total ROM Ore	(kg)	**275,128**	6,916	4,388	4,770	7,968	7,469	6,442	15,008	10,192	7,897	7,880	9,100	8,230	7,411	5,512	5,387	5,255	5,801	11,080		
Washing Plant ROM	(kg)	**155,003**	4,239	2,976	3,646	5,795	5,123	3,466	5,018	6,341	5,999	4,926	4,323	4,470	3,374	4,419	3,927	3,871	4,006	6,979		
Pit ROM	(kg)	**120,125**	2,677	1,412	1,124	2,174	2,346	2,975	9,990	3,851	1,897	2,954	4,777	3,760	4,037	1,094	1,460	1,384	1,796	4,101		
Sort House Physicals																						
Processing of Open Pit ROM Ore																						
ROM Tonnage	(kg)	**119,836**	2,677	1,412	1,124	2,174	2,346	2,975	9,990	3,851	1,897	2,954	4,777	3,760	4,037	1,094	1,460	1,384	1,796	4,101		
Total Recovered Gemstones	(kg)	**27,444**	794	430	224	489	493	480	1,538	771	425	633	858	801	754	186	252	248	311	837		
Premium Emerald	(kg)	**297**	8	1	1	2	1	0	5	4	0	5	3	1	1	0	0	0	2	3		
Emerald	(kg)	**6,139**	329	142	69	157	97	53	287	218	90	176	309	303	153	37	70	59	68	208		
Beryl-I	(kg)	**10,533**	172	113	78	174	107	99	559	258	144	246	270	235	256	65	94	84	90	270		
Beryl-II	(kg)	**6,258**	84	50	50	84	213	246	376	188	133	134	95	126	200	64	50	79	111	266		
Specimen	(kg)	**664**						1		1					2							
Fines	(kg)	**3,553**	201	123	28	73	75	80	310	102	57	72	181	135	143	20	38	26	41	90		
WIP	(kg)																					
PE + Em + Be	(kg)	**23,227**	593	307	197	416	418	399	1,227	668	368	562	677	666	610	166	214	222	270	747		
Gemstone Yeld	(%)	**23**	30	30	20	22	21	16	15	20	22	21	18	21	19	17	17	18	17	20		
Total Recovered Products (Open Pit + Underground)																						
PE + Em	(carat)	**62,315,080**	2,400,060	1,362,565	963,135	2,108,637	1,344,240	871,635	2,444,470	2,510,775	1,921,195	1,981,690	2,611,835	2,460,595	1,339,580	945,390	1,031,470	876,290	961,285	2,142,365		
PE + Em	(kg)	**12,463**	480	273	193	422	269	174	489	502	384	396	522	492	268	189	206	175	192	428		
PE + Em + Be	(carat)	**238,662,425**	6,416,980	3,853,632	3,514,050	6,253,889	5,578,465	4,458,225	9,689,360	8,119,725	6,870,680	6,515,655	6,790,160	6,907,945	5,610,340	4,181,070	3,800,940	3,441,095	3,782,075	7,991,965		
PE + Em + Be	(kg)	**47,732**	1,283	771	703	1,251	1,116	892	1,938	1,624	1,374	1,303	1,358	1,382	1,122	836	760	688	756	1,598		
% PE + Em	(%)	**26**	37	35	27	34	24	20	25	31	28	30	38	36	24	23	27	25	25	27		
Reaction Zone Mean Grade	(C/t)	**286**	328	239	219	293	219	199	388	237	269	284	348	251	212	193	236	127	123	173		
Forward Rolling Mean Grade	(C/t)		266	258	260	265	260	273	301	237	250	260	277	271	261	253	251	236	222	215		
Rolling Mean Grade	(C/t)		345	341	337	335	329	323	326	321	318	317	318	315	311	308	306	300	293	286		
2008 Q3 - 2011 Q2	(C/t)																					
2011 Q3 - 2015 Q2	(C/t)		328	239	219	293	219	199	388	237	269	284	348	251	212	193	236	127	123	173		
Product Proportions																						
Total Recovered Product (PE + E + BE1 + BE2)	(%)	**100**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
Premium Emerald	(%)	**1.1**	0.8	0.4	0.2	0.4	0.3	0.2	0.6	0.5	0.3	0.7	0.5	0.2	0.2	0.1	0.1	0.3	0.5	0.4		
Emerald	(%)	**25.1**	36.6	35.0	27.2	33.3	23.8	19.4	24.7	30.4	27.7	29.7	38.0	35.4	23.7	22.5	27.0	25.1	24.9	26.4		
Beryl-I	(%)	**45.4**	36.3	40.4	36.7	42.5	34.4	32.2	44.0	40.1	39.7	41.0	39.9	38.4	41.3	38.4	41.4	37.6	34.4	34.8		
Beryl-II	(%)	**28.5**	26.3	24.2	35.9	23.7	41.5	48.2	30.8	29.0	32.3	28.6	21.7	26.0	34.8	39.0	31.4	36.9	40.2	38.4		

Note: The results are reported for the financial years that start in July. Therefore, calendar year 2017 is reported as Q3 and Q4 2016, and Q1 and Q2 2017.

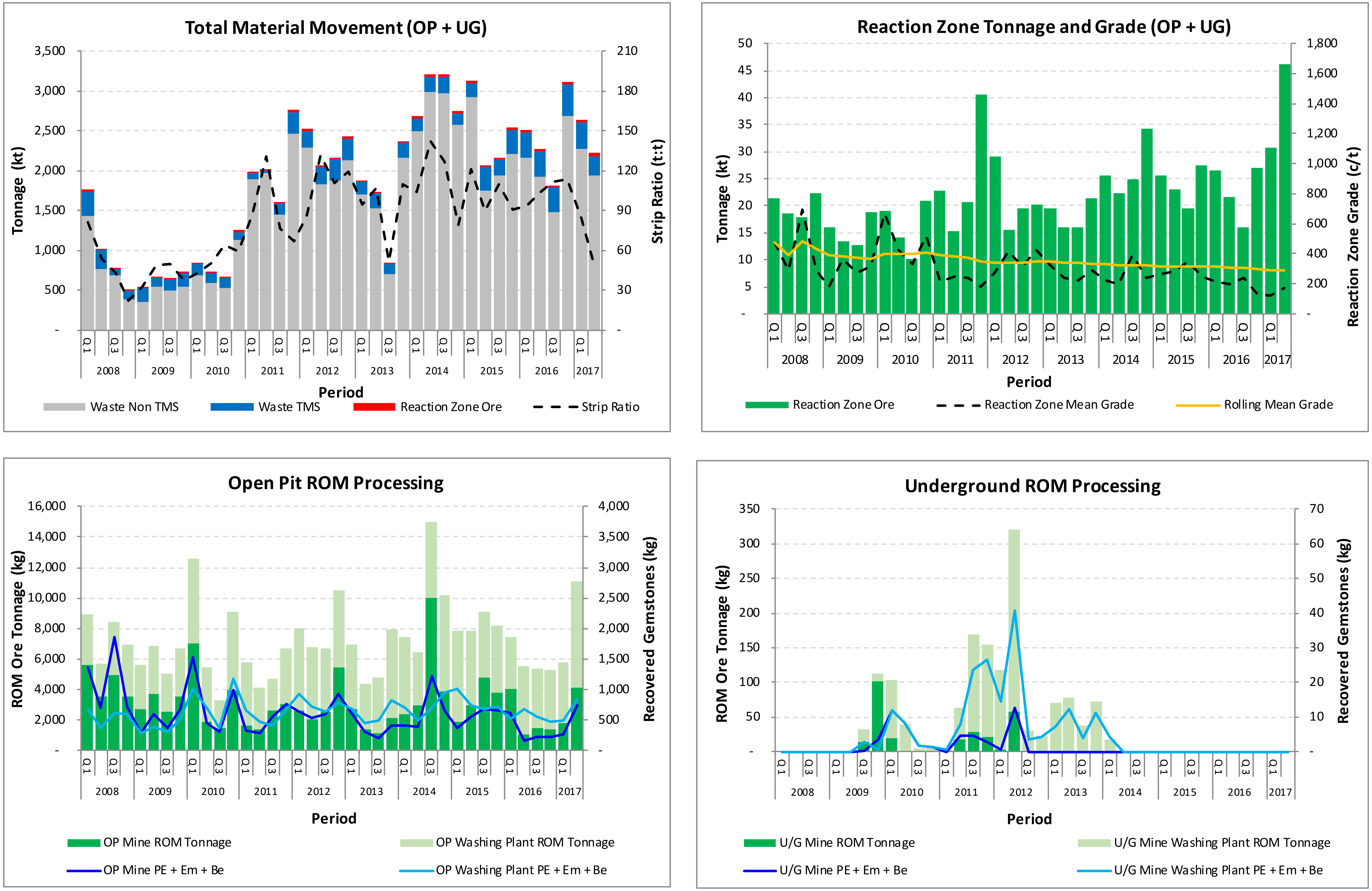


Figure 6-1: **Total Material Movement, RZ Tonnes & Grade, and OP and UG Processing**

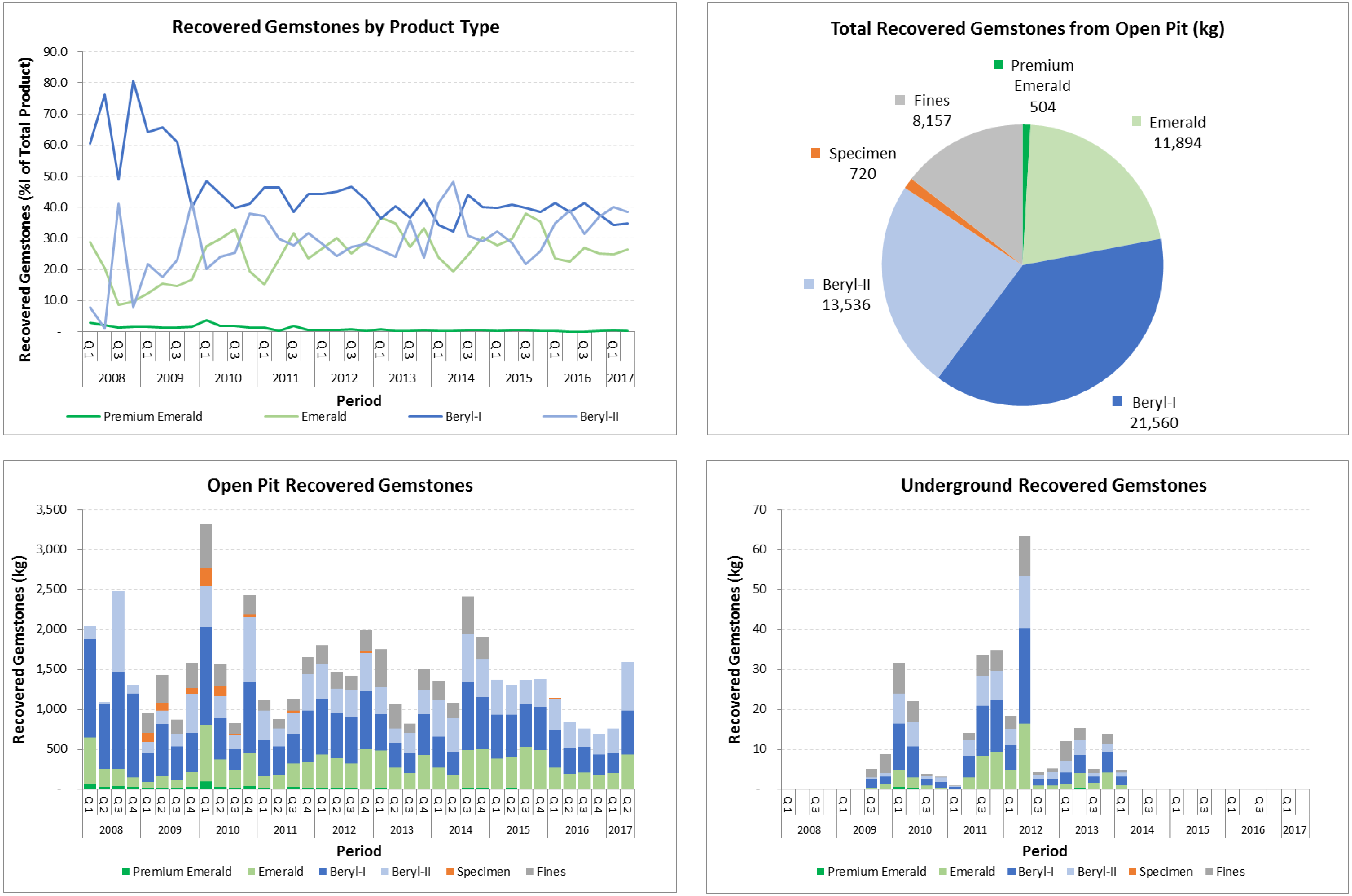


Figure 6-2: **Open Pit, Underground and Total Recovered Gemstones Summary**

6.2.2 Historic Operating Costs

Since the previous CPR, contractor mining has been suspended and all mining is done in-house. The in-house operating costs used for the CPR are based on the actual historical operating costs provided by Gemfields which the CP considers appropriate.

Gemfields has been operating the pit without a contractor for some time, and the costs supplied were therefore taken as representative of the likely costs to be incurred in the future.

Based on the operating costs provide by Gemfields from January 2017 to August 2017, a total mining and processing operating cost for this period of USD29.5 M was incurred to mine a total of 9.7 Mt of rock, resulting in an average in-house mining cost of USD3.01 /t rock mined, an increase from the previous CPR which showed USD2.28/t. The increases can be seen across the board, but the increases are relatively higher for security and repairs and maintenance.

Table 6-3 provides a breakdown of the estimated in-house mining and processing costs based on historic production and cost data provided by Gemfields from January 2017 to December 2017. Since FY2016 no deferred stripping has been capitalised and that cost has therefore been taken out of the total mining cost.

Table 6-3: Kagem Mining Cost Estimate

			Basis
In-House Mined Tonnages	**(Mt)**		
Total In-House Mined Quantity (Jan 2017-Dec 2017)	9.7		Client in-house production quantities.
Mining & Processing Costs	**(USDM)**	**(USD/t rock)**	
Total In-House Mining & Processing Costs (July 2015-August 2017)	**29.5**	**3.01**	Sum of cost components.
Labour Costs	12.3	1.26	Client historic data. Includes mining, processing and security labour costs.
Fuel Costs	7.6	0.78	Client historic data.
Repair and Maintenance	5.5	0.56	Client historic data.
Camp Costs	1.1	0.11	Client historic data.
Blasting Costs	1.6	0.16	Client historic data.
Security Costs	1.1	0.11	Client historic data.
Other Mining and Processing Costs	0.2	0.02	Client historic data.

6.3 Current Mining / Bulk Sampling Operations

6.3.1 Site Layout and Mining Locations

The mining operations at Kagem comprise a number of historically mined open-pits as well as the current open-pit operations situated mainly in the Chama Pit area and the bulk sampling operations at the Libwente and Fibolele areas. Figure 6-3 shows the Kagem Mine site layout and location of the operations around the Chama pit.

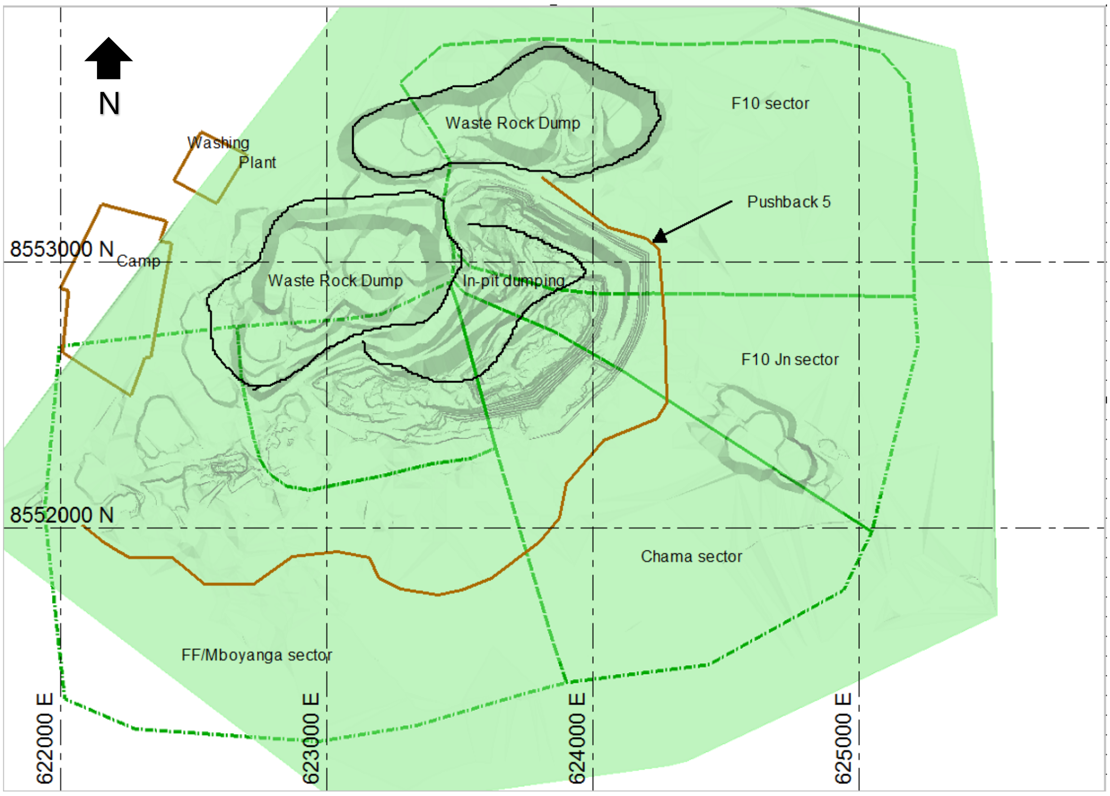


Figure 6-3: **Current Chama Pit Layout**

6.3.2 Chama Open Pit Operations and Reconciliation

Kagem is currently operating in two pushbacks at the main Chama Pit, which are based on pit designs and a mine planning block model developed by Kagem. Based on the pit designs and planning block model, Kagem has developed a 9 year internal mine plan for April 2015 to June 2024. The CP notes that the Kagem internal mine plan is based on the assumption that the RZ volume is 10% of the TMS volume. The CP notes that this has generally reconciled well against production figures.

Kagem is currently operating within the pushbacks laid out by SRK in the 2015 CPR, however the originally devised mine plan has not been adhered to. Gemfields has informed the CP that operation in the central part of the pit has fallen behind due to the following reasons:

- the SRK LoMp suggested a mining of 14.5 Mtpa, whereas the in-house capacity of Kagem for owner mining was confined to 11.5 Mtpa. When Kagem demobilised the contractor in September 2015, total material movement fell as a consequence;
- the F10S to M2 area on the pit floor has been hit with heavy downpours for a period of 4 months and a desilting for a further period of one month, which prevented mining there; and
- post removal of contractor, there was no significant addition to the mining fleet capacity, which compelled the depreciating machines to work lower grade lower strip areas to bridge the expected gap in total rock handling.

Currently, pit fringes like Mboyanga, Cutback 2 and Cutback 3 are being mined at a higher elevation due to a lower stripping ratio which is a stop-gap measure to deal with the lagging fleet availability. Although Gemfields notes that it is gradually increasing in quality (Premium recovery) and quantum, the quality of gemstones found there is not equivalent to the centre of the pit floor and there is therefore a lower carat production than was planned.

The CP is particularly concerned that waste stripping of the hangingwall wall ("HW") in the central section of the pit has lagged behind and this will restrict access to higher grade material for the next 3 to 5 years. The impact on the LoMp for carat production, in absolute numbers as well as quality of stones, is significant and the profitability of the operation for that period is substantially lower than predicted in the 2015 CPR.

6.3.2.1 Reconciliation and Mine Plan Targets

Reconciling the historic production figures with the volumes between the June 2015 and August 2017 face positions required some investigations. It was agreed with Gemfields that the survey positions for August 2017 were correct and that the historic production numbers to a very large degree appear correct. Since that agreement, the mine plan has been updated with the survey position of December 2017 Therefore, for the this CPR, the mine plan has been developed using the following agreements with Gemfields:

- the survey positions of 31 December 2017 will form the starting point for the plan;
- the focus is to get back onto the 2015 LoMp in the longer term;
- additional trucks (eight 45 t) and excavators (two 6 bcm buckets) will hopefully provide the capacity to get back to plan. There is overcapacity on the D&B side and so there is considered to be no bottleneck there;
- the planned catch-up period is 6 to 7 years;
- the ore in the central part of the pit will be the focus of the SRK plan prepared by the CP. The geology and geometry from the model indicates there should be the best tonnage and grade ore available there; and
- the updated plan is based on the 2015 LoMp. There will be no new pit optimisations done for the 2017 plan, nor any new designs for the final pit or the cutbacks.

As with the 2015 CPR, schedules are reported in line with Kagem's financial year, which runs from July through to June. For internal mine planning purposes, the Chama Pit is split into four key sectors, namely Chama, F10, F10 Junction, and FF. Figure 6-3 shows the layout of the Chama Pit, and is summarised below:

- pit survey as of 31 December 2017;
- Chama Pit is currently 120 m deep and 1,020 m in strike length (NE to SW);
- crest of current operating pushbacks, namely Pushback 4 and Pushback 5;
- waste haulage access via ramps on hanging wall side of pit;
- ore haulage access via ramps on footwall side of pit;
- in-pit dumping on the footwall side of the pit as outlined;
- ex-pit waste rock dumps located to the north and west of the Chama Pit; and
- camp and washing plant located to the west of the waste rock dumps.

6.4 Mining Method

The mining method comprises conventional open-pit operations: drill and blast, excavate and load and haul to in-pit backfill, waste rock dump locations and the various ex-pit stockpiles and a stockpile at the wash plant facility. Free dig techniques are employed in the weathered zones at the Mine. Free dig techniques are possible in the upper 20-30 m where weathering is present. Since September 2015, the open pit mining activities are undertaken by the in-house mining fleet. No significant changes from the current mining method are planned for the LoMp developed as part of this CPR.

Figure 6-4 shows a schematic overview of the open pit mining activities, described below:

- firstly the top 30 m of material to an approximate depth of 1,160 mRL are stripped. The majority of this material is free-dig, with the remaining overburden requiring drilling and blasting;
- waste material is mined from 1,160 mRL to the top of the TMS, the majority of which requires drilling and blasting. Access for the waste stripping is provided by haul ramps located on the hanging wall side of the pit;
- from the top of the TMS to 2 m below the base of the TMS is mined separately to recover as much RZ material as practical. Mining of the TMS requires drilling and blasting, and care is taken to not damage the RZs during blasting; and
- once the RZs are exposed, manual labour is used to remove the gemstones by hand directly from the in situ ore, and also from machine excavated material. Mining at a single exposed RZ is referred to as a production point. The number of simultaneously operating production points is limited to three to four for production rate and security purposes.

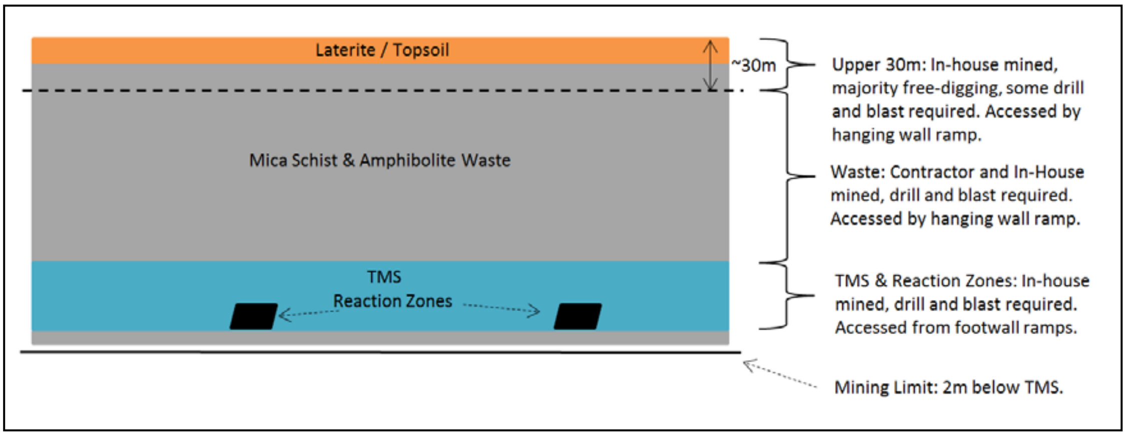


Figure 6-4: Mining Activity Overview

6.4.1 Grade Control

Grade control is practically constrained to visual inspection and mining of the mineralised zones is only undertaken during daylight hours. Historical and current practice in respect of reconciliation is to record production on a mined, washed and recovered basis on a pit by pit basis.

6.4.2 Excavatability

Based on discussions with the Kagem staff and observations made at site, the top 20-30 m of weathered material from surface is free-dig, and does not require blasting. Below the upper 20-30 m the waste rock becomes more competent and is un-weathered (fresh). The fresh rock requires drilling and blasting prior to excavation.

The RZ material is generally quite soft and able to be excavated using mechanical backhoe excavators or by hand with picks. The TMS material in the immediate vicinity of the RZ is more competent, and is drilled by hand held pneumatic drills and blasted with cartridge explosives. This blasting method provides relatively ‘light’ blasting of the RZ which enables easier excavation, whilst preventing excessive damage to the RZ and gemstones.

6.4.3 Waste Rock Dumps

At Kagem, external waste dumps are used for the majority of the upper 30 m and non-TMS waste; however, the majority of the TMS waste rock is dumped in-pit on the footwall side of the pit. The in-pit dumping face progresses towards the hanging wall. The waste rock is used to construct the footwall haul ramps, and ramps are widened and shifted where required to maintain footwall access.

Backfilling of the Chama Pit is only possible in mined out areas and areas which do not prohibit the mining operations, and consequently on-going use of external waste rock dumps will be required. The CP has developed ex-pit and in-pit waste dump designs as part of the 2015 CPR, which could be integrated as part of Kagem’s long term waste dumping strategy.

Laterite and PEG material is stockpiled at multiple locations near the pit crest for use as road construction material. Topsoil material is stockpiled at specific dumps separate from other waste rock, and is planned to be used for rehabilitation.

6.4.4 Ore Stockpiles

Current operational practices include an ore stockpiling strategy, where ore is stockpiled near the wash plant facility to manage the expected variability in the gemstone grading distribution and the impacts of the wet season on productivity.

6.4.5 Open Pit Dewatering

Ground water and rainfall contribute to the water in-flow to the Chama Pit, with high rainfall levels in the wet season. Areas at the pit bottom are utilised as sumps, which are utilised mostly during the wet season, where the water is collected and pumped ex-pit. The CP has noted that mining was abandoned in the bottom area of the pit due to flooding. Observations were not made on site as to the exact cause of this, but it is suspected that sumps at pit bottom were either of inadequate capacity or were not created in the dry season at all. It is recommended that the Mine looks carefully at the sump strategy for the coming wet seasons.

The CP notes additionally that as the pit increases in size, the quantity of ground and surface water run-off into the pit is likely to increase. Therefore, appropriate operational planning for in-pit sumps and surface waste diversion will be required to achieve effective pit water management.

6.4.6 Trafficability

Based on discussions with Kagem staff and observations at site, the haul road and pit floor trafficability is generally good during the dry and wet season. The use of articulated dump trucks mitigates some of the issues related to operating in wet conditions, which could otherwise significantly reduce productivity of larger rigid body trucks. This, however, can be mitigated to a large extent by proper dewatering management.

Discussions with the Kagem staff and the historic mining production physicals show that the mining rate is not significantly affected during the wet season; however, mining activities do cease during heavy downpours.

Below the upper 20-30 m, the in situ rock mass is generally of high strength and acts a good quality sub-grade material. In-pit haul roads are constructed from pit-run waste rock, with the PEG historically being especially good for haul road construction. Laterite material mined as part of the waste stripping is stockpiled at various locations near the pit crest and used for haul road construction and maintenance.

Based on the abundant availability of hard rock and laterite as pit-run material, the CP is confident that sufficient suitable road construction material is available for the in-pit and ex-pit haul roads. Kagem currently operates a number of graders and water trucks for road maintenance. The current approach for haul road construction and maintenance is envisaged to be suitable for future Kagem operations.

6.4.7 Mining Equipment

At the Kagem Mine, the in-house mining fleet consist of a waste mining and production fleet. The waste mining fleet mines only waste rock and the production fleet mines RZ ore and some of the waste rock when required. The fleets consist of diesel hydraulic backhoe excavators (2.4 m^3 to 6 m^3 buckets) and are used in conjunction with a fleet of 45t, 40 t and 30 t capacity articulated dump trucks (“ADT”).

Where blasting is required adjacent to or within the ore, hand-held drilling is employed to limit the potential damage to gemstones. The steeply dipping RZs are mined using manually intensive methods using picks and shovels with the assistance of hydraulic excavators under close supervision. Mining of RZs is only undertaken in daylight hours under constant security supervision with material mined and loaded into trucks accompanied by additional security vehicles on their journey to the Kagem Plant. All large and high grade emerald stones that are hand sorted at the mining face are placed in a drop safe type container which is numbered, tagged, and closed with security controlled locks.

The current mining fleet is supported by a number of ancillary equipment including wheel loader, track dozers, graders and water trucks. The current rock handling rate is approximately 990 kt per month.

The in-house owner mining fleet operating at the Chama Pit and Fibolele bulk sampling pit as of August 2017 is given in Table 6-4. The CP notes that Kagem owns additional mining equipment which is being utilised at other bulk sampling sites separate from Chama and Fibolele. The models that the CP has produced for this CPR show that the current mining fleet, augmented by one 6 m^3 excavator and 4 additional 45 t trucks to be purchased by June 2018, will be enough to cover the requirements for the mine plan for the next 9 years. From then on, the requirements increase due to longer haulage and additional waste stripping in the hanging wall. Additional trucks will need to bought to cover the increased cycle times.

Table 6-4: Current In-House Chama Open Pit Equipment Fleet

Equipment Type	Make/Model	Number of Units (#)
Excavator	CAT 374D/365	4
Excavator	CAT 336D	10
Excavator	CAT 390F	1
ADT	CAT 730	22
ADT	CAT 740	7
ADT	BELL B45	4
ADT	BELL B40	12
Ancillary		
Dozer	CAT D10T	1
Dozer	CAT D9R	3
Drill	Atlas Copco ROC D7	3
Drill	Atlas Copco ROC T35	2
Drill	Atlas Copco CS 1000 Core Drill	2
Backhoe Loader	CAT 428	1
FEL	CAT 950H	1
Grader	CAT 140H	1
Water Truck	CAT/BELL	2
Service Truck	CAT/BELL	2

6.4.8 Fleet Management

To provide security and ensure control of the movement of materials within and ex-pit, the in-house and contractor mining fleets are kept spatially separate. In general, the in-house and contractor waste mining fleets access the pit via haul ramps on the hanging wall, and do not operate on the footwall ramps. The in-house ore mining fleet access the pit via footwall ramps, and the ore haul trucks do not interact with the waste haulage fleet.

For security purposes, three to four RZ production points are simultaneously exposed and operational. The waste mining is coordinated in order to maintain sufficient ore exposure for the appropriate number of production points.

6.5 Open Pit Optimisation

The CP has undertaken open pit optimisation for the Chama and Fibolele deposits to demonstrate the principal of potentially economically mineable. This assessment includes consideration of the following technical and economic factors:

- long term commodity prices and macro-economics;
- revenue based deductions include royalties, production taxes and auction fees;
- operating expenditures; and
- modifying factors.

The key objectives of the open pit optimisations were to develop a practical and economic ultimate pit shells to form the basis of the mine design and production scheduling for the Kagem LoMp.

6.5.1 Mining Block Model

Unlike for the 2015 CPR, the mine planning block model was not transformed to a separate software suite, but the geological model (which resides in GEMS) was adapted in GEMS to ready it for export to Whittle.

The resulting mining block model global inventory is given in Table 6-5.

Table 6-5: Mining Model Inventory

	Mining Model "MRbm1"					
Rock Type	**Volume (MBCM)**	**Density (t/BCM)**	**Tonnage (Mt)**	**Ore Grade (ct/t)**	**Contained Product (Mct)**	**Basis**
Total Rock	**3,887**	**2.40**	**9,321**			Global Model
Cake	176.6	2.20	388.5	0	0	Standard folder, no percent model
PEG	81.4	2.65	215.6	0	0	PEG folder, percentage model
Non-TMS Waste	3,608.7	2.40	8,660.9	0	0	Standard folder, no percent model
TMS Waste	18.1	2.85	51.7	0	0	TMS folder, percentage model
Ore Bearing Rock	23.4	2.63	61.5	298	1,472	
Discordant RZ	1.07	**2.85**	3.05	299	991	DRZ folder, percentage model
Footwall RZ	0.66	**2.85**	1.89	297	562	FWRZ folder, percentage model

The CP notes that all mineralisation within the mining block model is classified as either Measured or Indicated Mineral Resource, and therefore the pit optimisation included all mineralisation.

The CP has used the Fibolele Resource Model for pit optimisation and mine planning, and has not developed a mining model for Fibolele. The CP notes that only Indicated classified mineralisation was included in the pit optimisation for Fibolele. The CP recommends that a mine planning block model is developed for Fibolele as part of future work.

6.5.2 Pit Optimisation for the 2017 LoMp

As mentioned previously in this CPR, for this update to the reserves no re-optimisation has taken place. The CP considers the parameters as given two years ago to be still valid under the current economic and geotechnical climate.

Therefore, the shells created for the 2015 CPR were used in the updated mine plan. For the 2017 CPR, a strategic schedule was created by importing the shells into Whittle, and combining them with an updated block model that was depleted against the August 2017 End of Month face position. This strategic schedule was then optimised for the requirements of the Mine by adding the mining fleet limits, and by splitting up the cuts into smaller blocks with a mining sequence that would force earlier mining of the central part of the pit to access higher grade.

Although no pit optimisation was done this time, the shells for the final design and the cutbacks are an important part of the strategic plan and for that reason the pit optimisation section of the 2015 CPR has been repeated below to ensure transparency and clarity.

It should be noted that since the pit shells were not changed, none of the parameters below were updated and the text describes how those parameters were derived in 2015.

6.5.3 Pit Optimisation Parameters

The pit optimisation parameters are given in Table 6-6, the basis of which is summarised in the following section. The parameters have not changed since the previous CPR of 2015 and the CP considers them still to be valid in 2017 after review of historic production and cost data.

The Chama and Fibolele pit optimisations used mostly the same parameters, the only difference being Chama using a 46° overall slope angle, compared to Fibolele using 50° due to its shallower depth.

Table 6-6: Pit Optimisation Parameters

Parameters	Units	Base Case	Basis
Production			
Production Rate - RZ Ore	(tpa)	90,000 Chama 30,000 Fibolele	Client Provided Data.
Geotechnical			
Overall Slope Angle	(Deg)	46-50	SRK Geotech Memo, closure slope angle.
Mining Factors			
Dilution	(%)	15.0	Historic Reconciliation of RZ to TMS %, 345 ct/t in situ grade, resulting in 300 ct/t diluted.
Recovery	(%)	100.0	Highly controlled selective mining.
Processing			
Recovery	(%)	100.0	Grade in Resource Model is Process Recovered Grade.
Operating Costs			
In-House Mining Cost	(USD/t_{rock})	2.28	2014-2015 Historic Mining & Processing Costs.
Proportion Mined In-House	(%)	72	Client Forecast.
Contractor Mining Cost	(USD/t_{rock})	3.16	Client Provided Data.
Proportion Mined by Contractor	(%)	28	Client Forecast.
Mining Cost Applied	(USD/t_{rock})	2.53	Weighted Average of In-House and Contractor Mining Costs.
Incremental Mining Cost	(USD/bench)	0.00	No Incremental Mining Cost Applied.
Bench Height	(m)	5	Resource Model Parent Block Height.
Reference Level	(Z Elevation)	NA	No Incremental Mining Cost Applied.
Processing Cost	(USD/t_{ore})	0.00	Assumed to be included in mining cost.
Rehabilitation Cost	(USD/t_{ore})	0.00	No additional rehabilitation cost assumed.
G&A	(USDM/Year)	4.5	
	(USD/t_{ore})	49.56	2014-2015 Historic G&A Costs.
Total Selling Costs	(USD/carat)	0.65	
Mineral Royalties	(%)	9.0	Government royalty on gemstone sales revenue, Client provided data.
	(USD/carat)	0.27	
Management & Auction Fees	(%)	12.5	12.5% on Auction Revenues, Client Provided Data.
	(USD/carat)	0.38	
Marketing & Advertising	(USD/carat)	0.005	2014-2015 Historic Marketing & Advertising Costs.
Product Price			
PE+Em+Be	(USD/ct)	3.00	Average assumed price for PE+Em+Be.
	(USD/g)	15.00	
Other			
Discount Rate	(%)	10	
Cut-Off Grade			
Marginal Cut-Off	(USD/t_{ore})	49.56	
	(ct/t)	18.15	

Geotechnical Slope Angles

Based on discussions with Kagem staff, the geotechnical parameters used in determining the ultimate pit extents are suitable for mine closure, with the appropriate pit slopes for long term stability and rehabilitation.

Based on the CP's initial geotechnical assessment, overall slope angles for closure of 46° and 50° were selected for the Chama and Fibolele pit optimisations respectively. The CP notes that based on the SRK geotechnical assessment, the operational overall slope angle of the interim cutbacks can be 49°-60° depending on an overall slope height range of 130-200 m.

Mining and Processing Cost

The mining cost used in the optimisation is based on historic production and cost data provided by Kagem from July 2014 to May 2015, and includes the processing costs. The historic cost data provided to the CP by Kagem does not provide a detailed split between mining and processing, and therefore the processing cost has been included in the mining cost. The majority of the processing costs are included within the labour, repair and maintenance, and other mining and processing costs.

Mining is undertaken by a combination of contractor and in-house fleets, and therefore the mining cost used for optimisation has been estimated as the weighted average unit cost based on Gemfields forecast contractor and in-house split. The weighted average mining cost is estimated at USD2.53 /t rock mined, as shown in Table 6-7. No depth related mining cost increase has been applied in the optimisation.

Table 6-7: Optimisation Mining & Processing Cost Estimate

	Unit		Basis
In-House Mining & Processing Cost	(USD/t_{rock})	2.28	2014-2015 Historic Mining & Processing Costs.
Proportion Mined In-House	(%)	72	Gemfields Business Plan Forecast.
Contractor Mining Cost	(USD/t_{rock})	3.16	Gemfields Provided Data.
Proportion Mined by Contractor	(%)	28	Gemfields Business Plan Forecast
Mining Cost Applied	(USD/t_{rock})	2.53	Weighted Average of In-House and Contractor Mining Costs

The CP notes the 2012 SRK FS assumed a processing cost of USD12.0 t/ore processed. Based on this cost and historic strip ratios, the processing costs are likely to be in the region of USD0.12 /t rock mined, but have not been differentiated from the mining costs in the pit optimisation. The majority of the processing costs are included within the labour, repair and maintenance, and other mining and processing costs.

G&A Cost

A general and administrative cost of USD49.56 t/ore is used in the optimisation. A breakdown of the G&A cost is presented in Table 6-8 and is based on the historic production and cost data provided by Gemfields from July 2014 to May 2015.

Table 6-8: Kagem G&A Cost Estimate

			Basis
In-House Mined Tonnages	**(kt)**		
Assumed Annual Ore Production Rate	90		Client Forecast.
G&A Costs	**(USDM)**	**(USD/t ore)**	
Total G&A Costs (July 2014-May 2015)	**4.1**	**49.56**	Client historic data.
Labour - G&A	1.6	19.76	Client historic data.
Rent and rates	0.1	1.11	Client historic data.
Travel and Accommodation	0.4	5.17	Client historic data.
Professional and consultancy	0.6	6.91	Client historic data.
Office expenses	0.0	0.22	Client historic data.
Other administrative expenses	1.4	16.39	Client historic data.

Selling Costs

A selling cost of USD0.65 /carat has been used in the optimisation, and is based on data provided by Gemfields as presented in Table 6-9.

Table 6-9: Kagem Selling Cost Estimate

	(%)	(USD/carat)	
Total Selling Cost		**0.65**	Based on USD3.00 /ct selling price.
Mineral royalties	9.0	0.27	Client Provided Data.
Management & Auction Fees	12.5	0.38	12.5% on Auction Revenues.
Selling, marketing and Advertising	-	0.005	Client historic data. USD131,000 spent and 28.0 Mct recovered product.

Modifying Factors

The CP has estimated the planned and operational mining dilution and ore recovery based on the current operating practice at the Kagem Mine and historic reconciliation data.

The estimated modifying factors are given in Table 6-10 and are summarised below:

- planned dilution and ore losses estimated to be 0%;
- the RZs are quite continuous and generally do not contain internal waste;
- this allows the waste to be planned distinctly separate from the ore; and
- all RZs that are encountered are planned to be mined.
- operational RZ dilution estimated to be 15%, based on the following historic tonnage reconciliation:
- historic reconciliation shows that the diluted RZ ore is consistently approximately 11-12% of the TMS by tonnage;
- the 2015 SRK Chama Resource Model in situ tonnages show the RZ to be 9.5% of the TMS by tonnage;
- a 15% dilution increases the 2015 Resource Model in situ tonnages (9.5% of TMS) to close to the historic diluted RZ to TMS proportions of 11-12%;
- operational mining loss is 0%; and
- no RZ is left behind in the pit, and is easily identifiable by the production geologists and equipment operators.

Table 6-10: Kagem Modifying Factors

	Unit	Value	Basis
Planned Modifying Factors			
Planned Mining Dilution	(%)	0	RZs are continuous and do not contain areas of internal waste, therefore no diluting material is planned to be mined.
Planned Mining Losses	(%)	0	Grade is variable within RZs, and therefore 100% of RZ volume is planned to be mined when encountered, therefore there are no planned mining losses.
Operational Modifying Factors			
Operational Mining Dilution	(%)	15	Historic RZ to TMS % reconciliation.
Operational Mining Losses	(%)	0	100% of RZ material encountered is loaded into haul trucks for processing, therefore no RZ is lost during operations.

6.5.4 Pit Optimisation Footprint Constraints

Based on the current infrastructure and site layout of the Kagem Mine, no specific optimisation footprint constraints have been applied.

6.5.5 Pit Optimisation Results

The product price sensitivity charts are presented in Figure 6-5 and Figure 6-6 for Chama and Fibolele respectively, and excerpts from the pit optimisation results are given in Table 6-11 and Table 6-12. The key results of the pit optimisation are summarised below:

Chama:

- a rapid increase in best and worst case DCF from pit shell 1 (RF USD0.30/ct) to 5 (RF USD0.70/ct), after which point the rate of increase in best case DCF slows;
- the 75th percentile DCF between worst and best case mining scenarios peaks at shell number 10 (RF USD1.20 /ct), and remains relatively level until shell 15 (RF USD1.70) /ct), after which point it steadily decreases;
- a relatively high operating margin is achieved at the full range of pit shells; and
- a relatively linear increase in strip ratio; however, a small step increase can be seen between shells 14 (RF USD1.60/ct) and 15 (RF USD1.70/ct), which in turn provides a step increase in ore tonnage and contained product.

Fibolele:

- a rapid increase in best and worst case DCF from pit shell 1 (RF USD1.30/ct) to 8 (RF USD2.00/ct), after which point the rate of increase in best case DCF slows;
- the 75th percentile DCF between worst and best case mining scenarios peaks at shell number 14 (RF USD2.60 /ct), and remains relatively level onwards;
- a relatively high operating margin is achieved at the full range of pit shells; and

  a relatively linear increase in strip ratio; however, a small step increase can be seen between shells 11 (RF USD2.30/ct) and 12 (RF USD2.40/ct), which in turn provides a step increase in ore tonnage and contained product.

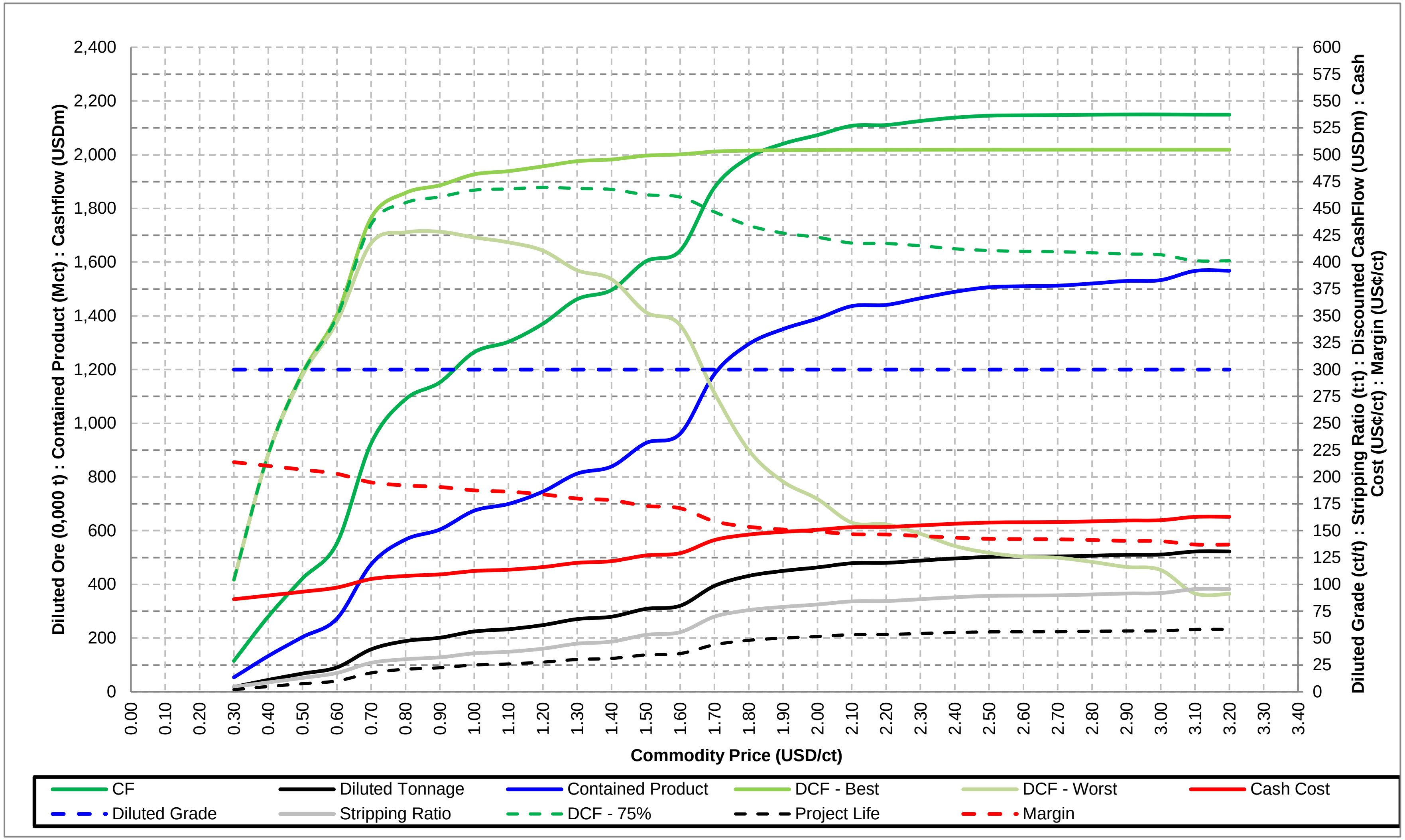


Figure 6-5: Chama Product Price Sensitivity Chart

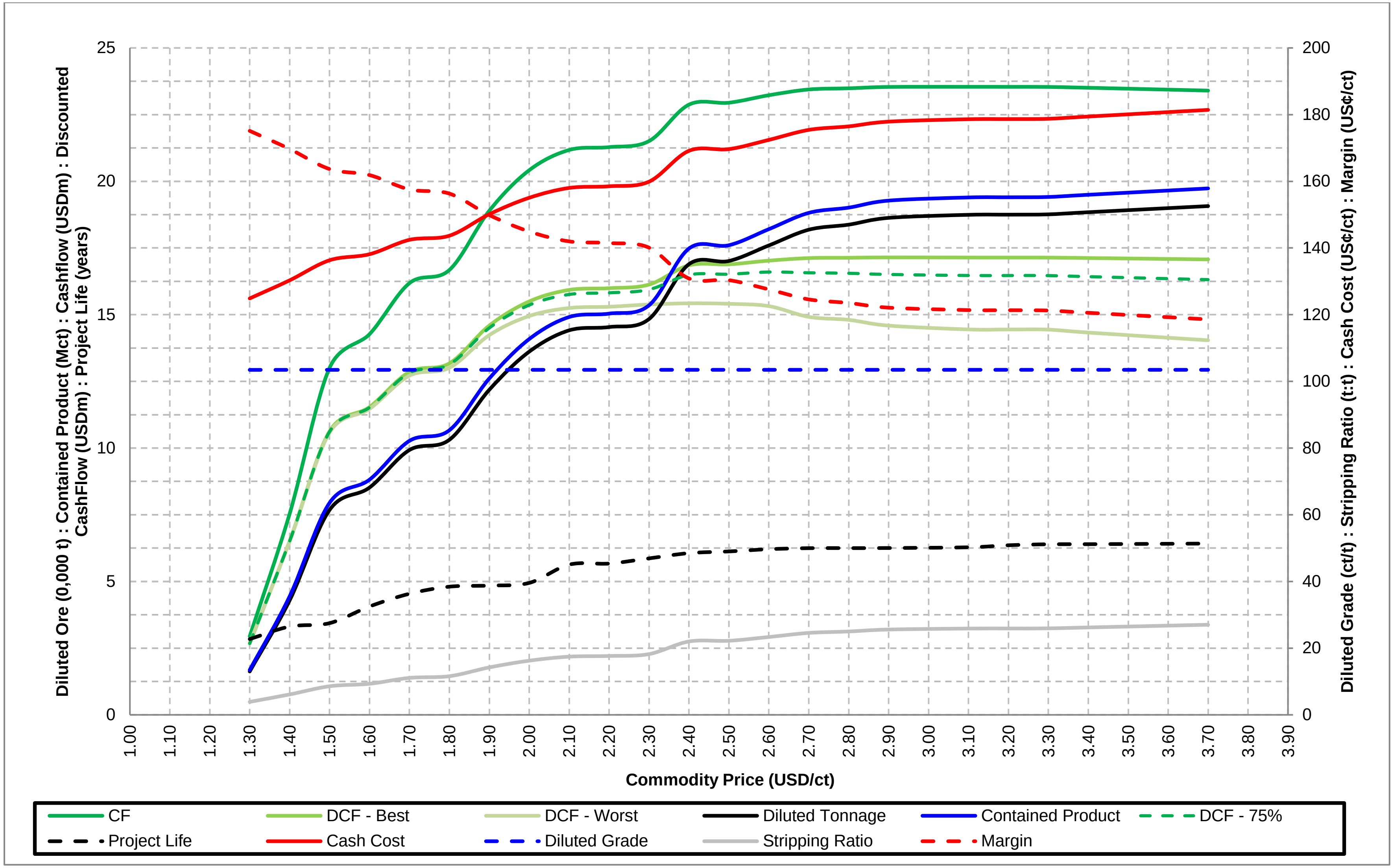


Figure 6-6: **Fibolele Product Price Sensitivity Chart**

Table 6-11: Excerpt from Chama Pit Optimisation Results

Pit # (Phase)	Revenue Factor (USD/ct)	Total Rock (t)	Strip Ratio (t_{waste}:t_{ore})	Total Waste (t)	Ore RoM (t)	(ct/t)	(ct)	Recovered Product (ct)	MC (USD)	PC (USD)	Selling Cost (USD)	Revenue (USD)	CF (USD)	DCF - Best (USD)	DCF - Worst (USD	DCF - 75% (USD)
Pit 1 (4)	0.30	994,197	4.7	838,072	179,543	300.00	53,862,937	53,862,937	2,515,317	8,898,157	35,010,909	161,588,812	115,164,429	104,275,048	104,275,048	104,275,048
Pit 2 (5)	0.40	4,283,531	8.8	3,897,255	444,217	300.00	133,265,231	133,265,231	10,837,335	22,015,416	86,622,400	399,795,692	280,320,541	221,278,479	220,857,968	221,173,351
Pit 3 (6)	0.50	9,410,789	13.0	8,819,189	680,340	300.00	204,102,017	204,102,017	23,809,297	33,717,653	132,666,311	612,306,052	422,112,791	297,086,368	294,899,716	296,539,705
Pit 4 (7)	0.60	16,724,585	17.5	15,934,758	908,302	300.00	272,490,516	272,490,516	42,313,201	45,015,433	177,118,835	817,471,550	553,024,081	350,824,875	344,537,322	349,252,987
Pit 5 (8)	0.70	44,146,465	27.0	42,769,657	1,583,328	300.00	474,998,546	474,998,546	111,690,555	78,469,760	308,749,055	1,424,995,638	926,086,268	441,425,591	417,760,480	435,509,313
Pit 6 (9)	0.80	59,046,506	30.4	57,402,552	1,890,547	300.00	567,164,172	567,164,172	149,387,660	93,695,521	368,656,712	1,701,492,517	1,089,752,624	464,539,112	427,758,886	455,344,056
Pit 7 (10)	0.90	66,399,741	32.1	64,647,768	2,014,769	300.00	604,430,559	604,430,559	167,991,344	99,851,928	392,879,863	1,813,291,677	1,152,568,542	471,614,359	428,338,247	460,795,331
Pit 8 (11)	1.00	82,499,110	35.8	80,544,152	2,248,201	300.00	674,460,240	674,460,240	208,722,747	111,420,831	438,399,156	2,023,380,720	1,264,837,986	481,743,105	423,049,079	467,069,599
Pit 9 (12)	1.10	88,965,538	37.3	86,937,464	2,332,285	300.00	699,685,368	699,685,368	225,082,811	115,588,023	454,795,489	2,099,056,104	1,303,589,781	484,745,132	418,439,591	468,168,747
Pit 10 (13)	1.20	101,982,202	40.2	99,821,474	2,484,837	300.00	745,451,212	745,451,212	258,014,970	123,148,540	484,543,288	2,236,353,635	1,370,646,837	489,206,095	410,766,447	469,596,183
Pit 11 (14)	1.30	123,824,859	44.8	121,469,429	2,708,781	300.00	812,634,324	812,634,324	313,276,893	134,247,190	528,212,311	2,437,902,972	1,462,166,578	494,040,013	392,439,992	468,640,008
Pit 12 (15)	1.40	133,034,377	46.7	130,602,596	2,796,584	300.00	838,975,259	838,975,259	336,576,973	138,598,713	545,333,918	2,516,925,775	1,496,416,171	495,605,467	384,071,409	467,721,953
Pit 13 (16)	1.50	166,373,102	53.0	163,687,873	3,088,050	300.00	926,415,156	926,415,156	420,923,949	153,043,784	602,169,851	2,779,245,467	1,603,107,883	499,188,499	353,484,666	462,762,541
Pit 14 (17)	1.60	180,775,192	55.5	177,988,635	3,204,579	300.00	961,373,433	961,373,433	457,361,237	158,818,891	624,892,731	2,884,120,298	1,643,047,439	500,344,125	341,371,357	460,600,933
Pit 15 (18)	1.70	279,595,753	70.0	276,165,587	3,944,754	300.00	1,183,426,110	1,183,426,110	707,377,256	195,501,993	769,226,972	3,550,278,330	1,878,172,109	502,972,586	278,213,989	446,782,937
Pit 16 (19)	1.80	332,082,057	76.1	328,328,095	4,317,118	300.00	1,295,135,585	1,295,135,585	840,167,604	213,956,398	841,838,130	3,885,406,756	1,989,444,624	503,882,746	224,836,103	434,121,085
Pit 17 (20)	1.90	359,854,962	79.0	355,939,344	4,503,023	300.00	1,350,906,826	1,350,906,826	910,433,054	223,169,807	878,089,437	4,052,720,478	2,041,028,180	504,214,907	195,664,404	427,077,281
Pit 18 (21)	2.00	380,765,022	81.3	376,736,426	4,632,948	300.00	1,389,884,291	1,389,884,291	963,335,505	229,608,885	903,424,789	4,169,652,873	2,073,283,694	504,397,669	179,471,638	423,166,161
Pit 19 (22)	2.10	407,340,245	84.2	403,176,583	4,788,273	300.00	1,436,482,186	1,436,482,186	1,030,570,820	237,306,857	933,713,421	4,309,446,557	2,107,855,459	504,556,190	157,511,456	417,795,007
Pit 20 (23)	2.20	409,988,457	84.5	405,812,113	4,802,858	300.00	1,440,857,275	1,440,857,275	1,037,270,796	238,029,622	936,557,229	4,322,571,824	2,110,714,177	504,569,865	155,896,842	417,401,609
Pit 21 (24)	2.30	425,438,542	86.2	421,190,221	4,885,631	300.00	1,465,689,325	1,465,689,325	1,076,359,511	242,131,876	952,698,061	4,397,067,974	2,125,878,526	504,632,301	147,118,670	415,253,893
Pit 22 (25)	2.40	441,219,036	88.0	436,901,227	4,965,541	300.00	1,489,662,474	1,489,662,474	1,116,284,160	246,092,240	968,280,608	4,468,987,422	2,138,330,414	504,678,118	135,781,649	412,454,001
Pit 23 (26)	2.50	453,033,561	89.3	448,666,442	5,022,249	300.00	1,506,674,705	1,506,674,705	1,146,174,909	248,902,661	979,338,558	4,520,024,114	2,145,607,986	504,703,191	129,356,127	410,866,425
Pit 24 (27)	2.60	455,745,374	89.6	451,367,300	5,034,847	300.00	1,510,454,141	1,510,454,141	1,153,035,796	249,527,024	981,795,192	4,531,362,423	2,147,004,411	504,708,258	125,891,581	410,004,089
Pit 25 (28)	2.70	457,325,665	89.8	452,941,500	5,041,852	300.00	1,512,555,681	1,512,555,681	1,157,033,933	249,874,198	983,161,193	4,537,667,042	2,147,597,718	504,710,405	124,787,958	409,729,793
Pit 26 (29)	2.80	463,710,999	90.6	459,303,454	5,068,740	300.00	1,520,621,910	1,520,621,910	1,173,188,828	251,206,739	988,404,242	4,561,865,729	2,149,065,920	504,715,138	120,925,943	408,767,839
Pit 27 (30)	2.90	471,510,215	91.6	467,075,358	5,100,149	300.00	1,530,044,493	1,530,044,493	1,192,920,844	252,763,350	994,528,920	4,590,133,477	2,149,920,363	504,717,135	116,220,011	407,592,854
Pit 28 (31)	3.00	474,240,891	91.9	469,796,750	5,110,824	300.00	1,533,247,312	1,533,247,312	1,199,829,454	253,292,456	996,610,753	4,599,741,935	2,150,009,272	504,717,316	113,400,574	406,888,131
Pit 29 (32)	3.10	504,162,743	95.6	499,619,109	5,225,241	300.00	1,567,572,274	1,567,572,274	1,275,531,739	258,962,939	1,018,921,978	4,702,716,821	2,149,300,165	504,699,949	91,537,722	401,409,392
Pit 30 (33)	3.20	504,619,015	95.7	500,073,927	5,226,913	300.00	1,568,074,047	1,568,074,047	1,276,686,108	259,045,832	1,019,248,131	4,704,222,139	2,149,242,068	504,699,773	91,272,387	401,342,927

Table 6-12: Excerpt from Fibolele Pit Optimisation Results

Pit	Revenue Factor	Total Rock	Strip Ratio	Total Waste	Ore RoM			Recovered Product	MC	PC	Selling Cost	Revenue	CF	DCF - Best	DCF - Worst	DCF - 75%
#	(USD/ct)	(t)	(t_{waste}:t_{ore})	(t)	(t)	(ct/t)	(ct)	(ct)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)
1	1.30	79,489	3.9	63,242	16,247	103.45	1,680,743	1,680,743	201,107	805,211	1,092,483	5,042,229	2,943,428	2,675,722	2,675,722	2,675,722
2	1.40	305,482	6.1	262,556	42,926	103.46	4,441,100	4,441,100	772,869	2,127,415	2,886,715	13,323,300	7,536,301	6,515,212	6,503,589	6,512,306
3	1.50	735,651	8.6	658,838	76,813	103.46	7,946,737	7,946,737	1,861,197	3,806,857	5,165,379	23,840,211	13,006,778	10,627,368	10,579,975	10,615,520
4	1.60	879,086	9.3	793,879	85,207	103.46	8,815,358	8,815,358	2,224,088	4,222,856	5,729,983	26,446,074	14,269,147	11,537,645	11,467,998	11,520,233
5	1.70	1,199,424	11.1	1,100,150	99,274	103.46	10,270,947	10,270,947	3,034,543	4,920,007	6,676,115	30,812,841	16,182,176	12,855,005	12,714,644	12,819,915
6	1.80	1,297,918	11.6	1,194,808	103,110	103.46	10,668,036	10,668,036	3,283,733	5,110,139	6,934,224	32,004,109	16,676,013	13,175,219	13,008,889	13,133,637
7	1.90	1,855,645	14.2	1,733,776	121,869	103.47	12,609,264	12,609,264	4,694,782	6,039,825	8,196,022	37,827,792	18,897,163	14,593,188	14,234,742	14,503,577
8	2.00	2,347,872	16.2	2,211,720	136,152	103.47	14,087,202	14,087,202	5,940,116	6,747,691	9,156,681	42,261,606	20,417,118	15,497,542	14,950,371	15,360,749
9	2.10	2,659,348	17.5	2,515,210	144,138	103.47	14,913,380	14,913,380	6,728,150	7,143,457	9,693,697	44,740,139	21,174,835	15,928,907	15,249,170	15,758,973
10	2.20	2,711,360	17.7	2,565,993	145,367	103.47	15,040,569	15,040,569	6,859,741	7,204,383	9,776,370	45,121,706	21,281,212	15,993,280	15,297,654	15,819,374
11	2.30	2,851,906	18.2	2,703,534	148,372	103.47	15,351,793	15,351,793	7,215,322	7,353,309	9,978,665	46,055,378	21,508,082	16,128,431	15,382,244	15,941,884
12	2.40	3,886,142	22.0	3,717,200	168,942	103.47	17,480,427	17,480,427	9,831,939	8,372,760	11,362,278	52,441,281	22,874,304	16,850,407	15,426,452	16,494,418
13	2.50	3,948,908	22.2	3,778,775	170,133	103.47	17,603,651	17,603,651	9,990,737	8,431,806	11,442,373	52,810,952	22,946,036	16,887,289	15,407,875	16,517,436
14	2.60	4,283,371	23.3	4,107,415	175,956	103.47	18,206,099	18,206,099	10,836,929	8,720,367	11,833,965	54,618,298	23,227,037	17,026,008	15,321,393	16,599,854
15	2.70	4,649,921	24.6	4,468,063	181,858	103.47	18,816,919	18,816,919	11,764,300	9,012,860	12,230,997	56,450,758	23,442,601	17,121,672	14,918,540	16,570,889
16	2.80	4,778,011	25.0	4,594,257	183,754	103.47	19,013,294	19,013,294	12,088,368	9,106,843	12,358,641	57,039,881	23,486,029	17,134,418	14,807,033	16,552,572
17	2.90	4,952,078	25.6	4,765,784	186,294	103.47	19,276,216	19,276,216	12,528,757	9,232,743	12,529,540	57,828,647	23,537,607	17,147,318	14,591,010	16,508,241
18	3.10	5,038,131	25.9	4,850,689	187,442	103.47	19,394,877	19,394,877	12,746,471	9,289,623	12,606,670	58,184,631	23,541,867	17,142,592	14,447,340	16,468,779
19	3.20	5,043,009	25.9	4,855,510	187,499	103.47	19,400,878	19,400,878	12,758,813	9,292,473	12,610,570	58,202,633	23,540,777	17,141,695	14,445,684	16,467,692
20	3.30	5,053,056	25.9	4,865,442	187,614	103.47	19,412,793	19,412,793	12,784,232	9,298,172	12,618,315	58,238,379	23,537,660	17,140,096	14,440,539	16,465,207
21	3.40	5,126,425	26.2	4,938,012	188,413	103.47	19,495,413	19,495,413	12,969,855	9,337,726	12,672,018	58,486,239	23,506,640	17,124,294	14,329,460	16,425,586
22	3.70	5,344,266	27.0	5,153,551	190,715	103.47	19,733,567	19,733,567	13,520,993	9,451,828	12,826,818	59,200,701	23,401,062	17,071,699	14,040,752	16,313,962

6.5.6 Ultimate Pit Shell Selection

The ultimate pit shell selection was driven by the following key objectives:

Chama:

- provide a significant mine life;
- target an average strip ratio in the region of 65-75 to 1 (t_{waste}:t_{ore});
- maximise the in situ ore inventory whilst maintaining economic viability of the open pit operations;
- contain rock from both higher and lower strip ratio mining areas, to enable a mining sequence which balances strip ratio; and
- allow additional cutbacks past the current planned and operating pushbacks, with a minimum cutback with of 100 m.

Fibolele:

- maximise the in situ ore inventory whilst maintaining economic viability of the open pit operations.

Based on the optimisation results and the key strategic objectives, pit shell 15 (RF USD1.70 /ct) and pit shell 17 (RF USD2.90 /ct) were selected as the ultimate pit shells for Chama and Fibolele mine planning respectively. Details of the pit optimisation results for these selected shells are given in Table 6-13.

Table 6-13: Selected Ultimate Pit Shells

Optimisation Results	Units	Chama Selected Ultimate Pit Shell	Fibolele Selected Ultimate Pit Shell
In Situ Ore			
Inventory	(Mt)	3.4	0.16
	(ct/t)	345.0	119.0
	(kct)	1,183,426	19,276
Modifying Factors			
Mining Dilution	(%)	15.0	15.0
Dilutant Grade	(ct/t)	0.0	0.0
Mining Recovery	(%)	100.0	100.0
Process Recovery	(%)	100.0	100.0
Diluted & Recovered Ore			
Inventory	(Mt)	3.9	0.19
	(ct/t)	300.0	103.5
	(kct)	1,183,426	19,276
Diluted & Recovered Quantities			
Total Rock	(Mt)	280.1	5.0
Mineral Inventory	(Mt)	3.9	0.2
Waste	(Mt)	276.2	4.8
Stripping Ratio	(t:t)	70.0	25.6
Operating Expenditures			
Mining + Processing	(USD/t_{mined})	2.53	2.53
	(USD/t_{ore})	179.32	67.25
	(USD/ct)	0.60	0.65
Rehabilitation Cost	(USD/$t_{ore\ rejected}$)	0.00	0.00
	(USD/ct)	0.0	0.0
G&A	(USD/t_{ore})	49.56	49.56
	(USD/ct)	0.17	0.48
Selling Cost	(USD/ct)	0.65	0.65
Total Cash Cost	(USD/ct)	1.41	1.78
Product			
Recovered Product	(kct)	1,183,426	19,276
Economic Summary			
Product Price	(USD/ct)	3.00	3.00
Revenue	(USDM)	3,550	58
Mining + Processing Costs	(USDM)	707	13
G&A Costs	(USDM)	196	9
Selling Costs	(USDM)	769	13
Rehab + Other Costs	(USDM)	0	0
Cashflow	(USDM)	1,878	24
Discount Rate	(%)	10.0	10.0
Mill Rate	(Mtpa)	0.090	30
DCF - Best Case	(USDM)	503	17.1
DCF - Worst Case	(USDM)	278	14.6
DCF - 75th Percentile	(USDM)	447	16.5
Project Life	(years)	43.8	6.2
Cut-Off Grade			
Break Even Operating COG - OPEX	(USD/t_{ore})	228.88	116.81
Marginal COG - OPEX	(USD/t_{ore})	49.56	49.56
Break Even Operating COG	(ct/t)	97.40	49.71
Marginal COG	(ct/t)	21.09	21.09
In Situ Break Even Operating COG	(ct/t)	112.01	57.16
In Situ Marginal COG	(ct/t)	24.25	24.25

The CP notes that Chama pit shell 15 has an increased strip ratio and a slightly reduced 75th percentile DCF compared to the immediately smaller pit shell 14. Pit shell 15 is therefore regarded as a slightly higher risk shell compared to shell 14; however, it still achieves a healthy operating margin (USD1.59/ct) and provides a 20% increase in contained product.

Figure 6-7 shows pit crests of Chama shell numbers 5, 14, 15 and 16, and provides an indication of the special sensitivity of the optimisation at a number of revenue factors. The direction of pit expansion between the shells 14 and 15 is such that the majority of higher strip ratio area in the south region of pit shell 15 can be planned as a separate cutback, mined at the later stages of the mine life and could be excluded from the mining sequence if desired.

The CP notes a sensitivity of the pit shells to the north, where pit shell 16 expands. This area is a higher strip ratio area, and was not deemed practical to include as part of the ultimate pit shell.

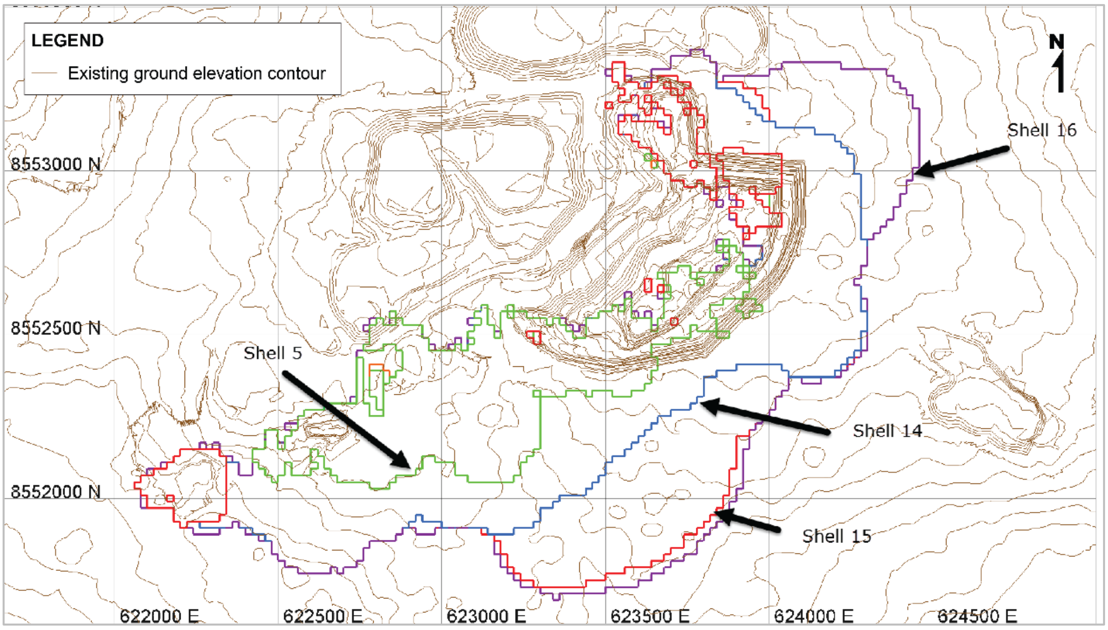


Figure 6-7: Chama Pit Optimisation Results Spatial Sensitivity and Selected Ultimate Shell (Contour intervals are 1m)

Figure 6-8 shows the pit crest of Fibolele shell number 17, shown with the topography contoured at 5 m intervals and the current Kagem bulk sampling pit design crest. The CP notes that the pit shell is offset to the south-east compared to the pit design. The CP recommends that the pit design is modified to extend towards the south-east to account for this shift.

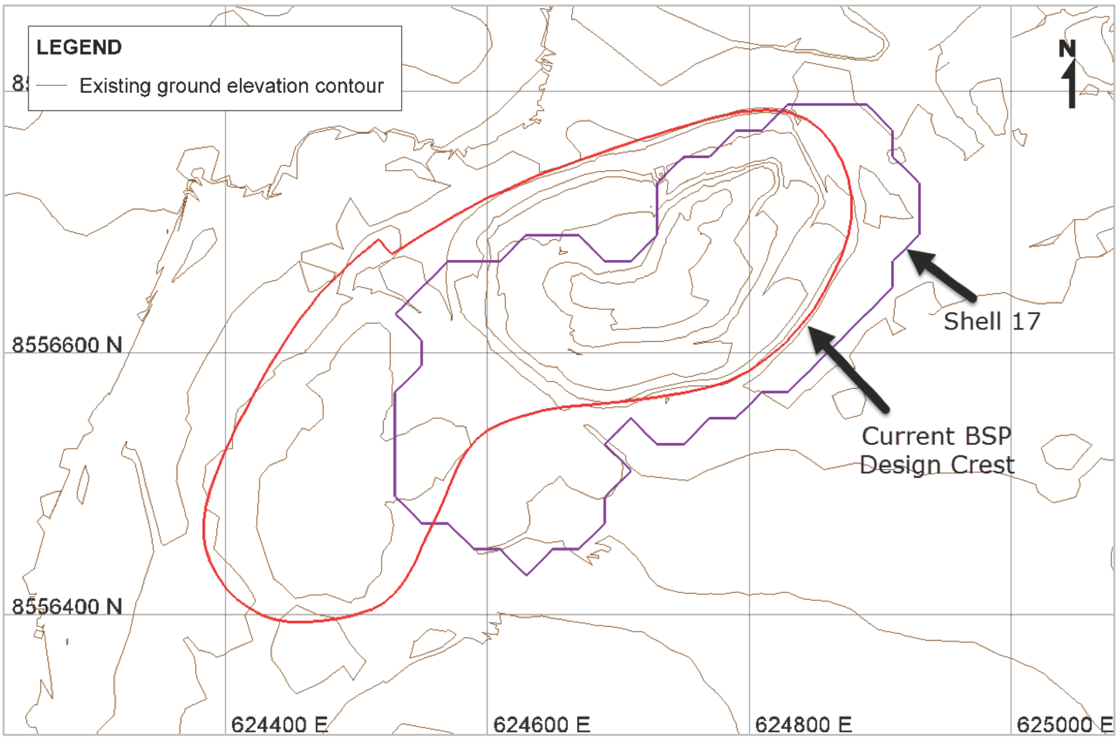


Figure 6-8: **Fibolele Pit Optimisation Results Selected Ultimate Shell (Contour intervals are 1m)**

6.5.7 Conclusions and Recommendations

Conclusions

The CP has undertaken open pit optimisation for the Chama deposit using the Kagem Mining Block Model and the Fibolele deposit using the 2015 SRK Fibolele Resource Model, and utilised historic operating costs and closure slope angles. Based on the optimisation results and Gemfields strategic objectives, the CP selected pit shell 15 (RF USD1.70/ct) for Chama and pit shell 17 (RF USD2.90/ct) for Fibolele as the ultimate pit shells for the LoMp. The Chama pit shell contains a total of 3.9 Mt of diluted and recovered RZ ore at a RoM grade of 300 ct/t, at a strip ratio of 70 t_{waste}:t_{ore}. The Fibolele pit shell contains a total of 0.19 Mt of diluted and recovered RZ ore at a RoM grade of 103.5 ct/t, at a strip ratio of 25.6 to 1 (t_{waste}:t_{ore}).

The Chama shell was selected as it provides a significant mine life and gives the flexibility of multiple simultaneous cutbacks, and a minimum mining width of 100 m from the current operating pushback.

The Fibolele shell was selected as it maximises the in situ ore inventory whilst maintaining economic viability of the open pit operations.

Recommendations

The CP recommends the following is undertaken as part of further study:

- Kagem to undertake a review of the historic operating costs, and develop a more detailed breakdown of the in-house mining and processing operating costs for use in future study;
- periodic (annual) review of the selected ultimate pit shell to ensure it is suitable given the market conditions; and

- undertake further pit optimisations when additional geological information is gathered.

6.6 Strategic Assessment

Based on discussions and in cooperation with Gemfields, the CP has developed a strategic cutback strategy for Kagem. The CP notes that due to the variability in grade and product type through the mineralisation, a key strategic driver for Kagem is to provide sequential cutbacks which provide a balance of high strip ratio – higher confidence ore, with lower strip ratio – lower confidence ore. The cutback strategy is based on the following key objectives:

- develop multiple simultaneously operating cutbacks which provides flexibility in the mining locations;
- the initial cutbacks should target the higher strip ratio - higher confidence zone immediately behind the current hanging wall, alongside a lower strip ratio – lower confidence zone to the south west of the current pit area;
- allow a minimum width between cutbacks of 80-100 m; and
- provide a cutback sequence with increasing strip ratio.

Based on the ultimate pit geometry and the strategic objectives, the CP developed six conceptual cutback shells within the ultimate pit which are shown in Figure 6-9 and summarised below:

- Cutback 1: the remaining rock within the current “Pushback 4”, planned internally by Kagem;
- Cutback 2: Higher strip ratio – higher confidence zone, based on the current “Pushback 5”, planned internally by Kagem;
- Cutback 3: Lower strip ratio – lower confidence zone, to be mined in combination with the higher strip ratio – higher confidence zones;
- Cutback 4: Planned to be mined after increased confidence is gained by mining of Cutback 1;
- Cutback 5: Higher strip ratio zone to be mined in combination with Cutback 3; and
- Cutback 6: Higher strip ratio zone, final cutback. The geometry of this cutback means it could be removed from the mine plan if the market conditions are deemed unfavourable.

The size and orientation of the Fibolele selected shell lends itself to be mined as a single pit, and therefore no intermediate cutbacks have been planned. This approach aligns with Kagem’s current plan for Fibolele.

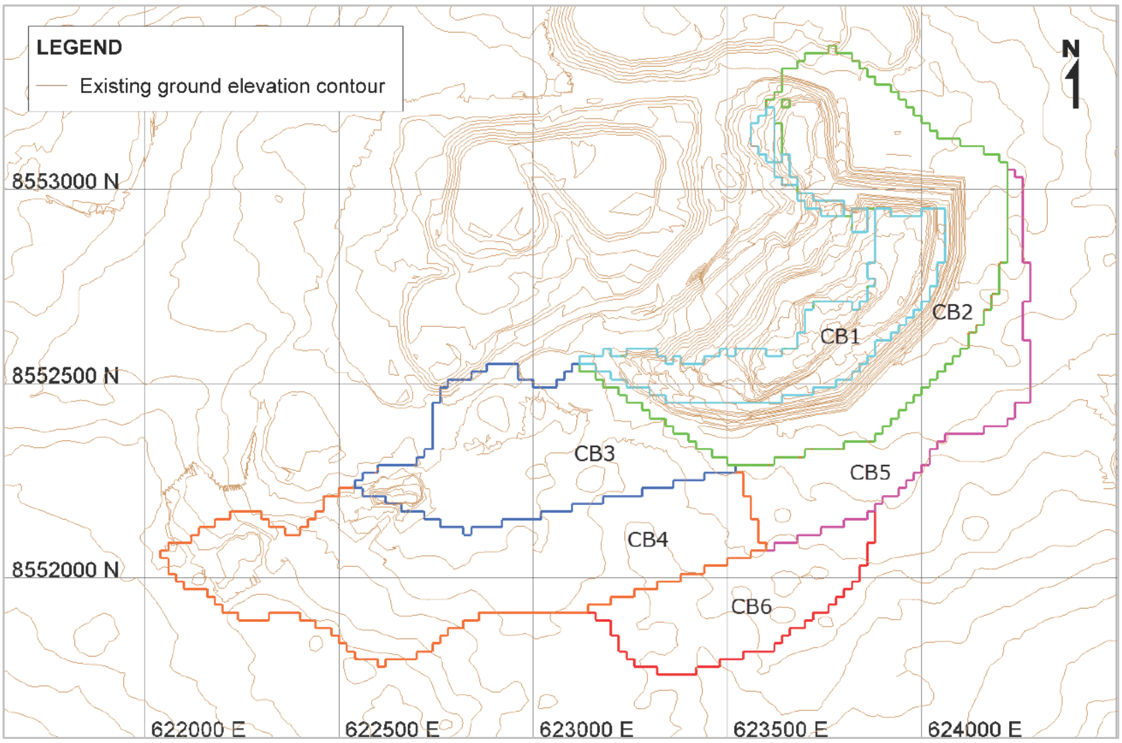


Figure 6-9: Strategic Cutback Sequence (Contour intervals are 1m)

6.7 Mine Design

6.7.1 Design Parameters

The CP has undertaken engineered pit design for the Chama Mine. Pit design was undertaken in Vulcan design software. The CP has not undertaken engineered pit design for the Fibolele pit; however, an 8% waste increase and 5% ore loss adjustments have been made to the optimised pit shell quantities to account for likely design ore losses and waste increases.

The geotechnical and operational pit design parameters for the Chama Mine design are given in Table 6-14 and Table 6-15 respectively.

The CP notes that based on an iterative process of pit design and geotechnical analysis, it was determined that the berm widths could be reduced from 7 m (as was used in the pit optimisation) to 5.5 m whilst still maintaining an appropriate slope FoS. This allowed for some reduction in waste material in the hanging was when moving from the optimised pit design to the engineered pit design.

The CP notes that the operational design parameters are based on the use of CAT 777 class rigid dump trucks, which are currently not being operated at the Mine; however, the Kagem staff requested for the design to have the flexibility to accommodate larger mining equipment if desired in the future. In the cost studies undertaken for the 2017 CPR, all indications are that rigid frame 777 trucks or equivalent are a more cost effective option for Kagem and it is recommended that a more detailed study should be undertaken.

Table 6-14: Geotechnical Open Pit Design Parameters

Parameter	Unit		Basis
Slope Configuration			
Weathered Rock (0 to 30m depth)			
Bench Height	(m)	10	Current bench height.
Batter Angle	(deg)	70	SRK geotech recommendations.
Berm Width	(m)	5.5	Access width for berm at closure.
Fresh Rock (below 30m depth)			
Bench Height	(m)	10	Current bench height.
Batter Angle	(deg)	75	SRK geotech recommendations.
Berm Width	(m)	5.5	Access width for berm at closure.

