MAIDEN MINERAL RESOURCE ESTIMATE FOR THE KBK INDUSTRIAL MINERALS PROJECT, KALIMANTAN

Prepared For

PT Kaltara Batu Konstruksi (PT KBK)

Report Prepared by

srk consulting

SRK Consulting (UK) Limited

UK7285

SRK Legal Entity:		SRK Consulting (UK) Limited
SRK Address:		5th Floor Churchill House 17 Churchill Way Cardiff, CF10 2HH Wales, United Kingdom.
Date:		September 2021
Project Number:		UK7285
SRK Project Director:	Dr Tim Lucks	Managing Director Principal Consultant (Geology/Study Management) • UK Geology
SRK Project Manager:	Mr Dean McMinn	Senior Consultant (Mine/Economic Geology)
Client Legal Entity:		PT. KALTARA BATU KONSTRUKSI (PT KBK)
Client Address:		Simprug Gallery Blok-S JI, Teuku Nyak Arif No. 10 Selatan, Jakarta, Indonesia, 12220

Table of Contents: Executive Summary

List of Tables: Executive Summary

List of Figures: Executive Summary

SRK Consulting (UK) Limited
5th Floor Churchill House
17 Churchill Way
Cardiff CF10 2HH
Wales, United Kingdom
E-mail: enquiries@srk.co.uk
URL: www.srk.com
Tel: + 44 (0) 2920 348 150

EXECUTIVE SUMMARY
MAIDEN MINERAL RESOURCE ESTIMATE FOR THE KBK INDUSTRIAL MINERALS PROJECT, KALIMANTAN

1 EXECUTIVE SUMMARY

1.1 Introduction

SRK Consulting (UK) Limited ("SRK") has been requested by PT. KALTARA BATU KONSTRUKSI ("PT KBK", herein also referred to as "the Company") to prepare a Maiden Mineral Resource Estimate (MRE) for its Industrial Minerals Project ("KBK" or the "Project"), located in Kalimantan, Indonesia. SRK understands that the purpose of the MRE is to inform discussions between the Company and its advisors (the "Advisors") in relation to the ongoing development of the Project.

The MRE presented in this Report has been prepared in accordance with the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, the JORC Code, 2012 Edition ("JORC Code"). This Report has been compiled by Dean McMinn (FAusIMM (CP)), a Senior Consultant and Geologist at SRK Consulting (KZ) Limited ("SRK KZ"), and Mr Peter Gleeson (MAIGS, MIMMM, Cert Eng), who is a Competent Person for Mineral Resources, and a Corporate Consultant and Resource Geologist at SRK KZ. The 3D modelling and geological interpretation has been completed by Mr Oliver Jones (MAusIMM), the Director of Impala Geomodelling Limited. SRK KZ also conducted a Competent Persons (CP) site visit for the purpose of the MRE and on-site support services were provided by Mr Dean McMinn from 15 March 2021 until 10 April 2021. The Project site was also visited by several other personal from SRK as part of other commissions in relation to due diligence, infrastructure development and geotechnical assessments.

1.2 Property Description and Location

The Project is located in the Malinau administrative District, North Kalimantan Province, Indonesia, close to the Malaysian border. The KBK port area is approximately 8 km northeast of the Project, close to the township of Malinau.

The regional infrastructure is relatively well established, several nearby mining operations utilise the existing infrastructure and utilities (grid power and river/water table water sources). The Project concept consists of a mine/quarry area (approximately 40 hectares), a retail hub area ("the Hub") for processing (crushing); a conveyor link from the Hub to the port for transport of material, and a proposed barge link service to transport product along the river to domestic and international customers.

The Company is currently investigating an aggregate production scenario whereby the mine will produce crushed rock aggregate of varying size fractions, as well as amourstone for domestic and export sales. The main operational scenario being considered by the Company is for contracted mine, processing and transport operations.

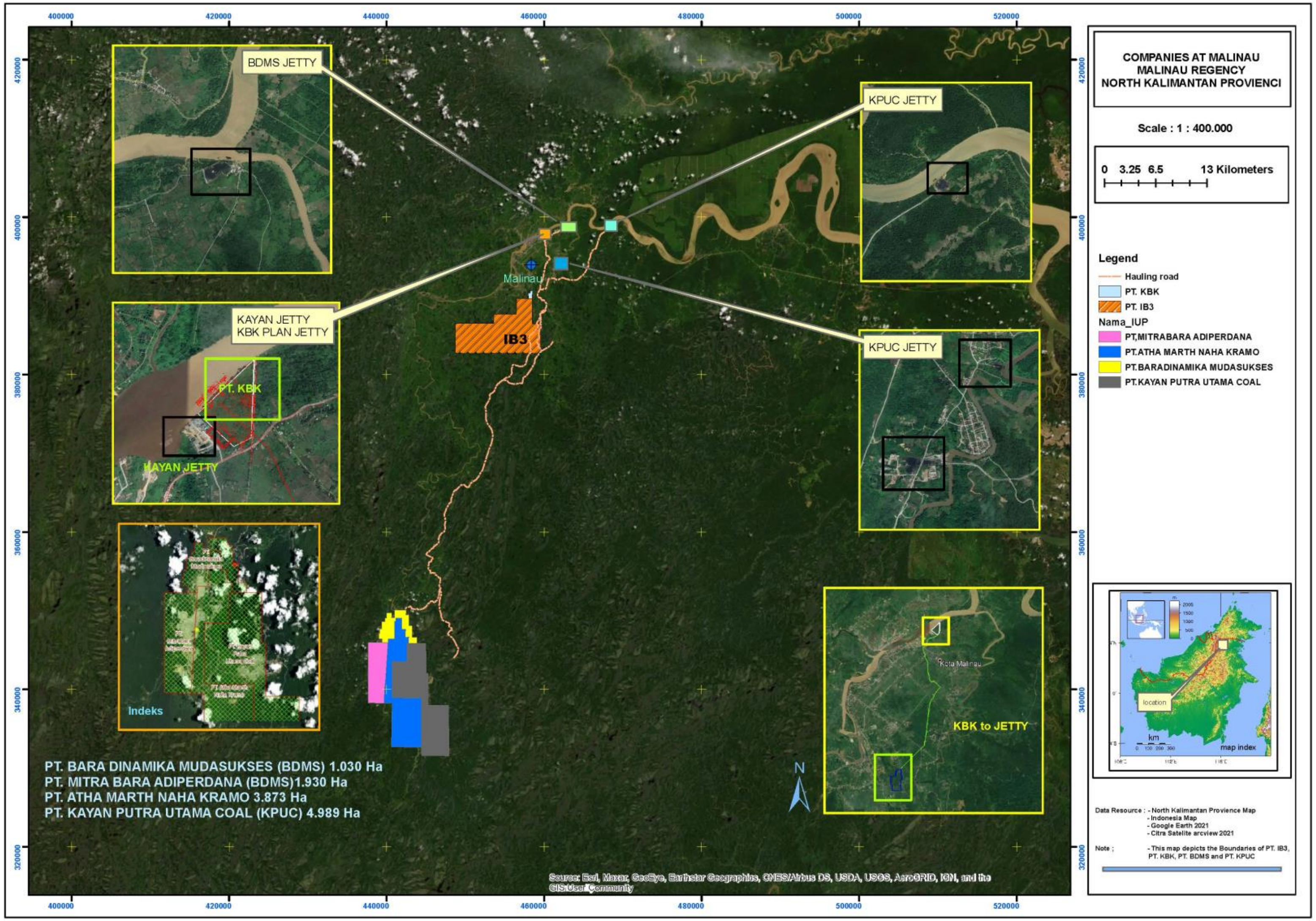


Figure ES 1: Location of KBK Quarry the Port/Jetty and link to PT KBK port area (source: PT KBK, Sept 2021)

1.3 Project History and Ownership

The Company is a joint venture ("JV") between PT. Puncak Mineral Investasi (60%) and Ozindo Investments Pty Ltd (40%). It acquired the land in 2017, secured the Regency Mayor recommendation in 2018, secured the exploration permit in 2019, secured the operation production permit in 2020 and has been investigating and developing the project area for its industrial minerals potential.

1.4 Geological Setting and Mineralisation

The study area is situated on the island of Borneo which sits in the southeast of the Eurasian plate. The northern region of Borneo is bordered by the margins of the South China Sea, in the east by the Makassar Strait and the southern part by the Java Sea.

1.5 Processing and Testwork

PT KBK has conducted several phases of mineralogical, geochemical and geophysical testwork programmes in order to investigate the product potential of the aggregate material at KBK. The most recent programme which was completed between March and June 2021 focused on assessing the aggregate's suitability for several specific intermediate and end product types, including; concrete, mortar/render, roadstone, civil engineering, railway ballast, and amourstone. The main product groups and results as provided by PetroLab UK are summarised in Table ES 1 below.

Table ES 1: KBK Aggregate Suitability for Specific Intermediatory and End Product Types

Lithology	Sample Number	Concrete	Mortar / Render	Roadstone*	Civil Engineering	Railway Ballast	Armourstone
Shale	10261						
Greywacke	10262						

Colour Key	Description
	Not suitable
	Potentially suitable
	Usually suitable

PetroLab provided a summary report that discloses the samples suitability for end uses as reported on the basis of the petrographic observations when compared against certain referenced standards (see Section 8) for specific end uses. Once specific end customers are identified, further physical and/or chemical testing against additional requirements (aggregate standards) for specific end-use applications will be required.

1.6 Optimisation Parameters

In order to determine the quantities of material offering "reasonable prospects for economic extraction", according to JORC requirements, SRK used reasonable mining and processing assumptions, with averaged prices for six product alternatives being applied to local and export product types. The optimisation assumptions applied when creating the pit shells for estimation purposes are as summarised in Section 9.7.2.

1.7 Mineral Resource Estimate

Mineral Resource estimation for aggregate projects typically has two main components, a volumetric assessment of the minable volume of target material, in this case greywacke, and the application of product quality variables to this material. In order to determine the volume of greywacke within the license area, SRK used drillhole lithological logging data to create a 3D geological model of the main geological units and constrained this below a high resolution topographic surface. SRK then created a block model and used conventional estimation techniques to estimate density into blocks to convert volumes into tonnages.

Sufficient data was also available to interpolate Uniaxial Compressive Strength ("UCS") measurements into the blocks. A geostatistical study of the estimated variables (UCS and density) did not yield robust variograms and as a result SRK used Inverse Distance Weighting as the main interpolation method, using lithological contacts as hard domain boundaries. The interpolation used a variable orientation large elliptical search following the dip and dip direction of the geological zones.

1.8 Mineral Resource Classification

The Mineral Resource Statement (see Table ES 2) has been prepared in accordance with the JORC Code and is authored by the Competent Person Mr Peter Gleeson, MAIGS, MIMMM, Cert Eng (CP), a Corporate Consultant (Resource Geology) with SRK KZ.

The Mineral Resource has an effective date of 30 September 2021 and uses a geological model to define the volume of greywacke, restricted to blocks within the exploration license and within an optimised pit shell. In addition, SRK has applied a reduction factor to greywacke tonnages of 4% for Indicated material and 10% for Inferred material to account for the quantity of unmodelled shale waste within the greywacke that was not possible to subdomain out.

To report the Mineral Resource Statement, the following conditions were applied:

- only classified material (Inferred and Indicated) has been reported;
- only material falling inside an optimised pit shell has been reported;
- only material within the current permit boundary has been reported; and
- only greywacke tonnages have been reported.

Table ES 2: Mineral Resource Statement for greywacke material reported within an optimised pit shell, as of 30 September 2021

	Volume	Average Density	Tonnes	Water Absorption	Average UCS	LAA (500X)	LAA (100X)	Total Sulfur	MgO	Fe2O3	SiO2	Al2O3
	Mm3	kg/m3	(Mt)	%	Mpa	%	%	%	%	%	%	%
Indicated	8.16	2.56	20.9	2.48	83.76	30.20	6.23	0.10	2.50	5.02	65.37	11.92
Inferred	19.82	2.57	51.0	2.48	85.74	30.20	6.23	0.10	2.50	5.02	65.37	11.92
Total (Ind + Inf)	**27.98**	**2.57**	**71.9**	**2.48**	**85.16**	**30.20**	**6.23**	**0.10**	**2.50**	**5.02**	**65.37**	**11.92**

Notes to table:

1. The tonnages and grades presented herein are reported on a dry basis.

2. SRK has applied a reduction in tonnage of 4% to Indicated material and 10% to Inferred material to account for the anticipated tonnages of internal waste that have not been possible to resolve with 3D modelling.

3. All figures have been rounded to reflect the relative accuracy of the estimates.

4. Mineral Resources are not Ore Reserves and do not have demonstrated economic viability.

5. Optimised pit has included the following parameters for the KBK base case as follows: Production Rate – crushed rock aggregate and armourstone production of 4.5 Mtpa, Geotechnical: Footwall (Deg) 45, Hanging wall (Deg) 45, Mining Factors: Dilution (%) 0.0, Recovery (%) 100.0, Processing: Recovery (%) 99.0, Operating Costs: Mining Cost (Armour) (USD/tore) 8.00, (USD/trock) 8.00, Mining Cost (Crushed Aggregates) (USD/tore) 5.00, (USD/trock) 5.00, Haulage(USD/t) Reference Level; (Z Elevation) 0, , Processing (USD/tprod) 1.00, Infrastructure (USD/tprod) 1.45, Export & Logistics (USD/tprod) 3.87, G&A (USD/tprod) 0.50, Other Fees (USD/tprod) 0.44, Royalty % 0.10, Crushed aggregates Local Sales (USD/tprod) 2.60, Armour Local Sales (USD/tprod) 3.17, Crushed aggregates Export Sales (USD/tprod) 3.12, Selling Cost: Crushed Aggregates Local Sales (USD/tprod) 2.60, Armour Local Sales (USD/tprod) 3.17, Crushed Aggregates Export Sales (USD/tprod) 3.12, Aggregate Rock Prices: Local Sales (USD/t) 25.99, 0-5mm (Dust) (USD/t) 5.63, 5-10mm (USD/t) 27.11, 10-20mm (USD/t) 27.11, 20-30mm (USD/t) 27.11, 30-50mm (USD/t) 26.40, Armour Local Sales (USD/t) 31.69, Armour Stone (USD/t) 31.69, Export Sales (USD/t) 31.18, 0-5mm (Dust) (USD/t) 6.76, 5-10mm (USD/t) 32.53, 10-20mm (USD/t) 32.53, 20-30mm (USD/t) 32.53, 30-50mm (USD/t) 31.68, Discount Rate (%); 10, Total operating cost: Marginal Local Crushed Aggregates (USD/tore) 8.39, Marginal Export Crushed Aggregates (USD/tore) 12.26, Marginal Local Armour (USD/tore) 10.39, Marginal Local Crushed Aggregates (USD/tore) 15.00, Marginal Export Crushed Aggregates (USD/tore) 15.81, Marginal Local Armour; (USD/tore) 18.13.

1.9 Risks and Opportunities

1.9.1 Risks

The structural geology of the deposit is still relatively poorly understood. No systematic geological mapping has been undertaken at the site and this remains a significant project risk. Although an attempt has been made to collect orientated core to allow downhole structural measurements to be taken, the output of this work was reviewed by SRK and was not considered to be reliable due to poor data collection practices.

Topographic dip slopes, as well as interpreted geometries from drillcore suggest a moderate to steep westerly dip to the sediments. Due to the current wide spaced drilling pattern, the geometry and extent of internal waste packages within the main greywacke unit is still poorly understood.

The implication of faulting on potentially dislocating greywacke blocks within the resource is still poorly understood. The systematic structural mapping advised above along with an improved topographic surface corrected for the tree canopy will help resolve this issue

Geotechnical engineering data will be required to move the project to the next phase of development. At this stage, there is not enough geotechnical (GT) data or supporting interpreted information to inform a detailed mining study. Commentary regarding GT risks has been provided in Section 5.11.

1.9.2 Opportunities

The Exploration Target (ET) described in Section 10 presents as a good opportunity to increase the Mineral Resource to potentially double its current size. If shown to be present this would create significant upside in terms of the overall economics of the Project and also provide the Company with other production options should the Company wish to proceed with developing the asset.

There is an immediate opportunity for the Company to potentially upgrade a significant amount of Inferred material to the Indicated category via the implementation of an infill drilling programme aimed at increasing the drilling density in low confidence areas of the deposit where there is minimal drilling, in particular the southern portion of the deposit. It would also provide drilling on planned drill lines to ensure more evenly spread information and not a random spread of data.

In additional to the above, the Company's owners have recently acquired the rights to an adjoining aggregate WIUP exploration permit (IB3). The Company's geologists advise that the geology and ground conditions of IB3 (see Section 9.10) appear to be very similar to that of KBK albeit that the permit covers some 400 hectares compared to 40 hectares at KBK. Should the work conducted at KBK be replicated following on from infill drilling recommended for KBK, the synergies of the two properties could be mutually beneficial in terms of technical assessment and criteria, and the potential shared infrastructure opportunities given the locations of the two assets.

Following the reporting of the Mineral Resource herein, the Company could now benefit from conducting a Scoping Level technical study in order to assess the viability of the property in respect of the Mineral Resource and including other relevant technical areas, such as; Mining, Geotechnical, Hydrology and Hydrogeology, Processing, Environmental and Social Governance (ESG), Marketing and Supply and Demand, Infrastructure and Transportation, Economics.

1.10 Conclusions and Recommendations

1.10.1 Conclusions

The primary aim of this report was to report an MRE in accordance with JORC 2012 for the Project, using all available and valid data. Competent Person, Mr Peter Gleeson, who assumes overall responsibility for the MRE and report is satisfied the aim has been achieved and the Project has met the original objectives. Mr Gleeson is independent of the Client.

It is the opinion of SRK that the quantity and quality of available data is sufficient to generate Indicated and Inferred Mineral Resources at KBK and that the Mineral Resource Statement has been classified in accordance with the Guidelines of the JORC 2012 code.

The Mineral Resource Statement generated by SRK has been restricted to all classified material falling within an optimised pit shell using a suite of aggregate prices and these have been applied to two product types as determined through the testwork completed and through the Company's offtake contracts as advised by the Company. All material that has been drilled, logged and categorised as greywacke material has been assumed to correspond with an aggregate material that would generate a product (either amourstone blocks or crushed aggregate) suitable for sale to prospective end customers. This represents the material which SRK considers has reasonable prospect for eventual economic extraction.

1.10.2 Recommendations

In terms of the estimate approach conducted herein, SRK would recommend an updated geostatistical review be undertaken in the next stage and it should be aimed at creating robust semi-variograms to allow interpolation of UCS by Ordinary Kriging.

It is recommended that a new drilling programme is implemented at KBK in order to improve the geological understanding of the Project. SRK recommends the objectives of the proposed Infill Programme should be as follows:

1. As a priority and as part of the drilling programme, the Company should conduct a surface structural mapping exercise to better define dips and strikes of the bedding contacts and other important structural features at the site.

2. Drilling should test the depth extent of the pit (greater than 100m current drilling depth or 60m true depth below surface).

3. Provide more drilling information in low confidence areas where there is minimal drilling and particular in the southern area where there are only 1-2 drill intercepts and to attempt to upgrade portions of the reported Inferred Mineral Resource to the Indicated category.

4. Implement drilling on planned drill lines to ensure more evenly spread information and not random spread of data. Current drilling is not drilled on the planned drill lines.

5. Exploration target areas need to be tested and this may assist in informing where areas of the permit could be released or expanded. It is evident from current drilling more greywacke material is beyond the current IUP (see description in Section 2.2.2).

6. More drilling is required to adequately define the footwall contact location of the main greywacke unit.

7. All planned drilling should be orientated to target and better define the structures within the deposit and increase confidence in the 3D geological interpretation.

8. A tight spaced drill hole programme should be conducted on approximately a 15m x 15m grid to 24-30m depth. SRK recommends that this needs to be implemented in order to upgrade a portion of the Indicated Mineral Resource in the initial mining area to the Measured category.

9. PT KBK should undertake a number of walked survey lines to confirm the location of the natural surface rather than the top of the tree as acquired by the drone. A present the MRE has applied a transformed topographic surface. While SRK considers this to be sufficient for the purpose of this MRE, more detailed studies in future will require a more precise topographic surface (ie. +/- 0.5m accuracy in x, y, z).

10. Coupled with an improvement in orientated core (mentioned above) the project would benefit from a dedicated geotechnical assessment in the next phase of study to inform a mine / pit geotechnical programme.

Table of Contents

List of Tables

List of Figures

List of Technical Appendices

SRK Consulting (UK) Limited
5th Floor Churchill House
17 Churchill Way
Cardiff CF10 2HH
Wales, United Kingdom
E-mail: enquiries@srk.co.uk
URL: www.srk.com
Tel: + 44 (0) 2920 348 150

MAIDEN MINERAL RESOURCE ESTIMATE FOR THE KBK INDUSTRIAL MINERALS PROJECT, KALIMANTAN

1 INTRODUCTION

1.1 Background

SRK Consulting (UK) Limited ("SRK") has been requested by PT. KALTARA BATU KONSTRUKSI ("PT KBK", herein also referred to as "the Company") to prepare a Maiden Mineral Resource Estimate (MRE) for its Industrial Minerals Project ("KBK" or the "Project"), located in Kalimantan, Indonesia. SRK understands that the purpose of the MRE is to inform discussions between the Company and its advisors (the "Advisors") in relation to ongoing development of the Project.

The Company is currently owned and managed by a joint venture ("JV") between PT Puncak Mineral Investasi (60%) and Ozindo Investments Pty Ltd (40%). Through a series of near-term technical studies, and with the assistance from SRK the Company is now actively progressing the Projects development timeline and planning to better define the project description and optimise the deposit to suit the corporate objectives of the JV.

Following completion of an internal company feasibility study and an Environmental and Social Impact Assessment ("ESIA") in 2019, the Company submitted its application for a mining concession to the head of investment coordinating board of the Republic of Indonesia. On 22 April 2020 the Company was awarded a "IUP Operation" ('Izin Usaha Pertampangan' Operation) which is a, mining and production concession for the right to extract non-metal minerals (including aggregate and silica) from within the active permit.

The MRE presented in this Report has been prepared in accordance with the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, the JORC Code, 2012 Edition ("JORC Code").

1.2 Project Team

The report has been compiled by Mr Dean McMinn (FAusIMM(CP)), who is a Senior Geologist at SRK, and the Project Manager for this MRE. Geological modelling and Mineral Resource estimation has been undertaken by Mr Oliver Jones (MSc, MAusIMM) who is an associate of SRK, a current Member of the AusIMM and has significant experience in the fields of geological modelling and Mineral Resource estimation.

This technical report (the Report) has been prepared under the direction of Mr Peter Gleeson whom is the Competent Person (CP) as defined in the JORC Code and who assumes overall responsibility for the MRE and report. Mr Gleeson (MSc, CEng AIGS, MIMMM) is a Corporate Consultant at SRK and is independent of the Client. Mr Gleeson's work covers a review of geological modelling, resource estimation and reporting. He has extensive experience in both operating open pit and development properties.

As part of its work, SRK also conducted a Competent Persons ("CP") site visit for the purpose of the MRE and further on-site support services were provided by Mr Dean McMinn from 15 March 2021 until 10 April 2021. SRK has visited the site on four previous occasions for separate phases of work including, geotechnical logging training, exploration drilling planning and training, due diligence and infrastructure reviews.

1.3 Qualifications of Consultants

The SRK Group comprises over 1,400 staff, offering expertise in a wide range of resource engineering disciplines with 45 offices located on six continents. The SRK Group prides itself on its independence and objectivity in providing clients with resources and advice to assist them in making crucial judgment decisions. For SRK this is assured by the fact that it holds no equity in client companies or mineral assets.

SRK 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 Ore Reserve Compliance Audits, Independent Valuation Reports and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies and financial institutions worldwide. SRK 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.

Neither SRK, nor any of the staff involved in the preparation of this Report, has any beneficial interest in the assets of PT KBK. SRK will receive a fee for this work in accordance with normal professional consulting practice.

1.4 Work Completed

In undertaking this commission, SRK has:

- conducted a site visit to the Project between 15 March and 10 April 2021;
- validated all data collected;
- compiled a drilling, geology logging and sampling database;
- undertaken QA-QC assessment of all relevant data;
- imported all data into Leapfrog Geo software;
- constructed 3D geology and weathering models of the KBK deposit;
- conducted classical statistical analyses on the assay data;
- conducted geostatistical analyses on the domained density and UCS data;
- interpolated the density and UCS data into the geological and mineralisation model using an Inverse Distance squared algorithm;

- applied average product quality values to the block model, by lithology domain type, based on product quality testwork results;
- validated the block model coding and estimates;
- reviewed the geotechnical studies undertaken;
- completed a pit optimisation study using the results of the laboratory geotechnical and geochemical testwork;
- reported a resource statement based on the above, and
- prepared this report presenting the results of the above work.

1.5 Conventions

The following conventions are used for the 2021 resource model and geological interpretations:

- metric units for distance and mass;
- grid WGS84 Zone 50N, Universal Transverse Mercator (“UTM”) projection;
- tonnages reported on an in situ dry basis;
- grades reported on a dry weight percentage basis; and
- optimised block and pit limits based on USD per tonne unit sold for the various product prices assumed.

2 PROPERTY DESCRIPTION AND LOCATION

2.1 Location

The Project is located in the Malinau Administrative District, in the Kuala Lapang Village Kota District, Malinau Regency, North Kalimantan Province, Indonesia (Figure 2-1). The IUP mining concession spans 40.9 ha in area. A map of the tenement location is provided in Figure 2-2.

Figure 2-1: General Location Map (source: PT KBK Sept 2021)

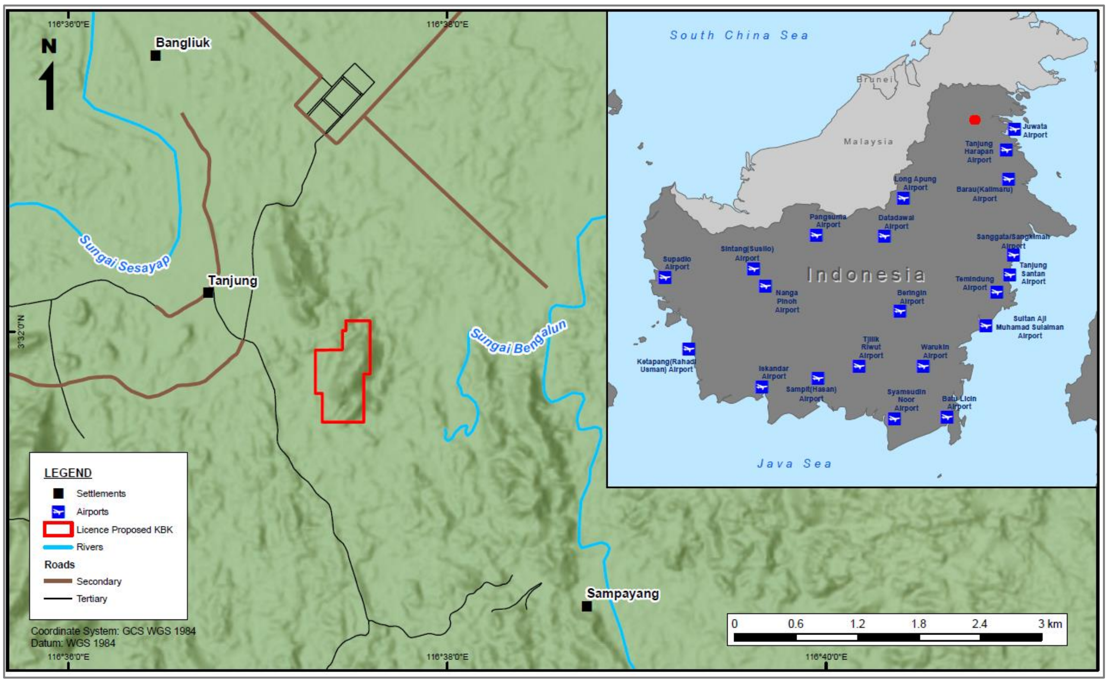


Figure 2-2: General Tenement Location Map also showing airport locations on Kalimantan (source: PT KBK Sept 2021)

The KBK port area is located approximately 7 km of the Project. As shown in Figure 2-3, the KBK port is situated nearby to the township of Malinau.

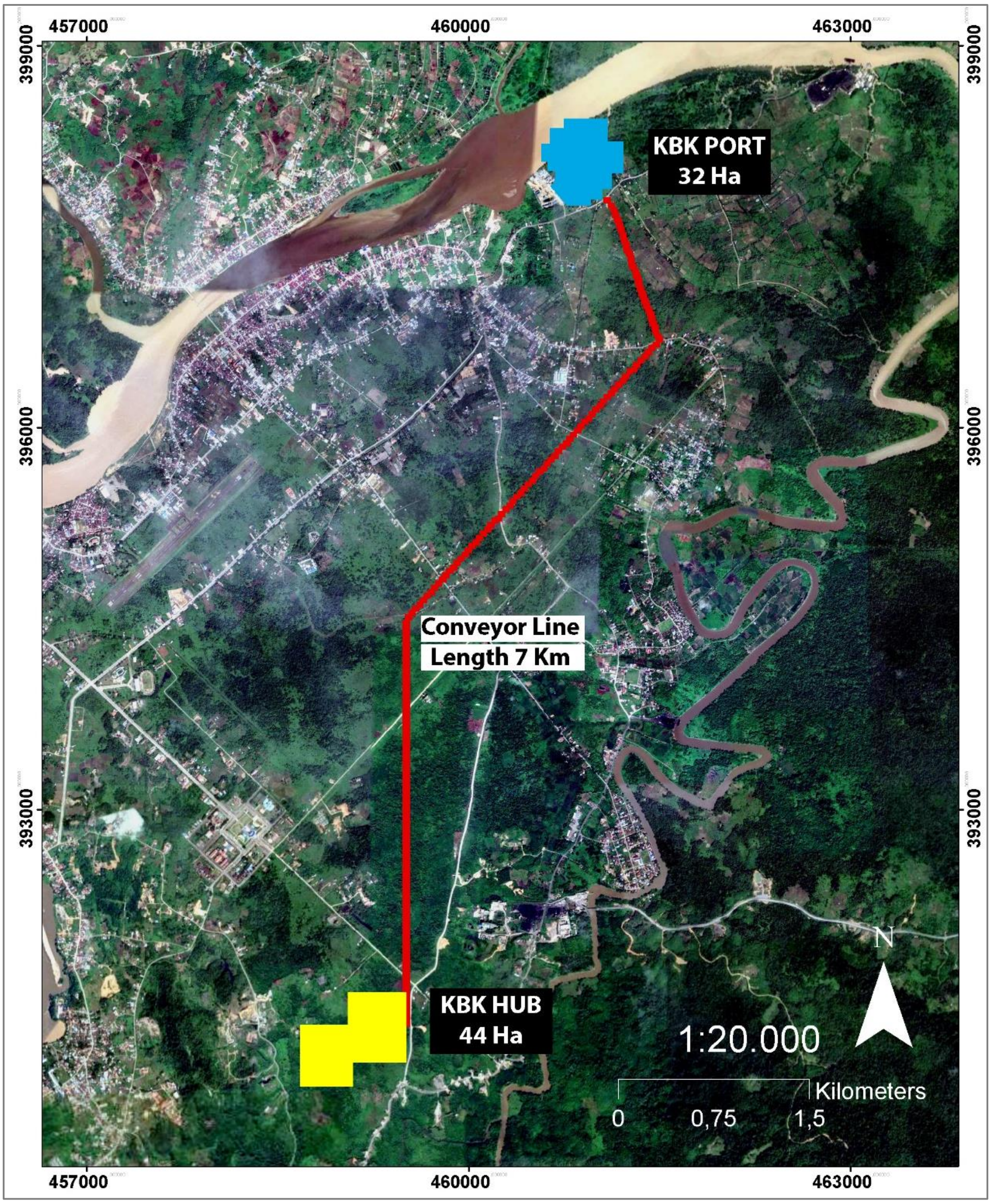


Figure 2-3: Location of KBK River Port (blue), existing road network (grey) and KBK Mining permit location (yellow), with proposed conveyor route (red) Source: PT KBK Sept 2021)

2.2 Project History

2.2.1 Introduction

The Company is a JV between PT Puncak Mineral Investasi (60%) and Ozindo Investments Pty Ltd (40%). It acquired the land in 2017, secured the Regency Mayor recommendation in 2018, secured the exploration permit in 2019, secured the operation (mining) permit in 2020 (see Section 2.2.2) and has been investigating and developing the project area for its industrial minerals potential.

Since acquiring the Project, the JV has conducted several rounds of early stage investigations and preliminary exploration which consisted primarily of general surveying, mapping and data collection activities.

2.2.2 KBK Mining Permit

SRK was provided with a “Declaration of Mining Permit and Land Ownership” status document (file ref: “KBK Declaration of Ownership,pdf”), the details of which are summarised below. A description of the WUIP and IUP approval process is provided Figure 2-4.

- Status: Production Operation Permit (locally known as a “IUP Operation” permit).
- Number: 38/ 1 / IUP / PMA / 2020.
- Issue Date: 02 September 2020.
- Ownership: 60% PT Puncak Mineral Investasi, 40% Ozindo Investments Pty Ltd.
- Total Area: 40.9 Hectares (circa 400,000 m^2).
- Permit Validation: 15 Years (5 years + 5 years + 5 years).
- Permit Extension: 15 years + 15 years.

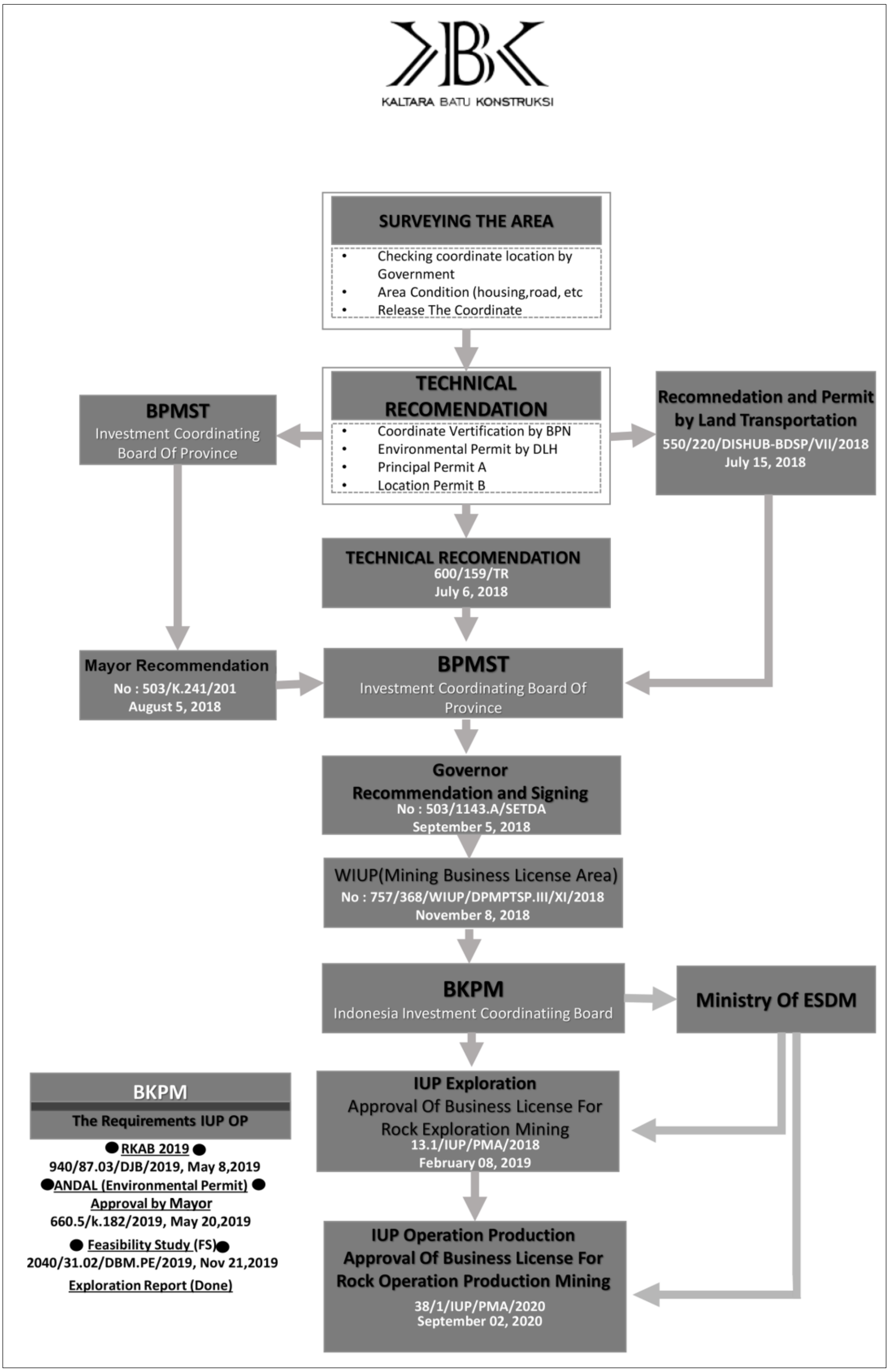


Figure 2-4: WUIP and IUP approvals process (source: PT KBK report May 2021)

2.2.3 Mining Land Ownership

Ownership of the property currently held by PT Puncak Mineral Investasi and Ozindo Investments Pty Ltd which consists total land size of approximately 40 ha, representing the KBK Mining Operation Production Permit (IUP OP).

The mining permit has the following proof of ownership:

1. Certificate of rights for Buildings / Plants On State Land in Kuala Lapang Village Number: 590 / 025 / Pem / 2017 date 7 November 2017.

2. Certificate of Right of Buildings / Plants On State Land Kuala Lapang Village Number: 590 026 / Pem / 2017 dated 7 November 2017.

The coordinates of the license are given below and it covers a total area of 104.2 km^2 as shown in Table 2-1.

Table 2-1: License coordinates for KBK Mining Permit (total of 40.9 ha)

Point	Easting	Northing
	(WGS84 UTM)	(WGS84 UTM)
1	458518	390137.7
2	458458.8	390137.7
3	458458.6	389674.7
4	458050.1	389674.8
5	458050.3	389954.2
6	457986.1	389954.3
7	457986.3	390374.9
8	458245.7	390374.8
9	458245.8	390565.8
10	458283.1	390565.8
11	458283.2	390658.8
12	458518.2	390658.7

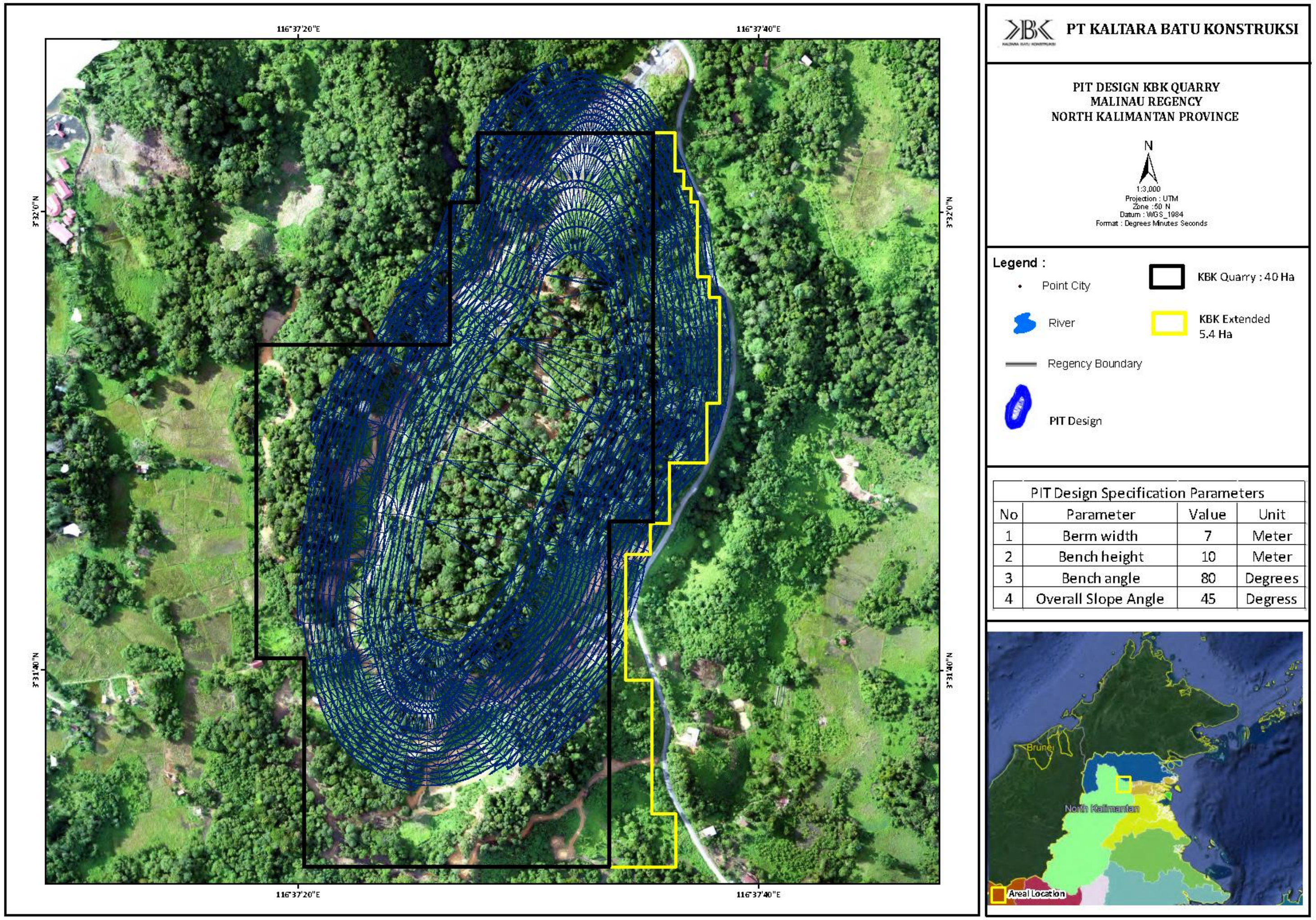


Figure 2-5: Permit outline (black polygon) draped to Landsat Image on main Area of Interest at KBK and optimised pit shell outline (blue contours), with expansion area showing (yellow) which is currently under application (Source: PT KBK Sept 2021)

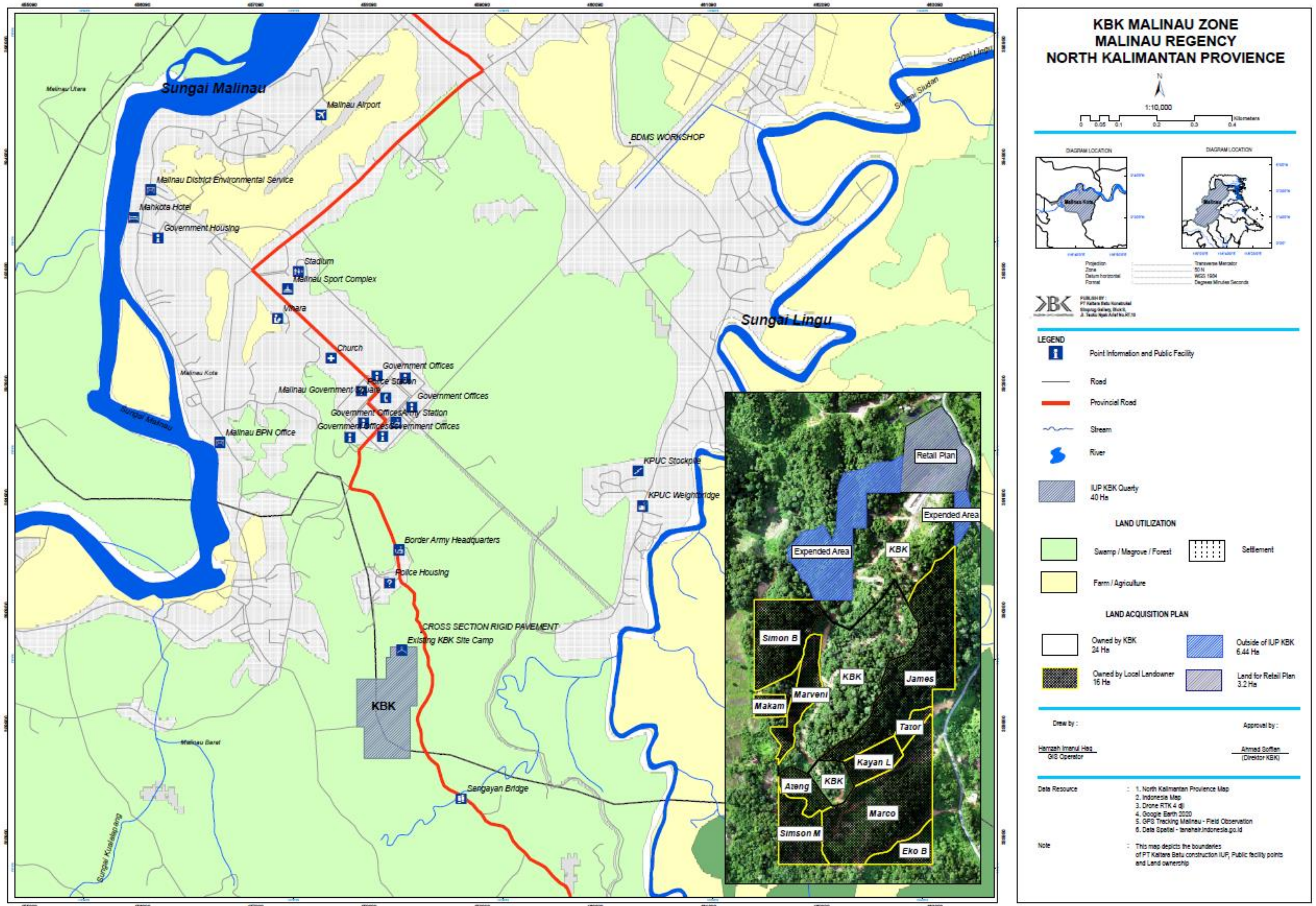


Figure 2-6: Location of the KBK IUP License Boundary and other Zone Areas at the permit (source: Company)

2.2.4 Port Land Ownership

KBK port site consists of approximately 12 ha (120,000 m^2) of land inside the total 32 ha of KBK Port Area Boundary (Figure 2-7). The Port Site has the following proof of ownership:

- Freehold Title No. 04964 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04967 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04968 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04969 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04971 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04972 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.
- Freehold Title No. 04973 Malinau Kota Village, Malinau Kota District, Malinau Regency, North Kalimantan Province.

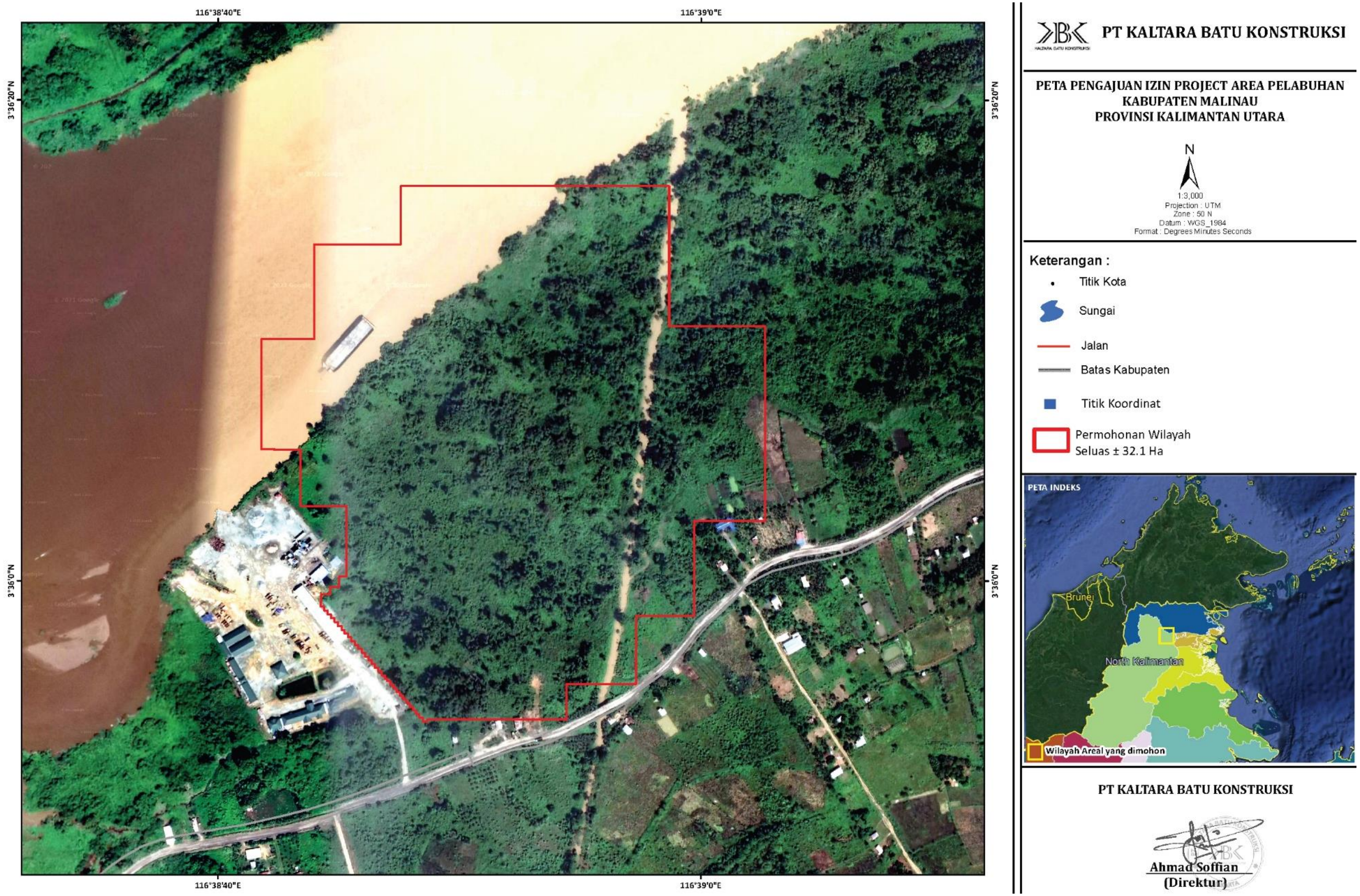


Figure 2-7: PT KBK Port (red outline) and existing surrounding infrastructure (Source: PT KBK Sept 2021)

2.2.5 Other Significant PT KBK Owned Infrastructure

The following items have been established at site and are also owned by the Company (Figure 2-8: PT KBK Port (yellow outline) and existing surrounding infrastructure (Source: PT KBK 11 /01/2021

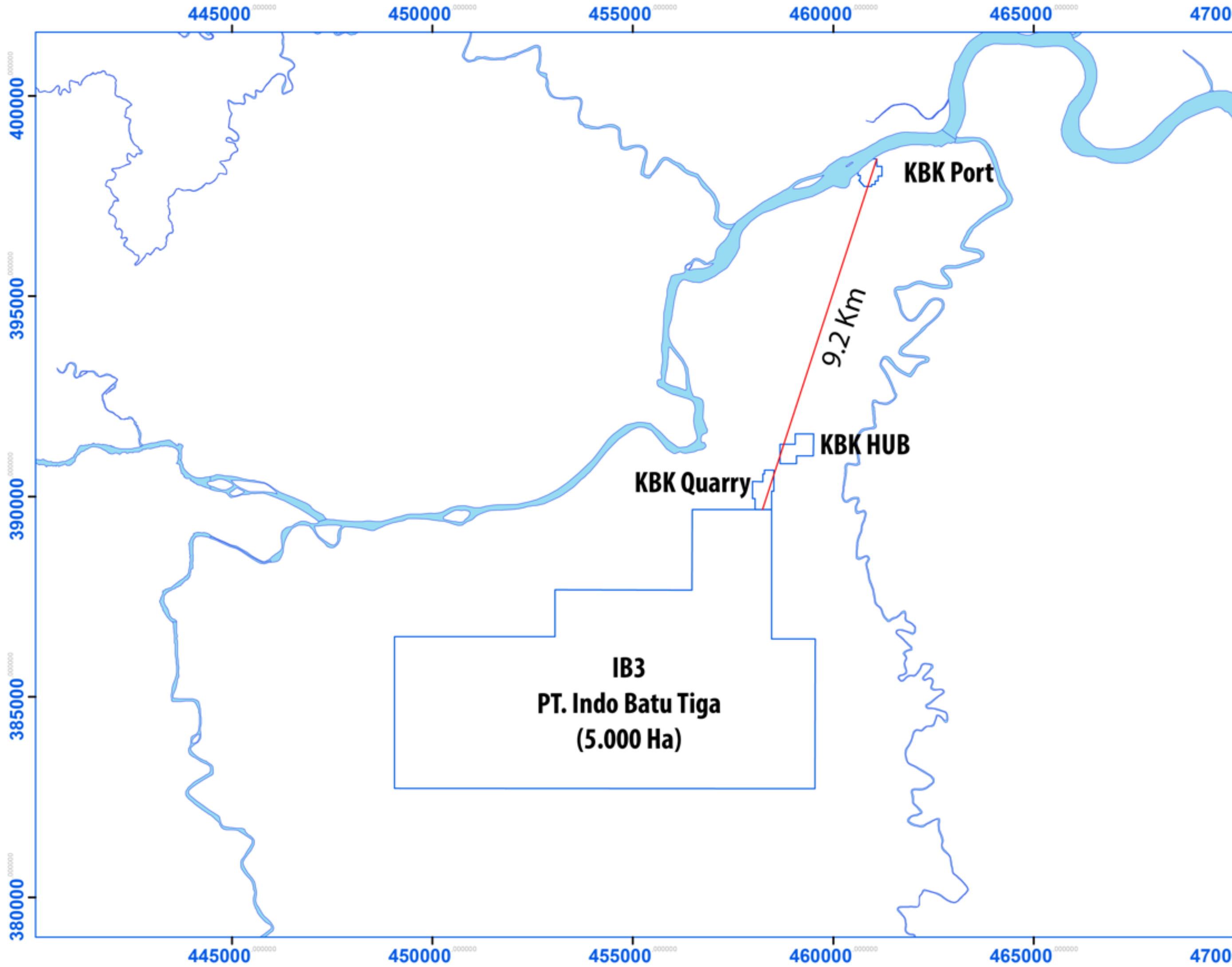


Figure 2-9).

- office buildings;
- site buildings (accommodation, workshops, core shed, security out-buildings);
- local vehicle fleet;
- access roads;
- surface water management (port site and mine site);
- retail and wholesale intermediate stockpile area; and
- periphery real-estate adjoining the IUP permit boundary including another aggregate property to the south and adjoining KBK (see).

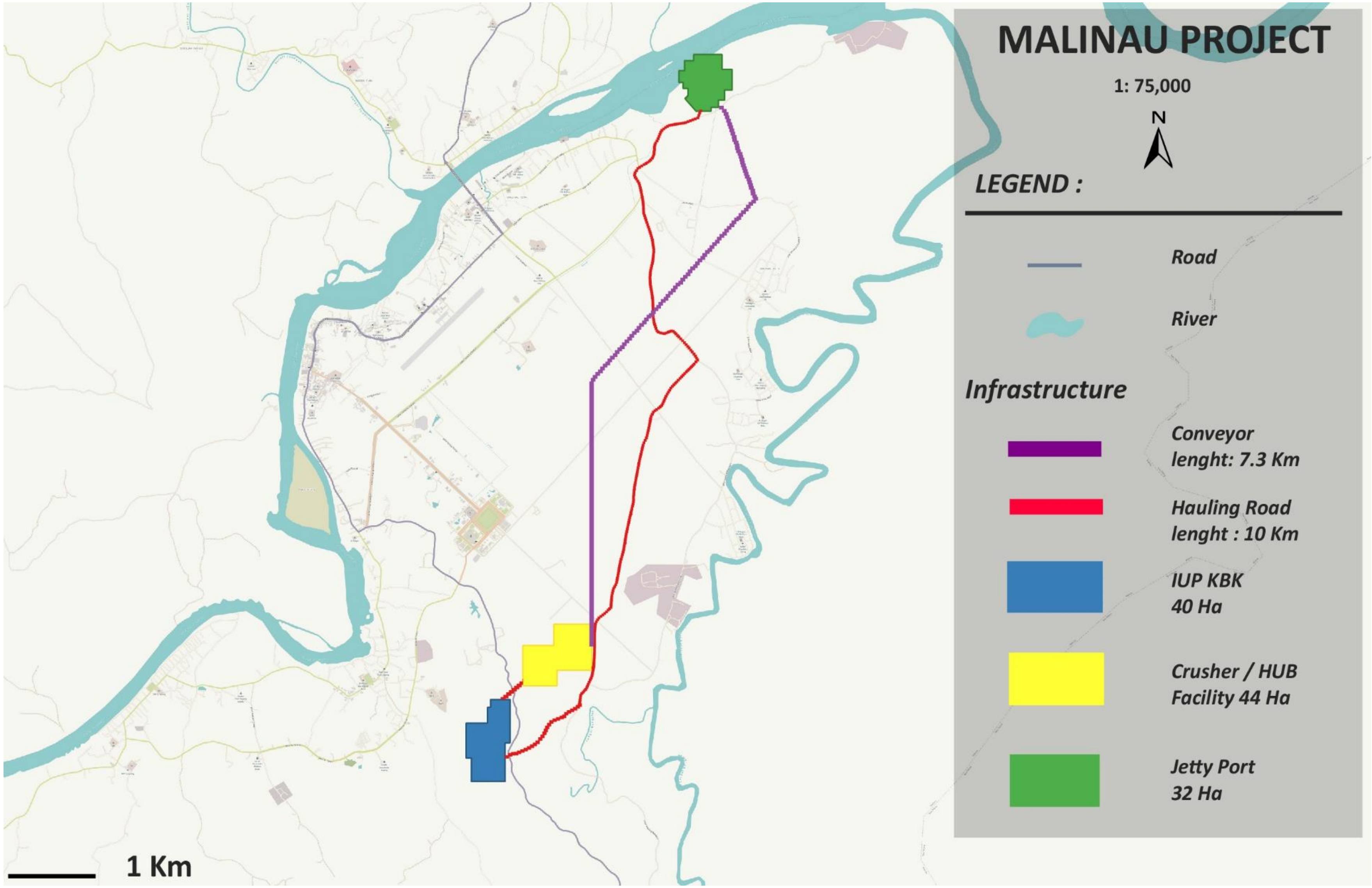


Figure 2-8: PT KBK Port (yellow outline) and existing surrounding infrastructure (Source: PT KBK 11 /01/2021

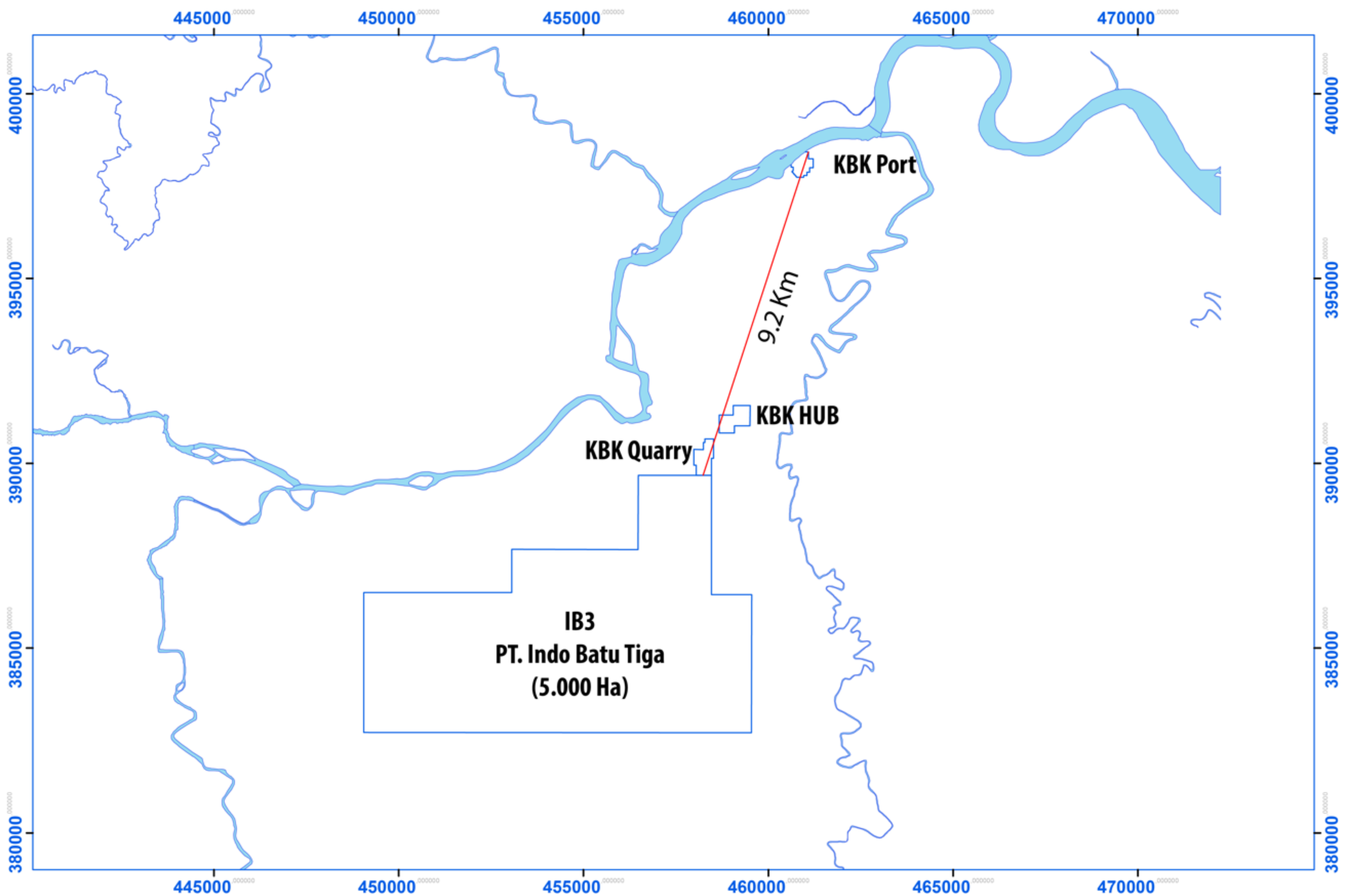


Figure 2-9: IB3 Aggregate Property (held by the parent company of PT KBK) adjoining KBK property and over ten times the area (source: PT KBK Sept 2021)

2.3 Access, Infrastructure and Physiography

2.3.1 Introduction

The proposed mine location and main access road are situated at the base of a topographic high, which has a maximum elevation of approximately 100 m above mean sea level (AMSL). The surrounding area and the entry to the mine is at approximately 32 m AMSL.

Malinau township (7 m AMSL) has population of circa 62,000 people (2010 census) and hosts a number of existing local services.

The local community are skilled and generally experienced with mining projects due to the presence of operating coal (and other) mines in the region. There are several known occurrences of active small aggregate mine operations near the KBK Project; however, these are predominantly low production operations (less than 100 ktpa) and often operating without licensing.

The regional infrastructure is relatively well established, and several nearby mining operations utilise the existing infrastructure and utilities (grid power and river/water table water sources) for their own operations. The following section gives a general description of the infrastructure that is not owned by PT KBK; however, it is existing and may be available to the Project.

2.3.2 Airport

Malinau has a domestic airport (the “Robert Atty Bessing Airport”) located within 10 minutes by road and receiving flights from Balikpapan. The airport is well supported by local services with flights regularly connecting to Tarakan and Balikpapan as well as international services to airports within Indonesia.

2.3.3 Roads

A number of national roads (Figure 2-10) and private mining haul roads cross the area. The most accessible haul road follows approximately 15 km of private road, followed by 0.7 km of national road. The private road is a purpose built mine haul road currently owned and operated by a nearby coal operation.

National roads are tarmac and approximately 6 m wide. These are well maintained and are reported to have a payload limit of 20 t. Speeds are restricted by road conditions, public users and equipment capability.

The KBK Project is easily accessed from Malinau by existing local roads, 7.5 km from the centre of the main township.

The license is mainly accessed by a network of established roads which are serviced year round. At the time of the site visit, new bitumen re-sealing of the road directly in front of the tenement was being undertaken by the local council. At the time of the March 2021site visit, there were no observed limitations to accessing the roadways even amid several severe tropical rainfall events.

Figure 2-10: Existing access road, looking north from the site entrance; also showing local electrical power supply lines.

2.3.4 Power

Power is supplied to Malinau from two 8 MW thermal powerplant installations. A low voltage distribution line runs directly adjacent to the licence area. The Company is investigating measures to supply power from a hybrid of grid power and alternative sources in order to potentially improve on environmental performance of the operation. The Company has advised that it is evaluating a combination of heavy fuel oil ("HFO") and renewables (mainly solar and wind power generation). It is thought at this stage that the grid base load operations will be supplemented with HFO generated power with a top-up from solar and wind power during the day.

2.3.5 Water

Primarily, water is required for washing, dust suppression and potable purposes only. Water supply infrastructure will be developed by the Company in the next stage of development.

A high level review of the mine water management requirements for the Project has been undertaken by SRK and this has included commentary on the status and adequacy of the information gathered so far and the provision of recommendations for further work to advance the Project.

Water management requirements for the future mine operation have been considered and are now being included in the environmental scope and field studies that are currently being undertaken by the international environmental consultancy, PT ESC Environment Indonesia ("ESC") who will undertake site visits, conduct field work for baseline data collection (if/where gaps exist) and compile summary reporting for the ESIA and the AMDAL documentation which is to be resubmitted for the revised project description in Q1 2022.

Little or nothing is known about the groundwater regime in deposit area, as there have been no formal assessments completed to date. Based on SRK's experience of similar sites, some attempt has been made to conceptualise the local hydrogeological conditions, but it is clear that the Project would benefit from a technical assessment of groundwater.

There may also be local villages that rely for water on: (a) springs that discharge from the slopes below the future operation; and (b) from the stream or streams that are selected to supply a water supply reservoir for the operation, should this form part of the mine-water management solution. In the case of (a), the derogation (drying-up) of resource results from the stripping of sediment overburden and aggregate ore from any areas above slopes that have sources of spring water. ESC's environmental impact study for the Project should assess both of these risks.

2.3.6 Climate

The climate at the Project site is tropical rainforest and characterized by heavy to very heavy rainfall year-round. Generally, the total average annual rainfall around 2,000 mm/year. Mean seasonality in Malinau is lower than in similar climates in other parts of the world. That is, on average, seasons (whether hot/cold or dry/ wet) are not markedly different. The mean monthly temperature ranges from 26.4°C to 27.3°C and precipitation from 205 to 360 mm/month (Figure 8). Maximum temperatures rise to approximately 29 degrees Celsius.

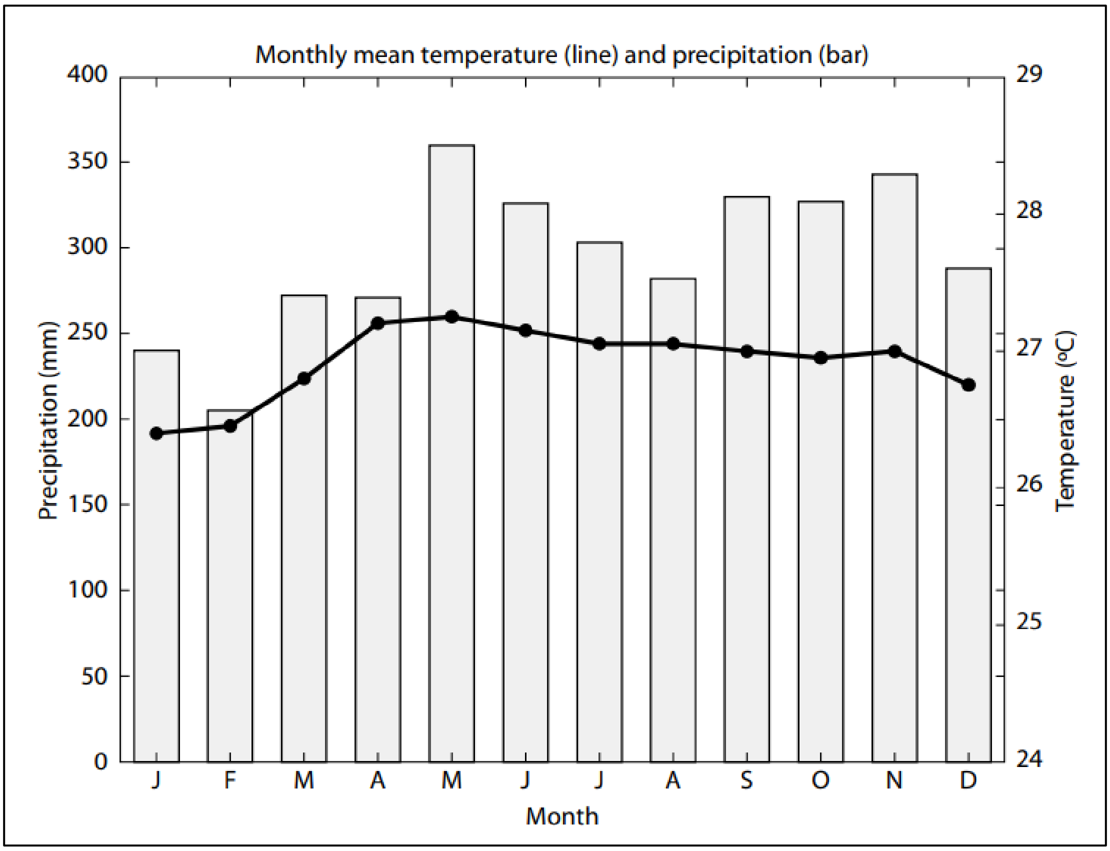


Figure 2-11: Monthly mean temperature and precipitation for Malinau (source:)

Annual climate variability data show that Indonesia has three distinct rainfall regions. Malinau is in what is characterized as Region B, with an equatorial climate and two precipitation peaks, in October– November and March–May (Aldrian and Susanto 2003). Those two peaks are associated with the southward and northward movements of the intertropical convergence zone. Although traditionally there had been no pronounced dry season, drought has been occurring with increasing frequency (Hilman et al. 2010).

The main water management issues for the Project are likely to be surface water control and potential impacts on the environment and local community. All these matters are being investigated by ESC in the environmental and social study which is now underway.

Various measures will need to be introduced to divert flows away from potentially polluting sources and to promote settlement of solids out of solution. The use of liners, diversion ditches, earth-clay bunds, and settlement ponds should help to mitigate these effects.

2.3.7 Rivers

Malinau lies on the southern bank of the River Sesayap (see Figure 2-12) which flows eastward to the Celebes Sea. Tarakan City (population 193,000 in 2010) is the next regional population centre on the Pelau Tarakan Island in the mouth of the River Sesayap. The approximate width of the River Sesayap is between 300 m to 500 m. A tributary of the River Sesayap is located immediately east of the licence area. This tributary is called the River Bengalun. Both the River Sesayap and River Bengalun have a number of river jetties being utilised for import / export of minerals and materials in the range of 300 ktpa to 6 Mtpa.

2.3.8 River Ports/Jetty's

There are three nearby river ports at which coal is loaded to barges:

- Batu Lidung Coal River Port, located on Sesayap River, owned by KPUC.
- Bengalun Coal River Port, located on Bengalun River, owned by KPUC and operated by AMNK.
- Tibu Coal River Port, located on Sesayap River, owned and operated by KPUC.

SRK made informal visits to the Tibu Coal River Port and Bengalun Coal River Port.

There is also a number of private and national jetties which are not used for coal. Of note are the Kayan Lestari Jetty, the Pemda Jetty, and the Public Jetty (Jetty Trisno). Other commodities, such as timber, aggregate and sand, are also transported regularly on the river. There is also a "Consumables Import Jetty" for coal mining located at the KPUC intermediate stockpile. These are shown in Figure 2-12 and Figure 2-13.

Figure 2-12: Location of River Ports (Labelled), national roads (light blue) and mining haul roads (Green)

Figure 2-13: River Transport of Coal (source: Company photo Nov 2020)

2.3.9 Topography and Physiography

Ground elevations in the study area typically range between 0 m AMSL at river level through to 150 m on hill tops, and generally flat deltaic plains lie directly to the north of the site. The Project site contains a number of small north south orientated hills and promontories, separated by valleys. The incline of the hill slopes are generally moderate but small areas of cliff are present in isolated locations. On the eastern side of the IUP mining permit is a steep drop in elevation separated by a public road and a low flat lying deltaic landform which extends approximately 8km to the north east toward the River Sesayap.

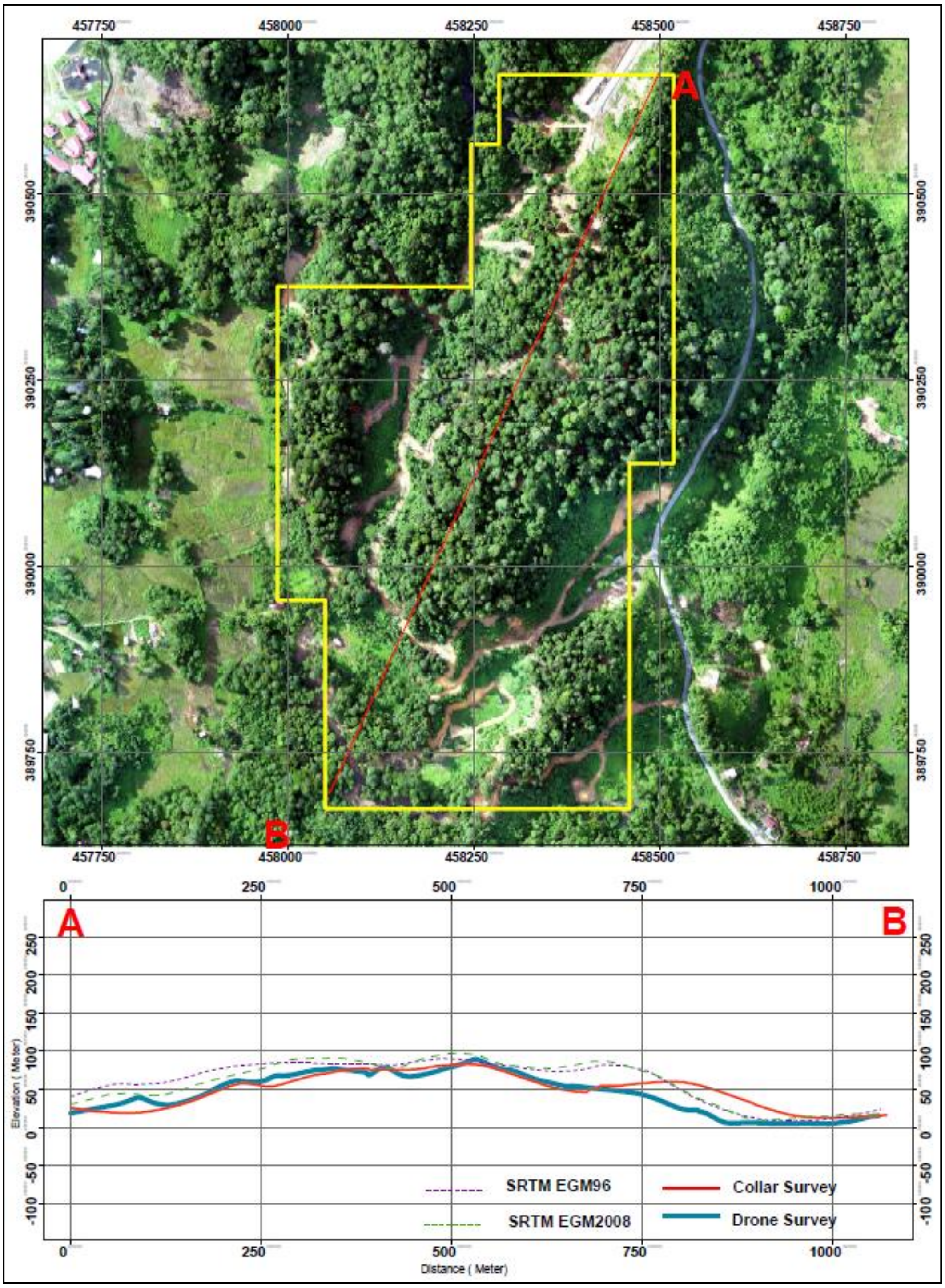


Figure 2-14: Permit outline, and elevation profile A-B at KBK .

3 PROJECT HISTORY

3.1 Previous Exploration Work

The Geological Research and Development Center (“PPPG”), Bandung, conducted the initial geological studies in the region between 1980 and 1995 and published a 1:250,000 geological map in 1995. The map includes details of the regional scale geological and structural interpretations made by the study group at the time. A summary, as provided by R. Heryanto et al., describes the regional geological interpretations and is included in Section 4.1. The map shows the permit to lay within the Malinau Group stratigraphy.

Initial exploration and evaluation of the deposit was initiated by the Company in 2016 with geological mapping conducted across the WIUP tenement by contractor Pemetaan Geologi Permukaan & Pengukuran Topografi. This study focused on a smaller (13 ha) WIUP that had originally been acquired by the Company and the results encouraged the Company to do further work as well as to acquire some additional neighbouring permit areas.

3.2 Historical Resource and Reserve Estimates

In 2018, the Company conducted an early stage volumetric survey and developed a block model of the aggregate horizons using Surpac © 3D modelling software. The block model was based on the land surveys, mapping and geological interpretations that had been made from the exploration work conducted at the time (see Figure 3-1, Figure 3-2).

The estimated volume (m^3) as predicted by the Company for this study was as follows:

- Batuan keras (kalkarenit) = 8,557,490 m^3.
- Batuan sangat keras (kalsilutit) = 2,234,660 m^3.
- Total Volume Batuan = 10,792,150 m^3.

SRK has not been provided with this data, has not seen the supporting block model and estimation files for this work, and therefore is not able to comment on the work, approaches taken or results obtained.

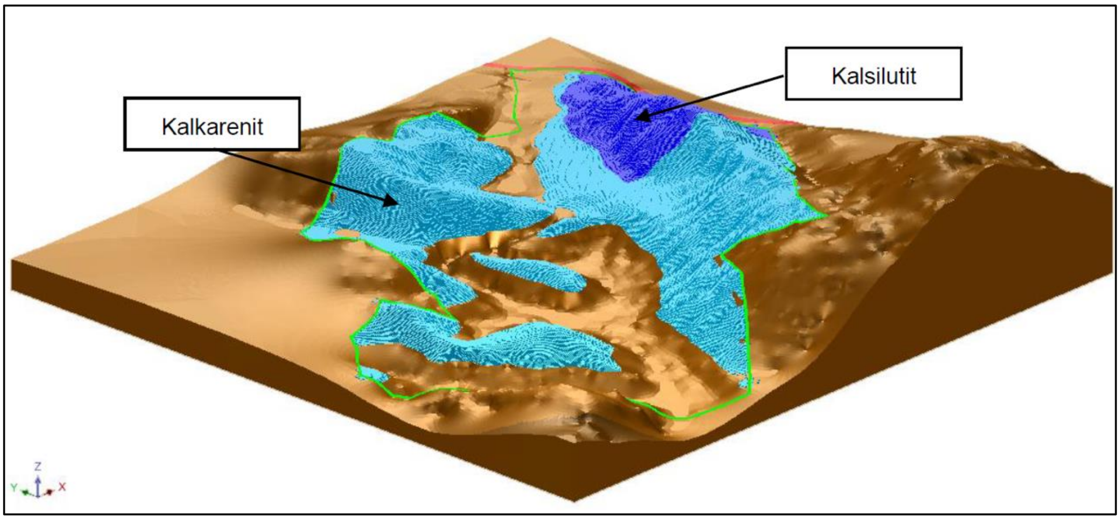


Figure 3-1: Digital terrain model showing potential mining blocks for ore and waste zones as interpreted by the Company (source: Company preliminary exploration report 2018: file ref: "Preliminary Exploration Report.pdf)

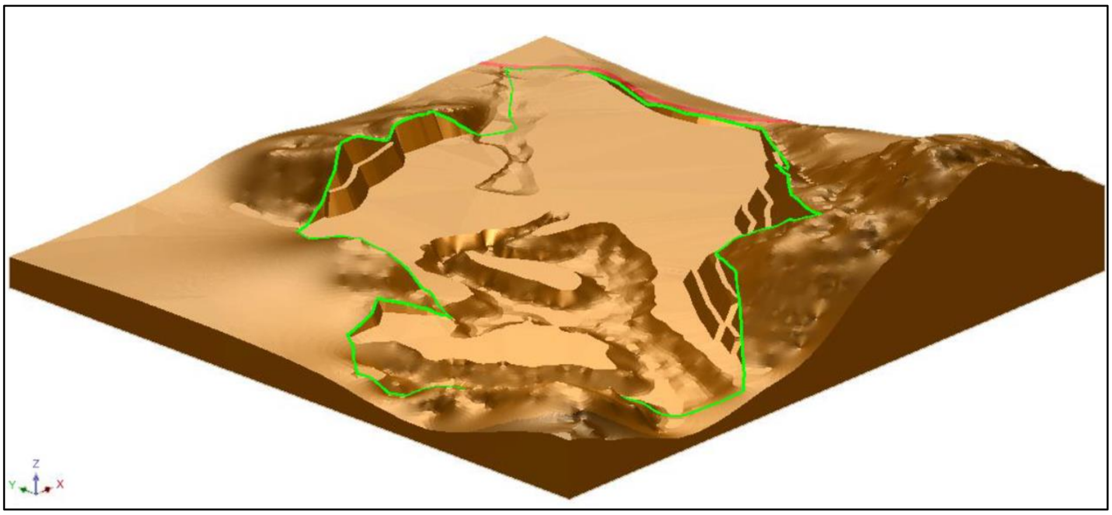


Figure 3-2: Digital terrain model and potential mined out zones showing post mining for ore and waste zones as interpreted by the Company (source: Company preliminary exploration report 2018: file ref: "Preliminary Exploration Report.pdf)

3.3 Independent Geological and Project Status Review

In November 2019, the Company engaged Geologica Pty Ltd on behalf of Elite Consultancy Pty Ltd ("Elite") to undertake a due diligence visit to assess the geology and economics of a potential bulk gravel mine. Independent consultant, Mr B. Davis visited site on behalf of Elite to undertake a review of the work conducted to date and provide an opinion on the quality of data and the overall Project current development status. During the site visit, Elite observed drill core, several drill hole locations and observed various reports produced by the Company.

Elite's summary (file ref: "B.Davis -KBK visit Nov2019.pdf") provided the following conclusions and recommendations:

- Generally the project fills all the material requirements for a large scale gravel and stone supply and is based on solid groundwork and a reliable database.

- Waste material in the form of shale bands and layers had not been quantified in the resource.
- Geological modelling of the extensive database and geotechnical information would produce much greater confidence in the volumes of quality stone compared to that of “waste”.
- The open-pit model comprising simple benching and removal of the topographic hill) is not an accurate or suitable design and, along with the reserve, will need to be revised in more detail in relation to the geology model.
- A more suitable haulage route to the jetty using a JV with the coal company haulage route and new access roads would be a better long term solution.
- The proposed new jetty site is appropriate for the project, however the capital costs would be high and so usage of the existing jetty facilities (even with toll charges) may be advantageous.
- The greywacke rock may have other uses, such as cement, porcelain and ornamental stone that warrant further investigation.

3.4 Historical Mining

To date there has been minimal mining activity within the mining concession. Following the ground survey work conducted in 2021 and during the topographic survey, the Company representatives noted two zones were there had been obvious removal of rock and estimated that a total of 40 m^3 of rock had been mined at these two locations.

In March 2021, the Company also removed approximately 20m^3 of fresh unweathered greywacke rock itself for the purpose of bulk sampling and processing testwork.

The total estimated volume of rock that has been removed from the project is therefore estimated to be 60 m^3.

4 GEOLOGICAL SETTING

4.1 Regional Geology

The study area is shown in Figure 4-1. Regionally, the island of Borneo is situated in the southeast part of the Eurasian plate. The northern part is bordered by the margins of the South China Sea, the east by the Makassar Strait and the south by the Java Sea.

The northern part of Kalimantan is dominated by the Cretaceous and Eocene-Miocene Crocker-Rajang-Embaluh accretion complexes while the southern part comprises the Melawi-Ketungai Basin and the Kutai Basin which were formed during the Late Eocene and are separated by the ofiolite-melange zones Lupar-Lubok Antu and Boyan.

In the southern part of the island of Borneo, away from the project, there is evidence of a large granite and granodiorite batholith of early Cretaceous era and this is observed in the Schwanner mountain region. This batholith breaks into low-grade regional metamorphic rocks resulting in a similar geology to that seen at the Project area.

Tinggi Meratus (a large mountain in Kalimantan) is situated in the south-eastern part of Kalimantan which borders the Barito Basin with the Asem-Asem Basin. The upper most section of Tinggi Meratus consists of the early Cretaceous ophiolite sequence and a volcanic arc. The Barito Basin and the Kutai Basin are limited by the Adang flexure.

The Embaluh zone is located in the north-eastern part of Kalimantan and extends to the southwest. Towards the north, the Embaluh zone forms a ridge which is elongated from northeast to southwest and is described as having a “coarse relief and elevation range of 100-1,000 m, comprising of marine sediments both from deep and shallow sources”.

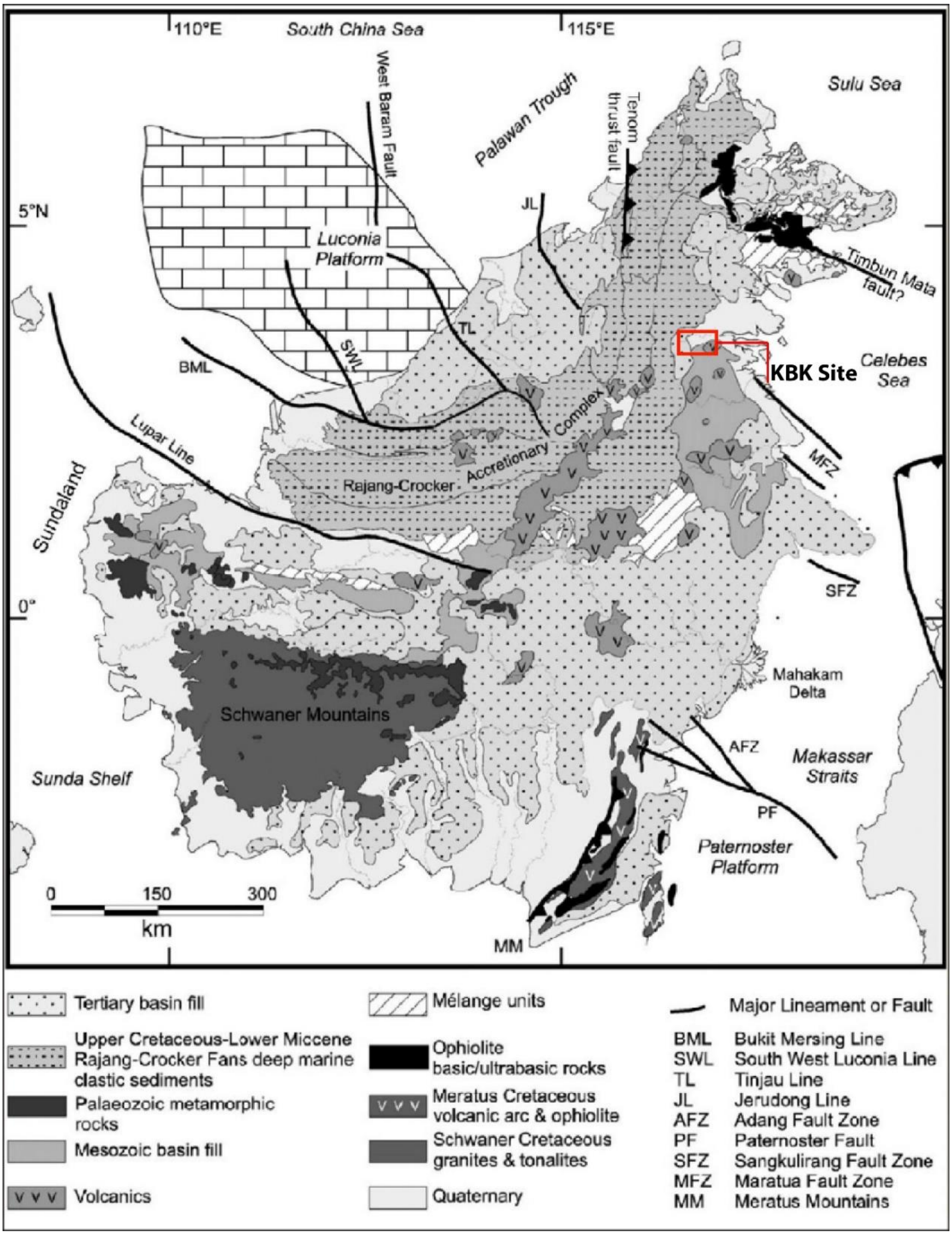


Figure 4-1: Regional geological map of Malinau Sheet (source: Company preliminary exploration report)

4.2 Regional Structure and Tectonics

Geological structures found in the Malinau sheet consist of open folds with associated normal, horizontal and thrust faults. Tectonic activity in the area commenced in the Paleocene, and resulted in a strongly folded sequence of sedimentary rocks called the Embaluh Group (Figure 4-2 and Figure 4-3). These folds, according to R. Heryanto (*et. al*.) [1], have axes in a N-S direction. The Tertiary tectonic activity also emplaced thrust faults parallel to the fold axes and SE-NW trending sinistral faults. The Pakis schist and the ultrabasic rocks are one of the resultant sequences within the Embaluh Group that formed as a direct result of Tertiary tectonic activity.

R. Heryanto (*et. al*.) describe the Embaluh Group as unconformably overlain by the Malinau Formation and interfingering with the Sembakung Formation. During the Oligocene to Miocene, volcanic activity resulted in the emplacement of the Jelai Volcanics. These rocks were unconformably overlain by the Langap Formation and were intruded by Miocene intrusives of andesitic and basaltic composition.

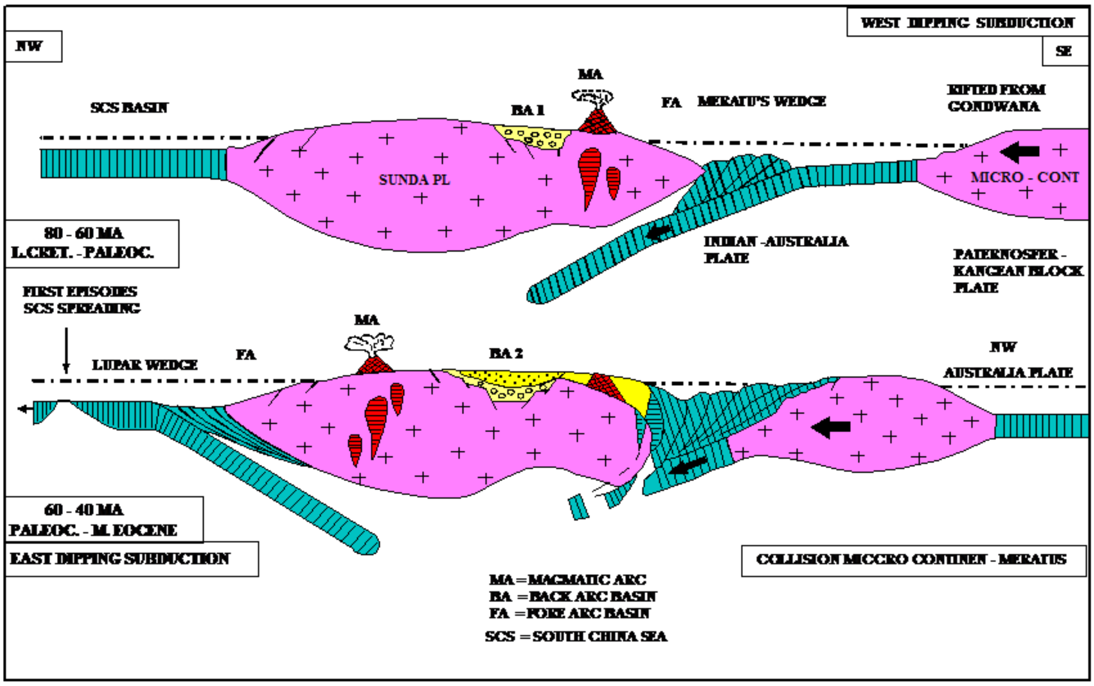


Figure 4-2: Regional geological cross sections Malinau Sheet (source: Source: Bachtiar 2006)

[1] *R. Heryanto, S Supriatna, H.Z. Abidin (1995), Peta Geologi Lembar Malinau, Kalimantan*

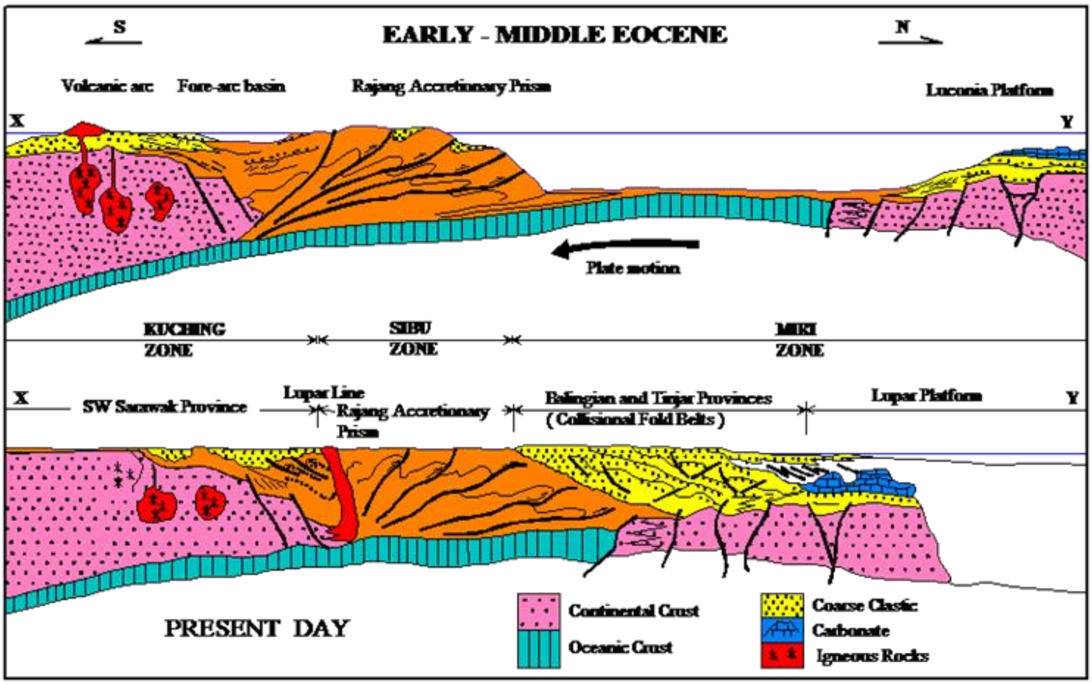


Figure 4-3: Reconstruction depicting a cross section from North Kalimantan describing subduction Lupar in Eocene (Source: Bachtiar 2006).

4.3 Malinau Group Stratigraphy

The rocks observed in the mining concession are part of the Malinau Formation and are interfingered with the Sembakung Formation. Each of the relevant stratigraphic units is described in detail by R. Heryanto (et. al.) and summarised in Table 4-1. The geological time scale showing the main rocks of the Malinau Group Stratigraphy is shown in Figure 4-4.

Table 4-1: Stratigraphy of the Malinau Group

Qa	Alluvium (Aluvium): Mud, silt, sand, pebble, cobble.
Tma, b, ab, l	Plug Dyke (Sumbat Retas): Andesite (Tma), basalt (Tmb), andesite-basalt (Tmab), trachyte (Tmk), most likely late Miocene.
Tml	Langap Formation (Formasi Langap): White tuff, chalky, conglomerate, clast about 80%-90% consisting of clayey sandstone and milky quartz, in a coarse-grained sandstone matrix, shows cross-bedding, contains some thick coal seam beds; late Miocene age possible lacustrine deposits; thickness of unit is about 50-100m.
Tomj	Jelai Volcanic Rocks (Batuan Gunungapi Jelai):Volcanic breccia, tuff, lava bereccia; basaltic-andesitic lava flows.

Tes	Sebakung Formation (Formasi Sebakung): Basalt conglomerate, claystone, siltstone and reef limestone, rich of algae, foraminifers, corals, molluscs' and gastropods; Middle Eocene-late Eocene age; was deposited in shallow marine environment; thickness of unit minimum of 300m.
Tema	Malinau Formation (Formasi Malinau): Feldsphatic sandstone, clayey and micaceous, grey-greenish grey; medium to coarse grained, dark grey to black, micaceous and calcareous; Middle Eocene age; was deposited in a shallow marine environment.
KTme	Mentarang Formation Embaluh Group (Formasi Mentarang Kelompok Embaluh): Sandstone blueish grey to greenish, fine to medium grained formed by quartz, feldspar, mica, and contains small rock fragments; intercalated with argillite's and shale, locally breccia and conglomerate; flysch type; Late Cretaceous-Palaeocene age; was probably deposited in a continental slope on edge of oceanic basin.
KTlu	Lurah Formation Embaluh Group (Formasi Lurah Kelompok Embaluh): Sandstone (sub-greywacke), greenish, feldspathic and micaeous; fine to medium grained, thickness of bed several decimeter to meters; the upper part occupied b limestone; siltstone and argillite facies. Probably Late Cretaceous to Paleocene age; the sedimentary environment could be of a continental margin, marginal flysch.
KTlb	Longbawan Formation Embaluh Group (Formasi Longbawan Kelopok Embaluh): Argillite, purple, green or light grey, well bedded friable, intercalated, sandstone, feldsphatic and arkostic, light grey, rich of organic matter, micaceous, thickness of bed of several decimeters to several meters, contains efavorites of salt water, and cool seams with maximum thickness of about 0.5-1.5m. Probably Late Cretaceous to Paleocene age; probably deposited in a fluvio-deltaic to coastal lagoon environment.
Mpa	Paking Formation (Formasi Paking): Sericite and chlorite schicts, greenish grey, green-schist facies, showing schistosity. It is interpreted as the oldest formation in this area, possibly Lower Creaceous or even older.
Mub	Ultramaphic (Ultramafik): Brecciated, milonitized serpentinite and gabbro. Based on stratigraphic position and correlation with another area, the age is suggested to be Jurassic.

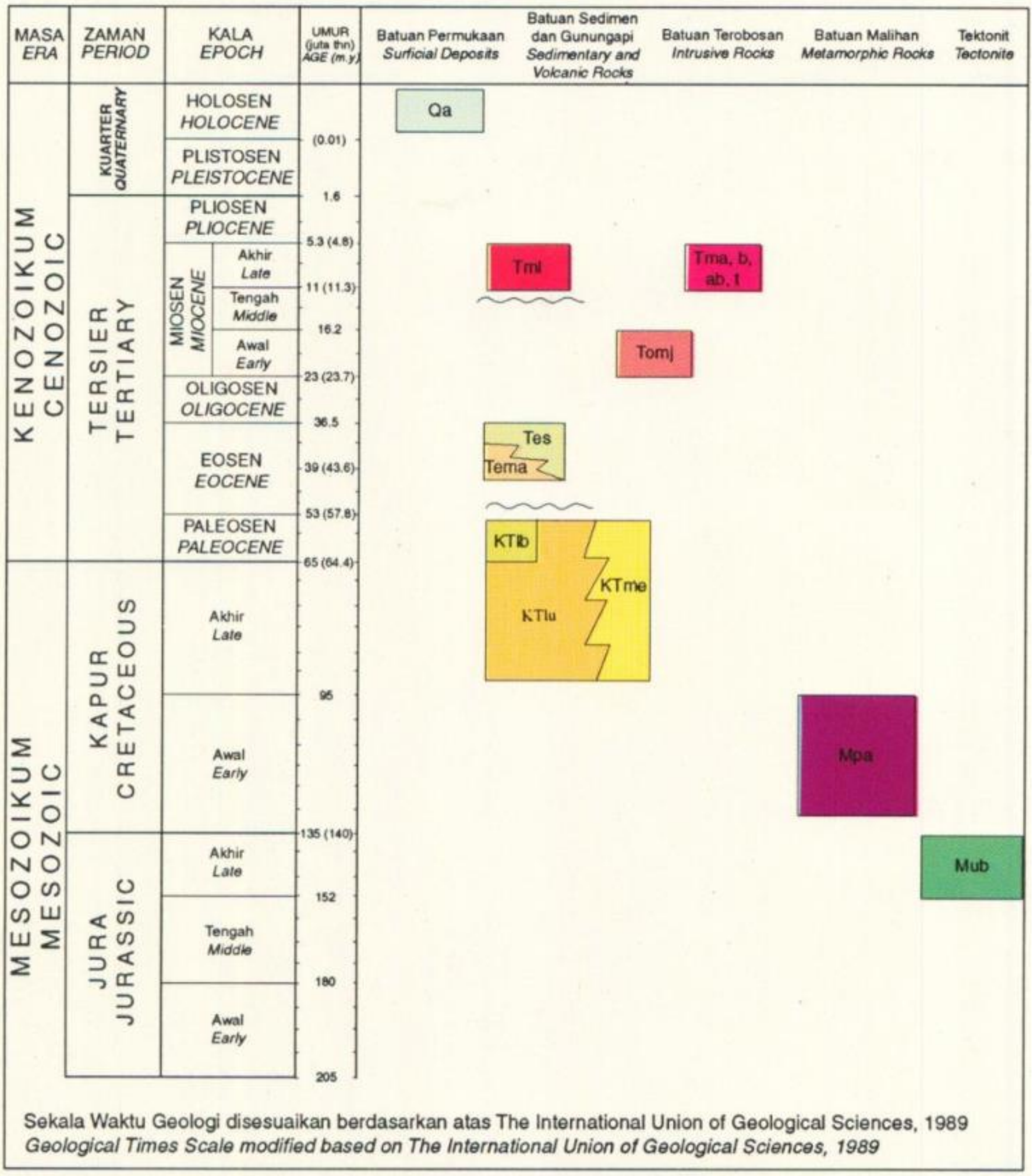


Figure 4-4: Malinau Group Stratigraphy (source: The International Union of Geological Sciences, (source: 1989, 1:250,000 scale series map)

4.4 Deposit Geology and Industrial Minerals

Previous work conducted by R. Heryanto (*Et al.)* describes the main rock types at the Project site to consist of Calcarenite, a grey, hard, layered sedimentary rock with medium-fine sand grain size and a carbonate cement; however, recent petrographic studies conducted by SRK suggests the rock would be better described as a greywacke. Greywacke is a variety of sandstone generally characterized by its hardness, dark colour, and poorly sorted angular grains of quartz, feldspar, and small rock fragments or lithic fragments set in a compact, clay-fine matrix. It is an immature sedimentary rock generally found in Palaeozoic strata. An example of the typical greywacke outcrop material observed at the Project site is shown in Figure 4-5.

Figure 4-5: Outcrop of predominantly fine-grained greenish-grey greywacke consisting of silt-sized clasts of quartz and feldspar (both potassium-feldspar and albite) hosted in a fine-grained matrix containing chlorite, clay, calcite and rare trace iron-oxides (source: PT KBK Sept 2021)

The main geological feature at the site is a large dome like complex comprised primarily of a fine-grained greenish-grey greywacke interspersed with thinner shale bands.

The clay mineralogy (where present) is very fine-grained but likely to consist of a mixture of sericite, illite and kaolinite. There is little to no apparent sedimentary banding in the main greywacke, either viewed in hand specimens (under a hand lens), diamond drill core, or under petrographic microscope. In this small irregular exposed face and outcrop displayed in Figure 4-5 there is a lithological contact between greywacke (GRY) and shale (SHA) showing a steeply dipping bedding sequence within the deposit (in the north of the permit), which is observed to strike approximately north-south).

Two unweathered samples collected at surface were submitted in April 2018 for petrographic analysis (see lab report: entitled, PetroLab Mineralogical Report OP4477 KBK Report_27_05_21.pdf, in Appendix B). Both samples appeared to be the same colour but there are some slight differences in the weathered surface. This may be due to subtle differences in the matrix mineralogy, possibly with the magnesium (Mg)/ iron (Fe) ratios within the chlorite (ClO_2). Importantly, the porosity of both samples is observed to be very low. An example of the fresh and weathered greywacke is shown in Figure 4-6.

Meta-sedimentary Greywacke unit

Interbedded Shale Unit

Heavily Weathered Grewacke unit

Aggregate Examples

Figure 4-6: grab samples of shale and meta-sedimentary (greywacke) lithologies at exposed rock face taken within the permit (Source: SRK 2021)

The recent drilling conducted at site (2018/19 and 2021) suggests the greywacke remains open at a depth of 100 m – 120 m below surface. Additional drilling conducted in March-April 2021 has tested the extent of the greywacke along strike and within the permit area. There are two main lithologies, greywacke and shale which make up approximately 95% of the material in all drill core that was logged during the two exploration programmes, with the majority of the remaining logged material being overburden.

Drilling within the main greywacke hill which represents the focus of current interest intersected occasional apparently intermittent shale bands. Originally, the Company thought these occurrences were much more prevalent as they were visible as interbeds in outcrop but the drilling suggests that may comprise up to 12% of the hill although the hill itself is also bounded by shales bands that that are 40m – 70m wide. An example of the types of shale and greywacke contacts observed at KBK is shown in Figure 4-7.

(a) Sharpe contact between fine grained shale and greywacke

(b) Irregular /undulating contact between fine grained shale and greywacke

Figure 4-7: Image (a) Drill core showing the sharp shale and Image (b) Irregular contact between greywacke and shale (source: SRK, 2021)

The shale is observed in most cases as a fine grained, thinly laminated, lenticular, brittle black to greyish, and extremely fissile sedimentary rock (see Figure 4-7 image b). SRK conducted unconfined compressive strength ("UCS") tests at site and as with the greywacke, the shale is particularly hard; however, cleavage is observed in the shale drillcore and in the outcrops and unlike the greywacke, the shale presents as brittle highly fractured material. This is observed in the drillcore and in the UCS test results.

Due to the brittle nature of the shale, it is not the primary target material and therefore the Company is considering alternative uses for this material given it will need to be mined in order to access the greywacke. Notably, the Company has recently advised SRK that an internal marketing study completed in April 2021 suggests there is local demand for decorative stone for pathways and driveway use by the local community and that given this potential use it intends stockpiling of this unit separately when mining commences.

4.5 Weathering Cap

Generally, the deposit has a minor cover of soil which consists of unconsolidated, loosely packed organic A-horizon consisting primarily of regolith soils and clays as shown in Figure 4-8. In some areas this material is not present at all and the outcropping sedimentary rocks (sandstone, greywacke, shale) have been considerably weathered and heavily eroded making the material relatively unconsolidated. Where it does exist, most of the oxidised weathered cap material retains the original textures and physical properties of the host material.

Figure 4-8: An outcrop showing heavily weathered yellow to orange-red bedded sandstone, overlain by fine-grained mixture of sericite, illite and kaolinite clays, light tan to brown in colour (source: SRK 2019)

4.6 Structural Geology

4.6.1 Available Data

The structural geology of the deposit is still relatively poorly understood. No systematic geological mapping has been undertaken at the site and this remains a significant project risk. Although an attempt has been made to collect orientated core to allow downhole structural measurements to be taken, the output of this work was reviewed by SRK and was not considered to be reliable due to poor data collection practices. Although the core of the deposit is relatively insensitive to this issue due to being largely composed of the target material, greywacke, the margins of the main greywacke unit are still poorly defined by drilling. A better understanding of the deposit structural geology remains a key focus of the future planned work for the project requiring detailed deposit scale mapping and correctly orientated drillcore to be acquired.

Overall the interbedded sequence of shales and greywackes strikes NNE-SSW with dips to the West and NW of between 30º in the south to 70º in the north of the project area. Only limited mapping has been completed and these dips are taken from dip slopes of topography, minimal outcrop and some more reliable oriented core measurements. It is highly likely that the greywacke dome in the centre of the Resource is situated on the NW flanks of a large anticlinal structure and that large variations in local dip may be due to the presence of parasitic folding on the limbs of the fold. It is also probable that the deposit is cut by late faults that may offset blocks of the greywacke material significantly both laterally and vertically. Some faults have been interpreted from the topographic data but detailed analysis remains difficult due to the canopy cover. Based on this limited data SRK have recognised the possible presence of a set of faults striking NNE-SSW (sub parallel to bedding) and a second set that appear to strike NW-SE and offset the strike of the bedding. (Figure 4-9). The dip and nature (normal – reverse etc) of these faults is unknown. These faults if present represent a risk to the project.

Due to the current wide spaced drilling pattern, the geometry and extent of internal waste packages within the main greywacke unit is still poorly understood. Further drilling and the collection of robust downhole orientation data would help to resolve this and this is recommended as well as further detailed surface mapping is recommended.

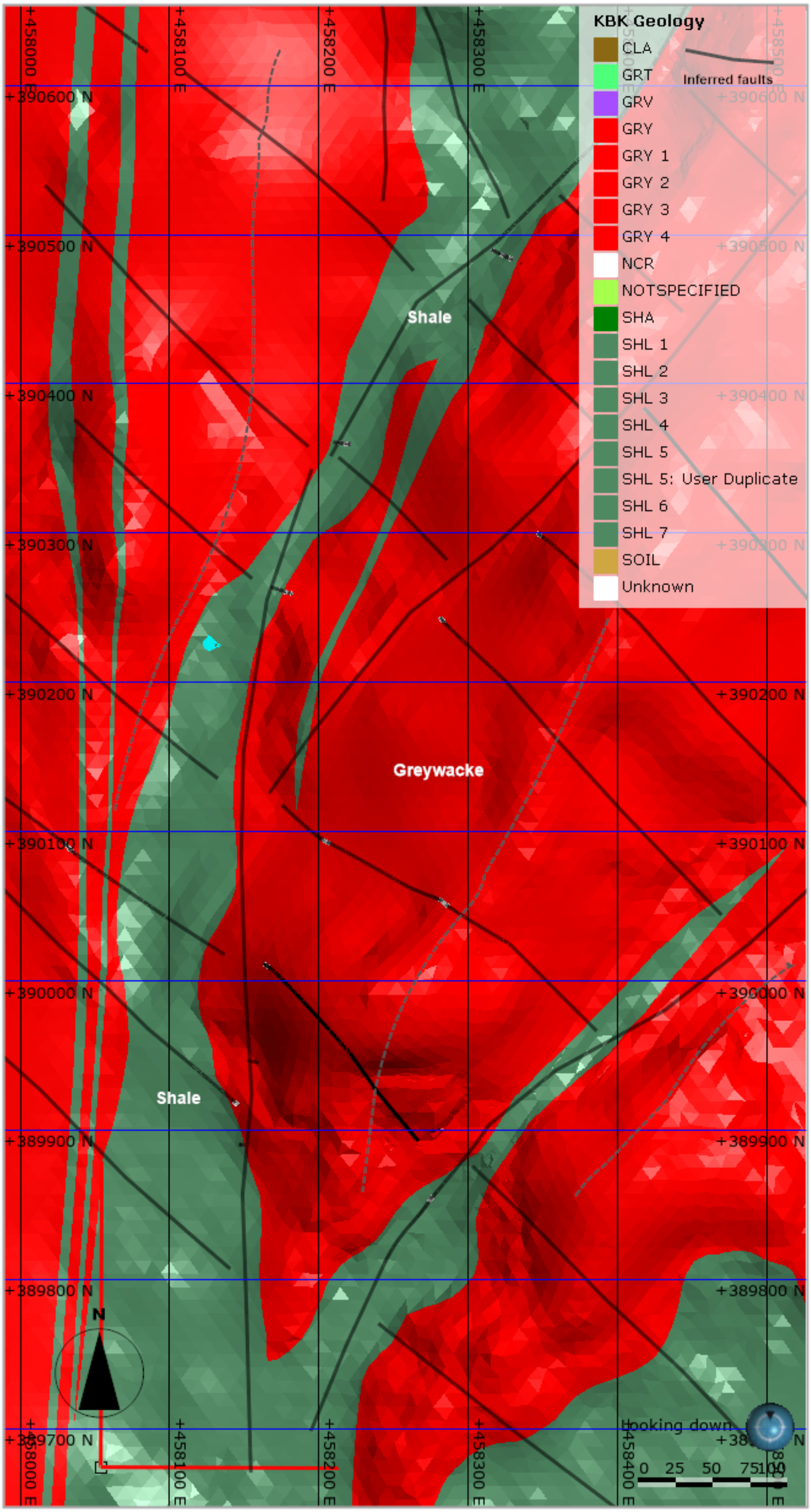


Figure 4-9: Geological map (based on geology model) showing main faults and lithologies

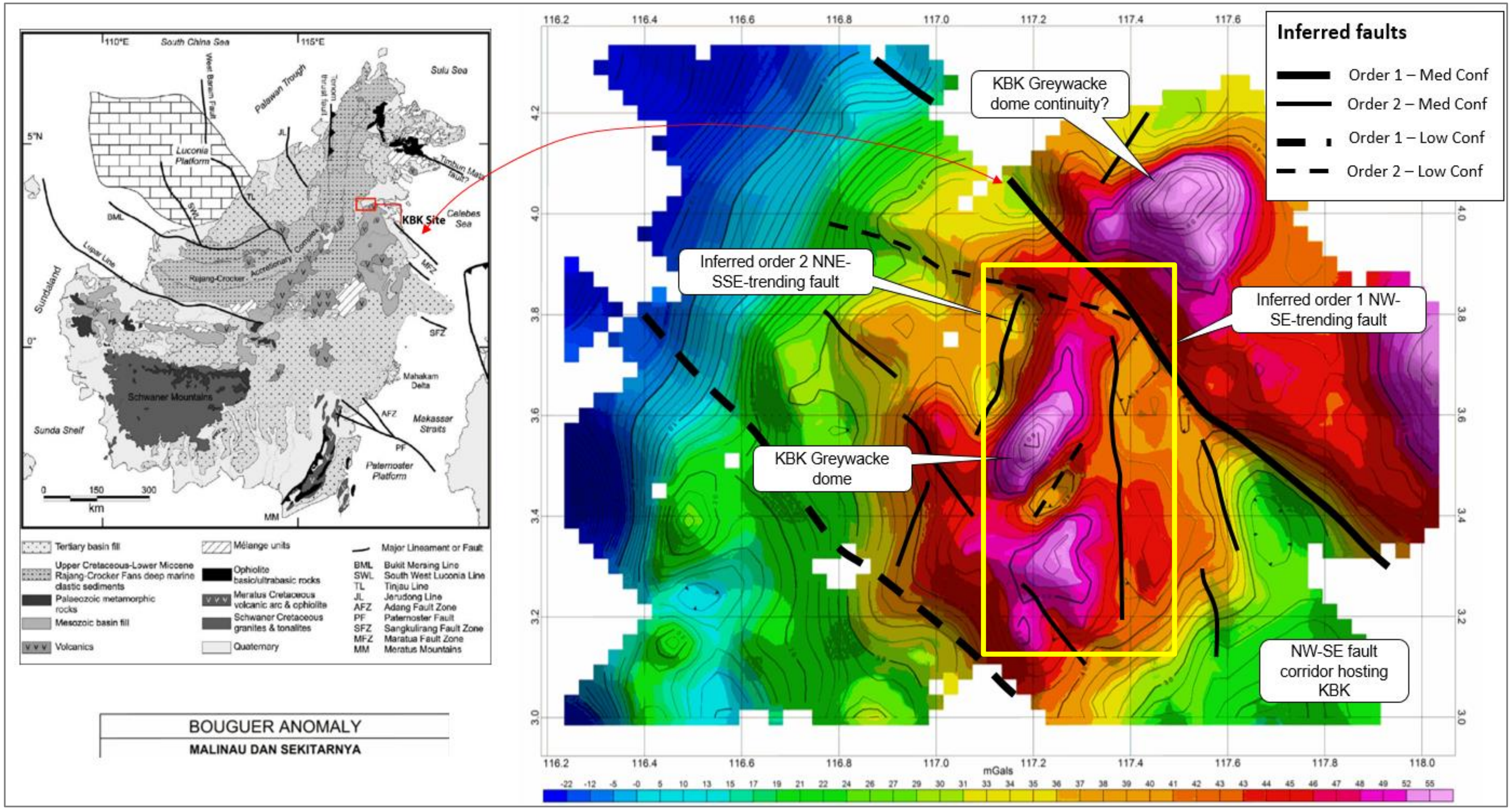


Figure 4-10: Publicly available Bouguer anomaly map covering the broader Malinau region and showing large dome structure in centre of the map (and AOI outlined in yellow) purportedly within the KBK permit, with several cross cutting fault anomalies striking NNE-SSW and NW-SE in the centre of the map. Conceptualised interpretation of possible fault anomalies by SRK and to be confirm through further mapping and structural assessment (source: SRK and PT KBK 2021)

4.6.2 Review of Structural Logging

As part of its work SRK has reviewed the structural data recorded at site and concluded that there are significant errors in the structural measurements due to some degree of random core rotation during marking of the orientation lines. As a result, SRK has not been able to use any of the orientated core data. The observed errors are evidenced by the following:

- The stereographic projections of poles to planes (veins, joints, bedding, faults) commonly show small circle distributions centred on the drillhole orientation. This pattern commonly evidences errors in structural measurements when the core has undergone some degree of random rotation during the marking of the orientation lines. (see Figure 4-11 to Figure 4-14).
- Oriented core data showing signs of rotation compared to consistently oriented surface data must be discarded (about 40% of drillholes).

One borehole (KDD031) drilled in the opposite direction to the main drilling shows a small circular distribution of poles to planes centered on the drillhole orientation but on the opposite side of the stereonet. Natural cases of small circle distribution should obviously show no relationship to the orientation of the drillhole. In particular, the bedding/contact data also show a small circle distribution of poles to planes, which is highly unlikely as folding would spread poles along a great circle. This supports the likeliness of some degree of random rotation during the marking of the orientation lines for a number of holes.