Table 6-15: Operational Open Pit Design Parameters

Parameter	Unit		Basis
Truck Width	(m)	6.7	Cat 777 Truck Specs
Dual Lane Multiplier	(-)	3.5	Cat Operating Handbook
Bund Wall Width	(m)	3.0	SRK Estimate
Toe Drain Width	(m)	3.0	SRK Estimate
Ramp Width - Dual Lane	(m)	29	Ramp width including safety bund & toe drain.
Single Lane Multiplier	(-)	2.0	SRK Estimate
Ramp Width - Single Lane	(m)	19	Ramp width including safety bund & toe drain.
Switchback Diameter	(m)	29	Turning Circle Clearance Diameter for CAT 777.
Minimum Mining Width	(m)	40	SRK Estimate

It is current operational practice at the Mine to extract the final hanging wall ramp and, based on discussions with site staff, this is planned to continue in future cutbacks. The ultimate pit design therefore does not have a final hanging wall ramp, as it is assumed this will be mined out.

Currently, access to the pit floor and ore mining areas is provided by temporary ramps on the footwall side of the pit, constructed from a combination of in situ and pit-run waste rock. These footwall access ramps change location over time and are planned to move as the in-pit waste backfill develops, therefore the ultimate pit design does not have footwall ramps, as it assumes they are temporary and will be constructed as needed.

The CP has undertaken reasonable checks on potential hanging wall and footwall ramp locations at a 10% ramp gradient within each cutback stage, and is satisfied that practical ramps can be located within the cutbacks and ultimate pit to allow waste stripping and ore production.

6.7.2 Engineered Pit Design

The engineered ultimate pit is shown in Figure 6-10. The ultimate pit design inventory and inventories within the conceptual cutbacks are given in Table 6-16 as updated for the 2017 CPR.

The CP notes that the ultimate pit design and cutback inventories were reporting from the NPVS scheduling software. The CP is aware that a small amount of toe-crest resolution is lost when the pit design is imported, and therefore the pit design inventories are slightly higher (within a few %) when reported from the GEMS design software. The CP does not view this to be a material issue for the reporting of the pit design inventory or scheduling process.

The CP has not undertaken detailed engineered cutback designs within the ultimate pit shell. The CP has however undertaken reasonable checks with regard to potential ramp locations and, due Company's proven historic performance on mining sequential cutbacks successfully, this lack of engineered cutback designs is not envisaged as a material issue for the CPR.

The CP has utilised the strategic cutback sequence to develop practical cutback shells which form the basis of the cutback inventories for scheduling. The cutback shells within used for the LoMP scheduling are shown in Figure 6-11. The Fibolele planned pit quantities, adjusted for likely design factors, are given in Table 6-17, and form the basis of the production schedule quantities.

Table 6-16: Ultimate Pit Design & Cutback In situ and Diluted Inventories (June 2015 topo)

	Units	Total	Cutback 1	Cutback 2	Cutback 3	Cutback 4	Cutback 5	Cutback 6
Total Rock	**(kt)**	**284,082**	**7,997**	**57,314**	**31,972**	**75,339**	**59,322**	**52,138**
Waste	**(kt)**	**280,415**	7,759	56,645	31,257	74,169	58,840	51,744
Cake	**(kt)**	**41,612**	80	15,169	6,150	8,794	7,924	3,495
Non-TMS Waste	**(kt)**	**150,540**	2,335	24,947	8,791	40,230	34,730	39,507
PEG	**(kt)**	**42,817**	1,894	8,612	3,449	12,510	10,979	5,373
TMS Waste	**(kt)**	**45,445**	3,449	7,917	12,867	12,636	5,208	3,369
TMS Waste Blocks	**(kt)**	**13,815**	551	1,566	5,676	3,801	1,283	938
Ore Block Waste (TMS)	**(kt)**	**31,630**	2,898	6,351	7,190	8,834	3,926	2,430
RZ Ore (Diluted & Recovered)	**(kt)**	**3,667**	238	669	715	1,170	481	394
RZ Ore Grade (Diluted & Recovered)	**(ct/t)**	**300**	300	300	300	300	300	300
	(g/t)	**60**	60	60	60	60	60	60
Contained Product (Diluted & Recovered)	**(Mct)**	**1,100**	71	201	214	351	144	118
	(kg)	**220,029**	14,297	40,131	42,886	70,171	28,885	23,660
Strip Ratio	**$(t_{waste}:t_{ore})$**	**76.5**	33	85	44	63	122	131

Table 6-17: Fibolele Pit Quantities (June 2015 topo)

	Unit	
Total Rock	**(kt)**	**5,326**
Waste	**(kt)**	5,149
RZ Ore (Diluted & Recovered)	**(kt)**	177
RZ Ore Grade (Diluted & Recovered)	**(ct/t)**	103.5
Contained Product (Diluted & Recovered)	**(kct)**	18,312
	(kg)	3,855
Strip Ratio	**$(t_{waste}:t_{ore})$**	33.5

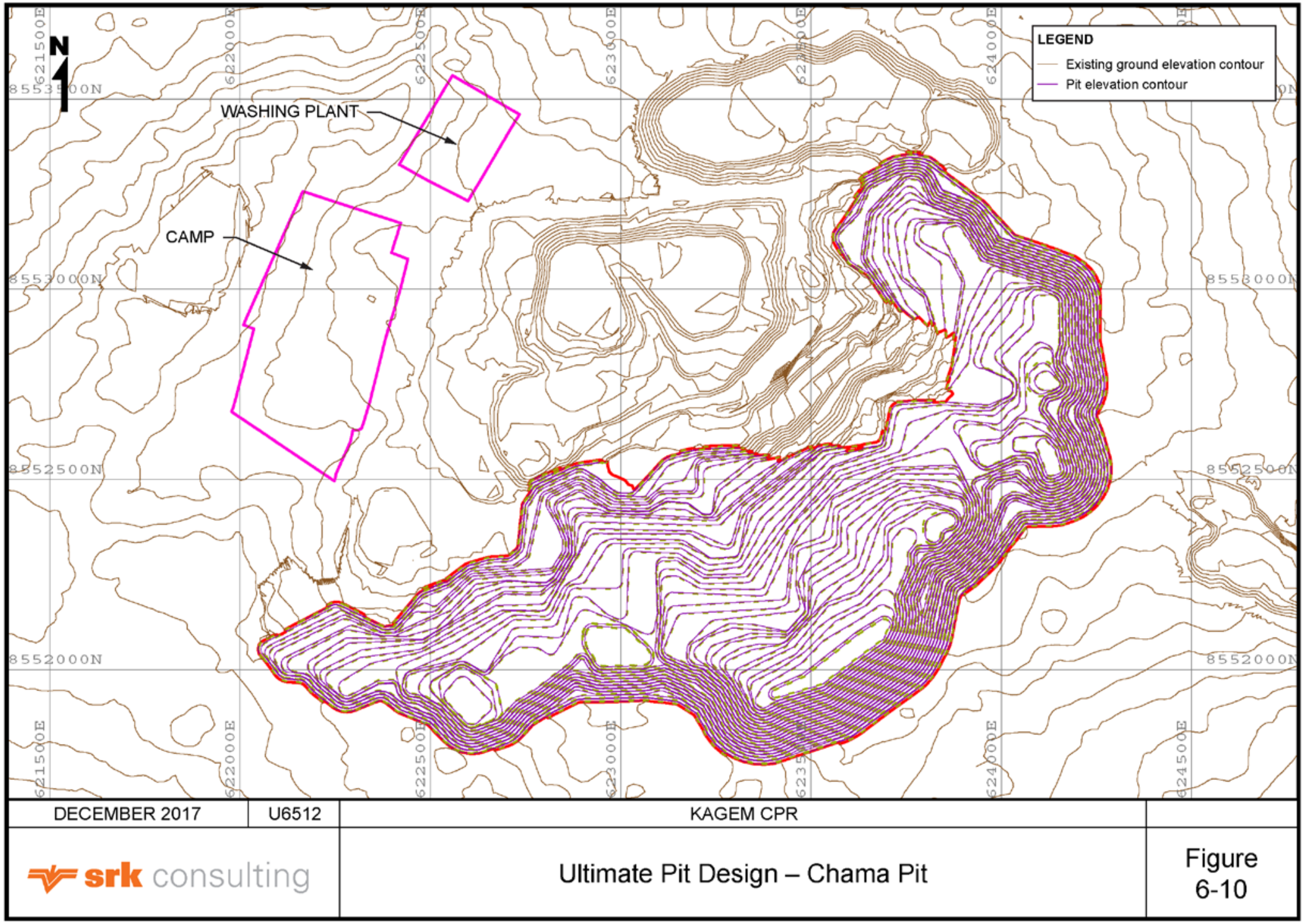


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Figure 6-10: Chama Ultimate Pit Design (Contour intervals are 1m)

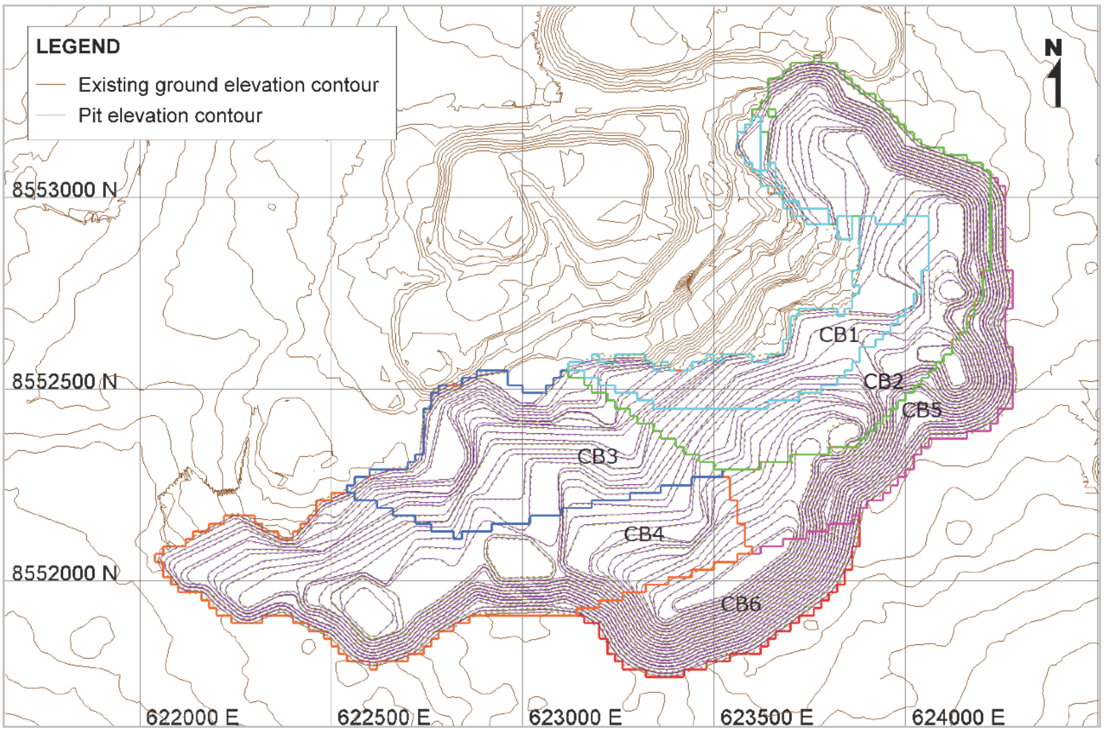


Figure 6-11: Chama Scheduling Cutback Sequence (Contour intervals are 1m)

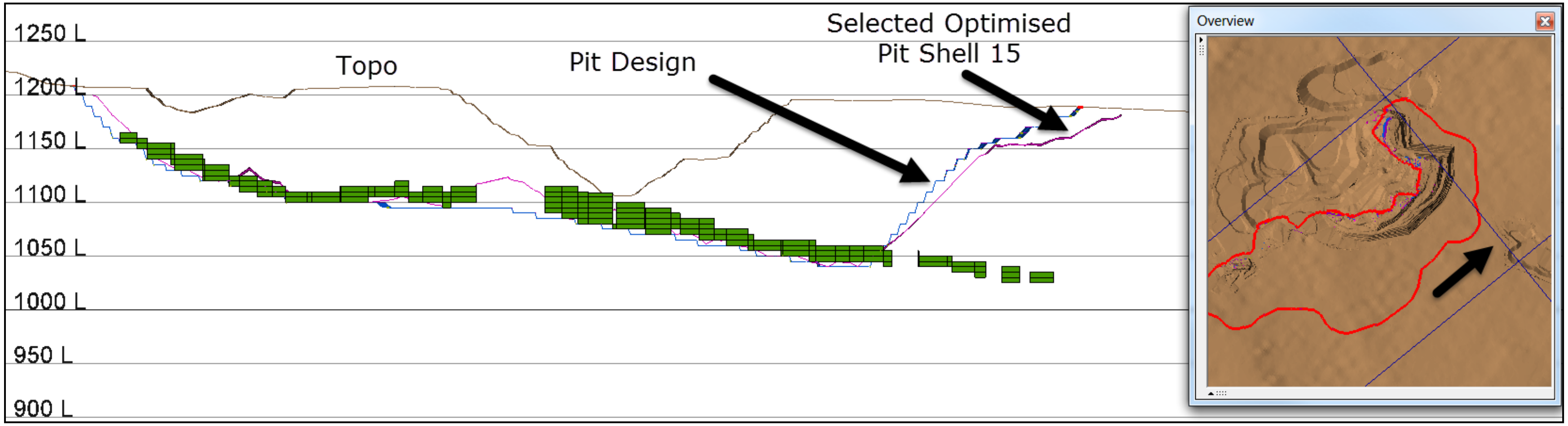
6.7.3 Comparison with Optimised Pit Shell

As the optimised shell and ultimate pit design have not changed for the CPR 2017, the comparison between the ultimate pit and the shell as given in the 2015 CPR is retained below in Table 6-18. The CP notes that moving from the optimised pit shell to the engineered design has resulted in a 7% loss is RZ ore, and a 1.5% increase in waste rock, and is deemed to be within reasonable design tolerance. The main cause of the ore losses was the application of the minimum mining width in the design.

Table 6-18: Chama Final Pit Design Comparison with Optimised Pit Shell

	Unit	Engineered Ultimate Pit Design	Selected Optimised Pit Shell	Difference	(%)
Total Rock	**(kt)**	**284,082**	**280,110**	**3,972**	**1.4**
Waste	**(kt)**	280,415	276,166	4,249	1.5
RZ Ore (Diluted & Recovered)	**(kt)**	3,667	3,945	-278	-7.0
RZ Ore Grade (Diluted & Recovered)	**(ct/t)**	300	300	0	0.0
Contained Product (Diluted & Recovered)	**(Mct)**	1,100	1,183	-83	-7.0
	(kg)	220,029	236,685	-16,656	-7.0
Strip Ratio	**(t_{waste}:t_{ore})**	76.5	70	6	9.2

A number of representative cross sections through the ultimate pit design and optimised pit shell are shown in Figure 6-12, and are shown with the Mining Block Model, colour coded with the ore bearing blocks. The blocks are coded green to indicate that they are ore bearing.


1250 L
1200 L
1150 L
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1050 L
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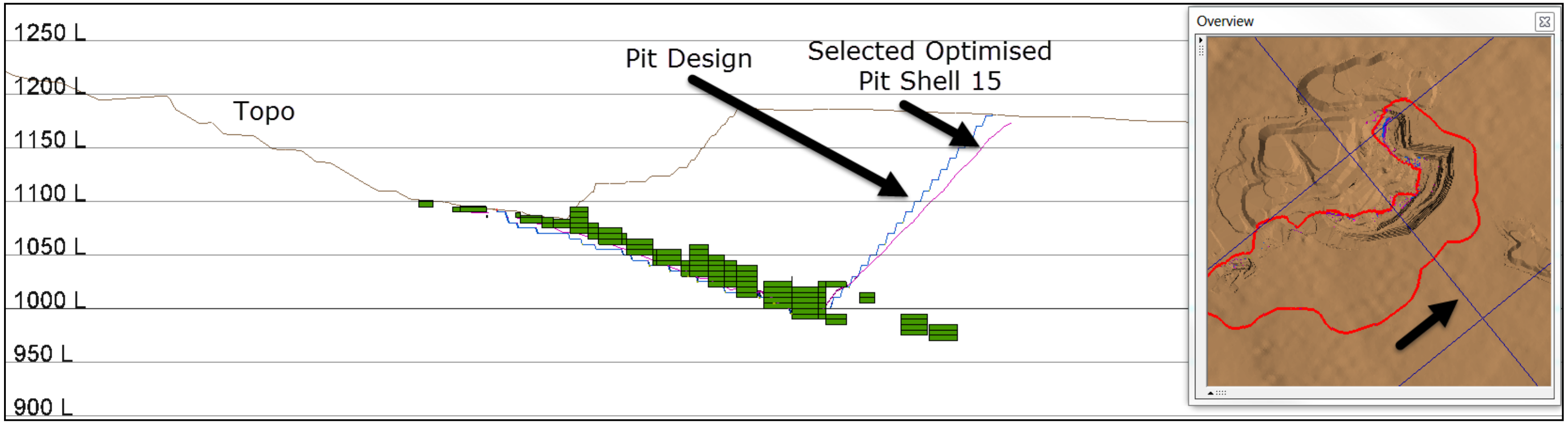
950 L
900 L
Topo
Pit Design
Selected Optimised
Pit Shell 15
Overview


1250 L
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950 L
900 L
Topo
Pit Design
Selected Optimised
Pit Shell 15
Overview

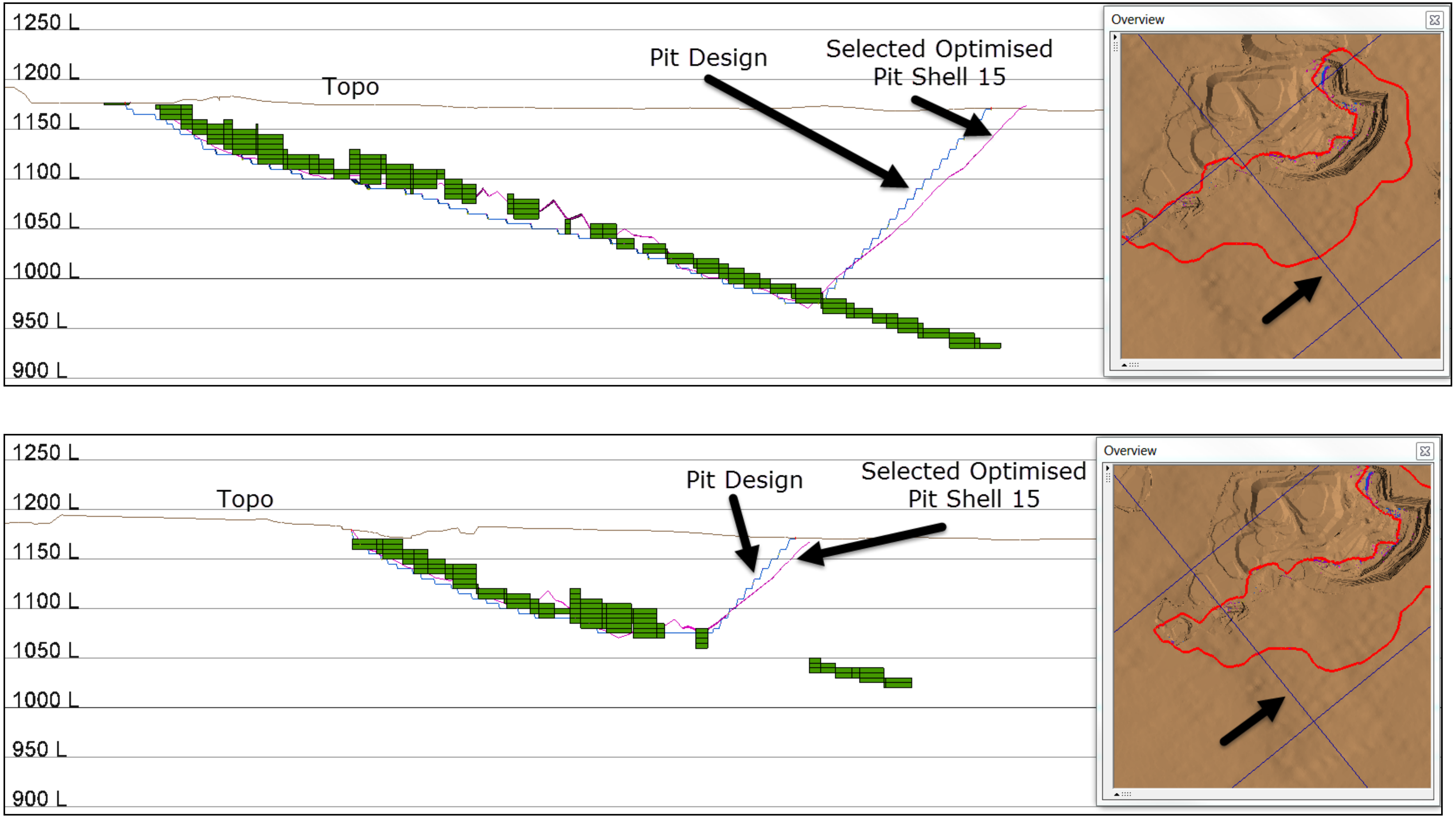

Figure 6-12: Ultimate Pit Design, Optimised Pit Shell and Mining Block Model Ore Bearing Blocks Cross Sections

6.7.4 Conclusions and Recommendations

Conclusions

The following key conclusions are made for the Chama pit design, taking into account the 31 December 2017 face position:

- the Chama design consists of a single open pit, with an approximate total strike length of 2.4 km, pit crest perimeter of 8.2 km, maximum depth of 200 m (975 mRL), and a maximum crest to crest width perpendicular to strike of 865 m;
- ultimate pit design inventory of 3,354 kt of diluted and recovered RZ ore at a RoM grade of 256 ct/t, at a strip ratio of 76.1 to 1 (t_{waste}:t_{ore});
- total rock of 258 Mt, and total contained product of 858 Mct B&E; and
- the results of the strategic assessment lead to the development of six conceptual cutback shells within the ultimate pit design for use in mine scheduling.

The CP has used adjusted optimised pit shell quantities for the basis of the mine planning quantities for Fibolele.

Recommendations

The CP recommends the following is undertaken as part of further study:

- undertake engineered cutback designs to improve upon the conceptual cutback shells;
- review the use of 5 m bench resolution on the footwall contact, and refine pit design if deemed suitable; and
- undertake engineered pit design for the Fibolele pit. A design has been completed by the engineers on site, but it is recommended this is adapted to the SRK shell and an update to local geotechnical conditions is recommended as the pit goes deeper.

6.8 Waste Rock Dump Design

The current ex-pit waste rock dump locations are planned to be extended to accept waste rock from the Chama open pit. In addition, existing and future in-pit waste dumping capacity is planned to be utilised predominantly for the TMS waste material, which should provide a shorter haul distance for this material compared to dumping at the ex-pit waste dumps. The CP has undertaken preliminary designs for extending the current ex-pit and in-pit waste dumps at Chama. These need further geotechnical work to ensure their long term stability.

The CP has not undertaken engineered waste dump designs for Fibolele; however, the CP understands that the current planned waste rock dumps are suitable for Kagem’s internal mine plan, which is similar in scale to the LoMp quantities at Fibolele. The CP recommends that engineered waste dump designs are developed for Fibolele as part of future work.

6.8.1 Design Parameters

Kagem management is planning to construct the waste rock dumps with pit closure in mind, which is in line with the 2014 Kagem Environmental Management Plan. The EMP states that reclamation of waste rock dumps will be achieved by combining good construction practice according to engineering design and progressive re-vegetation of dump slopes and upper surfaces.

Based on discussions with Kagem staff and the above environmental management plan objectives, the CP has undertaken designs for the ex-pit and in-pit dumps to facilitate progressive and practical closure. The design approach assumes that the waste dumps will be constructed at an operational slope configuration during the operational phase of the Mine, and the majority of the slope re-contouring will be undertaken during the mine life.

The slope configuration and operational waste rock dump design parameters are given in Table 6-19, and schematic cross sections of the ex-pit waste dump slope operational and closure slope configurations are shown in Figure 6-13 and Figure 6-14 respectively.

Based on the relatively high strength characteristics of the waste rock and low proposed overall slope angle, the CP does not envisage geotechnical stability to be an issue for the waste rock dumps at the Kagem Mine but recommends further work and monitoring to confirm this.

Table 6-19: Waste Rock Dump Design Parameters

	Unit	Operational Slope	Closure Slope	Basis
Geotechnical Parameters				
Maximum Dump Height	(m)	120	120	Discussion with Kagem.
Overall Slope Angle	(Deg)	22	20	Appropriate operational and closure overall slope angle.
Inter-Berm Slope Angle	(Deg)	35	24	Angle of rill and practical closure inter-berm slope angle.
Berm Width	(m)	40	10	Operational berm and erosion control and closure.
Lift Height	(m)	30	30	Current practical lift heights.
Operating Parameters				
Ramp Width	(m)	29	29	Ramp width including safety bund & toe drain.

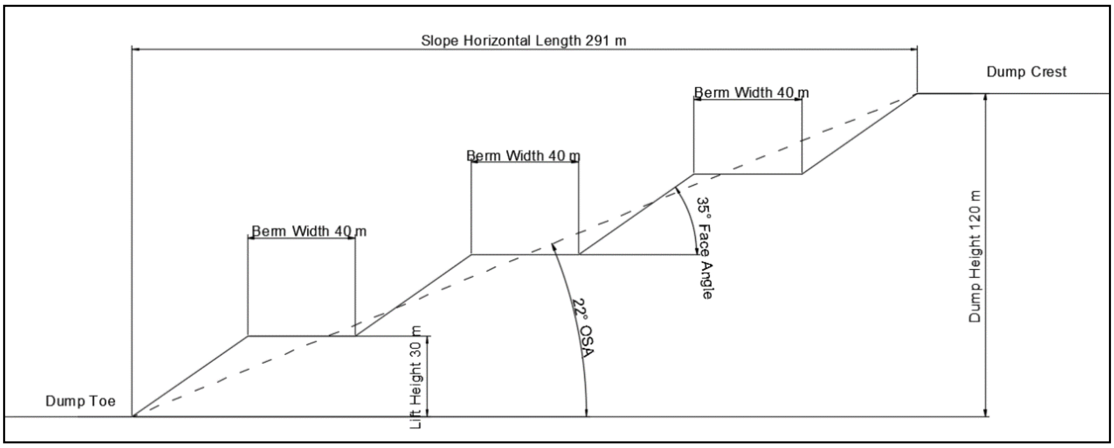

Figure 6-13: Waste Rock Dump Operational Slope Configuration Schematic

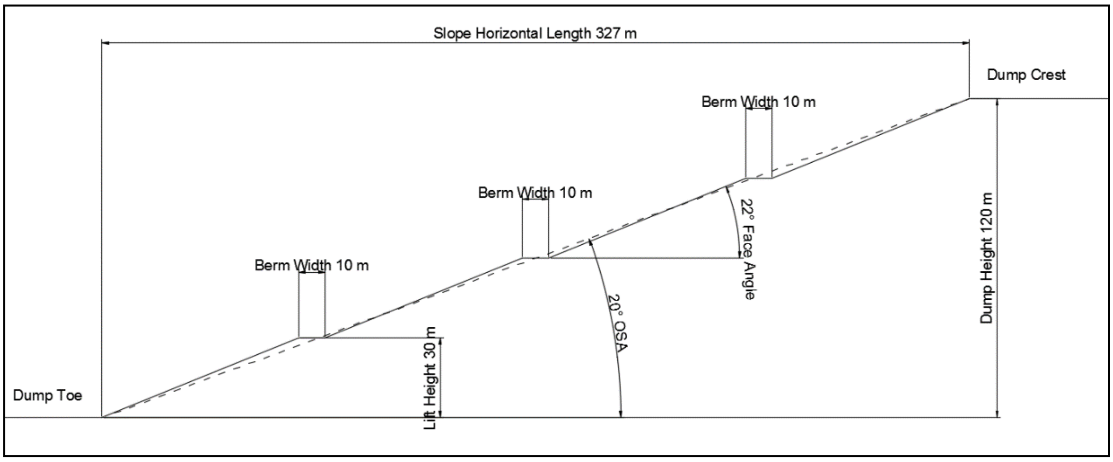

Figure 6-14: Waste Rock Dump Closure Slope Configuration Schematic

6.8.2 Engineered Waste Rock Dump Design

The CP has undertaken the waste dump designs using the closure slope configuration, as this provides the best representation of the ultimate footprint and dump profile at the end of the mine life. Based on discussion with the Client, the current swell factors achieved at site are in the region of 15-20%. In order to estimate the required waste dump capacities, the CP has assumed a swell factor of 20% for the waste material, and the estimated swollen densities are given in Table 6-20. The CP has made assumptions on the proportion of waste rock to be dumped in the ex-pit and in-pit dumps, and the proportions are provided in Table 6-21.

Table 6-20: Waste Swell Factor and Densities

	Units		Basis
Swell Factor	**(%)**	20	Discussion with Client on current site swell factor estimate.
In Situ Rock Densities			
Cake	**(t/BCM)**	2.20	SRK Resource Model.
PEG	**(t/BCM)**	2.65	SRK Resource Model.
Non-TMS Waste	**(t/BCM)**	2.40	SRK Resource Model.
TMS	**(t/BCM)**	2.85	SRK Resource Model.
Swollen Rock Densities			
Cake	**(t/LCM)**	1.83	
PEG	**(t/LCM)**	2.21	
Non-TMS Waste	**(t/LCM)**	2.00	
TMS	**(t/LCM)**	2.38	

Table 6-21: Waste Dump Material Proportions

	Unit	Total Waste	Cake	PEG	Non-TMS Waste	TMS
Total	**(%)**		**100**	**100**	**100**	**100**
	(Mt)	**280.4**	**41.6**	**42.8**	**150.5**	**45.4**
	(MBCM)	**113.7**	**18.9**	**16.2**	**62.7**	**15.9**
	(MLCM)	**136.5**	**22.7**	**19.4**	**75.3**	**19.1**
Ex-Pit Waste Dump	**(%)**		100	100	100	20
	(Mt)	**244.1**	41.6	42.8	150.5	9.1
	(MBCM)	**101.0**	18.9	16.2	62.7	3.2
	(MLCM)	**121.2**	22.7	19.4	75.3	3.8
In-Pit Waste Dump	**(%)**		0	0	0	80
	(Mt)	**36.4**	0.0	0.0	0.0	36.4
	(MBCM)	**12.8**	0.0	0.0	0.0	12.8
	(MLCM)	**15.3**	0.0	0.0	0.0	15.3

The engineered ex-pit and in-pit waste rock designs are shown in Figure 6-15 along with the engineered pit design, and the design capacities are given in Table 6-22 and are summarised below:

Ex-Pit Waste Dump:

- maximum height of 100 m from topography;
- volume capacity of 135.7 MLCM; capacity for 100% of cake, PEG, non-TMS waste and 20% of TMS waste; and
- maximum total length of 2.6 km, maximum total width of 1.8 km and surface area of 2.58 km^2.

In-Pit Waste Dump:

- pit floor dump toe limited to toe of cutback shell 4 and 5 for practical in-pit dumping limit;
- maximum height of approximately 145 m, measured from dump tow to crest;
- volume capacity of 17.6 MLCM; capacity for 80% of TMS waste; and
- the dump is designed over the full strike of the pit to provide dumping location flexibility over the mine life and maximise in-pit capacity.

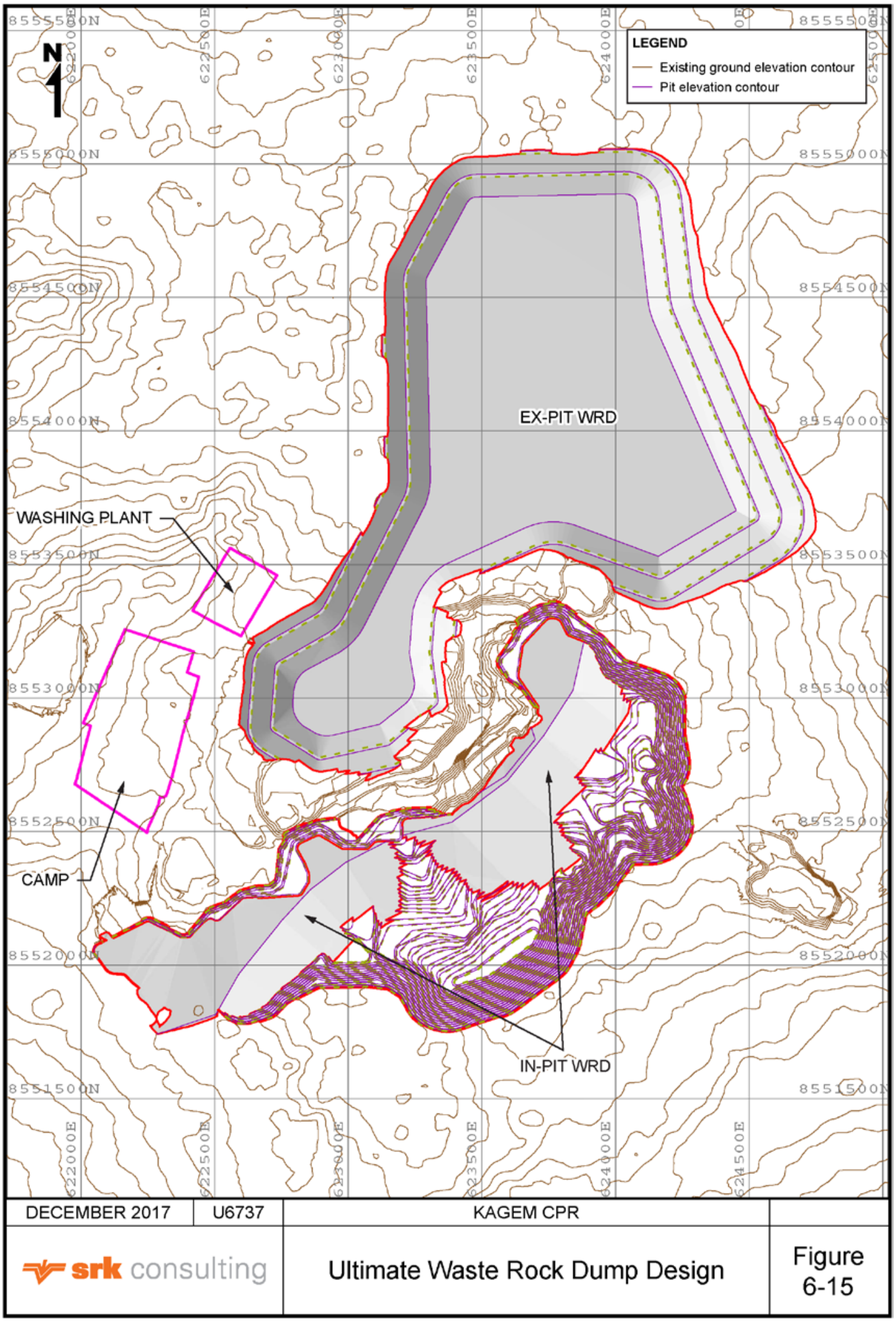

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Figure 6-15: Ultimate Waste Rock Dump Design (Contour intervals are 1m)

Table 6-22: Ultimate Waste Rock Dump Design Capacity

	Unit	Ex-Pit Waste Dump	In-Pit Waste Dump
Design Capacity	**(MLCM)**	135.7	17.6
Required Capacity	**(MLCM)**	121.2	15.3
Difference	**(MLCM)**	14.5	2.3
	(%)	12.0	15.0

6.8.3 Conclusions and Recommendations

Conclusions

The following key conclusions are made for the waste rock dump design:

- The CP has developed ex-pit and in-pit waste rock dump designs for Chama at an appropriate closure overall slope angle of 20 degrees;
- the ex-pit waste dump design has capacity for 100% of the cake, PEG, non-TMS waste and 20% of the TMS waste;
- the in-pit waste dump has capacity for 80% of the TMS waste; and
- a 20% swell factor has been used to estimate the ex-pit swollen rock volumes.

Recommendations

The CP recommends the following is undertaken as part of further study:

- undertake a trade-off study between dump height and dump length to ensure the design and slope configuration facilitates efficient waste haulage and dumping;
- undertake a trade-off for alternative waste dump locations, and determine if the alternative dump locations may provide more efficient waste hauls; and
- undertake engineered waste rock dump designs.

6.9 Operating Strategy

6.9.1 Drill and Blast

Drilling and blasting is undertaken by the both the mining contractor and in-house operator. Both fleets utilise track mounted drill rigs, drilling 89 mm production holes on 3-6 m benches, and use emulsion based explosives. The drill patterns are drilled on 4 x 4 m and 3 x 3 m square patterns with powder factors of 0.26 – 0.60 kg/m^3, depending on rock type. Blasting is generally undertaken most days.

6.9.2 Equipment Operating Time

The operation is assumed to operate 351 days per year, based on 7 days a week operation with 14 days per year national holidays. The waste mining fleet operates three shifts of 8 hours over 24 hours a day, and the ore production fleet operates a single 12 hour shift which includes a lunch break during the day. Based on information provided by the Client, the majority of the mining equipment is scheduled to operate approximately 4,220 effective direct operating hours per year, and the production excavators and trucks will operate approximately 1,900 effective direct operating hours per year. These estimates are based on the scheduled operating hours, 90% mechanical availability and 85% use of availability provided by the Client.

6.9.3 Equipment Productivities

The primary waste excavator loading productivities are estimated at 2.4 – 3.1 Mtpa depending mining location and material type. The production excavator loading productivities are estimated at 300 – 360 ktpa depending on mining location and material type. The CP notes that the productivity of the production excavators is relatively low due to operating only during daylight hours, and the restricted rate of mining within the TMS zones and around the RZ ore. The productivity rates are deemed reasonable and appropriate for the continuing operations. The estimated productivities are based on information provided by the Client and are comparable to the historic productivities provided by the Client.

6.10 Mine Production Schedule

The CP has developed production schedules for the Chama Mine and Fibolele pit, as described below:

- Chama Mine: 110 ktpa ore production in year 2018, ramping up to 130 ktpa in 2020 (over three years). The annual total material moved is as low as possible to achieve this target. Strategic scheduling in Whittle has revealed that the total material moved per annum can drop to 11.0 Mtpa for the first 10 years. From 2029 a small increase to 11.5 Mtpa is enough to carry the stripping hurdle that exists in later years, with help from the Fibolele pit in 20330; and
- Fibolele Pit: The strategy for this pit has changed due to the outcome of the Chama schedule. The Fibolele pit is now proposed to be used to reduce shortfalls in carat production at some crucial periods. The Fibolele pit is proposed to be mined for for 1 year in 2030, after which the pit is mined out when the Chama pit is reaching its end and can no longer sustain the ore production.

The CP has undertaken the LoMp production scheduling in Whittle software, and has used the ultimate pit design and cutback shell inventories as the basis for the scheduling for Chama. The mine schedule for Fibolele was undertaken in Whittle software, and used the ultimate pit shell adjusted for likely design ore losses and waste increases. The CP notes the schedules in previous editions of the CPR have been developed on an annual basis from July to June each year, which was the Client’s historical financial reporting year. However the Client has now changed their financial year to align with calender years and scheduling is therefore now presented based on calendar year.

6.10.1 Scheduling Targets

The following key scheduling targets were used for developing the mining schedules:

Chama Mine:

- target a combination of ore production from the lower strip ratio – lower confidence zones and higher strip ratio – higher confidence zones;
- ramp up from 110 ktpa to 130 ktpa ore production over four years;
- maintain a relatively constant strip ratio over the mine life; and
- mine to a rate of a maximum of 12 Mtpa.

Fibolele Pit:

- a maximum of 1.2 Mtpa total material moved; and
- a target of 31 kt of ore per annum

6.10.2 Scheduling Constraints

The following key scheduling constraints were used for developing the mining schedules:

- topography as of end of December 2017;
- maximum vertical sink rate of 6 x 10 m benches (60 m) per cutback per year. It should be noted that Figure 6-20 shows activity on 8 benches, however that does not represent a sink rate as benches at surface need to be mined down as the stripping in the HW lagged behind. The pit sinks only 20 m per annum during those periods;
- maximum total rock handling at Chama of 11.5 Mtpa, and 1.2 Mtpa at Fibolele; and
- no stockpiling is considered.

6.10.3 Life of Mine Plan

Material Movement

Figure 6-18 and Figure 6-19 show the total material movement (“TMM”), ex-pit rock by rock type, ex-pit rock by cutback and ore production by cutback for Chama and Fibolele respectively. Details of the mining production schedules are summarised below:

Chama Schedule:

- 27 year mine life;
- TMM ranges from 11.0 to 11.5 Mtpa for the majority of the mine life; and
- strip ratio ranges from 84 to 99 to 1 for the majority of the mine life, with a slight stripping hurdle of 118 in 2030.

Fibolele Schedule:

- 5 year mine life;
- TMM is 1.2 Mtpa for 2 years and then drops; and
- strip ratio peaks at 48 to 1 in the second year scheduled and then drops.

Strategic Scheduling

Using the strategic scheduling capabilities of the Whittle software, a mine plan was devised that matched the scheduling requirements. To force Whittle to mine in the central part of the pit during 2017, as well as to mine to a constant strip ratio, the cutbacks as shown in Figure 6-11 were split into smaller cuts which were given a mining sequence number. This resulted in a smooth schedule as can be seen in Figure 6-18. The cutbacks 5 and 6 were combined into one cutback named 5 as there was no strategic gain to be found in mining them separately.

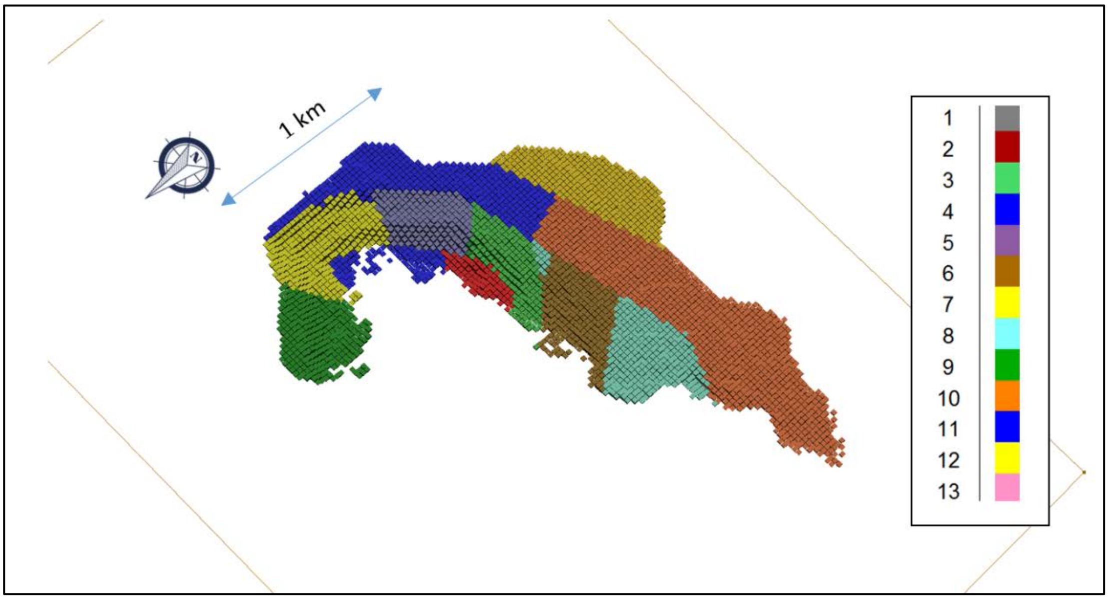

Figure 6-16: Mining Sequence Cuts for Strategic Scheduling

The following screenshot of the year 2019 of mining the Chama pit shows the philosophy adapted in producing the mine plan. The staggered bench approach that allows stripping the HW whilst granting the quickest possible access to the central pit floor is essential for achieving the highest possible carat yield. The carat production profile shows lower grade for the first four years, but limited access to higher grade blocks makes this unavoidable.

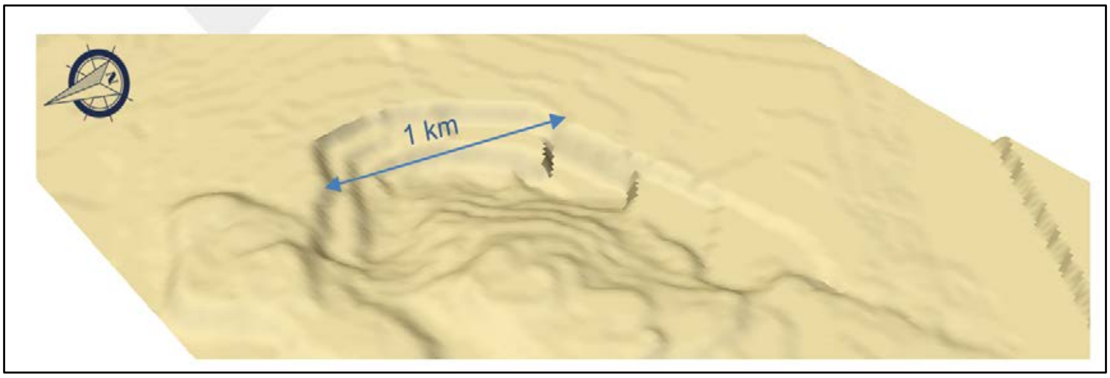

Figure 6-17: Staggered benches in the HW of Chama pit

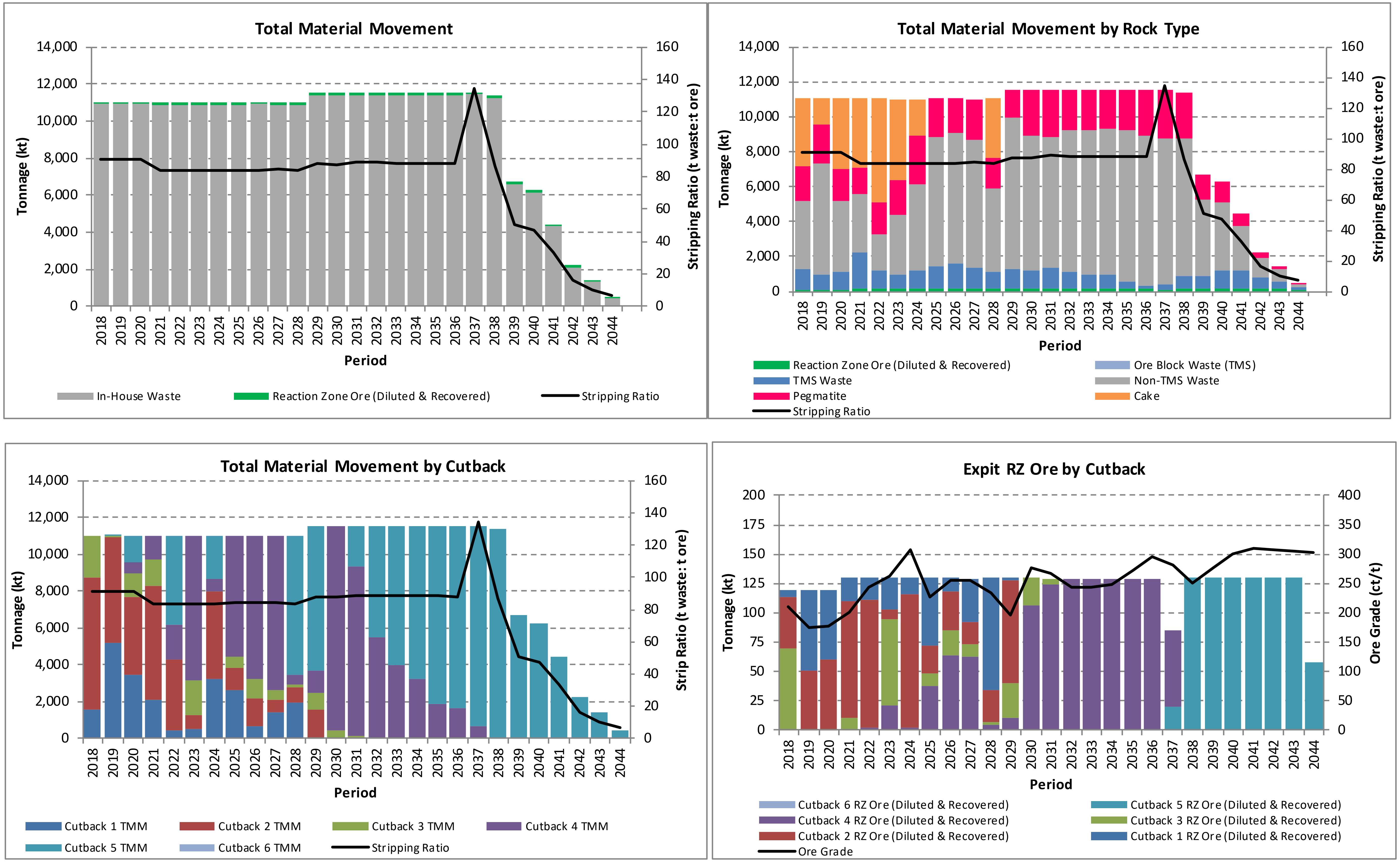

Figure 6-18: Chama Pit Total Material Movement and Ex-Pit RZ Ore

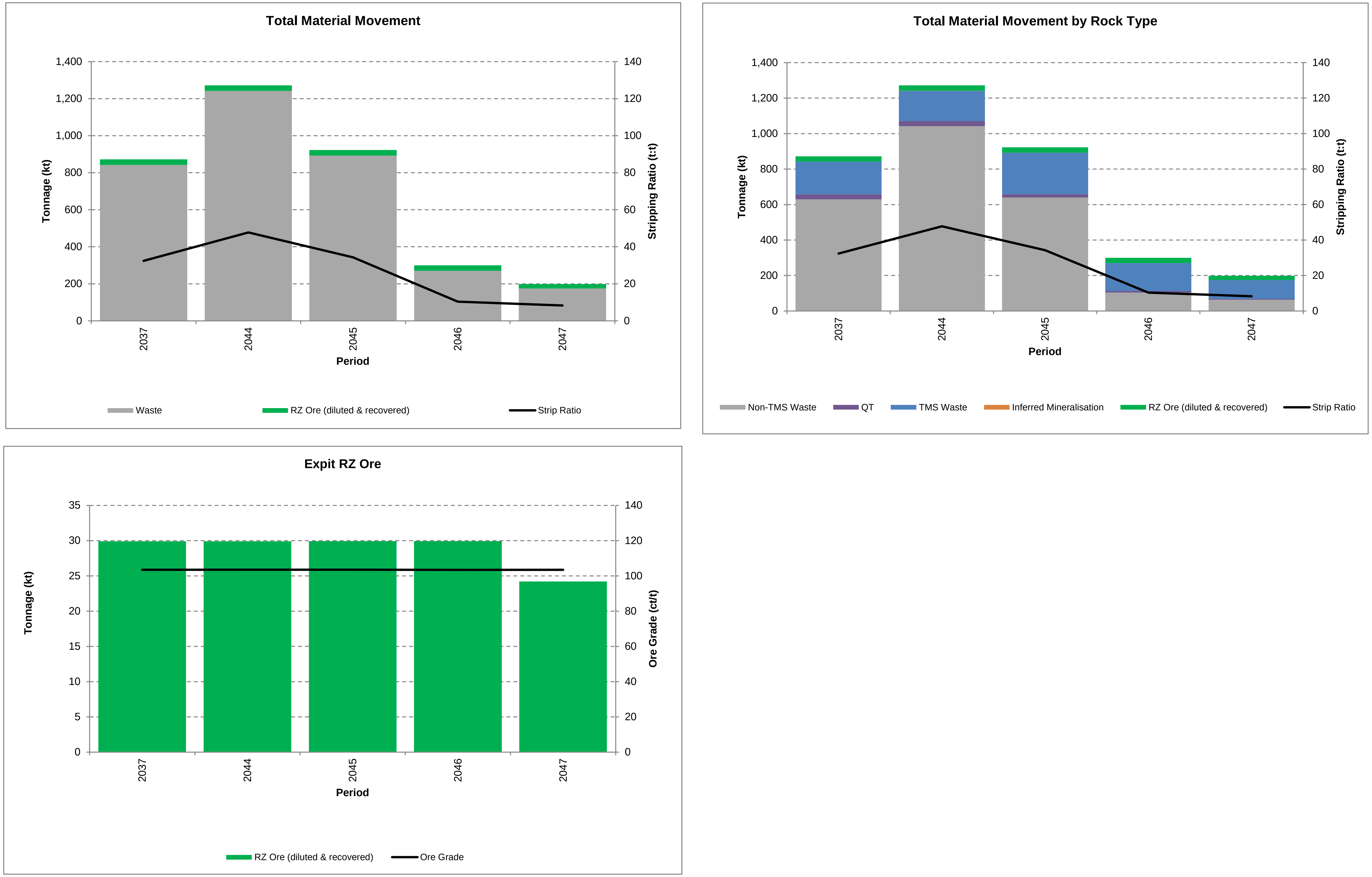

Figure 6-19: Fibolele Pit Total Material Movement and Ex-Pit RZ Ore

Bench Advance

The number of actively mined benches by cutback are given for the Chama schedule in Figure 6-20. The number of benches that are active has increased compared to the 2015 CPR schedule. This is a result of the need to get the production back in line with the 2015 plan, and to open up the mining in the central part of the pit. For this reason the HW needs to be pushed down 6 benches, but the pit floor only needs to be pushed down 2 benches. The schedule is therefore considered achievable given the fleet is available as planned.

The Fibolele schedule has been limited to five benches per year.

Both schedules have reasonably low and practical bench turnover rates, and therefore the schedules are regarded as being practical and achievable with regard to sink rate.

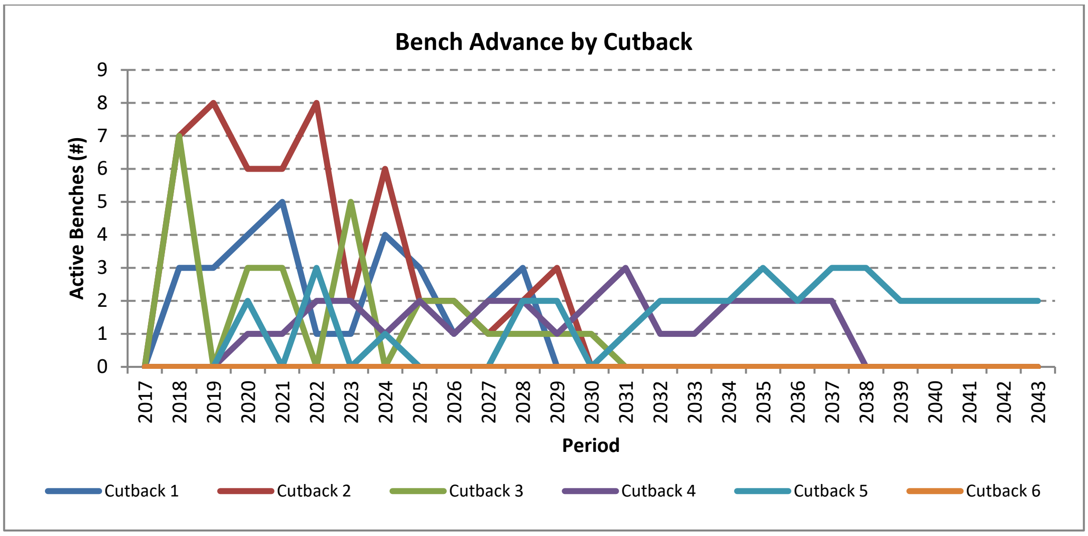

Figure 6-20: Bench Advance by Cutback: Chama Schedule

6.10.3.1 Updated Depleted Inventories

Due to the changed mining sequence, the inventory for the individual cutbacks has been grouped differently than in the 2015 CPR. The following two tables describe the depleted inventory for the updated 2018 LoMp.

Table 6-23: Ultimate Pit Design & Cutback Diluted Inventories (December 2017 face positions) for Chama pit

	Units	Total	Cutback 1	Cutback 2	Cutback 3	Cutback 4	Cutback 5
Total Rock	**(kt)**	**257,878**	**23,209**	**38,506**	**10,709**	**74,126**	**111,328**
Waste	**(kt)**	254,525	22,790	37,830	10,452	72,982	110,470
Cake	**(kt)**	29,369	2,856	4,619	2,843	7,928	11,122
Non-TMS Waste	**(kt)**	149,910	11,822	16,704	4,410	41,785	75,190
PEG	**(kt)**	50,159	5,868	7,736	1,629	15,954	18,971
TMS Waste	**(kt)**	25,087	2,244	8,772	1,569	7,316	5,187
RZ Ore (Diluted & Recovered)	**(kt)**	3,354	419	676	257	1,144	858
RZ Ore Grade (Diluted & Recovered)	**(ct/t)**	256	200	221	245	273	291
	(g/t)	51	40	44	49	55	58
Contained Product (Diluted & Recovered)	**(Mct)**	858	84	150	63	312	250
	(kg)	171,649	16,735	29,930	12,585	62,489	49,910
Strip Ratio	**(t_{waste}:t_{ore})**	75.9	54	56	41	64	129

Note: due to a different modelling method in GEMS, the TMS waste in ore blocks (reported as a separate category in the 2015 CPR figures) is reported within the TMS category.

Table 6-24: Fibolele Pit Quantities (December 2017 topo)

	Unit	
Total Rock	**(kt)**	**3,565**
Waste	**(kt)**	3,421
RZ Ore (Diluted & Recovered)	**(kt)**	144
RZ Ore Grade (Diluted & Recovered)	**(ct/t)**	103.5
Contained Product (Diluted & Recovered)	**(kct)**	14,888
	(kg)	2,978
Strip Ratio	**(t_{waste}:t_{ore})**	27.3

6.10.4 Haulage Travel Time Estimate

The CP has undertaken an estimate of the haulage travel times for the ore and waste material for the Chama schedule. The CP has not undertaken a haulage estimate for the Fibolele pit schedule; however, the CP has carried out appropriate checks and is satisfied that the haulage fleet capacity available at Fibolele is sufficient for the planned production rate.

The haul distances done by SRK for the 2015 CPR are still considered appropriate, considering there has been no change in mining method, destinations, nor mining areas. The haul time estimates have therefore been updated using the new mining schedule.

The travel time estimate is based on the bench schedule, 1 in 10 ramp gradient, estimated haul speeds and estimated haul route distances. The assumed haul speeds are given in Table 6-25.

Table 6-25: Haul Speeds

	Units		Basis
Loaded Speeds			
In-Pit, Flat Loaded	(km/h)	15	On-bench haul speed.
Ramp Up-Hill, Loaded	(km/h)	12	13% TRR CAT 740 Rimpull Curve.
Pit Crest to Destination, Flat Loaded	(km/h)	25	Practical assumed haul speed.
Haulage at Destination, Flat Loaded	(km/h)	20	Practical assumed haul speed.
Empty Speeds			
Haulage at Destination, Flat Empty	(km/h)	25	Practical assumed haul speed.
Destination to Pit Crest, Flat Empty	(km/h)	30	Practical assumed haul speed.
Ramp Down-Hill, Empty	(km/h)	25	Practical assumed haul speed.
In-pit, Flat Empty	(km/h)	20	On-bench haul speed.

The CP has estimated the representative haulage distances for each cutback based on measurements from topography, pit and waste rock dump designs and pit depth.

The estimated haulage distances, travel times and equipment haulage productivities are given in Figure 6-21, and are summarised below:

- waste and production truck productivities are relatively low, and reduce over the mine life due to increasing haul distances and travel times;
- ore and waste travel times increase annually at a varying rate depending on cutback;
- two way travel times range from approximately 10 minutes to a maximum of 28 minutes; and
- average truck speeds remain relatively stable between 16.5 – 20.0 km/h over the mine life.

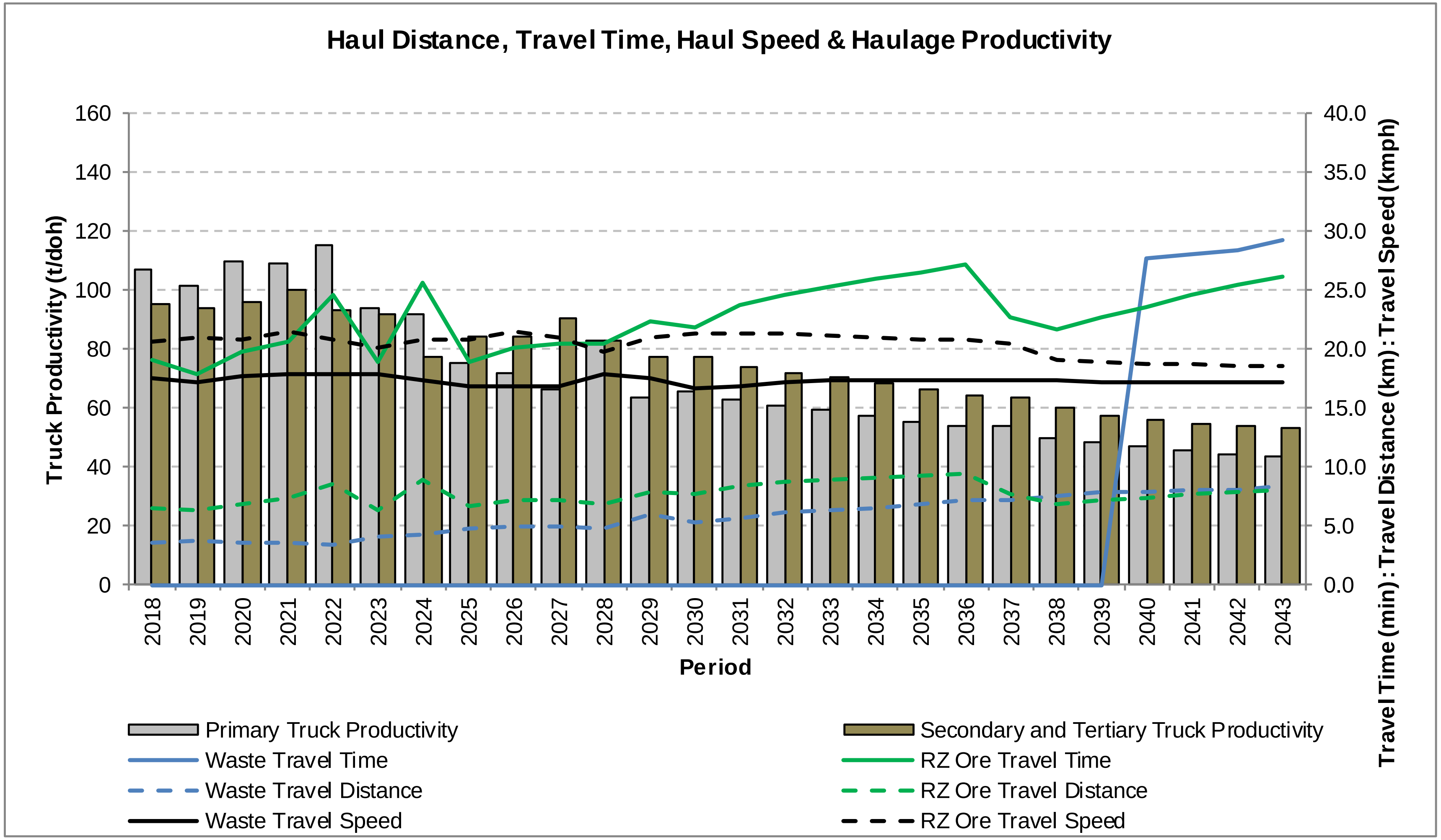

Figure 6-21: Estimated Haul Distances, Travel Times and Haulage Productivity: Chama Schedule

6.10.5 Conclusions and Recommendations

Conclusions

The following key conclusions are made for the LoMp:

- production schedules for Chama and Fibolele have been developed, which provide potential mine lives of 27 and 5 years respectively;
- Chama schedule incorporates an ore ramp up from 110 to 130 ktpa over three years;
- Fibolele schedule is mined at 31 ktpa, but is mined intermittently to cover for carat production shortfalls at Chama;
- both schedules are deemed practical and achievable with regard to vertical sink rate;
- haulage travel times for the Chama LoMp increase annually and range from 10 minutes to 28 minutes; and
- carat shortfalls could not be eliminated during 2018 – 2021, and 2027 and 2028. A stockpiling facility could further enhance the plan, however it is recognised that this introduces a security risk.

Recommendations

The CP recommends the following is undertaken as part of further study:

- undertake more detailed mine scheduling and an improved estimation of haulage distances and travel times;
- undertake site-based cycle time measurement and analysis to accurately determine the current cycle times being achieved on site for the waste and production haulage fleets. This information can then be used to calibrate future haulage estimates;
- future scheduling should utilise engineered cutback designs, rather than conceptual cutback shells;
- waste haulage should be optimised to ensure a practical and efficient combination of long and short hauls, and more accurately define the haulage for in-pit waste dumping. The CP notes the scheduling of long and short hauls to balance haulage fleet productivity is generally handled as part of site based operational planning; and
- undertake a trade-off study to determine the viability and potential advantages to utilising larger load and haul equipment, specifically for the waste mining activities. This point will be re-iterated in the next section on equipment requirements.

The CP considers that the accuracy of modifying factors are appropriate for the small amount of Proved Reserves that have been classified. The recommendations relate to improving confidence in the planning process even further. The recommendations are related to optimising the cutback sequence, haulage options and costs, but do not influence the confidence in the tonnage and grade estimates. Additionally, the profit margin on the Reserves is significantly large as to negate expected small changes in operating costs or changes to the cut back sequences, which will thus not affect the size of the Reserves.

6.11 Equipment Requirements

The mining equipment fleet requirements are calculated based on the mine production schedules, existing fleet and equipment productivities, and assumes that sufficient ancillary equipment will be available across the Kagem site to provide operational support.

Based on Kagem's operating strategy, mining will be undertaken by two to three waste excavators (4.6 m^3 bucket capacity), which are identified as the Primary fleet, and four to seven production excavators (2.4 m^3 bucket capacity), which are designated the Secondary fleet. In addition to this, one excavator with 6m^3 bucket capacity has been bought with four 45 t ADT trucks, which will be augmented by another shovel and 4 trucks of the same capacity during June 2018.

The equipment capital purchase cost and machine life used in the CPR are based on information provided by Gemfields and the CP's internal estimates, and are provided in Table 6-26. The equipment requirements for Chama and Fibolele are shown in Figure 6-22 and Figure 6-23 respectively.

Gemfields notified the CP that the projected mine life used on site is 23,000 hours. Information gathered from equipment manufacturers shows that a minimum expected life of ADT trucks is 30,000 hours, with 35,000 hours possible. This is based on a life with 1 rebuild. The impact on the capital expenditure is significant over the long life of mine of this project, and considering the lower carat production in earlier years The CP has taken the view that the equipment life must be improved upon to increase the financial viability of the Mine. For this reason, a Machine Life figure of 30,000 hrs was assumed.

Table 6-26: Equipment Capital Purchase Costs and Machine Life

Equipment	Description	Make	Model	Machine Life (h)	Purchase (USD)
Primary Excavator	4.6 m^3 Diesel hydraulic backhoe	CAT	374D	30,000	1,200,000
Secondary Excavator	2.4 m^3 Diesel hydraulic backhoe	CAT	336D	30,000	450,000
Tertiary Excavator	6.0 m^3 Diesel hydraulic backhoe	CAT	390F	30,000	1,500,000
Primary Loader	3.0 m^3 Diesel Wheel Loader	CAT	950	30,000	450,000
Primary Truck	40t ADT	BELL	B40	30,000	550,000
Secondary Truck	30t ADT	CAT	730	30,000	425,000
Tertiary Truck	45t ADT	BELL	B45	30,000	625,000
Primary Drill	Production Drill Rig	Atlas Copco	ROC	30,000	600,000
Primary Track Dozer	D10 Dozer	CAT	D10	30,000	1,500,000
Secondary Track Dozer	D9 Dozer	CAT	D9	30,000	1,150,000
Primary Grader	14M Grader	CAT	14M	30,000	500,000
Water Truck	Water Truck & Service ADT	CAT	730 Water Truck	30,000	800,000
Fuel Truck	Mobile Field fuel/lube truck			30,000	85,800
Explosives Truck	Explosives Truck	Explosives Truck	Explosives Truck	30,000	90,000
Tire Handler	Tire Handler			30,000	425,000
Lighting Plant	Lighting Plant			30,000	25,000
Light Vehicle	Light Vehicle			35,000	50,000
Pumps	Dewatering Pump	Primax	Primax	35,000	250,000

The CP reviewed changing the equipment size which indicates that moving the waste mining equipment from ADT's and relatively small excavators to 125 t class excavators (Cat 390F, Komatsu PC1250) or even 150 t class such as the Liebherr 6015B, combined with Cat 777 trucks can lead to a reduction of capital expenditure of USD10 M. This figure does not include the expected reduction in operating cost per tonne due to increased efficiency and lower fuel consumption. The machine life for rigid frame trucks is much longer than ADT's (a minimum of 40,000 hrs) and thus fewer trucks will need to be bought.

Based on the indicated possible cost savings, the CP strongly recommends a separate study optimising the mining fleet composition and size.

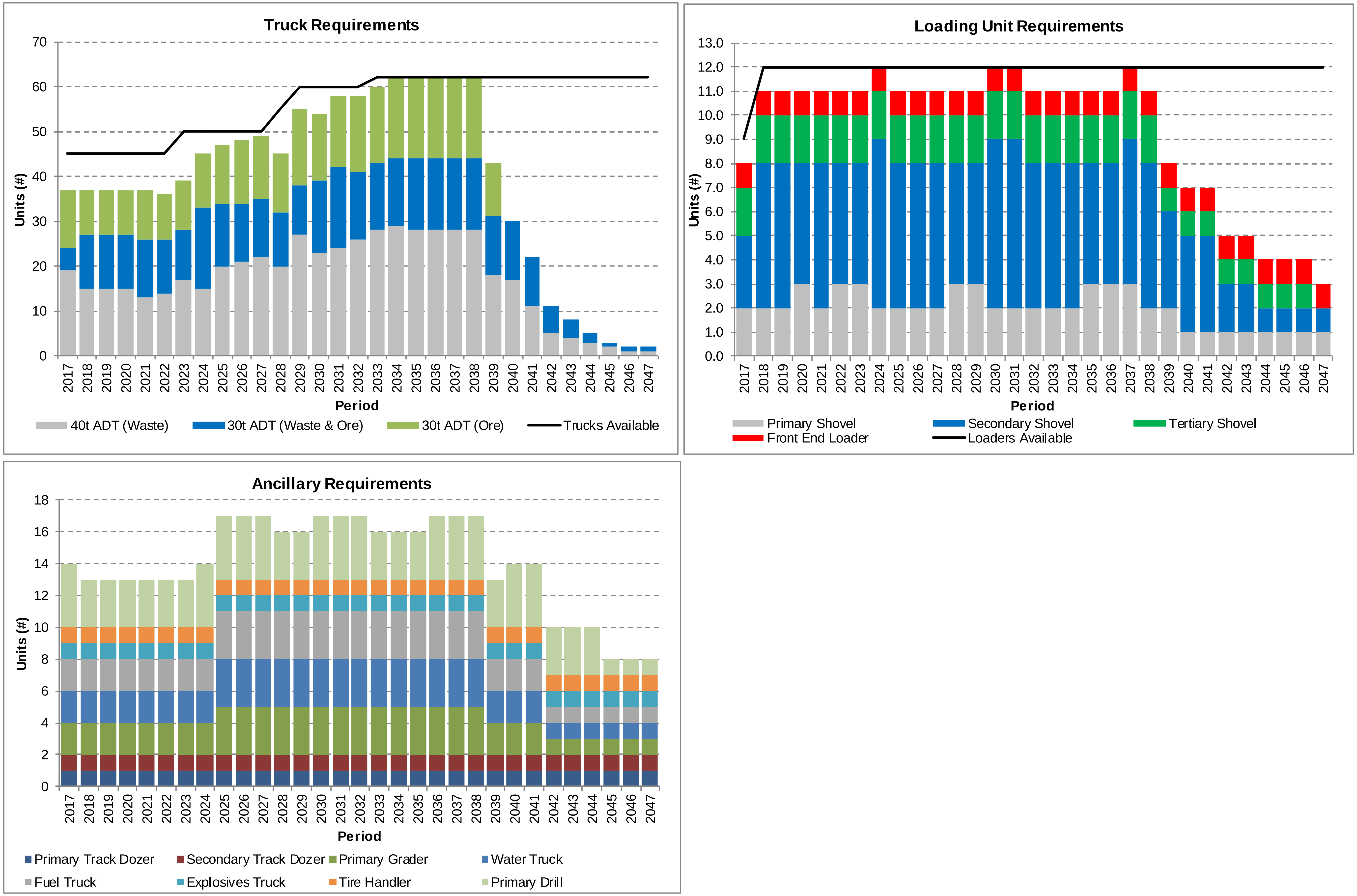

Figure 6-22: LoM Pit Equipment Requirements (Chama + Fibolele)

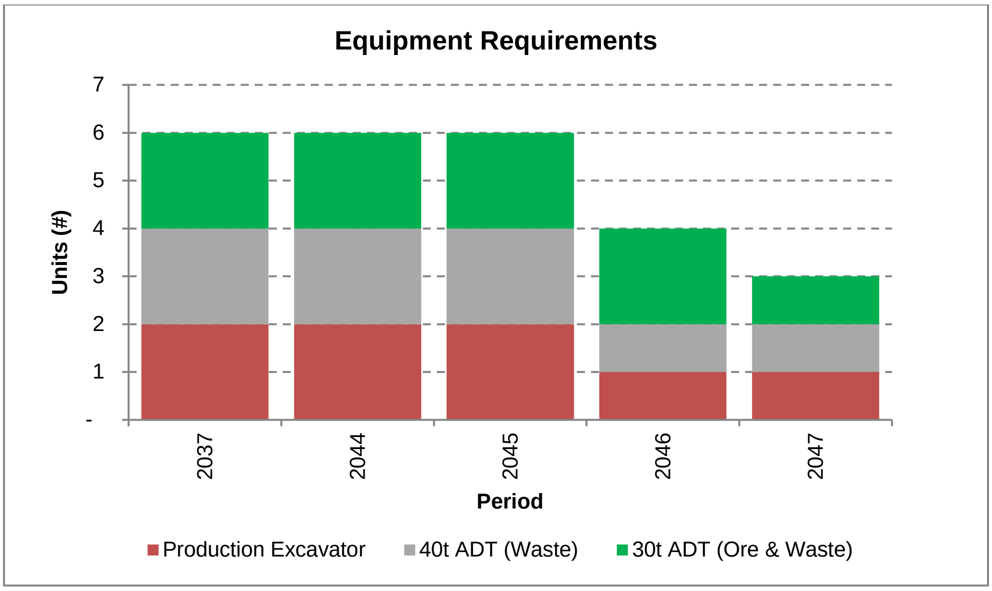

Figure 6-23: Fibolele Pit Equipment Requirements

6.12 Mineral Reserves

6.12.1 Introduction

The CP has estimated Mineral Reserves in accordance with the SAMREC Code. Details are provided in the following subsections with additional data provided in Appendix C, where the SAMREC Table 1 is presented.

6.12.2 Modifying Factors

The Modifying Factors applicable to the derivation of reserves comprise estimates for the mining dilution.

The Modifying Factors considered by the CP to be appropriate for the RZ mineralisation is based on the historical reconciliation of the proportion of RoM RZ relative to the TMS volume. The mining dilution is estimated at 15% and the diluting material is assumed to be TMS rock with a density of 2.85 t/m^3 at zero grade. Owing to the application of historical factors to derive RoM grades, no mining recovery grade adjustment factors are deemed necessary for the RZ mineralisation.

6.12.3 Emerald Prices

The CP has relied on the price forecasts provided by Gemfields for input to the financial model. The CP considers these forecasts acceptable as discussed in Section 12.4. Prices for premium emerald, emerald and beryl-1 and beryl-2 products are presented in Table 6-27.

Table 6-27: Forecast Commodity Prices

Commodity Prices (USD/ct)	2017-18+
Premium Emerald High Quality Auction	64.63
Emerald High Quality Auction[1]	64.63
Emerald Low Quality Auction[1]	4.19
Beryl-1 Low Quality Auction	0.11
Beryl-2 Low Quality Auction	0.006

Note 1. 18% of emerald products are sold at the High Quality Auction with the remainder sold in the Low Quality Auction.

These prices have been provided by Gemfields based on auction sales of gemstones from the Mine sold to date. Further justification to these prices is provided in Section 10 and 12.4.

6.12.4 Mineral Reserve Statement

The CP confirms that the Mineral Reserve statements presented in Table 6-28 have been derived from the Resource model authored by SRK. Based on the results of the financial modelling, the break-even price required to support this statement over the period of the business plan is USD1.33 /ct in December 2017 terms. This is calculated as the price required to cover all cash operating costs, including management and auction costs and mineral royalties (that is, including all on site mining, processing, maintenance and G&A operating costs, distribution costs and mineral royalties) which amounts to USD1,161 M to mine 3,498 kt of ore and produce 873,131 kct. Based on an average long term price of USD3.30 /ct the corresponding average operating cut-off grade is estimated at 120.0 ct/t_{ore}. The CP also confirms that no Inferred Mineral Resources have been converted to Mineral Reserves and notes that the Mineral Resource statements reported above are inclusive of the Mineral Resources used to generate the Mineral Reserves.

The CP has estimated Mineral Reserves in accordance with the SAMREC Code. These are presented in Table 6-28. As at 31 December 2017, the CP notes that the Kagem emerald deposit has Mineral Reserves, as presented in accordance with the SAMREC Code consisting of 3,354 kt of RZ material grading at 256 ct/t emerald at Chama Pit, and 144 kt of RZ material grading at 103 ct/t emerald at Fibolele Pit. Based on an average long term price of USD3.30 /ct the corresponding average operating cut-off grade is estimated at 120.0 ct/t_{ore}.

Table 6-28: Kagem Mineral Reserve Statement, as at 31 December 2017, for the Kagem Emerald Deposits

Classification	Mineralisation Type	Tonnage (kt_{dry})	PE+E Grade (ct/t)	Beryl Grade (ct/t)	B+E Grade (ct/t)	Contained Carats (kct)
Proved						
Chama	RZ	749	73	176	249	186,615
Fibolele	RZ	0	0	0	0	0
Total Proved	RZ	749	73	176	249	186,615
Probable						
Chama	RZ	2,604	75	181	256	671,629
Fibolele	RZ	144	22	81	103	14,888
Total Probable	RZ	2,748	72	176	250	686,517
Proved & Probable						
Chama	RZ	3,354	75	181	256	858,244
Fibolele	RZ	144	22	81	103	14,888
Total Proved & Probable	RZ	3,498	73	177	250	873,132

The average value of the beryl and emerald, as reported in the Mineral Reserve Statement is USD4.56 /ct. The value of the different product splits, are as follows:

- Premium Emerald and Emerald – USD15.66 /ct; and
- Beryl (Beryl 1 and Beryl 2) - USD0.07 /ct.

This study is an ongoing Life of Mine study with a feasible mine plan based on historic production figures, geotechnical parameters based on exposed faces and pit optimization studies using realistic costs and prices. All disciplines are at FS level.

The mineral resource models used for calculating the reserves have been MRbm1 for the Chama deposit and FBbm1 for the Fibolele deposit. Both models reside in the GEMS software project database.

The Competent Person ("CP") with overall responsibility for reporting of Mineral Reserves is Mr Mike Beare CEng BEng ACSM MIMMM, a Corporate Consultant (Mining Engineering) with SRK. Mr Beare has 26 years' experience in the mining industry and has been extensively involved in the reporting of Mineral Reserves on various diamond and gemstone projects during his career to date.

6.12.5 Reserves and Resources Locality Map

Figure 6-24 shows the pit shell, with a revenue factor of 1.3, that was used to determine resources (in blue) and the reserve pit shell (in transparent brown). The ore blocks have been coded to show resources in red and reserves in green. The figure shows a view looking South as that gives the best visual indication of distribution.

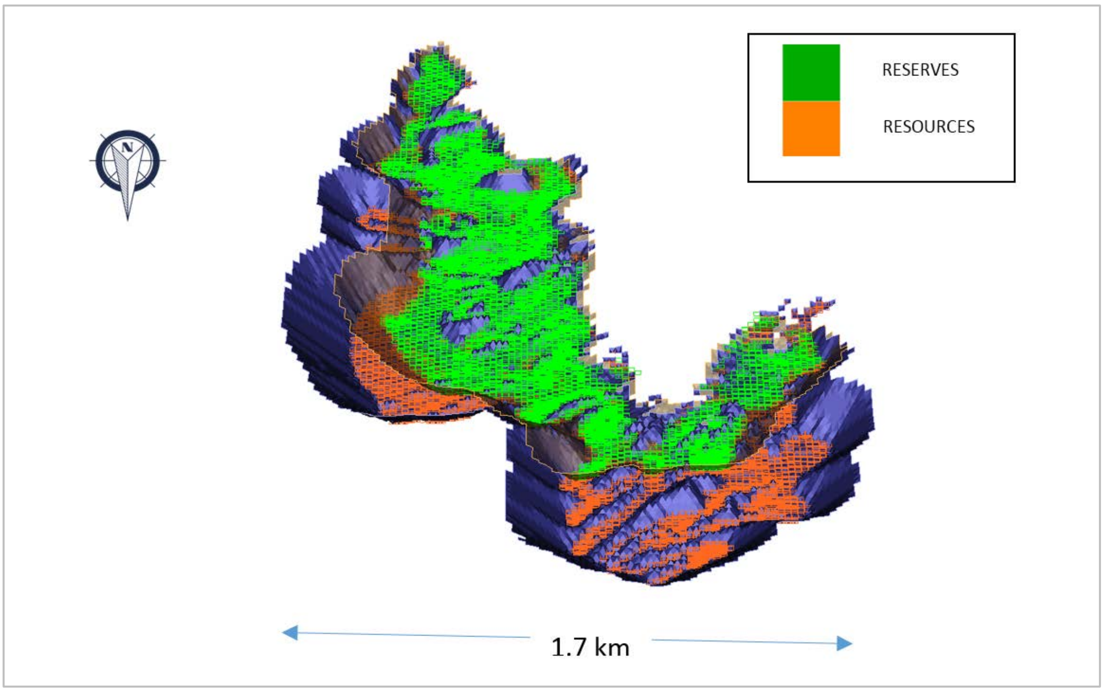

Figure 6-24: View looking South showing resources and reserves with respective pitshells

6.12.6 Comparison with 2015 CPR Mining Reserves

When comparing the 2015 reserves with the 2017 reserves, the production between the two reserves needs to be taken into account. Historic production tonnes and grade were taken from the client’s supplied data, and the mined carats and tonnes were added to the 2017 reserve.