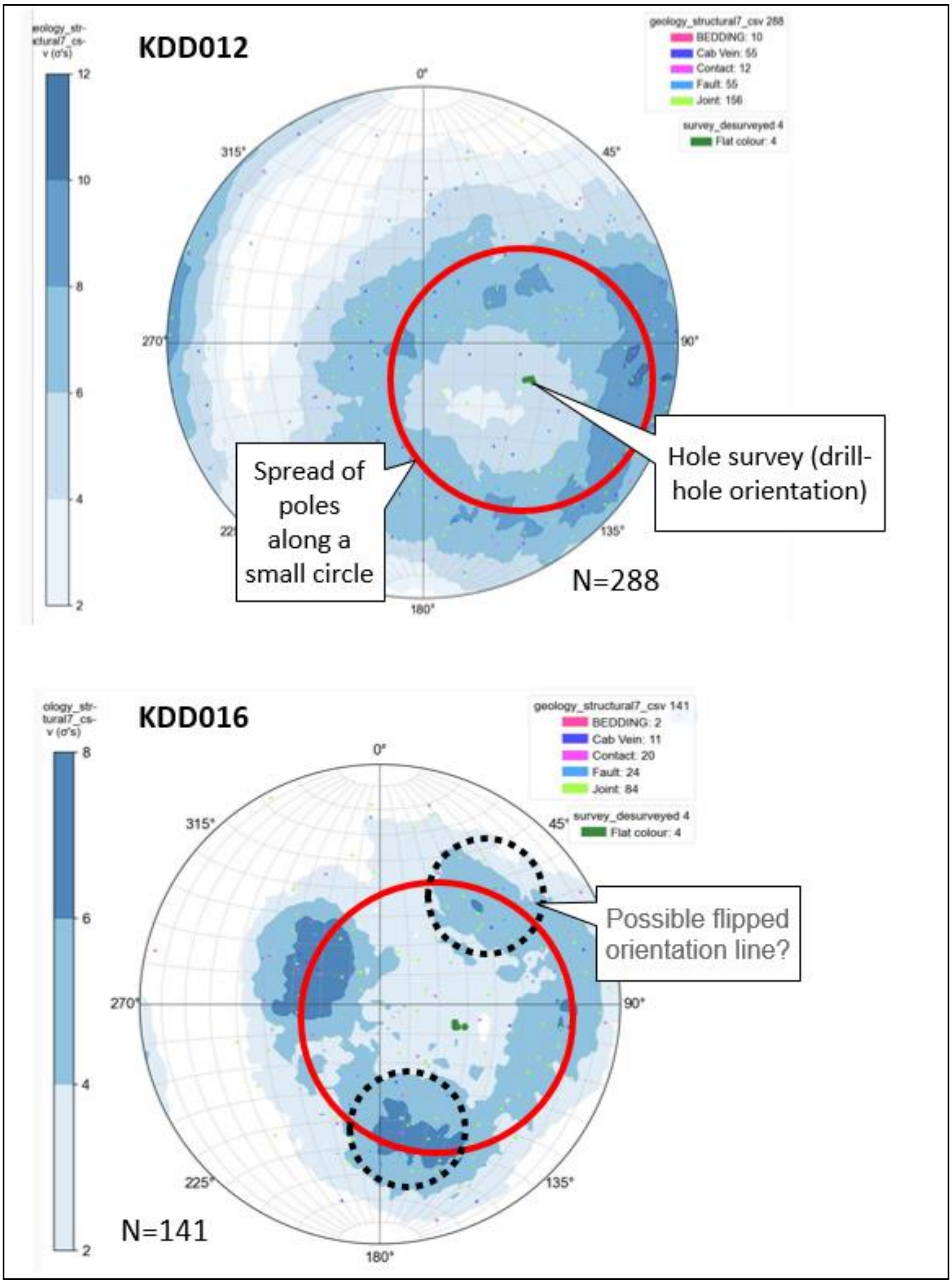


Figure 4-11: Example of the poles to planes (veins, joints, bedding, faults) commonly showing small circle distributions centred on the drill-hole orientation (Source: SRK 2021)

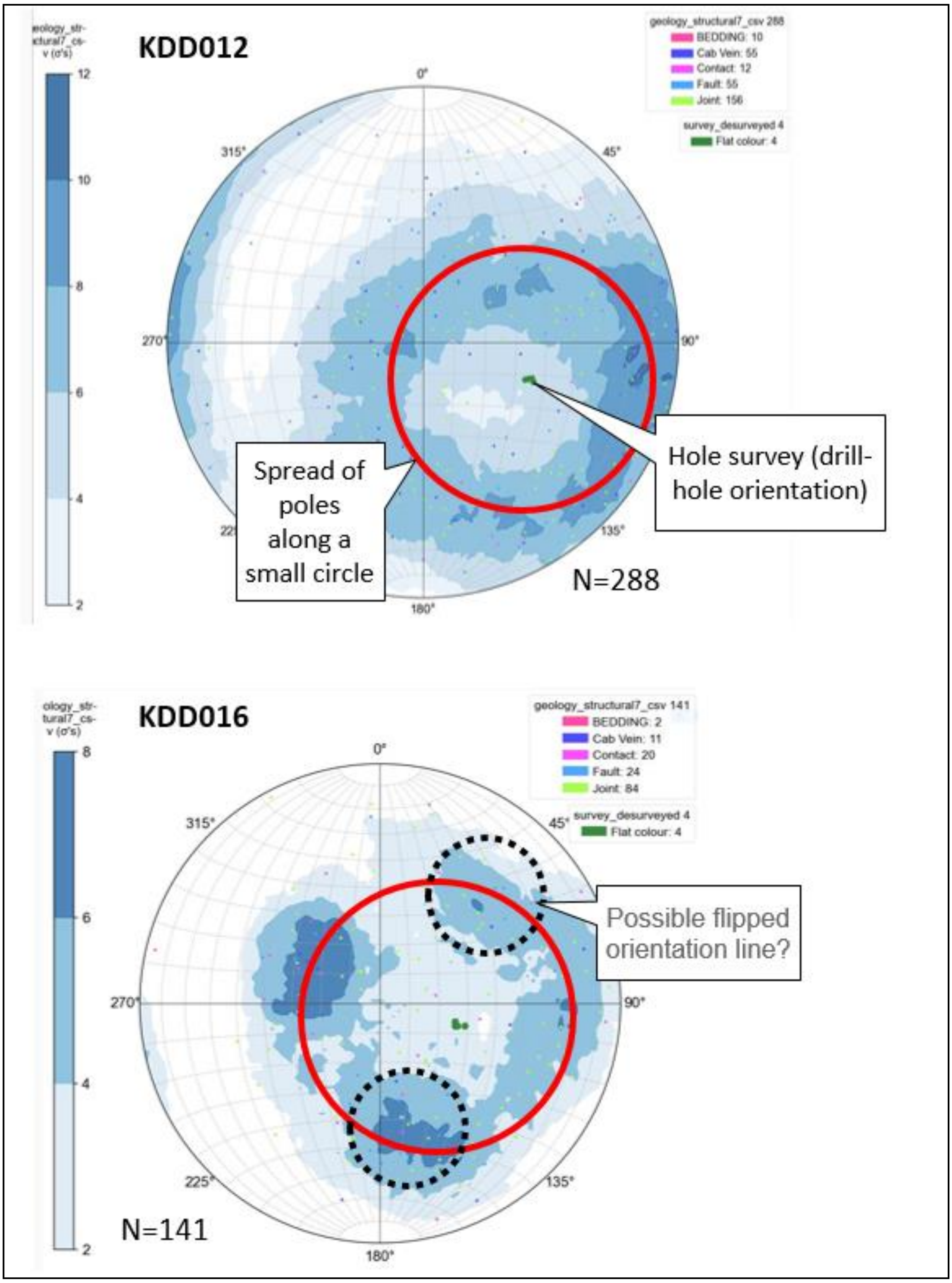


Figure 4-12: Example of the poles to planes (veins, joints, bedding, faults) commonly showing small circle distributions centred on the drill-hole orientation (Source: SRK 2021)

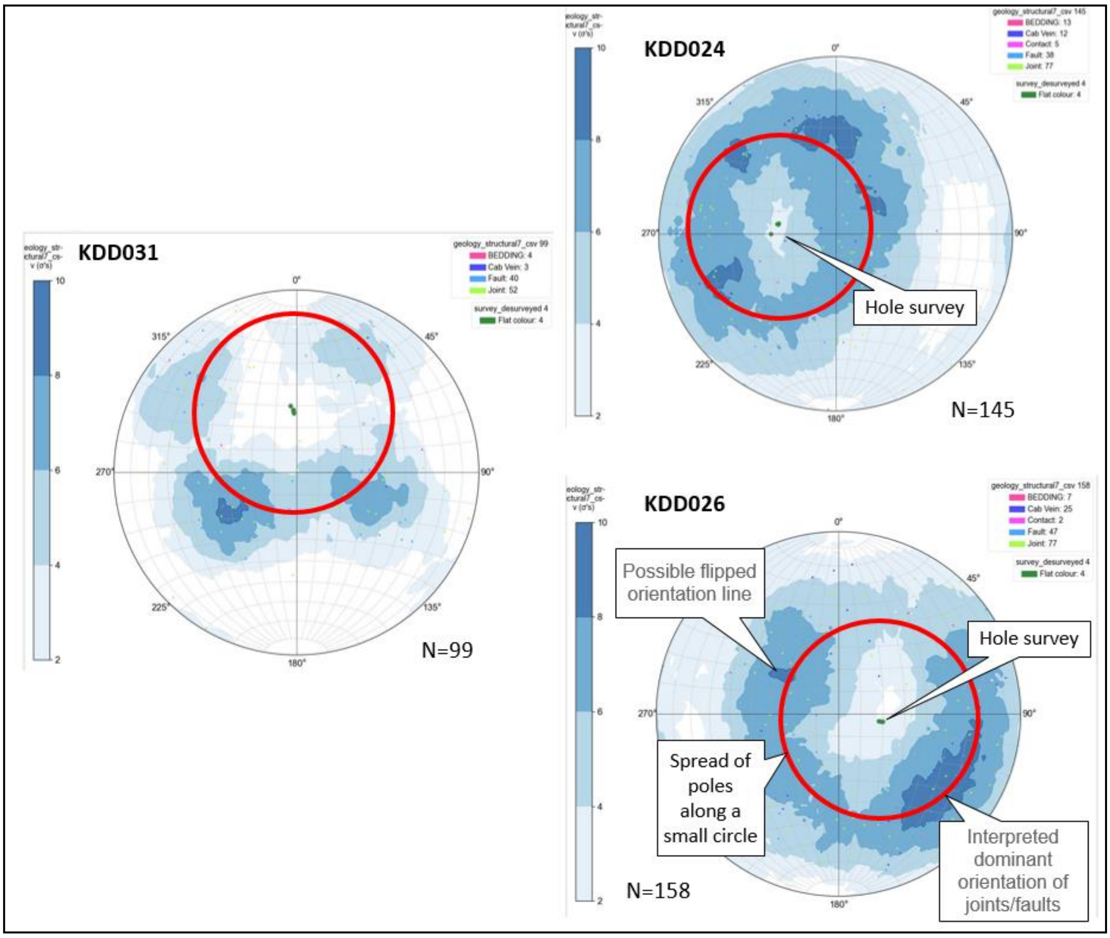


Figure 4-13: Example of a small circle distributions of poles to planes centred on the drill-hole orientation but on opposite side of the stereonet suggesting evidence of rotation of orientation line (Source: SRK 2021

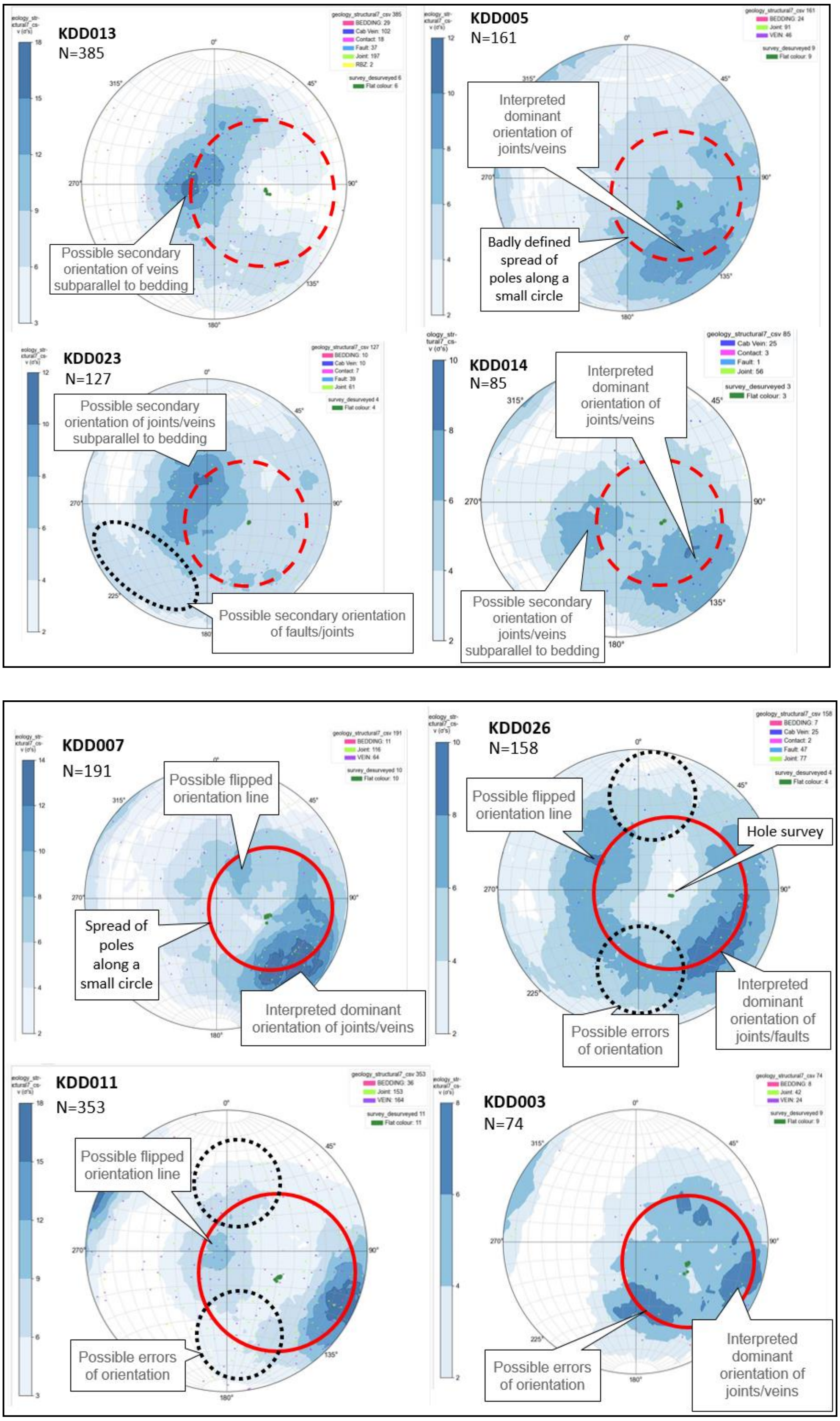


Figure 4-14: Eight examples of a small circle distributions of poles to planes centred on the drill-hole orientation but on opposite side of the stereonet suggesting evidence of possible flipped orientation line (Source: SRK 2021)

5 EXPLORATION DATA QUANTITY AND QUALITY

5.1 Introduction

This section briefly describes the nature of the exploration and resource evaluation data available for the Project and the sampling procedures put in place by the Company.

A description of the sampling methods, sample quality and the samples collected is set out in Section 5.8 and 5.11 of this Report.

All available and valid exploration data, up until the completion of the final drill campaign in 2021 was used to generate the MRE.

The Company had been supplied (by SRK) with a series of standard operating procedures (SOP) that are included in Appendix 0 and are summarised below in Table 5-1.

Table 5-1: PT KBK Standard Operating Procedures and Key Task Sheets

Task / Operation	SOP/Task Sheet	Date
Geology Core Logging	U7285 - SOP KBK - GEOLOGY LOGGING SAMPLING_v4.docx	April 2021
Density Using Immersion Method	U7285 - SOP KBK - DENSITY MEASUREMENT_v1.0.docx	April 2021
DD Sample Dispatch	U7285 - SOP KBK - DD SAMPLE DISPATCH_v1.0.docx	April 2021
Core Cutting	U7285 - SOP KBK - CORE CUTTING_v1.0.docx	April 2021
Water Table Depth Measurements	KEY TASK SHEET- WATER TABLE DEPTH MEASUREMENT_v1.0.docx	April 2021
Laboratory Sample Preparation	GeoSerivces_Testwork_FlowSheet_March_2021.png	April 2021
Field Tasks Geology Logging	KEY TASK SHEET- KBK GEOLOGY LOGGING_v1.0.docx	April 2021
Field Tasks Geotechnical Logging	KEY TASK SHEET- KBK GEOTECH CORE LOGGING_v1.0.docx	April 2021
Field Tasks Sampling Procedures	KEY TASK SHEET- KBK SAMPLING_v1.0.docx	April 2021
Reflex Act iii Core Orientation	ACTIII Manual (final).pdf	April 2021
Reflex Trac Survey Procedure	RTI-MAN-0050 REFLEX EZ-TRACT Quick User Guide v2.0.pdf	April 2021
Reflex IQ-Logger Measurements	IQL Hub WalktThrough.pdf (IMDEX document)	April 2021
IMDEXHUB – IQ	IQL Hub WalktThrough.pdf (IMDEX document)	April 2021
RTK Final Collar Pick up survey	KEY TASK SHEET - REACH RS2 RTK COLLAR PICK UP_v2.docx	April 2021

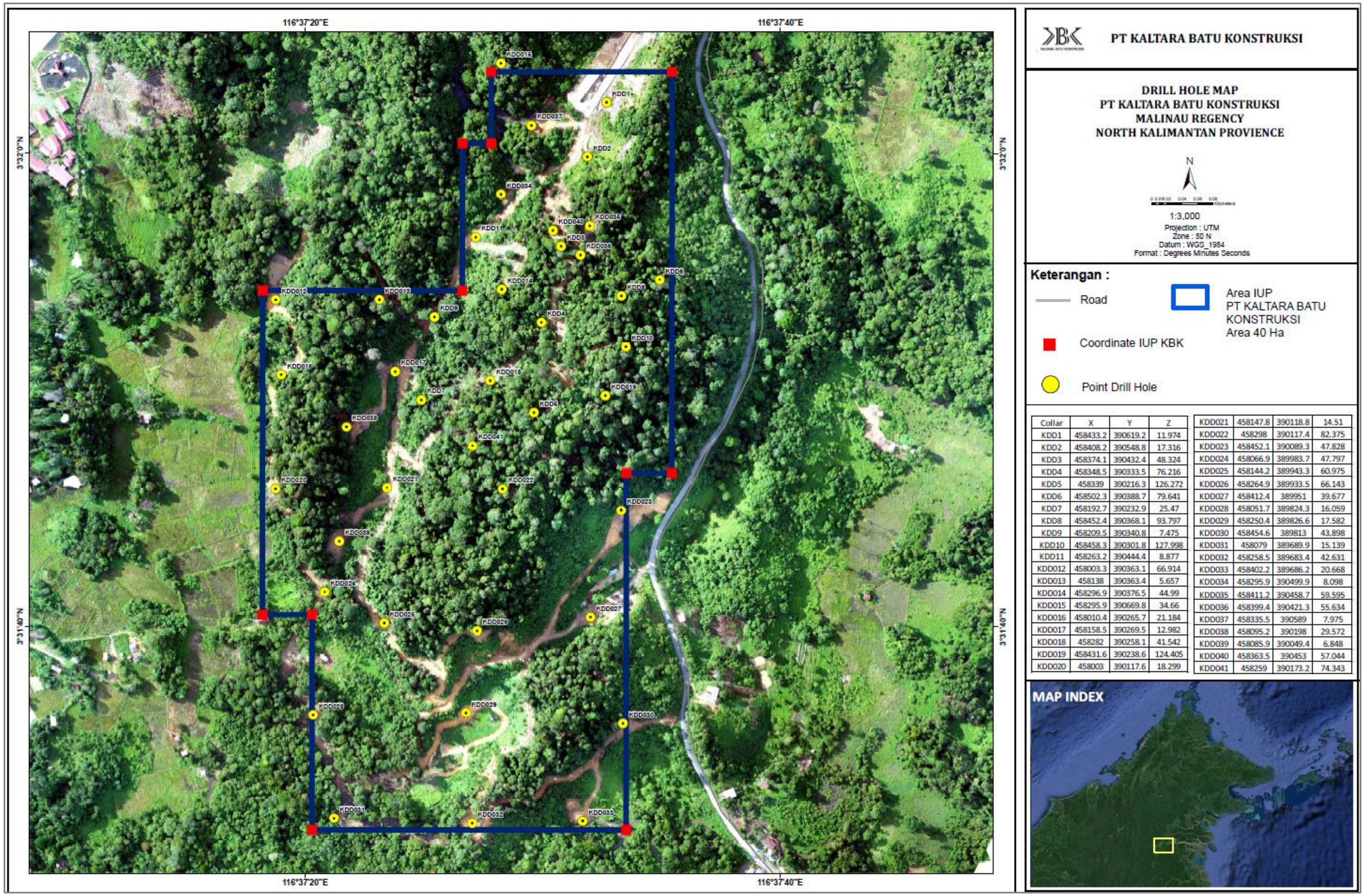
5.2 Drilling

5.2.1 Introduction

Since drilling commenced in 2019, a combination of vertical and inclined diamond drill holes, (some orientated) have been completed. All exploration drilling and sampling completed to date has been with HQ diameter diamond core. Table 5-2 and Figure 5-1 summarise the drilling completed to date and available for use in deriving the MRE presented in this report.

Table 5-2: Summary of Drilling Methods

Programme	Method	Sequence	Type	Meters	No. Sampled metres	No. Holes	Proportion
2019	DD	KDD0001 - 0014	HQ	1,315	30	14	35.5%
2021	DD	KDD0015 - 0041	HQ	2,400	100	27	64.5%
		Total	**Total**	**2,730**	**130**		**100%**



Collar	X	Y	Z
KDD1	458433.2	390619.2	11.974
KDD2	458408.2	390548.8	17.316
KDD3	458374.1	390432.4	48.324
KDD4	458348.5	390333.5	76.216
KDD5	458339	390216.3	126.272
KDD6	458502.3	390388.7	79.641
KDD7	458192.7	390232.9	25.47
KDD8	458452.4	390368.1	93.797
KDD9	458209.5	390340.8	7.475
KDD10	458458.3	390301.8	127.998
KDD11	458263.2	390444.4	8.877
KDD012	458003.3	390363.1	66.914
KDD013	458138	390363.4	5.657
KDD014	458296.9	390376.5	44.99
KDD015	458295.9	390669.8	34.66
KDD016	458010.4	390265.7	21.184
KDD017	458158.5	390269.5	12.982
KDD018	458282	390258.1	41.542
KDD019	458431.6	390238.6	124.405
KDD020	458003	390117.6	18.299
KDD021	458147.8	390118.8	14.51
KDD022	458298	390117.4	82.375
KDD023	458452.1	390089.3	47.828
KDD024	458066.9	389983.7	47.797
KDD025	458144.2	389943.3	60.975
KDD026	458264.9	389933.5	66.143
KDD027	458412.4	389951	39.677
KDD028	458051.7	389824.3	16.059
KDD029	458250.4	389826.6	17.582
KDD030	458454.6	389813	43.898
KDD031	458079	389689.9	15.139
KDD032	458258.5	389683.4	42.631
KDD033	458402.2	389686.2	20.668
KDD034	458295.9	390499.9	8.098
KDD035	458411.2	390458.7	59.595
KDD036	458399.4	390421.3	55.634
KDD037	458335.5	390589	7.975
KDD038	458095.2	390198	29.572
KDD039	458085.9	390049.4	6.848
KDD040	458363.5	390453	57.044
KDD041	458259	390173.2	74.343

Figure 5-1: Plan map showing the drilling completed to date and holes that form the basis of this MRE (Source: PT KBK Sept 2021)

5.2.2 Platform Preparation

The drillholes were positioned where possible on existing drill pads (Figure 5-2) or access tracks to reduce the requirement for additional disturbance. These pads needed little additional work; safety berms re-established, sumps dug, vegetation regrowth cleared; however, in approximately 15 cases, particularly in the southern portion of the deposit, new platforms and access was required to be built. It is understood that any future works will also require an updated certificate of environmental compliance.

Figure 5-2: Drill pads preparation 2021 (Source: PT KBK provided site photo)

5.2.3 Drilling Procedures

Two drilling contractors have been used during the 2019 and 2020 drilling campaigns, including:

- PT NORAS NUSANTARA (March – May 2019); and
- PT YEKADA MULTI ENERGI (March- June 2020).

In all cases, the Company's procedures required:

- The need to drill large diameter diamond holes up to approximately 100 m depth for geochemical and geophysical testwork.
- The need for small footprint (man-portable) drilling equipment for access to planned areas with small drill platforms on moderate and very steep slopes.
- The use of platform mounted equipment with winchable/towable capability in order to access areas where roads do not exist and gradients are steep.
- Coring and orienting in predominantly competent aggregate/sedimentary rock strata using standard double tube drilling equipment.

- Down hole surveying and core orientation of all non-vertical holes using Company supplied Reflex ACT.
- The drilling contractors to provide services such as core box delivery from drilling site to core site (workshop) for core cutting using diamond saw cutter.
- The maximisation of core recovery, while operating to the highest standards of safety and environmental control.

Figure 5-3 shows a man-portable Jacro-200 skid mounted wire line system diamond drill rig in operation during the 2020 campaign.

Figure 5-3: Diamond drilling being conducted by PT YEKADA MULTI ENERGI in 2019 (Source: SRK 2019)

The 2019 drilling report provided by PT YEKADA MULTI ENERGI states that the overall metre day / shift rate obtained across all operating drill rigs was 15 m for the programme (5 m per rig). According to the drilling company, the low rate of drilling was due to difficult ground, equipment breakdown, poor weather conditions, and availability of experienced personnel during the COVID pandemic. In SRK's opinion drilling rates and recovery could be improved with suitable changes in drill rig diameter, man portable rig equipment as opposed to sled mount, and more experienced teams.

In addition, it was evident that there was a need to improve recovery in the more noticeable friable / fractured zones which are evident in the deposit. Recovery did progressively improve between the 2019 and the 2021 campaigns despite the challenges noted above and the low production rates.

Notwithstanding the above comments it does need to be borne in mind that the typical terrain at the Project is steep to near vertical and so drilling does have its challenges. See example in Figure 5-4 showing access to drillhole KDD015 during drilling in 2021 and the main site access road and security building at main entrance.

(a) Typical terrain at KBK – steep near vertical hill top access to drillhole KDD015 in 2021 (source: SRK 2021)

(b) Main site access road and security building at main entrance (Source: SRK 2021)

Figure 5-4: Image (a) Typical terrain showing the steep/sub-vertical access to drill pad locations, and Image (b) main road to site (Source: SRK 2021)

5.3 Drilling Layout

Drill spacing at the Project is irregular, reflecting the challenging terrain and access at the project that requires drill pads to be located in areas away from extreme relief. The drill spacing varies from 50 m to 150 m with closer spaced drilling in the north of the Project area, and wider spaced drilling in the south. The majority of drill holes intercept the bedding normal to the dip of the bedding. Planned directional drillholes were approximately 60° with an azimuth of 115°. A map of drillhole collar locations is presented in Figure 5-5.

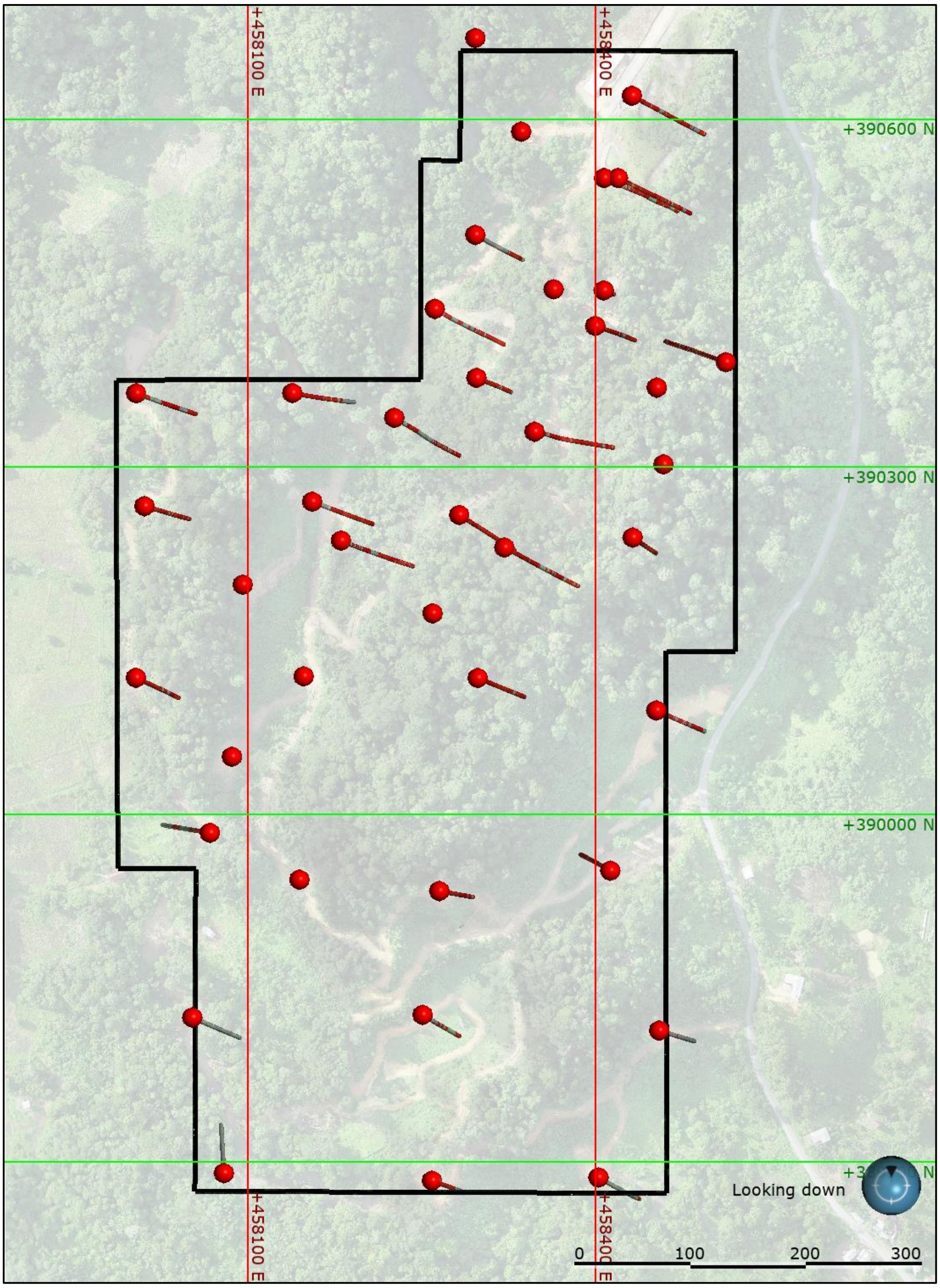


Figure 5-5: Drill collar locations with gridlines spaced at 300 m for scale (source: SRK 2021)

5.4 Drill Sample Recovery – Diamond Drilling

Drill recoveries are generally good, showing a slight increase from the 2019 to 2021 drill programmes. Table 5-3 shows drill recoveries, split by rock type and drill programmre. Average core recovery over both drill programmes for the target greywacke material is 95%, with a total of 3m out of 3,492 m of drilling logged as “No Core Recovered”.

SRK undertook an analysis of recovery vs. UCS to ensure there was no relationship between the variables that might introduce a sampling bias. The results of this analysis are presented in

Figure 5-6 and show no evidence of a correlation. Overall, SRK is satisfied that core recoveries are unbiased and average recoveries (95%) for the target greywacke lithology are sufficient for the calculation of Mineral Resources. A histogram showing core recovery is provided in Figure 5-7.

Table 5-3: Drilling recoveries split by program and lithology

Drill Programme	Logged Lithology	Metres Intersected (m)	Average Recovery (%)
2019	Greywacke	1,197	94.5
	Shale Soil Other	336 30 3	89.2 53.8 92.6
2021	Greywacke	1,279	95.4
	Shale Soil Other	1,090 68 20	97.5 50.7 72.3
Greywacke Average 2019/2021		**2,476**	**95%**

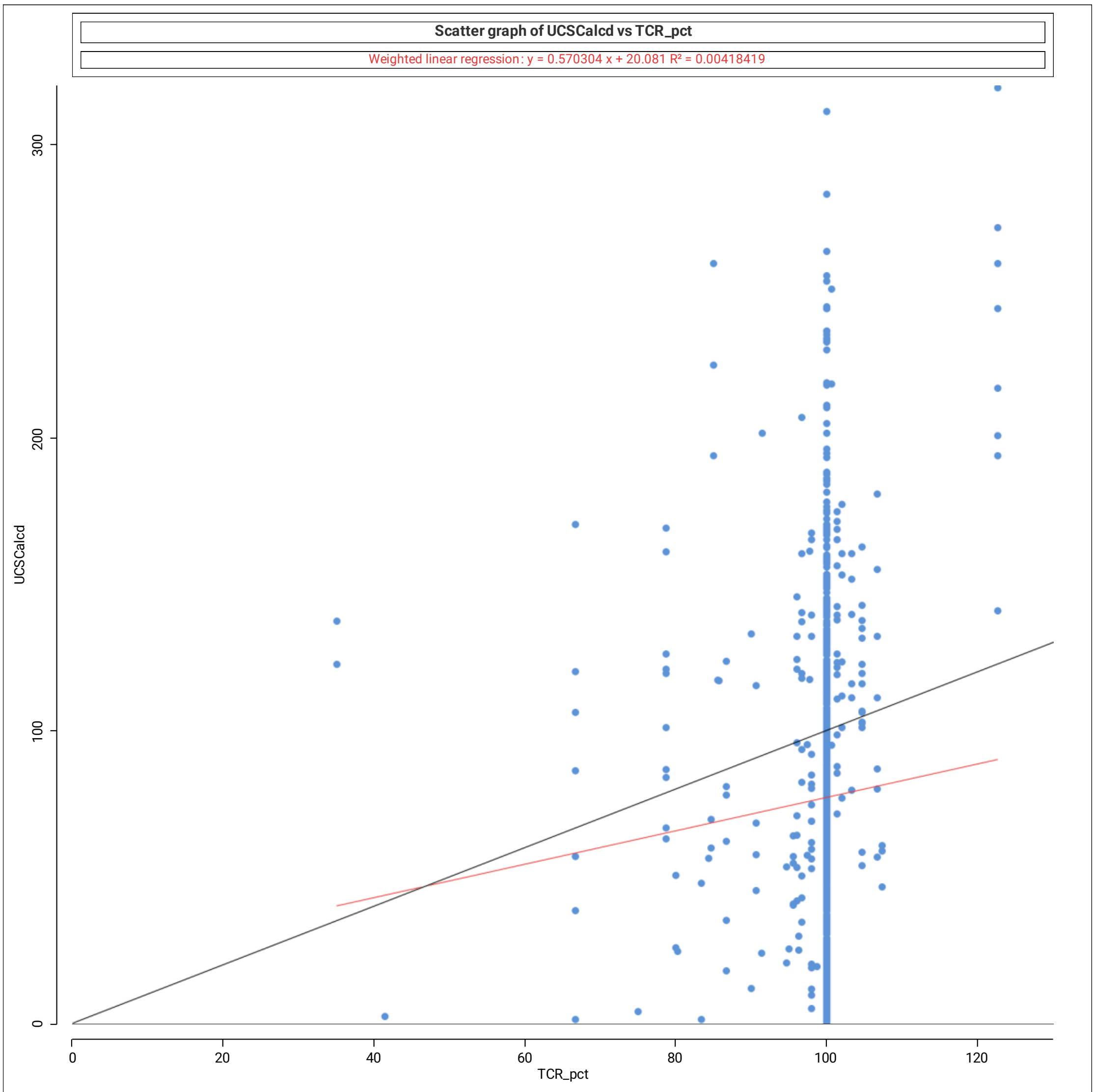


Figure 5-6: Scatter plot of TCR% (recovery) vs UCS

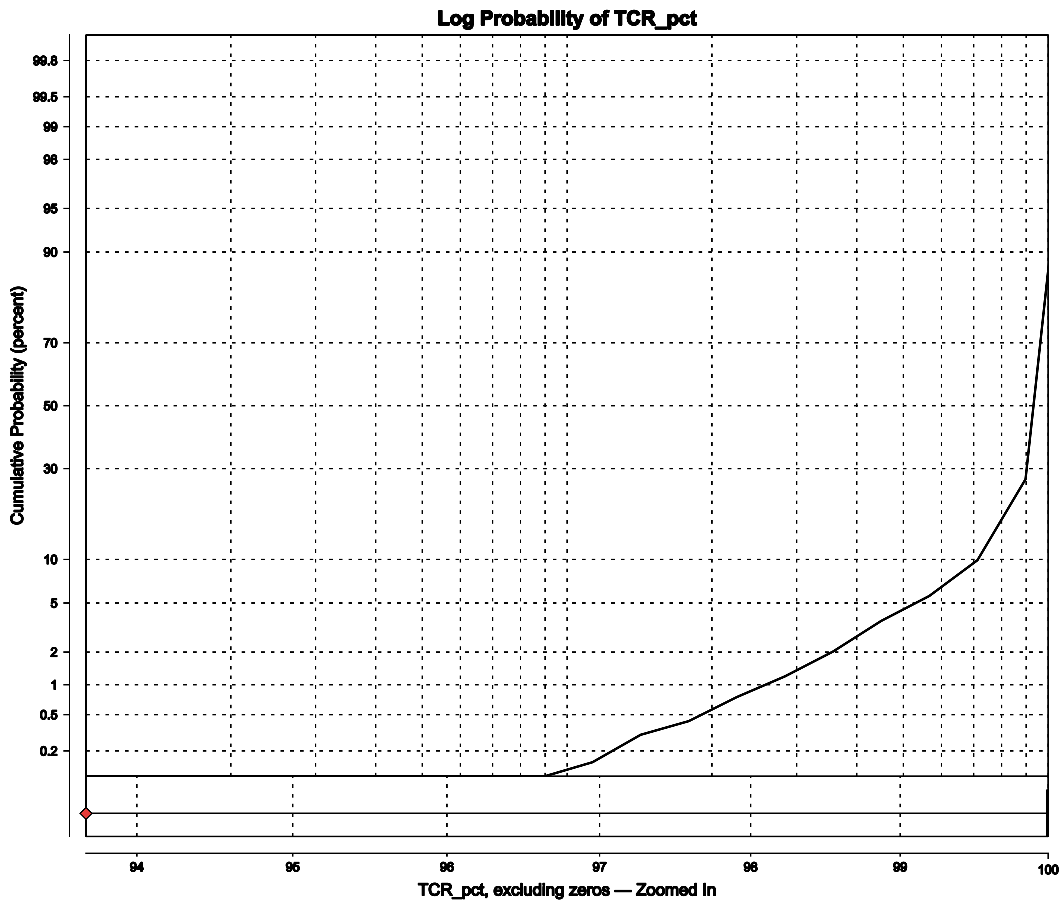


Figure 5-7: Log probability plot of TCR vs cumulative percentage

5.5 Downhole Surveys

During the 2021 drilling programme, downhole surveys were undertaken by the drilling contractor and supervised by the Company's geologists at each of the three drill rigs.

All downhole surveys were conducted using a Reflex EZ-Trac Survey tool (see Figure 5-8) and a Reflex ACT 3 tool (see Figure 5-9) for orientation recordings and data capture. Training was undertaken by a qualified Reflex technician (Mr Yanuar Fajrin of IMDEX, Jakarta) who attended site several times during the programme to train the drilling contractors and geological field technicians in correct use of the equipment.

Downhole surveys were taken at the beginning and the end of each hole and at regular 30 meter intervals during drilling to maintain planned direction. Incremental variations in dip and azimuth are recorded in the IMDEX-Reflex software at the rig, and then downloaded by the geologist into the IMDEX HUB software online portal as shown in Figure 5-10. Any relative changes in azimuth are compared to the surface azimuth as measured by the tool when drilling and noted to the drilling supervisor onsite for correction where necessary.

Figure 5-8: Reflex ACT III orientation survey tool being used on site

Figure 5-9: Reflex ACT III orientation survey line marking of core in barrel and with wax pen for scribing orientation line (base of core line)

Figure 5-10: Geologists downloading and recording of azimuth and dip downhole survey data in digital logs on site at rig (source: SRK 2021)

Data is downloaded and interpreted using Reflex software (see Appendix A) to generate a borehole trace and a measure of confidence (for example, the difference in measurements between the up-hole and down-hole data). Quality Control was assured by re-surveying a selection of holes (approximately 15%) to ensure the repeatability of the surveys. The IMDEX software allows a 3D visual and digital table summary comparison of all results obtained for the borehole (downhole original and downhole resurvey) against a 1% validation built into the software. The software allows a 1% lateral variation between the computed end of hole ("EOH") locations. For example, in a 100 m hole, a 1 m lateral difference at the end of hole between in and out run is considered acceptable. If a significant difference (3-4% plus) was encountered, then the surveys were given a rating of 3, meaning low confidence. If it was only slightly outside the 1% variation, say less than 2% (the Reflex 1% is not an industry standard, but a guide) and there was some mitigating reason for the discrepancy then it was assigned a confidence of 2, meaning there were some residual issues but the data was generally acceptable. If there was less than 1% variation, then the survey was rated 1.

5.6 Core Handling

SRK provided detailed SOP's for all processes that are followed by site geologists during the drilling programme. The following section provides a summary of these processes while a more detailed description is provided in Appendix A.

All core was managed by qualified contract geologists during the 2019 and 2021 drilling programmes. After core was removed from the barrel, the drill rig staff arranged core on v-rails to measure and record recoveries (Figure 5-11). Recovery was agreed at the rig with the supervising geologist and the drilling supervisor. This was physically written on the core block and inserted in the core tray with the core at the appropriate interval. Once core had been marked at the drill site, all trays were relocated by the geologists back to the core laydown area so detailed logging could commence. In general, SRK observed the core handling practices to be well managed.

(a) v-rails in use at drill rigs to arrange core and measure recoveries

(b) Geologists logging in the core laydown and logging area (source: SRK)

Figure 5-11: Image (a) use of v-rails at drill rigs to arrange core and measure recoveries, and Image (b) Geologists logging in the core laydown and logging area (Source: SRK 2021)

5.7 Geology Logging

Detailed lithological logging is undertaken and the following general parameters are recorded on the digital record sheet (excel format):

- Drillhole identifier number, DGPS coordinates, coordinate system, azimuth, dip, date, geologist's name.
- General rig details, core diameter.
- From and To, and final depth interval in metres.
- Lithology/ rock type, weathering/alteration.
- Ore minerals present.
- Colour.
- Grain size, texture.
- Structures and angle to core axis (alpha angle).
- Water table depth.
- Any other comments.

At the conclusion of the geological logging task, the following sheets are produced by the geologists and validated by the Senior Geologist onsite. The data is then imported into the purpose built geological database with the relevant relational data tables.

- COLLAR Logging Sheet (to be completed at the rig).
- RECOVERY Logging Sheet (to be completed at the rig).
- SURVEY Logging Sheet (to be completed at the rig).
- GEOTECH Lithology Logging Sheet (to be completed at the rig).
- LITHOLOGY Logging Sheet (to be completed at the rig and in the core shed).
- STRUCTURAL Logging Sheet (to be completed at the core shed).
- SAMPLE Logging Sheet (to be completed at the core shed).
- DENSITY Logging Sheet (to be completed at the core shed).

5.8 Detailed DD core logging procedure (at the core shed)

When full core boxes have arrived at the core shed, the geologist makes the following checks:

- Layout the core boxes in the correct down hole order.
- If necessary, clean the core with water.
- Ensure that core has been placed in the boxes so that depths read from left to right down the hole.
- Check that core blocks or plastic core spacers are all present with depths clearly marked and, if necessary, check against driller's daily logs.
- Check that all core lengths fit together within each drill run and that the start/end box labels match these.
- Check the core is the correct way up by examining geological indicators such as scour structures and graded bedding or drilling induced indicators such as core spring marks and ground ends.
- Check that the core at the end of each drill run joins up with the core at the start of the next.
- Look out for sudden differences in intersection angles or lithologies which may indicate missing, or displacement of core.
- Measure total core recovery ("TCR") between depth markers after to ensure all core sections fit tightly together. Where core is badly broken, make an assessment of the possible amount of solid core that could have been drilled over this section.
- When there is core loss, attempt to assess and record the depth interval at which this might have occurred.
- Where necessary, move core blocks / spacers to resolve problems of under recovery in one drill run and over recovery in the next. This could be due to retrieval of a core "stick-up" at the bottom of the hole after withdrawal of the inner tube during the previous run.

- Measure solid core recovery (“SCR”) which is a reflection of core quality as opposed to TCR. This is based on the sum of all core pieces whose length along the core axis is greater than, or equal to, the core diameter. This sum is then expressed as a percentage of the drilled length. Note that there must be a complete core circumference at the centre point of each core length.
- Walk over the core boxes and mark all lithological units whose length exceeds 1 m (unless an established marker horizon) with chalk. Narrower intervals can be recorded as inter-beds within the main unit description.
- Photograph the marked-up core (wet).
- Check for evidence of:
  - Folding;
  - significant changes in bedding intersection angle especially sections of core with near zero intersection angles;
  - changes in the relationship of bedding and cleavage;
  - inverse repetition of lithological units;
  - faulting;
  - excessive core loss;
  - zones of deep oxidation;
  - clay gouge; and/or
  - zones of shearing and brecciation.
- Assign a brief rock description or code for each lithological unit as per the lithological code table.
- Make a general description of each rock unit which should include:
  - Rock type; for example, fine grain greenish-grey greywacke or foliated meta-volcanic schist.
  - Grain size; for example, fine grained.
  - Colour; for example, pinkish grey.
  - Sedimentary, metamorphic or igneous characteristics.
  - Way-up indicators.
  - Mineralogical information relating to host rock.
  - Style and intensity of mineralization with description of ore minerals present.
  - Any geotechnical characteristics.
  - Core condition including porosity, friability, degree of weathering or alteration, leaching, presence of solution cavities, etc.
- Once the general description is complete, geologists add depth specific descriptions of particular features of interest.
- Keep core surface wet whilst logging. This will accentuate structures and textures in core.
- Write up all the log sheets (digital/hard copy which ever appropriate). The rock title should be positioned immediately adjacent to the first "from - to" depths for each/interval unit.
  - Where the contact with the next lithological unit occurs within a drill run, determine the depth of the contact taking into account core loss.

    - Where core loss cannot be assigned to a specific depth interval and it appears to be throughout, split the core loss pro-rata between the two portions of the drill run. For example, if the contact is 1 m into a recovered section of core 2.6 m long and if the core loss is 0.4 m, then the core loss assigned to the 1m section will be 1 * 0.4 / 2.6 = 0.15. That is, the recorded depth of the contact will be 1.15 m below the marker depth.

- For each lithological unit, record as many intersection angles as possible (rotate the core until the maximum angle is displayed and, with a EZ-LOGGER©, measure the angle to the edge of the core). Intersection angles could be for a vein, bedding, foliation / schistosity, cleavage, etc. EZ-LOGGER© is the preferred method to collect these measurements.
    - Record clockwise intersection angles between the low points of these features taking one as the reference (for example, cleavage, if locally uniform in direction).
    - Specify the depth of each measurement on the log sheet opposite the drill run in which it occurs.
- Record any changes in core diameter down the hole.

5.9 Structural Data

A structural logging programme was implemented as part of the 2021 drilling programme. No structural data was recorded as part of the 2019 drilling campaign due to unavailability of oriented core instruments.

For the 2021 programme, the Company geologists used a combination of tools and techniques to collect the structural data, including the EZI-logger manual logger device (Figure 5-12), and the IMDEX I-Q Logger (Figure 5-13) digital device. All data were recorded and summarised in the KBK Geological database (Figure 5-14).

Figure 5-12: Example Alpha/Beta measurement using the REFLEX EZ-LOGGER

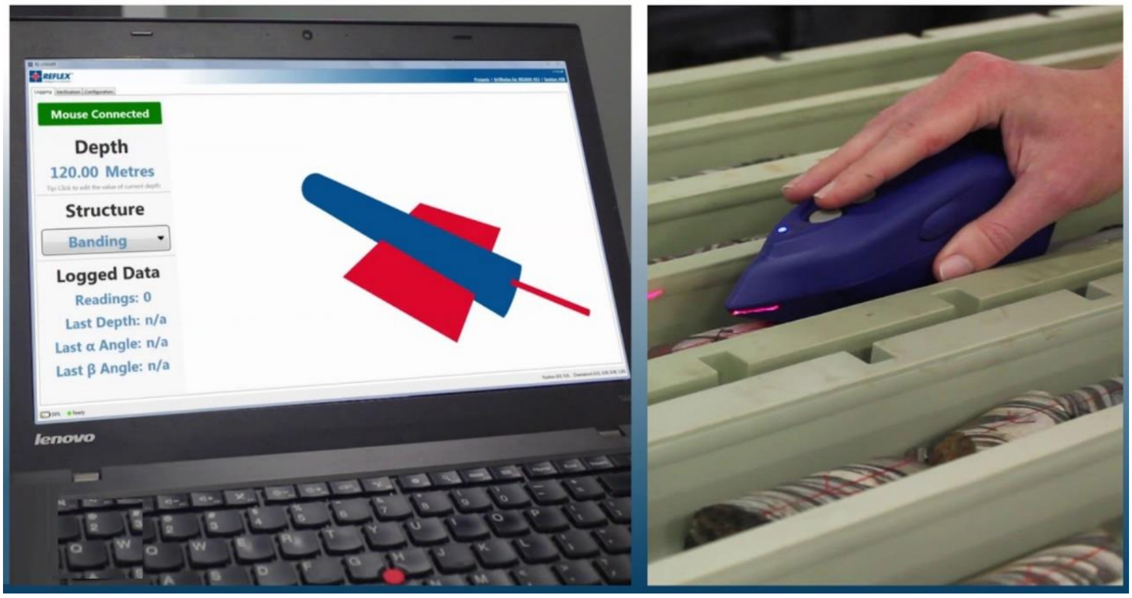


Figure 5-13: Example Alpha/Beta measurement using the REFLEX IQ-LOGGER and Bluetooth communication of data to REFLEX IQ-Logger software used at KBK site during 2021 programme

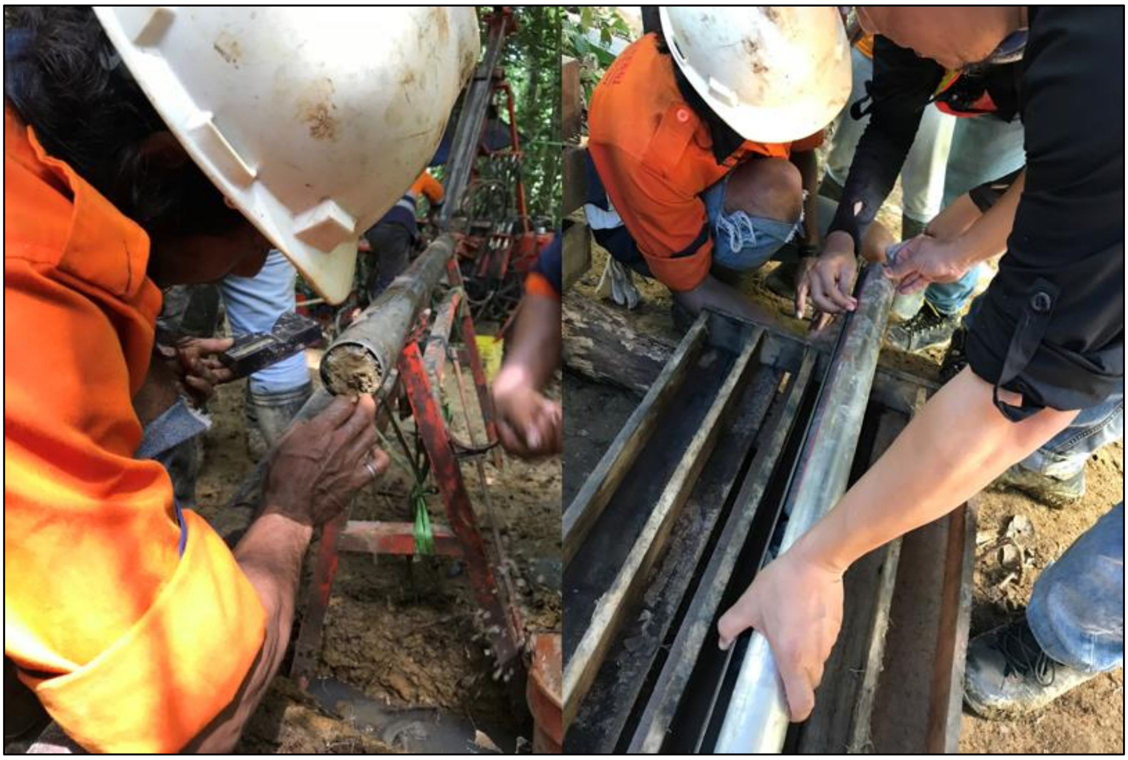


Figure 5-14: Example of the Company geologists marking core following extraction and drawing the orientation line as recorded by the ACT III tool. (source: SRK 2021)

Recommendations Regarding Structural Logging and Interpretation

SRK strongly recommends that a focused structural mapping and logging exercise is included in the next phase of exploration. Additional areas that could be addressed with respect to the structural data collection and interpretation in future are as follows:

- Oriented core data in the project needs to be compared with surface measurements to assess the confidence in the oriented core data at a given depth.
- Surface mapping is required to better gauge the general structural features in the project area. This would also define structures with a better confidence level, despite the rotation issues, the pole clusters that might be related to the main and secondary orientations of joints and veins in the rotated data.
- Currently, a limited number of drillholes about 30%) in the Project show much lower evidence of core rotation, where the pole populations show a limited number of strong clusters, interpreted as the main populations of structural data.
- Structural data from oriented holes with only the alpha angle measured are not reliable for structural purpose (14% of holes).
- Data from the following boreholes should be completely discarded: KDD003, KDD004, KDD007, KDD009, KDD012, KDD016, KDD018, KDD022, KDD023, KDD024, KDD026, KDD028, KDD029, KDD031, KDD033, KDD034, KDD035, KDD036.
- The following boreholes show a preferred (likely natural) orientation as well as evidence for random rotation, and the data should be used with caution: KDD005, KDD006, KDD011, KDD013, KDD014, KDD017, KDD019, KDD020, KDD030.

- Boreholes drilled vertically are not for use for structural purposes and must therefore be avoided.
- SRK recommends a full Qa-Qc check of all existing drillholes that have been orientated and to cross-check these with face mapping activities at site in order to confirm/discount the orientation effectiveness of the holes.

5.10 Core Photography

The core was photographed using a digital camera and a photo board emplaced in the picture as shown in Figure 5-15 and Figure 5-16. On arrival back at the core lay down area, core was initially photographed (wet) to record the natural core prior to sampling or marking.

Following all sampling and logging activities, including density and PLT measurements, a final photograph was taken of the core prior to being stored in the lockable sea-containers which are located onsite at the core laydown area. The Company has arranged the core in the store sheds so that the individual holes can be accessed should they need to be revisited of cross checked.

Figure 5-15: Example of pre-logging photographed core (Source: SRK 2021)

Figure 5-16: Example of final photographed core (Source: SRK 2021)

5.11 Geotechnical Logging

5.11.1 Introduction

A geotechnical site visit was undertaken by an SRK Consultant between 27 April and 1 May 2019. The main activities of the site visit comprised:

- Observation of core and general rock conditions;
- Inspection of core logging facilities;
- Geotechnical logging, sampling training and point load testing (PLT) training, and
- Review of current drilling and logging practice.

5.11.2 General observations of rock geotechnical material properties

The core was generally high-strength competent greywacke with intervals of weak shale, which was often sheared and appeared highly susceptible to weathering. A preliminary assessment indicated that the stability of the rock is likely to be structurally controlled, i.e., by orientation of jointing, faulting, and shale bedding, rather than by rock mass strength of the mainly competent greywacke. It is therefore likely that accurate orientation data will be crucial to geotechnical design.

5.11.3 Geotechnical Logging Training

Training given to logging technicians included an introduction to the theory and use of geotechnical logging, and the collection of data and completion of the following worksheets in the database: (1) Basic log, (2) Structural log, (3) Geotech Sampling and (4) PLT. Two hard-copy sheets for completion of the basic and structural geotechnical logs were issued. Staff were instructed to complete sheets 1 and 2 by hand at the drill rig as soon as the core is extruded, before input into the database at a later time. The remaining worksheets were to be completed either directly into the database or written up by hand before inputting.

Logging technicians were trained on geotechnical sampling selection and provided with a sampling regime to follow for the sampling of uniaxial compressive strength (UCS) samples, triaxial (TXT) samples, direct shear joint (DSJ) samples and direct shear saw-cut (DSS) samples. This regime recommended the collection of the following number of samples, based on the drilling programme at the time of the site visit:

- For the greywacke: 20 UCS, 5 TXT, 15 DSJ and 15 DSS samples.
- For the shale: 10 UCS, 2 TXT, 5 DSJ and 5 DSS samples.

Logging technicians were also trained on the use of the PLT machine and recording of results

5.11.4 Geotechnical Drilling and Logging Observations

During the site visit, a significant number of errors were noted regarding offsets of orientation lines between drill runs. An orientation offset is a difference in alignment of orientation lines between two consecutive runs that can be confidently 'locked' together, such that the logger is sure that the two runs are aligned in a continuous orientation. When recorded correctly, the orientation lines should be drawn in the same location across the two runs. However, as shown in Figure 5-17, a number of examples were found where the orientation lines did not match, despite the consecutive runs locking together. This shows an error in the location of the orientation mark, which leads to incorrect orientation of structures.

Figure 5-17: Orientation line offsets observed between drill runs

The potential causes of these errors were outlined to the logging team. These included:

- Inconsistency with the placement of the orientation mark – this should always be made of the bottom of the core.
- Incorrect drawing of orientation line, for example, as a result of using of short or bent edge to mark the line.
- Incorrect or incomplete assembly or locking together of the core before drawing the orientation line, causing rotation of the core pieces before marking the orientation line.
- Skew marking of the orientation mark.

- Triggering the orientation tool to record the bottom of the hole whilst the barrel is still spinning – drilling should be stopped for an appropriate amount of time before the bottom side is recorded.
- Malfunctioning of the orientation tool.

Training was provided on the determination of orientation offsets and the correct marking of the orientation mark and line. Given the importance of structural orientation to the geotechnical (GT) design, it was recommended that GT drilling be halted if this problem was found to persist.

5.11.5 Conclusions and Recommendations

Following the site visit, logged borehole structural orientation data was compared to structural orientation readings taken from various outcrops on site as a means of verification. As already commented in this report, this showed disparity between the two datasets. Furthermore, the borehole orientation data showed signs of rotation of the orientation line about the borehole axis in a number of boreholes – examples of this is shown in Figure 5-18.

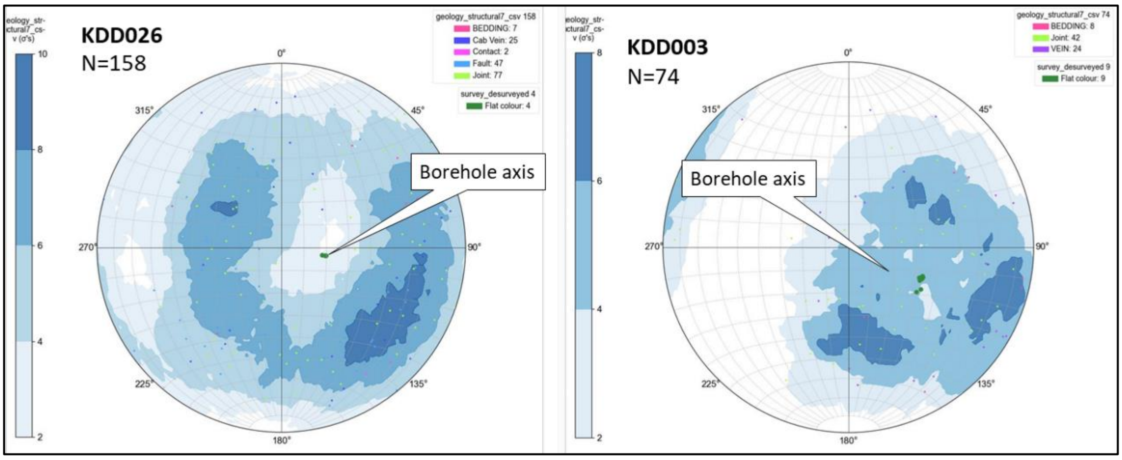


Figure 5-18: Example evidence of orientation line spinning

Due to these observations and the evidence of orientation line offsets observed on site, SRK does not believe it appropriate to rely upon this information to inform the slope design at this stage. Therefore, given the available information, SRK recommended an assumed inter-ramp angle of 50° slope, with the addition of ramps in the slope, the overall slope angle will be lower than 50° for the pit shell design. This is a conservative ramp angle, however until further information is available, SRK is of the opinion that this should be the basis of conceptual pit design.

It is noted that, with the continuation of drilling and the collection of additional structural orientations, the sets / general trends will become clearer. Nonetheless, the Company needs to ensure in future that these data are correctly recorded. To ensure the validity of future geotechnical data collection, the following actions are recommended:

- Full-time geotechnical supervision of drilling by a site senior to ensure validity and accuracy of geotechnical data collection;
- Geotechnical logging training of logging technicians;
- Continual technical QAQC of geotechnical data collection;

- Implementation of acoustic and/or optical televiewer downhole surveys for validation of orientation data;
- Additional outcrop mapping of structures, where possible; and
- Input from a suitably qualified structural geologist to provide insight on structural variability and provide some interpretation on the shale bed orientations, which will be important for pit slope optimisation.

6 SAMPLE PREPARATION, ANALYSES AND SECURITY

In both the 2019 and 2021 programmes, it was decided to sample quarter-core only for all samples submissions. This decision was made to allow for a sufficient amount of additional drill core to be made available for further much needed geophysical testing (see Section 8.3) and to allow for sufficient volume of sample material to be submitted to the labs. The Company assured quality of sample selection via cross checking the core as it was selected from core boxes and double checked as core was inserted in the sample bags that were being submitted to the laboratory.

The details of the sampling method applied for both the 2019 and 2021 programme are provided below.

- All previous testwork yielded relatively homogenous petrographic results (2017, 2018, 2019) for the greywacke material. There is little variation in respect to both mineralogical composition and the key geophysical properties (LAA, UCS, density, etc).
- Given the above, the Company decided to take only 10 x 10 m composited samples selected from a selection of holes across the deposit.
- Samples were selected by geologists at the laydown area, following the completion of all other logging activities (PLT, density, structural logging, etc).
- Only greywacke and shale lithologies were sampled.
- No sampling was conducted across lithological boundaries and where core loss was ≥0.25 m.
- Once cut the left side of the core (left of the marked base of core line) was left in the core box, and the right side of the core was cut into two equal pieces for creation of 1/4 core portions.
- Friable core was sampled by geologists using a scoop while competent core was sawed in quarter with a diamond saw blade.
- Selected sample intervals were placed into calico bags and labelled prior to dispatch. Two waterproof labels were recorded for each sample: (1) One label being placed into the bag with the sample; and (2) the other was maintained in the record book and is kept onsite for reference.
- Samples were delivered to the laboratory with a transmission sheet; signed at the site and on receiving at the Geoservices laboratory.
- Samples received at the laboratory were then processed as shown in Figure 6-2.

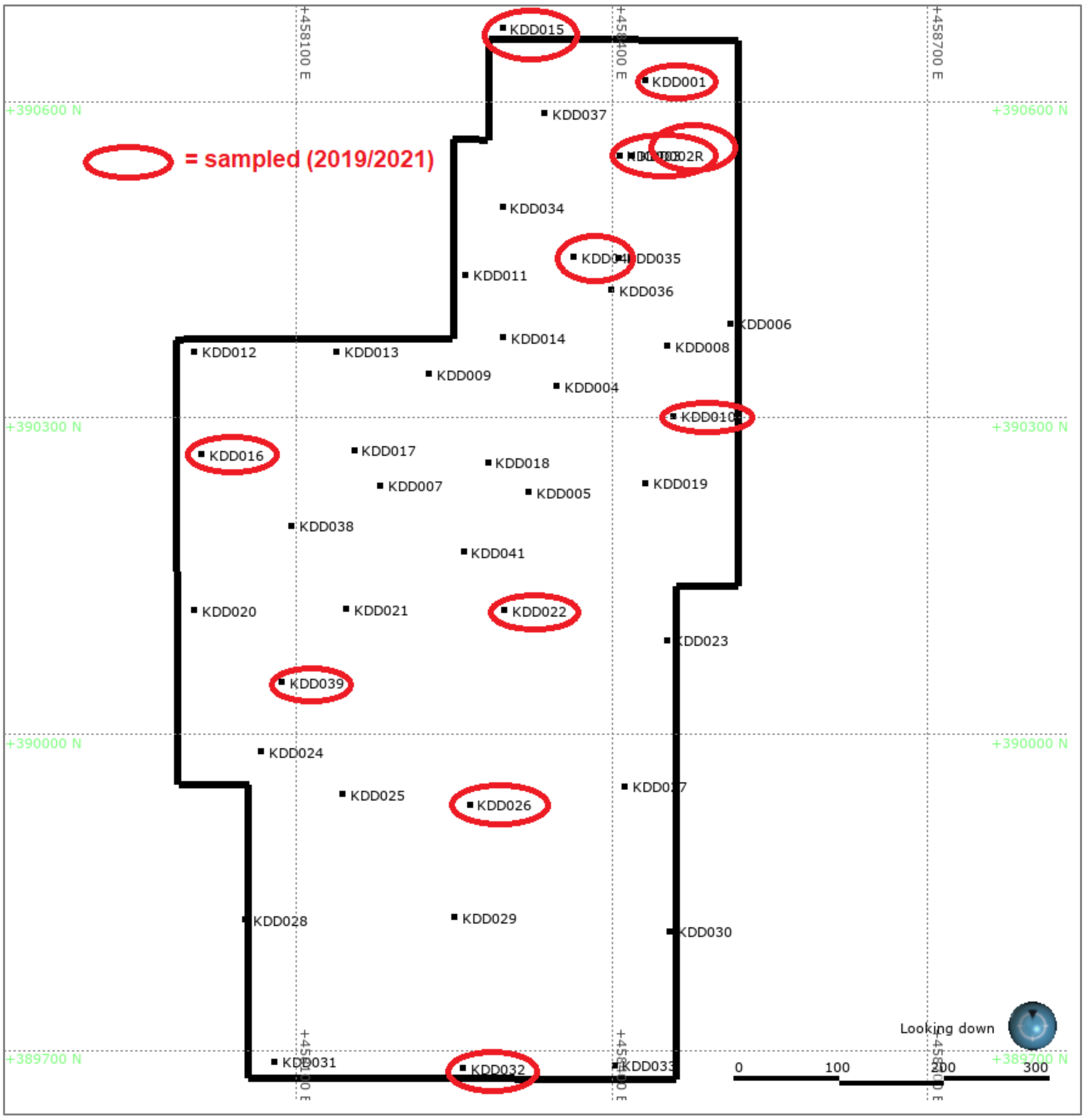


Figure 6-1: Location map of sampled drill holes for the 2019 and 2021 programmes Hole KDD015 circled is a shale sample all the remainder are greywacke (source: SRK Consulting 2021)

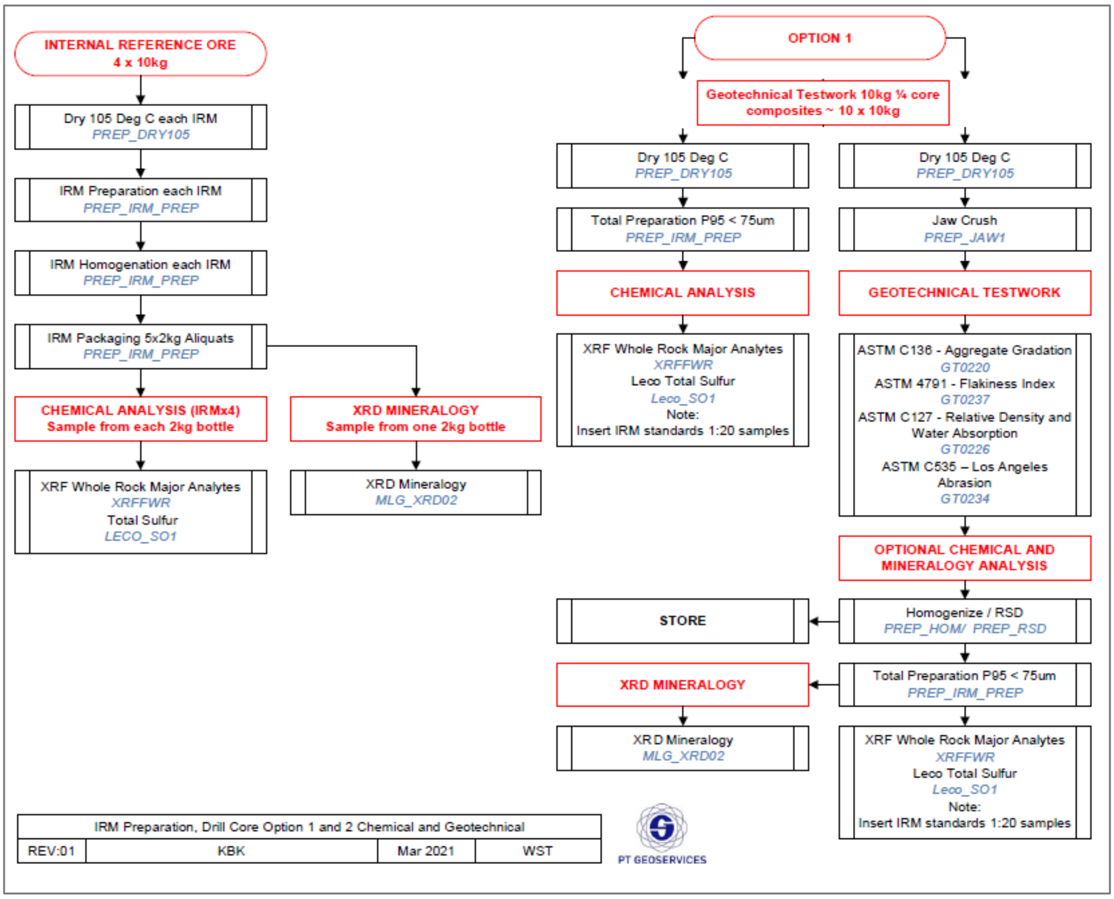


Figure 6-2: Laboratory Sample Preparation and Analysis (source: PT Geoservices Jakarta 2021)

7 DATA VERIFICATION

7.1 Master Drill Hole Database

SRK was supplied with a drillhole database constructed using CSV files extracted from the KBK master geological database (U7285_KBK_DHDb.accdb) on the 9 June 2021. This is a Microsoft database format file which is stored and managed by the Company offsite.

A total of 41 *.xlsb files were extracted from U7285_KBK_DHDb.accdb, all of which were renamed and prefixed with extraction date (EDD_[Hole ID]_[Date of Export]).

Nine additional output files were also created for input file formats for Leapfrog software. The export also produced a validation spreadsheet summary which highlighted any gross errors within the dataset.

A new data summary was also created (U7285_United_Database_2019-2021_v2.xlsx) and re- constructed in Datashed using the File – Import – Import CSV (databases) option. This step was done to cross check the site geological database and check for any errors. Several minor errors were identified and relayed back to site teams for correcting or explanation. The errors were then corrected in the natural database.

7.2 Quality Assurance and Quality Control (QA-QC)

Logging, and sampling and partial QA-QC of samples comprised:

- field duplicates,
- lab duplicates;
- umpire lab check samples.
- All hole collars verified on ground using DGPS / RTK and visual inspection;
- Review of SG measurements to ensure they are within reasonable limits; and
- Cross check of final database in Datashed.

No Certified Reference Material (CRM) was used in the sampling stream, as it was deemed not relevant given the nature of the sampling being assessed (only 10 x 10 meter composites) and because mineral grade is not an important factor in this case. In SRK's opinion the sampling and logging was conducted to industry acceptable standards.

An umpire lab was employed to compare the results of the primary lab against. The results of the two labs are shown in Section 8.3 (see Table 8-15).

7.3 Topography Data and Validation of Collars

A topographic survey was conducted in house by the Company using drone photogrammetry. This provides a highly accurate surface that includes all man-made features and tree cover. The project exists in a highly vegetated environment with mature tree cover. In some instances, the canopy cover is 30 m higher than the bare earth surface.

For the purposes of improved accuracy of the MRE, SRK engaged the services of AccuPixel Ltd to process the topography to remove the tree cover and attempt to recreate the bare earth surface. AccuPixel undertook manual stereo plotting to pick approximately 5,000 points on the bare earth surface. Although this approach provides a very high level of detail in areas with sparse or no canopy, lower accuracy is attained in areas of dense canopy where fewer points exist with clear view of the bare earth surface. A cross section through the bare earth model and the original drone photogrammetry generated point cloud is provided in Figure 7-1. An oblique image of the final processed surface is provided in Figure 7-2.

Although collars have been collected using a Real Time Kinetic ("RTK") system which provides highly accurate coordinates in the X and Y axis, the Z (height/elevation) values provided by the client showed significant discrepancies with the topographic surface. The poor control in the Z axis appears to have resulted from poor placement of the RTK base station resulting in low signal quality to the roving unit used to pick up collar locations. As a result, SRK has projected the collars vertically onto the topographic surface, overwriting the recorded Z value. SRK is confident that the final bare earth topographic surface is of sufficient resolution to accurately locate the collars in the Z axis, as well as for the reporting of Mineral Resources.

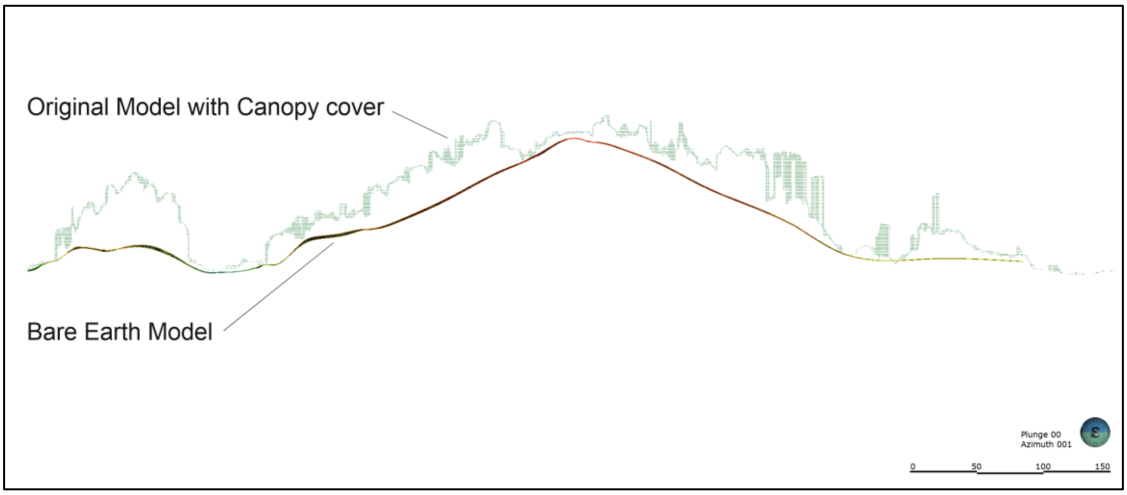


Figure 7-1: Bare earth model compared with unprocessed drone photogrammetry (source: SRK 2021)

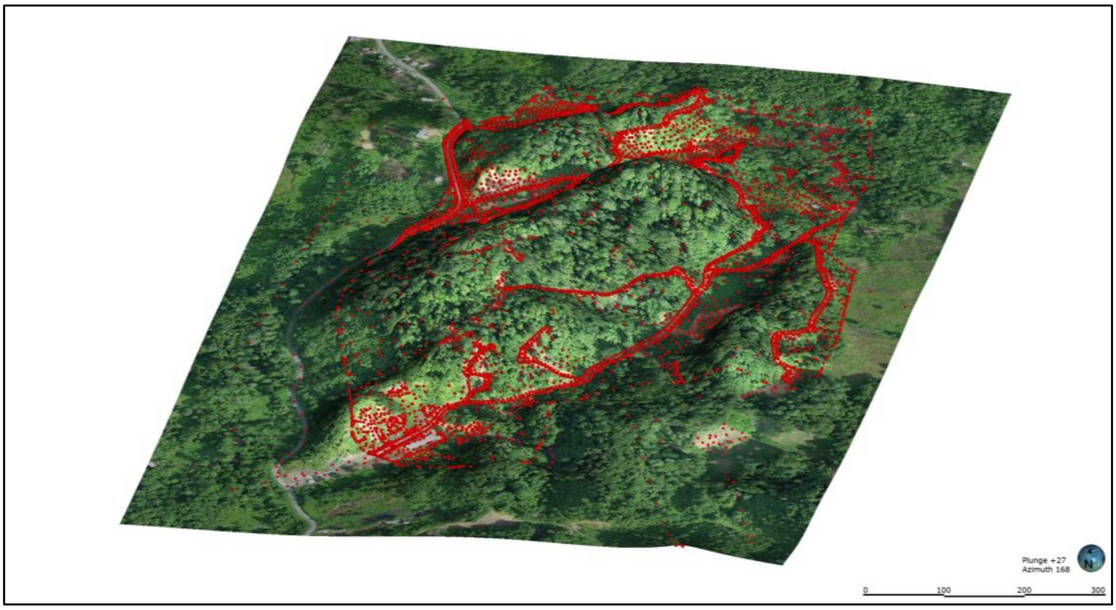


Figure 7-2: processed bare earth model showing the location of manually picked ground points used to inform the final surface

7.4 SRK comments on Data Quality

SRK is confident that the data available was of sufficient quality to be used in the production of a Mineral Resource estimate. Basic QA-QC has been completed and the exploration data has been validated by SRK on site and through various analytical studies. Where errors were found, these have been corrected in the site data records and the primary database and therefore do not carry over or influence the study undertaken.

8 PROCESSING AND TESTWORK

8.1 Introduction

The Company plans to have two main aggregate product streams from the Project:

1. simple crushed rock (with various size fractions); and
2. amourstone.

It is understood that the most critical parameters for assessing the quality of the aggregate is not the 'grade' being tested but rather the physical properties of the rock and how it performs when applied to specific end uses. The physical properties of importance include:

- physical strength (durability testing: mechanical deterioration (or 'wear' of the rock);
- durability of physio-chemical disintegration (or 'soundness' of the rock); and
- the chemical compositional characteristics.

The following reports have been provided by the Company in relation to testwork completed at the Project for the assessment of potentially producing several product types.

- PT. Geoservices LTD - Mineral Division Laboratory analysis results dated 18 April 2017, (File Ref: "Geo-Chemist_Report_Geoservices.pdf")
- PT. Geoservices LTD - Mineral Division Laboratory analysis dated 18 April 2017. Geotechnical Test work – July 2017 (file ref: "GTK.00143_Preliminary Report.pdf");
- PetroLab Petrography May 2018 results
- PetroLab 2019 Mineralogical Report, (file ref: "OP3164b_KBK_08-05-2019.pdf");
- 2021" Petrolab Results; (file reference: "PetroLab_Mineralogical_Report_OP4477_KBK_Report_27_05_21.pdf");
- 2021 Geoservices Laboratory results for geophysical and chemical analysis (file ref: "KBK GeoServices Test Results_2021.xlsx")

Over several campaigns the Company has conducted numerous phases of mineralogical, geochemical and geophysical testwork programmes to investigate the nature and potential of the aggregate material at the Project. Much of the work conducted to date has been at an early stage of assessment; however, the most recent programme (March – May 2021) focused on assessing the aggregate's suitability for several specific intermediate and end product types, including concrete, mortar/render, roadstone, civil engineering, railway ballast and amourstone. The focus product groups and concluded results as provided by PetroLab UK are summarised in Table 8-1.

Table 8-1: KBK Aggregate Suitability for Specific Intermediatory and End Product Types

Lithology	Sample Number	Concrete	Mortar / Render	Roadstone*	Civil Engineering	Railway Ballast	Armourstone
Shale	10261						
Greywacke	10262						

Key
Not suitable
Potentially suitable
Usually suitable

During the April 2021 site visit and following a review of initial testwork results from Geoservices and PetroLab, SRK recommended that additional focused testwork could be considered to determine suitability of the greywacke for six potential product types. It was recommended that the Company should commence specific aggregate testwork for the material if offtake is required for particular end uses. For example, in the case the Company would want to produce mortar/render type product from greywacke, then an additional set of specific tests would be required to ascertain suitability. The relevant reference standards/specifications for each of the product types are summarised in Table 8-2.

Sample 10261 represents a finely banded shale. The sample is composed predominantly of quartz, feldspar clasts and clay minerals. The sample is fractured and unstable in water with layers frequently splitting apart. The sample contains approximately 30% of clay and fine mica minerals, which will mean the sample is prone to mechanical damage caused by its structural weakness. Framboidal pyrite is present, usually associated with clay rich layers. In summary this rock type:-

- Is weak and fissile;
- would not produce a strong and durable aggregate: and
- as such, the sample is not considered prospective for use as a construction aggregate.

Sample 10262 is a fine grained greenish grey greywacke sandstone consisting of quartz and feldspar clasts hosted in a fine grained matrix containing clays, microcrystalline silica, dolomite and chlorite. The sample is also cut by dolomite-clay veins, which mark the sample weakness observed during a basic strength test. The sample strength is extremely strong within the parts of homogeneous material that does not contain any veins or veinlets. The strength is lowered in areas containing those veins, where the rock is splitting on those boundaries. In suumary:-

- Greywackes generally have a high polished stone value ("PSV") and high abrasion resistance, which makes them highly prospective as potential sources for roadstone[2] (1).
- The examined aggregate material may meet this criteria, subject to confirmatory physical testing, with silt-sized clasts of quartz and feldspar in a fine-grained clay-rich matrix and very low porosity.

[2] *British Geological Survey. Mineral planning factsheet - Construction aggregates.*

- It is noted that some greywackes, notably in the UK, have had alkali-silica reaction ("ASR") implications when used in concrete 2,3 or mortar 4 manufacture due to the presence of cryptocrystalline or microcrystalline silica, and therefore the source material may not prove suitable for this end use.
- Further testing would be required to demonstrate the level of alkali-silica reactivity. The sulphide content, however, is not sufficient to cause concern (total sulphur, TS <0.1%).

Table 8-2: KBK Aggregate relevant reference standards/specifications for each of the product types identified by PetroLab

		Physical tests			Mechanical tests: strength		Mechanical tests: durability		Chemical tests				
End Use	**Sample Number**	**Grading [9,10]**	**Density & Absorption [9,11]**	**Flakiness Index [12]**	**LA [13]**	**AIV [14]**	**PSV [15]**	**AAV [16]**	**Alkali reactivity [17,18]**	**Sulphur/ sulphates [19]**	**Organic matter [19]**	**Loss on ignition [19]**	**Chloride content [19]**
Concrete [1,2]	10262,	10262	10262	10262	10262	10262			10262	10262	10262	10262	
Mortar / Render [3,4]	10262,	10262	10262						10262	10262	10262	10262	10262
Roadstone [5]	10262,	10262	10262	10262	10262	10262	10262	10262				10262	
Civil Engineering [6]	10262,	10262	10262	10262	10262	10262				10262		10262	
Railway Ballast [7,8]	10262,	10262	10262	10262	10262	10262						10262	
Armourstone [9]	10262,	10262	10262									10262	

Key

(green)	Required test
(white)	test not required/not relevant

[ ]	Referenced Standard / specification	
1	EN 12620	Aggregates for concrete
2	PD 6682-1	Aggregates for concrete - Guidelines on the use of BS EN 12620
3	EN 13139	Aggregates for mortar
4	PD 6682-3 Aggregates - Part 3	Aggregates for mortar - Guidelines on the use of BS EN 13139
5	EN 13043	Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas
6	EN 13242	Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
7	EN 13450	Aggregates for railway ballast
8	PD 6682-8	Aggregates for railway ballast - Guidelines on the use of BS EN 13450
9	EN 13383-2	Armourstone Part 2: Test methods
10	EN 933-1	Tests for geometrical properties of aggregates - Part 1: Determination of particle size distribution - Sieving method.
11	EN 1097-6	Tests for mechanical and physical properties of aggregates – Part 6: Determination of particle density and water absorption.
12	EN 933-3	Tests for geometrical properties of aggregates - Part 3: Determination of particle shape - Flakiness index. (alt reference ASTM 4791-Flakiness Index)
13	EN 1097-2, Clause 5	Tests for mechanical and physical properties of aggregates – Part 2: Clause 5 - Determination of resistance to fragmentation by Los Angeles test method.
14	EN 1097-2, Clause 6	Tests for mechanical and physical properties of aggregates – Part 2: Clause 6 - Determination of resistance to fragmentation by the impact test method.
15	EN 1097-8	Tests for mechanical and physical properties of aggregates – Part 8: Determination of the polished stone value.
16	EN 1097-8, Annex A	Tests for mechanical and physical properties of aggregates – Part 8, annex A: Resistance to surface abrasion.
17	BS-812-123-1999 Part 123:	Method for determination of alkali-silica reactivity — Concrete prism method
18	ASTM C227-10	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
19	EN 1744-1	Tests for chemical properties of aggregates – Part 1: Chemical analysis.

8.2 Mining and Processing Sequence

Given that the Company intends to produce two aggregate product types, armourstone and crushed rock aggregate, two process streams and two separate mining operations would be required. Figure 8-1 shows the conceptual mining and processing sequence that has been developed by the Company for the purpose of illustrating the intended operational workflows and likely equipment required to support the production of crushed rock aggregate and armourstone.

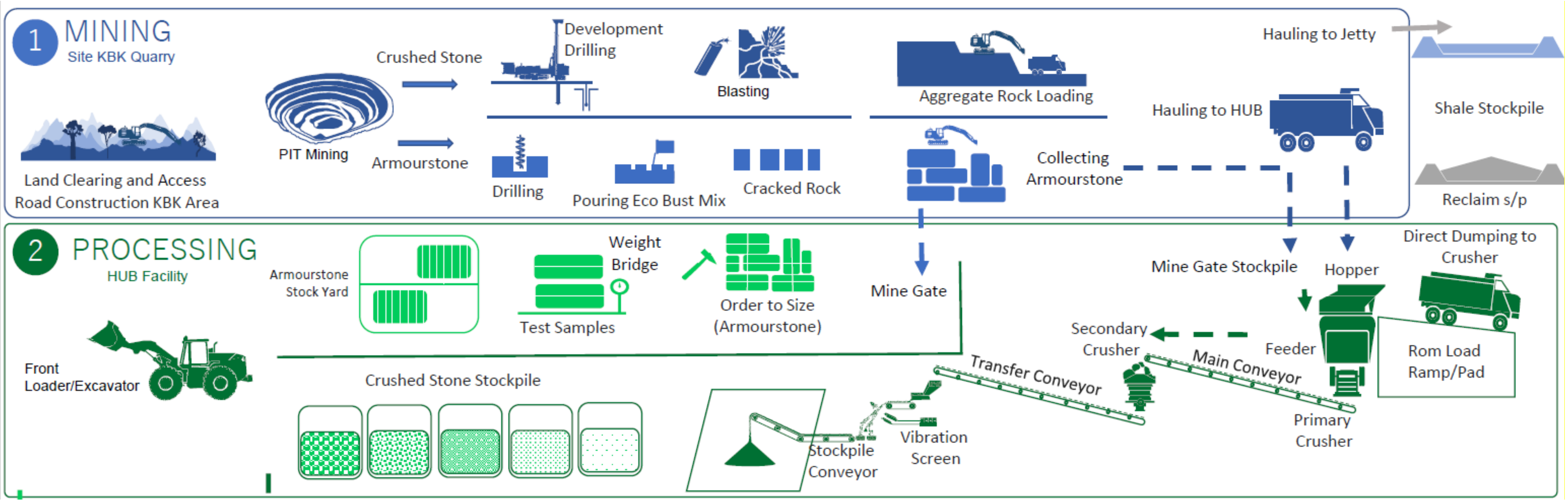


Figure 8-1: KBK Mining and Processing Sequence (source: PT KBK 2021)

8.3 Testwork

8.3.1 Introduction

Several testwork programmes have been undertaken on the greywacke material and this has included both site based tests and laboratory based tests. This section of the report summarises all of the tests that have been conducted during the 2019 and 2020 drilling campaigns aimed at determining the suitability of this material for the envisaged end uses.

8.3.2 Site Based Testwork

For both the 2019 and 2020 drilling campaigns, geotechnical sampling was performed so that all the major rock types are sufficiently sampled. For site based strength tests, the Company's geologists selected samples with as few defects as possible, to obtain a suitable geotechnical sample where applicable. To reduce the possibility of damage in transit to the laboratory, all samples were wrapped with cling-film prior to dispatch.

Each sample was labelled both on the core and on the outside packaging. The labels included the following details:

- type of sample (UCS, DSJ etc);
- location of the sample (Borehole ID);
- length of sample (from and to);
- lithology; and
- sample number (unique identifier).

Samples were also photographed, including a measure for scale and a visible label within the photograph. The Company's planned geotechnical sampling schedule is given in Table 8-3, which is based on 20 geotechnical borehole samples.

Table 8-3: Planned geotechnical sampling schedule

Test	Lithology	Number Required (Total Drilling)	Number Required (Approximate per Hole)	Example frequency
UCS	Greywacke	20	2	2 per hole
TXT	Greywacke	5	0.5	1 sample per 2 holes
UTS	Greywacke	0	0	None
DSJ	Greywacke	15	1.5	3 samples per 2 holes
DSS	Greywacke	15	1.5	3 samples per 2 holes
UCS	Shale	10	1	1 sample per hole
TXT	Shale	2	0.2	1 sample per 5 holes
UTS	Shale	0	0	None
DSJ	Shale	5	0.5	1 sample per 2 holes
DSS	Shale	5	0.5	1 sample per 2 holes

Point Load Testing

Point load testing (“PLT”) is used to determine rock strength indexes in geotechnical practice. The point load test apparatus and procedure enables economical testing of core or lump rock samples in either a field or laboratory setting. Specifically the PLT apparatus uses hydraulic pressure to compress a rock sample between two specially designed plates and then records the maximum achieved load of the sample before its failure. To estimate UCS, index-to-strength conversion factors are used, which are derived through comparisons between PLT results and UCS tests on the same sections of core. It is therefore important that some UCS tests are performed on sections that are also subject to PLT testing, so that the conversion factors can be derived.

In this case the PLT has been performed according to ASTM D5731 – 08 Standard Test Method for Determination of the Point Load Strength Index of Rock and Application of Strength Classifications. Selected core specimens are tested as axial (compression parallel to core axis) or diametral tests (compression perpendicular to core axis), as shown in Figure 8-2. Broadly speaking, a similar number of each type of test is performed. The size of each sample tested typically conforms to the following criteria, where “D” is the core diameter and “L” is the length or height of the core sample:

- For axial tests, 0.3*D < L < D
- For diametral tests, 0.5*D < L

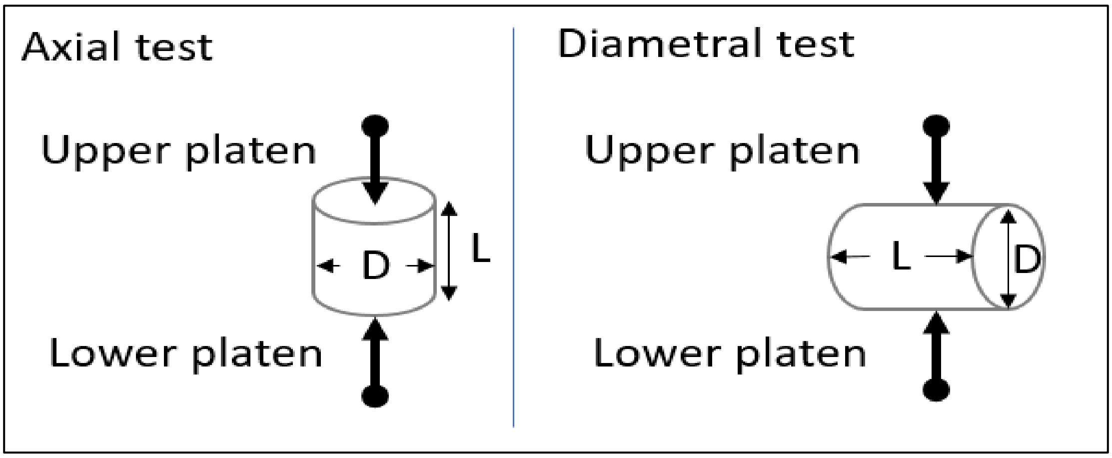


Figure 8-2: Axial and Diametral PLT

The procedure used is as follows:

- The calibration is done by an independent equipment supplier onsite and prior to testwork and sampling.
- A target of five sets of point load testing is completed for each hole (approximately one set of testing every 20 m), where one ‘set’ consists of 5 axial tests and five diametral tests.
- The core selected for testing is in-tact, with minimal defects/structures.
- One PLT set is performed next to at least one of the two UCS samples per hole.
- The maximum achieved load before failure is recorded in kN.
- The specimen to be tested is cut with a saw to ensure it adheres to the size criteria.

- Each tested specimen is measured (length and diameter) before testing; this is important as the size of the sample affects ultimate strength that is determined via the conversion factor.
- The type of break is recorded according to the codes in Table 8-4.

An image of the PLT machine used on site, and an example PLT set, is shown in Figure 8-3.

Table 8-4: Failure mode codes and descriptions for PLT

Code	Description
R	Failed through Rock
J	Failed on incipient joints
B	Failed through both Rock and incipient joints
F	Failed along foliation
P	Failed outside the platens
N	Did not fail at load indicated

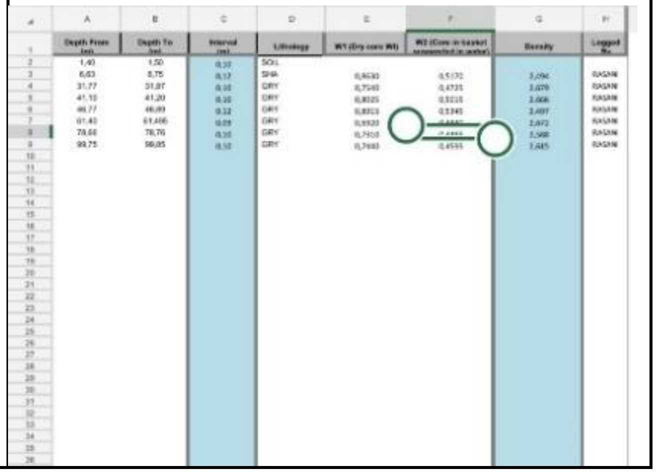
Figure 8-3: PLT machine used on site, with an example of one PLT ‘set’ before testing (source: SRK 2021)

Density (Dry Bulk Density)

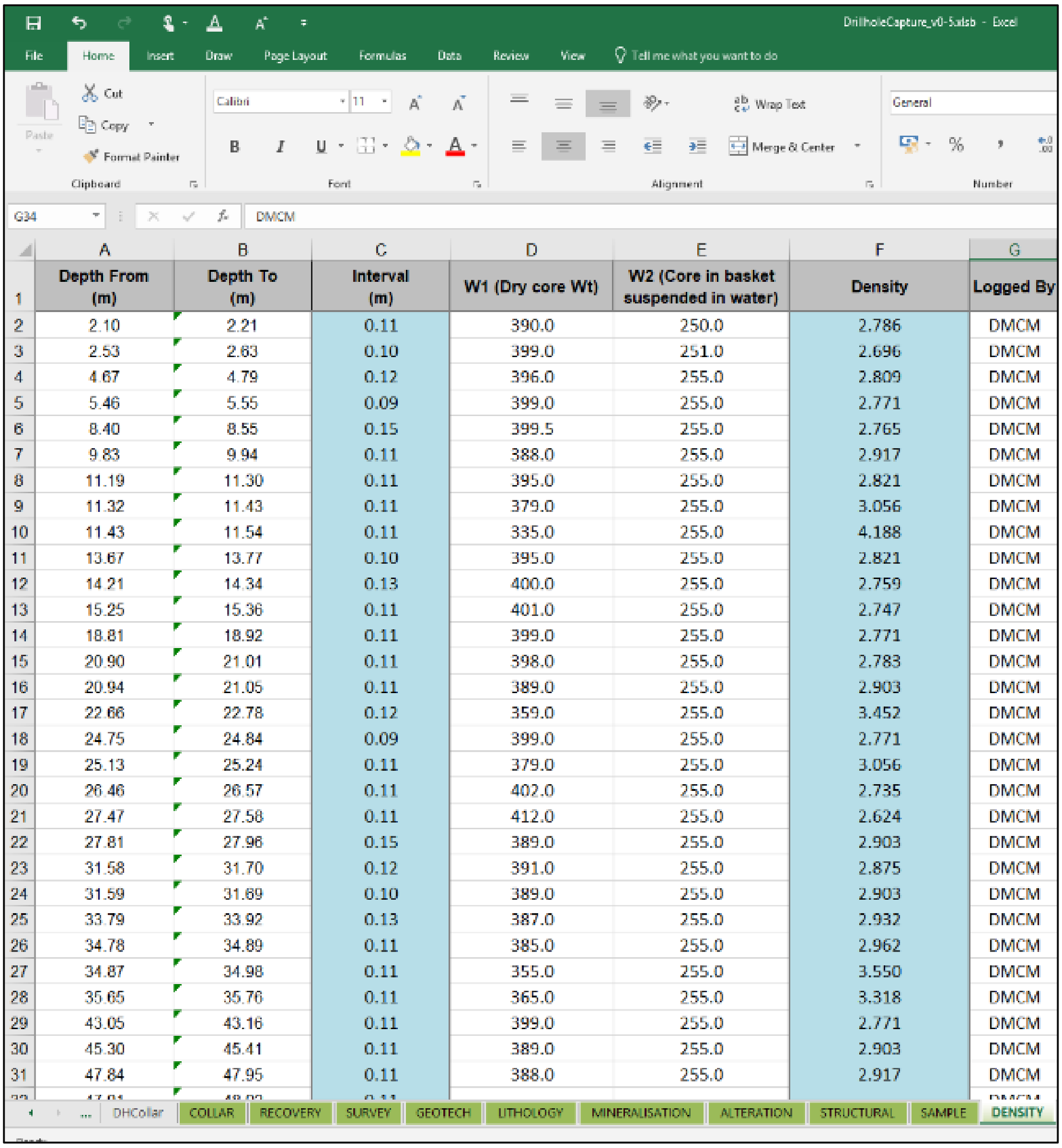
The Company provided SRK with SOP describing the method followed onsite for recording dry bulk density measurements of both greywacke and shale lithologies. A total of 467 measurements were recorded which SRK considers to be a sufficient quantity for this study.

The Company advised that during all drilling programmes (2019, 2021), diamond core material was sampled for density using the immersion method, whereby, samples were selected approximately every 10 m and selection was in line with the criteria set out in Table 8-5.

Table 8-5: Density Measurement Procedure

Task	Description	Photo Example
TASK #1 Geologist selects Core Interval from Core Box	The selected core will be: • approximately 10 cm in length • pre-labelled by the Logging Geologist showing: ○ interval metre mark start and end ○ lithological code	
TASK #2 Select Core Interval From Core Box	On the paper record sheet, note: ○ FROM (m), ○ TO (m), ○ LENGTH (m), and ○ ROCK TYPE Also Complete the rest of the form (Hole Number, Date, your name. etc)	

Task	Description	Photo Example
TASK #3 Record Weight (w1)	**(W_1)** Record Weight in Air Record measurement on paper record sheet against the correct metre interval	
TASK #4 Record Weight in Water (w2)	**(W_2)** Wrap unconsolidated samples in plastic wrap (OXIDE and TRANSITIONAL only) Place the core in the basket and submerge in water. Record Weight in Water Record measurement on the paper record sheet against the correct metre interval	



Depth From (m)	Depth To (m)	Interval (m)	W1 (Dry core Wt)	W2 (Core in basket suspended in water)	Density	Logged By
2.10	2.21	0.11	390.0	250.0	2.786	DMCM
2.53	2.63	0.10	399.0	251.0	2.696	DMCM
4.67	4.79	0.12	396.0	255.0	2.809	DMCM
5.46	5.55	0.09	399.0	255.0	2.771	DMCM
8.40	8.55	0.15	399.5	255.0	2.765	DMCM
9.83	9.94	0.11	388.0	255.0	2.917	DMCM
11.19	11.30	0.11	395.0	255.0	2.821	DMCM
11.32	11.43	0.11	379.0	255.0	3.056	DMCM
11.43	11.54	0.11	335.0	255.0	4.188	DMCM
13.67	13.77	0.10	395.0	255.0	2.821	DMCM
14.21	14.34	0.13	400.0	255.0	2.759	DMCM
15.25	15.36	0.11	401.0	255.0	2.747	DMCM
18.81	18.92	0.11	399.0	255.0	2.771	DMCM
20.90	21.01	0.11	398.0	255.0	2.783	DMCM
20.94	21.05	0.11	389.0	255.0	2.903	DMCM
22.66	22.78	0.12	359.0	255.0	3.452	DMCM
24.75	24.84	0.09	399.0	255.0	2.771	DMCM
25.13	25.24	0.11	379.0	255.0	3.056	DMCM
26.46	26.57	0.11	402.0	255.0	2.735	DMCM
27.47	27.58	0.11	412.0	255.0	2.624	DMCM
27.81	27.96	0.15	389.0	255.0	2.903	DMCM
31.58	31.70	0.12	391.0	255.0	2.875	DMCM
31.59	31.69	0.10	389.0	255.0	2.903	DMCM
33.79	33.92	0.13	387.0	255.0	2.932	DMCM
34.78	34.89	0.11	385.0	255.0	2.962	DMCM
34.87	34.98	0.11	355.0	255.0	3.550	DMCM
35.65	35.76	0.11	365.0	255.0	3.318	DMCM
43.05	43.16	0.11	399.0	255.0	2.771	DMCM
45.30	45.41	0.11	389.0	255.0	2.903	DMCM
47.84	47.95	0.11	388.0	255.0	2.917	DMCM

Figure 8-4: Density Example logging sheet for recorded density measurements (source: SRK 2021)

SRK observed the density testwork in progress and considers the final densities applied to the model to be appropriate. While some improvements could be made with respect to fully drying material at 105°C prior to measuring to ensure depletion of moisture and recording of moisture loss, in general the core was observed to be fresh/competent core and was air dried prior to measuring in natural sunlight.

The application of measuring the weathered condition of the material is also seen to be of importance; however, this has not been considered by the Company at this stage. It is recommended that future programmes consider incorporating weathering and hardness (for friable material or unconsolidated material) into the density measurement process. This is of importance as similar grades (or lithologies) can be observed across materials of varying hardness, friability and porosity and therefore there would be an expected difference in density (Figure 8-5).

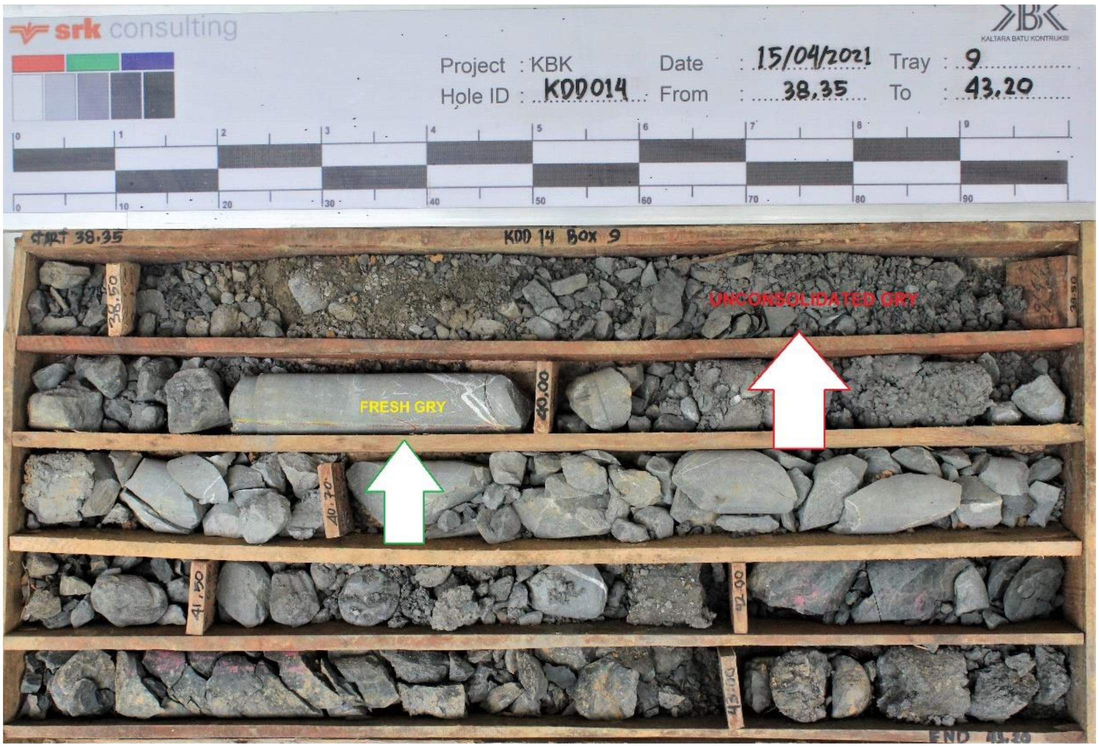


Figure 8-5: Greywacke presented in drill core showing varying types of hardness, porosity and density (Source: SRK 2021)

In total, 467 density samples have been collected by the Company and these have been interpolated into the Resource Block model. Measurements are taken from each hole and provide reasonable ranges of density values for the particular focus lithological codes (GRY and SHL). While no density measurements have yet been made for the Soil lithology code or for weathered material types, this is not material from a resource perspective and can be addressed in the follow up drilling programmes. A box and whisker plot showing density values from the programme split by lithology is presented in Figure 8-6 and by weathering state in Figure 8-7.

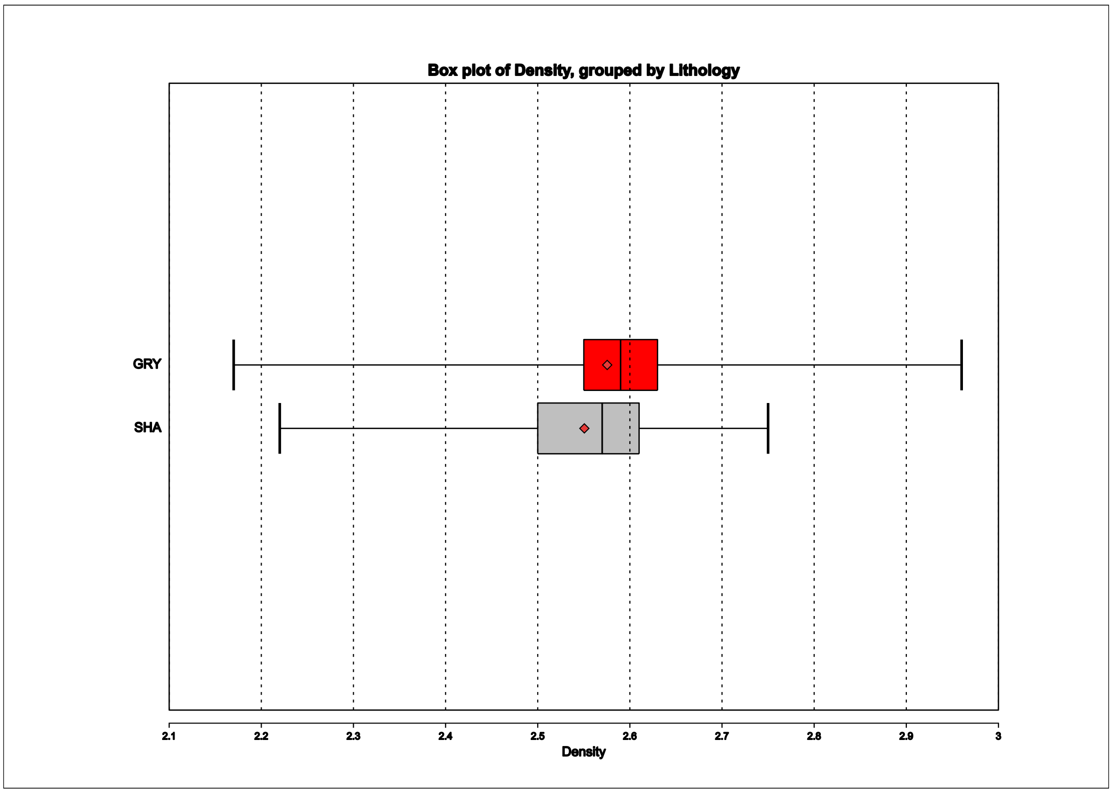


Figure 8-6: Box and whisker plot showing density data split by lithology type (source: SRK)

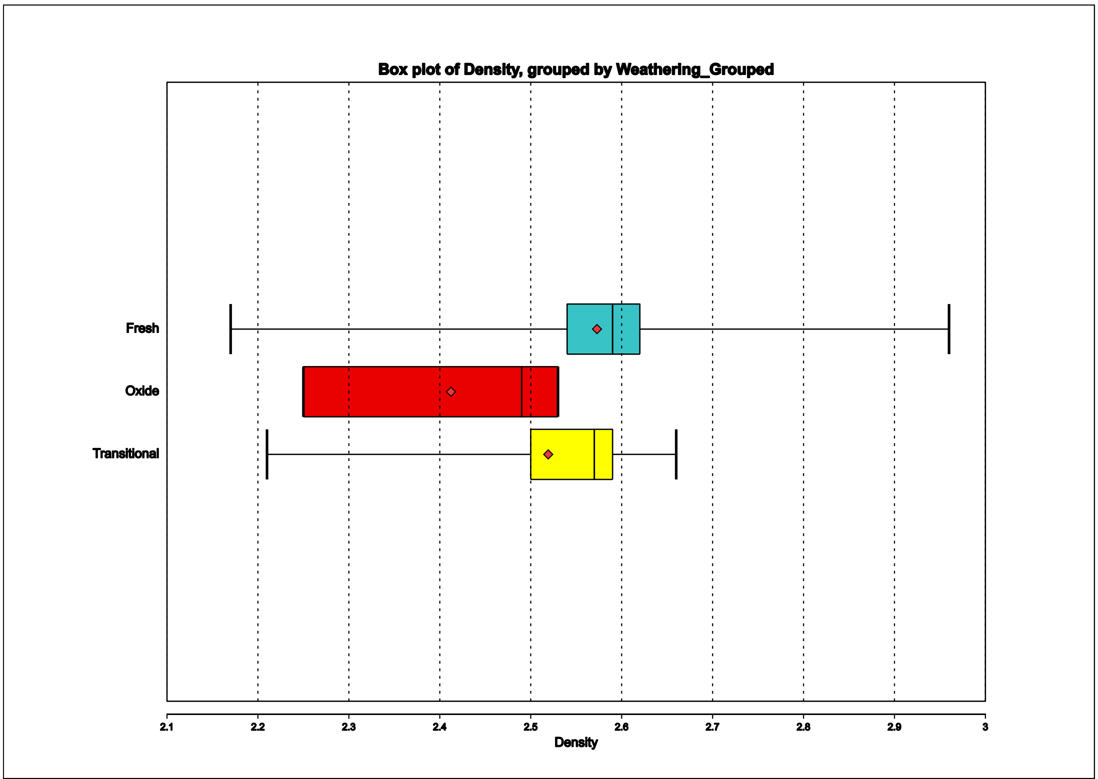


Figure 8-7: Box and whisker plot showing density data split by weathering state (source: SRK)

A copy of the procedure is included in Appendix A. At this stage, measurements have only been recorded for greywacke and shale lithologies in fresh competent core only. SRK recommends that in the next stage of assessment, the Company should increase density measurements to include a wider range of representative densities for every lithology, such as:

- weathering variation (i.e., Extremely Weathered, Heavily Weathered, Moderately Weathered, Slightly Weathered, Fresh);
- material type/condition (i.e. unconsolidated and consolidated core).

8.3.3 Testwork Sample Selection

For the main test laboratory (PT GeoServices Jakarta), two sample streams (see Table 8-6) were conducted for the 2021 drilling programme. Samples were tested for chemical analysis (Stream 1) and geotechnical (geophysical) analysis (Stream 2). In total ten 10 m half core composite intervals were selected from drill core representing the greywacke lithology, and two 10 m half core composite intervals were selected to represent the shale lithology.

Table 8-6: PT GeoServices Jakarta Testwork Scheme Summary

KBK Sample ID	Hole ID	Lithology	Sample Type	Testwork Stream 2 (a)	Testwork Stream 1 (a)			
				Geophysical (b)	Min_XRD	Min_XRF	Leco Total Sulphur	ICP (SO4)
10258	KDD015	Shale	1/4 core	No	No	No	No	No
10259	KDD034	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10260	KDD015	Shale	1/4 core					
10261	KDD016	Shale	1/4 core	No	No	No	No	No
10263	KDD026	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10265	KDD022	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10267	KDD032	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10251a	KDD04	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10252a	KDD04	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10253a	KDD02	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10254a	KDD02	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10255a	KDD01	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10256a	KDD003	Greywacke	1/4 core	Yes	Yes	Yes	Yes	Yes
10270	KDD039	Shale	1/4 core	Yes	Yes	Yes	Yes	Yes

Notes to Table:

(a) Highlighted Blue = testwork Stream 1, and Highlighted Brown = testwork Stream 2;

(b) Geophysical tests, including: Cumulative passing; Calc Fract mm, Absorption; Apparent Density; Bulk Density; Saturated Surface Density; Los Angeles Abrasion x100, and x500; Flat Partical Analysis; Elongated Particles %; Flat and Elongated Particles %; Flat Particles %; Unflat and Unelongated Particles %.

An example (Figure 8-8) was provided to site geologists as a guide to assist with the logging and sampling on site. As no drillhole is the same, this example was only provided as a guide and, as such, the Company's geologists were required to observe the core in detail and use their experience and understanding of the geology to guide the overall sampling process.

Field base tests included PLT tests and Density tests and laboratory based testwork comprised Petrographic Analysis and Aggregate Specific Tests.

Crushing

At the Geoservices laboratory, the following preparation was conducted to process the samples of core.

- For aggregates testing, samples are jaw crushed to optimise volume passing 14 mm and retained on a 10 mm sieve.

Washing / Drying

- This 10-14 mm sample is then washed before further testing to remove any dusty coating from the aggregate.
- The sample is then oven dried at 110ºC (maximum 120ºC), and the post-drying weight also measured and recorded.

Sample Splitting

- The 10-14 mm sample is then split using a riffle or rotary splitter to enable multiple physical and mechanical tests to be performed.

Physical Testing

Physical tests comprised:-

- Aggregate Grading: An assessment of the particle size distribution of a natural or crushed aggregate.
- Particle Shape / Flakiness Index: An assessment of the shape / elongation of aggregate particles.
- Relative Density: Measures specific gravity.
- Water Absorption: Measure's porosity and capacity to absorb water.

Aggregate grading is normally undertaken on a naturally occurring graded material, or on a material crushed through a specific processing plant, in order to understand the particle size distribution produced. On a prospect site, such as this, this analysis is unlikely to be of use until such stage where required crushing and screening equipment is being planned.

Particle shape is fundamental to the usability of a particular material for aggregates but can be heavily influenced by the choice of crushing and screening equipment; however, analysis after simple jaw crushing will provide an indication of whether the material will have a tendency to produce elongate or flaky material, and this information can be useful in specifying future plant requirements. A description of the shape (and flakiness measurement) of the 10-14 mm crushed sample should be undertaken before further test work is carried out. Ideally, flaky material should be removed from samples prior to the other mechanical tests, as presence of flaky material can lower values considerably.

Mechanical Testing

A selection from the following aggregates analyses are recommended (to suit potential end-uses) and to test strength and durability. However, at this stage the Company only instructs Geoservices to conduct key tests including ASTM C136-06- Sieve analysis of fine and coarse aggregates (Gradation), Aggregate Shape Test Flakiness Index (ASTM 4791), Aggregate Shape Test Elongation Index , ASTM C127-12- Density, Relative Density and Absorption of Coarse, and Los Angeles Abrasion at x100 and x500. LECO Ttoal Sulfur is also analysed to provide indicative sulphate soundness. The other range of testing is shown below. These are arranged with specific end customers in mind.

- Aggregate Crushing Value (“ACV”): Measure’s resistance to crushing under a gradually applied load.
- 10% Fines Value: An alternative to ACV.
- Aggregate Impact Value (“AIV”): Measures resistance to granulation under impact stresses.
- Aggregate Abrasion Value (“AAV”): Measures surface wear following abrasion.
- Los Angeles Abrasion Value (“LAAV”): Measures resistance to attrition following impact and abrasion.
- Polished Stone Value (“PSV”): Measure’s resistance to polishing for road surfacing aggregates.
- Sulphate Soundness: Measures resistance to disintegration by weathering action or salt crystallisation.

It is noted that PSV value can attract higher premiums on global markets so this should be tested.

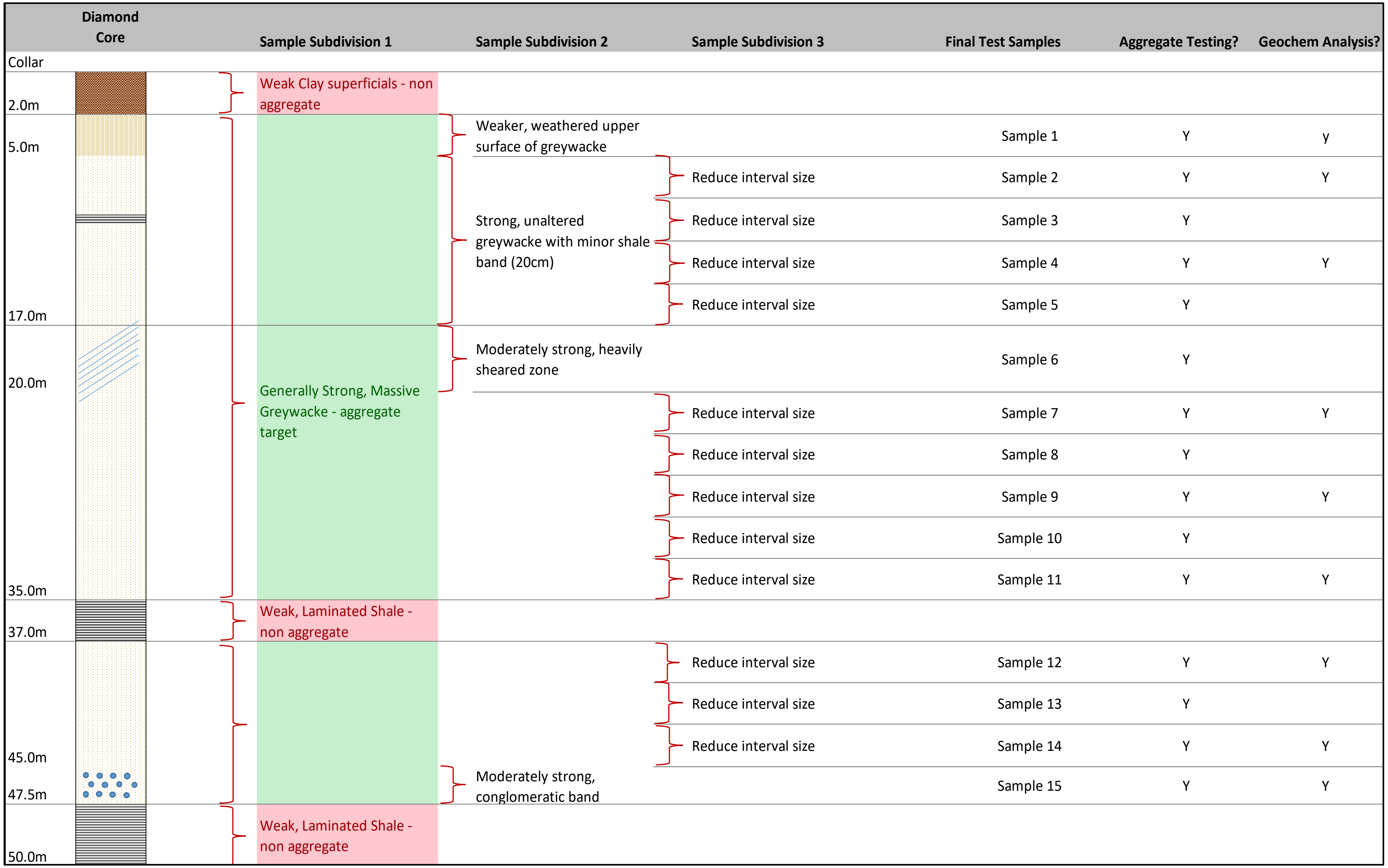


Figure 8-8: KBK Sample Selection Guide (KBK field guide example only)

8.3.4 Laboratory Testwork

The samples sent to the laboratory for geotechnical analysis were prepared as outlined in the sample preparation package and as described in Figure 8-9:

(file reference: MIN_KBK_202103 Rev 1_Geoservices_Quotation_Testwork_March 2021.pdf).

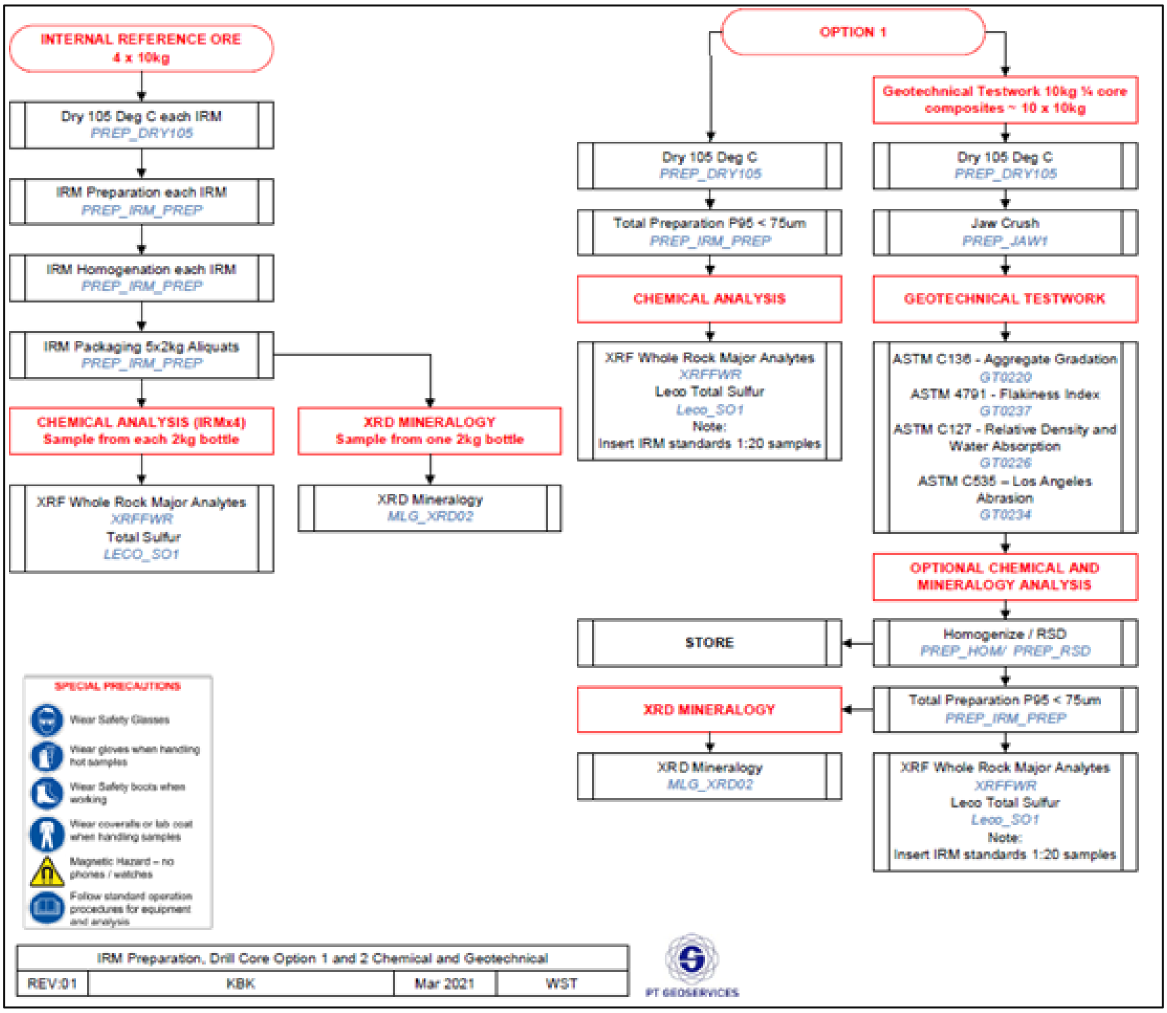


Figure 8-9: PT Geoservices Jakarta Sample Preparation and Analysis Flowsheet for the KBK 2021 Sample Programme (source: PT Geoservices 2021)

XRD and XRF Mineralogy Testwork (Stream 1)

The objective of the testing programme was to provide chemical and geophysical analyses and XRD Mineralogy on selected samples from the Project area. A total of 12 samples were received at Cikarang Laboratory in Jakarta on 4 June 2021.

The testwork included:

- chemical analysis;
- sample preparation for XRD bulk scans;
- XRD bulk scanning;
- XRD Phase Identification;
- XRD ‘DANA’ mineral classification; and

- XRD mineral general grouping.

The testwork results were communicated to the Company when available for modifications to the test programme as required to enable the testwork programme to progress on a fully informed basis.

Testwork Methodology (Geoservices)

XRD Sample Preparation The samples received for XRD testwork were pulverized in a tungsten carbide bowl to <53 µm for bulk scan. For special samples containing clay the prepared samples were split and further ground to <10 µm via the use of the McCron equipment (see image (a) in Figure 8-10).

(a) XRD-Mill McCrone used for fine grinding < 10um of samples prior to XRD analysis. The grinding helps to preserve the crystal lattice of the sample

(b) XRD Sample holders supplied by Bruker are used to mount the ore sample for mineralogy. The ore sample is placed into the holder ring and heaped up into a conical shape. The ore is pressed into the holder and excess removed using a glass slide to make sure the sample is spread uniformly across the sample mount

(c) XRD Bruker D8 Advance at Cikarang Laboratory

Figure 8-10: XRD Sample Preparation (Source: PT Geoservices 2021)

- The XRD technique is non-destructive in that it involves placing a powdered sample in a holder, then illuminating the sample with x-rays of a fixed wave-length. X-ray diffraction relies on the dual wave/particle nature of X-rays to obtain information about the structure of crystalline materials. Qualitative analysis is performed using Reitveld Correction with Bruker Diffrac Suite Search/Match software with the ICDD PDF-4 database.
- Rietveld refinement is a technique devised by Hugo Rietveld for use in the characterisation of crystalline materials. The x-ray diffraction of powder samples results in a pattern characterised by reflections (peaks in intensity) at certain positions. The height, width and position of these reflections can be used to determine many aspects of the material's structure. The Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the measured profile. The introduction of this technique was a significant step forward in the diffraction analysis of powder samples as it is able to deal reliably with strongly overlapping reflections. The Reitveld Refinement does not take into account any amorphous or poorly crystalline phases that may be present and do not contribute to diffraction peaks. Results for three of the samples from the 2021 programme are shown in Table 8-7.

Table 8-7: PT GeoServices XRD Standard Measurement Parameters

XRD OPERATING CONDITIONS - BULK SCAN		
Info	XRD Equipment	Bruker XRD D8 Advance Davinci
	Software	TOPAS Diffrac Suite, ICDD PDF4
	Xray Tube	Cobalt
	Generator Voltage	30 Kv
	Generator Current	45 mA
	Measurement Time	1:27:32 (h:mm:ss)
Ranges	Scan Mode	Continuous Scan
	Start Position	1
	Stop Position	100
	Increment	0.0194603
	# Steps	5087
	Time per Step	0.4 (s)
	Motorized Slit Changer	INSTALLED
	Synchronous Rotation	INSTALLED
	Spinner Rotation 10 (rpm)	10 (rpm)
Drives	Thets- Drive Number	1
	Theta - Encoder used	No
	Theta - Position	0.5000(°)
	Theta - Oscillation	No
	2Theta- Drive Number	2
	2Theta - Encoder used	No
	2Theta - Position	1.0000(°)
	2Theta - Oscillation	No
	Phi- Drive Number	3
	Phi - Encoder used	No
	Phi - Position	0.0(°)
	Phi - Oscillation	no
LYNXEYE	Electronic Window	2.95 (deg)

Table 8-8: PT GeoServices XRD DANA Mineral Classification Table

Native Element	Includes native metals, inter-metallic elements, semi-metals, non-metals, and natural alloys.
Sulfides	These are minerals that have Sulfur (S) in their composition in the form of S^{2-}as the major anion. Includes Sulfosalts.
Halides	Those Minerals that have Cl (chlorine), Br (bromine), F (fluorine), or I (iodine) at the end of their formula.
Oxides/Hydroxides	Mineral phases containing only only oxide of hydroxide anions in their structures.
Carbonates / Nitrates	Those minerals minerals containing the anion $(CO_3)2-$. Also includes nitrate (NO_3) containing minerals.
Borates	Those minerals minerals containing the anion (BO3)−
Sulfates	Those minerals minerals containing the anion $(SO_4)2-$
Phosphates	Includes any mineral with a tetrahedral unit (AO_4 $^{3-}$) where A can be Phosphorus (P), Antimony (Sb), Arsenic (As) or Vanadium (V).
Silicates	Includes minerals composed largely of silicon and oxygen, having the (SiO_2) , with the addition of ions such as aluminum, magnesium, iron, and calcium.
Organics	Naturally occuring in origin and composition. Non-minerals are amorphous. Coal, Limonite, Opal, Pearl, Amber

Testwork Methodology Summary

For the XRF fusion tests, a calcined or ignited sample is added to lithium borate flux, mixed well and fused between 1050 - 1100°C. A flat molten glass disc is prepared from the resulting melt. The fused-glass disk specimen is irradiated by a high-energy X-ray beam. Concentrations of the elements are determined by relating the measured radiation of unknown specimens to analytical curves prepared from reference materials of known composition. The following 14 elements or analytes were assessed by XRFFWR Whole Rock analysis; Al_2O_3, BaO, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O,P_2O_5, SiO_2, SO_3, SrO, TiO2 and loss on ignition ("LOI").

Results for three of the primary laboratory Rietveid % (see Figure 8-9) and XRF mineralogy descriptions (see Figure 8-10) and the geophysical tests conducted at Geoservices are summarised in Table 8-11 and Table 8-12. Figure 8-10 through to Figure 8-14 show the XRD Topaz Diffractogram sample results.

Table 8-9: PT GeoServices XRD Sample Mineral Phase Identification (Rietveid %) (only three samples showing #10263, #10265, and #10259)

MINERAL PHASE IDENTIFICATION- RIETVELD %

No	Abbreviation	Mineral Phase Identification	Mineral Chemical Formula	Mineral Classification	Mineral Group	RIETVELD REFINEMENT WT% 1	2	3	QA/QC
						10263	10265	10259	10259 REP
1	Ab	Albite	Na Al Si3 O8	Silicates	Plagioclase	25.9	27.8	22.9	22.4
2	Ant	Anatase	Ti O2	Oxides/Hydroxides	No Group	0.2	0.6	0.2	0.2
3	Cal	Calcite	Ca C O3	Carbonates/Nitrates	Calcite	2.5	7.5	1.5	1.8
4	Chl	Chlorite	(Mg,Fe)5 (Al,Si)5 O10 (O H)8	Silicates	Clay		9.0		
5	Dol	Dolomite	Ca Mg (C O3)2	Carbonates/Nitrates	Dolomite	9.4	1.0	11.7	11.8
6	Ill_Al	Illite	K Al2 Si3 Al O10 (O H)2	Silicates	Clay	16.1	15.2	16.3	16.2
7	Kln	Kaolinite	Al2 Si2 O5 (O H)4	Silicates	Clay	2.4		4.6	3.9
8	Mc	Microcline	K Al Si3 O8	Silicates	K-Feldspar	2.3	2.9	2.0	2.8
9	Qz	Quartz	Si O2	Silicates	Quartz	37.4	35.9	37.0	37.0
10	Sd	Siderite	Fe C O3	Carbonates/Nitrates	Calcite	3.8		3.8	4.0
					Total	100	100	100	100

Table 8-10: Mineral Chemical Analysis

Scheme	Analyte Code	Description	UNIT	D.L	10263	10265	10259	10259 REP
XRFFWR	Al2O3	Aluminium Oxide	%	0.01	11.84	12.14	12.04	11.98
XRFFWR	BaO	Barium Oxide	%	0.01	0.01	0.02	<0.01	<0.01
XRFFWR	CaO	Calcium Oxide	%	0.01	4.26	4.12	3.96	3.97
XRFFWR	Cr2O3	Chromium (III) Oxide	%	0.01	<0.01	<0.01	<0.01	<0.01
XRFFWR	Fe2O3	Iron (III) Oxide	%	0.01	5.17	4.92	5.13	5.15
XRFFWR	K2O	Potassium Oxide	%	0.01	1.50	1.52	1.34	1.34
XRFFWR	MgO	Magnesium Oxide	%	0.01	1.94	2.18	1.96	1.90
XRFFWR	MnO	Manganese Oxide	%	0.01	0.10	0.09	0.09	0.10
XRFFWR	Na2O	Sodium Oxide	%	0.01	2.07	2.38	1.96	1.97
XRFFWR	P2O5	Phosphorus Pentoxide	%	0.01	0.09	0.09	0.11	0.09
XRFFWR	SiO2	Silicon Dioxide	%	0.01	64.30	65.77	62.61	62.04
XRFFWR	SO3	Sulphur Trioxide	%	0.01	0.23	0.20	0.15	0.18
XRFFWR	SrO	Strontium Oxide	%	0.01	0.02	0.02	0.03	0.03
XRFFWR	TiO2	Titanium Dioxide	%	0.01	0.63	0.62	0.64	0.65
XRFFWR	LOI	Loss on Ignition @ 1000 DegC	%	0.01	8.54	4.81	8.92	8.94
XRFFWR	Sum	Sum of Majors + LOI	%	0.01	100.69	98.88	98.93	98.34

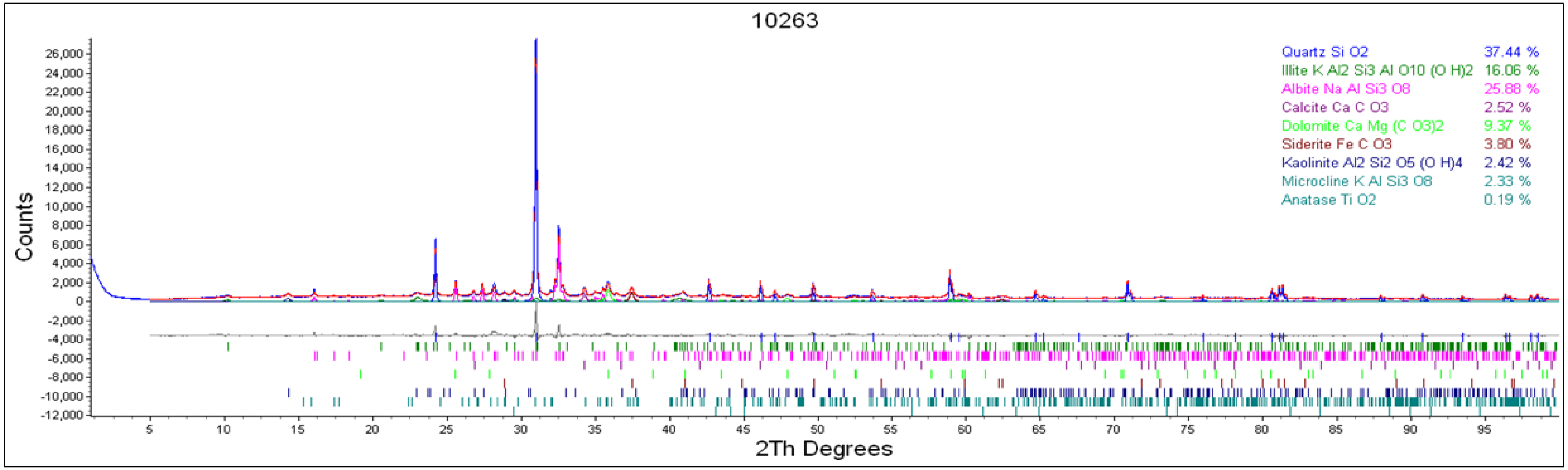
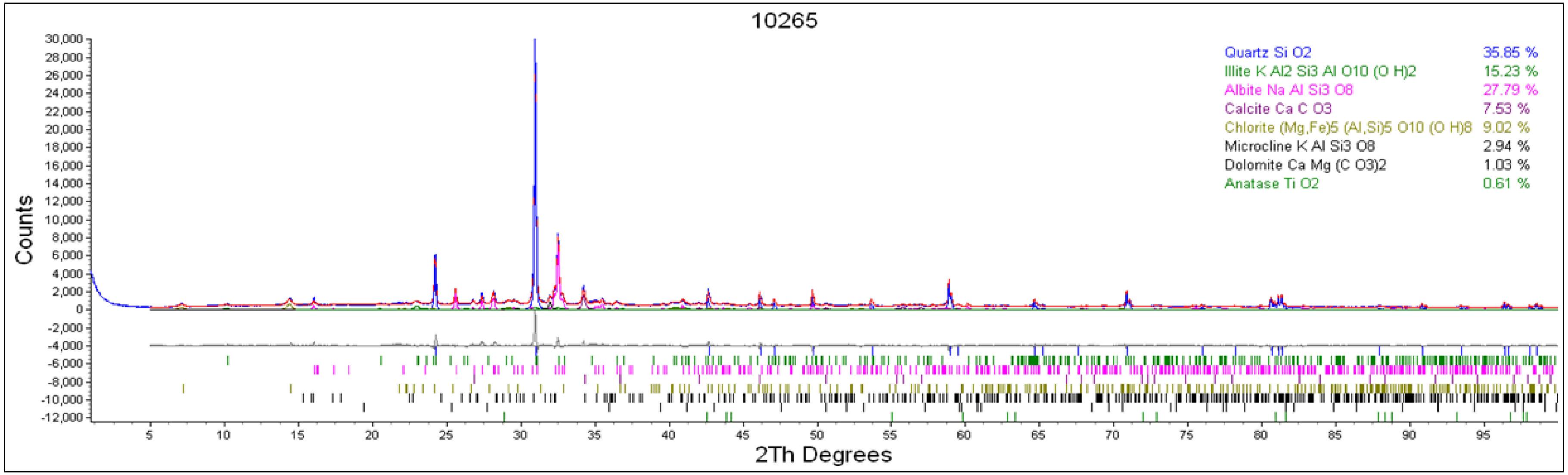


Figure 8-11: XRD Topaz Diffractograms samples 10263 (Source: Geoservices 2021)



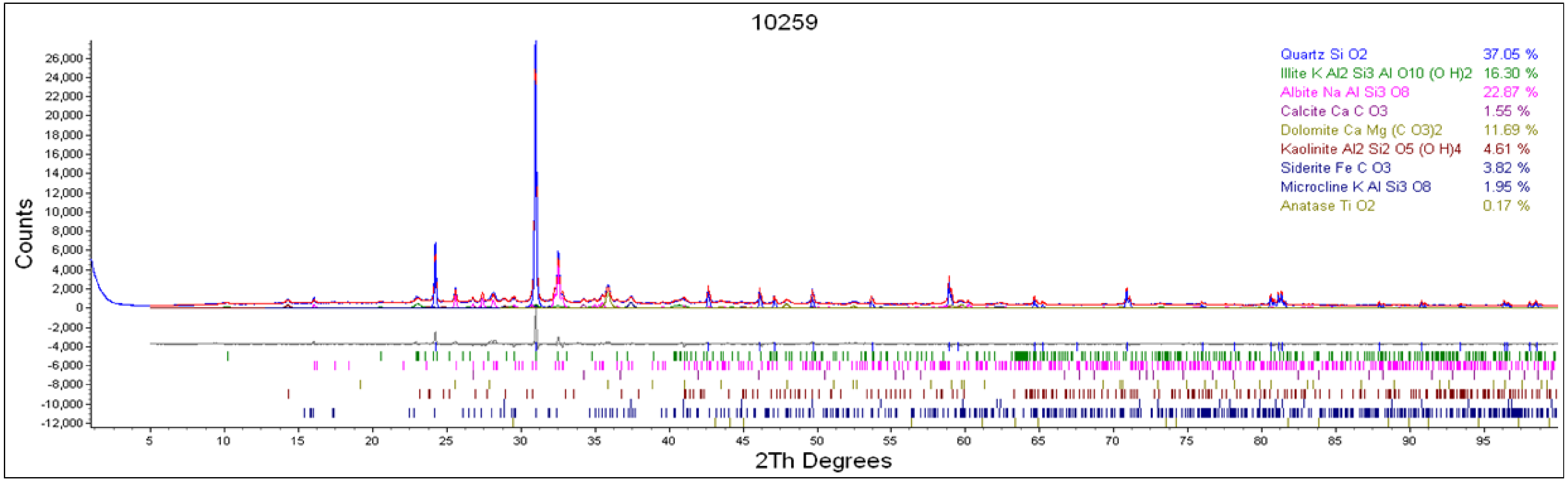


Figure 8-12: XRD Topaz Diffractograms samples 10265 and 10259 (Source: Geoservices 2021)

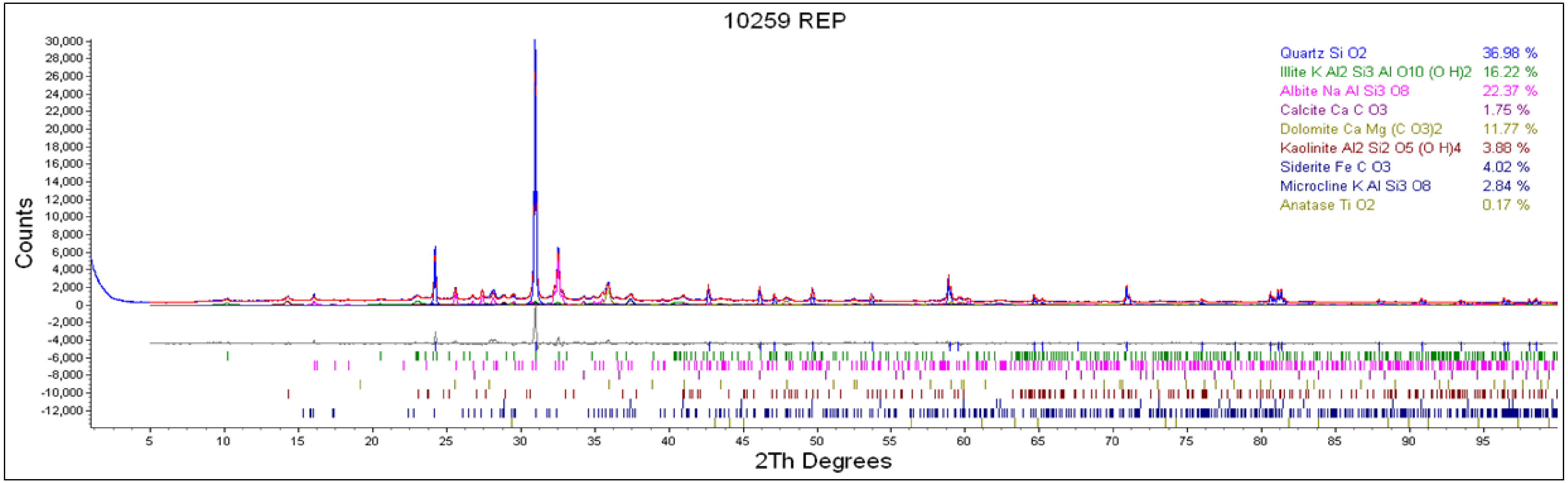


Figure 8-13: XRD Topaz Diffractograms samples 10259 laboratory repeat check sample (Source: Geoservices)

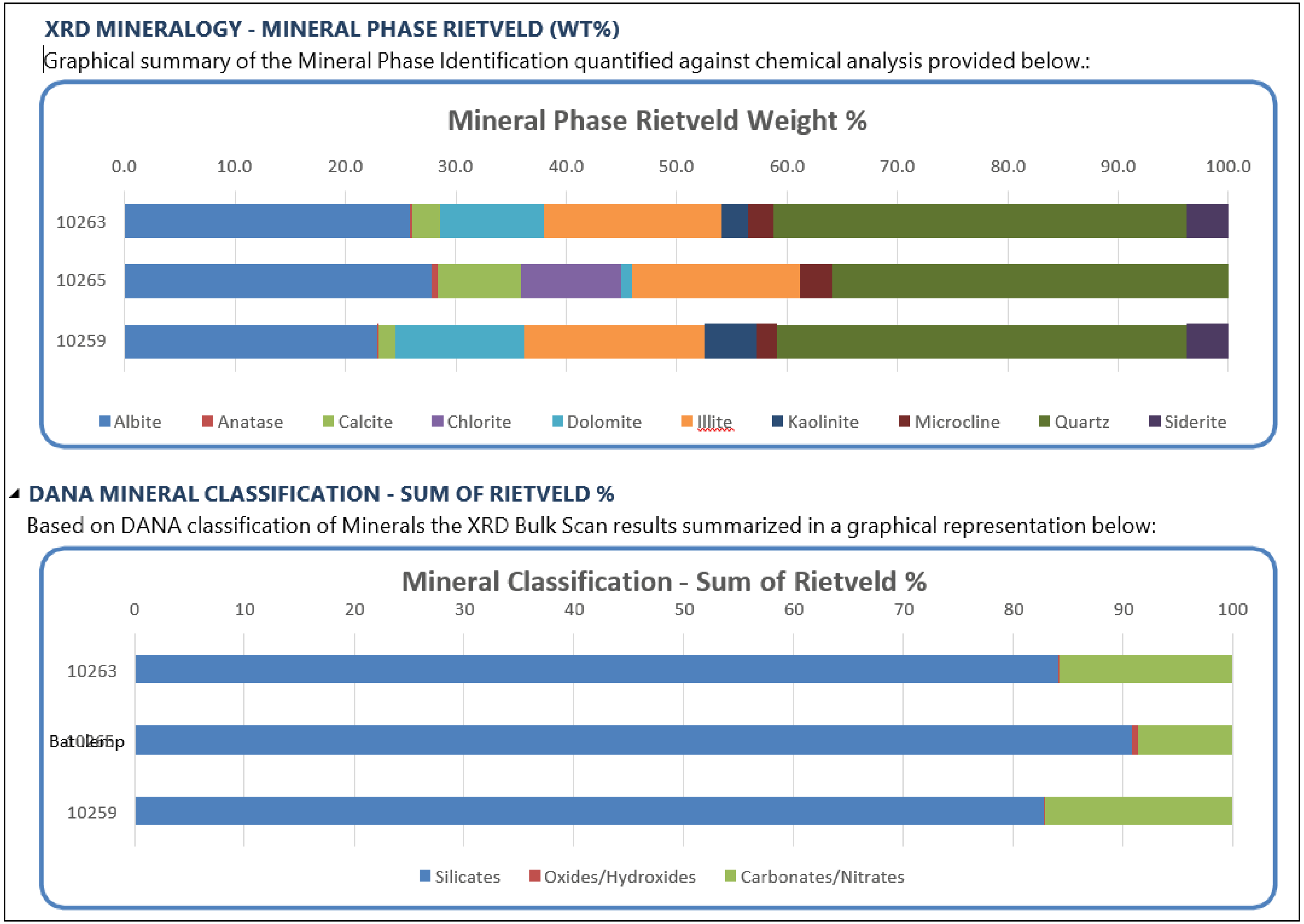


Figure 8-14: DANA mineral classification for XRD bulk sample results (Source: PT Geoservices 2021)

Table 8-11: PT GeoServices Jakarta (Primary Laboratory) Mineralogical Test Results 2021

Scheme	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a	10263	10265	10259	10267
LECO_S01	S_TOT	Total Sulfur	%	0.01	0.16	0.12	0.07	0.13	0.06	0.11	0.08	0.07	0.11	0.07
MIN_ICP_SO4	SO4	SO4	%	0.01	0.04	0.02	0.03	0.06	0.03	0.03	0.03	0.02	0.03	0.02
MLG_XRD_RPT	AB	Albite	%	0.1	33.5	28.1	30.6	31.8	29.4	33.5	25.9	27.8	22.9	22.9
MLG_XRD_RPT	ANDES_(NA,CA)	Andesine	%	0.1										
MLG_XRD_RPT	ANT	Anatase	%	0.1	0.6	0.5	0.6	0.7	0.5	0.2	0.2	0.6	0.2	0.2
MLG_XRD_RPT	AUG	Augite	%	0.1										
MLG_XRD_RPT	CAL	Calcite	%	0.1	4.1	4.8	5.1	6	5.9	5.7	2.5	7.5	1.5	0.5
MLG_XRD_RPT	CHL	Chlorite	%	0.1	9.6	10.4	11.8	11.7	10.6	10.6		9		
MLG_XRD_RPT	CRS	Cristobalite	%	0.1										
MLG_XRD_RPT	DI	Diopside	%	0.1										
MLG_XRD_RPT	DOL	Dolomite	%	0.1	0.6	0.8					9.4	1	11.7	11.3
MLG_XRD_RPT	FE	Iron	%	0.1										
MLG_XRD_RPT	FO	Forsterite	%	0.1										
MLG_XRD_RPT	GBS	Gibbsite	%	0.1										
MLG_XRD_RPT	GTH	Goethite	%	0.1										
MLG_XRD_RPT	HUL	Heulandite	%	0.1										
MLG_XRD_RPT	ILL_AL	Illite	%	0.1							16.1	15.2	16.3	15.8
MLG_XRD_RPT	ILL_FE	Illite	%	0.1	9.7	13.4	11.5	11.1	13	9.6				
MLG_XRD_RPT	KLN	Kaolinite	%	0.1							2.4		4.6	2.3
MLG_XRD_RPT	MAG	Magnetite	%	0.1	0.5	0.7	0.6	0.6	0.7					
MLG_XRD_RPT	MAY	Mayenite	%	0.1										
MLG_XRD_RPT	MC	Microcline	%	0.1	6.1	8.1	5.7	6.3	4.3	7.1	2.3	2.9	2	2.1
MLG_XRD_RPT	MGS	Magnesite	%	0.1										
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1	1.1	1.1	1.5	1.5	1.8	1.3				
MLG_XRD_RPT	PY	Pyrite	%	0.1										
MLG_XRD_RPT	QZ	Quartz	%	0.1	33.8	31.9	32.3	30	33.6	31.6	37.4	35.9	37	40.7
MLG_XRD_RPT	RT	Rutile	%	0.1										
MLG_XRD_RPT	SD	Siderite	%	0.1							3.8		3.8	4.1
MLG_XRD_RPT	TR	Tremolite	%	0.1										
PREP_DRY105	DRY_WT	Dry Weight	G	1	10048	10835	10642	72458	9687	10747	15893	15796	13611	15662
PREP_DRY105	H2O%	H2O%	%	0.01	0.73	1.03	0.96	0.84	1.03	1.33	1.62	1.56	1.13	1.37
PREP_DRY105	WET_WT	Wet Weight	G	1	10125	10948	10744	73067	9783	10890	16150	16043	13765	15877
XRFFWR_XRF	AL2O3	Aluminium Oxide	%	0.01	11.83	12.35	12.16	11.87	11.85	11.65	11.84	12.14	12.04	11.54
XRFFWR_XRF	BAO	Barium Oxide	%	0.01	0.02	0.03	0.02	0.03	0.02	0.02	0.01	0.02	<0.01	<0.01
XRFFWR_XRF	CAO	Calcium Oxide	%	0.01	3.14	3.68	3.57	3.55	3.58	3.75	4.26	4.12	3.96	3.54
XRFFWR_XRF	CR2O3	Chromium (III) Oxide	%	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
XRFFWR_XRF	FE2O3	Iron (III) Oxide	%	0.01	4.72	5.33	5.42	4.8	5.19	4.67	5.17	4.92	5.13	4.9
XRFFWR_XRF	K2O	Potassium Oxide	%	0.01	1.71	2.24	1.74	1.75	1.68	1.71	1.5	1.52	1.34	1.41
XRFFWR_XRF	LOI	LOI @ 1000 DegC	%	0.01	3.49	4.39	4.34	4.19	4.78	4.49	8.54	4.81	8.92	8.14
XRFFWR_XRF	MGO	Magnesium Oxide	%	0.01	2.12	2.28	2.44	2.27	2.31	2	1.94	2.18	1.96	2.03
XRFFWR_XRF	MNO	Manganese Oxide	%	0.01	0.09	0.1	0.09	0.09	0.09	0.1	0.1	0.09	0.09	0.1
XRFFWR_XRF	NA2O	Sodium Oxide	%	0.01	3.54	3.11	3.38	3.44	3.32	3.49	2.07	2.38	1.96	2.77
XRFFWR_XRF	P2O5	Phosphorus Pentoxide	%	0.01	0.09	0.1	0.11	0.1	0.1	0.1	0.09	0.09	0.11	0.09
XRFFWR_XRF	SIO2	Silicon Dioxide	%	0.01	67.49	65.44	65.96	66.17	65.36	66.61	64.3	65.77	62.61	64.01
XRFFWR_XRF	SO3	Sulphur Trioxide	%	0.01	0.2	0.17	0.14	0.17	0.12	0.21	0.23	0.2	0.15	0.1
XRFFWR_XRF	SRO	Strontium Oxide	%	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
XRFFWR_XRF	SUM	Sum	%	0.01	99.02	99.83	100.01	99	99.01	99.34	100.69	98.88	98.93	99.24
XRFFWR_XRF	TIO2	Titanium Dioxide	%	0.01	0.57	0.6	0.63	0.57	0.61	0.55	0.63	0.62	0.64	0.59

Table 8-12: PT GeoServices Jakarta (Primary Laboratory) Geotechnical/Geophysical Test Results 2021

Scheme	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a	10263	10265	10259	10267
GT0220	CP12.5MMPCT	Cummulative passing 12.5mm%	%	0.01	24.13	20	21.5	27.37	21.62	23.29	29.77	31.84	23.59	21.36
GT0220	CP19.0MMPCT	Cummulative passing 19.0mm%	%	0.01	45.06	39.66	41.07	50.41	40.05	45.64	55.17	56.37	42.52	39.94
GT0220	CP25.0MMPCT	Cummulative passing 25.0mm%	%	0.01	77	72.73	75.67	77.26	69.83	76.17	83.22	88.84	74.49	86.86
GT0220	CP37.5MMPCT	Cummulative passing 37.5mm%	%	0.01	98.98	100	100	97.46	100	100	100	100	100	99.05
GT0220	CP4.75MMPCT	Cummulative passing 4.75mm%	%	0.01	9.57	8.44	8.8	7.27	8.24	9.2	13.16	12.98	9.44	7.96
GT0220	CP6.3MMPCT	Cummulative passing 6.3mm%	%	0.01	11.76	10.7	11.4	14.8	10.49	11.53	16.18	15.79	12.04	10.1
GT0220	CP9.5MMPCT	Cummulative passing 9.5mm%	%	0.01	16.95	14.96	15.89	20.18	14.88	16.74	22.75	22.76	17.5	14.71
GT0220	D10MM	Derived D10 mm	MM	0.01	5.1	5.8	5.5	5.4	6	5.3			5.1	6.2
GT0220	D50MM	Derived D50 mm	MM	0.01	20.1	21.3	21.9	18.9	21.4	20	17.8	17.4	20.7	20.7
GT0220	D80MM	Derived D80 mm	MM	0.01	27	28.6	27.5	27	29.5	27.3	24.8	23.8	28	24.3
GT0220	D90MM	Derived D90 mm	MM	0.01	32.4	33	32.4	32.9	33.5	32.3	30.1	26.6	32.7	27.9
GT0220	MI4.75MMPCT	Minus 4.75mm%	%	0.01	9.57	8.44	8.8	7.27	8.24	9.2	13.16	12.98	9.44	7.96
GT0220	PL12.5MMPCT	Plus12.5mm%	%	0.01	20.93	19.66	19.56	23.04	18.43	22.35	25.4	24.53	18.92	18.58
GT0220	PL19.0MMPCT	Plus19.0mm%	%	0.01	31.93	33.07	34.61	26.85	29.78	30.53	28.05	32.46	31.97	46.92
GT0220	PL25.0MMPCT	Plus 25.0mm%	%	0.01	21.99	27.27	24.33	20.2	30.17	23.83	16.78	11.16	25.51	12.19
GT0220	PL37.5MMPCT	Plus 37.5mm%	%	0.01	1.02	<0.01	<0.01	2.54	<0.01	<0.01	<0.01	<0.01	<0.01	0.95
GT0220	PL4.75MMPCT	Plus 4.75mm%	%	0.01	2.2	2.26	2.6	7.53	2.25	2.33	3.01	2.81	2.6	2.14
GT0220	PL6.3MMPCT	Plus 6.3mm%	%	0.01	5.18	4.26	4.49	5.38	4.4	5.21	6.57	6.97	5.46	4.61
GT0220	PL9.5MMPCT	Plus9.5mm%	%	0.01	7.18	5.03	5.61	7.19	6.73	6.55	7.02	9.09	6.1	6.66
GT0226	ABS	Absorption	%	0.01	2.51	2.01	2.92	2.81	3.03	2.89	2.51	2.33	1.85	1.98
GT0226	AD	Apparent Density	KG/M3	0.01	2678.42	2691.63	2681.08	2681.16	2678.21	2670.43	2716.53	2683.73	2717.4	2714.86
GT0226	BD	Bulk Density	KG/M3	0.01	2509.22	2552.85	2485.73	2493.09	2476.79	2478.89	2542.67	2525.56	2587.3	2575.8
GT0226	SSDD	Saturated Surface Dry Density	KG/M3	0.01	2572.23	2604.28	2558.41	2563.06	2551.81	2550.44	2606.51	2584.35	2635.06	2626.89
GT0233	LAA X100	Los Angeles Abrasion X100	%	0.01	5.6	5.02	5.4	8.59	5.8	7.12	7.6	5.89	4.88	6.45
GT0233	LAA X500	Los Angeles Abrasion X500	%	0.01	27.58	24.37	24.37	38.76	30.38	33.42	37.91	31.38	23.96	30.4
GT0237	EP	Elongated Particles %	%	0.01	2.87	2.95	0.5	1.86	6.35	1.57	2.35	0.89	4	4
GT0237	FEP	Flat and Elongated Particles %	%	0.01	7.4	5.74	3.08	6.57	8.73	3.33	3.95	4	6.44	5.87
GT0237	FP	Flat Particles %	%	0.01	4.53	2.8	2.57	4.7	2.39	1.76	1.6	3.11	2.44	1.88
GT0237	UUP	Unflat & Unelongated Particles %	%	0.01	92.6	94.26	96.92	93.43	93.43	96.67	96.05	96	93.56	94.13

Umpire Laboratory

In order to check the primary laboratory results, the Company employed a secondary laboratory, PetroLab UK, to provide an assessment of selected shale and greywacke samples. Two sets of sample (greywacke and shale) where submitted to PetroLab UK and the results of the mineralogical assessment are summarised below in Table 8-13 and Table 8-14 and Figure 8-15 to Figure 8-19. Further details are also available in Appendix B.

Table 8-13: PetroLab UK Mineralogical Summaries (Greywacke Check Sample 10262)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Sample Number ID:</td><td>10262</td></tr>
<tr><td>Sample Photograph</td><td>

A Sample 10262

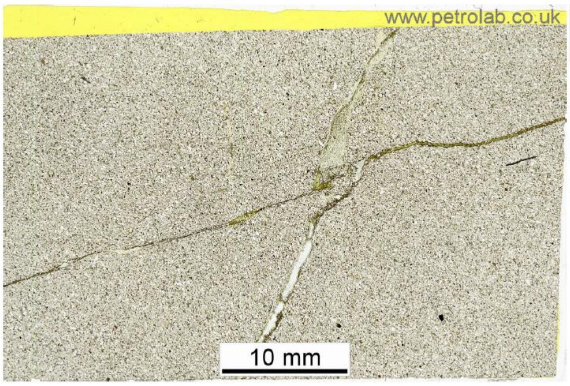
Photograph of sample as received (scale in cm).

Image A
Nikon D7000 digital camera
Daylight balanced oblique light

</td></tr>
<tr><td>Lithology</td><td>Sedimentary Greywacke</td></tr>
<tr><td>Macroscopic Description (visual)</td><td>
<table>
<tr><th colspan="2">Sample 10262</th></tr>
<tr><td>Group | Name</td><td>Sedimentary GREYWACKE</td></tr>
<tr><td>Colour</td><td>Greenish grey.</td></tr>
<tr><td>Strength</td><td>Strong (50 - 100 MPa), broken along fracture plane.</td></tr>
<tr><td>Structure</td><td>No layering seen at sample scale. Cross-cut by high angle veins and fractures.</td></tr>
<tr><td>Grain size</td><td>Uniformly fine grained with a typical size << 1 mm.</td></tr>
<tr><td>Weathering</td><td>Fresh.</td></tr>
<tr><td>Stability</td><td>Stable in water - No changes (Grade 1).</td></tr>
<tr><td colspan="2">Notes:
The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.</td></tr>
</table>
</td></tr>
</table>

Section

Section(s)



B Sample 10262

Low magnification view of sample thin section.

Image B
Epson scanner
White cold cathode light

Microscopic Examination

The sample is a fine-grained greywacke consisting of silt-sized clasts of quartz and feldspar (both plagioclase and alkali-feldspar) hosted in a fine-grained matrix containing micas (muscovite, biotite and chlorite), clay, dolomite, patches of microcrystalline silica and rare trace iron-oxides. The clay mineralogy is very fine grained but likely to consist of a mixture of sericite, illite, smectite, chlorite and kaolinite. The sample is cross-cut by high-angled coarse dolomite veins. Rare occasional anhedral grains of pyrite and pyrite framboids were observed within the greywacke matrix.

Greywackes have potential alkali-silica (ASR) implications when used in concrete due to the cryptocrystalline or microcrystalline silica which may be present. The sulphide content, however, is not sufficient to cause concern (total sulphur, TS <0.1%).

Mineral Abundance

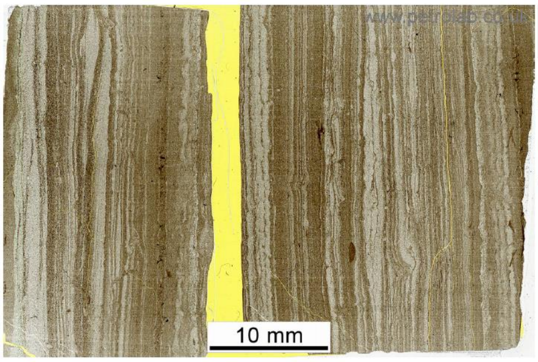
Sample 10262

Mineral / Phase	General formula	s.g.	Wt%[1]
Quartz, qtz	SiO_2	2.65	40.2%
Microcrystalline Silica, M qtz	SiO_2	2.65	
Feldspar group, fsp	$KAlSi_3O_8$ - $NaAlSi_3O_8$ - $CaAl_2Si_2O_8$	2.59	21.7%
Dolomite, dol	$CaMg(CO_3)_2$	2.84	20.0%
Illite, ill	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	2.75	10.3%
Muscovite, ms	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.82	
Kaolinite, kaol	$Al_2Si_2O_5(OH)_4$	2.60	4.8%
Illite/Smectite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2•n(H_2O)$	2.35	1.3%
Siderite, sid	$Fe^{++}CO_3$	3.96	1.3%
Anatase, ant	TiO_2	3.90	0.5%
Pyrite, py	FeS_2	5.01	trace
Fe oxides, FeO	$Fe^{+++}O(OH)$	3.80	trace
Chlorite, chl	$(Mg,Al,Fe^{++})_{12}(Si,Al)_8O_{20}(OH)_8$	2.65	trace
Apatite, apt	$Ca_5(PO_4)_3F$	3.16	trace
Zircon, zr	$ZrSiO_4$	4.65	trace

Note: (1) Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Phase Description	Sample 10262				
	Mineral / Phase	**Grain size (min | max | typical)**			**Prominent grain type**
	Quartz	50 µm	350 µm	200 µm	Clast
	Description	Inequigranular, angular, moderately to poorly sorted, monocrystalline quartz is the main constituent of sample. Grains rarely show undulose extinction and division into sub-grains, indicating a low level of deformation overall. Quartz grains do not show any alteration and are packed in between feldspar grains and clays.			
	Microcrystalline Silica	50 µm	1 mm	200 µm	Matrix & clast
	Description	Microcrystalline silica is a minor phase which is present in the matrix between clasts and also forming sub-rounded clast grains of chert. Within the matrix it is sometimes associated with clays. Microcrystalline silica is forming patches of silicified matrix < 1 mm within the sandstone texture.			
	Feldspar group	50 µm	300 µm	200 µm	Clast
	Description	Feldspars form angular clasts throughout the texture. Plagioclase feldspars are predominant throughout the sample with characteristic polysynthetic twinning. They rarely show slight sericitisation. Only minor alkali feldspar with simple twinning were observed. Rare alkali feldspars show slight kaolinisation.			
	Carbonates (dolomite, siderite)	10 µm	200 µm	100 µm	Sub-angular to sub rounded
	Description	Carbonate is present as predominantly dolomite with a trace amount of siderite. Carbonates are distributed throughout the sample as a component of the matrix and are also seen forming diffuse agglomerations up to 100 µm (possibly siderite). Well crystallised dolomite is a major component of veins that cut the sample in different angles. In veins dolomite occurs in association with clays.			
	Clay/fine micas	< 5µm	200 µm	50 µm	Matrix
	Description	Fine grained masses of subhedral (elongate to platy) undifferentiated micas and clay minerals form a significant proportion of interstitial matrix between clasts (XRD includes illite, smectite, kaolinite, mica and chlorite) They are sometimes interlayered with coarser micas (e.g. muscovite, chlorite) and also associated with iron oxides, anatase, dolomite, siderite and rarely microcrystalline silica. There is no obvious preferred alignment. Some pockets of sericite are also seen replacing altered feldspars, although they never replace the entire feldspar clast.			
	Muscovite	40 µm	500 µm	150 µm	Clast & matrix
	Description	Muscovite is generally present as elongate subhedral to euhedral (tabular) crystal clasts randomly distributed throughout the rock texture, sometimes showing weak compaction deformation around rigid detrital grains. It is also present in fine grained form in the matrix and as part of sericitisation of feldspars but is difficult to differentiate and has been grouped with other micas/clays.			
	Anatase	5 µm	70 µm	20 µm	Matrix & clast
	Description	Anatase is present as small anhedral grains, elongate needles and clusters of grains (up to 70 µm) associated with other interstitial phases (clays, iron oxides). It is also present as very rare inclusions in quartz.			
	Pyrite	5 µm	200 µm	30 µm	Matrix
	Description	Rare subhedral to anhedral crystals of pyrite are visible in reflected light, disseminated through the sandstone texture with no obvious association. Disseminated framboids were also visible, rarely creating an agglomeration of framboids. Some of them are oxidised to iron oxides.			
	Fe oxides	10 µm	70 µm	40 µm	Matrix
	Description	Iron oxides (mainly composed of hematite and goethite) are disseminated throughout the rock texture as individual grains and granular clusters associated with clays, anatase and chlorite. They usually occur within the matrix and also replace some of the pyrite crystals.			
	Chlorite	10 µm	200 µm	80 µm	Clast & matrix
	Description	Chlorite is present within the fine micas and clays forming sample matrix, it is generally too fine grained to separate out from green clays. However there are occasionally small aggregates solely comprising chlorite and larger individual clasts of chlorite present.			
	Apatite	5 µm	80 µm	20 µm	Clast
	Description	Apatite is an accessory phase within the sample and forms sub-rounded randomly distributed clasts throughout the sandstone texture.			
	Zircon	10 µm	20 µm	20 µm	Clast
	Description	Zircon is an accessory phase within the sandstone usually forming small, sub-rounded clast grains. There is no visible alteration associated with zircon.			

Table 8-14: PetroLab UK Mineralogical Summaries (Shale – Check Sample 10261)

Item	Description
Sample Number ID:	10261
Lithology	Shale
Macroscopic Description (visual)	**Group | Name**: Sedimentary SHALE **Colour**: Dark grey to black. **Strength**: Weak (5 - 25 MPa). **Structure**: Thinly laminated (1 mm -5 mm). **Grain size**: Uniformly fine grained with a typical size << 0.5 mm. **Weathering**: Fresh. **Stability**: Fairly stable in water - A few fissures are formed, or specimen surface crumbles slightly (Grade 2). Notes: The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.
Section	 B **Sample 10261** Low magnification view of sample thin section. Image B Epson scanner White cold cathode light
Microscopic Examination	The sample is a laminated dark grey shale. It comprises a fine-grained matrix (mainly varying clays and fine mica, with minor carbonate, iron oxides and organic matter) with variably abundant quartz and feldspar clasts. The abundance and varying size of clasts defines laminations. Muscovite mica, biotite mica and chlorite are also present often elongated parallel with laminations. The shale contains rare fine grained pyrite within the matrix with rare framboids randomly distributed throughout the shale texture. Cracking within the sample is also present as both parallel along bedding planes and rarely as sub-perpendicular to lamination. Cracking is already present associated with shale layers which contain rare framboidal pyrite. They show rare evidence of pyrite oxidation which may cause enhanced porosity and potential for further expansion. The shale layers show primarily lamination parallel cracking (<100 am width) and rare perpendicular cracking (<250 µm). There is no other microporosity and the rock appears unweathered. When exposed to water, the shale formed some fissures and expansive cracks, suggesting it is susceptible to water ingress and that swelling clays are present (XRD analysis recorded 3.0% illite/smectite).

Mineral Abundance

Sample 10261			
Mineral / Phase	**General formula**	**s.g.**	**Wt%[1]**
Quartz, qtz	SiO_2	2.65	44.7%
Microcrystalline Silica, M qtz	SiO_2	2.65	
Illite, ill	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	2.75	21.5%
Muscovite, ms	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.82	
Plagioclase feldspar, plag	$NaAlSi_3O_8 – CaAl_2Si_2O_8$	2.59	14.5%
Chlorite, chl	$(Mg,Fe^{++})_5Al(Si_3Al)O_{10}(OH)_8$	2.65	8.9%
Calcite, cal	$CaCO_3$	2.70	6.8%
Illite+Smectite, sm	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2{\bullet}n(H_2O)$	2.35	3.0%
Kaolinite, kaol	$Al_2Si_2O_5(OH)_4$	2.60	0.6%
Alkali feldspar. K fsp	$KAlSi_3O_8$	2.56	trace
Biotite, bt	$K(Fe,Mg)_3(AlSi_3O_{10})(OH)_2$	3.09	trace
Dolomite, dol	$CaMg(CO_3)_2$	2.84	trace
Fe oxides, FeO	$Fe^{+++}O(OH)$	3.80	trace
Pyrite, py	FeS_2	5.01	trace

Note: (1) Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Phase Description	Sample 10261				
	Mineral / Phase	Grain size (min | max | typical)			Prominent grain type
	Quartz	5 µm	80 µm	40 µm	Clast
	Description	Angular, moderately sorted fine quartz grains are a predominant clast type within the rock. They are typically silt sized and only rarely reach ~80 µm. The variation in size and abundance throughout the texture defines the rock laminations. Slightly coarser quartz grains are usually associated with carbonate rich layers.			
	Microcrystalline Silica	<5 µm	50 µm	20 µm	Matrix
	Description	Microcrystalline silica is only a minor phase in the sample. Small patches of microcrystalline silica are visible within the rock, either locally altering quartz and feldspar grains, or as sporadic patches within the matrix of quartz rich layers.			
	Clay	<1 µm	200 µm	5 µm	Matrix
	Description	The bulk of the rock sample comprises an ultra-fine matrix containing various clay and other phyllosilicate minerals (XRD includes illite, smectite, kaolinite, mica and chlorite). Clay minerals are typically too fine grained to differentiate, appear weakly aligned parallel to lamination direction and show a range of birefringence colours. Laminations mainly appear to be defined by the amount of brown-coloured clays and fine biotite within the matrix, with additional brownish staining associated with small oxide lenses.			
	Muscovite	20 µm	120 µm	50 µm	Clast & matrix
	Description	Elongate muscovite laths are present throughout the texture, typically aligned with laminations and showing local deformation kinking around quartz clasts. They are typically coarser grained with less alignment in the lightest quartz-rich laminations, and show variation in abundance across laminations. Some are interlayered with chlorite or clays, particularly in the clay rich layers.			
	Feldspar group	10 µm	70µm	50 µm	Clast
	Description	Moderate to well sorted, angular grains of plagioclase and alkali feldspar form a minor clast component throughout the rock texture. XRD analysis indicates the majority of feldspar is plagioclase. They show similar variations in grain size as quartz. Some clasts show local sericitisation, kaolinisation or alteration to microcrystalline silica.			
	Carbonates (calcite, dolomite)	<5 µm	100 µm	15 µm	Clast & matrix
	Description	Carbonate is present as both calcite and dolomite although could not be differentiated in thin section as it is present in microcrystalline form. This is distributed throughout the section as a component of the matrix and is also seen forming diffuse agglomerations up to 100 µm. There are also calcite and quartz rich layers within the rock texture. There are also rare calcite veins present, running perpendicular to sample lamination.			
	Biotite	10 µm	70 µm	40 µm	Clast & matrix
	Description	Elongated laths of biotite are present throughout the texture showing similar distribution and alignment as muscovite. They are usually finer grained than muscovite. They are commonly associated with chlorite, muscovite and clays.			
	Fe oxides	5 µm	60 µm	20 µm	Matrix
	Description	Rare angular to sub-angular grains and granular clusters (predominantly hematite and goethite) are typically disseminated throughout the sample.			
	Pyrite	5 µm	30 µm	10 µm	Matrix
	Description	Traces of small pyrite grains were visible in reflected light. They are typically disseminated throughout the rock texture and occur as framboids and angular crystals. They rarely form agglomeration of framboids.			

X-ray Diffraction Analysis **Client: Petrolab**

Size Fraction : Whole Rock **Project: OP4477**

Weight % by mineral phase

Sample	Illite/ Smectite	Illite+Mica	Kaolinite	Chlorite	Quartz	K Feldspar	Plagioclase	Calcite	Dolomite	Siderite	Pyrite	Anatase	Total
10261	3.0	21.5	0.6	8.9	44.7	0.0	14.5	6.8	TR	0.0	0.0	0.0	100
10262	1.3	10.3	4.8	0.0	40.2	0.0	21.7	0.0	20.0	1.3	0.0	0.5	100

Notes:
1) Quantification by Rietveld method (AutoQuan software)
2) Dolomite in sample 10262 is Fe-rich
3) Plagiocalse in sample 10257 is Andesine
4) K Feldspar in sample 19999 is Sanidine

Figure 8-15: XRD Results Summary for PetroLab UK (Umpire Lab) (file reference: PetroLab_Mineralogical_Report_ OP4477_KBK_Report_27_05_21.pdf)

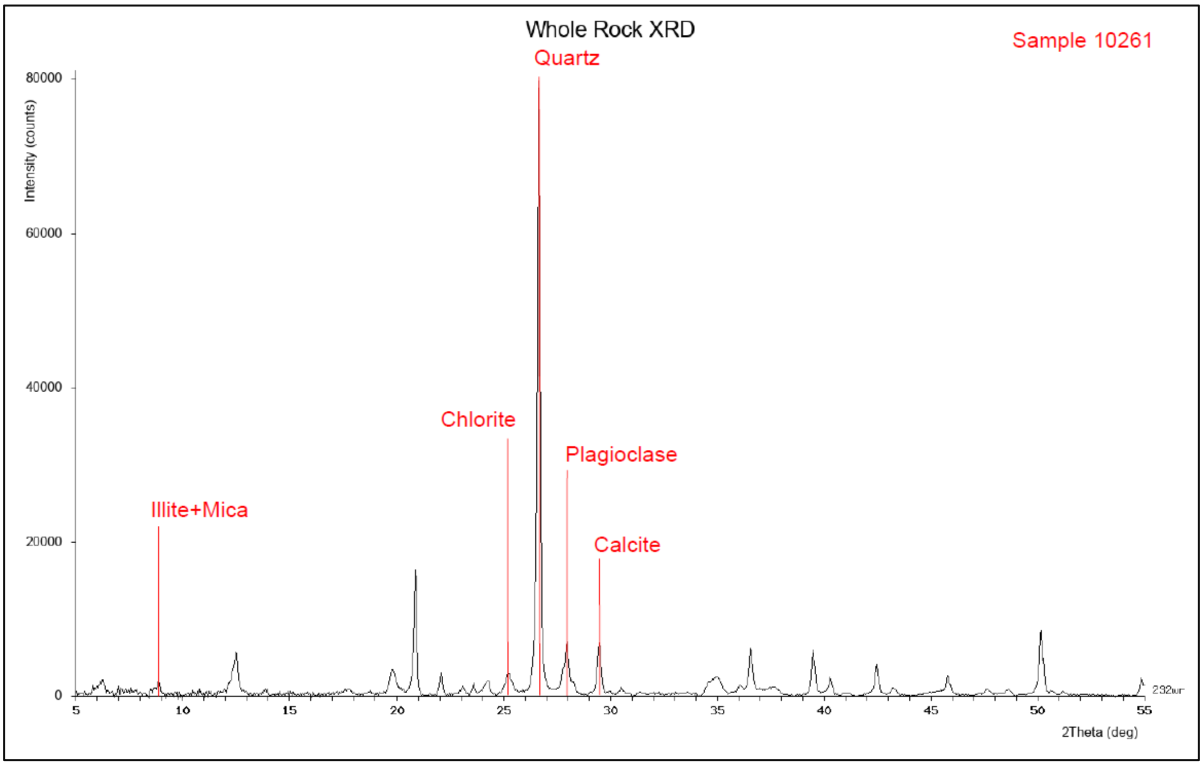


Figure 8-16: XRD Results Summary for PetroLab UK whole rock analysis sample 10261 (Source: PetroLab UK)

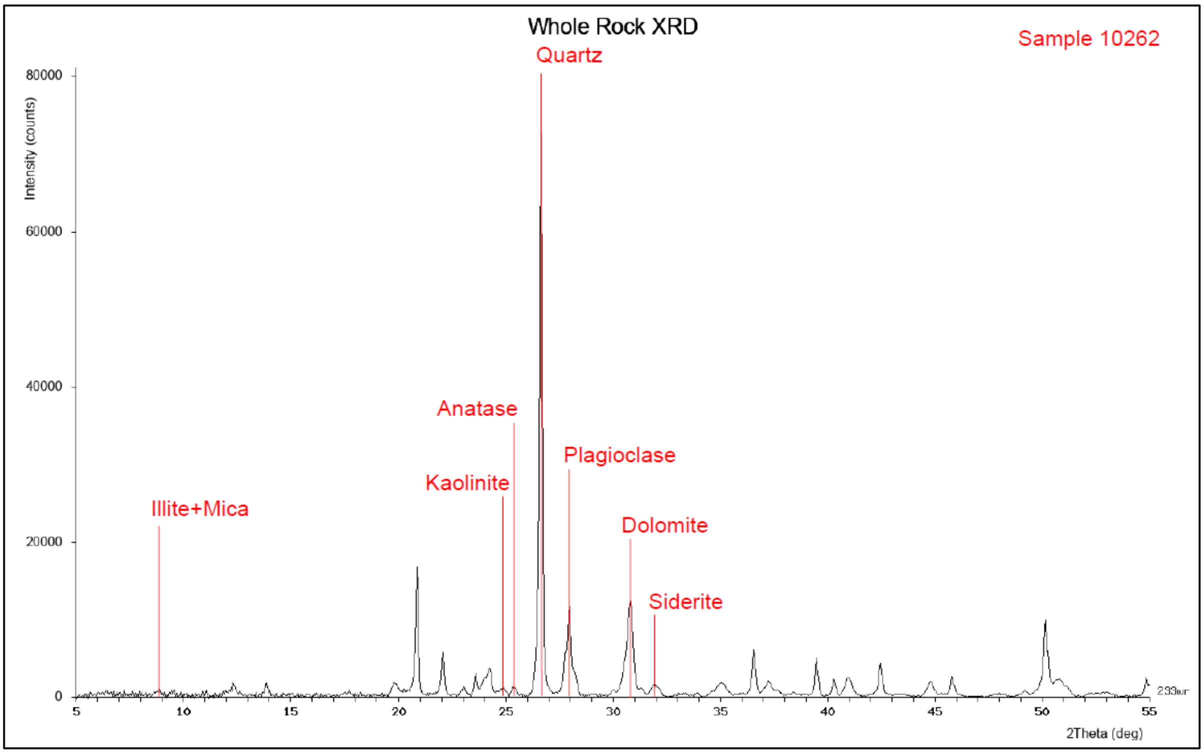


Figure 8-17: XRD Results Summary for PetroLab UK whole rock analysis sample 10262 (Source: PetroLab UK)

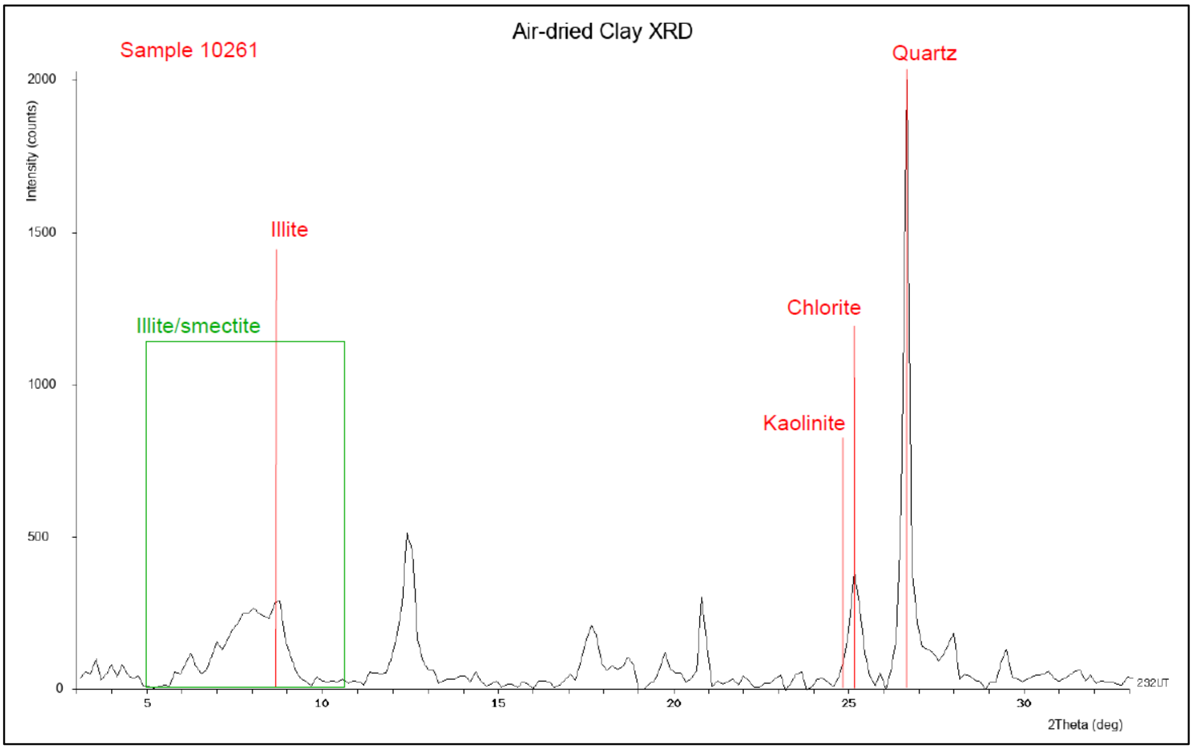


Figure 8-18: XRD Results Summary for PetroLab dried air clay analysis sample 10261 (Source: PetroLab UK)

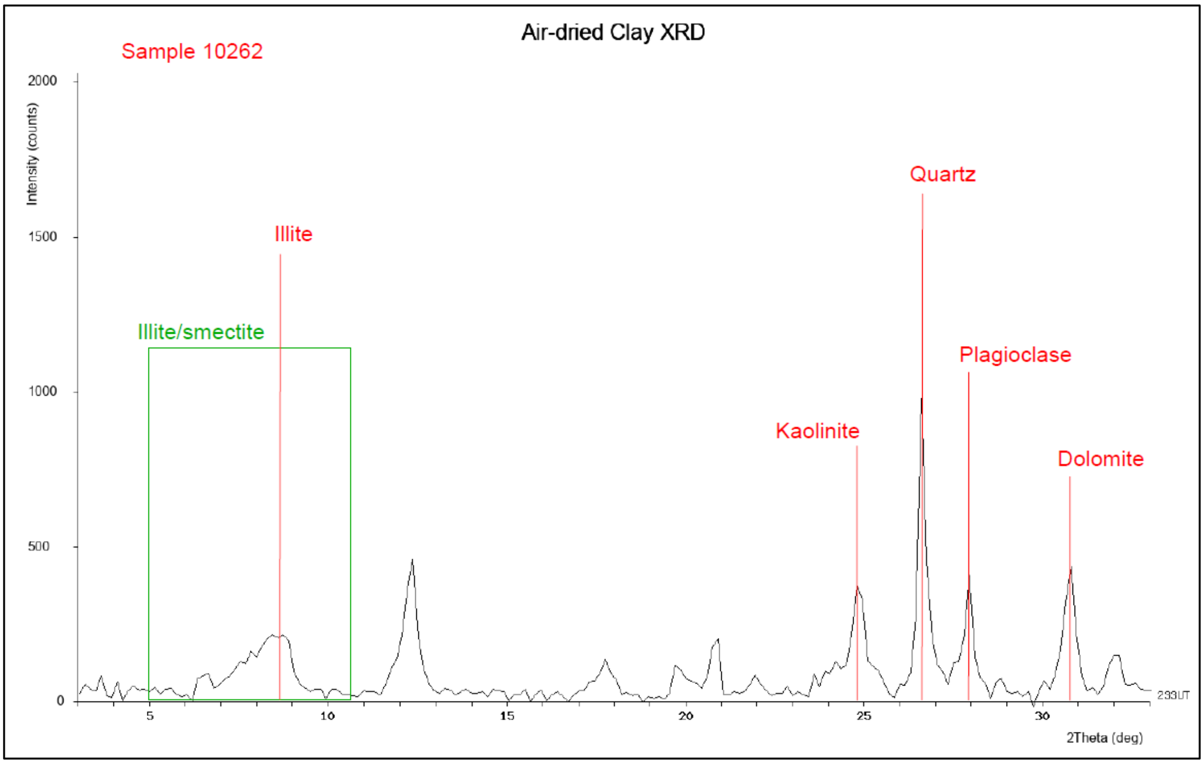


Figure 8-19: XRD Results Summary for PetroLab UK dried air clay analysis sample 10262 (Source: PetroLab UK)

XRF Method and interpretation

Whole (bulk) rock analysis was conducted by PetroLab UK to obtain a quantitative measurement of the elemental components of a sample. On receiving the samples, Petrolab assesses whether the samples need drying and pulverising prior to preparation and conducting the XRF. Drying is carried out by drying the samples at 105°C until a constant weight is achieved. If needed, the sample is passed through a jaw crusher to reduce the particle size in order to separate out a representative sub sample (normally 100 g). The sample is then pulverised to <53 µm using a TEMA mill.

The prepared samples were then analysed using a panalytical Epsilon 3 XL. Each sample was prepared and pressed as powder pellets using aluminium cups in a Herzog Hydraulic press. These pellets were then placed in the instrument using a polypropylene film. The samples were then run on the Omnium programme. This programme uses internal references in order to evaluate semi quantitatively. The results are then balanced by the software to 100% depending on the selection of the element output (oxides, elemental etc). The XRF is unable to evaluate atomically light elements (elements lighter than Na) due to the nature of the technology and so if there are known components such as carbonates etc this has to be taken into consideration. The results obtained are provided in Figure 8-20.

Wheal Jane Services Ltd t/a Wheal Jane Laboratory
Wheal Jane Services Ltd, Old Mine Offices, Wheal Jane, Baldhu, Truro, Cornwall TR3 6EE**Telephone (01872) 560200, Direct Line (01872) 562023, Facsimile (01872) 562000**
E-mail crice@wheal-jane.co.uk

Wheal Jane Laboratory

Test Report

WJL ID No: 126,123-126,125
Report No: 21050701c

Sample(s) Received: 26/04/21
Tested By: CR LP JH

Sample(s) Tested: 07/05/21
Test Procedure/Method(s): O1, O2, as requested

For the attention of: **Name:** J. Strongman
Company: **Petrolab**
Address: C Edwards Offices Redruth
Subject: OP4477

Sample	10261	10262
%		
L.O.I 1hr @ 600°C	5.98	4.75
%		
S(tot)	0.15	0.04
%		
Al_2O_3	21.3	20.8
BaO	<0.1	<0.1
CaO	4.0	4.5
Cr_2O_3	<0.1	<0.1
Fe_2O_3	7.2	5.1
K_2O	2.8	1.8
MgO	3.5	2.3
MnO	<0.1	<0.1
Na_2O	1.4	3.5
P_2O_5	<0.1	<0.1
SiO_2	58.3	60.7
SO_3	0.3	0.1
SrO	<0.1	<0.1
TiO_2	0.8	0.6

Figure 8-20: XRF Results Summary for PetroLab UK (Umpire Laboratory) (file reference: PetroLab_Mineralogical_Report_OP4477_KBK_Report_27_05_21.pdf)

Conclusions

The average XRF values of the primary samples for all analytes received from Geoservices compared to the XRF results from PetroLab are shown in Table 8-16.

There are no significant variations between the results produced by the two separate independent laboratories.

Table 8-15: GeoServices Jakarta (GS) and PetroLab UK XRF Comparison 2021

GeoServices and PetroLab XRF Comparison			GS	GS	GS	GS	GS	GS	GS	GS	GS	GS	GEOSERVICES (summary)						GS	PETROLAB
Scheme	Analyte Code	Unit	10254a (Duplicate of KDD02R)	10252a	10255a	10256a	10253a (Original of KDD02R)	10251a	10263	10265	10259	10267	Min	Max	Mean	Median	Q1	Q3	(Average Values)	10262 As Reported
XRF	AL2O3	%	11.83	12.35	12.16	11.87	11.85	11.65	11.84	12.14	12.04	11.54	11.54	12.35	11.93	11.86	11.83	12.12	11.93	20.80
XRF	BAO	%	0.02	0.03	0.02	0.03	0.02	0.02	0.01	0.02	<0.01	<0.01	0.01	0.03	0.02	0.02	0.02	0.02	0.02	<.01
XRF	CAO	%	3.14	3.68	3.57	3.55	3.58	3.75	4.26	4.12	3.96	3.54	3.14	4.26	3.72	3.63	3.56	3.91	3.72	4.50
XRF	CR2O3	%	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	> .01	>.01	>.01	>0.01	>.01	> .01	<.01	<.01
XRF	FE2O3	%	4.72	5.33	5.42	4.8	5.19	4.67	5.17	4.92	5.13	4.9	4.67	5.42	5.03	5.025	4.83	5.19	5.03	5.10
XRF	K2O	%	1.71	2.24	1.74	1.75	1.68	1.71	1.5	1.52	1.34	1.41	1.34	2.24	1.66	1.695	1.51	1.73	1.66	1.80
XRF	LOI	%	3.49	4.39	4.34	4.19	4.78	4.49	8.54	4.81	8.92	8.14	3.49	8.92	5.61	4.635	4.35	7.31	5.61	4.75 (1)
XRF	MGO	%	2.12	2.28	2.44	2.27	2.31	2	1.94	2.18	1.96	2.03	1.94	2.44	2.15	2.15	2.01	2.28	2.15	2.30
XRF	MNO	%	0.09	0.1	0.09	0.09	0.09	0.1	0.1	0.09	0.09	0.1	0.09	0.1	0.09	0.09	0.09	0.10	0.09	<0.01
XRF	NA2O	%	3.54	3.11	3.38	3.44	3.32	3.49	2.07	2.38	1.96	2.77	1.96	3.54	2.95	3.215	2.48	3.43	2.95	3.50
XRF	P2O5	%	0.09	0.1	0.11	0.1	0.1	0.1	0.09	0.09	0.11	0.09	0.09	0.11	0.10	0.1	0.09	0.10	0.10	<0.01
XRF	SIO2	%	67.49	65.44	65.96	66.17	65.36	66.61	64.3	65.77	62.61	64.01	62.61	67.49	65.37	65.605	64.57	66.12	65.37	60.70
XRF	SO3	%	0.2	0.17	0.14	0.17	0.12	0.21	0.23	0.2	0.15	0.1	0.1	0.23	0.17	0.17	0.14	0.20	0.17	0.10
XRF	SRO	%	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.02	<0.01
XRF	TIO2	%	0.57	0.6	0.63	0.57	0.61	0.55	0.63	0.62	0.64	0.59	0.55	0.64	0.60	0.605	0.58	0.63	0.60	0.60
XRF	SUM	%	99.02	99.83	100.01	99	99.01	99.34	100.69	98.88	98.93	99.24	98.88	100.69	99.40	99.13	99.00	99.71	99.40	99.40

Notes: (1) Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Comparison of XRF GeoServices to XRF PetroLab UK

A comparison between the two sets of XRF results from Geoservices and PetroLab UK shows similar reported values for each corresponding analyte (Table 8-15).

Table 8-16: GeoServices Jakarta and PetroLab XRF Comparison 2021

Geoservices XRF	PETROLAB XRF	Difference
(Average Values)	sample: 10262 As Reported	%
11.93	20.8	-8.9
0.02	<.01	< 0.01
3.72	4.5	-0.8
<.01	<.01	< 0.01
5.03	5.1	-0.1
1.66	1.8	-0.1
5.61	4.75	0.9
2.15	2.3	-0.2
0.09	<0.01	< 0.01
2.95	3.5	-0.6
0.1	<0.01	< 0.01
65.37	60.7	4.7
0.17	0.1	0.1
0.02	<0.01	< 0.01
0.6	0.6	0.0
99.4	99.4	0.0

8.4 Processing and Testwork Conclusions

In regards to the testwork completed following the 2019 and 2021 drilling and sampling programmes, SRK believes the geochemical and geophysical testwork and data is sufficient in terms of quantity and quality to support the mineral resource as reported herein.

9 MINERAL RESOURCE ESTIMATE

9.1 Introduction

This section presents an overview of the work completed by SRK in producing a Maiden MRE for the Project.

SRK has been advised that there are currently no title, legal, taxation, marketing, permitting, socio-economic or other relevant issues that may materially affect the reporting of an MRE other than those described in this report.

The MRE is based on all drilling data collected by the Company between 15th March 2019 and 30 June 2021 and is constrained by an optimised pit shell. Domain modelling was undertaken in Leapfrog Geo and estimation in Leapfrog Edge.

The MRE and Domain Modelling was completed by Mr Oliver Jones (MAusIMM), an Associate Resource Geologist of SRK, under the supervision of Mr Peter Gleeson, MAIGS, MIMMM, Cert Eng (CP), a Principal Consultant (Resource Geology) with SRK and the Competent Person in accordance with the JORC 2012 Code, with responsibility for the reporting of the Mineral Resource Statement presented herein. Mr Gleeson has the relevant experience in reporting Mineral Resources on various base, precious and Industrial material assets globally. The resulting MRE has been reported according to the JORC 2012 and has an effective date of 30 September 2021.

9.2 Estimation Domain Modelling

9.2.1 Introduction

Estimation domains were created using all available drillhole data. DGPS collar surveys and a high-resolution drone photogrammetry topographic surface provide suitably accurate constraints to the model.

9.2.2 Lithology Modelling

SRK constructed wireframes of the key lithological units, based on the geological logging completed by the Company's geologists. The following units were modelled:

- Soil;
- greywacke; and
- shale.

The lithology wireframes were clipped below the topography surface. Plan and oblique views of the lithology domains are presented in Figure 9-1 and Figure 9-2. A cross section through the model is provided in Figure 9-3. A relatively simple geological model has been created, reflecting the quantity of available data and level of understanding of the project.

In general, SRK has interpreted the main units to dip moderately to steeply towards the west. Due to the complex interbedded nature of the shale and greywacke horizons intersected in the drilling, it has not been possible to create domains for every separate lithological intersection and a degree of simplification into broad lithological zones has been required.

SRK notes that it is likely that the complexity of the model will increase with further drilling, particularly in areas away from the main hill where the majority of data currently exists. A review of the logged intervals within the main GRY 2 unit (that forms the entirety of the classified Mineral Resource) suggests that some 12% of this unit may comprise shale that it has not been possible to subdomain. This waste rock has been accounted for in the MRE statement as a factored reduction in the total tonnes of greywacke reported.

At this stage of study, and given the available data, it has not been possible to account for the presence of any faulting within the deposit area in the 3D geological model produced. It is recognised that there are visible discontinuities observed at site that seem to generally cross-cut the bedding in both north-south and east-west directions; however, these have not been systematically recorded or provided to SRK. It has also been observed in drill core that there are zones within the deposit that show evidence of faulting. SRK recommends that collection of these data are made a priority for future work.

Figure 9-1: Plan view of the KBK geology model with the soil horizon removed and aerial orthophoto shown with low transparency for reference. Drillhole collars are shown as black points (source: SRK 2021)

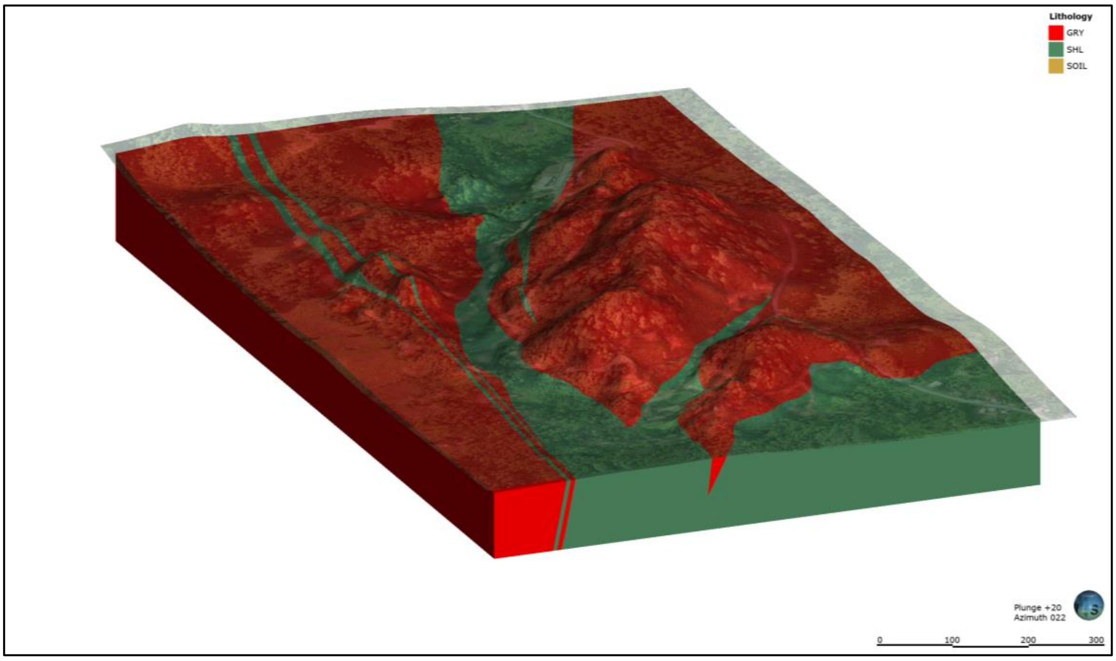


Figure 9-2: Oblique view of KBK geology model, facing NE. Soil horizon removed, aerial orthophoto shown with low transparency for reference (source: SRK 2021)

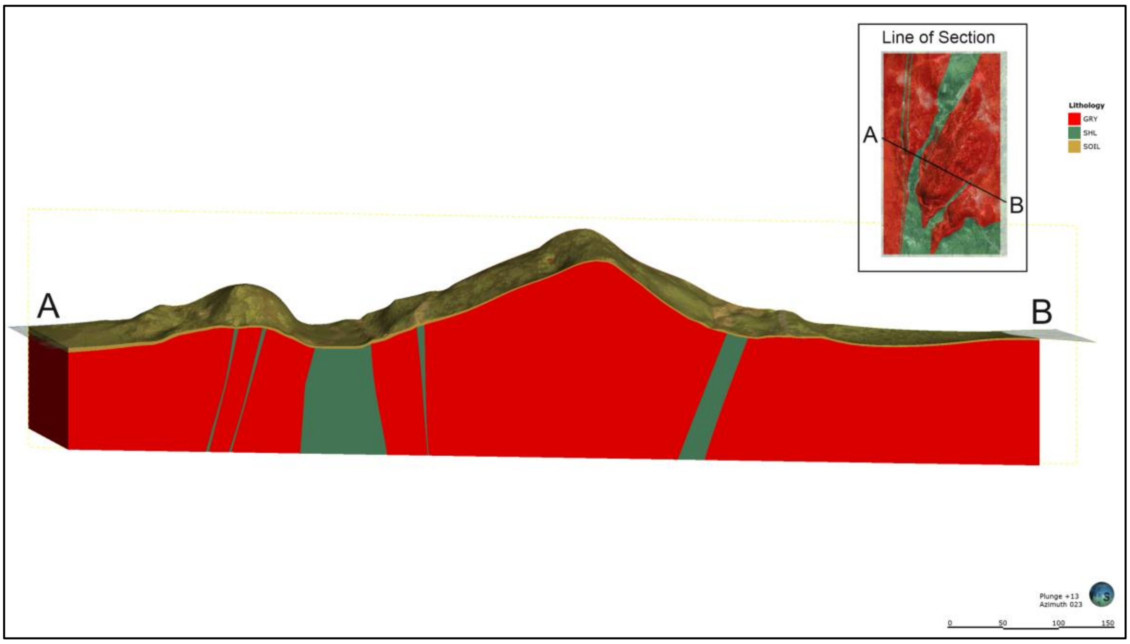


Figure 9-3: North facing cross section through the KBK geological model (source: SRK 2021)

9.2.3 Weathering Model

A weathering model has been created to reflect the following weathering codes in the weathering database:

- Extremely Weathered;
- Heavily Weathered;

- Moderately Weathered;
- Slightly Weathered; and
- Fresh.

Due to the logging subjectivity of these weathering codes, SRK made the decision to re-code these into three divisions, namely:

- Oxide (Extremely and Heavily Weathered);
- Transitional (Moderately and Slightly Weathered);
- Fresh.

Based on these simplified codes, SRK was able to construct a basic weathering model that used the ground surface as a guide and created surfaces offset using the drillhole weathering data. An oblique view of the weathering model is provided in Figure 9-4. A cross section through the weathering model is presented in Figure 9-5.

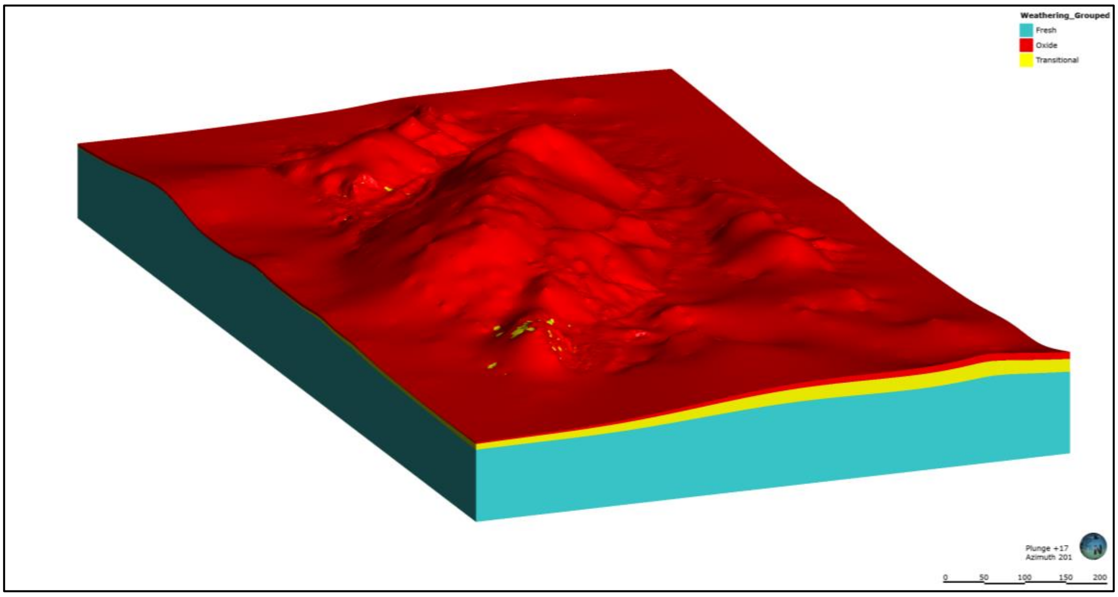


Figure 9-4: Oblique view of the weathering model clipped to the topographic surface (source: SRK 2021)

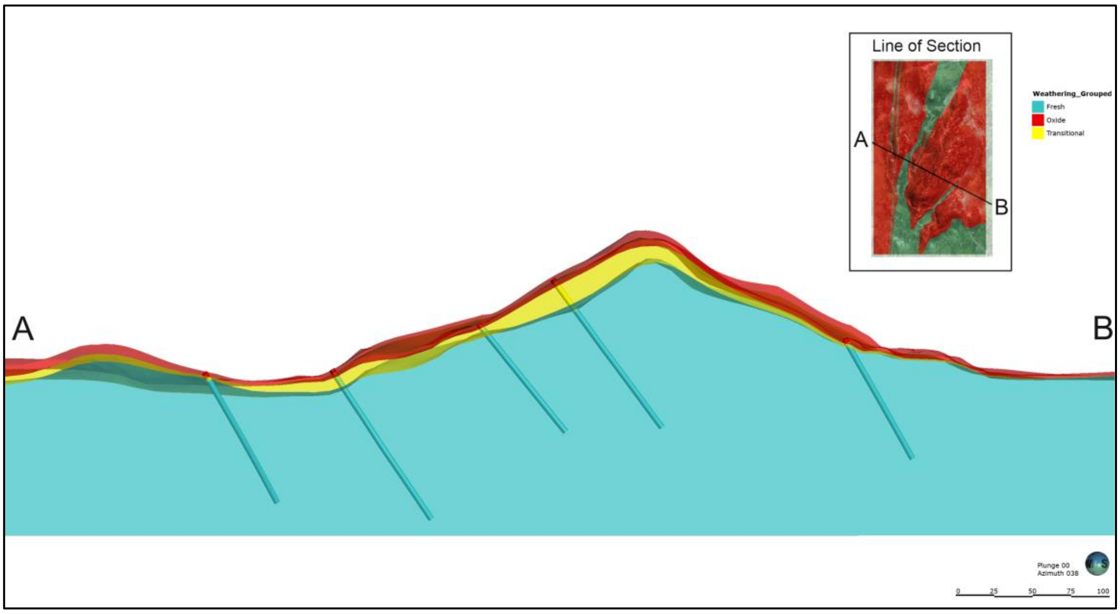


Figure 9-5: Cross section through the weathering model showing weathering logs on drillholes (source: SRK 2021)

9.2.4 Domaining

SRK interpolated a number of variables (described in Section 9.3) into the model, constrained by lithological domains. A list of the final geological model domain codes is presented in Table 9-1.

Table 9-1: Geological domain codes for estimation

Geological domain	Estimation domains
Soil	SOIL
Greywacke	GRY 1 GRY 2 GRY 3
Shale	SHL 1 SHL 2 SHL 3 SHL 4 SHL 5 SHL 6 SHL 7

9.3 Interpolation and Estimation

9.3.1 Variables Modelled

The following variables were code into the block model based on the geological models:

- Lithology.
- Weathering State.

The following variables were interpolated into the block model using the drillhole sample data:

- Unconfined Compression Strength.
- Density.

In addition Intact Rock Strength ("IRS") values were assigned to blocks based on the interpolated UCS values as this variable converts ranges of UCS values into IRS values (see description Section 8.3.2).

9.3.2 Data Conditioning

Variables were interpolated into the block model using lithological domain boundaries as hard boundaries. Prior to this SRK undertook a sample length analysis to assess the need for compositing of the density data (no compositing was applied to the UCS database as this represents point readings rather than intervals). Density testwork was typically undertaken on 10 cm full core prior to sampling for laboratory analysis. The majority of samples falling between 8 cm to 15 cm. A histogram of density sample length is presented in Figure 9-6. No compositing was applied to the density database.

SRK also undertook a capping analysis for the two interpolated variables. Raw sample values for UCS and density are presented in Figure 9-7 and Figure 9-8, respectively. SRK identified five density samples that had erroneously high density values of 3.0 or 3.5 resulting from typographic errors. These samples were removed from the database. Once the validated density dataset was used, no capping was required.

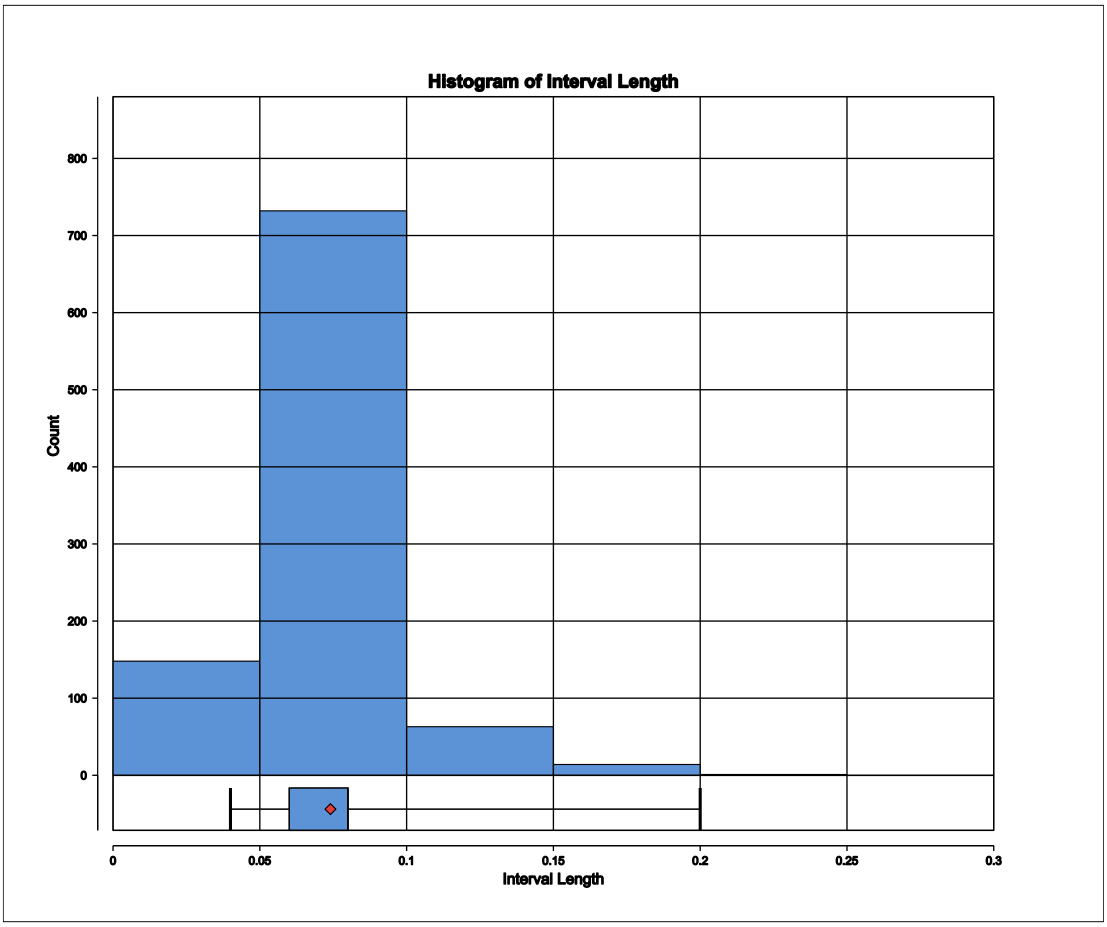


Figure 9-6: Histogram of raw density sample length

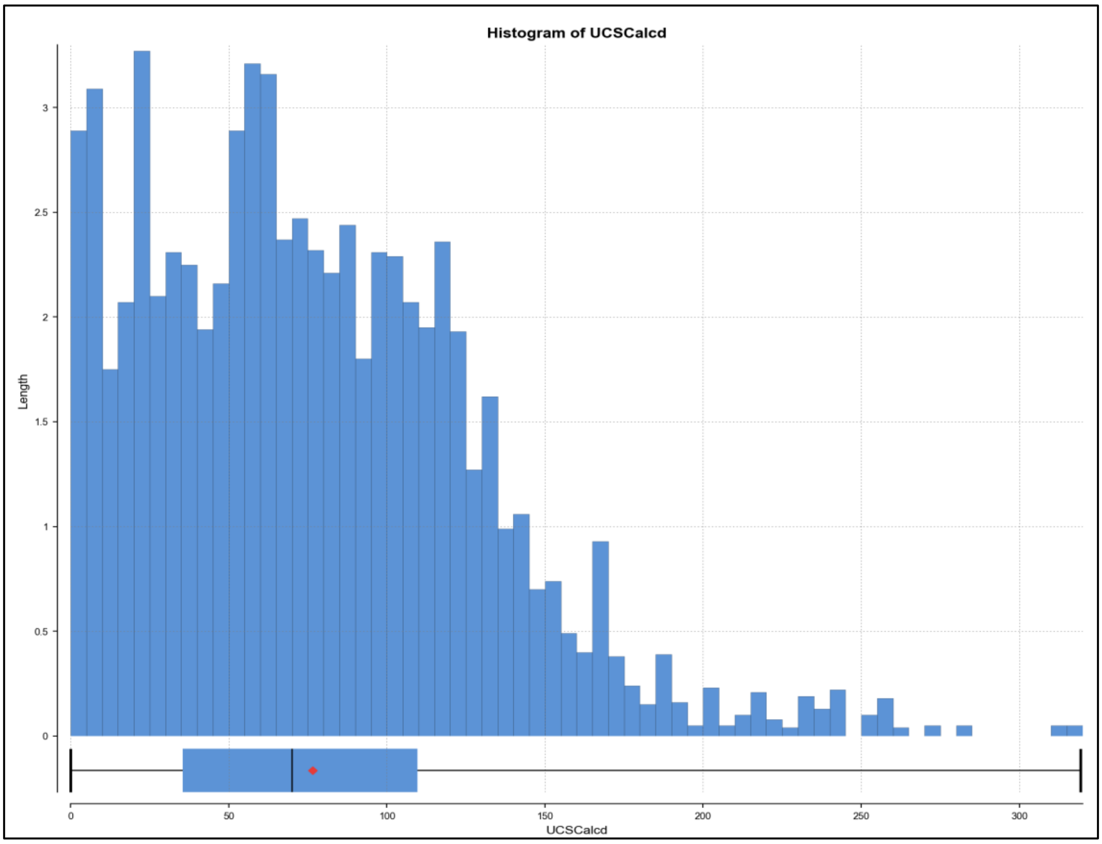


Figure 9-7: Histogram of raw UCS values

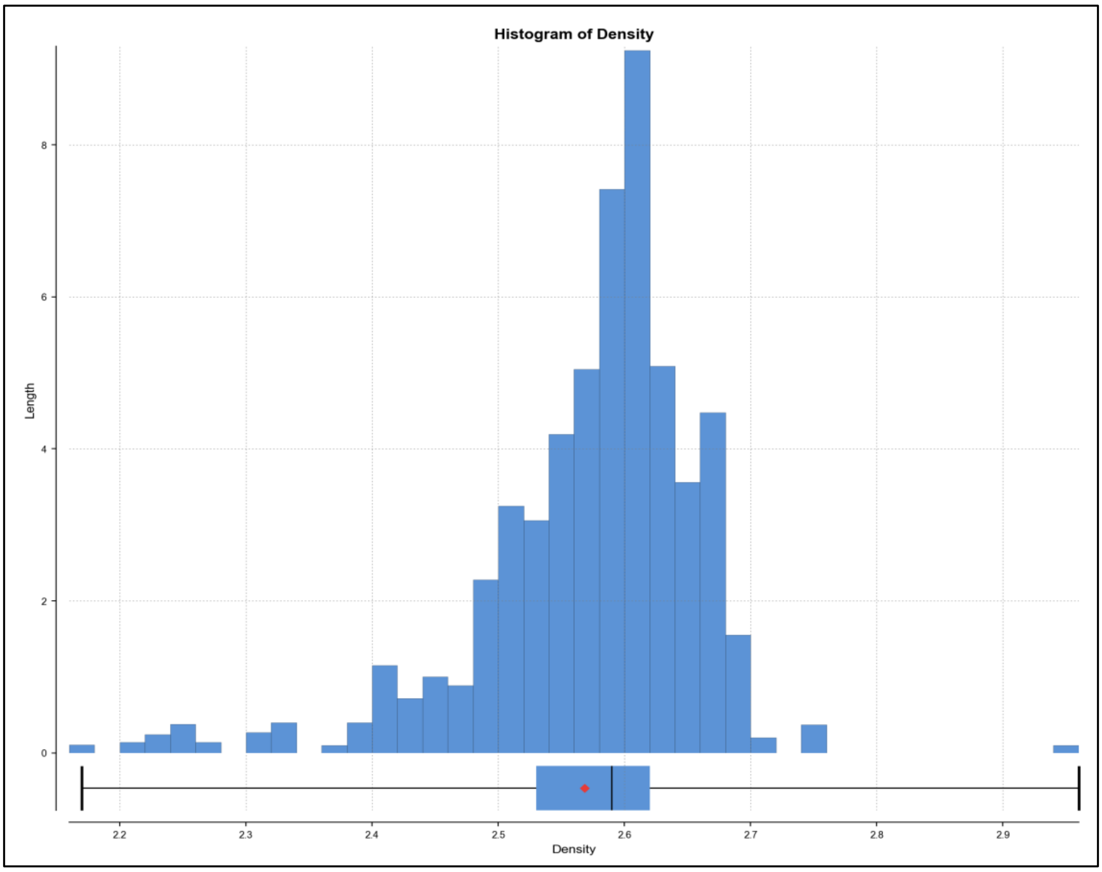


Figure 9-8: Histogram of density readings

9.3.3 Domain Statistics

Lithological domain statistics are presented in Table 9-2, showing the quantity and average values for the interpolated variables. Box plots for density and UCS, split by lithological domain, are provided in Figure 9-9 and Figure 9-10.

Table 9-2: Lithological domain statistics

Domain	Variable	Number of Samples	Mean	Coefficient of Variation
GRY 1	**UCS**	83	90.11	0.54
	Density	46	2.62	0.02
GRY 2	**UCS**	613	88.37	0.55
	Density	263	2.56	0.03
GRY 3	**UCS**	57	89.11	0.47
	Density	23	2.59	0.02
SHL 1	**UCS**	32	51.13	1.29
	Density	20	2.58	0.02
SHL 2	**UCS**	108	23.51	0.90
	Density	64	2.54	0.03
SHL 3	**UCS**	24	67.78	0.73
	Density	13	2.48	0.06
SHL 4	**UCS**	8	102.88	0.77
	Density	13	2.62	0.02
SHL 5	**UCS**	25	47.78	0.87
	Density	33	2.57	0.02
SHL 6	**UCS**	5	47.53	0.73
	Density	20	2.51	0.01
SHL 7	**UCS**	4	9.54	0.67
	Density	19	2.61	0.01

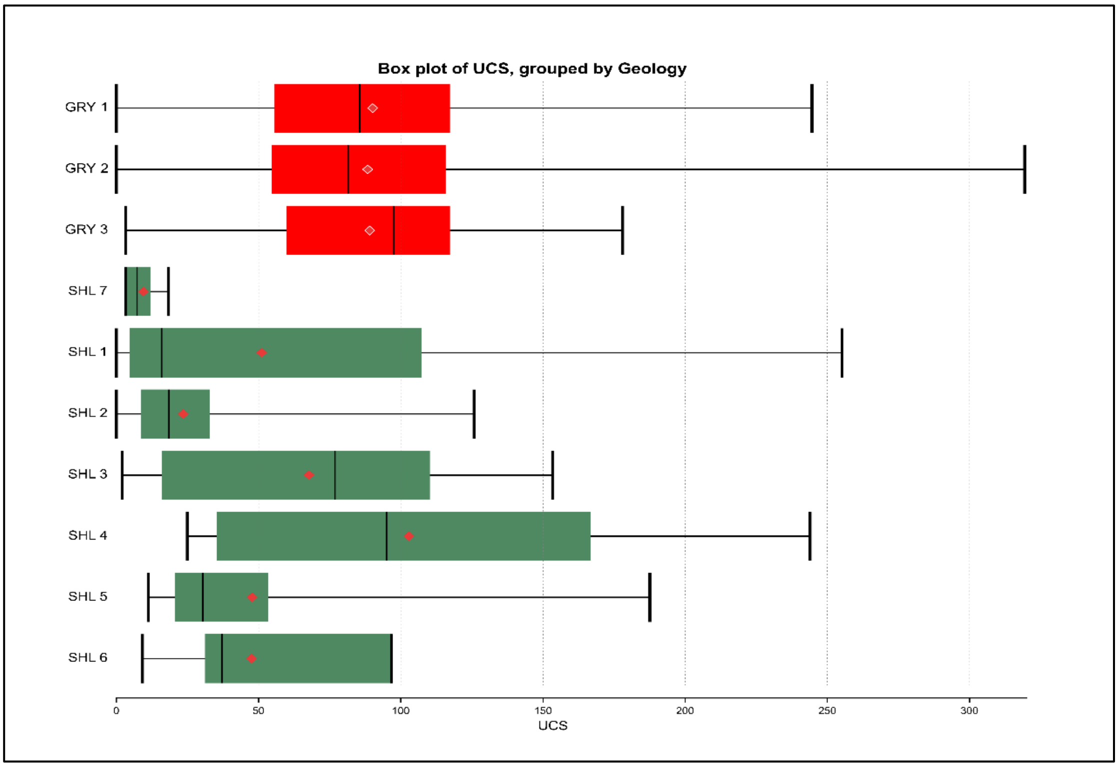


Figure 9-9: Box plot of UCS data grouped by lithological domain

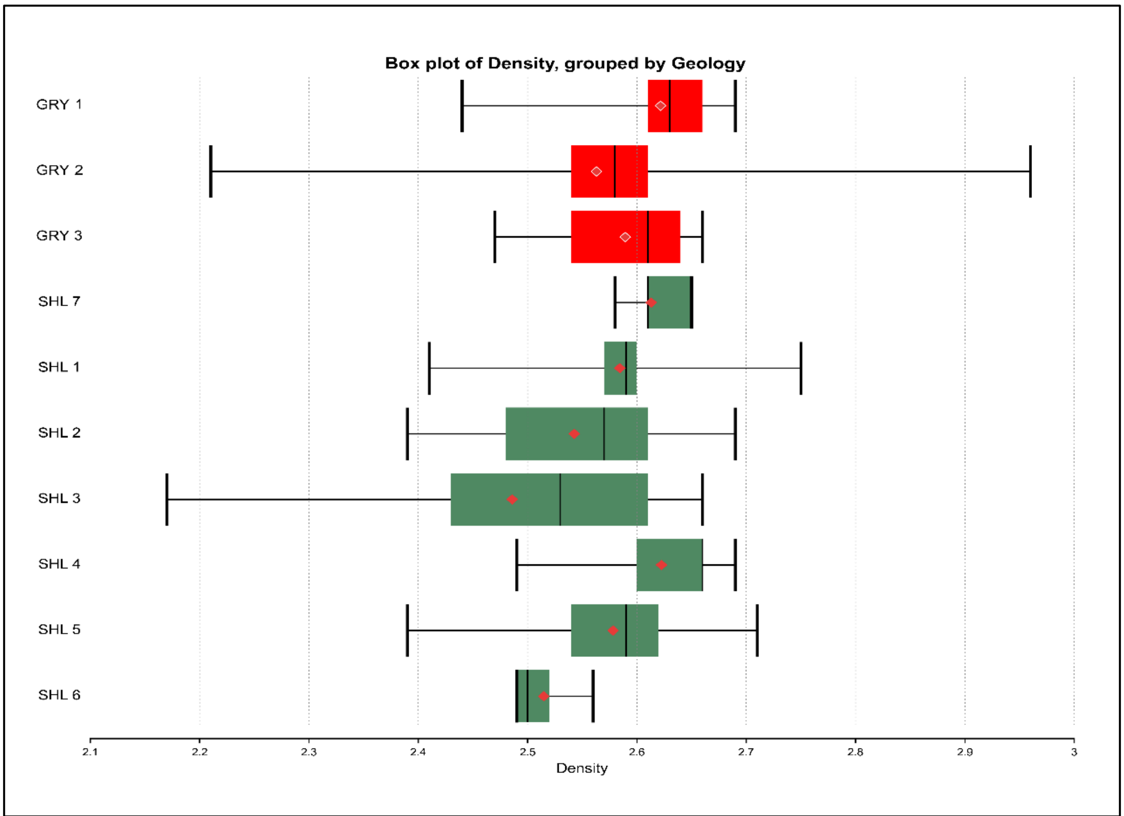


Figure 9-10: Box plot of density grouped by lithological domain

9.4 Block Model

A block model was constructed by SRK with cell dimensions of 25 m(X) by 25 m(Y) by 10 m(Z). The block size was chosen based on the drillhole spacing and results in 3-4 parent blocks between drillholes on average. The block model was sub-blocked to a minimum sub-cell size of 5 m(X) by 5 m(Y) by 5 m(Z). Estimation domain wireframes and the topographic surface were used as sub-blocking triggers. An oblique view of the block model is shown in Figure 9-11.

Although the greywacke units are open to depth, SRK has limited the block model to 50 m below the deepest drillhole intersection as beyond this depth the confidence in the geological interpretation diminishes rapidly.

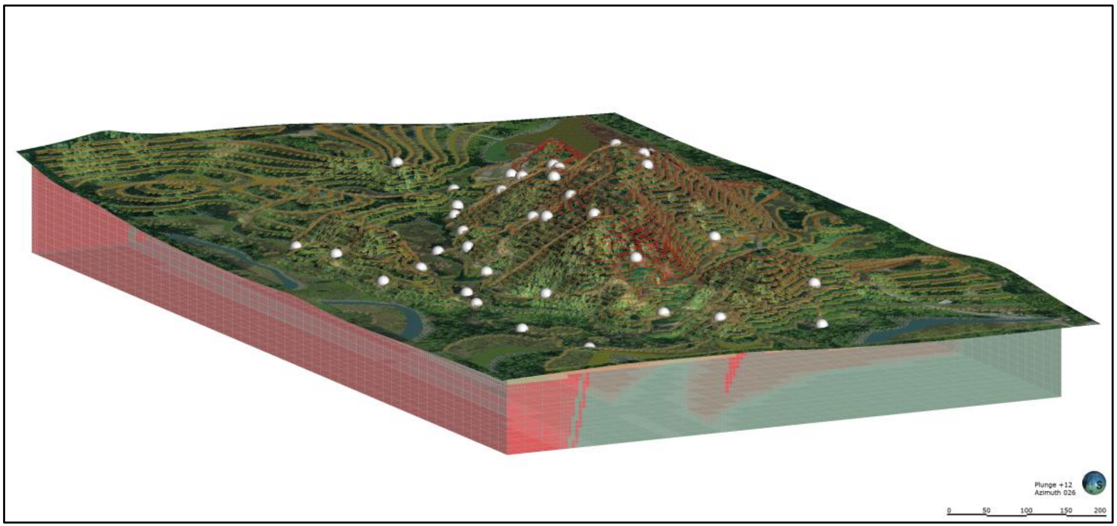


Figure 9-11: Oblique view of the topography and block model, coloured by lithology. Collars shown in white (source: SRK 2021)

9.5 Interpolation/Estimation

9.5.1 Geostatistical Analysis

Directional semi-variograms were investigated for each domain using the uncomposited density and UCS data. It was not possible to model robust variograms, although some indications suggest that approximate ranges in the vicinity of 200m exist. SRK suggests that directional semi-variograms are investigated as part of future work once more data becomes available.

9.5.2 Interpolation Parameters

Since variograms could not be modelled for the lithological domains, both density and UCS values were interpolated into the parent blocks using an Inverse Distance Weighting Squared (IDW^2) algorithm Minimum and maximum composite numbers, as well as ellipsoid ratios are presented in Table 9-3. Interpolation parameters were varied by lithological domain due to the variability of data quantity in each domain requiring some domains with limited data to have less stringent search parameters. Where possible, a maximum number of samples per drillhole limit was applied to ensure a minimum of two drillholes informed each block estimate. A large search ellipsoid was used in all domains to ensure all blocks were estimated in a single pass. This has resulted in a degree of smoothing in the estimate. A variable orientation search was applied, with the orientations of the search ellipse based on the lithological domain wireframe to align with the sub-vertical layering.

Table 9-3: Interpolation parameters by lithological domain

Domain	Variable	Search Distance			Number of Samples		Max Samples per Drillhole
		X	Y	Z	Min	Max	
GRY 1	UCS	2000	2000	1000	4	12	N/A
	Density	2000	2000	1000	4	12	N/A
GRY 2	UCS	450	450	200	8	12	4
	Density	450	450	200	8	12	4
GRY 3	UCS	450	450	200	8	12	4
	Density	450	450	200	8	12	4
SHL 1	UCS	2000	2000	1000	8	12	4
	Density	2000	2000	1000	8	12	4
SHL 2	UCS	450	450	200	8	12	4
	Density	450	450	200	8	12	4
SHL 3	UCS	450	450	200	4	12	N/A
	Density	2000	2000	1000	4	12	N/A
SHL 4	UCS	450	450	200	4	12	N/A
	Density	450	450	200	4	12	N/A
SHL 5	UCS	450	450	200	8	12	4
	Density	450	450	200	8	12	4
SHL 6	UCS	2000	2000	1000	4	12	N/A
	Density	2000	2000	1000	4	12	N/A
SHL 7	UCS	2000	2000	1000	4	12	N/A
	Density	2000	2000	1000	4	12	N/A

9.6 Validation

Validation of estimated block UCS and density values was undertaken by SRK using the following methods:

- Visual examination of the input data against the block model estimates
- Swath plots, that compare the average block values against the input data along a number of corridors in various directions through the deposit
- Comparison of the input data statistics against the block model statistics

The validation checks completed by SRK suggest that the drillhole values are well represented by the estimated block model domains, both locally and globally. Swath plots of density and UCS in the main GRY 2 estimation domain are displayed in Figure 9-12 and Figure 9-13. The mean input sample values are compared to the average block model values, by estimation domain, in Table 9-4. SRK notes that there is a large variance between the average UCS block model values and input sample values at the margin of the Z axis in the main domain GRY 2. This is due to the large search ellipse used and the limited number of samples at the margin (three in total) resulting in the estimation taking into account samples from a wider area and resulting in smoothing of the block model values.

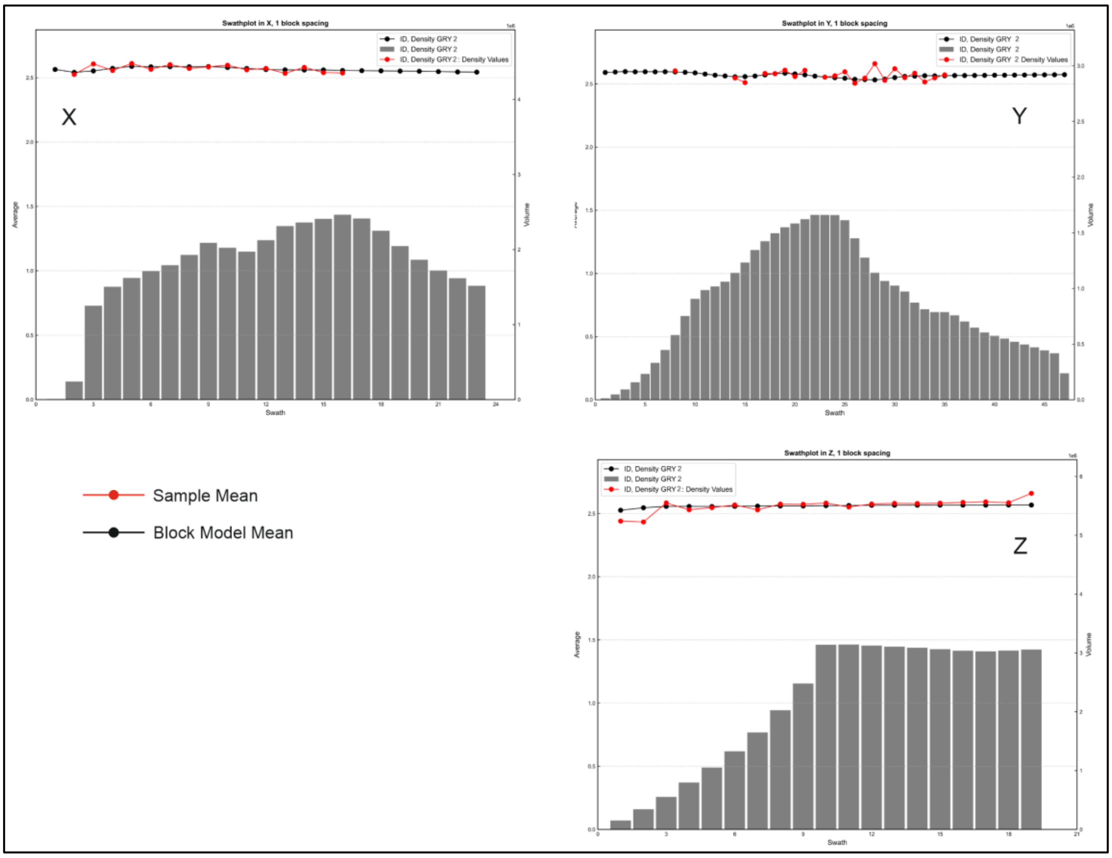


Figure 9-12: Swath plot for Density in main domain GRY 2 (source: SRK 2021)

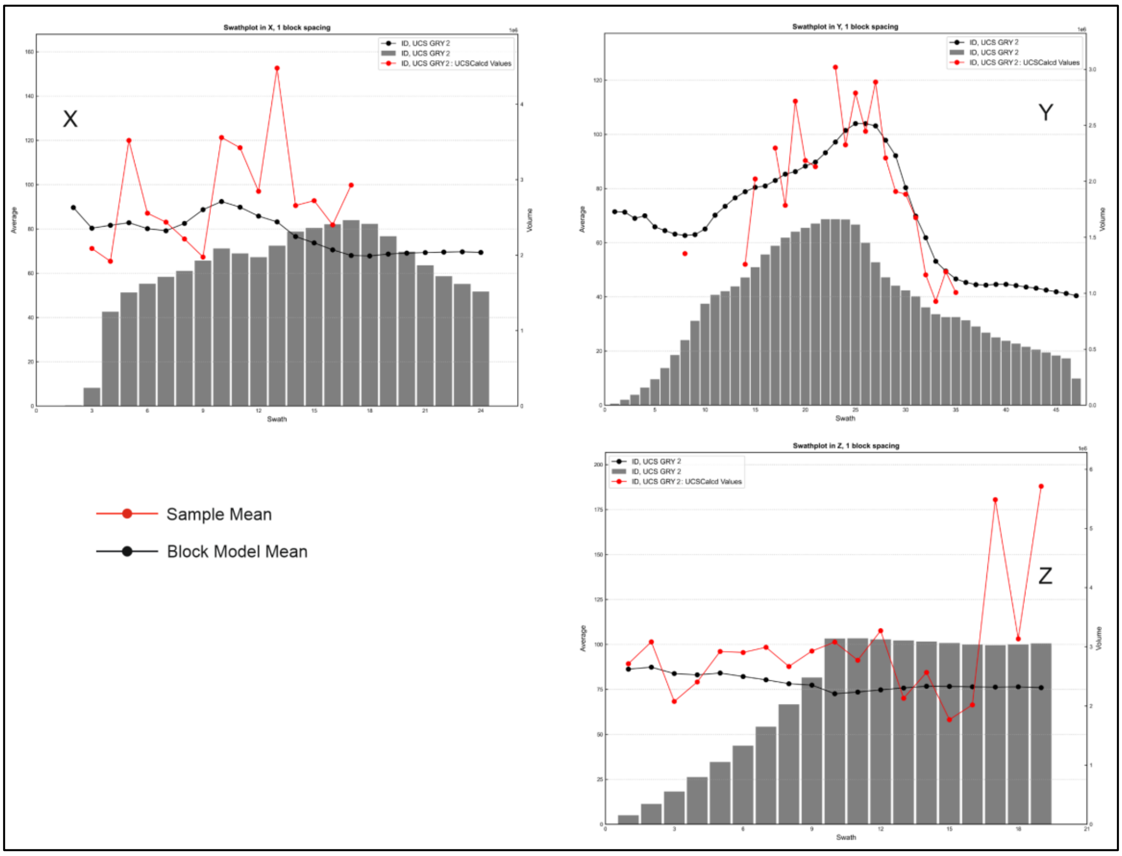


Figure 9-13: Swath plot for UCS in main domain GRY 2 (source: SRK 2021)

Table 9-4: Input sample value and block model mean value statistics

Domain	Input sample mean			Block Model mean		Percentage difference (%)	
	UCS	Density	Number of samples (UCS)	UCS	Density	UCS	Density
GRY 1	90.11	2.62	83	78.73	2.62	-13	0
GRY 2	88.37	2.56	613	76.77	2.56	-13	0
GRY 3	89.11	2.58	57	71.78	2.59	-19	0
SHL 1	51.13	2.58	32	69.23	2.59	35	0
SHL 2	23.51	2.54	108	21.06	2.56	-10	1
SHL 3	67.78	2.48	24	84.05	2.47	24	0
SHL 4	102.80	2.63	8	98.37	2.62	-4	0
SHL 5	47.78	2.57	25	71.57	2.57	50	0
SHL 6	47.53	2.51	5	60.18	2.54	27	1
SHL 7	9.54	2.61	4	10.27	2.61	8	0

Relative differences between the block model values and input data values for density are less than 1%, largely due to the very low relative variability of density readings within the separate lithologies. The block model UCS values show some variance with the raw input data, particularly within the shale domains. This is due to a combination of simplification of domains in the modelling process allowing a small number of greywacke samples within the shale domains that were not possible to domain out, as well as sampling bias within the shale domains towards taking UCS measurements in the greywacke material, as this forms the economic focus of the Project. This sampling bias can result in isolated high UCS value shale samples informing large areas of blocks. This remains an area for domaining and estimation improvement in the future as more data becomes available. As the shale domains do not form the economic driver of the project SRK does not consider this to be material to the Project. SRK has reviewed the estimation visually to assess the quality of the estimation and is satisfied that the given the constraints on domaining due to the limited spread of data at the margins of the deposit, the estimation has performed well. Oblique views of the estimated block model and input data for the main greywacke domain (GRY 2) are presented in Figure 9-14 and Figure 9-15.

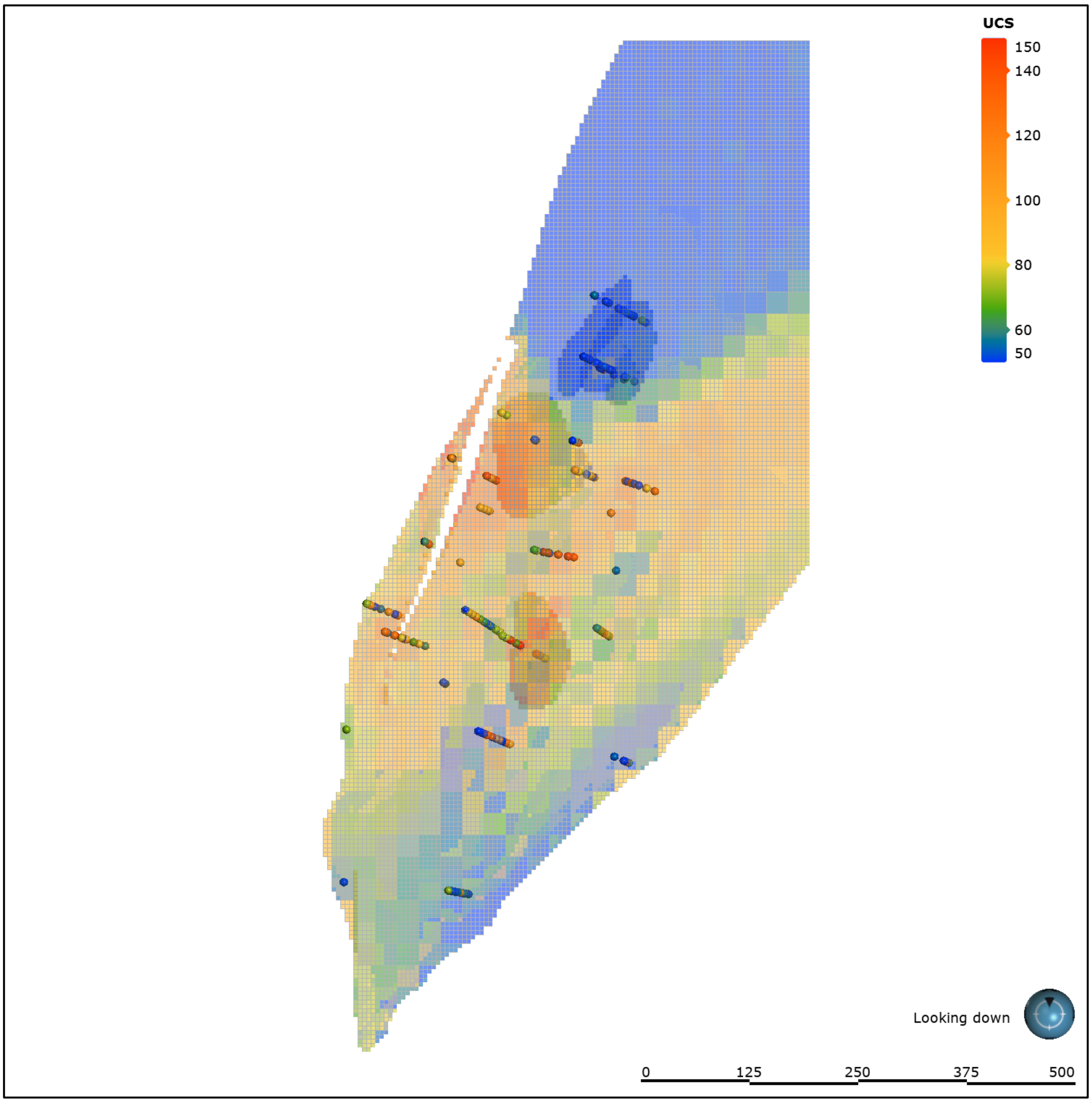


Figure 9-14: Plan view of the GRY 2 domain block model showing estimated UCS values with input data shown as points (source: SRK 2021)

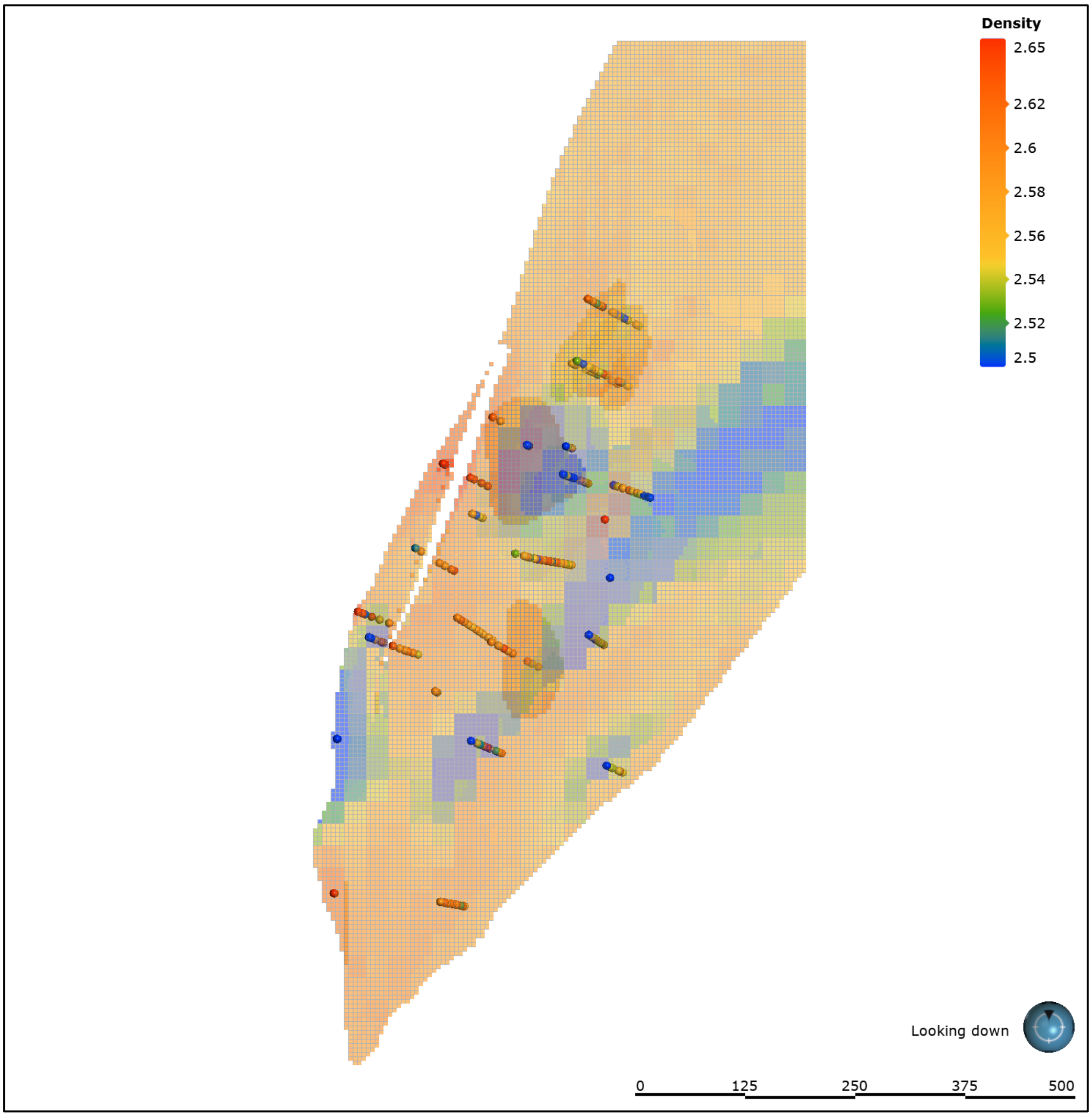


Figure 9-15: Plan view of the GRY 2 domain block model showing estimated density values with input data shown as points (source: SRK 2021)

9.7 Mineral Resource Classification

9.7.1 JORC 2012 definitions

The MRE reported here has bene classified into areas of differing confidence based on the terms and definitions as set out in the JORC Code.