The table shows the resulting comparison. The 2017 reserves show a slight increase in ore tonnage, with a drop in grade in line with the revised mineral resources for 2017. Mined grade over the 2015 – 2017 period has been lower than the average reserve grade. The CP has verified that this is due to mining in lower grade areas during this period, and that it is not representative of the average grade in the 2017 estimation.

Table 6-29 : A comparison table between the December 2017 reserves and the 2015 reserves.

		2015	2017	2017+HP	2015	2017	2017+HP	2015	2017	2017+HP
Classification	**Mineralisation Type**	**Tonnage (kt_{dry})**	**Tonnage (kt_{dry})**	**Tonnage (kt_{dry})**	**Grade (ct/t)**	**Grade (ct/t)**	**Grade (ct/t)**	**Contained Carats (kct)**	**Contained Carats (kct)**	**Contained Carats (kct)**
Proved										
Chama	Reaction Zone	920	749	1,013	300	249	239	276,018	186,615	242,507
Fibolele	Reaction Zone	0	0	0	0	0	0	0	0	0
Total	Reaction Zone	920	749	1,013	300	248	239	276,018	186,615	242,507
Probable										
Chama	Reaction Zone	2,739	2,604	2,603	300	256	256	821,808	671,629	671,629
Fibolele	Reaction Zone	177	144	144	103	103	103	18,312	14,888	14,888
Total	Reaction Zone	2,916	2,744	2,747	288	248	248	840,121	686,517	686,517
Proved & Probable										
Chama	Reaction Zone	3,659	3,354	3,616	300	256	253	1,097,826	858,244	914,136
Fibolele	Reaction Zone	177	144	144	103	103	103	18,312	14,888	14,888
Total	Reaction Zone	3,836	3,498	3,760	291	250	253	1,116,138	873,132	929,024

The 2017+HP columns indicate the December 2017 Reserves plus the Historic Production between July 2015 and August 2017 (the 2015 Reserve was declared on 30th June 2015)

6.13 SRK Comments

6.13.1 Conclusions

Based upon the work undertaken to date, the CP concludes the following:

- the open pit mining operation at the Mine is a relatively simple operation which is not expected to present any major technical or logistical challenges during future operations;
- the production loading and haulage fleet currently operate at relatively low productivity rates and operating efficiencies, which should be analysed to identify areas of potential improvement;
- the strategy to produce ore from at least three production points considered appropriate given the expected variability of the RZ in terms of gemstone distribution and quality;
- stockpiling of ore could prove to be useful to introduce higher grade material earlier into the schedule, however security is a worry and a good study would need to be done before this is implemented;
- the plan to expand mining in the lower strip ratio areas of the deposit is considered appropriate; however, the grade and continuity of the mineralisation will need to be verified during the early phases of mining in this area; risks related to mining in this area can be reduced by simultaneously mining in higher confidence areas;
- given the nature of the grade distribution in an emerald deposit, the CP recommends reconciliation of grades on a continuous basis from the results of on-going mining. It is the view of the CP that Reserve estimates (and the modifying factors that support them) need to be continually reviewed to ensure that they most accurately reflect the deposit and what it can deliver;
- there may be further scope to optimise mining costs through more detailed mine planning and scheduling; and
- whereas the LoMp presents emerald production forecasts based on a Mineral Reserve, the CP recognises the nature of gemstone deposits and variability of emerald grades. This is expected to result in variable emerald production and revenue on a monthly basis which balances out on an annual basis as has been observed from the historical statistics.

6.13.2 Recommendations

Based upon the work undertaken to date, the CP recommends the following:

- more accurate mine scheduling and planning is carried out to optimise costs and contractor utilisation;
- undertake engineered cutback design to provide detailed pushbacks for use in mine planning and haul ramp location;
- undertake a trade-off study to determine the viability and advantages of using larger mining equipment, specifically for the waste rock mining;
- develop a more detailed and auditable recording system for operating costs to identify potential areas of cost saving;
- undertake a review of equipment productivities and utilisations to optimise the existing fleet capacity;

- estimate the quantities of current stockpiled and future planned top soil quantities to ensure sufficient topsoil for mine closure purposes; and
- calibrate the reserve estimates by comparing the results of mine production against the estimates of in situ tonnage from the resource model.

7 PROCESSING AND WASHING

7.1 General Description

The washing plant at the Kagem Mine consists of a series of comminution, screening, washing and sorting facilities which are located close to the current mining activities in the Fwaya-Fwaya area. The plant currently in operation was commissioned in 2006 and has an operating capacity of approximately 330 ktpa of ore. A schematic of the wash plant flowsheet is shown in Figure 7-1.

RZ ore is fed into the feed bin using an excavator or small wheel loader. The bin has a grizzly that removes +300 mm material, which is stored to the north of the RoM pad (see Figure 7-2). A further grizzly allows -100 mm material to by-pass the primary (jaw) crusher. At the double deck vibrating screen, the +60 mm oversize material is directed to the secondary crusher operating in open circuit. The double deck screen operates wet, and the -3 mm fines from the double deck vibrating screen (approximately 35% of the feed mass) are directed to the fines storage area in the valley to the west of the plant (see Figure 7-2). The product from the double deck screen (+3 mm, -60 mm) is fed to a triple deck screen that separates the material into three product streams for hand picking: +3 mm -6 mm, +6 mm -30 mm, and +30 mm -60 mm. Each stream is directed to individual picking belts; the +30 mm is split to feed two belts. The prospective emerald and beryl gemstones are picked off of the belt by hand and dropped in a drop safe type box similar to that used at the mining faces. The nominal capacity of the washing plant is 70 tph.

Figure 7-2 shows an aerial view of the washing plant and its surrounds. RoM ore is stored to the east of the plant ahead of processing, and +300 mm oversize is stockpiled to the north of the RoM pad. The -3 mm fines are sent to a storage area in the valley to the west of the plant, and sorting rejects are stockpiled to the south of the plant. Prior to 2014, both the fines and sorting rejects were re-handled and disposed of in the mine waste dumps, however, Kagems' intention is to make the current storage locations permanent facilities. For the sorting rejects, this storage area will expand to the south and the west, and Kagem is considering installing a conveyor system to place these rejects rather than transferring them by loader as is the current practice. The fines will be progressively spread out over the valley, where decant water will return to the process via the lake as shown. An intermediate barrage has been constructed to assist with fines settling in this recycle stream.

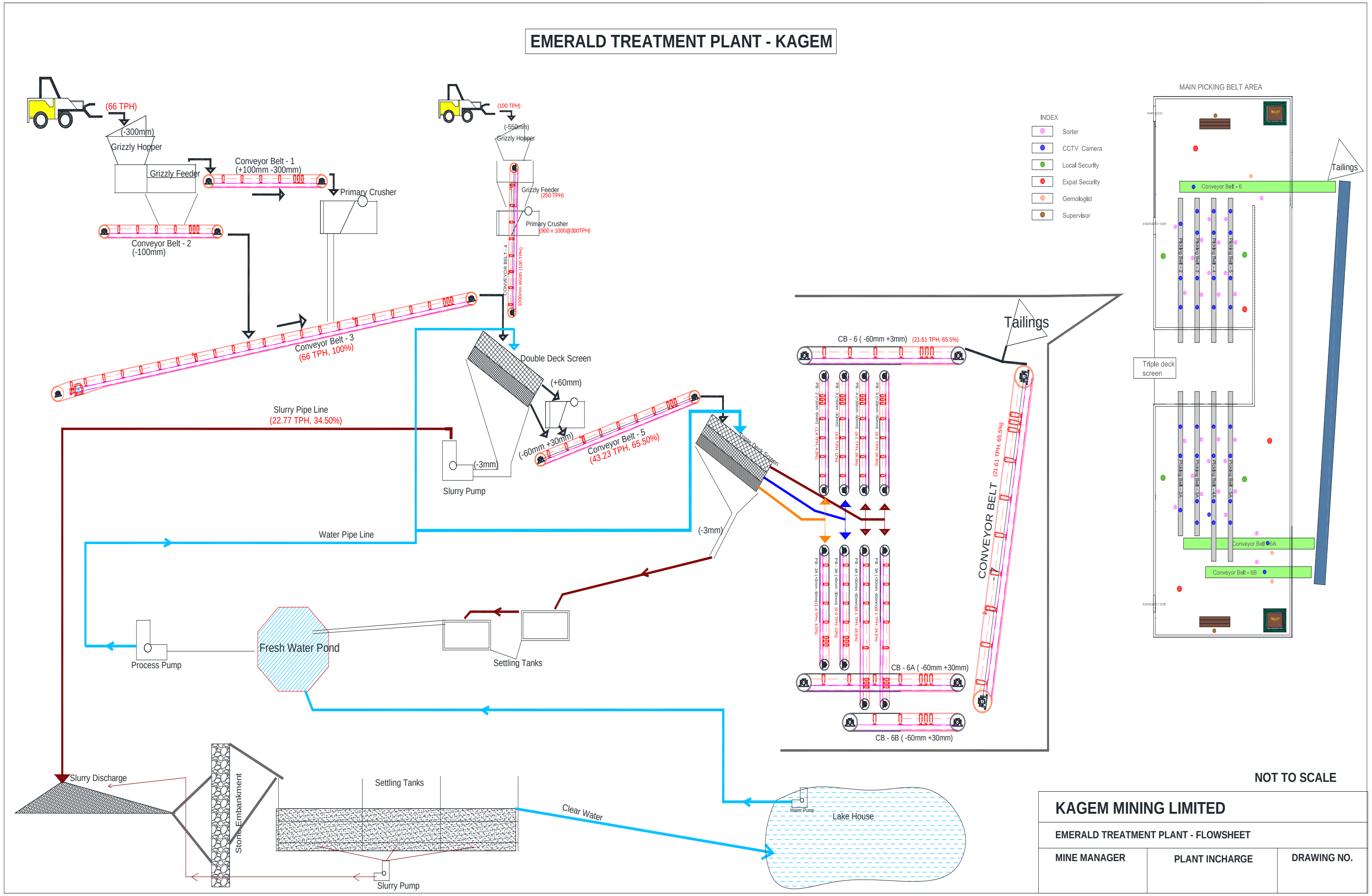

Figure 7-1: Kagem washing plant schematic flowsheet

Figure 7-2: Kagem Washing Plant Aerial View

The washing plant products, together with the high quality product directly recovered from the mine known on site as run-of-mine (RoM), are sent to the secure sort house facility. The prospective beryl and emerald gemstones are sorted and upgraded using manual methods. The sorting house is a high security area and access is controlled. The drop safe type boxes from the mine and the plant are opened and emeralds are picked out from the remaining material which is washed and tumbled. Products from this are also picked and the fines and waste separated. Where necessary, the product is chipped to upgrade the gemstone and further lightly tumbled and cleaned. The product gemstones from this process are sized into six size classes, then sorted in to the following categories: premium emerald; (standard) emerald; beryl-1; and beryl-2. The two emerald products are further graded, these and the beryl-1 product are then dried, dressed with oil, weighed, catalogued and stored for evaluation and subsequent export to Lusaka (or otherwise) for auction.

Gemstones sourced directly from the mining operations account for approximately half of the volume of gemstones recovered, but account for approximately 70% of the recovered value. Premium emeralds account for 1% or less of the recovered gemstones, with emeralds accounting for 25-35%, with the remaining being the beryl categories, of which beryl-2 carries little value.

Kagem has doubled the potential capacity of the wash plant, by duplicating the picking belts. The circuit upstream of the picking belts has been assessed as being capable of handling the additional capacity, although conveyor 3 (see Figure 7-1) is upgraded with a wider belt and larger motor, and the raw water supply line has been upgraded.

This upgrade has sufficient capacity at the Kagem wash plant to handle the on-going production from the Chama pit (approximately 100-120 ktpa), the projected production from the re-start of the Mbuva-Chibolele pits (also approximately 100-120 ktpa), as well as the various bulk sampling operations at Fibolele and others. The maximum capacity of the upgraded plant is expected to be 330 ktpa. This expansion requires 90 operational and supervisory staff.

The expansion cost is USD1.02M.

Kagem is also considering installing an additional primary crusher that will be capable of handling the largest size rocks produced by the mining operation, up to 700 mm. This crusher will handle both on-going production, as well as being able to process the stockpiled oversize (+300 mm -700 mm) material over time.

Kagem is also investigating the potential for mechanising the emerald picking process. As there is no density difference between emeralds, beryl and the host rock, there is no potential for gravity separation (unlike with rubies and sapphires). Some material has been sent to Germany for test work using optical sorting; results are encouraging, however, multi tests will be conducted, to conclude the design, based on Kagem style of crystal.

7.2 Conclusions

Based upon the work undertaken to date, the CP concludes the following:

- the Kagem washing plant is relatively simple in its configuration, and appears to work effectively;
- current security measures appear to be adequate;

- the emerald recovery process is entirely dependent on hand picking of gemstones, and given the lack of clear distinction between the emeralds and the host rock, particularly with regard to density, there is little potential for automation other than the possibility of optical sorting which is currently under review; and
- the plant is capable of handling the current feed rate, and the on-going plant expansion will provide sufficient capacity for a potential additional increase in production volumes coming from the 100% Gemfields owned Mbuva-Chibolele pits. It also seems likely that the plant will be able to handle any increase that will arise from the re-processing of current and stockpiled oversize material.

7.3 Recommendations

Based upon the work undertaken to date, the CP recommends the following:

- while the storage areas identified for both washed fines and sorting rejects adjacent to the plant area appears adequate for the medium term, and will save on rehandle costs, the CP is unsure whether the areas identified will have sufficient capacity for the expanded production rate for the expected life of the operation. The CP therefore expects that it may be necessary at some point in the future to move some of this material to the waste rock dumps; and
- The CP recommends that a more comprehensive assessment is made of the available area for tailings disposal such that an estimate of the need to eventually rehandle tailings can be made.

8 INFRASTRUCTURE

8.1 Introduction

Figure 1-3 presents the existing Mine layout and shows the roads and the primary operational and infrastructure areas.

8.2 Mine Roads

The Mine offices and camp are situated close together, and are connected to the Chama pit and Fibolele and Libwente bulk sampling operations by gravel roads within the Kagem Mine site boundary. Gravel haul roads 25 m wide connect the wash plant with the Chama pit and bulk sampling areas which are shared by both light and heavy vehicles. For security reasons, ore and waste haul trucks generally use separate roads, and security posts are positioned at several locations on the mine roads.

8.3 Accommodation and Administration

The main Mine offices, stores and accommodation are located at the Kagem camp and comprises predominantly prefabricated and block work structures within a fenced compound.

The accommodation at the camp is used by the management and operational staff, which consists of a mixture of expatriate and local personnel.

The CP understands that a portion of the operation work force stay at the mine camp during their roster, and buses are used to transport the majority of the operational work force to and from their local town on the off-days.

8.4 Mobile Equipment Maintenance

All light and heavy mobile equipment is currently maintained in a common maintenance area comprising a triple bay heavy workshop, light vehicle workshop, parts stores, wash pad and lay down area. The existing workshop presented is of steel construction. Plans are in place for construction of heavy duty workshop closer to the mine area.

8.5 Power

The Kagem site is supplied with a 33 kV ZESCO supply, which is stepped down to 11 kV at a main substation at site, which then stepped down to 400V and supplies the washing plant and camp transformers. A 400 V supply is provided for the camp, offices, mess and washing plant electrical power requirements. There are two standby gensets (600 KVA and 400 KVA capacity) available for the camp area and washing plant.

Construction of a medium voltage electrical overhead line around the camp has been completed, and extends to the river pump and field canteen at Chama, which also provides the security lights around the camp area.

8.6 Water Supply

River water is pumped to the camp (accommodation, offices, mess, and ablution blocks) and washing plant for non-drinking water usage. Drinking water is provided by ground water treated at a water treatment plant and supplied to the senior mess, junior mess, washing plant, and offices. There are no major changes planned for the site water supply.

8.7 Communications

The main communication network within the camp comprises of fibre links connecting various buildings and CAT 6 cable connecting office data points, terminating at Cisco gigabit switches and managed by a Unified Threat Management System (FortiGate firewall) as gateway to the internet. Wireless (Wi-Fi and Point to Point); comprising of Ubiquity Unifi Access Points and Ligowave Radios provides wireless access to the network. This is managed by a Wi-Fi Gateway/Controller which connects to the main network.

Internal and external voice communication using Siemens Open Scape Business PBX, running on a separate network from the data system, are in place. The PBX system is licensed for 65 IP phones, 46 Analogue and four trunks.

Two-way communication for the pits and security operations is provided using Motorola radio system. Mobile phone networks (MTN, Airtel and Zamtel) for voice communications are available at site.

8.8 Conclusions

Based upon the work undertaken to date, the CP concludes the following:

- the Mine is well served with infrastructure and the site is accessed by good quality gravel roads which connect to the main highway;
- power is sourced from the national transmission grid to transformers at the camp and wash plant. Backup diesel generators are used when the fixed connection is interrupted to ensure operations remain unaffected;

- process and non-potable water at the Mine is sourced from river water, and potable water is provided by treated ground water; and
- the site has appropriate communication systems in place.

8.9 Recommendations

Based upon the work undertaken to date, the CP recommends that Kagem continues to develop infrastructure plans and continues its planned program of investment and maintenance of infrastructure.

9 ENVIRONMENTAL, SOCIAL AND HEALTH & SAFETY

9.1 Introduction

This chapter focuses on the compliance of Kagem with:

- applicable Zambian environmental legislation and environmental authorisations;
- performance relative to good international industry practice (GIIP, including the International Finance Corporations Performance Standards);
- appropriateness of the existing management systems and corporate social responsibility (CSR) activities;
- environmental and social issues of concern;
- risks and liabilities;
- the appropriateness of closure planning and cost estimates; and
- recommendations for improvement to existing management measures.

This section of the report is an update to the report produced following a site visit in 2015. The update has been provided by Kagem management and reviewed by SRK Principal Consultant, John Merry in February 2018. The update includes a review of legislation pertinent to mining environmental management in Zambia and study of documents provided by Kagem, including policy and strategy documents, audit reports, correspondence with the Zambian Environmental Management Agency (“ZEMA”) and Mine Safety Department (“MSD”), permits and licences, environmental project briefs (“EPB”), the environmental impact assessment; environmental management plans (“EMP”), pollution reports and monitoring data.

9.2 Environmental and Social Setting

Kagem’s concession covers an area of approximately 41 km^2 within the central part of the 750 km^2 Ndola Rural Emerald Restricted Area (“NRERA”), Zambia. The Mine is located south west of Kitwe in a relatively remote part of the Zambian Copperbelt. There are no settlements allowed within the concession area, other than the mine camp.

Social setting

The closest village (informal settlement) to the original Kagem operations is Pirala, situated about 5 km south of the Mine; it is also the only settlement located within the mine protected area. Immediately north of the Fibolele Pit is the village of Sempala. This appears to be associated with the Grizzley Mine on the northern border of the Kagem Concession. The other three villages sampled are located outside the mine protected area. Pirala is an informal settlement established after the development of the third-party mine south west of Kagem and abutting the Mbuva-Chibolele operation, currently on care and maintenance. Some of the inhabitants of Pirala are known to be involved in illegal mining activities and there is a market for the sale of illegal emeralds in the village. Although Kagem and other mining operators in the area requested the relocation of this settlement, the government has thus far refused this request. A primary school was developed at Pirala by Grizzly mine. A clinic was also developed at Pirala by a number of mining companies in the area which included a contribution from Kagem.

A Socio-economic Assessment Report ("SAR") was compiled for Kagem in October 2012. The report assessed social structure, activity and movement around the Kagem Mine site and assessed expectations and perceptions of development and potential conflicts between industry and local communities. It involved fieldwork, including semi-structure interviews, participant observation, gender specific focus groups and one-to-one interviews, undertaken over a three week period (during August 2012) at Pirala, Kapila, Kandole and Nkana. There are approximately 6,567 people living in the villages sampled.

The Lufwanyama District is one of the poorer parts of Zambia and is the least developed in the Copperbelt Province. Access to important facilities and services is limited and the majority of people lack access to infrastructure such as housing, health, education, transport and telecommunications.

Within the concession area, land use is restricted to mining with no residential or subsistence agriculture taking place. In the wider Copperbelt, agriculture is the biggest employer, with public sector and mining having similar levels of employees. No current data on population, education levels, livelihoods etc. is available for the communities in the immediate vicinity of the NRERA, with the latest figures available coming from the 2010 census. The nearest major towns are Kalulushi (schools and shops) and Kitwe (city with schools, university, hospitals, shops, banks, rail station etc.).

Illegal mining of emeralds is occurring on a small scale and some charcoal burning may also take place. A number of individual settlements occur around the perimeter of the licence, probably associated with illegal miners and charcoal burners. Discussions with Kagem Security personnel and other mine staff indicates that there are sometimes illegal miners operating on site. Numbers are uncertain, however they are more numerous in the rainy season, arriving in groups of individuals that camp in the bush surrounding the Mine. People also come from Pirala village as the rains expose emeralds on the overburden stockpiles. No formalised study of the illegal miners has been undertaken at Kagem.

Environmental Setting

The operation is located in a gently undulating area at elevations of between 1,180 to 1,220 m amsl. Based on weather data from Ndola, the area experiences about 1,250 mm of rainfall per annum divided into three seasons: a cool dry season (April to July); a hot dry season (August to October); and a hot wet/rainy season (November to March). The maximum calculated rainfall in a 24-hour period is 126 mm for a 30-year return and 149 mm for a 100-year return. Flooding during heavy storms, with which most rainfall is associated, is localised and temporary. Evaporation in the area exceeds precipitation for eight months of the year. Prevailing winds are from the north-east and south-east, but strong westerly winds are not uncommon during the rainy season (averaging 7.4 m/s at this time). Wind speeds between April and October average at 10 m/s. Temperatures vary from a minimum of 7.5ºC (average cold season) to a maximum of 31ºC (average hot season).

The property is bounded on two sides by the Kafue River and its tributary the Chantete Stream (to the east) and the Kafubu (to the south). The Kafubu River forms a wide (up to 2 km) low lying swampy drainage plain on the southern boundary of the license. Dambo (wetland) and swampy areas in the central part of the license area form a natural discharge point for one of the tributaries draining the site, which runs southwards into the Kafubu River. The immediate area in and around the main Kagem Chama pit is drained via two small (ephemeral) streams that flow into the Kafubu River. These are also fed by water presently being pumped out of the Kagem Open Pit. The Kafue River drains much of the Zambian Copperbelt before heading south towards Lusaka and the Kariba Dam. The river is used for irrigation, washing, domestic supply (particularly in the larger towns where it receives some treatment) and recreational purposes.

The site has 8 dambo areas, as well as two artificially created dams to supply water to the Mine. The Fibolele dam is associated with an abandoned mine pit and has been stocked with fish in the past. The dambo areas are considered environmentally sensitive and soils in these areas are prone to erosion if disturbed.

Water quality sampling is undertaken on a weekly, monthly and quarterly basis for various parameters for potable, raw, and waste water respectively at various ground and surface water sampling locations; however, there is limited monitoring taking place upstream and downstream of the Kagem operations, which limits the Mine’s understanding of impacts on the environment (both its own and those arising from external third parties). Water sampling at point SW5, the only sampling point on the Chantete stream, was stopped in 2010 due to limited access to the area, which has been resumed now. Artisanal mine workings occur in this stream between Kagem’s site and the Kafue River. In the absence of this sampling location it is not possible for Kagem to demonstrate it is not polluting this stream or distinguish its effects from other influences on the stream. Five groundwater sampling sites have been identified and the 2014 EMP update states monitoring wells will be drilled around the Chama open pit and waste rock dumps for groundwater quality and water level measurements; and, currently 8 monitoring wells have been drilled.

In comparison to WHO drinking water guidelines (WHO, 2011), the Mining EHS Liquid effluent guidelines (WBG, 2007a) and the General EHS Sanitary sewage guidelines (WBG, 2007b), the available water quality data indicate there are no particular water quality concerns. Although sampling has recently expanded to include faecal coliforms and total chromium, the currently assessed list of parameters is too short for comprehensive water quality assessment and should include chromium VI as opposed to total chromium.

Water collecting at the bottom of the Chama pit is primarily rain water, surface run off water travelling over and down the sides of the open pit walls, and seepage as well as some ground water flow via weathered PEGs. At the time of the site visit, there was minimal water observed in the pit as a result of pit dewatering activities. Geoquest undertook a desktop hydological/hydrogeological study in 2009, but the study did not include a conceptual groundwater model. No formalised ground water monitoring system has been implemented at Kagem.

The emerald deposits are found within the Muva Supergroup, which is made up of folded quartzites and schists. The emeralds are found associated with the contact between the PEG intrusions into the ultramafic schist. Soil sampling done in 2008, as part of the study for the EPB, indicates soils are generally sandy with some clay minerals present. The major clay mineral is kaolinite. Glysol soils dominate the dambo areas. Soil erosion is observed where surfaces have been disturbed by mining related activities.

Based on a survey by the Zambian Forestry Department, the principal vegetation present on the Kagem property and its surrounding area is typical of that found in the Kafue headwaters. This includes:

- miombo woodland;
- riparian forest along the rivers;
- chipya woodland;
- grassland (where forests have been cleared historically and around the dambos); and
- swamps in the dambo areas.

Sparse miombo woodland is the most extensive vegetation type in the Kagem license area. The tree canopy is dominated by *Brachystegia* spp. *Isoberlinia* spp. *Julbernardia* spp and *Marquesia macroura* reaching a height of approximately 15 m. The understorey is defined by either a tall grass and a sub-shrub layer, or dense evergreen thickets reaching heights of about 3.5 m. Miombo woodland is economically important in the region for the supply of timber, poles, firewood and charcoal. It is also the source of many non-wood forest products such as honey, mushrooms, caterpillars and other edible insects.

Vegetation has been disturbed within the area by historical mining activities, charcoal burning, forest fires, road works and soil/wind erosion; however, based on the CP's experience in the region, residential and agricultural activities are restricted within the NRERA resulting in less visible disturbance to the miombo woodland than seen elsewhere in the Copperbelt.

No biodiversity baseline studies have been undertaken by Kagem prior to clearing of vegetation. Major fauna are absent from the area, although some bird and fish species are reported to occur, particularly around the flooded pits. In the 2012 FS, the CP was informed Kagem was awaiting the results of a biodiversity survey undertaken by the University of East Anglia (UK) in December 2011 coordinated by conservation charity World Land Trust ("WLT"). Gemfields Group Sustainability Manager followed up in 2015 and established the study was of limited value. Kagem thus plans to commission a biodiversity assessment going forward. The CP understands this is planned for 2019.

The three main rivers bordering the area are known to host a relatively rich fish population dominated by different species of bream and tilapia, both important species for human consumption. A variety of frogs, lizards and snakes also occur within the area.

In the SAR (2012) respondents repeatedly referred to the presence of wild animals such as impala, hare, monkeys, common duiker, warthog, bush baby and wood mouse in the areas surrounding the Mine.

Health and Safety

Occupational health monitoring is facilitated by the Safety, Health, Environmental and Quality ("SHEQ") Manager once a month for air quality and twice a week for noise (at Chama open pit, Sort House, Wash Plant and Workshop) in accordance with Zambian regulatory requirements. Where noise exceeds the 85 dBA limits, ear muffs and ear plugs are provided to staff. Noise and air quality monitoring has been undertaken with government inspectors on-site. The noise meters and records were available to the external auditors of the 2014 EMP.

Since the Zambian authorities did not require an environmental impact assessment for Kagem no environmental baseline data for either air quality or noise was collected prior to bulk sampling activities at Kagem. On-going environmental noise and air quality monitoring takes place at Kagem on a monthly basis. Levels are typical of a rural Zambian context with limited industrial or commercial influences (air quality is impacted by wood burning for fuel and the occasional forest fires that occur in the dry season).

In-pit backfilling of active Fwayafwaya and Chama pits is taking place and systematic dumping of waste rock has helped preserve air quality around the mining areas and has reduced the costs associated with waste rock disposal. Progressive rehabilitation and revegetation of the waste rock dumps as well as regular spraying of the roads in the pit with the water bowser is also contributing to dust management on the Mine.

9.3 Environmental and Social Approvals

9.3.1 Environmental Approvals

Environmental legislation relevant to activities at Kagem Mine includes the Environmental Management Act (No 12 of 2011) and the Mines and Minerals Development Act (No 11 of 2015, and also the Water Resources Management Act (No 21 of 2011). The statutory bodies enforcing these laws are the ZEMA, the Ministry of Mines through the MSD and Water Resources Management Authority.

The environmental approvals required to proceed with construction of new projects and continue operations are summarised in Table 9-1 and the actual environmental approvals obtained for Kagem Mine and the new developments on the site are summarised in Table 9-2. The submissions made to obtain these approvals are also identified in the table.

An EPB for Kagem was prepared in July 2008 by African Mining Consultants which has since been superseded by the EIA prepared in 2016. The EIA provides standard assessment of a high-level impact summary concluding with an EMP and closure cost estimate. Since 2008 the EMP has been updated annually. A full EIA is not required for small projects with limited environmental impacts, though it is at the discretion of ZEMA whether a project developer is required to submit an EPB or an EIS. The expansion into the Fibolele Pit was deemed significant enough for a full EIA. The EIA was approved in November 2016. The approval letter includes twenty six conditions in addition to the requirements of the EMP. Kagem have 36 months from the start of the project within which time it must commission an audit of the operation.

Kagem has obtained the necessary environmental licenses in terms of the Environmental Management Regulations (SI 112 of 2013). Bi-annual reports for these environmental licenses are required to be submitted to ZEMA on or before the 15 July and 15 January of each year. Kagem submitted bi-annual reports to ZEMA for the period ending June 2017 on 14 July 2017 and period ending December 2016 on 14 January 2017. These reports refer to continuous water analysis of surface and groundwater within the licence boundary, mine infrastructure noise monitoring, and bioremediation of total petroleum hydrocarbons (“TPH”) contaminated soil.

Since there is potential for contamination of soil with hydrocarbons, water quality analysis of surface and groundwater should also include appropriate hydrocarbon parameters. SRK noted in 2015 that the assessed list of parameters was not comprehensive enough for a comprehensive water quality assessment. The CP understands that a more comprehensive list is now included in the regular water monitoring. According to the most recent verification audit, Kagem are in compliance with the monitoring requirements of their permitted EMP.

Table 9-1: Environmental Approvals Required

Required approvals	Submissions to be made	Relevant legislation	Responsible regulatory authority
Environmental approval of new projects • Approval is granted based on information submissions made • Approval is required for all scheduled projects and for any alterations or extensions to scheduled projects/ operations (the schedules are attached to the relevant regulations)	• EPB is the first submission made for all scheduled projects. • Environmental Impact Statement ("EIS") developed by means of an Environmental Impact Assessment ("EIA") process must be submitted. An EIS is not required for small projects with negligible impacts. • EIS must contain an EMP and a closure plan and cost estimate	• Environmental Management Act (No 12 of 2011) • The Environmental Impact Assessment (EIA) Regulations (SI 28 of 1997)	• ZEMA – was named the Environmental Council of Zambia ("ECZ") prior to 2011 • ZEMA consults with the Ministry responsible for mines and receives mining industry submissions via this Ministry
	• Audit report on compliance with EIS approval conditions (12 to 36 months after approval and then as required by ZEMA)	• Mines and Minerals Development Act (No 11 of 2015) • Mines and Minerals (Environmental) Regulations (SI No 29 of 1997) • The Mines and Minerals Development (General) Regulations (SI No. 84 of 2008)	• Director of Mine Safety Department ("MSD") in the Ministry responsible for mines • (The Ministry of Energy and Water Development has been merged with the Ministry of Mines to form a new Ministry of Mines, Energy and Water Development) • The EIS approval is a prerequisite to granting a Mining Licence.
	• An annual update to the EMP must be submitted as part of the application for an annual operating permit		
	• Environmental Protection Fund ("EPF") - The mine must make a contribution to the EPF to cover the cost of protecting the environment based on the EMP; this is audited by MSD who then determine the category of the mine and hence the "concession" (or discount applied).	• Mines and Minerals Development Act, 2008; Mines and Minerals (Environmental) Regulations of 1997 (SI 29 of 1997); • Mines and Minerals (Environmental Protection Fund) Regulations, 1998 (came into effect December 2007)	• MSD within Ministry of Mines
Environmental licences required for: emissions; non-hazardous waste management; hazardous management; and pesticides and toxic substances.	• Applications for licences	• The Environmental Management (Licensing) Regulations (SI 112 of 2013)	• ZEMA
• Permits for water abstraction and use for industrial purposes	• Applications for permits	• Water Resources Management Act (No 21 of 2011)	• Water Resources Management Authority (The Ministry of Energy and Water Development has been merged with the Ministry of Mines to form a new Ministry of Mines, Energy and Water Development)

Table 9-2: Environmental Approvals Obtained for Kagem Emerald Mine and Developments on the Mine Site

<table>
<tr><th colspan="2">Document Type</th><th rowspan="2">License No.; Serial No.</th><th colspan="2">Approval</th></tr>
<tr><th colspan="2">Type, date - subject</th><th>Authority</th><th>Validity Period</th></tr>
<tr><td colspan="2">Approval and conditions of the Environmental Impact Statement, 2016</td><td>ZEMA/EA/EIS/506</td><td>ZEMA</td><td>11 November 2016
(Note - this is the date of issuance of the Approval and it remains valid for as long as the mine is in operation)</td></tr>
<tr><td colspan="5">Environmental Licenses</td></tr>
<tr><td colspan="5">The mine has three environmental licences in terms of the Environmental Management Act No. 12 of 2011 and Environmental Management (Licensing) Regulations (SI 112 of 2013).</td></tr>
<tr><td colspan="2">Waste Management License, 2017 (For operation of waste disposal sites and transportation of general and industrial waste)</td><td>NDL/WM/00515/Z09/2014; 00125</td><td>ZEMA</td><td>1 January 2017 – 31 December 2019</td></tr>
<tr><td colspan="2">Hazardous Waste Management License, 2017 (For generation, transportation and storage of hazardous waste including used oil, waste batteries, waste oil filters and waste fluorescent tubes only and operation of Lunshingwa overburden dump (53C) only and operation of Fwayafwaya Waste Rock Dump only)</td><td>NDL/LHWM/00515/Z09/2014; 000118</td><td>ZEMA</td><td>1 January 2017 – 31 December 2019</td></tr>
<tr><td colspan="2">Emissions License, 2017 (For emission or discharge of pollutants/contaminants into the environment for the Healthcare Waste Incinerator Stack) and for effluent discharge of water from the pits.</td><td>NDL/EMM/00515/Z09/214; 000066</td><td>ZEMA</td><td>1 January 2017 – 31 December 2019</td></tr>
<tr><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">EMP updates and EPF Audit Reports</td></tr>
<tr><td>2015/16</td><td>Audit report classified the Kagem operation as Category 1</td><td></td><td colspan="2">Ecowise Solutions 2015 - 2016</td></tr>
<tr><td>2013</td><td>Letter from MSD classifying mine as category 2.</td><td>MSD/20/1/17</td><td colspan="2">MSD, dated 16/06/204</td></tr>
</table>

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Since the production of the CPR report in 2015, the requirement for an Annual Operating Permit that was required under the Mines and Minerals Act 2008 is no longer applicable. The operation is now managed under the EIS approval and associated conditions with a requirement for regular auditing of these conditions and the EMP. The MMA 2008 has been superseded by The Mines and Minerals Development Act, 2015.

9.3.2 Outstanding environmental license and water permit approvals

Kagem have had three licences extended but the CP understands there is still a water abstraction permit still pending.

9.3.3 EIA required for expansion of Fibolele pit

Kagem submitted an application to ZEMA, for environmental clearance to expand the Fibolele exploration pit from bulk sampling to a larger scale open pit, as per the requirements of the Environmental Management Act (“EMA”) 2011. ZEMA subsequently issued a directive for a full EIA in accordance with Sections 29 & 36 of the EMA (2011) and regulation 7(2) subsection 7 (a) of the EIA regulations statutory instrument no 28 of 1997.

This EIA has since been approved following a successful completion of the activity, followed by the generation of an EIS.

9.3.4 Annual Updates to EMPs and EPF Audits

Annual updates to approved EMPs are required in terms of both environmental and mining legislation and in 2011 the MSD gave Kagem a directive to conduct annual EMP updates and EPF Audits. Kagem’s EMP is updated on an annual basis (or as and when requested by MSD) and submitted to the MSD considering the environmental monitoring data and the outcomes of audits and reviews. MSD officially stamps a copy of each document to acknowledge receipt and returns it to Kagem for their records. Copies of Kagem’s EMP updates were provided for 2012, 2013, 2014 and 2015/16.. The EMPs were prepared to meet Zambian legal obligations as well as the requirements of relevant Gemfields standards and policies. They include social impact management plans.

The Eleventh Schedule of the MMER 1997 establishes three categories of mine based on their environmental management performance:

- Category 3 is awarded for sites meeting basic operational and strategic environmental protection requirements;
- Category 2 is awarded for sites demonstrating environmental compliance (rehabilitation) capability; and
- Category 1 is awarded for sites showing validated environmental (rehabilitation) actions.

Table 9-3 shows the compliance status from the last external audit. Once the Director of Mine Safety confirms the EPF category, he/she may then apply concessions (discounts) on the calculated total closure costs as follows:

- Category 1: 95% off full rehabilitation cost;
- Category 2: 90% off full rehabilitation cost; and
- Category 3: 80% off full rehabilitation cost.

Table 9-3: Table showing degree of compliance with previous EMP.

Category	# of Commitments	% (with NA and REV)	% (Without NA and REV)
Compliant	90	81.81	81.08
Partially Compliant	15	13.64	13.51
Not Compliant	5	4.55	4.51
Not Applicable	0	0.0	
Revise	1	0.90	
Total	111	100	100

Following MSD's review and site verification inspection in 2011 it provided Kagem with a letter classifying Kagem Emerald Mine as Category 1. In 2013 a verification inspection was undertaken by MSD of the 2012 and 2013 EMP updates and EPF audits. Kagem subsequently received a letter from MSD classifying the Mine as category 2. In 2014 Kagem Mine was again assessed as Category 1 resulting in a 5-year EP liability after the 95% concession of USD17,461.

A lower classification category would require a larger annual payment to the EPF although this is not considered a material cost.

Ecowise Solutions, on behalf of MSD, conducted a verification inspection for 2015/16 EMP updates and EPF audits and classified Kagem as Category 1.

9.4 Approach to Environmental, Social, Labour and Health & Safety Management

9.4.1 Gemfields and Kagem Policies and Systems

Gemfields Group Sustainability Policies (dated 6 November 2014) include Environmental, Societal, Health and Safety, Human Rights and Security (Kagem's approach to Security is dealt with separately in Section 9.6) and Product Integrity and Stewardship Policies. Kagem developed site specific SHEQ Policies in 2016 following commencement of implementation of IMS. Although a number of supporting management plans and standard operating procedures are in development they have yet to be implemented. The key content and status of compliance by the site for some of these is discussed below:

- the Environmental Policy commits to the undertaking of biodiversity assessments and development of biodiversity action plans ("BAPs") and states a commitment to the biodiversity mitigation hierarchy. There was no evidence of biodiversity assessments being undertaken prior to disturbance and no BAPs have been developed for Kagem. Miombo woodland is cleared without assessment of baseline vegetation conditions. The CP notes that the biodiversity commitments included in the Gemfields Environmental Policy are, however, in the process of being incorporated into the Kagem SHEQ policies;
- Gemfields has a Group Disciplinary Policy and Procedure. Kagem's status of compliance with this policy was not assessed; and

- Gemfields has a group recruitment and selection policy that is coherent with the governing legislation of UK, Zambia and India. The Group considers itself an equal opportunity employer and therefore strives to take on individuals based on merit, suitability and their ability to perform the required function, as well as being able to meet the job requirements and performance expectations. Kagem employs Zambians where possible. This is supported by the fact that of the total 652 Kagem employees 589 of these people are Zambian nationals and 63 are expatriates. Kagem has a collective agreement (2014/2016) with the National Union of Miners and Allied Workers and the Mine Workers Union of Zambia. The agreement is intended to ensure stable and equitable employment and encouragement of morale to assist high productivity.

Kagem has historically focused on compliance with national regulatory requirements; however, it now intends to align its environmental management systems with GIIP and is committed to the standards stipulated in the Gemfields Group Sustainability Policies. This transition is being driven by Gemfields Group Sustainability Manager. Kagem has committed to carry out its operations in compliance with relevant national legislation and regulatory requirements and to maintain a system that complies with the requirements of ISO 14001-2015 Environmental Management System, OHSAS 18001-2007 Occupational Health and Safety Management Systems and BS EN ISO 9001:2015- Quality Management System. The implementation process has been commenced with initial internal audits conducted and soon to be followed by external third party ones.

The systems should be based on the standard concept of the “plan-do-check-act” business performance improvement cycle. Emergency planning and response and stakeholder engagement are elements applying to all systems. The EMP and the company policies, which are in place, are the starting point of the planning stage of the process. Following on from this sufficient supporting management plans, procedures or protocols are needed to enable specific activities to be managed. The CP acknowledges a number of standard operating procedures have been identified as required and these are being developed but are not yet linked to an overall management system nor are they being implemented.

Inductions of new employees are taking place but these appear to be relatively brief and focused mainly on H&S aspects. In contrast, human resources appear to have the necessary management plans in place and these being implemented.

Kagem has developed an Emergency Preparedness Plan that aims to provide a safe and healthy environment for its employees to work in. The plan lays out emergency contacts, incident/accident and fatality reporting procedures.

9.4.2 Human resources needed to implement SHEQ policies, systems and plans

The SHEQ staff numbers at Kagem have grown since 2012 when there was only a single person on site. The SHEQ team comprises a SHEQ Manager supported by a SHEQ officer (focussing on environment) and another SHEQ officer focussing on safety. The SHEQ Manager is responsible for environmental, health & safety and quality issues including monitoring, training, auditing, document production, rehabilitation management and he is also the site risk management champion (for the entire operation from financial to operational risks). He reports administratively to the Mine Manager of Kagem but for technical purposes he reports to Head of Mining, Deputy General Manager - Operations or General Manager depending on the issue of concern. The Kagem management structure organogram is not clear how SHEQ staff fit into the management structure; the organogram should be updated to include this information.

With regard to corporate social responsibility (“CSR”) the Senior Manager - Sustainability reports to the General Manager administratively and liaises with Gemfields Group Sustainability Manager for group level matters.

Gemfields plans to merge the Kagem SHEQ and CSR departments and additional CSR staff will be employed once this has taken place. This process is being driven by the Gemfields Group Sustainability Manager.

9.4.3 Implementation of SHEQ policies, systems, plans and CSR projects at Kagem

The EIA undertaken in 2015 was based predominantly on secondary data, with the exception of limited sampling of soils, water quality and flora. In the absence of a robust pre-Kagem mining baseline the impact evaluation in the EIA is qualitative only and the effectiveness of the management measures being implemented by Kagem cannot be confirmed.

What impacts are occurring can be managed relatively easily with accepted industry practices such as limiting surface areas disturbed, ensuring appropriate settlement of all discharges (some improvements are needed here), dust suppression, improved housekeeping and prompt rehabilitation once disturbance ceases (good progress being made here, though more will be needed when the current contract finishes). Such practices will limit future liabilities, thus reducing closure obligations.

On the socio-economic side, the absence of nearby receptors means community health and safety risks, other than to the illegal miners, are low. With the government discouraging settlement within the NRERA, there is lower risk of population influx by job seekers though this is still occurring and is not fully understood. Population influx, and associated socio-economic impacts on surrounding communities, is not actively being evaluated or managed by Kagem and the other gem miners in the NRERA.

Environmental management

There is a high level EMP in place but limited systemisation of environmental and health and safety issues has taken place. During the site visit and further to the review of the Gemfields and Kagem policies, systems and procedures as well as the 2014 EMP update and EPF Audit Report, the CP identified that Kagem had still not implemented some of the required environmental management actions. However, Kagem is taking action to address these non-conformances. Where the CP had specific concerns these are discussed under key environmental and social issues (Section 9.7). Additional proposed management actions are included in the recommendations (Section 9.11).

The findings of the SAR do not appear to have been incorporated into management plans and community development initiatives.

CSR/Community development initiatives

Health, education and agriculture are the three main areas of investment by mining companies in the area.

Kagem has been proactive with respect to CSR and has spent more than USD1.7 M to date. The key CSR projects and activities historically or currently being undertaken include:

- construction of community primary schools at Chapula, Kapila;
- construction of Chapula Secondary school;
- partial road clearing at Kapila (Blessings farm Co-operative);
- improvements to Pirala clinic and construction of new mini-hospital to replace the Nkana clinic;
- agriculture support, training and provision of a market and linkages to two four (4) co-operatives (Blessings Farms Cooperative, involving 15 people, Kapila Green Farms Cooperative, involving 25 people, Twasanta co-operative involving 42 people and Tweende co-operative involving 12 people);
- provision of Triddle pumps to co-operative members for irrigation purposes;
- construction of guest wing, car port, drive way and walk ways at Chief Nkana’s Palace/ Construction and completion of Chief Lumpuma’s palace house, furnishing, soak away, provision of electricity and water. Kagem has also signed an MOU with Chief Lumpuma and donated a car and monthly allocations of food stuffs and an allowance (per month);
- financial assistance of annual traditional ceremonies (six traditional ceremonies from 2014 to date, approximately ZMW5000 (USD630) is contributed per ceremony; and
- other donations such as school materials and provision of staff recreational facilities such as soccer fields.

Kagem’s CSR department has employed community workers who are in charge of oversight of the community development projects. Quarterly reports on community development projects are submitted to the Kagem Board. The CP was provided with a copy of one report that contained limited information. Gemfields has committed to improving the content and quality of these reports as part of the CSR and SHEQ management improvements being driven by the Group Corporate Sustainability Manager.

Minutes of meetings are recorded, and as an example, minutes of the meeting with the Lunfwanyama District Council, held on 3 February 2014, were shared with the CP. The meeting involved primarily government and council officials and relates to the construction of the Chapula Secondary School and the upgrading of the Nkana Clinic to a Hospital. The minutes stated that Kagem had committed USD1 M to the school and clinic community development projects in 2015. The CP has not seen any subsequent meeting minutes.

The choice of CSR initiatives is, however, not driven by the outcome of a comprehensive impact assessment or collaborative engagement with the affected communities. With Kagem thus far preferring to focus on key projects that it determines to be most important, such as education, farming and agriculture, with some additional effort aimed at responding to requests on an ad hoc basis following letters written by community members to the Mine. To date discussions and engagement with the local community have been direct and ad hoc with local chiefs and administrators. There have been various committee meetings over the last two years or so, where representatives of the Mine, Kagem's government business partners, and local community have discussed the various needs of the community and responded accordingly.

Going forward, Gemfields has committed to improving its community development programme to ensure more transparent governance and input from a wider section of the community.

The CP recognises that Kagem was initially responding to community requests based on the available free-cash within the operation and the need to turn it around from being a long-term lossmaking organisation, to that of a sustainable profitable mining operation; however, based on the 25 years LoMp, there is now the possibility for long-term planning with the appropriate level of community consultation.

Gemfields has appointed a new community liaison officer who is responsible for putting in place a strategy with improved governance regarding community investment and is responsible for developing and implementing formal Community Development and Livelihood Restoration Plans.

Additional short term resources may be required to facilitate the initial investigation and planning, as well as documentation of Kagem's community development plan.

The Director of Operations, SHEQ Manager and Sustainability Manager monitor, health, safety and environmental aspects of these CSR project developments. An external civil consultant was engaged to monitor the CSR construction projects (clinic and secondary school) to ensure they are undertaken in accordance with agreements. The government also sent inspectors from the health and education departments to monitor the construction developments; they reported their findings and shared with the SHEQ Manager. Kagem generally hands over the buildings to government to run once construction is completed.

9.5 Stakeholder Engagement

Meetings are held with communities (mainly as input to the CSR activities) and relations are reportedly good. According to the SAR reviewed by the CP, the general perception regarding decision-making is that mining companies tend to make some decisions without detailed consultation with key community players.

However it should be noted that according to Zambian law there should be no people residing within the NRERA, so public consultation should only be undertaken at a district level.

Although meetings have been held, there is no formal stakeholder engagement plan or stakeholder database. In addition, there is no formalised grievance procedure. If complaints or grievances are raised during the above meetings they are relayed to Kagem but there is no process to formally follow them up. The necessity for these formal documents was raised in the review of the 2012 FS and is a requirement of Gemfields' Societal Policy, which refers to the necessity for internal monitoring and measurement of community investment projects, social performance and documented engagement to maintain support for communities. The Policy also states Gemfields will provide local communities with a channel for discussing grievances they feel are the direct result of its operations, employees or contractors, and that, this is a two-way process. The policy refers to the necessity for Gemfields to inform, engage and ensure communities understand the potential risks and benefits of its operations on the physical and economic aspects of their lives as well as engaging them on its mine lifecycle plans with regards to environmental rehabilitation, safety and closure planning.

Development of a stakeholder database to capture information about stakeholders and their issues, as well as assist with record keeping of any stakeholder interactions, will enable Kagem to confirm its positive relations with communities and protect its reputation. Without formal evidence of stakeholder meetings and grievances it is not possible to confirm the extent to which Kagem has achieved its 'social licence to operate'.

The SEP should include the following:

- the kinds of information to be disclosed and information about data gathering and baseline surveys;
- the ease of understanding across the range of stakeholders – use of local language(s) and communication in a culturally appropriate form;
- the location and method of disclosure and consultation – distinct approaches for affected people and specialist interest groups including NGOs, media, and Government;
- the record of consultation and disclosure, and making it available to the project team and to all affected parties; the response / feedback, maintaining two-way communication (where appropriate all interactions will begin with feedback on responses to the issues raised or action points agreed upon in the previous interaction); and
- the time and frequency of public consultations and should include advance notice to stakeholders and the client of when interactions are likely to occur.

Gemfields is fully committed to addressing these issues and has already hired a Head of Department to oversee sustainability (including HSE) and a new Community Affairs Manager who will be responsible for putting in place a strategy with improved governance (regarding community investment), engagement, grievance and partnerships. The CP has been informed that there were no grievances received from stakeholder of local communities within the last reporting period.

9.6 Approach to Security at Kagem

9.6.1 Gemfields and Kagem Security Policies and Strategies

Gemfields Group Sustainability Policies (dated 6 November 2014) includes a Security Policy, which refers to the necessity to proactively understand the site-specific dynamics of illicit and unlicensed mining on its concessions to enhance community relations and minimise commercial risk. Gemfields has also developed a system of Standard Operating Procedures, relating to search procedures and dress code, they are subject to reviews to accommodate new challenges and changing circumstances.

9.6.2 Human resources at Kagem to implement Security policies, systems and plans

In 2015 there were 136 Zambian security personnel employed at Kagem, with 68 security staff on site at any time, as well as 37 guard dogs used for 24 hr patrolling. The majority of the mine security force is Zambian, with only 24 expats employed, mainly Indian and Nepalese (mostly Ghurkhas who are globally renowned for their high level of discipline/integrity, resilience, courage and endurance). If an illegal miner is caught they are handed over to the Zambian police, who are armed. The Kagem security staff have their own firearms but are only armed at critical locations and as and when specifically required. During the night critical locations are guarded by a combination of armed Zambian Mobile Police and Kagem security staff. There is a quick reaction team that is armed and stationed at the security control room which can be moved to threatened locations at short notice; their prime focus being the sort house and wash plant. It is recognised by Kagem's security that chasing illegals at night can lead to injuries of the pursuers and the pursued hence Kagem security staff prefer to rather focus on area domination through foot and vehicle patrolling in and around critical locations to keep the illegals miners at bay.

Changes to security measures and personnel are handled through the HR department. Any vacancies require formal requests for the category to be filled, inductions, pre-employment clearance and security clearance. Recruitment agencies are occasionally used.

9.6.3 Implementation of Security policies, systems, plans and CSR projects at Kagem

In response to Gemfields' policies and procedures, Kagem has developed a Security Strategy. It includes the implementation of a three-tier security system with the combination of Zambia Police Mobile Unit, local Kagem Mine security personnel and expatriate Kagem Mine security personnel. Security at Kagem Mine is taken seriously with clear evidence of strict implementation of formal and spot searches, and is equally applied to all persons on site at all times. Security teams are assisted by CCTV at various locations around the site and infrared cameras at the pits. There are also dog patrols.

The approach to illegal miners is to avoid confrontation and use the security measures to limit/inhibit intrusions as far as practicable. The CP was shown one incident report from 2011; however, it is unlikely this was the last incident of conflict between illegal miners and security, although Kagem security personnel stated there had not been any recordable recent incidents. Security staff allegedly catch two to three illegal miners per week, who are generally 20-25 years old, and the majority of which are poorly educated. Of the illegal miners caught over the past 10 years, apparently only two have been Congolese, the rest Zambian. The illegal miners are apparently not armed but have on the odd occasion been known to attack the security forces with stones, crowbars or their digging tools. If the illegal miners do not find emeralds they have sometimes been known to resort to stealing other mine equipment such as batteries and fuel.

Kagem's current approach to security appears to be effective in minimising tensions with the artisanal miners, although a formal stakeholder engagement process with their representatives may enable a more structured management plan to be implemented.

9.7 Key Environmental and Social Issues

Based on the site visit and review of available documentation, the CP has identified the following key environmental and social issues for consideration by Kagem's management team:

- **groundwater management:** with the planned increase production rate at the Mine, increased attention is being focused on water management. Currently groundwater data is being gathered on-site to enable the development of a more detailed groundwater model and water balance;
- **pollution of Chantete stream:** the potential for Kagem operations to affect the water quality of the Chantete stream is lowered by the pit dewatering flow being passed through an effective silt trap system prior to discharge. However, the absence of any surface water quality monitoring on the Chantete Stream since 2010, which is affected by illegal mining and potentially by other licenced operations along the river, places Kagem at risk of allegations of polluting the Chantete stream. The CP notes that the Chantete stream flows into the Kafue River and is a source of water supply to downstream water users. Kagem has commenced water sampling upstream of the illegal mining site and records are being taken of the sampling results, which will assist Kagem to defend itself if allegations are made;
- **pollution of soil and surface water and sensitive dambo sites caused by slimes storage facility:** the slimes from the wash plant is currently deposited on an unlined area adjacent to the wash plant. Due to the natural slope of the ground the water drains down gradient towards bunded walls that catch the contaminated water and allow it to be recycled to the slimes settlement pond and reused as process water. Although there are no reagents used in the wash plant the water becomes polluted with fine material and there is the risk that this highly turbid water will seep/overflow into the sensitive dambo downstream of the slimes storage facility potentially smothering vegetation and affecting aquatic organisms. The 2016 EIS document does include management and mitigation measures. Future audits will determine the adequacy and effectiveness of these controls.
- **pollution of soil and water due to oil spills:** Kagem is commended on having a fully operational soil treatment plant for the treatment of contaminated soil;

- **health and safety concerns:** Kagem does not keep a formal documented record of conflicts between illegal miners and security forces. There are potential community H&S issues should trespassers be injured by falls or the dogs that chase them and the potential for conflict in the wider community if their activities are aggressively prohibited by Kagem's security. The first can be best managed with improved signage with respect to the personal injury risks and raising awareness in the surrounding communities of the hazards should people (miners, hunters or charcoal burners) venture on site. The CP was informed by Gemfields Group Sustainability Manager that a security and asset protection review is currently being undertaken by consultants and improvements to the existing systems would be implemented once the findings of this report were released;

- **engineering design of overburden dumps impeding revegetation:** during the site visit it was observed that Kagem is undertaking proactive rehabilitation and revegetation on the tops of its overburden dumps. The top surfaces are flattened, covered in topsoil, from a separate topsoil stockpile near Chama pit, and indigenous trees planted from an established nursery. These efforts were, however, being hampered by the tops not being adequately flattened leading to run-off of water and loss of carefully placed topsoil and subsequent loss of transplanted trees. Section 7.2 of the 2014 EMP refers to progressive re-vegetation of dump slopes and upper surfaces. Dump slopes at site were noted to be at the angle of rill (32°), which prevents adequate placement of topsoil and proactive revegetation. The CP notes that since the site visit, when this issue was highlighted, Kagem has committed to flattening the slopes angles to 20°, which will facilitate the on-going rehabilitation in accordance with the EMP;

- **lack of biodiversity information** – the absence of biodiversity data means Kagem has no knowledge of the conservation status and impact of natural habitat prior to clearing of vegetation. In 2015 the Gemfields Group Sustainability Manager has confirmed a baseline biodiversity assessment would form part of the 2016 EIA. This does not appear to have been done however, the CP have been assured that a more comprehensive biodiversity assessment has been programmed for 2019. The results of this study will need to be incorporated into the next update to the Kagem EMP;

- **lack of understanding of illegal mining activities and voluntary principles:** Gemfields Group Human Rights and Security Policy makes reference to the Voluntary Principles for Security and Human Rights (VP), and the same is in the process of being incorporated in current security contracts. Egis has been entrusted to impart training in how they affected their activities at the Mine. A detailed study of illegal mining activities at Kagem is yet to be completed, although this was recommended in the 2012 FS; and

- **Unmet community expectations:** the high level of poverty in the area and low unemployment means the nearby communities have high expectations of mining companies in their area. This needs to be addressed through formal stakeholder engagement and formal grievance procedures.

9.8 Closure Costs and Planning and Environmental Protection Fund

9.8.1 Closure Costs and Planning

Kagem does not have an in-house life of mine closure plan or detailed cost estimate; however, the annual Kagem EMP updates include a section entitled "overview of reclamation, decommissioning, closure and closure cost estimation" relating mainly to rehabilitation and demolition of current levels of disturbance. These costs are based on the disturbed footprint and existing infrastructure at the time of calculation of the costs. This cost estimate is required as part of the EPF Audit to assess the cash contribution Kagem needs to pay to the EPF (as per the Mines and Minerals Act) on an annual basis. The objectives of the EPF are:

- to provide assurance to Director of MSD that the mining project developer shall execute the EIS/EPB in accordance with requirements of Mines and Minerals (Environment) Regulations Statutory Instrument No.29 of 1997; and
- to provide protection to the Government against the financial risk of undertaking the rehabilitation of a mining area, in the circumstances the holder of the mining license fails to do so.

The contributions to the Fund that Gemfields will have to make are based on the environmental management performance (as provided for in the Mines and Minerals (Environmental) Regulations No.66) and subsequent EPF categorisation. The Fund contributions are calculated using the mine closure costs prepared specifically for financial assurance.

The CP considers the closure costs are most likely underestimated, possibly by as much as an order of magnitude as the costs do not:

- take consideration of a specific closure and rehabilitation plan developed in association with stakeholders including local communities and regulatory authorities;
- use rates developed from first principles or taken from recent contractor quotes;
- take into account associated earthworks that may be required around the pits to make these safe; and/or
- consider any socio-economic or labour related issues that may arise at closure.

During the 2008 and 2012 reviews, SRK estimated conceptual LoMp closure costs as USD9.43 M and USD3.0 M, respectively. These estimates were based on high level assumptions and in the absence of any formal LoMp closure cost estimate by Kagem. As part of this study, the CP has revised the previous conceptual LoMp closure cost; however a further detailed assessment is required. The current financial cost estimate in this CPR include a provision of USD20million for closure liabilities.

9.8.2 Environmental Protection Fund

Kagem Mine started its EPF contributions in 2009, making 2016 the eighth year of its EPF contributions towards closure costs. In 2016, Kagem Mine was assessed as Category 1 resulting in a 5-year EP liability after the 95% concession of USD 23,696. The 2015-16 verification audit for Kagem includes an updated financial assurance closure cost of USD 473,918 The report contains a reasonably detailed breakdown of this cost. As noted above, this is not in line with the CP's estimate of the true closure costs.

9.9 Environmental and Social Risks and Opportunities

The following key environmental and social risks and opportunities were identified by SRK as a result of the 2015 review:

- **permitting delays:** delays in project advancement, specifically the proposed expansion of the Fibolele pit, could be caused by the time taken for data collection, report compilation and subsequent approval of the Kagem EIA. These time constraints need to be taken into consideration by the FS and LoMp;
- **mining activities delayed or disrupted:** ZEMA/MSD could delay or disrupt mining activities at Kagem due to current non-conformances in the EMP and outstanding permits (water abstraction and discharge licenses). Improved pro-active environmental management, as discussed below, will minimise this risk as will maintaining good relationships with the authorities. Since the Zambian government is a 25% shareholder in Kagem and ZEMA and MSD have been proactively involved in the review of annual EMP and EPF updates for the Mine this risk is anticipated to be quite low;
- **reputational risks associated with alleged human rights abuses:** although there have not been any human rights abuses in the past, due to the presence of illegal miners on the site, Kagem needs to monitor the situation more carefully. The absence of a formal incident reporting system increases the company's exposure to this risk. Adherence to Gemfields' Standard Operating Procedures and implementation of the Voluntary Principles on Security and Human Rights (VP) will minimise this risk;
- **strategic evaluation of current CSR activities:** the lack of a community development plan based on primary socio-economic data collections means that Kagem's CSR activities are responsive and leaning towards short term corporate giving. There is an opportunity for Kagem to re-evaluate its approach to community development, in close association with affected communities, to focus on investment in initiatives resulting in sustainable long term outcomes with benefits extending beyond the life of mine. The CP acknowledges this will be addressed through the hiring of additional staff and development and implementation of appropriate strategies and governance systems, plans and procedures; and
- **improved environmental performance:** Kagem is complying with the commitments articulated in the Gemfields and Kagem SHEQ policies, but needs further improvement and this provides an opportunity for Kagem to bring in systems in line with other mining operations in the Copperbelt as well as GIIP and corporate Gemfields requirements. Kagem has historically not been required to undertake an EIA for bulk sampling activities. The CP recommends Kagem to undertake further baseline work. The limited baseline data (on noise, air quality, biodiversity etc.) and on-going operational monitoring data from which to evaluate impacts and monitor effectiveness of management measures means that environmental and social impacts are not necessarily fully understood and managed. There is an opportunity through the new EIA required for the Fibolele pit to address these current gaps.

9.10 Conclusions

Overall, the site visit and review of available data indicate that Gemfields operation is largely in compliance with the requirements of Zambian environmental legislation and extant licence conditions aside from the outstanding abstraction permits. Based on the available data and observations during the site visit, the CP acknowledges that the risk of significant environmental impacts is relatively low. Most of the potential environmental and social impacts evident at the site can be further reduced through management measures that are not difficult to implement and are known to be reliable. Relative to good international practice and SAMESG guidelines, the key areas to be addressed include:

- the Mine has an excellent safety record, having recently achieved a safety record of 3.5 M injury free man-shifts. This was recognised by the Zambian Government with a prestigious award;
- implementing the new EMP associated with the 2016 EIS and the twenty six conditions attached to the EIS approval;
- fully meeting Gemfield’s corporate SHEQ policies and standardising Kagem’s policies and ESMS with GIIP - The CP notes this transition is underway and is being driven by Gemfields Group Sustainability Manager;
- relooking at current corporate social investment to ensure this focuses on sustainable outcomes rather than corporate donations;
- ensuring full compliance with its EMP or if conditions are not appropriate, negotiate with the authorities to revise the conditions - The CP notes that actions are being undertaken by Kagem to address non-compliances;
- conducting the long-awaited biodiversity assessment and development of a biodiversity action plan; and
- developing a life of mine closure cost estimate.

9.11 Recommendations

Further improvements (and on-going compliance with environmental standards / licence conditions) can be expected from the following actions:

- build the combined SHEQ and CSR team and undertake formal stakeholder analysis and prepare a stakeholder database and a formal Stakeholder Engagement Plan and Grievance Mechanism as per Gemfields Societal Policy;
- as part of the development of an effective proactive management system, expand the existing socio-economic assessment report to include additional detail on the illegal miners and identify potential receptors in terms of community health and safety (traffic, dust, water discharges) as well as socio-economic impacts (population influx, job creation and benefiting from CSR activities). Use this data to confirm environment and community impacts and revise management measures to be included in an updated EMP and newly developed Community Development Plan;
- continue to construct the waste rock dumps at appropriate slope angles that will facilitate slope re-contouring and revegetation;

- update the monitoring programme to identify key indicators that can be monitored on an on-going basis to gauge the effectiveness of the revised management measures;
- continue to install active groundwater monitoring wells around active and disused overburden dumps as per its commitments in the EMP;
- improve understanding of the surface and ground water regime in the Mine area as outlined above;
- for future annual EMP updates include an update on construction and operational activities and surface infrastructure layouts and design features relevant to the mitigation of environmental impacts, also consider revised impacts, from work described above, to re-evaluate management measures;
- develop a BAP for Kagem in accordance with Gemfields Group Environmental Policy requirements following the undertaking of the biodiversity baseline study;
- update the current closure plan and cost estimate to reflect the end of life of mine closure cost including:
- formally agreeing the end land use objective with stakeholders;
- developing rates from first principles using recent and current equipment operating, labour, fuel and contracting costs;
- verifying the disturbed footprint areas for high unit cost rates of infrastructure areas such as the wash plant;
- incorporating the current revegetation of the pit high wall in the area calculations;
- preserving existing intact Miombo woodland on/near the operations to assist future natural revegetation of disturbed areas;
- constructing bund walls of the hanging wall that do not already exist to an appropriate height to prevent vehicle access and dissuade human access;
- designing waste rock dumps for closure and ensuring mine plans align with the EMP by either modifying the EMP or mine plans;
- designing future pit walls for long-term stability at closure without additional earth moving at end of life of mine.
- undertake training of Security personnel on the VP and incorporate these principles into security contracts and activities; and
- undertake risk assessments and develop the necessary policies, procedures and guidelines as described by the VPs and maintain a record of their implementation.

10 EMERALD AND BERYL MARKETING AND SALES

10.1 Introduction

The following section includes an overview of emerald production and the emerald market, historical prices and future sales as they apply to the Kagem Mine. The CP notes however that this overview does not quantitatively analyse historical demand-supply-price relationships nor attempts to comment on the impact on price of assumed increases in supply such as that proposed by the Company. Furthermore the price overview is limited to the rough gemstones sold in auctions and any potential relationships between historical rough and cut prices are not discussed to enable an assessment of the entire value chain and the potential uplift should the Company decide to become more vertically integrated. The CP notes that consensus market forecasts are not available for coloured gemstones and accordingly reliance for future price scenarios are generally linked to those achieved historically.

10.2 Overview of Emerald Production

Historically, emeralds have been mined in Colombia, Russia, Afghanistan and Brazil. Colombia has been the largest supplier in US Dollar terms for the past five hundred years or so, but conflict and low investment have resulted in significantly reduced export values in recent years. The easily accessible deposits within the mainstay mines of Muzo, Coscuez and Chivor have largely become depleted in recent years. Colombian gemstones have traditionally fetched the highest quality for quality per carat prices whereas Brazilian gemstones, being lighter in colour with a yellow-green tinge have generally fetched lower prices. Zambian emeralds are relatively new to the market but have been fetching increasingly higher prices over the past few years.

10.2.1 Colombian Dominance

Colombia has traditionally been the principal producer of fine quality emerald for centuries. However, Colombia’s output and share of global production has decreased considerably in the last few years (Table 10-1). The primary reason for this drop in production of Colombian emeralds is believed to be on account of the very limited amount of formal investment and lack of professional mining techniques. Traditionally, the three main mining districts were Muzo, Coscuez and Chivor. The mines lie in a series of black shales. More recently the La Pita mine has also been a major producer of Colombian emerald surpassing Muzo and Coscuez in total kilogrammes of rough emerald produced. Whilst all qualities are produced, fine and extra fine quality gemstones are scarce.

Table 10-1: Historical Emerald Production from Colombia

Year	Emerald Production (kg)
1996	2,100
1998	2,500
2000	2,200
2002	1,600
2004	2,500
2006	1,146
2008	424
2010	1,040
2012	240
2013	520
2014	393
2015	433
2016	477

(Source USGS and Ministry for Mining and Energy, Colombia)

Emerald was one of the top selling gemstones in the international market during the mid to late 1980s through the early 1990s. Driven by demand, emerald prices hit record highs during this period. Increased demand by Japanese and European buyers helped trigger pricing volatility. With demand outpacing supply, prices remained volatile

10.2.2 Brazil

Emeralds were discovered in Brazil in the seventeenth century, with more recent deposits being found in the 1980’s, making Brazil one of the most significant suppliers in the world. Deposits are located in the state of Bahia, in a mica schist horizon near Salininha as well as deposits at Carnaiba in mica schists. It is the largest supplier of the low grade emerald market. The country continues to export rough as well as cut and polished emeralds.

10.2.3 Other Significant Emerald Deposits

Emeralds are also found in the Panshir valley of Afghanistan and the Swat region of Pakistan. The colour of these emeralds has been said to be similar to the colour of Colombian gemstones. However, the gemstones are almost always small and this limits their market value. Other emerald deposits have been discovered in Australia (Emmaville), South Africa (Leysdorp), Zimbabwe (Belingwe), India (Rajasthan), Tanzania (Gregory Rift Valley), Nigeria (Plateau), Madagascar (Kianjavato), Norway (Akerhus), USA (Hiddenite), and Mozambique (Morrua).

According to Gemfields’ estimations, Zambia, Colombia and Brazil are the world’s top producer of emeralds, each accounting for around 30% of global supply, with significant production currently coming from Pakistan and Afghanistan as well. Efficient mining and distribution practices and coordinated marketing efforts by Gemfields have been crucial to the development of the Zambian market, as Gemfields’ Kagem Mine still accounts for roughly 70% of Zambian emerald production by value.

Zambia hosts several important emerald deposits including the Ndola-Rural Restricted Area. Emerald deposits have been known for decades in Zambia, with some newer deposits being less than a decade old. However, the market appreciation for Zambian emerald has been driven both by its ability to provide a consistent supply as well as the quality of its gemstones. Zambian emeralds tend to have an overall higher clarity than that of the other two main sources (Colombia and Brazil). Many dealers prize Zambian emeralds for their transparency, with many gemstones exhibiting a clear "crystal" transparency that gives them a wonderfully attractive appearance. Zambian emeralds are also prized for their rich bluish green colour, a colour which is generally considered unique to this area. As a result the need for enhancements to be applied to this material is generally less than that of any other known active emerald source. This has proven increasingly important to consumers, especially those in the Asian market.

10.2.4 Distribution Network for Zambian Emeralds

Zambia is a geologically rich and diverse country and an important source to the international emerald trade. Emeralds are produced at numerous locations along Zambia's copper belt. However, production is reported to be most active at Kagem.

A turning point for the supply of Zambian emeralds was the acquisition of a controlling interest in the Kagem Mine by Gemfields' parent company, Pallinghurst, in December 2007. This was later transferred, via a reverse takeover in 2008, to Gemfields which now owns 75% of the Kagem Mine. It has successfully implemented a turnaround strategy and transformed Kagem into the world's single largest producing emerald mine, responsible for roughly 25% of global emerald supply. A large reason for this success is Gemfields' move to providing the international markets with consistent access to graded rough which has significantly developed the entire downstream global emerald market. With some of the major emerald fields of Zambia now under the control of a single management group, this has further enhanced the attractiveness and potential for even greater investment into the Zambian emerald sector. Further development as well as the transition to mechanized mining has supported increased production and improved operational efficiency. In 2007, Kagem produced 9.4 million carats, which has increased to 30.1 million carats in the year ending June 2015, and 19.1 million carats in the year ending June 2016.

Gemfields sells its production through its auction platform rather than through a private dealer network. In 2014, Gemfields also paid its first dividend of USD16 M, with USD3.2 M going to the Zambian government in addition to mineral royalties and corporate income taxes. In 2016, dividend payments rose to $34 million for the year.

Production is expected to continue to grow as current demand increases in the major gemstone markets. Investment in further exploration should result in the development of more diverse sources in the future. Prices for finished emeralds from all three major producing nations have increased since 2004. Higher prices have held firm due to increased demand in India and China.

10.2.5 The Market Mechanisms

Once finished (faceted), Zambian emeralds are sold on the wholesale market globally. Two distinct routes to market exist. One is through international coloured gemstone trade-shows such as the annual Tucson (USA) GemFair, others include the international Hong Kong and Bangkok gem shows. The second route is the more common method observed in the coloured gemstone market. This involves Zambian emerald buyers visiting the cutting centres in Jaipur, India and Ramat Gan and Tel Aviv, Israel to purchase rough directly from the cutters and private brokers and dealers.

It is noted that Zambian emeralds service an important niche in the global gemstone market, this is mainly because Zambian rough produces a certain quality and size of product at an attractive price point.

10.3 Emerald Value

Emeralds, both in Colombia and Zambia have been traditionally mined in small scale cooperatives. However, fair trade principles have been steadily growing in importance to buyers according to the Jewellery Consumer Opinion Council. It has been suggested that the "beauty" of gem products can be further enhanced by providing a greater level of ethics, transparency and improved employment practices. Globally, third world gem producing areas remain some of the poorest areas in spite of the wealth that others further up the distribution channel have historically gained through the sale of these products.

Development of mining areas through the payment of taxes, appropriate employee practices and the construction of social necessities such as schools and medical clinics can further enhance these gemstone products.

Although emerald mining has traditionally been conducted following variants of small scale models, there is tremendous upside potential to the emergence of a large scale model in the Zambian emerald industry.

Through proper development the Zambian emerald industry can expand its important niche of supplying the world market with fine quality emeralds. The relationship between government and private sector is favourable to further the development of the mineral resources of the nation.

Assuming the proper investment in product development and brand enhancement, emerald continues to offer strong upward potential. In that regard, the desirability for Zambian emerald (traditionally recognized in the gemmological community for its higher overall clarity) cannot be overstated.

10.3.1 The World Coloured Gemstone Market

The coloured gemstone market is in a phase of fast growth, primarily due to the major economies' recovery and growth combined with a fashion trend which has shifted towards coloured gemstones supported by Gemfields ability to ensure a consistent supply of quality gemstones to the downstream markets and its intensive global marketing and communications efforts. According to the United Nations Commodity Trade Statistics Database, the international coloured gemstone industry has been growing at a Compound Annual Growth Rate (CAGR) of 19% for the last five years (2012 – 2016) and currently stands at USD8.6 billion. The emerald, ruby and sapphire market make up 87% of the coloured gemstone market and currently stands at USD7.5 billion, with 22% CAGR over the period, 2012-2016. The information is still largely lacking but it is estimated that rubies and sapphires make up for 50% of the world's coloured gemstone market with the largest demand for rubies originating from Asia.

The gemstone industry is highly fragmented. Small to medium scale miners produce a large amount of the gemstones and do not declare their data. The world's top gemstone manufacturing hubs – India and Thailand - experienced steady growth in their exports of emeralds, rubies and sapphires in 2016 – 9% and 8% respectively. Meanwhile, exports from Hong Kong, the main trading hub, more than doubled reaching USD2 billion (2015: USD1.3 billion). Asian markets and the USA regained momentum and showed extremely encouraging results with China, Japan and India growing by 92% (US$2.3 billion), 11% (US$1.4 billion) and 19% (USD0.08 billion) respectively, and the USA imports increasing by 8% (USD1.3 billion).

Over the last five years (2012-2016) prices have increased 17% for rubies, 8% for sapphires and a staggering 100% for emeralds, in contrast to slight negative trend observed for diamonds, according to GemVal and Rapnet. The sustainability of price increases remains to be seen, but demand growth remains strong at present. The trajectory of received emerald prices at Gemfields' auctions has broadly followed the Polished Prices Diamond Index.

10.3.2 Historical Cut Emerald Prices

Table 10-2: Cut Emerald Prices USD/ct

Period	Commercial	Good	Fine	Extra Fine
2016	**110**	**1420**	**4500**	**7200**
2015	**110**	**1420**	**4000**	**6200**
2014	**110**	1420	4000	6200
2013	**110**	1420	4400	6500
2012	**110**	1420	4400	6500
2011	**110**	1420	4400	6500
2010	**110**	1350	4000	6500
2009	**110**	1350	4000	6500

Source: 'The Gem Guide'

Since 2002, emerald prices have been on the increase, reaching a peak in 2011, stabilizing thereafter and then reaching another peak in 2016. Professional marketing efforts started by Gemfields in 2010 have had an important influence in driving demand for emeralds up and increasing desirability of the gemstones among younger generations, turning them into a very modern choice. A key point to note about emeralds and other coloured gemstones is that they offer the retail jeweller a much more attractive profit margin compared to the slim margins more recently seen in diamonds. This makes them appealing products to stock and promote. Emeralds already possess a strong brand with consumers. Emeralds are one of the earliest gems used in jewellery and have been held in high regard dating back many centuries.

Historically, a key constraint to the sale of coloured gemstones has been the limited quantities and erratic nature of the supply. With the bulk of world production coming from small scale miners, the downstream supply chain has not had access to sufficiently consistent supplies of rough for large production runs of certain product lines or the ability to support these with the necessary marketing campaigns. Now that Gemfields has entered the market, cutters can purchase large parcels of consistent grade emerald product at auction. This enables retailers and manufacturers to plan larger production runs of jewellery that rely on consistent supply, stable pricing and the reliable grading of the rough and they can in turn support this with an increased level of consumer focussed marketing. The result of this is the opportunity to grow the size of the market and broaden the appeal of the products while keeping prices stable or increasing.

10.3.3 Auction Results

Table 10-3 to Table 10-6 and Figure 10-1 present tabular and graphical representations of Gemfields' auction results (per carat prices) for both lower and higher quality grades from 2009 until October 2017. The high quality auction consists of all premium emeralds and 18% of emeralds. The low quality auction is the remaining 82% of emeralds. No beryl is included in these auction results. It can be noted that both of the graphs are trending steadily upwards. This is considered most likely due to increased consumer confidence in Gemfields' product as a result of the proprietary grading, marketing and sales platform developed by the Company, as well as a general increase in consumer demand for coloured gemstones.

Table 10-3: Higher Quality Auction Results

Details	JUL `09	NOV `09	JUL `10	DEC `10	JUL `11	MAR `12	NOV `12
Dates	20-24 Jul `09	23-27 Nov `09	19-23 Jul `10	6-10 Dec `10	11-15 Jul `11	19-23 Mar `12	29 Oct - 2 Nov `12
Location	London, UK	Johannesburg, SA	London, UK	Johannesburg, SA	Singapore	Singapore	Singapore
Type	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality
Carats offered (million)	1.36	1.12	0.85	0.87	1.07	0.77	0.93
Carats sold (million)	1.36	1.09	0.8	0.75	0.74	0.69	0.9
No. of companies placing bids	23	19	37	32	38	29	35
Average no. of bids per lot	10	13	18	16	16	11	11
No. of lots offered	27	19	27	19	25	23	19
No. of lots sold	26	14	24	18	18	20	16
Percentage of lots sold	96%	74%	89%	95%	72%	87%	84%
Percentage of lots sold by weight	99.80%	97%	94%	86%	69%	89%	98%
Percentage of lots sold by value	82%	76%	87%	99%	91%	94%	90%
Total sales realised at auction (US$ Million)	5.9	5.6	7.5	19.6	31.6	26.2	26.8
Average per carat sales value	USD 4.40/carat	USD 5.10/carat	USD 9.35/carat	USD 26.20/carat	USD 42.71/carat	USD 38.25/carat	USD 29.71/carat

Table 10-4: Higher Quality Auction Results Cont.