The JORC Code defines a 'Mineral Resource' as a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade (or quality), and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade (or quality), continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

Inferred

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. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes.

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

Indicated

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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to assume geological and grade (or quality) continuity between points of observation where data and samples are gathered.

Measured

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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to confirm geological and grade (or quality) continuity between points of observation where data and samples are gathered.

9.7.2 JORC classification applied to KBK estimates

Introduction

To classify the KBK deposit, the following key indicators have been assessed:

- Geological complexity and the accuracy of the volumetric assessment of greywacke material, including the quality and distribution of the logging data.
- Quality of density data used in the determination of tonnages.
- Quality and quantity of data used in the determination of product quality:
  - QAQC;
  - Product pricing.
- Quality of the estimated block model for determining block density and UCS.

- Application of ”reasonable prospects for economic extraction,” for economic exploitation by applying a pit optimisation study to the model.

Geological Complexity

SRK considers the Company to have completed enough drilling to largely mitigate the risks associated with the geological understanding of the higher elevations of the primary GRY 2 domain. With depth, drilling density decreases and the quantity of logged shale intervals within the broad greywacke domain slightly increases. SRK has considered the boundary between higher and lower quantities of logged shale internal waste in the selection of the boundary between Indicated and Inferred Mineral Resources. The correlation between the area of resistant greywacke, reflected in the model, and a marked topographic high provides reasonable boundaries for the domain at surface. Outside of this area, greywacke has been intersected over large areas, corresponding with other topographic highs; however, insufficient data and understanding exists to report a Mineral Resource for these areas. As a result, only the GRY 2 domain has been considered for reporting as a Mineral Resource. SRK has specific concerns about the lack of structural data to inform the location of potential faults, as well as understand the precise dip and or deformation of geological contacts. For many classic metallic mineral projects this would be a serious limiting factor; however, given the homogenous nature of the central greywacke domain, the effect of changes to contact dip angles, or the presence of minor crosscutting faults would likely have a minimal effect on global Mineral Resource numbers.

Notwithstanding the above comments, SRK strongly recommends that a programme of systematic surface geological and structural mapping be undertaken before the next resource update to provide tighter constraints on the lithological model, future drill targeting and better understanding of the project scale geology and deformation

Quality of Density Data

A total of 473 density samples were taken by the Company. The samples show a low degree of variability when split by rock type, with the vast majority of samples falling with the 2.5 to 2.7 g/cm^3 range. While SRK has recommended that some modifications are introduced during the next stage of drilling to account for differences in hardness (fresh/unconsolidated material for example) and perhaps weathering types (notably all density measurements were completed in fresh competent core), overall SRK is satisfied with the methodology and recording of data.

Product Quality Data

‘Aggregates’ including sand, gravel and crushed rock, are three very important materials within the industrial minerals group. Natural aggregates (crushed stone, sand and gravel) are among the most abundant natural resources and they provide a major basic raw material used in construction, agriculture, and other industries employing complex chemical and metallurgical processes. Aggregates are low in cost and are a major contributor to economies across the globe.

According to the testwork completed to date, the aggregate material in the Project area is suitable for more than one potential product a full description of which is provided in Section 8, specifically Table 8-1. The MRE has included only the crushed rock and amourstone intermediate products (see Section 8.2) as a basis for this assessment.

Quality of the Estimated Model for determining block density and UCS

The estimation of density and UCS data has been constrained within lithological domains and the quality of the estimation, gauged visually and through comparison between the input sample grades and the block model grades, appears to be sufficient for the classification of Mineral Resources. Although the estimation of UCS data into the block model has shown some poor results at the margins of the deposit, validation of the model within the portions included in the MRE show a good comparison between the input and estimated UCS data. SRK is therefore confident in the quality of the block model estimations of density and UCS for reporting Mineral Resources.

Application of an optimal pit

In order to determine the quantities of material offering “reasonable prospects for economic extraction”, according to JORC requirements, by open pit mining methods, SRK used reasonable mining and processing assumptions, with averaged prices for six product alternatives being applied to local and export product types as determined by a combination of metallurgical testwork and the Company’s offtake proposals or memorandum’s of understanding (“MOU”) to evaluate the proportions of the block model (either Indicated and Inferred blocks) that could “reasonably be expected” to be mined. All material has been assumed to correspond with a beneficiable (crushable) material that would generate a product suitable for sale, as determined in the preliminary testwork.

The reader is cautioned that the results from this evaluation are used solely for the purpose of testing the “reasonable prospects for economic extraction” by a conceptual mining scenario and do not represent an attempt to estimate or report mineral reserves.

The following additional constraints were considered as part of the pit optimisation for constraining the Mineral Resource.

- The requirement for an exit north ramp from the pit as a direct link to the Hub area;
- The application of a 20m buffer zone around the public road which is situated in the north of the permit; and
- The following geotechnical parameters:
    - Berm width: 7 m.
    - Bench height: 10 m.
    - Bench angle: 80°.
    - Overall Slope Angle: 45°.

The optimisation assumptions applied when creating the pit shells for estimation purposes are as summarised in Table 9-5.

Table 9-5: Assumed Optimisation Parameters

Parameters	Units		
Geotechnical OSA			
Footwall	(Deg)	45	
Hanging wall	(Deg)	45	
Mining Factors			
Dilution	(%)	0.0	
Recovery	(%)	100.0	Assumed
Processing			
Recovery	(%)	99.0	Assumed
Operating Costs			Client data
Mining Cost (Armour)	(US$/tore)	8.00	
Mining Cost (Crushed Aggregates)	(US$/tore)	5.00	
Processing	(US$/tprod)	1.00	
Infrastructure	(US$/tprod)	1.45	(1)
Export & Logistics	(US$/tprod)	3.87	(2)
G&A	(US$/tprod)	0.50	
Other Fees	(US$/tprod)	0.44	(3)
Royalty	%	0.10	
Selling Cost			
Crushed Aggregates Local Sales	(US$/tprod)	2.60	
Armour Local Sales	(US$/tprod)	3.17	
Crushed Aggregates Export Sales	(US$/tprod)	3.12	
Aggregate Rock Prices			Client data
Local Sales	(US$/t)	**25.99**	
0-5mm (Dust)	(US$/t)	5.63	
5-10mm	(US$/t)	27.11	
10-20mm	(US$/t)	27.11	
20-30mm	(US$/t)	27.11	
30-50mm	(US$/t)	26.40	
Armour Local Sales	(US$/t)	**31.69**	
Armour Stone	(US$/t)	31.69	
Export Sales	(US$/t)	**31.18**	
0-5mm (Dust)	(US$/t)	6.76	
5-10mm	(US$/t)	32.53	
10-20mm	(US$/t)	32.53	
20-30mm	(US$/t)	32.53	
30-50mm	(US$/t)	31.68	
Other			
Discount Rate	(%)	10	
Total operating cost			
Marginal Local Crushed Aggregates	(US$/$t_{ore}$)	8.39	
Marginal Export Crushed Aggregates	(US$/$t_{ore}$)	12.26	
Marginal Local Amourstone	(US$/$t_{ore}$)	10.39	
Margin			
Marginal Local Crushed Aggregates	(US$/$t_{ore}$)	15.00	
Marginal Export Crushed Aggregates	(US$/$t_{ore}$)	15.81	
Marginal Local Amourstone	(US$/$t_{ore}$)	18.13	

Notes to Table:
(1) Accommodation camp, Facilities & Utilities, Stockpiles Operation, Medical, Security, Retail Hub
(2) Conveyor line rental, Haulage, Barging & Transhipment, Port
(3) Land Development Fund, Surfaces fees, exploration, ESG

Classification

SRK has taken into consideration all the factors described in this section of the report and has reported Indicated and Inferred resources within the most heavily drilled GRY 2 section of the deposit area. The boundary between Indicated and Inferred resources reflects the boundary between diminishing drilling quantity and increasing quantity of logged shale intervals within the greywacke domain. SRK has also restricted the Indicated portion of the deposit to within the area of the topographic high associated with the more resistant greywacke lithology. An oblique view of the final classified block model unconfined to the optimised pit shell or the permit (IUP) is presented in Figure 9-16.

A plan map showing the location of the GRY 2 domain is presented in Figure 9-17.

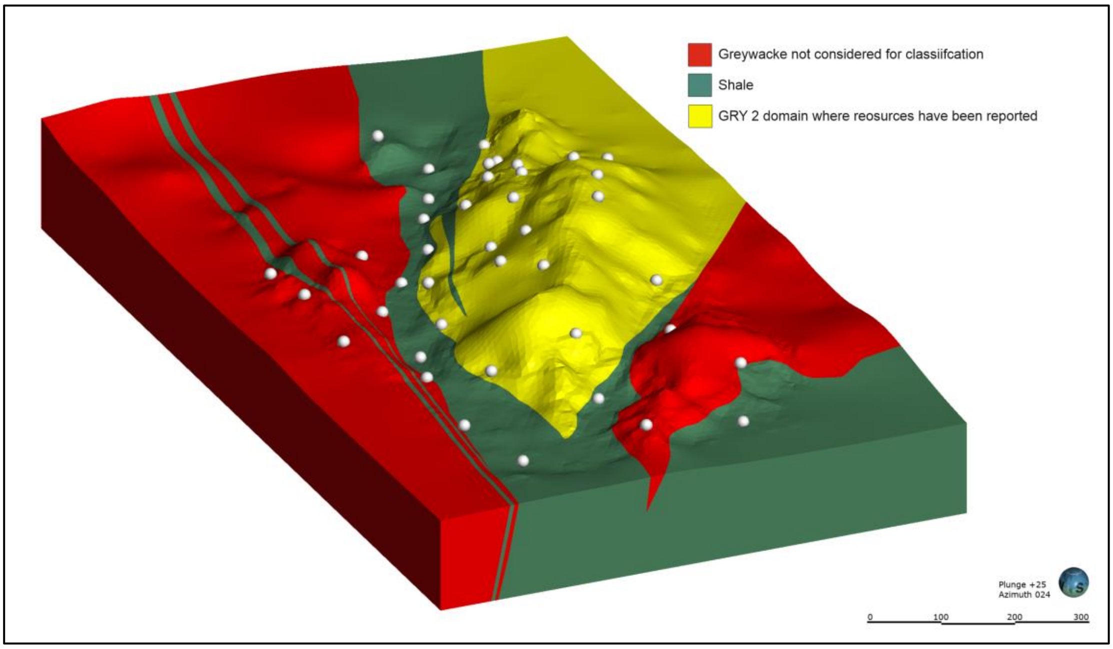


Figure 9-16: Lithological model showing the location of the GRY 2 lithological domain that has been considered for the classification of Mineral Resources (drillhole collars shown as white points)

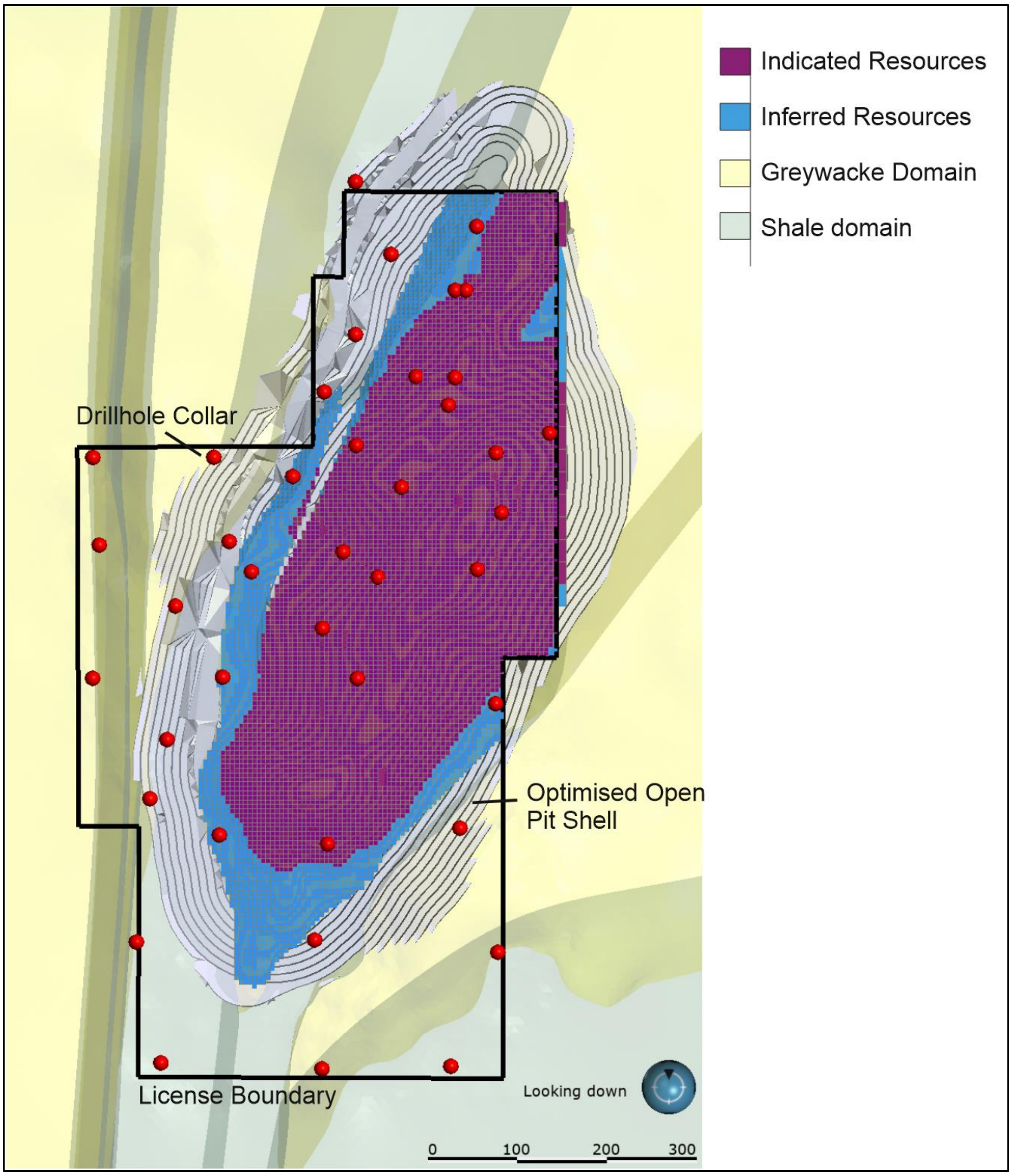


Figure 9-17: Plan map showing the classified block model showing Indicated (purple) and Inferred (blue) portions of the GRY 2 domain as well as drillhole collars as red points confined within the current IUP (mining permit) and restricted to the optimised pit shell with a northern exit ramp showing

Figure 9-18 presents an oblique view of the optimised pit shell and the containing classified resource block model restricted by the mining permit (IUP). Also showing is the Indicated Resources blocks in purple and Inferred resources blocks in blue.

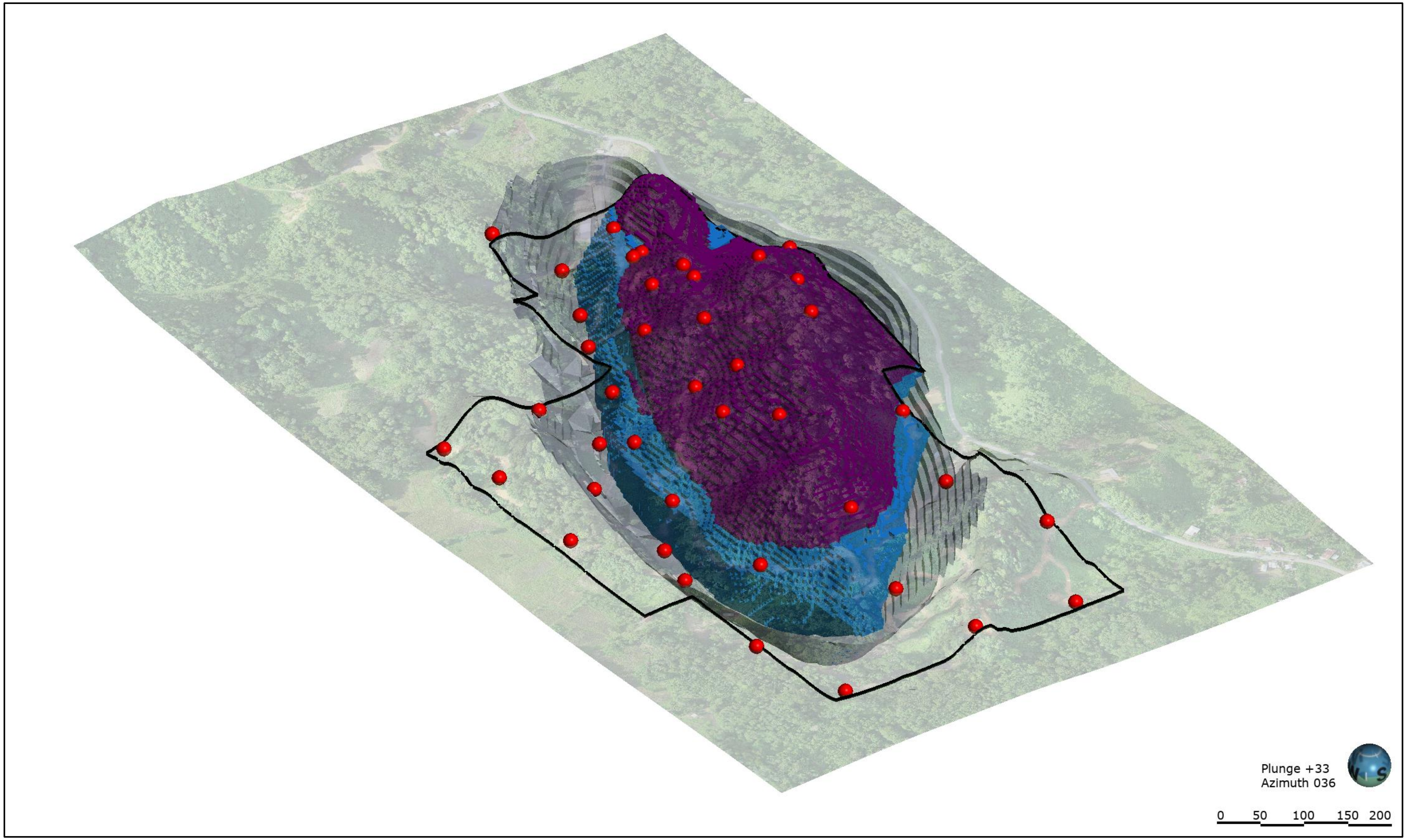


Figure 9-18: Optimised pit shell containing classified resource model, showing Indicated Resources in purple and Inferred resources in blue (Source: SRK)

9.8 Mineral Resource Adjustments

9.8.1 Internal Waste

The KBK deposit exists within a sequence of Greywacke and Shale units that dip steeply to the west. Although these units can be domained into broad packages of either shale or greywacke, within the greywacke target unit a number of discontinuous shale interbeds exist that do not have enough continuity to be separately modelled with the current drilling density. While, as commented earlier in this report, these have been estimated to comprise some 12% of the GRY 2 domain in total they are less prevalent in the area of this that comprises the reported mineral resource where some 135m of the 1,919 m of drilling (i.e. 7%) has been logged as shale.

Further, the shale bands are unevenly distributed within the GRY 2 unit, with more shale bands intersected at depth. This has been taken into consideration during the classification of Mineral Resources, where the boundary between Indicated and Inferred resources has been drawn at the transition between higher and lower quantities of logged shale.

As a result, in order to quantify the expected quantity of internal waste within the classified greywacke portion of the deposit, SRK has reduced the reported tonnages of greywacke material by the proportion of logged waste shale within the Indicated and Inferred portions of the deposit. This results in a reduction of ore tonnes in the Indicated resource of 4% and 10% within the Inferred resource. SRK considers this approach to allow a high-level estimation of the quantity of internal waste expected during mining to be appropriate for the level of the study conducted.

9.8.2 Permit Boundary

The target greywacke lithology extends to, and likely beyond the permit boundary of the KBK Project. The area surrounding the current permit is under application by the Client, with approval expected in Q4 2021. SRK has therefore allowed the pit optimisation to extend beyond the boundaries of the permit but has limited the reported resources to within the permit boundary. SRK considers that limiting the optimised pit to the boundary of the current permit would unduly penalise the project as potential avenues for acquiring the mineral resource rights to the adjacent licenses exist and are currently being pursued by the client. A plan view of the larger area model and the clipped model for Mineral Resource reporting is presented in Figure 9-19.

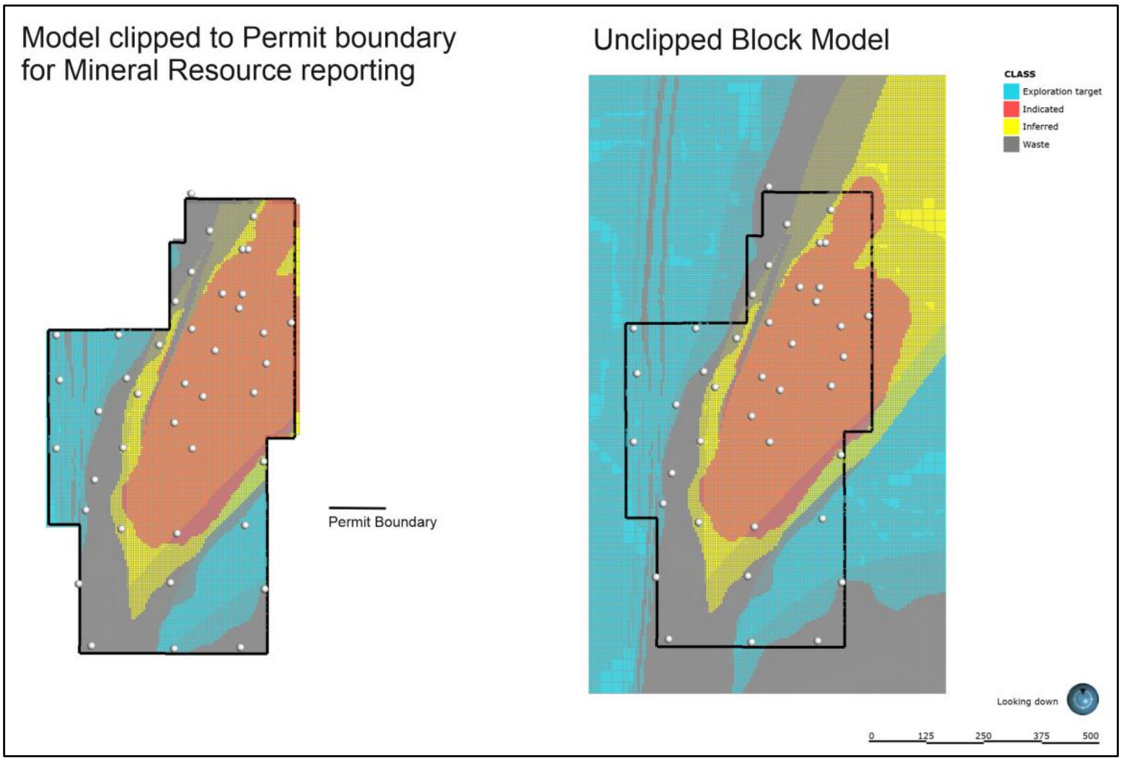


Figure 9-19: Larger area model used for pit optimisation and model clipped to permit boundary for Mineral Resource reporting purposes

9.9 Mineral Resource Statement

SRK's Mineral Resource Statement only comprises material that satisfies the following criteria:-

- Has been classified as Inferred or Indicated;
- falls within the optimised used to limit the mineral resource to material with reasonable prospects of eventual economic exploitation;
- falls within the current permit boundary; and
- is within the main modelled greywacke domain.

In total, the Project has an Indicated greywacke tonnage of 20.89 Mt and an Inferred greywacke tonnage of 51.03 Mt. The final Mineral Resource Statement is shown in Table 9-6.

This technical report has been prepared under the direction of Mr Peter Gleeson, as defined in the JORC Code, who assume overall responsibility for the MRE and report. The JORC Consent Form and Certificate for Peter Gleeson is attached at Appendix F to this report.

Table 9-6: Mineral Resource Statement for greywacke material reported within an optimised pit shell and restricted to the current mining permit (IUP OP), as 30 September 2021

	Volume	Average Density	Tonnes	Water Absorption	Average UCS	LAA (500X)	LAA (100X)	Total Sulphur	MgO	Fe2O3	SiO2	Al2O3
	m3	kg/m3	(Mt)	%	Mpa	%	%	%	%	%	%	%
Indicated	8,159,000	2.56	20.9	2.48	83.76	30.20	6.23	0.10	2.50	5.02	65.37	11.92
Inferred	19,819,000	2.57	51.0	2.48	85.74	30.20	6.23	0.10	2.50	5.02	65.37	11.92
Total (Ind + Inf)	**27,978,000**	**2.57**	**71.9**	**2.48**	**85.16**	**30.20**	**6.23**	**0.10**	**2.50**	**5.02**	**65.37**	**11.92**

Notes to table:

1. The tonnages and grades presented herein are reported on a dry basis.

2. SRK has applied a reduction in tonnage of 4% to indicated material and 10% to Inferred material to account for the anticipated tonnages of internal waste that have not been possible to resolve with 3D modelling.

3. All figures have been rounded to reflect the relative accuracy of the estimates.

4. Mineral Resources are not Ore Reserves and do not have demonstrated economic viability.

5. Optimised pit has included the following parameters for the KBK base case as follows: Production Rate – crushed rock aggregate and amourstone production of 4.5 Mtpa, Geotechnical: Footwall (Deg) 45, Hanging wall (Deg) 45, Mining Factors: Dilution (%) 0.0, Recovery (%) 100.0, Processing: Recovery (%) 99.0, Operating Costs: Mining Cost (Armour) (USD/tore) 8.00, (USD/trock) 8.00, Mining Cost (Crushed Aggregates) (USD/tore) 5.00, (USD/trock) 5.00, Haulage(USD/t) Reference Level; (Z Elevation) 0, , Processing (USD/tprod) 1.00, Infrastructure (USD/tprod) 1.45, Export & Logistics (USD/tprod) 3.87, G&A (USD/tprod) 0.50, Other Fees (USD/tprod) 0.44, Royalty % 0.10, Crushed aggregates Local Sales (USD/tprod) 2.60, Armour Local Sales (USD/tprod) 3.17, Crushed aggregates Export Sales (USD/tprod) 3.12, Selling Cost: Crushed Aggregates Local Sales (USD/tprod) 2.60, Armour Local Sales (USD/tprod) 3.17, Crushed Aggregates Export Sales (USD/tprod) 3.12, Aggregate Rock Prices: Local Sales (USD/t) 25.99, 0-5mm (Dust) (USD/t) 5.63, 5-10mm (USD/t) 27.11, 10-20mm (USD/t) 27.11, 20-30mm (USD/t) 27.11, 30-50mm (USD/t) 26.40, Armour Local Sales (USD/t) 31.69, Armour Stone (USD/t) 31.69, Export Sales (USD/t) 31.18, 0-5mm (Dust) (USD/t) 6.76, 5-10mm (USD/t) 32.53, 10-20mm (USD/t) 32.53, 20-30mm (USD/t) 32.53, 30-50mm (USD/t) 31.68, Discount Rate (%); 10, Total operating cost: Marginal Local Crushed Aggregates (USD/tore) 8.39, Marginal Export Crushed Aggregates (USD/tore) 12.26, Marginal Local Armour (USD/tore) 10.39, Marginal Local Crushed Aggregates (USD/tore) 15.00, Marginal Export Crushed Aggregates (USD/tore) 15.81, Marginal Local Armour; (USD/tore) 18.13.

9.10 Adjacent Properties

Clause 4 of the JORC Code (Materiality) obliges the Competent Person(s) to understand and report on the potential impact of abstraction at adjacent properties.

The nearest such property, Indo Batu Tiga (IB3), is majority own by PMI who also is a majority (60%) owner of PT KBK.

IB3 is a 5,000 hectare aggregate target and the current tenement holding is a Mining Exploration Permit (IUP). The property is majority (60%) owned by PMI who is also a majority owner of the KBK jetty. The Company has plans of carrying out a drilling programme in early 2022. IB3 contains the same general geological stratigraphy as KBK.

Most importantly, the IB3 property is directly adjacent to the KBK asset, and there are likely synergies in respect to infrastructure sharing, that both IB3 and KBK properties could mutually benefit from. Infrastructure sharing including (but not limited to): water supply and hydro management facilities, access roads, crushing facilities, stockpile handling and carriage ways, port and jetties, and power installations.

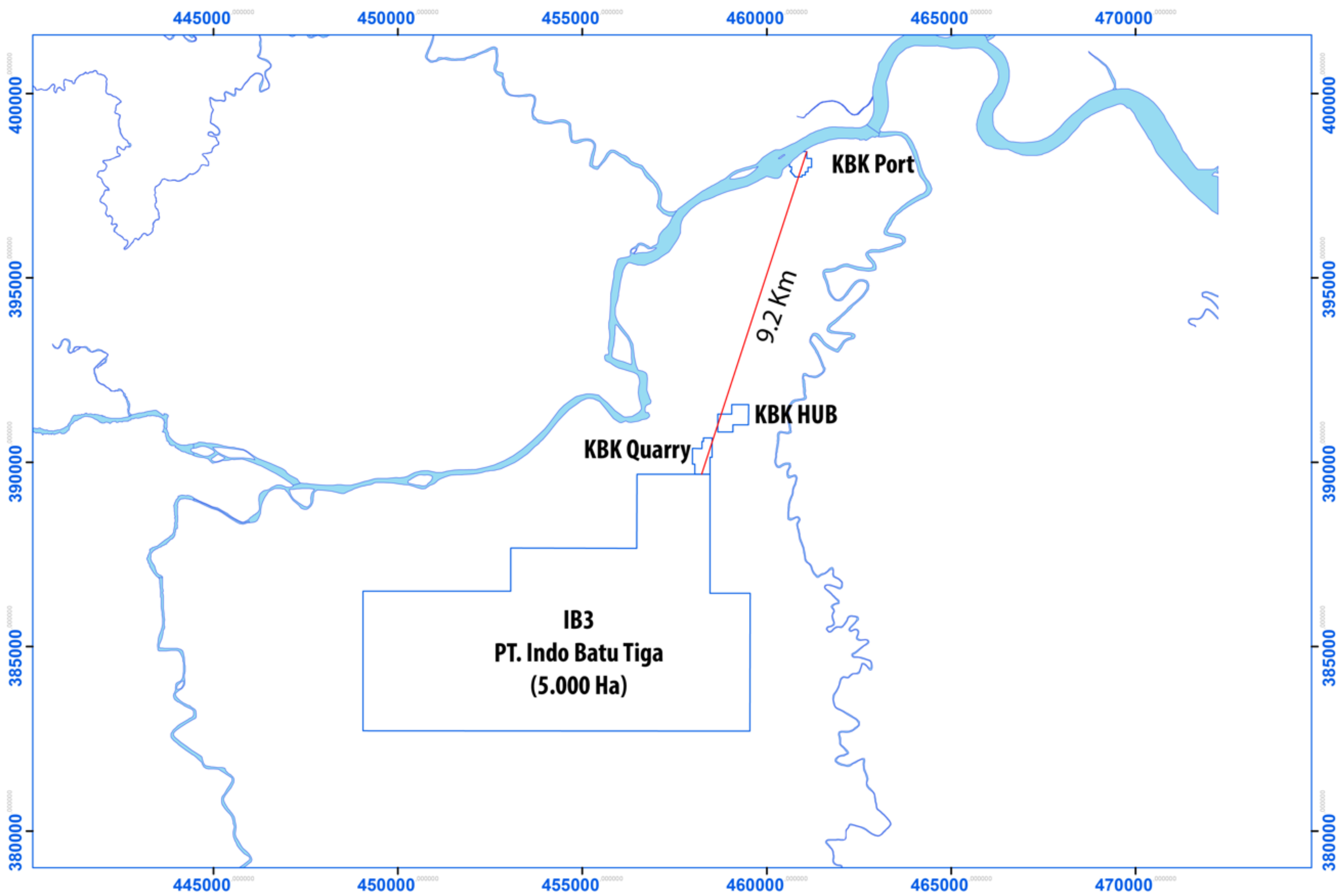


Figure 9-20: Map showing IB3 (approximately 5,000 hectares) property adjoining KBK (40 hectares) (source: PT KBK , Sept 2021)

9.11 Nearby Operating Mines

9.11.1 Introduction

Currently, there are no existing ‘nearby’ mining operations. However, there are four main coal mining companies operating in the local region and these have associated infrastructure which could be beneficial to the Company. These are:

- “AMNK” - PT Arta Marth Naha Kramo
- “BDMS” - PT Bara Dinamika Muda Sukses
- “KPUC” - PT Kayan Putra Utama Coal
- “MBA “ - PT Mitra Bara Adiperdana Tbk

9.11.2 PT. Atha Marth Naha Kramo (AMNK)

AMNK is a Coal Mining Company established on December 28, 2009. The company shares are owned by PT. STM Tunggal Jaya Indonesia (99%), and Mr. KIM SUNG HYUNG (1%). AMNK holds a Coal Mining Permit with area of 3,873 hectares in Malinau, with coal calories ranging from 5,100GAR to 6,100GAR (Medium Calories), with a total reserved of approximately 80 million tons. The operation is approximately 50 kilometres from KBK.

9.11.3 PT. Bara Dinamika Mudasukses (BDMS)

Established in 1989, BDMS was granted an Exploration Mining Permit in 1993 and an extension of the Production Operation Mining Business Permit (IUP) in 2017. BDMS is known for its integrated infrastructure for upstream to downstream exploration activities. MBA is the majority shareholder of BDMS with more than 99.99% share ownership. BDMS holds a Coal Mining Permit with an area of 1,030 hectares in Malinau. The operation is approximately 50 kilometres from KBK.

9.11.4 PT. Kayan Putra Utama Coal (KPUC)

KPUC is a thermal coal mine located in the Malinau regency. The mine's exploration license was approved in 2004 and forms part of a privately owned KPP Group. The mine sells most of its coal to Korea, with smaller volumes exported to Japan, Taiwan, Malaysia and India. KPUC ships its coal through the Samarinda and Tarakan ports. KPUC holds a Coal Mining Permit with an area of 4,989 hectares in Malinau. The operation is approximately 50 kilometres from KBK.

9.11.5 PT. Mitra Bara Adiperdana Tbk (MBA)

MBA is a Publicly listed coal mining company currently trading on the Indonesia Stock Exchange. MBA holds a Coal Mining Permit with an area of 1,930 hectares in Malinau. The Company is part of the Baramulti Group, an integrated and world-class energy company. MBA has several subsidiaries, such as PT Baradinamika Muda Sukses, PT ENGIE Cipta Tenaga Surya, PT Malinau Hijau Lestari, PT Duta Bara Utama, PT Mitra Malinau Energi, and PT Mitra Muda Makmur. The operation is approximately 50 kilometres from KBK.

SRK understands that the mining areas are located circa 55 km south of the River Sesayap and coal is mined by open pit methods. The coal is then transported by road, using trucks with a capacity of up to 30 t on purpose built haul roads (see Figure 9-21). Coal is directly transported to one of three river jetties on the River Sesayap or River Bengalun, or via KPUC intermediate stockpile located at N4160455, E392069. Further information on the River Jetties is provided below.

Figure 9-21: Mining haul road in Malinau region [source: SRK, photo taken 20 March 2018]

10 EXPLORATION TARGET

In order to help the Company assess the remaining potential of the deposit area, SRK has derived an Exploration Target for the KBK Project to account for modelled greywacke material that falls within the model, but outside of the optimised open pit and the reported Mineral Resource.

The Exploration Target comprises greywacke within the GRY 2 domain that hosts the reported Mineral Resource but which falls outside of the optimised pit used to constrain this as well as greywacke in the GRY 1 and GRY 3 domains. In all cases though this occurs within the current license boundary.

Further, while SRK has provided a range of tonnages to reflect the uncertainty in the estimation of accurate tonnages, it is not possible to estimate a range of product properties for the material due to an absence of testing. SRK has therefore assumed that product characteristics in the Exploration Target will be in line with those in the classified portion of the deposit, due to the homogeneity of the rock mass and until proven otherwise.

SRK's Exploration Target derived as above is 50 Mt to 80 Mt. It should be noted that this estimate is conceptual in nature, that there has been insufficient exploration of this material to estimate a Mineral Resource and that it is uncertain if further exploration of this will result in the estimation of a Mineral Resource.

11 RISKS AND OPPORTUNITIES

11.1 Risks

The structural geology of the deposit is still relatively poorly understood. No systematic geological mapping has been undertaken at the site and this remains a significant project risk. Although an attempt has been made to collect orientated core to allow downhole structural measurements to be taken, the output of this work was is not reliable due to poor data collection practices. Although the Company made significant investment in ensuring good training was provided to drilling contractors and contracted geologists in 2019, and 2021, this intervention has not yielded a positive result in terms of provided more detailed understanding of the structure of the deposit. In this regard, a better understanding of the deposit structural geology remains a key focus of the future planned work for the project requiring detailed deposit scale mapping and correctly orientated drillcore to be acquired.

Topographic dip slopes, as well as interpreted geometries from drillcore suggest a moderate to steep westerly dip to the sediments. Due to the current wide spaced drilling pattern, the geometry and extent of internal waste packages within the main greywacke unit is still poorly understood. Further planned drilling and collection of robust downhole orientation data will work towards resolving this.

Geotechnical engineering data will be required to move the project to the next phase of development. At this stage, there is not enough geotechnical data or supporting information to inform a detailed mining study. Coupled with an improvement in orientated core (mentioned above) the project would benefit from a dedicated geotechnical assessment in the next phase of study to inform a mine / pit geotechnical programme. SRK recommends as part of the next phase of drilling a geotechnical drilling programme including logging which would involve the following stages:

1. Geotechnical interval log (run-by-run) using the Bieniawski 1989 Rock Mass Rating (RMR89).
2. Discontinuity measurements for all structures.
3. ATV/OTV logging.
4. PLT Testing.
5. Laboratory sample selection.

11.2 Opportunities

The Exploration Target described in Section 10 presents as a good opportunity to increase the volume / tonnes of current Mineral Resource to potentially double the current size. This would create significant upside in terms of the overall economics of the Project and also provide the Company with other production options should this increase be realised and should the Company wish to proceed with developing the asset. SRK believes that minimal drilling in the less geologically confident areas could easily determine the extent of this material.

In additional to the above, the Company's owner has recently acquired the rights to an adjoining aggregate WIUP exploration permit. The Company geologists advise that the geology and ground conditions of IB3 (see Section 9.10) appears very similar to that of KBK; however, the size of the permit is approximately 400 ha, compared to 40 ha at KBK. Should the work conducted at KBK be replicated following on from infill drilling recommended for KBK, the synergies of the two properties could be mutually beneficial in terms of technical assessment and criteria, and the potential shared infrastructure opportunities given the locations of the two assets.

Following the reporting of the Mineral Resource herein, the Company could benefit from conducting a Scoping Level technical study in order to assess the viability of the property in respect of the Mineral Resource and including other relevant technical areas, such as; Mining, Geotechnical, Hydrology and Hydrogeology, Processing, Environmental and Social Governance ("ESG"), Marketing and Supply and Demand, Infrastructure and Transportation, Economics.

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

The primary aim of this report was to prepare a Mineral Resource Estimate for the Project, using all available and valid data. SRK believes the aim has been achieved and that the Project has met the original objectives.

It is the opinion of SRK that the quantity and quality of available data is sufficient to generate Indicated and Inferred Mineral Resources at KBK and that the Mineral Resource Statement has been classified in accordance with the JORC Code.

In total, the Project has a Mineral Resource tonnage of some 71.9 Mt with grades of 5.02% Fe, 65.37% SiO2, 11.92% Al2O3, and an average UCS of 85 Mpa. Some 29% of this has been reported in the Indicated category and 71% in the Inferred category.

The Mineral Resource has been restricted to material falling within an optimised pit shell produced using a suite of aggregate prices and these have been applied to two product types as determined through the testwork completed and through the Company's offtake contracts as advised by the Company. All material that has been drilled, logged and categorised as greywacke material has been assumed to correspond with an aggregate material that would generate a product (either armourstone or greywacke) that is suitable for sale to the prospective end customer. This represents the material which SRK considers has reasonable prospect for eventual economic extraction potential.

In addition SRK has reported an Exploration Target of between 50 and 80MT of greywacke but this is conceptual in nature, that there has been insufficient exploration to estimate a Mineral Resource for this and that it is uncertain if further exploration will result in the estimation of a Mineral Resource.

12.2 Recommendations

12.2.1 Introduction

SRK has provided recommendations to allow KBK to expand the current resource, as well as increase the confidence in the current Mineral Resource. An indicative exploration budget is also provided in this section to outline the approximate costs anticipated for the exploration programme proposed.

The suggested changes in Mineral Resource classification proposed in this section represent SRK's informed opinion of the work required to upgrade the Mineral Resources to higher confidence categories. SRK does not provide any guarantees that the results of this further work will definitively result in improvements in Mineral Resource classification as this depends on the results of this work which may not be as expected.

12.2.2 Further Exploration Drilling

Specifically, SRK recommends further diamond drilling to:

- Test the depth extent of the optimised open pit produced as part of the Mineral Resource estimate down to a depth of -140m rL.

- Increase the drilling density in low confidence areas of the deposit where there is minimal drilling, in particular the southern portion of the deposit.
- Provide drilling on planned drill lines to ensure more evenly spread information and not a random spread of data.
- Further explore the Exploration Target.
- Provide better resolution to the footwall contact between greywacke and shale in the main deposit area.
- Provide drilling data to support the classification of Mineral Resources in the small subsidiary hill area of the main deposit area.

All planned drilling should utilise orientated core to better define the structures within the deposit and increase confidence in the geological interpretation. This information is lacking at present. In addition to the exploration and resource upgrade programme, SRK also proposes the following:

- Commence a tight spaced drill hole programme on a 20 x 20 m grid to depths of around 24 m to create an area of Measured Mineral Resources for initial mining toward the north-east of the permit. At this nominal spacing, the intention will be to align resource infill drilling with bench and batter heights for mining drilling requirements. In addition, the 20 x 20m grid will potential “piggy-back” on the drilling convention for armourstone development drilling and production in the next phase of assessment.
- The programme should be conducted prior to the armourstone drilling development and where possible these holes can be used for the armourstone production drilling.

In total, SRK estimates that approximately 7,000 m of drilling will be required to upgrade further marginal areas of the current model to the Inferred Mineral Resource classification, with a portion of the current Inferred Mineral Resource being upgraded to Indicated. In addition to this, SRK estimates 576 m of drilling will be required for the upgrading of a portion of the deposit to Measured Mineral Resources using the tight spaced grid described above.

A figure showing the planned exploration and Measured Resource drilling is provided in Figure 12-1. Planned drillhole collar locations as well as drilling parameters are provided in Table 12-1.

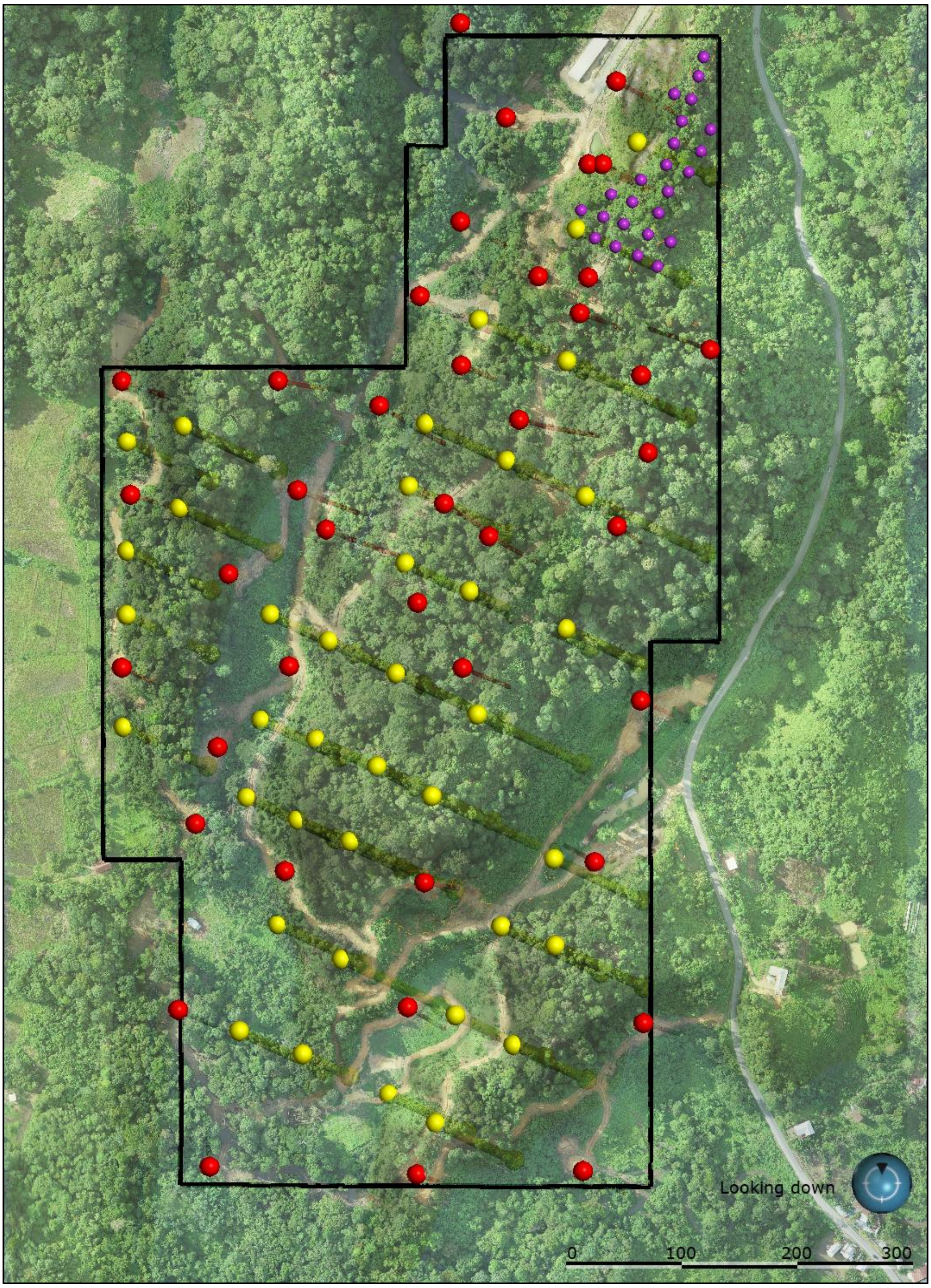


Figure 12-1: Exploration plan for further diamond drilling. Existing collars in red, proposed exploration holes in yellow and initial mining grid in purple

Table 12-1: Planned drilling parameters. All "Exploration Drilling" holes will be drilled at -60° towards an azimuth of 115°. All "Initial Mining Grid" holes will be drilled vertically

Exploration Drilling						Initial Mining Grid (20 x 20 m)				
BHID	X	Y	Z	DEPTH		BHID	X	Y	Z	DEPTH
EXP 1	458132	390163	6	160		MIN 1	458430	390478	57	24
EXP 2	458241	390113	49	200		MIN 2	458449	390471	44	24
EXP 3	458124	390073	7	150		MIN 3	458437	390498	53	24
EXP 4	458171	390056	29	190		MIN 4	458458	390489	39	24
EXP 5	458224	390033	65	220		MIN 5	458445	390517	43	24
EXP 6	458271	390008	94	230		MIN 6	458468	390507	34	24
EXP 7	458182	390141	23	180		MIN 7	458467	390461	48	24
EXP 8	458311	390077	85	200		MIN 8	458478	390482	36	24
EXP 9	458111	390007	11	170		MIN 9	458452	390536	43	24
EXP 10	458155	389987	38	200		MIN 10	458476	390526	36	24
EXP 11	458201	389969	76	200		MIN 11	458474	390548	43	24
EXP 12	458138	389898	4	160		MIN 12	458493	390542	33	24
EXP 13	458193	389868	23	190		MIN 13	458481	390567	45	24
EXP 14	458234	389752	1	150		MIN 14	458504	390560	34	24
EXP 15	458275	389727	26	150		MIN 15	458488	390586	45	24
EXP 16	458292	389820	6	170		MIN 16	458513	390579	35	24
EXP 17	458331	389896	28	190		MIN 17	458496	390605	48	24
EXP 18	458378	389879	56	170		MIN 18	458502	390624	48	24
EXP 19	458342	389794	29	140		MIN 19	458412	390486	58	24
EXP 20	458251	390273	29	190		MIN 20	458420	390504	51	24
EXP 21	458266	390327	39	190		MIN 21	458427	390523	38	24
EXP 22	458336	390295	66	200		MIN 22	458481	390609	53	24
EXP 23	458404	390264	104	230		MIN 23	458507	390641	46	24
EXP 24	458312	390415	37	200		MIN 24	458401	390510	41	24
EXP 25	458388	390380	69	230						
EXP 26	458397	390493	46	200						
EXP 27	458248	390207	47	210						
EXP 28	458304	390183	75	230						
EXP 29	458387	390151	74	140						
EXP 30	458007	390312	14	160						
EXP 31	458008	390218	14	160						
EXP 32	458007	390163	9	160						
EXP 33	458005	390067	8	160						
EXP 34	458057	390325	34	180						
EXP 35	458053	390255	33	180						
EXP 36	458105	389806	6	160						
EXP 37	458159	389786	11	90						
EXP 38	458449	390568	28	140						
EXP 39	458377	389954	23	170						

12.2.3 Additional Exploration Activities

SRK has highlighted a number of areas where additional exploration work would improve the overall understanding of the deposit and aid the reporting of Mineral Resources, and potentially Mineral Reserves, in the future. Specifically, SRK recommends that the Company:-

- Refines the current topographic surface by compiling a walked survey grid using a DGPS system in order to quantify accurately the elevation of the bare earth surface, rather than the top of the canopy as derived from flown surveys. PT KBK should use in house survey teams in this endeavour.
- Undertakes a programme of focused geological and structural mapping over the deposit area.
- Undertakes further geochemical and geotechnical sampling on 10 m composites from existing drillhole core to increase the size of the sampled population.
- Undertakes additional tests inclusive of:
  - UCS and density measurements for all infill, development and exploration drilling.
  - Density measurements of all lithologies including weathered material types (consolidated core and unconsolidated core). Density should also include a record (additional step in the current method) whereby the geologist dry material for 12 hours at 105°C prior to immersion in water for weight measurement. The amount of water/moisture loss should also be recorded.
  - Direct shear (saw-cut) tests (“DSS”) and Discrete shear joint tests (“DSJ”) sampling for geotechnical analysis. These are already detailed in the Company SOP.
- Undertakes checks on orientated core and the base of core line that is used in the geotechnical and geological logging on site. These checks should be routine and completed by a suitably qualified geologist to ensure that data being collected is high quality and error free.
- Undertakes the following aggregates analyses (as required to suit potential end-uses) to test strength and durability:
  - Aggregate Crushing Value: Measure’s resistance to crushing under a gradually applied load.
  - 10% Fines Value: An alternative to ACV.
  - Aggregate Impact Value: Measures resistance to granulation under impact stresses.
  - Aggregate Abrasion Value: Measure surface wear following abrasion.
  - Los Angeles Abrasion Value: Measures resistance to attrition following impact and abrasion.
  - Polished Stone Value: Measure’s resistance to polishing for road surfacing aggregates. PSV value can attract higher premiums on global markets so this should be investigated with all potential material where relevant and possible.
  - Sulphate Soundness: Measures resistance to disintegration by weathering action or salt crystallisation.

A detailed summary of the additional testwork is also provided in Section 8.3.4

12.2.4 Further Exploration Budget

A simplified exploration budget is provided in Table 12-2 to outline the likely costs associated with the proposed programme of work.

Table 12-2: KBK Planned Infill Resource Drilling Programme for Q1 2022

Exploration method	Cost per unit (USD)	Required number of units	Programme Estimated Cost (USD)	Justification for cost
Exploration Drilling	$175/m drilled (all in cost including analysis)	7,000	1,225,000	Cost based on external contractor quote in addition to known analysis costs
Initial Mining Grid	$175/m drilled (all in cost including analysis)	576	100,800	Cost based on external contractor quote in addition to known analysis costs
Additional analysis of existing core	$30/analysis	100	30,000	Analysis costs taken from analyses undertaken in the currently completed work
Geological and Structural Mapping	$1100/mapping day	7	17,700	Cost based on typical industry standard for a consultant structural geologist for 7 days of mapping
Additional walked topographic survey	n/a	n/a	n/a	KBK to use in-house survey team
Additional Drilling For Informing the Mine Study				
Geotechnical Boreholes	$175/m drilled (all in cost including analysis)	4		No focused geotech data is currently available at KBK. At present all geotechnical logging has been basic and all orientation has not been reliable
Hydro Boreholes	$175/m drilled (all in cost including analysis)	4		No hydro (or flow) data is currently available at KBK
		Sub-total Cost:	**1,375,500**	
Further Technical Assessment				
Geotechnical Assessment		**Sub-total Cost**	**20,000**	
Hydrological & Hydrology Assessment		**Sub-total Cost**	**25,000**	
Testwork (aggregates)		**Subtotal**	**NA***	
MRE and Report Update 2022		**Sub-total Cost**	**40,000**	
Mine Study and Mine Reserves Development		**Sub-total Cost**	**65,000**	
		Total Estimated Cost	**1,525,500**	

Notes: (*) Extent of the testwork required is not yet determined and will be established following the MRE update in 2022.

For and on behalf of SRK Consulting (UK) Limited

Dean McMinn,
Senior Consultant
(Mining Geology / Mineral Economics),
SRK Consulting (KZ) Limited

Peter Gleeson,
Corporate Consultant
(Geology & Resources)
SRK Consulting (KZ) Limited

13 REFERENCES

The geological map of the Malinau Sheet, Kalimantan by R. Heryanto, S. Supriyatna and H.Z.Abidin, 1995, shows a scale of 1:250,000 (published by the PPPG)

PT. Geoservices LTD - Mineral Division Laboratory analysis results dated 18 April 2017, (File Ref: “Geo-Chemist_Report_Geoservices.pdf”)

PT. Geoservices LTD - Mineral Division Laboratory analysis dated 18 April 2017. Geotechnical Test work – July 2017 (file ref: “GTK.00143_Preliminary Report.pdf”);

PetroLab Petrography May 2018 results

PetroLab 2019 Mineralogical Report, (file ref: “OP3164b_KBK_08-05-2019.pdf”);

Petrolab Results; (file reference: “PetroLab_Mineralogical_Report_OP4477_KBK_Report_27_05_21.pdf”);

2021 Geoservices Laboratory results for geophysical and chemical analysis (file ref: “KBK GeoServices Test Results_2021.xlsx”)

R. Heryanto, S Supriatna, H.Z. Abidin (1995), Peta Geologi Lembar Malinau, Kalimantan

Hilman M, Boer R, Sulistyowati, Las L, Zed F, Masripatin N, Kartakusuma DA, Hilman D, Mulyanto HS et al. 2010. Indonesia Second National Communication under the United Nations Framework Convention on Climate Change. Jakarta: Ministry of Environment.

APPENDIX

A JORC CODE ASSESSMENT CHECKLIST)

Table A 1: JORC Table 1

Section 1 Sampling Techniques and Data

Criteria	JORC Code explanation	Commentary
Sampling techniques	• *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.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.*	• quarter core sampling of diamond core was undertaken to create suitable volume samples for product testing. • A total of ten 10m composites were submitted for product analysis with a random selection of holes across the length/breath of the deposit. • A comparison between the primary laboratory results for both greywacke and shale show an extremely low variability between the samples and therefore gives SRK confidence in the representivity of the sampling and the use of 10m composites for this MRE. • Density sampling was undertaken on site by trained KBK geologists using the wet immersion method. • A total of 427 recorded density measures have been taken in fresh greywacke and shale lithologies • UCS values were routinely determined on site by trained KBK geologists using KBK equipment • Samples were securely packaged and labelled and then submitted to the primary lab for further product chemical and physical tests which were conducted at the Geoservices lab in Jakarta.
Drilling techniques	• *Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, 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).*	• Drilling is exclusively standard tube diamond core. • Both directional (inclined) holes and vertical drillholes have been completed for the 2019 and 2021 drilling campaigns. • All cores have been drilled at HQ diameter. • The 2021 program included downhole survey of every hole using a Reflex EZI-trac survey tool. • The 2021 program included downhole orientation surveys using a Reflex ACT iii tool for all inclined drill holes. • Although some core has been orientated, this data was deemed by SRK to be unreliable and has not been used in this Mineral Resource estimation.
Drill sample recovery	• *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.* • *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.*	• Core recovery has been measured and recorded for all the diamond core runs and is recorded in the sample database. • On site geologist constantly monitored core recoveries during drilling to ensure drilling practices were optimized to maximise recovery. • Sample recovery is generally acceptable, ranging from between 80-90% for the majority of intervals. No clear relationship between recovery and rock type exists
Logging	• *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.*	• All drilling has undergone systematic geological logging of core in line with procedures set out for the Client by SRK. • Consistent logging codes were used for lithology type, weathering and

	• *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.* • *The total length and percentage of the relevant intersections logged.*	alteration and for each drill programme (2019 and 2021) • All core has been photographed prior to sampling and after sampling. • Geotechnical logging of all holes has been conducted to record RQD, SCR and TCR values. • Logging of UCS values was also completed systematically down hole using a professionally calibrated PLT machine. • Diamond drilling covered a total of 4,025m, of which 2,476m intersected the target lithology (greywacke). This equates to 61.5% of the total drilled meterage.
Sub-sampling techniques and sample preparation	• *If core, whether cut or sawn and whether quarter, half or all core taken.* • *If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.* • *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* • *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	• Diamond core taken for product testing utilised half core samples for submission to the laboratory. • Half core submission from HQ core created a significant volume of material for product characterisation testing. • Wide diameter diamond core samples are considered appropriate for the product characterisation testwork completed. • Sampling is considered representative of the in-situ material which is highly homogeneous.
Quality of assay data and laboratory tests	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established.*	• A single field duplicate pair (1/10 samples) was submitted for product characterisation testwork comprising a quarter core sample for the original and the duplicate sample. The results of this duplicate sampling suggested extremely low variability between duplicate samples. (summary values are provided in Table 8-15). • Two samples were submitted to the umpire lab (PetroLab UK) and a comparison of the average of ten samples submitted to the primary lab (Geoservices) compared with the umpire lab shows a very low variation of XRF and XRD values report by both labs. • Accuracy for all elements is considered acceptable.
Verification of sampling and assaying	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.* • *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	• The drill database had been audited by SRK in Microsoft database formats and validation, as well as cross-checked in Datashed format and error free • SRK retained a significant presence on site during both drill campaigns and has independently verified the intersection of greywacke in diamond drilling • Data was captured and stored in template data capture and entry sheets provided by SRK into a MS Access database
Location of data points	• *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* • *Specification of the grid system used.* • *Quality and adequacy of topographic control.*	• Collar coordinates have been collected using and RTK system that provides a high level of accuracy in the X and Y axis. Typically, Z values are also well established by this methodology. However, due to poor placement of the base station, Z values collected for this system showed a high level of imprecision. As result SRK used the drone captured stereographic topography to assign Z values to the collars. SRK considers the re-vised topographic surface to be accurate to within 1m in the Z axis. Due to the bulk nature of the proposed mining operation and commodity, the precision of collar locations is considered to be more than sufficient.

		• Downhole deviation surveys were conducted at 30m intervals down hole using a Reflex EZI-trac instrument. Assessment of the downhole surveys show that downhole deviation is not excessive.
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* • *Whether sample compositing has been applied.*	• A drill spacing of between 75 and 100 m has been retained in the north and central parts of the main deposit area. The southern area is less well drilled and ranges from 120 to 150 m spacing. This decrease in drilling density is reflected in the classification of Mineral Resources with Indicated resources only stated for the northern portion of the deposit area. • SRK considers the distribution of data within the main deposit area to be sufficient to define the margins of the main lithological horizons. • For the estimated variables of UCS and density, no sample compositing was applied as UCS values represent point readings and the density samples were taken on regular intervals between 0.1 and 0.15m and therefore have equal weighting.
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	• Drilling sections have been oriented perpendicular to the strike of the geological units. Where possible holes were inclined to crosscut the local geology • Two reverse directional holes were put inplace to guage /better define the hangwall contacts and other structures, however this was less effective than planned and therefore should be re-addressed in the next stage of assessment.
Sample security	• *The measures taken to ensure sample security.*	• All samples have been stored on site prior to dispatch. • All remainder core samples (half core) is kept onsite in locked sea contatiners
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	• In November 2019, the Company engaged Geologica Pty Ltd on behalf of Elite Consultancy Pty Ltd to undertake a due diligence visit to assess the geology and economics of the potential bulk gravel mine. Independent consultant, Mr B. Davis of Elite Consultancy Pty Ltd visited site to undertake a review of the drilling (and other) work conducted to date and provide an opinion on the quality of data and the overall Project current development status. During the site visit, Mr Davis observed drill core, several drill hole locations, and observed various reports produced by the Company. ○ Generally the project fills all the material requirements for a large scale gravel and stone supply and is based on solid groundwork and a reliable database. ○ The greywacke rock may have other uses, such as cement, porcelain and ornamental stone which could benefit the company if initial studies proved this to be the case.

Section 2 Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
Mineral tenement and land tenure status	• *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* • *The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.*	•
Exploration done by other parties	• *Acknowledgment and appraisal of exploration by other parties.*	•
Geology	• *Deposit type, geological setting and style of mineralisation.*	•
Drill hole Information	• *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:* ○ *easting and northing of the drill hole collar* ○ *elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar* ○ *dip and azimuth of the hole* ○ *down hole length and interception depth* ○ *hole length.* • *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.*	•
Data aggregation methods	• *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.* • *Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* • *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	•
Relationship between mineralisation widths and intercept lengths	• *These relationships are particularly important in the reporting of Exploration Results.* • *If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.* • *If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').*	•
Diagrams	• *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include,*	•

	but not be limited to a plan view of drill hole collar locations and appropriate sectional views.	
Balanced reporting	• *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	•
Other substantive exploration data	• *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.*	•
Further work	• *The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).* • *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.*	•

Section 3 Estimation and Reporting of Mineral Resources

(Criteria listed in section 1, and where relevant in section 2, also apply to this section.)

Criteria	JORC Code explanation	Commentary
Database integrity	• *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.* • *Data validation procedures used.*	• Digital spreadsheets are used to log data on site at the rig and in the core laydown area. • Errors are checked prior to finalizing each record for each drillhole as an individual data workbook (ie. Each drillhole has its own separate drill record file in excel format) • Look up tables are used to unsure only standard logging codes can be entered during logging. • Data is held in a holding database offsite and any validation issues highlighted by the standard checks. • Prior to transfer to the master database for each drill hole has to be reviewed and approved by the responsible senior geologist. • Data validation follows standard SRK standard database validation processes. • A secondary check was also implemented using Datashed software. This was done independent of the Companies Microsoft Database verification checks. • General descriptive statistics are generated on data extract and compared to general statistics once loaded into Leapfrog Software to confirm there are no data errors in transfer.
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* • *If no site visits have been undertaken indicate why this is the case.*	• A site visit has been completed by Mr Dean McMinn, FAusIMM(CP) #304499, a Senior Consultant of SRK Consulting. The site visit was completed in 8th March – 10 April 2021. Drilling commenced in the 15 th March during Dean McMinn site visit. At this time Dean McMinn was able to observe drilling and sampling practices, confirm 2019 drilling locations, inspected drill core and visit outcrops at the Project. Logging activities were also observed • Previous site visits also undertaken by Mr Dean McMinn on 5-12th March 2019, and 18-22 March 2018.
Geological interpretation	• *Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.* • *Nature of the data used and of any assumptions made.* • *The effect, if any, of alternative interpretations on Mineral Resource estimation.* • *The use of geology in guiding and controlling Mineral Resource estimation.* • *The factors affecting continuity both of grade and geology.*	• The geological interpretation is based on drill logging and geomorphology, with the more resistive greywacke unit forming topographic highs that are well defined in the drone topography. • Uncertainty remains about the quantity of shale internal waste within the main greywacke units as numerous small and discontinuous intersects of shale were intersected during drilling. SRK has taken a conservative approach by reducing the tonnage of greywacke by the proportion of shale left unmodelled intersected with the 3D model greywacke domains

Dimensions	• *The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.*	• The main greywacke horizon at the KBK Deposit has a defined strike of 1000m and is 300m wide, having been intersected at up to 90m below the surface. The greywacke horizon is open at depth and to the north outside of the current license boundary.
Estimation and modelling techniques	• *The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.* • *The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.* • *The assumptions made regarding recovery of by-products.* • *Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).* • *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.* • *Any assumptions behind modelling of selective mining units.* • *Any assumptions about correlation between variables.* • *Description of how the geological interpretation was used to control the resource estimates.* • *Discussion of basis for using or not using grade cutting or capping.* • *The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.*	• The estimation of resources at for the KBK project fall into 3 main streams. Firstly the definition of the volume and location of greywacke material, secondly, the estimation of density and UCS into the lithological model to allow tonnages and rock mass characterisation respectively to be defined, and thirdly, the assignment of product quality parameters to the calculated tonnage by means of a straight average of the sample product characterisation sample data. • Of these, only the second (estimation of density and UCS) required the use of geostatistical estimation techniques. • A parent block size of 25m x 25m x 5m was used (equating to approximately 1/3rd of the drill spacing). • Inverse distance squared was used for the interpolation of variables into blocks, using the lithological domains as hard boundaries • A capping and compositing analysis was conducted and no capping or compositing was deemed to be required. • Global comparisons of density and UCS values to be estimated block grades was conducted and local variability checked by visual comparison to drill samples and the use of swath plots.
Moisture	• *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	• Tonnages are quoted on a dry tonnage basis.
Cut-off parameters	• *The basis of the adopted cut-off grade(s) or quality parameters applied.*	• No cut off grade has been applied. All greywacke material is considered to be equally mineable
Mining factors or assumptions	• *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.*	• Mining is assumed to be large scale open pit mining.
Metallurgical factors or assumptions	• *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.*	• Parameters and assumptions applied in the consideration of the " reasonable prospects for eventual economic extraction " for the reporting of the Mineral Resource are summarised in • Table 9-5 • There are no beneficiation or considerable processing methods required other than simple crushing of greywacke ore. • Production of amourstone is via the use of non blasting techniques and proven contracted services ustilising ECOBUST©

Environmental factors or assumptions	• *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.*	• …There are no waste material considerations at this stage. The Company has planned to mine and stockpile all material. Shale potential use as decorative stone is being investigated and may also be sold as a by-product of mining process in addition to the greywacke aggregate stone saleable material (primary product). • The Company will establish an environmental bond which is to be agreed at the time the mining license is ratified and when the revised project description is set. The Company has engaged international Environmental Consultancy to undertake a revision of the current ESIA to meet the criteria of • An environmental / social impact analysis (Analisa Dampak Lingkungan or 'ANDAL') for the project was submitted to the regional government (Malinau Regent, North Kalimantan Province) in late March 2019, along with an environmental management plan (Rencana Pengelolaan Lingkungan Hidup or 'RKL') and an environmental monitoring plan (Rencana Pemantauan Lingkungan Hidup or 'RPL'). Collectively, the ANDAL, the RKL and the RPL are referred to as the Analisa Mengenai Dampak Lingkungan, or 'AMDAL'. It is SRK's understanding that the AMDAL was prepared by officers in the local branch of the Ministry of Forestry and Environment, in consultation with KBK. • An environmental permit (Izin Lingkungan) for the project was issued for the project on 20 May 2019 (permit number 660.5/K. 182/2019). The permit is valid for the 5-year duration of the project. SRK notes that under Article 50 of Government Regulation number 27 of 2012, environmental permits may lapse if no project activities occur within three years of the grant of the environmental permit (in this instance, by 20 May 2022). If the permit were to lapse a new approval would be required. • In April 2021,SRK conducted a preliminary review and gap analysis (file ref: "ESC Malinau AMDAL.ESIA_170521_SRK.pdf") of project documentation relating to environmental and social aspects of the proposed KBK aggregate mine. The review was undertaken to focus on the Projects work conducted to date and in respect to good international industry practice or GIIP. For the purposes of the assessment GIIP is considered to include consideration of the requirements of Equator Principles 2020 and the International Finance Corporations (IFC) Performance Standards 2012. SRKs review was prepared at the request of PT. KBK. • Water management requirements for the future mine operation have been considered and are now being included in the environmental scope and field studies that are currently underway by the international environmental consultancy, PT ESC Environment Indonesia (ESC) who will undertake site visits, conduct field work for baseline data collection (if/where gaps exist) and compile summary reporting for the ESIA and the AMDAL documentation which is to be resubmitted for the revised project description in Q1 of 2022.
Bulk density	• *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.* • *The bulk density for bulk material must have been measured by methods that*	• In situ bulk density was estimated into the block model based on a dataset of 467 measurements • These measurements were taken using immersion testing of 10-15cm lengths of core taken at approximately 10m intervals.

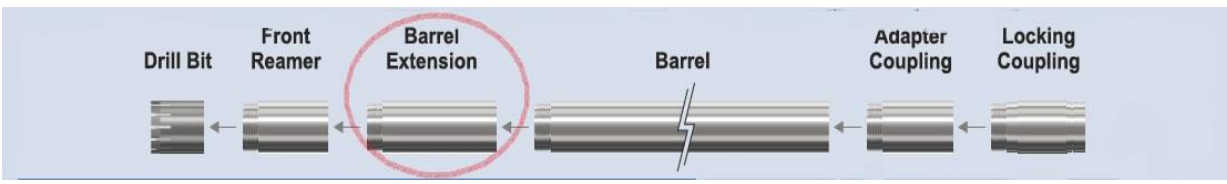
	adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • *Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.*	• The samples were fully dried prior to testing • No porosity or permeability issues were encountered that would require the use of core wrapping or wax coating
Classification	• *The basis for the classification of the Mineral Resources into varying confidence categories.* • *Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).* • *Whether the result appropriately reflects the Competent Person's view of the deposit.*	• Classification is based on a combination of geological understanding, quality and quantity of data and the quality of the estimated block model. • Indicated and Inferred Mineral resources have been quoted.
Audits or reviews	• *The results of any audits or reviews of Mineral Resource estimates.*	• This represents the maiden Mineral Resource estimation for the project
Discussion of relative accuracy/ confidence	• *Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.* • *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.* • *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	• The relative accuracy of the Mineral Resource estimate is factored into the classification categories applied. • The final estimated model was checked to assess the amount of material classified as Inferred or Indicated that lies in excess of 150m from a drill hole. It was shown that less than 1% of the global resource of was outside of the 150m buffer.

APPENDIX

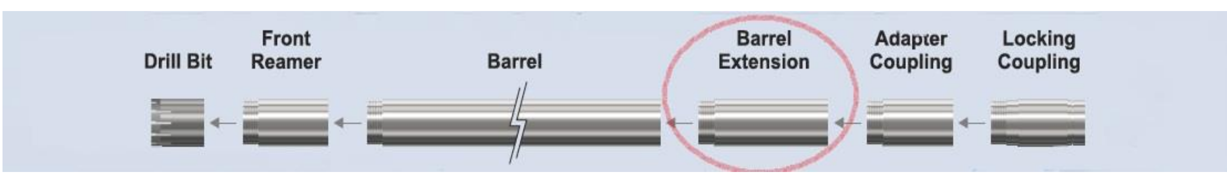
B KBK STANDARD OPERATING PROCEDURES (SOP)

PERAKITAN

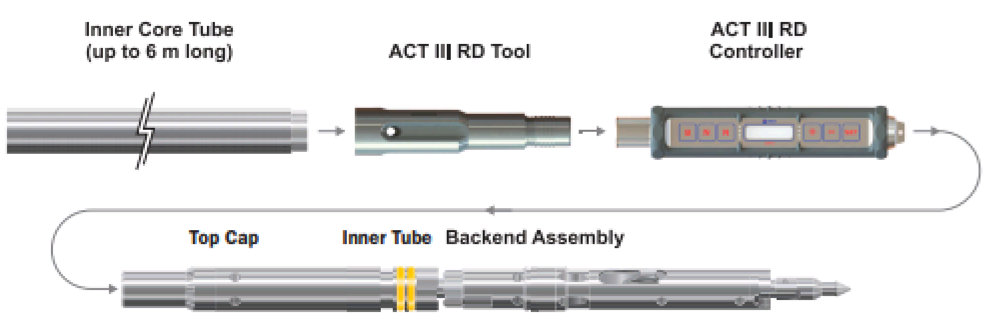
- **Depan Barel - HQ & NQ**



- **Belakang Barel – PQ**



- **Perakitan Innertube**



INISIALISASI

1

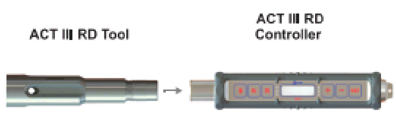


Fig. 4

Masukkan Pengontrol ke Alat

- Masukkan Pengontrol ke Alat yang terhubung ke Inner Tube

2

Fig. 5

Fig. 6

Tekan dan Tahan N

- "Memulai" akan ditampilkan
- Jika tampilan kosong, ulangi Tekan dan Tahan N
- Nomor seri akan ditampilkan setelah 3 detik

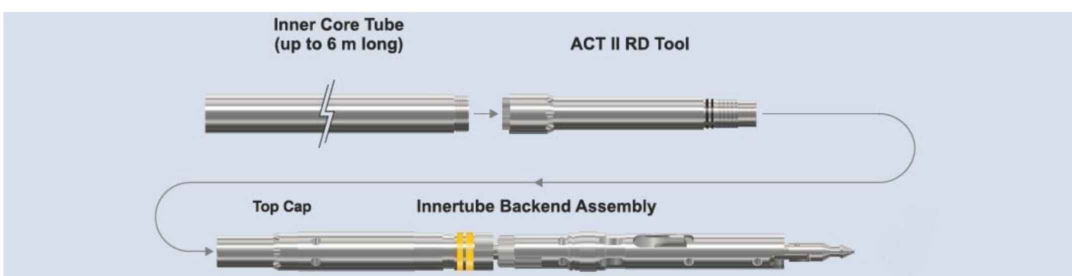
- Terus menekan N

- Setelah 5 detik, "SELESAI" akan muncul, menyala dan bunyi beep akan menandakan.

3

SIAPKAN RAKITAN INNER TUBE INTI

- Lepas Pengontrol, dan kemudian pasang Rakitan Ujung Belakang Inner Tube.



- Kencangkan sesuai praktik pengeboran standar menggunakan kunci pas Inner Tube.

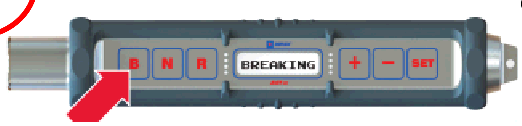
4 **DRILL RUN**

BREAKING

5 **END OF DRILL RUN. DO NOT BREAK CORE**

Tekan dan Tahan B

6



- "BREAKING" akan muncul selama 5 detik.
- Jika tampilan kosong, ulangi Tekan dan Tahan **B**

TUNGGU

7

- Tunggu hingga tampilan hitung mundur selesai.

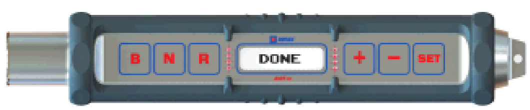
8

Kedalaman (opsional)

- Tetapkan kedalaman dengan menggunakan tombol **ATUR**, +, dan -.

9

Tekan B



- "SELESAI" akan muncul, menyala, dan bunyi beep akan menandakan akhir Breaking.

1

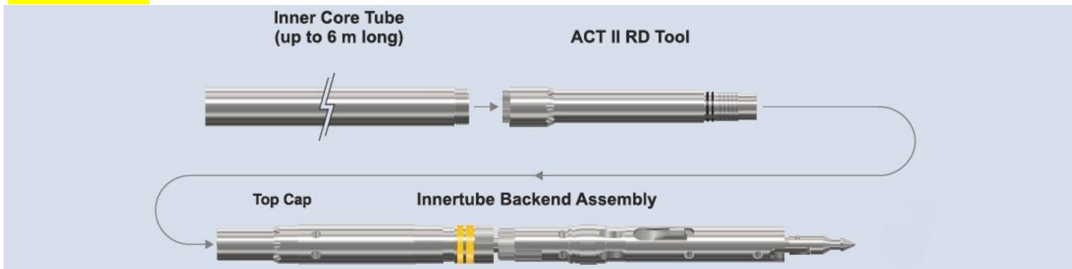
BREAK INTI DAN KEMUDIAN AMBIL KEMBALI

- Saat mengambil kembali inti, Anda dapat menginisialisasi Alat kedua sebagai persiapan untuk menjalankan bor berikutnya. Inisialisasi pada Langkah 1.

PEMBACAAN

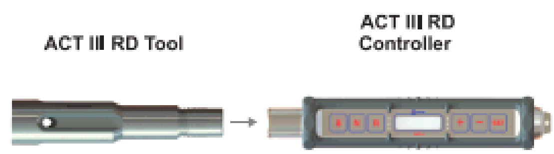
1

LEPASKAN TUTUP ATAS UNTUK MEMBUKA ALAT

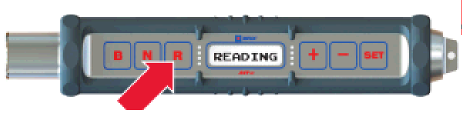


1

MASUKKAN PENGONTROL KE ALAT



1



TEKAN DAN TAHAN R

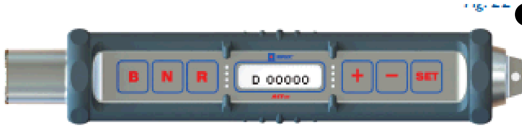
- "PEMBACAAN" akan ditampilkan.
- Jika tampilan kosong, ulangi Tekan dan Tahan R
- Nomor seri akan ditampilkan setelah 3 detik
- Lanjutkan Menekan R

1

BATERAI OK

- Status baterai Alat akan ditampilkan.
- Cahaya akan berkedip untuk menandakan pengunduhan telah selesai.
- **TEKAN R**

1



KEDALAMAN

- Input kedalaman dari Break akan ditampilkan
- **TEKAN R**

1

INKLINASI

- Inklinasi di bagian bawah lubang akan ditampilkan
- **TEKAN R**

1

MENYELARASKAN ULANG

- "PENYELARASAN ULANG" akan muncul dan menampilkan sinyal awal orientasi inti.
- Tunggu selama 2 detik

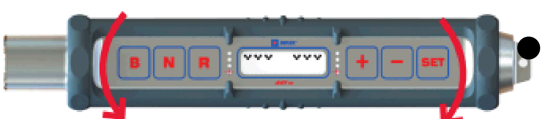
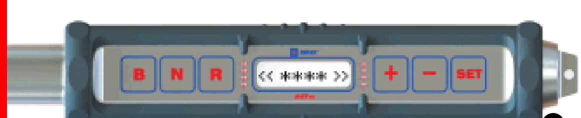


Fig. 29

- Tanda Sisipan (^) dan lampu akan menampilkan arah mana untuk memutar barel.
- Pastikan pengontrol tidak bergerak saat memutar barel.

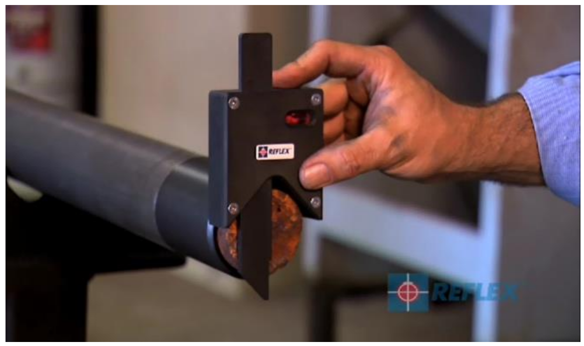


- <<****>> dan lampu akan menandakan bahwa inti berorientasi.
- Orientasi dapat diulang dengan menekan R

MENANDAI INTI

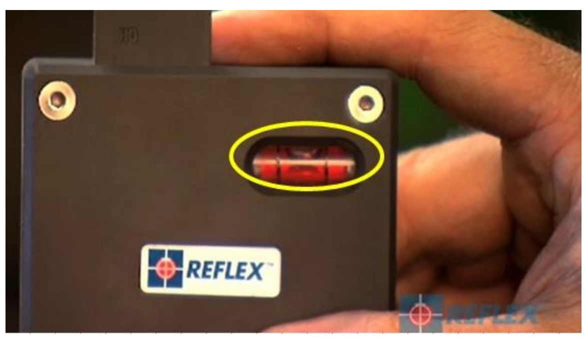
1

TEMPATKAN TANDA JIG DI ATAS INTI



1

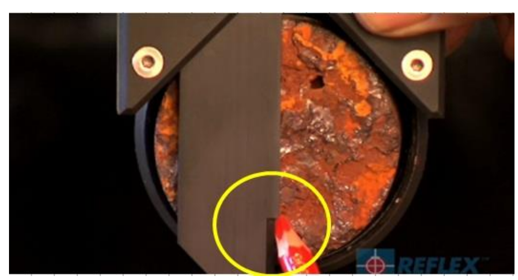
SELARASKAN GELEMBUNG DI ANTARA DUA GARIS DI JIG YANG DITANDAI



2

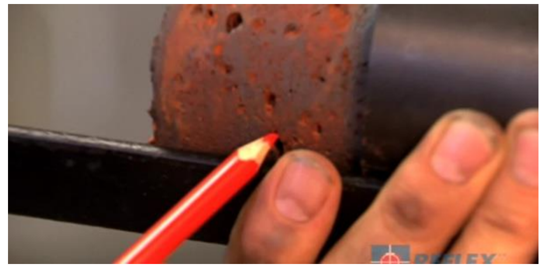
TANDAI INTI

- Tandai inti di bagian bawah.



2

- Menggunakan penggaris lurus, tandai inti.
- Pastikan agar sejajar dengan bagian bawah.



PENGATURAN UNIT DAN PEMBATALAN SURVEI

1

PENGATURAN UNIT – TEKAN B & ATUR

- Tekan B & ATUR secara bersamaan
- Nomor seri Pengontrol akan muncul
- **TEKAN R**

2

STATUS BATERAI

- Status baterai Pengontrol ditampilkan
- **Ini akan menampilkan "BATERAI OK" atau "BATERAI LEMAH"**
- **TEKAN R**

3

WAKTU SISTEM

- Tampilan akan menampilkan Jam: Menit: Detik
- Ubah menggunakan tombol ATUR, +, dan -
- **TEKAN R**

4

TANGGAL SISTEM

- Tampilan akan menampilkan Hari/Bulan/Tahun
- Ubah menggunakan tombol ATUR, +, dan -
- **TEKAN R**

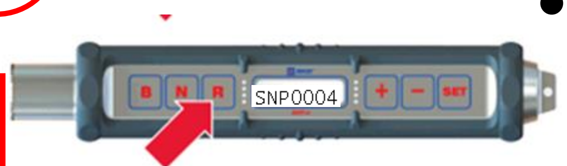
7

Alat ke-1 Terhubung

- Tampilan akan menampilkan nomor seri alat pertama yang terhubung

- **UNTUK MEMBATALKAN SURVEI, TEKAN ATUR**
- **TEKAN R**

8



Alat ke-2 Terhubung

- Tampilan akan menampilkan nomor seri alat pertama yang terhubung
- **UNTUK MEMBATALKAN SURVEI, TEKAN ATUR**
- Tekan R untuk mengulangi siklus tampilan
- Tekan B atau N untuk keluar

KASUS KHUSUS

SAAT MEMULAI ALAT "N"

- Saat terhubung ke Alat

TAMPILAN KOSONG

- N dilepas selama periode menekan & menahan

Apa yang harus dilakukan: Tekan & Tahan N

BATERAI LEMAH

- Baterai alat lemah

Apa yang harus dilakukan:

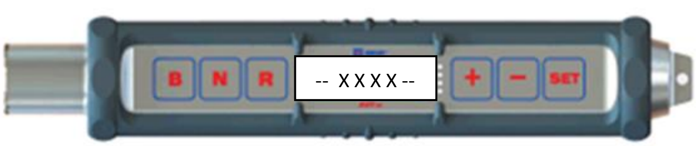
Kembali ke REFLEX

TIDAK ADA KOMUNIKASI

- Tidak ada tautan dengan alat

Apa yang harus dilakukan:

Masukkan kembali pengontrol ke Alat

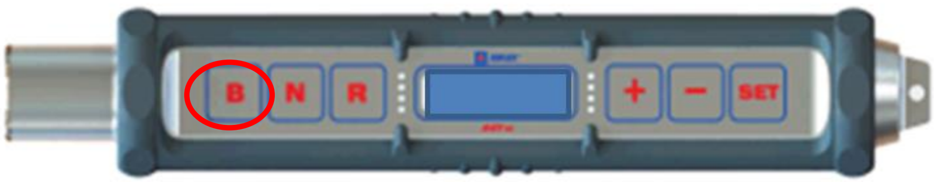


--XXXX--

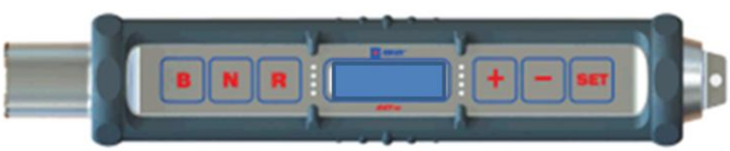
- Diinisialisasi ke alat lain
- Tidak diinisialisasi

Apa yang harus dilakukan: Break sebelum memulai Alat selanjutnya atau batalkan survei alat lain

SAAT BREAKING "B"



TAMPILAN KOSONG



- B dilepas selama periode menekan & menahan

Apa yang harus dilakukan: Tekan & Tahan B

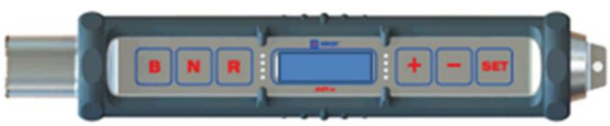
--XXXX--

- Alat tidak diinisialisasi
- Sudah rusak

Apa yang harus dilakukan: Orientasi tidak mungkin jika tidak diinisialisasi, lanjutkan dengan membaca jika sudah rusak

SAAT PEMBACAAN “R”

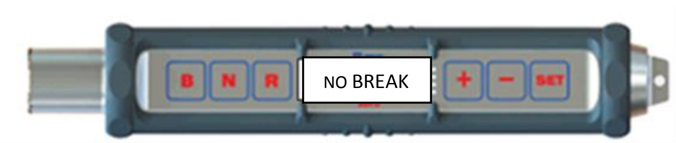
TAMPILAN KOSONG



- R dilepas selama periode menekan & menahan

Apa yang harus dilakukan: Tekan & Tahan R

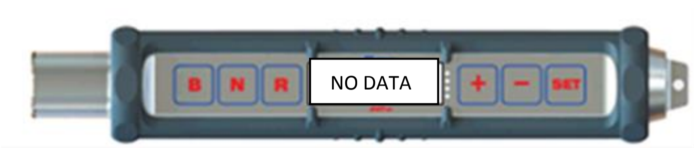
TIDAK ADA BREAK



- Alat diinisialisasi tetapi tidak ada break terdaftar

Apa yang harus dilakukan: Orientasi tidak mungkin, batalkan survei

TIDAK ADA DATA



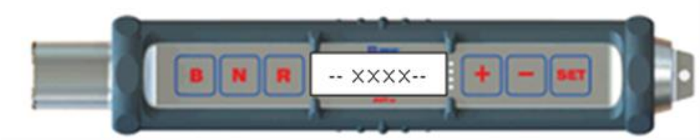
- Kemungkinan kegagalan sistem

Apa yang harus dilakukan:
Alat Uji

G FAULT

- Kemungkinan kerusakan Alat

Apa yang harus dilakukan:
Alat Uji



--XXXX--

- Sudah diinisialisasi ke alat lain
- Tidak diinisialisasi

Apa yang harus dilakukan: Orientasi tidak memungkinkan

TIDAK ADA KOMUNIKASI

- Tidak ada tautan dengan alat

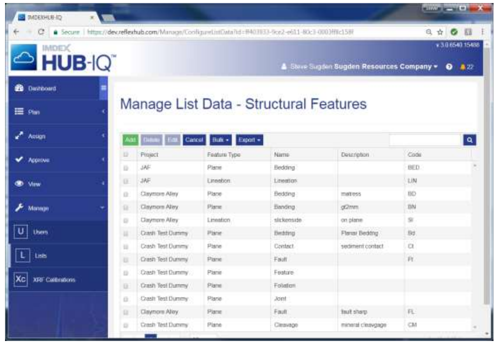
Apa yang harus dilakukan: Masukkan kembali pengontrol ke Alat

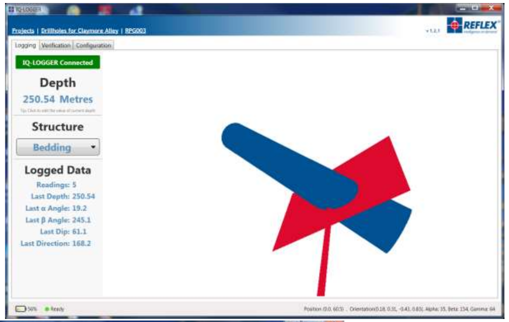
Typical Structural logging workflow Using the IMDEXHUB-IQ

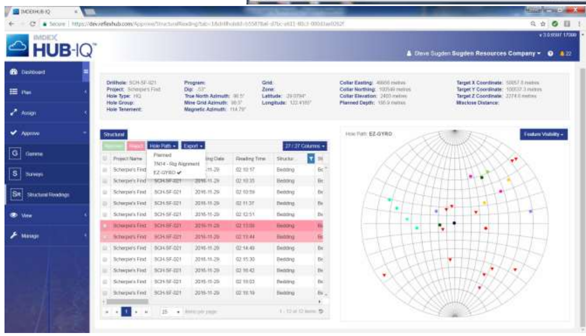
Workflow Overview

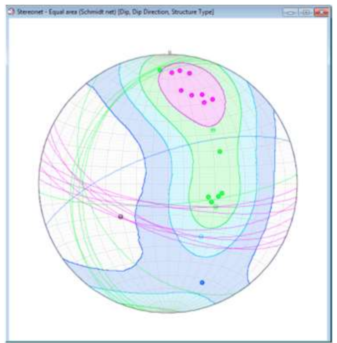
IMDEX
REAL-TIME SUBSURFACE SOLUTIONS

- IMDEXHUB-IQ
  - Create Project
  - Create and activate drill hole
  - Set up Structure Type and Custom 1 and 2 lists.
- IQ-LOGGER application
  - Sync projects, drill holes and lists
  - Configure drill hole
  - Take and edit/validate readings.
  - Sync readings to the IMDEXHUB-IQ
- IMDEXHUB-IQ
  - View readings and recalculate angles using Gyro/Ez-Trac/TN14 survey data.
  - Approve/reject readings.
  - Upload/Export to company Acquire/Datashed database
  - Analyise/visualise in ioGAS and Leapfrog.



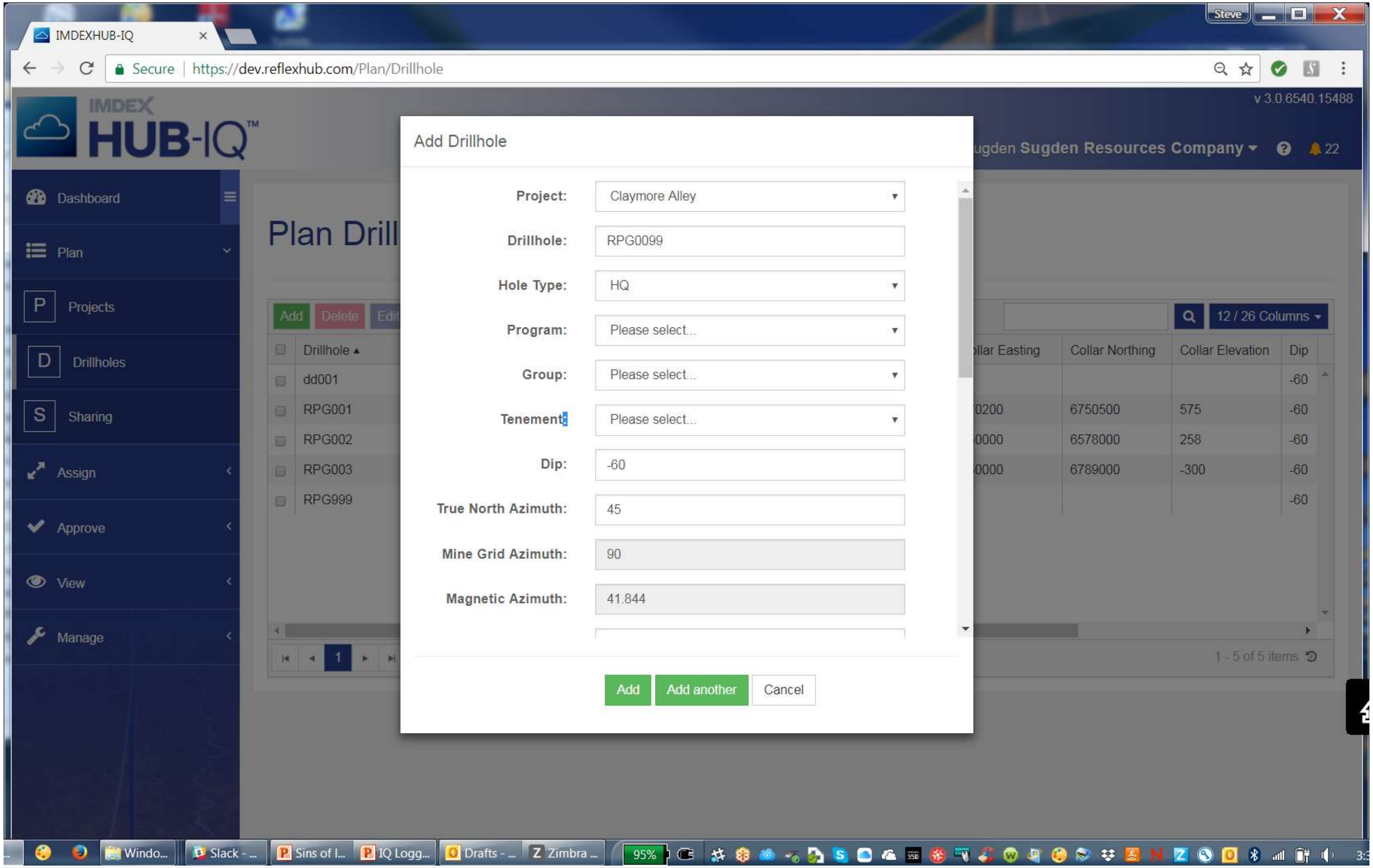




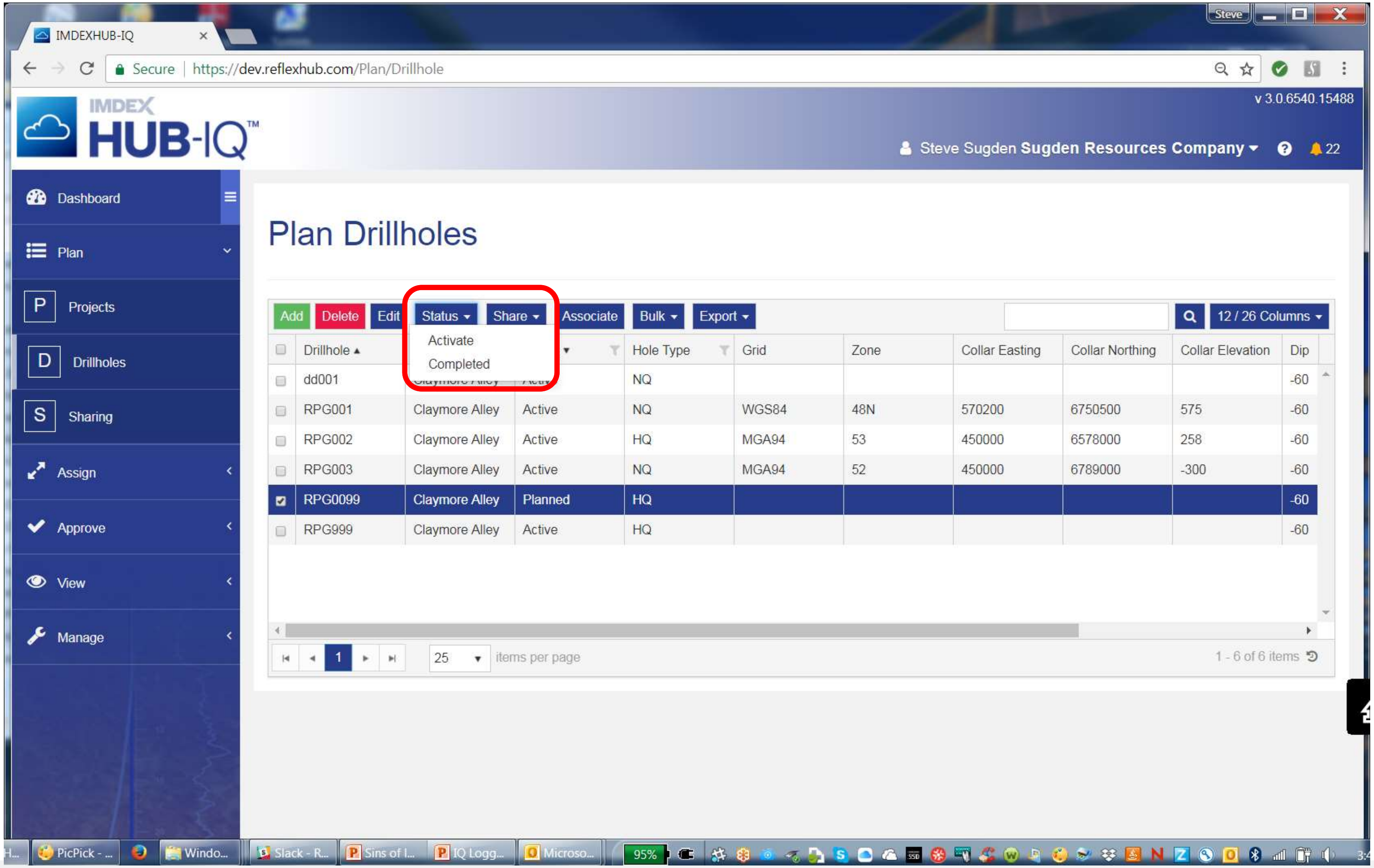


IQ-HUB - Create planned hole.

REAL-TIME SUBSURFACE SOLUTIONS



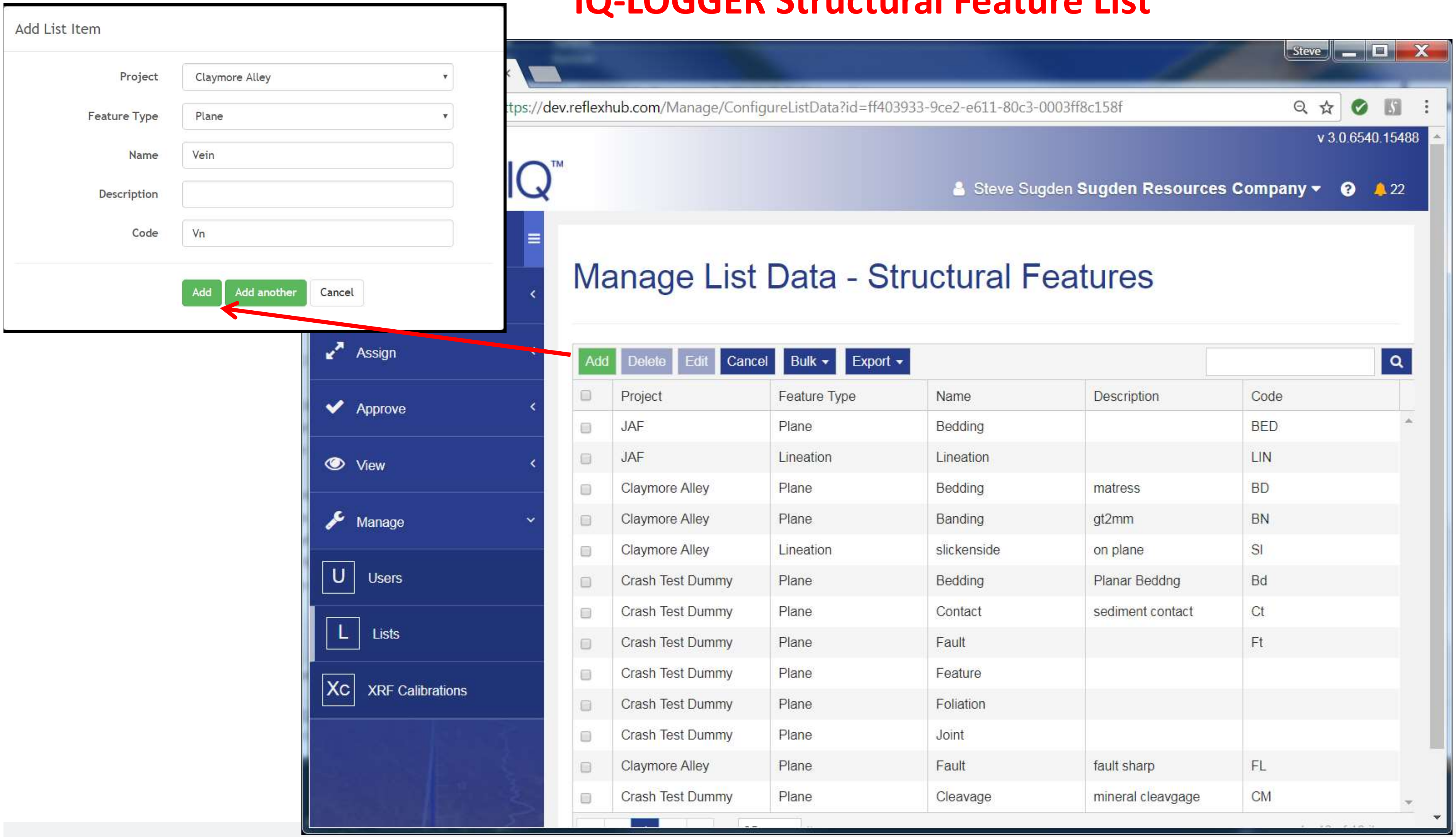
HUB-IQ - Activate Hole for Logging.



HUB-IQ Setup Custom Feature Lists

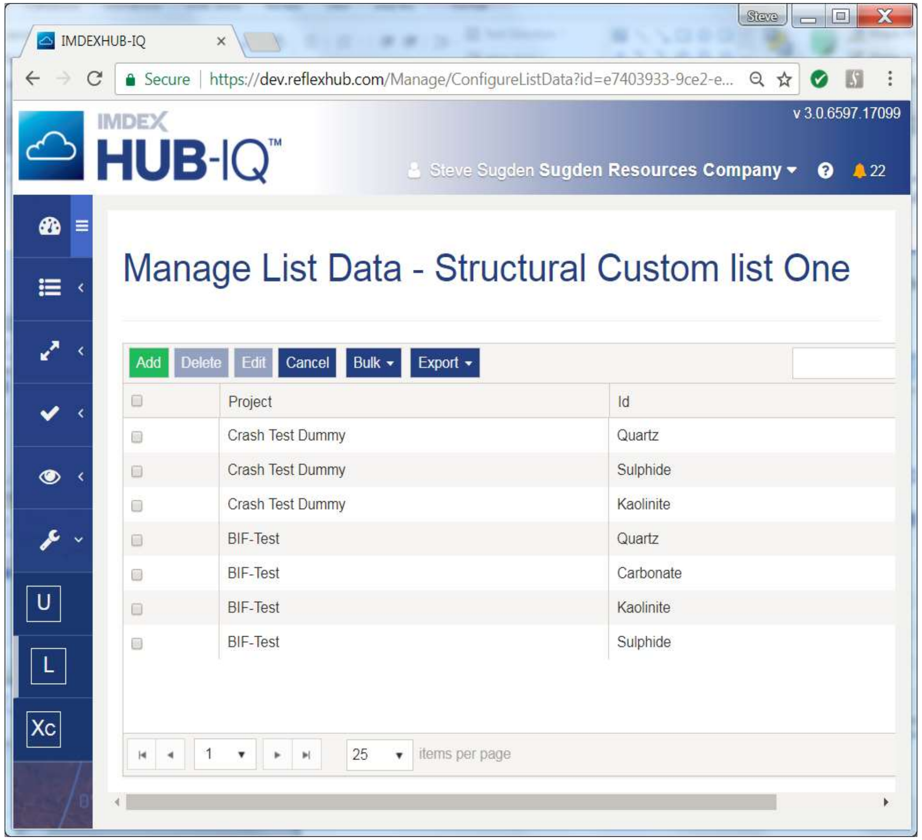
IMDEX REAL-TIME SUBSURFACE SOLUTIONS

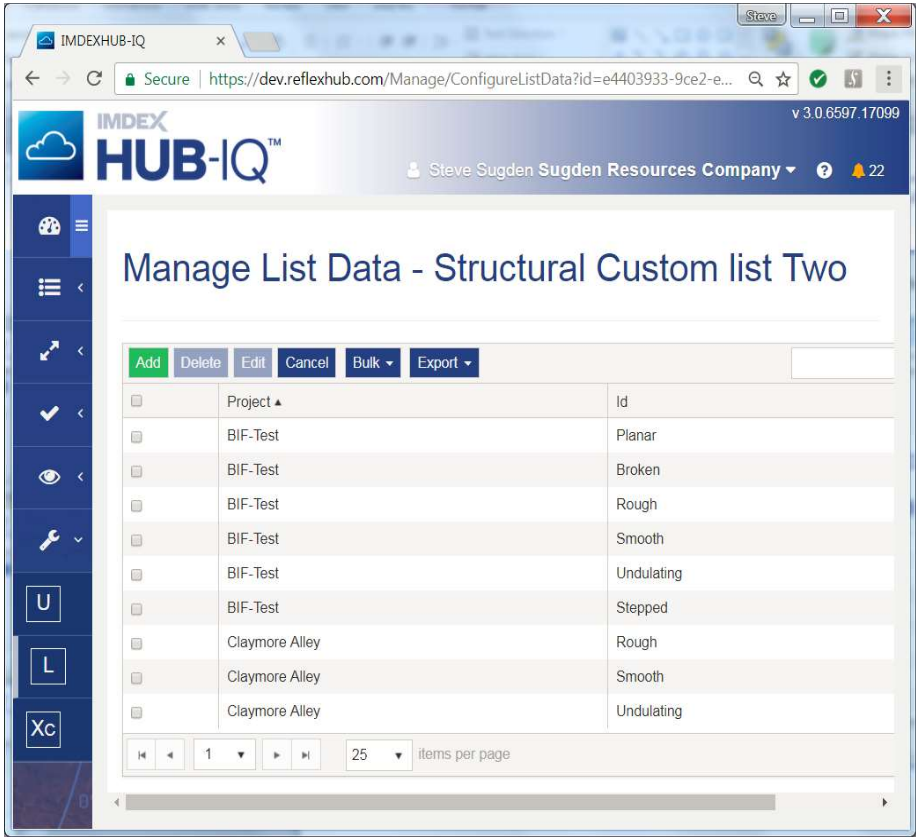
IQ-LOGGER Structural Feature List



HUB-IQ Setup Custom Feature Lists 1 & 2

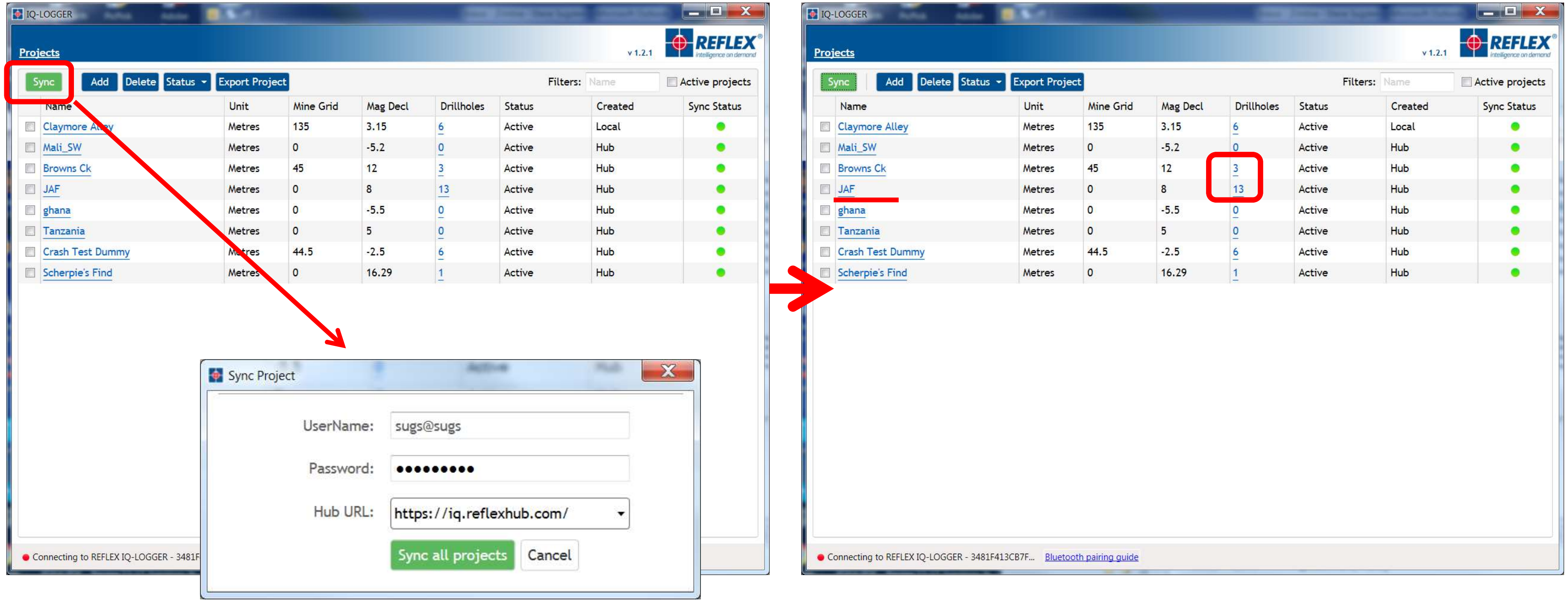
To capture additional detail e.g. mineral and structure geometry. These lists can be renamed.





IQ-LOGGER - Sync Projects

Download projects, holes and feature lists.



GEOLOGY LOGGING TASK

March 15, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	KEY TASK SHEET - KBK GEOLOGY LOGGING	Dean McMinn	Geologist	Site Operations Manager	15/03/2021
v-2.0					

2 KEY TASK OVERVIEW

This document describes the task for logging of drill core in the field and it has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

3 DESCRIPTION OF ACTIVITY

This document has been compiled as a guide for field project geologists, and to assist in standardizing the operating procedures taken by the Project Geologists for the logging and marking up of diamond drill (DD) core.

This document focuses on the exploration drilling programme currently underway (commencing October 2018) and it provides a description of the DD, the logging of DD, and the mark up of DD core in the core laydown area. This document's intended audience is the Project Geologists, Senior Geologist, and core yard technicians. This task sheet document should be read in conjunction with the Companies Occupation Health and Safety (OH&S) policy and related Geology Logging SOP documents.

4 MATERIALS, EQUIPMENT, AND PPE

Personal Protective Equipment	Materials/Consumables	Geology Equipment
• Cool water for the rig Geologists • Emergency contact list (safety officer number, driver's / vehicle numbers etc.) • Communications • First Aid Kit • Standard PPE (minimum) • hard hat • steel capped boots • ear plugs • protective eye wear • sun cream • insect repellant • protective gloves	• All hard/digital copy logging sheets (prepared and ready to log) • Black permanent markers for bag labels • Cable ties (zip locks) to securely fasten the sample bags • Core trays (enough for at least one shift) • Coated paper/plastic/aluminium sample tags • Yellow, green, and red wax pencils for structural logging • Pencils and erasers for logging	• Map of drillhole locations and coordinates list • Measuring tape • Hand held GPS device • Digital camera • Chair and table for logging • Shelter for the rig geologists • Soft brush (1 minimum) • Spoon (1 minimum)for moving material into chip trays • Spray can/bottle for wetting core • Core logging trestles (core shed) • V-rail (or angle bar) • Torch • Compass/brunton • Ezi logger instrument • Geologists hand lens • Lantern/lights for logging and safety at night • Laminated scale bar/colour chart for chip tray photography • Laminated geology sampling code sheets (3 sheets) • Rig diary for Geologist to track events • Laptop/tablet for data entry • Data file: "U7285_DH_v1-3.xlsb"

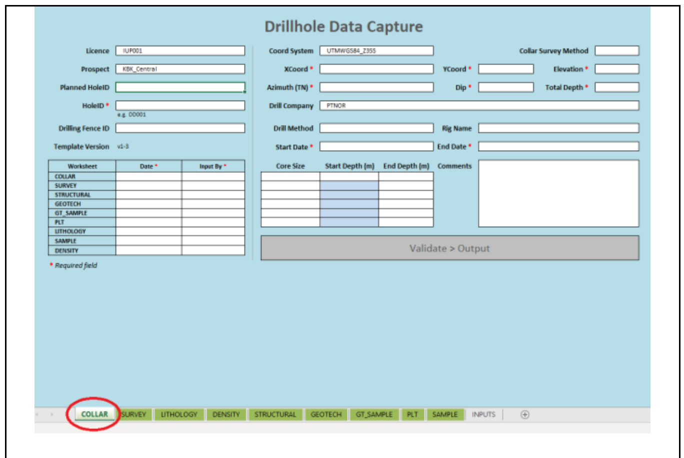
4.1.1 Geology Logging (commencing at the rig)

At the drill rig whilst supervising the drilling, open the Microsoft Excel Data-capture spreadsheet, (file ref; U7285_DH_v1-3.xlsb) and commence filling the COLLAR, SURVEY, LITHOLOGY tabs. The information should accurate and completed in full. The information should also be recorded on hard copy log sheets for backup, if data files are corrupted or lost.

All drilling and core handling should be monitored by a suitably qualified Geologist. Detailed lithological logging should commence starting at the drill rig and the following general parameters should be recorded on the paper record sheet as a minimum:

COLLAR Tab, must include the following details:

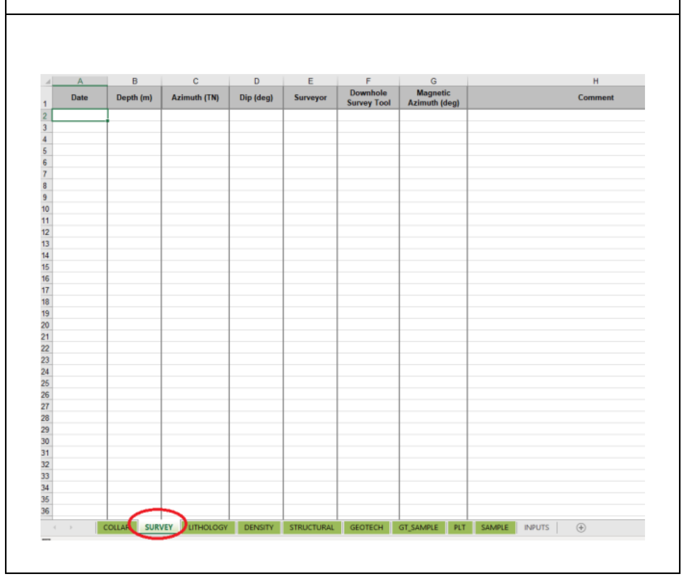
- Licence no.; Prospect Name; Planned HoleID: HoleID (final hole name); Drilling Fence ID; Coordinate System; XCoord /YCoord / Elevation (from gps reading); Azimuth (True North); Drill Company;
- Drill Method: Rig Name: Start Date; End Date; Core Size; Start and Finish Depths, and
- Comments (hole was re-drilled due to stuck barrel, hole is next to existing historical hole, drilling started 1m below current real surface level etc etc)



All the above detail is vitally important as it is the base information for each drillhole.

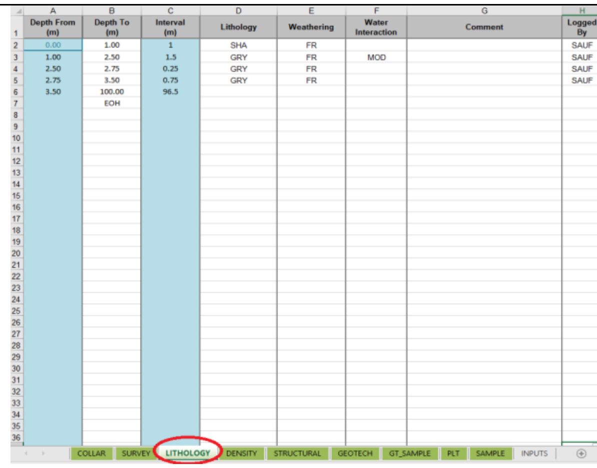
SURVEY Tab, must include the following details:

- Date; Depth(m); Azimuht (true north); Dip (degrees); Surveyor name; Downhole survey tool; Magnetic Azimuth (degrees).
- Note, this information is provided by the drilling following completion of the downhole survey using the approved downhole survey tool (ie, reflex ezi-trac) file ref: "Terjemahan RTI-MAN-0050 REFLEX EZ-TRACT Quick User Guide v2.0 (1).pdf".



LITHOLOGY Tab, must include log details for;

- Depth To (m);
- Lithology;
- Weathering;
- Water Interaction (if any);
- Comments;
- Logged by;



	A	B	C	D	E	F	G	H
1	Depth From (m)	Depth To (m)	Interval (m)	Lithology	Weathering	Water Interaction	Comment	Logged By
2	0.00	1.00	1	SHA	FR			SAUF
3	1.00	2.50	1.5	GRY	FR	MOD		SAUF
4	2.50	2.75	0.25	GRY	FR			SAUF
5	2.75	3.50	0.75	GRY	FR			SAUF
6	3.50	100.00	96.5					
7		EOH						

COLLAR SURVEY LITHOLOGY DENSITY STRUCTURAL GEOTECH GT_SAMPLE PLT SAMPLE INPUTS

At the conclusion of the Geological Logging task, the following hard copy and digital sheets should be produced, fully filled-in and then verified/checked by the Senior Geologist onsite.

- COLLAR Logging Sheet (to be completed at the rig)
- SURVEY Logging Sheet (to be completed at the rig)
- LITHOLOGY Logging Sheet (partial entry at the rig, and complete in the core shed area)
- DENSITY Logging Sheet (to be completed at the core shed)
- GEOTECH Lithology Logging Sheet (to be completed at the rig)
- STRUCTURAL Logging Sheet (to be completed at the core shed)
- SAMPLE Logging Sheet (to be completed at the core shed)

Logging can also be recorded directly in the Data-capture log sheet (file ref: "U7285_DH_v1-3.xlsb").

4.1.2 Detailed DD core logging procedure (at the core shed)

When full core boxes have arrived at the core shed, the Geologist makes the following checks:

1) Layout the core boxes in the correct down hole order
2) If necessary, clean the core with spray bottle, water and/or wet rag/towel.
3) Ensure that core has been placed in the boxes so that depths read from left to right down the hole.
4) Check that core blocks or plastic core spacers are all present with correct depths clearly marked and, if necessary, check against driller's daily logs.
5) Check that all core lengths fit together within each drill run and that the start/end box labels match these.

6) Check the core is the correct way up by examining geological indicators such as scour structures and graded bedding or drilling induced indicators such as core spring marks and ground ends.

7) Check that the core at the end of each drill run joins up with the core at the start of the next.

8) Look out for sudden differences in intersection angles or lithologies which may indicate missing, or disturbance / displacement of core.

9) Measure total core recovery (TCR) between depth markers after ensuring that all core sections fit tightly together. Where core is badly broken, make an assessment of the possible amount of solid core that could have been drilled over this section.

10) When there is core loss, attempt to assess and record the depth interval at which this might have / has occurred. Note, drillers should also be able to clarify how much estimated core loss and it should be recorded on their drill plods.

11) Where necessary, move core blocks / spacers to resolve problems of under recovery in one drill run and over recovery in the next. This could be due to retrieval of a core "stick-up" at the bottom of the hole after withdrawal of the inner tube during the previous run, or simple someone has placed the core block in the incorrect position.

12) Measure solid core recovery (SCR) which is a reflection of core quality as opposed to quantity (TCR). This is based on the sum of all core pieces whose length along the core axis is greater than, or equal to, the core diameter. This sum is then expressed as a percentage of the drilled length. Note, for it to be considered "solid core", there must be a complete core circumference at the center point of each core length.

13) Walk over the core boxes and mark all lithological units whose length exceeds 1m (unless an established marker horizon) with chalk. Narrower intervals can be recorded as inter-beds within the main unit description.

14) Photograph the marked-up core (wet), each core box must be individually photographed and a copy stored in the appropriate drive.

15) Complete the Logging Sheet (file ref: U7285_DH_v1-3.xlsb), located on the tab entitled "LITHOLOGY".

    a. input the "TO" meter (m) depths to indicate the changes in lithology as you progress down the drill core. Note, the "FROM" (m) will automatically populate as will the "INTERVAL" column.
    b. Select the lithology (drop down list is provided.
    c. Describe the weathering (drop down list is provided)
    d. Note Water interaction if this has been noted during drilling by the driller. (note; water interaction is if water has been intersected during drilling and the driller has determined if it is "POOR", "MODERTE", or "EXTREME").
    e. Include any comments about the interval section (this is free format alpha-numeric which will be included in the final database) , some guidance as follows:
        i. Colour e.g., pinkish grey, Way-up indicators, Mineralogical information relating to host rock, if more than one predominant litho present, Style and intensity of features with description of ore minerals present, Core condition including porosity, friability, leaching, presence of solution cavities, vugs etc
        ii. Record any changes in core diameter down the hole.
    f. Use drop down list to select the geologist name that has conducted the Lithology logging.