Details	JUL `13	FEB '14	NOV `14	SEP '15	APR'16	FEB'17	Oct '17
Dates	15-19 Jul `13	21-25 Feb '14	13 Nov - 17 Nov	31 Aug - 4 Sept' 15	30 Mar-3 Apr 2016	13-17 Feb 2017	2-5 Oct 2017
Location	Lusaka	Lusaka	Lusaka	Singapore	Lusaka	Lusaka	Lusaka
Type	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality	Higher Quality
Carats offered (million)	0.58	0.84	0.6	0.6	0.56 million	0.42 million	0.32 million
Carats sold (million)	0.58	0.62	0.53	0.59	0.47 million	0.35 million	0.32 million
No. of companies placing bids	36	34	34	37	33	33	36
Average no. of bids per lot	8	13	12	11	9	7	11
No. of lots offered	18	17	17	19	18	19	18
No. of lots sold	18	15	16	18	16	17	18
Percentage of lots sold	100%	88%	94%	95%	89%	89%	100%
Percentage of lots sold by weight	100%	74%	89%	98%	84%	84%	100%
Percentage of lots sold by value	100%	86%	89%	88%	94%	95%	100%
Total sales realised at auction (US$ Million)	31.5	36.5	34.9	34.7	33.1	22.3	21.5
Average per carat sales value	USD 54.00/carat	USD 59.31/carat	USD 65.89/carat	USD 58.42/carat	USD 70.68/carat	USD 63.61/carat	USD 66.21/carat

Table 10-5: Lower Quality Auction Results

Details	MAR `09	MAR `11	NOV `11	JUN `12	APR `13	NOV `13
Dates	11-15 Mar 2010	10-14 Mar 2011	21-25 Nov 2011	9-13 Jun 2012	15-19 Apr 2013	11-15 Nov 2013
Location	Jaipur, India	Jaipur, India	Jaipur, India	Jaipur, India	Lusaka, Zambia	Lusaka, Zambia
Type	Lower Quality	Lower Quality	Lower Quality	Lower Quality	Lower Quality	Lower Quality
Carats offered*	28.90 million	16.83 million	10.83 million	10.85 million	17.34 million	5.62 million
Carats sold (million)	22.8	12.98	9.82	3.47	6.3	4.94
No. of companies placing bids	25	44	27	20	25	20
Average no. of bids per lot	8	14	9	3	6	7
No. of lots offered	56	35	26	33	28	21
No. of lots sold	49	34	19	17	23	19
Percentage of lots sold	88%	97%	73%	52%	82%	90%
Percentage of lots sold by weight	79%	77%	91%	32%	36%	88%
Percentage of lots sold by value	89%	76%	87%	99%	91%	91%
Total sales realised at auction (US$ million)	7.2	10	11	9	15.2	16.4
Average per carat sales value (US$/c)	USD 0.31/carat	USD 0.77/carat	USD 1.12/carat	USD 2.61/carat	USD 2.42/carat	USD 3.32/carat

Table 10-6: Lower Quality Auction Results Cont.

Details	AUG '14	FEB'15	NOV'15	MAY'16	SEP'16	MAY '17
Dates	05 -08 Aug 2014	24-27 Feb 2015	18–21 November 2015	17–20 May 2016	26 – 29 September 2016	15-18 May 2017
Location	Lusaka, Zambia	Lusaka, Zambia	Jaipur, India	Jaipur, India	Jaipur, India	Jaipur, India
Type	Lower Quality	Lower Quality	Commercial quality	Commercial quality	Commercial Quality	Commercial Quality
Carats offered*	12.11 million	10.10 million	5.07 million	3.67 million	4.05 million	3.10 million
Carats sold (million)	11.58	3.9	4.45	2.78	3.27	3.10
No. of companies placing bids	21	21	29	26	30	33
Average no. of bids per lot	7	5	6	7	7	9
No. of lots offered	21	26	23	18	19	23
No. of lots sold	17	19	18	14	15	23
Percentage of lots sold	81%	73%	78%	78%	7900%	100%
Percentage of lots sold by weight	96%	39%	88%	76%	8100%	100%
Percentage of lots sold by value	88%	88%	95%	79%	8200%	100%
Total sales realised at auction (US$ million)	15.5	14.5	19.2	14.3	10.7	14.5
Average per carat sales value (US$/c)	USD 1.34/carat	USD 3.72/ carat	USD 4.32/ carat	USD 5.15/ carat	USD3.28/ carat	USD 4.68/ carat

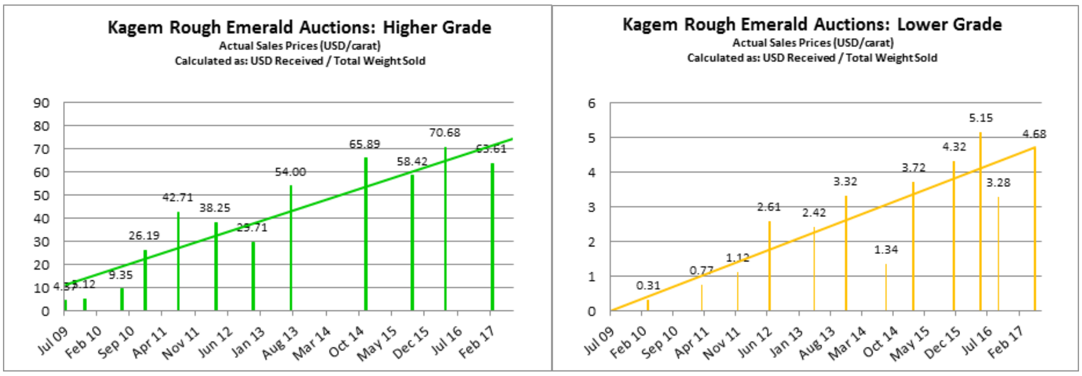

Figure 10-1: Auction Results – Graph

10.4 Gemstone Marketing Strategy

The global market has recently witnessed a significant rise in demand for coloured gemstones. This was primarily linked to the general trends in the fashion industry towards revealing the significance of colour, the growing economies of the developing world, increasing importance of ethics and transparency in business and realising the investment value of coloured gemstones.

Gemfields has significantly invested in marketing an industry that has never seen formalised and coordinated marketing efforts in the past, thereby revealing the value of the Zambian emeralds both to the trade and consumer.

To be able to market effectively, Gemfields had to be able to guarantee constant supply of these gemstones to the global market and ensure that Zambian emeralds are available on the market in the key geographies. In order to achieve this, Gemfields keeps roughly one year's rough production available as a stock balance at any given point in time and manages its inventory to meet growing market demands. Through its auction platform and cut and polished sales department Gemfields is able to reach directly to its customers. Gemfields Kagem Mine has over 25 years life of mine with a capacity to provide sustainable supply to the market throughout this period and beyond.

Gemfields initial Zambian emeralds marketing efforts were focused on the trade participants. Starting from 2010 Gemfields began targeted trade advertising campaigns through trade publications and presence at the major trade shows to create awareness and demand for its emeralds. Gemfields created two advertising campaigns and two 'Emeralds for Elephants' campaigns in 2010 and 2011 where renowned international jewellers created emerald pieces to promote the gemstones. Global launch of its brand ambassador Mila Kunis in 2013 featured emerald, ruby and amethyst jewellery. Gemfields Emerald Book launched in 2013 aimed at telling the story of emeralds to the end consumer and was very successful.

Currently, Gemfields continue to market Zambian emeralds as an exclusive gemstone in collaboration with jewellers, artists and designers. The target customer focus is at the end consumer as firm foundations are created in the trade community.

To conclude, Gemfields directs a high level of attention to doing business in a responsible, transparent and ethical way. From responsible environmental, labour and social policies, to safe mining operations, transparent auction process, accountable government engagement and through to the final customers Gemfields is a leader within its segment, is increasingly looking to be on par with global best practices and believes that integrity is a key demand driver for its product. By continuing to recognise and address major social, environmental, health & safety, transparency issues Gemfields believes it can satisfy its stakeholders' expectations and maximise value as a business. Notwithstanding the limitations in respect of a historical and forecast supply-demand-price analysis, the CP notes the Company's overall objectives in developing a strategy whereby the substantial increase in production at Kagem will in essence seek to compete within the broader gemstone market. Accordingly the Company considers that the projected increase in overall production whilst significant in respect of rough emeralds will ultimately be absorbed without a negative correction for the price of cut emerald.

10.5 Future Emerald Prices

In respect of the commodity price, the CP has not undertaken a detailed price analysis, but in discussion with Gemfields has relied on the historical auction results (Section 10.3.3) in this regard. The average price achieved at the high quality auctions for the period 2015 to 2017 has been USD64.63/ct. All premium emeralds and 18% of emeralds are sold at the high quality auction. The average price achieved at the low quality auctions for the same period has been USD4.19/ct for the lower quality emeralds (remaining 82%). Note that Beryl products are not sold at these auctions. Price forecast for Beryl I, based on historical direct sales, is USD0.11/ct and the estimate for the Beryl II product is 0.006/ct as estimated by Gemfields. The CP consider the premium emerald and emerald product forecasts based on historical average prices achieved to be acceptable for these products. With forecast revenue from Beryl products amounting to 1% of LoM revenue the CP considers there to be negligible risk from Gemfields beryl price forecasts and consider them acceptable. Prices for premium emerald, emerald and beryl-1 and beryl-2 products are presented in Table 12-1.

10.6 SRK Comments

While Colombian emeralds continue to dominate the higher quality and value spectrum of global emerald supply, production is significantly down, meaning that Zambian and other sources now supply a substantial proportion of the global market. In turn, Gemfields contributes a significant proportion of total Zambian production, making the company one of the most important sources of emerald in the world. Due to the success of Gemfields' proprietary grading, marketing and sales platform, and increased production efficiency, the company has become a major driver in the continued growth of emerald prices in the last few years. This has increased consumer confidence and demand for the precious gemstones. This achievement is especially notable given the relatively poor performance of the diamond industry over the same period. The CP considers that the projected prices presented in this CPR as a basis for Reserves estimates are reasonable and are supported by the historical prices achieved.

11 RISKS AND OPPORTUNITIES

11.1 Introduction

The following section includes a summary of the principal risks and opportunities as they may relate to the Kagem Mine and seeks to identify and quantify the potential impact should such a risk or opportunity materialise. In certain instances, the analysis is limited to qualitative assessment only and accordingly no direct financial impact can or has be determined.

In all likelihood, many of the identified risks and/or opportunities will have an impact on the cash flows as presented in Section 12 of this CPR. The CP has provided sensitivity tables for simultaneous (twin) parameters, which cover the anticipated range of accuracy in respect of commodity prices, operating expenditures and capital expenditures. The CP is of the view that the general risks and opportunities are, with the aid of the sensitivity tables, adequately covered. Specifically, these largely address fluctuations in operating expenditure and commodity prices.

In addition to those identified above, the Mine is subject to specific risks and opportunities, which independently may not be classified to have a material impact (that is likely to affect more than 10% of Kagem's annual post-tax pre-finance annual operating cash flow), but in combination may do so.

The CP has further reviewed the risks identified below in accordance with their potential likelihood and associated consequence of risk in order to derive an overall risk measure classified as low, medium or high. It is important, however, to note that the classification of specific risks with an overall risk measure of medium or high does not necessarily constitute a scenario which leads to *"project failure"*. Where appropriate, the CP has classified all specific risks with a medium risk or higher as the most material risks to which Kagem Mine is subject.

Certain of the specific risks identified comprise either generic risk elements which are adequately addressed by the various twin-parameters sensitivities analysis undertaken or which do not readily lend themselves to quantitative analysis. The specific risks which fall into such categories are: commodity price risk; foreign exchange and CPI risk; water management risk; occupational health and safety risk, and cost of production risk.

11.2 Risks

The Mine is subject to certain inherent risks and opportunities, which apply to some degree to all participants of the international mining industry. These include:

- **commodity price fluctuations:** these many be influenced, inter alia, by commodity demand-supply balances for gemstones, specifically rough and cut emeralds. In all cases, these are critically dependent on the demand in the primary sales markets in which cut gemstones are consumed, an indication of which is the disposable income as generally reflected by the projected growth in GDP. Furthermore, the sales price varies significantly between both rough and cut gemstones and within the specific quality categories. Historical prices as recorded for the Mine production are largely based on a weighted average price received from auctions. Accordingly, the CP notes that increased production of emeralds has the potential to adversely impact the market price for rough and/or cut emeralds. Increased production could come from the Kagem Mine or other parts of the world where gemstones could be mined;
- **foreign exchange and CPI risk:** CPI for each specific country/currency is impacted by the assumed relationship between exchange rates and the differential in inflation between the respective currencies, that is, purchase price parity or non-purchase price parity. Given the low exposure to non-USD related expenditures as noted by Kagem, the overall foreign exchange risk is however considered immaterial;
- **country risk:** specifically country risk including: political, economic, legal, tax, operational and security risks;
- **legislative risk:** specifically changes to future legislation (tenure, mining activity, labour, occupational health, safety and environmental) within Zambia;
- **Mineral reserve estimation risk:** the presence and proportion of premium or higher quality gemstones may be more erratic than indicated from the bulk sampling (mining) undertaken to date. It is possible that certain parts of the deposits are richer than others and this has not yet been fully appreciated at this stage of the Mine life;
- **water management risk:** this risk relates to managing the impact of dewatering and discharge on water resources used by the local community;

- **environmental and social risks:** these risks are largely related to issues surrounding artisanal mining in and around the concession area. The experience of other mining operations across the globe would indicate that there is always a risk of uncontrolled inundation of the mining areas by artisanal miners. Should this issue not have been properly identified and managed by Kagem production may be prevented from taking place. Related to this is the risk that local communities become dissatisfied with Kagem and engage in civil unrest forcing suspension of operations. Other environmental risks largely relate to certain deficiencies of environmental documentation and management. Areas of environmental documentation that could be improved include: development of a detailed closure plan in accordance with local regulations, enhancement of the baseline characterisation of the Mine area; and development of a more detailed stakeholder engagement plan and management systems to include commitments for on-going relationships with the local communities; and
- **economic performance risk** is largely addressed by the combination of the assessment economic performance criteria and the accompanying sensitivity tables as included in Section 12 of this CPR.

11.2.1 Risk Assessment Methodology

The CP has completed a risk assessment in respect of the Mine which largely draws upon the issues highlighted in Section 11.2. The CP notes that such assessments are necessarily subjective and qualitative, however, where quantification is possible, the consequence rating has been classified from minor to major:

- **major risk:** the factor poses an immediate danger of a failure, which if uncorrected, will have a material effect (>15% to 20%) on the Mine cash flow and performance and could potentially lead to closure of the operation;
- **moderate risk:** the factor, if uncorrected, could have a significant effect (10% to 15%) on the Mine cash flow and performance unless mitigated by some corrective action; and
- **minor risk:** the factor, if uncorrected, will have little or no effect (<10%) on the Mine cash flow and performance.

The likelihood of any specific risk materialising has also been assessed and falls into three categories:

- likely: will probably occur;
- possible: may occur; and
- unlikely: unlikely to occur.

The degree or consequence of a risk and the likelihood of occurrence has been combined into an overall risk assessment the matrix for which is presented in Table 11-1.

Table 11-1: Overall Risk Assessment Matrix

Likelihood of Risk	Consequence of Risk		
	Minor	Moderate	Major
Likely	Medium	High	High
Possible	Low	Medium	High
Unlikely	Low	Low	Medium

11.2.2 Specific Risk Assessment

Table 11-2 presents the results of the specific risk assessment as considered applicable to the Kagem Mine. On this basis, one specific risk has been classified with an overall risk of medium and thereby material in the overall specific risks identified in Section 11.2.1 of this CPR.

Table 11-2: Kagem Project Risk Assessment before mitigation

Hazard Risk	Likelihood	Consequence Rating	Overall Risk
Legislative Risk			
Revision to the current fiscal terms	Unlikely	Moderate	Low
Mineral Reserve Risk			
Impact of erratic distribution of premium gemstones	Possible	Moderate	Medium
Environmental and Social Risk			
Impact of strained relations with local communities	Unlikely	Moderate	Low

11.3 Opportunities

The principal opportunities with respect to the Kagem Mine are largely constrained to:

- **Mineral Resource** potential increases through completion of successful exploration drilling at the Mine and the broader area within the licence.
- **Mineral Reserve** potential increase through:
  - refining current estimates with further exploration drilling and bulk mining to help to calibrate the estimation process and better define the presence of high value gemstones; and
  - upgrading of the Inferred Mineral Resources and unclassified material to Indicated and Measured through additional drilling; and
- **Plant Throughput:** improvement through implementation of an expansion beyond that planned in this LoMp; however, the CP notes that further production rate increases are likely to be contingent upon the capacity of the world market for emeralds.

11.4 Summary Comments, Risks and Opportunities

The risk and opportunity assessment undertaken for Kagem and specifically the current LoMp and accompanying Mineral Reserves, indicates that there are opportunities to substantially increase the current Mineral Resource through further exploration. The principal risks which require management to mitigate their negative impacts are as follows:

- **legislative and permitting risk:** Kagem should maintain the current good relations with government to ensure permits are approved in a timely manner and to lobby for no negative changes to the mining fiscal regime or export regulations;
- **Mineral reserve estimation risk:** the expected variation in mined grade from month to month requires some buffering between production and sales activities. Kagem has a significant quantity of rough gemstones in a secure storage facility on surface equivalent to approximately one year's production to meet this objective. The CP considers this to be adequate, but has also recommended that mining blocks are delineated with further sampling prior to mining to predict future production more accurately:

- **water management:** hydrogeological investigations are required to assess long-term water requirements and careful day-to-day management is necessary to ensure that zero discharge of silty water to the environment is maintained; and
- **environmental and social risks:** Kagem has made significant efforts to maintain good relations in the local communities through a number of social initiatives. The CP considers that the approach being applied is appropriate but needs to be maintained and enhanced through to be effective in the medium to long term.

12 ECONOMIC ANALYSIS

12.1 Introduction

For the economic analysis, the CV has constructed an independent technical economic model ("TEM") for the Mine as described in Section 1.2 of this CPR. This economic analysis has been undertaken in accordance with the SAMVAL code to determine the "Intrinsic Value" of the Kagem Mine Mineral Reserves as part of this CPR and is not a market valuation of the Company. This CPR has been prepared to support the reporting and sign-off by SRK's CP's of Mineral Resources and Mineral Reserve estimates for the Mine in accordance with the SAMREC Code as requested by the Client. The Client requires the CPR at the request of the JSE following the recent acquisition of Gemfields. .

The full Scope of Work for the financial and valuation aspects of the CPR as contained in the proposal to the Client, dated September 2017, was:

- ***Financial*** *– SRK will update the financial model for the operation which will bring together the production profiles, capital costs, operating costs and price profiles. The model will be expressed in real terms, post tax and pre-finance. The model will generate NPV, IRR and payback. The LoMp report will contain an appropriately detailed commentary on the financial assessment.*
- ***Valuation*** *– SRK will add a chapter in the CPR which values the assets in accordance with the SAMVAL Code.*

No further commissioning instructions were received.

The valuation date of this TEM is 31 December 2017 to align with reporting date of the Mineral Reserves. Further as this is economic analysis is estimating the "Intrinsic Value" value of the Mines Mineral Reserves the valuation has been prepared and presented on a 100% basis for the Mine and does not reflect the value attributable to Pallinghurst. Again, it is noted that the Mine is effectively 75% owned by Gemfields which in turn is 100% owned by Pallinghurst.

The TEM has been developed based on forward looking statements and forecasts with respect to production schedules, operating costs, capital costs and fiscal regime. Forward looking statements and forecasts are not guarantees of future performance or results. They involve risks, uncertainties and assumptions. Future results of operations and financial conditions may be materially different from those described in these forward looking statements and forecasts. Potential risks and opportunities have been discussed in Section 11 of this CPR and the sensitivity of results is further addressed in Section12.6.3.

The Competent Valuator (CV) for this valuation is Mr Keith Joslin BEng ACSM MSAIMM, an Independent Consultant with SRK. Mr Joslin has 30 years' experience in the mining industry and has been involved in the valuation of mineral assets across many commodities during his career to date. No qualifications or restrictions with respect to the conclusions of this analysis, other than noted in Section 1.5, have been imposed on the CV.

12.2 Key Assumptions

The CP has considered a base case scenario initially targeting 120 ktpa building up to 130 ktpa in 2020 from Chama Pit. Production of 30 ktpa from Fibolele Pit is scheduled to supplement periods of low grade mining from the Chama Pit in 2030 with the remainder scheduled after the depletion of Chama pit. The life of Chama pit is 27 years, with Fibolele contributing in 5 years, depleting in the year 2047.

In the opinion of the CP, converting the Measured and Indicated Resources to Proven and Probable Reserves for the full 27 year life of mine is justified on the basis that the price for emeralds is robust and has a history of real term increases. The impact of this is that there is a considerable margin on the difference between the contained value per tonne of ore and the extraction costs per tonne of ore. Variation of the modifying factors has little impact of which parts of the resources are economic, therefore it is considered appropriate to schedule the life of mine with full conversion of resources to reserves.

The Base Case reflects production, capital and operating expenditures and revenues from 31 December 2017 through to 2047 on an annual basis. Total ore treated over the LoM amounts to 3.4 Mt at an average grade of 256 ct/t from Chama pit and 0.14 Mt at an average grade of 103 ct/t from Fibolele pit.

The TEM is based on the production schedule derived by the SRK team with adjustments based on SRK's CP's views on the forecast capital and operating costs. In addition, the TEM:

- based on an income approach with discounted cash flow analysis undertaken on estimated future cash flows;
    - the CP notes that a market approach was not considered due to the lack of similar comparable market transactions to allow a comparative valuation;
    - as Kagem is an operating concern that has generated significant positive cashflows a cost to date approach was also not considered;
- is expressed in real terms; this means un-inflated United States Dollars (USD) with no allowances for inflation on capital or operating costs, inputs or revenues, however real terms escalation will be considered where appropriate;
- is presented at December 2017 money terms for Net Present Value ("NPV") calculation purposes;
- applies a Base Case discount rate of 10%;
    - the CP considers a 10% discount rate to be appropriate for this type of mine within the jurisdiction it is operating. NPV values are also presented at 8% and 12% discount rates;
- is based on historical commodity prices achieved at auctions by Gemfields;
- is based on product spilt provided by Gemfields;

- is expressed in post-tax and pre-financing terms and assumes 100% equity;
- a base Corporate tax rate of 30 %, as per the standard GoZ corporate tax rate for mining operations, has been used
- royalties are included at 6% of revenue as per the standard GoZ royalty rate for gemstone mining;
- Management Fees and Auction Fees have been included at effective 1.75% of revenue, as advised by Gemfields;
- ignores VAT; and
- capital investment is depreciated on an annual fixed percentage basis. It has been assumed that all capital items have been fully depreciated and at the end of the mine life there is no terminal value to consider.

12.3 Modifying Factors

This valuation has been prepared as part of this CPR and the modifying factors are as described in the preceding sections of this report.

This CPR has been prepared based on a technical and economic review by a team of consultants (Section **1.7**) sourced from the SRK Group's offices in the United Kingdom over a nine-month period. These consultants are specialists in the fields of geology, resource and reserve estimation and classification, open-pit mining, mineral processing, tailings management, infrastructure, environmental management and mineral economics.

In preparing this valuation reliance has been placed on the SRK team and this CPR and the CV is satisfied with the technical information provided.

Key modifying factors are:

Mining

As described in Section 6.12 the Modifying Factors applicable to the derivation of reserves comprise estimates for the mining dilution.

The Modifying Factors considered by the CP to be appropriate for the RZ mineralisation is based on the historical reconciliation of the proportion of RoM RZ relative to the TMS volume. The mining dilution is estimated at 15% and the diluting material is assumed to be TMS rock with a density of 2.85 t/m^3 at zero grade. Owing to the application of historical factors to derive RoM grades, no mining recovery grade adjustment factors are deemed necessary for the RZ mineralisation.

Environmental

As discussed in Section 9 the CP has reviewed the available documentation to assess compliance of Kagem with applicable Zambian environmental and social legislation, performance relative to good international industry practice, including the SAMESG Guideline, appropriateness of existing management systems and CSR activities, environmental and social issues, risks and liabilities and appropriateness of closure planning and cost estimates.

The CP has revised the previous conceptual LoMp closure cost; however a further detailed assessment is required. The current financial cost estimate in this CPR include a provision of USD20million for closure liabilities.

12.4 Commodity Prices

In respect of the commodity price, the CP has not undertaken a detailed price analysis, but in discussion with Gemfields has relied on the historical auction results (See Section 10.3.3) in this regard. The average price achieved at the high quality auctions for the period 2015 to 2017 has been USD64.63/ct. All premium emeralds and 18% of emeralds are sold at the high quality auction. The average price achieved at the low quality auctions for the same period has been USD4.19/ct for the lower quality emeralds (remaining 82%). Note that Beryl products are not sold at these auctions. Price forecast for Beryl I, based on historical direct sales, is USD0.11/ct and the estimate for the Beryl II product is 0.006/ct as estimated by Gemfields. The CP consider the premium emerald and emerald product forecasts based on historical average prices achieved to be acceptable for these products. With forecast revenue from Beryl products amounting to 1% of LoM revenue the CP considers there to be negligible risk from Gemfields beryl price forecasts and consider them acceptable. Prices for premium emerald, emerald and beryl-1 and beryl-2 products are presented in Table 12-1.

Table 12-1: Forecast Commodity Prices

Commodity Prices (USD/ct)	2017-18+	% of LoM Revenue
Premium Emerald High Quality Auction	64.63	5.9%
Emerald High Quality Auction[1]	64.63	71.6%
Emerald Low Quality Auction[1]	4.19	21.5%
Beryl-1 Low Quality Auction	0.11	0.99%
Beryl-2 Low Quality Auction	0.006	0.04%

Note 1. 18% of emerald product (not including Premium emeralds) are sold at the High Quality Auction with the remainder sold in the Low Quality Auction.

12.5 Production, Operating and Capital Costs

The LoMp assumes that overall ore production from all sources will be 3,498 kt. Over the life of mine based on the current Measured and Indicated Resource, it is planned to produce 0.889 Mct, and will generate USD4,049 M in gross revenue.

Operating costs have been based on the Client’s historical costs in the 2017 calendar year and are summarised on a unit basis in Table 12-2. Average total operating costs are estimated at USD339.16 /t treated, with total operating costs amounting to USD1,186 M over the LoM.

Table 12-2: Unit Operating Costs

Operating Costs	(USD/t total moved)	(USD/t Treated)
Mining and production costs	**3.01**	**225.10**
Labour costs - mining and production	1.26	94.12
Fuel costs	0.78	58.24
Repairs and maintenance	0.56	42.11
Camp costs	0.11	8.05
Blasting costs	0.16	12.33
Security costs	0.11	8.58
Other mining and processing costs	0.02	1.67
Administrative expenses		**24.35**
Labour - G&A		5.57
Selling, marketing and advertising		2.21
Rent and rates		0.51
Travel and accommodation		3.01
Professional and consultancy		4.15
Office expenses		0.91
Share based payment (options)		0.00
Other administrative expenses		7.98
Management and auction fees		**20.26**
Management Fee		20.26
Mineral royalties and production taxes		**69.45**
Royalty		69.45
Total Operating Cost		**339.16**

Total capital expenditure is estimated to be USD216 M over the LoM as summarised in Table 12-3. Capital for engineering and mining has been estimated at USD109 M. Sustaining capital for the on-going operations is estimated at USD87 M. Closure costs of USD20 M are included.

Table 12-3: Capital Expenditure

Capital Costs	LoM (USDM)
Engineering and Mining	**108.90**
Equipment Purchase Capital	10.30
Equipment Replacement Capital	98.60
Other	**87.25**
Sustaining Capital	87.25
Closure	**20.00**
Total Capital	**216.14**

12.6 Results

12.6.1 Cash Flow

Figure 12-1 provides an analysis of Mine cashflow over the LoM. Table 12-5 to Table 12-7 presents a summary of the results of the financial modelling. Table 12-4 provides a summary of the key financial parameters from the TEM.

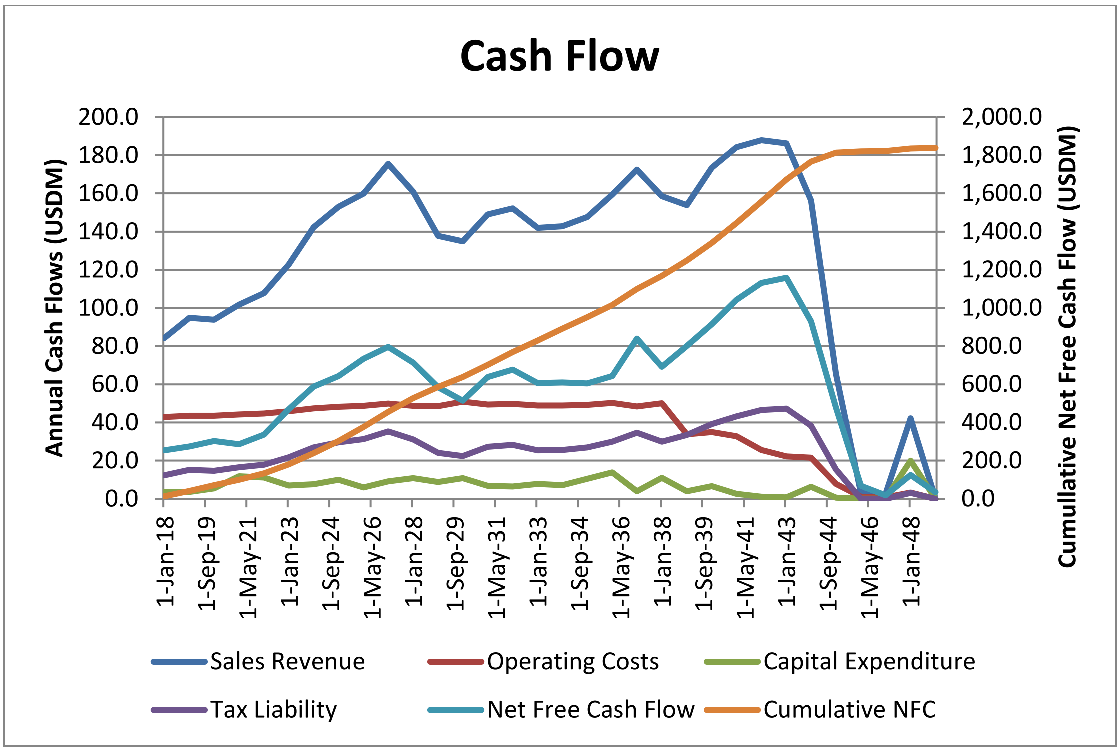

Figure 12-1: Net Cash Flow

Table 12-4: Summary of LoM Financial Parameters Base Case

		Total LoM
Sales Revenue	(USDM)	4,049
Operating Costs	(USDM)	1,186
Operating Profit - EBITDA	**(USDM)**	**2,862**
Tax Liability	(USDM)	794
Capital Expenditure	(USDM)	216
Net Free Cash Flow	**(USDM)**	**1,850**
Total Waste Mined	(kt)	257,946
Total Ore Mined	(kt)	3,498
S/R	(t:t)	73.75
Total Ore Treated	(kt)	3,498
Grade	(ct/t)	249.6
Contained ct	(kct)	873,131
Stock Inventory	(kct)	15,566
Total Sales	(kct)	888,698
Mining and production costs	(USD/t Treated)	225.10
Administrative expenses	(USD/t Treated)	24.35
Management and auction fees	(USD/t Treated)	20.26
Mineral royalties and production taxes	(USD/t Treated)	69.45
Total Operating Costs	(USD/t Treated)	339.16
Revenue	(USD/ct)	4.56
Operating Costs	(USD/ct)	1.33
Operating Profit	**(USD/ct)**	**3.22**

Table 12-5: Kagem Mine Cash Flow Summary Years 1 to 10

Year			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Period - Beginning			1-Jan-18	1-Jan-19	1-Jan-20	1-Jan-21	1-Jan-22	1-Jan-23	1-Jan-24	1-Jan-25	1-Jan-26	1-Jan-27
	Units	Total/Ave										
Production Mining												
Total Waste	**(kt)**	**257,946**	**10,914**	**10,904**	**10,905**	**10,891**	**10,890**	**10,896**	**10,901**	**10,891**	**10,891**	**10,889**
Chama Contractor Waste	(kt)	0	0	0	0	0	0	0	0	0	0	0
Chama In-house Waste	(kt)	254,525	10,914	10,904	10,905	10,891	10,890	10,896	10,901	10,891	10,891	10,889
Fibolele In-house Waste	(kt)	3,421	0	0	0	0	0	0	0	0	0	0
Total Ore	**(kt)**	**3,498**	**110**	**120**	**120**	**130**	**130**	**130**	**130**	**130**	**130**	**130**
Chama In-house Ore	(kt)	3,354	110	120	120	130	130	130	130	130	130	130
Fibolele In-house Ore	(kt)	144	0	0	0	0	0	0	0	0	0	0
Total Material Moved	**(kt)**	**261,443**	**11,024**	**11,024**	**11,025**	**11,021**	**11,020**	**11,026**	**11,031**	**11,021**	**11,021**	**11,019**
Tons Moved Owner	(kt)	261,443	11,024	11,024	11,025	11,021	11,020	11,026	11,031	11,021	11,021	11,019
Tons Moved Contractor	(kt)	0	0	0	0	0	0	0	0	0	0	0
Stripping Ratio	**(t:t)**	**73.75**	**99.23**	**90.87**	**90.87**	**83.84**	**83.81**	**83.97**	**83.85**	**83.91**	**83.87**	**83.89**
Processing												
Total Ore Treated	**(kt)**	**3,498**	**110**	**120**	**120**	**130**	**130**	**130**	**130**	**130**	**130**	**130**
Chama Ore	(kt)	3,354	110	120	120	130	130	130	130	130	130	130
Fibolele Ore	(kt)	144	0	0	0	0	0	0	0	0	0	0
Total Grade	**(ct/t)**	**249.6**	**209.6**	**183.9**	**188.5**	**198.7**	**195.9**	**209.0**	**260.1**	**244.7**	**283.1**	**295.6**
Chama Grade	(ct/t)	**255.9**	209.6	183.9	188.5	198.7	195.9	209.0	260.1	244.7	283.1	295.6
Fibolele Grade	(ct/t)	**103.5**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Content	**(ct 000's)**	**873,131**	**23,057**	**22,070**	**22,624**	**25,809**	**25,449**	**27,115**	**33,807**	**31,757**	**36,757**	**38,373**
Carats Sales Calculated												
Total Sales	**(ct 000's)**	**888,698**	**18,933**	**20,307**	**20,112**	**21,795**	**23,066**	**26,282**	**30,461**	**32,782**	**34,257**	**37,565**
Premium Emerald	(ct 000's)	3,703	74	87	87	94	99	113	131	141	147	162
Emerald	(ct 000's)	252,126	5,217	5,855	5,799	6,284	6,651	7,578	8,783	9,452	9,878	10,831
Beryl-I	(ct 000's)	361,138	7,341	8,247	8,167	8,851	9,367	10,673	12,370	13,312	13,912	15,255
Beryl-II	(ct 000's)	271,730	6,300	6,118	6,059	6,566	6,949	7,918	9,177	9,876	10,321	11,317
Specimen	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0
Fines	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0
Commodity Prices												
Total Sales	**(USD/ct)**	**4.56**	**4.45**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**
Premium Emerald	(USD/ct)	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63
Emerald	(USD/ct)	14.94	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07	15.07
Beryl-I	(USD/ct)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Beryl-II	(USD/ct)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Specimen	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fines	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Revenue												
Total Revenue	**(USDM)**	**4,048.6**	**84.3**	**94.8**	**93.9**	**101.8**	**107.7**	**122.7**	**142.2**	**153.1**	**159.9**	**175.4**
OPERATING COSTS, Real												
Mining and production costs	(USDM)	787.3	33.20	33.20	33.20	33.19	33.19	33.20	33.22	33.19	33.19	33.18
Administrative expenses	(USDM)	85.2	3.07	3.06	3.07	3.10	3.09	3.11	3.17	3.15	3.19	3.21
Management and auction fees	(USDM)	70.8	1.47	1.66	1.64	1.78	1.88	2.15	2.49	2.68	2.80	3.07
Mineral royalties	(USDM)	242.9	5.06	5.69	5.63	6.11	6.46	7.36	8.53	9.18	9.60	10.52
Total Operating Costs	**(USDM)**	**1,186.2**	**42.8**	**43.6**	**43.5**	**44.2**	**44.6**	**45.8**	**47.4**	**48.2**	**48.8**	**50.0**
CAPITAL COSTS, Real												
Engineering and Mining	(USDM)	108.9	0.0	0.0	1.8	8.2	7.5	3.4	4.0	6.4	2.3	5.6
Other	(USDM)	87.2	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Closure	(USDM)	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Capital	**(USDM)**	**216.1**	**3.6**	**3.6**	**5.4**	**11.8**	**11.1**	**7.0**	**7.6**	**10.0**	**5.9**	**9.2**
Economics, Real: BASE DATE												
Sales Revenue	(USDM)	4,049	84	95	94	102	108	123	142	153	160	175
Operating Costs	(USDM)	1,186	43	44	44	44	45	46	47	48	49	50
Operating Profit - EBITDA	(USDM)	2,862	41	51	50	58	63	77	95	105	111	125
Tax Liability	(USDM)	794	12	15	15	17	18	22	27	30	31	35
Capital Expenditure	(USDM)	216	4	4	5	12	11	7	8	10	6	9
Working Capital	(USDM)	2	0	5	0	1	0	1	2	1	1	1
Net Free Cash Flow	**(USDM)**	**1,850**	**25**	**28**	**30**	**29**	**34**	**47**	**59**	**64**	**73**	**80**

Table 12-6: Kagem Mine Cash Flow Summary Years 11 to 20

Year			Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Period - Beginning			1-Jan-28	1-Jan-29	1-Jan-30	1-Jan-31	1-Jan-32	1-Jan-33	1-Jan-34	1-Jan-35	1-Jan-36	1-Jan-37
	Units	Total/Ave										
Production Mining												
Total Waste	**(kt)**	**257,946**	**10,894**	**11,394**	**12,260**	**11,394**	**11,405**	**11,393**	**11,392**	**11,398**	**11,397**	**10,430**
Chama Contractor Waste	(kt)	0	0	0	0	0	0	0	0	0	0	0
Chama In-house Waste	(kt)	254,525	10,894	11,394	11,418	11,394	11,405	11,393	11,392	11,398	11,397	10,430
Fibolele In-house Waste	(kt)	3,421	0	0	842	0	0	0	0	0	0	0
Total Ore	**(kt)**	**3,498**	**129**	**130**	**127**	**124**	**124**	**125**	**126**	**124**	**126**	**130**
Chama In-house Ore	(kt)	3,354	129	130	97	124	124	125	126	124	126	130
Fibolele In-house Ore	(kt)	144	0	0	30	0	0	0	0	0	0	0
Total Material Moved	**(kt)**	**261,443**	**11,023**	**11,523**	**12,387**	**11,518**	**11,529**	**11,518**	**11,517**	**11,522**	**11,523**	**10,560**
Tons Moved Owner	(kt)	261,443	11,023	11,523	12,387	11,518	11,529	11,518	11,517	11,522	11,523	10,560
Tons Moved Contractor	(kt)	0	0	0	0	0	0	0	0	0	0	0
Stripping Ratio	**(t:t)**	**73.75**	**84.43**	**87.96**	**96.49**	**91.54**	**92.35**	**91.10**	**90.55**	**91.91**	**90.39**	**80.23**
Processing												
Total Ore Treated	**(kt)**	**3,498**	**129**	**130**	**127**	**124**	**124**	**125**	**126**	**124**	**126**	**130**
Chama Ore	(kt)	3,354	129	130	97	124	124	125	126	124	126	130
Fibolele Ore	(kt)	144	0	0	30	0	0	0	0	0	0	0
Total Grade	**(ct/t)**	**249.6**	**237.0**	**219.5**	**250.6**	**276.7**	**249.1**	**240.2**	**247.4**	**259.1**	**286.7**	**289.9**
Chama Grade	(ct/t)	**255.9**	237.0	219.5	295.8	276.7	249.1	240.2	247.4	259.1	286.7	289.9
Fibolele Grade	(ct/t)	**103.5**	0.0	0.0	103.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Content	**(ct 000's)**	**873,131**	**30,577**	**28,426**	**31,837**	**34,437**	**30,765**	**30,037**	**31,122**	**32,136**	**36,154**	**37,688**
Carats Sales Calculated												
Total Sales	**(ct 000's)**	**888,698**	**34,475**	**29,501**	**30,131**	**33,137**	**32,601**	**30,401**	**30,580**	**31,629**	**34,145**	**36,921**
Premium Emerald	(ct 000's)	3,703	148	127	124	137	140	131	132	136	147	159
Emerald	(ct 000's)	252,126	9,940	8,506	8,564	9,431	9,400	8,766	8,817	9,120	9,845	10,646
Beryl-I	(ct 000's)	361,138	14,000	11,980	12,196	13,417	13,239	12,346	12,418	12,844	13,866	14,993
Beryl-II	(ct 000's)	271,730	10,386	8,888	9,247	10,152	9,822	9,159	9,213	9,529	10,287	11,123
Specimen	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0
Fines	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0
Commodity Prices												
Total Sales	**(USD/ct)**	**4.56**	**4.67**	**4.67**	**4.48**	**4.50**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**
Premium Emerald	(USD/ct)	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63
Emerald	(USD/ct)	14.94	15.07	15.07	14.66	14.70	15.07	15.07	15.07	15.07	15.07	15.07
Beryl-I	(USD/ct)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Beryl-II	(USD/ct)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Specimen	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fines	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Revenue												
Total Revenue	**(USDM)**	**4,048.6**	**161.0**	**137.7**	**135.0**	**149.0**	**152.2**	**141.9**	**142.8**	**147.7**	**159.4**	**172.4**
OPERATING COSTS, Real												
Mining and production costs	(USDM)	787.3	33.19	34.70	37.30	34.68	34.72	34.68	34.68	34.70	34.70	31.80
Administrative expenses	(USDM)	85.2	3.14	3.12	3.15	3.17	3.14	3.13	3.14	3.15	3.19	3.20
Management and auction fees	(USDM)	70.8	2.82	2.41	2.36	2.61	2.66	2.48	2.50	2.58	2.79	3.02
Mineral royalties	(USDM)	242.9	9.66	8.26	8.10	8.94	9.13	8.52	8.57	8.86	9.57	10.34
Total Operating Costs	**(USDM)**	**1,186.2**	**48.8**	**48.5**	**50.9**	**49.4**	**49.7**	**48.8**	**48.9**	**49.3**	**50.2**	**48.4**
CAPITAL COSTS, Real												
Engineering and Mining	(USDM)	108.9	7.2	5.1	6.8	3.0	2.7	4.1	3.5	6.8	10.1	0.5
Other	(USDM)	87.2	3.6	3.8	4.0	3.8	3.8	3.8	3.8	3.8	3.8	3.5
Closure	(USDM)	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Capital	**(USDM)**	**216.1**	**10.9**	**8.8**	**10.8**	**6.8**	**6.5**	**7.8**	**7.2**	**10.5**	**13.9**	**4.0**
Economics, Real: BASE DATE												
Sales Revenue	(USDM)	4,049	161	138	135	149	152	142	143	148	159	172
Operating Costs	(USDM)	1,186	49	48	51	49	50	49	49	49	50	48
Operating Profit - EBITDA	(USDM)	2,862	112	89	84	100	103	93	94	98	109	124
Tax Liability	(USDM)	794	31	24	22	27	28	25	26	27	30	35
Capital Expenditure	(USDM)	216	11	9	11	7	6	8	7	11	14	4
Working Capital	(USDM)	2	-1	-2	-1	2	0	-1	0	0	1	2
Net Free Cash Flow	**(USDM)**	**1,850**	**71**	**58**	**51**	**64**	**68**	**61**	**61**	**60**	**64**	**84**

Table 12-7: Kagem Mine Cash Flow Summary Years 21 to 31

Year			Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Year 31
Period - Beginning			1-Jan-38	1-Jan-39	1-Jan-40	1-Jan-41	1-Jan-42	1-Jan-43	1-Jan-44	1-Jan-45	1-Jan-46	1-Jan-47	1-Jan-48
	Units	Total/Ave											
Production Mining													
Total Waste	**(kt)**	**257,946**	**11,407**	**6,098**	**5,963**	**4,972**	**2,468**	**1,408**	**1,962**	**893**	**270**	**175**	**0**
Chama Contractor Waste	(kt)	0	0	0	0	0	0	0	0	0	0	0	0
Chama In-house Waste	(kt)	254,525	11,407	6,098	5,963	4,972	2,468	1,408	720	0	0	0	0
Fibolele In-house Waste	(kt)	3,421	0	0	0	0	0	0	1,242	893	270	175	0
Total Ore	**(kt)**	**3,498**	**122**	**130**	**130**	**130**	**130**	**130**	**118**	**30**	**30**	**24**	**0**
Chama In-house Ore	(kt)	3,354	122	130	130	130	130	130	88	0	0	0	0
Fibolele In-house Ore	(kt)	144	0	0	0	0	0	0	30	30	30	24	0
Total Material Moved	**(kt)**	**261,443**	**11,529**	**6,228**	**6,093**	**5,102**	**2,598**	**1,538**	**2,080**	**923**	**300**	**199**	**0**
Tons Moved Ow ner	(kt)	261,443	11,529	6,228	6,093	5,102	2,598	1,538	2,080	923	300	199	0
Tons Moved Contractor	(kt)	0	0	0	0	0	0	0	0	0	0	0	0
Stripping Ratio	**(t:t)**	**73.75**	**93.65**	**46.91**	**45.87**	**38.25**	**18.98**	**10.83**	**16.61**	**29.83**	**9.03**	**7.22**	**0.00**
Processing													
Total Ore Treated	**(kt)**	**3,498**	**122**	**130**	**130**	**130**	**130**	**130**	**118**	**30**	**30**	**24**	**0**
Chama Ore	(kt)	3,354	122	130	130	130	130	130	88	0	0	0	0
Fibolele Ore	(kt)	144	0	0	0	0	0	0	30	30	30	24	0
Total Grade	**(ct/t)**	**249.6**	**248.0**	**274.7**	**296.8**	**310.2**	**308.8**	**305.0**	**252.4**	**103.5**	**103.5**	**103.5**	**0.0**
Chama Grade	(ct/t)	**255.9**	248.0	274.7	296.8	310.2	308.8	305.0	303.0	0.0	0.0	0.0	0.0
Fibolele Grade	(ct/t)	**103.5**	0.0	0.0	0.0	0.0	0.0	0.0	103.5	103.5	103.5	103.5	0.0
Total Content	**(ct 000's)**	**873,131**	**30,209**	**35,706**	**38,588**	**40,329**	**40,141**	**39,653**	**29,809**	**3,097**	**3,096**	**2,505**	**0**
Carats Sales Calculated													
Total Sales	**(ct 000's)**	**888,698**	**33,949**	**32,957**	**37,147**	**39,458**	**40,235**	**39,897**	**34,731**	**16,453**	**3,097**	**2,801**	**18,890**
Premium Emerald	(ct 000's)	3,703	146	142	160	170	173	172	144	60	2	2	17
Emerald	(ct 000's)	252,126	9,789	9,503	10,711	11,377	11,601	11,504	9,890	4,496	645	583	2,661
Beryl-I	(ct 000's)	361,138	13,786	13,384	15,085	16,024	16,339	16,202	14,064	6,601	1,177	1,065	8,615
Beryl-II	(ct 000's)	271,730	10,228	9,929	11,191	11,888	12,122	12,020	10,633	5,295	1,272	1,150	7,596
Specimen	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0	0
Fines	(ct 000's)	0	0	0	0	0	0	0	0	0	0	0	0
Commodity Prices													
Total Sales	**(USD/ct)**	**4.56**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.67**	**4.50**	**3.97**	**0.97**	**0.97**	**2.23**
Premium Emerald	(USD/ct)	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63	64.63
Emerald	(USD/ct)	14.94	15.07	15.07	15.07	15.07	15.07	15.07	14.71	13.51	4.19	4.19	15.07
Beryl-I	(USD/ct)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Beryl-II	(USD/ct)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Specimen	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fines	(USD/ct)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Revenue													
Total Revenue	**(USDM)**	**4,048.6**	**158.5**	**153.9**	**173.4**	**184.2**	**187.9**	**186.3**	**156.4**	**65.4**	**3.0**	**2.7**	**42.2**
OPERATING COSTS, Real													
Mining and production costs	(USDM)	787.3	34.72	18.75	18.35	15.37	7.82	4.63	6.26	2.78	0.90	0.60	0.00
Administrative expenses	(USDM)	85.2	3.14	3.18	3.21	3.23	3.22	3.22	3.13	0.03	0.03	0.02	0.00
Management and auction fees	(USDM)	70.8	2.77	2.69	3.04	3.22	3.29	3.26	2.74	1.14	0.05	0.05	0.74
Mineral royalties	(USDM)	242.9	9.51	9.23	10.41	11.05	11.27	11.18	9.39	3.92	0.18	0.16	2.53
Total Operating Costs	**(USDM)**	**1,186.2**	**50.1**	**33.9**	**35.0**	**32.9**	**25.6**	**22.3**	**21.5**	**7.9**	**1.2**	**0.8**	**3.3**
CAPITAL COSTS, Real													
Engineering and Mining	(USDM)	108.9	7.2	1.8	4.6	0.8	0.0	0.0	5.4	0.4	0.0	0.0	0.0
Other	(USDM)	87.2	3.8	2.2	2.2	1.9	1.1	0.8	0.9	0.3	0.1	0.1	0.0
Closure	(USDM)	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0
Total Capital	**(USDM)**	**216.1**	**11.0**	**4.0**	**6.7**	**2.7**	**1.1**	**0.8**	**6.3**	**0.7**	**0.1**	**0.1**	**20.0**
Economics, Real: BASE DATE													
Sales Revenue	(USDM)	4,049	159	154	173	184	188	186	156	65	3	3	42
Operating Costs	(USDM)	1,186	50	34	35	33	26	22	22	8	1	1	3
Operating Profit - EBITDA	(USDM)	2,862	108	120	138	151	162	164	135	57	2	2	39
Tax Liability	(USDM)	794	30	34	39	43	47	47	38	15	0	0	3
Capital Expenditure	(USDM)	216	11	4	7	3	1	1	6	1	0	0	20
Working Capital	(USDM)	2	-2	2	1	1	1	0	-3	-6	-5	0	3
Net Free Cash Flow	**(USDM)**	**1,850**	**69**	**80**	**91**	**104**	**113**	**116**	**93**	**48**	**7**	**2**	**13**

12.6.2 Net Present Value

Net present values of the cash flows are shown in Table 12-8 using discount rates from 8% to 12% in a post-tax context. The CV notes that at 10% discount rate the post-tax NPV is USD528 M. As there are no initial negative cash flows, an Internal Rate of Return cannot be determined. The NPV attributable to the Client is also shown at the 75% ownership level of the Client.

Table 12-8: NPV Profile Base Case

	Discount Rate	NPV USDM (100%)	NPV USDM (75%)
Net Present Value	8.0%	645	484
	10.0%	528	396
	12.0%	441	331

12.6.3 Sensitivity Analysis

General Sensitivity

Figure 12-2 shows an NPV sensitivity chart for mine operating costs; capital expenditure and revenue. The Mine's NPV is most sensitive to revenue (product split, grade or commodity price) as illustrated by the blue line in Figure 12-2. The Mine has lower sensitivity to operating costs and least sensitivity to capital as indicated by the flatter red and green lines in Figure 12-2. The revenue, operating and capital cost sensitivity of NPV is further illustrated in Table 12-9.

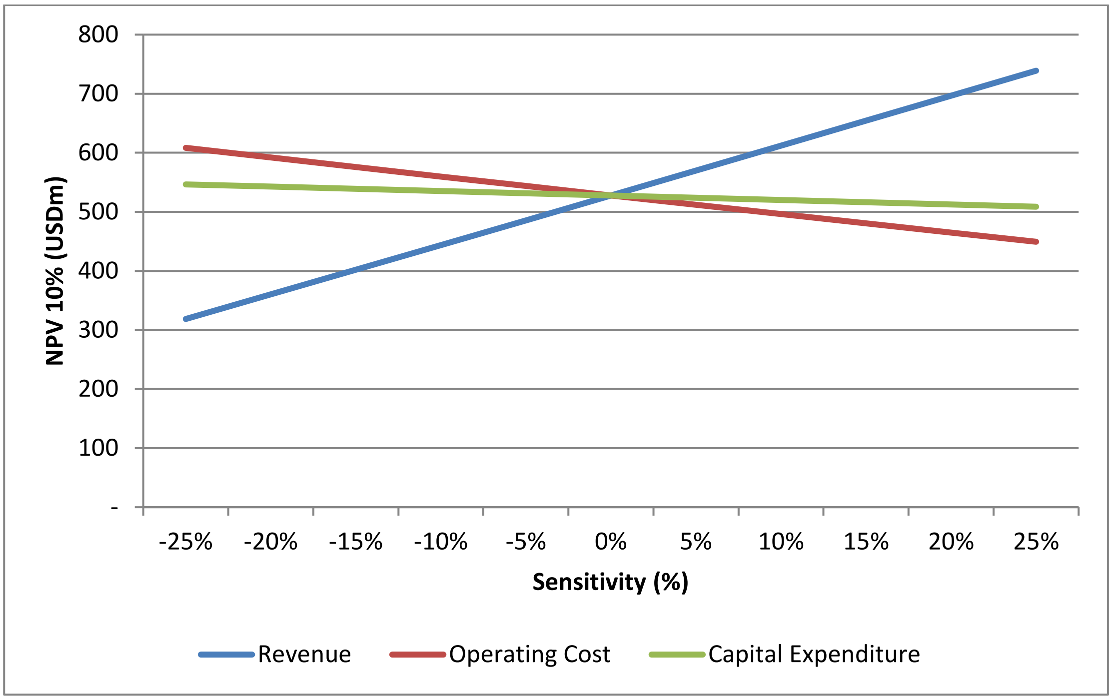

Figure 12-2: Sensitivity Analysis

Table 12-9: Base Case Dual Sensitivity Analysis for NPV at 10%

NPV 10% (USDM)		REVENUE SENSITIVITY				
		-20%	-10%	0%	10%	20%
OPEX SENSITIVITY	-20%	420	506	592	678	764
	-10%	390	475	560	645	730
	0%	360	444	528	612	697
	10%	331	413	496	579	663
	20%	301	383	465	547	629

NPV 10% (USDM)		REVENUE SENSITIVITY				
		-20%	-10%	0%	10%	20%
CAPEX SENSITIVITY	-20%	375	459	543	627	712
	-10%	368	451	535	620	704
	0%	360	444	528	612	697
	10%	353	436	520	605	689
	20%	345	429	512	597	682

NPV 10% (USDM)		OPEX SENSITIVITY				
		-20%	-10%	0%	10%	20%
CAPEX SENSITIVITY	-20%	607	575	543	511	480
	-10%	600	567	535	504	473
	0%	592	560	528	496	465
	10%	585	552	520	489	457
	20%	577	545	512	481	450

Sensitivity to Resource/Reserve Grade

The sensitivity to the overall Reserve grade is illustrated in Table 12-10.

Table 12-10: Sensitivity to Reserve Grade

Grade Sensitivity	Average Reserve Grade (ct/t)	NPV@10% (USDM)
25%	312.1	733.2
20%	299.6	692.1
15%	287.1	651.0
10%	274.6	609.8
5%	262.1	568.7
0%	249.6	527.6
-5%	237.2	486.4
-10%	224.7	445.3
-15%	212.2	404.2
-20%	199.7	363.0
-25%	187.2	321.8

12.6.4 Payback Period

The mine is a going concern and there is no initial negative cash flow.

12.7 Previous Valuation

SRK authored a CPR on Kagem in 2015. A comparison of key parameters between the 2015 CPR and this 2017 updated CPR is presented in Table 12-11. Key changes are:

- the cancellation of the capitalised waste stripping contract in favour of owner mining resulting in a significant decrease in the overall capital partially offset by an increase in operating costs; and
- the reduction on Mineral Resource grade.

Table 12-11: Comparison of Key Parameters Between the 2015 and 2017 CPRs

		2017 CPR	2015 CPR
NPV@10%	(USDM)	528	520
Cash Flow			
Sales Revenue	(USDM)	4,049	4,322
Operating Costs	(USDM)	1,186	1,017
Operating Profit - EBITDA	**(USDM)**	**2,862**	**3,305**
Tax Liability	(USDM)	794	1,203
Capital Expenditure	(USDM)	216	516
Net Free Cash Flow	**(USDM)**	**1,850**	**1,586**
Production			
Total Waste Mined	(kt)	257,946	285,253
Total Ore Mined	(kt)	3,498	3,836
S/R	(kt)	73.75	74.36
Total Ore Treated	(kt)	3,498	3,836
Grade	(ct/t)	249.6	291.0
Contained Ct	(ct 000's)	873,131	1,116,138
Stock Inventory	(ct 000's)	15,566	239
Total Sales	(ct 000's)	888,698	1,116,377
Operating Costs			
Mining and production costs	(USD/t Treated)	225.10	113.46
Administrative expenses	(USD/t Treated)	24.35	30.43
Management and auction fees	(USD/t Treated)	20.26	19.71
Mineral royalties and production taxes	(USD/t Treated)	69.45	101.39
Total Operating Costs	(USD/t Treated)	339.16	264.99

12.8 Conclusions

Based on the work carried out for this CPR, the CV concludes the following:

- the review work by the CV indicates that the Intrinsic Value of the Kagem Mine Mineral Reserves to be an NPV of USD528 M at a discount rate of 10% of which USD396 M is attributable to the Client (75% ownership);
- the Kagem Mine Base Case has favourable economics and based on the historical commodity prices is considered robust in terms of the estimated operating margins and return on investment;;
- the Mine’s NPV is most sensitive to revenue (grade or commodity price); however, the overall economics of the Kagem Mine are robust;
- average operating costs for the Mine have been estimated to be USD339.16 /t treated;

and

- total capital expenditure is estimated to be USD216 M over the LoM. Capital for engineering and mining has been estimated at USD109 M, Sustaining capital for the on-going operations is estimated at USD87 M. Closure costs of USD20 M are included.
- key risks, described in more detail in Section 11, are:
    - legislative and permitting risk;
    - Mineral Reserve estimation risk;
    - water management; and
    - environmental and social risks:

12.9 Recommendations

Based on the work carried out for this study, the CV recommends the following:

- further develop a system for recording and tracking operating costs over time, split by operational department to facilitate identification of potential cost saving and efficiency improvements;
- further refinement of capital cost estimates are undertaken in order to optimise Project profitability; and
- the financial model is updated regularly to reflect new information relative to revised mine plans, resource estimates and prices realised at auctions.

12.10 Sources of Information

This valuation was prepared as part of this CPR. All information used in undertaking the valuation has been derived by the CP's and key technical staff responsible for preparing the CPR.

Historical information on Kagem's production and costs was provided by the Mine and collated on the site visits and through discussion with Kagem and Gemfields staff by the SRK team.

The LoM production plan was prepared by the SRK team. Forecast operating costs and capital costs were prepared by the mine and collated by SRK staff. This has been reviewed and adjusted where appropriate by the SRK CP's.

13 SIGNATURE PAGE

For and on behalf of SRK Consulting (UK) Limited

Lucy Roberts.

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APPENDIX

A JSE COMPLIANCE CHECKLIST

U7367 Kagem JSE COMPLIANCE CHECKLIST

Chapter 12 of JSE Listing Rules		SAMREC ("SR") Code		SAMVAL ("SV") Code	
Section	**Where complied with**	**Section**	**Where complied with**	**Section**	**Where complied with**
12.8(a)	This Report	SR1.1	Section 1.2, Section 1.5	SV1.0	Section 12.3 and Appendix C
12.8(b)	Section 1.6.3	SR1.2	Section 1.2.1	SV1.1	Part of full CPR
12.8(c)	Financial information with respect to Pallinghurst is available on their website at www.pallinghurst.com	SR1.3	None of significance	SV1.2	Part of full CPR – Section 12.1 and 12.2
12.8(d)	Section 1.5.3	SR1.4	Section 1.2.7	SV1.3	Section 1.1 and Section 12.1
12.8(e)	Section 1.2.1, Section 3.2 Section 1.5.3, Section 9.3	SR1.5	Section 1.2.1, Section 3.2, Section 1.5.3, Section 9.3	SV1.4	Section 1.3.3
12.9(a)	Section 1.4	SR1.6	Section 12.1	SV1.5	Section 1.2
12.9(b)	Not applicable	SR1.7	Section 9.8	SV1.6	Section 1.2.7
12.9(c)	Section 1.6.3	SR2.1	Section 2, Section 3 and Section 4	SV1.7	Section 2
12.9(d)	This table, below section headings	SR3.1	Section 2, Section 3 and Section 4	SV1.8	Section 3.1
12.9(e)	Section 1.3.3 –	SR3.2	Section 3	SV1.9	Section 4.10 and Section 6.12.4
12.9(e)(i)-(iii)	Section 3	SR3.3	Section 3.3, Section 3.4, Section 3.5 Section 3.6, Section 3.7	SV1.10	Section 12.3
12.9(f)	Section 12	SR3.4	Section 3	SV1.11	Section 12.7
12.9(g)	To be published in full on website	SR3.5	Section 3	SV1.12	Section 12.1
12.9(h)	Set out below	SR3.6	Section 3	SV1.13	Section 12.1
12.9(h)(i)	Section 1.1	SR3.7	Section 3 and Section 4	SV1.14	Section 12.6 Section 12.8
12.9(h)(ii)	Section 1.2	SR3.8	Sections 3, 4, 6, and 7	SV1.15	Section 12.1 Section 12.8 Section 1.6.1
12.9(h)(iii)	Section 1.2, Figures 1-1 and 1-2	SR4.1	Section 3, Section 4 and Section 6	SV1.16	Not applicable
12.9(h)(iv)	Section 1.2.1Section 3.2, Section 1.5.3, Section 9.3	SR4.2	Section 4.2 through to Section 4.7	SV1.17	Section 6.2
12.9(h)(v)	Section 2	SR4.3	Section 4.10, Section 5, Section 6.4, Section 6.12.3, Section 8.5, Section 8.6, Section 9.3, Section 9 This Report	SV1.18	Section 10
12.9(h)(vi)	Section 3	SR4.4	Section 4.8	SV1.19	Section 12.10
12.9(h)(vii)	Section 6.12.2	SR4.5	Section 4.9, Section 6.12.4		
12.9(h)(viii)	Section 9.7	SR5.1	Section 6.12.4, Section 6.12.2		
12.9(h)(ix)	Section 4.10, Section 6.12.4	SR5.2	Section 6.7 through Section 6.11		
12.9(h)(x)	Section 11	SR5.3	Section 7		
12.9(h)(xi)	Section 1.1	SR5.4	Section 8		
12.9(h)(xii)	Table 12-8	SR5.5	Section 9		
12.10(a)	Section 1.3.3, Section 1.6.3, Section 4.10, Section 6.12.4	SR5.6	Section 10		
12.10(b)	Not applicable	SR5.7	Section 11		
		SR5.8	Section 12		
		SR6.1	Section 6.12		
		SR6.2	Section 6.12.4		
		SR6.3	Section 6.12.4, Section 6.4.4, Section 6.12,		
		SR7.1	Not applicable		
		SR8.1	Not relevant		

SR9.1	Section 4.10, Section 6.12.4 –
SR10	Not applicable
SR11.1	Section 2
SR11.2	Section 3.3, Section 3.4, Section 3.5 Section 3.6, Section 3.7
SR11.3	Section 3.7
SR11.4	Section 4.2 through to Section 4.7
SR11.5	Section 4.8 Section 6.12
SR11.6	Not relevant
SR12.1	Not relevant
SR13.1	Not relevant

APPENDIX

B SAMREC TABLE 1 & SAMVAL TABLE 1

a

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 1: Project Outline					
1.1	Property Description	(i)	Brief description of the scope of project (i.e. whether in preliminary sampling, advanced exploration, scoping, pre-feasibility, or feasibility phase, Life of Mine plan for an ongoing mining operation or closure). Section 1.2		
		(ii)	Describe (noting any conditions that may affect possible prospecting/mining activities) topography, elevation, drainage, fauna and flora, the means and ease of access to the property, the proximity of the property to a population centre, and the nature of transport, the climate, known associated climatic risks and the length of the operating season and to the extent relevant to the mineral project, the sufficiency of surface rights for mining operations including the availability and sources of power, water, mining personnel, potential tailings storage areas, potential waste disposal areas, heap leach pad areas, and potential processing plant sites. Section 1.2		
		(iii)	Specify the details of the personal inspection on the property by each CP or, if applicable, the reason why a personal inspection has not been completed. Section 1.5		
1.2	Location	(i)	Description of location and map (country, province, and closest town/city, coordinate systems and ranges, etc.). Section 1.2		
		(ii)	Country Profile: describe information pertaining to the project host country that is pertinent to the project, including relevant applicable legislation, environmental and social context etc. Assess, at a high level, relevant technical, environmental, social, economic, political and other key risks. Section 1.2		
		(iii)	Provide a general topocadastral map Section 1.2	Provide a Topo-cadastral map in sufficient detail to support the assessment of eventual economics. State the known associated climatic risks.	Provide a detailed topo-cadastral map. Confirm that applicable aerial surveys have been checked with ground controls and surveys, particularly in areas of rugged terrain, dense vegetation or high altitude.
1.3	Adjacent Properties	(i)	Discuss details of relevant adjacent properties If adjacent or nearby properties have an important bearing on the report, then their location and common mineralized structures should be included on the maps. Reference all information used from other sources. Not relevant – neighboring properties do not have an important bearing on the CPR		
1.4	History	(i)	State historical background to the project and adjacent areas concerned, including known results of previous exploration and mining activities (type, amount, quantity and development work), previous ownership and changes thereto. Section 1.2		

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
			Section 1: Project Outline		
1.4	History	(ii)	Present details of previous successes or failures with reasons why the project may now be considered potentially economic. Section 6.12.6		
		(iii)		Discuss known or existing historical Mineral Resource estimates and performance statistics on actual production for past and current operations.	
		(iv)			Discuss known or existing historical Mineral Reserve estimates and performance statistics on actual production for past and current operations. Section 6.12.6
1.5	Legal Aspects and Permitting		Confirm the legal tenure to the satisfaction of the Competent Person, including a description of the following: Section 3.2, Section 1.5.3, Section 9.3		
		(i)	Discuss the nature of the issuer's rights (e.g. prospecting and/or mining) and the right to use the surface of the properties to which these rights relate. Disclose the date of expiry and other relevant details.		
		(ii)	Present the principal terms and conditions of all existing agreements, and details of those still to be obtained, (such as, but not limited to, concessions, partnerships, joint ventures, access rights, leases, historical and cultural sites, wilderness or national park and environmental settings, royalties, consents, permission, permits or authorisations).		
		(iii)	Present the security of the tenure held at the time of reporting or that is reasonably expected to be granted in the future along with any known impediments to obtaining the right to operate in the area. State details of applications that have been made.		
		(iv)	Provide a statement of any legal proceedings for example; land claims, that may have an influence on the rights to prospect or mine for minerals, or an appropriate negative statement.		
		(v)	Provide a statement relating to governmental/statutory requirements and permits as may be required, have been applied for, approved or can be reasonably be expected to be obtained.		
1.6	Royalties	(i)	Describe the royalties that are payable in respect of each property. Section 12.2		

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 1: Project Outline</th></tr>
<tr><td>1.7</td><td>Liabilities</td><td>(i)</td><td colspan="3">Describe any liabilities, including rehabilitation guarantees that are pertinent to the project. Provide a description of the rehabilitation liability, including, but not limited to, legislative requirements, assumptions and limitations. Section 9.8</td></tr>
</table>

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 2: Geological Setting, Deposit, Mineralisation</th></tr>
<tr><td rowspan="7">2.1</td><td rowspan="7">Geological Setting, Deposit, Mineralisation</td><td>(i)</td><td colspan="3">Describe the regional geology. (Section 2)</td></tr>
<tr><td>(ii)</td><td colspan="3">Describe the project geology including deposit type, geological setting and style of mineralisation. (Section 2)</td></tr>
<tr><td>(iii)</td><td colspan="3">Discuss the geological model or concepts being applied in the investigation and on the basis of which the exploration program is planned. Describe the inferences made from this model. (Section 2)</td></tr>
<tr><td>(iv)</td><td colspan="3">Discuss data density, distribution and reliability and whether the quality and quantity of information are sufficient to support statements, made or inferred, concerning the Exploration Target or Mineralisation. (Section 2 and Section 3)</td></tr>
<tr><td>(v)</td><td colspan="3">Discuss the significant minerals present in the deposit, their frequency, size and other characteristics. Includes minor and gangue minerals where these will have an effect on the processing steps. Indicate the variability of each important mineral within the deposit. (Section 2 and Section 4.3)</td></tr>
<tr><td>(vi)</td><td colspan="3">Describe the significant mineralised zones encountered on the property, including a summary of the surrounding rock types, relevant geological controls, and the length, width, depth, and continuity of the mineralisation, together with a description of the type, character, and distribution of the mineralization (Section 2)</td></tr>
<tr><td>(vii)</td><td colspan="3">Confirm that reliable geological models and / or maps and cross sections that support interpretations exist. (Sections 2, 3, and 4)</td></tr>
</table>

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 3: Exploration and Drilling, Sampling Techniques and Data					
3.1	Exploration	(i)	Describe the data acquisition or exploration techniques and the nature, level of detail, and confidence in the geological data used (i.e. geological observations, remote sensing results, stratigraphy, lithology, structure, alteration, mineralisation, hydrology, geophysical, geochemical, petrography, mineralogy, geochronology, bulk density, potential deleterious or contaminating substances, geotechnical and rock characteristics, moisture content, bulk samples etc.). Confirm that data sets include all relevant metadata, such as unique sample number, sample mass, collection date, spatial location etc. (Section 3)		
		(ii)	Identify and comment on the primary data elements (observation and measurements) used for the project and describe the management and verification of these data or the database. This should describe the following relevant processes: acquisition (capture or transfer), validation, integration, control, storage, retrieval and backup processes. It is assumed that data are stored digitally but hand-printed tables with well organized data and information may also constitute a database. (Section 2 and 3)		
		(iii)	Acknowledge and appraise data from other parties and reference all data and information used from other sources. (Section 3)		
		(iv)	Clearly distinguish between data / information from the property under discussion and that derived from surrounding properties (Section 3)		
		(v)	Describe the survey methods, techniques and expected accuracies of data. Specify the grid system used. (Section 3)		
		(vi)	Discuss whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the estimation procedure(s) and classifications applied. (Section 3 and Section 4)		
		(vii)	Present representative models and / or maps and cross sections or other two or three dimensional illustrations of results, showing location of samples, accurate drill-hole collar positions, down-hole surveys, exploration pits, underground workings, relevant geological data, etc (Sections 2, 3, and 4)		
		(viii)	Report the relationships between mineralisation widths and intercept lengths. The geometry of the mineralisation with respect to the drill hole angle is particularly important. If it is not known and only the down-hole lengths are reported, confirm it with a clear statement to this effect (e.g. 'down-hole length, true width not known'). (Sections 2, 3, and 4)		
3.2	Drilling Techniques	(i)	Present the type of drilling undertaken (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Banka, sonic, etc) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc). (Section 3)		

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 3: Exploration and Drilling, Sampling Techniques and Data					
3.2	Drilling Techniques	(ii)	Describe whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, technical studies, mining studies and metallurgical studies. (Section 3)		
		(iii)	Describe whether logging is qualitative or quantitative in nature; indicate if core photography. (or costean, channel, etc) was undertaken (Section 3)		
		(iv)	Present the total length and percentage of the relevant intersections logged. (Section 3)		
		(v)	Results of any downhole surveys of the drill hole to be discussed. (Section 3)		
3.3	Sample method, collection, capture and storage	(i)	Describe the nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling. (Section 3)		
		(ii)	Describe the sampling processes, including sub-sampling stages to maximize representivity of samples. This should include whether sample sizes are appropriate to the grain size of the material being sampled. Indicate whether sample compositing has been applied. (Section 3)		
		(iii)	Appropriately describe each data set (e.g. geology, grade, density, quality, diamond breakage, geo-metallurgical characteristics etc.), sample type, sample-size selection and collection methods (Section 3 and Section 4)		
		(iv)	Report the geometry of the mineralisation with respect to the drill-hole angle. State whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type. State if the intersection angle is not known and only the downhole lengths are reported. (Section 3)		
		(v)	Describe retention policy and storage of physical samples (e.g. core, sample reject, etc.) (Section 3)		
		(vi)	Describe the method of recording and assessing core and chip sample recoveries and results assessed, measures taken to maximise sample recovery and ensure representative nature of the samples and whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material. (Section 3)		

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 3: Exploration and Drilling, Sampling Techniques and Data</th></tr>
<tr><td>3.3</td><td>Sample method, collection, capture and storage</td><td>(vii)</td><td colspan="3">If a drill-core sample is taken, state whether it was split or sawn and whether quarter, half or full core was submitted for analysis. If a non-core sample, state whether the sample was riffled, tube sampled, rotary split etc. and whether it was sampled wet or dry. (Not relevant – core samples are not used for grade estimation directly, and so sub-sampling is not required)</td></tr>
<tr><td>3.4</td><td>Sample Preparation and Analysis</td><td>(i)</td><td colspan="3">Identify the laboratory(s) and state the accreditation status and Registration Number of the laboratory or provide a statement that the laboratories are not accredited. (Not relevant – core samples are not used for grade estimation directly. Details regarding the laboratories are provided in Section 3 for completeness)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td colspan="3">Identify the analytical method. Discuss the nature, quality and appropriateness of the assaying and laboratory processes and procedures used and whether the technique is considered partial or total. (Not relevant – core samples are not used for grade estimation directly. Details regarding the assaying are provided in Section 3 for completeness)</td></tr>
<tr><td></td><td></td><td>(iii)</td><td colspan="3">Describe the process and method used for sample preparation, sub-sampling and size reduction, and likelihood of inadequate or non representative samples (i.e. improper size reduction, contamination, screen sizes, granulometry, mass balance, etc.) (Not relevant – core samples are not used for grade estimation directly. Details regarding the sub-sampling (where relevant) are provided in Section 3 for completeness)</td></tr>
<tr><td>3.5</td><td>Sampling Governance</td><td>(i)</td><td colspan="3">Discuss the governance of the sampling campaign and process, to ensure quality and representivity of samples and data, such as sample recovery, high grading, selective losses or contamination, core/hole diameter, internal and external QA/QC, and any other factors that may have resulted in or identified sample bias. (Not relevant for Chama and Libwente. For Fibolele, only part of the sampling data was used due to an understood potential bias in part of the sampling campaign. This is discussed in Section 4.5)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td colspan="3">Describe the measures taken to ensure sample security and the Chain of Custody. (Section 3)</td></tr>
<tr><td></td><td></td><td>(iii)</td><td colspan="3">Describe the validation procedures used to ensure the integrity of the data, e.g. transcription, input or other errors, between its initial collection and its future use for modelling (e.g. geology, grade, density, etc.) (Section 3)</td></tr>
<tr><td></td><td></td><td>(iv)</td><td colspan="3">Describe the audit process and frequency (including dates of these audits) and disclose any material risks identified. (Section 3)</td></tr>
<tr><td>3.6</td><td>Quality Control/Quality Assurance</td><td>(i)</td><td colspan="3">Demonstrate that adequate field sampling process verification techniques (QA/QC) have been applied, e.g. the level of duplicates, blanks, reference material standards, process audits, analysis, etc. If indirect methods of measurement were used (e.g. geophysical methods), these should be described, with attention given to the confidence of interpretation. (Section 3)</td></tr>
</table>

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 3: Exploration and Drilling, Sampling Techniques and Data					
3.7	Bulk Density	(i)	Describe the method of bulk density determination with reference to the frequency of measurements, the size, nature and representativeness of the samples. (Section 3)		
		(ii)	If target tonnage ranges are reported state the preliminary estimates or basis of assumptions made for bulk density. (Section 3)		
		(iii)	Discuss the representivity of bulk density samples of the material for which a grade range is reported. (Section 3 and Section 4)		
		(iv)	Discuss the adequacy of the methods of bulk density determination for bulk material with special reference to accounting for void spaces (vugs, porosity etc.), moisture and differences between rock and alteration zones within the deposit. (Section 3)		
3.8	Bulk-Sampling and/or trial-mining	(i)	Indicate the location of individual samples (including map). (Section 3 and Section 4)		
		(ii)	Describe the size of samples, spacing/density of samples recovered and whether sample sizes and distribution are appropriate to the grain size of the material being sampled. (Section 3 and Section 4)		
		(iii)	Describe the method of mining and treatment. (Section 6 and Section 7)		
		(iv)	Indicate the degree to which the samples are representative of the various types and styles of mineralisation and the mineral deposit as a whole. (Sections 3, 4, 6, and 7)		

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 4: Estimation and Reporting of Exploration Results and Mineral Resources					
4.1	Geological model and interpretation	(i)	Describe the geological model, construction technique and assumptions that forms the basis for the Exploration Results or Mineral Resource estimate. Discuss the sufficiency of data density to assure continuity of mineralisation and geology and provide an adequate basis for the estimation and classification procedures applied. (Section 4)		
		(ii)	Describe the nature, detail and reliability of geological information with which lithological, structural, mineralogical, alteration or other geological, geotechnical and geo-metallurgical characteristics were recorded. (Sections 3, 4, and 5)		
		(iii)	Describe any obvious geological, mining, metallurgical, environmental, social, infrastructural, legal and economic factors that could have a significant effect on the prospects of any possible exploration target or deposit. (Not relevant – Exploration Targets are not reported)		
		(iv)		Discuss all known geological data that could materially influence the estimated quantity and quality of the Mineral Resource. (Sections 3 and 4)	
		(v)		Discuss whether consideration was given to alternative interpretations or models and their possible effect (or potential risk) if any, on the Mineral Resource estimate. (Section 4)	
		(vi)		Discuss geological discounts (e.g. magnitude, per reef, domain, etc.), applied in the model, whether applied to mineralized and / or un-mineralized material (e.g. potholes, faults, dykes, etc). (Section 4)	
4.2	Estimation and modelling techniques	(i)	Describe in detail the estimation techniques and assumptions used to determine the grade and tonnage ranges. (Section 4, although no Exploration Targets are specifically reported)		

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 4: Estimation and Reporting of Exploration Results and Mineral Resources					
4.2	Estimation and modelling techniques	(ii)		Discuss the nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values (cutting or capping), compositing (including by length and/or density), domaining, sample spacing, estimation unit size (block size), selective mining units, interpolation parameters and maximum distance of extrapolation from data points. (Sections 2 and 4)	
		(iii)		Describe assumptions and justification of correlations made between variables. (Not specifically relevant, although discussion on the variability between emerald and beryl are given in Sections 2, 3, and 4)	
		(iv)		Provide details of any relevant specialized computer program (software) used, with the version number, together with the estimation parameters used. (Sections 2 and 4)	
		(v)		State the processes of checking and validation, the comparison of model information to sample data and use of reconciliation data, and whether the Mineral Resource estimate takes account of such information. (Sections 2, 3, and 4)	
		(vi)		Describe the assumptions made regarding the estimation of any co-products, by-products or deleterious elements. (Not relevant – no co-products or deleterious elements are estimated or reported)	
4.3	Reasonable and realistic prospects for eventual economic extraction	(i)		Disclose and discuss the geological parameters. These would include (but not be limited to) volume / tonnage, grade and value / quality estimates, cut-off grades, strip ratios, upper- and lower- screen sizes. (Section 4)	
		(ii)		Disclose and discuss the engineering parameters. These would include mining method, dilution, processing, geotechnical, geohydraulic and metallurgical) parameters. (Section 6.4)	
		(iii)		Disclose and discuss the infrastructure, including, but not limited to, power, water, site-access. (Section 8)	
		(iv)		Disclose and discuss the legal, governmental, permitting, statutory parameters. Section 9	
		(v)		Disclose and discuss the environmental and social (or community) parameters. Section 9	

		(vi)		Disclose and discuss the marketing parameters. (Section 10)

SAMREC TABLE 1					
			Exploration Results	Mineral Resources	Mineral Reserves
Section 4: Estimation and Reporting of Exploration Results and Mineral Resources					
4.3	Reasonable and realistic prospects for eventual economic extraction	(vii)		Disclose and discuss the economic assumptions and parameters. These factors will include, but not limited to, commodity prices and potential capital and operating costs (Section 6.12.3)	
		(viii)		Discuss any material risks (Section 4, Section 9.9, Section 11)	
		(ix)		Discuss the parameters used to support the concept of "eventual" (Section 4)	
4.4	Classification Criteria	(i)		Describe criteria and methods used as the basis for the classification of the Mineral Resources into varying confidence categories. (Section 4)	
4.5	Reporting	(i)	Discuss the reported low and high-grades and widths together with their spatial location to avoid misleading the reporting of Exploration Results, Mineral Resources or Mineral Reserves. (Not relevant – grades are reported to reflect the understanding of grade distribution)		
		(ii)	Discuss whether the reported grades are regional averages or if they are selected individual samples taken from the property under discussion. (Section 4)		
		(iii)	State assumptions regarding mining methods, infrastructure, metallurgy, environmental and social parameters. State and discuss where no mining related assumptions have been made. (Sections 5, 6, 7, 8, and 9)		
		(iv)	State the specific quantities and grades / qualities which are being reported in ranges and/or widths, and explain the basis of the reporting (Section 4 (where relevant))		

		(v)		Present the detail for example open pit, underground, residue stockpile, remnants, tailings, and existing pillars or other sources in the Mineral Resource statement (Section 4)	

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 4: Estimation and Reporting of Exploration Results and Mineral Resources					
4.5	Reporting	(vi)		Present a reconciliation with any previous Mineral Resource estimates. Where appropriate, report and comment on any historic trends (e.g. global bias). (Section 4, specifically Section 4.11)	
		(vii)		Present the defined reference point for the tonnages and grades reported as Mineral Resources. State the reference point if the point is where the run of mine material is delivered to the processing plant. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported. (Section 6.12.4 Reserve statement)	
		(viii)	If the CP is relying on a report, opinion, or statement of another expert who is not a CP, disclose the date, title, and author of the report, opinion, or statement, the qualifications of the other expert and why it is reasonable for the CP to rely on the other expert, any significant risks and any steps the CP took to verify the information provided. (Not relevant – CP is not relying on reports of other experts, except where indicated)		
		(ix)	State the basis of equivalent metal formulae, if applied. (Not relevant – no metal equivalents are calculated or used for reporting)		

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 5: Technical Studies					
5.1	Introduction	(i)	Technical Studies are not applicable to Exploration Results	State the level of study – whether scoping, prefeasibility, feasibility or ongoing Life of Mine	The level of study can be found in Section 6.12.4
		(ii)			
5.2	Mining Design	(i)	Technical Studies are not applicable to Exploration Results	State assumptions regarding mining methods and parameters when estimating Mineral Resources or explain where no mining assumptions have been made.	Modifying factors applied can be found in Section 6.12.2 Mining method can be found in section 6.4 Geotechnical information can be found in section 5.5 Pit design details can be found in section 6.7

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 5: Technical Studies					
5.2	Mining Design	(ii)			
		(iii)			The models used for the mineral reserve estimation can be found in Section 6.12.4
		(iv)			Pricing used in the estimation of reserves can be found in section 6.12.3
		(v)			Mining method information can be found in section 6.4
		(vi)			Information on the slope stability analysis can be found in section 5.5. Information on the strip ratio is found in section 6.7.4

		(vii)			N/A

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 5: Technical Studies					
5.2	Mining Design	(viii)			Comments on the mining rate can be found in section 6.4 as well as the Operating Strategy section 6.9 and the Equipment Requirement section 6.11
		(ix)			Pit optimization and factors applied in them can be found in section 6.5. The mining schedule and comments on its viability can be found in section 6.10
5.3	Metallurgical and Testwork Section 7	(i)	Technical Studies are not applicable to Exploration Results		Discuss the source of the sample and the techniques to obtain the sample, laboratory and metallurgical testing techniques.
		(ii)			Explain the basis for assumptions or predictions regarding metallurgical amenability and any preliminary mineralogical test work already carried out.
		(iii)		Discuss the possible processing methods and any processing factors that could have a material effect on the likelihood of eventual economic extraction. Discuss the appropriateness of the processing methods to the style of mineralisation.	Describe and justify the processing method(s) to be used, equipment, plant capacity, efficiencies, and personnel requirements.

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 5: Technical Studies					
5.3	Metallurgical and Testwork Section 7	(iv)			Discuss the nature, amount and representativeness of metallurgical test work undertaken and the recovery factors used. A detailed flow sheet / diagram and a mass balance should exist ,especially for multi-product operations from which the saleable materials are priced for different chemical and physical characteristics.
		(v)			State what assumptions or allowances have been made for deleterious elements and the existence of any bulk-sample or pilot-scale test work and the degree to which such samples are representative of the ore body as a whole.
		(vi)			State whether the metallurgical process is well-tested technology or novel in nature.
5.4	Infrastructure Section 8	(i)	Technical Studies are not applicable to Exploration Results	Comment regarding the current state of infrastructure or the ease with which the infrastructure can be provided or accessed	

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 5: Technical Studies					
5.4	Infrastructure	(ii)			Report in sufficient detail to demonstrate that the necessary facilities have been allowed for (which may include, but not be limited to, processing plant, tailings dam, leaching facilities, waste dumps, road, rail or port facilities, water and power supply, offices, housing, security, resource sterilisation testing etc.). Provide detailed maps showing locations of facilities. (Section 8 Infrastructure)
		(iii)			Statement showing that all necessary logistics have been considered. (Section 8.5 Logistics and Stores)
5.5	Environmental and Social (Section 9)	(i)	Technical Studies are not applicable to Exploration Results	Confirm that the company holding the tenement has addressed the host country environmental legal compliance requirements and any mandatory and/or voluntary standards or guidelines to which it subscribes Section 9.10	
		(ii)		Identify the necessary permits that will be required and their status and where not yet obtained, confirm that there is a reasonable basis to believe that all permits required for the project will be obtained Section 9.3	
		(iii)		Identify and discuss any sensitive areas that may affect the project as well as any other environmental factors including I&AP and/or studies that could have a material effect on the likelihood of eventual economic extraction. Discuss possible means of mitigation. Section 9.7	
		(iv)		Identify any legislated social management programmes that may be required and discuss the content and status of these. Section 9.2, Section 9.4	
		(v)		Outline and quantify the material socio-economic and cultural impacts that need to be mitigated, and the~~ir~~ mitigation measures and where appropriate the associated costs. Section 9.4 Section 9.7	

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 5: Technical Studies					
5.6	Market Studies and Economic criteria Section 10	(i)	Technical Studies are not applicable to Exploration Results		Describe the valuable and potentially valuable product(s) including suitability of products, co-products and by products to market.
		(ii)			Describe product to be sold, customer specifications, testing, and acceptance requirements. Discuss whether there exists a ready market for the product and whether contracts for the sale of the product are in place or expected to be readily obtained. Present price and volume forecasts and the basis for the forecast.
		(iii)			State and describe all economic criteria that have been used for the study such as capital and operating costs, exchange rates, revenue / price curves, royalties, cut-off grades, reserve pay limits.
		(iv)			Summary description, source and confidence of method used to estimate the commodity price/value profiles used for cut-off grade calculation, economic analysis and project valuation, including applicable taxes, inflation indices, discount rate and exchange rates.

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 5: Technical Studies					
5.6	Market Studies and Economic criteria Section 10	(v)			Present the details of the point of reference for the tonnages and grades reported as Mineral Reserves (e.g. material delivered to the processing facility or saleable product(s)). It is important that, in any situation where the reference point is different, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported.
		(vi)			Justify assumptions made concerning production cost including transportation, treatment, penalties, exchange rates, marketing and other costs. Provide details of allowances that are made for the content of deleterious elements and the cost of penalties.
		(vii)			Provide details of allowances made for royalties payable, both to Government and private.
		(viii)			State type, extent and condition of plant and equipment that is significant to the existing operation(s).
		(ix)			Provide details of all environmental, social and labour costs considered
5.7	Risk Analysis	(i)	Technical Studies are not applicable to Exploration Results	Report an assessment of technical, environmental, social, economic, political and other key risks to the project. Describe actions that will be taken to mitigate and/or manage the identified risks. Section 11	

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 5: Technical Studies					
5.8	Economic Analysis	(i)	Technical Studies are not applicable to Exploration Results	At the relevant level (Scoping Study, Pre-feasibility, Feasibility or on-going Life-of Mine), provide an economic analysis for the project that includes: Section12	
		(ii)		Cash Flow forecast on an annual basis using Mineral Reserves or an annual production schedule for the life of the project Section12	
		(iii)		A discussion of net present value (NPV), internal rate of return (IRR) and payback period of capital Section12	
		(iv)		Sensitivity or other analysis using variants in commodity price, grade, capital and operating costs, or other significant parameters, as appropriate and discuss the impact of the results. Section12	

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 6: Estimation and Reporting of Mineral Reserves</th></tr>
<tr><td rowspan="3">6.1</td><td rowspan="3">Estimation and modelling techniques</td><td>(i)</td><td></td><td colspan="2">Describe the Mineral Resource estimate used as a basis for the conversion to a Mineral Reserve. (Section 4)</td></tr>
<tr><td>(ii)</td><td></td><td colspan="2">Report the Mineral Reserve Statement with sufficient detail indicating if the mining is open pit or underground plus the source and type of mineralisation, domain or ore body, surface dumps, stockpiles and all other sources. (Section 6.12 Reserves)</td></tr>
<tr><td>(iii)</td><td></td><td></td><td>Provide a reconciliation reporting historic reliability of the performance parameters, assumptions and modifying factors including a comparison with the previous Reserve quantity and qualities, if available. Where appropriate, report and comment on any historic trends (e.g. global bias)</td></tr>
<tr><td>6.2</td><td>Classification Criteria</td><td>(i)</td><td></td><td></td><td>Describe and justify criteria and methods used as the basis for the classification of the Mineral Reserves into varying confidence categories, based on the Mineral Resource category, and including consideration of the confidence in all the modifying factors. (Section 6.12.4 Ore reserve statement)</td></tr>
<tr><td>6.3</td><td>Reporting</td><td>(i)</td><td></td><td></td><td>Discuss the proportion of Probable Mineral Reserves, which have been derived from Measured Mineral Resources (if any), including the reason(s) therefore. (Section 6.12.4 Reserve statement)</td></tr>
</table>

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 6: Estimation and Reporting of Mineral Reserves					
6.3	Reporting	(ii)			Present details of for example open pit, underground, residue stockpile, remnants, tailings, and existing pillars or other sources in respect of the Mineral Reserve statement. (Section 6.4.4 Ore stockpiles)
		(iii)			Present the details of the defined reference point for the Mineral Reserves. State whether the reference point is the point where the run of mine material is delivered to the processing plant. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported. State clearly whether the tonnages and grades reported for Mineral Reserves are in respect of material delivered to the plant or after recovery. (Section 6.12 Reserves)
		(iv)			Present a reconciliation with the previous Mineral Reserve estimates. Where appropriate, report and comment on any historic trends (e.g. global bias). (Section 6.12 Reserves)
		(v)			Only Measured and Indicated Mineral Resources can be considered for inclusion in the Mineral Reserve. (Section 6.12 Reserves)
		(vi)			State whether the Mineral Resources are inclusive or exclusive of Mineral Reserves.

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 7: Audits and Reviews					
7.1	Audits and Reviews	(i)	State type of review/audit (e.g. independent, external), area (e.g. laboratory, drilling, data, environmental compliance etc), date and name of the reviewer(s) together with their recognized professional qualifications Section 9.3		
		(ii)	Disclose the conclusions of relevant audits or reviews. Note where significant deficiencies and remedial actions are required. Section 9.9		
Section 8: Other Relevant Information					
8.1		(i)	Discuss all other relevant and material information not discussed elsewhere. Not relevant		
Section 9: Qualification of Competent Person(s) and other key technical staff. Date and Signature Page					
9.1		(i)	State the full name, registration number and name of the professional body or RPO, for all the Competent Person(s). State the relevant experience of the Competent Person(s) and other key technical staff who prepared and are responsible for the Public Report. Appendix C		
		(ii)	State the Competent Person's relationship to the issuer of the report. Appendix C		
		(iii)	Provide the Certificate of the Competent Person (Appendix 2), including the date of sign-off and the effective date, in the Public Report.. Appendix C		

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 11: Reporting of Diamonds and Gemstones</th></tr>
<tr><td colspan="6">This section highlights criteria that are applicable to diamond deposits and to other gemstone deposits. Reports of diamond and other gemstone properties must also take cognisance of sections 59-71 of the Code, Sections 1 - 9 of Table 1 and the Guidance notes in the SAMCODE Companion Volume. The information required in this section (Section 11) should be included with the relevant sections and should not comprise a separate chapter.</td></tr>
<tr><td>11.1</td><td>Geological Setting, Deposit, Mineralisation</td><td>(i)</td><td colspan="3">For diamond placer occurrences, describe the overburden and gravel thicknesses, as well as bedrock topography (Not relevant – mineralization described is not diamondiferous, or a placer)</td></tr>
<tr><td rowspan="9">11.2</td><td rowspan="9">Sampling of Diamond Projects</td><td>(i)</td><td colspan="3">Describe the type of sample (outcrop, boulder, drill-core, RC drill cuttings, gravel, stream sediment or soil) and purpose (for example: RC drilling to identify gravel thickness, large diameter drilling to establish stones per unit of volume, bulk-sample, etc.) (Section 3)</td></tr>
<tr><td>(ii)</td><td colspan="3">Discuss sample size, distribution and representivity (Section 3 and 4)</td></tr>
<tr><td>(iii)</td><td colspan="3">Identify the type of sample facility, treatment rate and accreditation (Section 7)</td></tr>
<tr><td>(iv)</td><td colspan="3">Discuss sample size reduction, bottom and top screen sizes and any re-crush (Section 7)</td></tr>
<tr><td>(v)</td><td colspan="3">Discuss the sample processes (e.g. DMS, grease, X-Ray, Hand-sorting, etc.) (Section 7)</td></tr>
<tr><td>(vi)</td><td colspan="3">Discuss process efficiency, tailings auditing and granulometry (Section 7)</td></tr>
<tr><td>(vii)</td><td colspan="3">Identify the laboratory used, type of process for microdiamonds and accreditation. Reports of microdiamond recoveries should describe the extraction process, crushing methodology and the stone counts per unit weight, as a minimum. (Not relevant – micro/macro diamond studies are not relevant to the mineralization style)</td></tr>
<tr><td>(viii)</td><td colspan="3">State whether the reports of kimberlitic indicator minerals ("KIM’s") or diamond indicator minerals ("DIM's") have been prepared by a suitably qualified laboratory which must be identified. (Not relevant to mineralization style)</td></tr>
<tr><td>(ix)</td><td colspan="3">Supply details of the sampling parameters for reports dealing with recoveries of diamonds or KIM's, including, but not limited to type of sample (stream sediment, soil, bulk, rock, etc.) as well as sample size, sample frequency, representivity and screen parameters are required. (Not relevant to mineralization style)</td></tr>
</table>

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 11: Reporting of Diamonds and Gemstones					
11.2	Sampling of Diamond Projects	(x)	Discuss the relevant major and trace element chemistry of any kimberlitic indicator minerals recovered. Reference relevant peer-reviewed published research articles when reporting the interpretation of mineral chemistry data for diamond exploration projects. (Not relevant to mineralization style)		
		(xi)	Provide details of the form, shape, colour and size of the diamonds recovered and, where relevant, comments regarding the nature of the source of the diamonds. (Section 3)		
11.3	Bulk-Sampling and/or trial-mining	(i)	Provide a table of relevant results , including (but not limited to) volume of sample, number of individual diamonds, total number of carats, sample grade, diamond value (it is not possible to evaluate diamond assortment from microdiamonds). (Section 3 and Section 4)		
		(ii)	Discuss micro- and macro- diamond sample results per geological domain. (Not relevant to mineralization style)		
		(iii)	Discuss stone-size and -number distribution (Size-frequency distribution). Include the suitability of the sample size to the stage of the project and its relevance for both SFD and valuation (assortment) purposes. (Not relevant to mineralization style)		
		(iv)	State the top and bottom sieve cut-off sizes. (Section 7 or Not relevant. Also Section 4)		
		(v)	Discuss diamond breakage, where relevant (Section 4)		
		(vi)	Define the unit of grade measure used in the document (e.g. carat per units of mass, area or volume). Where carats per unit of mass is used, include a discussion of mass to tonnage conversion. (Section 4)		
11.4	Estimation and Modelling Techniques	(i)	Describe in detail any estimation techniques (including geostatistical estimation, where relevant) used to determine the volume/tonnage, grade and value data, including their applicability to the deposit type. (Section 4)		
		(ii)	Express applicable volumes, grades and values in ranges (with appropriate clarifiers to denote lack of reliability of data). The use of "ranges" in this context has no statistical connotation (Not relevant – Exploration Targets are not reported)	State all Diamond Resource estimates so as to convey the order of accuracy by rounding off to appropriately significant figures. (Section 4)	State all Diamond Reserve estimates so as to convey the order of accuracy of the estimates by rounding off to appropriately significant figures.

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 11: Reporting of Diamonds and Gemstones					
11.4	Estimation and Modelling Techniques	(iii)	Discuss volume/tonnage, grade and value information per identified domain (where possible, even if in a very preliminary form)	Discuss volume/tonnage, grade and value information per identified domain (Section 4)	
		(iv)	If grades are reported then state clearly whether these are regional averages, based on microdiamond assessment, KIM analyses, or if they are selected individual samples taken from the property under discussion. The occurrence of individual diamonds or microdiamonds in surficial deposits or from inadequate samples (too small to be statistically valid) from a primary or secondary rock source would not typically qualify as an exploration target. This may not be true for marine deposits, in which case further explanation and discussion would be necessary.	State that the grades for the Diamond Resources are estimated from sampling data derived from the property itself (Sections 2, 3 and 4)	State that the grades for Diamond Reserves have been estimated from bulk-sampling and/or trial-mining
		(v)	Report all diamond values in US$/ct. If reference is made to local currencies then provide the prevailing exchange rate as well as the effective date of the exchange rate. Also supply the date of valuation. (Sections 10 and 12)		
		(vi)	Specify details of the type and size of individual samples (including top and bottom cut-off size, in millimetres, used in the recovery). (Not relevant to mineralization style, although minimum sizes of stones recovered in the plant is described in Sections 6 and 7)		
		(vii)	Discuss the representivity of the type, size, number and location of the samples (Sections 3 and 4)		

SAMREC TABLE 1					
			Exploration Results	**Mineral Resources**	**Mineral Reserves**
Section 11: Reporting of Diamonds and Gemstones					
11.4	Estimation and Modelling Techniques	(viii)	Discuss geostatistical estimation (where relevant) and interpolation techniques applied and their applicability to the deposit type (Not relevant to estimation method used)		
		(ix)	Specify the number and total weight (in carats) of diamonds recovered. The weight of diamonds recovered may only be omitted from the report when the diamonds are less than 0.5mm in size (i.e. when the diamonds recovered are microdiamonds) or when the diamonds are below a specified commercial cut-off value, which must be specified. (Sections 4 and 6)		
		(x)		Disclose the number of stones and the total number of carats used in the SFD, grade and value estimation and discuss the validity of this data. (Not relevant to mineralization style and estimation method used)	
		(xi)		Note whether a strict lower cut-off has been applied or if the modelled results include incidental diamonds below the lower cut-off? Discuss the implications. (Not relevant to mineralization style and estimation method used)	
		(xii)		Present aspects of spatial structure analysis and grade and value distribution (Not relevant to mineralization style and estimation method used)	
		(xiii)		Present aspects of micro and macro- diamond sample results per domain (Not relevant to mineralization style and estimation method used)	
		(xiv)		Present aspects of the effect on sample grade and value with change in bottom cut off screen size. (Not relevant to mineralization style and estimation method used)	
		(xv)		Describe any adjustments made to size distribution for sample plant performance and performance on a commercial scale, where applicable. (Not relevant to mineralization style and estimation method used)	
		(xvi)		Confirm that valuations have not been reported for samples of diamonds processed using total liberation methods (which are commonly used for processing kimberlite exploration samples and which are based on microdiamonds). (Not relevant to mineralization style and estimation method used)	
		(xvii)		Justify the use of microdiamonds to extrapolate diamond value at depth through the presentation of geological and size frequency distribution models (Not relevant to mineralization style and estimation method used)	

		(xviii)		State the name, qualifications, experience and independence of the recognised expert responsible for the classification and valuation of the diamond parcel(s). (Not relevant to mineralization style and estimation method used)

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 11: Reporting of Diamonds and Gemstones					
11.4	Estimation and Modelling Techniques	(xix)		For each diamond parcel valued, supply information relating to the number of stones and the carats and size distribution using a standard progression of sieve sizes or diamond mass ranges for each identified geological domain. For marine or alluvial placers the average price per average stone size may be used instead of a size distribution (Not relevant to mineralization style and estimation method used)	
		(xx)		State that the valuation is on the run-of-mine diamond parcel (i.e. not partial parcel) (Not relevant to mineralization style and estimation method used)	
		(xxi)		Define the unit of grade measure used in the resource/reserve estimation (e.g. carat per units of mass, area or volume). Where carats per unit of volume is used, include a discussion of mass to tonnage conversion. (Section 4)	
11.5	Resource/ Reserve Classification Criteria	(i)		A Diamond Resource/Reserve must be described in terms of volume/tonnage, grade and value. A Diamond Resource/Reserve must not be reported in terms of contained diamond content unless corresponding tonnages/volumes, grades and values are also reported. The average diamond grade and value must not be reported without specifying the applicable bottom cut-off screen size. (Sections 4 and 6)	
		(ii)		Discuss issues surrounding stone frequency (stones per cubic metre, per tonne, or per square metre) and stone size (carats per stone) relating to grade (carats per cubic metre, per tonne or per square metre). Consider the elements of uncertainty in these estimates and develop the Diamond Resource classification accordingly. (Section 6.12 Reserves)	
		(iii)		Present relevant aspects of stone size and number distribution, including the applicability of the parcel size. Note that a Diamond Resource/Reserve may not be declared without reference to an SFD. (Not relevant to mineralization style and estimation method used)	
		(iv)		Present aspects of global sample grade per geological domain and local block estimates in the case of Indicated Resources (Section 4)	
11.6	Audits and Reviews	(i)	State that the samples were sealed after excavation and discuss the chain of custody from source to reporting of results (Sections 3 and 7)		
		(ii)	Discuss security standards in sampling plant and recovery sections of bulk-sampling/trial-mining programmes for macrodiamonds (Sections 3 and 7)		

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 11: Reporting of Diamonds and Gemstones</th></tr>
<tr><td>11.6</td><td>Audits and Reviews</td><td>(iii)</td><td colspan="3">Describe the type of facility, treatment rate, and accreditation (if any) of the sample plant. It is especially important to discuss the bottom screen size, top screen size and recrush parameters, in addition to the concentration methodology (e.g. pan, DMS, Optical, etc.) and the recovery technique (e.g. grease, X-ray, hand-sorting, etc.). (Section 7)</td></tr>
<tr><td></td><td></td><td>(iv)</td><td colspan="3">Discuss valuer location, escort, delivery, cleaning losses, reconciliation with recorded sample carats and number of stones; (Not relevant)</td></tr>
<tr><td></td><td></td><td>(v)</td><td colspan="3">State whether core samples were washed prior to treatment for microdiamonds and discuss the use of diamond drill-bits (Not relevant)</td></tr>
<tr><td></td><td></td><td>(vi)</td><td colspan="3">State whether any audit samples were treated at alternative facilities (Not relevant)</td></tr>
<tr><td></td><td></td><td>(vii)</td><td colspan="3">Discuss QA/QC of sampling results, including the process efficiency, tailings auditing and granulometry (Not relevant)</td></tr>
<tr><td></td><td></td><td>(viii)</td><td colspan="3">Discuss the recovery of tracer monitors used in sampling and treatment (Not relevant)</td></tr>
<tr><td></td><td></td><td>(ix)</td><td colspan="3">Discuss geophysical (logged) density and particle density, where relevant (Section 3)</td></tr>
<tr><td></td><td></td><td>(x)</td><td colspan="3">Discuss cross-validation of sample weights, wet and dry, with hole volume and density, moisture factor (Not relevant)</td></tr>
</table>

<table>
<tr><th colspan="6">SAMREC TABLE 1</th></tr>
<tr><th colspan="3"></th><th>Exploration Results</th><th>Mineral Resources</th><th>Mineral Reserves</th></tr>
<tr><th colspan="6">Section 12: Reporting of Industrial Minerals</th></tr>
<tr><td>12.1</td><td>Specific for Reporting of Industrial Minerals</td><td>(i)</td><td colspan="3">Confirm that the reports on Industrial Mineral deposits take cognisance of Sections 80 of the Code and Sections 1 - 9 of Table 1. (Not relevant)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td colspan="3">Describe the exploration or geologically specific specialised industry techniques appropriate to the minerals under investigation (Not relevant)</td></tr>
<tr><td></td><td></td><td>(iii)</td><td colspan="3">Describe the nature and quality of sampling or specific specialised industry standard measurement tools appropriate to the minerals under investigation (Not relevant)</td></tr>
<tr><td></td><td></td><td>(iv)</td><td colspan="3">Describe the appropriate saleable product qualities being reported. Describe the basis for reporting (physical or chemical parameters, air-dried basis, dry basis, etc.). Reporting of deleterious chemical elements or physical parameters is required. (Not relevant)</td></tr>
<tr><td></td><td></td><td>(v)</td><td colspan="3">State assumptions regarding in particular mining methods, infrastructure, metallurgy, environmental and social parameters. Explain where no mining related assumptions have been made. (Not relevant)</td></tr>
<tr><td></td><td></td><td>(vi)</td><td colspan="3">Disclose and discuss the marketing parameters, customer specifications, testing, and acceptance requirements. (Not relevant)</td></tr>
<tr><td></td><td></td><td>(vii)</td><td colspan="3">Discuss the nature, amount and representativeness of metallurgical studies completed which form the basis for the various saleable materials which may be priced for different chemical and physical characteristics. (Not relevant)</td></tr>
<tr><td></td><td></td><td>(viii)</td><td colspan="3">Present the defined reference point of the reported tonnages and grades/qualities. Where the reference point is the point is a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported. State whether the tonnages and grades/qualities of the material delivered to the plant or after recovery. (Not relevant)</td></tr>
</table>

SAMREC TABLE 1

			Exploration Results	Mineral Resources	Mineral Reserves
Section 13: Reporting using Metal Equivalents					
13.1	Specific for Metal Equivalents Reporting	(i)	Confirm that reports on all deposits take cognisance of Sections 73 of the Code and Sections 1 - 9 of Table 1. (Not relevant)		
		(ii)		Discuss and describe the basis for the grade estimation for each metal relating to the metal equivalence (Not relevant)	
		(iii)		Disclose all economic criteria that have been used for the calculation such as exchange rates, revenue / price curves, royalties, cut-off grades, pay limits. (Not relevant)	
		(iv)		Discuss the basis for assumptions or predictions regarding metallurgical factors such as recovery used in the metal equivalents calculation. (Not relevant)	
		(v)		Show the calculation formula used. (Not relevant)	

Kagem SAMVAL Table 1

Criteria	Comments	Where complied with
T1.0 **General**	The Valuation Report shall contain: The signature of the CV; The CV's qualifications and experience in valuing mineral properties, or relevant valuation experience; A statement that all facts presented in the report are correct to the best of the CV's knowledge; A statement that the analyses and conclusions are limited only by the reported forecasts and conditions; A statement of the CV's present or prospective interest in the subject property or asset; A statement that the CV's compensation, employment, or contractual relationship with the Commissioning Entity is not contingent on any aspect of the Report; A statement that the CV has no bias with respect to the assets that are the subject of the Report, or to the parties involved with the assignment; A statement that the CV has (or has not) made a personal inspection of the property; and A record of the CP's and experts who have contributed to the valuation. Written consent to use and rely on such Reports shall be obtained. Significant contributions made by such experts shall be highlighted individually.	Section 12.3 and Appendix C
T1.1 Illustrations	There are numerous instances (especially in the non-listed environment) when a valuation is not accompanied by the CPR on which it is based. In these cases, especially, diagrams/illustrations are required and shall be in the required format. Diagrams, maps, plans, sections, and illustrations shall be legible and prepared at an appropriate scale to distinguish important features. Maps shall be dated and include a legend, author or information source, coordinate system and datum, a scale in bar or grid form, and an arrow indicating north. A location or index map and more detailed maps showing all important features described in the text, including all relevant cadastral and other infrastructure features, shall be included.	Part of full CPR
T1.2 **Synopsis**	Provide the salient features of the report – a brief description of the terms of reference, scope of work, the Valuation Date, the mineral property; its location, ownership, geology, and mineralization; history of exploration and production, current status, Exploration Targets, mineralization and/or production forecast, Mineral Resources and Mineral Reserves, production facilities (if any); environmental, social, legal, and permitting considerations; valuation approaches and methods, valuation, and conclusions.	Part of full CPR – Section 12.1 and 12.2
T1.3 **Introduction and Scope**	Introduction and scope, specifying commissioning instructions including reference to the valuation, engagement letter, date, purpose and intended use of the valuation. The CV shall fully disclose any interests in the Mineral Asset or Commissioning Entity. Any restrictions on scope and special instructions followed by the CV, and how these affect the reliability of the valuation, shall be disclosed.	Section 1.1 and Section 12.1
T1.4 **Compliance**	A statement that the report complies with SAMVAL shall be included. Any variations shall be described and discussed.	Section 1.3.3
T1.5 **Identity, Tenure and Infrastructure**	The identity, tenure, associated infrastructure and locations of the property interests, rights or securities to be valued (*i.e*. the physical, legal, and economic characteristics of the property) shall be disclosed.	Section 1.2
T1.6 **History**	History of activities, results, and operations to date shall be included.	Section 1.2.7
T1.7 **Geological Setting**	Geological setting, models, and mineralization shall be described.	Section 2
T1.8 **Exploration Results and Exploration Targets**	Exploration programmes, their location, results, interpretation, and significance shall be described. Exploration Targets shall be discussed.	Section 3.1
T1.9 **Mineral Resources and Mineral Reserves**	Mineral Resource and Mineral Reserve statements shall be provided. They shall be signed off by a Competent Person in compliance with the SAMREC Code or another CRIRSCO code. The CV shall set out the manner in which he has satisfied himself that he can rely upon the information in the CPR.	Section 4.10 and Section 6.12.4
T1.10 **Modifying Factors and Key Assumptions**	A statement of Modifying Factors shall be included, separately summarizing material issues relating to each applicable Modifying Factor. The CV shall set out the manner in which he has satisfied himself that he can rely upon the technical information provided. (**NOTE:** All the Modifying Factors shall be listed, or references provided to relevant definitions). This shall include an explanation of all material assumptions and limiting factors. When reporting on environmental, social and governance modifying factors, reference should be made to the ESG reporting parameters as required by the Southern African Minerals Environmental, Social and Governance Guideline (SAMESG) or other recognised code, e.g. Equator Principles.	Section 12.3
T1.11 **Previous Valuations**	The valuation shall refer to all available and relevant previous valuations of the Mineral Asset that have been performed in at least the previous two years, and explain any material differences between these and the present valuation.	Section 12.7
T1.12 **Valuation Approaches and Methods**	The valuation approaches and methods used in the valuation shall be described and justified in full.	Section 12.1
T1.13 **Valuation Date**	A statement detailing the Report Date and the Valuation Date, as defined in this Code, and whether any material changes have occurred between the Valuation Date and the Report Date.	Section 12.1
T1.14 **Valuation Results**	For the Income Approach, the valuation cash flow shall be disclosed. For the Market Approach, the market comparable information shall be disclosed. For the Cost Approach, the relevant and applicable cost shall be disclosed.	Section 12.6 Section 12.8
T1.15 **Valuation Summary and Conclusions**	A summary of the valuation details, consolidated into single material line items, shall be provided. The Mineral Asset Valuation shall specify the key risks and forecasts used in the valuation. A cautionary statement concerning all forward-looking or forecast statements shall be included. The valuation's conclusions, illustrating a range of values, the best estimate value for each valuation, and whether the conclusions are qualified or subject to any restrictions imposed on the CV, shall be included.	Section 12.1, Section 12.8, Section 1.6.1

Criteria	Comments	Where complied with
T1.16 **Identifiable Component Asset (ICA) Values**	In some valuations, the valuation shall be broken down into Identifiable Component Asset Values (an ICA valuation) equalling the Mineral Asset Value. This could be, for example, due to the requirements of other valuation rules and legislative practices including taxation (*i.e*. fixed property, plant, and equipment relative to Mineral Asset Value allocations such as in recoupment or capital gains tax calculations or where a commissioned Mineral Asset Valuation specifies a need for a breakdown of the Mineral Asset Valuation). In such cases, the separate allocations of value shall be made by taking account of the value of every separately identifiable component asset. Allocation of value to only some, and not all, identifiable component assets is not allowed. This requires a specialist appraisal of each identifiable component asset of property, plant and equipment, with the 'remaining' value of the Mineral Asset being attributed to the Mineral Resources and Reserves. Such valuations shall be performed by suitably qualified experts, who may include the CV. If the Mineral Asset Valuation includes an ICA Valuation, the CV shall satisfy himself or herself that the ICA Valuation is reasonable before signing off the Mineral Asset Valuation.	Not applicable
T1.17 **Historic Verification**	A historic verification of the performance parameters on which the Mineral Asset Valuation is based shall be presented.	Section 6.2
T1.18 **Market Assessment**	A comprehensive market assessment should be presented.	Section 10
T1.19 **Sources of Information**	The sources of all material information and data used in the report shall be disclosed, as well as references to any published or unpublished technical papers used in the valuation, subject to confidentiality. A reference shall be made to any other report that has been compiled, for the purpose of providing information for the valuation, including SAMREC-compliant reports and any other contributions or reports from experts.	Section 12.10

APPENDIX

C LETTERS OF CONSENT

srk consulting

SRK Consulting (UK) Limited
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17 Churchill Way
City and County of Cardiff
CF10 2HH, Wales
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URL: www.srk.co.uk
Tel: + 44 (0) 2920 348 150
Fax: + 44 (0) 2920 348 199

CERTIFICATE OF COMPETENT PERSON

As the author of the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia’ I hereby state:-

1. My name is Michael Beare, Director and Corporate Consultant (Mining Engineering), SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. That I am a Chartered Member of the Institute of Mining, Materials and Metallurgy, C.Eng, MIMMM; Associateship of the Camborne School of Mines, ACSM
3. After starting my career in Tanzania working as a gemstone buyer and explorer, I have worked on a number of technical studies including the Grib Feasibility Study (Diamonds), various technical studies on the Kagem Emerald Mine in Zambia (Emeralds), two technical studies on the MRM Ruby Mines in Mozambique and a technical study on the Costcuez Mine in Colombia (Emeralds).
4. I am a ’Competent Person’ as defined in the SAMREC Code.
5. I have worked as the Project Manager for the preparation of the ‘A Competent Persons Report on the Montepuez Ruby Mine, Mozambique’.
6. I have not visited site but entrusted this aspect of the study to Mr Hanno Buys my colleague at SRK who prepared the mining section of the study. Prior to that, another colleague Gabor Bacsfalusi visited site on my behalf.
7. As a CP, I am the lead CP for this report and for reporting of Ore Reserves and also responsible for Sections 1, 8, 10 and 11 of this report.
8. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
9. I declare that this Report appropriately reflects the Competent Person’s/author’s view.
10. I am independent of Gemfields.
11. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
12. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine.
13. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017.

This signature has been scanned. The author has given permission to its use for this particular document. The original signature is held on file.

Michael Beare
SRK Consulting UK Ltd

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Key Technical Staff

As a contributor to the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia’ I hereby state:-

1. My name is Onno Ewald Edwin ten Brinke, Associate Principal Consultant, Strategic Mine Planning) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am a Senior Mining Engineer, and I am listed as Member 990493 of the AusIMM
3. I have a Master of Science in Mining Engineering (University of Technology, Delft, NL), which included a Master of Engineering in Mining Engineering with Rock Mechanics (Royal School of Mines, London, UK)
4. 20 years’ experience in open pit and underground mines, of which 7 years at operating mines, 7 years as a consultant in the mining software industry, and 6 years as an independent consultant on strategic mine planning. The experience stretches to a large number of commodities (13) in a large number of projects (over 50), the majority of which in Africa. Particularly relevant for the Kagem project is feasibility work done on a rare earths’ project in Malawi, a rare earths’ project in Mozambique, and work done on various alluvial and kimberlite diamond mines in Southern Africa.
5. I am a key technical contributor to the CPR.
6. I have been responsible for generating a new strategic mine plan for the Kagem Mine, which included a reconciliation of produced tonnes, strategic scheduling on existing pit designs, and an update on the equipment requirements.
7. I have not personally been to site, but during my work I have closely worked with the SRK consultants who delivered the previous CPR and have been to site, as well as had direct contact with the engineers working on the site via e-mail and Skype.
8. As a key technical contributor to the CPR, I am responsible for Section 6 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. I declare that the sections of this report detailed in 8 above appropriately reflects the author’s view.
11. I am independent of Gemfields
12. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
13. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Mine in Zambia or Gemfields.

14. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

Onno Ewald Edwin ten Brinke
Associate Principal Consultant of SRK Consulting UK Ltd

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CERTIFICATE OF COMPETENT PERSON

This Certificate of Competent Person is given only as a guide to the CP. It is designed to incorporate all of the requirements of the Code.

As the author of the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia I hereby state:-

1. My name is Dr Lucy Roberts, MAusIMM (CP) and Principal Consultant (Resource Geology), SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. That I am a Chartered Professional Member of the Australasian Institute of Mining and Metallurgy. My membership number is 211381.
3. I hold a BSc(Hons) in Exploration Geology and MSc in Mineral Resources from Cardiff University, in the United Kingdom. I also a hold a PhD in Applied Geostatistics from James Cook University, Australia.
4. I have worked on various gemstone projects over the last 10 years, including various technical studies on the Kagem Emerald Mine in Zambia (Emeralds), previous involvement at Montepuez (rubies), geological modelling and review of various other gemstone projects in Mozambique, Zambia, and the former Soviet Union.
5. I am a ’Competent Person’ as defined in the SAMREC Code.
6. My main contribution to the competent persons report, was to act as the CP for the Mineral Resources, which included reviewing the geological modelling completed by my colleagues, and to write the relevant sections of the CPR. I also authored and tabulated the Mineral Resource Statements presented.
7. I undertook a site visit (site inspection) from 16-25 June 2015 at Kagem Emerald and Beryl Mine in Zambia. During the site visit, I visited the mining operations, various exploration sites, maintenance workshops, parts warehouse, waste dumping areas, stockpiles, old workings, mining camp, offices and the sorting house.
8. As a CP I am responsible for Sections 2, 3 and 4 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. I declare that this Report appropriately reflects the Competent Person’s view.
11. I am independent of Pallinghurst and its subsidiary, Gemfields.
12. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
13. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine, Pallinghurst or its subsidiary, Gemfields.

14. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

Lucy Roberts

Dr Lucy Roberts
SRK Consulting UK Ltd

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CERTIFICATE OF KEY TECHNICAL STAFF

As a contributor to the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia’ I hereby state:-

1. My name is James Haythornthwaite, Consultant (Geology) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am a Fellow of the Geological Society of London.
3. I hold a Master of Science Degree, MSc (Mining Geology) from Camborne School of Mines, University of Exeter and a Batchelor of Science Degree, BSc (Geology) from Durham University.
4. I have over 6 years of experience in resource geology in the mining sector. I specialise in 3D geological modelling, resource estimation and the interpretation of structurally complex mineral deposits. I have broad technical experience in multiple commodity types, including iron ore, base metals, precious metals and coloured gemstones, predominantly in Africa and Europe.
5. I am a key technical contributor to the CPR.
6. My main contribution to the competent persons report, under the guidance of the CP, was to construct the emerald-bearing reaction zone wireframes used to constrain the Kagem resource. I also contributed to the text in Sections 2, 3 and 4 of the report.
7. I visited the Kagem Project site in June 2015. During this site visit I reviewed the geology and drilling and sampling procedures employed.
8. As a key technical contributor to the CPR, I am responsible for subsections of Chapters 2, 3 and 4 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. I declare that the sections of this report detailed in 8 above appropriately reflects the author’s view.
11. I am independent of Pallinghurst Resources Ltd.
12. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
13. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine or Pallinghurst Resources Ltd.
14. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

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James Haythornthwaite
SRK Consulting UK Ltd

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Key Technical Staff

As a contributor to the report entitled 'A Competent Persons Report on the Kagem Emerald Mine, Zambia' I hereby state:-

1. My name is Neil Marshall, Corporate Consultant (Geotechnical Engineering) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am a Member of the Institute of Mining, Materials and Metallurgy.
3. I hold an MSc and BSc
4. I have worked as a geotechnical engineer with 20 years consulting and 15 years' operating experience in underground and open pit mines in Zambia and Ghana where he held various technical positions. He specialises in the geotechnical characterisation of rock masses, open pit slope design, underground mining method design and evaluation, underground support and excavation design and numerical modelling.
5. I am a key technical contributor to the CPR.
6. I have reviewed the geotechnical aspects for the Kagem mine as presented in this CPR.
7. I visited the site between 22 and 26 June 2016.
8. As a key technical contributor to the CPR , I am responsible for Section 5 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. I declare that the sections of this report detailed in 8 above appropriately reflects the author's view.
11. I am independent/not independent of Pallinghurst Resources Ltd.
12. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
13. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine or Pallinghurst Resources Ltd.
14. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

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Key Technical Staff

As a contributor to the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia’ I hereby state:-

1. My name is John Anthony Willis, Principal Consultant (Mineral Processing) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am a Member and Chartered Professional of the Australasian Institute of Mining and Metallurgy, member number 103635.
3. I hold a BE (Hons) in Metallurgy and a PhD in Minerals Process Engineering, both awarded by the University of Queensland in Australia, in 1985 and 1994 respectively.
4. I have worked as a mineral processing engineer for in excess of 30 years since my graduation from university, and have twice reviewed the Kagem emerald operation.
5. I am a key technical contributor to the CPR.
6. I have physically inspected the emerald recovery operation and Kagem and have summarised and provided review commentary on the operation for this report.
7. I visited the site between 22 and 26 June 2016.
8. As a key technical contributor to the CPR , I am responsible for Section 7 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. I declare that the sections of this report detailed in 8 above appropriately reflects the author’s view.
11. I am independent/not independent of Pallinghurst Resources Ltd.
12. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
13. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine or Pallinghurst Resources Ltd.
14. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

John Willis
SRK Consulting UK Ltd

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CERTIFICATE OF KEY TECHNICAL STAFF

As a contributor to the report entitled ‘A Competent Persons Report on the Kagem Emerald Mine, Zambia’ I hereby state:-

1. My name is John Merry, Principal Consultant (Environment and Social) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am an Associate Member of the Institute for Environmental Management and Assessment.
3. I hold a MPhil & BSc .
4. I am a Principal Consultant with over 20 years of experience in social and environmental management in the mining sector. I have worked on projects covering a number of different commodities including, iron ore, gold, copper, diamonds and coal. My areas of expertise include; project management; project design; health, safety and environment; community development strategies, stakeholder engagement and government interface. I have also managed a number of EIA processes for various commodities.
5. I am a key technical contributor to the CPR.
6. I have undertaken a desktop review of the environmental and social performance of the Kagem operations in Zambia against recognised international standards. These include the IFC performance standards as well as the ICMM 10 Principles. Reference was also made to the SAMESG Guideline as part of the scope for the review and site visit.
7. As a key technical contributor to the CPR, I am responsible for Section 9 of this report.
8. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
9. I declare that the sections of this report detailed in 8 above appropriately reflects the author’s view.
10. I am independent of Pallinghurst Resources Ltd.
11. I have read the SAMREC Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMREC Code.
12. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine or Pallinghurst Resources Ltd.
13. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017

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CERTIFICATE OF COMPETENT VALUATOR

As an author of the report entitled 'A Competent Persons Report on the Kagem Emerald Mine, Zambia' I hereby state:-

1. My name is Keith Joslin, Independent Consultant (Mining) of SRK Consulting UK Ltd, Level 5 Churchill House, 17 Churchill Way, Cardiff, CF10 2HH Wales, United Kingdom.
2. I am a Member of the Southern African Institute of Mining and Metallurgy, MSAIMM; Associateship of the Camborne School of Mines, ACSM.
3. I have over 30 years' experience in the mining industry. Keith has worked as a mining consultant since 2010 and have been a Project Manager on due diligence reviews, undertook economic assessments and valuations on a number of due diligence and technical Projects and acted as a competent person signing off Ore Reserves for underground platinum projects. I spent over 20 years in South Africa on platinum, gold and diamond operations in both operational and corporate roles. At Anglo Platinum I was involved in the evaluation and valuation of the company's portfolio of business units through to new projects and also involved in due diligence reviews of major capital projects and annual reviews of current. I have also been an analyst on the Johannesburg Stock Exchange and spent time in Management Consulting to the mining industry.
4. I am a 'Competent Valuator' as defined in the SAMVAL Code.
5. As the CV I have been responsible for the preparing an update of the financial model for inclusion in this CPR .
6. I have not visited site but the site was visited by a cross-section of technical experts upon whom I have placed reliance for input on operating and capital costs and productivity assumptions.
7. This CPR has been prepared based on a technical and economic review by a team of consultants sourced from the SRK Group's offices in the United Kingdom. I have placed reliance in preparing this valuation on the SRK team as a whole but specifically Mr. Mike Beare, lead CP, Dr. Lucy Roberts (CP Resources and site visit) and Mr. Onno ten Brinke (Mining). I am satisfied with the technical information provided by this team.
8. As a CV, I am responsible for Section 12 of this report.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Report, the omission of which would make the Report misleading.
10. This analysis and conclusions are limited only by the forecasts of production, commodity prices, future sales, operating and capital costs
11. I declare that this Report appropriately reflects the Competent Valuator's view.
12. I am independent of both Gemfields and Pallinghurst.
13. I declare that my compensation, employment, or contractual relationship with the Commissioning Entity is not contingent on any aspect of the CPR.
14. I have read the SAMVAL Code (2016) and the Report has been prepared in accordance with the guidelines of the SAMVAL Code.

15. I do not have, nor do I expect to receive, a direct or indirect interest in the Kagem Emerald Mine.
16. At the effective date of the Report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated at Cardiff, December 2017.

Keith Joslin
SRK Consulting UK Ltd

APPENDIX

D GLOSSARY OF TERMS, ABBREVIATIONS AND UNITS

Kagem CPR Glossary

Term	Definition
Assay	The chemical analysis of mineral samples to determine the metal content.
Be-bearing fluids	Fluids rich in beryllium, thought to be associated with the formation of beryl and emerald mineralisation
Capital Expenditure	All other expenditures not classified as operating costs.
Composite	Combining more than one sample result to give an average result over a larger distance.
Concentrate	A metal-rich product resulting from a mineral enrichment process such as gravity concentration or flotation, in which most of the desired mineral has been separated from the waste material in the ore.
Cr-rich mafic	Mafic rocks with a high chromium content, thought to be associated with the formation of beryl and emerald mineralisation
Cut-off Grade (CoG)	The grade of mineralized rock, which determines as to whether or not it is economic to recover its gold content by further concentration.
Dilution	Waste, which is unavoidably mined with ore.
Dip	Angle of inclination of a geological feature/rock from the horizontal.
Discordant and concordant RZ material	Reaction zone material (emerald and beryl bearing) which is either cross-cutting (discordant) or lying along (concordant) the bedding or foliation of the host country rock
Fault	The surface of a fracture along which movement has occurred.
Footwall	The underlying side of an orebody or stope.
Gangue	Non-valuable components of the ore.
Grade	The measure of concentration of gold within mineralized rock.
Hangingwall	The overlying side of an orebody or slope.
Igneous	Primary crystalline rock formed by the solidification of magma.
Lithological	Geological description pertaining to different rock types.
Mineral/Mining Lease	A lease area for which mineral rights are held.
Mining Assets	The Material Properties and Significant Exploration Properties.
Ongoing Capital	Capital estimates of a routine nature, which is necessary for sustaining operations.
Pillar	Rock left behind to help support the excavations in an underground mine.
Sedimentary	Pertaining to rocks formed by the accumulation of sediments, formed by the erosion of other rocks.
Shaft	An opening cut downwards from the surface for transporting personnel, equipment, supplies, ore and waste.
Sill	A thin, tabular, horizontal to sub-horizontal body of igneous rock formed by the injection of magma into planar zones of weakness.
Stope	Underground void created by mining.
Stratigraphy	The study of stratified rocks in terms of time and space.
Strike	Direction of line formed by the intersection of strata surfaces with the horizontal plane, always perpendicular to the dip direction.
Tailings	Finely ground waste rock from which valuable minerals or metals have been extracted.
Thickening	The process of concentrating solid particles in suspension.
Total Expenditure	All expenditures including those of an operating and capital nature.

Kagem CPR Abbreviations

Abbreviation	Unit or Term
º	Degree/s
ºC	Degrees Celsius
~	Approximately/circa
>	Greater than
<	Less than
%	percent
µm	micron/s
AMP	amphibolite
ADP	ADP Projects (PTY) LTD, Cape Town, South Africa
BGS	British Geological Survey
CAPEX	Capital Expenditure; all other expenditures not classified as operating costs
cm	centimetre
cm^2	square centimetre
cm^3	cubic centimetre
CoG	cut-off grade
CP	Competent Person
CPI	Consumer Price Index
CPR	Competent Persons Report
CSR	corporate social responsibility
ct	carat
ct/t	Carat per tonne
CV	Competent Valuator
dia	diameter
DMS	Dense media separation
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortisation
EDM	Electricidade de Moçambique
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPB	environmental project briefs
EPF	Environmental Protection Fund
Equator	Equator Drilling
Fe	Iron
FEL	Front End Loader
FoS	factor of safety
g	gram
g/L	gram per litre
g/t	grams per tonne
GB	Gravel Bed
Gemfields	Gemfields Plc
GIIP	good international industry practice
GoZ	Government of Zambia
GPR	ground penetrating radar
ha	hectares
HLS	Heavy Liquid Separation
IMMT	Council of Scientific and Industrial Research, Institute of Minerals and Materials Technology, India
IRR	Internal Rate of Return
JORC Code	The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves
JSE	Johannesburg Stock Exchange
k	thousand (kilo)
kg	kilograms
km	kilometre
km^2	square kilometre

Abbreviation	Unit or Term
kt	thousand tonnes
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
kWh/t	kilowatt-hour per metric tonne
ktpa	kilo tonnes per annum
LoM	Life of mine
LoMP	Life of mine plan
M	Million (mega)
m	metre
m^2	square metre
m^3	cubic metre
Ma	Million years
masl	metres above sea level
MDS	Mineral Density Separation
mg/L	milligrams/litre
mm	millimetre
mm^2	square millimetre
mm^3	cubic millimetre
Moz	million troy ounces
mRL	Relative Level (m)
MRM	Montepuez Ruby Mine
MSD	Mineral Safety Department
Mt	million tonnes
Mtpa	million tonnes per annum
MTADR	Ministry of Lands, Environment and Rural Development
NGU	Norges Geolgiske Undersakelse
NorConsult	NorConsult AS an Eteng
NPV	Net Present Value
NRERA	Ndola Rural Emerald Restricted Area
OEM	Original Equipment Manufacturers
OPEX	Operating
Pallinghurst	Pallinghurst Resources Ltd
PEG	pegmatite
QA/QC	Quality Assurance/Quality Control
QMS	quartz mica schist
RAP	Resettlement Action Plan
RC	rotary circulation drilling
RoM	run of mine
ROM	Run of mine
RZ	reaction zone
SAMREC Code	The South African Code For The Reporting Of Exploration Results, Mineral Resources And Mineral Reserves
SAMVAL Code	The South African Code For The Reporting Of Mineral Asset Valuation
SAMESG	The South African Guideline For The Reporting Of Environmental, Social And Governance Parameters Within The Solid Minerals And Oil And Gas Industries
SAR	Socio-economic Assessment Report
sec	second
SG	specific gravity
SHEQ	Safety, Health, Environmental and Quality
SPT	standard penetration testing
SRK	SRK Consulting (UK) Ltd
SRK Group	SRK Global Limited
SRTM	Shuttle Radar Topography Mission
t	tonne (metric ton)
t_{dry}	Tonne (metric ton) undiluted by moisture
TEM	Technical Economic Model
Terravision	Terravision Radar

Abbreviation	Unit or Term
TMI	total magnetic intensity
tpa	tonnes per year
tpd	tonnes per day
tph	tonnes per hour
TMS	talc-magnetite schists
TPH	total petroleum hydrocarbons
TSF	tailings storage facility
TSP	total suspended particulates
USD	United States dollar
UV	Ultra violet
V	volts
VFD	variable frequency drive
W	Watt
WLT	World Land Trust
XRD	x-ray diffraction
XRF	X-ray fluorescence
y	Year
ZEMA	Zambia Environmental Management Agency

APPENDIX

E GEOTECHNICAL LOGS

Project: U6512 2015 Kagem CPR

Client: Gemfield Plc

Key for Geotechnical Logs

Lithology

■ AMPH : Amphibolite
■ BPS
□ DUMP
■ FMS : Felsic Mica Schist
■ LAT : Laterite
■ MS : Mica Schist
■ PEG : Pegmatite
■ QF : Quartz Felsic
■ QT : Quartz Tourmaline
■ QV : Quartz Vein
■ RZ : Reaction Zone
■ SOIL
■ TMS : Talc Mica Schist

Weathering

■ CW : Completely Weathered
■ FR : Fresh
■ HW : Highly Weathered
■ MW : Moderately Weathered
■ SW : Slightly Weathered

GSI Codes

■ BLKY : Blocky
■ DISINT : Disintegrated
■ MASS : Massive
■ SOIL
■ VBLKY : Very Blocky

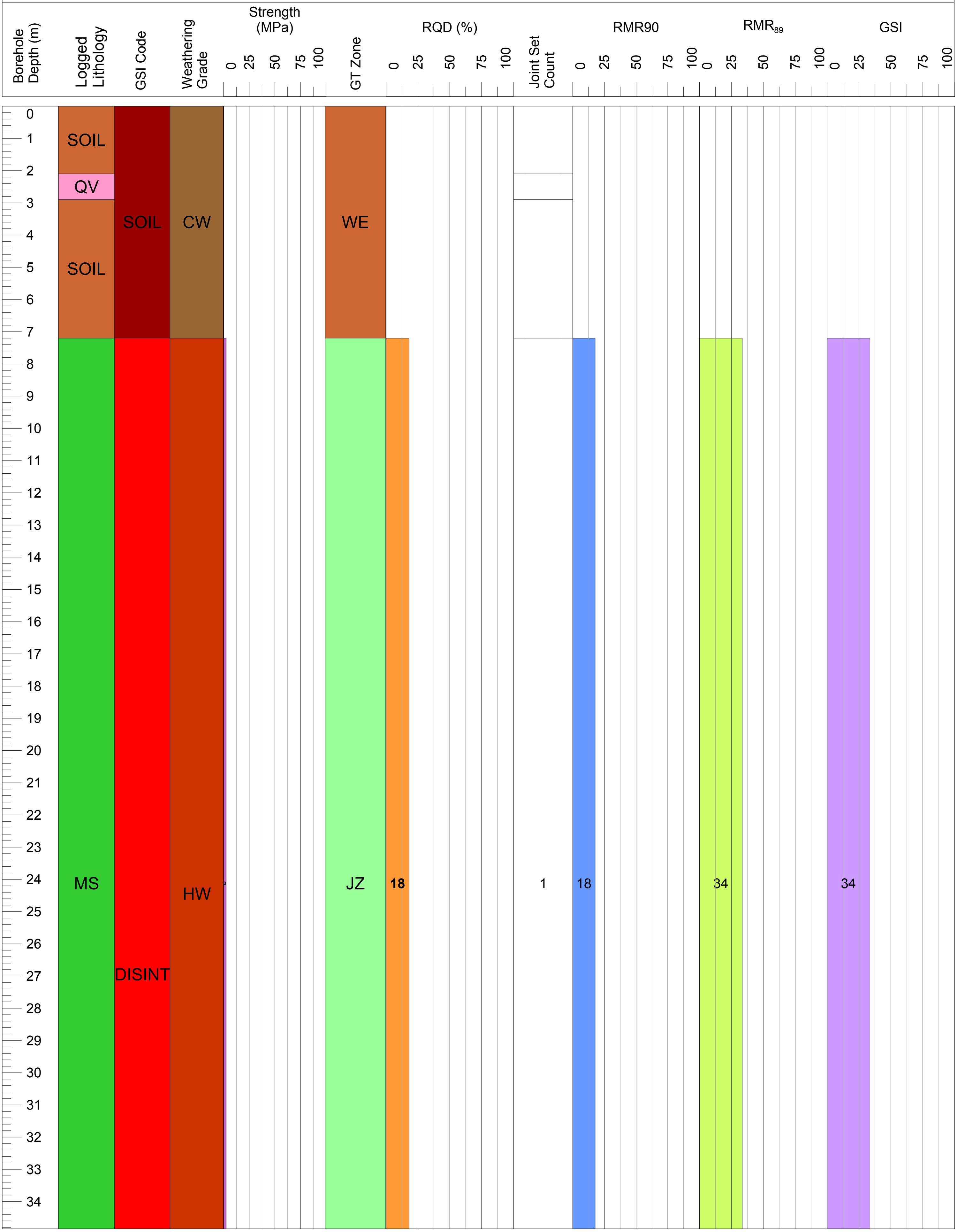
GT Zone

□ 0
■ AR : Artificial
■ FZ : Fault Zone
■ IZ : Intrusion
■ JZ : Jointed Zone
■ WE : Weathered Zone
■ WZ : Water Zone

KD101 Geotechnical Log

srk consulting

Project: U6512
Client: 2015 Kagem CPR
Easting (m): 623767 Northing (m): 8552300 Elevation (m): 1182 Maximum BH Depth (m): 200.7
Source:
Page 1 of 6



KD101 Geotechnical Log

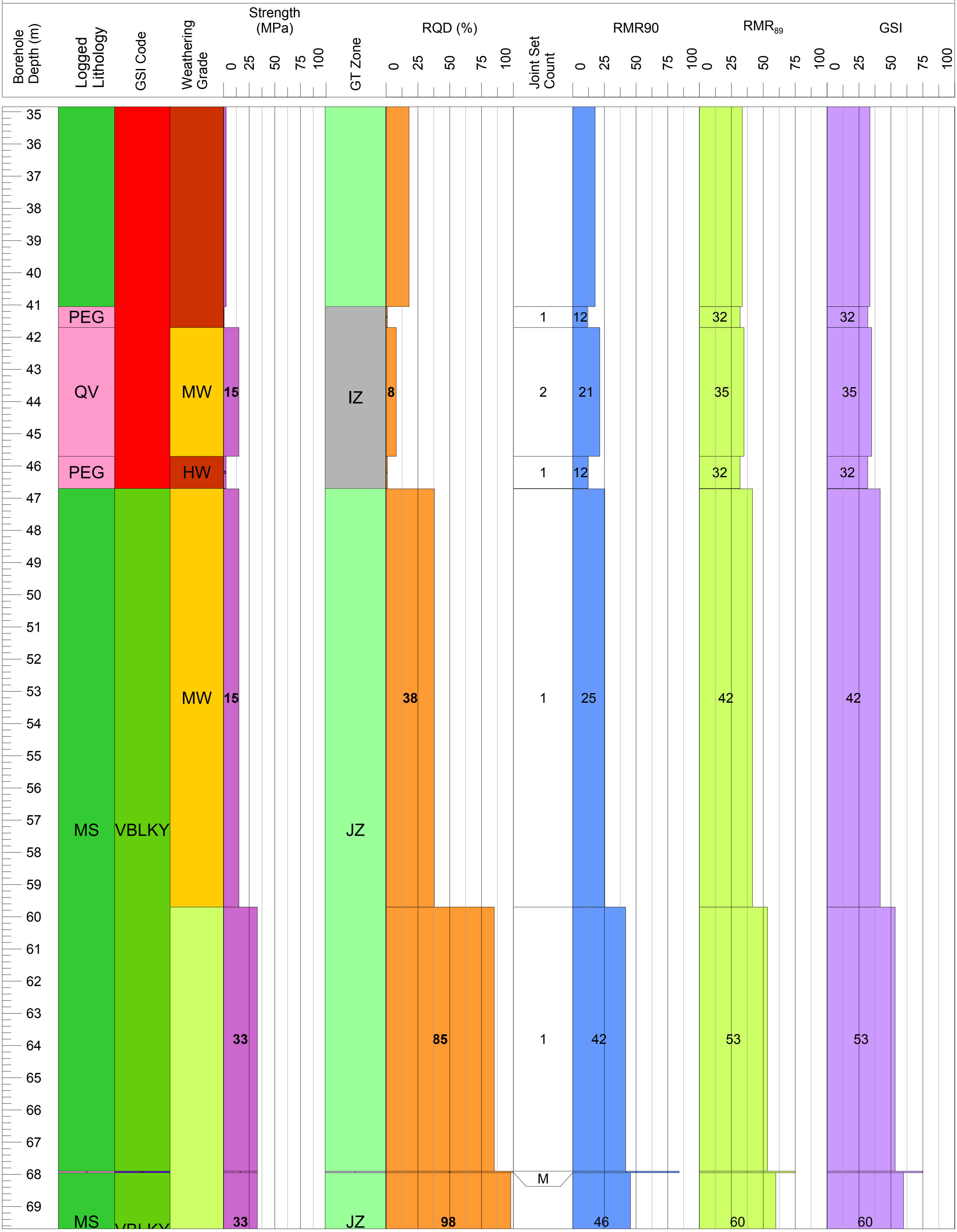
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623767 Northing (m): 8552300 Elevation (m): 1182

Maximum BH Depth (m): 200.7

Source:



KD101 Geotechnical Log

srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623767 Northing (m): 8552300 Elevation (m): 1182 Maximum BH Depth (m): 200.7

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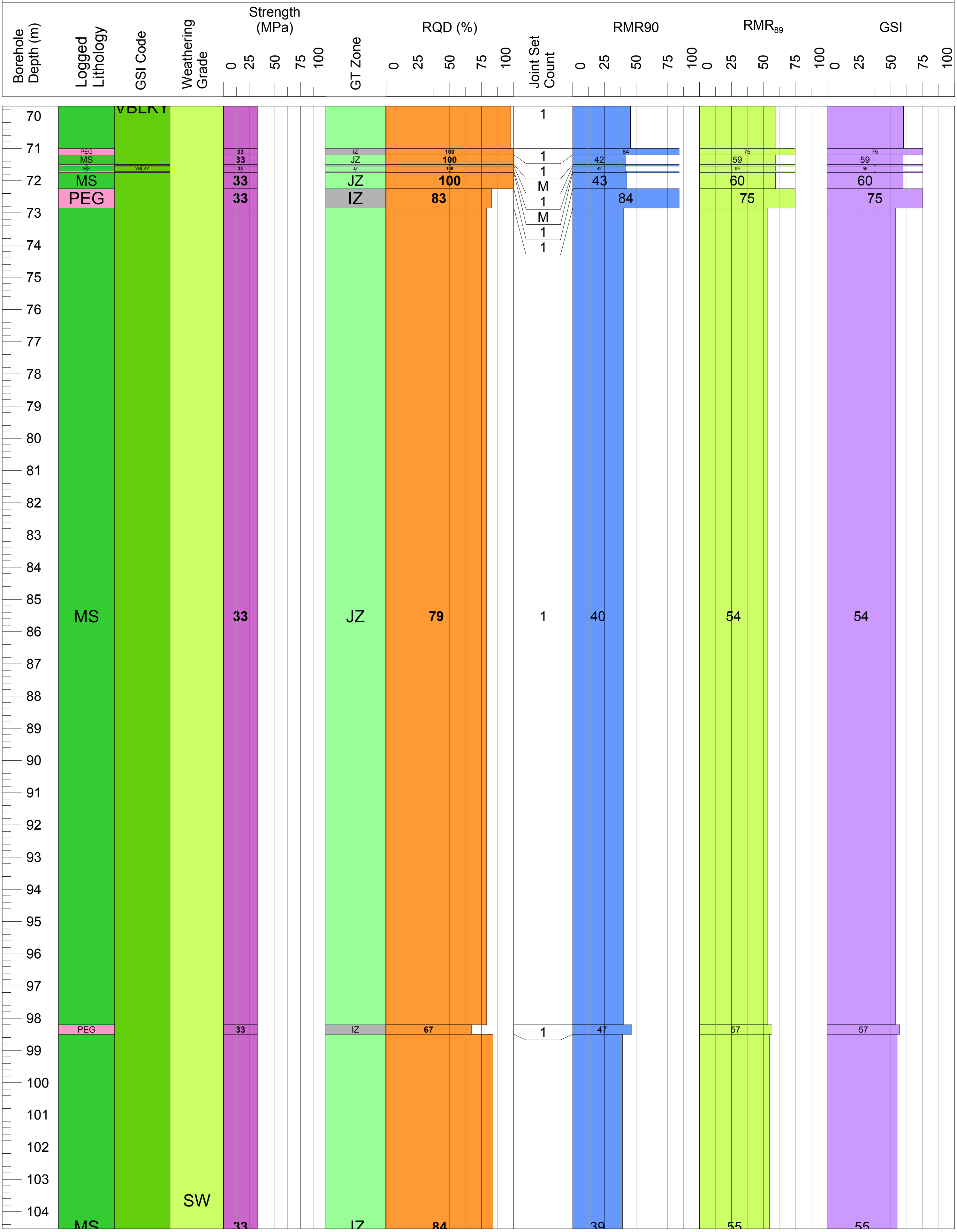

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Easting (m): 623767   Northing (m): 8552300   Elevation (m): 1182

Maximum BH Depth (m): 200.7

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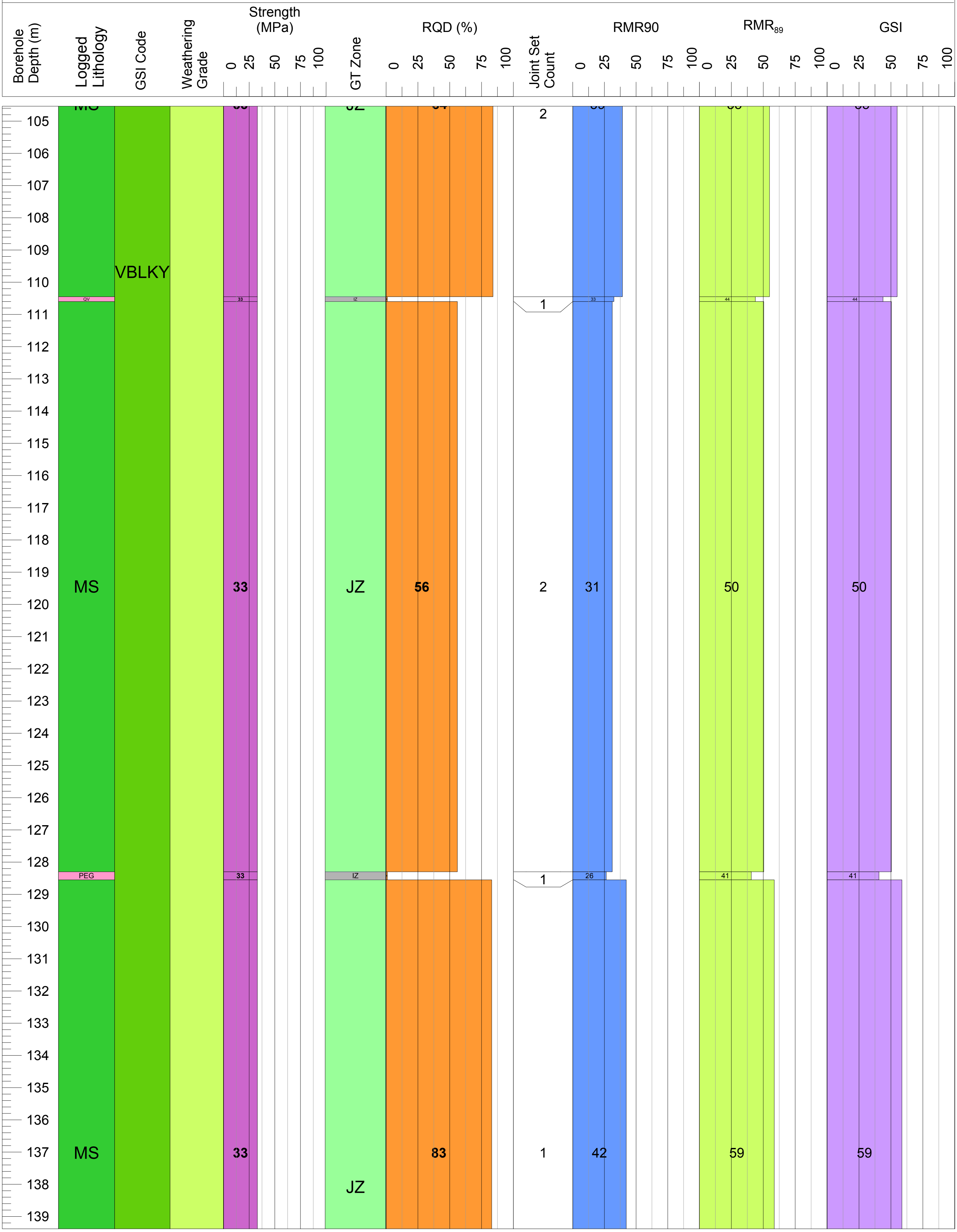

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Client: 2015 Kagem CPR

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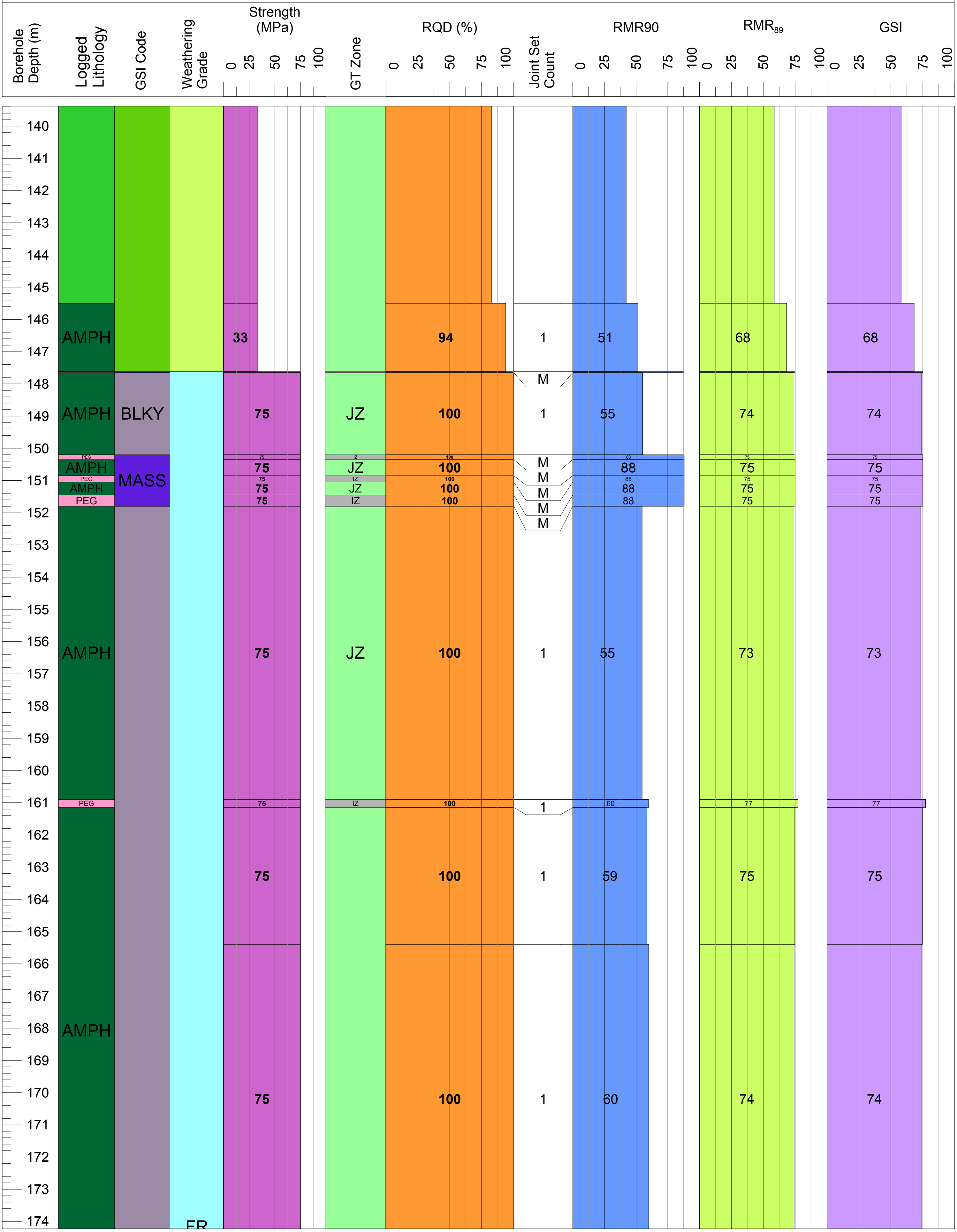


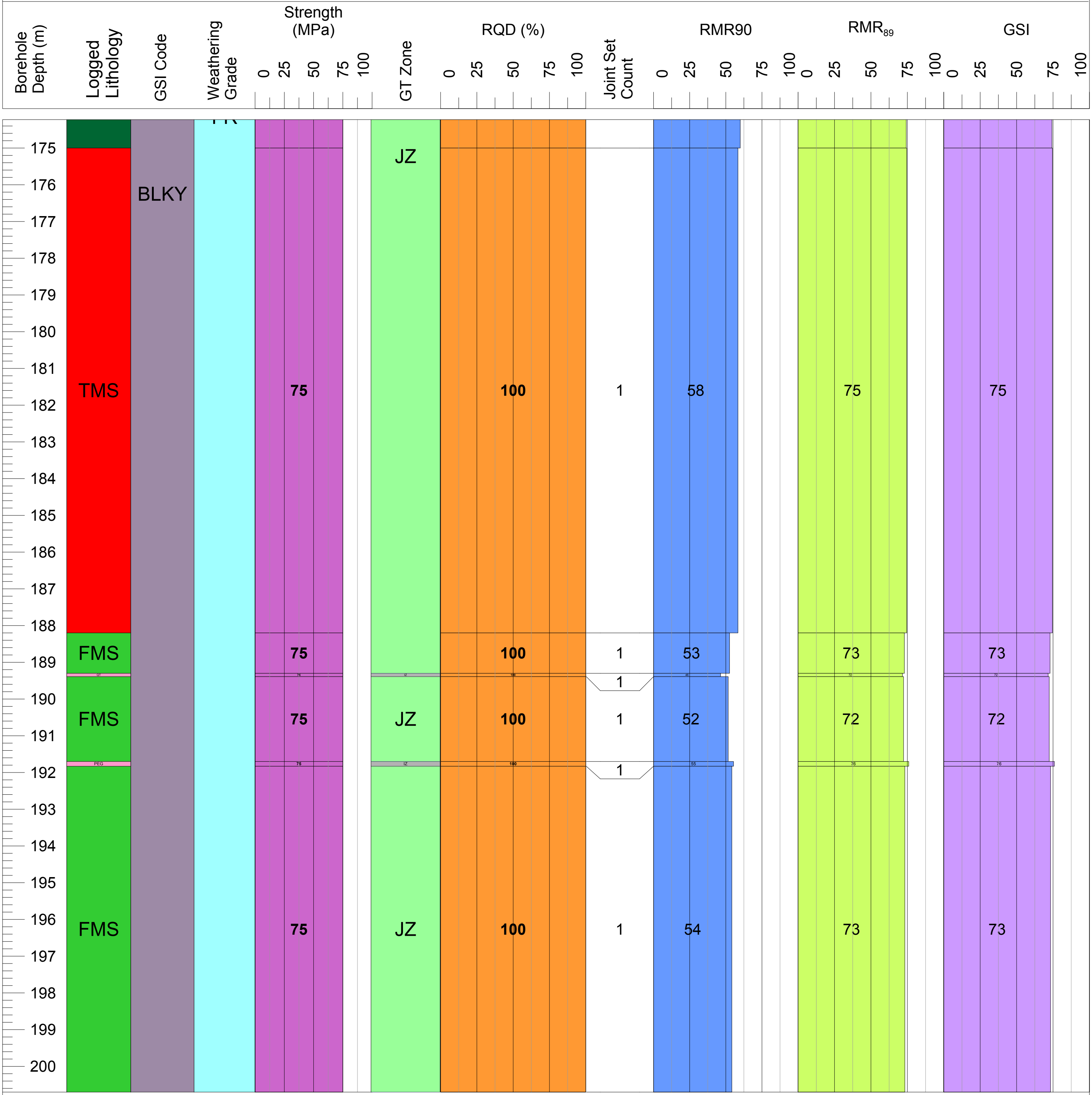
KD101 **Geotechnical Log** srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623767 Northing (m): 8552300 Elevation (m): 1182 Maximum BH Depth (m): 200.7

Source:



KD73 *Geotechnical Log*

srk consulting

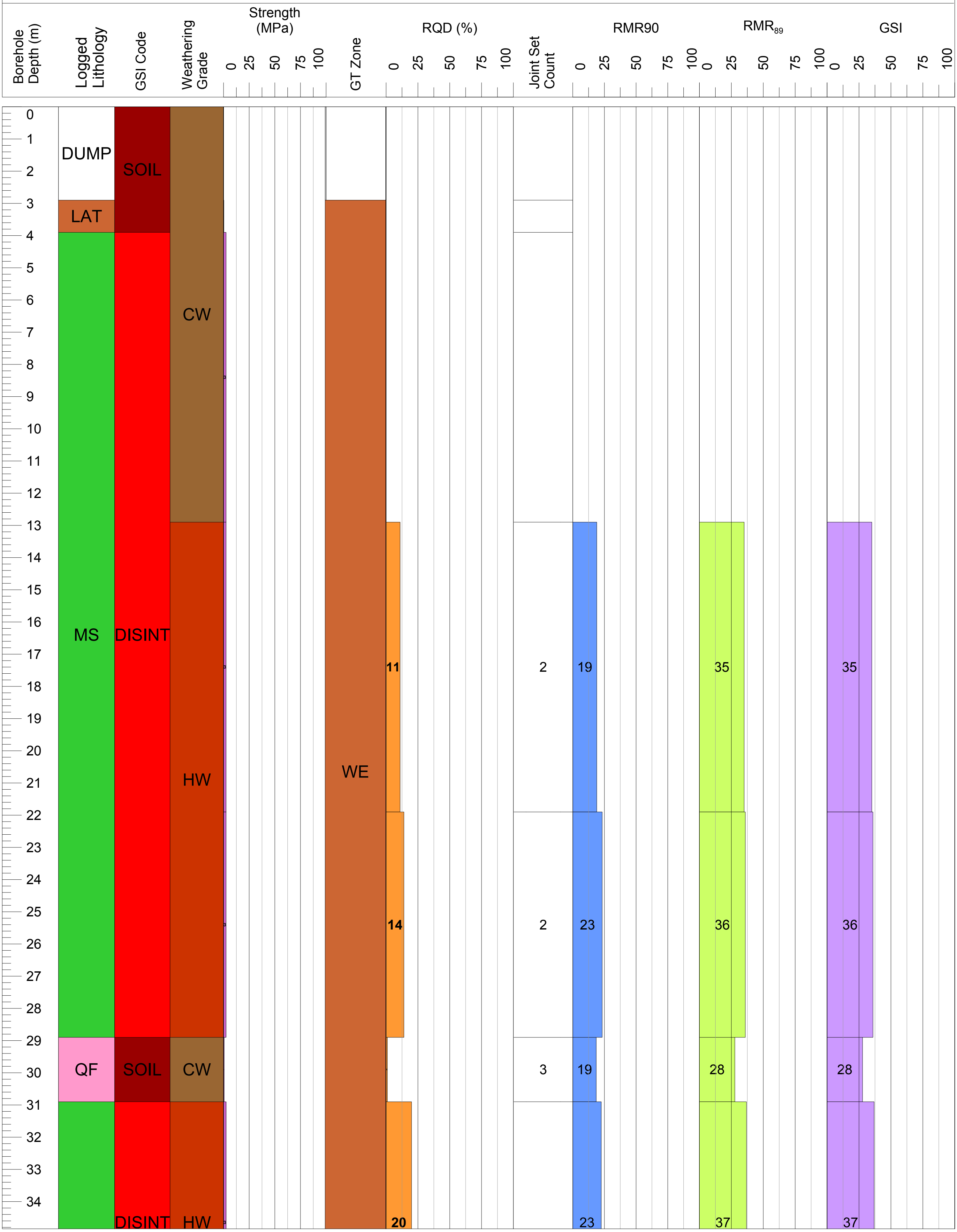
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623476 Northing (m): 8552329 Elevation (m): 1183

Maximum BH Depth (m): 131.4

Source:



KD73 **Geotechnical Log**

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623476

Northing (m): 8552329

Elevation (m): 1183

Maximum BH Depth (m): 131.4

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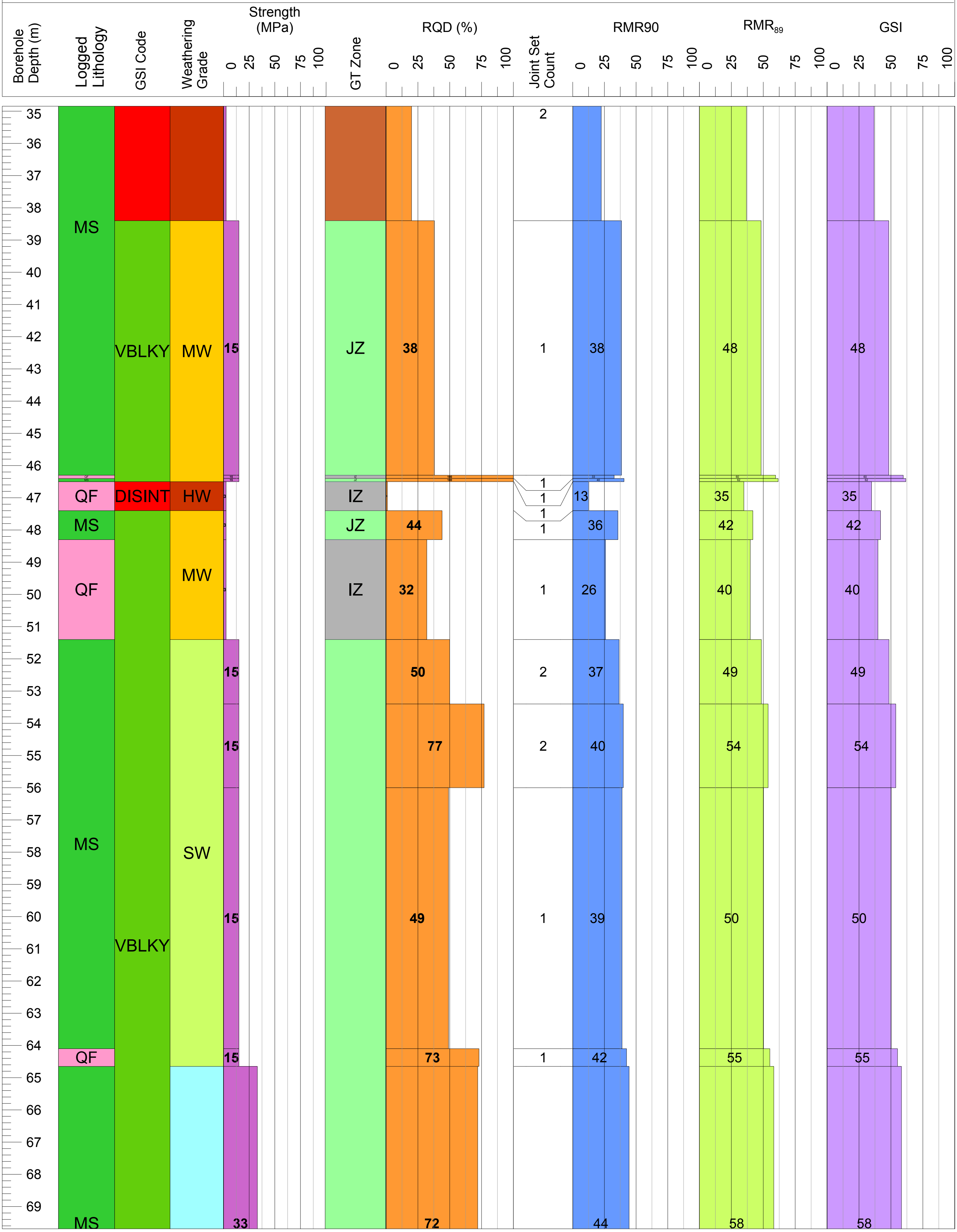