16) Save the file as the Drill Hole ID. (ie. KDD015), and the remainder of logging (ie. structural, density, geotechnical etc) as well as sampling can now be conducted using the same file.

Figure 1: Example of

Completed Structural Log Sheet

Depth From (m)	Structural Feature	Structural Type	Alpha Dip	Beta Direction	Roughness	Infill Strength	Aperture	Structural Weathering	Comments	Logged By
1.55	JOINT	OPEN	20.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	HIGHLY		ILHM
1.75	VEIN	CLOSED	20.0			HARD <5MM	CLOSED	HIGHLY		ILHM
1.95	JOINT	OPEN	30.0		SLIGHTLY ROUGH	SOFT >5MM	>5MM	HIGHLY		ILHM
2.10	JOINT	OPEN	40.0		SLIGHTLY ROUGH	SOFT >5MM	>5MM	HIGHLY		ILHM
2.65	JOINT	OPEN	10.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	HIGHLY		ILHM
4.38	JOINT	OPEN	70.0		SLIGHTLY ROUGH	NONE	1-5MM	HIGHLY		ILHM
5.07	JOINT	OPEN	25.0		VERY ROUGH	NONE	1-5MM	HIGHLY		ILHM
6.30	JOINT	OPEN	65.0		SMOOTH	SOFT <5MM	1-5MM	MODERATELY		ILHM
7.88	JOINT	OPEN	55.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	MODERATELY		ILHM
8.09	JOINT	OPEN	70.0		SLIGHTLY ROUGH	NONE	1-5MM	UNWEATHERED		ILHM
10.95	JOINT	OPEN	40.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	MODERATELY		ILHM
11.05	JOINT	OPEN	25.0		SLIGHTLY ROUGH	SOFT <5MM	0.1-1MM	HIGHLY		ILHM
11.15	JOINT	OPEN	5.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	HIGHLY		ILHM
12.00	JOINT	OPEN	25.0		SMOOTH	SOFT <5MM	1-5MM	HIGHLY		ILHM
13.80	JOINT	OPEN	10.0		SMOOTH	SOFT <5MM	1-5MM	HIGHLY		ILHM
16.67	JOINT	OPEN	70.0		ROUGH	SOFT <5MM	1-5MM	MODERATELY		ILHM
19.40	JOINT	OPEN	55.0		ROUGH	NONE	1-5MM	SLIGHTLY		ILHM
20.61	JOINT	OPEN	75.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM	UNWEATHERED		ILHM
21.35	BEDDING	CLOSED	25.0			NONE	CLOSED	UNWEATHERED		ILHM
21.83	BEDDING	CLOSED	25.0			NONE	CLOSED	UNWEATHERED		ILHM
22.05	VEIN	CLOSED	40.0			HARD <5MM	CLOSED	UNWEATHERED		ILHM
22.15	VEIN	CLOSED	55.0			HARD <5MM	CLOSED	UNWEATHERED		ILHM
22.85	JOINT	OPEN	40.0		VERY ROUGH	NONE	1-5MM	UNWEATHERED		ILHM
23.79	JOINT	OPEN	20.0		SLIGHTLY ROUGH	NONE	1-5MM	MODERATELY		ILHM
25.00	JOINT	OPEN	5.0		SLICKENSIDED	NONE	1-5MM	UNWEATHERED		ILHM
25.83	JOINT	OPEN	50.0		SMOOTH	SOFT <5MM	1-5MM	SLIGHTLY		AGNG
26.93	BEDDING	CLOSED	45.0			NONE	CLOSED	UNWEATHERED		AGNG
26.10	FBZ	OPEN			VERY ROUGH	HARD <5MM	>5MM	SLIGHTLY		AGNG
27.38	BEDDING	CLOSED	40.0			NONE	CLOSED	UNWEATHERED		AGNG
27.69	JOINT	OPEN	40.0		SMOOTH	SOFT <5MM	1-5MM	MODERATELY		AGNG
27.74	JOINT	OPEN	40.0		SLIGHTLY ROUGH	HARD <5MM	1-5MM	SLIGHTLY		AGNG
28.00	JOINT	OPEN	50.0		SMOOTH	SOFT <5MM	1-5MM	SLIGHTLY		AGNG
28.25	FBZ	OPEN			VERY ROUGH	SOFT <5MM	>5MM	SLIGHTLY		AGNG
29.38	JOINT	OPEN	20.0		SLIGHTLY ROUGH	HARD <5MM	1-5MM	SLIGHTLY		AGNG
29.84	JOINT	OPEN	25.0		SMOOTH	SOFT >5MM	>5MM	SLIGHTLY		AGNG
30.77	JOINT	OPEN	25.0		SLICKENSIDED	HARD <5MM	0.1-1MM			AGNG
31.95	JOINT	OPEN	60.0		SLIGHTLY ROUGH	HARD <5MM	0.1-1MM			AGNG
32.00	JOINT	OPEN	20.0		SLIGHTLY ROUGH	SOFT >5MM	>5MM			AGNG
32.17	FBZ	OPEN			VERY ROUGH	HARD >5MM	>5MM	SLIGHTLY		AGNG
32.30	JOINT	OPEN	15.0		SMOOTH	SOFT <5MM	>5MM			AGNG
32.35	JOINT	OPEN	20.0		SMOOTH	SOFT <5MM	1-5MM			AGNG
32.53	JOINT	OPEN	15.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM			AGNG
33.74	JOINT	OPEN	50.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM			AGNG
34.26	JOINT	OPEN	60.0		SMOOTH	SOFT <5MM	1-5MM			AGNG
34.90	JOINT	OPEN	25.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM			AGNG
34.99	JOINT	OPEN	25.0		SLIGHTLY ROUGH	SOFT >5MM	>5MM			AGNG
35.08	JOINT	OPEN	55.0		SMOOTH	HARD <5MM	1-5MM			AGNG
36.86	JOINT	OPEN	50.0		SLIGHTLY ROUGH	HARD <5MM	0.1-1MM			AGNG
37.36	JOINT	OPEN	10.0		SLIGHTLY ROUGH	SOFT <5MM	1-5MM			AGNG
38.18	BEDDING	CLOSED	40.0			NONE	CLOSED	UNWEATHERED		AGNG
38.24	BEDDING	OPEN	40.0		SMOOTH	HARD <5MM	0.1-1MM			AGNG

Figure 2: Example of Completed Lithology Log transposed into the Data Capture sheet

Depth From (m)	Depth To (m)	Interval (m)	Lithology	Weathering	Water Interaction	Comment	Logged By
0.00	1.00	1	SHA	FR			SAUF
1.00	2.50	1.5	GRY	FR	MOD		SAUF
2.50	2.75	0.25	GRY	FR			SAUF
2.75	3.50	0.75	GRY	FR			SAUF
3.50	100.00	96.5					
	EOH						

COLLAR | SURVEY | LITHOLOGY | DENSITY | STRUCTURAL | GEOTECH | GT_SAMPLE | PLT | SAMPLE | INPUTS

KBK AGGREGATE

KEY TASK SHEET

HYDRO WEATHER STATION MONITORING

March 15, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.1	KEY TASK SHEET – KBK HYDRO WEATHER STATION MONITORING.docx	Fauzi Achmad Wiguna	Hydro Weather Station Monitoring	Wellsite Geologist	15/3/2021
v-2.0					

2 KEY TASK OVERVIEW

2.1 Overview

This document describes the task for water table depth measurement in the field and it has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

2.2 Description

Rain Gauge is a tool used to record rainfall intensity over a certain period of time. The results of recording rainfall are generally related to the results of recording soil movements on the extensometer. The results of recording a rainfall gauge can be used as a comparison with the results of recording soil movements on the extensometer which can be stated that the greater the intensity of the rainfall, the soil tends to move easily, the rain gauge consists of several types:

• OBS Rain gauge (Manual)

• Netta Rain gauge (Manual)

• Hellmann Rain gauge (Automatic)

• Rain gauge with data download system

And for the Rain Gauge that we use, namely the OBS (Manual) Rain Gauge.

1) **Rain gauge (OBS / Observatory)**

Rain is one of the weather parameters needed for the benefit of BMKG in determining environmental conditions and / or an agency that requires rainfall data.

2) **Rainfall**

It is a drop of rain drops or drops that reach the surface of the earth.

3) **Total Rainfall**

Is the rainfall that reaches the surface of the earth during a specified period of time and is expressed in terms of its depth, provided that no water is lost due to water evaporation or flow.

4) **Time of observation**

Observation for rainfall must be done every day at certain hours even though the weather is good. However, the stipulation is that the rain is measured every 3 hours starting from 00.00, 03.00, 09.00, 12.00, 15.00 UTC, and so on.

5) **Rain Gauge**

Rain gauge is a meteorological instrument used to measure rainfall which consists of two types of rain gauge, namely recording and non-recording rain gauge. The following are rain gauges that are usually used by the BMKG.

6) **Rain Gauge (OBS / Observatory type)**

Rain gauge is a type of collector that uses a measuring cup to measure rainwater. This rain gauge is made of zinc sheet BWG 24 with a length / height of ± 60cm, in white paint or aluminum to reduce heating / evaporation of water due to the heat of the sun. The glass must be drained with clean water.

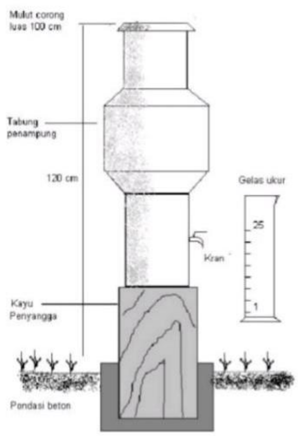


Figure 1

The mouth measuring 100cm (diameter = 11.3 cm) is made of brass. Must be attached horizontally. Narrow pipe to supply water to the collector. Collector tube with a capacity of 3-5 liters, equivalent to 300-500mm of rainfall
Faucet
Measuring cup

3 INSTALLMENT AND OPERATING PROCEDURE

3.1.1 Terms of installation:

The rain gauge must be installed in an open field, without any disturbance around the gauge, such as trees and buildings, cables or antennas that cross over it. The closest distance between the tree / building and the rain gauge is 1 times the height of the tree / building.

Rain gauge should not be installed on sloping ground (hillside), hilltop, above walls or roofs. The increment is installed by screwing / nailing it to a round block that is painted white and planted on a concrete foundation (see picture), so that the height of the rain gauge from the funnel surface to the soil surface is 120 cm. the location of the cross section of the funnel must be flat (horizontal) and the opening of the faucet is given a padlock as a safety

The incubator must be fenced around with a wire, measuring 1.5 m x 1.5 m and 1 m high, so that animals and unauthorized people can not disturb it.

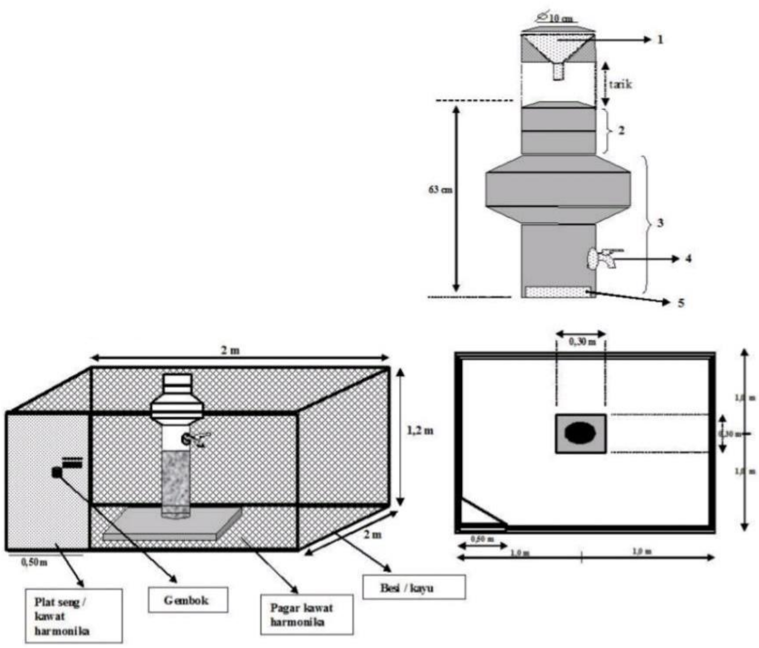


Figure 2

1. Rain collecting funnel with a funnel area of 100 cm² (mouth of the funnel is made of brass / copper).
2. Rain gauge neck (13 cm diameter, made of 5mm zinc / paralon).
3. Rainwater pempung tube (for 3 L of water, made of zinc / paralon).
4. Water drain faucet
5. Collector to retain the position of the rain gauge against the wood support / foundation.

Figure 3
The Ombrometer

3.1.2 How to observe the Ombrometer:

Observations for rainfall must be made every day at 07.00 local time, or certain hours. Open the key lock and place the measuring cup of rain under the faucet, then open the tap so that the water is collected in the measuring cup.

If the rainfall is expected to exceed 25mm. before reaching the 25mm scale, the faucet is closed first, take the reading and take notes. Then continue measuring until the water in the measuring tub runs out, all that is recorded is added up.

To avoid parallax error, the reading of the rainfall on the measuring cup is done right at the base of the meniscus. If the base of the meniscus cannot be on the scale line, the scale line closest to the base of the meniscus is taken. When the base of the meniscus is exactly halfway between two scale lines, an odd number is taken, for example: 17.5mm becomes 17mm. 24.55mm to 25mm.

For a reading as high as x mm where 0.5 / x / 1.5 mm, then read x = 1 mm. For readings smaller than 0.5mm, the number 0 (Zero) is written on the rain card and it is still declared as a rainy day.

If there is no rain, put a mark (-) or (.) On the rain card.
If the observation cannot be made within a day or so, put an (X) mark on the rain card.
If the ordinary rain measuring glass (Obs) breaks, a Hellman rain gauge can be used where the reading is multiplied by 2. Or you can also use a measuring cup with an ml scale. (Cc), which can be purchased at a pharmacy.

With this measuring cup, the measurement results are the volume of water that is accommodated divided by the area of the funnel (100cm²) and then the unit is made into millimeters (mm). For example, 170ml of water is collected. (170 cm³) then the result is: 170 cm³: 100 cm² = 1.7 cm = 17 mm or 1 mm equals 10 ml (cc).

3.1.3 Maintenance of Rain Gauge Ombrometer

- Always keep the appliance clean, and paint it aluminum.
- The wood is painted white, so it is durable against termites and weather.
- The funnel must be kept clean, and should not be covered with objects or dirt that can clog it
- The faucet must always be checked, if it leaks (water drips out) the valve opening axis is removed and then greased. If the measuring body of the rain leaks, it must be repaired immediately by soldering it
- Rainwater collection tanks must be frequently controlled and cleaned of dust / dirt deposits, by pouring water into them and opening the faucet.
- Keep cup of rain dropping clean, do not get mossy, and stored in a safe place so that it does not fall / break.

• The grass around the place where the rain gauge is installed, must always be short and neat, there should be no bushes around it.

Based on the intensity, rain is divided into:

PROPERTIES OF RAIN POWDER RAIN INTENSITY (mm / hour)

- VERY LIGHT RAINFALL<1
- LIGHT RAINFALL 1-5
- NORMAL RAINFALL 5-10
- HEAVY RAINFALL 10-20
- VERY HEAVY RAINFALL >20

GEOLOGY POINT LOAD TEST TASK

April 12, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	KEY TASK SHEET – POINT LOAD TEST	Rifki Asrul Sani	Geologist		
v-2.0					

2 KEY TASK OVERVIEW

This document describes the task for point load test in the field which has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

3 DESCRIPTION OF ACTIVITY

Point Load (PL) is a test that aims at characterizing rock materials in terms of strength. It is an index test, meaning that it can be performed relatively quickly and without the necessity of sophisticated equipment to provide important data on the mechanical properties of rocks. Point Load test is an alternate method that can be used to adequately predict the Uniaxial Compressive Strength (UCS) of a rock material using a portable and simpler equipment.

4 MATERIALS, EQUIPMENT, AND PPE

A rock sample with various shapes (see below) is subjected to compression between two conical steel platens until failure. The apparatus consists of a rigid loading frame, a loading measuring system and a simple system of measuring the distance between the two platens. This distance is usually 1.5 to 10 centimeters so that specimens of various sizes can be tested. The capacity of the loading machine is usually 25kN or 50kN and typically utilizes a hydraulic pressure gauge. The load measurements are accurate to, at least, 5% regardless of the strength and the size of the sample. A typical, digital, Point Load Test apparatus is presented in Figure 1.

Figure 1: Digital Point Load Test Apparatus by ControlsGroup (Controls-group.com).

A benefit of Point Load tests is that they can be conducted on cylindrical, rectangular or even irregular specimens given that they comply with some geometric regulations. According to the American Society for Testing and Materials (ASTM), a specimen's external dimensions must range between 3,0 to 8,5 centimeters with the preferred dimension being 5 centimeters.

TESTING PROCEDURE

Depending on the shape of the specimen, the Point Load strength index can be derived via 4 different types of tests such as diametral test, axial test, block lump test and irregular lump test. For this project there will be two types of PLT which must be done, diametral and axial test.

Diametral Test

Diametral Point Load Tests are conducted on cylindrical samples. The ratio of the specimen's length to its diameter (2L/D) should be more than unity. The sample is placed in the loading device and is loaded perpendicular to its core axis so that the platens make contact along its diameter. The distance between the free end and the location of the contact points must be greater than 0.5D. Then, the distance between the contact points (which should be equal to the diameter) is recorded and the specimen is loaded to failure.

Axial Test

The Axial Point Load Test is conducted on cylindrical samples that have a relatively smaller length. The ratio between the length and the diameter of the specimen must range between 0.3 and 1.0. The specimen is placed so that the loading platens are parallel to its core axis. The distance between the contact points is measured before initiating the test. A typical configuration of diametral and axial PL test is shown in Figure 2.

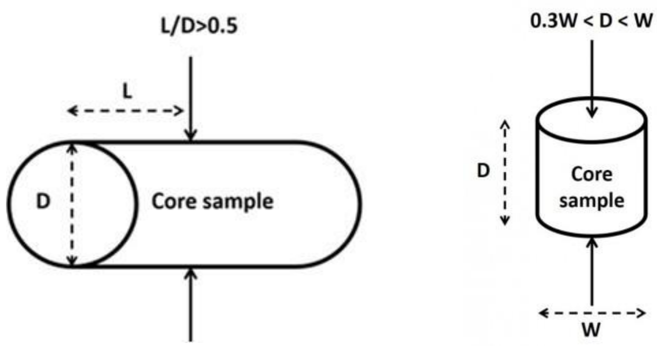


Figure 2: Sample's shape requirements for the Diametral and Axial PL Test and loading forces applied by the apparatus platens.

In all cases, at least 10 samples of the examined material should be tested in order to obtain reliable results (even more required if the rock is anisotropic or heterogeneous). The distance D should be recorded within ±2% accuracy. The load should steadily increase so that the specimen fails within 10 to 60 seconds.

Validity of PL tests

Based on the mode of failure, Point Load tests are classified as valid or invalid. Invalid tests are not taken into consideration in the final results; therefore, it is crucial to acknowledge when a test is valid. The failure surface should pass through both contact points. Typical examples of valid and invalid modes of failure in PL tests are depicted in Figure 3.

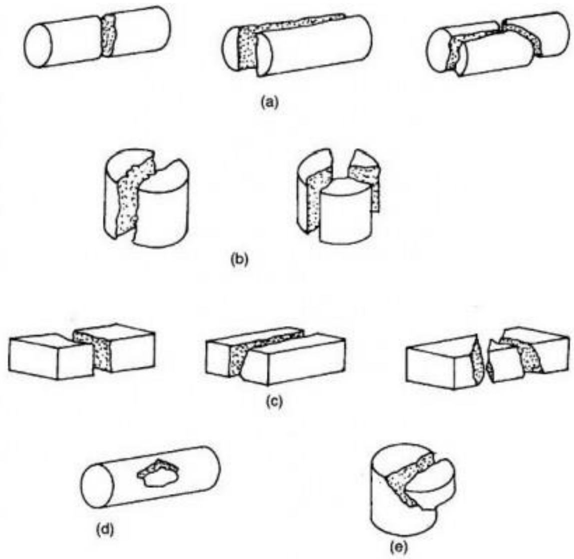


Figure 3: a,b,c) Typical modes of failure for valid PL tests. d, e) Typical modes of failure for invalid PL tests (ISRM, 1985)

When a PL test is completed, the raw data include the dimensions of the sample and the load of failure P (kN). Initially, the equivalent core diameter "De" is calculated based on the shape of the specimen as:

$$D_e = D, for\ diametral\ tests$$

$$D_e = \sqrt{\frac{4 * A}{\pi}}, for\ axial, block\ lump\ and\ irregular\ lump\ tests$$

Where, A is the minimum cross-section area of a plane through the contact point of the planes and is calculated as:

$$A = W * D$$

The Uncorrected Point Load Strength IS (the term will be explained below), is derived via the following equation:

$$I_s(kPa) = \frac{P}{{D_e}^2}$$

It is generally acknowledged that, in rock mechanics, the size of a tested specimen affects its mechanical properties. This is highly associated with the non-homogenous nature of rock materials. In bigger samples, there is a higher probability of a weaker plane or a fracture affecting the behavior of the material. For this reason, the value of the IS is corrected based on the size of the sample to a reference dimension (50mm) as:

$$I_{s50} = F * I_s$$

Where, F is a size correction factor which is calculated as:

$$F = (\frac{D_e}{50})^{0.45}$$

After each corrected PL strength index is calculated, the two highest and two lowest values are excluded (given that 10 or more tests have been conducted on the tested material) and the average IS50 is derived.

Estimation of Uniaxial Compressive Strength (UCS) based on IS_{50}

The PL tests are a rock classification index but they can also be used to estimate the UCS of the tested rock. There have been many studies on the correlation between IS_{50} and UCS and research has shown that there is no valid relation that could predict with high accuracy the actual UCS of a material based on IS_{50}. However, an approximate value can be determined.

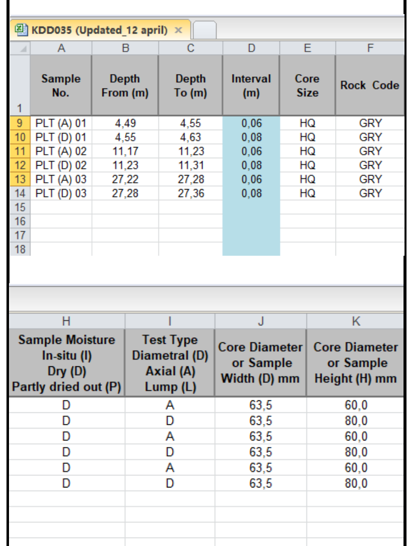
The UCS can be estimated using the following formula:

$$UCS = C * I_{s50}$$

Table 1: Step by Step Task for Point Load Test in the Field

Task	Description	Photo Example

TASK #1
 	
Geologist selects Core from Core Box
	The selected core will be:
	• Approximately 6 cm for axial test and 8 cm for diametral test
	• Pre-labelled by the Logging Geologist showing:
	  ○ Hole ID and box number
	  ○ Lithological code
	  ○ PLT ID
	
	As a general rule, each 20 m of core should have at least one (1) of each Litho code, where possible. The selected core must be intact rock (fresh rock) or core with minimum discontinuities.
	
	Note: per 100 m of drilling there should be at least 20 PLT (10 axial and 10 diametral test) taken for EACH Lithology / domain.
	
	In terms of frequency of measurements:
	The project geologist should take at least 2 PLT for every 2 core box (10 m) or every 4 core box (20 m) based on lithological type.
		

TASK #2
 	
Preparing test equipment and data record
	PLT equipment must be ready, don't forget to use safety equipment such as safety googles/glasses and gloves.
	Record all data by tablet or laptop, on the excell sheet, note:
	  ○ SAMPLE NO;
	  ○ FROM (m);
	  ○ TO (m);
	  ○ ROCK TYPE;
	  ○ TEST TYPE (AXIAL/DIAMETRAL);
	  ○ SAMPLE MOISTURE; and
	  ○ CORE DIAMETER/WIDTH (D) AND SAMPLE HEIGHT (H).
		

KDD035 (Updated_12 april)

	Sample No.	Depth From (m)	Depth To (m)	Interval (m)	Core Size	Rock Code
9	PLT (A) 01	4,49	4,55	0,06	HQ	GRY
10	PLT (D) 01	4,55	4,63	0,08	HQ	GRY
11	PLT (A) 02	11,17	11,23	0,06	HQ	GRY
12	PLT (D) 02	11,23	11,31	0,08	HQ	GRY
13	PLT (A) 03	27,22	27,28	0,06	HQ	GRY
14	PLT (D) 03	27,28	27,36	0,08	HQ	GRY

Sample Moisture In-situ (I) Dry (D) Partly dried out (P)	Test Type Diametral (D) Axial (A) Lump (L)	Core Diameter or Sample Width (D) mm	Core Diameter or Sample Height (H) mm
D	A	63,5	60,0
D	D	63,5	80,0
D	A	63,5	60,0
D	D	63,5	80,0
D	A	63,5	60,0
D	D	63,5	80,0

Task	Description	Photo Example
TASK #3 Break the core and record PLT Gauge Load (G)	Place sample on PLT apparatus, make sure the sample placed on the center of pressure point (platens). Load pressure slowly until the sample has been broken.	 

Task	Description	Photo Example
TASK #4 Record PLT Gauge Load (G) and Failure type	Record PLT Gauge Load (G) on the sheet and failure type based on broken sample condition. The PLT gauge will automatically converted into calculated UCS, then select rock STR code based on that value. The failure type are: • R, failed through rock; • J, failed on incipient joint; • B, failed through both rock and incipient joint; • P, failed outside the platens; and • N, didn't fail at load indicated.	 

Example of Completed Point Load Test Log Sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Sample No.	Depth From (m)	Depth To (m)	Interval (m)	Core Size	Rock Code	Rock STR Code	Sample Moisture In-situ (I) Dry (D) Partly dried out (P)	Test Type Diametral (D) Axial (A) Lump (L)	Core Diameter or Sample Width (D) mm	Core Diameter or Sample Height (H) mm	Diameter Equivalent (De) mm	PLT Gauge Load (G) kN	Is = (P*1000)/ De^2 MPa	Is(50) = Is*(De/50) ^0.45 MPa	Calculated UCS	Failure (RJBPN)
2	PLT (A) 01	6,61	6,67	0,06	HQ	SHA	R3	D	A	63,5	58,0	68,48	4,9	1,04	1,20	**29**	R
3	PLT (D) 01	12,67	12,77	0,10	HQ	SHA	R3	D	D	63,5	86,0	63,50	6,9	1,71	1,91	**46**	R
4	PLT (A) 02	32,57	32,63	0,06	HQ	SHA	R3	D	A	63,0	57,0	67,62	7	1,53	1,75	**42**	B
5	PLT (D) 02	32,63	32,73	0,09	HQ	SHA	R2	D	D	63,5	90,0	63,50	1	0,25	0,28	**7**	R
6	PLT (D) 03	59,29	59,39	0,09	HQ	SHA	R4	P	D	63,5	92,0	63,50	7,8	1,93	2,15	**52**	R
7	PLT (A) 04	66,70	66,76	0,06	HQ	GRY	R4	D	A	63,5	59,0	69,07	14,4	3,02	3,49	**84**	J
8	PLT (D) 04	66,76	66,86	0,09	HQ	GRY	R4	D	D	63,5	90,0	63,50	9,4	2,33	2,60	**62**	J
9	PLT (A) 05	79,78	79,84	0,06	HQ	GRY	R4	P	A	63,5	56,0	67,29	11,9	2,63	3,00	**72**	B
10	PLT (D) 05	79,84	79,94	0,09	HQ	GRY	R4	P	D	63,5	91,0	63,50	14,1	3,50	3,89	**93**	B
11	PLT (A) 06	88,73	88,79	0,06	HQ	GRY	R5	D	A	63,5	56,0	67,29	23,9	5,28	6,03	**145**	R
12	PLT (D) 06	89,83	89,93	0,09	HQ	GRY	R4	P	D	63,5	94,0	63,50	14,8	3,67	4,09	**98**	B
13																	
14																	
15																	

References

ISRM (1985): Suggested method for determining point load strength. International Journal of Rock Mechanics and Mining Sciences and Geomechanical Abstract, 22(2), 51-60.

ASTM D5731-16, Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications, ASTM International, West Conshohocken, PA, 2016, www.astm.org

KBK AGGREGATE

STANDARD OPERATING PROCEEDURE

SURVEY FINAL DRILL HOLES

March 18, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.1	U7285 – SOP KBK – SURVEY PICKUP.docx	S.HANDRI	Project Geologist	PM Site Operations Manager	15/3/2020
v-2.0	U7285 – SOP KBK – SURVEY PICKUP.docx	G.ANDRIYANTO	Project Engineer	Project Engineer	18/3/2021

2 STANDARD OPERATING PROCEEDURE OVERVIEW

2.1 Background and Description

The procedures have been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK or the Company) and are specifically for the practices required at the KBK Resource Drilling Project. This document has been compiled as a guide for field project geologists, and to assist in standardizing the operating procedures taken by the Project Geologists for the logging and marking up of diamond drill (DD) core.

This document describes the standard operating procedure (SOP) for setting up the Emlid ReachRS2 © receivers units (ReachRS) for both the base receiver (Base RS) and the rover receiver (Rover RS). This document also provides guidance on the ReachView software that is supplied with the devices. The purpose of the ReachRS is to collect valuable survey data during the exploration programme currently underway (commencing May 2017 / March 2021). This task is regarded as a non-risk, or hazardous task, however, other Company documentation should be consulted if working in potentially harmful conditions (such as extreme heat, or adverse weather conditions) and all personnel should be aware of the various safety aspects and the associated equipment and personal protective equipment (PPE) required in high risk operating environments.

In order to provide accurate survey points of the drill collar locations it is necessary for the drill collars (both RC and DD) to be accurately surveyed. The initial survey and location of drillholes is typically completed by a Hand Held Global Position System (HHGPS) devices which are less accurate than high resolution survey tools such as a Total Station, Multi-station, GNSS GPS Base and receiver, Theodolite, or the ReachRS system. To provide a more accurate representation of the data collected for mineral resource assessments (in particular the drill hole collars), the Company is required to accurately position collar locations.

3 MATERIALS, EQUIPMENT AND PPE

The training and equipment will be provided by the Company and it is essential the equipment is treated carefully, maintained and any defaults are reported immediately. To start setting up the Emlid ReachRS2 survey equipment you will need the following items (as minimum):

Equipment

- 2 x Emlid ReachRS2© antennae receiver (fully charged batteries)
- 1 x Emlid user guide (compiled by MangoesMapping) document version 0.2
- Base Station survey tripod
- Rover receiver telescopic adjustable monopole (or bike clamp adjuster if doing a moving assisted survey)
- 1 x Survey Samsung A12 Smartphone Android (fully charged batteries)
- [**MAKE SURE THE BATTERIES ARE FULLY CHARGED ON ALL DEVICES**]

See Table 1: Photographs of Relevant equipment for examples of these listed above.

Relevant Devices, Software/Applications

- Bluetooth, Chrome Internet Browser
- Android Smartphone General Operating Software
- Mappt data capture application (not compulsory)
- BluetoothGPS application (not compulsory)

Table 1: Photographs of Relevant equipment

		
ReachRS2 (Base)	ReachRS2 (Rover)	Survey Samsung A12 Smartphone Android
		
tripod/mount – “PSM”	telescopic adjustable pole	Action Clamp and Locking Arm

A.1 Safety Precautions

Extra safety precautions must be taken when surveying, these include (but are not limited to) the following:

- Personnel are not to undertake surveying under the influence of drugs or alcohol or other materials that may impair their ability to undertake this task.
- Heat stress and dehydration is also to be observed. Plenty of drinking water should be available.
- Trip hazards are identified risks and should be observed and monitored.
- Open edges (nearby excavations, or mine shafts etc) are identified hazards across the entire exploration site and these amongst other things should be observed and monitored when surveying.
- Lightning is an identified hazard and should be observed and monitored.

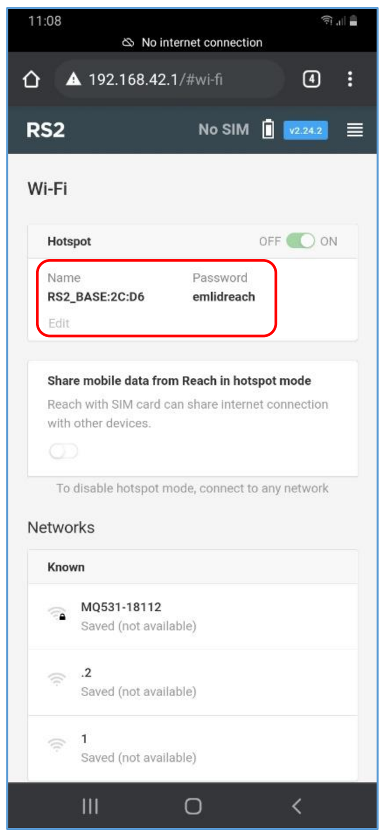
A.2 Setup Procedure

A.2.1 Base Unit Set up

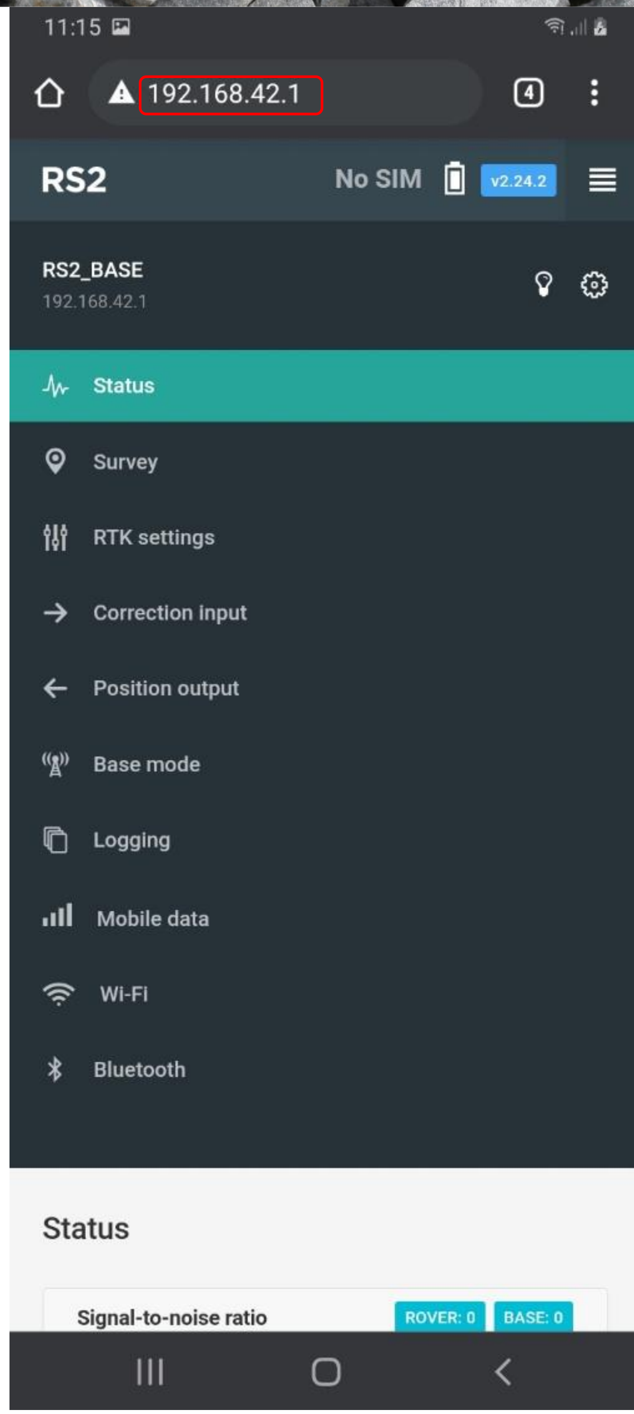
1) Put Base ReachRS on tripod/mount - Place on top of PSM (see Table 1)

2) Turn on the ReachRS "Base" unit (holding the power button on for 5 seconds)

3) Using your Survey Samsung A12 Smartphone Android, connect to the Base ReachRS via the Wi-Fi hotspot ………………(note: the internet is not required and the ReachRS Base unit will appear as "RS2_BASE:2C:D6" in the Wi-Fi list)



4) Once the Survey Samsung A12 Smartphone Android is connected to the ReachRS Base (RS2_BASE:2C:D6), use your Chrome internet browser to open the ReachView software. To do this type http://192.168.42.1 in the IP address bar (as shown below)



5) When the ReachView software opens you can now update the user settings for the Base Unit. (note: this is just for the base receiver “RS2_BASE:2C:D6”). Follow (exactly) the screen shots below.

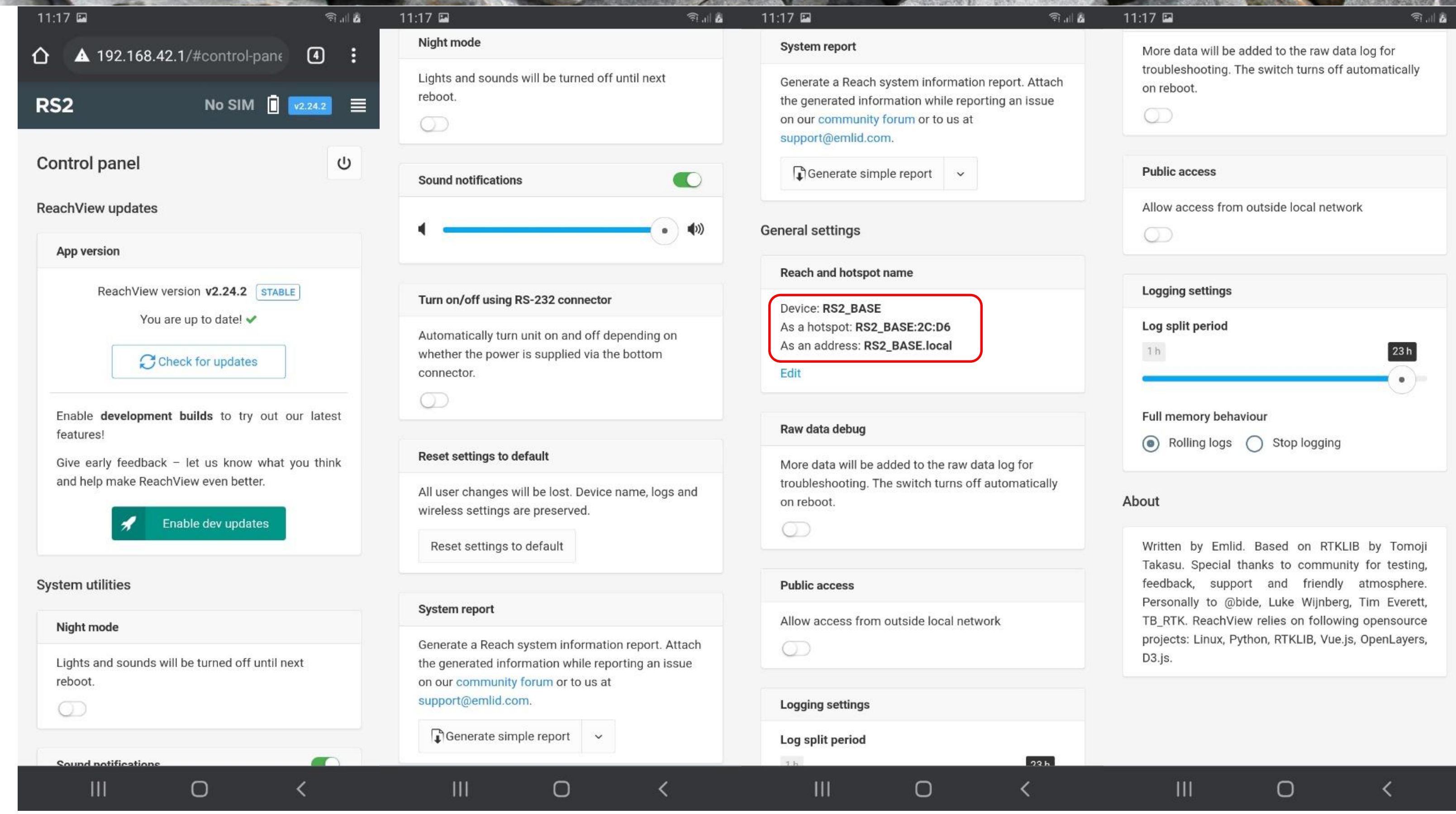


Figure 1. Settings Tab – on the Settings tab, make sure you see the connection to "RS2_BASE:2C:D6"

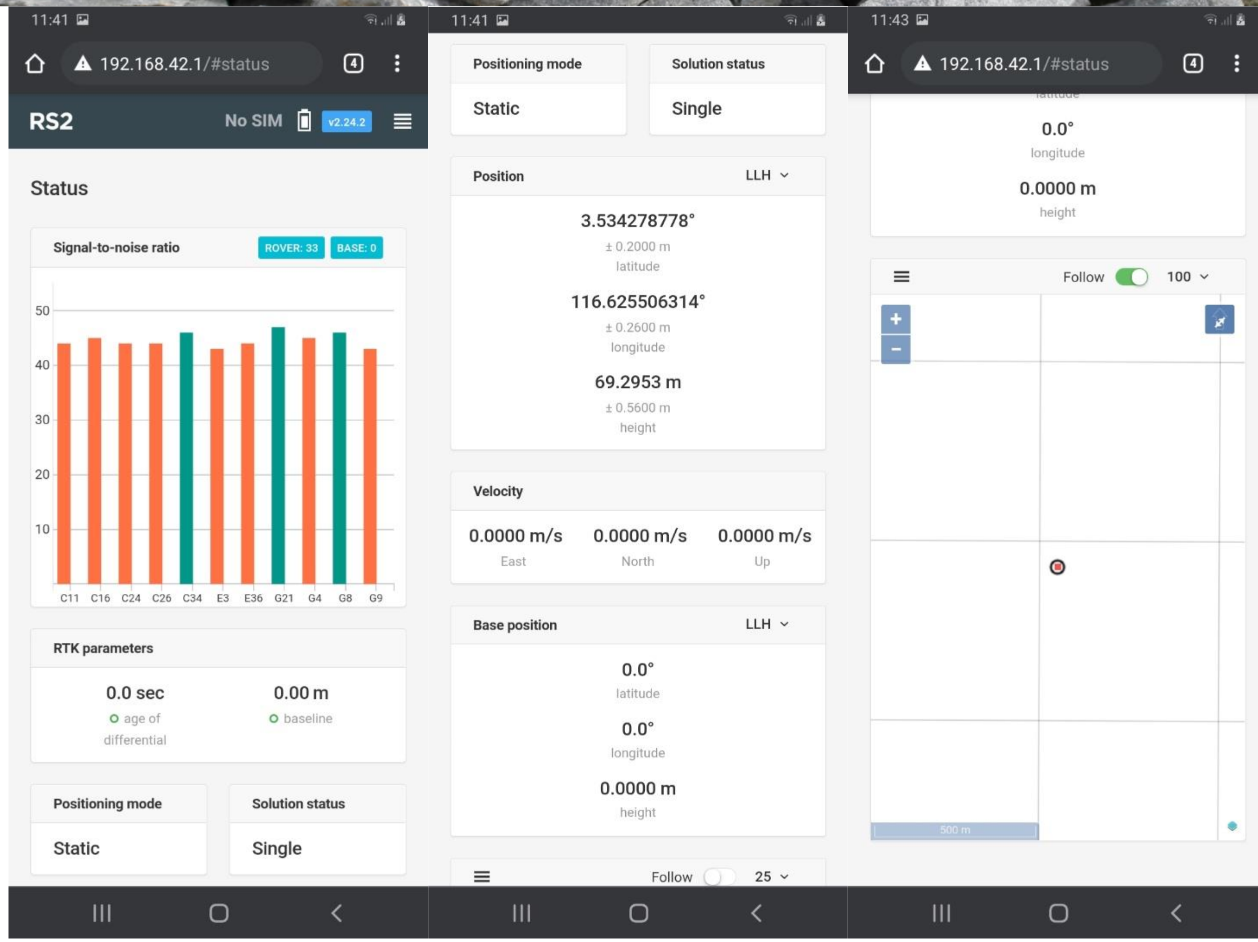


Figure 2. Status – nothing to set on this screen (and data may not appear at first start up or as other parameters are being set up)…continue

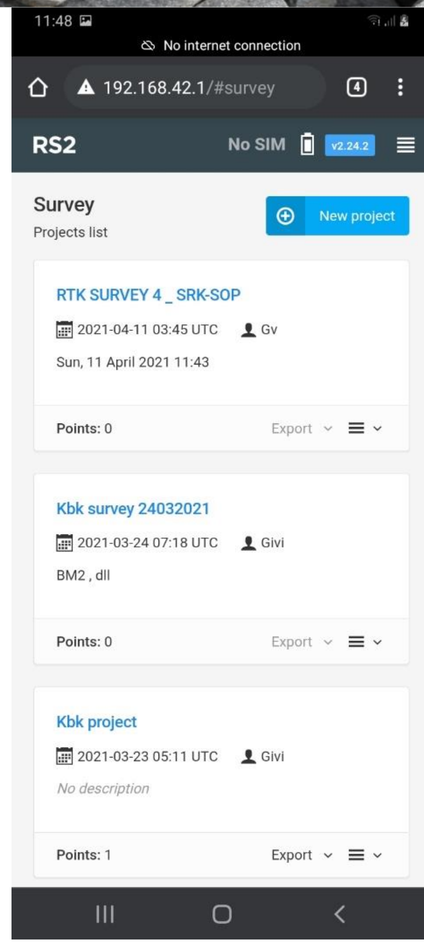
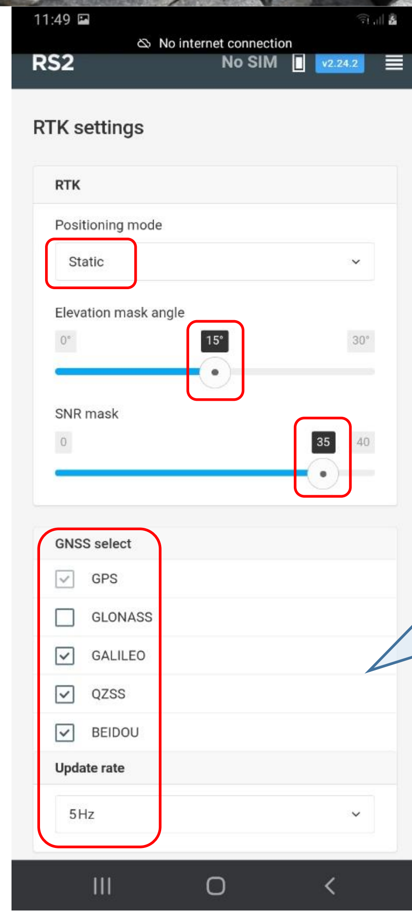


Figure 3. Survey – nothing to set on this screen (the Base ReachRS unit – at the Base location is not recording any data)…continue



Modify GNSS select to: GPS, Galileo, QZSS, Beidou – unselect the others.

Modify Max acceleration so it is higher than $0m/s^2$, say 1m/s for a base. The GPS AR Mode 'Fix and Hold' should take care of movement. -Allowing greater than $0m/s^2$ will stop our device rejecting observations entirely. Select <APPLY>

Figure 4. RTK Settings – see key parameters (note: When mapping Collar locations, the Base Receiver is to be set to Static mode)

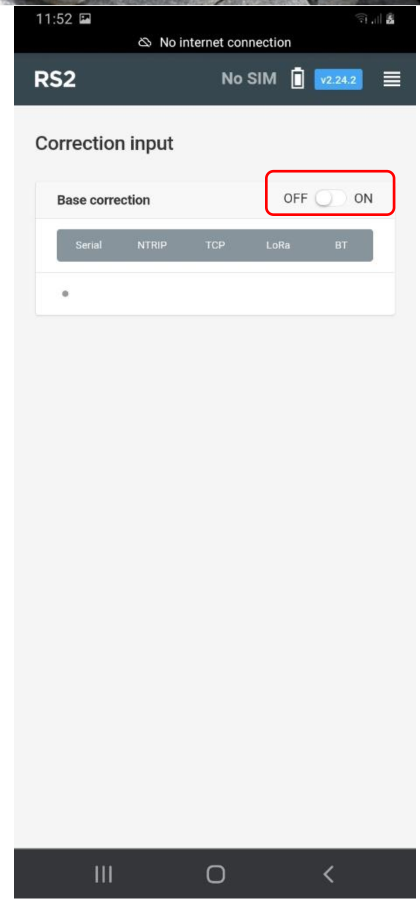


Figure 5. Correction Input – see key highlighted parameters (make sure Base Correction and Additional Correction are turned "OFF")…continue

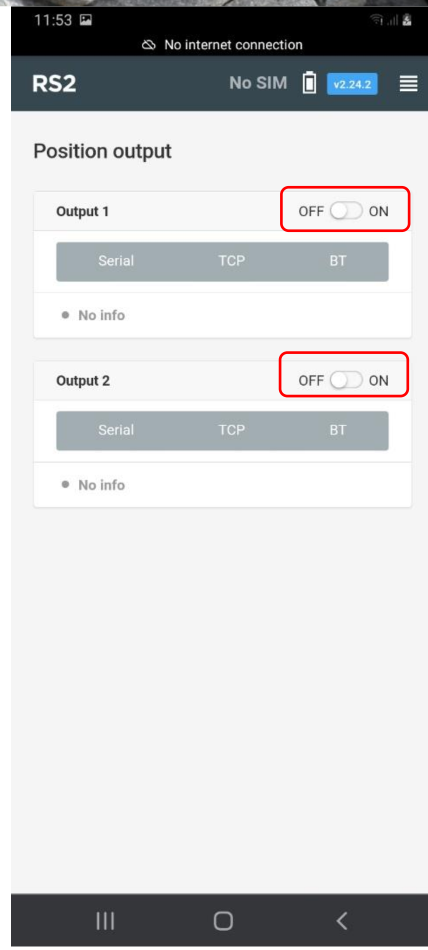


Figure 6. Position Output – for the Base Receiver Output 1 is set to "OFF"

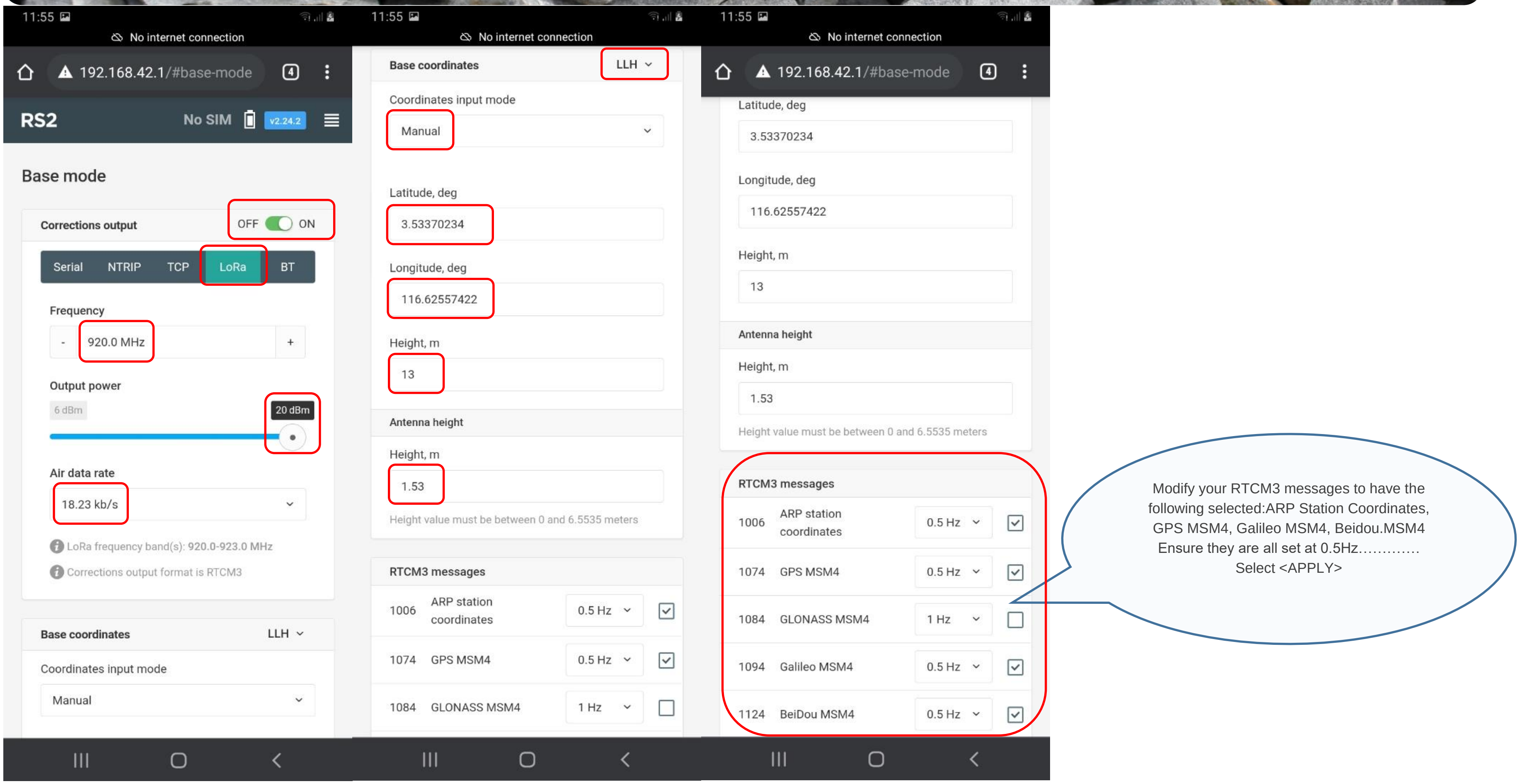


Figure 7. Base Mode – set key parameters as above (Note: Base Coordinates must be set to the Actual Position)

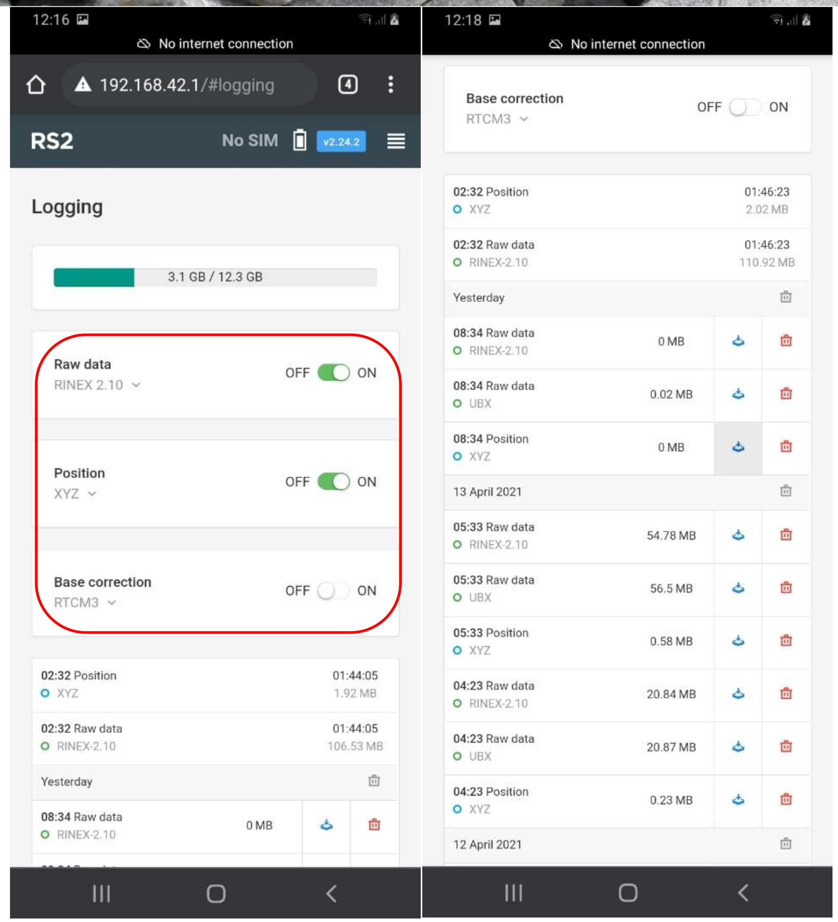


Figure 8. Logging – set all parameters as shown above

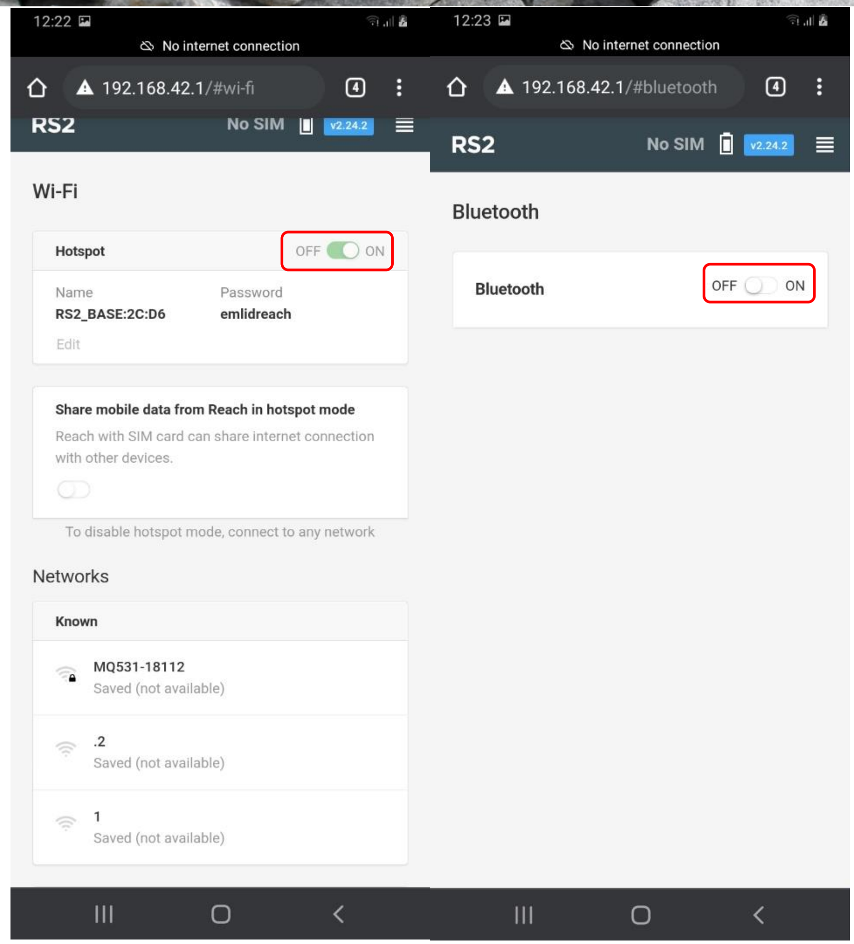


Figure 9. Wi-Fi/Bluetooth – for the base receiver, Wi-Fi is to be set to "ON"

A.2.2 Rover Receiver Unit Set up

6) Put Rover ReachRS on the monopole – (note the pole should be screwed into the receiver and be careful not to cross-thread the receiver unit)

7) Stand approximately 20-30 meters away from the Base Station you set up already.

8) Now using your Survey Samsung A12 Smartphone Android, connect to the Rover ReachRS via the Wi-Fi hotspot it has establish……(note: the internet is not required and the ReachRS Base unit will appear as "reach_rover:88:A8" in the Wi-Fi list as shown below.

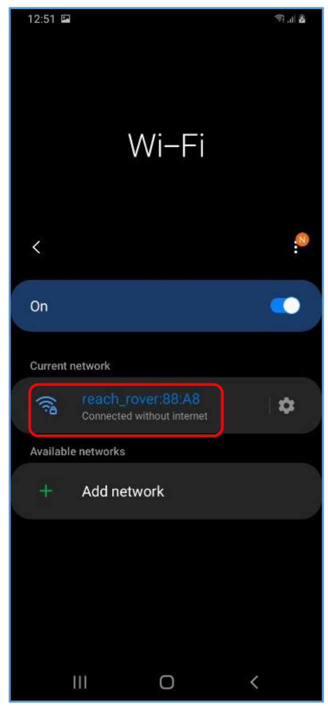


Figure 10. Connect to the ReachRS RS Rover by Wi-Fi (it will appear in the list as reach_rover:88:A8) if required the password is "emlidreach"

9) Once the Survey Samsung A12 Smartphone Android is connected to the ReachRS Base (reach_rover:88:A8), use your Chrome internet browser to open the ReachView software. To do this type http://192.168.42.1 in the IP address bar (as shown below).

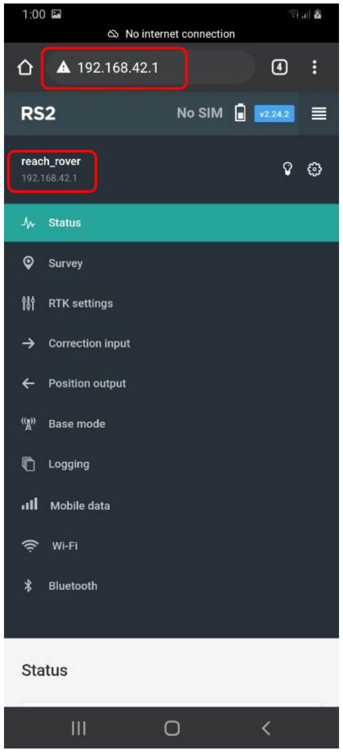


Figure 11. Http IP address to connect to the ReachView Software

10) When the ReachView software opens you can now update the user settings for the Rover Unit. (note: this is just for the rover "reach_rover:88:A8). Follow (exactly) the screen shots below.

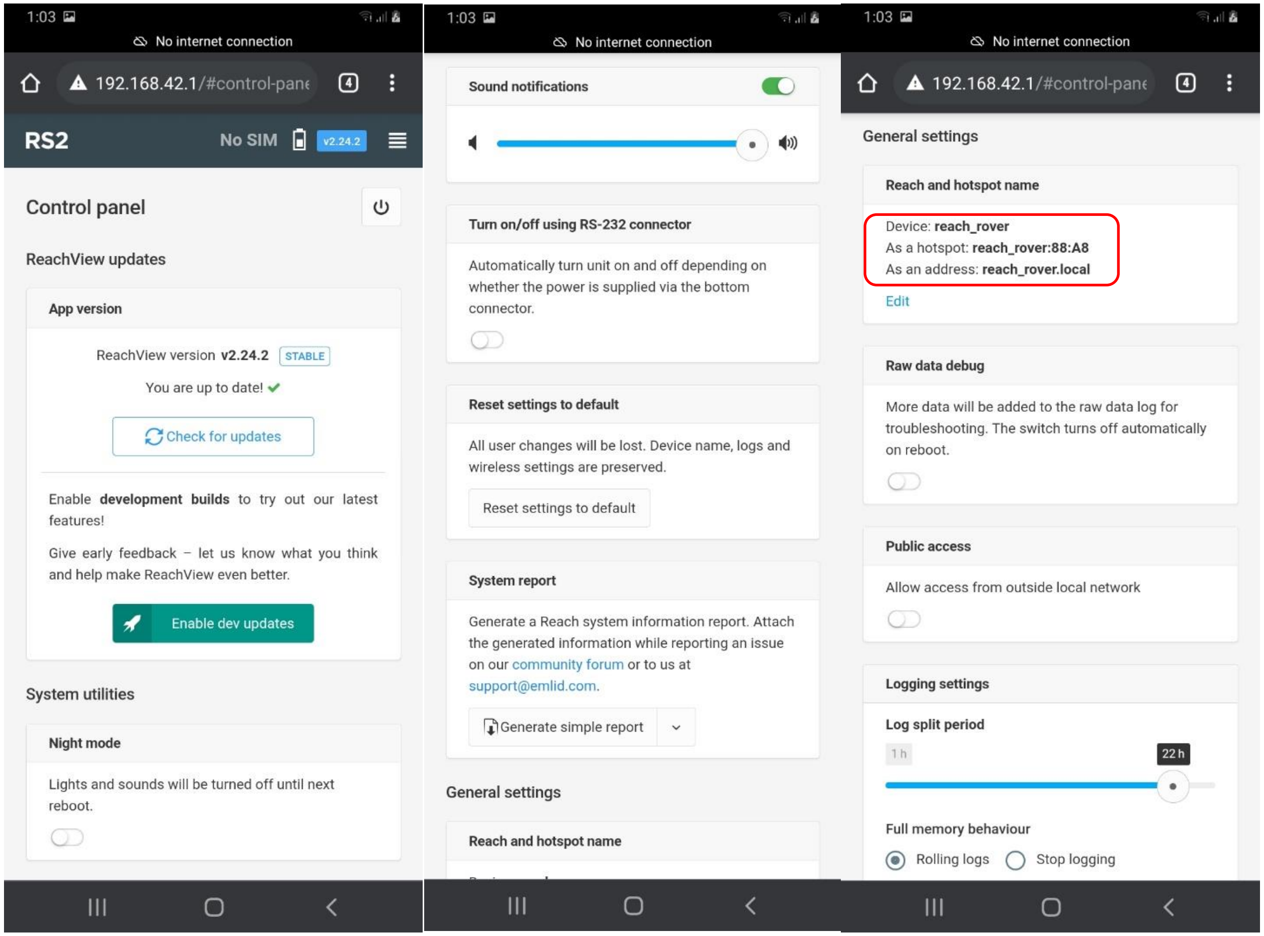


Figure 12. Settings (ROVER) – On the setting page, the User should first check if the Survey Samsung A12 Smartphone Androidis connected to the "reach_rover:88:A8"

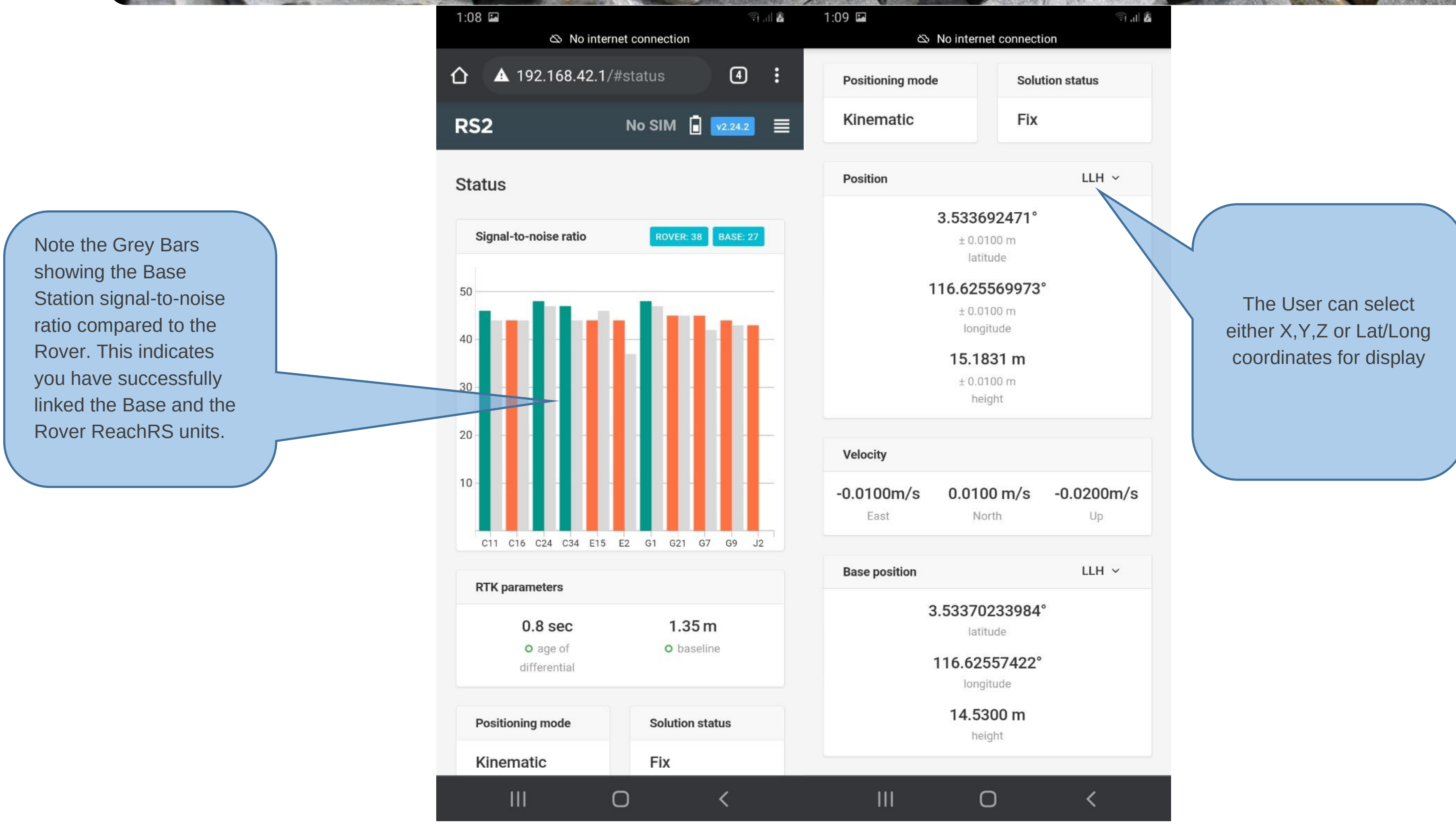


Figure 13. Status (ROVER) – Visual check of available data and signal strength (to check if the Rover is receiving a strong signal)

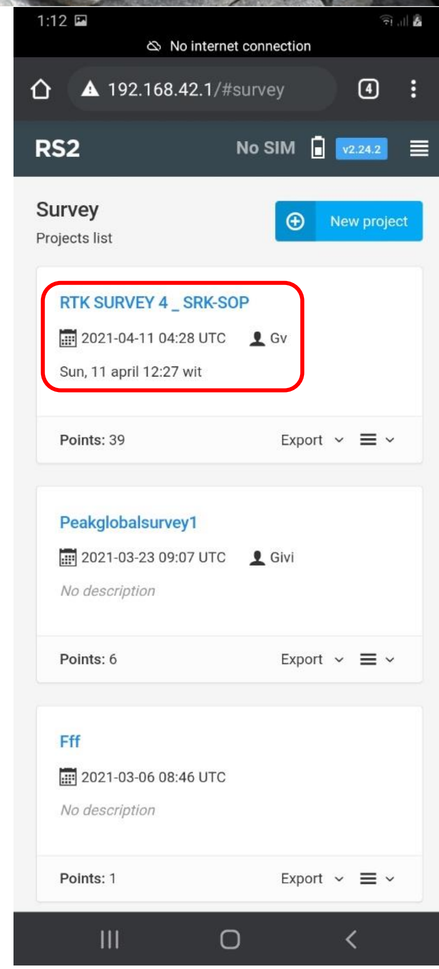


Figure 14. Survey (ROVER) – Select the pre-set project "RTK SURVEY 4_SRK-SOP" and this is where data will be saved to the device for exporting later. The data can only be exported as Latitude and Longitudes, and height (m). Note: You need to do a Lat/Long conversion to UTM after exporting (using the "UTMConversions1.xls")

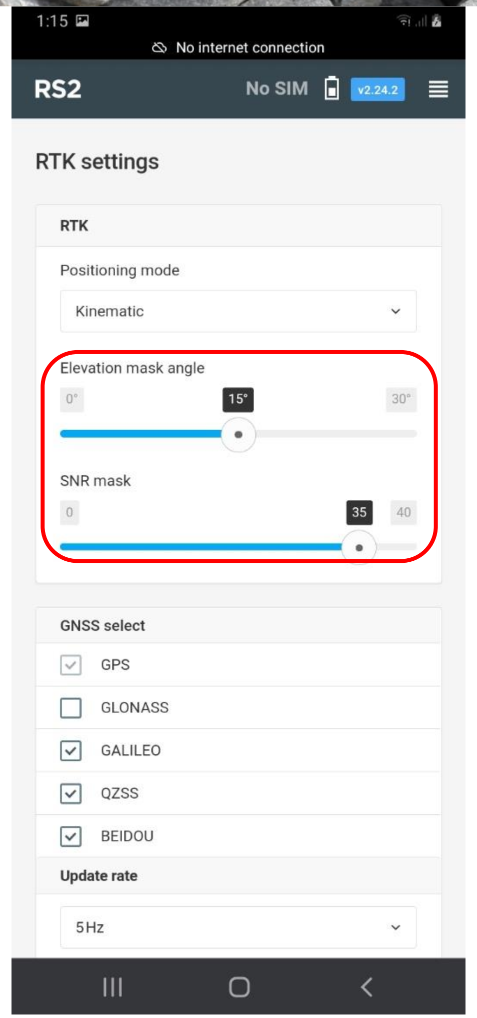


Figure 15. RTK Settings (ROVER) – When mapping Collar locations (use Kinematic) mode and adjust your anticipated acceleration.

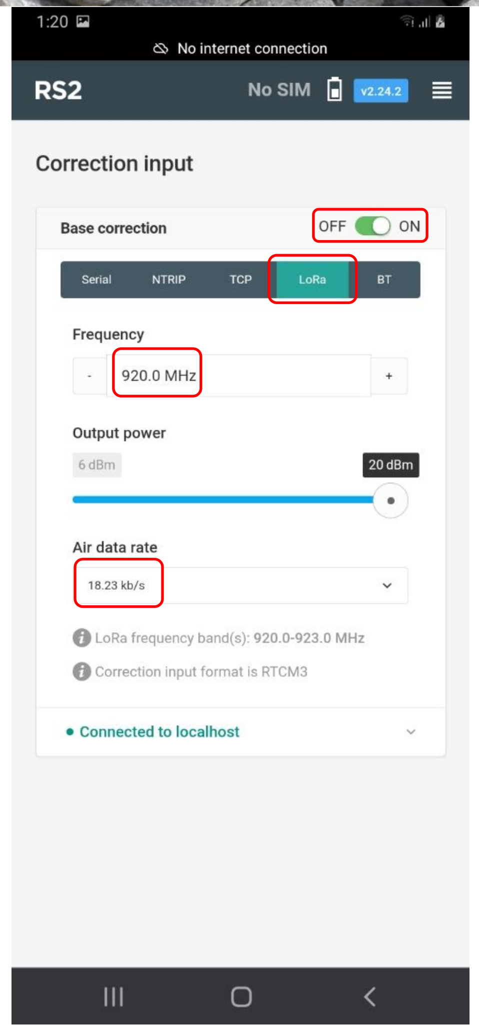


Figure 16. Correction Input (ROVER) – enable the key highlighted parameters above

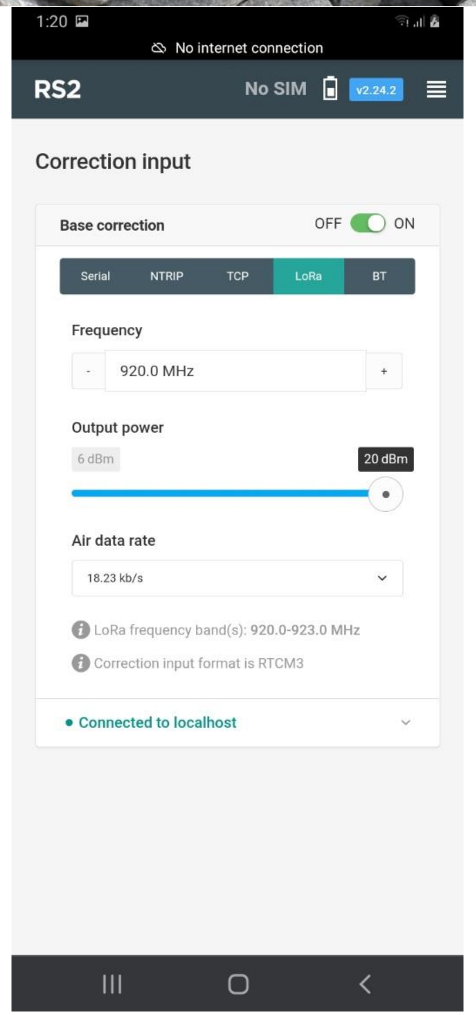


Figure 17. Position Output (ROVER) – Position out page is used if you want an output to view in Mappt. (we use inbuilt system software ReachView)

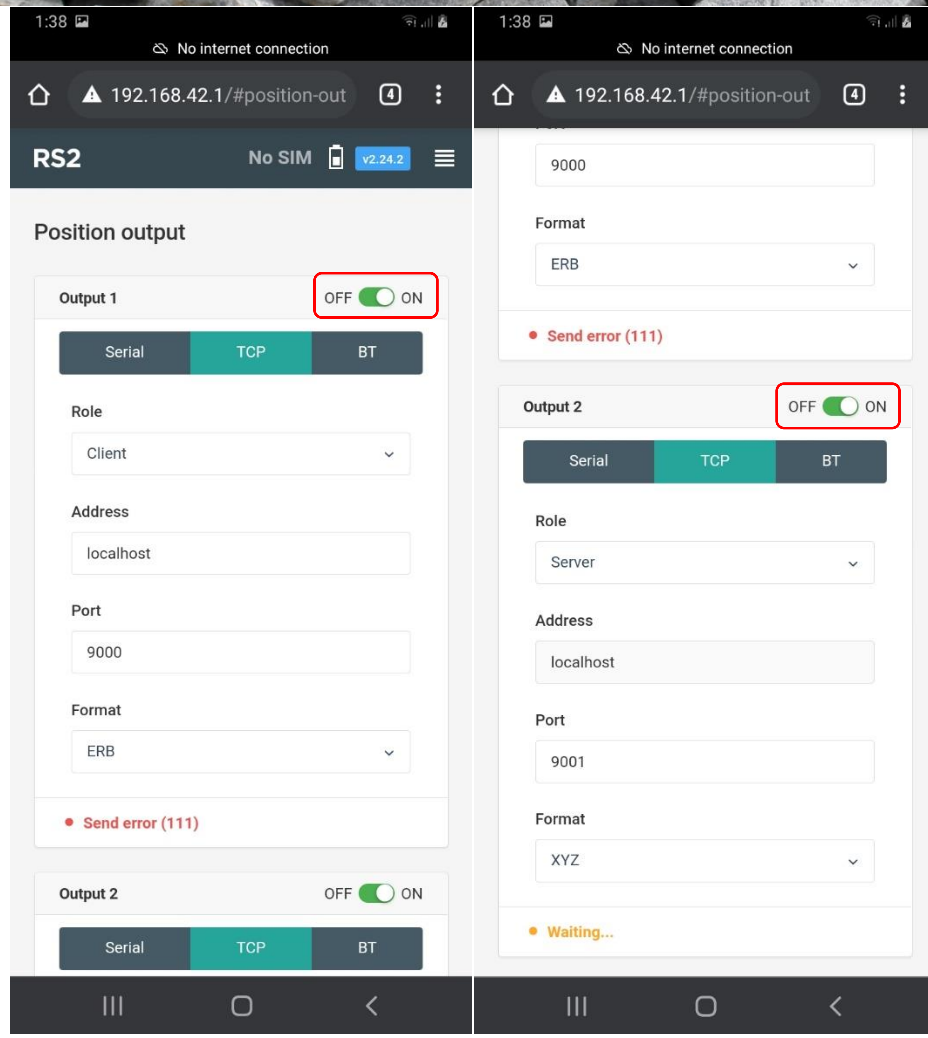

1:38
No internet connection
192.168.42.1/#position-out
RS2
No SIM
v2.24.2
Position output
Output 1
OFF ON
Serial
TCP
BT
Role
Client
Address
localhost
Port
9000
Format
ERB
Send error (111)
Output 2
OFF ON
Serial
TCP
BT
1:38
No internet connection
192.168.42.1/#position-out
9000
Format
ERB
Send error (111)
Output 2
OFF ON
Serial
TCP
BT
Role
Server
Address
localhost
Port
9001
Format
XYZ
Waiting...

Figure 18. Base Mode (ROVER) – Base mode is off for the Rover. (therefore everything on this tab is irrelevant)

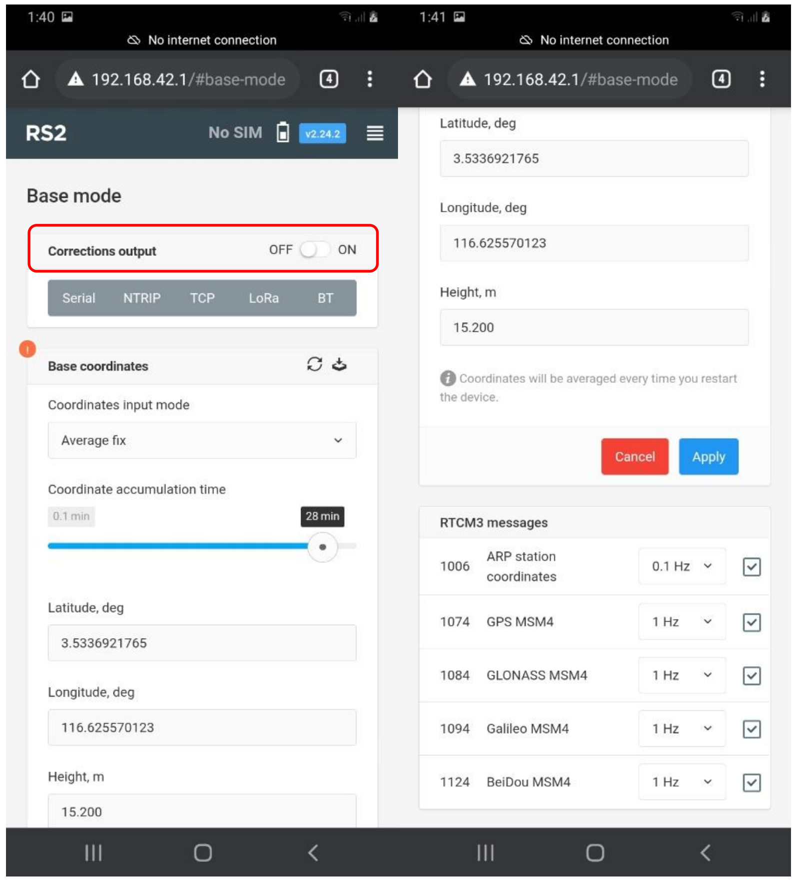


Figure 19. Logging (ROVER) – Logging (option to use/trial switching the "Base Correction to either RTCM3 or other (but RTCM3 is default as pictured)

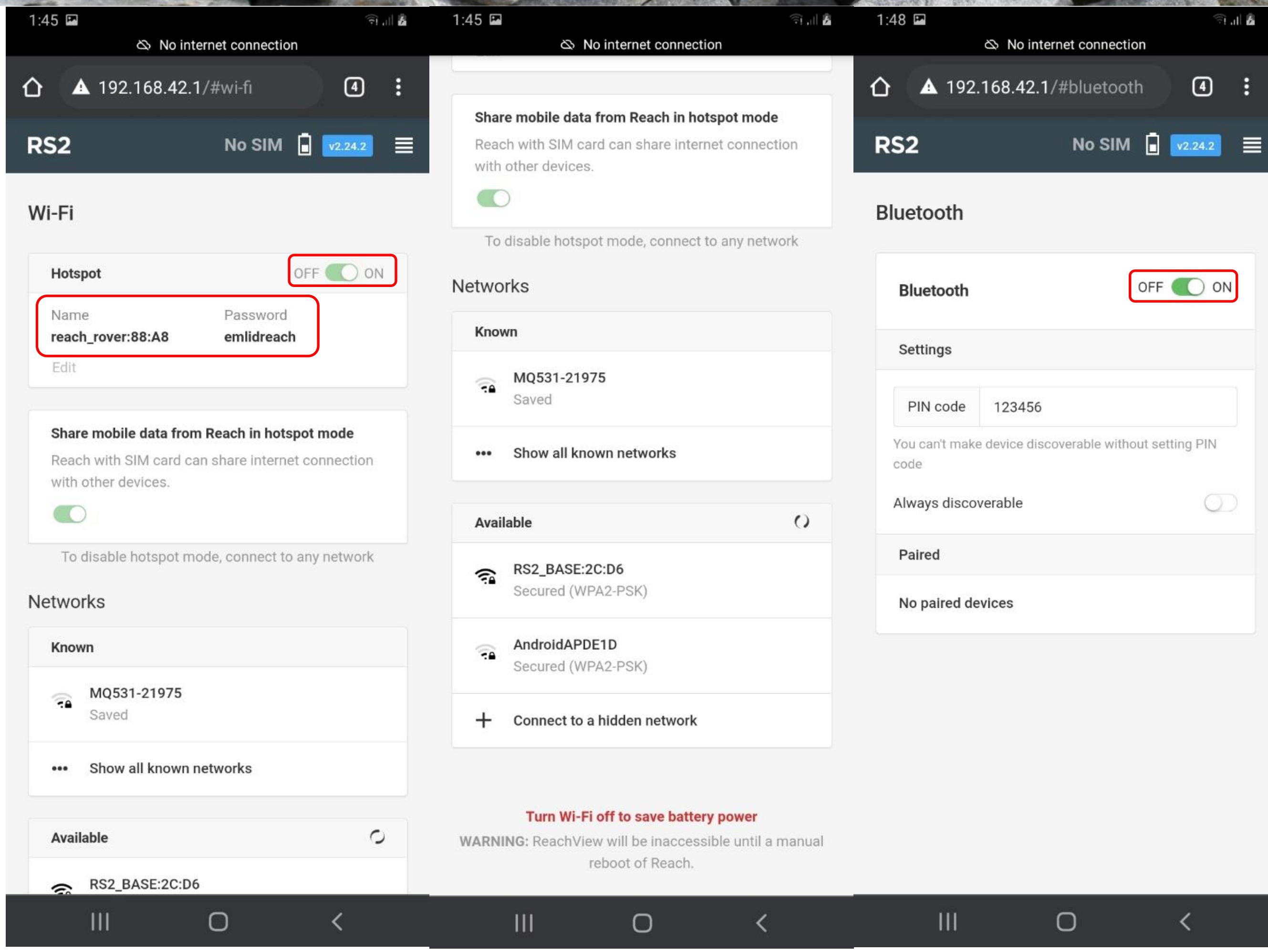


Figure 20. Wi-Fi/Bluetooth (ROVER) – WiFi Must be "ON" ***and*** **the user will also need to pair (via Bluetooth) to the Survey Samsung A12 Smartphone Android if wanting to be communicating to third party applications/software on the Survey Samsung A12 Smartphone Android.**

A.2.3 How to survey collars

When the Base receiver and the Rover receiver settings are completed as above you can commence surveying. A quick check of the “Status” tab (when connected to the Rover “reach_rover:88:A8”) will show the signal to noise ratio (or signal quality). DO NOT PROCEED IF THIS IS POOR!! (note: Red and Orange bars represent bad/poor signal to noise ratio as shown below).

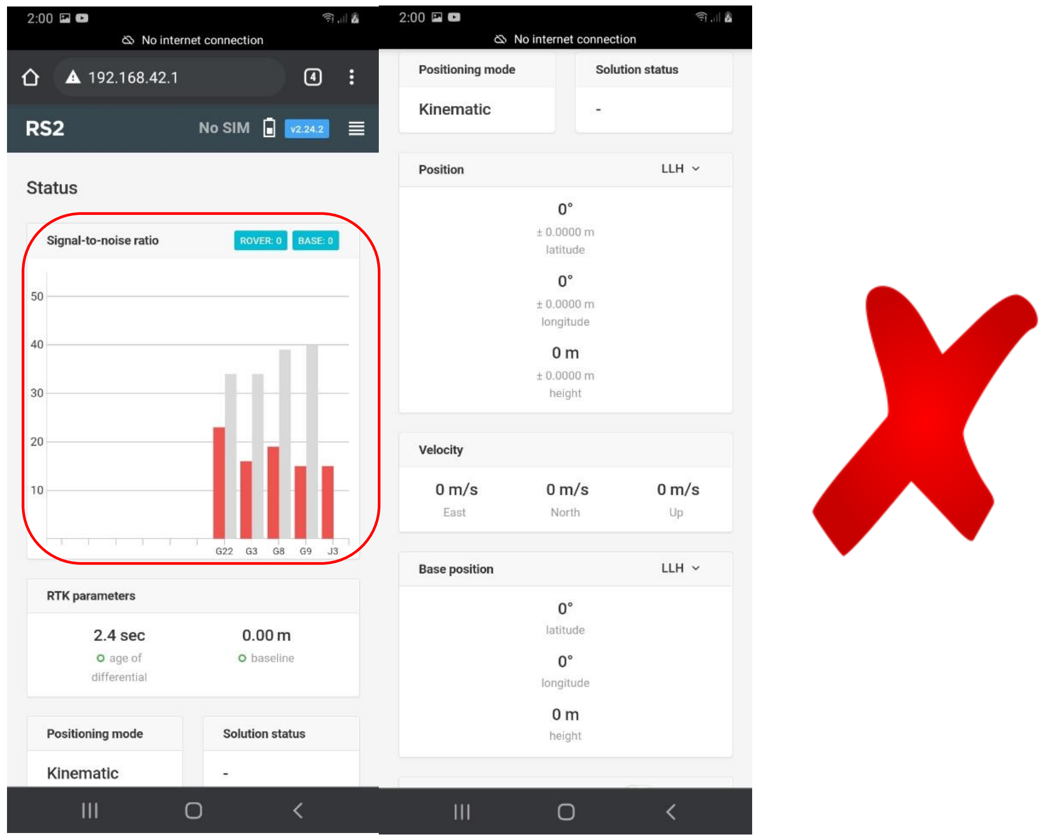


Figure 21. Screen shot example of “poor signal quality” to the Rover receiver (do not proceed with surveying until rectified)

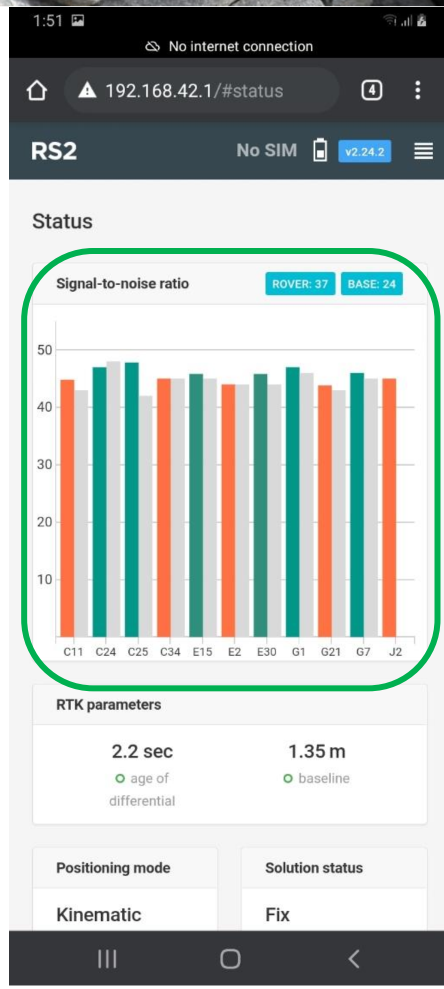


Figure 22. Screen shot example of "good signal quality" to the Rover receiver should be picking-up the same satellites as the Base receiver. (do not proceed with surveying until rectified). Note: ROVER: 37 and BASE:24 at the top of green highlighted section shows the number of available satellites.

1) On the “Survey tab” within the ReachView interface on the Survey Samsung A12 Smartphone Android as shown.

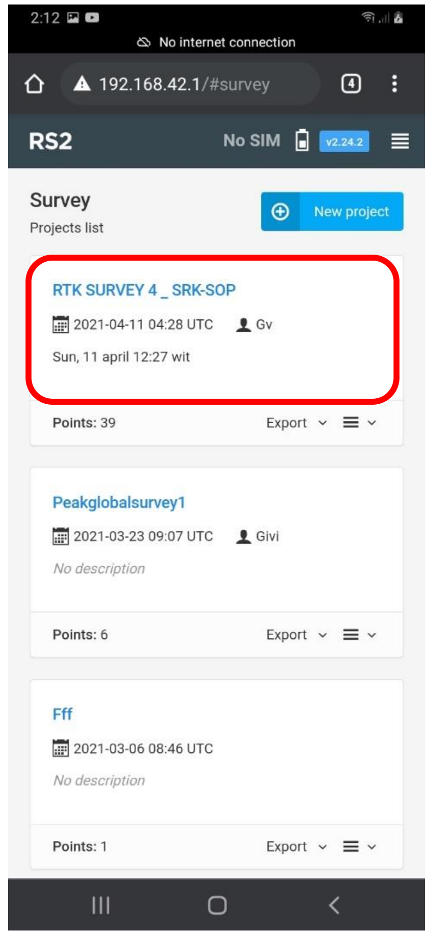


Figure 23. Screenshot of Survey Samsung A12 Smartphone Android “Open Project” (Select Project called “RTK SURVEY 4_SRK-SOP” as shown)

2) Take the Rover receiver and the Survey Samsung A12 Smartphone Android to the first Collar position and place the telecope pole on the collar.

Figure 24. Taking collar point survey (3 minutes duration for each survey point)

3) When in position directly over the cemented collar press the green “add” (+) button.

(Note: the survey project is set to average the position over 3 minutes and the Rover receiver must be held as steady as possible for this period.

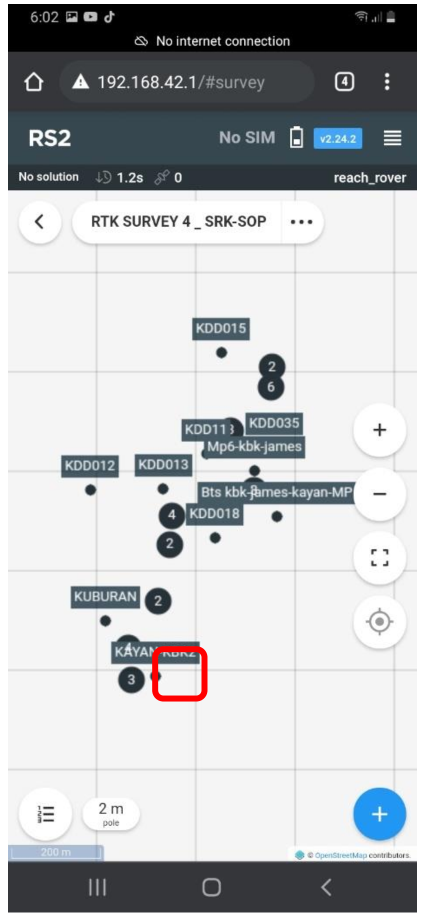


Figure 25. Screenshot of “Add New Point”

4) Change the Point name to the following convention “KDD013” (as shown below)

5) Press green “Collect” button to commence averaging the point location (as shown below).

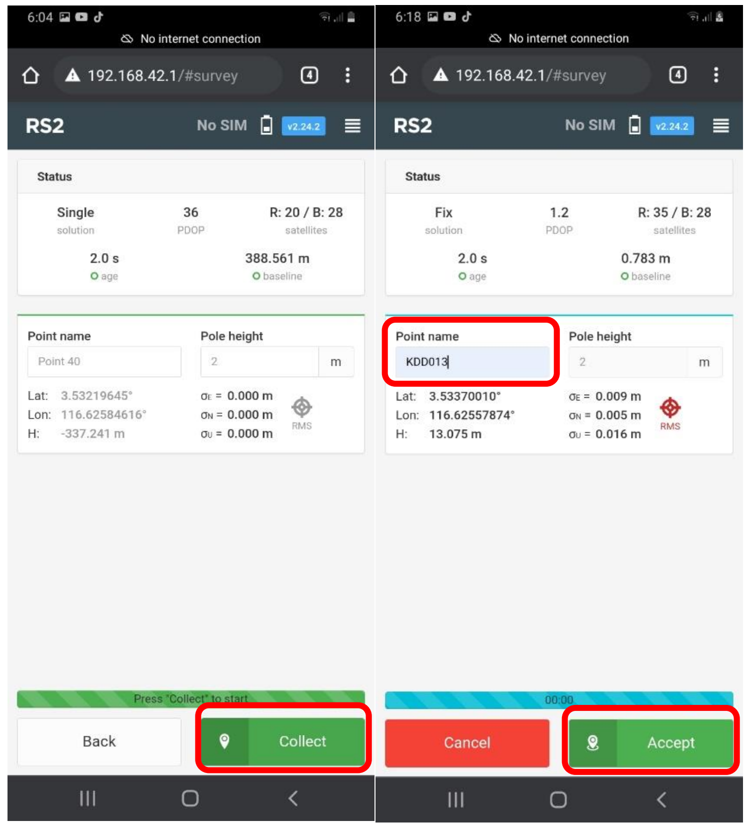


Figure 26. Screenshot point collection (The Correct nomecature is KDD013)

6) Once completed the 3 minutes the user should select “accept”.

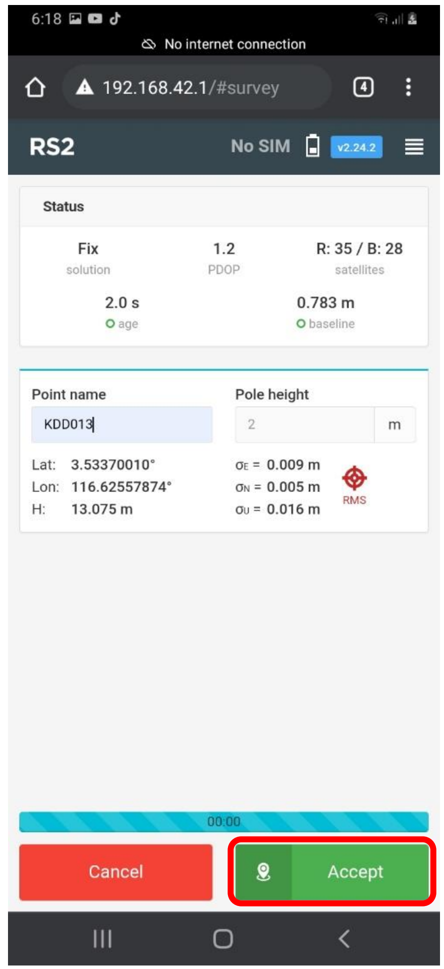


Figure 27. Screenshot point collection confirmation – select “Accept”

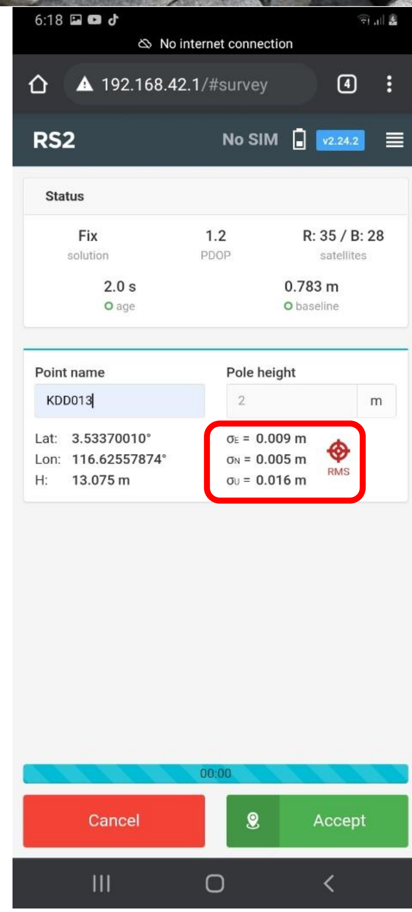


Figure 28. Sometimes the RMS is outside of the desired range (+/-2m approximately) however this is sometimes unavoidable due to various interference reasons. When this occurs the operator should make the choice if the Collar point should be either collected again or "Accepted" and noted that the RMS is outside of range. – user can select "Accept" but undertake best attempts to get a better result where possible.

A.2.4 Trouble Shooting and Technical Advice

Trouble Shooting and email assistance please contact - Tim or Alistair at MangoesMappping. The email is written on both receiver units

- Alistair Hart: **alistair@mangoesmapping.com.au**
- Tim Fraser: **tech@mangoesmapping.com.au**

Prior to conducting the surveying in the field, it is recommended that the operators read the Emlid proprietary quick start guide online. This is available here.

- **https://docs.emlid.com/reach/quickstart/**

A.3 Special Qualifications/Licenses Required

- All persons undertaking surveying with the ReachRS system must familiarize themselves with the proprietary document and online module.

  https://docs.emlid.com/reachrs/common/reachview/
- Any person not “passed out” (trained / assessed) on this task cannot undertake the task.
- No other formal qualifications/permits are required.

4 APPROVAL AND AUTHORITY TO PROCEED

The above standard operating procedure has been reviewed on [insert date] and is approved by the relevant personnel signed and dated below.

5 REVEVANT TECHNICAL TEAM MEMBERS

Name	Title	Signature	Date
Givi Andriyanto	Project Engineer		March 18 , 2021
Yusten Agung	Field Officer		March 18 , 2021

Approved by ______________________ Date ________

APPENDIX A EXAMPLE

COLLAR FINAL HOLE CLOSE-UP

April 16, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	KEY TASK SHEET - KBK COLLAR FINAL HOLE CLOSE-UP	Muhamad Rizki Ilahi	Junior Geologist	Wellsite Geologist	16/04/2021
v-2.0					

2 KEY TASK OVERVIEW

This document describes the task of closing the results of drilling holes in the field that has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project

3 DESCRIPTION OF ACTIVITY

For the closure of the drill holes, it is carried out after the drilling process is complete. This is done to cover the results of the drilling holes which will be made casting so that the drilling results can be seen and there are signs of drilling test results.

4 MATERIALS, EQUIPMENT, AND PPE

- Cement, sand and gravel
- Square wood mold 4 (40cmx40cm)
- Black permanent marker
- PVC Paralon with a size of 4 inches
- Field tape
- Compass Geological

Table 1-1: Step by Step Task for collar final hole close-up

Task	Description	Photo Example
TASK #1 Installation of PVC paralon at the point of the drill hole	All drilled holes that have ended will be marked with PVC paralon as a sign that drilling has been carried out.	

KALTARA BATU KONSTRUKSI

Task	Description	Photo Example
TASK #2 Take azimuth and dip measurements on the paralon at the point of the borehole	After the drill hole is marked with PVC, point the azimuth and dip that have been specified in the drilling plan and write azimuth and dip on the paralon to indicate that the drill hole has been drilled.	
TASK #3 Perform cement at the point of the borehole	After we have measured the azimuth and dip directions, then cement the borehole with the dimensions 40cm x 40 cm. This cementing is carried out to stabilize the azimuth and dip directions in the borehole.	
TASK #4 Providing coding and recording of coordinates on the field tape and drill point markers	Write down the drilling code and azimuth direction, dip, the last depth in the drill hole, write down the drilling start date and the drilling end date. The coordinate code and drilling code will be made a plate to be affixed to the cement floor.	

Figure 1:

Example of Completed collar final hole close-up

GEOLOGY DRY BULK DENSITY MEASUREMENT TASK

April 16, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	KEY TASK SHEET - KBK DENSITY MEASUREMENT	Dean McMinn	Geologist	Site Operations Manager	15/03/2021
v-2.0	KEY TASK SHEET – KBK DENSITY MEASURMENT	Muhamad Rizki Ilahi	Geologist	Wellsite Geologist	16/04/2021

2 KEY TASK OVERVIEW

This document describes the task for dry bulk measurement in the field which has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

3 DESCRIPTION OF ACTIVITY

Prior to cutting diamond drill (DD) core and before samples are submitted analysis at the laboratory, whole drill core needs to be measured for density. In this task we will conduct measure the drill core for its calculated dry bulk density.

In situ dry bulk density is represented by the mass per unit volume, including porosity but excluding any natural water content (expressed as t/m^{-3}). This is the important parameter which is used to compute the overall tonnage estimated in the Mineral Resource Estimation (MRE) phases of development.

4 MATERIALS, EQUIPMENT, AND PPE

- Hard Copy Logging Sheet for recording dry bulk weights (prepared and ready to log)
- Specific Gravity (SG) Stand and wire basket
- Fresh tap water for the stand
    - Alternate material if unconsolidated material- Plastic wrap to wrap unconsolidated sample (OXIDE and TRANSITIONAL only)
- Pen / Pencil / Black Permanent Marker Pen
- Flagging Tape to mark samples in the core trays
- Electronic scales and basket (provided with SG stand)
- Ear plugs if in noisy conditions and where appropriate

The method for density measurement is as follows:

Figure 1: Bulk Density Measurement Station

1. Select 10cm of drill core from core tray. Note the FROM and TO meters and also the LITHO. Cross check the LITHO record match with the geology logging also as a secondary check

2. weigh the selected core in air by placing directly on the weight scales. This is the (dry mass, or weight in air = **W1**)

3. then weigh the core completely submerged under fresh water by placing the core in the hanging submerged basket. This is the weight in water = **W2**). Note the basket is hanging off the hook in the metal basket without touching the bottom or sides of the bucket.

4. The density is calculated using the Archimedean principle, as follows:

$$\text{Density} = W_1 / (W_2 - W_1)$$

5. Then record the results saved into the Data capture log sheet tab. It is recommended that all data should be collected manually on paper ("file ref: "LOG SHEET - DENSITY_Template.docx")

6. then enter log results into the data capture spreadsheet (file ref: "U7285_DH_v1-3.xlsb") .

Other notes: The density measurements should also be supplemented with QAQC check samples (a standard, or ‘known test weight’) to ensure the precision and accuracy of the density measurements taken. The **standard** should be measured on the upper and lower scale both in and out of water (lower scale meaning the hanging basket) at the start and end of the day and recorded at the top of the density measurement sheet. The standard should also be measured once every 20 normal sample density measurements.

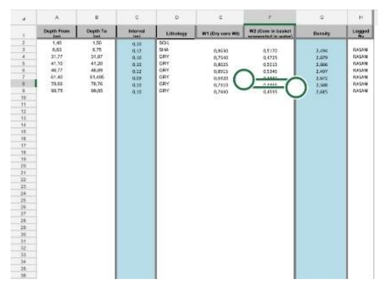
Additionally, it is suggested that at regular intervals (such as once in every 20 normal samples or 1/20 for each Density Measurement taken), a **repeat** measurement should be made in order to check for repeatability (precision) and truthfulness (accuracy) of the measurements taken and if the equipment is functioning.

A step by step description of the task is provided in the table below with pictured examples of each item.

Table 4-1: Step by Step Task for Density Measurement in the Field

Task	Description	Photo Example

TASK #1
 	
Geologist selects Core Interval from Core Box
	The selected core will be:
	• approximately 10 cm in length
	• pre-labelled by the Logging Geologist showing:
	  ○ interval metre mark start and end
	  ○ lithological code
		

TASK #2
 	
Select Core Interval From Core Box
	On the paper record sheet, note:
	  ○ FROM (m),
	  ○ TO (m),
	  ○ LENGTH (m), and
	  ○ ROCK TYPE
	
	Also Complete the rest of the form (Hole Number, Date, your name. etc)
		

TASK #3 Record Weight (w1)	**(W_1)** Record Weight in Air Record measurement on paper record sheet against the correct metre interval	

KALTARA BATU KONSTRUKSI

Task	Description	Photo Example
TASK #4 Record Weight in Water (w2)	**(W_2)** Wrap unconsolidated samples in plastic wrap (OXIDE and TRANSITIONAL only) Place the core in the basket and submerge in water. Record Weight in Water Record measurement on the paper record sheet against the correct metre interval	

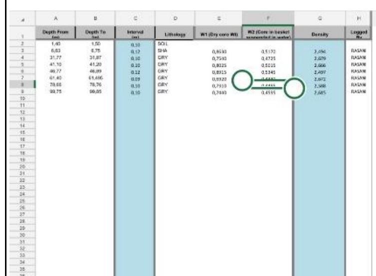
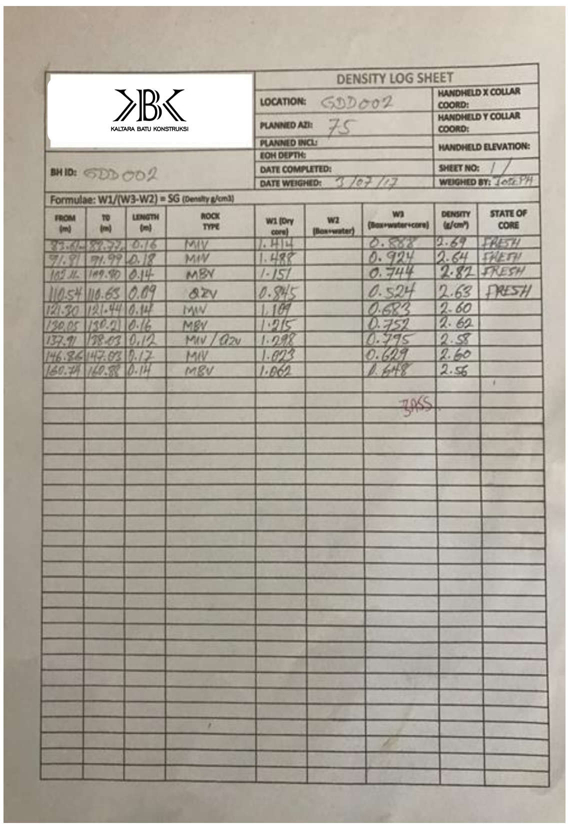
Task	Description	Photo Example
#5 Calculate density and describe core weathering condition (m/t3)	Enter the calculated field value of Density Describe the STATE of the core: ○ OX = Oxidised ○ TRAN = Transitional ○ FR = Fresh Rock Repeat steps 1 – 5 until suitable amount of representative core is obtained As a general rule, each 10 m of core should have at least one (1) of each Litho code, where possible. Note: per 100m of drilling there should be at least 10 density measurements taken and 4 (four) for EACH Lithology / domain Ie. if there are four domains or four Lithologies Lithology 1 = GRY approx., x 5 density measurements Lithology 2 = SHA approx. x 5 density measurements In terms of frequency of measurements: The project geologist should take at least 1 density measurement for every second core box and per lithology	

Figure 2:

Example of Completed Density Log Sheet



DENSITY LOG SHEET

KALTARA BATU KONSTRUKSI

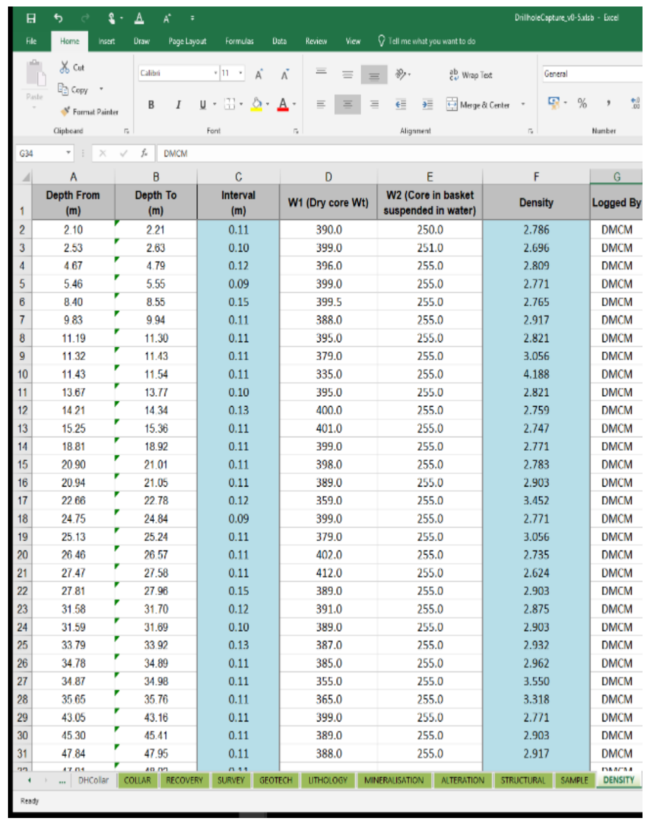
BH ID: GDD002	LOCATION: GDD002	HANDHELD X COLLAR COORD:	
	PLANNED AZI: 75	HANDHELD Y COLLAR COORD:	
	PLANNED INCL:	HANDHELD ELEVATION:	
	EOH DEPTH:		
	DATE COMPLETED:	SHEET NO: 1/	
	DATE WEIGHED: 3/07/17	WEIGHED BY: JOSEPH	

Formulae: W1/(W3-W2) = SG (Density g/cm3)

FROM (m)	TO (m)	LENGTH (m)	ROCK TYPE	W1 (Dry core)	W2 (Box+water)	W3 (Box+water+core)	DENSITY (g/cm³)	STATE OF CORE
83.61	83.77	0.16	MIV	1.414		0.888	2.69	FRESH
91.81	91.99	0.18	MIV	1.488		0.924	2.64	FRESH
109.76	109.90	0.14	MBV	1.151		0.744	2.82	FRESH
110.54	110.63	0.09	QZV	0.845		0.524	2.63	FRESH
121.30	121.44	0.14	MIV	1.109		0.683	2.60	
130.05	130.21	0.16	MBV	1.215		0.752	2.62	
137.91	138.03	0.12	MIV / QZV	1.298		0.795	2.58	
146.86	147.03	0.17	MIV	1.023		0.629	2.60	
160.74	160.88	0.14	MBV	1.062		0.648	2.56	

Figure 3:

Example of Completed Density Log transposed into the Data Capture sheet



	Depth From (m)	Depth To (m)	Interval (m)	W1 (Dry core Wt)	W2 (Core in basket suspended in water)	Density	Logged By
2	2.10	2.21	0.11	390.0	250.0	2.786	DMCM
3	2.53	2.63	0.10	399.0	251.0	2.696	DMCM
4	4.67	4.79	0.12	396.0	255.0	2.809	DMCM
5	5.46	5.55	0.09	399.0	255.0	2.771	DMCM
6	8.40	8.55	0.15	399.5	255.0	2.765	DMCM
7	9.83	9.94	0.11	388.0	255.0	2.917	DMCM
8	11.19	11.30	0.11	395.0	255.0	2.821	DMCM
9	11.32	11.43	0.11	379.0	255.0	3.056	DMCM
10	11.43	11.54	0.11	335.0	255.0	4.188	DMCM
11	13.67	13.77	0.10	395.0	255.0	2.821	DMCM
12	14.21	14.34	0.13	400.0	255.0	2.759	DMCM
13	15.25	15.36	0.11	401.0	255.0	2.747	DMCM
14	18.81	18.92	0.11	399.0	255.0	2.771	DMCM
15	20.90	21.01	0.11	398.0	255.0	2.783	DMCM
16	20.94	21.05	0.11	389.0	255.0	2.903	DMCM
17	22.66	22.78	0.12	359.0	255.0	3.452	DMCM
18	24.75	24.84	0.09	399.0	255.0	2.771	DMCM
19	25.13	25.24	0.11	379.0	255.0	3.056	DMCM
20	26.46	26.57	0.11	402.0	255.0	2.735	DMCM
21	27.47	27.58	0.11	412.0	255.0	2.624	DMCM
22	27.81	27.96	0.15	389.0	255.0	2.903	DMCM
23	31.58	31.70	0.12	391.0	255.0	2.875	DMCM
24	31.59	31.69	0.10	389.0	255.0	2.903	DMCM
25	33.79	33.92	0.13	387.0	255.0	2.932	DMCM
26	34.78	34.89	0.11	385.0	255.0	2.962	DMCM
27	34.87	34.98	0.11	355.0	255.0	3.550	DMCM
28	35.65	35.76	0.11	365.0	255.0	3.318	DMCM
29	43.05	43.16	0.11	399.0	255.0	2.771	DMCM
30	45.30	45.41	0.11	389.0	255.0	2.903	DMCM
31	47.84	47.95	0.11	388.0	255.0	2.917	DMCM

DHCollar | COLLAR | RECOVERY | SURVEY | GEOTECH | LITHOLOGY | MINERALISATION | ALTERATION | STRUCTURAL | SAMPLE | DENSITY

Figure 4:

Example of Completed Density Log transposed into the Data Capture sheet

	A	B	C	D	E	F	G	H
1	Depth From (m)	Depth To (m)	Interval (m)	Lithology	W1 (Dry core Wt)	W2 (Core in basket suspended in water)	Density	Logged By
2	1,40	1,50	0,10	SOIL				
3	6,63	6,75	0,12	SHA	0,8630	0,5170	2,494	RASANI
4	31,77	31,87	0,10	GRY	0,7540	0,4725	2,679	RASANI
5	41,10	41,20	0,10	GRY	0,8025	0,5015	2,666	RASANI
6	46,77	46,89	0,12	GRY	0,8915	0,5345	2,497	RASANI
7	61,40	61,495	0,09	GRY	0,6920	0,4330	2,672	RASANI
8	78,66	78,76	0,10	GRY	0,7310	0,4485	2,588	RASANI
9	99,75	99,85	0,10	GRY	0,7440	0,4595	2,615	RASANI
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								

WATER TABLE DEPTH MEASUREMENT

April 14, 2021

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	KEY TASK SHEET - KBK WATER TABLE DEPTH MEASUREMENT	Rifki Asrul Sani	Geologist		
v-2.0					

2 KEY TASK OVERVIEW

This document describes the task for water table depth measurement in the field and it has been developed by PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

3 DESCRIPTION OF ACTIVITY

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water in an open borehole, cased borehole, monitor well, or piezometer. These standard operating procedures may be varied or changed as required, dependent on site conditions, and equipment limitations. In all instances, the actual procedures employed will be documented and described in an appropriate site report.

Generally, water-level measurements taken in boreholes, piezometers, or monitor wells are used to construct water table or potentiometric surface maps and to determine flow direction as well as other aquifer characteristics.

4 MATERIALS, EQUIPMENT, AND PPE

A survey mark should be placed on the top of the riser pipe or casing as a reference point for groundwater level measurements. If the lip of the riser pipe is not flat, the reference point may be located on the grout apron or the top of the outer protective casing (if present). The measurement reference point should be documented in the site logbook and on the groundwater level data form (Appendix A), if used. All field personnel must be made aware of the measurement reference point being used in order to ensure the collection of comparable data.

The electric water level indicator and the chalked steel tape are the devices commonly used to measure water levels. Both have an accuracy of 0.01 feet. Procedures for determining water levels are as follows:

1. Remove locking well cap, note well ID, time of day, and date in site logbook or an appropriate groundwater level data form.
2. Remove well cap.
3. Lower water-level measuring device into the well. Electrical tapes are lowered to the water surface whereas chalked steel tapes are lowered generally a foot or more below the water surface. Steel tapes are generally chalked so that a 1-to 5-foot long section will fall below the expected water level.
4. For electrical tapes record the distance from the water surface, as determined by the audio signal or meter, to the reference measuring point and record in the site logbook. For chalked tapes, an even foot mark is held at the reference point, once the chalked section of the tape is below the water level. Both the water level on the tape and the foot mark held at the reference point is recorded. The depth to the water is then the difference between the two readings. In addition, note the reference point used (top of the outer casing, top of the riser pipe, ground surface, or some other reproducible position on the well head). Repeat the measurement.

To determine groundwater elevation above mean sea level, use the following equation:

$$E_w = E - D$$

where:

E_W = Elevation of water above mean sea level (m) or local datum

E = Elevation above sea level or local datum at point of measurement (m)

D = Depth to water (m)

APPENDIX A

Figure 1. Water table depth measurement equipment.

GROUNDWATER LEVEL DATA FORM

SITE NAME (PROJECT) : **LOGGER NAME :**

LOG DATE :

Hole ID	Date and time	Weather condition	Elevation (m)	Depth to water (m)	Elevation to water (E_W)	Comment

REFLEX EZ-TRAC™

Panduan Pengguna Cepat

SOFTWARE V1.0.28

IMDEXHUB-IQ™ ENABLED

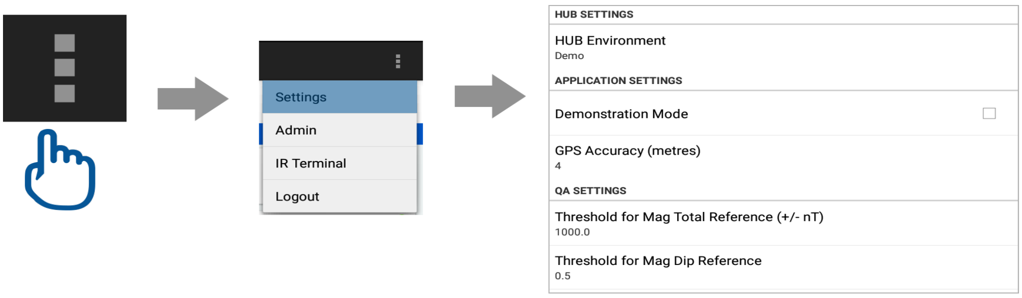
PENGATURAN

① Atur Wi-Fi pada tablet

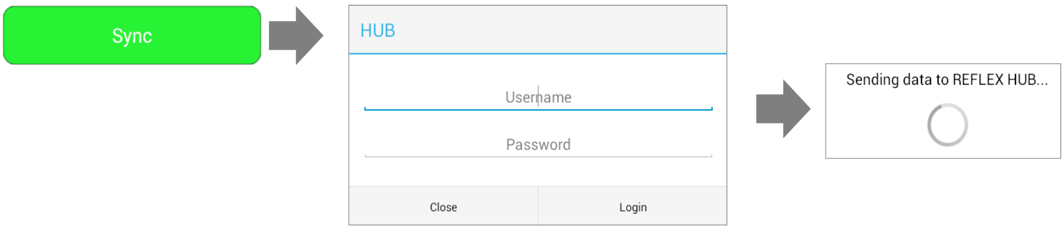
② Ketuk untuk meluncurkan aplikasi EZ-TRAC™

EZ-TRAC

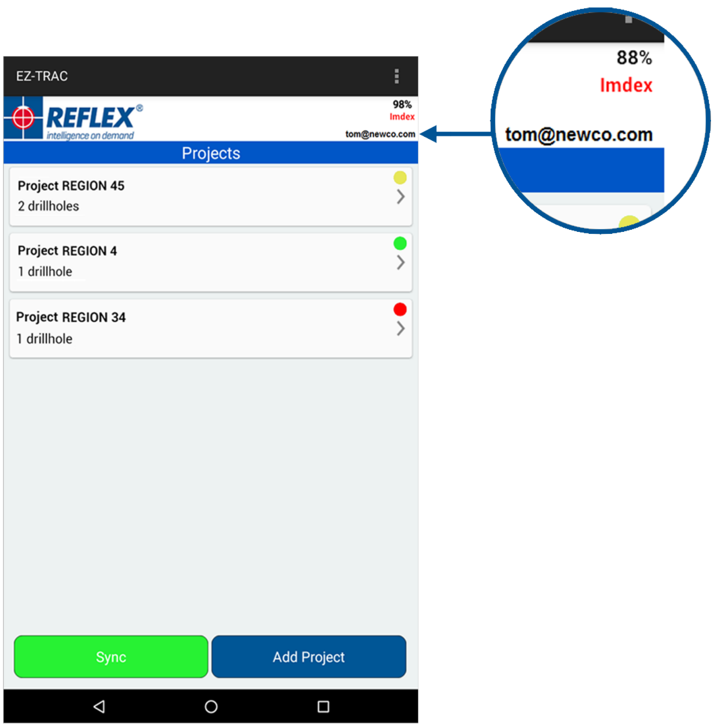
③ Atur parameters



④



Layar Proyek muncul



Login yang berhasil menampilkan nama pengguna

- Synced
- Partial Sync
- Not Synced (Created on REFLEXHUB-IQ)
- Not Synced (Created on tablet)

⑤ Add Project → Add Project

Project name:
REGION 749
Cancel Save

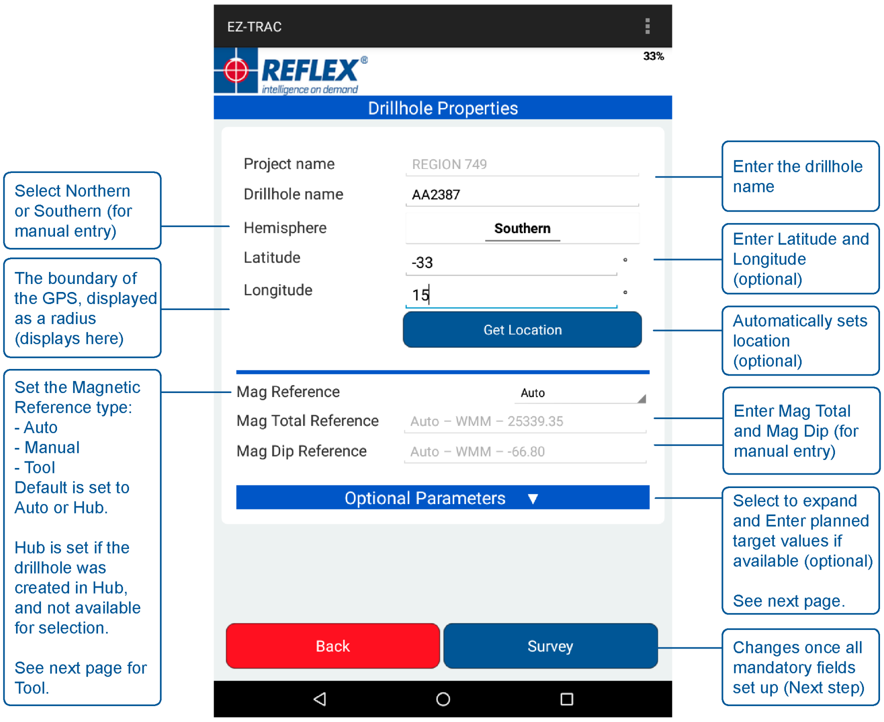
atau pilih proyek

Project REGION 749
2 drillholes

⑥ Add Drillhole

Atau pilih (gulir atau filter)

Ketikkan beberapa huruf pertama dari nama Lubang Bor



Get Location

Latitude	-31.862485 °
Longitude	115.816641 °
Accuracy	16.6 m

Watching position
Cancel Accept

→

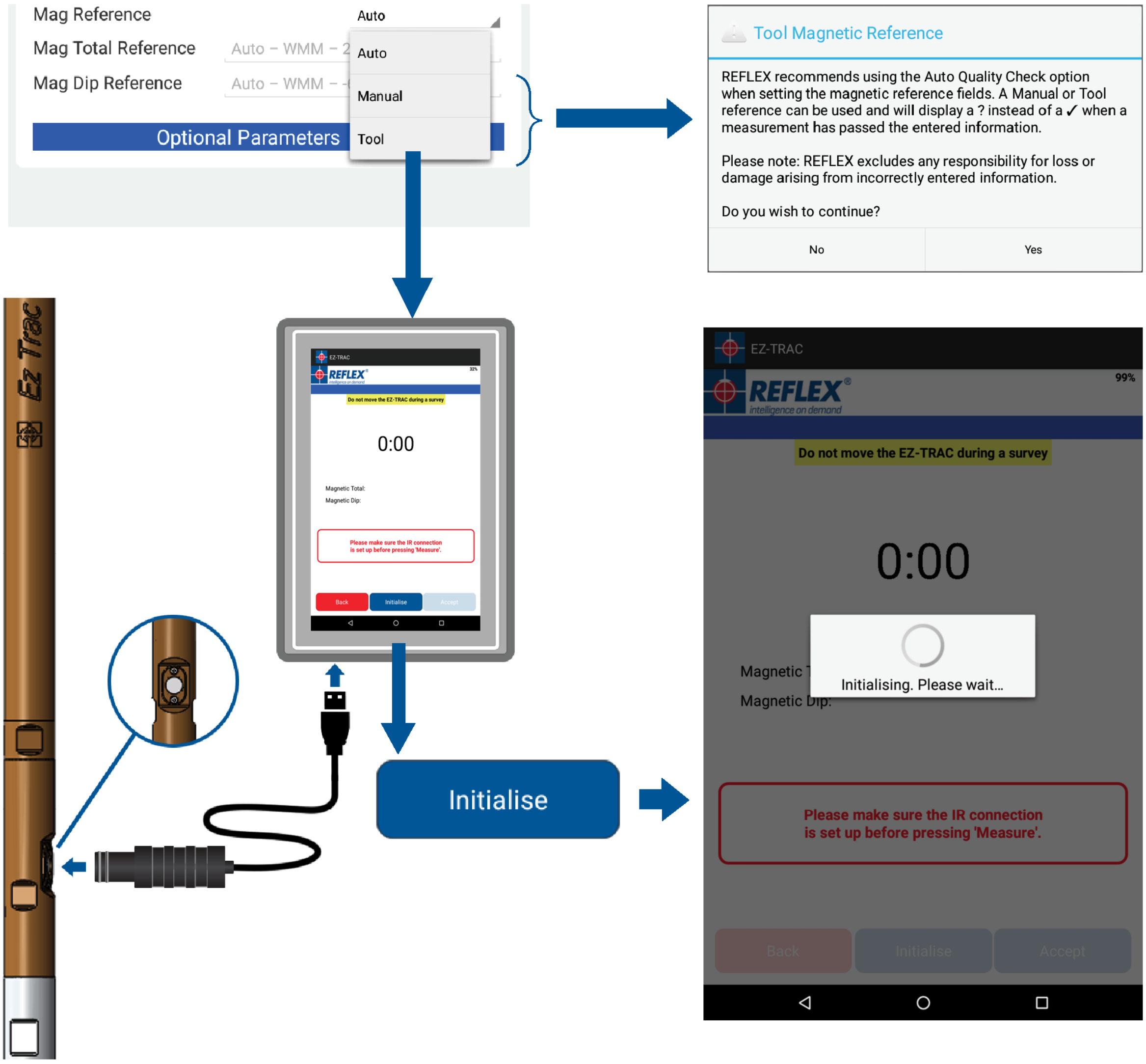
Latitude	-31.862868 °
Longitude	115.816816 °
Accuracy	3.6 m

Watching position
Cancel Accept

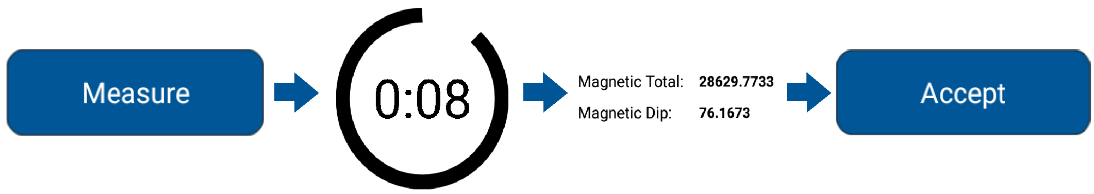
⑦ Survey → Survey

(menjadi aktif)

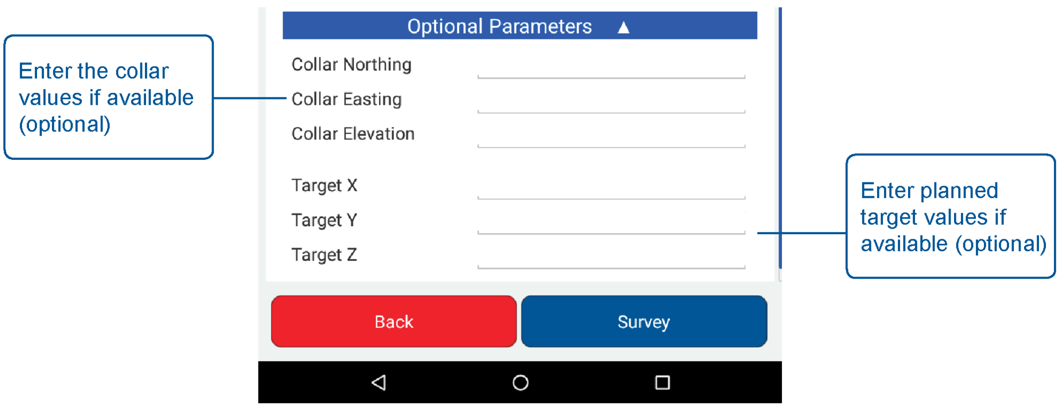
⑧ Mag Reference dengan Alat



⑨



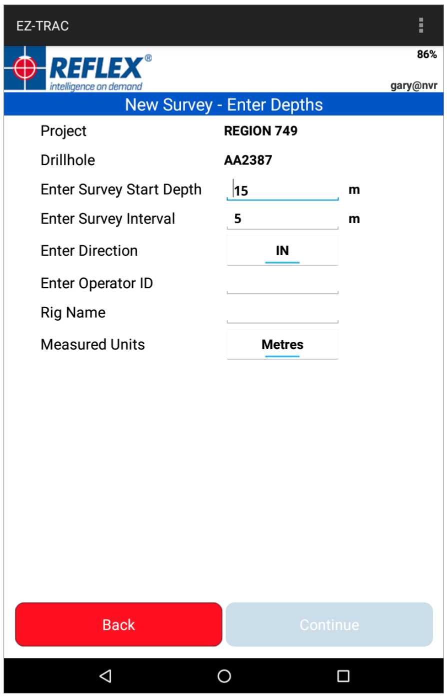
⑩ Masukkan parameter opsional



INISIALISASI

① **Survey** dan Entri Kedalaman

- Lubang Bor: tidak bisa diubah
- Entri Kedalaman Awal Survei: Masukkan level dasar atau titik mana saja untuk memulai
- Entri Interval Survei: Jumlah meter atau kaki untuk setiap pengukuran
- Entri Arah: Ketuk IN atau OUT
- Entri ID Operator: Masukkan nama Anda
- Nama Rig: (opsional)
- Unit Terukur: Pilih metrik atau imperial, mengubah bidang ini membutuhkan Kedalaman Awal dan Interval yang harus dimasukkan kembali (Setelah ditetapkan, tidak dapat diedit)

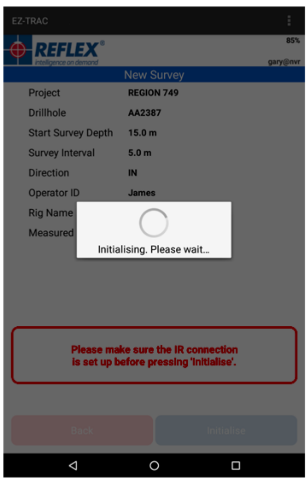


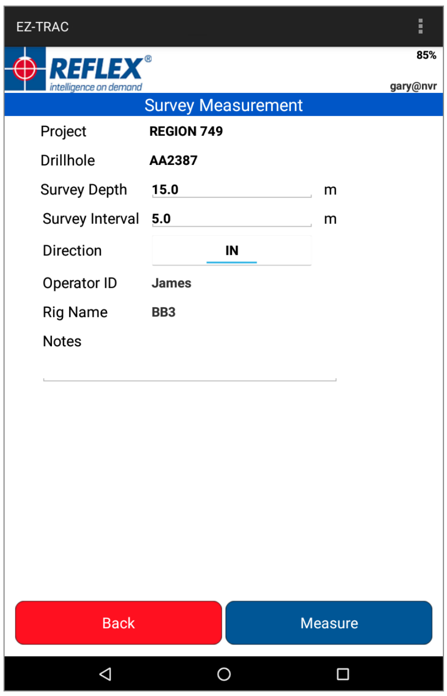
② Ketuk saat berwana biru

Continue → **Continue**

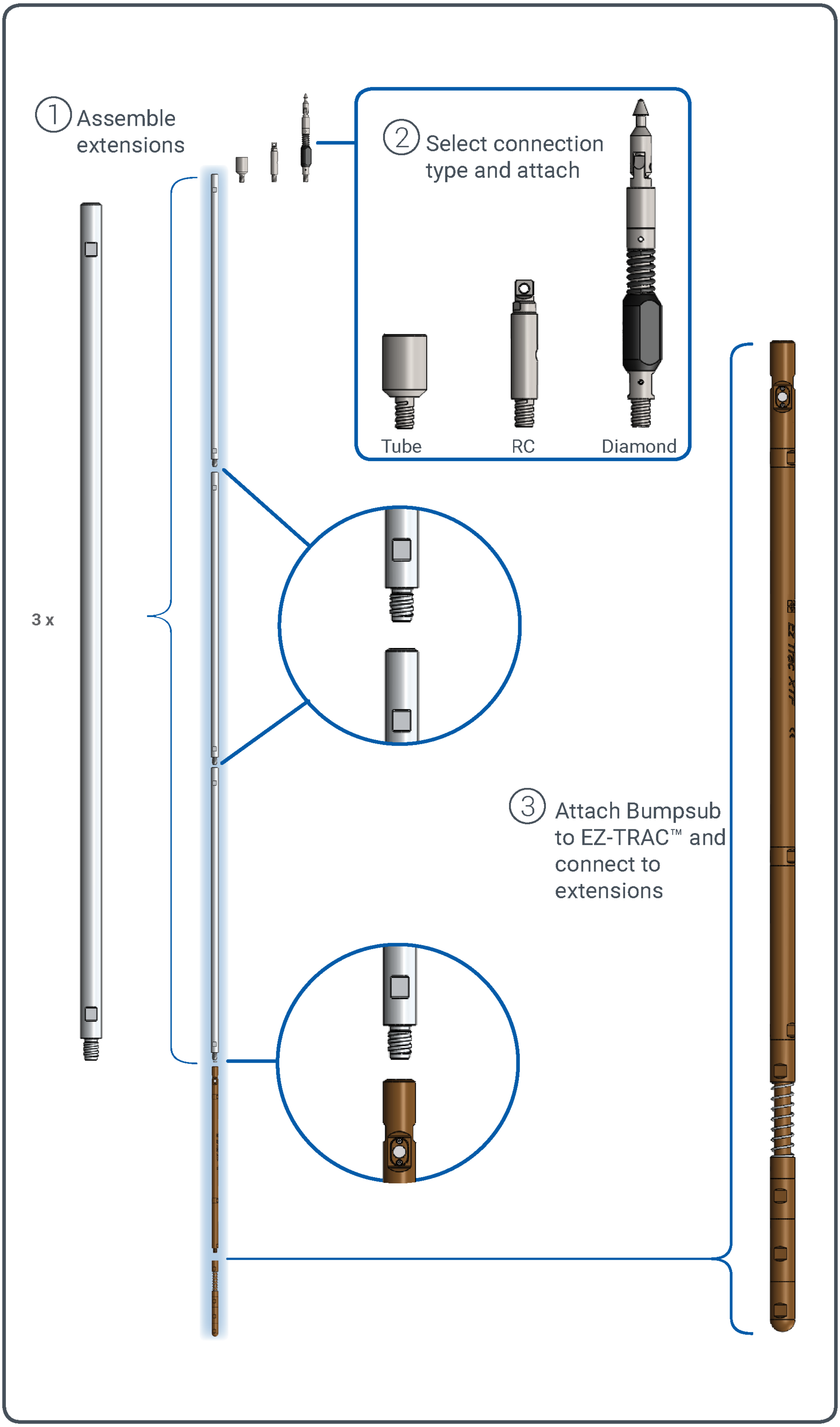
③ Hubungkan HTMS IR Adaptor ke tablet (lihat Lampiran)

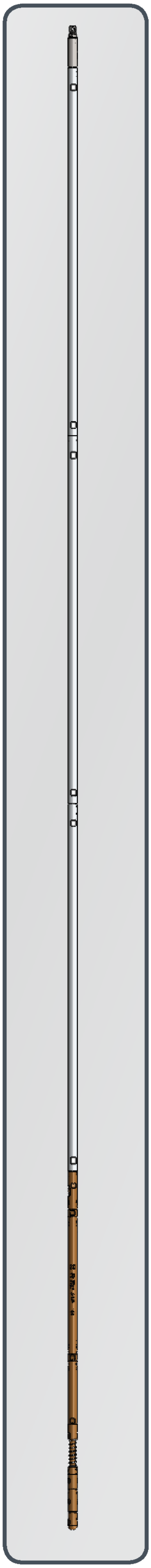
④ **Initialise**





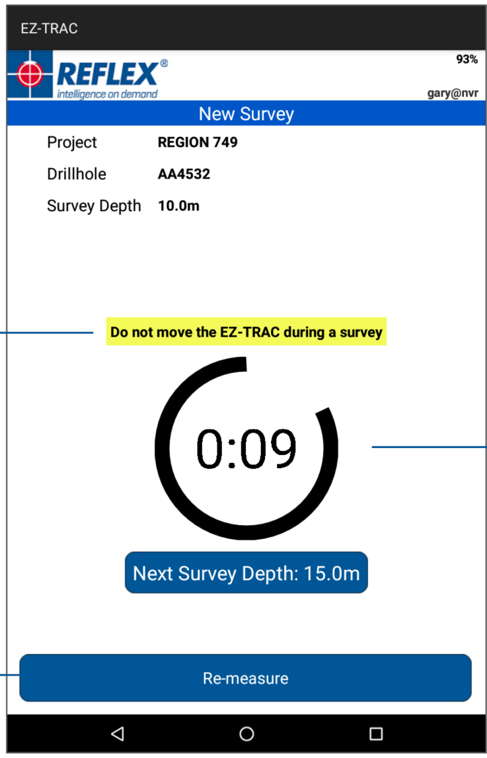
PERAKITAN


1 Assemble extensions
3 x
2 Select connection type and attach
Tube
RC
Diamond
3 Attach Bumpsub to EZ-TRAC™ and connect to extensions



SURVEI

① Measure



Reminder to keep the EZ-TRAC still while the survey is in progress.

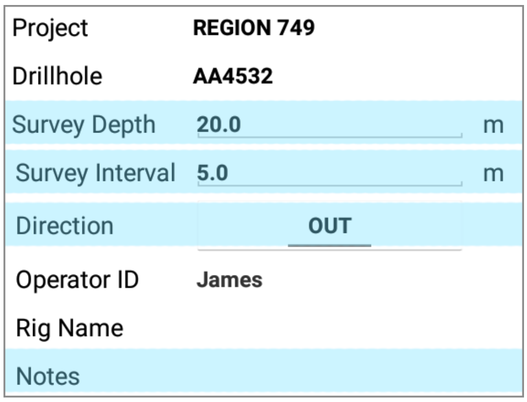
The EZ-TRAC requires 10 seconds to take a shot.

Change the current **survey depth**, **direction** or **survey interval**.

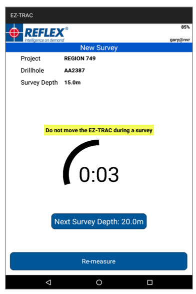
② Ubah rincian?

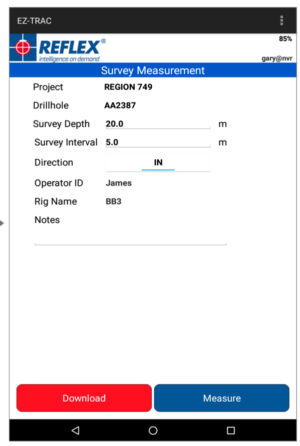
Re-measure

Measure



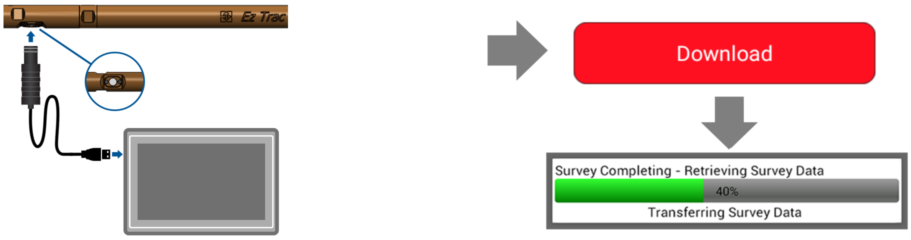
③ Setelah selesai, layar Pengukuran Survei kembali, ulangi langkah untuk pengukuran lebih lanjut



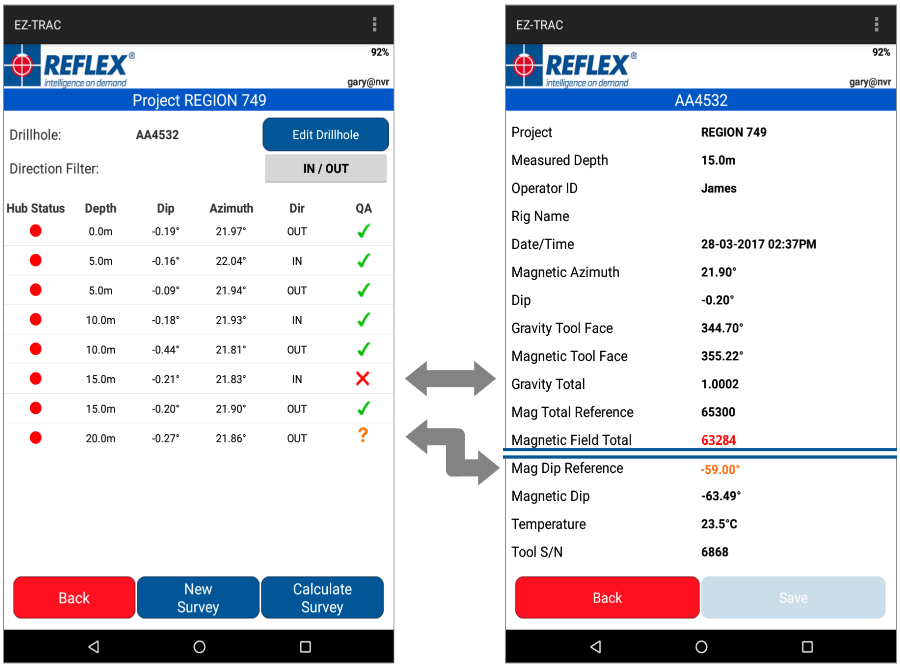


④ Hubungkan tablet ke REFLEX EZ-TRAC™ dan mulai unduh

Tempatkan HTMS IR Adaptor flush ke jendela REFLEX EZ-TRAC™IR

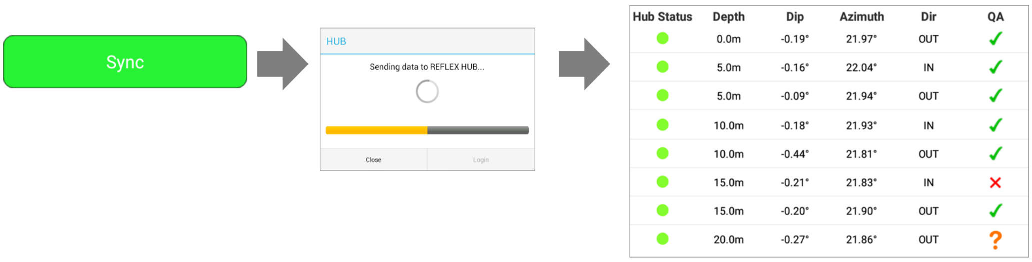


⑤ Survei terdaftar

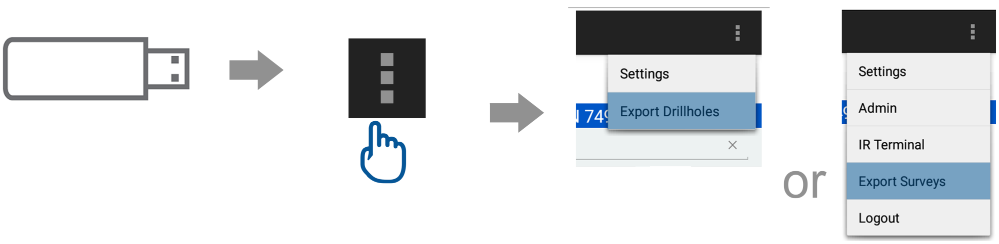


Bidikan yang gagal QA ditandai dengan tanda X, dan perincian lebih lanjut ditandai dengan warna merah. Bidikan juga dapat lulus dengan data yang meragukan seperti yang ditunjukkan dengan tanda ? dan selanjutnya ditandai dengan bendera dalam warna kuning.

⑥ Unggah ke IMDEXHUB-IQ™

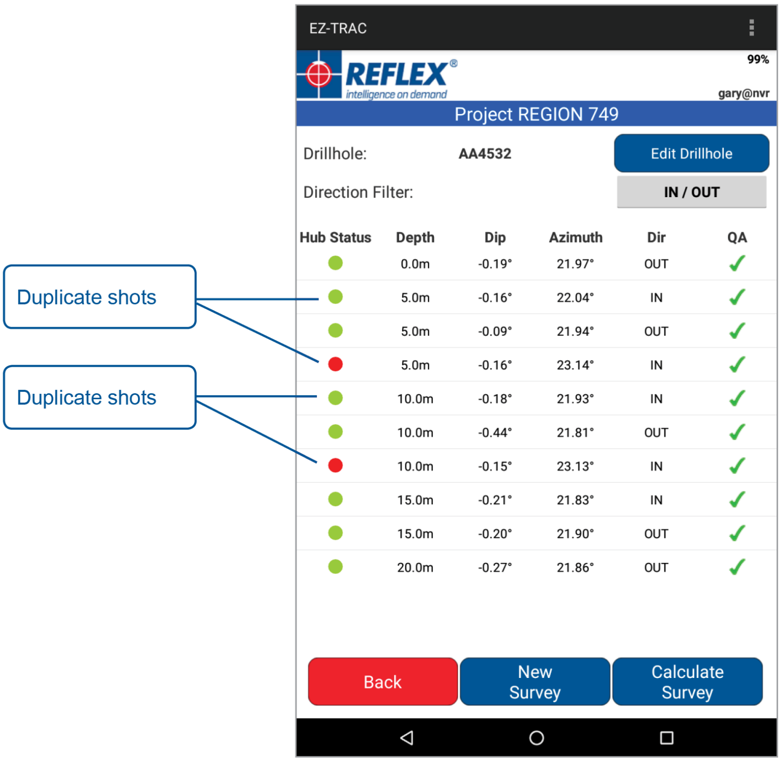


⑦ Ekspor ke Memory Stick

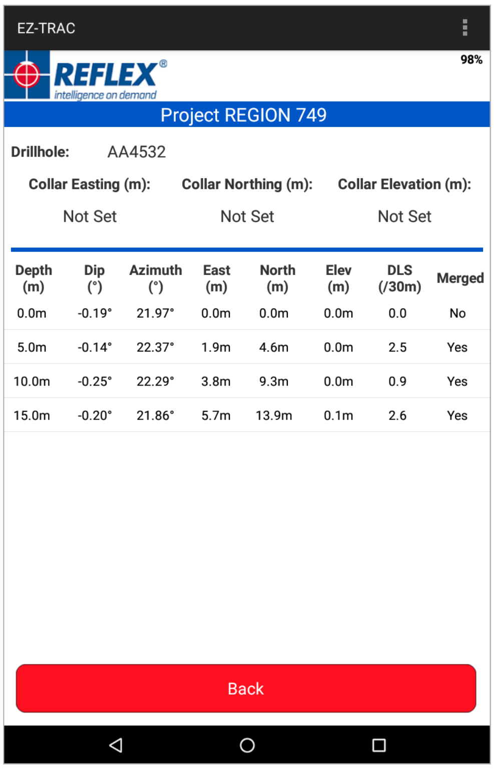


⑧ **Calculate Survey** untuk mengkonsolidasikan duplikat bidikan

> Aplikasi EZ-TRAC menggabungkan duplikat bidikan dan menghitung rata-rata. Dalam contoh salah satu bidikan dengan gagal QA, bidikan ini dibuang. Jika kedua bidikan gagal QA, maka bidikan akan dibuang.

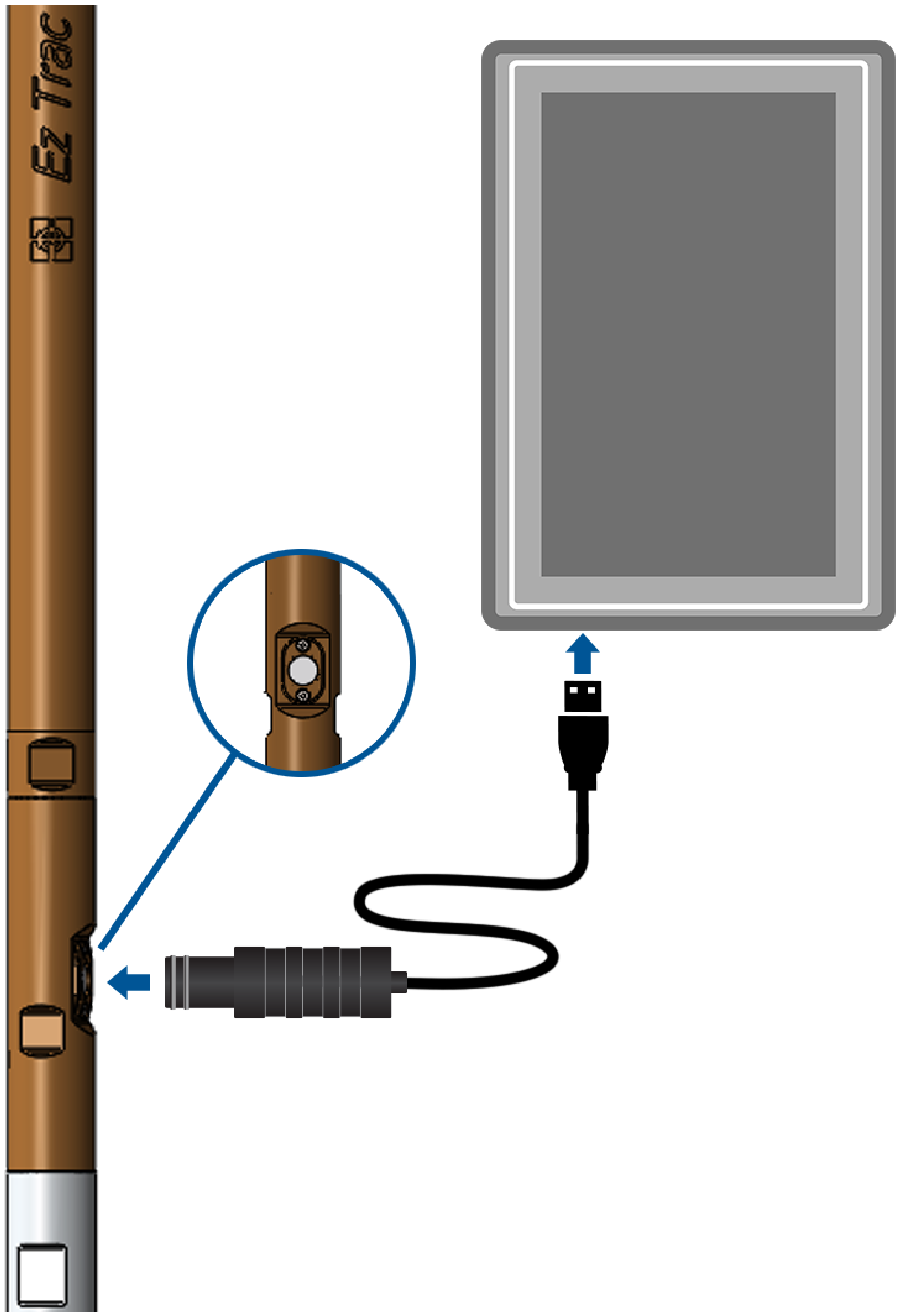


Daftar bidikan yang dikonsolidasikan muncul



> Pembacaan yang gagal tidak terdaftar.

Tempatkan HTMS IR Adaptor flush ke jendela EZ-TRAC™ IR untuk menginisialisasi atau mengunduh



Untuk informasi lebih lanjut, kunjungi www.reflexnow.com/contact atau hubungi kantor REFLEX™ terdekat

KBK AGGREGATE MINING

STANDARD OPERATING PROCEEDURE

GEOLOGY CORE CUTTING

October 12, 2018

DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	SOP KBK - CORECUTTING	Dean McMinn	Project Geologist	Saufi Handri Site Manager	12/10/2018
v-1.1	SOP KBK - CORECUTTING				

STANDARD OPERATING PROCEEDURE OVERVIEW

1. Background and Description

This document describes the standard operating procedure (SOP) for core cutting protocol developed by SRK Consulting (UK) Ltd and PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project. The document focuses on the exploration drilling programme currently underway (commencing October 2018) and it provides a description of the core cutting task, the various safety aspects, and the associated equipment and personal protective equipment (PPE).

2. Description of the Activity

In order to provide the assay laboratory with sample material, the diamond drill core needs to be cut along its core axis. To avoid introduction of any bias in the sample stream, the core is divided as accurately as possible into two equal parts using the base of drill core line. The base of drill core line is marked on the core when extracted from the ground at the drill rig. The base of drill core line also has an arrow which indicates the direction of drilling down the hole. Core cutting is an important and essential part of exploration at the Project. This policy aims to ensure that the relevant personnel understand the requirements and the risks associated with handling and cutting drill core.

3. Materials, Equipment and PPE Requirements

Core cutting is a high risk activity on any mine site. Only trained and experience personnel should undertake this task. The training and equipment will be provided by the Company and it is essential that protective equipment (PPE) is worn at all times during cutting. Some examples (for illustration purposes only) are provided in the images below.

Persons undertaking core cutting must use the following:

- Helmet with face shield (and ear protection)
- Protective Glasses/Goggles
- P2 Face Mask
- Ear Plugs and Industrial Ear Muffs
- Core Cutter (example: Norton Clipper)
- Cutting block/pusher
- Additional spare core boxes

Operators should only use approved, working and fit for purpose safety gear. Broken safety gear must not be used.

Use Approved:

Eye Protection | **Hearing Protection** | **Respiratory Protection** | **Head Protection**

	
Norton Clipper CM 501 - Core Cutter	Safety Helmet Hat With Large Metal Mesh Visor For Extra Protection

	
P2 Safety Personal Face Mask	Spare core boxes

4. Safety Precautions

Extra safety precautions must be taken when undertaking core cutting, including (but not limited to) the following:

- When in operation (switched on), the core cutter and the immediate work area is classified as a “Restricted Area”.
- Core cutting is to be conducted by one trained, experienced individual at a time.
- Personnel are not to undertake core cutting under the influence of drugs or alcohol or other materials that may impair their ability to undertake this task.
- Extra care must be taken to ensure that there is no potential for distractions from other people, activities, or surrounding environmental stimuli.
- The core cutter must ensure he/she is aware of other hazards and be trained in cutting and correct use and maintenance of the equipment.
- Individuals must be aware of emergency procedures (such as cut out switches and emergency phone numbers) and be formally trained in first aid.
- The following potential causes of injury must be monitored at all times, and the Company’s HSE documents must be read and understood for appropriate actions to be taken:
    - Personal Injury due to cutting, jarring or repetitive process strains.
    - Heat stress and dehydration.
    - Injury caused from rotary action of the rig/cutting blade to upper body and limbs.
- The core cutter should take sufficient breaks to limit tiredness and maintain suitable awareness when operating the core cutter.
- The hazards associated with the operating equipment and the cutting area should be identified and monitored, including:

- Dust (and small flying debris if windy)
- Trip hazards
- Open edges (nearby tails drain, etc)
- Unstable tables and nearby core trays
- Lightning
- Noise; ensure appropriate PPE is worn

5. Core Cutting Procedure

I. PREPARATION

A. Safety Precautions

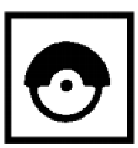
<u>Important! The following safety precautions must always be observed.</u>

Hazard Symbols

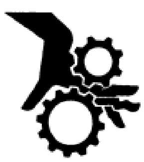
Fuel (gasoline) is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well-ventilated, unoccupied approved areas, and away from sparks or flames. Do not fill the fuel tank while the engine is hot or running. Do not start the engine near spilled fuel.

Never use the fuel as a cleaning agent

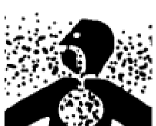
Engine components can get extremely hot from operation. To prevent burns, do not touch the engine or related parts while the engine is running or immediately after it is turned off. Never operate the engine with any heat shields or guards removed.



Keep all guards in place when operating any piece of equipment



Keep hands, feet, hair, and clothing away from all rotating parts



Lethal Exhaust Gas use only in well ventilated areas. Engine exhaust gases contain poisonous carbon monoxide, which is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area

Never tamper with the governor components of settings to increase the maximum speed. Severe personal injury and damage to the engine or equipment can result if operated at speed above maximum. Always obey the maximum speed rating of blade.

DO NOT LIFT THE SAW BY THE HANDLE OR GUARDS!!!

STEP	WORK STEP	DESCRIPTION
1	Before you begin – Pre-task Preparation	• Read the operator manual "Block buster large masonry saw.pdf", included as appendix to this SOP. • Have I got the required equipment and safety gear to do this job? • Is the area free from hazards and other distractions? • Is there suitable ventilation (air circulation) at the equipment to conduct the core cutting? • Have I had suitable training and am I able to conduct the task safely and correctly? • Has the "whole core" been photographed prior to cutting?
2	Tidy working area	• Cordon/barrier off the area • Ensure area is free from trip hazards • Ensure water pump is free from debris • Ensure general good house-keeping so that core trays are ready and in order of cutting
3	Fill the cutting pan/sump with water	• The sump must be filled with water to enable the water pump to function Important Note: Ensure water covers the bottom of the pump at all times. Do not allow sludge and dirt to build up in the pan and block the pump inlet
4	Set up core table	
5	Discuss core to be cut with Geologist	• The Geologist must advise the core cutter which core is to be cut • Core should be removed in a systematic order from the core boxes and placed back in the order it was provided by the geologist
6	Arrange core on conveyor cart	Important Note: Core orientation mark presented facing away
7	Ensure core is secured in core cart	

STEP	WORK STEP	DESCRIPTION
8	Ensure core is in alignment with saw blade	Important Note: • Cut to the RIGHT of the RED orientation mark • Ensure the red orientation mark is on the left piece of core so this will be available in the core box when the other half of the sample is removed for assaying • It is essential to cut straight down the core to get the best results (Equal size of core on each side)
9	Turn on Norton Clipper Machine	• Do not start cutting until the blade comes to reaches full rotation speed
10	Commence cutting drill core pieces	Important Note: • All care must be exercised to ensure safe cutting practises are maintained • Typically, 1m of competent core will take approximately 10-15 minutes to cut • Core is cut straight in HALF (equal sized pieces either side of cut) • The LEFT piece should show the Orientation line (RED LINE) and the RIGHT piece should not show the orientation line • Jam cutting and Step Cutting techniques are fully described in the Norton Clipper user manual as attached in the appendix of this SOP
11	Replace drill pieces into core box/tray	• Place the core pieces in the order each piece came from the box/tray and in the direction that the core is arranged (downhole direction) with the red line arrow pointing down the core tray sequence
12	Refill water pan (as required)	• Ensure water covers the bottom of the pump at all times. • Do not let the sludge and dirt build up in the pan and blocks the pump inlet •
13	Flush system with clean water after cutting is complete	• Flush the system with clean water at the end of each operation

STEP	WORK STEP	DESCRIPTION
14	Turn Machine Off	
15	Pack up area	• All cut core must be removed to core laydown • All uncut core (in trays) should be neatly stacked and ready for next cutting operations • All core cutting general areas to be tidy
16	Cover any remaining core trays	• All cut core should be returned to the core shed and the core shed Geologist must be notified. • Core must not be left out in the open air in plain sight. • Uncut core required for the next shift must be covered with a tarpaulin.

6. Special Qualifications/Licenses Required

- Only personnel “passed out” (trained / assessed) on this task can undertake the task.
- No other formal qualifications/permits are stipulated.

7. Related Company Policies, SOPs, and Documents

- Norton Clipper User Manual: “Block buster large masonry saw.pdf”
- U7285 - SOP KBK - GEOLOGY LOGGING & SAMPLING_v1.0.docx
- Company OH&S documents

APPROVAL AND AUTHORITY TO PROCEED

The above standard operating procedure has been reviewed on [Monday, 12 October 2018] and is approved by the relevant personnel signed and dated below.

RELEVANT TECHNICAL TEAM MEMBERS:

Name	Title	Signature	Date
Saufi Handri	Project Manager		12/10/2018

Approved By

Date

KBK AGGREGATE MINING

STANDARD OPERATING PROCEDURE

SOP GEOLOGY DD SAMPLE DISPATCH

October 8, 2018

1. DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.1	SOP - SOP KBK - DD SAMPLE DISPATCH	Saufi Handri	Project Geologist	Site Manager	08/10/2018
v-1.2					
v-1.3					

2. STANDARD OPERATING PROCEDURE

2.1. BACKGROUND AND OVERVIEW

This procedure has been developed by SRK Consulting (UK) Ltd in collaboration with the PT. KALTARA BATU KONSTRUKSI specifically for the practices required at the KBK Resource Drilling Project. This document describes the standard operating procedure (SOP) for the dispatch of all diamond drilling (DD) core samples to the laboratory and relevant to the KBK Drilling Project. This document has been compiled as a guide on the procedures taken by the Project Geologists on how the samples are arranged prior to dispatch and at the time of dispatch.

This document focuses on the exploration drilling program currently underway (commencing October 2018). This document's intended audience is the Project Geologists, and Senior Geologist, and core yard technicians. The various safety aspects and the associated equipment and personal protective equipment (PPE) have also been described throughout the following sections.

A critical aspect of sample dispatch is the CORRECT labelling and insertion of CRM, and Blank materials (described further in Sections 3.9 and 3.10) into the sample stream. If this is done incorrectly the samples submitted to the laboratory will be out of sequence, difficult to track, making appropriate adjustments difficult. There is no room for error is this regard, therefore, the sample dispatch must be conducted by a qualified Geologist who understands the entire process and "Chain of Custody" requirements as stipulated in the JORC Code (see definitions in Section 3.1 and Section 3.2).

2.2. MATERIALS, EQUIPMENT AND PPE REQUIREMENTS

Sample dispatch is not considered a high-risk activity and therefore the activity has less intensive Personal Protective Equipment (PPE) requirements. Notwithstanding, the activity does involve heavy lifting and this should be understood by the personnel undertaking this task.

It should be noted that the location where the samples are set down for dispatch is a thoroughfare and a high trafficable area. It should always be clean to avoid contamination and free from trip hazards for other personnel working in the area.

The following has been identified as the minimum PPE required to undertake the sampling dispatch, and this PPE will be provided by the Company. PPE is essential and should be worn at all times during sample dispatch.

- Protective Gloves for hands

The following equipment is required to undertake sample dispatch:

- Certified Reference Material (CRM) or Standards
- Prepared (approved) Blank material

- Logging Dispatch Sheets (Hard Copies)
- Pen/pencils
- Permanent marker(s)
- Large poly-weave bags
- Canvas sample bags
- Zip ties/cable ties
- Laptop for digital recording
- Large scale/electronic weight-meter

3. DEFINITIONS

3.1. JORC (2012) COMPLIANCE AND REPORTING STANDARDS

Typically, the results of exploration drill programs are used to generate Mineral Resource Estimates ("MREs") which define the quantity and grade of the Mineral Asset under investigation. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.

The definitions of Measured, Indicated and Inferred Resources as described below are taken from the JORC Code (2012).

Mineral Resource

A 'Mineral Resource' is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade (or quality), and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade (or quality), continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

All reports of Mineral Resources must satisfy the requirement that there are reasonable prospects for eventual economic extraction (i.e. more likely than not), regardless of the classification of the resource.

Portions of a deposit that do not have reasonable prospects for eventual economic extraction must not be included in a Mineral Resource. The basis for the reasonable prospects assumption is always a material matter, and must be explicitly disclosed and discussed by the Competent Person within the Public Report using the criteria listed in Table 1 for guidance. The reasonable prospects disclosure must also include a discussion of the technical and economic support for the cut-off assumptions applied.

Where untested practices are applied in the determination of reasonable prospects, the use of the proposed practices for reporting of the Mineral Resource must be justified by the Competent Person in the Public Report.

Geological evidence and knowledge required for the estimation of Mineral Resources must include sampling data of a type, and at spacing, appropriate to the geological, chemical, physical, and mineralogical complexity of the mineral occurrence, for all classifications of Inferred, Indicated and Measured Mineral Resources. A Mineral Resource cannot be estimated in the absence of sampling information.

Inferred Mineral Resource

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. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to an Ore Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral 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.

Indicated Mineral 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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to assume geological and grade (or quality) continuity between points of observation where data and samples are gathered.

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 Ore Reserve.

Measured 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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to confirm geological and grade (or quality) continuity between points of observation where data and samples are gathered.

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 Ore Reserve or under certain circumstances to a Probable Ore Reserve.

3.2. QAQC

Quality assurance - quality control (“QAQC”) systems and procedures have been developed over time based on mining industry demand for reliable and accurate data with monitored accuracy and precision. The basic definitions are described in various publications dealing with theory of sampling, sampling practice, and standard practice and techniques of geological exploration and laboratory testing. Among others, AusIMM Monograph 23, Australian Standard, ISO Standard deals with QAQC in mineral exploration.

In general, modern laboratories generally utilise internal QAQC samples in order to comply with internal regulations and external audits. Additional QAQC samples should also be inserted ‘blind’ into the sample stream without the laboratories’ knowledge, in order to ascertain an unbiased opinion of quality.

3.3. QUALITY ASSURANCE (QA)

QA is defined as the management system developed to ensure that surveyed geological, geotechnical data and analytical results are precise and accurate. QA includes establishing protocols for all aspects of exploration. QA should always be prepared and implemented before a program is initiated.

3.4. QUALITY CONTROL (QC)

QC is defined as the procedures defined by the QA system designed to measure precision and accuracy. QC involves a system of checks which are applied systematically during data collection, prior to the finalisation of the dataset.

3.5. PRECISION

Precision is defined as the repeatability of an assay result. It is necessary to know the precision of a set of assays to enable any potential bias to be corrected at a later date. If a batch of assays is repeatable, any bias or accuracy problems can be universally amended. If there is low precision, there can be no confidence in the ability to do this.

3.6. ACCURACY

Accuracy is defined as the measure of the truthfulness of the assays (how close they are to reality). Accuracy problems are usually caused by problems with analytical equipment, (such as XRF calibrations both in the field or at the laboratory) and can occur at any time. It is important to monitor this on a regular basis. It is much more time dependent than precision and must be corrected as soon as a problem is detected.

3.7. BIAS

Bias is defined as the distortion in a result or set of results. It can occur as a result of both sampling problems and analytical errors.

3.8. CONTAMINATION

At the laboratory, contamination in reference to geochemical analysis is defined as the effect of elevated grades smearing across multiple samples due to a lack of cleaning between samples. The same thing can happen at the exploration site when samples are being collected and where there may be a mixing of metre intervals when samples are being selected, cut, and bagged.

3.9. CERTIFIED REFERENCE MATERIALS (CRM)

Internationally Certified Reference Materials (“CRM”), or other “standards” that have been manufactured and have gone through a lengthy and rigorous certification process are typically included in QAQC measures onsite during exploration programmes. CRM are usually ordered specifically for the purpose of a drill programme and should closely represent the typical ore types being assessed. The CRM are inserted into the sample stream ‘blind’ (unknown to the laboratory) in order to check for accuracy at the laboratory. Both the mean and the standard deviation of the analyses of the various elements in the sample as determined by the reference laboratories must be known.

CRM can also be inserted by the laboratory into each sample batch as part of their internal QA programme. Details of the laboratory-based CRM should be kept in the database as reference data.

For the purpose of the KBK drilling, no CRM will be required at this stage.

3.10. BLANK MATERIAL

Blank material is material which does not contain any mineralisation, or any properties related to the key ore types expected at the project and for the elements being analysed. ‘Blanks’ are inserted into the sample stream prior to sample preparation in order to check for contamination issues between samples, highlighting a lack of cleaning between samples. Blanks should be a large amount of readily available sample consisting of simple mineralogical composition, which is easily homogenised. The blanks are submitted blind to the laboratory in sample batches from the field or with pulps for re-assay. Barren granite is commonly used for metalliferous deposits, or simple river sand sourced from a local area nearby the project. Ideally it will be assayed to check for elevated levels of elements.

3.11. DUPLICATES / REPEATS

Duplicates or repeats are samples which are submitted twice into the sample stream. Duplicates can be taken from core (that is, ¼ core extracted from ½ core), coarse reject, or pulp reject sample material, depending on which part of the sampling process is considered most critical to monitor.

During the KBK programme, project geologists will perform duplicate sample selection during core logging and cutting in the core shed. The duplicate samples that have been selected by the project geologist will be labelled as part of the normal sample number sequence prior to dispatch to the laboratory for testing.

4. DESCRIPTION OF THE ACTIVITY

This section describes the sample handling procedures and is in three parts: at the rig, at the core yard and at the office.

4.1. AT THE RIG

The following procedures are performed at the rig prior to the dispatch of the DD sample core to the yard.

Document entitled, "U7285 - SOP - KBK GEOLOGY ACTIVITY SIGN-OFF SHEET" is to be used in conjunction with this SOP for sample dispatch QAQC.

A Geologist (or approved Geotech) must always be present at the DD rig to witness core being drilled. It is incumbent on the Geologist to always ensure that the core is secure and not tampered with.

At the rig, the following general tasks are performed, prior to logging, and sample dispatch.

1) The Geologist must record any event or activity that occurs at the rig site in the rig diary. This includes change to drilling, different planned depths and why, any event that impacts the rig and drilling, visitors, weather, etc.

2) The Geologist should prepare the core trays and mark them with:

    - Hole ID
    - Box Number
    - Start (m)/ End (m)
    - Arrows that indicate direction of drilling
    - Core blocks with depths, drilled length and recovered length

3) The Geologist should then locate and position the core trays in a safe and stable area away from heavy works and any potential danger.

4) The Geologist should witness the driller marking the core orientation point onto the core whilst it is still in the barrel. This is usually done by wax pen, or a metal spike indentation (depending on what tool is used by the drilling contractor). If the Geologist does not know what tool is being used or how it works, they should ask for a demonstration.

5) When the core from the barrel (or drill string) is ready to be placed on the angle iron (also referred to as the core holder (see Figure 1)), the Geologist should ensure that all core pieces fit together correctly after which the Geologist should mark the core orientation line (see Figure 2). At this point, the Geologist should confirm with the driller the recovered core. For example, 1 m drilled should equate to 1 m of core. Any overruns or under recovered drill lengths should be explained and recorded in the rig diary.

6) When the Geologist is satisfied that the core orientation line is marked correctly, the orientated marked drill core is removed from the angle bar to the core box (Figure 3 and Figure 4).

Figure 1: Project Geologist marking up diamond drill core with an orientation line using angle bar

Figure 2: Start of orientation line/mark shown on drill core

Figure 3: Removing orientated marked drill core from the angle bar to the core box

Figure 4: Correct mark up of metre marks, placement of drillers blocks, and orientation line

Note: It is sometimes the case that core orientation cannot be determined by the drillers due to loss of point or mark on the core or extremely broken ground. In these instances, the project geologist and the drillers should work together to determine what is “the best fit” to reconstruct the core on the angle bar. Where it is not determined, the Geologist should simply mark a dashed line (see **Figure 5**). This dash should continue until the next known point along the core where the orientation is known.

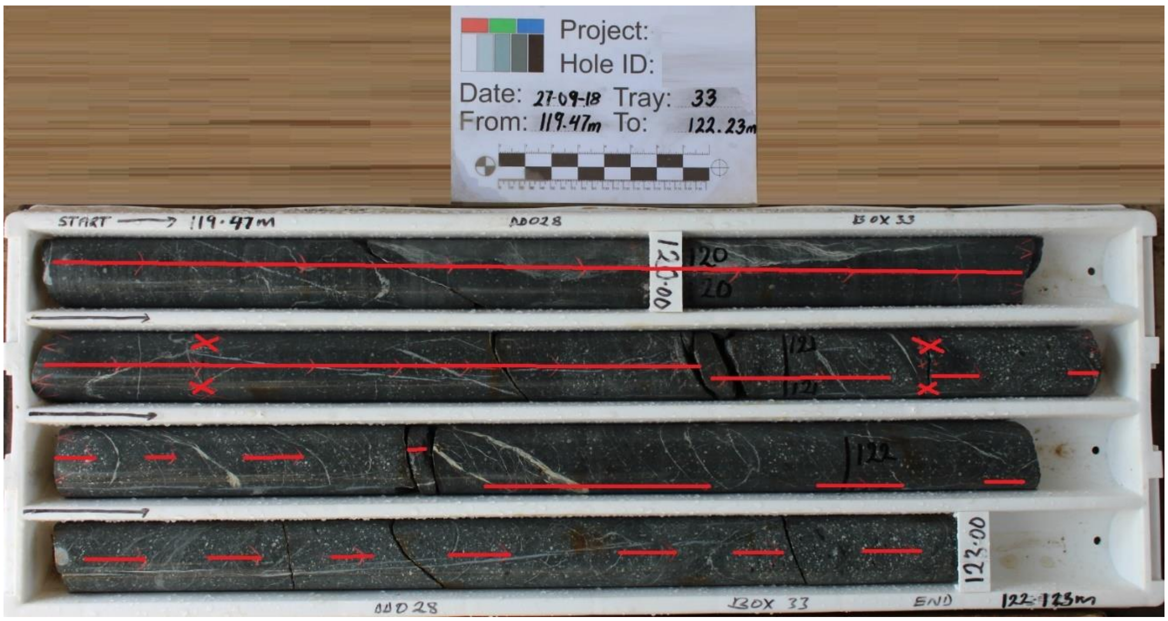


Figure 5: Example of core mark up when there is unknown core orientation

7) The Geologist then enters the recovery information into Recovery Log Sheet (ref Appendix B). The rig geologist should then call the core yard geologist and request for space to be made for incoming core delivery.

8) The core should be delivered to the yard in sets of 20 boxes. Core is to be stacked neatly on pick-up, covered in plywood and tied down with ratchet straps.

9) These activities are to be entered and signed off in the *U7285 - SOP - KBK GEOLOGY ACTIVITY SIGN-OFF SHEET.docx.*

4.2. AT THE CORE YARD

The following procedures are performed at the yard prior to the handover of the DD sample core to the office.

The Geologist will need to complete several phases of logging before core can be presented for cutting and sampling; these are summarised below.

IMPORTANT: As this work does not form part of the sample dispatch activity (this SOP), please refer to the following SOP reference materials for full instruction regarding geological logging activities:

- SOP - KBK - GEOLOGY LOGGING & SAMPLING
- SOP - KBK - DENSITY MEASUREMENT
- SOP - KBK - CORE CUTTING
- SOP- KBK - DD SAMPLE DISPATCH

1) On delivery, the project geologist working at the core yard checks the number of core boxes and correct ID numbers are in accordance with the information provided by the rig geologist on the U7285 - SOP - KBK GEOLOGY ACTIVITY SIGN-OFF SHEET.docx.

2) At the core yard, the Geologist observes the core is carefully off-loaded from the truck and stored / stacked in its pre-allocated area. It is important that the tray stacking is on level and stable ground. Trays are usually best stacked in two (or more) towers side by side to stabilize each stack and no higher than 15 boxes high (Figure 6).

Figure 6: Good and bad examples of core stacking in the core yard

3) The core will then be processed by the Geologist in the core yard. It is the Geologist's role to ensure that the core is safe in its tray and is not inadvertently switched or mishandled.

4) Once all core for each drill hole has been logged, the Geologist then enters all the information into the geological database.

5) All core boxes should be individually photographed (wet) for digital record prior to being marked for sampling and cutting and sample selection.

6) When the selected core is cut, the geologist then organizes the core boxes to be distributed to the core saw(s) for core cutting. The geologist will retain responsibility for the core at all stages of this activity. Remember – RESPONSIBILITY CAN NOT BE DELEGATED.

7) The Geologist then supervises the core movement between the cutting machines to the sampling point Core should not be cut without instruction from the project geologist(s).

8) At the end of each shift, the Geologist checks and reviews the cut core that has been placed back into the appropriate core boxes, and in correct sequence/direction. paying particular attention to sample numbers, sample intervals, and ensuring core is put in the correct place back in the core box.

9) The Geologist checks that the sampler/core cutter has sequentially and correctly stacked core boxes ready for sample bagging.

10) The Geologist checks that the Samplers Calico bag numbering is correct and that it corresponds with the sample sheet (digital and/or hard copy).

11) The Geologist then hands over the DIAMOND CORE SAMPLING SHEET (REF APPENDIX A), to the sampler ensuring that all requirements are clearly communicated.

12) The Geologist checks and ensures that the sampler consistently takes the correct side (sample side) of core consistently.

13) The Geologist then ensures the core is weighed and recorded.

14) The Geologist calls the office and advises that a sample pickup is required, and states the overall expected weight and number of samples for dispatch.

15) The Senior Geologist advises the project manager to book the appropriate laboratory to pick up the samples.

16) The sampler will then line the large labelled poly-weave bags up in numerical order and inserts small individual calico sample bags.

17) The Geologist will then inspect and check the following:

18) All poly-weave bags are correctly labelled.

19) The correct calico bags are inside the poly-weave bags, generally in groups of 5 (about 15-20 kg).

20) The Geologist also checks that all blanks and duplicates are correctly recorded and allocated.

21) If all is in order, then the Senior Geologist then signs off the GEOLOGY ACTIVITY SIGN-OFF SHEET (see example 10) and the SAMPLE BATCH SHEET (see example Section 12) that all bags have been individually checked and are accounted for as correct.

22) The bags are then dispatched to the office accompanied by a geologist.

4.3. AT THE OFFICE

1) The Geologist hands over the core and the DIAMOND CORE SAMPLE LOG SHEET (see example in Section 8) to the Senior Geologist.

2) The Senior Geologist double checks blanks and repeats in accordance with the DIAMOND CORE SAMPLE LOG SHEET (REF APPENDIX A in Section 8).

3) At this time, the Geologist should do several spot checks to confirm the material in the samples bag is approximately about the correct weight, and (where it is obvious) that it is representative of the “Lithology” that has been logged by the rig geologist. The Senior Geologist should also cross check that duplicates and blanks have been inserted correctly in accordance with the DIAMOND CORE SAMPLE LOG SHEET (APPENDIX A in Section 8).

    - Duplicates inserted at a rate of 1/30
    - Banks inserted at rate of 1/30

4) All poly-weave bags are laid out in ascending order of sample number ranges and readied for dispatch (Figure 7).

Figure 7: DD samples in calico bags lined-up for dispatch

4.4. SAMPLE DISPATCH

1) When the entire hole has been prepared and checked that every sample is accounted for, the Senior Geologist then checks all poly-weave bags are correctly bagged and labelled and zip locked (cable tied). If all is in order, the Senior Geologist signs the sample LAB DISPATCH SHEET (see example in Section 11).

2) The Senior Geologist or Project Manager should call/email the laboratory and reconfirm pick up and advise of the size and general weight of the samples.

3) The core is then picked up by the laboratory in entirety / complete hole(s). Part holes are to be avoided if at all possible.

4) It is mandatory that the Project Manager (PM) or Senior Geologist or Project Geologist supervises the laboratory truck pick up. It is the responsibility of the Senior Geologist to ensure this step is conducted prior to dispatch on the transport truck. Verification should be by means of a signature and date on the Lab Sample Dispatch sheet by the KBK representative and the laboratory representative (see example in Appendix D).

5) PM is to sign and distribute laboratory dispatch sheets to all relevant parties.

4.5. DATA ENTRY

Information of samples ready for dispatch is entered into a dispatch form provided by the laboratory contracted to analyse the samples (see example in Section 11). KBK should also provide additional information of samples dispatch to the laboratory for easy identification of samples (or the batch) shown in Appendix E (see Section 12).

4.6. SAFETY AND ENVIRONMENTAL PRECAUTIONS

The work area where samples are being organized and prepared for dispatch should be tidy and free from trip hazards. Any spills of dust from vehicle drop off are to be cleaned to avoid dust particles contaminating DD samples. Trafficable areas are also to remain free from bags or materials/equipment associated with sample dispatch at the office.

Prolonged lifting of the full sample bags (poly-weave bags) is considerably heavy labour-intensive task. Where possible, two KBK staff should be allocated to undertake the lifting tasks.

5. SPECIAL QUALIFICATIONS/LICENSES REQUIRED

- A critical aspect of sample dispatch is for the CORRECT labelling and insertion of QAQC materials into the sample stream. If this is done incorrectly, the samples submitted to the laboratory will be out of sequence, very hard to track and it will then be difficult and time consuming when making appropriate adjustments. There is no room for error is this regard, therefore, the sample dispatch must be conducted by a qualified Geologist who understands the entire process and "Chain of Custody" requirements as stipulated in the JORC Code (See definitions in Section 3.1 and Section 3.2).

- Only persons "passed out" (trained / assessed) on this task can undertake the task.

- No other formal qualifications/permits are stipulated.

6. APPROVAL AND AUTHORITY TO PROCEED

The above standard operating procedure has been reviewed on [10/10/2018] and is approved by the relevant personnel signed and dated below.

7. RELEVANT TECHNICAL TEAM MEMBERS:

Name	Title	Signature	Date

Approved By Date

8. APPENDIX A – DIAMOND CORE SAMPLE LOG SHEET

KALTARA BATU KONSTRUKSI

DIAMOND CORE SAMPLING SHEET

BH ID:	LOCATION:	DATE SAMPLED:
		NO. OF SAMPLES:
	AZI:	NO. OF QA/QC SAMPLES:
	INCL:	TOTAL SAMPLES:
	EOH:	
	SAMPLED BY:	SIGNATURE:

From (m)	To (m)	Interval (m)	Sample ID	Sample Type	Sample Fraction	CRM Code	Duplicate Sample ID	Comment

9. APPENDIX B – DD RECOVERY LOG SHEET

KALTARA BATU KONSTRUKSI	DD RECOVERY LOG SHEET	
	PROSPECT :	
	AZI :	DATE LOGGED :
	INCL :	LOGGED BY :
BH ID:	TOTAL DEPTH :	
	DRILLED BY :	SHEET of

FROM (m)	TO (m)	DRILL (m)	REC (m)	SCR (m)	% REC	COMMENTS

10. APPENDIX C – GEOLOGY ACTIVITY SIGN-OFF SHEET

KALTARA BATU KONSTRUKSI

Diamond Drill Rig **Rig Name: ....** **Hole ID: ....**

- ☐ Core orientation line marked, checked correct — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Core Box fully marked up (including drillers break marks) — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Set up (Hole Orientation/Direction, safe area, equipment/PPE available) — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Confirm 6m, and 45m survey shot — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Confirm Recoveries checked and confirmed with handover — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ All personnel wearing correct PPE — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Boxes arranged at rig in stable, out of main work areas — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Boxes picked up at beginning and end of shift — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018

Core Transport to Yard **Rig Name: ....** **Hole ID: ....**

☐	Rig Geologist notify Core Yard Geologist pickup of boxes:		Name: _ _ _ _ _ _ _ _ _ _ _ _ _	Date: _ _ / _ _ / 2018
☐	No. core boxes Transported:		Name: _ _ _ _ _ _ _ _ _ _ _ _ _	Date: _ _ / _ _ / 2018
☐	No. core boxes Received:		Name: _ _ _ _ _ _ _ _ _ _ _ _ _	Date: _ _ / _ _ / 2018

Core Cutting **Hole ID (s):...............................** **Box Number (s): ....**

- ☐ Geologist indicates core boxes ready for cutting (x2 of 10 boxes minimum) — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist supervised cutting & correct return of cut core to correct trays — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist observed rotation of core cutting staff throughout the shift — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018

Core Yard Logging **Hole ID (s): ....**

- ☐ Core Markup checked and completed — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Recovery checks — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Core Box markup complete — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Logging by Geologist completed (various geologists to acknowledge) — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Litho Logging — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Mineralisation — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Alteration — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Structural — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Density intervals selected (geologist) indicated with flag tape — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
  - ☐ Sampling — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Final Core Photos Taken (wet) and uploaded to network folder — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018

Sampling in the core yard **Hole ID (s): ....**

- ☐ Geologist ensures cut core is correctly stacked and available for sampling — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist supervises the correct samples being inserted — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist has inserted the correct CRMs and Blanks — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist ensures the correct labelled samples inserted into polyweaves — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist signs and dates the "Sampling Sheet" on completion of the shift — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018
- ☐ Geologist (with driver) escorts labelled samples to office for dispatch — Name: _ _ _ _ _ _ _ _ _ _ _ _ _ Date: _ _ / _ _ / 2018

11. APPENDIX D – EXAMPLE LAB DISPATCH SHEET

ANNEXURE 1

Deliver to: SGS LABORATORY SERVICES (GH)
1 JUNCTION, BANK

Attention to: TAI

LAB INFO

CLIENT INFORMATION

Send Report to:		**Send Invoice to:**	
Name: DAVID		**Send to same address as report** X	
Company: MINING LTD		Name:	
Mailing Address:		Company:	
		Mailing Address:	
		VAT Reg no:	
Email: david@ .com		Email:	
Phone:	Fax: —	Phone:	Fax:

SAMPLE INFORMATION

Results and Invoice will be sent by PDF email at no additional charge. A fee per page will apply for all faxes.

Send Report: QMINE ☐ Fax ☐ Email as PDF ☒ Email as XLS ☒ Other: ____

Pulps and Residues will be disposed of after 3 months unless requested otherwise in writing. Additional storage and shipping costs will be charged to the client. If the samples are to be returned please provide courier account information.

After analysis samples are to be: Disposed of (default) ☐ Stored ☒ until (date): 90 days, then call

Returned to client ☒ Return samples using courier: NEXT SGS PICK UP Acct: ____

IMPORTANT: Please specify Sample Type/Required Quality				
Exploration ☒	Met Plant ☐	Party ☐	Umpire ☐	Other:
Pulps ☐	Cores/Rock ☐	Soils ☐	Solutions ☐	Other:

Please specify Assay basis
(Party/Umpire assays are reported on a dried at 105°C basis unless requested otherwise)

Dry at 105°C ☒ As received ☐ Other (specify) ☐ ______°C

Invoicing information

SGS Quote#: 0011.17

Order #: 0#0012

Laboratory Services Ghana Limited 14 Ridge Road, Roman Ridge, P.O. Box 732, Accra, Ghana. Tel: +233 302 773994/5 Fax: +233 302 773677

Directors: M. Davidson (Managing), N. K. Omaboe, F. Egloff, Stephen Rossiter

Member of SGS Group (Société Générale de Surveillance)

E. Manu

30/6/17

30/6

12. APPENDIX E – KBK SAMPLE BATCH SHEET

BATCH 5

Bag Number	Sample Numbers	Number of Samples
1	GRCD6249 - GRCD6260 & GRCD6207	13
2	GRCD6261 - GRCD6275	15
3	GRCD6276 - GRCD6290	15
4	GRCD6291 - GRCD6305	15
5	GRCD6306 - GRCD6320	15
6	GRCD5631 - GRCD6335	15
7	GRCD6336 - GRCD6350	15
8	GRCD6351 - GRCD6365	15
9	GRCD6366 - GRCD6380	15
10	GRCD6381 - GRCD6395	15
11	GRCD6396 - GRCD6410	15
12	GRCD6411 - GRCD6425	15
13	GRCD6426 - GRCD6440	15
14	GRCD6441 - GRCD6455	15
15	GRCD6456 - GRCD6470	15
16	GRCD6471 - GRCD6485	15
17	GRCD6486 - GRCD6500	15
18	GRCD6501 - GRCD6515	15
19	GRCD6516 - GRCD6530	15
20	GRCD6531 - GRCD6545	15
21	GRCD6546 - GRCD6560	15
22	GRCD6561 - GRCD6575	15
23	GRCD6576 - GRCD6590	15
24	GRCD6591 - GRCD6605	15
25	GRCD6606 - GRCD6620	15
26	GRCD6621 - GRCD6635	15
27	GRCD6636 - GRCD6650	15
28	GRCD6651 - GRCD6665	15
29	GRCD6666 - GRCD6680	15
30	GRCD6681 - GRCD6695	15
31	GRCD6796 - GRCD6710	15
32	GRCD6711 - GRCD6725	15
33	GRCD6726 - GRCD6740	15
34	GRCD6741 - GRCD6755	15
35	GRCD6756 - GRCD6770	15
36	GRCD6771 - GRCD6785	15
37	GRCD6786 - GRCD6800	15
38	GRCD6801 - GRCD6815	15
39	GRCD6816 - GRCD6830	15
40	GRCD6831 - GRCD6845	15
41	GRCD6846 - GRCD6860	15
42	GRCD6861 - GRCD6872	12
TOTAL SAMPLES DISPATCHED		625

memu
30/6/17

30/6/17

KBK AGGREGATE MINING

STANDARD OPERATING PROCEEDURE

GEOLOGY DRY BULK DENSITY MEASUREMENT

October 3, 2018

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.0	U7285 – SOP KBK – DENSITY MEASUREMENT	Saufi Handri	Project Geologist	Site Operations Manager	3/10/2018
v-2.0					

2 STANDARD OPERATING PROCEEDURE OVERVIEW

2.1 Background and Description

This document describes the standard operating procedure (SOP) for dry bulk measurement in the field which has been developed by SRK Consulting (UK) Ltd and PT. KALTARA BATU KONSTRUKSI (PT KBK) for the KBK Drilling Project.

The document focuses on the exploration drilling programme currently underway (commencing October 2017) and it provides a description of the equipment set-up, measurement and recording of data. Although this is not regarded as a high risk or hazardous task, the various safety aspects and the associated equipment and personal protective equipment (PPE) have also been described.

3 DESCRIPTION OF ACTIVITY

Prior to cutting diamond drill (DD) core and sampling for assaying at the laboratory, whole drill core needs to be measured for density.

Density can be expressed in several ways (see Table 3-1) and the results of a mineral resource assessment rely heavily on the density applied for the assessment. As most assay data and grades are expressed as dry weight percentages, it is generally well accepted that mineral resources are expressed in dry weight tonnes. Therefore, a in situ dry bulk density is the most appropriate parameter to applied in the mineral resource estimate (MRE). In situ dry bulk density is represented by the mass per unit volume, including porosity but excluding any natural water content (expressed as t/m^{-3}). This procedure aims to ensure that the personnel understand the general requirements for density measurement onsite and the methodologies that have been developed specific to the Project.

Table 3-1: Description of key density terms

Term	Units	Definition
Specific Gravity		Relative Density: the ratio of density of the material to the density of water at 4ºC (1.00 tm^{-3})
Density	tm^{-3}	Mass per unit volume
In situ bulk density	tm^{-3}	Density of the material at natural water content
Dry bulk density	tm^{-3}	Density of the material when all water has been dried out of the voids
Grain density	tm^{-3}	Density of the solid grains only – both mass and volume refer to grains only
Apparent porosity	%	Ratio of the open, interconnected pore volume to the bulk volume, expressed as a percentage
Total porosity	%	Ratio of the total pore volume, including occluded pores, to the bulk volume, expressed as a percentage
Moisture content	%	Ratio of the mass of water contained in the material to the mass of the dry solid, expressed as a percentage

3.1 DD Core Density Measurement Procedure

Prior to DD core being cut, SRK recommends that multiple “dry” bulk density measurements should be taken on the some of the full core samples that are going to be sampled and sent for assay. Importantly, this should be conducted directly before sample preparation. At KBK, the density of a sample is measured using the Archimedean method of weighing dry full sample and then weighing the same full sample submerged in water. An example of the density measurement equipment is shown in Figure 1: .

Figure 1: **Bulk Density Measurement Station**

The method for density measurement is to weigh the core dry in air (dry mass, or weight in air = **W1**) and then weigh the core completely submerged under fresh water (weight in water = **W2**) hanging off the hook in the metal basket without touching the bottom or sides of the bucket. A high resolution industrial balance capable of measuring up to 8 kg at a resolution of 0.1 g should be used to take the measurements of the core.

The density is calculated using the Archimedean principle, as follows:

$$\text{Density} = W_1 / (W_2 - W_1)$$

It is recommended that all data should be collected manually and recorded on paper and then entered into the database. The data should be recorded in digital format (Microsoft Excel spreadsheet) and then transposed/exported to the geological database which is to be stored and updated offsite.

At regular intervals (one 10 cm sample every 10 m), the Geologist (also referred herein as the Project Geologist) selects the samples that are relatively representative of the main lithology types and labels these for a technician to collect the density measurement.

The density measurements should also be supplemented with QAQC check samples (a standard, or 'known test weight') to ensure the precision and accuracy of the density measurements taken. The **standard** should be measured on the upper and lower scale out of water (lower scale meaning the hanging basket) at the start and end of the day and recorded at the top of the density measurement sheet. The standard should also be measured once every 20 normal sample density measurements.

Additionally, it is suggested that at regular intervals (such as once in every 20 normal samples or 1/20 for each Density Measurement taken), a **repeat** measurement should be made in order to check for repeatability (precision) and truthfulness (accuracy) of the measurements taken and if the equipment is functioning.

A step by step description of the task is provided in the table below with pictured examples of each item.

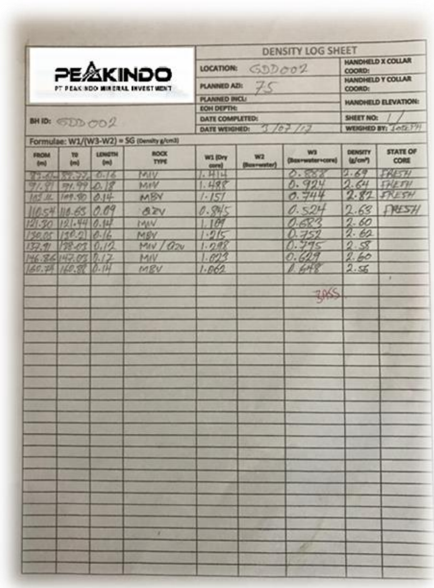
Table 3-2: Step by Step Task for Density Measurement in the Field

Task	Description	Photo Example

#1 Geologist selects Core Interval from Core Box	The selected core will be:
	• approximately 10 cm in length
	• pre-labelled by the Logging Geologist showing:
	  ○ interval metre mark start and end
	  ○ lithological code
		

#2 Select Core Interval From Core Box	On the paper record sheet, note: ○ FROM (m), ○ TO (m), ○ LENGTH (m), and ○ ROCK TYPE Complete the rest of the form (Hole Number, Date, your name. etc)	

#3	**(W_1)** Record Weight in Air Record measurement on paper record sheet against the correct metre interval	

#3	**(W_2)** Wrap unconsolidated samples in plastic wrap (OXIDE and TRANSITIONAL only) Place the core in the basket and submerge in water. Record Weight in Water Record measurement on the paper record sheet against the correct metre interval	
#4	Enter the calculated field value of Density Describe the STATE of the core: ○ OX = Oxidised ○ TRAN = Transitional ○ FR = Fresh Rock	

PEAKINDO
PT PEAKINDO MINERAL INVESTMENT

DENSITY LOG SHEET

LOCATION: GDD002
PLANNED AZI: 75
PLANNED INCL:
EOH DEPTH:
DATE COMPLETED:
DATE WEIGHED: 3/07/17
HANDHELD X COLLAR COORD:
HANDHELD Y COLLAR COORD:
HANDHELD ELEVATION:
SHEET NO: 1/1
WEIGHED BY: [illegible]
BH ID: GDD002

Formulae: W1/(W3-W2) = SG (Density g/cm3)

FROM (m)	TO (m)	LENGTH (m)	ROCK TYPE	W1 (Dry core)	W2 (Box+water)	W3 (Box+water+core)	DENSITY (g/cm³)	STATE OF CORE
[illegible]	89.77	0.16	MIV	1.414		0.888	2.69	FRESH
91.81	91.99	0.18	MIV	1.488		0.924	2.64	FRESH
[illegible]	109.90	0.14	MBV	1.151		0.744	2.82	FRESH
110.54	110.63	0.09	QZV	0.845		0.524	2.63	FRESH
121.30	121.44	0.14	MIV	1.109		0.683	2.60	
130.05	130.21	0.16	MBV	1.215		0.752	2.62	
137.91	138.03	0.12	MIV / QZV	1.298		0.775	2.58	
146.86	147.03	0.17	MIV	1.023		0.629	2.60	
160.79	160.88	0.14	MBV	1.062		0.648	2.56	

#5	Repeat steps 1 – 4 until suitable amount of representative core is obtained As a general rule, each 30 m of core should have at least one (1) of each Litho code, where possible.	Note: per 100m of drilling there should be at least 30 density measurements taken for EACH Lithology / domain Ie. if there are four domains or four Lithologies Lithology 1 = MSQz approx., x 10 density measurements Lithology 2 = SHA approx. x10 density measurements Lithology 3 = DIO approx. x10 density measurements Lithology 4 = GRD approx. x10 density measurements In terms of frequency of measurements: The project geologist should take at least 1 density measurement for every second core box and per lithology
#6	Completed worksheets should be given directly to the Senior Geologist for entry into the database	

4 MATERIALS, EQUIPMENT, AND PPE

- Hard Copy Logging Sheet for recording dry bulk weights (prepared and ready to log)
- Specific Gravity (SG) Stand and wire basket
- Fresh tap water for the stand
    - Alternate material if unconsolidated material- Plastic wrap to wrap unconsolidated sample (OXIDE and TRANSITIONAL only)
- Pen / Pencil
- Flagging Tape to mark samples in the core trays
- Electronic scales (provided with SG stand)
- Ear plugs in noisy conditions and where appropriate

5 HEALTH AND SAFETY

Field Geologists are expected to set a good example in terms of safety awareness and the wearing of protective clothing and equipment and also in ensuring that all personnel working in operational areas are likewise protected and working in a safe manner. High Visual Clothing and suitable strong footwear are mandatory within most areas where operations are in progress. Prior to starting density testwork, it is the responsibility of the Field Geologist to ensure that the site and access are safe/stable.

6 APPROVAL AND AUTHORITY TO PROCEED

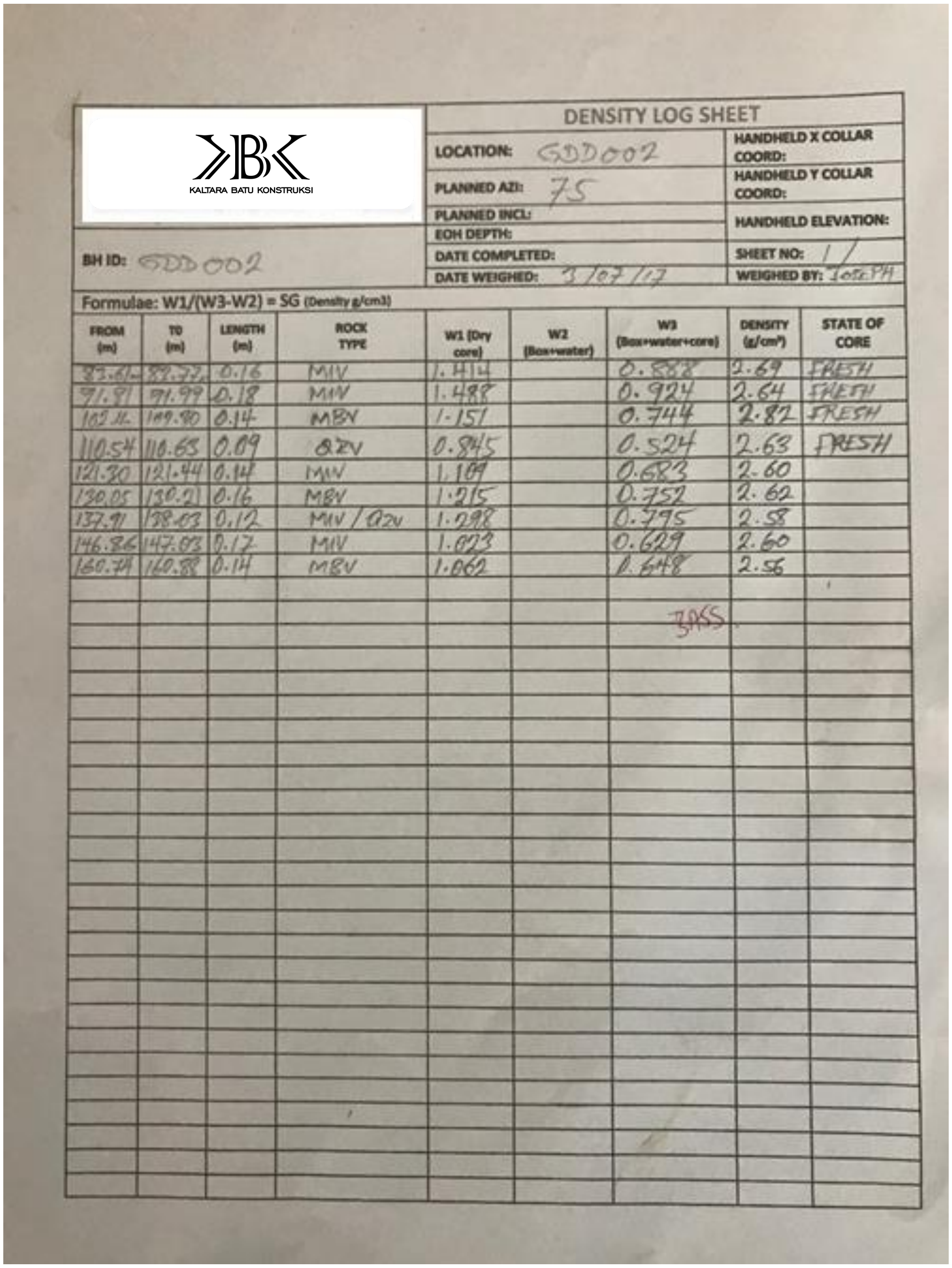
The above standard operating procedure has been reviewed on Monday, October 3, 2018 and is approved by the relevant personnel signed and dated below.

7 REVEVANT TECHNICAL TEAM MEMBERS

Name	Title	Signature	Date
Saufi Handri	Project Manager		3/10/2018

Approved by Date

8 APENDIX A – EXAMPLE DENSITY LOGGING SHEET



DENSITY LOG SHEET

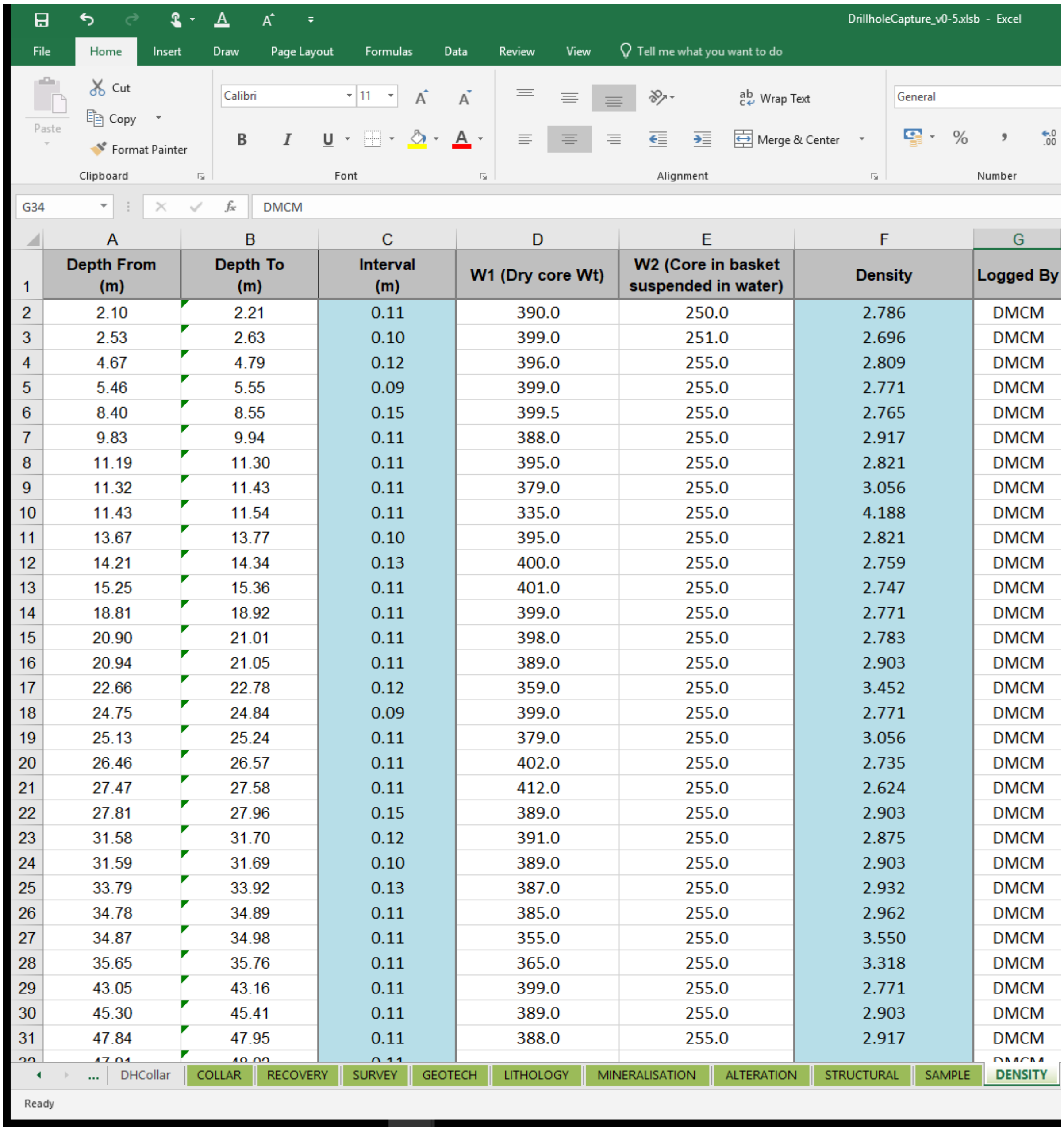
KALTARA BATU KONSTRUKSI

BH ID: GDD002	LOCATION: GDD002	HANDHELD X COLLAR COORD:	
	PLANNED AZI: 75	HANDHELD Y COLLAR COORD:	
	PLANNED INCL:	HANDHELD ELEVATION:	
	EOH DEPTH:		
	DATE COMPLETED:	SHEET NO: 1/1	
	DATE WEIGHED: 3/07/17	WEIGHED BY: JOSEPH	

Formulae: W1/(W3-W2) = SG (Density g/cm3)

FROM (m)	TO (m)	LENGTH (m)	ROCK TYPE	W1 (Dry core)	W2 (Box+water)	W3 (Box+water+core)	DENSITY (g/cm³)	STATE OF CORE
83.61	83.77	0.16	MIV	1.414		0.888	2.69	FRESH
91.81	91.99	0.18	MIV	1.488		0.924	2.64	FRESH
109.76	109.90	0.14	MBV	1.151		0.744	2.82	FRESH
110.54	110.63	0.09	QZV	0.845		0.524	2.63	FRESH
121.30	121.44	0.14	MIV	1.109		0.683	2.60	
130.05	130.21	0.16	MBV	1.215		0.752	2.62	
137.91	138.03	0.12	MIV / QZV	1.298		0.795	2.58	
146.86	147.03	0.17	MIV	1.023		0.629	2.60	
160.74	160.88	0.14	MBV	1.062		0.648	2.56	

BASS



Depth From (m)	Depth To (m)	Interval (m)	W1 (Dry core Wt)	W2 (Core in basket suspended in water)	Density	Logged By
2.10	2.21	0.11	390.0	250.0	2.786	DMCM
2.53	2.63	0.10	399.0	251.0	2.696	DMCM
4.67	4.79	0.12	396.0	255.0	2.809	DMCM
5.46	5.55	0.09	399.0	255.0	2.771	DMCM
8.40	8.55	0.15	399.5	255.0	2.765	DMCM
9.83	9.94	0.11	388.0	255.0	2.917	DMCM
11.19	11.30	0.11	395.0	255.0	2.821	DMCM
11.32	11.43	0.11	379.0	255.0	3.056	DMCM
11.43	11.54	0.11	335.0	255.0	4.188	DMCM
13.67	13.77	0.10	395.0	255.0	2.821	DMCM
14.21	14.34	0.13	400.0	255.0	2.759	DMCM
15.25	15.36	0.11	401.0	255.0	2.747	DMCM
18.81	18.92	0.11	399.0	255.0	2.771	DMCM
20.90	21.01	0.11	398.0	255.0	2.783	DMCM
20.94	21.05	0.11	389.0	255.0	2.903	DMCM
22.66	22.78	0.12	359.0	255.0	3.452	DMCM
24.75	24.84	0.09	399.0	255.0	2.771	DMCM
25.13	25.24	0.11	379.0	255.0	3.056	DMCM
26.46	26.57	0.11	402.0	255.0	2.735	DMCM
27.47	27.58	0.11	412.0	255.0	2.624	DMCM
27.81	27.96	0.15	389.0	255.0	2.903	DMCM
31.58	31.70	0.12	391.0	255.0	2.875	DMCM
31.59	31.69	0.10	389.0	255.0	2.903	DMCM
33.79	33.92	0.13	387.0	255.0	2.932	DMCM
34.78	34.89	0.11	385.0	255.0	2.962	DMCM
34.87	34.98	0.11	355.0	255.0	3.550	DMCM
35.65	35.76	0.11	365.0	255.0	3.318	DMCM
43.05	43.16	0.11	399.0	255.0	2.771	DMCM
45.30	45.41	0.11	389.0	255.0	2.903	DMCM
47.84	47.95	0.11	388.0	255.0	2.917	DMCM

KBK AGGREGATE MINING

STANDARD OPERATING PROCEEDURE

GEOLOGY DD LOGGING & SAMPLING

March 11, 2019

1 DOCUMENT REVISION

VERSION	FILE NAME	COMPILED BY (NAME)	TITLE / FUNCTION	APPROVED BY (NAME/FUNCTION)	DATE APPROVED
v-1.1	U7285 – SOP KBK - GEOLOGY LOGGING & SAMPLING.docx	S.HANDRI	Project Geologist	PM Site Operations Manager	10/10/2018
v-2.0	U7285 - SOP KBK - GEOLOGY LOGGING SAMPLING_v2.0.docx	S.HANDRI	Project Geologist	PM Site operations	11/03/2019

2 STANDARD OPERATING PROCEEDURE OVERVIEW

2.1 Background and Description

The procedures have been developed by SRK Consulting (UK) Ltd in collaboration with the PT. KALTARA BATU KONSTRUKSI (PT KBK or the Company) and are specifically for the practices required at the KBK Resource Drilling Project. This document has been compiled as a guide for field project geologists, and to assist in standardizing the operating procedures taken by the Project Geologists for the logging and marking up of diamond drill (DD) core.

This document focuses on the exploration drilling programme currently underway (commencing October 2018) and it provides a description of the DD, the logging of DD, and the mark up of DD core in the core laydown area. This document's intended audience is the Project Geologists, Senior Geologist, and core yard technicians. The various safety aspects and the associated equipment and personal protective equipment (PPE) have also been described throughout the following sections.

3 DEFINITIONS

3.1 JORC (2012) Mineral Resource definitions

The results of exploration drill programmes will be used to generate Mineral Resource estimates ("MRE") defining the quantity and grade of the Mineral Asset under investigation. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.

The definitions of Measured, Indicated and Inferred Resources below are taken from the JORC Code (2012).

Mineral Resource

A 'Mineral Resource' is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade (or quality), and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade (or quality), continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

All reports of Mineral Resources must satisfy the requirement that there are reasonable prospects for eventual economic extraction (i.e. more likely than not), regardless of the classification of the resource.

Portions of a deposit that do not have reasonable prospects for eventual economic extraction must not be included in a Mineral Resource. The basis for the reasonable prospects assumption is always a material matter, and must be explicitly disclosed and discussed by the Competent Person within the Public Report using the criteria listed in Table 1 for guidance. The reasonable prospects disclosure must also include a discussion of the technical and economic support for the cut-off assumptions applied.

Where untested practices are applied in the determination of reasonable prospects, the use of the proposed practices for reporting of the Mineral Resource must be justified by the Competent Person in the Public Report.

Geological evidence and knowledge required for the estimation of Mineral Resources must include sampling data of a type, and at spacing, appropriate to the geological, chemical, physical, and mineralogical complexity of the mineral occurrence, for all classifications of Inferred, Indicated and Measured Mineral Resources. A Mineral Resource cannot be estimated in the absence of sampling information.

Inferred Mineral Resource

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. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to an Ore Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral 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.

Indicated Mineral 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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to assume geological and grade (or quality) continuity between points of observation where data and samples are gathered.

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 Ore Reserve.

Measured 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 gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes, and is sufficient to confirm geological and grade (or quality) continuity between points of observation where data and samples are gathered.

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 Ore Reserve or under certain circumstances to a Probable Ore Reserve.

4 MATERIALS, EQUIPMENT AND PPE

4.1 Personal Protective Equipment (PPE)

- Cool water for the rig Geologists
- Emergency contact list (safety officer number, driver's / vehicle numbers etc.)
- Communications
- First Aid Kit
- Standard PPE (minimum)
- hard hat
- steel capped boots
- ear plugs
- protective eye wear
- sun cream
- insect repellant
- protective gloves

4.2 Materials/Consumables

- All hard/digital copy logging sheets (prepared and ready to log)
- Black permanent markers for bag labels
- Cable ties (zip locks) to securely fasten the sample bags
- Core trays (enough for at least one shift)
- Coated paper/plastic/aluminium sample tags
- Yellow, green, and red wax pencils for structural logging

- Heavy ply sample bags (or calico bags)
- Plastic sample bags for core samples
- Plastic/rubber sample bags for grab samples/chips
- Poly-weave sacks
- Prepared blank material (ready to go)
- Water proof sample tags; ideally three tags are needed with the same number

4.3 Geology Equipment

- Map of drillhole locations and coordinates list
- Measuring tape
- Hand held GPS device
- Digital camera
- Chair and table for logging
- Shelter for the rig geologists (marquee / tent / tarp)
- Soft brush (1 minimum)
- Spoon (1 minimum)for moving material into chip trays
- Spray can/bottle for wetting core
- Core logging trestles
- V-rail (or angle bar)
- Torch (solar charge blue type)
- Compass/brunton
- Ezi logger instrument
- Generator to power lights/phone chargers etc.
- Geologists hand lens
- Geologists field note book for (rig notes).
- Bottled acid (labelled)
- Lantern/lights for logging and safety at night
- Large electronic weight scales for SG testing
- Laminated scale bar/colour chart for chip tray photography
- Laminated geology sampling code sheets (3 sheets)
- Pencils and erasers for logging
- Rig diary for Geologist to track events (for comparison to drillers plods, or records down time or errors)

- Ruler
- Clip board for logging
- Rag, water and bucket for washing core at the rig

5 CORE LOGGING FACILITY

A purpose-built core logging facility is available at the KBK site adjacent to the mine working areas, which also contains core sawing equipment. Although core boxes are transported a short distance over gentle terrain with minimal vegetation cover, allowing for rapid relocation of samples with limited opportunity for core damage, all care should be taken when transporting full core boxes.

The current facility will require some improvements to ensure the conditions are optimal for extended logging and storage. Logging tables, and core photography equipment is provided to ensure the geologists can log to a high level of detail without causing injury to themselves or damage to the core. The core logging area is divided into three key areas (1) density measuring, (2) core logging, (3) sample preparation, and (4) sample secure storage.

6 DESCRIPTION OF THE ACTIVITIES

The following sections detail the logging and sampling activities of the KBK exploration programme. Several key areas have been described that highlight the main aspects of the programme in relation to resource geology and health and safety, and including, a general task list, logging and sampling, structural data collection.

6.1 Health and Safety

Field Geologists are expected to set a good example in terms of safety awareness and the wearing of protective clothing and equipment and also in ensuring that all personnel working in the vicinity of drill rig are protected and working in a safe manner. Hard hats and suitable strong footwear are mandatory within 20 m of a rig and in areas where hazardous operations are in progress. Prior to starting a new drillhole, it is the responsibility of the Field Geologist to ensure that the site and access are safe/stable.

At the rig, and certainly whilst the rig is in operation, it is the responsibility of the drilling contractor to control safety measures and train anyone working around the rig. All personnel undertaking activities nearby the drill should be provided with a rig induction and safety training.

6.1.1 Specific Drilling Risks

There are many dangers associated with drilling. SRK has listed some of the major risk categories below taken from the Australian Government guidelines on mineral exploration drilling (Western Australia Department of Mines and Petroleum, 2012).

SRK recommends that a risk assessment (including emergency management) is undertaken prior to drilling and updated throughout the drill programme to ensure the project-specific risks are assessed.

- Rotating and moving parts (drill rods, masts, drive shafts, cyclones/splitters).
- Compressed air systems (compressors and hoses, boosters, air hoists).
- Hydraulic systems (pumps, fluid reservoirs, valves, tubes/pipes/hoses).
- Hazardous goods and substances (fuel, acids, oils).
- Electricity (generators, lighting, overhead power lines, appliances, fences).
- Manual tasks (heavy goods lifting, rod handling, tyre changing).
- Working at height (rig masts and decks, truck boxes).
- Falling objects (drill rods and bits, hoses and fittings, top drive units, tools).
- Fatigue and mental well-being (working hours / shifts working, physically / mentally demanding tasks).
- Dust, noise, gas (respiratory, or hearing related damage).
- Hot work (welding, grinding).
- Naturally occurring radioactive or fibrous materials (NORM, e.g. asbestos, uranium, thorium) exposure).
- Extreme weather (high winds, flooding, lightning, fire, temperatures).
- Vehicle control (driving light / heavy / unfamiliar vehicles).
- Remoteness of site (getting lost, limited rapid medical attention).
- Existing workings (unprotected mine openings, ground subsidence, open drill holes).
- Housekeeping (site layout, management of hazardous substances).

6.2 Safety Precautions at the Rig an in the Core Facility/Laydown

Extra safety precautions must be taken when undertaking core logging at the rig and within the core yard, these include (but are not limited to) the following:

- When in operation (switched on) the drill rig and the immediate work area is classified as a “Restricted Area” and it should be restricted to those who have undergone the required training (not part of this SOP).
- All personnel undertaking activities nearby the drill should be provided with a rig induction and safety training.
- Geologists should not approach the rig and should keep a suitable, safe distance from these areas.
- Only trained drillers may work in the rig hazardous prone areas.
- Personnel are not to undertake logging at the rig under the influence of drugs or alcohol or other materials that may impair their ability to undertake this task.
- The Company’s own occupational health and safety documents should be read in conjunction with this SOP and adhered to at all times.

- Individuals must be aware of emergency procedures (such as rig cut out switches and emergency phone numbers) and formally trained in first aid. If you don't know, ask someone who does. The following potential causes of injury must be monitored at all times:
- Personal Injury due to lifting heavy core boxes / bags or repetitive process strains
- Heat stress and dehydration
- The hazards associated with the operating equipment and the cutting area should be identified and monitored, including:
- Dust (and small flying debris if windy)
- Trip hazards
- Open edges (nearby tails drain, etc)
- Unstable tables and nearby core trays
- Lightning
- Poor lighting at night
- Chemicals, spills and drilling fluids; all spills must be reported
- Noise; ensure appropriate PPE worn at all times.

For instruction as to actions required on/when any of the above hazards are identified, the geologist should consult the Company's own Occupational Health and Safety (OH&S) documentation.

6.3 Geologist General Task Checklist

- Check that the surveyor has located any old drill lines and drill collars (renumbered if necessary). Lay out and verify new hole locations where necessary.
- Supervise drilling operations (24 hours or as required) and check whether holes need to be stopped or extended to complete intersections of mineralization. Confirm with Senior Geologist and/or Project Manager.
- Maintain records of drillholes and completion of specific studies on each hole.
- Ensure that the driller records the depth and intensity of any water strike or of water loss during drilling.
- Ensure that drillhole internal surveys (single or multi-shot) are carried out as specified in this SOP whilst drilling is in progress to detect excessive deviation.
- Monitor core recovery and DD core quality during drilling and report problems.
- If it doesn't look right, STOP and fix it.
- Ensure that core orientations are undertaken as specified by the Geotechnical/Structural Geologist.
- Geologically log and photograph core.
- Ensure that lithological and structural logging has been completed prior to sampling.
- Produce separate mineralization and alteration logs through waste and ore zones and undertake sampling as specified.

- Ensure a regular dispatch of samples to laboratory, accompanied by relevant documentation and verified by a qualified geologist.
- Immediately on completion of holes ensure that the collar is resurveyed and rehabilitate the general drill pad area to normal conditions as best as possible.
- After a suitable recovery period, a selected number of open holes (where possible) should be monitored for water table depth variation.
- Maintain working cross sections (1:1000) showing mineralized intervals and geological units intersected in 3D geological digital design packages (such as Leapfrog Geo) and paper copy where necessary.
- Send summary geological logs of each hole along with details of samples submitted to the laboratory to the Senior Geologist on a regular basis.
- Record down-hole survey information on completion of each hole in a spreadsheet.
- Submit weekly drilling progress reports including information of mineralized intersections.
- Complete all detail geological logging information and verify this in the database which forms the basis of this standard operating procedure (SOP).

The following sections describe the various logging processes for the KBK exploration programme, focusing on DD logging.

6.4 Geological Logging

Throughout the KBK exploration programme there will be various sets of data collected by the Project team. In the first instance, detailed lithological logging should be undertaken with the parameters being recorded on the paper record sheet. A detailed description of the parameters and method of collection is provided in Section 0.

6.5 DD Core Handling and Storage

6.5.1 Handling Diamond Drill Core

The drillers shall carefully extract the core from the core barrel directly into the core boxes or preferably onto open core trays before transfer to the core boxes. Hammers should only be used as a last resort. All drilling should be conducted at a steady pace and not advancing at rates beyond what is normally expected in good to competent ground conditions. Particularly slow or fast rates of drilling penetration should be recorded, as these can be an early indication of strength of materials.

7 GEOLOGICAL LOGGING PROCESS

7.1 Geology Logging (commencing at the rig)

Lithology logging is required for both the DD core and RC chips samples. Detailed lithological logging should be undertaken The detailed DD logging approach is provided in section.7.1.1. The following general parameters should be recorded on the paper record sheet as a minimum:

- Drillhole identifier number, DGPS coordinates, coordinate system, azimuth, dip, date, geologist's name
- General rig details, core diameter
- From and To, and final depth interval in metres
- Lithology/ rock type, , weathering/alteration
- Ore minerals present
- Colour
- Grain size, texture
- Structures and angle to core axis (alpha angle)
- Water table depth (ie, water insected at ??m)
- Any other comments

At the conclusion of the Geological Logging task, the following sheets should be produced, fully filled-in and then verified/checked by the Senior Geologist onsite.

- COLLAR Logging Sheet (to be completed at the rig)
- RECOVERY Logging Sheet (to be completed at the rig)
- SURVEY Logging Sheet (to be completed at the rig)
- GEOTECH Lithology Logging Sheet (to be completed at the rig)
- LITHOLOGY Logging Sheet (to be completed at the rig and in the core shed)
- STRUCTURAL Logging Sheet (to be completed at the core shed)
- SAMPLE Logging Sheet (to be completed at the core shed)
- DENSITY Logging Sheet (to be completed at the core shed)

7.1.1 Detailed DD core logging procedure (at the core shed)

When full core boxes have arrived at the core shed, the Geologist makes the following checks:

1) Layout the core boxes in the correct down hole order
2) If necessary, clean the core with water and/or wet rag/towel.
3) Ensure that core has been placed in the boxes so that depths read from left to right down the hole.

4) Check that core blocks or plastic core spacers are all present with depths clearly marked and, if necessary, check against driller's daily logs.
5) Check that all core lengths fit together within each drill run and that the start/end box labels match these.
6) Check the core is the correct way up by examining geological indicators such as scour structures and graded bedding or drilling induced indicators such as core spring marks and ground ends.
7) Check that the core at the end of each drill run joins up with the core at the start of the next.
8) Look out for sudden differences in intersection angles or lithologies which may indicate missing, or disturbance / displacement of core.
9) Measure total core recovery (TCR) between depth markers after ensuring that all core sections fit tightly together. Where core is badly broken, make an assessment of the possible amount of solid core that could have been drilled over this section.
10) When there is core loss, attempt to assess and record the depth interval at which this might have / has occurred.
11) Where necessary, move core blocks / spacers to resolve problems of under recovery in one drill run and over recovery in the next. This could be due to retrieval of a core "stick-up" at the bottom of the hole after withdrawal of the inner tube during the previous run.
12) Measure solid core recovery (SCR) which is a reflection of core quality as opposed to quantity (TCR). This is based on the sum of all core pieces whose length along the core axis is greater than, or equal to, the core diameter. This sum is then expressed as a percentage of the drilled length. Note that there must be a complete core circumference at the centre point of each core length.
13) Walk over the core boxes and mark all lithological units whose length exceeds 1m (unless an established marker horizon) with chalk. Narrower intervals can be recorded as inter-beds within the main unit description.
14) Photograph the marked-up core (wet).
15) Check for evidence of:
    a. folding.
    b. Significant changes in bedding intersection angle especially sections of core with near zero intersection angles
    c. Changes in the relationship of bedding and cleavage.
    d. Inverse repetition of lithological units.
    e. faulting.
    f. Sudden changes in lithology or intersection angles.
    g. Excessive core loss.
    h. Zones of deep oxidation.
    i. Clay gouge.
    j. Zones of shearing and brecciation.
16) Select a suitable core logging sheet format.
    a. Fixed format - usually containing columns in which alpha-numeric codes are inserted.
    b. Free format - allows full descriptions to be written by the geologist.

17) Assign a brief rock description or code for each lithological unit as per Lithological Code table.

18) Make a general description of each rock unit which should include:

   a. Rock type e.g., coarsely foliated meta-volcanic schist.
   b. Grain size e.g., fine grained.
   c. Colour e.g., pinkish grey.
   d. Sedimentary, metamorphic or igneous characteristics.
   e. Way-up indicators.
   f. Mineralogical information relating to host rock.
   g. Style and intensity of mineralization with description of ore minerals present.
   h. Any geotechnical characteristics.
   i. Core condition including porosity, friability, degree of weathering or alteration, leaching, presence of solution cavities etc.

19) Once the general description is complete, add depth specific descriptions of particular features of interest.

20) Keep core surface wet whilst logging. This will accentuate structures and textures in core.

21) Write up all the log sheets (digital/hard copy which ever appropriate). The rock title should be positioned immediately adjacent to the first "from - to" depths for each/interval unit.

   a. Where the contact with the next lithological unit occurs within a drill run, determine the depth of the contact taking into account core loss.
   b. Where core loss cannot be assigned to a specific depth interval and it appears to be throughout, split the core loss pro-rata between the two portions of the drill run. For example, if the contact is 1 m into a recovered section of core 2.6 m long and if the core loss is 0.4 m, then the core loss assigned to the 1m section will be 1 * 0.4 / 2.6 = 0.15. That is, the recorded depth of the contact will be 1.15 m below the marker depth.

22) For each lithological unit, record as many intersection angles as possible (rotate the core until the maximum angle is displayed and, with a clinorule, protractor or ezi-logger©, measure the angle to the edge of the core). Intersection angles could be for a vein, bedding, foliation / schistosity, cleavage, etc. Ezi-logger© is the preferred method to collect these measurements.

   a. Record clockwise intersection angles between the low points of these features taking one as the reference (e.g. cleavage, if locally uniform in direction).
   b. Specify the depth of each measurement on the log sheet opposite the drill run in which it occurs.

23) Record any changes in core diameter down the hole.

7.2 Structural Logging and Orientation

7.2.1 Core Orientation (using Reflex tool)

Core orientation is used in the KBK drilling programme due to the geological complexity and structurally-controlled nature of the deposit. The core orientation is limited to DD drilling, and the suggested orientation procedure is as follows:

- Preferred orientation method for both HQ and NQ is the reflex ACT (version II or newer).
- Regardless of what method is applied by the drillers, the orientation method used should be routinely recorded in the drilling database.
- The orientation method used should be routinely recorded in the drilling database.

7.2.2 Orientation of Core using a Spear Tool

- Spear orientations should be completed at least every second run. If an orientation attempt fails (the mark is clearly bad, for example) then core section should be marked with red dashed line and another orientation should be attempted the next run (Figure 1). It should be noted that the spear tool is much less reliable then new more advanced technology, so care must be taken when using it.
- The spear should be checked regularly for straightness. Only china-graph wax pencils should be used for spear orientation. The procedure for spear use is as follows:

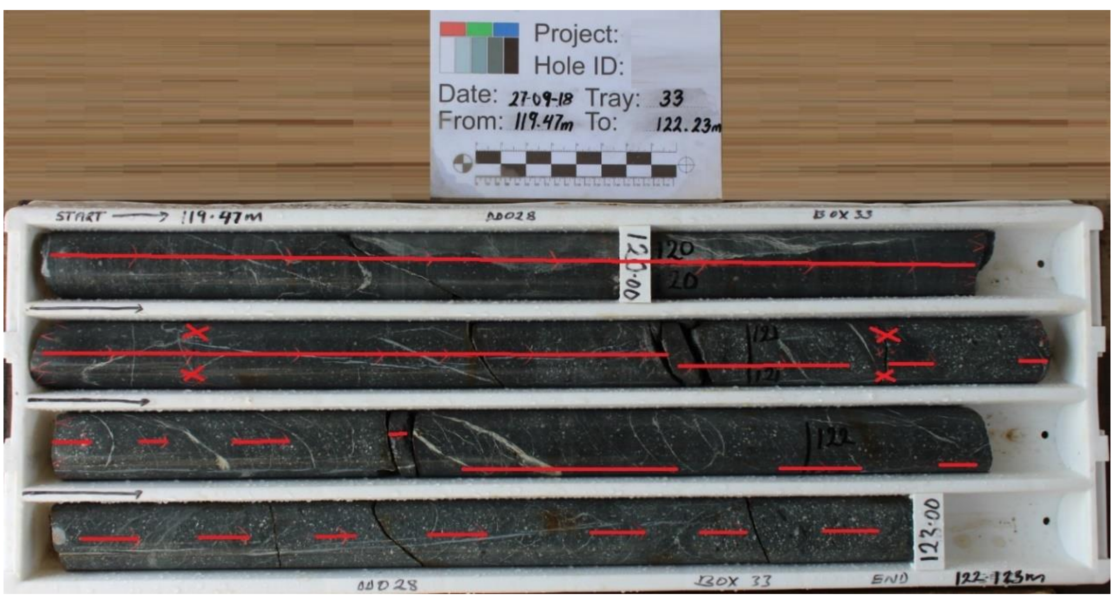


Figure 1: Example of unclear or failed orientation marker point (geologist denotes unclear section with dashed red line).

- After the end of a run, pull up approximately 5 m of wireline and mark this point, typically with flagging tape.
- Check the china-graph pencil has enough lead exposed.
- Lower the spear down the hole, until it is 5 m above the bottom of hole (as indicated by the mark (flagging tape) made during wireline retrieval. Come to a complete stop at this point.
- Gently lower the spear down the remaining 5 m at a speed of <1 m/s. China-graph pencils are soft so the spear doesn't need a lot of speed to make a good mark.
- When the run is finished, check the core mark for quality. There should be a single clear mark; this should be a set distance from the edge of the core (the radius of the spear tool). If the mark is too close to either the edge or the centre of the core, then the mark is unreliable (this could be indicative of lowering too fast or a bent spear). If there are multiple impact points then the mark is also unreliable (this is typically indicative of lowering too fast and bouncing of spear).
- Feedback should be given to the driller immediately if problems with the orientation mark are identified.
- The driller should write his name or initials on the adjacent core block so that any problems or errors can be correctly qualified and addressed.
- The orientation mark should be left 'as is' so the geologist can also check its quality.

7.2.3 Lining up the core

Lining up of the core should be completed by a geologist or experienced core technician. For instances of very broken core, this can be a very time-consuming task. It is sometimes beneficial to discuss this with the experience driller contractor who will be able to adjust his approach to drilling in efforts to improve recovery and quality of the core.

Lining up spear oriented core

- An extra step is required prior to lining up spear oriented core.to assign a 'confidence value' from 1 (low) to 3 (high). This should be recorded on the geological structural logs and in the database.
- For the spear tool, confidence is based on two key factors:
    - Whether there is a clear 'first impact' mark.
    - Whether the distance from the edge of the core to the mark is the same as the radius of the spear.
- Orientations with a confidence of 1 should be ignored. Orientations with a confidence of 2 should only be used if supported by another matching orientation mark. Orientations with a confidence of 3 can be used as stand-alone orientation marks.
- Once confidence values have been assigned to spear orientation marks, a small tick should made on the core at the interpreted Base of Core (BOC) position. You must be holding the core so you are looking straight down-hole while you do this accurately. As a check, the continuation of the imaginary line between the orientation mark and the BOC mark should divide the core into two symmetric halves. The tick mark should lie on a radial line that passes through the orientation mark and the centre of the core. It should also be the edge of the core which is the shortest distance from the orientation mark.
- Once completed, continue lining up the core.

Example of Lining up core

- Core from each individual run should be pieced together in an angle iron jig by matching the ends of each piece of core (Figure 2). Care must be taken to ensure that each piece of core 'locks' into the adjacent pieces. Matching planar structures (e.g. a vein or consistent foliation) between each piece of core can also be used if the core ends are damaged. If there is any doubt at this stage of the process, the core orientation should not be extended past this point.

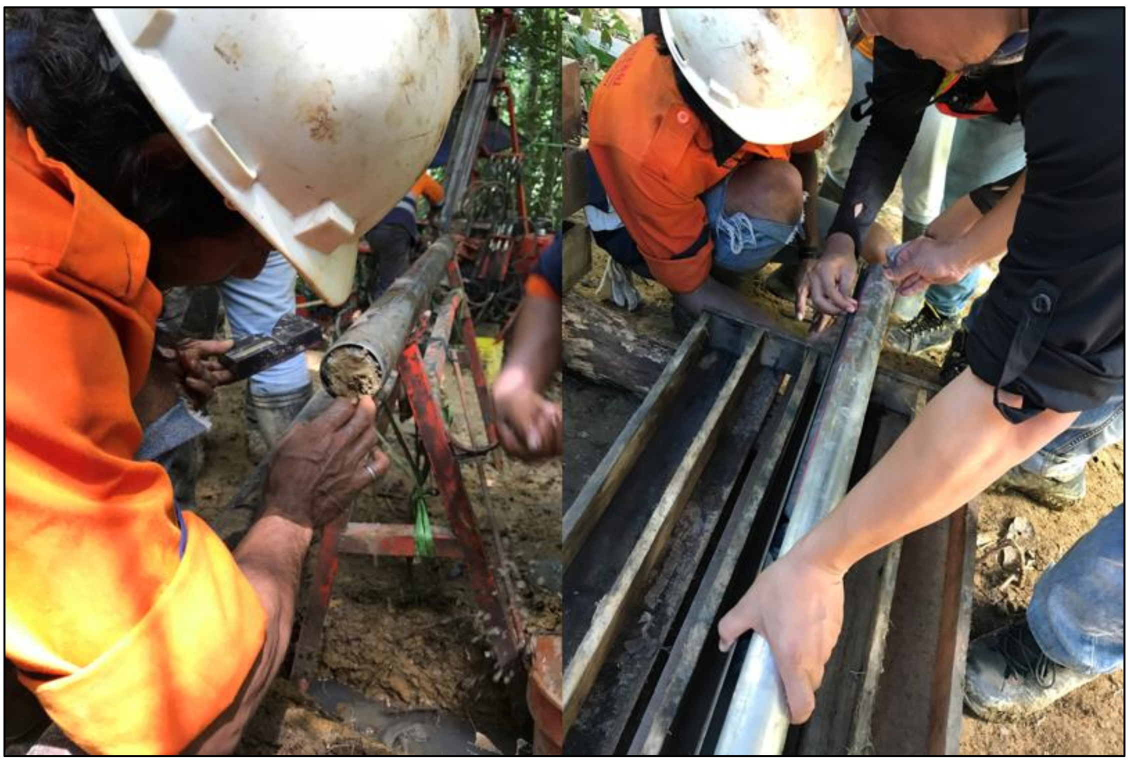


Figure 2: Example of making the orientation mark and drawing the orientation line.

- Once a section of core is lined up, the BOC orientation line should be drawn on using the edge of the angle iron and a chinagraph pencil. Arrows should be drawn on the orientation line indicating the down-hole direction.
- At the same time as the orientation line is drawn on a cut line should be drawn on with a different coloured chinagraph pencil. The cut line should 2- 3 cm to the right (clockwise) of the orientation line when looking down-hole. Sections without a reliable orientation should have a cut line but no orientation line.
- When another orientation mark is reached, it should be checked for consistency. Angular differences of <10º are acceptable (4 mm/5 mm arc lengths for NQ and HQ respectively). For the ACT orientation marks. Angular differences of <15º are acceptable (6 mm/8 mm arc lengths for NQ and HQ, respectively) for spear orientation marks. The angular difference between the orientation line and the orientation mark should be recorded on the logging sheet entitled "STRUCTURAL" in the data capture software and also in the drilling database.

- If the angular differences are greater than acceptable levels, then an iterative process must be undertaken going up and down-hole until an orientation line is found which minimises the overall errors between high confidence orientation marks.
- Once the orientation line is finalised, it should be marked permanently with a paint marker.
- A confidence value also needs to be assigned to each oriented section. The confidence value should be based on how many matching core orientations have been used:
  - 1 = orientation line based on only one orientation mark
  - 2 = orientation line based on two matching orientation marks
  - 3 = orientation line based on more than two matching orientation marks
- Confidence values should be recorded on the logging sheet entitled "STRUCTURAL" in the data capture software and recorded in the database.
- Confidence intervals, can also be indicated on the core (e.g. 1 = dashed orientation line and single arrow head; 2 = solid orientation line and single arrowhead, 3 = solid orientation line and double arrowhead).
- Intervals where there are greater than acceptable errors must also be flagged with the Senior Geologist who should then address this with the driller and/or field technician responsible.
- The whole process of marking up the orientation line should be completed in a timely manner so feedback can be given to the drillers and problems can be fixed when they first appear (AT THE RIG).
-

7.2.4 Structural Core Logging

What and Where to Measure

- The first decision that needs to be made is what to measure. This depends on the nature of the deposit. In some deposits, foliation and bedding measurements are very important; in others vein orientations are more important. In the early stages of a drilling programme it is perhaps best to measure a representative selection of all major structural elements (e.g. veins, bedding, foliations, veins, dykes, faults, axial planes, lineations etc.).
- As the drilling programme progresses, you may decide to concentrate on a fewer structural elements that are believed to be key to understanding the deposit. However, sufficient data for all structures present still needs be collected to characterise each population.
- Keep in mind the needs of downstream users such as geotechnical engineers and hydrogeologists. The amount of time invested in collecting data for these users should scale with the development of the project.
- Note: Faults can be very difficult to measure at the scale of drill core. If there are obvious major slip planes (e.g. a sharp boundary between cataclasite and fractured wall rock) then this can be measured. However, treat these measurements with caution until it is supported by a number of other fault measurements or you have intercepted the same fault in 3 or more drillholes, at which point you can calculate an orientation using the 3-point problem technique or by plotting it in a 3D software package.
- The next decision is how often to record structural measurements. Generally, more measurements should be recorded in structurally complex intervals and less in structurally simple intervals. Due to errors in the orientation process and natural variability in many structural features, typically a number of measurements

for any one structural element are required to accurately constrain their characteristic orientation and variability.

- For **continuous features** such as bedding or foliations, measurement spacing depends on how variable these features are down-hole. However, an initial spacing of about 5-10 m is a good starting point. Importantly, for continuous feature an attribute column that indicates the representativeness of the measurement is useful (e.g. 1st order = representative of >10-15 m of drill core, 2nd order = representative of 3-10 m of drill core, 3rd order = representative of <3 m of drill core).
- For **discrete features** such as veins there is no need for an 'order' attribute. However, details such as relative timing, mineralogy, texture and thickness should be recorded as individual attributes. Obviously, larger faults or veins from zones of high vein density are more important to measure than minor faults or isolated veins.
- The final decision is what to record in addition to the orientation information. Similar to the question of what to measure, it is often advisable to record a wide range of attributes until it becomes clear what is relevant. Timing relationships are a key attribute so if there are different generations of foliations, dykes or veins, then the generation of each measurement should be recorded where possible. As the drilling programme progresses the logging sheet may be simplified. A non-exhaustive list of parameters that might be collected is included below:

❑ Foliations and bedding:

- Type (bedding, axial planar foliation, shear foliation etc.)
- Host rock
- Representativeness (1st order, 2nd order etc.)
- Generation (S1, S2 etc.)
- Style (spaced, crenulation etc.)