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623476 Northing (m): 8552329 Elevation (m): 1183

Maximum BH Depth (m): 131.4

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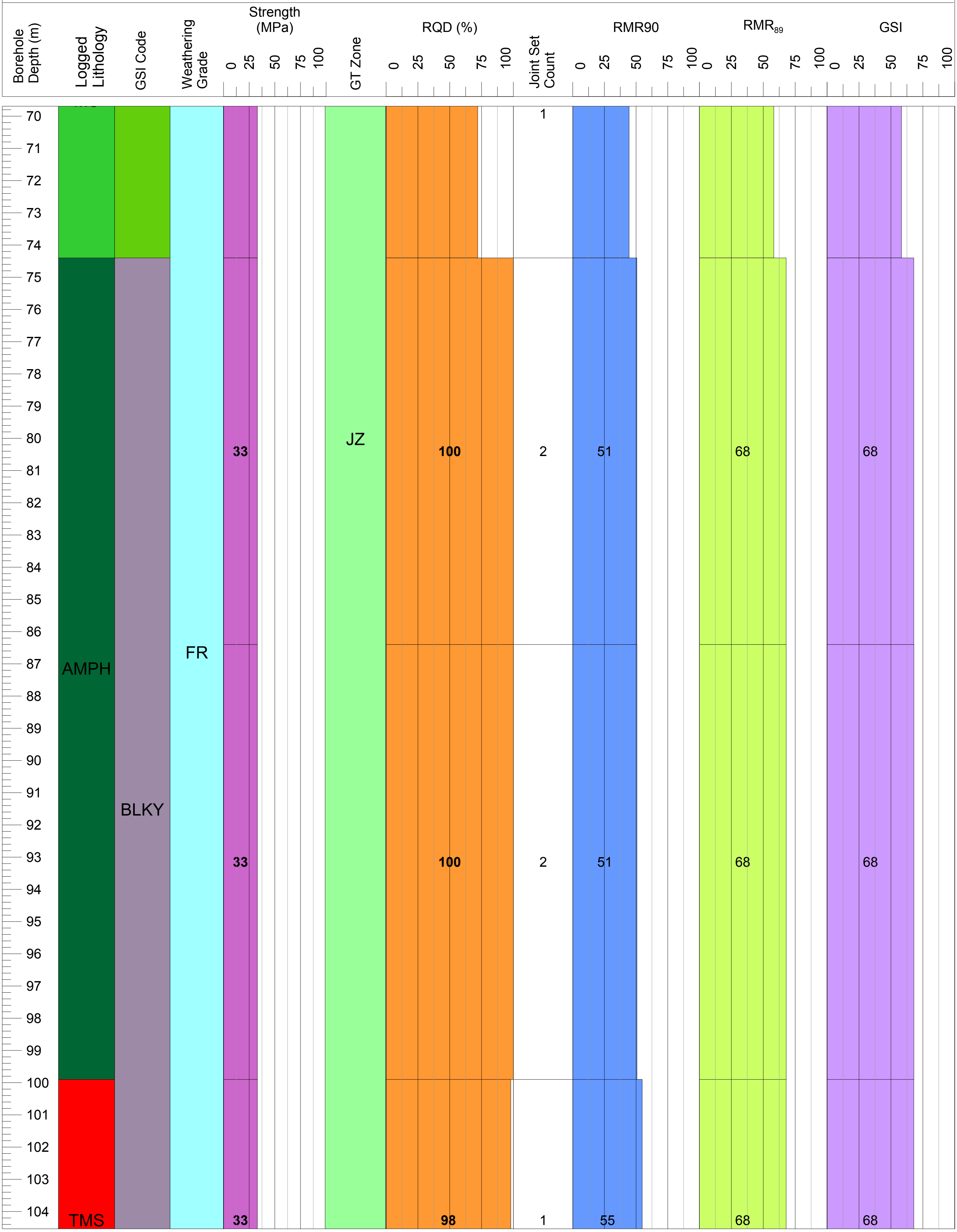


KD73 *Geotechnical Log*

srk consulting

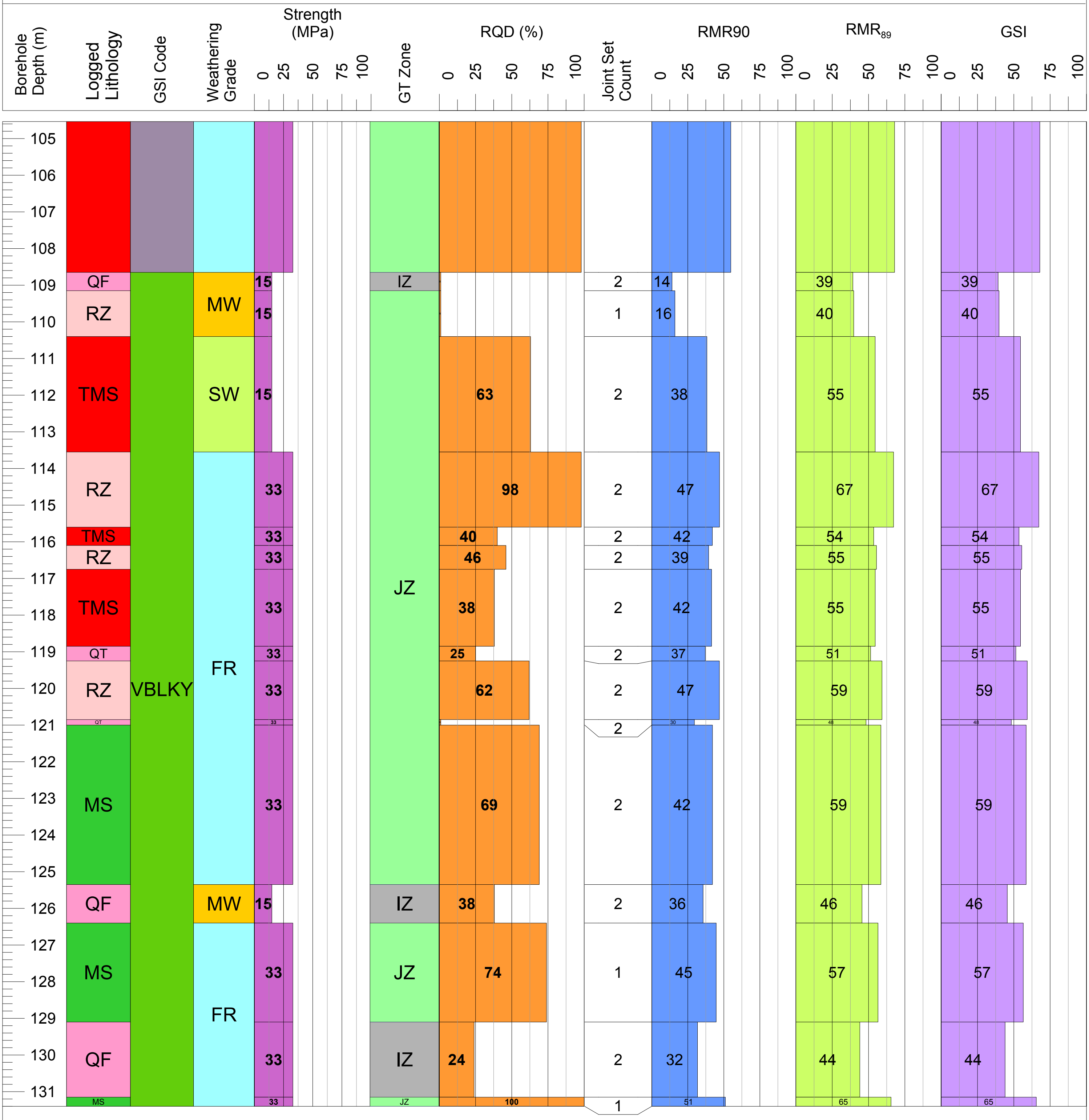
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623476 Northing (m): 8552329 Elevation (m): 1183

Maximum BH Depth (m): 131.4

Source:



KD74 *Geotechnical Log*

srk consulting

Project: U6512

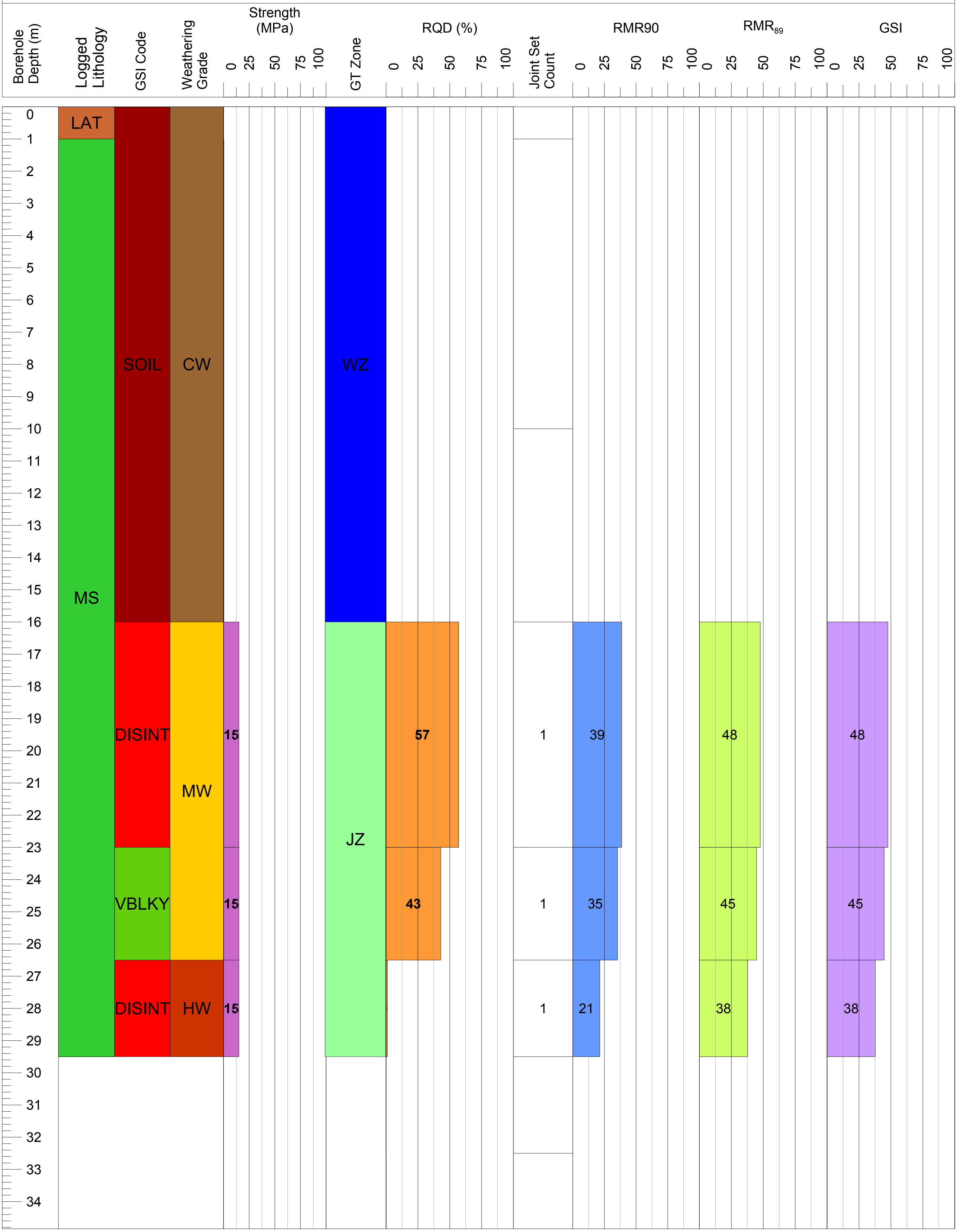
Client: 2015 Kagem CPR

Easting (m): 623916 Northing (m): 8552460 Elevation (m): 1188

Maximum BH Depth (m): 191.5

Source:

Page 1 of 6



KD74 Geotechnical Log

srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623916 Northing (m): 8552460 Elevation (m): 1188

Maximum BH Depth (m): 191.5

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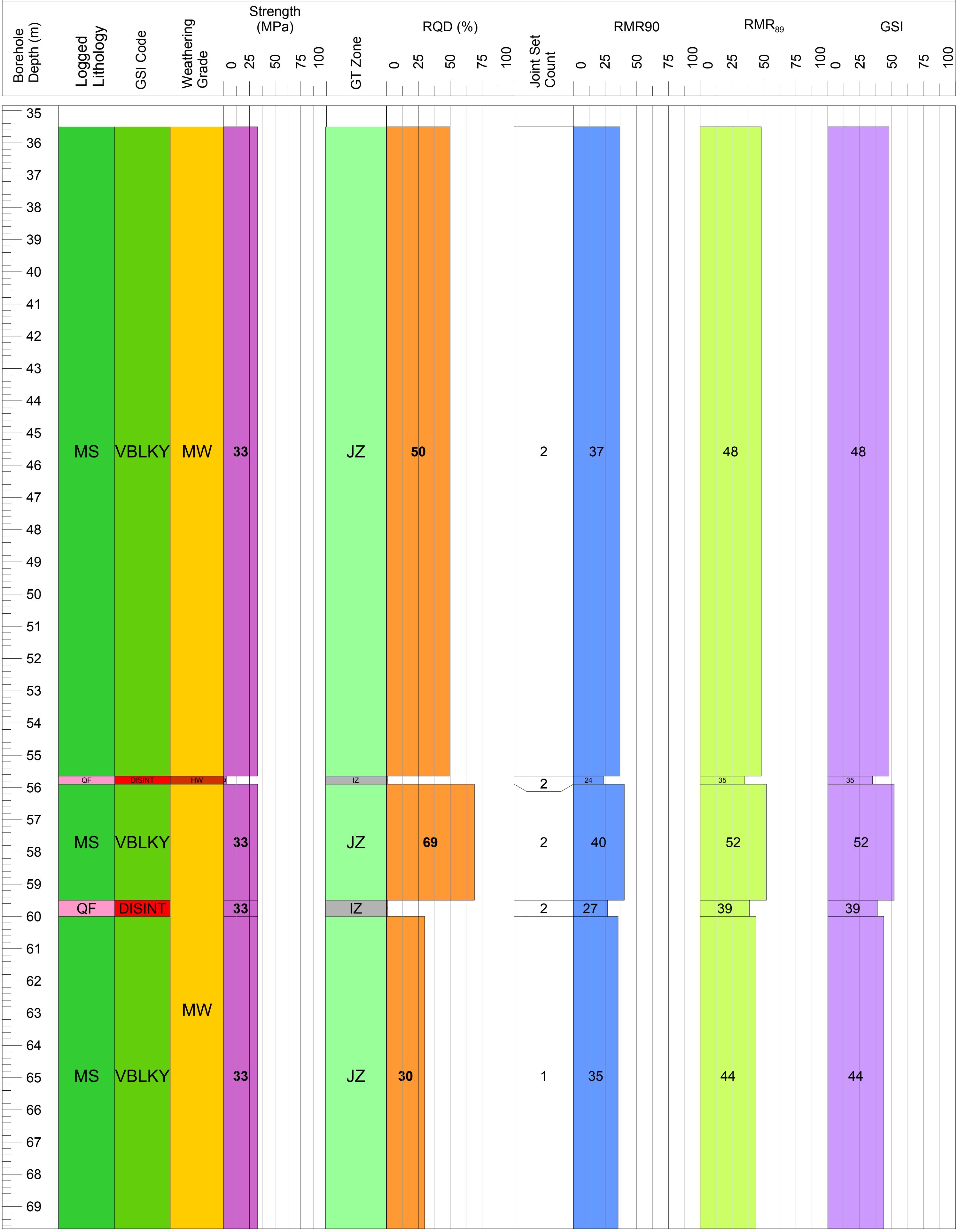

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623916 Northing (m): 8552460 Elevation (m): 1188 Maximum BH Depth (m): 191.5

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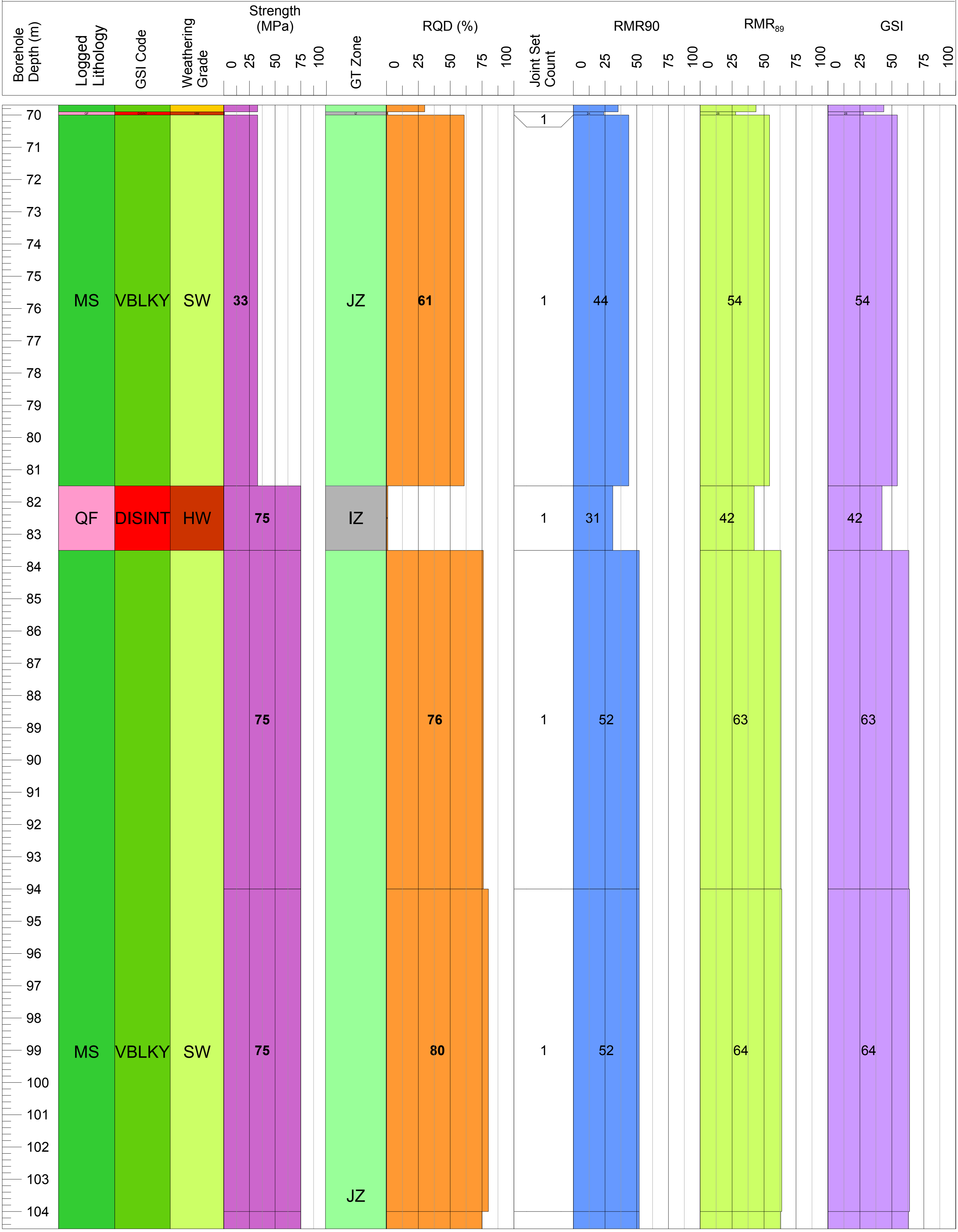

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Client: 2015 Kagem CPR

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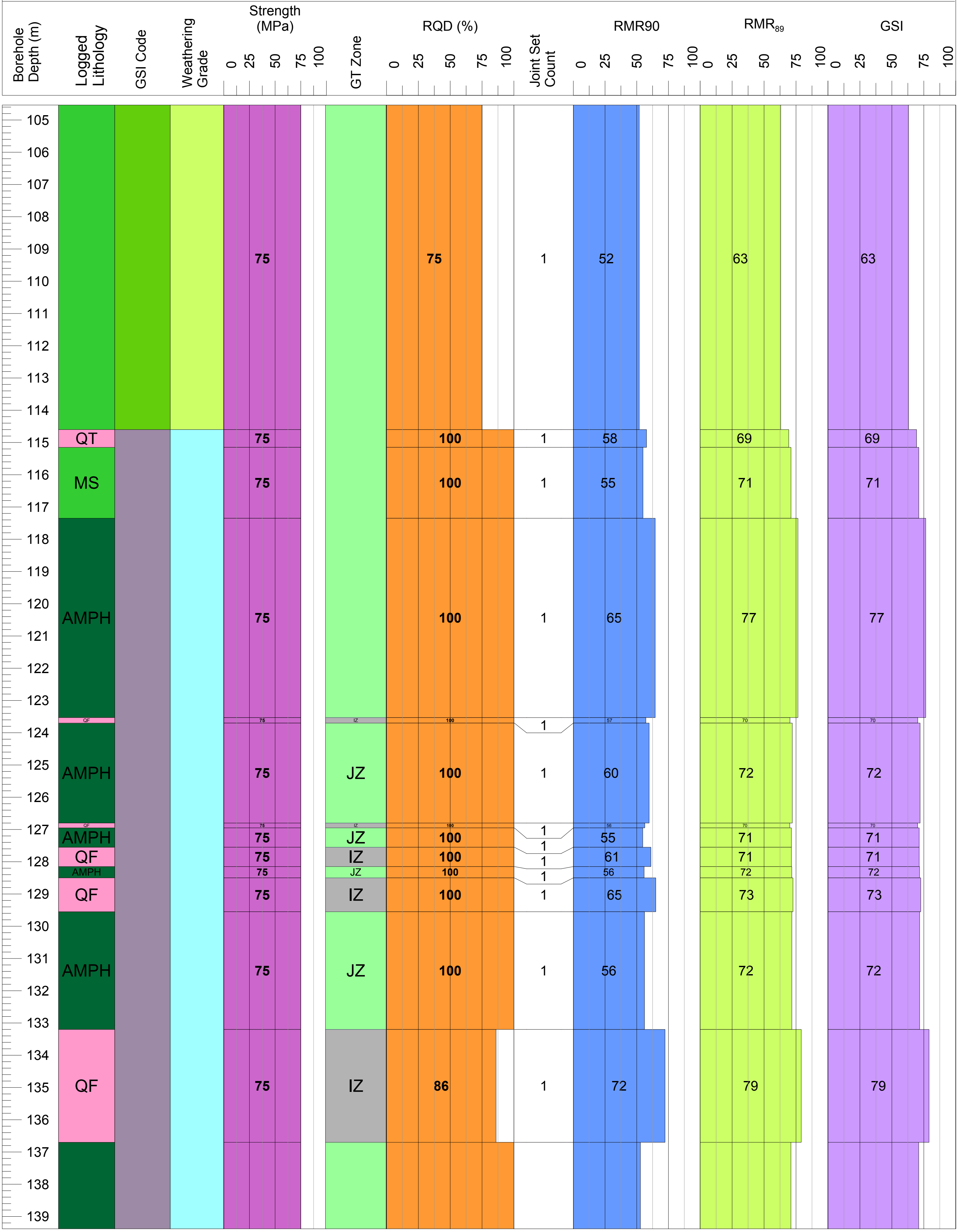

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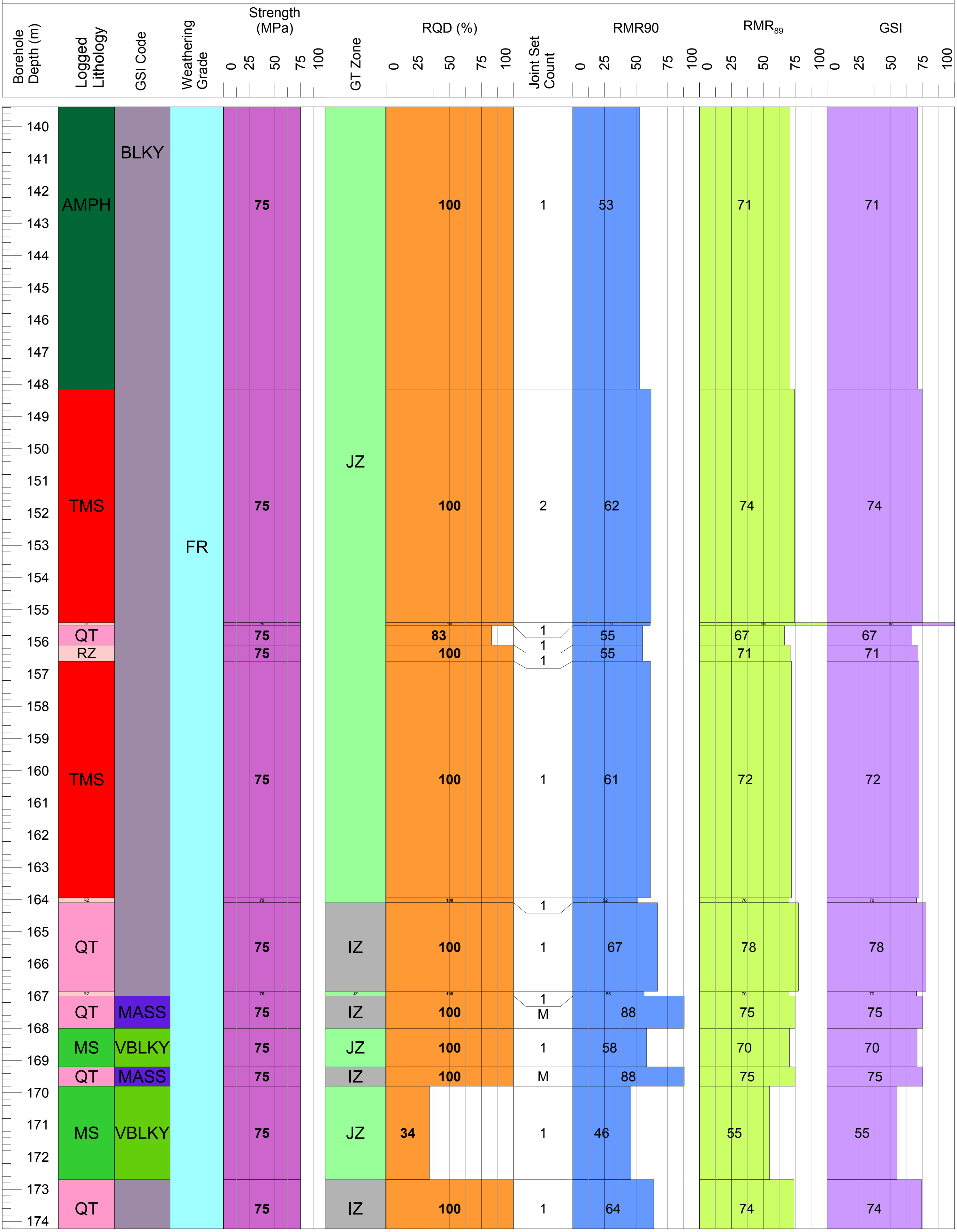
QT	75		100	1	58	69	69
MS	75		100	1	55	71	71
AMPH	75		100	1	65	77	77
QF	75	IZ	100	1	57	70	70
AMPH	75	JZ	100	1	60	72	72
QF	75	IZ	100	1	56	70	70
AMPH	75	JZ	100	1	55	71	71
QF	75	IZ	100	1	61	71	71
AMPH	75	JZ	100	1	56	72	72
QF	75	IZ	100	1	65	73	73
AMPH	75	JZ	100	1	56	72	72
QF	75	IZ	86	1	72	79	79

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623916 Northing (m): 8552460 Elevation (m): 1188 Maximum BH Depth (m): 191.5

Source:



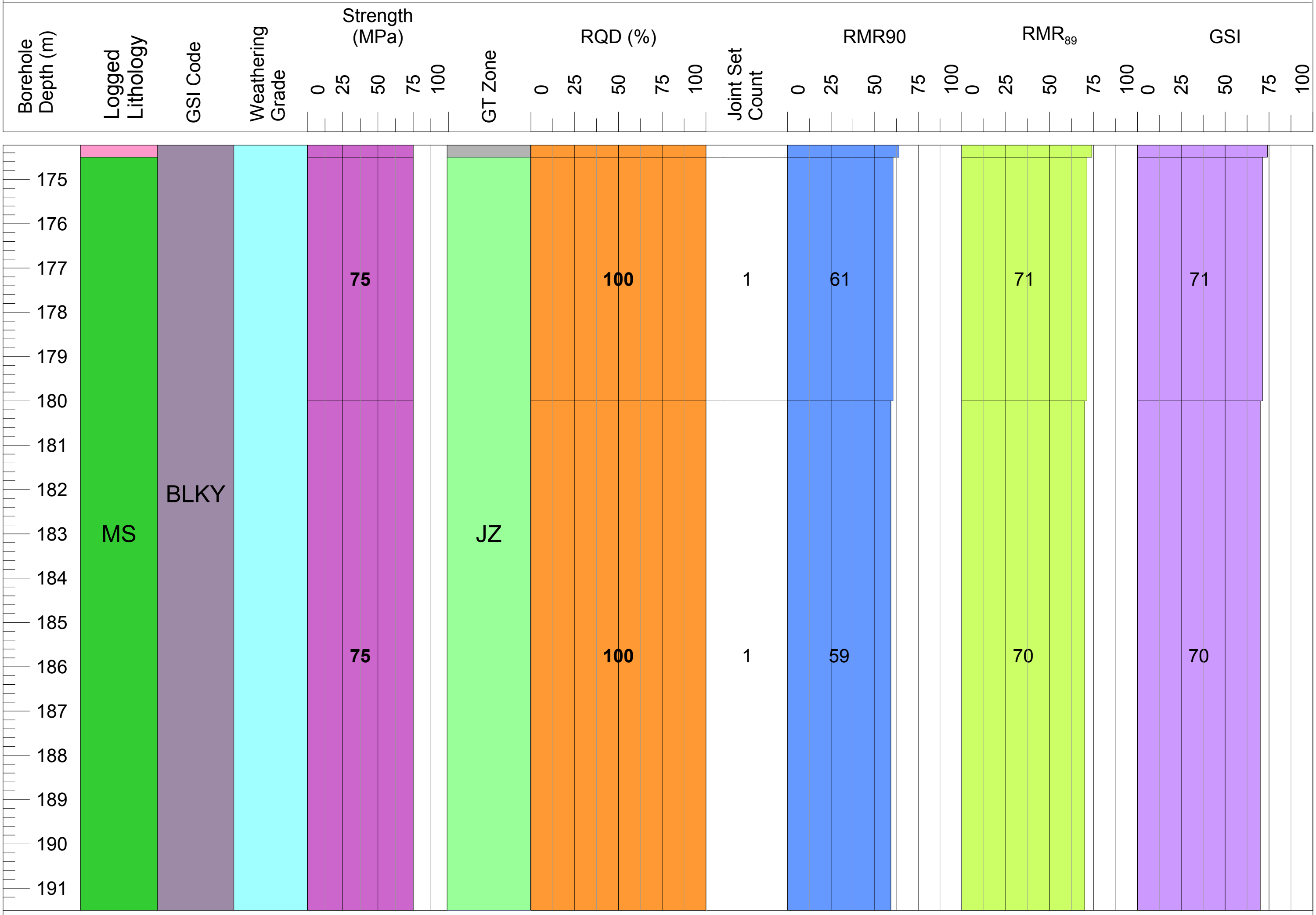
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623916 Northing (m): 8552460 Elevation (m): 1188

Maximum BH Depth (m): 191.5

Source:



KD77 **Geotechnical Log**

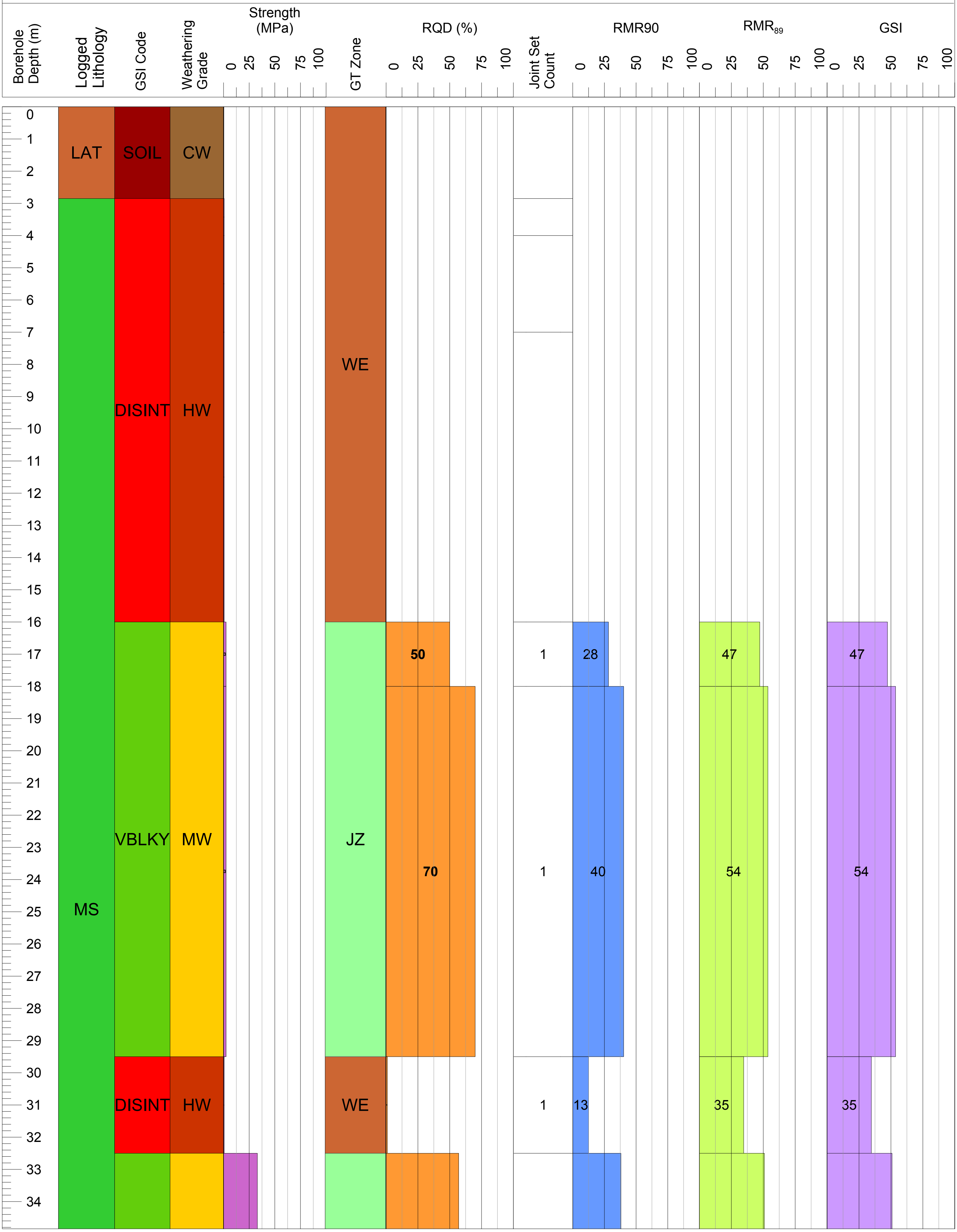
srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623936 Northing (m): 8553190 Elevation (m): 1208 Maximum BH Depth (m): 134.5

Source:



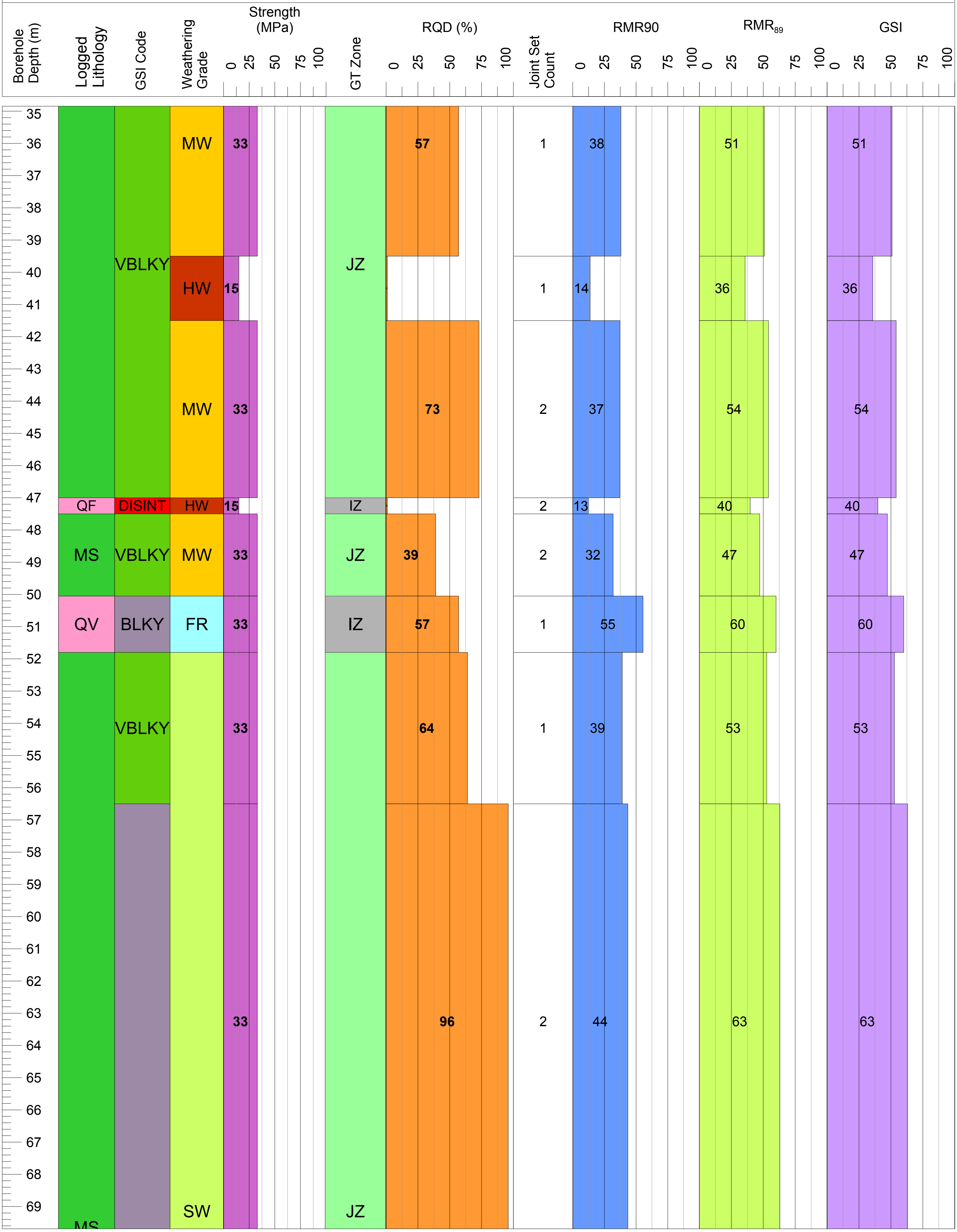
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623936 Northing (m): 8553190 Elevation (m): 1208

Maximum BH Depth (m): 134.5

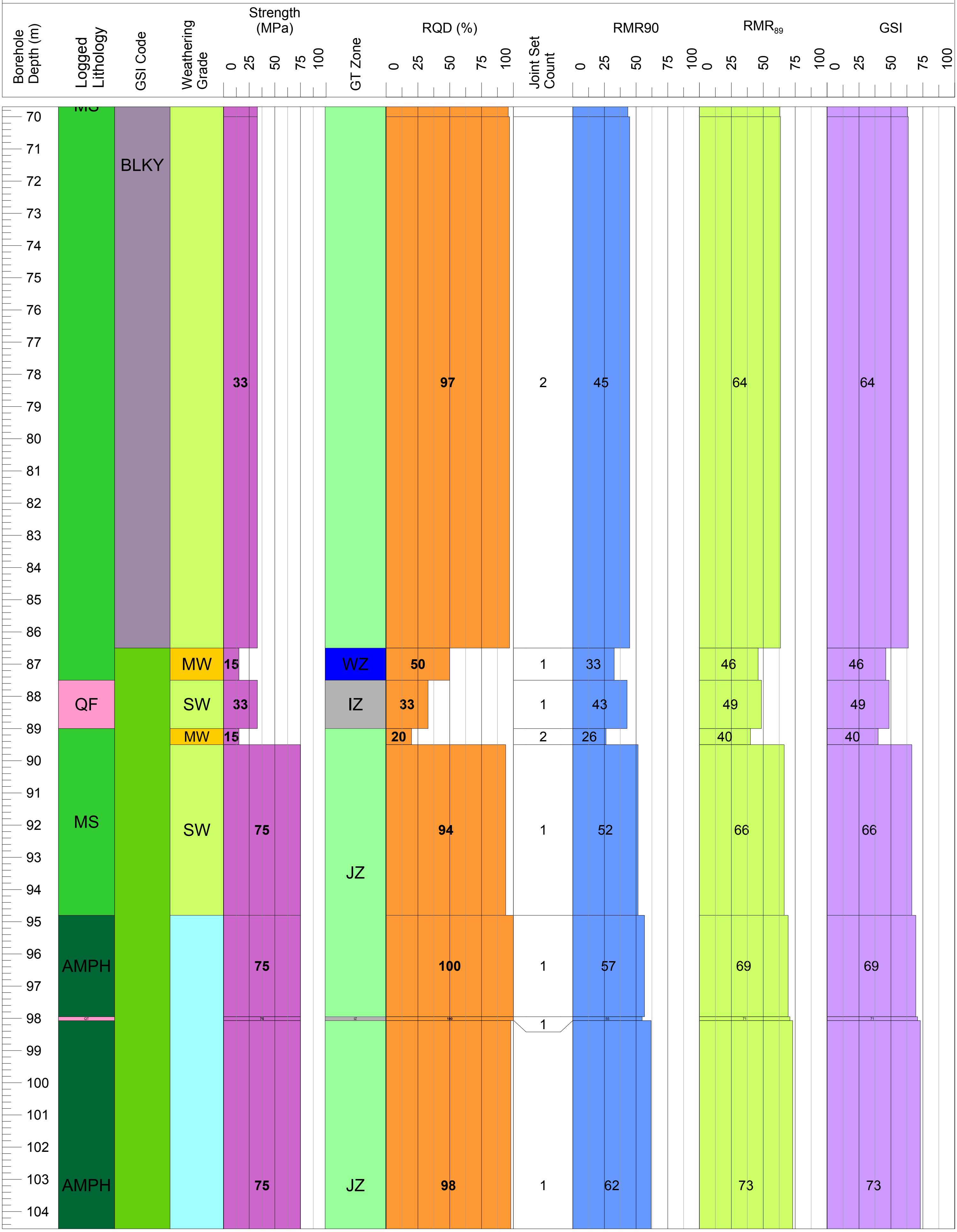
Source:



Project: U6512 Client: 2015 Kagem CPR

Easting (m): 623936 Northing (m): 8553190 Elevation (m): 1208 Maximum BH Depth (m): 134.5

Source:

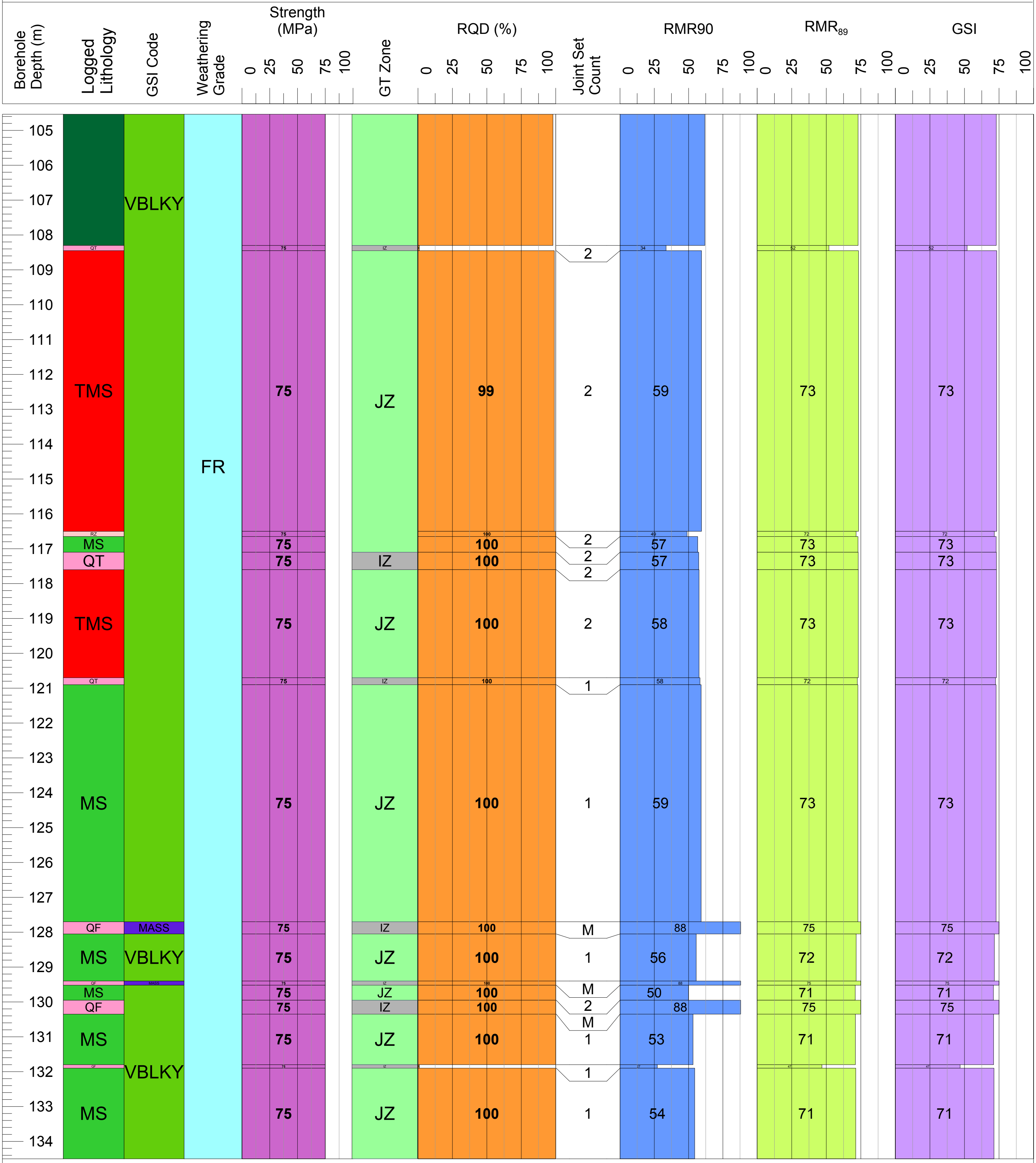


Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623936 Northing (m): 8553190 Elevation (m): 1208 Maximum BH Depth (m): 134.5

Source:



KD79 **Geotechnical Log**

Project: U6512

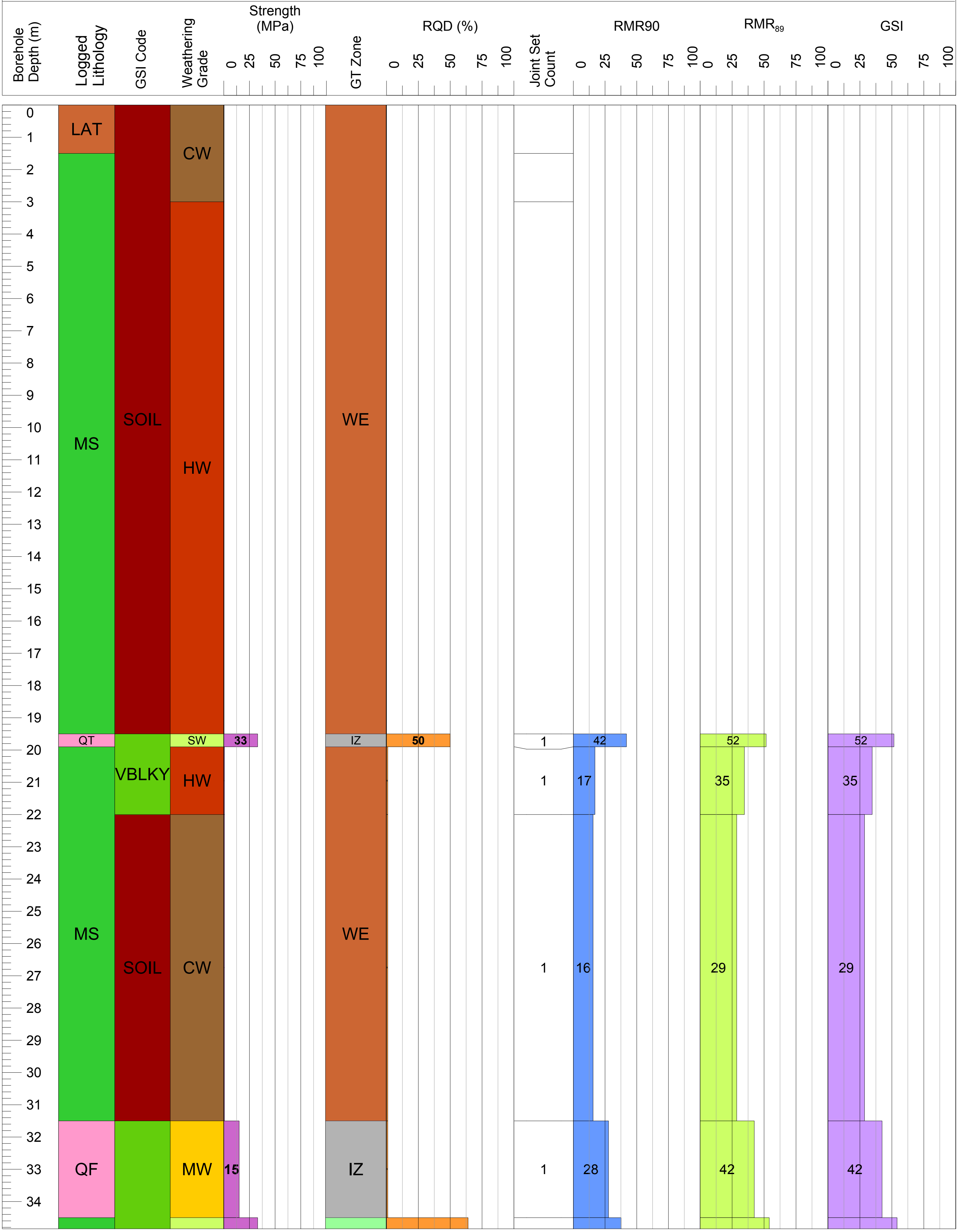
Client: 2015 Kagem CPR

Easting (m): 624021 Northing (m): 8553087 Elevation (m): 1205

Maximum BH Depth (m): 142.5

Source:

Page 1 of 5



KD79 Geotechnical Log

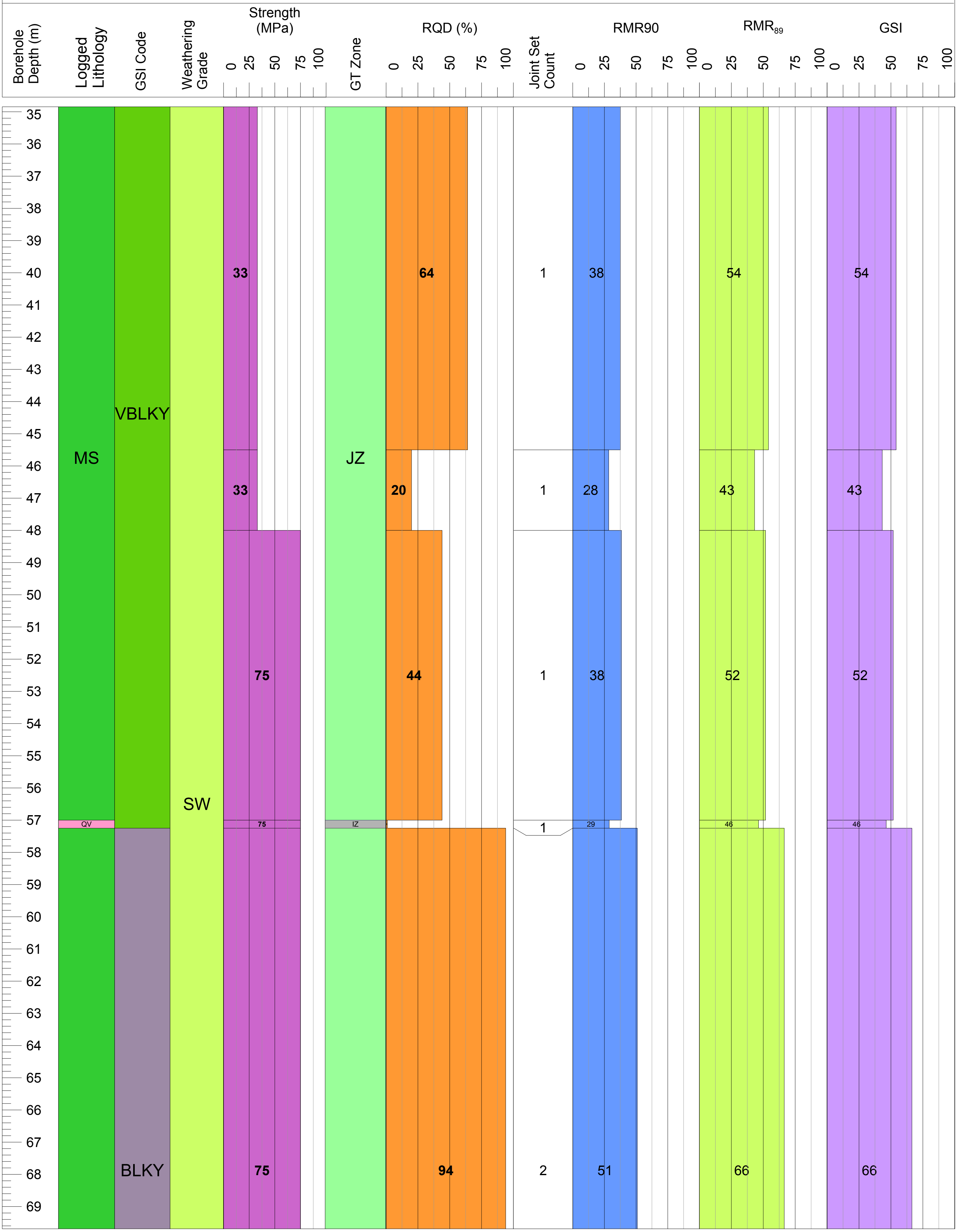
srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624021 Northing (m): 8553087 Elevation (m): 1205 Maximum BH Depth (m): 142.5

Source:



KD79 Geotechnical Log

srk consulting

Project: U6512

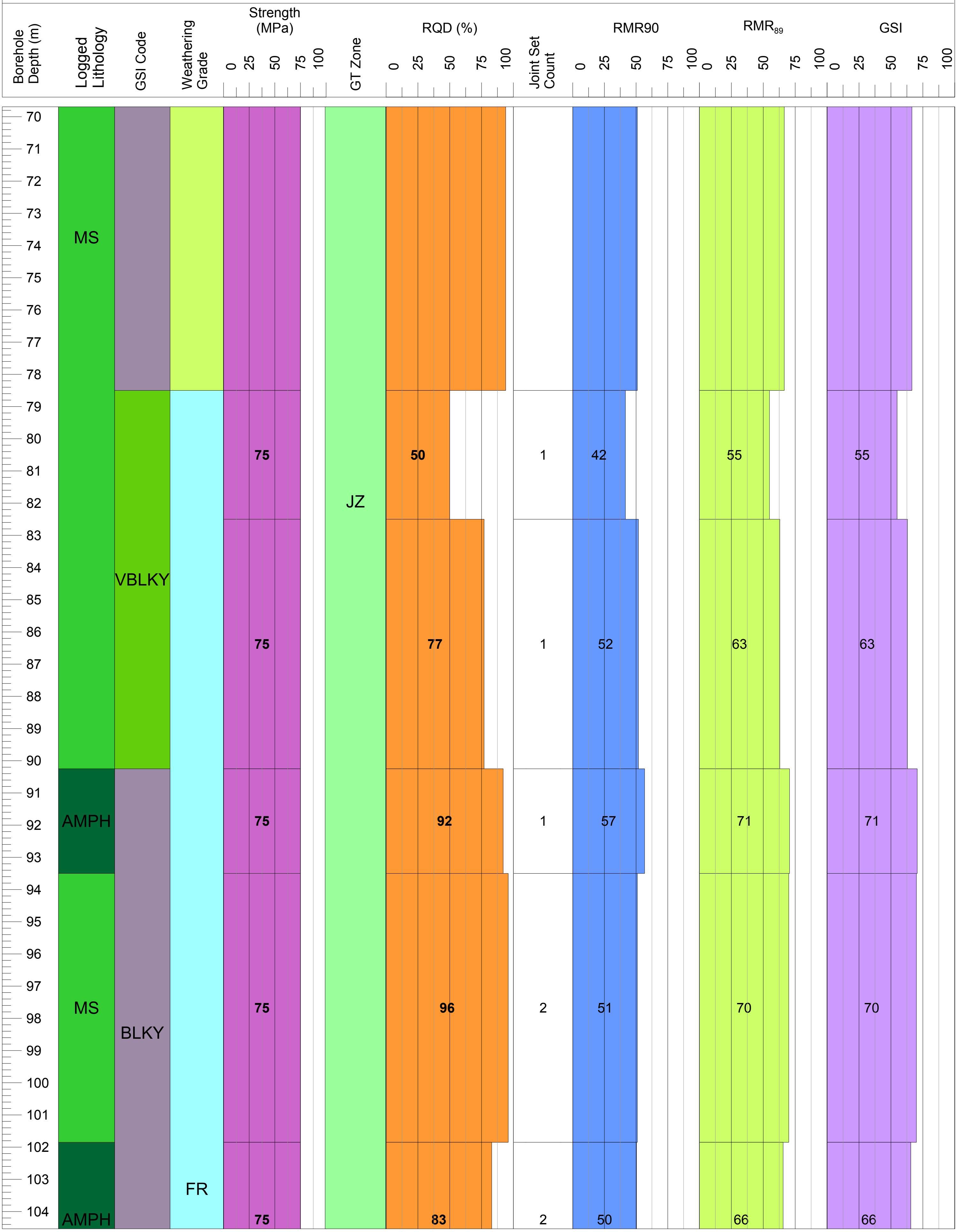
Client: 2015 Kagem CPR

Easting (m): 624021 Northing (m): 8553087 Elevation (m): 1205

Maximum BH Depth (m): 142.5

Source:

Page 3 of 5



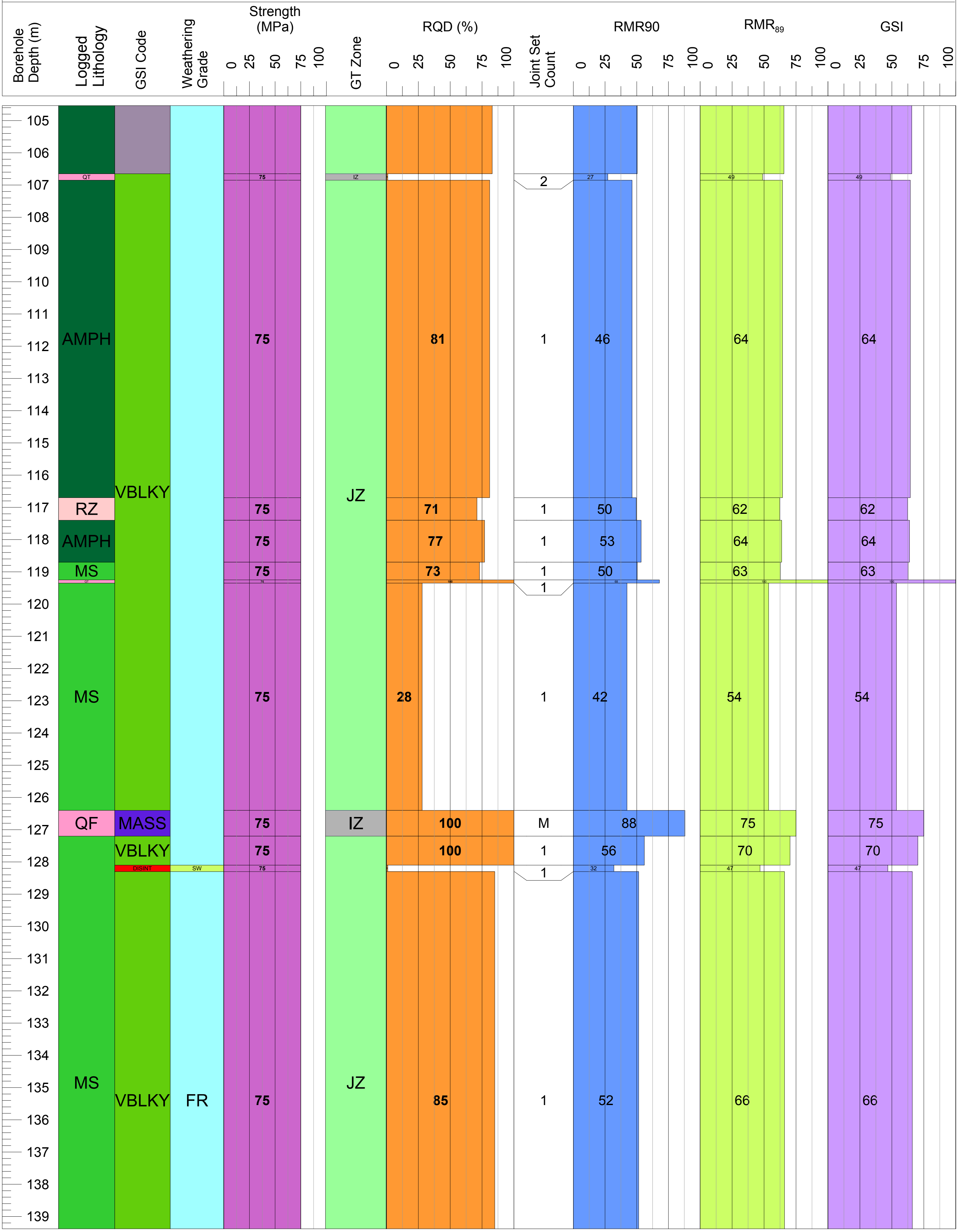
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624021 Northing (m): 8553087 Elevation (m): 1205

Maximum BH Depth (m): 142.5

Source:



KD79 Geotechnical Log

Project: U6512

Client: 2015 Kagem CPR

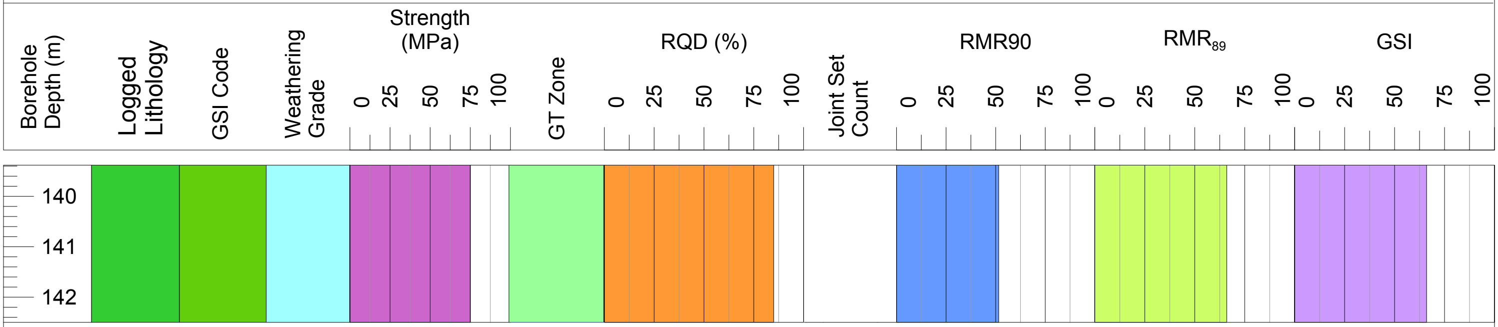
Easting (m): 624021

Northing (m): 8553087

Elevation (m): 1205

Maximum BH Depth (m): 142.5

Source:



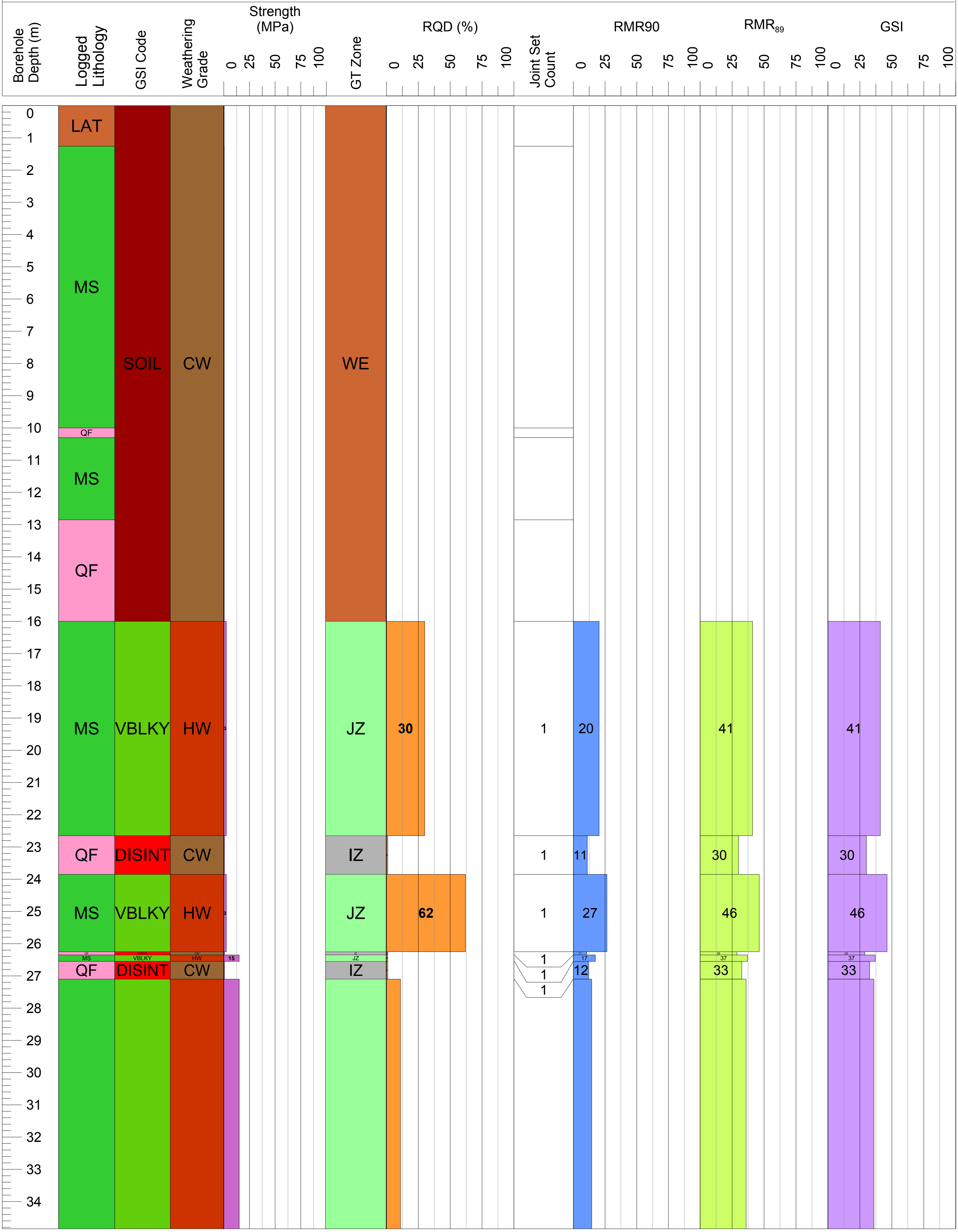
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624094 Northing (m): 8552675 Elevation (m): 1193

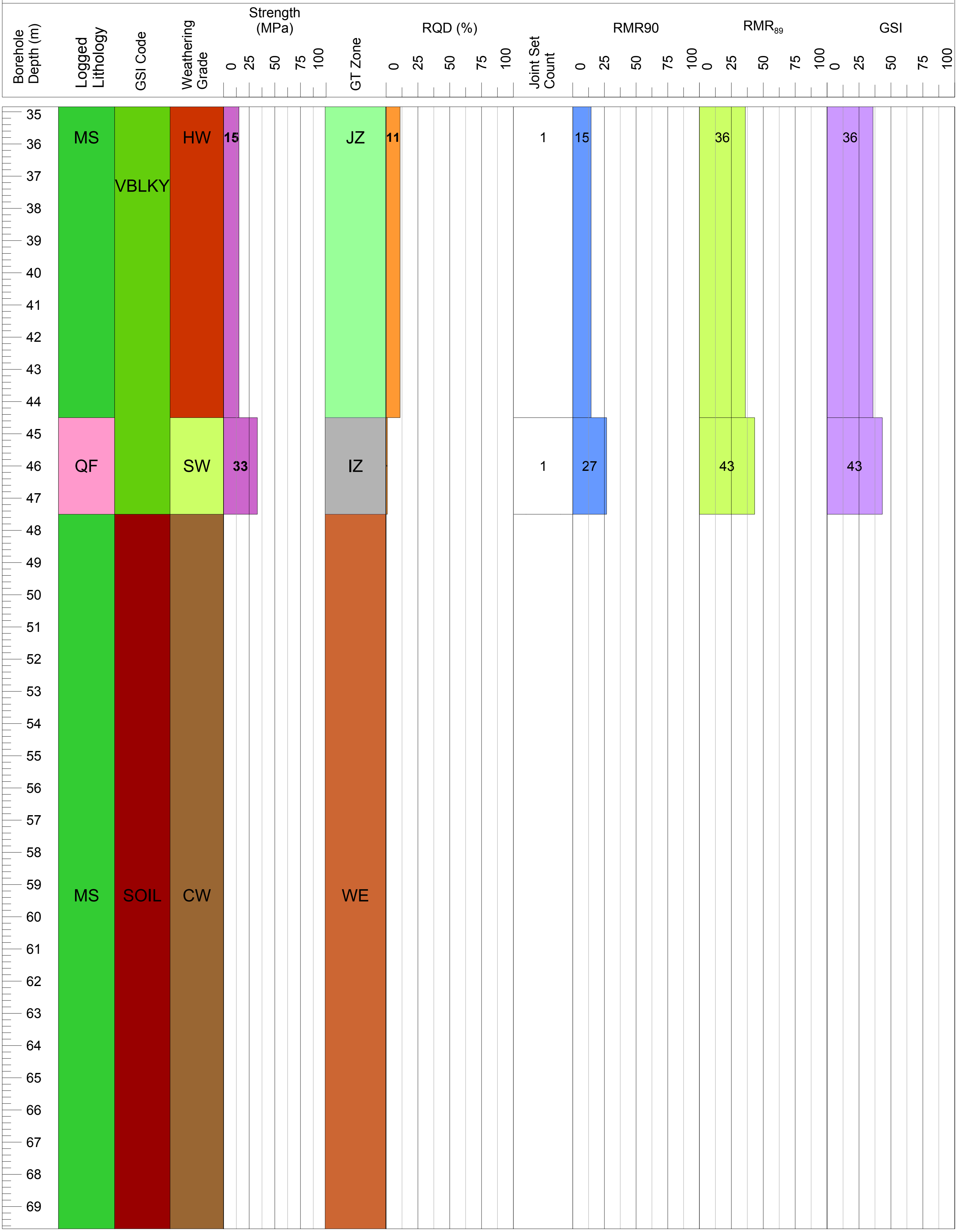
Maximum BH Depth (m): 158.5

Source:



KD82 **Geotechnical Log** srk consulting

Project: U6512
Client: 2015 Kagem CPR
Easting (m): 624094 Northing (m): 8552675 Elevation (m): 1193
Maximum BH Depth (m): 158.5
Source:
Page 2 of 5



KD82 Geotechnical Log

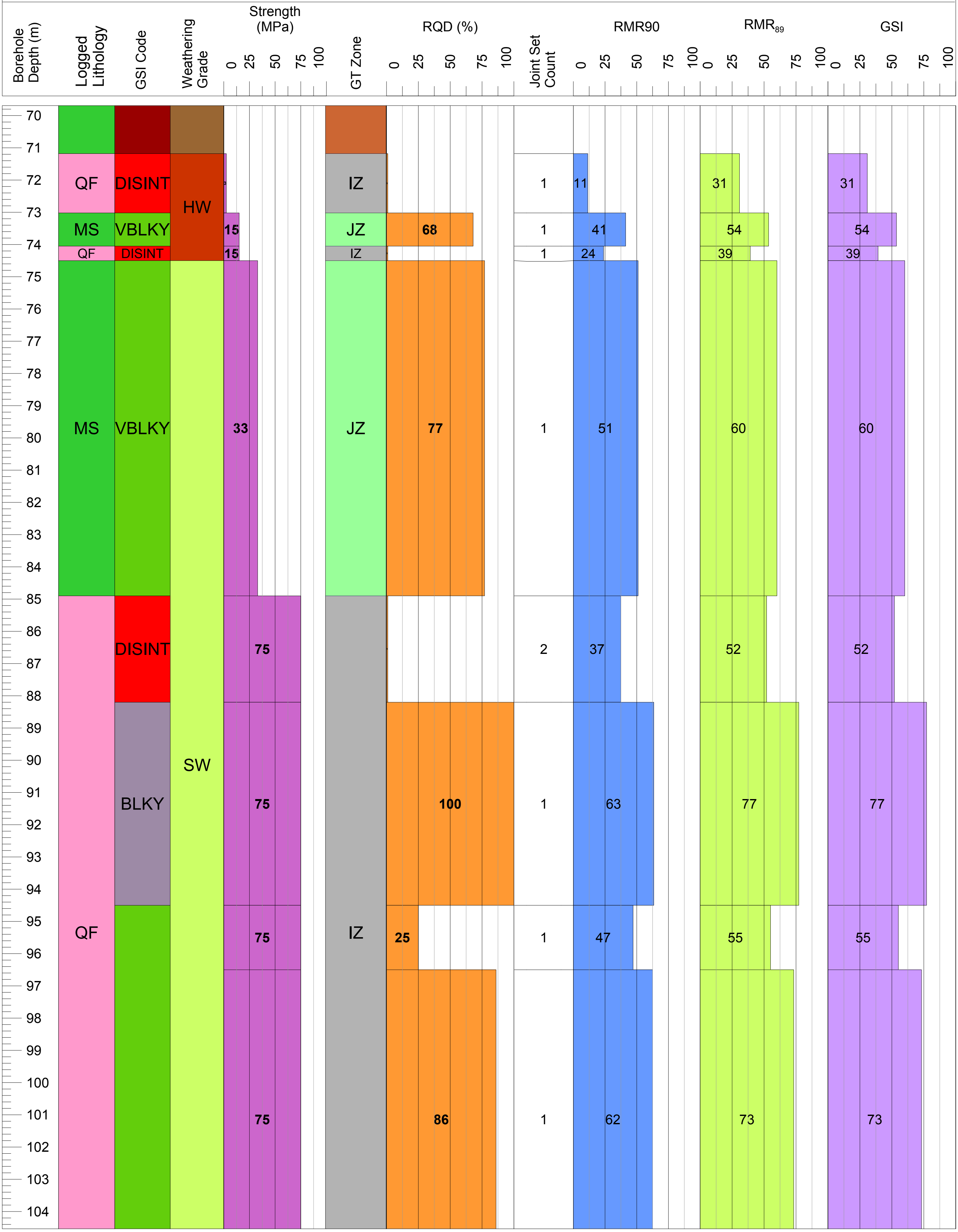
srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624094 Northing (m): 8552675 Elevation (m): 1193 Maximum BH Depth (m): 158.5

Source:



Logged Lithology	GSI Code	Weathering Grade	Strength (MPa)	GT Zone	RQD (%)	Joint Set Count	RMR90	RMR_{89}	GSI
QF	DISINT	HW	3	IZ		1	11	31	31
MS	VBLKY		15	JZ	68	1	41	54	54
QF	DISINT		15	IZ		1	24	39	39
MS	VBLKY	SW	33	JZ	77	1	51	60	60
QF	DISINT		75	IZ		2	37	52	52
	BLKY		75		100	1	63	77	77
			75		25	1	47	55	55
			75		86	1	62	73	73

KD82 Geotechnical Log

srk consulting

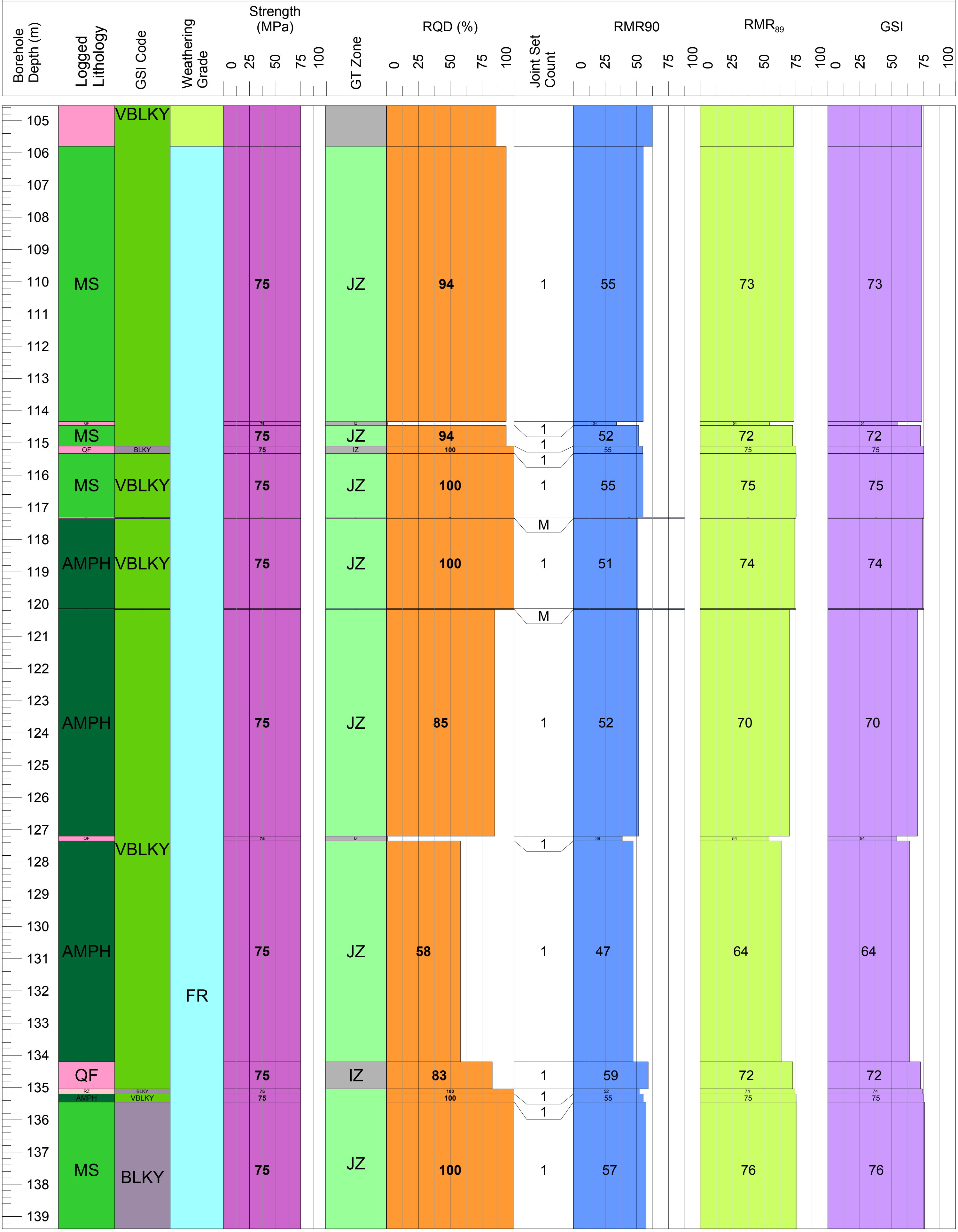
Project: U6512

Client: 2015 Kagem CPR

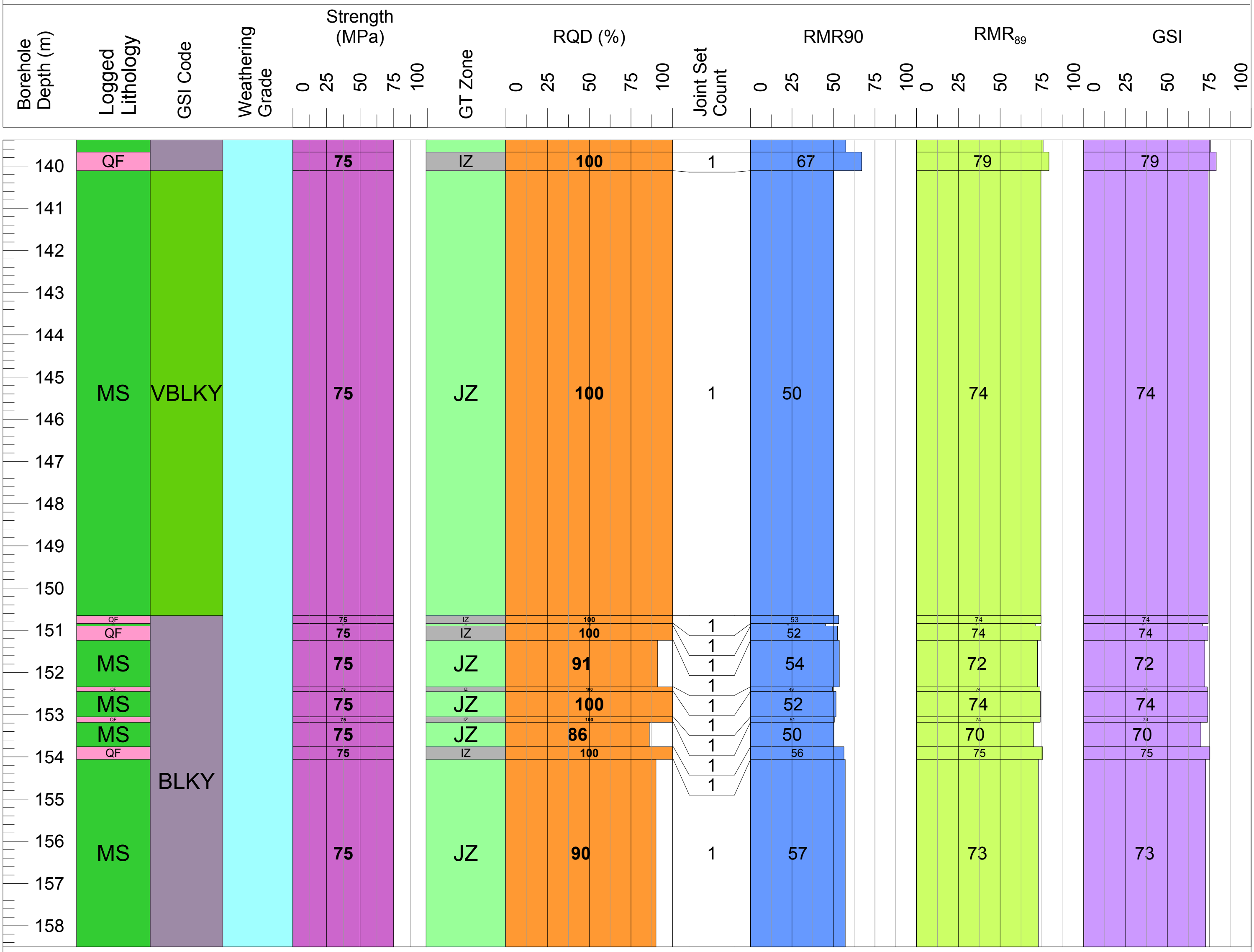
Easting (m): 624094 Northing (m): 8552675 Elevation (m): 1193