❑ Faults

- Fault rock (fault breccia, gouge, cataclasite etc.)
- Width of fault rock
- Alteration
- Width, intensity and style of any associated fracturing

❑ Veins

- Mineralogy
- Thickness
- Texture (fibrous, layered, crystalline etc.)
- Associated Alteration

How to Measure alpha/beta angles

There are a number of tools available for measuring alpha/beta angles. These include:

- Wrap-around templates: https://www.hcovglobal.com/downloads.
- Kenometers: https://www.dynamicsgex.com.au/products/kenometer-core-orientation-tool-alpha-beta.

- A simple core orientation template for beta angles combined with a protractor and some string for alpha angles: http://structuralgeology.net/wp-content/uploads/2016/08/free_template.pdf.

All of these approaches use the same concept; however, some are faster, more robust and/or less error prone. There are advantages and disadvantages for each of the methods provided as examples above, these are:

- Tends to be much quicker, especially with a kenometer or similar.
- This technique is unaffected by strongly magnetic drill core.
- Data collection is less intuitive and potentially more error-prone.
- Data requires post-processing using appropriate spreadsheets or software.
- It should only be used to measure planar structures with alpha angles of less than 75°
- Only some lineations can be measured in this way.

SRK recommends using a kenometer or REFLEX EZ-LOGGER™ (Figure 3:) for alpha/beta measurement. Example definitions for alpha/beta angles are shown in Figure 4. An example of using a kenometer is given below.

Figure 3: Example Alpha/Beta measurement using the REFLEX EZ-LOGGER™

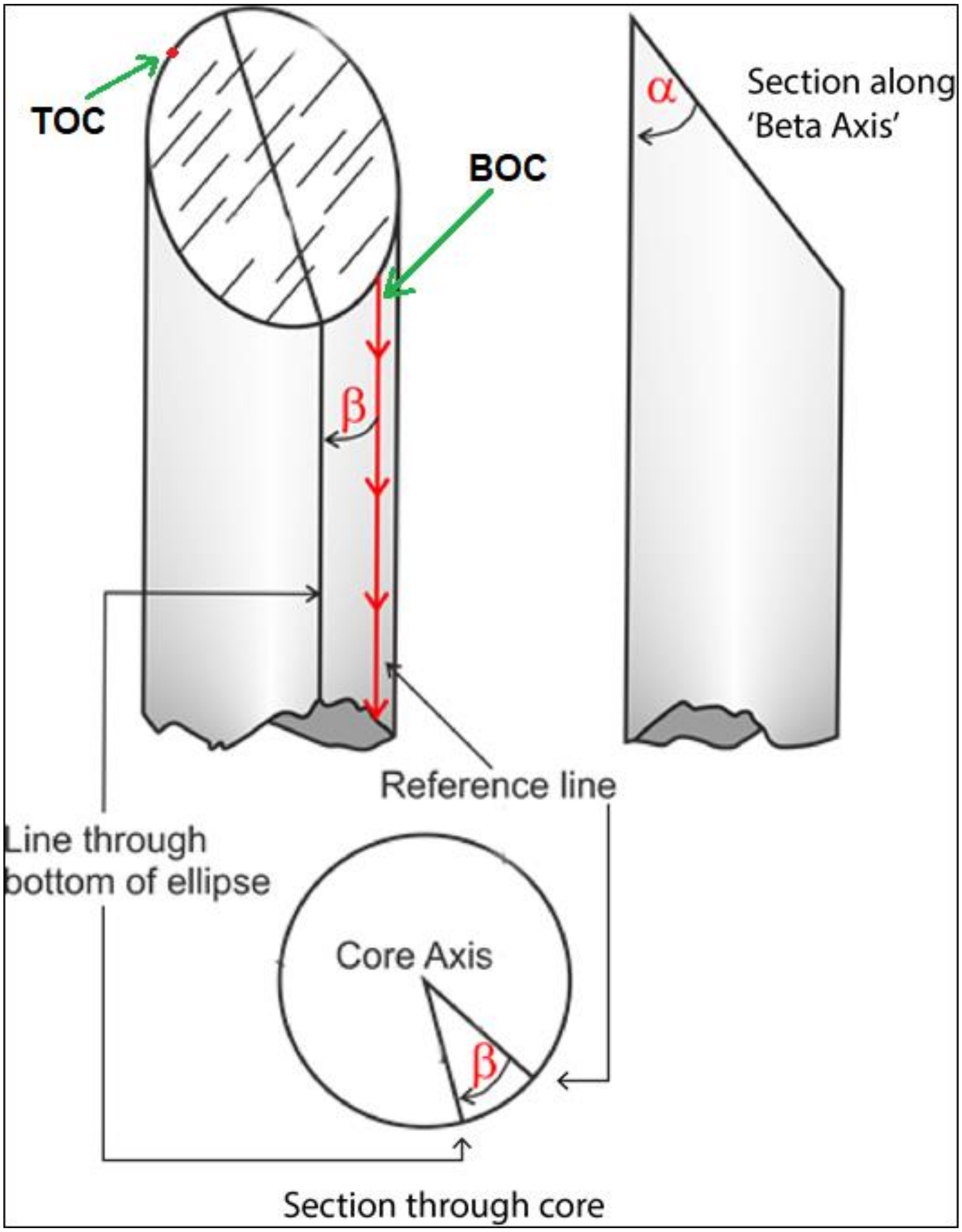


Figure 4: Example definitions for alpha and beta angles

Example: Measuring Alpha/Beta Angles of a foliation using a Kenometer

- Trace the ellipse of several foliation planes with a chinagraph pencil. Make sure the ellipse joins up (if it doesn't, you have traced the ellipse incorrectly) and take extra care around the top and bottom apices of the ellipse as the trace of the foliation often becomes vague at these points.
- Mark the beta axis on each of the traced ellipses (Figure 5). This can be subjective and, in some instances where there is lower confidence in an individual trace, you may only be able to define a band within which the beta axis lies. Once this is complete, use the edge of the kenometer to draw an average beta axis line that best fits the individual beta axes.
- Place the core into the kenometer with the down-hole arrows pointing in the same direction as the down-hole arrow marked on the kenometer.
- Align the beta axis line with the 0º mark on the top of the kenometer.
- The beta angle can be read off the kenometer where the BOC line intersects it; it should be noted that the type of kenometer pictured, the Beta angle is read from the ellipse apex to the orientation line in an anti-clockwise manner, as the Beta angle protractor is in reverse-order (increases in an anti-clockwise sense)).
- The alpha angle can be read off the alpha angle protractor located on the main body of the kenometer sleeve (Figure 6).

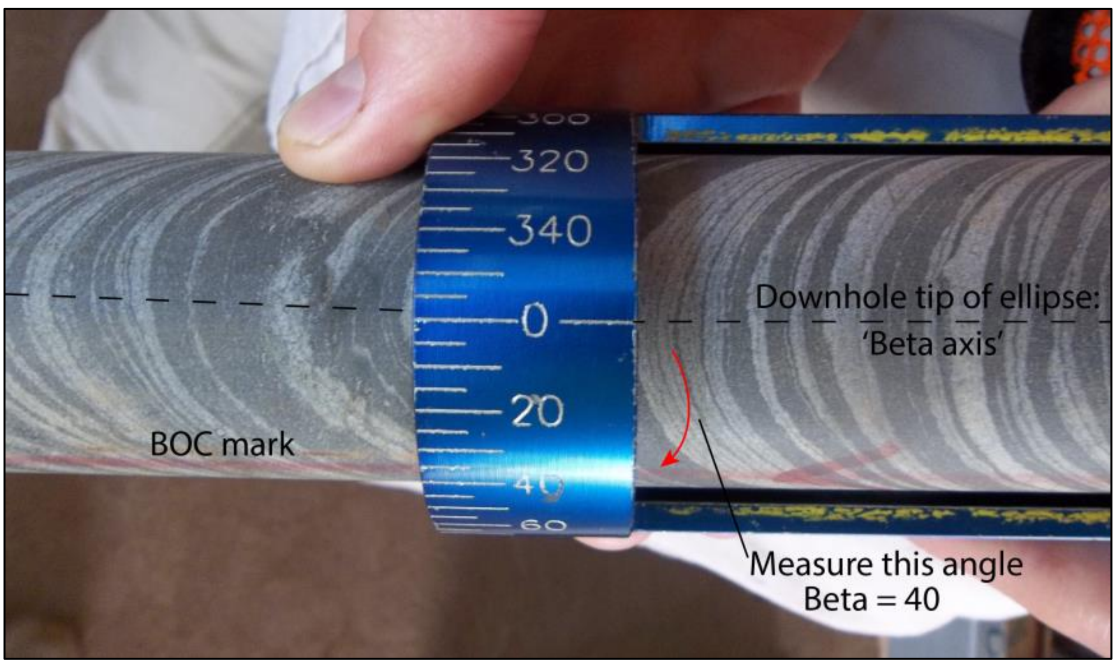


Figure 5: Example of measuring the beta angle using a kenometer

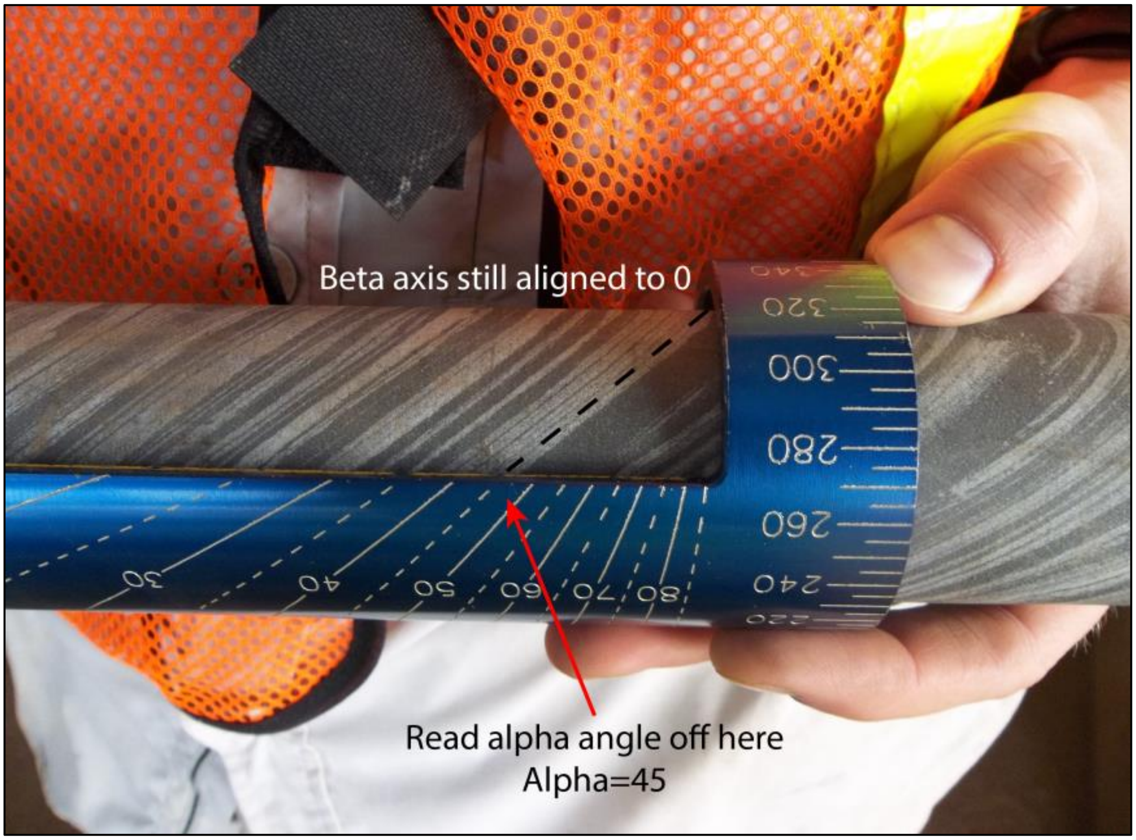


Figure 6: Example of measuring alpha angle using a kenometer

Using Alpha/Beta/Gamma Angles to Measure Lines

- Only lineations which occur on an exposed planar surface (e.g. slickensides) can be confidently measured using angular relationships.
- In addition to alpha/beta angles, lineations require the measurement of an additional angle: gamma.
- Initially, measure the alpha/beta angles of the plane containing the lineation as per the previous section.
- Next measure the angle between the beta axis and the lower intersection of the lineation with the edge of the core (Figure 7). Again, if you imagine the drillhole is vertical, the lower intersection would be the down-hole tip of the lineation. The convention for this measurement is the similar to the convention for measuring beta angles, clockwise from the beta axis to the lower intersection of the lineation while looking down-hole.
- This angle can be measured with a protractor.
- The most common errors in measuring gamma are typically either looking up-hole while you measure gamma (surprisingly easy to do if the surface you are measuring is the down-hole end of a piece of core)

or measuring to the nearest intersection between the lineation and the core edge rather than the lower intersection. Therefore, care must be taken to ensure that these conventions are always followed.

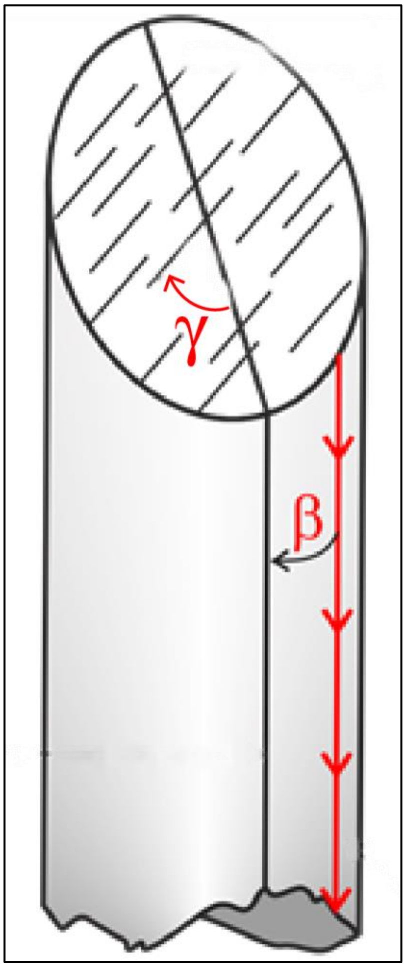


Figure 7: Example measurement of the gamma angle

Post-Processing of Alpha/Beta Angles

In order to convert alpha/beta angles to a structural orientation, you also need to know the orientation (azimuth and dip) of the drillhole at the depth the alpha/beta measurement was taken.

Once you have these four angles there are three ways to calculate the orientation of the structure: graphically using a stereonet; mathematically; or using one of several commonly available commercial software programs such as GeoCalculator.

Generally, the software programs are quickest and easiest as they allow batch processing; however, it is vital to ensure that the conventions are correctly set prior to data input. Checking one or two of the results is important for identifying such errors. Structures with beta angles close to 0° or 180° are easy to verify using some simple calculations.

SRK recommends using GeoCalculator for converting alpha/beta measurements: (http://www.holcombe.net.au/software/geocalculator.html) or if using suitably enables software (such as Laepfrog), the conversions can be completed within the package.

Cutting and Sampling Oriented Core

- Core should NOT be cut along the orientation line, but ***next*** to it.
- Core should be cut along a nominal cut line. Conventions vary between companies, but commonly the cut line is 2-3 cm from the orientation line in an anti-clockwise direction when looking down-hole.
- This method will preserve the orientation line and also any orientation mark (e.g. spear impacts) so that the quality of the orientation line/mark can be verified and evaluated at a later date.
- It is also important for both sampling and future structural logging that the core is cut precisely in half.
- Finally, always sample the half core that DOES NOT have the orientation line. This allows for verification and further structural measurements at a later date (Figure 8:).
-

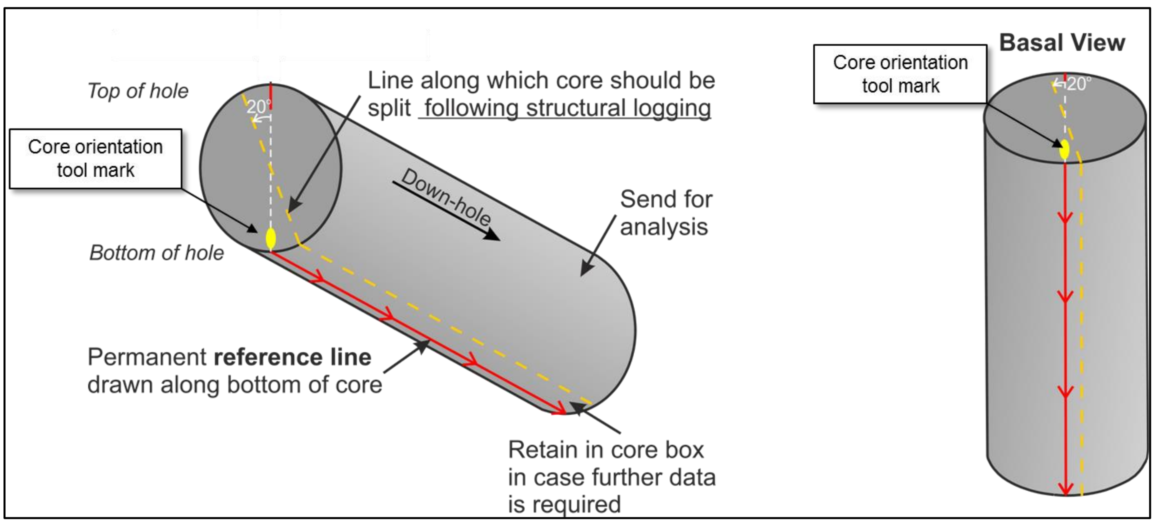


Figure 8: Example if the correct procedure for splitting and sampling core

QAQC of Structural Measurements

- Quality assurance primarily involves ensuring you have competent staff that have undergone sufficient training. It is important that everybody from the rig technicians and drillers to the senior geologists understands how structural data is collected and why it is important.
- There should be multiple layers of quality control in place to ensure that the structural measurements being collected are reliable.
- If the orientation line is not being drawn on at the drill site, then the first layer of quality control comes from the technician or geologist who draws on the orientation line.
- Any problems with the orientation mark or correlation between core runs needs to be identified and reported to the geologist in charge. Where errors between core runs cannot be resolved, the magnitude of this error needs to be recorded in the drilling database.
- The logging geologist provides the next layer of quality control.
- They need to constantly assess the quality of the orientation marks/line and whether the measurements they record make sense. For example, if banding looks very planar and visibly consistent in its attitude relative to the core but measurements are varying significantly, then this indicates that the logging geologist may need to check the quality of the orientation line.
- Ensure that structural data is checked for consistency by a senior geologist either on a weekly basis or at the completion of each drillhole.
- Physically checking the quality of the orientation line and any structural measurements from a few randomly selected (spot checked) drillhole intervals.
- Plotting structural data for each drillhole on a stereonet to check for problems such as obscure distribution of measurements about small circles (‘doughnuts’) (Figure 9:) and false clusters (Figure 10:).
- ‘Doughnuts’ are where structural measurements are distributed in small circles around the drillhole orientation.
- Doughnuts indicate problems with the orientation line or with measurement of the beta angle.
- False clusters occur when a single orientation set produces two clusters, one is real the other is false.
- This is typically occurs due to switching of the orientation line between Top of Core (TOC) and BOC (shown in Figure 4).
- It can also be produced by occasionally looking up-hole when measuring the beta angle or by placing the core into the rocket launcher upside down.
- Where possible, drillhole structural data should also be compared with nearby surface data to check that they match.
- Plot the data spatially (i.e. cross sections or in 3D software) to check whether changes in orientation are systematic or random (Figure 11:).
- Random spatial variations could indicate errors in the orientation line, errors in the measurements or that the logging geologist is placing too much emphasis on small-scale features and not capturing representative structures. Physical checking of the drill core will be required to differentiate these possibilities.

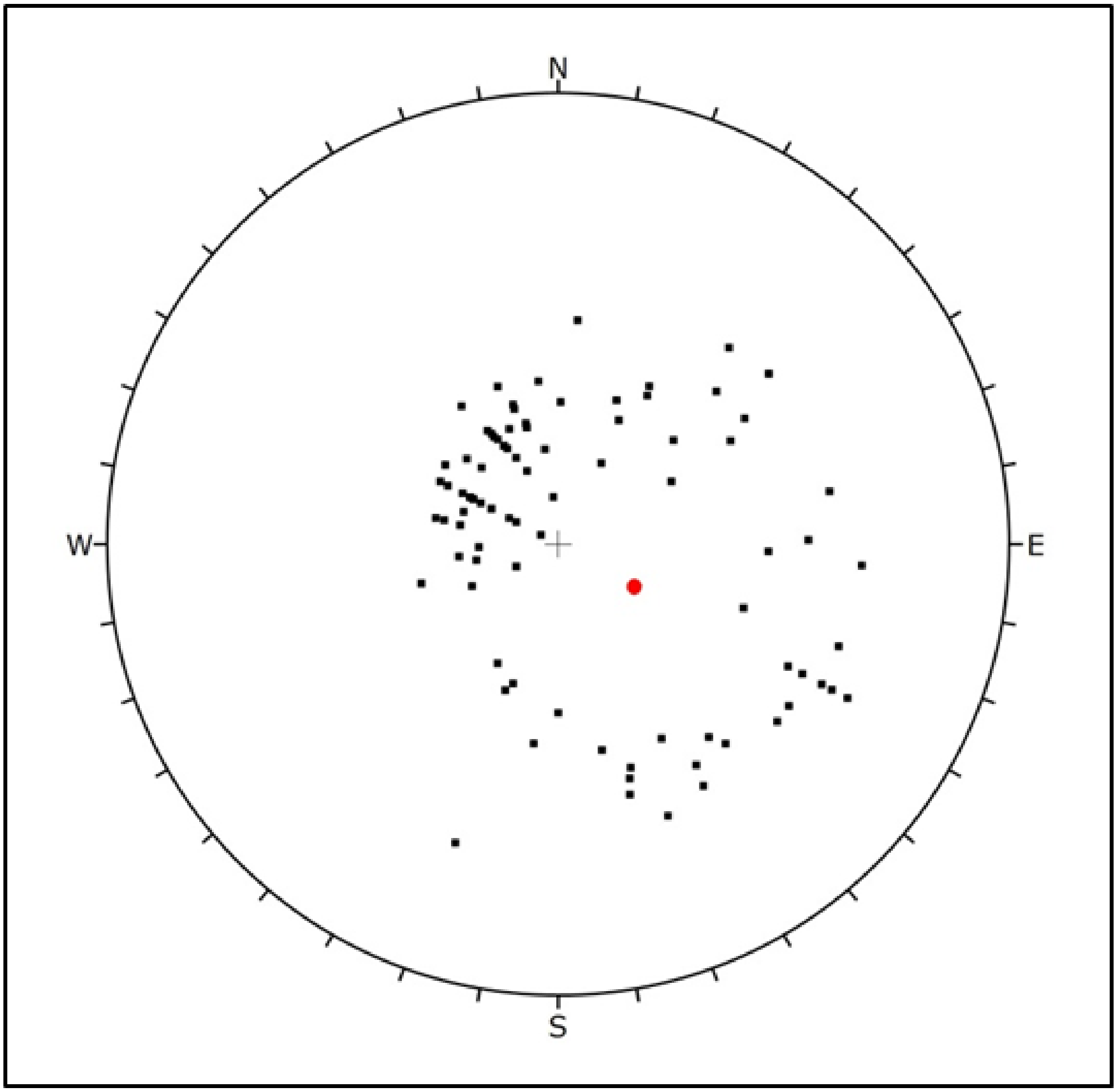


Figure 9: Example of structural measurements (black squares) from a single drillhole forming a 'doughnut' shape around the drillhole orientation (red circle), indicating errors in the beta angle

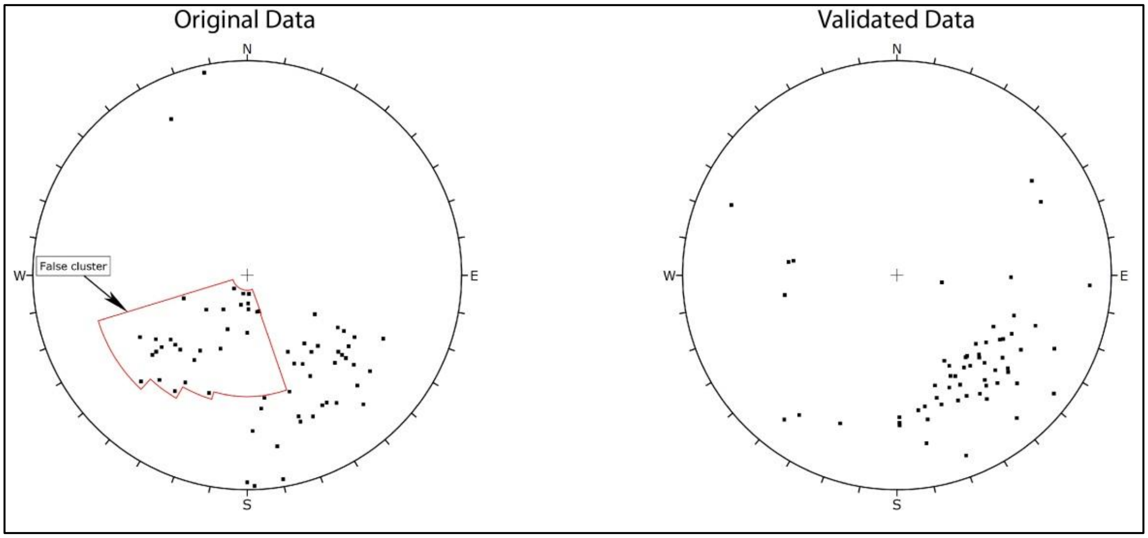


Figure 10: Example of a false cluster, commonly produced by switching the orientation mark between TOC and BOC

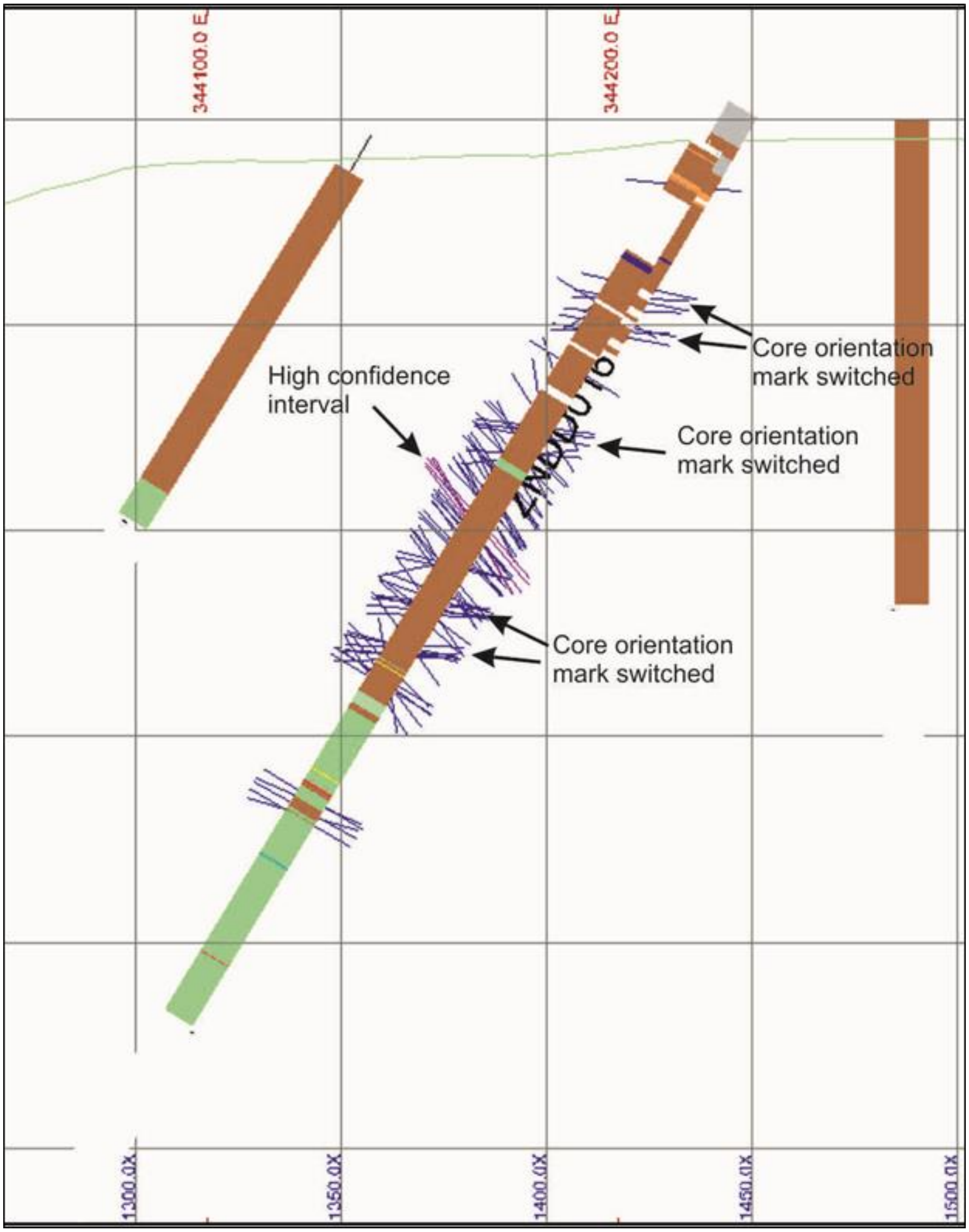


Figure 11: Example of plotting structural data in section highlights apparently random variations, caused in this case by switching between a TOC and BOC orientation mark

8 SAMPLING DIAMOND CORE FOR AGGREGATES

8.1 Introduction

Diamond drilling has many advantages over other drilling and sampling techniques, particularly in that:

- A continuous sample is obtained through the zone of interest.
- Constant volume per unit length is maintained; this is very difficult to achieve in auger, chip, or channel sampling.
- Good geological, mineralogical, structural, hydrological, and geotechnical information can be obtained, as well as assay (geochemistry) information.
- Problems of contamination, which plague auger, sidewall and muck-pile type sampling, are minimal for DD core samples as it has good clean well-defined surfaces. Where contamination does exist, the core can be easily cleaned/washed using water, or industrial solvents.
- Drilling allows samples to be taken in areas remote from physical access, i.e. between mine levels and raises or within ore-blocks.
- Critically, structural measurements can be obtained from orientated core. This information is useful for determining the deposit geometry, and other mine planning activities.

8.2 Sample Selection

Once all logging (see section 7) is completed, and in order to provide the laboratory with representative sample material the Project Geologists and Senior Geologists are required to select sample material from DD production. The various activities associated with sampling and the sample selection process is described throughout the following sections.

8.2.1 DD Core Sample Mark up and Preparation

The following is a guide for preparation and selection of DD core once it has been fully logged by the Project Geologists.

1) It is assumed that 2m composites will be used in the sampling and future estimation process. Therefore sampling mark up will require 2m intervals to be established by the geologist, and only greywacke lithological units will be sent for laboratory testing.
2) In preparation for sampling, a line is drawn longitudinally down the length of core (see Figure 12) which is to be sampled with a wax crayon so that the whole zone of interest is covered.
3) Where the core is totally homogeneous and massive then one should draw the line down the whole core length ensuring that, as far as possible, all the pieces are correctly positioned relative to each other.
4) Barbs (arrow marks) should be marked on the longitudinal line pointing in the down-hole direction and on one side of the core only (e.g. the right-hand side when holding the core vertically and the right way up). This prevents confusion as to which way up each piece is when it is returned to the box after cutting.

5) The core can now be split longitudinally using a diamond saw along the marked line. The diamond saw, allows an accurately centred longitudinal cut to be made using a 'V'-shaped sample guide. It also gives a flat surface on which the mineralization can be examined with a hand lens, and on which intersection angles of bedding or vein contacts can be measured with ease. The maximum intersection angle is displayed on the surface because the cut is through both the high and low points of the plane being measured.

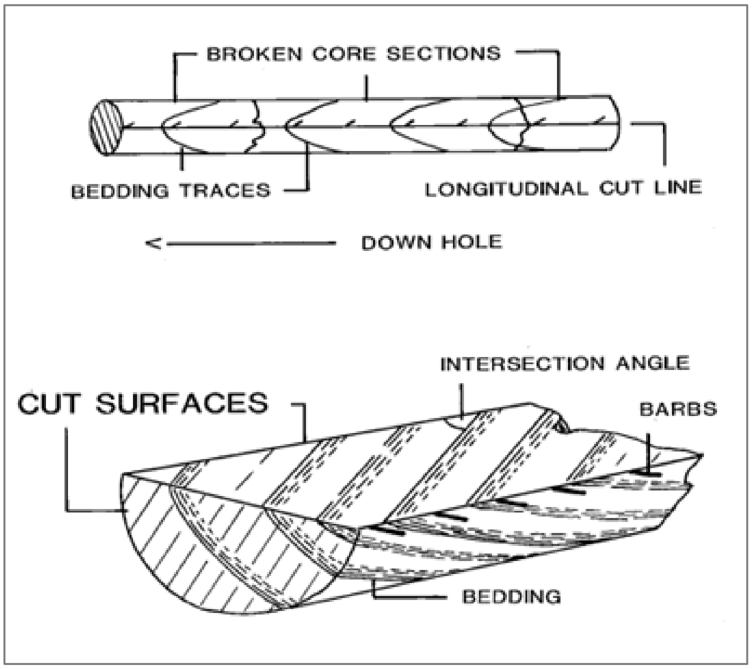


Figure 12: Example of cut core for dispatch to assay test work

8.2.2 Sample Selection Method

1) The next stage is the subdivision of the split core into sample intervals using chalk. There are three main strategies which can be employed, these are:

A. Geologically controlled samples but with length constraints. This is usually the most appropriate method for aggregates assessment.
B. Constant length samples, e.g., 2 meters per sample length.
C. Stratigraphically controlled, i.e. subdivision of stratigraphic units between marker horizons into a constant number of intervals so that the same number is used for all holes for the same unit despite intersected length.

For the KBK programme, the geologist will use mainly the constant length method (listed as Strategy B above).

2) Where some variability is to be allowed in sample length, there are many criteria which could be taken into account and a decision has to be made as to what information is the most important and what can be lost without too great an impact.

   - ‘it is noted. To some extent, the method that will be used to compute the mineral resources/reserves will also play a role in the final decision of which is the best method for sample selection. In assessing sample intervals for aggregates, the potential zone of interest may be the whole core length. In this situation, lithology (greywacke) becomes the primary determinant, with minor intervals being derived from structural or geotechnical parameters. Potential future method of site operation should also be considered (ie. small scale changes in lithology such as minor shale bands within a target sandstone unit may be excluded from the sampling to allow a true analysis of the sandstone alone. However, a composite sample including them may be beneficial, for example to reflect a typical working face where it may not be possible to remove such materials from the production process. An example of establishing intervals for aggregate assessment can be seen in Figure 13.

Diamond Core	Sample Subdivision 1	Sample Subdivision 2	Sample Subdivision 3	Final Test Samples	Aggregate Testing?	Geochem Analysis?
Collar						
2.0m	Weak Clay superficials - non aggregate					
5.0m	Generally Strong, Massive Greywacke - aggregate target	Weaker, weathered upper surface of		Sample 1	Y	y
		Strong, unaltered greywacke with minor shale band (20cm)	Reduce interval size	Sample 2	Y	Y
			Reduce interval size	Sample 3	Y	
			Reduce interval size	Sample 4	Y	Y
17.0m			Reduce interval size	Sample 5	Y	
20.0m		Moderately strong, heavily sheared zone		Sample 6	Y	
			Reduce interval size	Sample 7	Y	Y
			Reduce interval size	Sample 8	Y	
			Reduce interval size	Sample 9	Y	Y
			Reduce interval size	Sample 10	Y	
35.0m			Reduce interval size	Sample 11	Y	Y
37.0m	Weak, Laminated Shale - non aggregate					
			Reduce interval size	Sample 12	Y	Y
			Reduce interval size	Sample 13	Y	
45.0m			Reduce interval size	Sample 14	Y	Y
47.5m		Moderately strong, conglomeratic band		Sample 15	Y	Y
50.0m	Weak, Laminated Shale - non aggregate					

Figure 13: Example of sample Sub-division of diamond drill core for aggregate

3) Principal factors that should influence sampling for aggregates are as follows:

- Changes in lithology, e.g. shale to greywacke, etc.
- Changes in rock strength produced by shearing, leaching, hydrothermal activity, weathering, etc.
- Changes in geotechnical parameters, ie intensity of fracturing, jointing.
- Changes in style or intensity of associated mineralization, e.g. from massive to disseminated or stringer ore.
- Significant changes in structure, colour, grain size, petrography
- The degree of smoothing required of erratic/minor deleterious elements to reduce nugget effect - the longer/larger the sample, the less effect localized poor quality material will have on the overall sample grade.
- Whether sample values will be composited at a later stage.

6) Once the core has been subdivided as indicated above, the top half of the core for each sample interval (i.e. the side without the barbs) is bagged ready for laboratory analysis (also referred herein as assay or geochemical analysis). At this stage, one small representative piece of core should be separated for petrographic analysis. One assay ticket should be placed in the main sample bag, one assay ticket should be separately bagged with the piece of core, and an aluminium (or plastic coated) tag is stamped with the assay number and placed in the core box at the end of the sample interval. If necessary, transverse saw cuts can be made across the core at the beginning and ends of sample lengths. The use of aluminium tags is preferable to the use of paper tickets, or wooden blocks marked with felt-tip pen, as both tend to become illegible with time or disintegrate. Alternatively, specially designed plastic core separators can be used which have the added advantage that they are less likely to be displaced or fall out of the core box.

7) The next stage in the process is to produce a sample log for the samples. This will be a separate log from the geological ('litho') log and will contain columns into which results from the laboratory can be added at a later stage. This log gives the assay ticket number for each sample (sample ID), its depth range (FROM and TO), its represented and recovered lengths, the type of sample (ORGINAL, CRM (or Standard), DUPLICATE, BLANK etc), if applicable.

8) If a diamond saw has been used, a clean-cut face of the lower section of core will be exposed which facilitates accurate visual estimates. Left part of the cut remains in the core box and the right cut section go to assay. (Diamond Core Cutting SOP has also be provided (

8.3 Sampling for Laboratory Analysis

In order to determine the sulphur content, reactivity of silica and clay content, the samples determined in 8.2 are sent for geochemical analyses.

APPENDIX A THE PROJECT GEOLOGIST SHOULD DETERMINE IF SAMPLE INTERVALS SHOULD BE GEOCHEMICALLY TESTED (IE, NOT WASTE, OR SHALE FOR EXAMPLE), AND THIS SHOULD BE NOTED ON THE SAMPLE SUBMISSION SHEET (SEE EXAMPLE SAMPLE RESULTS (FROM LAB)

Insert example sheet from lab

DIAMOND CORE SAMPLE LOG SHEET).

Once the samples have been received and prepared for aggregate assessment at the laboratory, the laboratory prepares the sample ready for analysis. Output format is shown in APPENDIX A

9 GEOTECHNICAL DATA COLLECTION

Geotechnical data collection is highly important as it enables the geotechnical risks associated with the mining operation to be better understood. This influences the mine design, which ultimately affects the safety and profitability of the mine. Geotechnical assessments are mainly concerned with the engineering properties of the rock, such as strength and structure. Both these elements dictate how the rock will behave once excavated, and can influence what slope angles and slope configurations are viable to maintain a safe yet profitable mine. There are a number of ways to assess the strength rock masses, which are often defined as Rock Mass Rating (RMR) systems. These systems categorise rock material through quantitative assessments, which enable computer modelling and empirical assessments to be carried out, which indicate rock mass stability. RMR values can be developed for rock masses through geotechnical logging of core, which is described in this section. This data collection is tailored to enable the calculation of RMR89 as defined by Bieniawski (1989), which has specific application to open pit mines, and also enables additional assessments of rock structures and their effects on stability. To enable this, the geotechnical data collection is split into the three following elements:

- Core logging (structural and basic)
- Geotechnical Sampling
- Point Load Testing

The following sections give details of each of these above elements, with specific reference to the geotechnical logging data capture sheets, which have been provided to team members on site and are found in Appendix E and Appendix F, and the specific inputs into the database for the later calculation of RMR89.

9.1 Geotech Core Logging

9.1.1 Data Capture Sheets

There are two separate logging sheets that capture the following geotechnical characterisation data:

1. Structure Logging Sheet
    - Structure Type
    - Structure State
    - Structure Orientation (Alpha and Beta)
    - Structure Conditions (SC)

2. Basic Logging Sheet

- Total Core Recover (TCR)
- Solid Core Recovery (SCR)
- Rock Quality Designation (RQD)
- Rock Type
- Weathering
- In-tact Rock Strength (IRS)
- Orientation Line (ORI)
- Orientation Line Offset (OFFSET)

Details of each of these data and how to record them are given in the following sections.

9.1.2 Geotechnical Structural Logging

Structure Feature

There are five possible types to input into Structure Feature: Joint, Vein, Bedding, Fault and Rubble Zone (RBZ).

- Joints are open or cemented fractures of typically <10 cm thickness that are continuous across the core axis. Joints are the most common type of structure found in rock core.
- Veins are open or closed fractures in rock containing a deposit of minerals or ore. Veins often display ‘vuggy’ texture.
- Bedding planes are depositional surfaces that separate each successive layer of a stratified rock from its preceding layer.
- Faults are discontinuities that show signs of significant displacement as a result of rock-mass movement. Faults are generally thicker than joints and show evidence of broken or brecciated material, which has undergone shearing related to shear movement.
- Rubble Zones are where core is broken to a degree such that the joint spacing is approximately at least 4 joints per 10 cm. If joint spacing is less than this, then individual joints should be recorded, not a rubble zone. If small sections of competent/unbroken core are found within a rubble zone they should be included in the same rubble zone if they are less than 30 cm; if they are greater than 30 cm then two separate rubble zones should be created either side of the competent core.

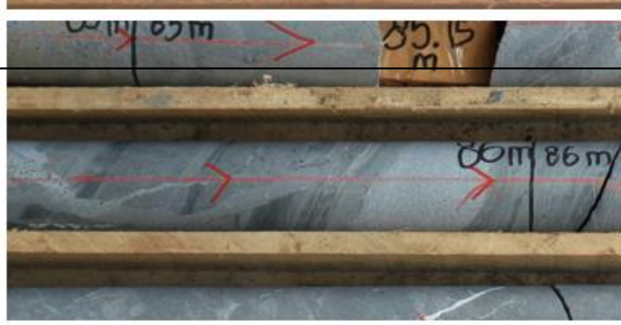
The depth of the structure should be measured at its centre point where it crosses the core, except for Rubble Zones, whose depth is recorded as the beginning depth of the zone. Figure 9-1 shows examples of each of the structure types, which are taken from site core photographs.

Fault – clayey, brecciated material showing signs of having been sheared

Rubble Zone

Vein

Joint



Bedding

Structure Type

There are two possible inputs for Structure Type: Open and Closed. Open structures are fully broken across the diameter of the core, whereas closed structures have not caused a break in the core. Figure Figure 9-2 shows examples of each. These structures should both be recorded as 'JOINT' under Structure Type and 'CLOSED' and 'OPEN', respectively, in the Structural Logging Sheet.

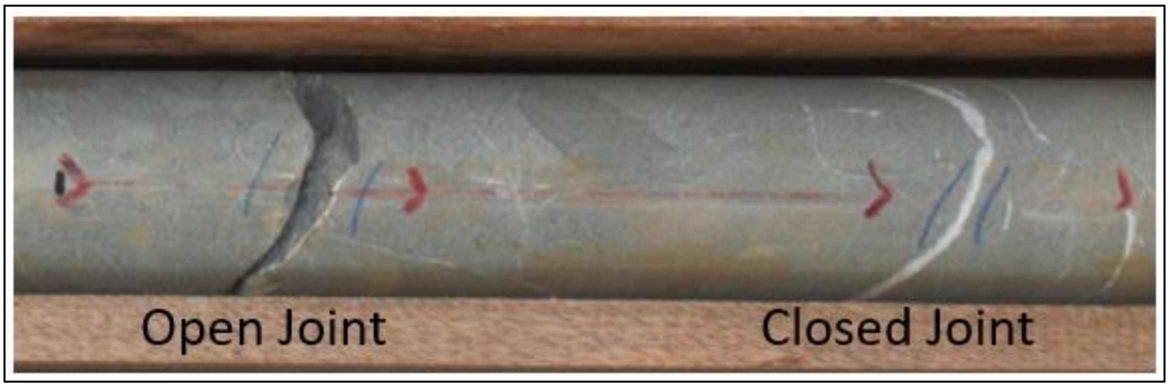


Figure 9-2: **Examples of closed and open joints.**

Structure Orientation

The structure orientation is captured through measuring Alpha and Beta angles in degrees. Figure Figure 9-3 shows how this is measured using the orientation line. The beta angle is measured as the distance in degrees around the core from the orientation line to the downward apex of the structure. The alpha angle is the angle of the structure relative to the core axis. Further instruction on how to measure these is given in Section 7.2. In cases where no orientation line is present, the Beta angle cannot be recorded; however, the Alpha angle should still be recorded.

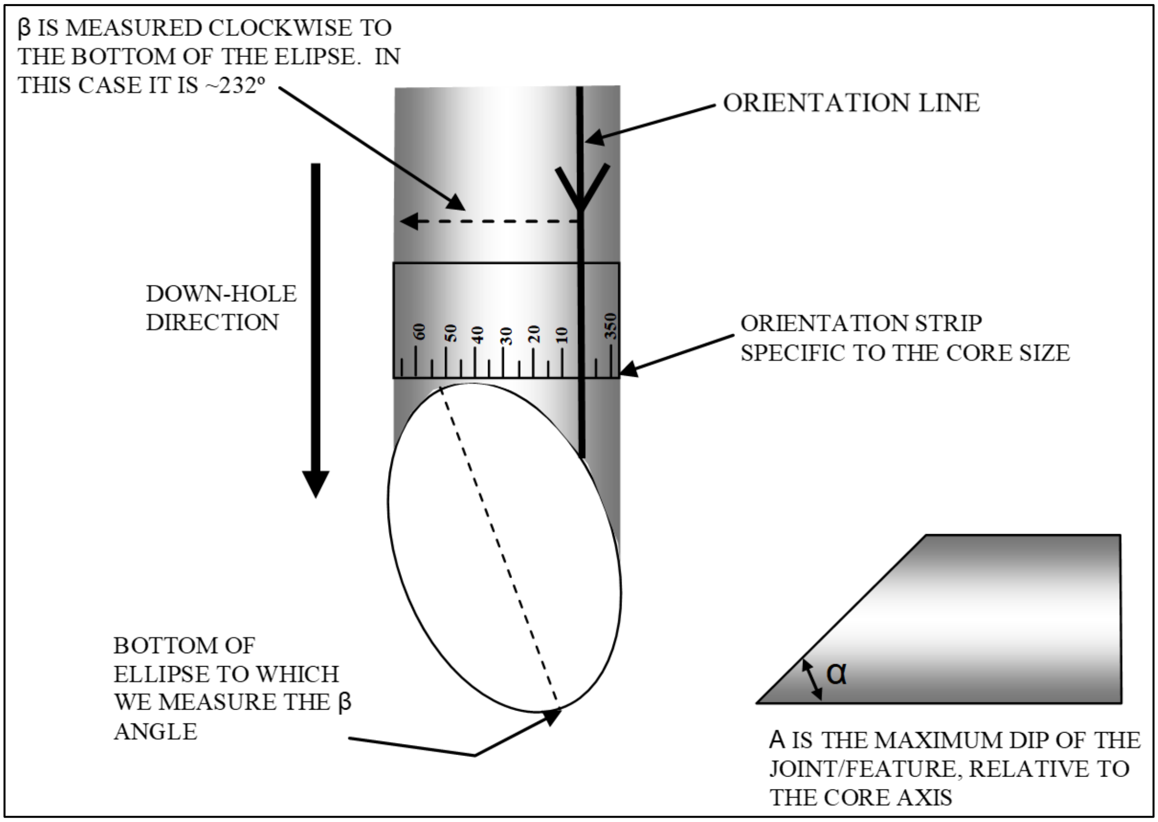


Figure 9-3: Determining Alpha and Beta angles of joints.

Structure Conditions

The condition of the structures is based on 5 factors: Persistence, Aperture, Roughness, Infill Strength and Weathering. Each structure must be assigned a rating for each of these factors, which are shown in Table Table 9-1.

Table 9-1: Structure condition ratings (from Bieniawski, 1989).

Persistence	Observation	< 1m	1 - 3m	3 - 10m	10 - 20m	>20m
	Rating	6	4	2	1	0
Aperture	Observation	None	< 0.1mm	0.1 - 1.0mm	1 - 5mm	>5mm
	Rating	6	5	4	1	0
Roughness	Observation	Very rough	Rough	Slightly rough	Smooth	Slickensided
	Rating	6	6	3	1	0
Infilling	Observation	None	Hard filling < 5mm	Hard filling > 5mm	Soft filling < 5mm	Soft filling > 5mm
	Rating	6	4	2	2	0
Weathering	Observation	Unweathered	Slightly weathered	Moderately weathered	Highly weathered	Decomposed
	Rating	6	5	3	1	0

Since the persistence of the structure cannot be understood based on the core alone, this is not inputted into a log and a nominal value is applied to represent persistence in the later phase of data analysis, based on site observations and engineering judgement.

For joints, it can be difficult to determine whether they are natural (existing in-situ) or artificial (drilling- or handling-induced). It is highly important that only structures such as joints deemed to be natural are logged; those that are artificial should be ignored for geotechnical logging. There are several keys differences to look out for, which include the following:

Staining: Artificial joints will tend not to have any staining as they are relatively fresh.

Infill: Artificial joints will not have any infill. However, it is important to understand that natural joints may also not have any infill. Additionally, make sure that you don't mistake drilling fluid that has accumulated in the break as infill. Observing the drilling fluid and processes at the rig will help to decipher this.

Angle: Artificial breaks tend to result in breaks that are perpendicular to the core axis (alpha of 90 deg); breaks that are more parallel to the core axis are less likely to be artificial (but this is not a definitive rule!).

Locking: Artificial breaks will tend to lock very tightly together when both sides of the joint are pushed together; natural breaks are less likely to fit tightly together. This is due to the relatively recent breakage of artificial breaks compared to natural breaks. However, breaks that occur due to drill can be rounded off by spinning of the core within the core barrel during drilling. This can often be easily spotted as rings on the joints that look like tree rings.

Examples of natural and artificial joints found in the core on site are shown in Figure 9-4 and Figure 9-5**,** respectively.

Figure 9-4: Examples of natural joints.

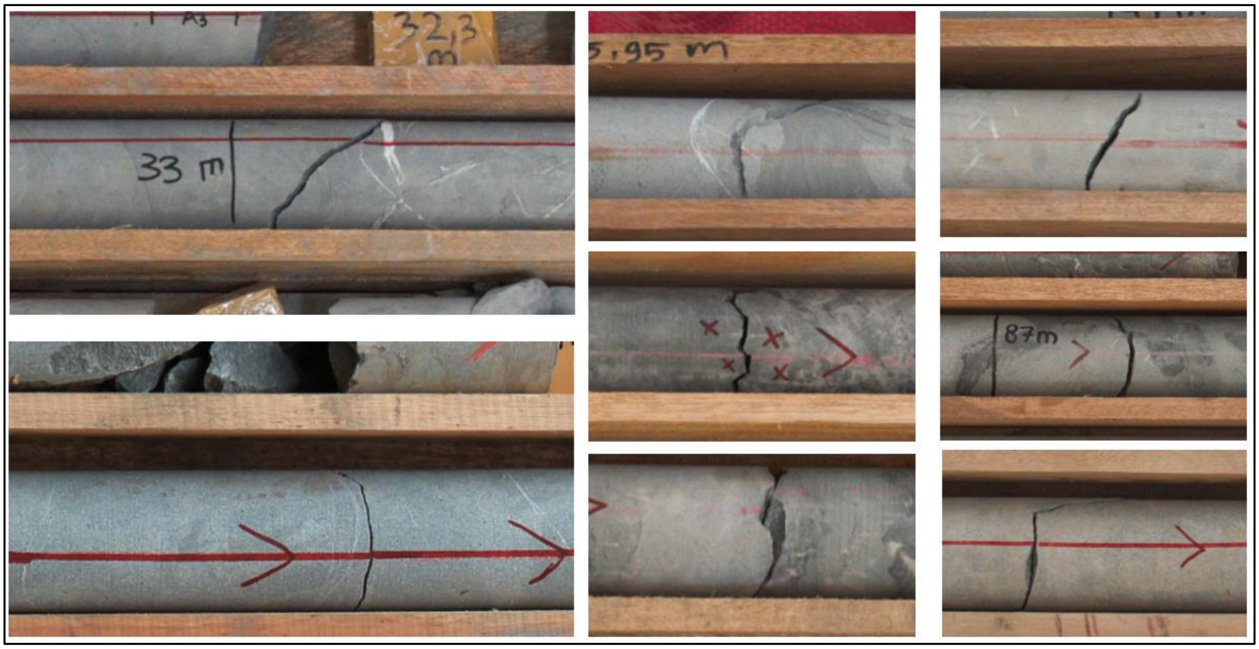


Figure 9-5: Examples of artificial joints.

Although there is no hard and fast rule to determining natural joints from artificial joints, it is possible to accurately decipher one from the other by analysing all the above-mentioned points, rather than basing your decision on just one difference.

Once identified, the natural and artificial joints should be marked up as shown in Figure 9-6. Natural joints should be marked in blue with parallel lines either side of the joint; artificial joints should be marked with red crosses either side of the joint.

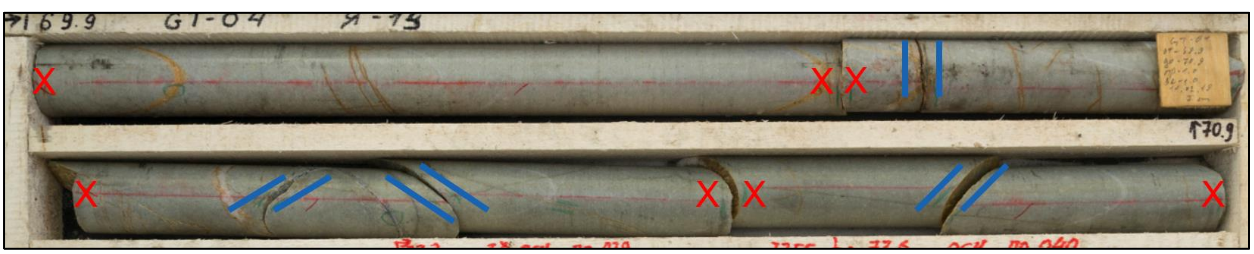


Figure 9-6: Marking up of joints to be completed on V-trays.

9.1.3 Geotechnical Basic Logging

Intervals

For the basic log the interval length should match the drill run length. For example, if the drilling is performed in 3.00 m runs, the start of the first interval should be 0.00 m and its end should be 3.00 m. The next run will then begin at 3.00 m and end at 6.00 m, and so on. However, if significantly different materials are encountered within these intervals, such as faults, rubble zones or significantly weaker materials, the interval length should be altered so that the interval begins where the different material begins and ends where the different material ends. For example, if a 1.20 m thick layer of soil were encountered at 9.50 m amongst stronger rock, the interval lengths should be altered as shown in Figure 9-7. Figure 9-8 shows an example of this taken from a core photograph from site.

Interval		Recovery Data		RQD	Rock Fabric		Strength			Comments
FROM (m)	TO (m)	TCR (m)	SCR (m)	RQD (m)	ROCK TYPE	WEATH'G	IRS	ORI?	ORI OFFSET	
0.00	3.00	3.00	3.00	3.00	GRY	SLIGHTLY	R3	YES	0	
3.00	6.00	3.00	3.00	3.00	GRY	SLIGHTLY	R3	YES	0	
6.00	9.00	3.00	3.00	3.00	GRY	SLIGHTLY	R3	YES	0	
9.00	9.50	0.50	0.50	0.50	GRY	SLIGHTLY	R3	YES	0	
9.50	10.70	1.20	1.20	1.20	SOIL	SLIGHTLY	S5	NO		
10.70	12.00	1.30	1.30	1.30	GRY	SLIGHTLY	R3	YES		
12.00	15.00	3.00	3.00	3.00	GRY	SLIGHTLY	R3	YES	0	
15.00	19.00	3.00	3.00	3.00	GRY	SLIGHTLY	R3	YES	0	

Figure 9-7: Example of changing interval length based on rock type.

Figure 9-8: Example of when interval lengths should be changed. From approximately 11.30 m to 11.62 m the rock material is significantly weaker to the surround rock, a separate interval should therefore be logged for this section.

Total Core Recover (TCR)

This is a measure of the core that is recovered in the drill run. All the core in the run, regardless of whether it is broken or not, is measured; parts of the core that are disintegrated should be pushed together to ensure that TCR is not exaggerated. Figure 9-9 shows an example of TCR measurement using a site core photograph.

Figure 9-9: Example of TCR measurement; the length of the material under the orange arrows will be measured as TCR.

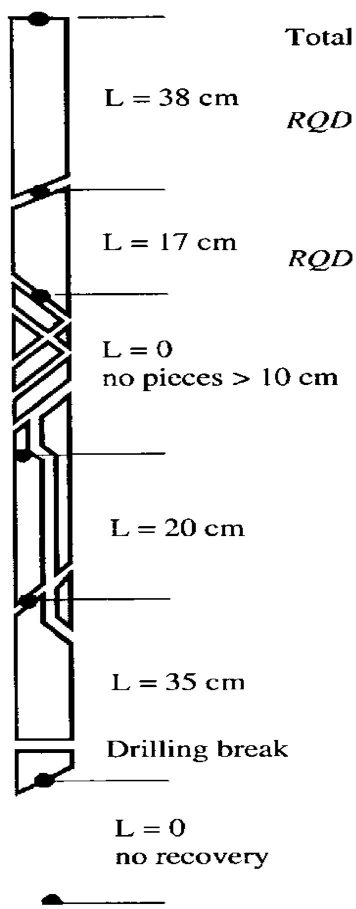
Solid Core Recovery (SCR)

This is the length of core that is recovered in the drill run that is solid core. Solid core is core that forms a cylinder and is not broken into smaller pieces. Figure 9-10 shows an example of SCR measurement using a site core photograph.

Figure 9-10: Example of SCR measurement; the length of the material under the red arrows will be measured as SCR.

Rock Quality Designation (RQD)

This is the sum length of the solid core pieces that are 10 cm or longer. It is important to define those fractures in the core are natural (present in-situ) and those that are drill- or handling-induced (artificial). The RQD should be calculated based on natural fractures only (see Section 0). Figure 9-11 shows an example of how RQD is calculated, however, the basic geotechnical logging spreadsheet only requires input of the RQD length in metres; the final RQD value (%) is calculated automatically at a later stage. Figure 9-12 shows an example from a site core photograph; note all counted pieces are above 10 cm in length.



Total length of core run = 200 cms

$$RQD = \frac{\Sigma \text{ Length of core pieces} > 10 \text{ cm length}}{\text{Total length of core run}} \times 100\%$$

$$RQD = \frac{38 + 17 + 20 + 35}{200} \times 100 = 55\%$$

Figure 9-11: Example of RQD calculation.

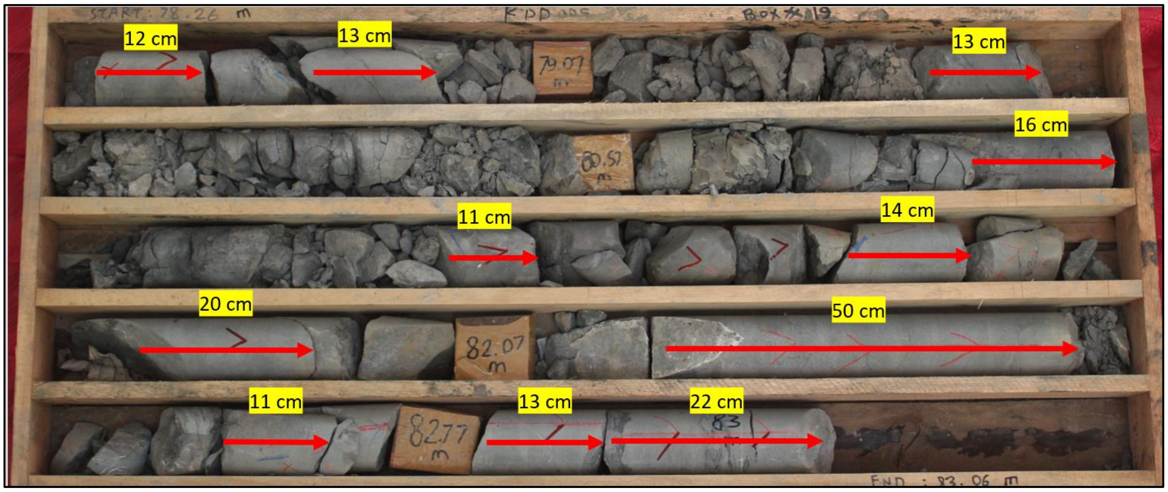


Figure 9-12: Example core photograph from site showing which lengths of rock will be included in the calculation of RQD.

Rock Type

This is a basic description of the rock type according to its lithology. The inputs for this column are the same for the geological/lithology log. In addition to the main lithologies, the presence of any faults should be noted in this column by using the code ‘FLT’, and the presence of a rubble zone should be noted as ‘RBZ’. As stated in ‘Intervals’, any faults or rubble zones found within the core should be given its own interval in the basic log.

Weathering

The weathering of each run should be described according to the categories in Table 9-2. Table 9-3 describes how to determine each of these weathered zones, according to the Working Party Report of the Geological Society Engineering Group of Great Britain. This may serve as a useful guide, however, for simplification remember that the key indicator of weathering is discolouration. Rocks near the surface will often have a different colouration to those below – often a redder tinge – despite being the same rock type. This is often an indication oxidation near surface, which is a form of weathering. Figure 9-13 shows an example of different degrees of weathering in a sequence.

Table 9-2: Weathering codes

Shorthand Code	Database Input
UW	Unweathered
SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
CW	Completely Weathered / Decomposed

Table 9-3: Determination of weathering zones

Description	Discolouration	Fracture Condition	Surface Characteristics	Original Texture	Grain Boundary Condition
Unweathered	None	Closed or discoloured	Unchanged	Preserved	Tight
Slightly Weathered	20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discolouration	Preserved	Tight

Moderately Weathered	20% of fracture spacing on both sides of fracture	Discolou red, may contain thick filling	Partial to complete discolour ation not friable except in poorly cemented rocks	Preser ved	Partial
Highly Weathered	Throug hout	-	Friable and possibly pitted	Mainly preser ved	Partial separa tion
Completely Weathered Decompose	Throug hout	-	Resemble s a soil	Partly preser ved	Compl ete separa tion

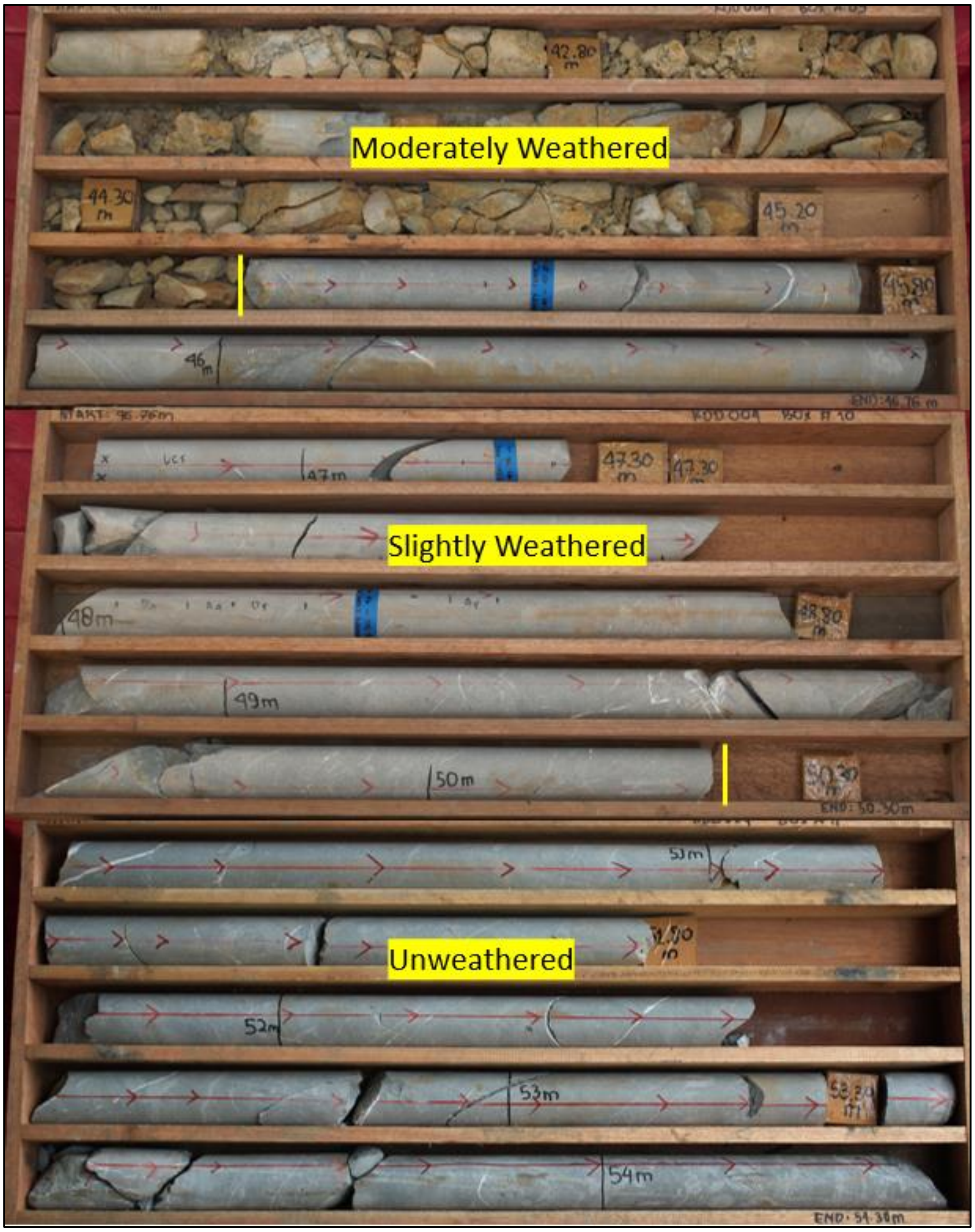


Figure 9-13: An example of different degrees of weathering within the same core box. The core in the upper half of the box is moderately to highly weathered, which then transitions to slightly weathered after 45.40 m and then to unweathered at 50.30 m.

In-tact Rock Strength (IRS)

This is an approximate measure of the in-tact strength of the rock, based on assessment with a geological rock hammer, hardness probe tool and hand manipulation. Approximation of the IRS should be inputted as the Index Abbreviation (e.g. R1, S3, etc.) as shown in the first column in Table 9-4 If the core material is of soil strength (e.g. clay), the range of S values should be used (S1-S6). Likewise, if the core material is of rock strength (e.g. brittle), the range of R values should be used (R1-R6).

Table 9-4: Guide used for determination of IRS of core material.

Material	Code	Description	Field Test	Approximate Range UCS (MPa)
Soil / Clay	S1	Very Soft	Easily penetrated several inches by fist	<0.025
	S2	Soft	Easily penetrated several inches by thumb	0.025-0.05
	S3	Firm	Penetrated several inches by thumb with moderate effort	0.05-0.10
	S4	Stiff	Idented by thumb with great effort	0.10-0.25
	S5	Very Stiff	Easily indented by thumbnail	0.25-0.50
	S6	Hard	Indented by thumbnail with difficulty	>0.50
Rock	R0	Extremely Weak	Indented by thumbnail with difficulty	0.25-1
	R1	Very Weak	Crumbles under firm blow of geologic hammer pick, peeled by pocket knife	1-5
	R2	Weak	Shallow indentation under firm blow geological hammer pick	5-25
	R3	Medium Strong	Fractured with single firm blow of geological hammer	25-50
	R4	Strong	Requires more than one blow of hammer to fracture	50-100

R5	Very Strong	Requires multiple blows of hammer to fracture	100-250
R6	Extremely Strong	Can only be chipped with strong blows of hammer	>250

Orientation Line (ORI)

This column is a simple indication as to whether the core run being logged has been orientated (i.e. is there an orientation line?). This is recorded as ‘YES’ or ‘NO’.

Orientation Line Offset (OFFSET)

This is the offset in the orientation line between one core run and the next (deeper) core run, if the two core runs can be locked tightly together. This gives an indication of whether the orientation tool is giving a consistent reading between runs and can be used to determine confidence in the orientation line and signal if there may be errors with the tool or its use. If there is no orientation line or the ends of the core runs do not lock together (i.e. the ends are highly broken), then no value needs to be added to this column. However, if there are orientation lines and two consecutive cores runs then the offset should be marked. If the offset is zero, record '0'. Figure 9-14 shows a conceptual example of orientation line offset between core runs and Figure 9-15 shows examples of offset found on site.

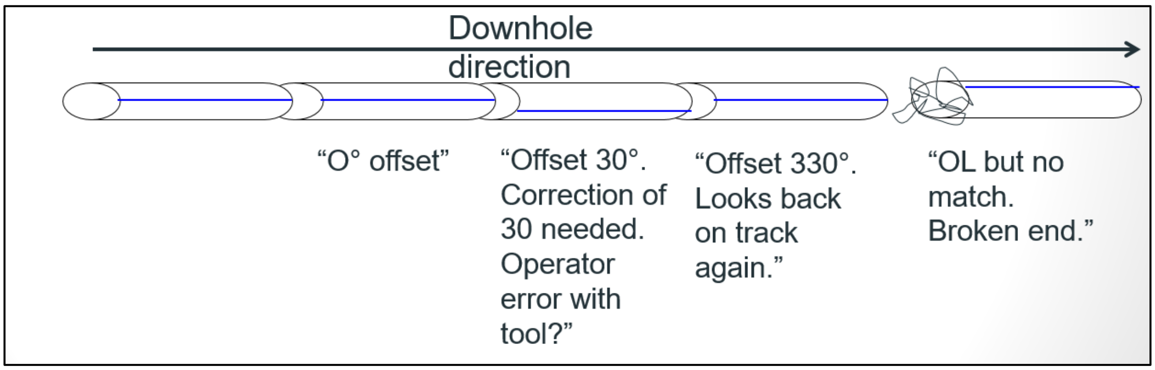


Figure 9-14: Orientation line offset – a conceptual example

Figure 9-15: Examples of offset between core runs. The offset on the left is approximately 45°, on the right it is 0°.

9.2 Geotech Core Logging – Procedure

9.2.1 Work Order

Upon extraction the core should be laid out on V-trays where the geotechnician will mark up the core, marking up the natural and artificial joints (see Section 0). Once this is complete, the geotechnician will complete the Structural Logging Sheet, which is given in **Error! Reference source not found.**

Upon completion of the Structural Logging Sheet, the geotechnician will then complete the Basic Logging Sheet, which is given in **Error! Reference source not found.**. To reduce artificial damage of core, as much logging as possible should be performed at the rig as soon as the core is extracted.

Both these logging sheets can be completed either as a hard copy to be later typed up into a digital version, or completed directly into the digital database.

Once the two logging sheets have been completed, the core must be stored in an appropriate core storage facility. This facility must have a high capacity and protect the core from degradation by sunlight or rainfall.

9.2.2 Core Photographs

High resolution core photographs of the core in core boxes will be required to serve as a record of the core and for QA/QC. The photographs will require the following to be clearly visible:

- Borehole Identification
- Location (depths from and to)
- Scale measure (ruler)
- Colour chart
- Both wet and dry photos

9.2.3 QA/QC

SRK will perform a remote QA/QC check on the data after the training site visit to ensure that the data is being captured correctly by the on-site geotechnicians. This will require both the completed geotechnical logs and the core photographs. Feedback will be provided to the geotechnical staff in the form of a powerpoint presentation.

9.3 Geotechnical Sampling

The following tests are recommended for the geotechnical characterisation:

- Uni-axial Compressive Strength (UCS)
- Multi- or Single-stage Triaxial (TXT)
- Discrete Shear Joints (DSJ)
- Discrete Shear Saw-Cut (DSS)

The following section describes how samples should be collected for each of these tests.

9.3.1 Samples

UCS

A Uni-axial Compressive Strength test core sample must have a minimum length of 2.5 times its diameter. For HQ core, which is 63.5 mm, the minimum length is therefore 158.75 mm, approximately 16 cm. It is advised to take additional lengths either side of the core sample length to allow for trimming of the sample ends to fit tightly with the platens of the testing equipment and to allow for chips and breaks at the ends of the samples. For HQ core, it is therefore advised to collect 20 cm core lengths for samples.

The goal of a UCS test is to measure the **in-tact** strength of the rock. It is therefore important to select samples with no or minimal defects, such as joints, veins or zones of weakness. If a UCS test breaks along a joint within the core the test becomes invalid and the result is unusable.

Triaxial

Triaxial test samples have similar requirements to UCS tests: the minimum length is 2.5 times the diameter of the core and the goal is to test in-tact strength (i.e the core must have no or minimal defects).

The two types of triaxial test, multi- and single-stage, depend on the availability of samples and cost restraints. Multi-stage triaxial tests are performed on one sample length, with the core being compressed to near failure at three separate confining stresses; whereas single-stage triaxial tests involve compressing three separate samples to failure at three different confining stresses. Hence, for multi-stage testing only one sample length is required, whereas for single-stage testing three adjacent samples are required. As single-stage tests allow the sample to reach failure each time, the results from these tests are thought to be more reliable than those from multi-stage tests, however, they are costlier.

DSJ

Discrete shear joint tests require joints to be selected from the core with the purpose of testing their shear strength in a shear box. For the joints to be held in the shear box at least 50 mm is required at either end of the joint (shown by the blue arrows in Figure 9-16 The joints most represented in the core should be selected for DSJ testing. It is important to wrap these samples very carefully to not spoil the condition of the joint surface.

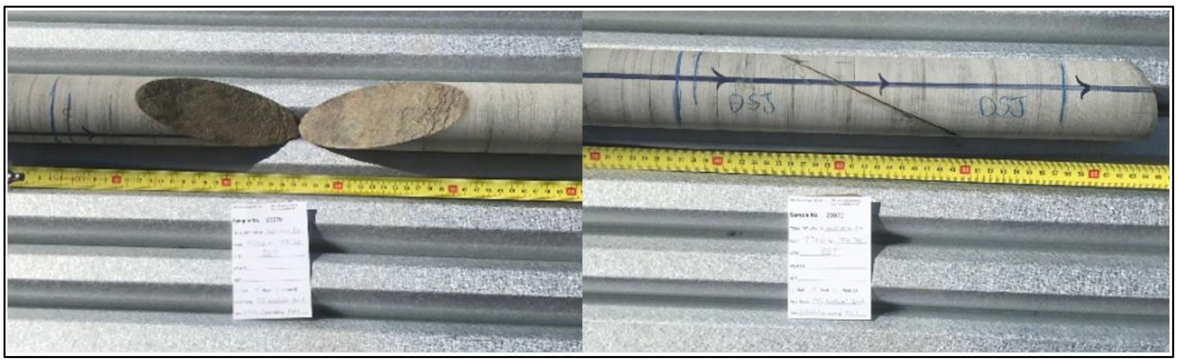


Figure 9-16: Example of a DSJ sample and how they should be photographed.

DSS

Direct shear (saw-cut) tests are performed to determine the strength of the in-tact rock surface once broken. These are similar to DSJ samples in that a minimum length is required to maintain the samples in the shear boxes. A minimum length of 15 cm is recommended for these tests.

9.3.2 Sampling procedure

Geotechnical sampling should be performed so that all the major rock types are sufficiently sampled. For strength tests it is important to select samples with as few defects as possible. As such, geotechnical sampling should not be systematic but performed where applicable.

To reduce the possibility of damage in transit to the laboratory, all samples should be very well wrapped with bubble-wrap (or a similar packaging material).

Each sample should be labelled both on the core and on its outside packaging. These labels should include the following:

- Type of sample (UCS, DSJ etc)
- Location of the sample (Borehole ID)
- Length of sample (from and to)
- Lithology

- Sample number (unique identifier)

Samples should also be photographed, including a measure for scale and the label within the photograph.

A recommended sampling schedule is given in Table 9-5, which is based on 20 geotechnical boreholes.

Table 9-5: Recommended sampling schedule (based on 20 geotechnical boreholes).

Test	Lithology	Number Required (Total Drilling)	Number Required (Approximate per Hole)	Example frequency
UCS	Greywacke	20	2	2 per hole
TXT	Greywacke	5	0.5	1 sample per 2 holes
UTS	Greywacke	0	0	None
DSJ	Greywacke	15	1.5	3 samples per 2 holes
DSS	Greywacke	15	1.5	3 samples per 2 holes
UCS	Shale	10	1	1 sample per hole
TXT	Shale	2	0.2	1 sample per 5 holes
UTS	Shale	0	0	None
DSJ	Shale	5	0.5	1 sample per 2 holes
DSS	Shale	5	0.5	1 sample per 2 holes

9.4 Point Load Testing

Point load testing (PLT) is used to determine rock strength indexes in geotechnical practice. The point load test apparatus and procedure enables economical testing of core or lump rock samples in either a field or laboratory setting. A PLT machine uses hydraulic pressure to compress a rock sample between two specially designed platens and record the maximum achieved load of the sample before its failure. To estimate uniaxial compressive strength, index-to-strength conversion factors are used, which are derived through comparisons between PLT results and UCS tests on the same sections of core. It is therefore important that some UCS tests are performed on sections that are also subject to PLT testing, so that the conversion factors can be derived.

PLT should be performed according to ASTM D5731 – 08 Standard Test Method for Determination of the Point Load Strength Index of Rock and Application of Strength Classifications. Core specimens can be tested as axial (compression parallel to core axis) or diametral tests (compression perpendicular to core axis), as shown in Figure 9-17. It is recommended that a similar number of each type of test is performed. The size of each sample tested must conform to the following criteria:

For axial tests, $0.3*D < L < D$

For diametral tests, $0.5*D < L$

where d is the core diameter and L is the length or height of the core sample.

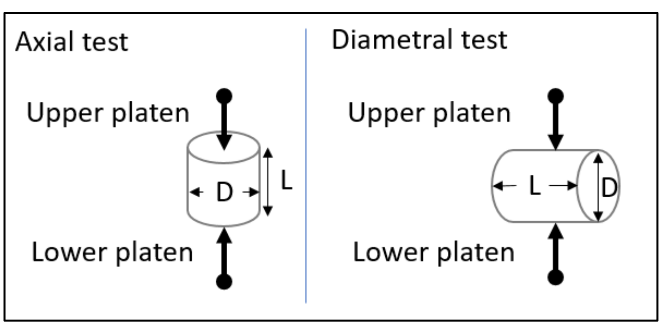


Figure 9-17: Axial and Diametral PLT.

The following practice is advised for PLT:

- A target of 5 sets of point load testing is to be completed for each hole (approximately 1x set of testing every 20 m), where one 'set' consists of 5 axial tests and 5 diametral tests.

- The core to be selected for testing should be in-tact, with minimal defects/structures.
- One PLT set should be performed next to a at least one of the two UCS samples per hole.
- The maximum achieved load before failure should be recorded in kN.
- The specimen to be tested should be cut with a saw to ensure it adheres to the size criteria – a hammer should not be used to resize the specimen.
- Each tested specimen must be measured (length and diameter) before testing – this is important as the size of the sample affects ultimate strength that is determined via the conversion factor.
- The type of break should be recorded according to the codes in Table 9-6.

An image of the PLT machine used on site, as well as an example of a PLT set, is shown in Figure 9-18.

Table 9-6: Failure mode codes and descriptions for PLT.

Code	Description
R	Failed through Rock
J	Failed on incipient joints
B	Failed through both Rock and incipient joints
F	Failed along foliation
P	Failed outside the platens
N	Did not fail at load indicated

Figure 9-18: PLT machine used on site, with an example of one PLT 'set' before testing.

10 SUBMISSION OF SAMPLES TO LABORATORY

- The “Sample Number Allocation Sheet” (or Sample Logging Sheet) contains a Sample ID column which records the borehole number and the consecutive sample number in the hole, e.g.
- KDD00012, made up of two parts, the KBK Prefix KDD and a five-digit number 00012.
- An example of a DD sampling form completed in the field is provided in Appendix A of this procedure.
- All Duplicates, Blanks will have already been included in the number sequencing (Sample ID) and have the next assay sample number in the sequence on the “Diamond Core Sample Log Sheet”.
- Once the logging of each core is completed, a “Sample Submission Sheet” from the Assay Laboratory (a generic laboratory submission sheet example is provided in Appendix B) should be completed and a KBK hard copy showing only assay sample numbers (not ID numbers) and batch numbers appended.
- All data is then entered into the KBK Drillhole Database which is backed-up, maintained, and stored offsite. This is to be overseen by the database administrator.
- Further reference and detailed descriptions regarding the sample dispatch is provided in the additional SOP entitled “U7285 - SOP KBK - DD SAMPLE DISPATCH_v1.0.docx.

11 LABORATORY TESTWORK, PT. GEOSERVICES GEOTECHNICAL LABORATORY

The samples sent to the laboratory should be prepared as outlined in their sample preparation package (xxxx), and as described below.

There will two sample streams conducted for the 2021 drilling programme. These are described further in the following sections.

A.1 Sampling for Mineral Resource Estimation

Sampling for Aggregate Testwork

11.1 Sample Receipt

The samples to be dispatched to the laboratory are collected at the laboratory delivery yard and checked against KBK dispatch notes (also see example in Section Appendix D). Any discrepancies are recorded, and the issue is resolved prior to commencing preparation. The samples are logged onto the system and a Job Number and PO number assigned to the batches. The samples are labelled and barcoded with this Job Number to enable the material to be tracked around the laboratory using the barcodes and a scanning system.

11.2 Weighing

Once the sample is logged into the tracking system, it is then weighed and compared to the sample weights sent by KBK to make sure that there is no sample loss or gain for chain of custody reasons and sample assurance purposes.

11.3 Crushing and Pulverising

In the laboratory, the half-core sections should initially be jaw crushed to 10-14mm. Physical and mechanical testing for aggregates is normally carried out on this size fraction.

If geochemical analysis is also required from a sample interval, the sample should be split into two equal portions using a riffle splitter. One half should used for the physical testing, the other for geochemical analysis.

The geochemical samples should be crushed to 70% passing the 2 mm (Tyler 9 mesh, US Std. No 10) screen. The sample is then split using a riffle or rotary splitter to 250 g sample which is then sent for pulverising, and the rest is kept for storage as coarse reject.

The geochemical samples are to be pulverised to a pulp that passes at an 85% pass rate of a -75 µm screen size (Tyler 200 mesh, US Std. No. 200). The entire pulped sample (250 g) is then sent for assay.

11.4 Aggregate Testing

11.4.1 Crushing

For aggregates testing, samples should be jaw crushed to optimise volume passing 14mm and retained on a 10mm sieve.

11.4.2 Washing / Drying

This 10-14mm sample should then be washed before further testing to remove any dusty coating from the aggregate.

The sample is then oven dried at 110ºC (maximum 120ºC), and the post-drying weight also measured and recorded.

11.4.3 Sample Splitting

The 10-14mm sample should now be split using a riffle or rotary splitter to enable multiple physical and mechanical tests to be performed (see 8,1.4 and 8.1.5)

11.4.4 Physical Testing (on site)

- Aggregate Grading – An assessment of the particle size distribution of a natural or crushed aggregate
- Particle Shape / Flakiness Index – An assessment of the shape / elongation of aggregate particles
- Relative Density – Measures specific gravity
- Water Absorption – Measures porosity and capacity to absorb water

NB. Aggregate grading is normally undertaken on a naturally occurring graded material, or on a material crushed through a specific processing plant, in order to understand the particle size distribution produced. On a prospect site, such as KBK, this analysis is unlikely to be of use until such stage where required crushing and screening equipment is being planned.

NB. Particle shape is fundamental to the usability of a particular material for aggregates but can be heavily influenced by the choice of crushing and screening equipment. However, analysis after simple jaw crushing will provide an indication of whether the material will have a tendency to produce elongate or flaky material, and this information can be useful in specifying future plant requirements. A description of the shape (and flakiness measurement) of the 10-14mm crushed sample should be undertaken before further test work is carried out. Ideally, flaky material should be removed from samples prior to the other mechanical tests, as presence of flaky material can lower values considerably.

11.4.5 Mechanical Testing

A selection from the following aggregates analyses are recommended (to suit potential end-uses) to test strength and durability:

- Aggregate Crushing Value (ACV) – Measures resistance to crushing under a gradually applied load.
- 10 Percent Fines Value – An alternative to ACV.
- Aggregate Impact Value (AIV) – Measures resistance to granulation under impact stresses.
- Aggregate Abrasion Value (AAV) – Measure surface wear following abrasion.
- Los Angeles Abrasion Value (LAAV) – Measures resistance to attrition following impact and abrasion.
- Polished Stone Value (PSV) – Measures resistance to polishing for road surfacing aggregates.
- Sulphate Soundness – Measures resistance to disintegration by weathering action or salt crystallisation.
- Note: PSV value can attract higher premiums on global markets so this should be investigated with all potential material where relevant and possible.

11.4.6 Petrographic Analysis

Several grab samples that were retrieved from site on the 20 April 2018, have now been petrographically analysed by PetroLab Ltd located in the United Kingdom (ref: KBK OP2821-SRK_05_05_2018.pdf). This analysis has described the typical material observed at KBK as “a fine-grained greywacke consisting of silt-sized clasts of quartz and feldspar (both potassium feldspar and albite) hosted in a fine-grained matrix containing chlorite, clay, calcite and rare trace iron-oxides. The clay mineralogy (in the 2 grab samples observed by PetroLab) presented as very fine-grained but likely to consist of a mixture of sericite, illite and kaolinite. There was no apparent sedimentary banding to the sample, either viewed under a hand lens, or under the petrographic microscope.

Greywackes generally have a high polished stone value (PSV), which makes them highly prospective as potential sources for roadstone. The examined aggregate material may meet this criteria, subject to confirmatory physical testing, with silt-sized clasts of quartz and feldspar in a fine-grained clay-rich matrix and very low porosity. It is noted that some greywackes, notably in the UK, have had alkali-silica reaction (ASR) implications when used in concrete manufacture due to the presence of cryptocrystalline or microcrystalline silica, and therefore the material may not be suitable for this end use. Therefore it has been recommended that a detailed petrographic examination and appropriate physical testing is undertaken prior to determining the suitability of the material for specific end uses.

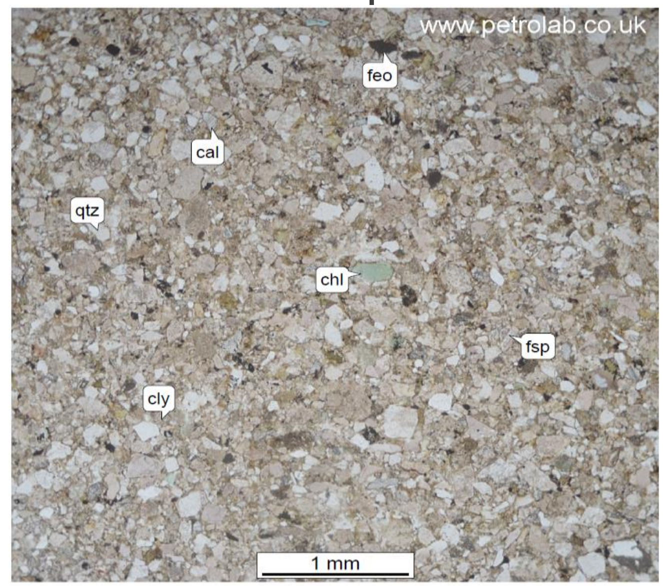
A summary of the petrographic analysis completed on two individual grab samples is provided in Table 7 and Table 8. Major, minor and trace minerals identified in both grab samples are summarised in Figure 19, and Figure 20.

Table 7: Mineral Identification – (Grab Sample A)

Sample A			
Phase	**Formula**	**≈ s.g.**	**Abundance[1]**
Quartz	SiO_2	2.65	Major
Clay	Undifferentiated crystalline clay/ mica minerals – likely to consist of sericite, illite and kaolinite	2.60	Major
Chlorite	$(Mg,Al,Fe{++})_{12}(Si,Al)_8O_{20}(OH)_8$	2.65	Major
Orthoclase	$KAlSi_3O_8$	2.56	Minor
Albite	$NaAlSi_3O_8$	2.62	Minor
Calcite	$CaCO_3$	2.70	Minor
Fe oxides	Fe+++O(OH)	3.80	Trace

Table 8: Mineral Identification – (Grab Sample B)

Sample B			
Phase	**Formula**	**≈ s.g.**	**Abundance[1]**
Quartz	SiO_2	2.65	Major
Clay	Undifferentiated crystalline clay/ mica minerals – likely to consist of sericite, illite and kaolinite	2.60	Major
Chlorite	$(Mg,Al,Fe^{++})_{12}(Si,Al)_8O_{20}(OH)_8$	2.65	Major
Orthoclase	$KAlSi_3O_8$	2.56	Minor
Albite	$NaAlSi_3O_8$	2.62	Minor
Calcite	$CaCO_3$	2.70	Minor
Fe oxides	$Fe^{+++}O(OH)$	3.80	Trace

<table>
<tr><th>Grab Sample A</th><th>Grab Sample A</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Photograph of sample as received (scale in cm). The sample had a greenish-grey colour. There is no apparent banding to the sample observable by hand lens. There is some iron-oxide staining along the surface, and the weathered surface is a darker shade of greenish grey[2].

Notes: [2] Specifically the colour has moved from 5/5G GLEY to 6/10Y GLEY on the Munsell colour chart.</td><td>Photomicrograph [1] of sample showing main phases and typical associations. The sample consists of a fine-grained matrix containing chlorite (chl), clay (cly) and calcite (cal) supporting siltsized particles of quartz (qtz) and feldspar (fsp). The porosity of the sample is very low.

Notes: [1] Visual estimate of abundance is approximate:
Trace < 2% · Minor > 2% < 10% · Major > 10% · Major+ > 50%.</td></tr>
</table>

Figure 19: <u>Grab Sample A</u> Taken from KBK - fine-grained greywacke consisting of silt-sized clasts of quartz and feldspar (both potassium feldspar and albite) hosted in a fine-grained matrix containing chlorite, clay, calcite and rare trace iron-oxides. (Source: OP2821 04/05/2018.pdf)

Grab Sample B	Grab Sample B
	
Photograph of sample as received (scale in cm). As with sample A, this sample has a greenish-grey colour. There is no apparent banding to the sample observable by hand lens. There is some iron-oxide staining along the surface. The weathered surface is similar to the unweathered surface in colour. [1] Notes: [1] Visual estimate of abundance is approximate: Trace < 2% · Minor > 2% < 10% · Major > 10% · Major+ > 50%.	Photomicrograph of sample showing main phases and typical associations. The sample consists of a fine-grained matrix containing chlorite (chl), clay (cly) and calcite (cal) supporting siltsized particles of quartz (qtz) and feldspar (fsp). The porosity of the sample is very low. Notes: [1] Nikon Microphot-FXA petrological microscope Plane polarised transmitted light x25

Figure 20: Grab Sample B Taken from KBK - fine-grained greywacke consisting of silt-sized clasts of quartz and feldspar (both potassium feldspar and albite) hosted in a fine-grained matrix containing chlorite, clay, calcite and rare trace iron oxides. The clay mineralogy is very fine-

grained but likely to consist of a mixture of sericite, illite and kaolinite. There is no apparent sedimentary banding to the sample, either viewed under a hand lens, or under the petrographic microscope. (Source: OP2821 04/05/2018.pdf)

11.5 Geochemical Analysis

The type of geochemical analysis carried out on samples submitted to the laboratory is determined by the quality control geologist in charge. This is done in consultation with the exploration manager, having carried out some orientation survey on which analysis suits the type of mineralization and also a firm understanding of the typical end product that is desired. As with the petrographic analysis, the key properties which need to be tested are as follows:

- Aggregate impurities, including:
  - Clay and mica (weak, absorptive, expansive)
  - Reactive (disordered) silica, (ie, Opal, Chalcedony, Microcrystalline or Strained Quartz, (alkali reactive))
  - Pyrite (weathers to sulphuric acid and rust)
  - Coal and Lignite, (reacts with bitumen binders)
  - Organic shell or plant, (which is weak and reactive)
  - Salt, (corrosive, efflorescence, and expansion)
  - Sulphate, (expansion, efflorescence)

Two grab samples retrieved from site have identified presence of clay (>10% and <50%), silt-sized clasts of quartz (>10% and <50%) , and minor to trace presence of calcites and oxides. It is recommended by SRK that at this stage of development that a very simple low-cost assay method is conducted. Consideration should be given to the abundance of the above listed impurities.

In addition to the geological logging (see Section 7.1), structural logging (see Section 7.2), and the other geotechnical logging and tests that are needed, geochemical analysis of the core sample is also required. The geochemical analysis will consist of;

TBC

The recommended method requires a minimum screening of 500 g of the sample to 106 µm. The >106 µm fraction is fire assayed for impurities and a duplicate assay is performed on the <106 µm fraction. The size fraction weights, coarse and fine fraction elemental content and total content are reported.

12 RELATED SOFTWARE

- Microsoft Excel for Database entry of logging sheets
- 3D Geological Modelling Software (ie.Leapfrog Geo © Aranz Geo)
- Microsoft Access for geological database

13 SPECIAL QUALIFICATIONS/LICENSES REQUIRED

- Drill rigs are considered high risk hazardous working environments. Only persons “passed out” (trained / assessed) on working in the vicinity of an operating drill rig is permitted to do so and therefore undertaking the tasks described within this SOP related to drilling.
- All Geological Logging activities specified in this SOP are to be undertaken by qualified experienced geologists with formal qualifications.

14 RELATED COMPANY POLICIES, SOP, AND OTHER DOCUMENTS

- U7285 - SOP KBK - DENSITY MEASUREMENT.docx
- U7285 - SOP KBK - DD SAMPLE DISPATCH.docx
- U7285 - SOP KBK - QAQC ANALYSIS.docx
- U7285 - SOP KBK - CORE CUTTING.docx

15 APPROVAL AND AUTHORITY TO PROCEED

The above standard operating procedure has been reviewed on [insert date] and is approved by the relevant personnel signed and dated below.

16 REVEVANT TECHNICAL TEAM MEMBERS

Name	Title	Signature	Date

Approved by ________________________ Date ____________

APPENDIX B EXAMPLE SAMPLE RESULTS (FROM LAB)

Insert example sheet from lab

APPENDIX C DIAMOND CORE SAMPLE LOG SHEET

PEAKINDO PT PEAKINDO MINERAL INVESTMENT	DIAMOND CORE SAMPLING SHEET	
	LOCATION:	DATE SAMPLED:
		NO. OF SAMPLES:
	AZI:	NO. OF QA/QC SAMPLES:
	INCL:	TOTAL SAMPLES:
BH ID:	EOH:	
	SAMPLED BY:	SIGNATURE:

From (m)	To (m)	Interval (m)	Sample ID	Sample Type	Sample Fraction	CRM Code	Duplicate Sample ID	Comment

APPENDIX D EXAMPLE SUBMISSION SHEET FOR LAB

ANNEXURE 1

Deliver to: SGS LABORATORY SERVICES (GH) 1 JUNCTION, BANK

Attention to: T [redacted] DJEI PATRICIA OTCHWEMAH, FRANKLIN INKOOM

LAB INFO

CLIENT INFORMATION

Send Report to:	**Send Invoice to:**
Name: DAVID	**Send to same address as report** X
Company:	Name:
Mailing Address:	Company:
	Mailing Address:
	VAT Reg no:
Email: david@ .com	Email:
Phone: / Fax: —	Phone: / Fax:

SAMPLE INFORMATION

Results and Invoice will be sent by PDF email at no additional charge. A fee per page will apply for all faxes.

Send Report: QMINE ☐ Fax ☐ Email as PDF ☒ Email as XLS ☒ Other: ________

Pulps and Residues will be disposed of after 3 months unless requested otherwise in writing. Additional storage and shipping costs will be charged to the client. If the samples are to be returned please provide courier account information.

After analysis samples are to be:	Disposed of (default) ☐	Stored ☒ until (date): 90 days, then call
Returned to client ☒	Return samples using courier: NEXT SGS PICK UP	Acct: ________

IMPORTANT: Please specify Sample Type/Required Quality				
Exploration ☒	Met Plant ☐	Party ☐	Umpire ☐	Other:
Pulps ☐	Cores/Rock ☐	Soils ☐	Solutions ☐	Other:

Please specify Assay basis (Party/Umpire assays are reported on a dried at 105°C basis unless requested otherwise)			**Invoicing information** SGS Quote#: 0011-17
Dry at 105°C ☒	As received ☐	Other (specify) ☐ ______ °C	Order # 0# 0012

Laboratory Services Ghana Limited 14 Ridge Road, Roman Ridge, P.O. Box 732, Accra, Ghana. Tel: +233 302 773994/5 Fax: +233 302 773877

Directors: M. Davidson (Managing), N. K. Omaboe, F. Egloff, Stephen Rossiter

Member of SGS Group (Société Générale de Surveillance)

E. Manu

30/6/17

30/6

BATCH 5

Bag Number	Sample Numbers	Number of Samples
1	GRC06249 - GRC06260 & GRC06207	13
2	GRC06261 - GRC06275	15
3	GRC06276 - GRC06290	15
4	GRC06291 - GRC06305	15
5	GRC06306 - GRC06320	15
6	GRC05631 - GRC06335	15
7	GRC06336 - GRC06350	15
8	GRC06351 - GRC06365	15
9	GRC06366 - GRC06380	15
10	GRC06381 - GRC06395	15
11	GRC06396 - GRC06410	15
12	GRC06411 - GRC06425	15
13	GRC06426 - GRC06440	15
14	GRC06441 - GRC06455	15
15	GRC06456 - GRC06470	15
16	GRC06471 - GRC06485	15
17	GRC06486 - GRC06500	15
18	GRC06501 - GRC06515	15
19	GRC06516 - GRC06530	15
20	GRC06531 - GRC06545	15
21	GRC06546 - GRC06560	15
22	GRC06561 - GRC06575	15
23	GRC06576 - GRC06590	15
24	GRC06591 - GRC06605	15
25	GRC06606 - GRC06620	15
26	GRC06621 - GRC06635	15
27	GRC06636 - GRC06650	15
28	GRC06651 - GRC06665	15
29	GRC06666 - GRC06680	15
30	GRC06681 - GRC06695	15
31	GRC06796 - GRC06710	15
32	GRC06711 - GRC06725	15
33	GRC06726 - GRC06740	15
34	GRC06741 - GRC06755	15
35	GRC06756 - GRC06770	15
36	GRC06771 - GRC06785	15
37	GRC06786 - GRC06800	15
38	GRC06801 - GRC06815	15
39	GRC06816 - GRC06830	15
40	GRC06831 - GRC06845	15
41	GRC06846 - GRC06860	15
42	GRC06861 - GRC06872	12
TOTAL SAMPLES DISPATCHED		625

30/6/17

30/6/17

APPENDIX E GEOTECHNICAL BASIC LOGGING SHEET

KALTARA BATU KONSTRUKSI

GEOTECHNICAL JOINT LOG SHEET

PROSPECT :
AZI :
INCL :
TOTAL DEPTH :
DRILLED BY :

BHID :

DEPTH (m)	STRUCTURE	TYPE	ALPHA	BETA	ROUGHNESS	INFILL STRG	APERTURE	WEATH'G	ORI CON

BHID : SHEET OF .

KALTARA BATU KONSTRUKSI

APPENDIX F GEOTECHNICAL STRUCTURAL LOGGING SHEET

KALTARA BATU KONSTRUKSI

BHID :

BASIC GEOTECHNICAL LOG SHEET

PROSPECT :

AZI :

INCL :

TOTAL DEPTH :

DRILLED BY :

Interval		Recovery Data		RQD	Rock Fabric		Strength			Comments
FROM (m)	TO (m)	TCR (m)	SCR (m)	RQD (m)	ROCK TYPE	WEATH'G	IRS	ORI?	ORI OFFSET	

BHID :　　　　SHEET　OF　.

APPENDIX

C PETROLAB_MINERALOGICAL_REPORT_OP4477

Petrolab Mineralogy · Petrography

KBK Aggregates

PT Kaltara Batu Konstruksi

Mineralogical Report OP4477(a) 27/05/2021

Petrolab Ltd | www.petrolab.co.uk
tel +44 (0)1209 219 541 **email** petrolab@petrolab.co.uk
C Edwards Offices, Gweal Pawl, Redruth, Cornwall TR15 3AE
Registered in England & Wales · Company No. 4777735

Contents

Petrolab document control

Client	PT Kaltara Batu Konstruksi		
Report title	KBK Aggregates		
Analysis required	Detailed petrography of 4 rock samples, XRD analysis, XRF and total sulphur analyses.		
Client reference	KBK Greywacke	**Client contact**	Dean McMinn <dmcminn@srk.co.uk>
Report ID (issue date)	OP4477(a) 27/05/2021	**Version note**	Report Initial Issue
Prepared by	M Zajac BSc MSc	**Checked by**	C Brough PhD CGeol J Fletcher BSc MSc

Limitations

This report relates only to those samples submitted and specimens examined and to any materials properly represented by those samples and specimens. This report is issued to the Client named above for the benefit of the Client for the purposes for which it was prepared. It does not confer or purport to confer on any third party any benefit or right pursuant to the Contracts (Rights of Third Parties) Act 1999.

Report key findings and suitability for use

NOTE: Suitability for end uses has been provisionally considered on the basis of the petrographic observations against certain referenced requirements for specific end uses. Further physical and/or chemical testing against additional requirements for specific end-use applications has not been undertaken. Economic and environmental factors have not been considered. The materials examined may be suitable for other uses that have not been considered.

This is a petrographic report for PT Kaltara Batu Konstruksi to investigate four samples. It was reported that these were samples of prospective aggregate materials.

Sample 10261 represent finely banded shale. The sample is composed predominantly of quartz, feldspar clasts and clay minerals. The sample is fractured and unstable in water with layers frequently splitting apart. The sample contains ~30% of clay and fine mica minerals, which will mean the sample is prone to mechanical damage caused by its structural weakness. Framboidal pyrite is present, usually associated with clay rich layers.

➔ This rock type is weak and fissile, and it would not produce a strong and durable aggregate. As such, the sample is not considered prospective for use as a construction aggregate.

Sample 10262 is a fine grained greenish grey greywacke sandstone consisting of quartz and feldspar clasts hosted in a fine grained matrix containing clays, microcrystalline silica, dolomite and chlorite. The sample is also cut by dolomite-clay veins, which mark the sample weakness observed during a basic strength test. The sample strength is extremely strong within the parts of homogeneous material that does not contain any veins or veinlets. The strength is lowered in areas containing those veins, where the rock is splitting on those boundaries.

➔ Greywackes generally have a high polished stone value (PSV) and high abrasion resistance, which makes them highly prospective as potential sources for roadstone[1]. The examined aggregate material may meet this criteria, subject to confirmatory physical testing, with silt-sized clasts of quartz and feldspar in a fine-grained clay-rich matrix and very low porosity.

➔ It is noted that some greywackes, notably in the UK, have had alkali-silica reaction (ASR) implications when used in concrete[2,3] or mortar[4] manufacture due to the presence of cryptocrystalline or microcrystalline silica, and therefore the source material may not prove suitable for this end use. Further testing would be required to demonstrate the level of alkali-silica reactivity. The sulphide content, however, is not sufficient to cause concern (total sulphur, TS <0.1%).

Sample 10257 represents a medium-grained granodiorite composed of quartz, plagioclase feldspars and chlorite with minor amount of calcite and amphiboles. The sample is cut by two sulphide bearing veins and contains disseminated sulphide mineralisation. The sample strength is extremely strong and does not preferentially split along the sulphide veins.

➔ Most of the igneous rocks tend to produce strong aggregates with a degree of skid resistance and are hence suitable for e.g. road surfacing applications, road pavements or use as a railway ballast[5].

➔ Sample 10257 contains a considerable amount of sulphur due to the sulphide bearing

1 British Geological Survey. Mineral planning factsheet - Construction aggregates.
2 Alkali-silica reaction (ASR) – The reaction between the alkalis (sodium and potassium) in Portland cement binder, moisture and certain siliceous rocks or minerals, such as opaline chert, microcrystalline quartz, and acidic volcanic glass, present in some aggregates; the products of the reaction may cause abnormal expansion and cracking of concrete in service.
3 The Diagnosis of Alkali-Silica Reaction, Report of a working party. Appendix D. British Cement Association, 1992. Where rocks or mineral types are noted as 'reactive', it does not necessarily imply that damage has been caused by ASR when these have been used.
4 BS EN 12620:2013 Aggregates for concrete. BS EN 13139:2013 Aggregates for mortar.
5 British Geological Survey. Mineral planning factsheet - Construction aggregates.

veins and disseminated mineralisation. The TS value for this sample is 0.84%, which is a significant amount if considered for use as a construction aggregate, particularly as the trace presence of the sulphide mineral pyrrhotite has been identified. Further sulphur variability testing is recommended on representative samples of the material to ascertain that the TS values remain below the appropriate limits specified in European standards for aggregates used in concrete or mortar[1], and unbound and hydraulically bound material[2].

- ➔ Granodiorite aggregate is generally considered as having low alkali–silica reactivity when used as aggregate in concrete[3].

Sample 19999 is a silicified volcanic rock containing light beige and grey laminae cut by abundant fine microcrystalline silica veins and veinlets. The sample is composed of different polymorphs of quartz and sanidine feldspar, and is extremely strong.

- ➔ Silicified rocks are high in strength, which is a desirable feature for aggregate production, but usually contain abundant microcrystalline or/and cryptocrystalline silica, which may promote alkali-silica reaction (ASR) when used in concrete manufacture. Further testing would be required to demonstrate the level of alkali-silica reactivity.
- ➔ The sulphide content (rare crystals of pyrite observed) does not appear sufficient to cause concern.

1 BS EN 12620:2013 Aggregates for concrete. BS EN 13139:2013 Aggregates for mortar.
2 BS EN 13242:2013. Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.
3 See BRE Digest 330, Part 2, 2004. Alkali-silica reaction in concrete. Detailed guidance for new construction.

Introduction

Scope

This is a petrographic report for PT Kaltara Batu Konstruksi to investigate four samples. It was reported that these were samples of prospective aggregate materials.

This report relates only to the samples examined (and any materials properly represented by those samples). It presents the findings of a mineralogical investigation by optical microscopy on thin sections prepared from selected sub-samples. The results of supplementary Whole rock XRD + Clay analysis are considered (results are reproduced in Appendix 1). The results of chemical analyses for 14 trace elements (XRF), loss on ignition (LOI) at 600ºC and total sulphur are also provided (see Appendix 2).

List of samples

Samples received			
Report no.	**Sample reference**	**Mass (g)**	**Type**
1	10261	4394.4	Rock chip
2	10262	2442.8	Rock core
3	10257	895.0	Rock chip
4	19999	614.5	Rock chip

Methods of investigation

A detailed mineralogical investigation was requested, with special reference to the properties with the potential to effect suitability for aggregate use.

The submitted samples were examined as received using a Nikon SMZ-U stereoscopic microscope with fibre optic illuminator. One thin section and one polished chip were prepared from each selected sample. The sections were examined by conventional transmitted and reflected light polarising microscopy using a Nikon research polarising microscope.

Digital photomicrographs were taken using a high resolution digital camera attached to the trinocular head of the microscope.

Representative sub-samples were sent to an independent specialist laboratory for whole rock and clay XRD analysis. The results are considered in this report and reproduced in Appendix 1.

Sub-samples from 10261, 102622 & 10257 were sent to an independent specialist laboratory for XRF, LOI and total sulphur (LECO) analysis. The results are provided in Appendix 2.

Sample description

A detailed mineralogical description of each sample received (which includes annotated photomicrographs), based on a high-power microscopical examination of prepared thin-sections, begins over-page.

10261

Sample as received

Sample 10261		
Petrolab ID	**Date received**	**Type · properties**
#24936	19/04/2021	Rock chip · 4394 g

A **Sample 10261**

Photograph of sample as received (scale in cm).

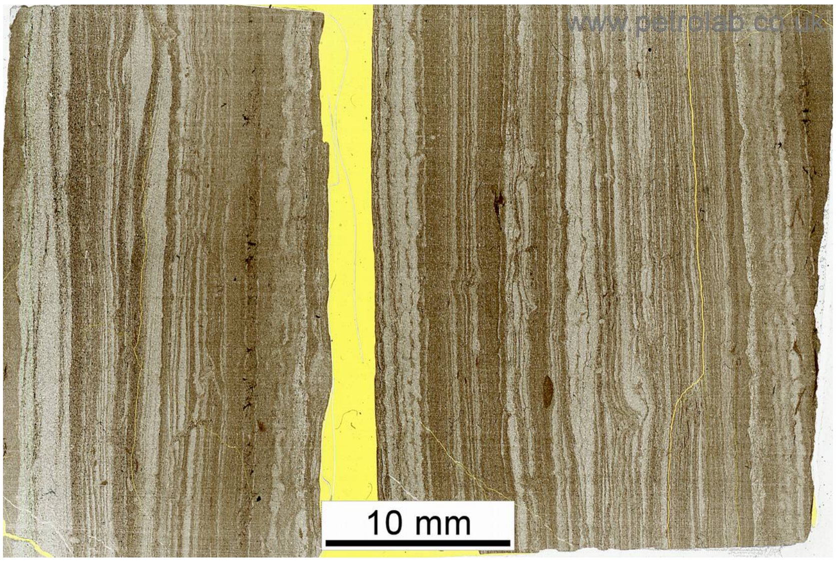
Image A
Nikon D7000 digital camera
Daylight balanced oblique light

Macroscopic (visual) description

Sample 10261	
Group | Name	Sedimentary SHALE
Colour	Dark grey to black.
Strength	Weak (5 - 25 MPa).
Structure	Thinly laminated (1 mm -5 mm).
Grain size	Uniformly fine grained with a typical size << 0.5 mm.
Weathering	Fresh.
Stability	Fairly stable in water - A few fissures are formed, or specimen surface crumbles slightly (Grade 2).

Notes:
The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.

Section(s)



B **Sample 10261**

Low magnification view of sample thin section.

Image B
Epson scanner
White cold cathode light

Microscopical examination

Sample 10261	
Texture and fabric, weathering & alteration	The sample is a laminated dark grey shale. It comprises a fine-grained matrix (mainly varying clays and fine mica, with minor carbonate, iron oxides and organic matter) with variably abundant quartz and feldspar clasts. The abundance and varying size of clasts defines laminations. Muscovite mica, biotite mica and chlorite are also present often elongated parallel with laminations. The shale contains rare fine grained pyrite within the matrix with rare framboids randomly distributed throughout the shale texture. Cracking within the sample is also present as both parallel along bedding planes and rarely as sub-perpendicular to lamination.
Constituents of concern	Cracking is already present associated with shale layers which contain rare framboidal pyrite. They show rare evidence of pyrite oxidation which may cause enhanced porosity and potential for further expansion. The shale layers show primarily lamination parallel cracking (<100 μm width) and rare perpendicular cracking (<250 μm). There is no other microporosity and the rock appears unweathered. When exposed to water, the shale formed some fissures and expansive cracks, suggesting it is susceptible to water ingress and that swelling clays are present (XRD analysis recorded 3.0% illite/smectite).

Mineral abundance

Sample 10261			
Mineral / Phase	**General formula**	**s.g.**	**Wt%[1]**
Quartz, qtz	SiO_2	2.65	44.7%
Microcrystalline Silica, M qtz	SiO_2	2.65	
Illite, ill	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	2.75	21.5%
Muscovite, ms	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.82	
Plagioclase feldspar, plag	$NaAlSi_3O_8 – CaAl_2Si_2O_8$	2.59	14.5%
Chlorite, chl	$(Mg,Fe^{++})_5Al(Si_3Al)O_{10}(OH)_8$	2.65	8.9%
Calcite, cal	$CaCO_3$	2.70	6.8%
Illite+Smectite, sm	$(Na,Ca)_{0,3}(Al,Mg)_2Si_4O_{10}(OH)_2•n(H_2O)$	2.35	3.0%
Kaolinite, kaol	$Al_2Si_2O_5(OH)_4$	2.60	0.6%
Alkali feldspar. K fsp	$KAlSi_3O_8$	2.56	trace
Biotite, bt	$K(Fe,Mg)_3(AlSi_3O_{10})(OH)_2$	3.09	trace
Dolomite, dol	$CaMg(CO_3)_2$	2.84	trace
Fe oxides, FeO	$Fe^{+++}O(OH)$	3.80	trace
Pyrite, py	FeS_2	5.01	trace

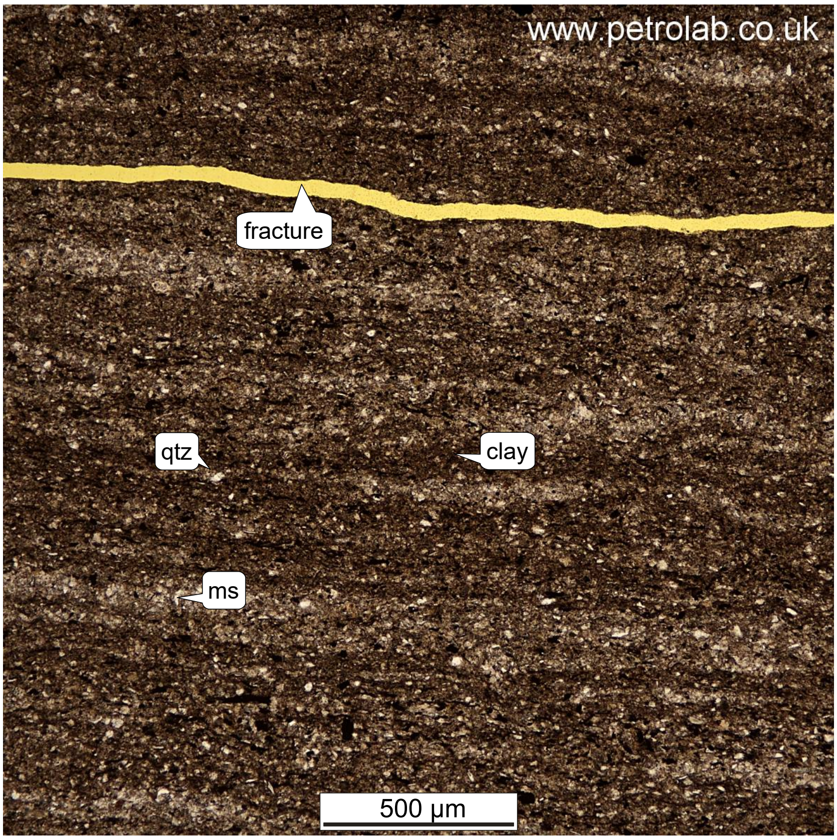
Phase description

Sample 10261				
Mineral / Phase	**Grain size (min | max | typical)**			**Prominent grain type**
Quartz	5 µm	80 µm	40 µm	Clast
Description	Angular, moderately sorted fine quartz grains are a predominant clast type within the rock. They are typically silt sized and only rarely reach ~80 µm. The variation in size and abundance throughout the texture defines the rock laminations. Slightly coarser quartz grains are usually associated with carbonate rich layers.			
Microcrystalline Silica	<5 µm	50 µm	20 µm	Matrix
Description	Microcrystalline silica is only a minor phase in the sample. Small patches of microcrystalline silica are visible within the rock, either locally altering quartz and feldspar grains, or as sporadic patches within the matrix of quartz rich layers.			
Clay	<1 µm	200 µm	5 µm	Matrix
Description	The bulk of the rock sample comprises an ultra-fine matrix containing various clay and other phyllosilicate minerals (XRD includes illite, smectite, kaolinite, mica and chlorite). Clay minerals are typically too fine grained to differentiate, appear weakly aligned parallel to lamination direction and show a range of birefringence colours. Laminations mainly appear to be defined by the amount of brown-coloured clays and fine biotite within the matrix, with additional brownish staining associated with small oxide lenses.			

1 Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Sample 10261				
Muscovite	20 µm	120 µm	50 µm	Clast & matrix
Description	Elongate muscovite laths are present throughout the texture, typically aligned with laminations and showing local deformation kinking around quartz clasts. They are typically coarser grained with less alignment in the lightest quartz-rich laminations, and show variation in abundance across laminations. Some are interlayered with chlorite or clays, particularly in the clay rich layers.			
Feldspar group	10 µm	70µm	50 µm	Clast
Description	Moderate to well sorted, angular grains of plagioclase and alkali feldspar form a minor clast component throughout the rock texture. XRD analysis indicates the majority of feldspar is plagioclase. They show similar variations in grain size as quartz. Some clasts show local sericitisation, kaolinisation or alteration to microcrystalline silica.			
Carbonates (calcite, dolomite)	<5 µm	100 µm	15 µm	Clast & matrix
Description	Carbonate is present as both calcite and dolomite although could not be differentiated in thin section as it is present in microcrystalline form. This is distributed throughout the section as a component of the matrix and is also seen forming diffuse agglomerations up to 100 µm. There are also calcite and quartz rich layers within the rock texture. There are also rare calcite veins present, running perpendicular to sample lamination.			
Biotite	10 µm	70 µm	40 µm	Clast & matrix
Description	Elongated laths of biotite are present throughout the texture showing similar distribution and alignment as muscovite. They are usually finer grained than muscovite. They are commonly associated with chlorite, muscovite and clays.			
Fe oxides	5 µm	60 µm	20 µm	Matrix
Description	Rare angular to sub-angular grains and granular clusters (predominantly hematite and goethite) are typically disseminated throughout the sample.			
Pyrite	5 µm	30 µm	10 µm	Matrix
Description	Traces of small pyrite grains were visible in reflected light. They are typically disseminated throughout the rock texture and occur as framboids and angular crystals. They rarely form agglomeration of framboids.			

Photomicrographs



C **Sample 10261**

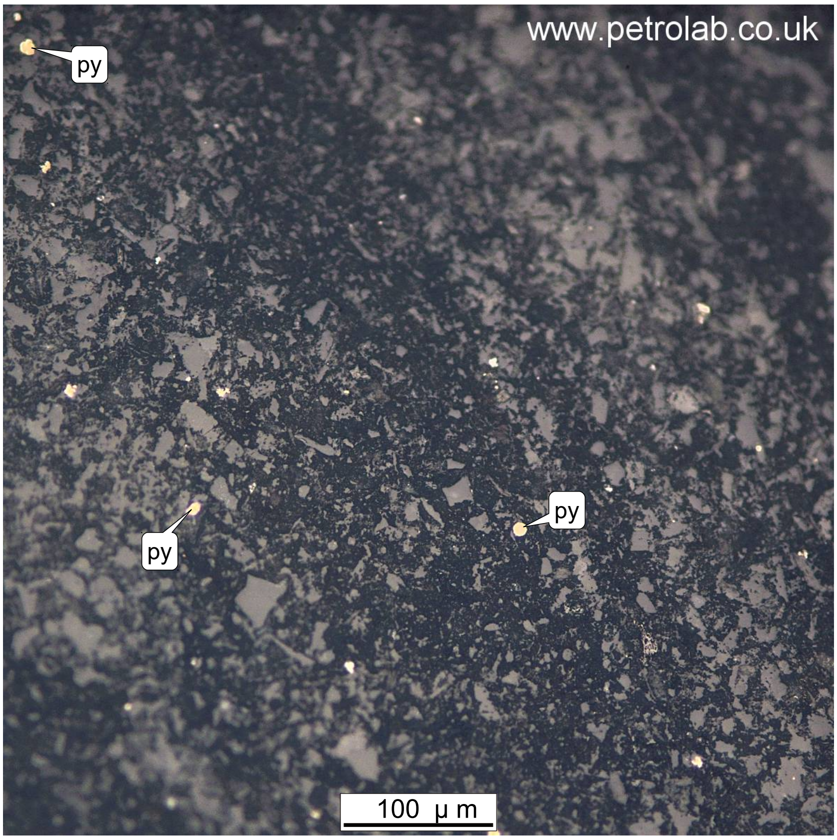
Photomicrograph of sample showing general texture of shale composed of darker, clay rich layers and lighter clast rich layers. There is also visible a fracture running parallel to rock lamination.

Image C
Nikon Microphot-FXA petrological microscope
Plane polarised transmitted light
x50

D **Sample 10261**

Photomicrograph of sample showing general texture of shale, cut by a calcite vein.

Image D
Nikon Microphot-FXA petrological microscope
Cross polarised transmitted light
x50



E **Sample 10261**

Photomicrograph of sample showing general texture with disseminated rounded framboidal pyrite (py).

Image E

Nikon Microphot-FXA petrological microscope

Plane polarised reflected light

x200

10262

Sample as received

Sample 10262		
Petrolab ID	**Date received**	**Type · properties**
#24937	19/04/2021	Rock chip · 2443 g

A **Sample 10262**

Photograph of sample as received (scale in cm).