Maximum BH Depth (m): 158.5

Source:



Project: U6512
Client: 2015 Kagem CPR
Easting (m): 624094 Northing (m): 8552675 Elevation (m): 1193
Maximum BH Depth (m): 158.5
Source:



KD84 Geotechnical Log

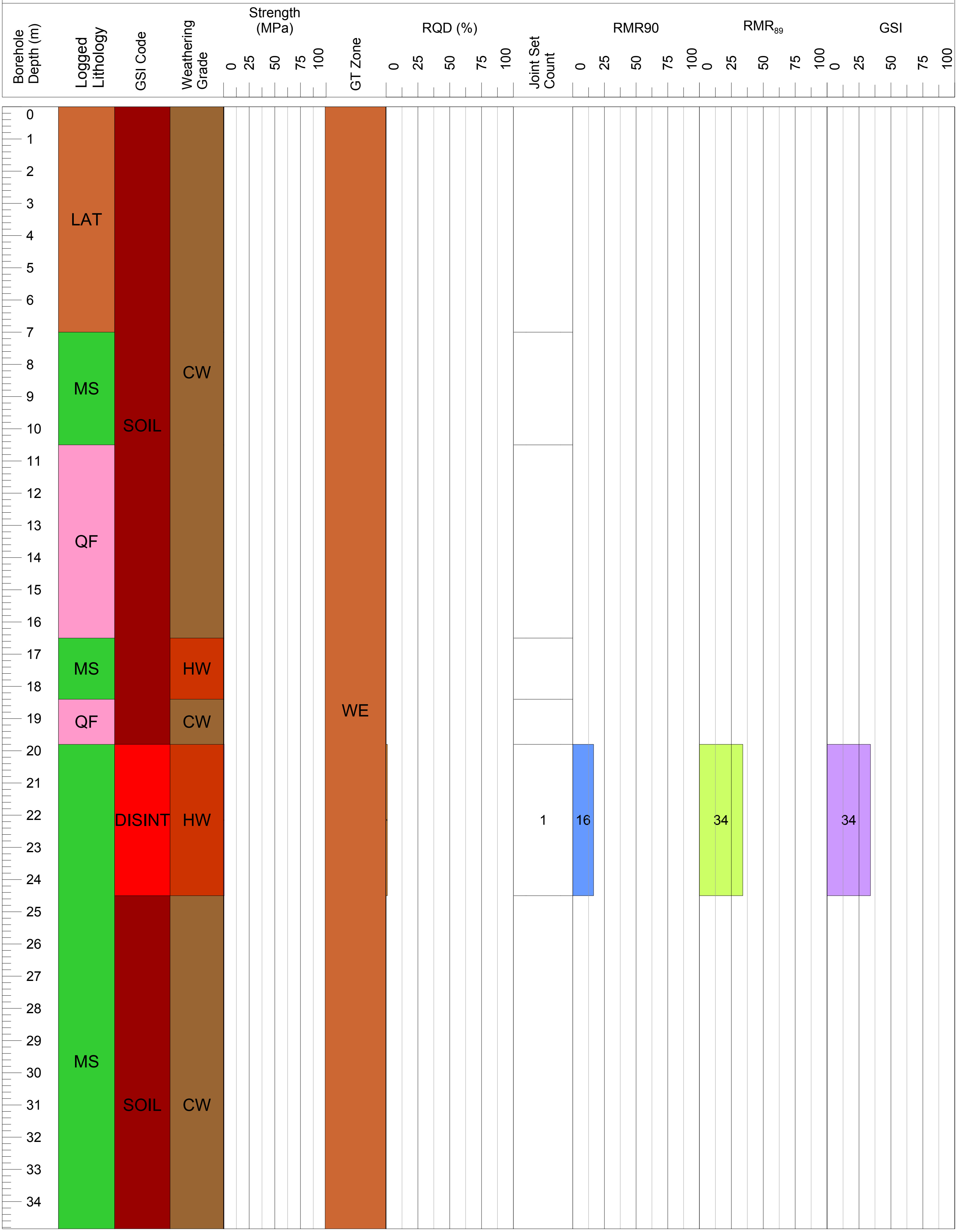
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624204   Northing (m): 8552889   Elevation (m): 1197

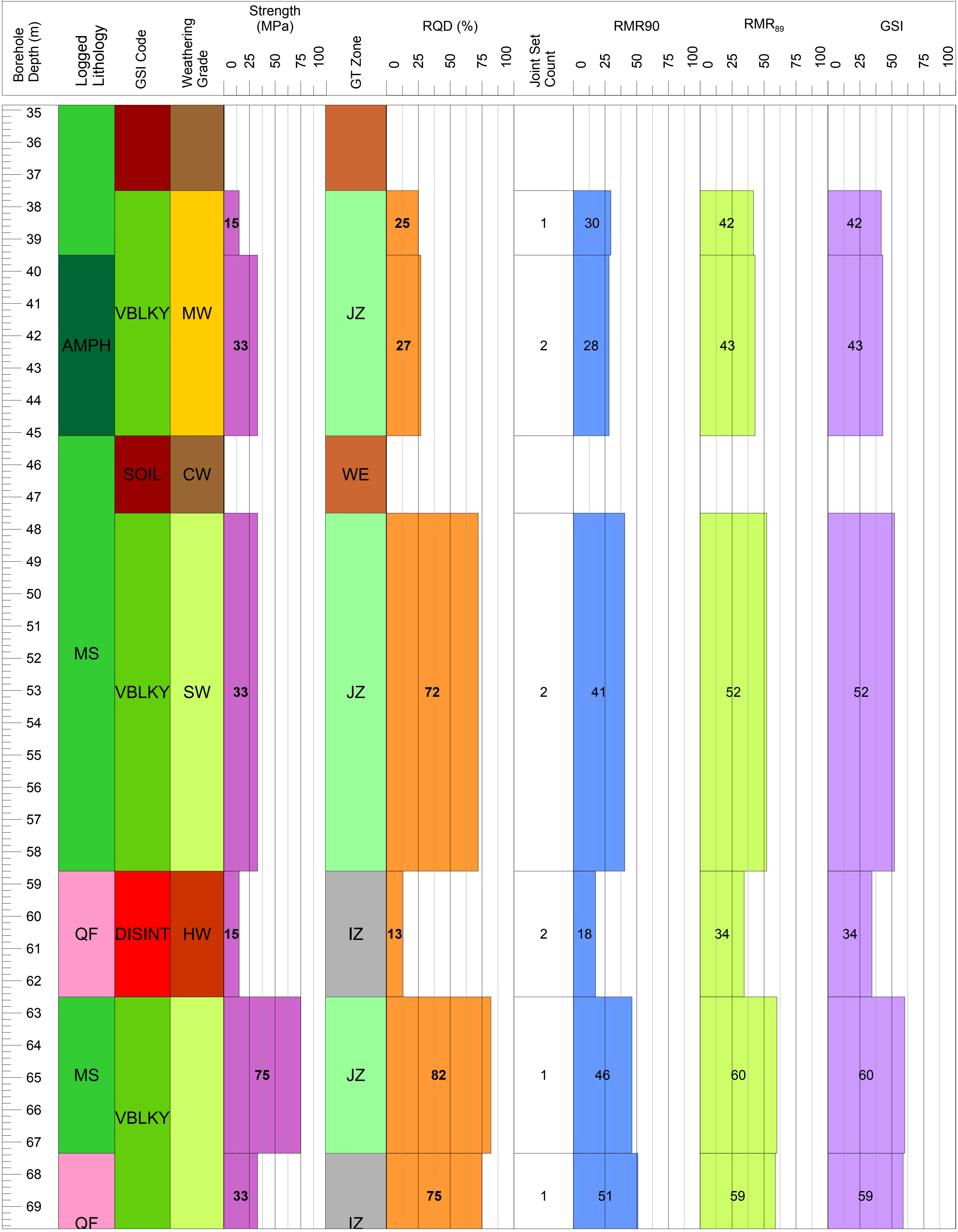
Maximum BH Depth (m): 164.5

Source:



KD84 **Geotechnical Log**

Project: U6512
Client: 2015 Kagem CPR
Easting (m): 624204 Northing (m): 8552889 Elevation (m): 1197
Maximum BH Depth (m): 164.5
Source:



Logged Lithology	GSI Code	Weathering Grade	Strength (MPa)	GT Zone	RQD (%)	Joint Set Count	RMR90	RMR_{89}	GSI
	VBLKY	MW	15	JZ	25	1	30	42	42
AMPH			33		27	2	28	43	43
	SOIL	CW		WE					
MS	VBLKY	SW	33	JZ	72	2	41	52	52
QF	DISINT	HW	15	IZ	13	2	18	34	34
MS	VBLKY		75	JZ	82	1	46	60	60
QF			33	IZ	75	1	51	59	59

KD84 Geotechnical Log

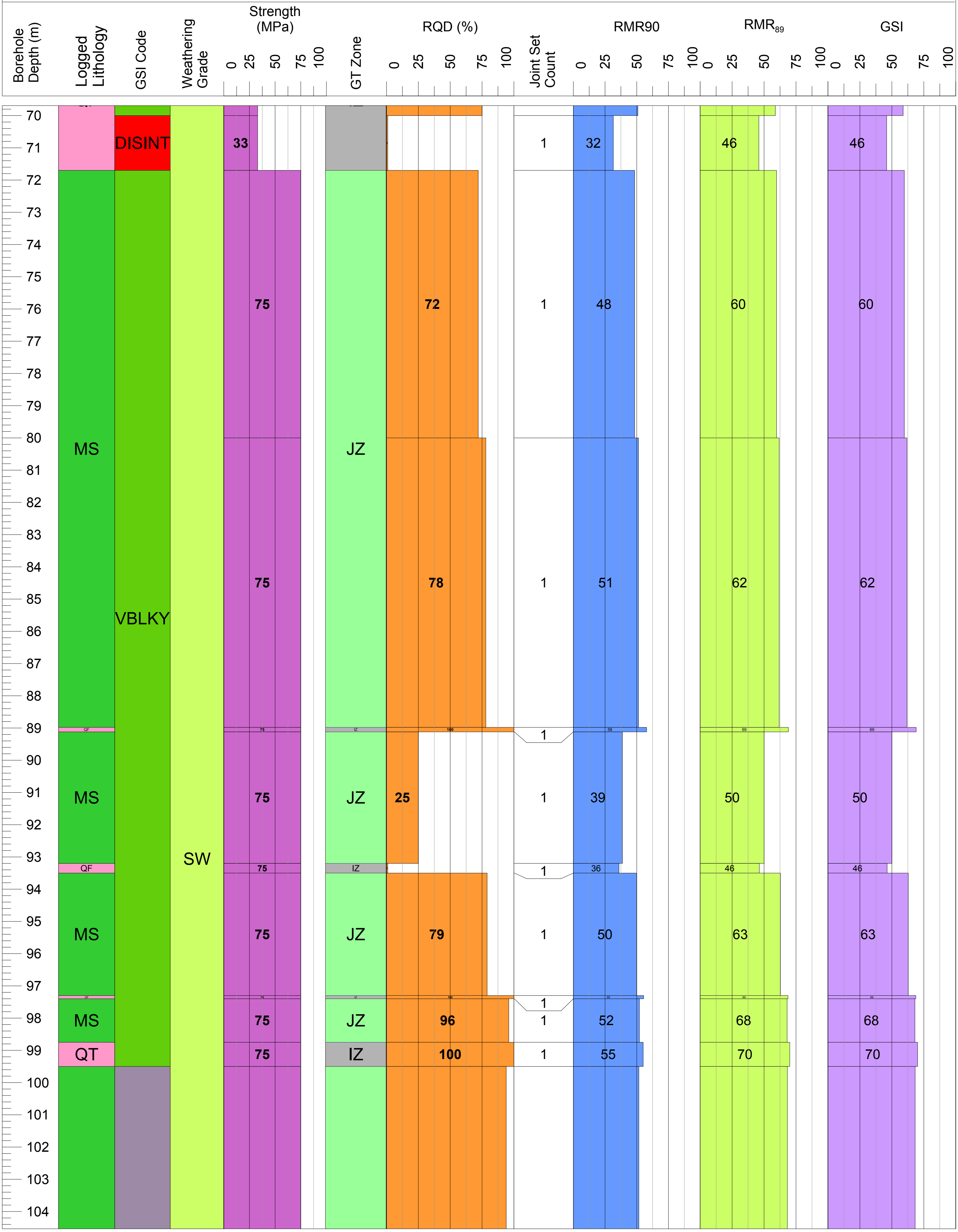
srk consulting

Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624204 Northing (m): 8552889 Elevation (m): 1197 Maximum BH Depth (m): 164.5

Source:



KD84 Geotechnical Log

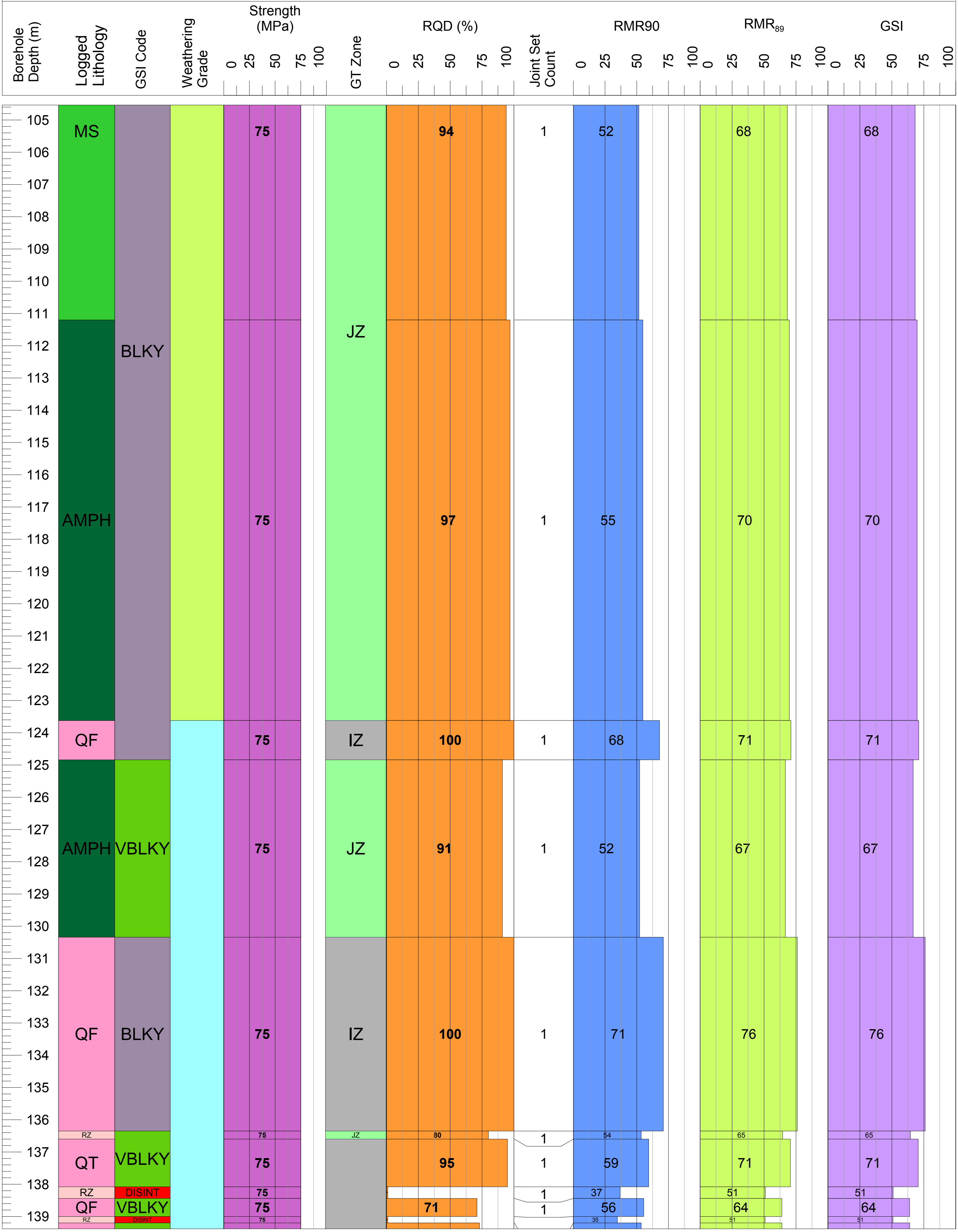
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624204 Northing (m): 8552889 Elevation (m): 1197

Maximum BH Depth (m): 164.5

Source:

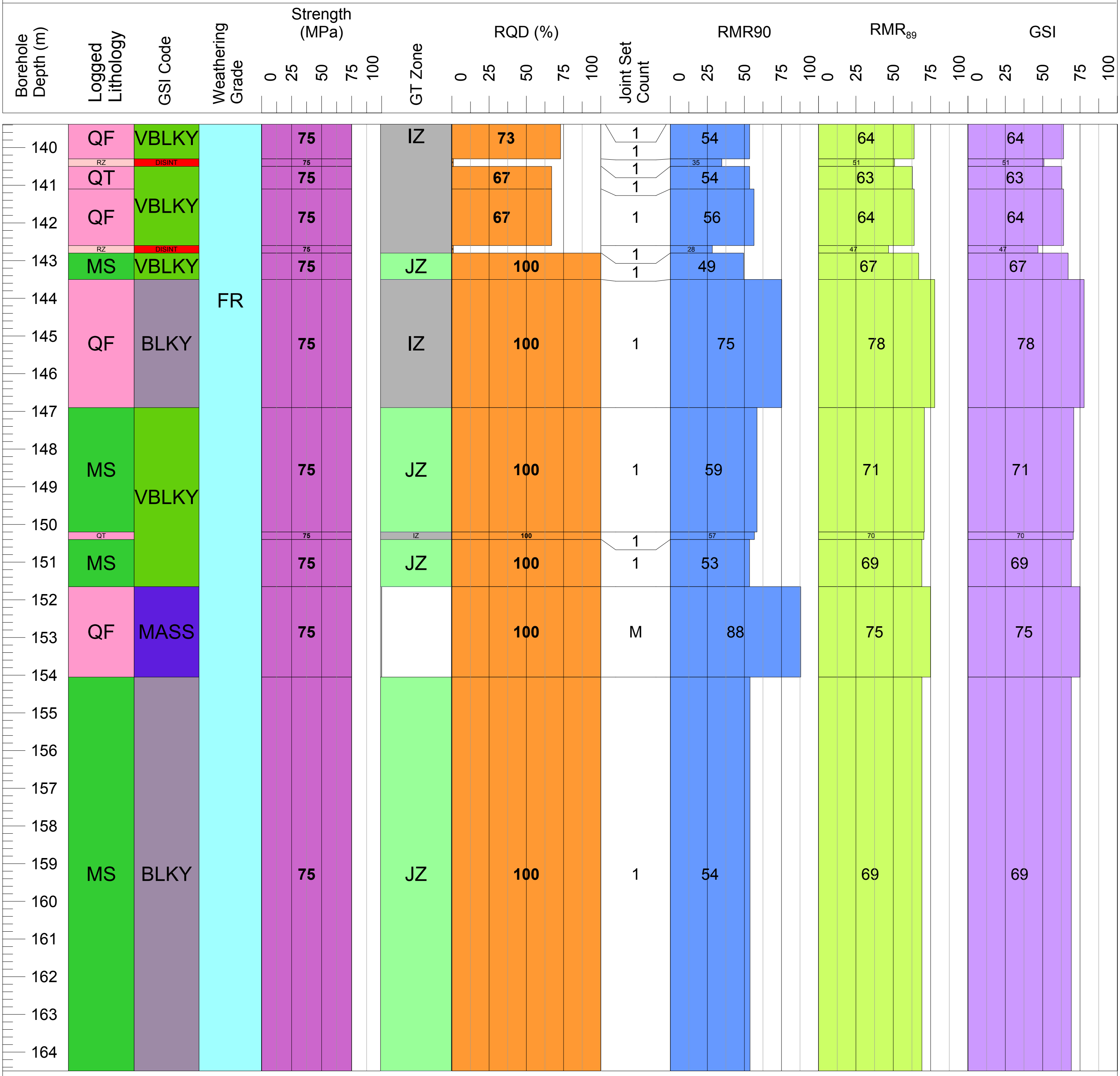


Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624204 Northing (m): 8552889 Elevation (m): 1197 Maximum BH Depth (m): 164.5

Source:



KD85 Geotechnical Log

srk consulting

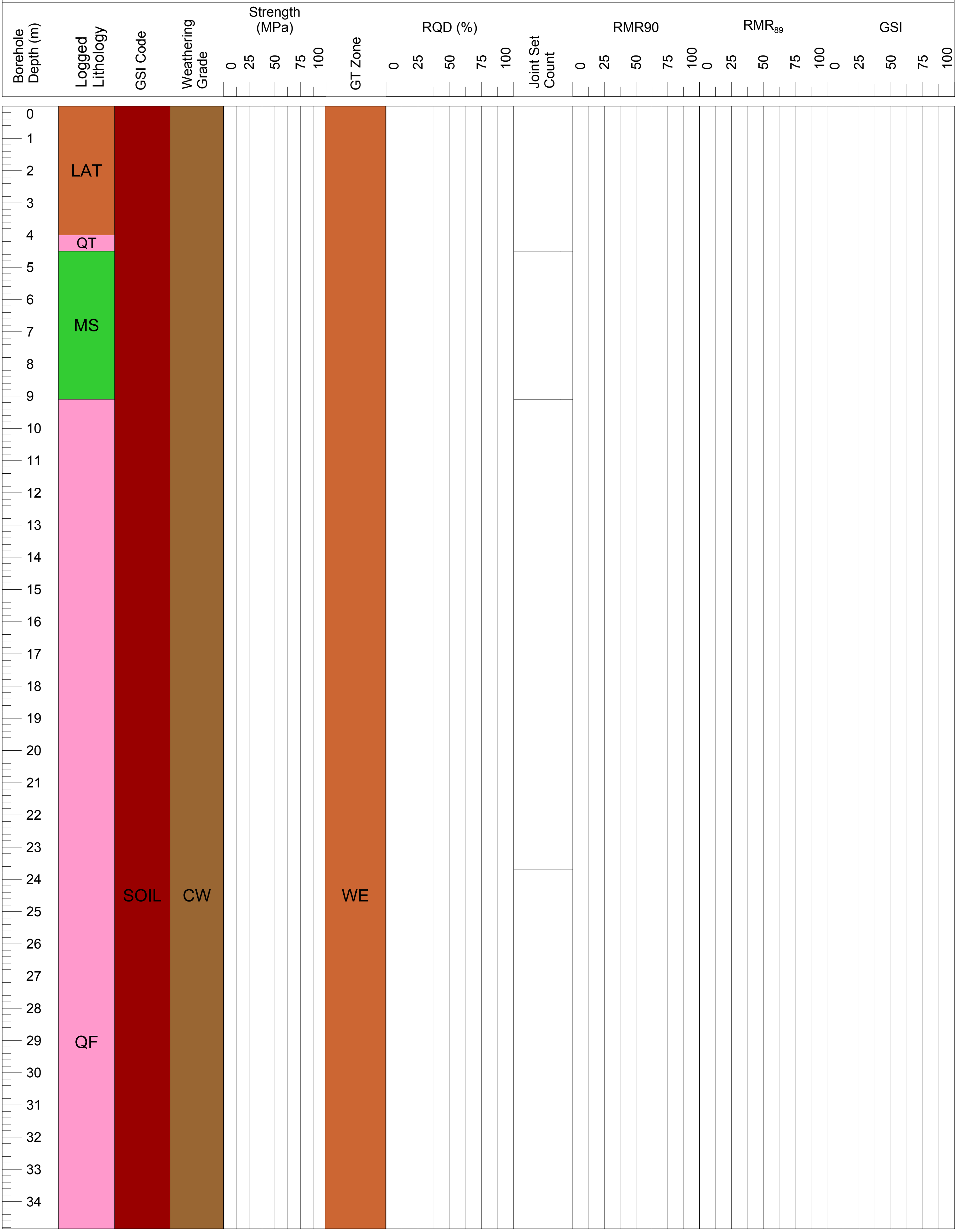
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624142 Northing (m): 8552745 Elevation (m): 1194

Maximum BH Depth (m): 164.5

Source:



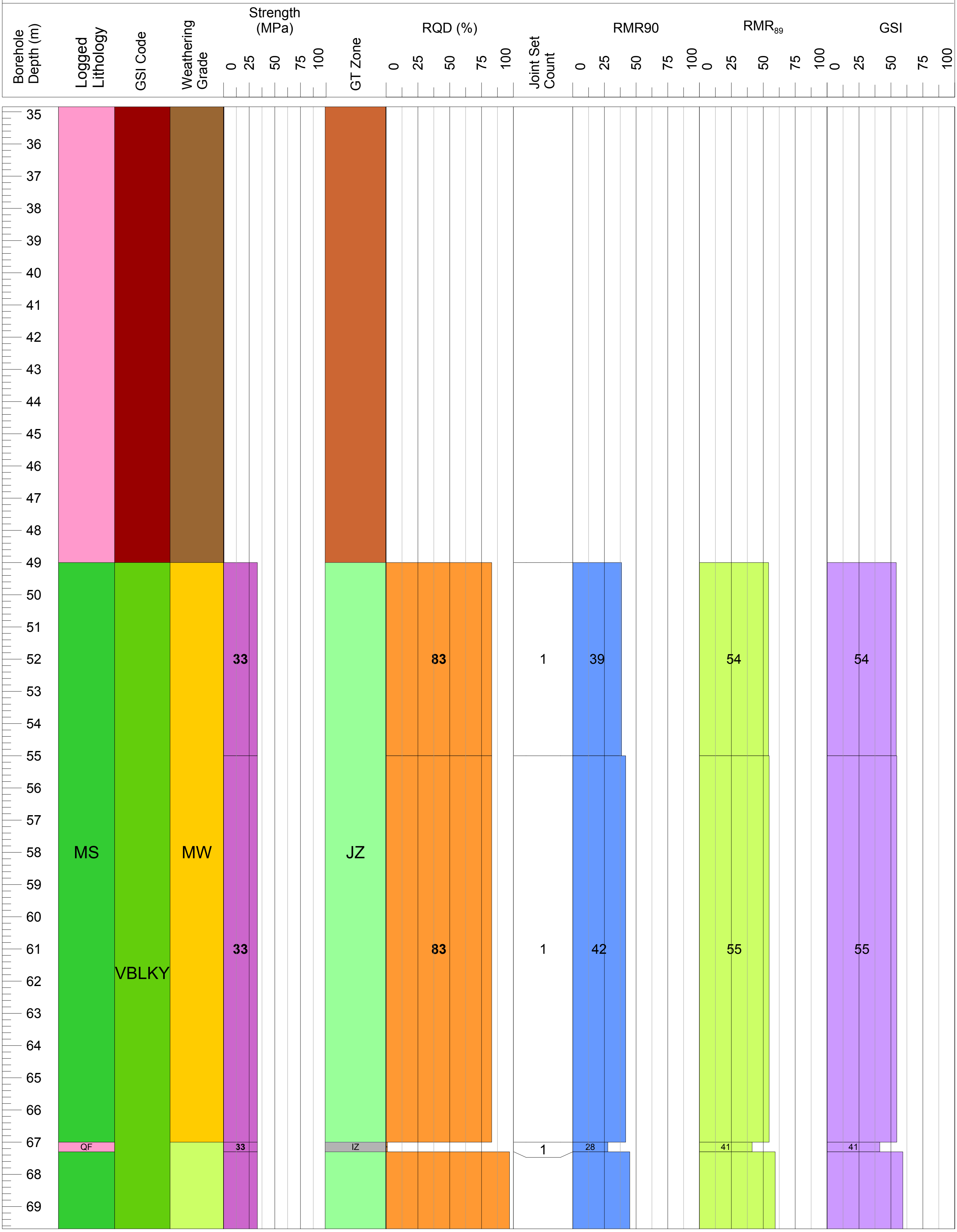
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624142 Northing (m): 8552745 Elevation (m): 1194

Maximum BH Depth (m): 164.5

Source:



KD85 *Geotechnical Log*

srk consulting

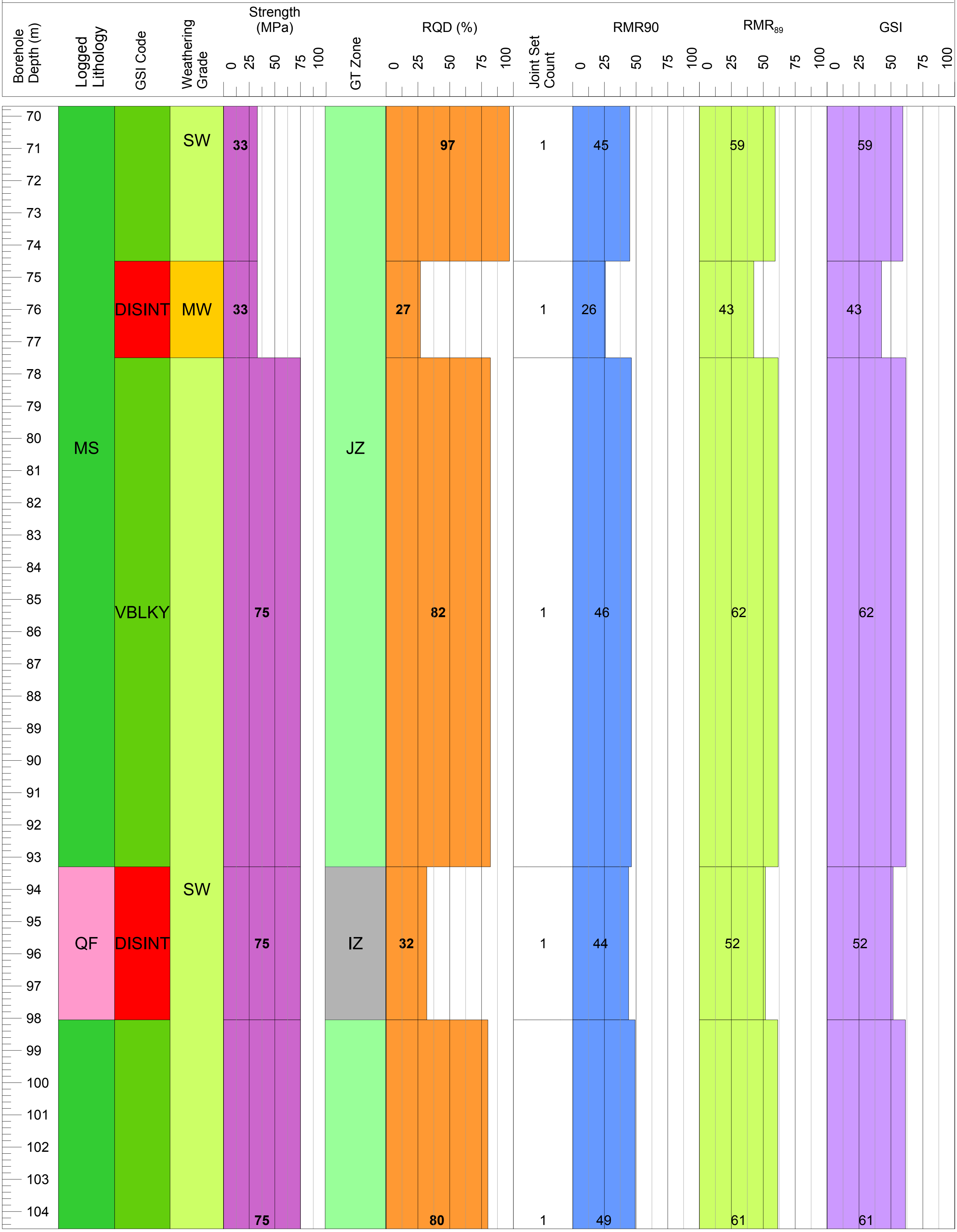
Project: U6512

Client: 2015 Kagem CPR

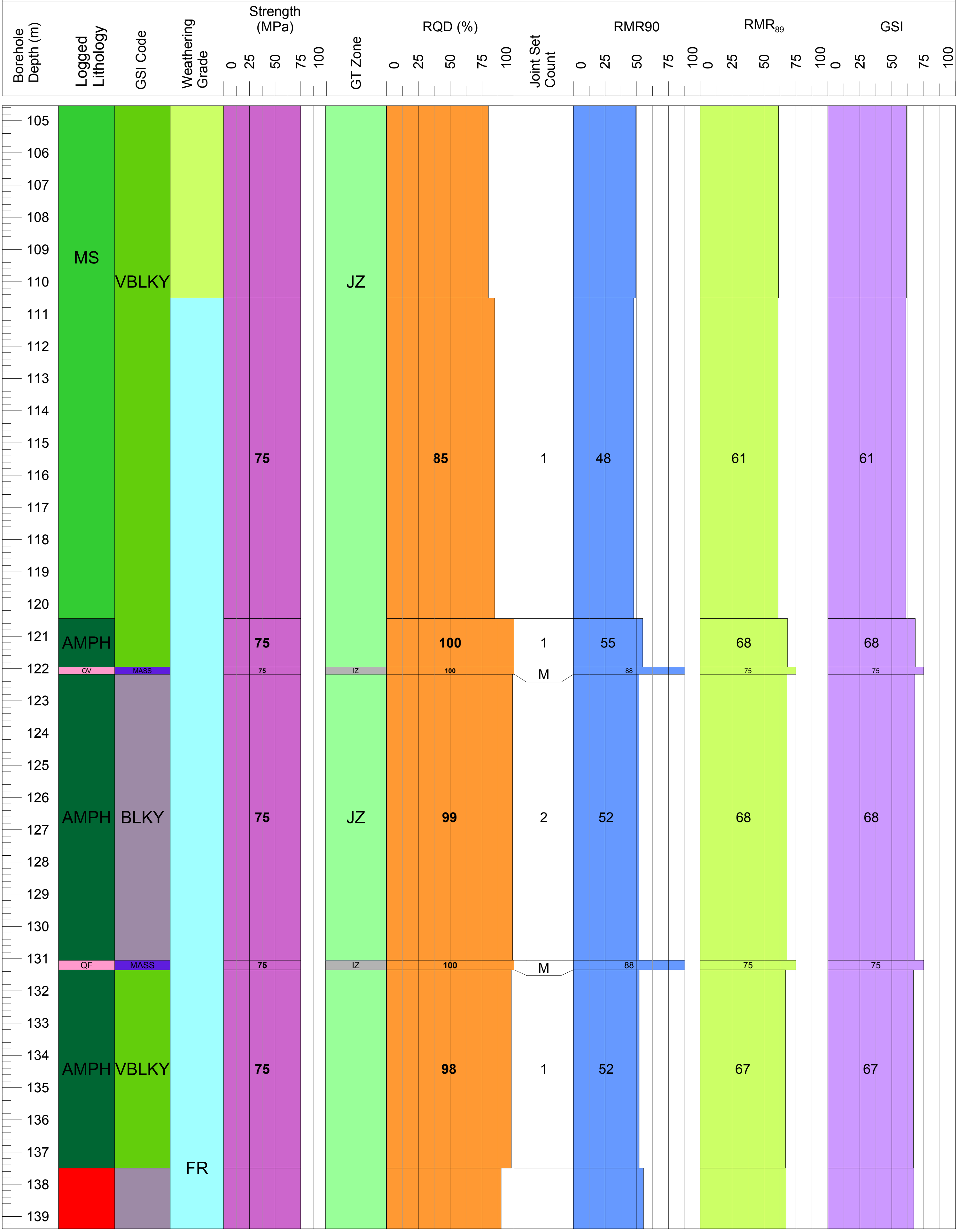
Easting (m): 624142 Northing (m): 8552745 Elevation (m): 1194

Maximum BH Depth (m): 164.5

Source:



Project: U6512
Client: 2015 Kagem CPR
Easting (m): 624142 Northing (m): 8552745 Elevation (m): 1194 Maximum BH Depth (m): 164.5
Source:



KD85 **Geotechnical Log** srk consulting

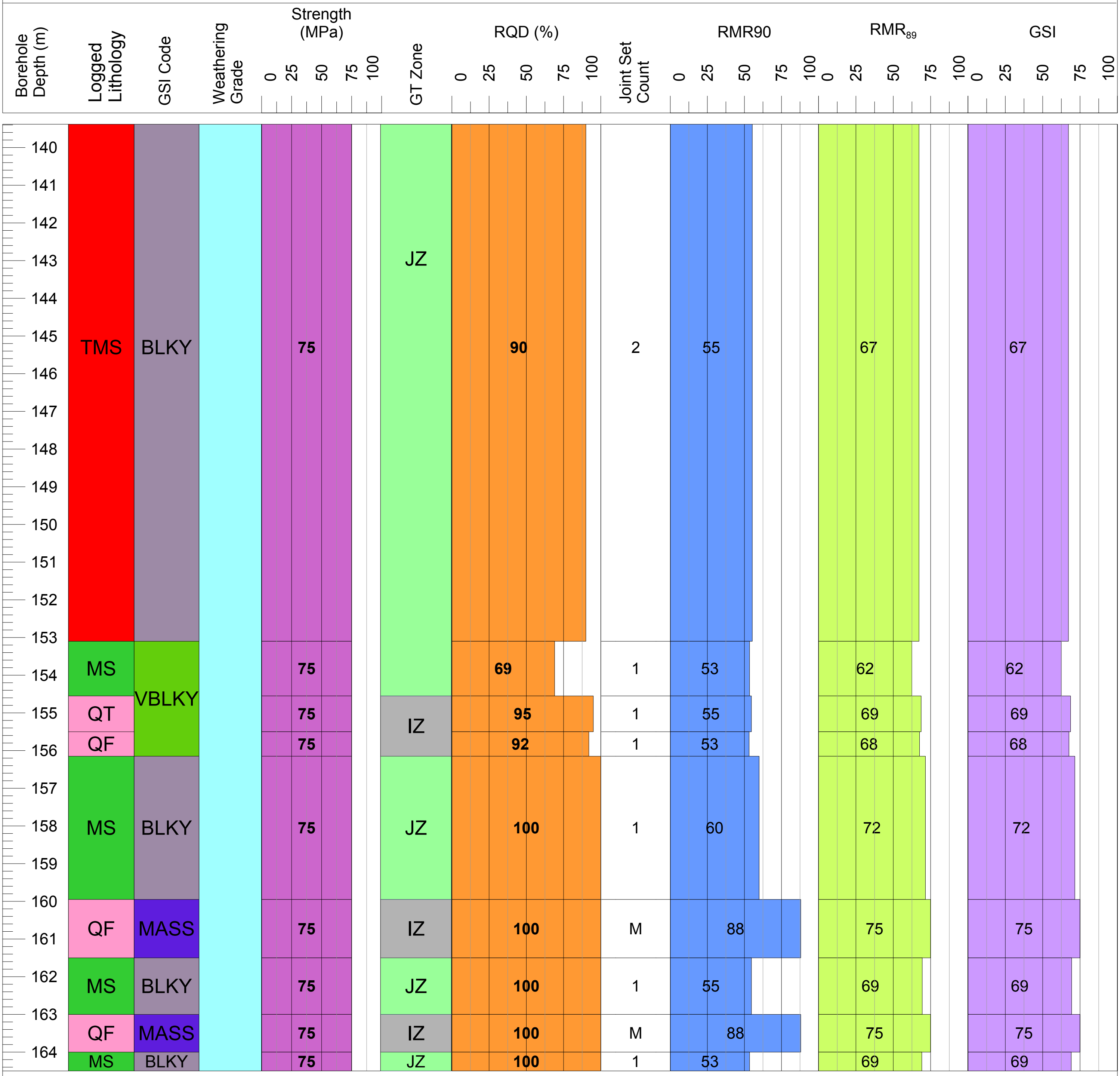
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624142 Northing (m): 8552745 Elevation (m): 1194 Maximum BH Depth (m): 164.5

Source:

Page 5 of 5



KD93 Geotechnical Log

srk consulting

Project: U6512

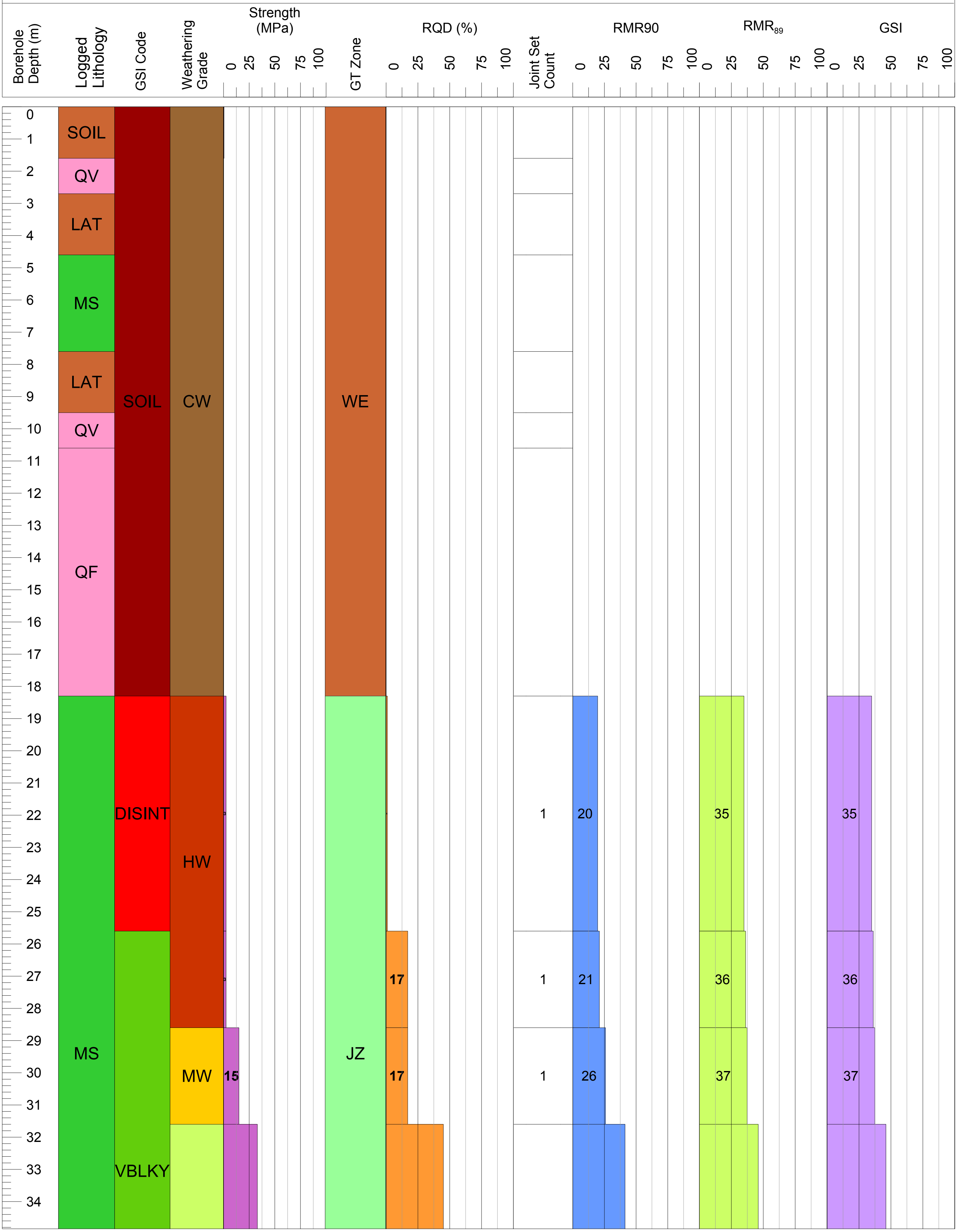
Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189

Maximum BH Depth (m): 180.1

Source:

Page 1 of 6



KD93 Geotechnical Log

srk consulting

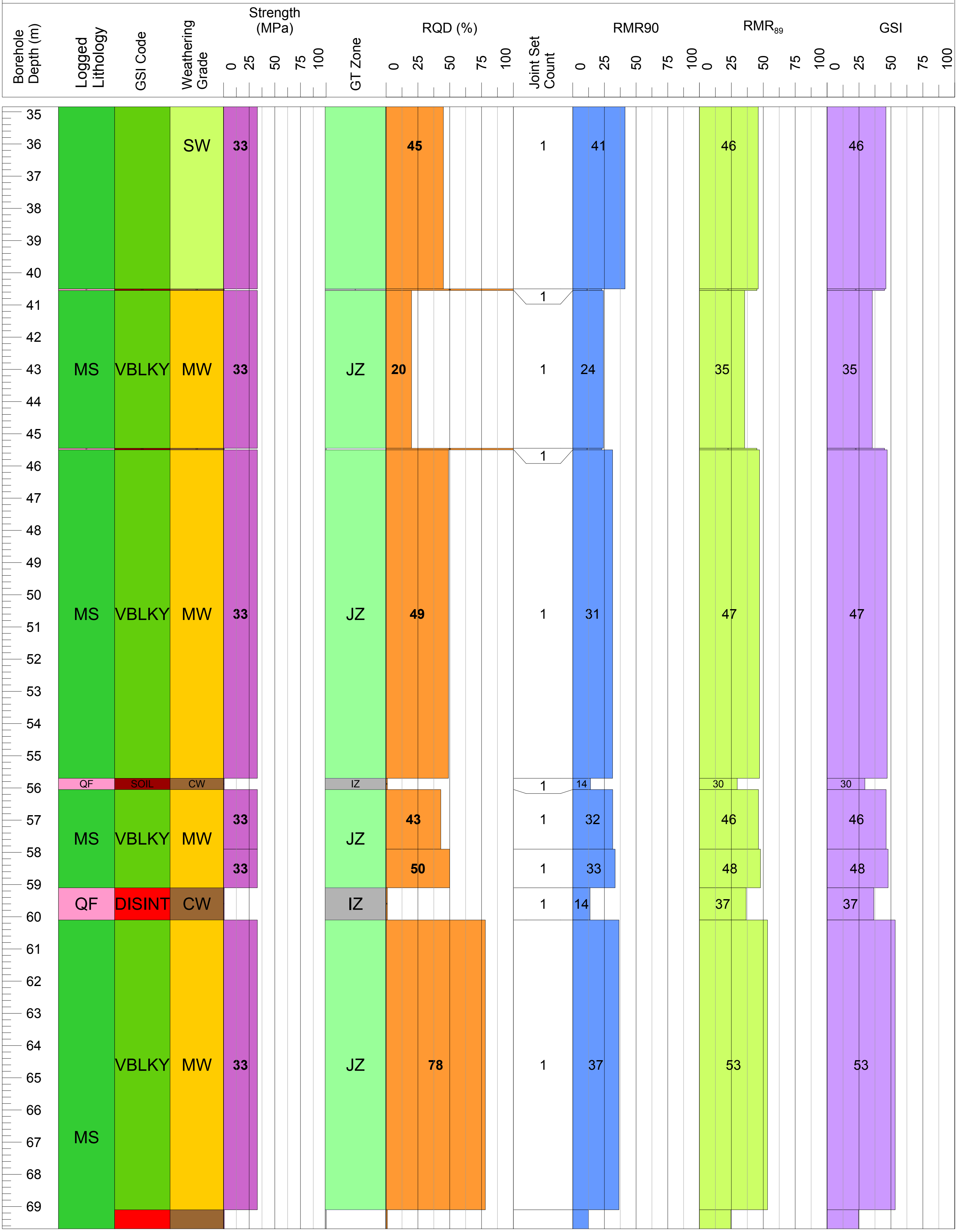
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189

Maximum BH Depth (m): 180.1

Source:



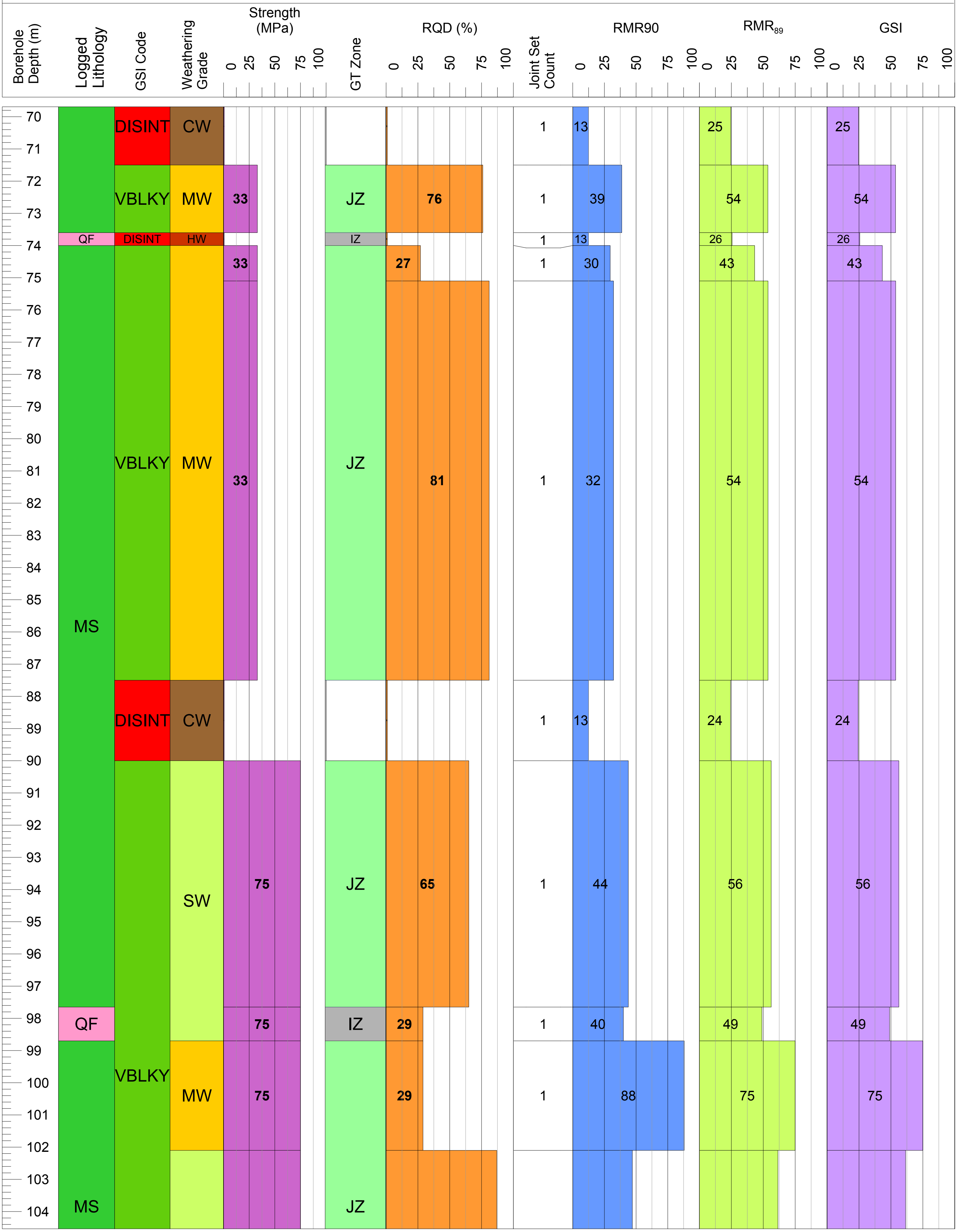
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189

Maximum BH Depth (m): 180.1

Source:

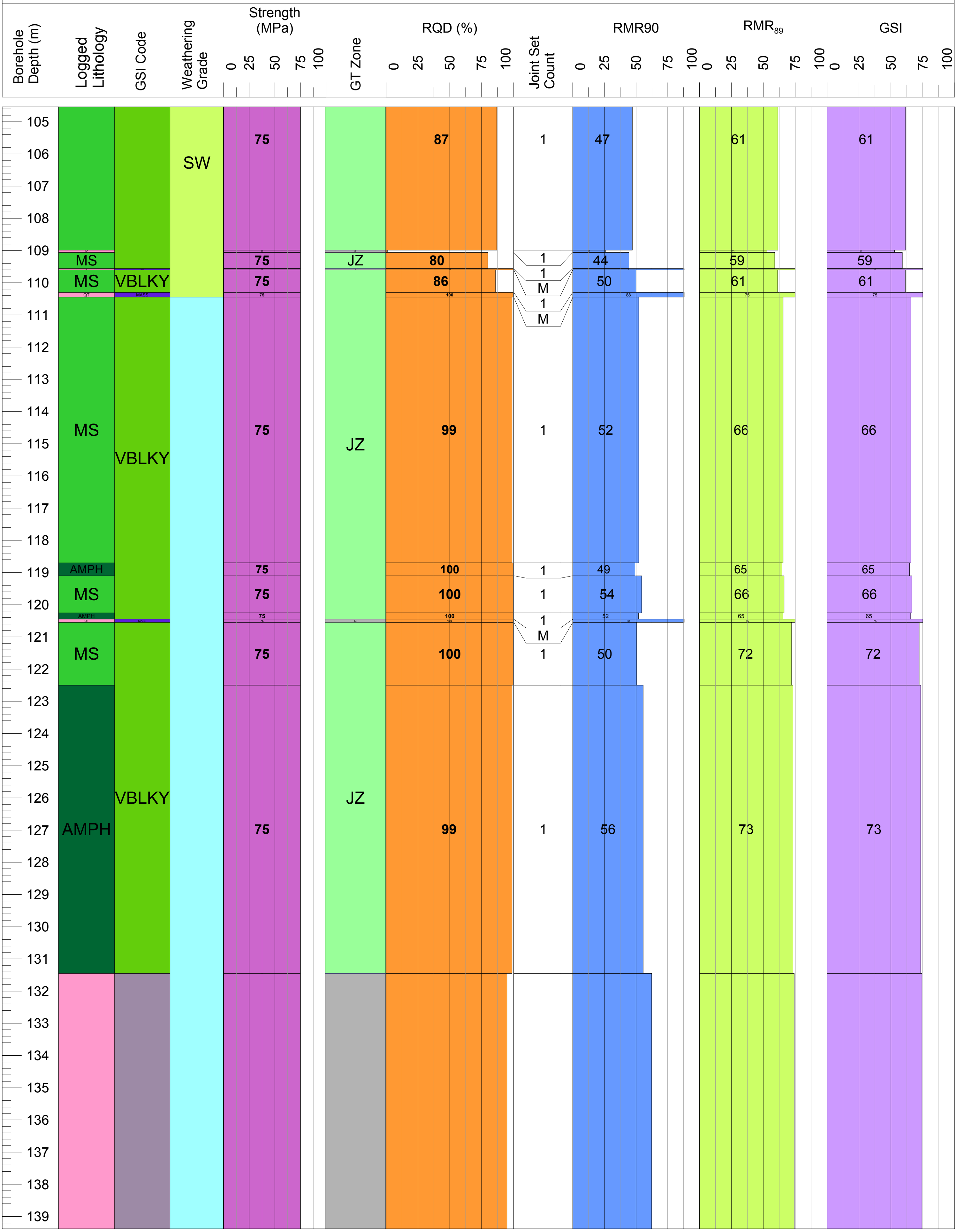


Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189 Maximum BH Depth (m): 180.1

Source:



KD93 Geotechnical Log

srk consulting

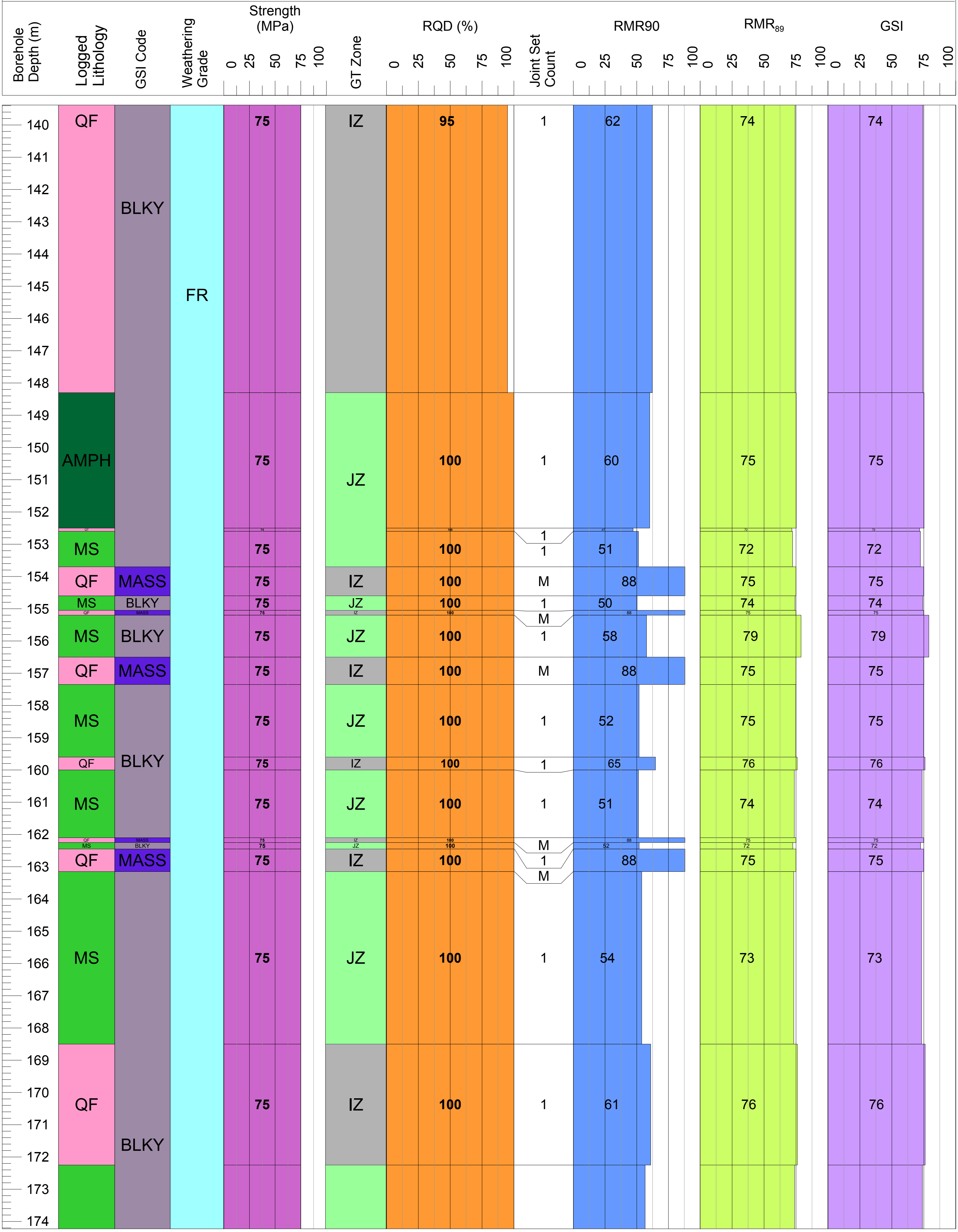
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189

Maximum BH Depth (m): 180.1

Source:



KD93 Geotechnical Log

Project: U6512

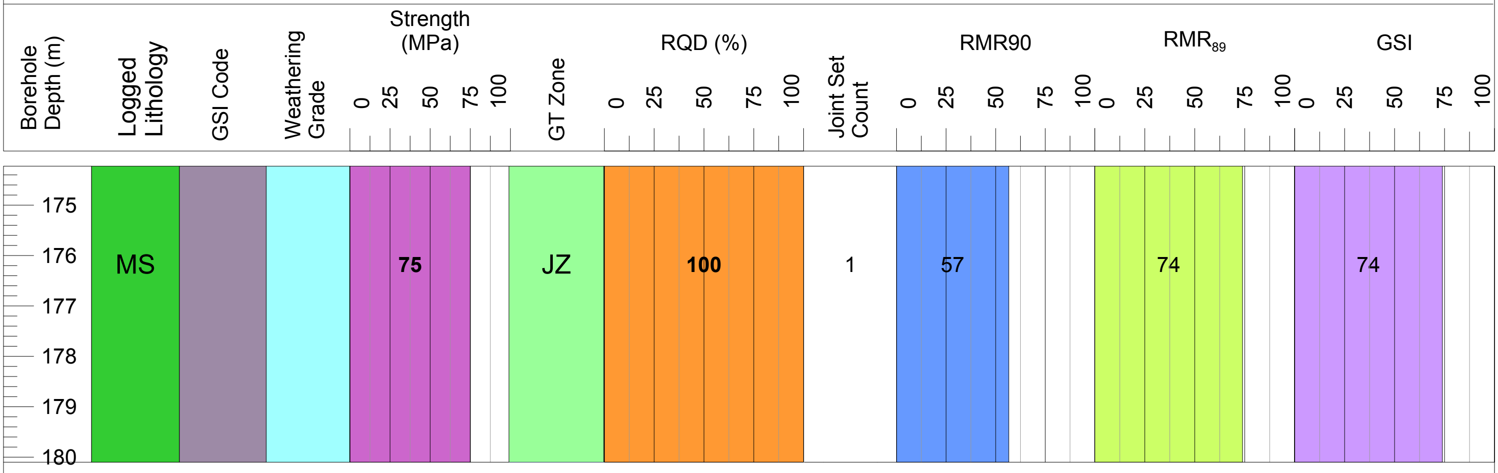
Client: 2015 Kagem CPR

Easting (m): 624012 Northing (m): 8552557 Elevation (m): 1189

Maximum BH Depth (m): 180.1

Source:

Page 6 of 6



ZD22 **Geotechnical Log** srk consulting

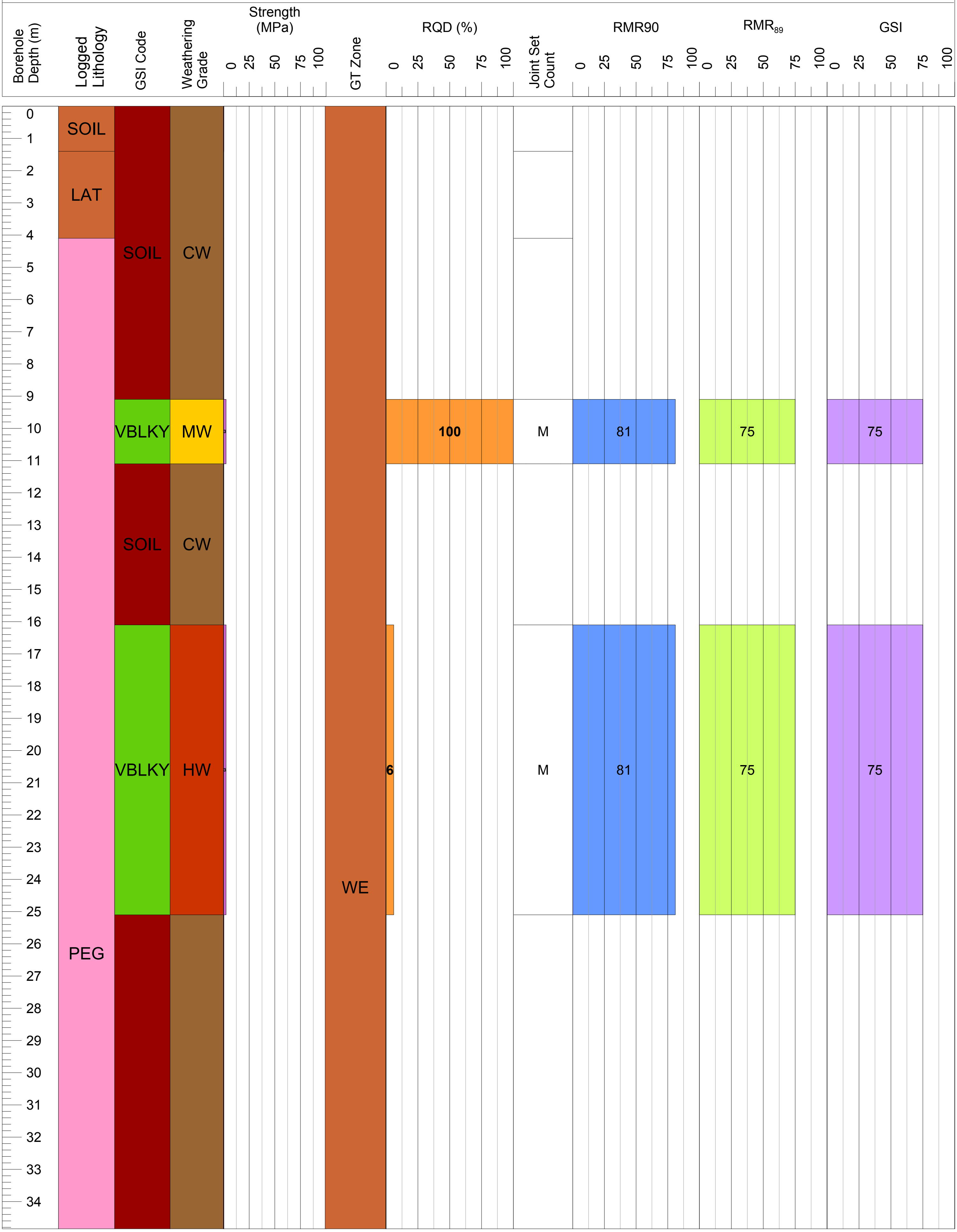
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623606 Northing (m): 8552281 Elevation (m): 1181 Maximum BH Depth (m): 154.5

Source:

Page 1 of 5



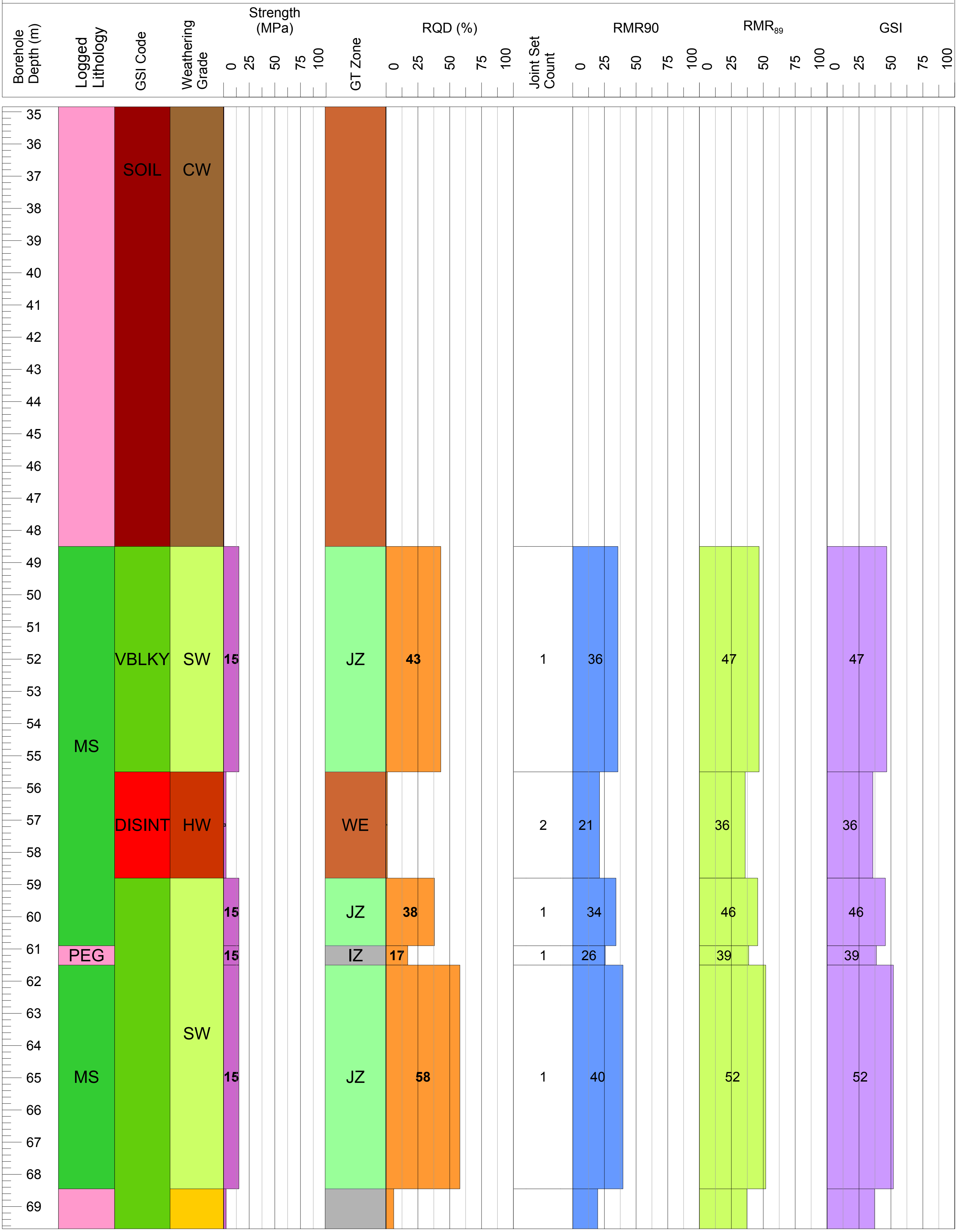
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623606 Northing (m): 8552281 Elevation (m): 1181

Maximum BH Depth (m): 154.5

Source:



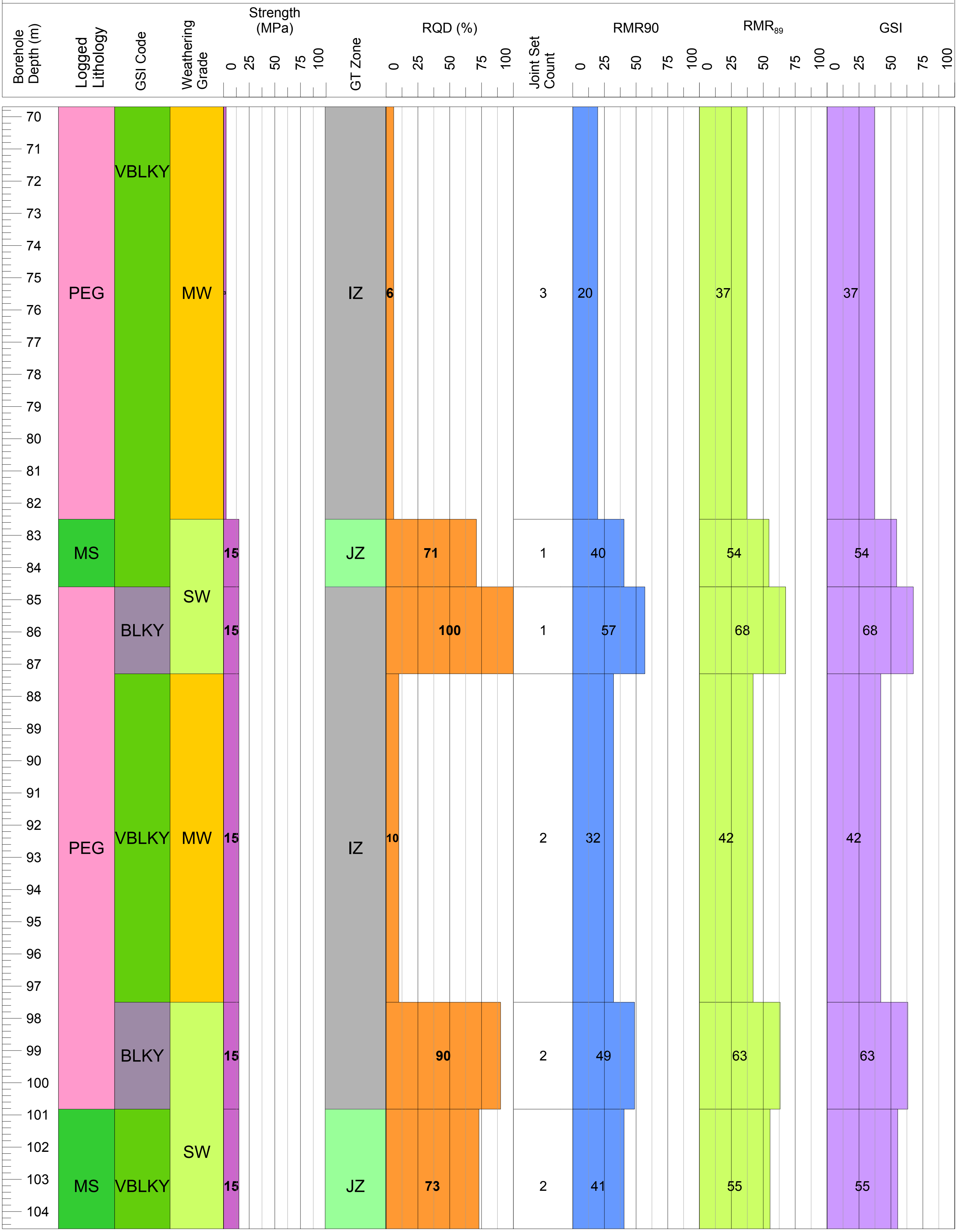
Project: U6512

Client: 2015 Kagem CPR

Easting (m): 623606 Northing (m): 8552281 Elevation (m): 1181

Maximum BH Depth (m): 154.5

Source:



ZD22 **Geotechnical Log**

Project: U6512

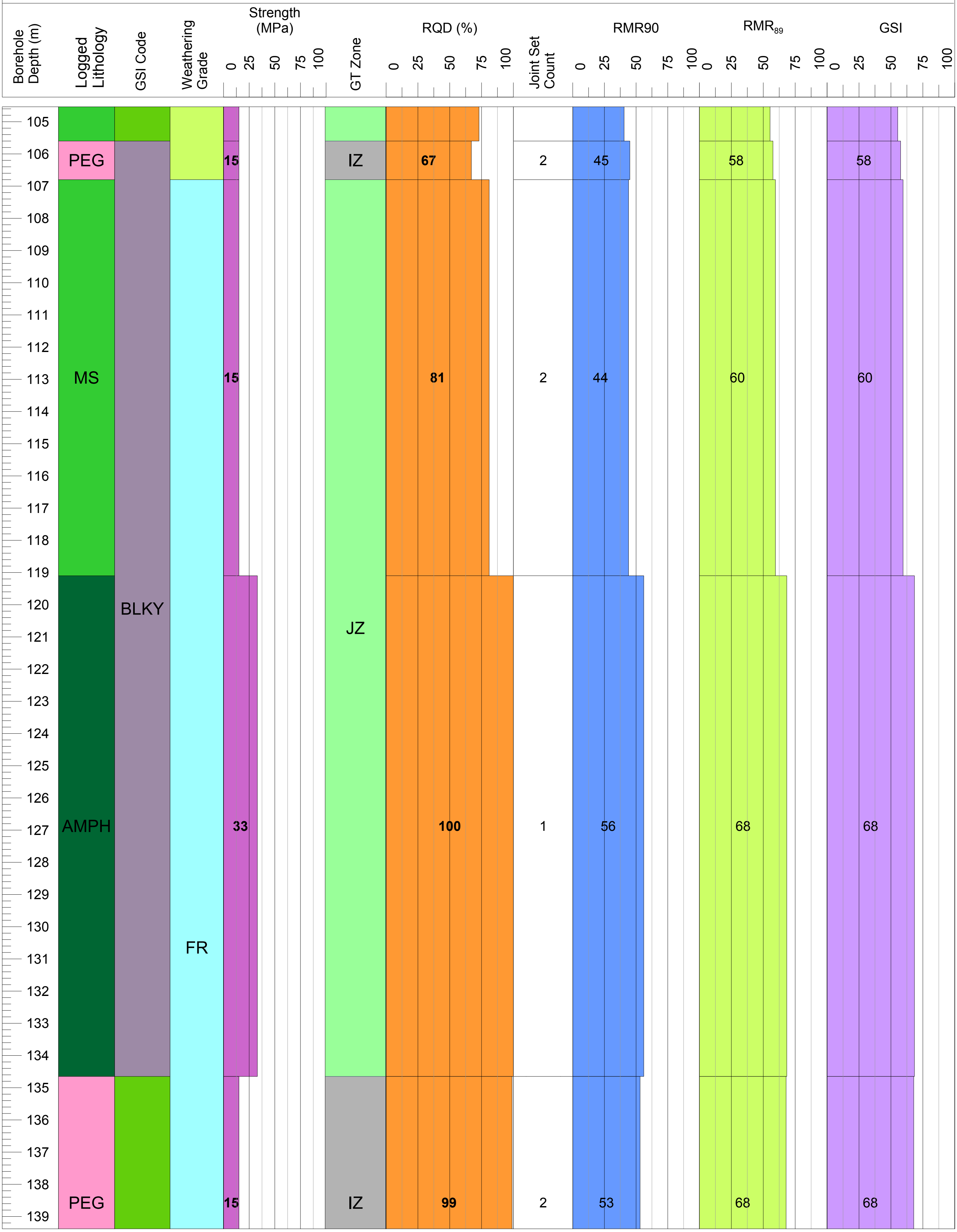
Client: 2015 Kagem CPR

Easting (m): 623606 Northing (m): 8552281 Elevation (m): 1181

Maximum BH Depth (m): 154.5

Source:

Page 4 of 5



ZD22 **Geotechnical Log**

Project: U6512

Client: 2015 Kagem CPR

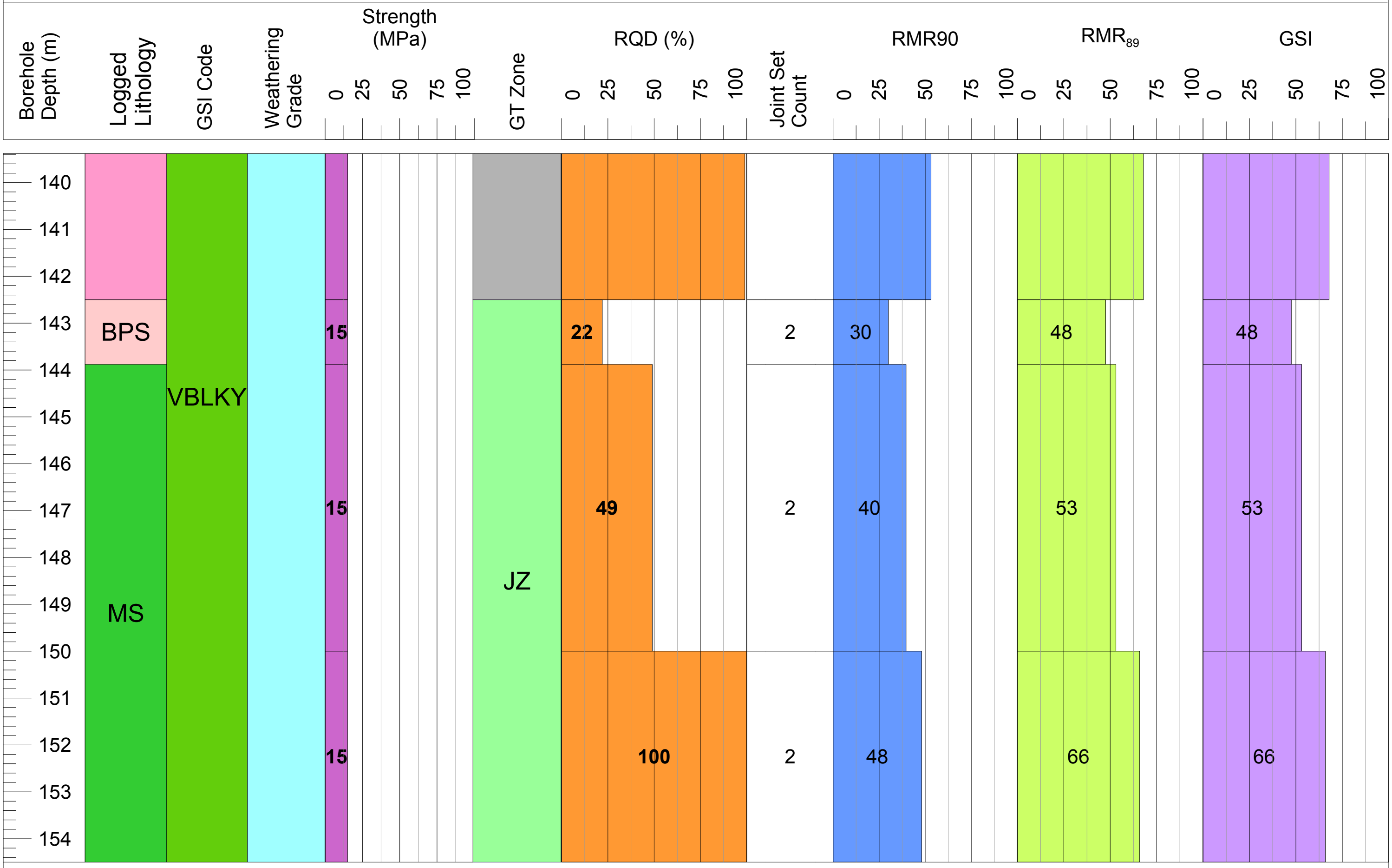
Easting (m): 623606

Northing (m): 8552281

Elevation (m): 1181

Maximum BH Depth (m): 154.5

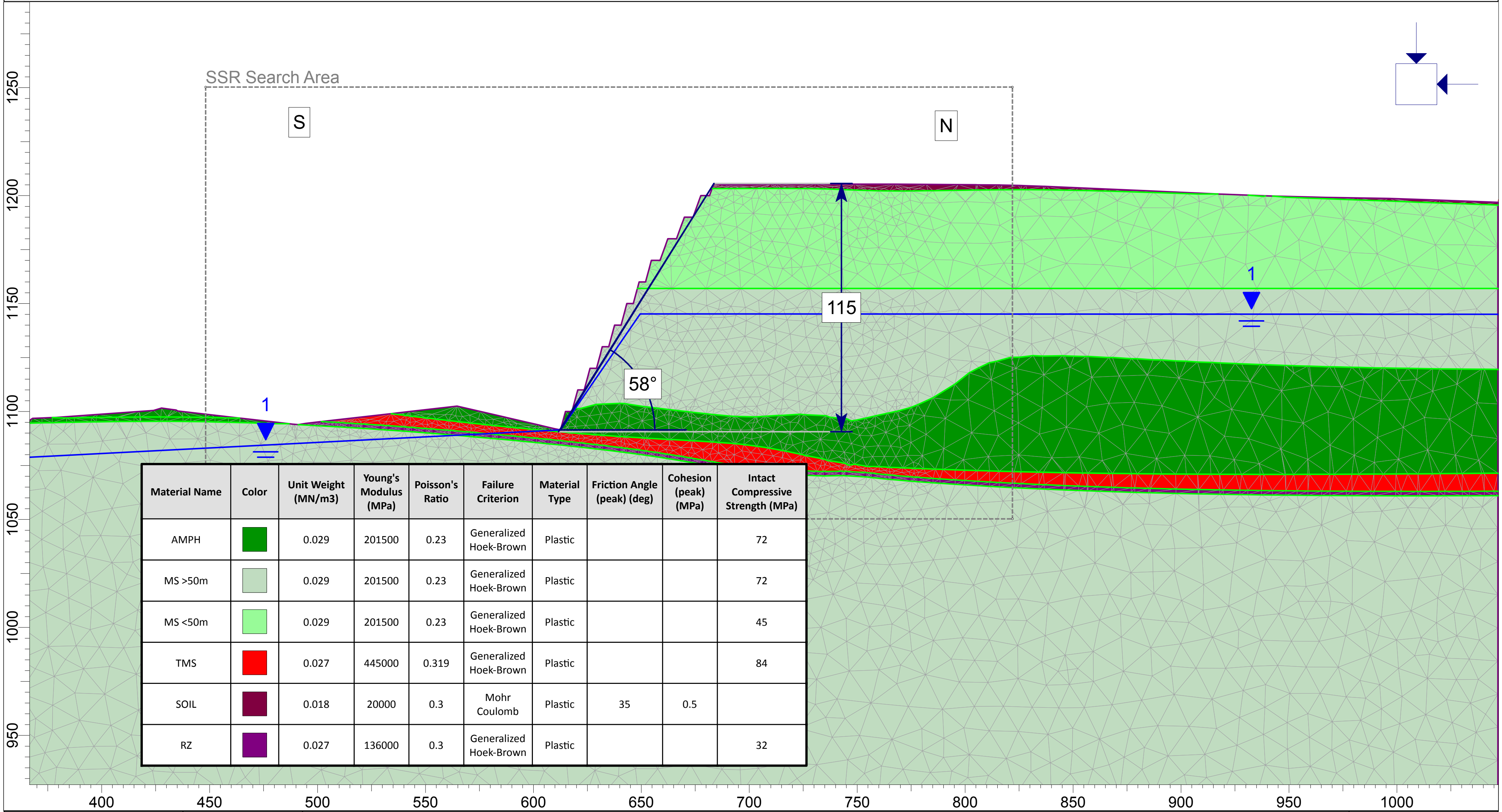
Source:



APPENDIX

F GEOTECHNICAL MODELLING OUTPUT

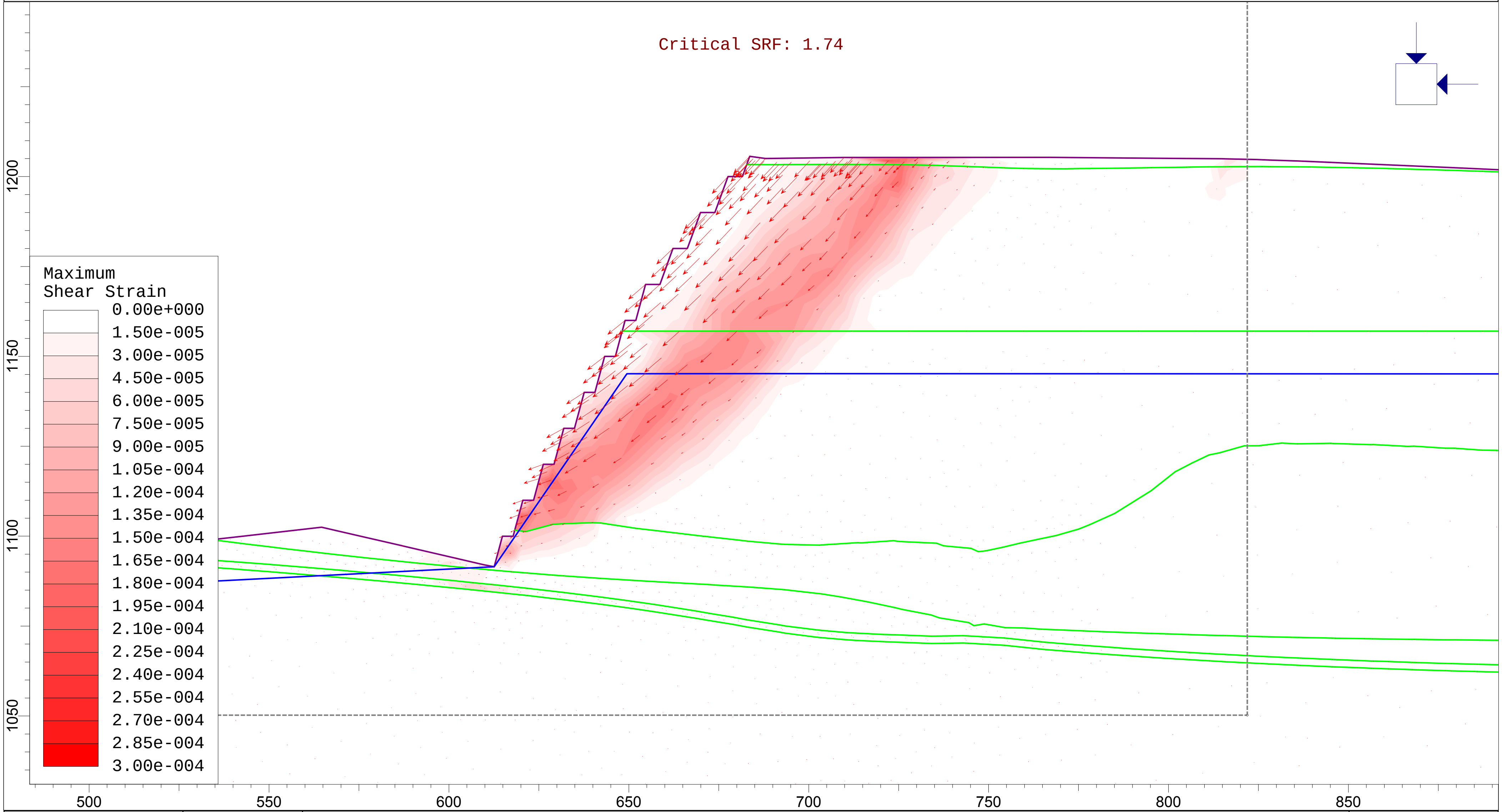
U6512_NE-SW_view_NW_FINAL_6mH2O_.fez



Material Name	Color	Unit Weight (MN/m3)	Young's Modulus (MPa)	Poisson's Ratio	Failure Criterion	Material Type	Friction Angle (peak) (deg)	Cohesion (peak) (MPa)	Intact Compressive Strength (MPa)
AMPH	🟩	0.029	201500	0.23	Generalized Hoek-Brown	Plastic			72
MS >50m	🟩	0.029	201500	0.23	Generalized Hoek-Brown	Plastic			72
MS <50m	🟩	0.029	201500	0.23	Generalized Hoek-Brown	Plastic			45
TMS	🟥	0.027	445000	0.319	Generalized Hoek-Brown	Plastic			84
SOIL	🟫	0.018	20000	0.3	Mohr Coulomb	Plastic	35	0.5	
RZ	🟪	0.027	136000	0.3	Generalized Hoek-Brown	Plastic			32

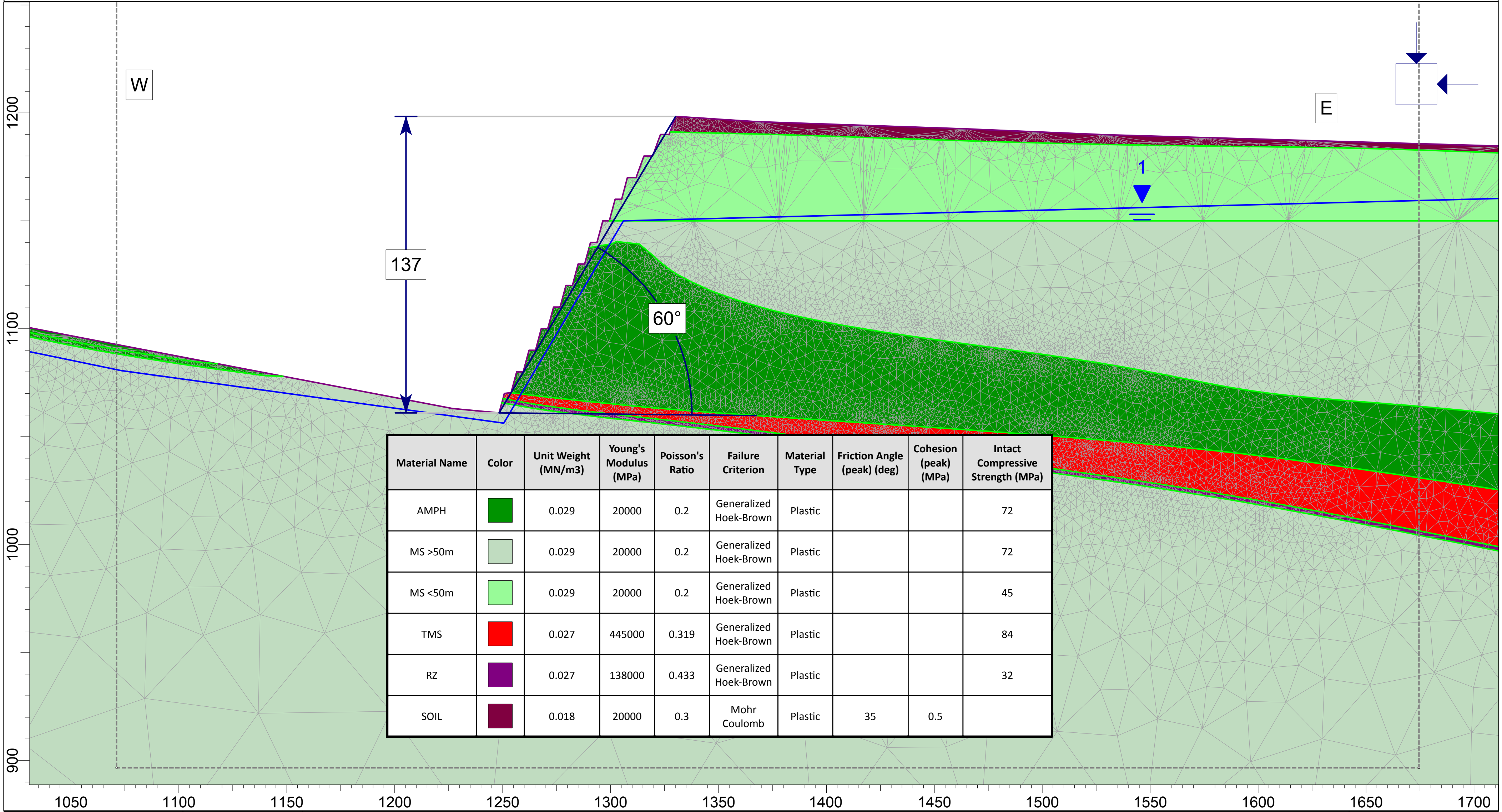
September 2015	U6512	2015 Kagem CPR	1:2500
srk consulting		Pushback 5 - Section 0: FEM Model	0 - 1

U6512_NE-SW_view_NW_FINAL_6mH2O_.fez



September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 - Section 0: FEM Model Results - Mean Strength Parameters	0 - 2

U6512_E-W_view_N_av.fez

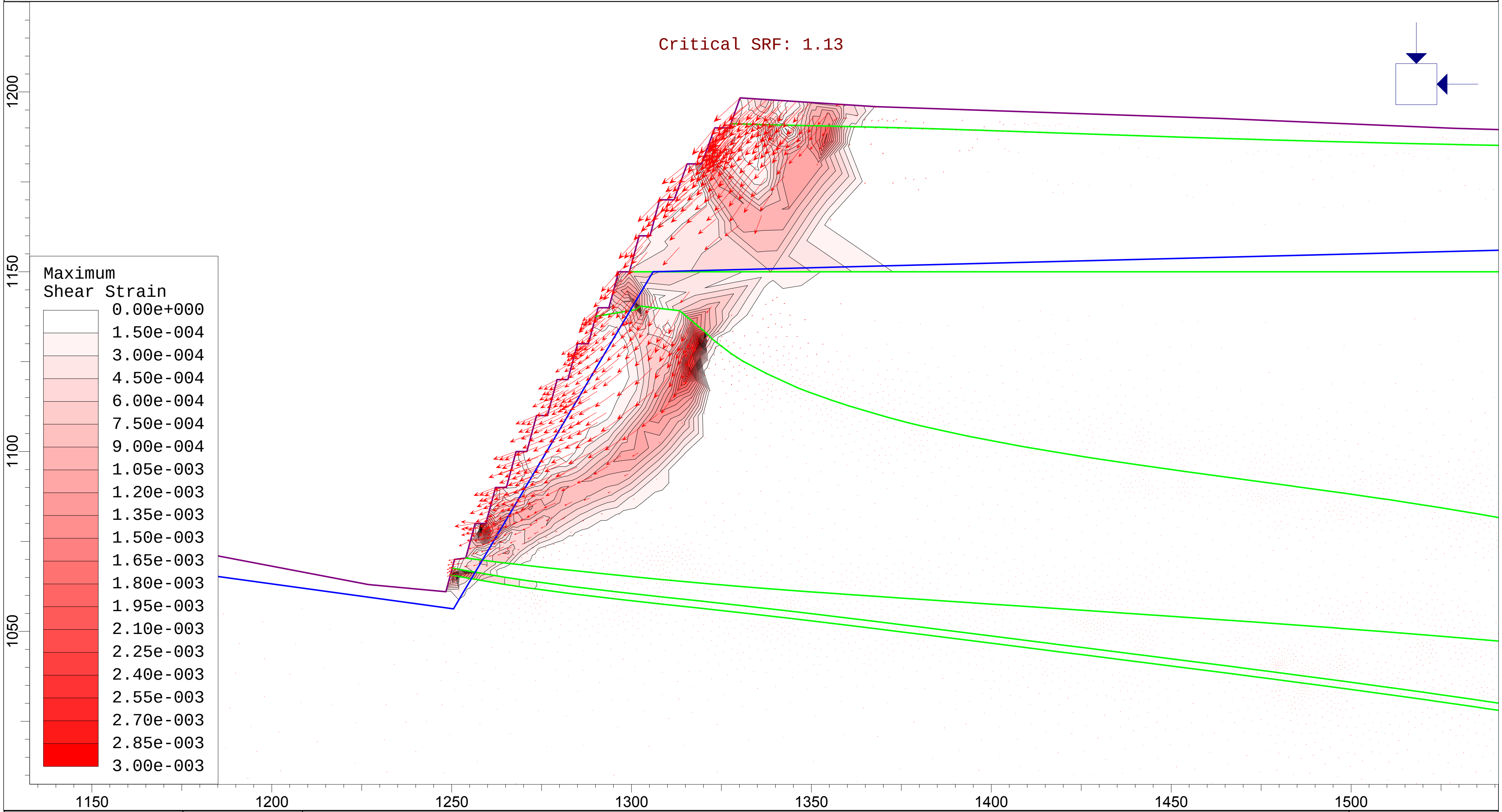


Material Name	Color	Unit Weight (MN/m3)	Young's Modulus (MPa)	Poisson's Ratio	Failure Criterion	Material Type	Friction Angle (peak) (deg)	Cohesion (peak) (MPa)	Intact Compressive Strength (MPa)
AMPH	🟩	0.029	20000	0.2	Generalized Hoek-Brown	Plastic			72
MS >50m	🟩	0.029	20000	0.2	Generalized Hoek-Brown	Plastic			72
MS <50m	🟩	0.029	20000	0.2	Generalized Hoek-Brown	Plastic			45
TMS	🟥	0.027	445000	0.319	Generalized Hoek-Brown	Plastic			84
RZ	🟪	0.027	138000	0.433	Generalized Hoek-Brown	Plastic			32
SOIL	🟫	0.018	20000	0.3	Mohr Coulomb	Plastic	35	0.5	

September 2015	U6512	2015 Kagem CPR	1:2500

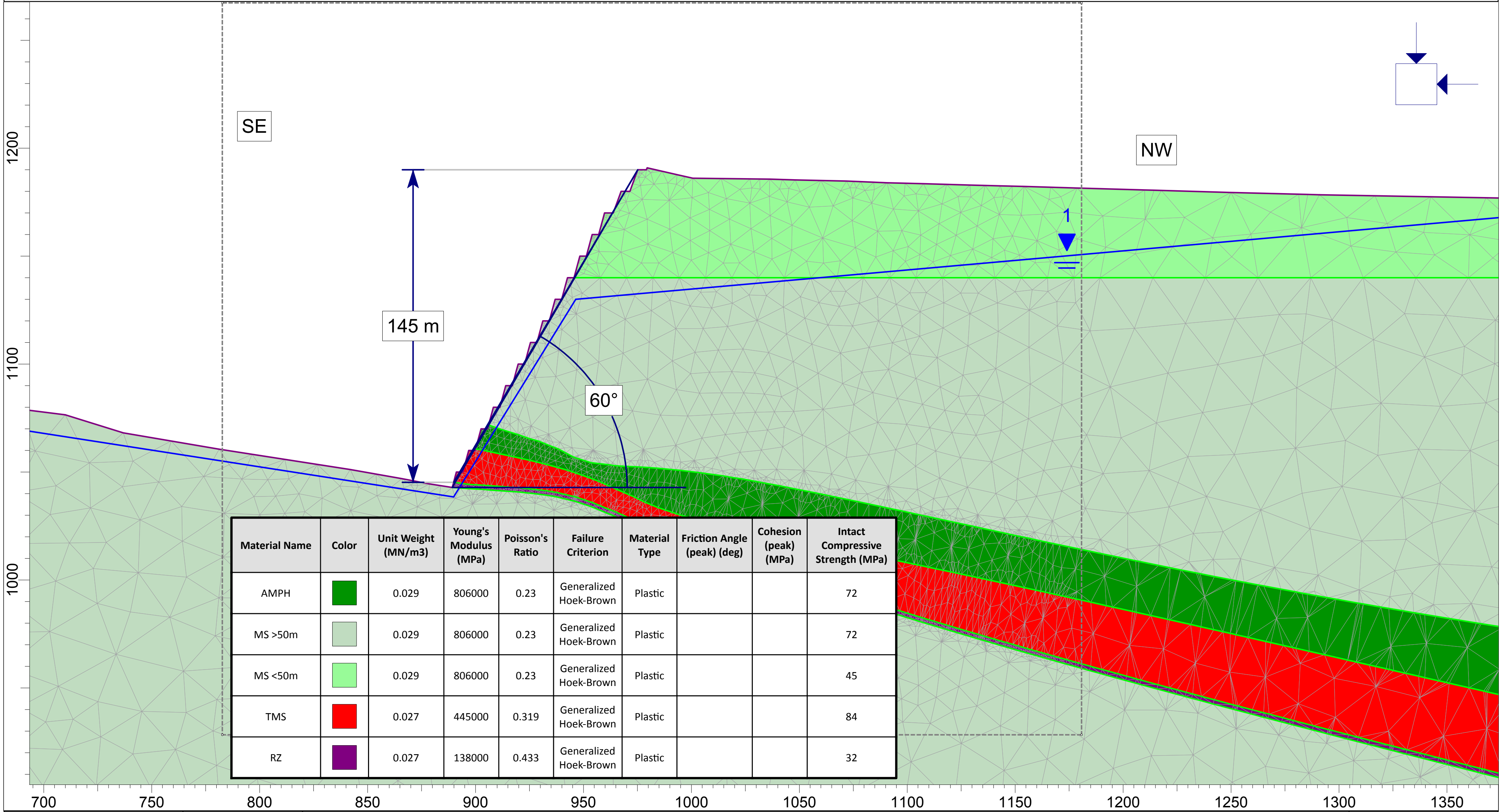
Pushback 5 - Section 2: FEM Model

U6512_E-W_view_N_av.fez



September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 - Section 2: FEM Model Results - Mean Strength Parameters	2 - 2

U6512_NW-SE_view_NE_FINAL_av_D07.fez



Material Name	Color	Unit Weight (MN/m3)	Young's Modulus (MPa)	Poisson's Ratio	Failure Criterion	Material Type	Friction Angle (peak) (deg)	Cohesion (peak) (MPa)	Intact Compressive Strength (MPa)
AMPH	🟩	0.029	806000	0.23	Generalized Hoek-Brown	Plastic			72
MS >50m	🟩	0.029	806000	0.23	Generalized Hoek-Brown	Plastic			72
MS <50m	🟩	0.029	806000	0.23	Generalized Hoek-Brown	Plastic			45
TMS	🟥	0.027	445000	0.319	Generalized Hoek-Brown	Plastic			84
RZ	🟪	0.027	138000	0.433	Generalized Hoek-Brown	Plastic			32

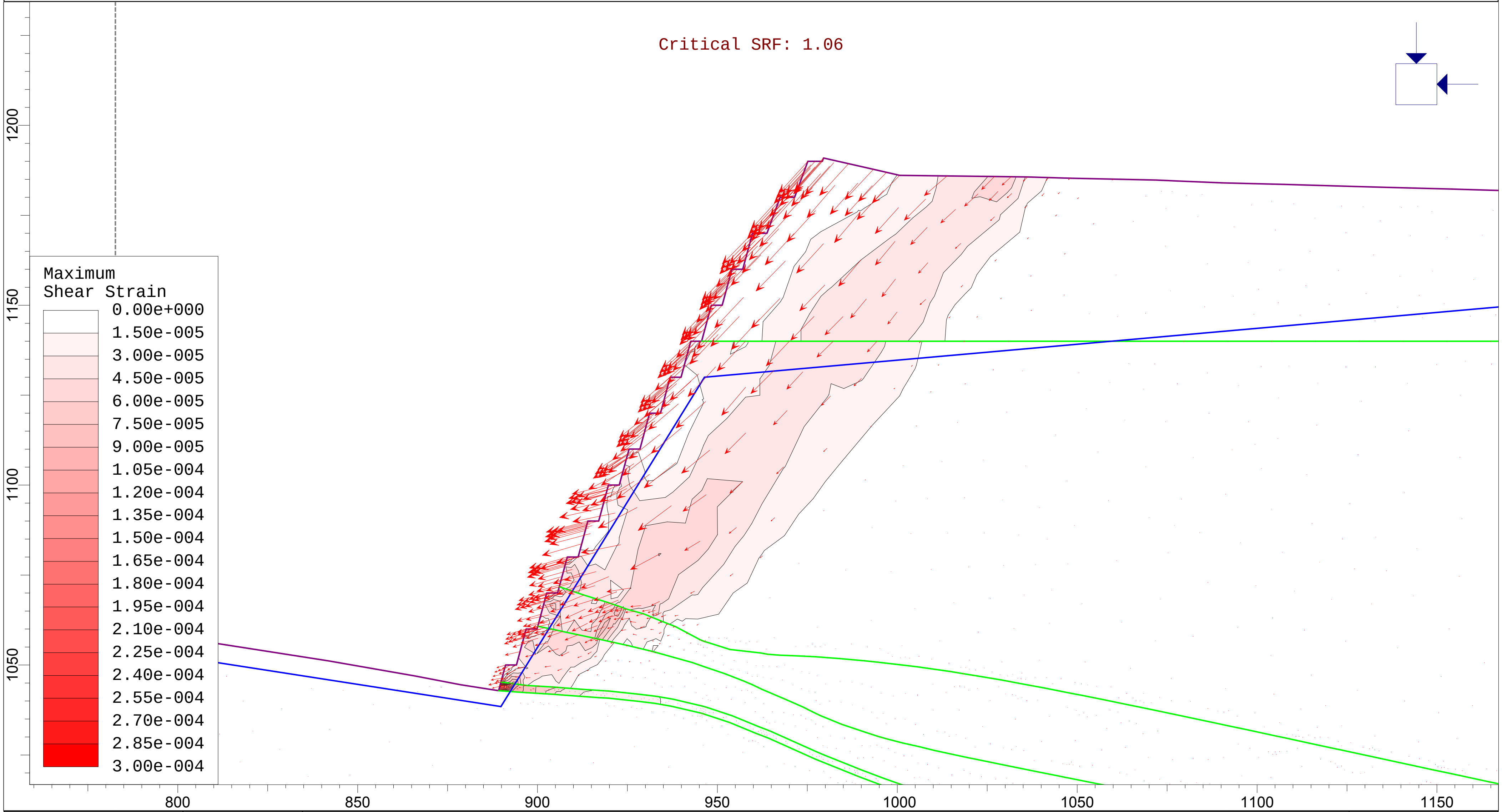
September 2015	U6512	2015 Kagem CPR	1:2500

srk consulting

Pushback 5 - Section 3: FEM Model

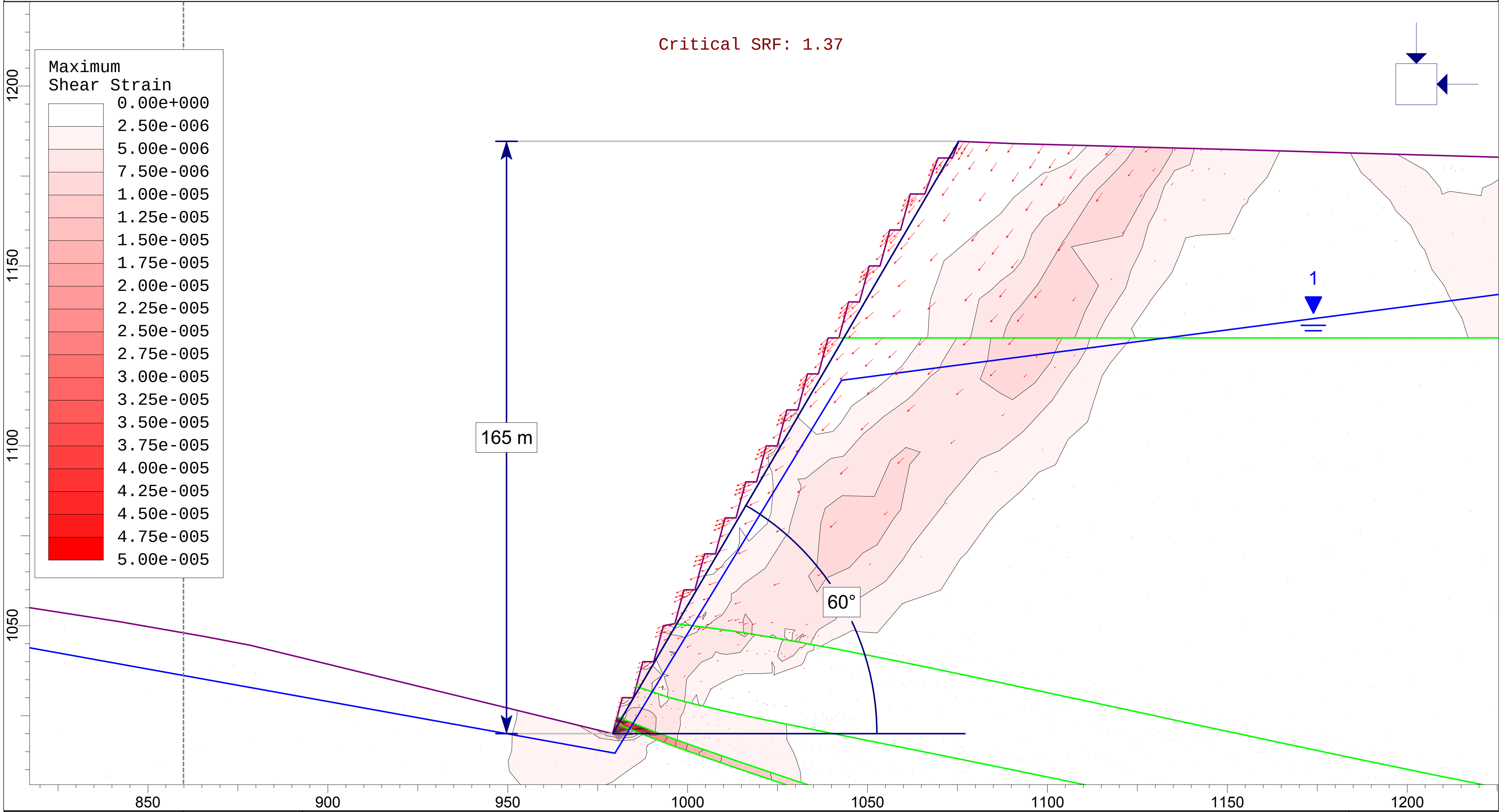
3 - 1

U6512_NW-SE_view_NE_FINAL_av_D07.fez



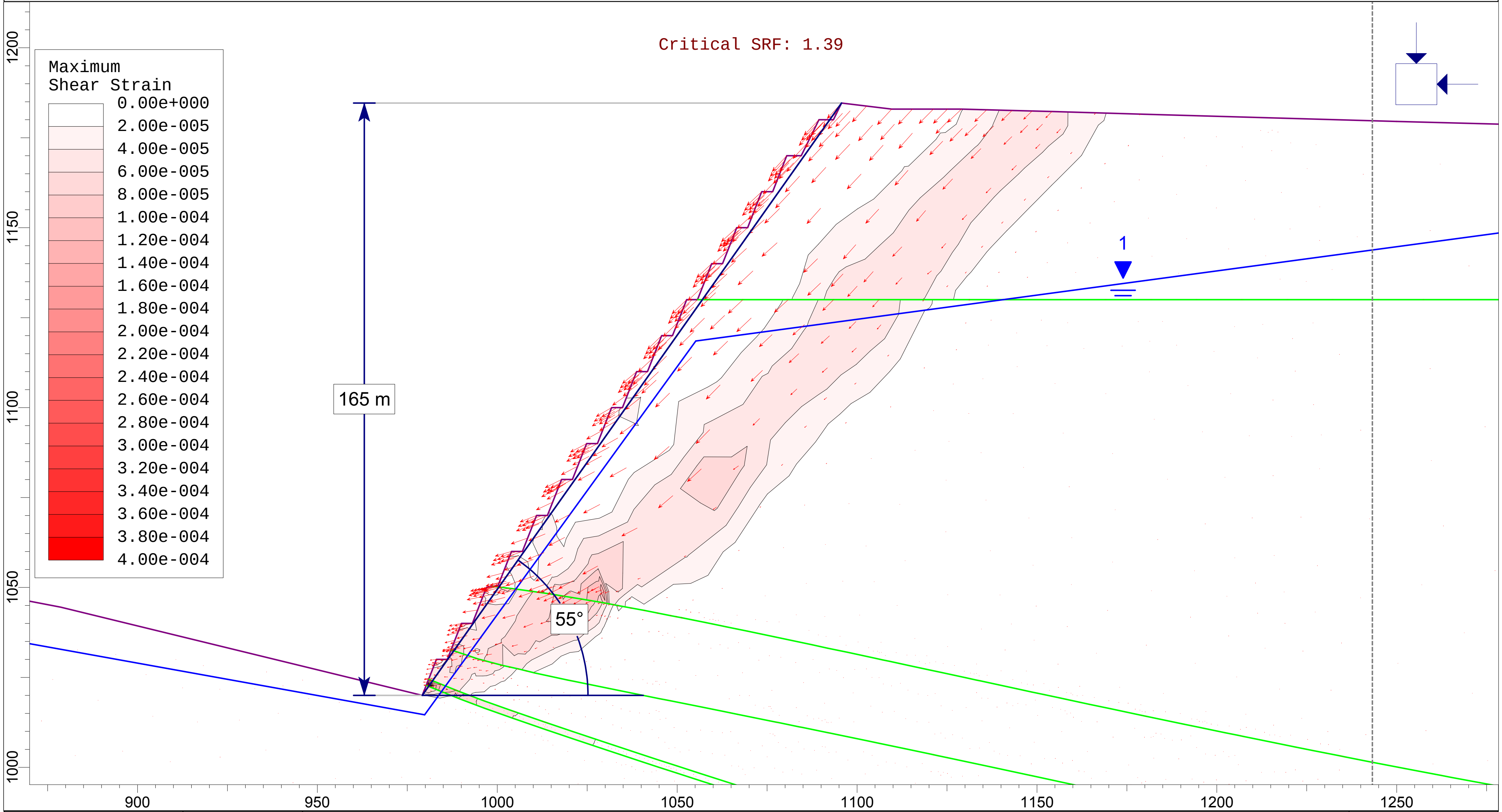
September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 - Section 3: FEM Model Results - Mean Strength Parameters	3 - 2

U6512_NW-SE_view_NE_FINAL_100m_av new mesh.fez



September 2015	U6512	2015 Kagem CPR	1:1500
		Pushback 5 + 100m @ 60° - Section 3: FEM Model Results - Mean Strength Parameters	3 - 3

U6512_NW-SE_view_NE_FINAL_100m_av_D07_55sl.fez



September 2015

U6512

2015 Kagem CPR

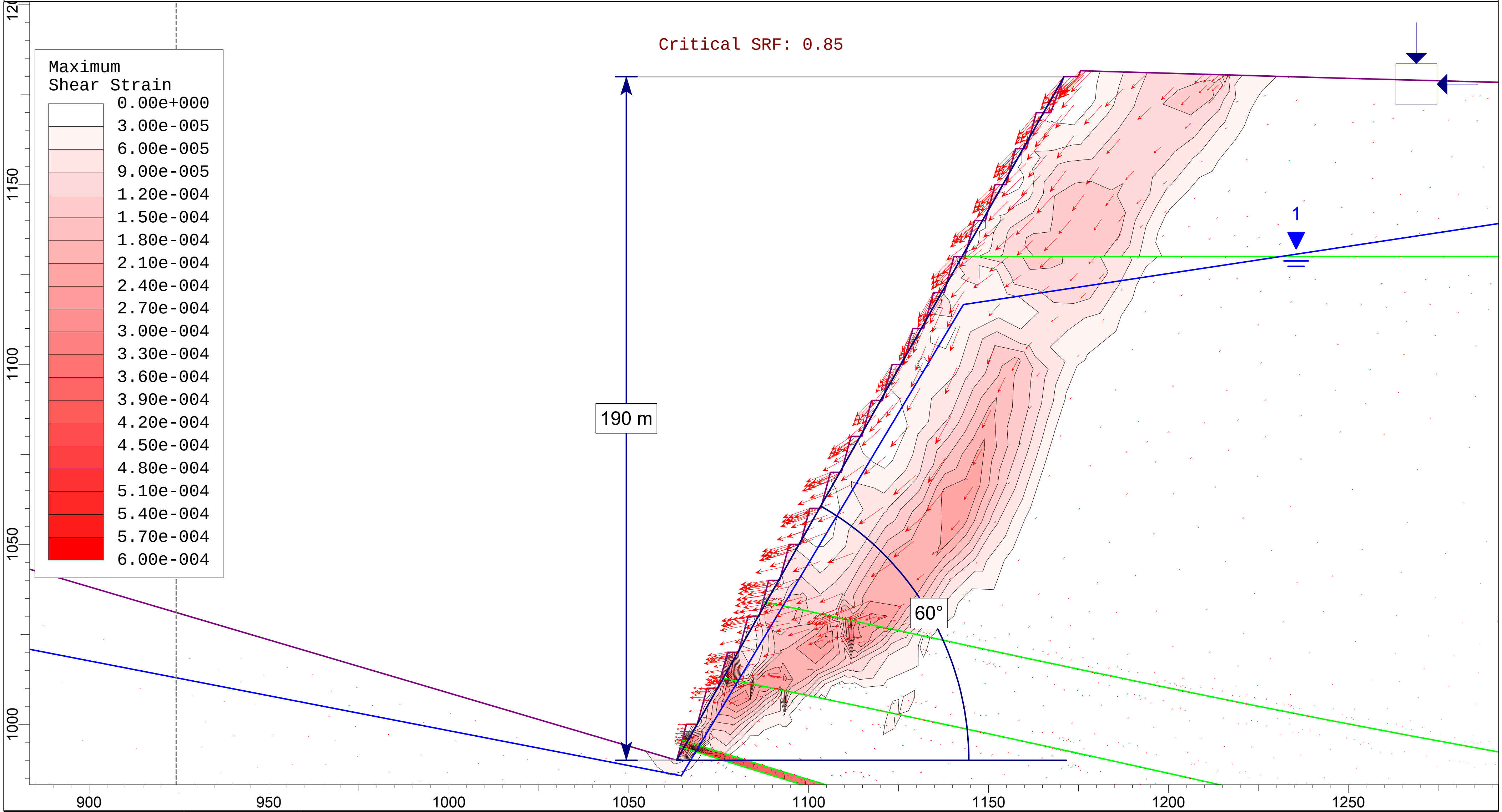
1:1500

srk consulting

Pushback 5 + 100m @ 55° - Section 3: FEM Model Results - Mean Strength Parameters

3 - 4

U6512_NW-SE_view_NE_FINAL_200m_av_D07.fez



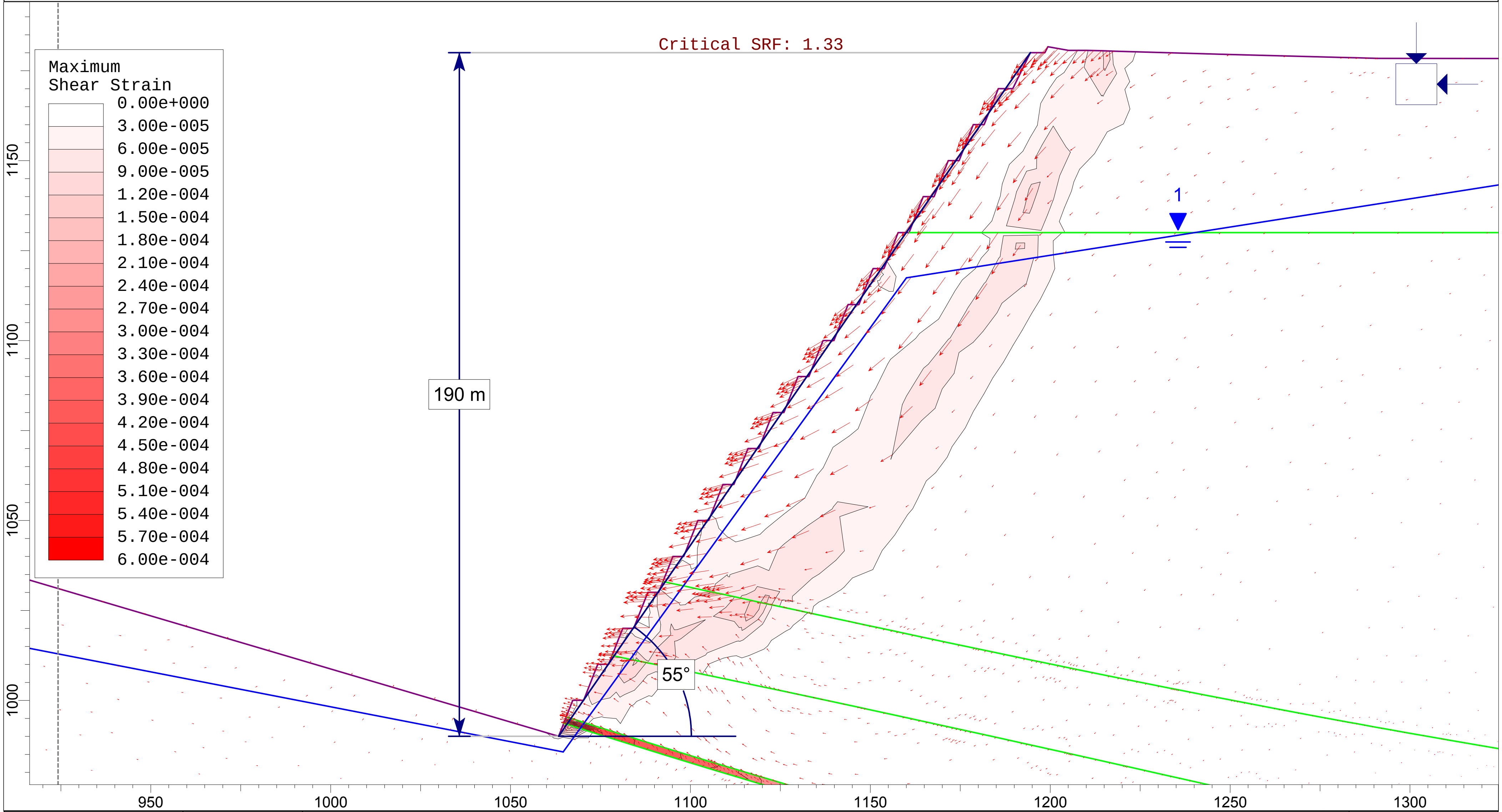
September 2015
U6512
2015 Kagem CPR
1:1500

srk consulting

Pushback 5 + 200m @ 60° - Section 3: FEM Model Results - Mean Strength Parameters

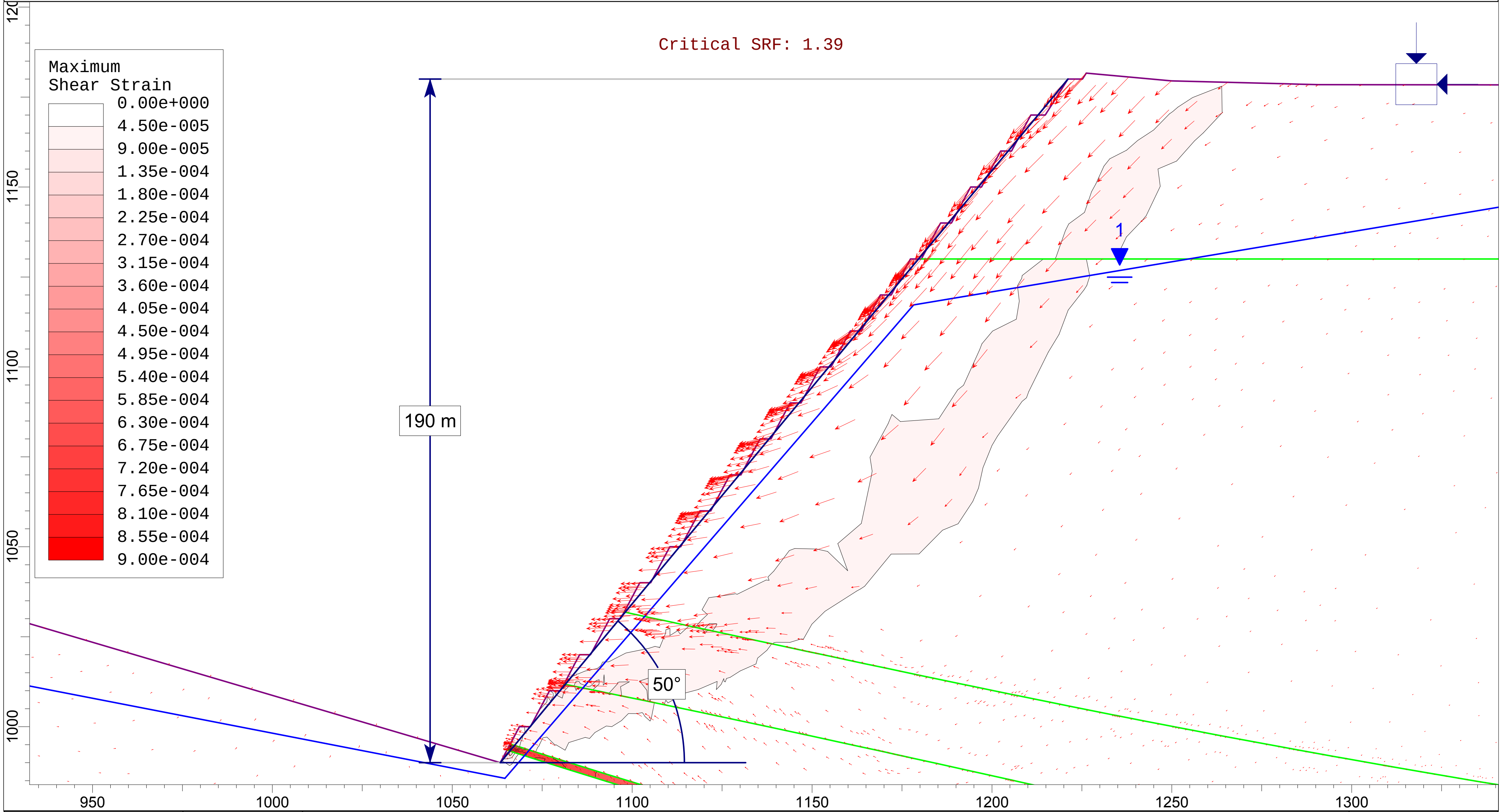
3 - 5

U6512_NW-SE_view_NE_FINAL_200m_av_D07_55sl.fez



September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 + 200m @ 55° - Section 3: FEM Model Results - Mean Strength Parameters	3 - 6

U6512_NW-SE_view_NE_FINAL_200m_av_D07_50sl.fez

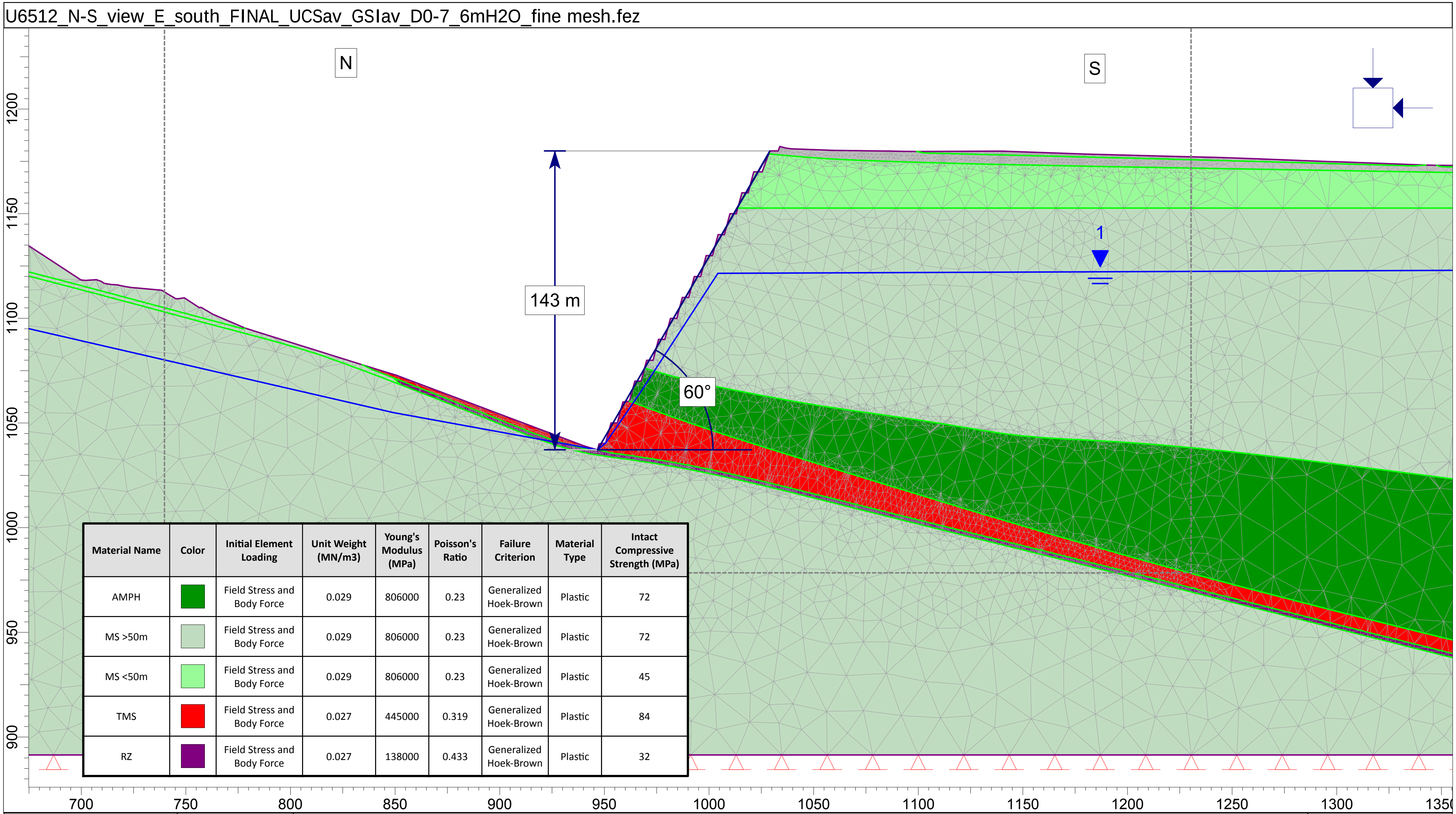


September 2015 | U6512 | 2015 Kagem CPR | 1:1500

srk consulting

Pushback 5 + 200m @ 50° - Section 3: FEM Model Results - Mean Strength Parameters

3 - 7



Material Name	Color	Initial Element Loading	Unit Weight (MN/m3)	Young's Modulus (MPa)	Poisson's Ratio	Failure Criterion	Material Type	Intact Compressive Strength (MPa)
AMPH	🟩	Field Stress and Body Force	0.029	806000	0.23	Generalized Hoek-Brown	Plastic	72
MS >50m	🟩	Field Stress and Body Force	0.029	806000	0.23	Generalized Hoek-Brown	Plastic	72
MS <50m	🟩	Field Stress and Body Force	0.029	806000	0.23	Generalized Hoek-Brown	Plastic	45
TMS	🟥	Field Stress and Body Force	0.027	445000	0.319	Generalized Hoek-Brown	Plastic	84
RZ	🟪	Field Stress and Body Force	0.027	138000	0.433	Generalized Hoek-Brown	Plastic	32

September 2015
U6512
2015 Kagem CPR
1:2500

srk consulting

Pushback 5 - Section 4: FEM Model

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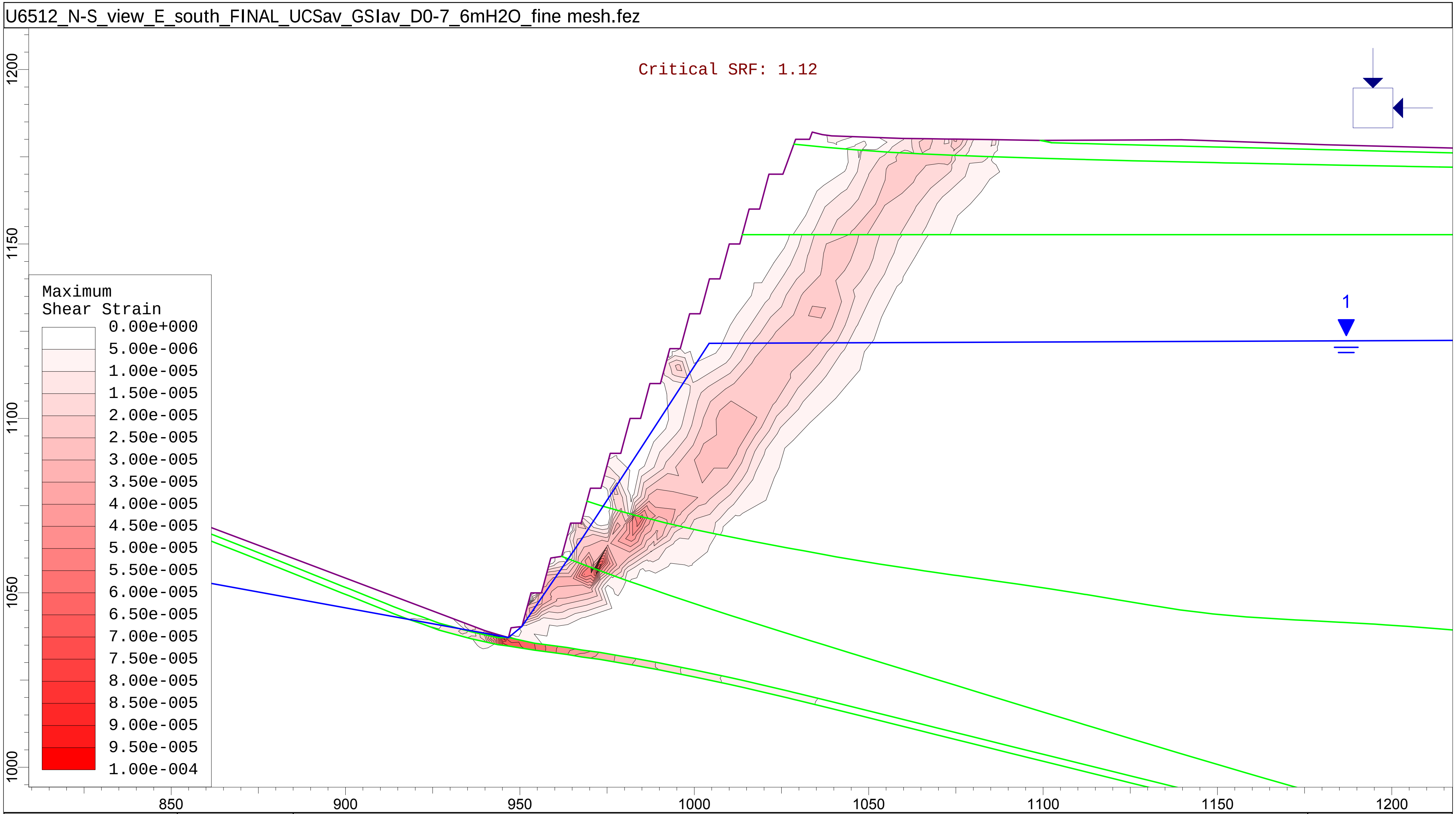
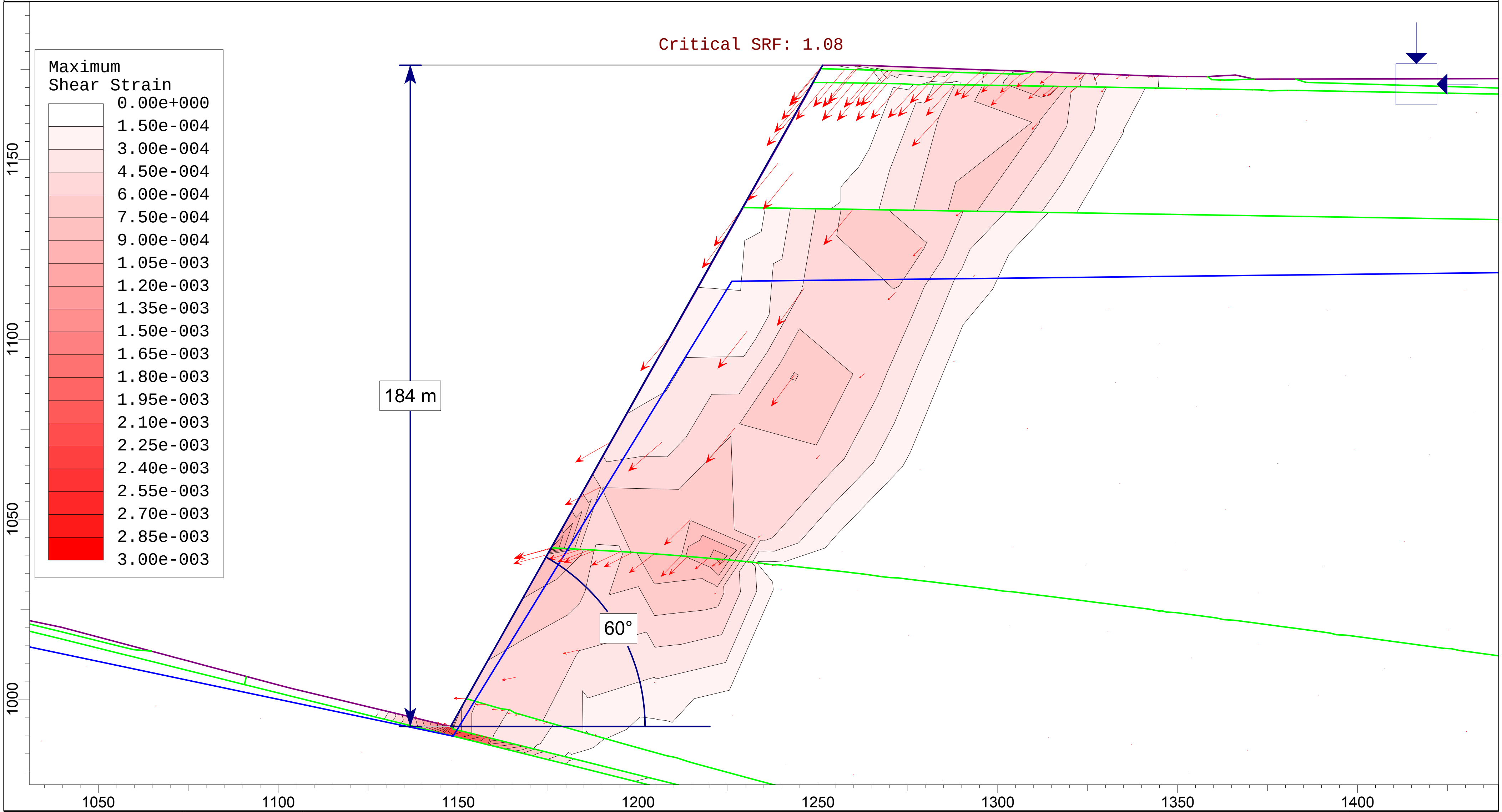


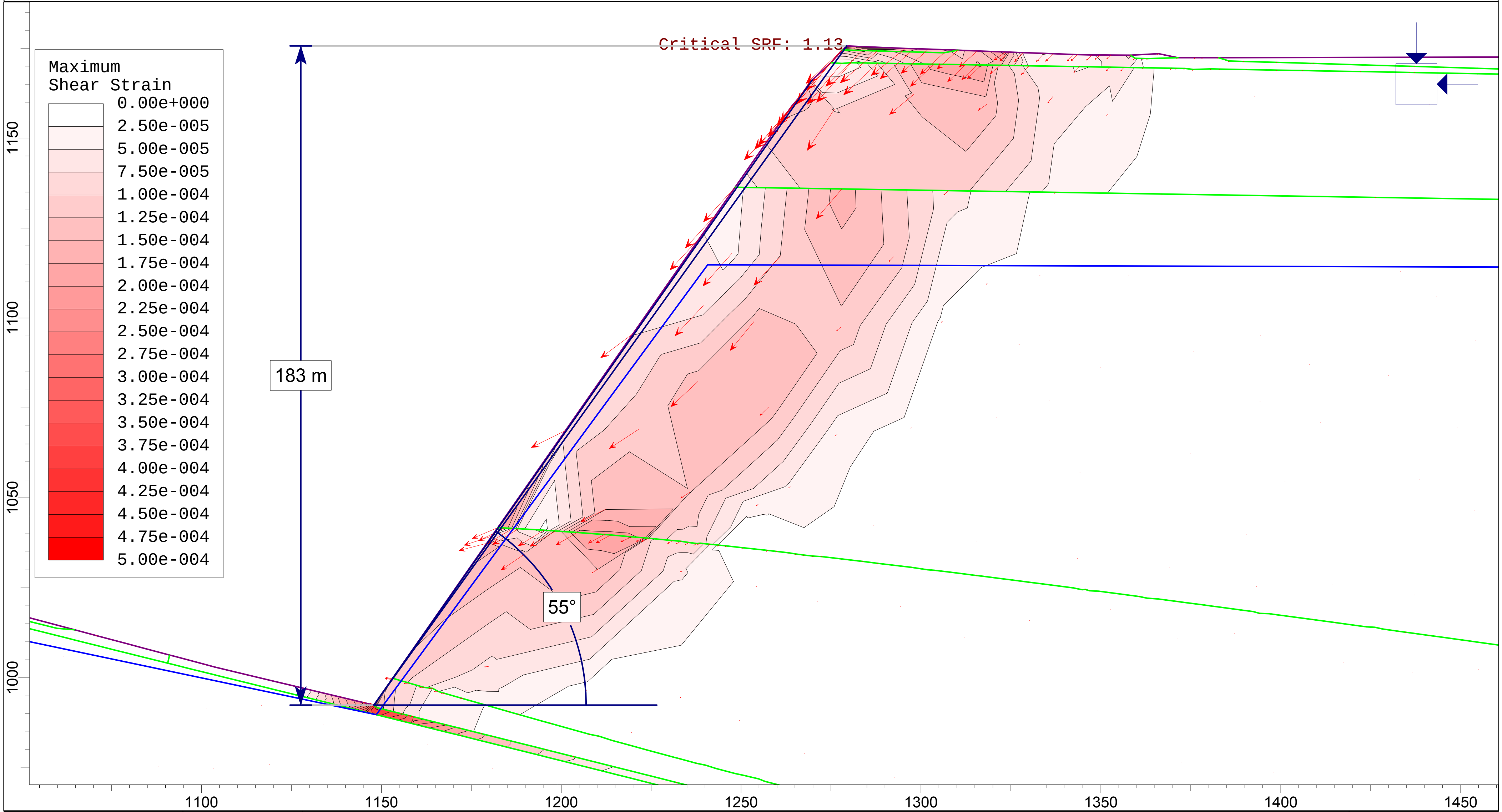
September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 - Section 4: FEM Model Results - Mean Strength Parameters	4 - 2

U6512_N-S_view_E_south_cutback200m_D0-7_6mH2O_.fez



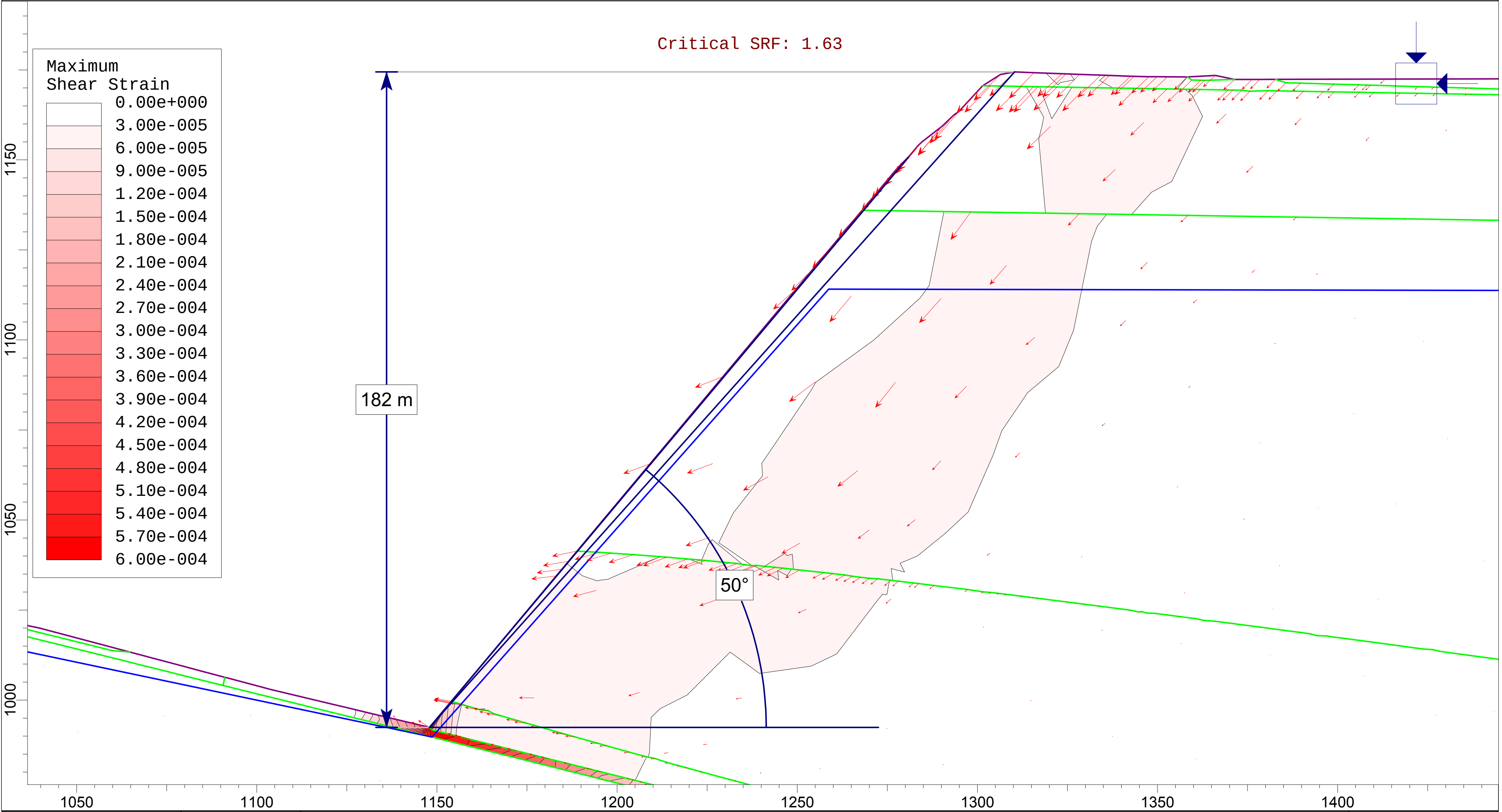
September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 + 200m @ 60° - Section 4: FEM Model Results - Mean Strength Parameters	4 - 3

U6512_N-S_view_E_south_cutback200m_55deg_UCSAv_GSIAv_D0-7_6mH2O_.fez



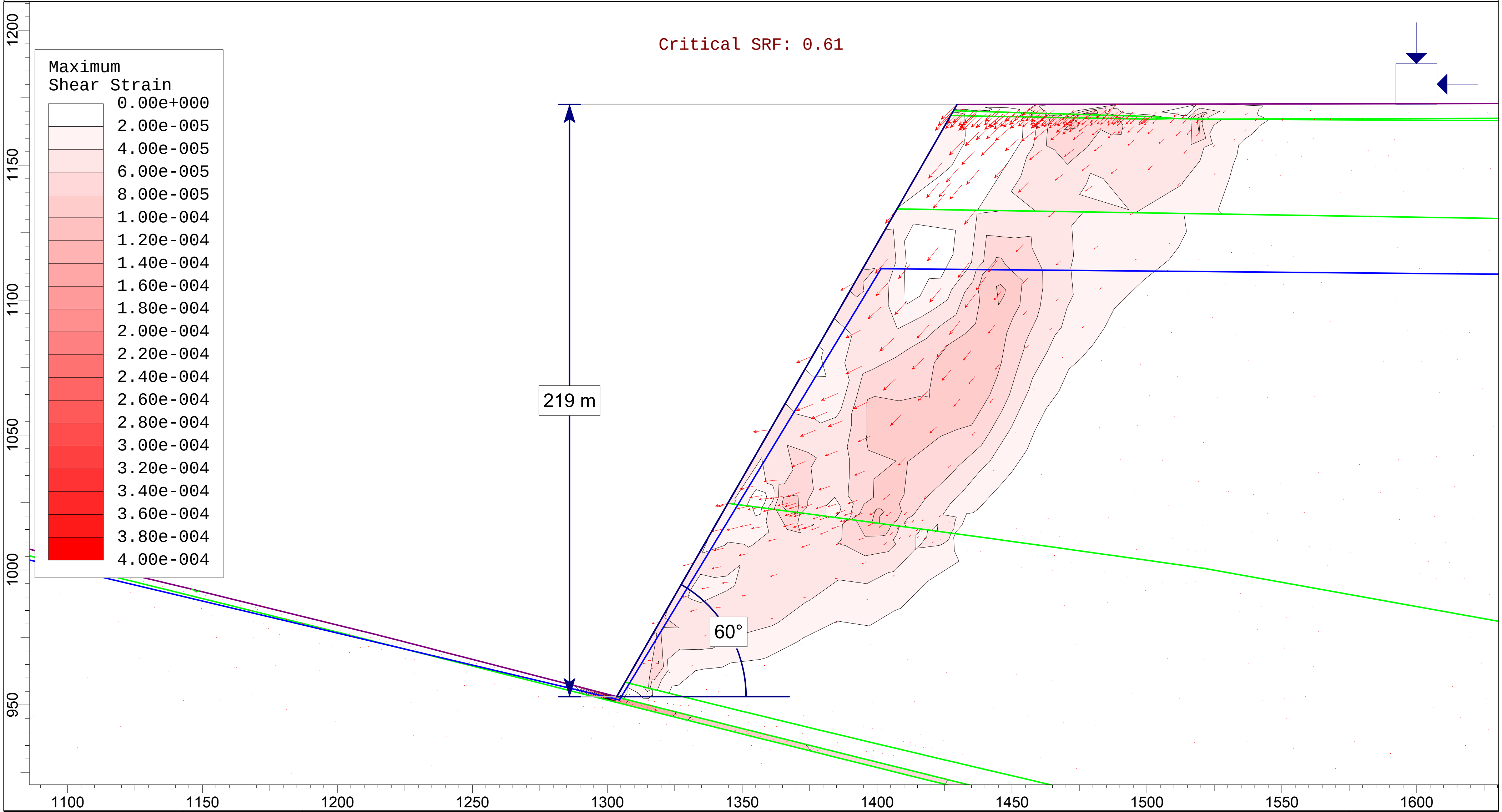
September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 + 200m @ 55° - Section 4: FEM Model Results - Mean Strength Parameters	4 - 4

U6512_N-S_view_E_south_cutback200m_50deg_UCSAv_GSIAv_D0-7_6mH2O_.fez



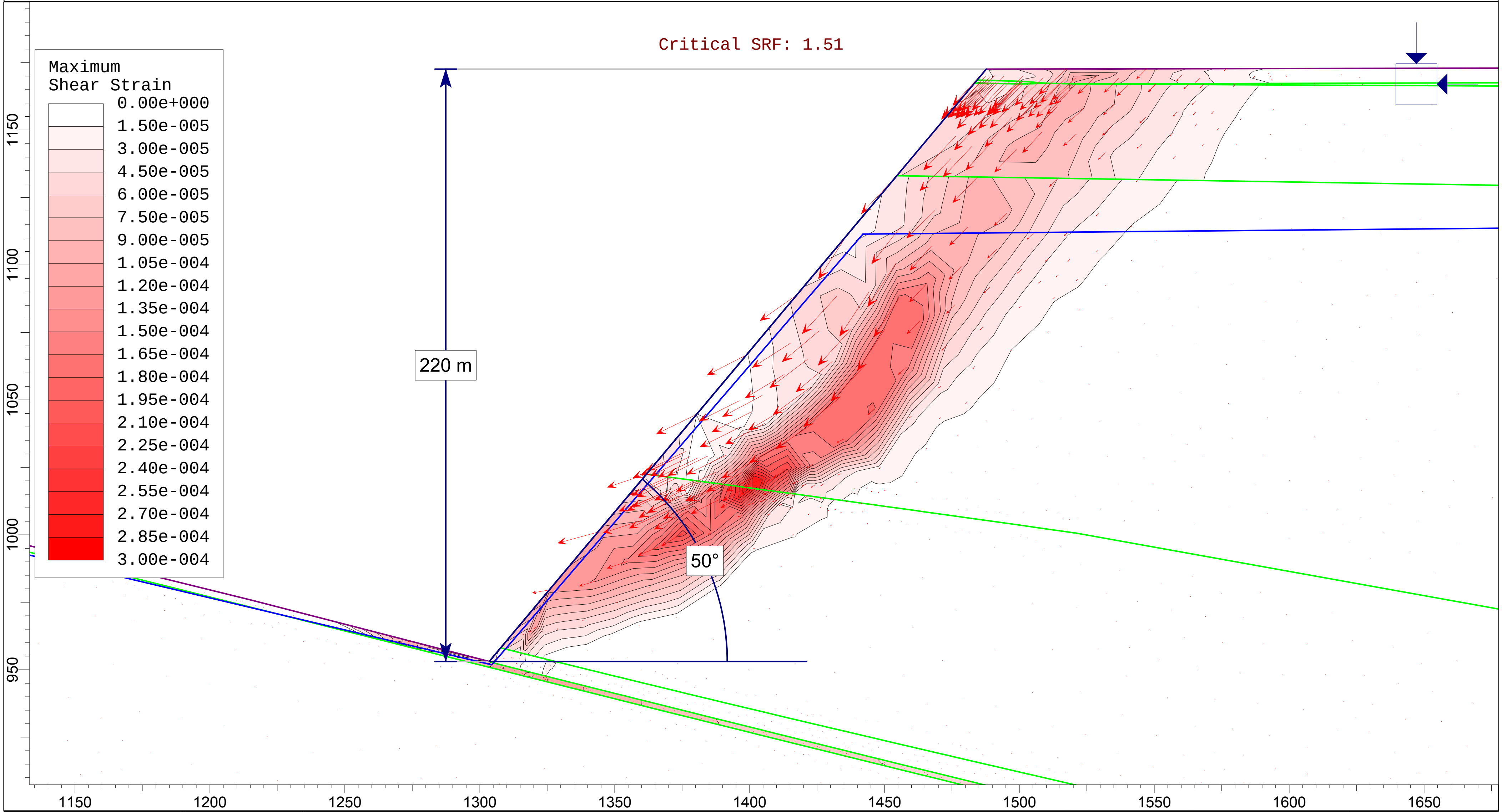
September 2015	U6512	2015 Kagem CPR	1:1500
srk consulting		Pushback 5 + 200m @ 50° - Section 4: FEM Model Results - Mean Strength Parameters	4 - 5

U6512_N-S_view_E_south_cutback400m_UCSav_GSIav_D0-7_6mH2O_.fez



September 2015	U6512	2015 Kagem CPR	1:2000
srk consulting	Pushback 5 + 400m @ 60° - Section 4: FEM Model Results - Mean Strength Parameters		4 - 6

U6512_N-S_view_E_south_cutback400m_50deg_UCSAv_GSIAv_D0-7_6mH2O_.fez



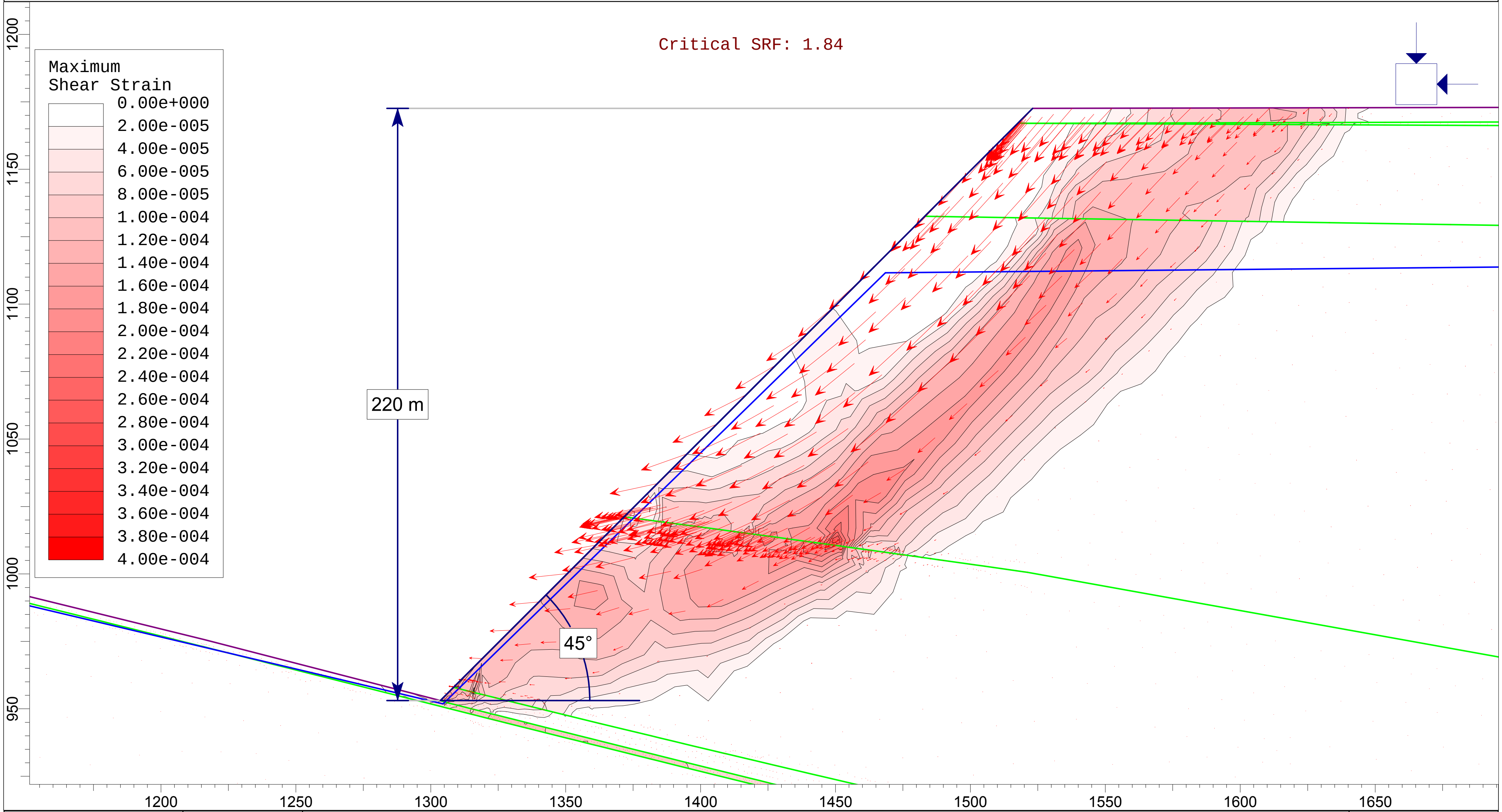
September 2015	U6512	2015 Kagem CPR	1:2000

srk consulting

Pushback 5 + 400m @ 50° - Section 4: FEM Model Results - Mean Strength Parameters

4 - 7

U6512_N-S_view_E_south_cutback400m_45deg_UCSAv_GSIAv_D0-7_6mH2O_.fez



September 2015	U6512	2015 Kagem CPR	1:2000
srk consulting		Pushback 5 + 400m @ 45° - Section 4: FEM Model Results - Mean Strength Parameters	4 - 8