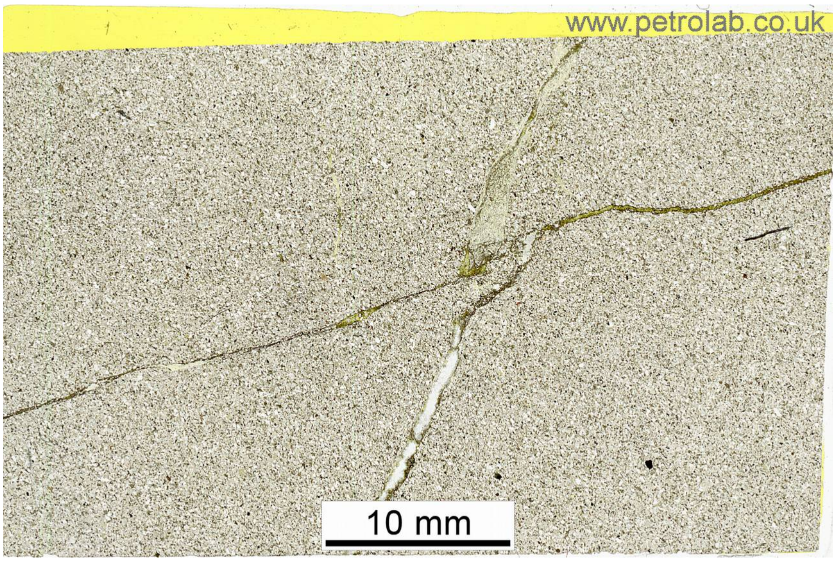
Image A
Nikon D7000 digital camera
Daylight balanced oblique light

Macroscopic (visual) description

Sample 10262	
Group | Name	Sedimentary GREYWACKE
Colour	Greenish grey.
Strength	Strong (50 - 100 MPa), broken along fracture plane.
Structure	No layering seen at sample scale. Cross-cut by high angle veins and fractures.
Grain size	Uniformly fine grained with a typical size << 1 mm.
Weathering	Fresh.
Stability	Stable in water - No changes (Grade 1).

Notes:
The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.

Section(s)



B **Sample 10262**

Low magnification view of sample thin section.

Image B
Epson scanner
White cold cathode light

Microscopical examination

Sample 10262	
Texture and fabric, weathering & alteration	The sample is a fine-grained greywacke consisting of silt-sized clasts of quartz and feldspar (both plagioclase and alkali-feldspar) hosted in a fine-grained matrix containing micas (muscovite, biotite and chlorite), clay, dolomite, patches of microcrystalline silica and rare trace iron-oxides. The clay mineralogy is very fine-grained but likely to consist of a mixture of sericite, illite, smectite, chlorite and kaolinite. The sample is cross-cut by high-angled coarse dolomite veins. Rare occasional anhedral grains of pyrite and pyrite framboids were observed within the greywacke matrix.
Constituents of concern	Greywackes have potential alkali-silica (ASR) implications when used in concrete due to the cryptocrystalline or microcrystalline silica which may be present.

Mineral abundance

Sample 10262			
Mineral / Phase	**General formula**	**s.g.**	**Wt%[1]**
Quartz, qtz	SiO_2	2.65	40.2%
Microcrystalline Silica, M qtz	SiO_2	2.65	
Feldspar group, fsp	$KAlSi_3O_8$ - $NaAlSi_3O_8$ - $CaAl_2Si_2O_8$	2.59	21.7%
Dolomite, dol	$CaMg(CO_3)_2$	2.84	20.0%
Illite, ill	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	2.75	10.3%
Muscovite, ms	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	2.82	
Kaolinite, kaol	$Al_2Si_2O_5(OH)_4$	2.60	4.8%
Illite/Smectite	$(Na,Ca)_{0,3}(Al,Mg)_2Si_4O_{10}(OH)_2$•$n(H_2O)$	2.35	1.3%
Siderite, sid	$Fe^{++}CO_3$	3.96	1.3%
Anatase, ant	TiO_2	3.90	0.5%
Pyrite, py	FeS_2	5.01	trace
Fe oxides, FeO	$Fe^{+++}O(OH)$	3.80	trace
Chlorite, chl	$(Mg,Al,Fe^{++})_{12}(Si,Al)_8O_{20}(OH)_8$	2.65	trace
Apatite, apt	$Ca_5(PO_4)_3F$	3.16	trace
Zircon, zr	$ZrSiO_4$	4.65	trace

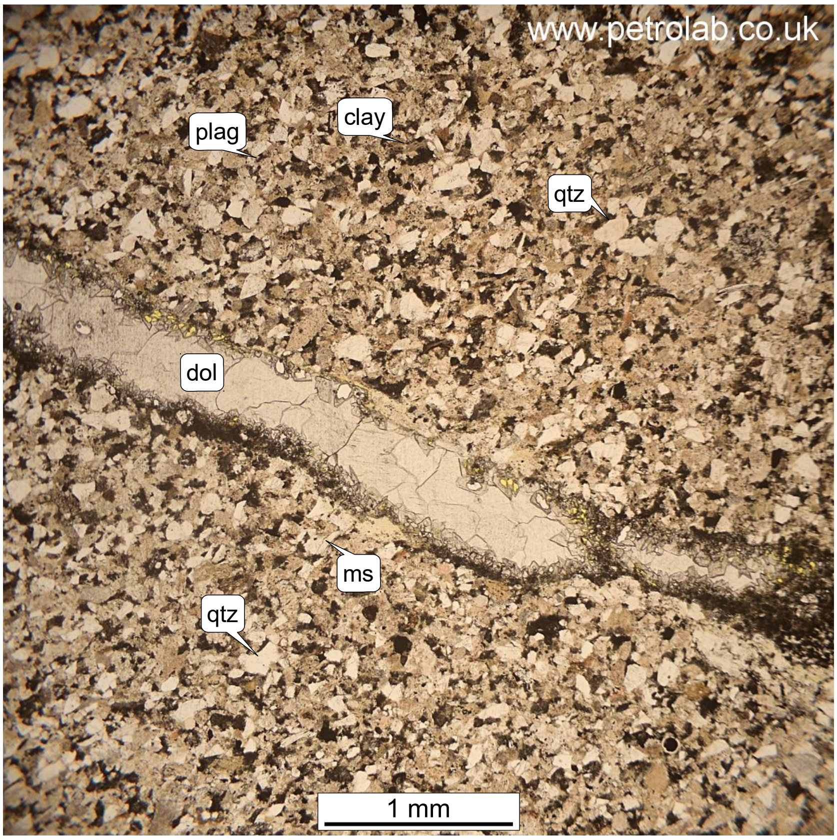
Phase description

Sample 10262				
Mineral / Phase	**Grain size (min | max | typical)**			**Prominent grain type**
Quartz	50 µm	350 µm	200 µm	Clast
Description	Inequigranular, angular, moderately to poorly sorted, monocrystalline quartz is the main constituent of sample. Grains rarely show undulose extinction and division into sub-grains, indicating a low level of deformation overall. Quartz grains do not show any alteration and are packed in between feldspar grains and clays.			
Microcrystalline Silica	50 µm	1 mm	200 µm	Matrix & clast
Description	Microcrystalline silica is a minor phase which is present in the matrix between clasts and also forming sub-rounded clast grains of chert. Within the matrix it is sometimes associated with clays. Microcrystalline silica is forming patches of silicified matrix < 1 mm within the sandstone texture.			
Feldspar group	50 µm	300 µm	200 µm	Clast
Description	Feldspars form angular clasts throughout the texture. Plagioclase feldspars are predominant throughout the sample with characteristic polysynthetic twinning. They rarely show slight sericitisation. Only minor alkali feldspar with simple twinning were observed. Rare alkali feldspars show slight kaolinisation.			

1 Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Sample 10262				
Carbonates (dolomite, siderite)	10 µm	200 µm	100 µm	Sub-angular to sub rounded
Description	Carbonate is present as predominantly dolomite with a trace amount of siderite. Carbonates are distributed throughout the sample as a component of the matrix and are also seen forming diffuse agglomerations up to 100 µm (possibly siderite). Well crystallised dolomite is a major component of veins that cut the sample in different angles. In veins dolomite occurs in association with clays.			
Clay/fine micas	< 5µm	200 µm	50 µm	Matrix
Description	Fine grained masses of subhedral (elongate to platy) undifferentiated micas and clay minerals form a significant proportion of interstitial matrix between clasts (XRD includes illite, smectite, kaolinite, mica and chlorite) They are sometimes interlayered with coarser micas (e.g. muscovite, chlorite) and also associated with iron oxides, anatase, dolomite, siderite and rarely microcrystalline silica. There is no obvious preferred alignment. Some pockets of sericite are also seen replacing altered feldspars, although they never replace the entire feldspar clast.			
Muscovite	40 µm	500 µm	150 µm	Clast & matrix
Description	Muscovite is generally present as elongate subhedral to euhedral (tabular) crystal clasts randomly distributed throughout the rock texture, sometimes showing weak compaction deformation around rigid detrital grains. It is also present in fine grained form in the matrix and as part of sericitisation of feldspars but is difficult to differentiate and has been grouped with other micas/clays.			
Anatase	5 µm	70 µm	20 µm	Matrix & clast
Description	Anatase is present as small anhedral grains, elongate needles and clusters of grains (up to 70 µm) associated with other interstitial phases (clays, iron oxides). It is also present as very rare inclusions in quartz.			
Pyrite	5 µm	200 µm	30 µm	Matrix
Description	Rare subhedral to anhedral crystals of pyrite are visible in reflected light, disseminated through the sandstone texture with no obvious association. Disseminated framboids were also visible, rarely creating an agglomeration of framboids. Some of them are oxidised to iron oxides.			
Fe oxides	10 µm	70 µm	40 µm	Matrix
Description	Iron oxides (mainly composed of hematite and goethite) are disseminated throughout the rock texture as individual grains and granular clusters associated with clays, anatase and chlorite. They usually occur within the matrix and also replace some of the pyrite crystals.			
Chlorite	10 µm	200 µm	80 µm	Clast & matrix
Description	Chlorite is present within the fine micas and clays forming sample matrix, it is generally too fine grained to separate out from green clays. However there are occasionally small aggregates solely comprising chlorite and larger individual clasts of chlorite present.			
Apatite	5 µm	80 µm	20 µm	Clast
Description	Apatite is an accessory phase within the sample and forms sub-rounded randomly distributed clasts throughout the sandstone texture.			
Zircon	10 µm	20 µm	20 µm	Clast
Description	Zircon is an accessory phase within the sandstone usually forming small, sub-rounded clast grains. There is no visible alteration associated with zircon.			

Photomicrographs



C **Sample 10262**

Photomicrograph of sample showing main constituents of greywacke sandstone including quartz (qtz), plagioclase feldspar (plag) and mica (ms) grains, cut by a dolomite (dol) vein.

Image C

Nikon Microphot-FXA petrological microscope

Plane polarised transmitted light

x25

D **Sample 10262**

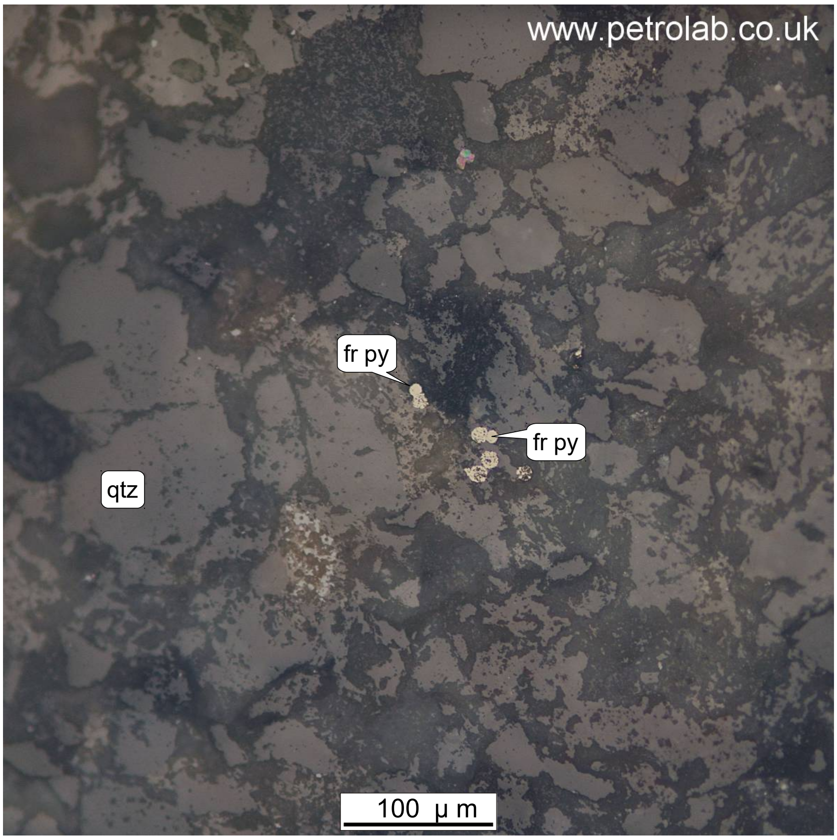
Photomicrograph of sample showing main constituents of greywacke sandstone, including quartz (qtz), plagioclase feldspar (plag) and mica (ms) clast within clay, microcrystalline silica (M qtz) and dolomite (dol) matrix.

Image D

Nikon Microphot-FXA petrological microscope

Cross polarised transmitted light

x50



E Sample 10262

Photomicrograph of sample showing general texture of greywacke sandstone with small framboidal pyrite (fr py) agglomerations.

Image E

Nikon Microphot-FXA petrological microscope

Plane polarised reflected light

x200

10257

Sample as received

Sample 10257		
Petrolab ID	**Date received**	**Type · condition · properties**
#24938	19/04/2021	Rock chip · 895.0 g

A **Sample 10257**

Photograph of sample as received (scale in cm).

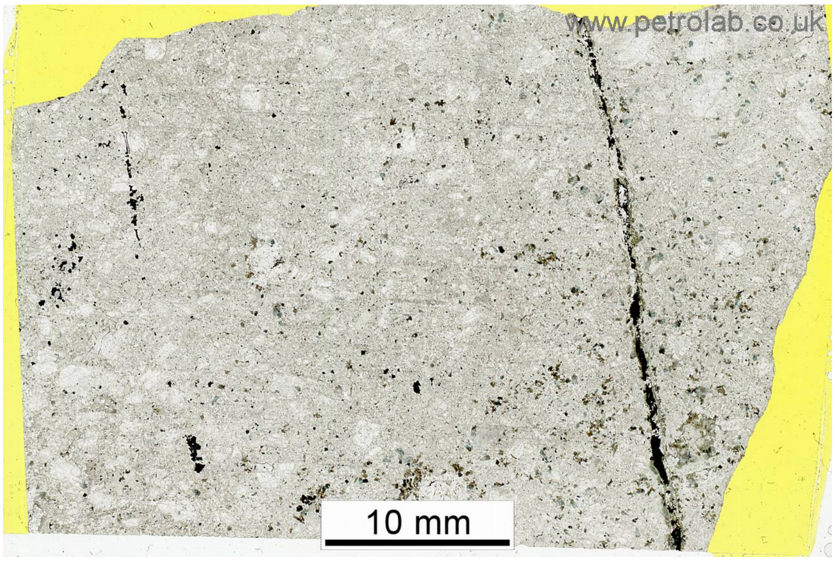
Image A
Nikon D7000 digital camera
Daylight balanced oblique light

Macroscopic (visual) description

Sample 10257	
Group | Name	Plutonic | GRANODIORITE
Colour	Greenish grey.
Strength	Extremely strong (> 250 MPa).
Structure	No layering seen at sample scale. Cut by sulphide bearing, 1 mm wide vein.
Grain size	Uniformly medium grained with a typical size < 3 mm.
Weathering	Slightly discoloured on surface due to weathering.
Stability	Stable in water - no changes (Grade 1).

Notes:
The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.

Section(s)



B **Sample 10257**

Low magnification view of sample thin section.

Image B
Epson scanner
White cold cathode light

Microscopical examination

Sample 10257	
Texture and fabric, weathering & alteration	The sample is a medium-grained granodiorite consisting of equigranular quartz crystals with coarser-grained plagioclase feldspars with major amount of chlorite and minor amphibole, calcite, iron oxides and sulphides. The sample is cut by set of two parallel veins with one of them more superior. the veins consist of pyrite and arsenopyrite mineralisation hosted within microcrystalline silica. The sample also contains disseminated sulphide mineralisation. Some sulphides are replaced by iron or titanium oxides.
Constituents of concern	Elevated amounts of sulphur, predominantly hosted in sulphide minerals may be a concern for the particular end uses.

Mineral abundance

Sample 10257			
Mineral / Phase	**General formula**	**s.g.**	**Wt%[1]**
Quartz, qtz	SiO_2	2.65	35.3%
Plagioclase feldspar, pg	$(Na,Ca)(Si,Al)_4O_8$	2.68	27.8%
Chlorite, chl	$(Mg,Fe^{++})_5Al(Si_3Al)O_{10}(OH)_8$	2.65	23.0%
Calcite, cal	$CaCO_3$	2.70	2.3%
Pyrite, py	FeS_2	5.01	1.3%
Amphibole group, amph	$Ca_2[(Fe^{++}{}_4,Mg_4)(Al,Fe^{+++})]Si_7AlO_{22}(OH)_2$	3.23	trace
Goethite, Gt	FeOOH	4.27	trace
Ilmenite, ilm	$Fe^{++}TiO_3$	4.72	trace
Arsenopyrite, apy	FeAsS	6.07	trace
Hematite, hem	Fe_2O_3	5.30	trace
Magnetite, mag	Fe_3O_4	5.15	trace
Pyrrhotite, po	$Fe_{(1-x)}S$ (x=0-0.17)	4.61	trace
Chalcopyrite, cpy	$CuFeS_2$	4.19	trace

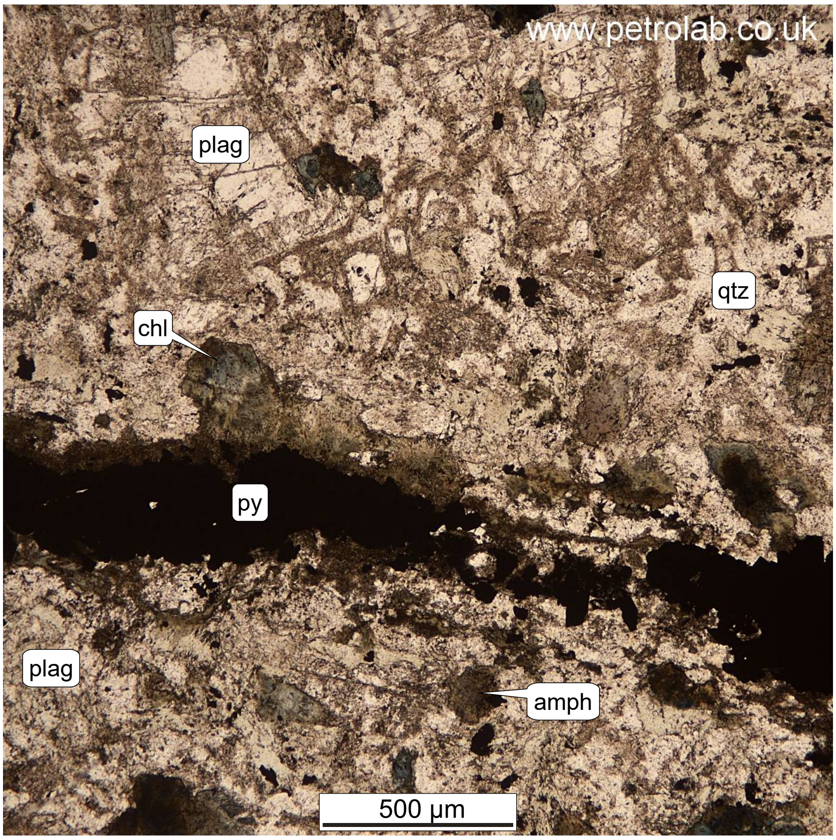
Phase description

Sample 10257				
Mineral / Phase	**Grain size (min | max | typical)**			**Prominent grain type**
Quartz	50 µm	2.5 mm	200 µm	Subhedral
Description	Quartz is the main mineral phase in this sample. It forms subhedral to anhedral crystals, often agglomerated into coarser patches. Quartz crystals commonly have intergrown boundaries.			
Plagioclase feldspar	100 µm	2.5 mm	1 mm	Tabular
Description	Plagioclase feldspar is one of the main phases within the sample. It creates tabular crystals with polysynthetic twinning. It is interstitial to finer grained quartz groundmass. Plagioclase rarely shows evidence of sericitisation. Some crystals are cut by thin calcite veins.			
Chlorite	50 µm	1 mm	300 µm	Anhedral
Description	Chlorite occurs as anhedral patches within the rock groundmass. It occurs commonly in proximity to sulphide veins and in association with acicular amphibole. Chlorite is also associated with patches of calcite, that commonly replaces its structure. Chlorite also occasionally replaces biotite laths.			
Calcite	50 µm	2 mm	300 µm	Subhedral to anhedral
Description	Calcite occurs as anhedral patchy replacement on chlorite crystals or plagioclase feldspar. It forms subhedral crystals within sulphide bearing vein. Thin calcite veins also commonly cut the sample in different directions.			
Pyrite	5 µm	1 mm	150 µm	Euhedral to anhedral
Description	Pyrite is the main ore phase within the sample. Euhedral to subhedral crystals are scattered throughout the sample. Pyrite occurs in bigger agglomerations within the main vein cutting through the sample in association with arsenopyrite. Pyrite contains sporadic inclusions of pyrrhotite. There are also instances of slightly to pervasively altered pyrite, replaced by hematite.			
Amphibole group	50 µm	500 µm	150 µm	Subhedral
Description	Amphibole group is predominantly comprised of hornblende, which is a minor phase in the sample. It forms subhedral to anhedral crystals and occurs randomly in association with plagioclase and quartz. It is commonly altered to chlorite and biotite, sometimes also containing weak iron oxide filled fractures. There are also rare acicular amphiboles forming rare radial agglomerations. They usually occur in close proximity to the sulphide bearing veins.			
Goethite	< 5 µm	50 µm	20 µm	Anhedral
Description	Goethite is only a trace phase within the sample and occurs within the sulphide bearing vein, rimming some sulphide crystals or creating anhedral patches.			
Ilmenite	5 µm	150 µm	70 µm	Subhedral to anhedral
Description	Ilmenite is the main oxide present in the sample. It forms subhedral to anhedral crystals and is scattered throughout the rock texture. It commonly contains exsolutions of hematite and magnetite with rare pyrite inclusions hosted within hematite patches.			
Arsenopyrite	50 µm	600 µm	200 µm	Subhedral
Description	Arsenopyrite forms subhedral crystals and occurs in association with pyrite within sulphide bearing vein cutting through the sample.			

1 Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Sample 10257				
Hematite	10 µm	150 µm	50 µm	Anhedral
Description	Hematite is predominantly associated with ilmenite and creates patches of exsolutions within ilmenite crystals. Hematite also commonly replaces pyrite crystals. It rarely occurs by its own.			
Magnetite	5 µm	70 µm	20 µm	Anhedral
Description	Magnetite is a trace mineral phase and creates anhedral crystals. Commonly occurs as exsolutions within ilmenite crystals or replaces rare pyrrhotite crystals.			
Pyrrhotite	5 µm	50 µm	20 µm	Anhedral
Description	Pyrrhotite is only a trace phase within the sample. It occurs as inclusions within pyrite and as nearly completely altered crystals, replaced by magnetite.			
Chalcopyrite	50 µm	70 µm	50 µm	Subhedral
Description	Chalcopyrite occurs as a trace phase, associated with pyrite.			

Photomicrographs



C **Sample 10257**

Photomicrograph of sample showing texture of granodiorite cut by pyrite (py) vein rimmed by amphiboles (amph).

Image C

Nikon Microphot-FXA petrological microscope

Plane polarised transmitted light

x50

D **Sample 10257**

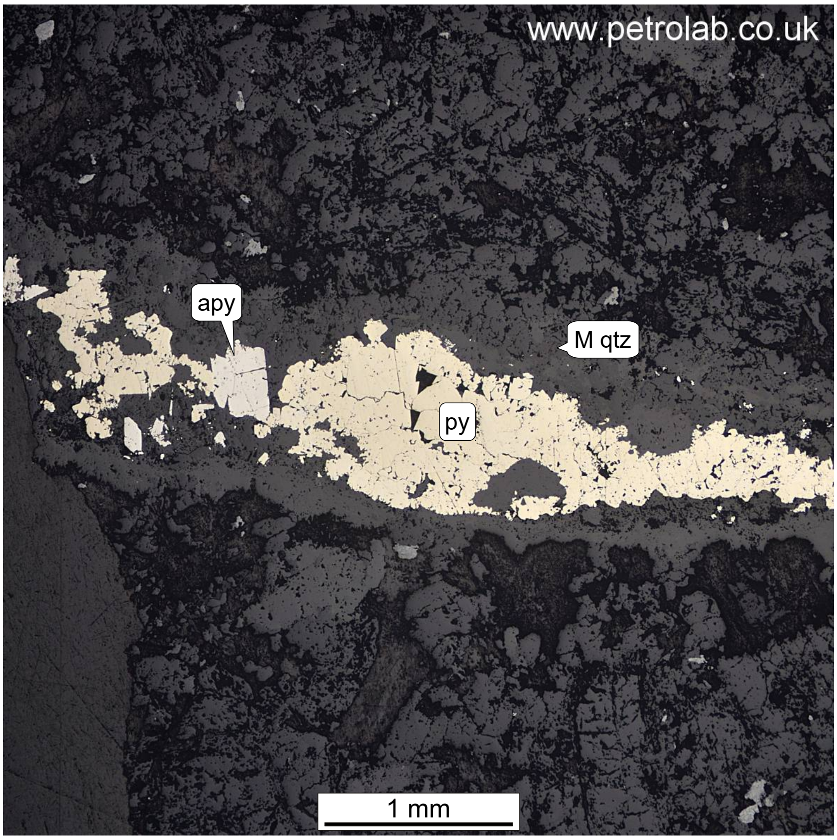
Photomicrograph of sample showing texture of granodiorite with calcite patches (cal) replacing some of the chlorite crystals (chl) and amphiboles (amph).

Image D

Nikon Microphot-FXA petrological microscope

Cross polarised transmitted light

x50



E **Sample 10257**

Photomicrograph showing microcrystalline quartz (M qtz) vein containing pyrite (py) and arsenopyrite (apy) mineralisation.

Image E

Nikon Microphot-FXA petrological microscope

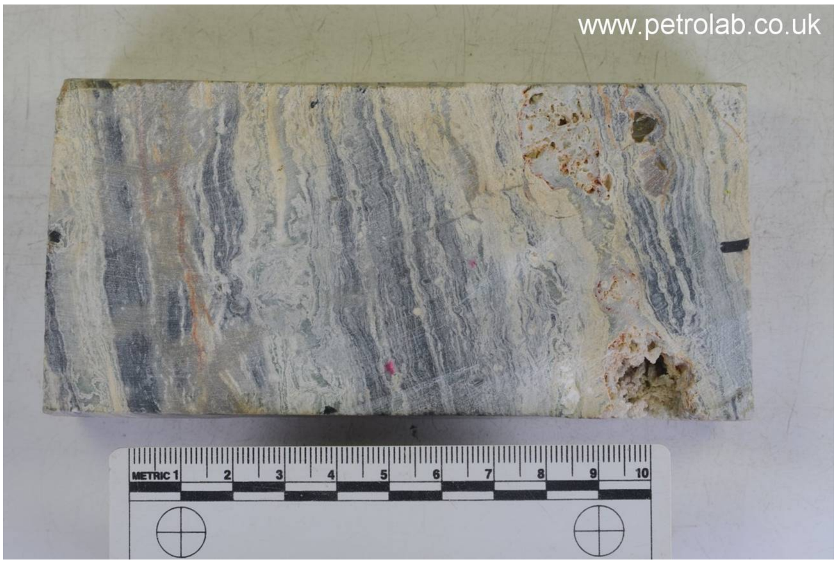
Plane polarised reflected light

x25

19999

Sample as received

Sample 19999		
Petrolab ID	**Date received**	**Type · properties**
#24939	19/04/2021	Rock chip · 615 g



A **Sample 19999**

Photograph of sample as received (scale in cm).

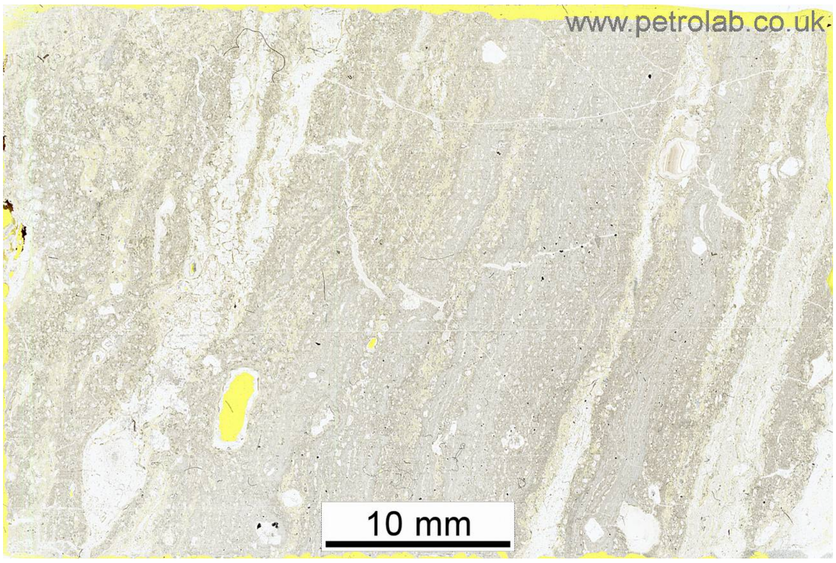
Image A
Nikon D7000 digital camera
Daylight balanced oblique light

Macroscopic (visual) description

Sample 19999	
Group | Name	Volcanic | SILICIFIED VOLCANICS
Colour	Cream to grey.
Strength	Extremely strong (> 250 MPa).
Structure	Thinly laminated (0.3 - 4 mm) with silicified cream and grey laminae. Cross-cut by high angle veins and fractures.
Grain size	Typically << 0.5 mm, maximum 6 mm.
Weathering	Fresh.
Stability	Stable in water - No changes (Grade 1).

Notes:
The macroscopic description is based on visual and manual identification of the material characteristics at the scale of the sample provided. Colour, strength, structure, grain size, rock material weathering and stability terms used in the description are defined in BS EN ISO 14689-1:2003.

Section(s)



B **Sample 19999**

Low magnification view of sample thin section.

Image B
Epson scanner
White cold cathode light

Microscopical examination

Sample 19999	
Texture and fabric, weathering & alteration	The sample is a silicified flow banded tuff/rhyolite containing light beige and grey laminae. The sample is composed of different polymorphs of quartz and sanidine feldspar. It contains abundant secondary microcrystalline silica and chalcedony fills within the original vesicles and abundant microcrystalline quartz veining system running parallel, perpendicular and at high angles to the sample lamination. There are sporadic occurrences of iron oxide crust. There are rare instances of small pyrite crystals scattered throughout the sample.
Constituents of concern	Heavily silicified rocks may have potential alkali-silica (ASR) implications when used in concrete due to the cryptocrystalline or microcrystalline silica which is present within their texture.

Mineral abundance

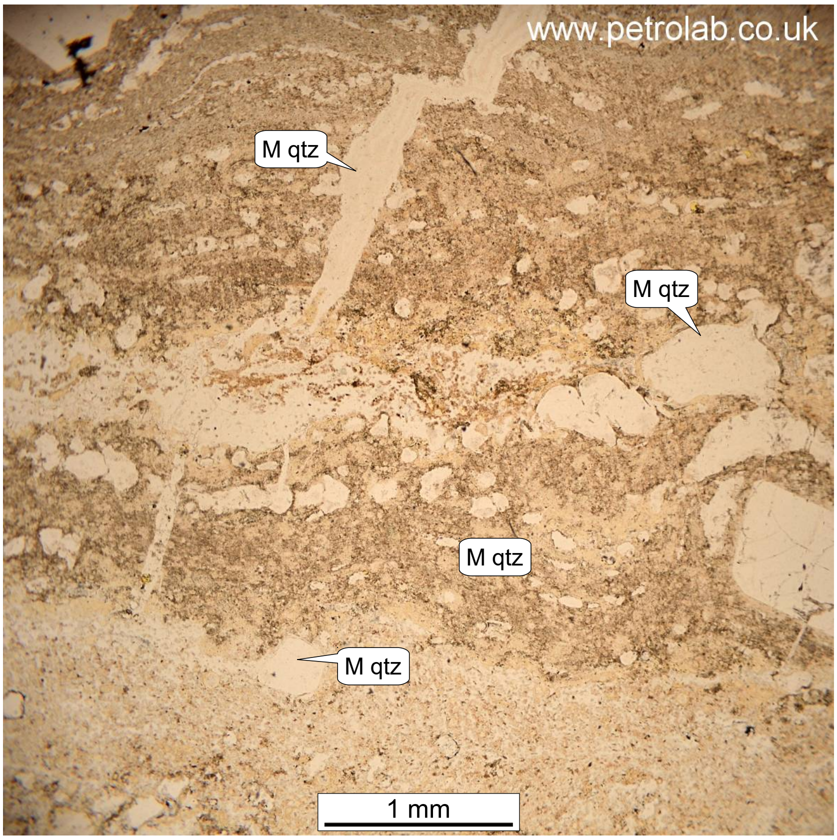
Sample 19999			
Mineral / Phase	**General formula**	**s.g.**	**Wt%[1]**
Microcrystalline Silica, M qtz	SiO_2	2.65	57.5%
Quartz, qtz	SiO_2	2.65	
Chalcedony, chc	$SiO_2 \cdot n(H_2O)$	2.09	
Sanidine, snd	$(K,Na)(Si,Al)_4O_8$	2.52	42.5%
Monazite, mon	$(Ce,La,Nd,Th)PO_4$	5.15	trace
Iron oxides, FeO	$Fe^{+++}O(OH)$	3.80	trace
Pyrite, py	FeS_2	5.01	trace
Dolomite, dol	$CaMg(CO_3)_2$	2.84	trace

1 Wt% mineral abundance reported using results from XRD analysis undertaken by X-ray Mineral Services Ltd (2021). Minerals recorded as tr (trace) were observed during this petrographic analysis but had not been detected by XRD as they were present below the limit of detection.

Phase description

Sample 19999				
Mineral / Phase	**Grain size (min | max | typical)**			**Prominent grain type**
Microcrystalline Silica	<5 µm	50 µm	20 µm	Anhedral
Description	Microcrystalline silica is the predominant component of this sample. It forms the sample groundmass, occurs within numerous veins and layers present in the sample and marks different layers within its texture. It also rims some of the quartz and secondary filled vesicles.			
Quartz	50 µm	1 cm	200 µm	Subhedral
Description	Subhedral, rarely euhedral quartz crystals are randomly distributed throughout the silicified texture of the rock. The are unaltered and commonly much coarser than other components of the sample. They may resemble the primary crystals of the original rock texture.			
Chalcedony	< 5 µm	50 µm	10 µm	Anhedral
Description	Occurs usually within filled vesicles or as irregular patches within silicified groundmass.			
Sanidine	100 µm	500 µm	200 µm	Subhedral
Description	Sanidine crystals are scattered throughout the rock texture but are also a component of sample groundmass. They are rarely associated with accessory phases.			
Monazite	25 µm	150 µm	50 µm	Subhedral
Description	Subhedral monazite is an accessory phase occurring rarely in association with sanidine.			
Iron oxides	< 5 µm	50 µm	20 µm	Anhedral
Description	Iron oxides, predominantly goethite are very rare and form crust deposits on some silicified layers, also interstitial to some quartz crystals.			
Pyrite	5 µm	150 µm	50 µm	Subhedral
Description	Rare subhedral pyrite crystals are scattered throughout the rock texture.			
Dolomite	-			
Description	Dolomite was not observed during petrographic study, but may be present as a remnant mineral phase within light beige layers.			

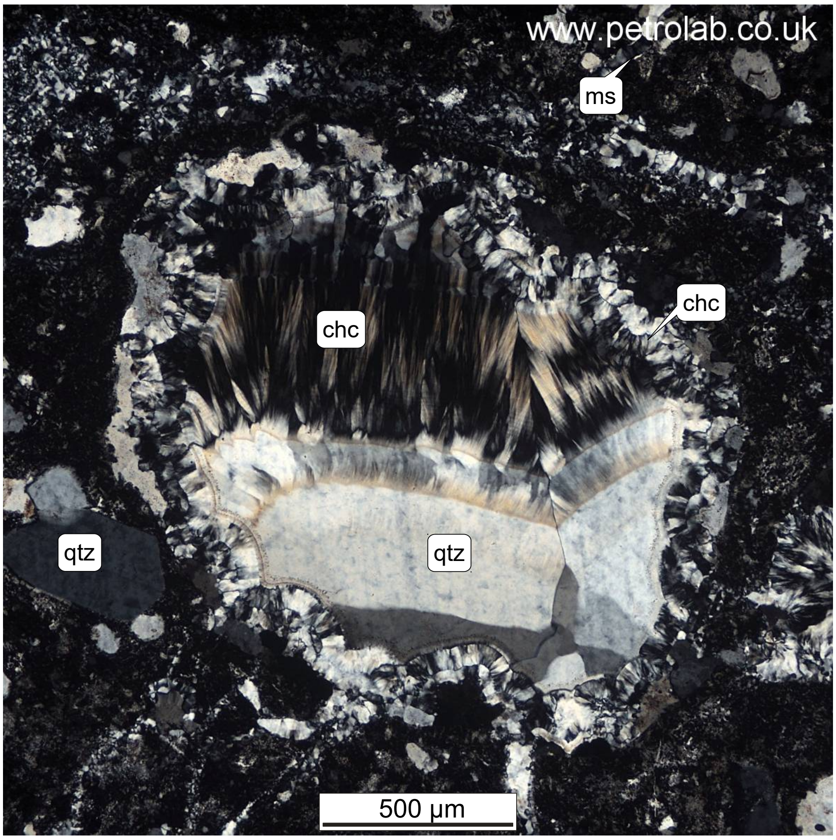
Photomicrographs



C **Sample 19999**

Photomicrograph of sample showing general texture of rock composed entirely of microcrystalline quartz (M qtz). It contain silicified laminae with rare coarser quartz (qtz) grains. The sample is cut by numerous microcrystalline quartz (M qtz) veins running in different directions.

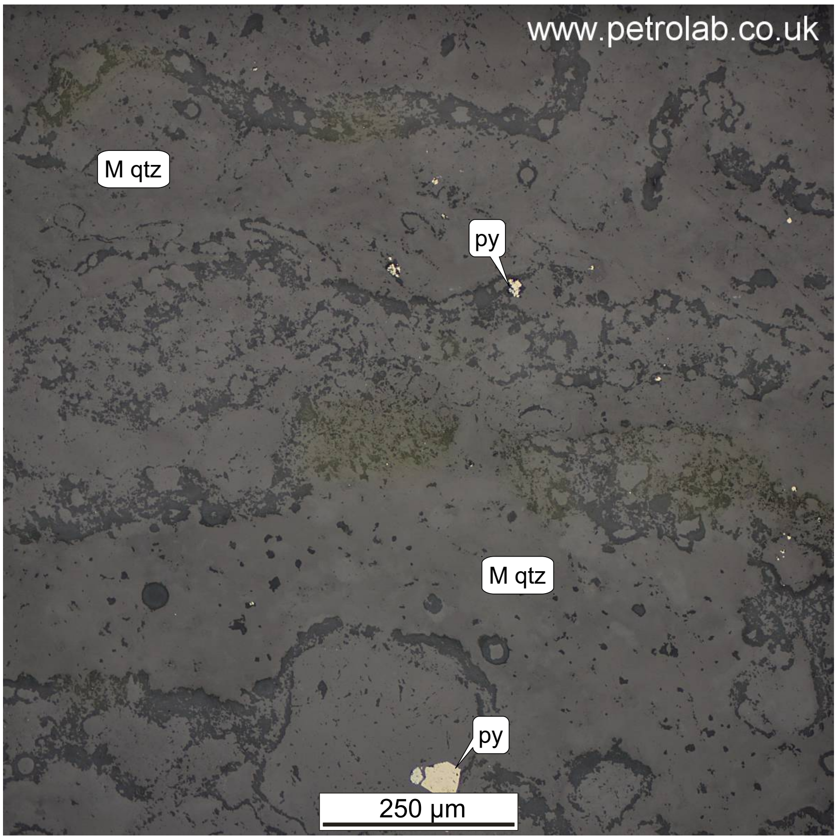
Image C
Nikon Microphot-FXA petrological microscope
Plane polarised transmitted light
x25



D **Sample 19999**

Photomicrograph showing secondary fill in vesicle composed of coarse quartz (qtz) crystals and chalcedony (chc).

Image D
Nikon Microphot-FXA petrological microscope
Cross polarised transmitted light
x50



E Sample 19999

Photomicrograph of sample showing general texture rock composed of microcrystalline quartz (M qtz) with disseminated pyrite (py) crystals.

Image E
Nikon Microphot-FXA petrological microscope
Plane polarised reflected light
x100

Appendix 1 · X-ray diffraction (XRD) analysis

Introduction and background

XRD analysis is chiefly undertaken to confirm the presence of clay minerals in suspected problematic lithologies, as clay minerals can be too fine to be readily identifiable by detailed thin section petrography.

Methods of investigation

Whole (Bulk) Rock Analysis

The objective is to obtain a quantitative measurement of the mineral components of a sample.

Sample Preparation

The sample is first disaggregated gently using a pestle and mortar. A 2 gram split of this material is then ‘micronised’ using a McCrone Micronising Mill to obtain an x-ray diffraction ‘powder’ with a mean particle diameter of between 5 - 10 microns. The sample as a slurry can then be treated in one of the following ways:-

If sample quantity is limited the slurry is dried overnight at 80°C, re-crushed to a fine powder and back-packed into an aluminium cavity mount, producing a randomly orientated sample for presentation to the x-ray beam. When appropriate, and with samples where 5-10g are available, the (water-based) slurry is sprayed under pressure into an oven where it is instantly dried into a powder comprising microspherical aggregates of mineral particles. This powder is front-packed into an aluminium cavity mount, producing a randomly orientated sample for presentation to the x-ray beam.

X-Ray Diffraction

The prepared sample was analysed using a PANalytical X'Pert3 Powder Diffractometer between 2° and 60° 2ϴ (theta) with a step size of 0.05°/sec using x-ray radiation from a copper anode at 35kV, 30mA.

Identification of unknown minerals was achieved by using “Traces” and “Search-Match” software to compare the x-ray diffraction pattern from the unknown sample with the International Centre for Diffraction Data PDF-4 Minerals database containing reference patterns for more than 157,000 phases.

Rietveld Analysis

Quantification was by intensity method validated by selected Rietveld analysis. The Rietveld method, first published in 1967, was used at first to understand and refine crystal structure as determined by X-ray diffraction. Since the 1980’s the method has been extended to quantification of phases in mineral samples. The Rietveld equation allows a synthetic diffractogram to be calculated for a mineral mixture and takes account of practical difficulties such as dispersion, absorption, particle-size and preferred orientation. The output of the equation can be compared continuously with the experimental trace and ‘refined’ by incorporating modified parameters until a best fit is obtained. At this point the equation incorporates the percentage composition of the phases which are present, and those can be output directly together with statistical data relating to the fitting process. Rietveld analysis is most effective when the sample contains a limited number of well characterised mineral phases. The accuracy of the method diminishes as the percentage of the mineral phase is reduced. The reliable detection limit of the XRD method is 0.5 – 2% depending on the mineral phase, and is affected by crystallinity.

Clay Mineral Analysis

The objective is to obtain further definition of the clay mineral components of the sample.

Sample Preparation

Although clay minerals are evident in whole rock diffractograms, the most satisfactory method for their quantification is to extract and analyse separately the clay fraction. A 5 gram split of the sample that was disaggregated as the first stage of the whole rock preparation (see above) is taken and weighed accurately. The weight is recorded in a central register for later reference.

Separating the <2 micron fraction is achieved by ultrasound, shaking and centrifugation. Size fractions other than <2 micron (e.g. 2-16 micron) are obtained by varying the centrifuge speed and time. The total weight of clay extracted is determined by removing a 20ml aliquot of the final clay suspension and evaporating to dryness at 80°C. The initial and final weights of the beaker used are also recorded in the register.

The clay XRD mount is obtained by filtering the clay suspension through a Millipore glass microfibre filter and drying the filtrate on the filter paper. The samples are analysed as an untreated clay, after saturation with ethylene glycol vapour overnight and following heating at 380°C for 2 hours and 550°C for one hour. The initial scan for these four treatments is between 3° and 35° 2Θ (theta) at a step size of 0.05°/sec using x-ray radiation from a copper anode at 40kV, 30mA. The untreated sample is also analysed between 24-27° 2Θ at a step size of 0.02 °/2 sec to further define kaolinite/chlorite peaks.

Interpretation

Diffractograms from the four clay treatments are overlain to identify the clay mineral assemblages present and to assess the effect this treatment has had on this assemblage. Peak intensities are measured and incorporated in a formula to indicate the relative amounts of clay minerals present. This data is then used to quantify the clay minerals with respect to the whole rock by reference to the total amount of <2 micron clay fraction, which is calculated from the 20ml aliquot previously extracted and dried. An indication of the clay minerals crystallinity can be given by assessment of the peak width for each component. Where applicable the relative intensities of the chlorite 001 and 003 peaks can be used to measure the total heavy metal (predominantly Fe) content of the mineral.

Analysis results

The XRD analysis results are reproduced over page:

Whole Rock & Clay Fraction

X-ray Diffraction Analysis **Client: Petrolab**

Size Fraction : Whole Rock **Project: OP4477**

Weight % by mineral phase

Sample	Illite/ Smectite	Illite+Mica	Kaolinite	Chlorite	Quartz	K Feldspar	Plagioclase	Calcite	Dolomite	Siderite	Pyrite	Anatase	Total
10261	3.0	21.5	0.6	8.9	44.7	0.0	14.5	6.8	TR	0.0	0.0	0.0	100
10262	1.3	10.3	4.8	0.0	40.2	0.0	21.7	0.0	20.0	1.3	0.0	0.5	100
10257	0.0	0.0	0.0	23.0	35.3	10.3	27.8	2.3	0.0	0.0	1.3	0.0	100
19999	0.0	0.0	0.0	0.0	57.5	42.5	0.0	0.0	TR	0.0	0.0	0.0	100

Notes:
1) Quantification by Rietveld method (AutoQuan software)
2) Dolomite in sample 10262 is Fe-rich
3) Plagiocalse in sample 10257 is Andesine
4) K Feldspar in sample 19999 is Sanidine

X-ray Mineral Services Ltd

X-ray Diffraction Traces

Client: Petrolab

Key to laboratory numbering

No	Sample	Lab No
1	10261	232
2	10262	233
3	10257	234
4	19999	235

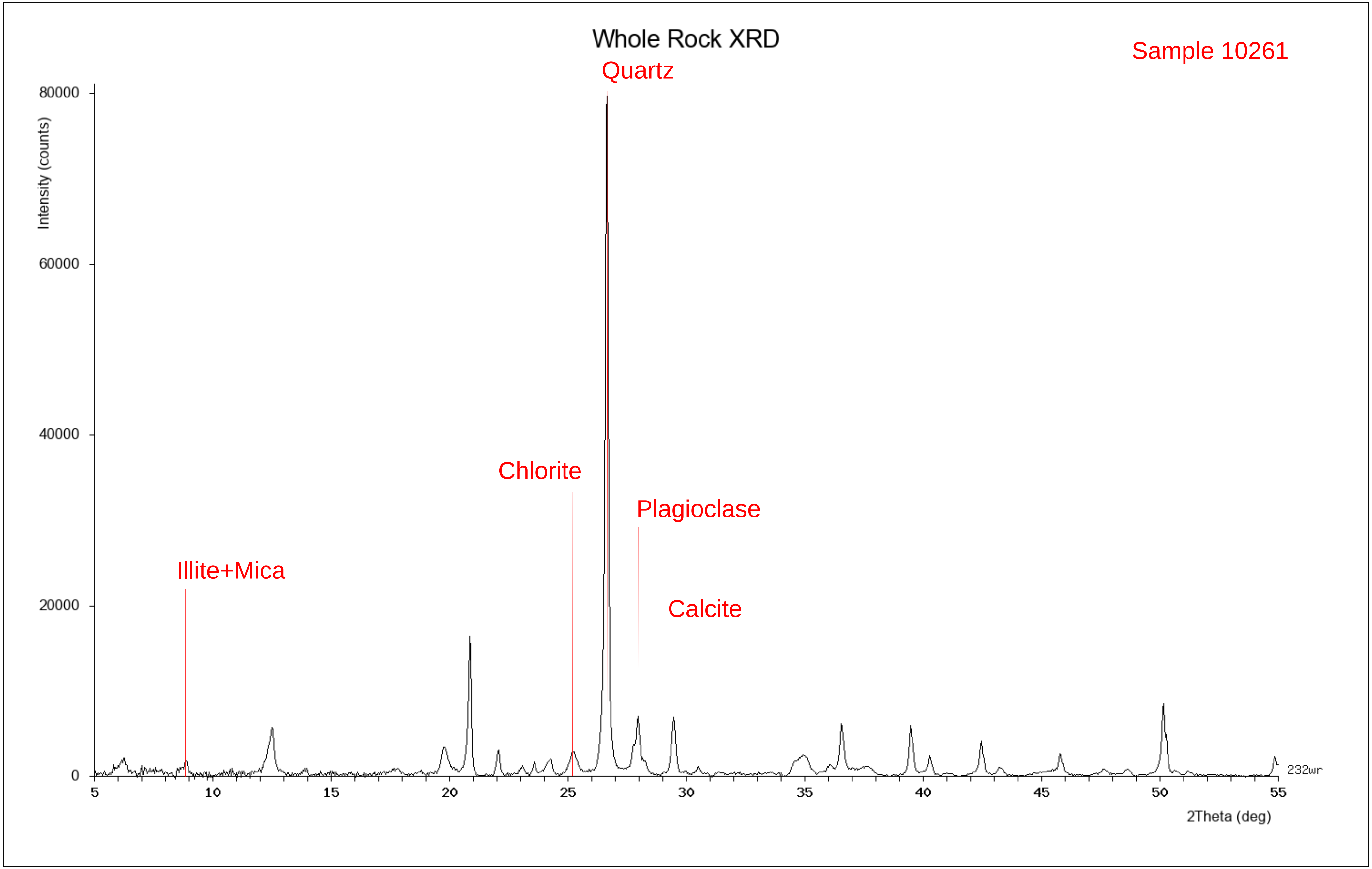
wr = Whole rock XRD
ut = Air-dried clay XRD

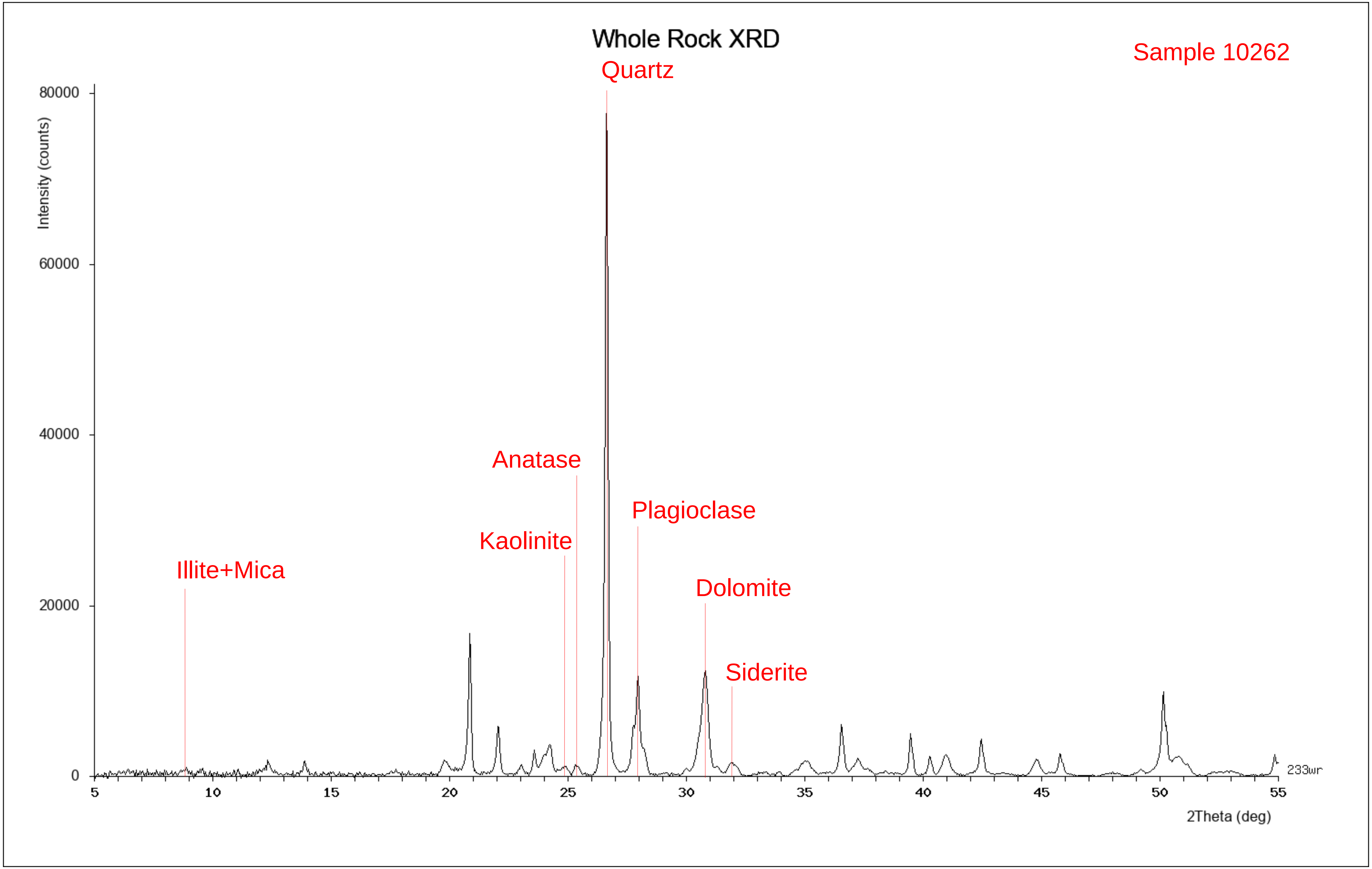
Calcite

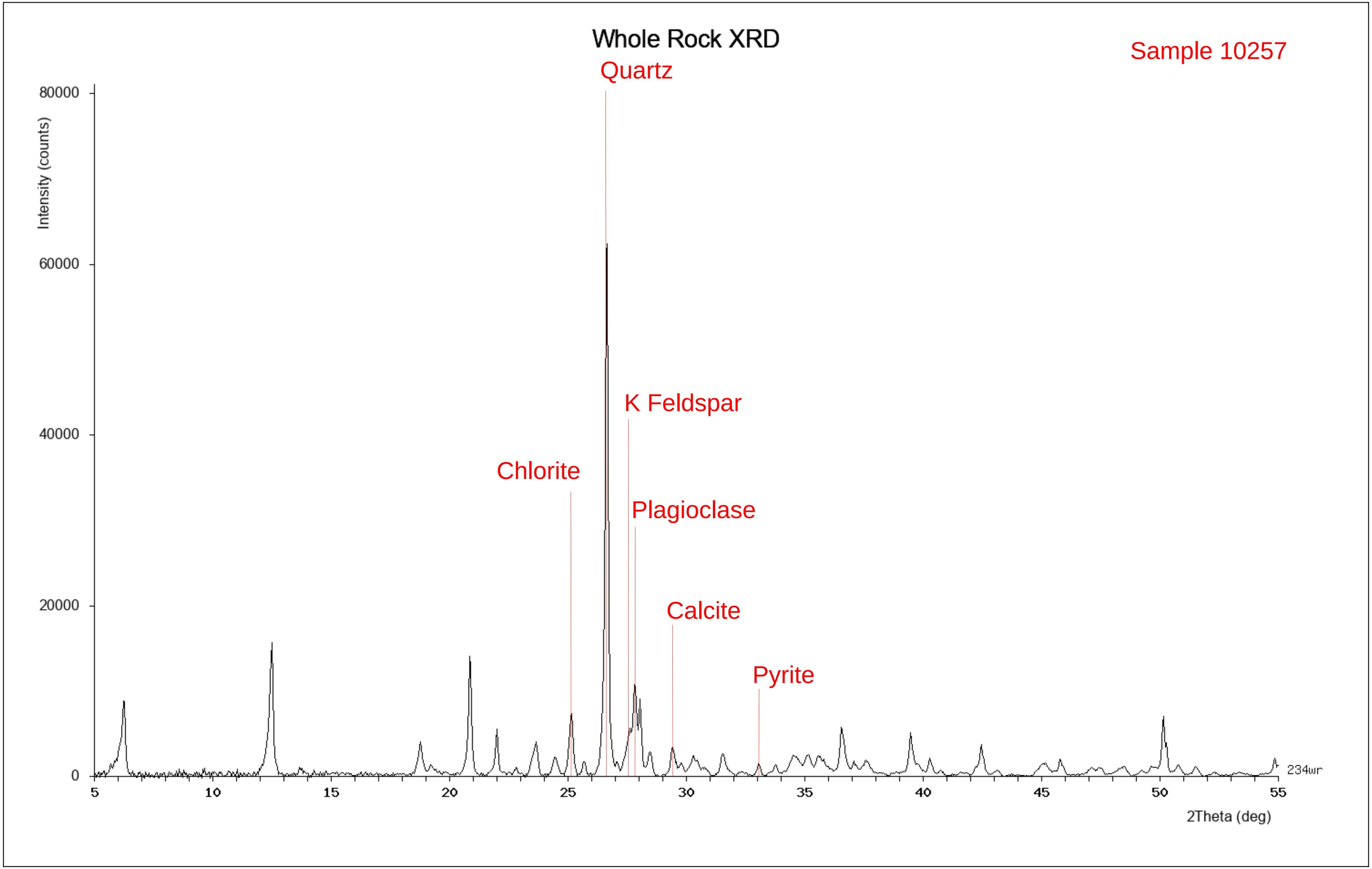
Only the main peak for interpretation is indicated in this style. Other peaks are ancillaries of the minerals listed

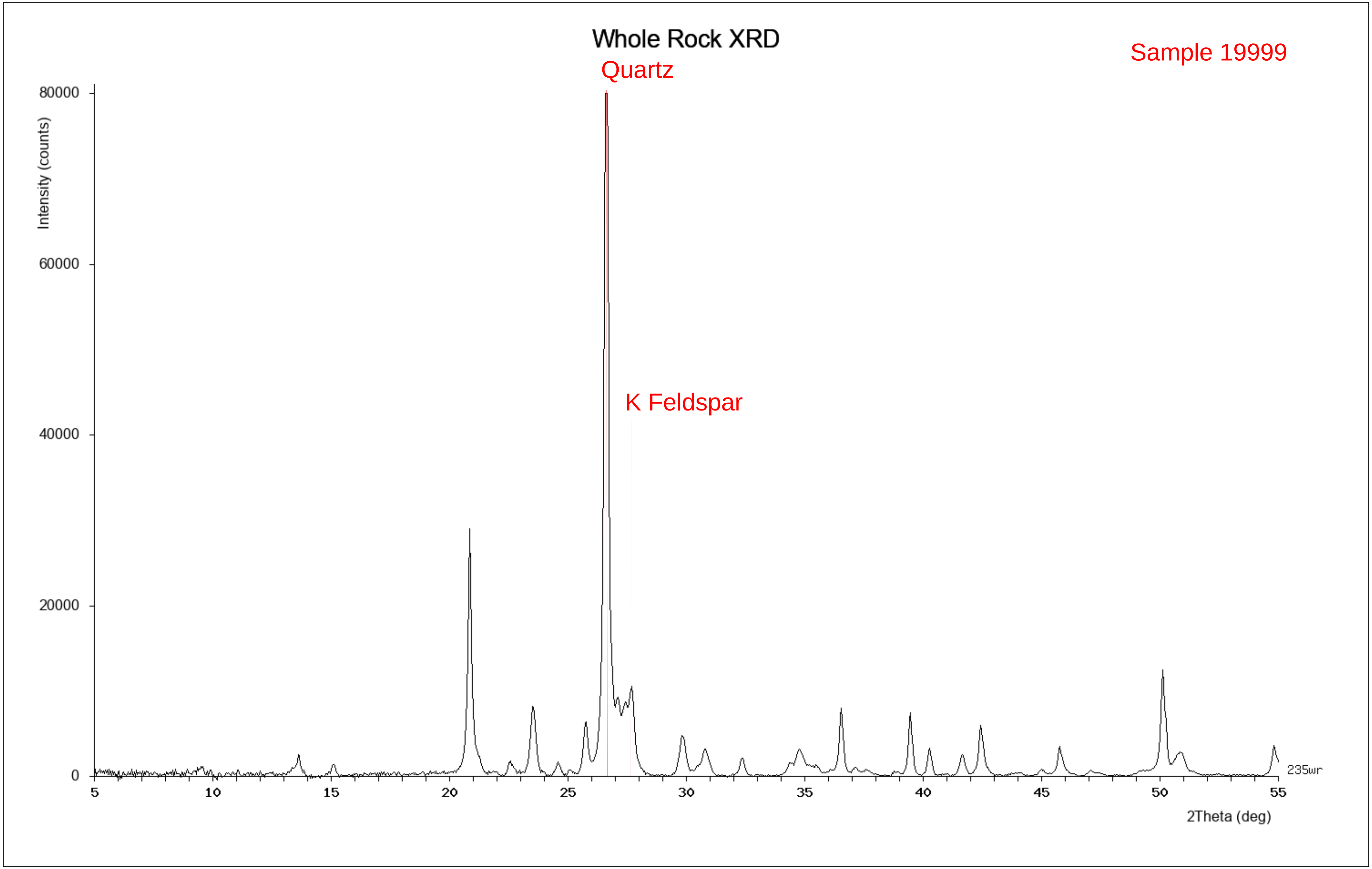
Illite/smectite

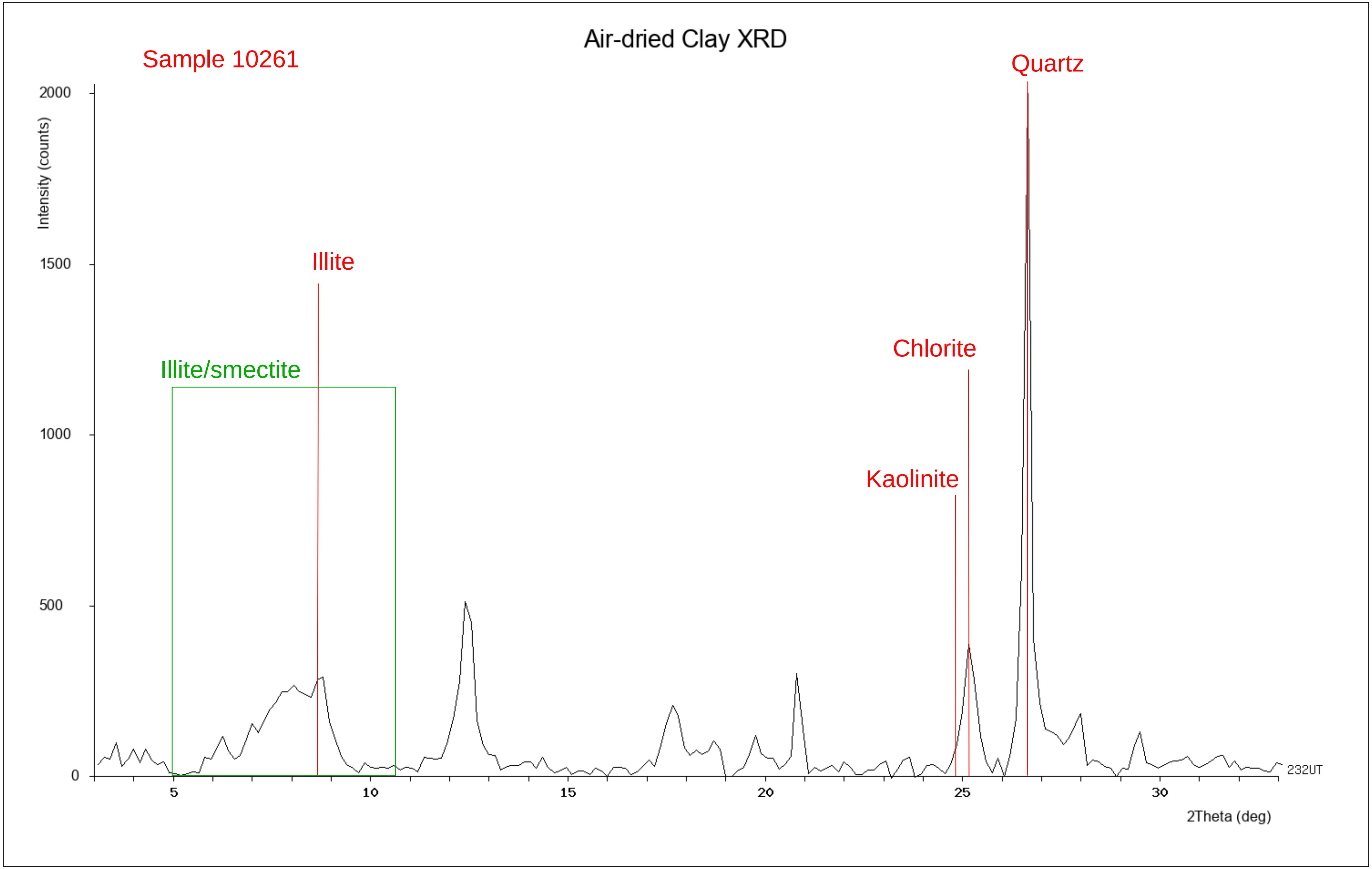
Mixed-layer clays are interpreted within the area indicated, but not based upon peak-height

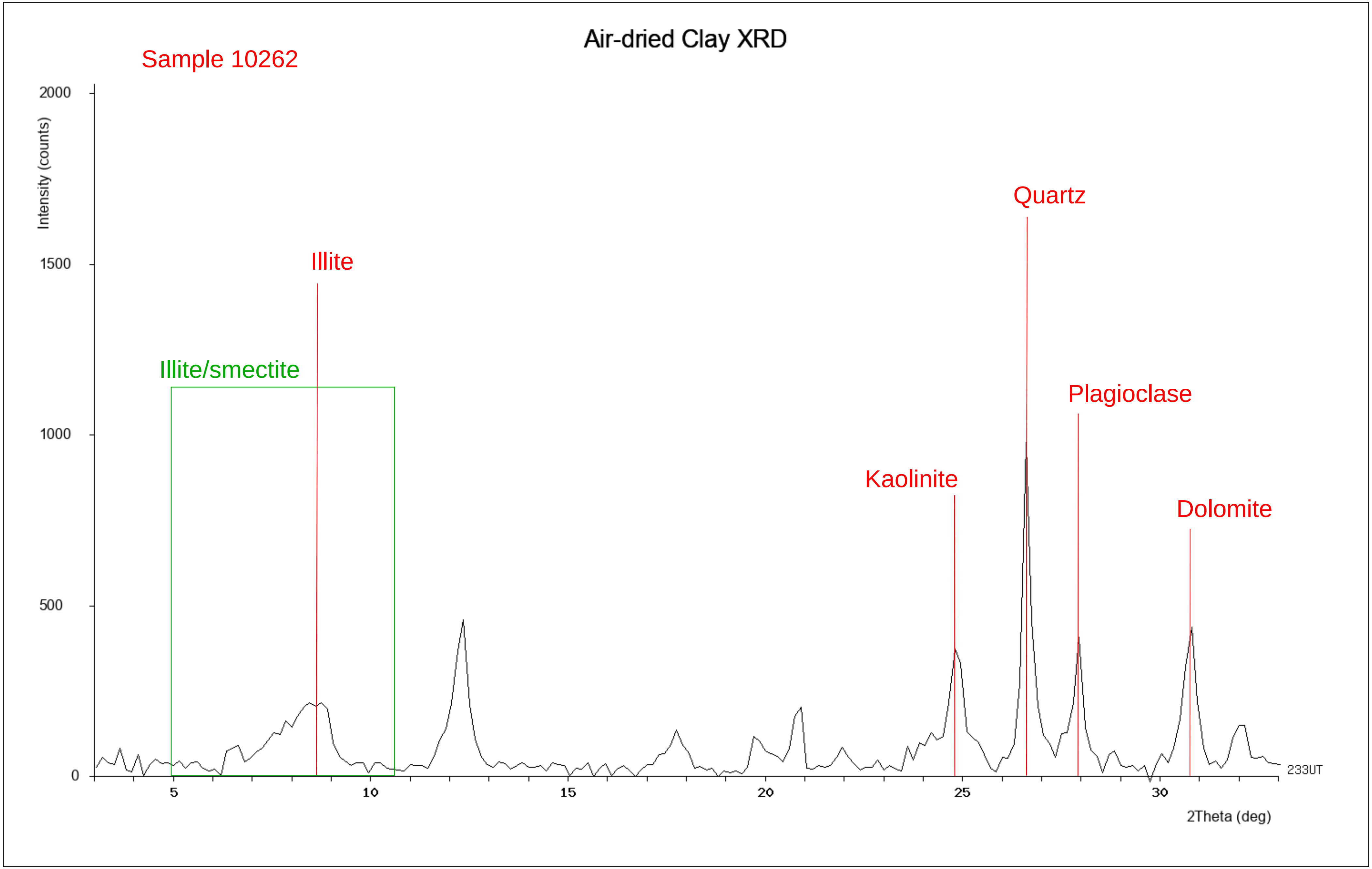

Whole Rock XRD
Sample 10261
Quartz
Chlorite
Plagioclase
Illite+Mica
Calcite
Intensity (counts)
80000
60000
40000
20000
0
5
10
15
20
25
30
35
40
45
50
55
2Theta (deg)
232wr

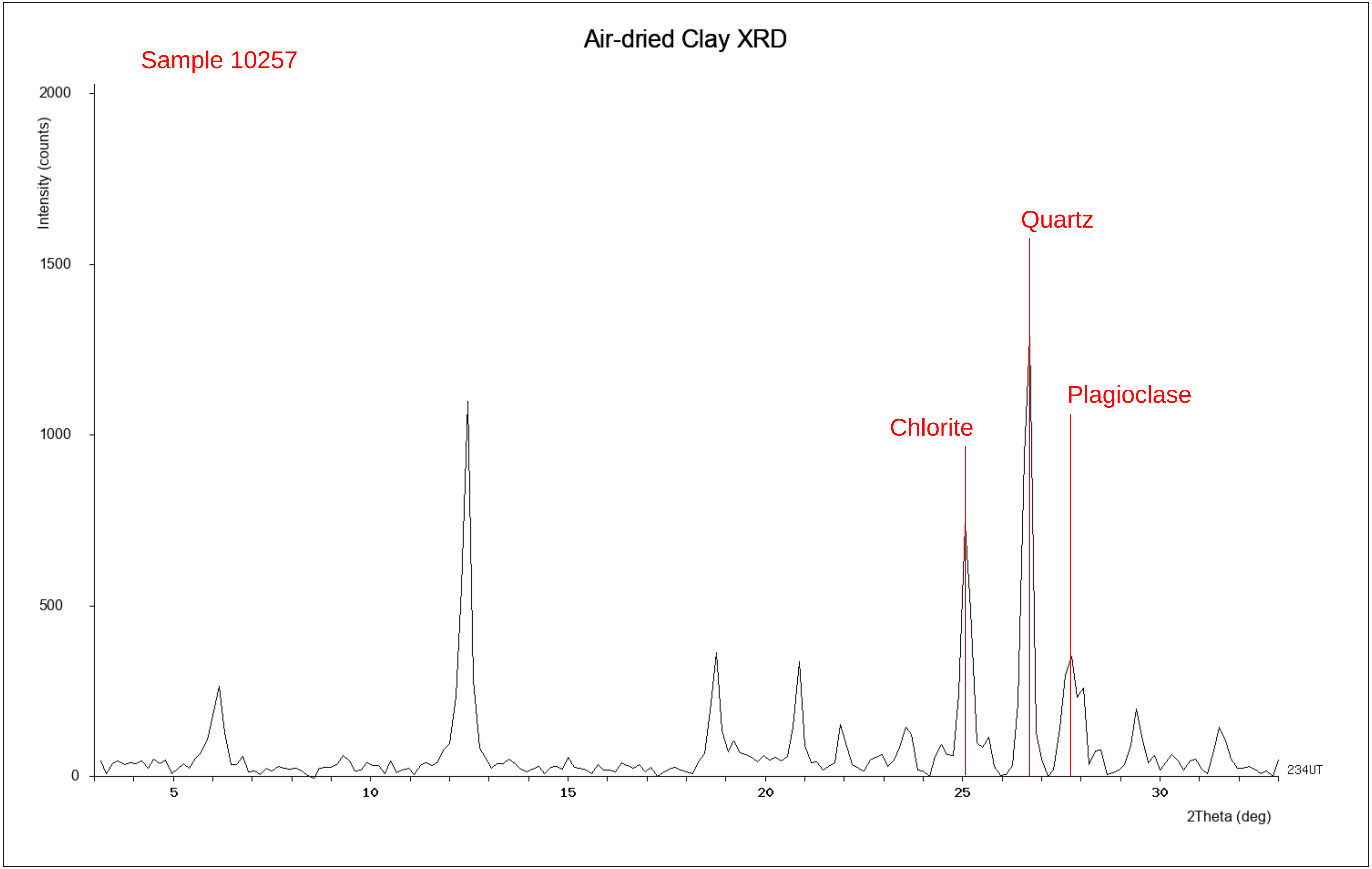

Whole Rock XRD
Sample 10262
Quartz
Anatase
Plagioclase
Kaolinite
Illite+Mica
Dolomite
Siderite
Intensity (counts)
80000
60000
40000
20000
0
5
10
15
20
25
30
35
40
45
50
55
2Theta (deg)
233wr


Whole Rock XRD
Sample 10257
Quartz
K Feldspar
Chlorite
Plagioclase
Calcite
Pyrite
Intensity (counts)
80000
60000
40000
20000
0
5
10
15
20
25
30
35
40
45
50
55
2Theta (deg)
234wr

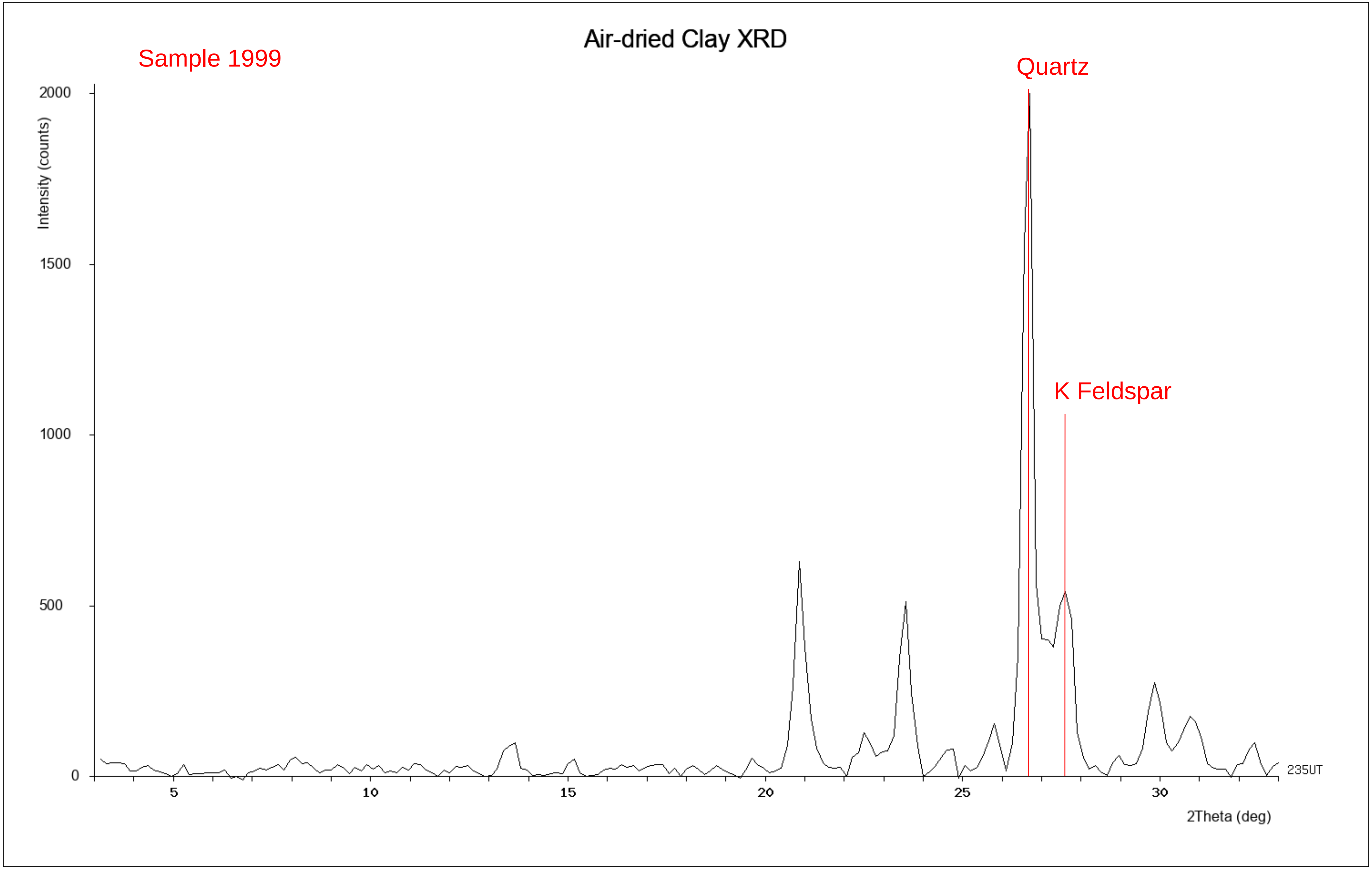

Whole Rock XRD
Sample 19999
Quartz
K Feldspar
Intensity (counts)
80000
60000
40000
20000
0
5
10
15
20
25
30
35
40
45
50
55
2Theta (deg)
235wr


Air-dried Clay XRD
Sample 10261
Quartz
Illite
Chlorite
Illite/smectite
Kaolinite
Intensity (counts)
2000
1500
1000
500
0
5
10
15
20
25
30
2Theta (deg)
232UT


Air-dried Clay XRD
Sample 10262
Intensity (counts)
2000
1500
1000
500
0
5
10
15
20
25
30
2Theta (deg)
233UT
Illite
Illite/smectite
Kaolinite
Quartz
Plagioclase
Dolomite



Air-dried Clay XRD
Sample 10257
Intensity (counts)
2000
1500
1000
500
0
5
10
15
20
25
30
2Theta (deg)
234UT
Quartz
Plagioclase
Chlorite


Air-dried Clay XRD
Sample 1999
Quartz
K Feldspar
Intensity (counts)
2000
1500
1000
500
0
5
10
15
20
25
30
2Theta (deg)
235UT

Appendix 2 · XRF analysis

XRF Method and interpretation

Whole (Bulk) Rock Analysis

The objective is to obtain a quantitative measurement of the elemental components of a sample.

Sample Preparation

Before we conduct any analysis we assess whether the samples need drying and pulverising etc. We carry this out by drying the samples at 105C until constant weight. If needed we pass the sample through a jaw crusher to reduce the particle size in order to separate out a representative sub sample (normally 100g). We then pulverise this sub sample to <53 micron using a TEMA mill.

X-Ray Fluorescence

The prepared sample was analysed using a panalytical Epsilon 3 XL. We prepare pressed powder pellets using aluminium cups in a Herzog Hydraulic press. These pellets are then placed in the instrument using a polypropylene film. The samples are then run on the Omnium program. This program uses internal references in order to evaluate semi quantitatively. The Omnium program also uses the entire range of power settings and tube filters to evaluate each sample comprehensively. The results are then balanced by the software to 100% depending on the selection of the element output (oxides, elemental etc). The XRF is unable to evaluate atomically light elements (elements lighter than Na) due to the nature of the technology and so if there are known components such as carbonates etc this has to be taken in to consideration.

Wheal Jane Services Ltd t/a Wheal Jane Laboratory
Wheal Jane Services Ltd, Old Mine Offices, Wheal Jane, Baldhu, Truro, Cornwall TR3 6EE**Telephone (01872) 560200, Direct Line (01872) 562023, Facsimile (01872) 562000**
E-mail crice@wheal-jane.co.uk

Test Report

WJL ID No: 126,123-126,125
Report No: 21050701c

Sample(s) Received: 26/04/21
Sample(s) Tested: 07/05/21
Tested By: CR LP JH
Test Procedure/Method(s): O1, O2, as requested

For the attention of:	**Name:**	J. Strongman
	Company:	**Petrolab**
	Address:	C Edwards Offices Redruth
	Subject:	OP4477

Sample	10261	10262	10257
%			
L.O.I 1hr @ 600°C	5.98	4.75	2.82
%			
S(tot)	0.15	0.04	0.84
%			
Al2O3	21.3	20.8	20.5
BaO	<0.1	<0.1	<0.1
CaO	4.0	4.5	5.7
Cr2O3	<0.1	<0.1	<0.1
Fe2O3	7.2	5.1	8.1
K2O	2.8	1.8	1.5
MgO	3.5	2.3	6.2
MnO	<0.1	<0.1	<0.1
Na2O	1.4	3.5	1.1
P2O5	<0.1	<0.1	0.2
SiO2	58.3	60.7	54.2
SO3	0.3	0.1	1.3
SrO	<0.1	<0.1	<0.1
TiO2	0.8	0.6	0.7

Signed		Authorised Signatories:	Signed by:	Checked by:
		Clifford Rice, Laboratory Director		
		Liam Palmer, Laboratory Manager	X	
		Rebecca Turner, Systems Administrator		
Dated	07/05/21	Fiona Dennis, Administrator		X

APPENDIX

D KBK GEOSERVICES TEST RESULTS

Job Number					GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00266	GTK.00266	GTK.00266	GTK.00268
Client ID					10254a	10252a	10255a	10256a	10253a	10251a	10263	10265	10259	10267
Scheme	AnalyteCode	AnalyteName	Unit	DL										
GT0220	CP12.5MMPCT	Cummulative passing 12.5mm%	%	0.01	24.13	20	21.5	27.37	21.62	23.29	29.77	31.84	23.59	21.36
GT0220	CP19.0MMPCT	Cummulative passing 19.0mm%	%	0.01	45.06	39.66	41.07	50.41	40.05	45.64	55.17	56.37	42.52	39.94
GT0220	CP25.0MMPCT	Cummulative passing 25.0mm%	%	0.01	77	72.73	75.67	77.26	69.83	76.17	83.22	88.84	74.49	86.86
GT0220	CP37.5MMPCT	Cummulative passing 37.5mm%	%	0.01	98.98	100	100	97.46	100	100	100	100	100	99.05
GT0220	CP4.75MMPCT	Cummulative passing 4.75mm%	%	0.01	9.57	8.44	8.8	7.27	8.24	9.2	13.16	12.98	9.44	7.96
GT0220	CP6.3MMPCT	Cummulative passing 6.3mm%	%	0.01	11.76	10.7	11.4	14.8	10.49	11.53	16.18	15.79	12.04	10.1
GT0220	CP9.5MMPCT	Cummulative passing 9.5mm%	%	0.01	16.95	14.96	15.89	20.18	14.88	16.74	22.75	22.76	17.5	14.71
GT0220	D10MM	Derived D10 mm	MM	0.01	5.1	5.8	5.5	5.4	6	5.3			5.1	6.2
GT0220	D50MM	Derived D50 mm	MM	0.01	20.1	21.3	21.9	18.9	21.4	20	17.8	17.4	20.7	20.7
GT0220	D80MM	Derived D80 mm	MM	0.01	27	28.6	27.5	27	29.5	27.3	24.8	23.8	28	24.3
GT0220	D90MM	Derived D90 mm	MM	0.01	32.4	33	32.4	32.9	33.5	32.3	30.1	26.6	32.7	27.9
GT0220	MI4.75MMPCT	Minus 4.75mm%	%	0.01	9.57	8.44	8.8	7.27	8.24	9.2	13.16	12.98	9.44	7.96
GT0220	PL12.5MMPCT	Plus12.5mm%	%	0.01	20.93	19.66	19.56	23.04	18.43	22.35	25.4	24.53	18.92	18.58
GT0220	PL19.0MMPCT	Plus19.0mm%	%	0.01	31.93	33.07	34.61	26.85	29.78	30.53	28.05	32.46	31.97	46.92
GT0220	PL25.0MMPCT	Plus 25.0mm%	%	0.01	21.99	27.27	24.33	20.2	30.17	23.83	16.78	11.16	25.51	12.19
GT0220	PL37.5MMPCT	Plus 37.5mm%	%	0.01	1.02	<0.01	<0.01	2.54	<0.01	<0.01	<0.01	<0.01	<0.01	0.95
GT0220	PL4.75MMPCT	Plus 4.75mm%	%	0.01	2.2	2.26	2.6	7.53	2.25	2.33	3.01	2.81	2.6	2.14
GT0220	PL6.3MMPCT	Plus 6.3mm%	%	0.01	5.18	4.26	4.49	5.38	4.4	5.21	6.57	6.97	5.46	4.61
GT0220	PL9.5MMPCT	Plus9.5mm%	%	0.01	7.18	5.03	5.61	7.19	6.73	6.55	7.02	9.09	6.1	6.66
GT0226	ABS	Absorption	%	0.01	2.51	2.01	2.92	2.81	3.03	2.89	2.51	2.33	1.85	1.98
GT0226	AD	Apparent Density	KG/M3	0.01	2678.42	2691.63	2681.08	2681.16	2678.21	2670.43	2716.53	2683.73	2717.4	2714.86
GT0226	BD	Bulk Density	KG/M3	0.01	2509.22	2552.85	2485.73	2493.09	2476.79	2478.89	2542.67	2525.56	2587.3	2575.8
GT0226	SSDD	Saturated Surface Dry Density	KG/M3	0.01	2572.23	2604.28	2558.41	2563.06	2551.81	2550.44	2606.51	2584.35	2635.06	2626.89
GT0233	LAA X100	Los Angeles Abrasion X100	%	0.01	5.6	5.02	5.4	8.59	5.8	7.12	7.6	5.89	4.88	6.45
GT0233	LAA X500	Los Angeles Abrasion X500	%	0.01	27.58	24.37	24.37	38.76	30.38	33.42	37.91	31.38	23.96	30.4
GT0237	EP	Elongated Particles %	%	0.01	2.87	2.95	0.5	1.86	6.35	1.57	2.35	0.89	4	4
GT0237	FEP	Flat and Elongated Particles %	%	0.01	7.4	5.74	3.08	6.57	8.73	3.33	3.95	4	6.44	5.87
GT0237	FP	Flat Particles %	%	0.01	4.53	2.8	2.57	4.7	2.39	1.76	1.6	3.11	2.44	1.88
GT0237	UUP	nflat and Unelongated Particles	%	0.01	92.6	94.26	96.92	93.43	93.43	96.67	96.05	96	93.56	94.13
LECO_S01	S_TOT	Total Sulfur	%	0.01	0.16	0.12	0.07	0.13	0.06	0.11	0.08	0.07	0.11	0.07
MIN_ICP_SO4	SO4	SO4	%	0.01	0.04	0.02	0.03	0.06	0.03	0.03	0.03	0.02	0.03	0.02
MLG_XRD_RP	AB	Albite	%	0.1	33.5	28.1	30.6	31.8	29.4	33.5	25.9	27.8	22.9	22.9
MLG_XRD_RP	ANDES_(NA,CA	Andesine	%	0.1										
MLG_XRD_RP	ANT	Anatase	%	0.1	0.6	0.5	0.6	0.7	0.5	0.2	0.2	0.6	0.2	0.2
MLG_XRD_RP	AUG	Augite	%	0.1										
MLG_XRD_RP	CAL	Calcite	%	0.1	4.1	4.8	5.1	6	5.9	5.7	2.5	7.5	1.5	0.5
MLG_XRD_RP	CHL	Chlorite	%	0.1	9.6	10.4	11.8	11.7	10.6	10.6		9		
MLG_XRD_RP	CRS	Cristobalite	%	0.1										
MLG_XRD_RP	DI	Diopside	%	0.1										
MLG_XRD_RP	DOL	Dolomite	%	0.1	0.6	0.8					9.4	1	11.7	11.3
MLG_XRD_RP	FE	Iron	%	0.1										
MLG_XRD_RP	FO	Forsterite	%	0.1										
MLG_XRD_RP	GBS	Gibbsite	%	0.1										
MLG_XRD_RP	GTH	Goethite	%	0.1										
MLG_XRD_RP	HUL	Heulandite	%	0.1										
MLG_XRD_RP	ILL_AL	Illite	%	0.1							16.1	15.2	16.3	15.8
MLG_XRD_RP	ILL_FE	Illite	%	0.1	9.7	13.4	11.5	11.1	13	9.6				
MLG_XRD_RP	KLN	Kaolinite	%	0.1							2.4		4.6	2.3
MLG_XRD_RP	MAG	Magnetite	%	0.1	0.5	0.7	0.6	0.6	0.7					
MLG_XRD_RP	MAY	Mayenite	%	0.1										
MLG_XRD_RP	MC	Microcline	%	0.1	6.1	8.1	5.7	6.3	4.3	7.1	2.3	2.9	2	2.1
MLG_XRD_RP	MGS	Magnesite	%	0.1										
MLG_XRD_RP	MNT	Montmorillonite	%	0.1	1.1	1.1	1.5	1.5	1.8	1.3				
MLG_XRD_RP	PY	Pyrite	%	0.1										
MLG_XRD_RP	QZ	Quartz	%	0.1	33.8	31.9	32.3	30	33.6	31.6	37.4	35.9	37	40.7
MLG_XRD_RP	RT	Rutile	%	0.1										
MLG_XRD_RP	SD	Siderite	%	0.1							3.8		3.8	4.1
MLG_XRD_RP	TR	Tremolite	%	0.1										
PREP_DRY105	DRY_WT	Dry Weight	G	1	10048	10835	10642	72458	9687	10747	15893	15796	13611	15662
PREP_DRY105	H2O%	H2O%	%	0.01	0.73	1.03	0.96	0.84	1.03	1.33	1.62	1.56	1.13	1.37
PREP_DRY105	WET_WT	Wet Weight	G	1	10125	10948	10744	73067	9783	10890	16150	16043	13765	15877
XRFFWR_XRF	AL2O3	Aluminium Oxide	%	0.01	11.83	12.35	12.16	11.87	11.85	11.65	11.84	12.14	12.04	11.54
XRFFWR_XRF	BAO	Barium Oxide	%	0.01	0.02	0.03	0.02	0.03	0.02	0.02	0.01	0.02	<0.01	<0.01
XRFFWR_XRF	CAO	Calcium Oxide	%	0.01	3.14	3.68	3.57	3.55	3.58	3.75	4.26	4.12	3.96	3.54
XRFFWR_XRF	CR2O3	Chromium (III) Oxide	%	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
XRFFWR_XRF	FE2O3	Iron (III) Oxide	%	0.01	4.72	5.33	5.42	4.8	5.19	4.67	5.17	4.92	5.13	4.9
XRFFWR_XRF	K2O	Potassium Oxide	%	0.01	1.71	2.24	1.74	1.75	1.68	1.71	1.5	1.52	1.34	1.41
XRFFWR_XRF	LOI	LOI @ 1000 DegC	%	0.01	3.49	4.39	4.34	4.19	4.78	4.49	8.54	4.81	8.92	8.14
XRFFWR_XRF	MGO	Magnesium Oxide	%	0.01	2.12	2.28	2.44	2.27	2.31	2	1.94	2.18	1.96	2.03
XRFFWR_XRF	MNO	Manganese Oxide	%	0.01	0.09	0.1	0.09	0.09	0.09	0.1	0.1	0.09	0.09	0.1
XRFFWR_XRF	NA2O	Sodium Oxide	%	0.01	3.54	3.11	3.38	3.44	3.32	3.49	2.07	2.38	1.96	2.77
XRFFWR_XRF	P2O5	Phosphorus Pentoxide	%	0.01	0.09	0.1	0.11	0.1	0.1	0.1	0.09	0.09	0.11	0.09
XRFFWR_XRF	SIO2	Silicon Dioxide	%	0.01	67.49	65.44	65.96	66.17	65.36	66.61	64.3	65.77	62.61	64.01
XRFFWR_XRF	SO3	Sulphur Trioxide	%	0.01	0.2	0.17	0.14	0.17	0.12	0.21	0.23	0.2	0.15	0.1
XRFFWR_XRF	SRO	Strontium Oxide	%	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
XRFFWR_XRF	SUM	Sum	%	0.01	99.02	99.83	100.01	99	99.01	99.34	100.69	98.88	98.93	99.24
XRFFWR_XRF	TIO2	Titanium Dioxide	%	0.01	0.57	0.6	0.63	0.57	0.61	0.55	0.63	0.62	0.64	0.59

APPENDIX

E JORC CONSENT FORM

SRK Consulting (Kazakhstan) Limited

77 Kunayev St., 14th Floor
Park View Office Tower
Almaty, Kazakhstan
050010

T: +7 (727) 3210101
E: info@srk.kz

www.srk.kz

Competent Person's Consent Form

Pursuant to the requirements of ASX Listing Rules 5.6, 5.22 and 5.24 and Clause 9 of the JORC Code 2012 Edition (Written Consent Statement)

Report name

"Maiden Mineral Resource Estimate for the Kaltara Batu Konstruksi Industrial Minerals Project, Kalimantan"

Please note, this Consent only applies to the Mineral Resource Estimate for K**altara Batu Konstruksi (KBK) Aggregate Deposit**, which was completed in 30 September 2021 and is considered to be 2012 JORC compliant and which prior to this announcement has not been disclosed to ASX.

Maiden Mineral Resource Estimate for the Kaltara Batu Konstruksi Industrial Minerals Project, Kalimantan ('Report')

PT Kaltara Batu Konstruksi

(Insert name of company releasing the Report)

KBK Aggregate Deposit

(Insert name of the deposit to which the Report refers)

30 September 2021

(Date of Report)

Statement

I/We,

Peter Gleeson of SRK Consulting (Kazakhstan) Limited, AIG membership number 3491

(Insert full name(s))

confirm that I am the Competent Person for the KBK MRE report of September 2021 and:

- I have read and understood the requirements of the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 Edition).
- I am a Competent Person as defined by the JORC Code, 2012 Edition, having twenty five years' experience that is relevant to the style of mineralisation and type of deposit described in the Report, and to the activity for which I am accepting responsibility.
- I am a Member or Fellow of *The Australasian Institute of Mining and Metallurgy* or the *Australian Institute of Geoscientists* or a 'Recognised Professional Organisation' (RPO) included in a list promulgated by ASX from time to time.
- I have reviewed the Report to which this Consent Statement applies.

I am a full-time employee of

SRK Consulting (Kazakhstan) Limited

SRK Consulting (Kazakhstan) Limited has been engaged by **PT Kaltara Batu Konstruksi** for this specific report and Mineral Resource Estimate

to confirm and provide a Competent Person sign-off for the KBK JORC Resource dated 30 September 2021 to be included in the Companies ANNOUNCEMENT "KBK Maiden Mineral Resource Estimate".

on which the Report is based, for the period ended

30th September 2021

I have disclosed to the reporting company the full nature of the relationship between myself and the company, including any issue that could be perceived by investors as a conflict of interest.

I verify that the Report on which my input has been sought is based on and fairly and accurately reflects in the form and context in which it appears, the information in my supporting documentation relating to Mineral Resources.

Consent

I consent to the release of the Report and this Consent Statement by the directors of:

PT Kaltara Batu Konstruksi

Signature of Competent Person:

31-10-2021

Date:

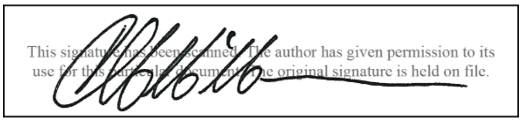
AIGS

Professional Membership:

(insert organisation name)

3491

Membership Number:



Signature of Witness:

Dean McMinn
(Cardiff Wales United Kingdom)

Print Witness Name and Residence:

(e.g. town/suburb)

APPENDIX

F KBK MASTER GEOLOGICAL DATABASE EXPORT FILES (U7285_KBK_DHDB.ACCDB) 9 JUNE 2021

Name	Date modified	Type	Size
EDD_KDD041_20210609.xlsb	09/06/2021 10:20	Microsoft Excel Bi...	320 KB
EDD_KDD040_20210609.xlsb	09/06/2021 10:19	Microsoft Excel Bi...	328 KB
EDD_KDD039_20210609.xlsb	09/06/2021 10:10	Microsoft Excel Bi...	318 KB
EDD_KDD038_20210609.xlsb	09/06/2021 10:08	Microsoft Excel Bi...	319 KB
EDD_KDD037_20210609.xlsb	09/06/2021 10:08	Microsoft Excel Bi...	317 KB
EDD_KDD036_20210609.xlsb	09/06/2021 10:06	Microsoft Excel Bi...	323 KB
EDD_KDD035_20210609.xlsb	09/06/2021 09:59	Microsoft Excel Bi...	311 KB
EDD_KDD034_20210608.xlsb	09/06/2021 17:48	Microsoft Excel Bi...	323 KB
EDD_KDD033_20210609.xlsb	09/06/2021 09:48	Microsoft Excel Bi...	320 KB
EDD_KDD032_20210609.xlsb	09/06/2021 09:46	Microsoft Excel Bi...	325 KB
EDD_KDD031_20210609.xlsb	09/06/2021 09:43	Microsoft Excel Bi...	319 KB
EDD_KDD030_20210609.xlsb	09/06/2021 09:42	Microsoft Excel Bi...	317 KB
EDD_KDD029_20210609.xlsb	09/06/2021 09:39	Microsoft Excel Bi...	325 KB
EDD_KDD028_20210609.xlsb	09/06/2021 09:40	Microsoft Excel Bi...	320 KB
EDD_KDD027_20210608.xlsb	09/06/2021 17:31	Microsoft Excel Bi...	323 KB
EDD_KDD026_20210608.xlsb	08/06/2021 17:42	Microsoft Excel Bi...	328 KB
EDD_KDD025_20210608.xlsb	08/06/2021 17:39	Microsoft Excel Bi...	317 KB
EDD_KDD024_20210608.xlsb	08/06/2021 17:38	Microsoft Excel Bi...	322 KB
EDD_KDD023_20210608.xlsb	08/06/2021 17:37	Microsoft Excel Bi...	326 KB
EDD_KDD022_20210608.xlsb	08/06/2021 17:36	Microsoft Excel Bi...	324 KB
EDD_KDD021_20210608.xlsb	08/06/2021 17:35	Microsoft Excel Bi...	318 KB
EDD_KDD020_20210608.xlsb	08/06/2021 17:35	Microsoft Excel Bi...	322 KB
EDD_KDD019_20210608.xlsb	08/06/2021 17:32	Microsoft Excel Bi...	329 KB
EDD_KDD018_20210608.xlsb	09/06/2021 16:59	Microsoft Excel Bi...	327 KB
EDD_KDD017_20210608.xlsb	09/06/2021 17:01	Microsoft Excel Bi...	325 KB
EDD_KDD016_20210608.xlsb	09/06/2021 16:58	Microsoft Excel Bi...	525 KB
EDD_KDD015_20210608.xlsb	09/06/2021 16:53	Microsoft Excel Bi...	319 KB
EDD_KDD014_20210608.xlsb	09/06/2021 16:50	Microsoft Excel Bi...	316 KB
EDD_KDD013_20210608.xlsb	09/06/2021 16:49	Microsoft Excel Bi...	663 KB
EDD_KDD012_20210428.xlsb	08/06/2021 15:59	Microsoft Excel Bi...	328 KB
EDD_KDD011_20210608.xlsb	08/06/2021 15:49	Microsoft Excel Bi...	354 KB
EDD_KDD010_20210608.xlsb	09/06/2021 16:34	Microsoft Excel Bi...	342 KB
EDD_KDD009_20210608.xlsb	08/06/2021 13:34	Microsoft Excel Bi...	350 KB
EDD_KDD008_20210608.xlsb	09/06/2021 16:25	Microsoft Excel Bi...	611 KB
EDD_KDD007_20210608.xlsb	08/06/2021 13:28	Microsoft Excel Bi...	412 KB
EDD_KDD006_20210608.xlsb	08/06/2021 13:24	Microsoft Excel Bi...	398 KB
EDD_KDD005_20210608.xlsb	08/06/2021 13:12	Microsoft Excel Bi...	400 KB
EDD_KDD004_20210608.xlsb	08/06/2021 13:14	Microsoft Excel Bi...	343 KB
EDD_KDD003_20210608.xlsb	09/06/2021 16:01	Microsoft Excel Bi...	405 KB
EDD_KDD002R_20210608.xlsb	09/06/2021 14:07	Microsoft Excel Bi...	339 KB
EDD_KDD001_20210608.xlsb	09/06/2021 14:03	Microsoft Excel Bi...	338 KB

APPENDIX

G KBK_GEOSERVICES_GEOCHEM_GEOTECHNICAL REPORT 2017-2021.PDF

Geotechnical Report

for

PT. Kaltara Batu Konstruksi

Samples received 2017 - 2021

PT. GEOSERVICES – GEOTECHNICAL LABORATORY

Jl Industri Selatan 2, Blok MM1, Jababeka 2, Cikarang Bekasi 17520, Indonesia

SUMMARY OF RESULTS 2017 - 2021

From 2017 to October 2021 PT. Geoservices carried out a defined Geotechnical testwork program on 13 samples originating from PT. Kaltara Batu Konstruksi projects.

Individual job submissions summary results are provided in Paragraph 4 with individual job worksheets provided in Appendix B

The key findings arising from the testwork program on all received samples are summarized in the following tables.

Geotechnical Testwork

GT0130 - ASTM 7263-09 – Rock Physical Properties

Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	KBK_Peakindo_1
GT0130	ASTM D7263-09	A	Saturated Water Content- Absorption (A)	%	0	3.71
GT0130	ASTM D7263-09	E	Void Ratio (n)	NOUNIT	0	0.1
GT0130	ASTM D7263-09	N	Porosity (n)	%	0	9.05
GT0130	ASTM D7263-09	PD	Dry Density (pd)	NOUNIT	0.01	2.44
GT0130	ASTM D7263-09	PN	Natural Density (pn)	NOUNIT	0.01	2.47
GT0130	ASTM D7263-09	PS	Saturated Density (ps)	NOUNIT	0.01	2.53
GT0130	ASTM D7263-09	S	Saturated Degree (S)	%	0	29.29
GT0130	ASTM D7263-09	SGAPP	Apparent Specific Gravity (S.Gapp)	NOUNIT	0.01	2.44
GT0130	ASTM D7263-09	SGTR	True Specific Gravity (S.Gtr)	NOUNIT	0.01	2.68
GT0130	ASTM D7263-09	W	Natural Water Content (W)	%	0	1.09

Table 1 – ASTM 7263-09 - Rock Physical Properties

GT0133 – ASTM D7012C-10 – Unconfined Compressive Strength

				JOB NUMBER		GTK.00100A
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	KBK_Peakindo_1
GT0133	ASTM D7012C-10	E AXIAL	E Axial	KG/CM3	0	44273.18
GT0133	ASTM D7012C-10	UCS	Compressive Strength	KG/CM3	0	314.44

Table 2 – ASTM D7102C – Unconfined Compressive Strength

GT0220 – ASTM C136-06 – Sieve Analysis of Fine and Coarse Aggregates

				JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a
GT0220	ASTM C136-06	D10MM	Derived D10 mm	MM	0.01	5.1	5.8	5.5	5.4	6	5.3
GT0220	ASTM C136-06	D50MM	Derived D50 mm	MM	0.01	20.1	21.3	21.9	18.9	21.4	20
GT0220	ASTM C136-06	D80MM	Derived D80 mm	MM	0.01	27	28.6	27.5	27	29.5	27.3
GT0220	ASTM C136-06	D90MM	Derived D90 mm	MM	0.01	32.4	33	32.4	32.9	33.5	32.3

				JOB NUMBER		GTK.00266	GTK.00266	GTK.00266	GTK.00268	GTK.00275	GTK.00275
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10263 KDD	10265 KDD	10259 KDD	10267	10269	10270
GT0220	ASTM C136-06	D10MM	Derived D10 mm	MM	0.01			5.1	6.2		6.1
GT0220	ASTM C136-06	D50MM	Derived D50 mm	MM	0.01	17.8	17.4	20.7	20.7	19.6	24.2
GT0220	ASTM C136-06	D80MM	Derived D80 mm	MM	0.01	24.8	23.8	28	24.3	31.7	34.6
GT0220	ASTM C136-06	D90MM	Derived D90 mm	MM	0.01	30.1	26.6	32.7	27.9	36	38.6

Table 3 – ASTM C136-06 – Sieve Analysis of Fine and Coarse Aggregates.

GT0226 – ASTM C127-12 – Density, Relative Density and Absorption of Coarse Aggregate.

				JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10254a**	**10252a**	**10255a**	**10256a**	**10253a**	**10251a**
GT0226	ASTM C127-12	ABS	Absorption	%	0.01	2.51	2.01	2.92	2.81	3.03	2.89
GT0226	ASTM C127-12	ABS	Absorption	KG/M3	0.01						
GT0226	ASTM C127-12	AD	Apparent Density	KG/M3	0.01	2678.42	2691.63	2681.08	2681.16	2678.21	2670.43
GT0226	ASTM C127-12	BD	Bulk Density	KG/M3	0.01	2509.22	2552.85	2485.73	2493.09	2476.79	2478.89
GT0226	ASTM C127-12	SSDD	Saturated Surface Dry Density	KG/M3	0.01	2572.23	2604.28	2558.41	2563.06	2551.81	2550.44

				JOB NUMBER		GTK.00266	GTK.00266	GTK.00266	GTK.00268	GTK.00275	GTK.00275
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10263 KDD**	**10265 KDD**	**10259 KDD**	**10267**	**10269**	**10270**
GT0226	ASTM C127-12	ABS	Absorption	%	0.01	2.51	2.33	1.85	1.98		
GT0226	ASTM C127-12	ABS	Absorption	KG/M3	0.01					15.58	7.58
GT0226	ASTM C127-12	AD	Apparent Density	KG/M3	0.01	2716.53	2683.73	2717.4	2714.86	2189.97	2702.78
GT0226	ASTM C127-12	BD	Bulk Density	KG/M3	0.01	2542.67	2525.56	2587.3	2575.8	1631.84	2242.45
GT0226	ASTM C127-12	SSDD	Saturated Surface Dry Density	KG/M3	0.01	2606.51	2584.35	2635.06	2626.89	1886.06	2412.34

Table 4 – ASTM C127-12 - Density, Relative Density and Absorption of Coarse Aggregate

GT0231 – ASTM C566 – Water Content Total Evaporable

				JOB NUMBER		GTK.00275	GTK.00275
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10269**	**10270**
GT0231	ASTM C566-13	DRY_WT	Dry Weight	G	0.1	16685	22291
GT0231	ASTM C566-13	H20%	H20%	%	0.01	2.08	1.83
GT0231	ASTM C566-13	WET_WT	Wet_wt	G	0.1	17040	22706

Table 5 – ASTM C566 - Water Content Total Evaporable

GT0233 – ASTM C131-06 – Los Angeles Abrasion

				JOB NUMBER		GTK.00100A	GTK.00100A	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**KBK_Peakindo_1 _-19.0+12.5mm**	**KBK_Peakindo_1 _-12.5+9.5mm**	**10254a**	**10252a**	**10255a**	**10256a**	**10253a**	**10251a**
GT0233	ASTM C131-06	LAA X100	Los Angeles Abrasion X100	%	0.01	12.33	11.32	5.6	5.02	5.4	8.59	5.8	7.12
GT0233	ASTM C131-06	LAA X500	Los Angeles Abrasion X500	%	0.01	62.24	53.36	27.58	24.37	24.37	38.76	30.38	33.42

				JOB NUMBER		GTK.00266A	GTK.00266A	GTK.00266A	GTK.00268A	GTK.00275A	GTK.00275A
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10263 KDD 026_-**	**10265 KDD 022_-**	**10259 KDD 034_-**	**10267 KDD032_-**	**10269_- 37.5+9.5m**	**10270_- 37.5+9.5m**
GT0233	ASTM C131-06	LAA X100	Los Angeles Abrasion X100	%	0.01	7.6	5.89	4.88	6.45	15.06	10.08
GT0233	ASTM C131-06	LAA X500	Los Angeles Abrasion X500	%	0.01	37.91	31.38	23.96	30.4	53.7	40.58

Table 6 – ASTM C131-06 – Los Angeles Abrasion

GT0237 – ASTM D4791 – Flat and Elongated Particles in Coarse Aggregate

				JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	**Reference Method**	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10254a**	**10252a**	**10255a**	**10256a**	**10253a**
GT0237	ASTM D4791	EP	Elongated Particles %	%	0.01	2.87	2.95	0.5	1.86	6.35
GT0237	ASTM D4791	FEP	Flat and Elongated Particles %	%	0.01	7.4	5.74	3.08	6.57	8.73
GT0237	ASTM D4791	FP	Flat Particles %	%	0.01	4.53	2.8	2.57	4.7	2.39
GT0237	ASTM D4791	UUP	Unflat and Unelongated Particles %	%	0.01	92.6	94.26	96.92	93.43	93.43

				JOB NUMBER		GTK.00262	GTK.00266	GTK.00266	GTK.00266	GTK.00268
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10251a	10263 KDD 026	10265 KDD 022	10259 KDD 034	10267 KDD032
GT0237	ASTM D4791	EP	Elongated Particles %	%	0.01	1.57	2.35	0.89	4	4
GT0237	ASTM D4791	FEP	Flat and Elongated Particles %	%	0.01	3.33	3.95	4	6.44	5.87
GT0237	ASTM D4791	FP	Flat Particles %	%	0.01	1.76	1.6	3.11	2.44	1.88
GT0237	ASTM D4791	UUP	Unflat and Unelongated Particles %	%	0.01	96.67	96.05	96	93.56	94.13

Table 7 - ASTM D4791 – Flat and Elongated Particles in Coarse Aggregate

GT0238A/B – BS812-1 – Determination of Particle Shape

				JOB NUMBER		GTK.00275	GTK.00275
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10269	10270
GT0238A	BS812-1	EI	Elongation Index	%	0.01	33.71	35.96
GT0238B	BS812-1	FI	Flakiness Index	%	0.01	27.32	34.46

Table 8 – BS812-1 – Determination of Particle Shape

Chemical Analysis

The key chemical analysis results from the aggregate samples are summarized in the following tables:

LECO_SO1 / MIN_ICP_SO4

				JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a
LECO_S01		S_TOT	Total Sulfur	%	0.01	0.16	0.12	0.07	0.13	0.06	0.11
MIN_ICP_SO4		SO4	SO4	%	0.01	0.04	0.02	0.03	0.06	0.03	0.03

				JOB NUMBER		GTK.00266	GTK.00266	GTK.00266	GTK.00268	GTK.00275	GTK.00275
Scheme	Reference Method	AnalyteCode	AnalyteName	Unit	DL	10263 KDD 026	10265 KDD 022	10259 KDD 034	10267 KDD032	10269	10270
LECO_S01		S_TOT	Total Sulfur	%	0.01	0.08	0.07	0.11	0.07	0.04	0.12
MIN_ICP_SO4		SO4	SO4	%	0.01	0.03	0.02	0.03	0.02	0.04	0.01

Table 9 –LECO_SO1 / MIN_ICP_SO4

XRFFWR – XRF Fusion Whole Rock Elements

			JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a
XRFFWR_XRF	AL2O3	Aluminium Oxide	%	0.01	11.83	12.35	12.16	11.87	11.85	11.65
XRFFWR_XRF	BAO	Barium Oxide	%	0.01	0.02	0.03	0.02	0.03	0.02	0.02
XRFFWR_XRF	CAO	Calcium Oxide	%	0.01	3.14	3.68	3.57	3.55	3.58	3.75
XRFFWR_XRF	CR2O3	Chromium (III) Oxide	%	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
XRFFWR_XRF	FE2O3	Iron (III) Oxide	%	0.01	4.72	5.33	5.42	4.80	5.19	4.67
XRFFWR_XRF	K2O	Potassium Oxide	%	0.01	1.71	2.24	1.74	1.75	1.68	1.71
XRFFWR_XRF	LOI	LOI @ 1000 DegC	%	0.01	3.49	4.39	4.34	4.19	4.78	4.49
XRFFWR_XRF	MGO	Magnesium Oxide	%	0.01	2.12	2.28	2.44	2.27	2.31	2.00
XRFFWR_XRF	MNO	Manganese Oxide	%	0.01	0.09	0.10	0.09	0.09	0.09	0.10
XRFFWR_XRF	NA2O	Sodium Oxide	%	0.01	3.54	3.11	3.38	3.44	3.32	3.49
XRFFWR_XRF	P2O5	Phosphorus Pentoxide	%	0.01	0.09	0.10	0.11	0.10	0.10	0.10
XRFFWR_XRF	SIO2	Silicon Dioxide	%	0.01	67.49	65.44	65.96	66.17	65.36	66.61
XRFFWR_XRF	SO3	Sulphur Trioxide	%	0.01	0.20	0.17	0.14	0.17	0.12	0.21
XRFFWR_XRF	SRO	Strontium Oxide	%	0.01	0.02	0.03	0.02	0.02	0.02	0.02
XRFFWR_XRF	SUM	Sum of Major Oxides + LOI	%	0.01	99.02	99.83	100.01	99.00	99.01	99.34
XRFFWR_XRF	TIO2	Titanium Dioxide	%	0.01	0.57	0.60	0.63	0.57	0.61	0.55

			JOB NUMBER		GTK.00266	GTK.00266	GTK.00266	GTK.00268	GTK.00275	GTK.00275
Scheme	AnalyteCode	AnalyteName	Unit	DL	10263 KDD 026	10265 KDD 022	10259 KDD 034	10267 KDD032	10269	10270
XRFFWR_XRF	AL2O3	Aluminium Oxide	%	0.01	11.84	12.14	12.04	11.54	14.80	14.28
XRFFWR_XRF	BAO	Barium Oxide	%	0.01	0.01	0.02	<0.01	<0.01	0.02	0.02
XRFFWR_XRF	CAO	Calcium Oxide	%	0.01	4.26	4.12	3.96	3.54	3.23	3.88
XRFFWR_XRF	CR2O3	Chromium (III) Oxide	%	0.01	<0.01	<0.01	<0.01	<0.01	0.24	0.19
XRFFWR_XRF	FE2O3	Iron (III) Oxide	%	0.01	5.17	4.92	5.13	4.90	6.26	6.07
XRFFWR_XRF	K2O	Potassium Oxide	%	0.01	1.50	1.52	1.34	1.41	2.42	2.45
XRFFWR_XRF	LOI	LOI @ 1000 DegC	%	0.01	8.54	4.81	8.92	8.14	12.65	11.64
XRFFWR_XRF	MGO	Magnesium Oxide	%	0.01	1.94	2.18	1.96	2.03	2.71	2.73
XRFFWR_XRF	MNO	Manganese Oxide	%	0.01	0.10	0.09	0.09	0.10	0.10	0.11
XRFFWR_XRF	NA2O	Sodium Oxide	%	0.01	2.07	2.38	1.96	2.77	1.70	1.33
XRFFWR_XRF	P2O5	Phosphorus Pentoxide	%	0.01	0.09	0.09	0.11	0.09	0.16	0.16
XRFFWR_XRF	SIO2	Silicon Dioxide	%	0.01	64.30	65.77	62.61	64.01	54.78	55.96
XRFFWR_XRF	SO3	Sulphur Trioxide	%	0.01	0.23	0.20	0.15	0.10	0.63	0.52
XRFFWR_XRF	SRO	Strontium Oxide	%	0.01	0.02	0.02	0.03	0.03	0.04	0.03
XRFFWR_XRF	SUM	Sum of Major Oxides + LOI	%	0.01	100.69	98.88	98.93	99.24	100.44	100.03
XRFFWR_XRF	TIO2	Titanium Dioxide	%	0.01	0.63	0.62	0.64	0.59	0.70	0.69

Table 10 – XRF Fusion Whole Rock Chemical Analysis

XRD Mineralogy

Scheme	AnalyteCode	AnalyteName	Unit	DL	GTK.00262 10254a	GTK.00262 10252a	GTK.00262 10255a	GTK.00262 10256a	GTK.00262 10253a	GTK.00262 10251a
			JOB NUMBER							
MLG_XRD_RPT	AB	Albite	%	0.1	33.5	28.1	30.6	31.8	29.4	33.5
MLG_XRD_RPT	ANT	Anatase	%	0.1	0.6	0.5	0.6	0.7	0.5	0.2
MLG_XRD_RPT	CAL	Calcite	%	0.1	4.1	4.8	5.1	6	5.9	5.7
MLG_XRD_RPT	CHL	Chlorite	%	0.1	9.6	10.4	11.8	11.7	10.6	10.6
MLG_XRD_RPT	DOL	Dolomite	%	0.1	0.6	0.8				
MLG_XRD_RPT	DSN	Dawsonite	%	0.1						
MLG_XRD_RPT	ILL_AL	Illite	%	0.1						
MLG_XRD_RPT	ILL_FE	Illite	%	0.1	9.7	13.4	11.5	11.1	13	9.6
MLG_XRD_RPT	KLN	Kaolinite	%	0.1						
MLG_XRD_RPT	MAG	Magnetite	%	0.1	0.5	0.7	0.6	0.6	0.7	
MLG_XRD_RPT	MC	Microcline	%	0.1	6.1	8.1	5.7	6.3	4.3	7.1
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1	1.1	1.1	1.5	1.5	1.8	1.3
MLG_XRD_RPT	MS	Muscovite	%	0.1						
MLG_XRD_RPT	PLG	Palygorskite	%	0.1						
MLG_XRD_RPT	PY	Pyrite	%	0.1						
MLG_XRD_RPT	QZ	Quartz	%	0.1	33.8	31.9	32.3	30	33.6	31.6
MLG_XRD_RPT	SD	Siderite	%	0.1						

Scheme	AnalyteCode	AnalyteName	Unit	DL	GTK.00266 10263 KDD 026	GTK.00266 10265 KDD 022	GTK.00266 10259 KDD 034	GTK.00268 10267 KDD032	GTK.00275 10269	GTK.00275 10270
			JOB NUMBER							
MLG_XRD_RPT	AB	Albite	%	0.1	25.9	27.8	22.9	22.9	3.7	6.8
MLG_XRD_RPT	ANT	Anatase	%	0.1	0.2	0.6	0.2	0.2		
MLG_XRD_RPT	CAL	Calcite	%	0.1	2.5	7.5	1.5	0.5		
MLG_XRD_RPT	CHL	Chlorite	%	0.1		9				
MLG_XRD_RPT	DOL	Dolomite	%	0.1	9.4	1	11.7	11.3	10.8	13.1
MLG_XRD_RPT	DSN	Dawsonite	%	0.1					7.1	2.1
MLG_XRD_RPT	ILL_AL	Illite	%	0.1	16.1	15.2	16.3	15.8		
MLG_XRD_RPT	ILL_FE	Illite	%	0.1					23.3	23.8
MLG_XRD_RPT	KLN	Kaolinite	%	0.1	2.4		4.6	2.3	3.6	3.4
MLG_XRD_RPT	MAG	Magnetite	%	0.1						
MLG_XRD_RPT	MC	Microcline	%	0.1	2.3	2.9	2	2.1	4.5	4.6
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1						
MLG_XRD_RPT	MS	Muscovite	%	0.1					7.6	7.8
MLG_XRD_RPT	PLG	Palygorskite	%	0.1					1.3	2.1
MLG_XRD_RPT	PY	Pyrite	%	0.1					0.5	0.4
MLG_XRD_RPT	QZ	Quartz	%	0.1	37.4	35.9	37	40.7	32.1	30.6
MLG_XRD_RPT	SD	Siderite	%	0.1	3.8		3.8	4.1	5.7	5.4

Table 11 – XRD Mineralogy Results

DISCLAIMER

This report has been prepared for the Client by PT. Geoservices Geotechnical Laboratory Division. Other parties, at the discretion of the Client may be given access to the report or receive copies of the report, but only in full including this page, the title page, and appendices.

PT. Geoservices Ltd has performed the Services reported herein based on the information provided by the Client to PT. Geoservices Ltd and PT. Geoservices Ltd understanding of the Client's requirements.

PT. Geoservices Ltd is not responsible for any loss or damage arising out of any inaccurate, incomplete, or misleading information that the Client gives to PT. Geoservices Ltd or any misunderstanding of the Client's requirements by PT. Geoservices Ltd.

PT. Geoservices Ltd is not responsible for any loss or damage arising out of the performance or non-performance in connection with the Services by any third party that PT. Geoservices Ltd engages to assist it in performing the Services.

PT. Geoservices Ltd has performed the Services and prepared this Report based only upon the sample material that the Client provided to PT. Geoservices Ltd.

PT. Geoservices was not involved in:

1. The drilling, collection, or transportation of the samples: and
2. The handling of the samples prior to their delivery to Geoservices

PT. Geoservices Ltd Laboratories, nor its agents or subcontractors shall be liable for any loss, deterioration, or destruction of, or damage to, any of the client's samples or property, but at all times the samples or property shall be at the risk of the client, who shall indemnify the Laboratory and its agents or subcontractors against any action, claim, suit or demand arising from any loss, deterioration, destruction or damage.

Samples considered to be radioactive will be returned to the client or sent to a regulated third party for disposal at client's expense. Geoservices is not licensed for long term storage of radioactive material.

The results presented in this report pertain only to the sample(s) as received.

TABLE OF CONTENTS

List of Tables

List of Photos

List of Worksheets

1 INTRODUCTION

The objective of this testing program was to provide Geotechnical testwork data on PT. Kaltara Batu Konstruksi submitted samples.

A total of 13 samples were received at Cikarang Laboratory from 2017 until October 2021

The test program provided on the samples included testwork provision as follows:

- Sample Preparation
- Geotechnical Testwork
- Chemical Testwork
- XRD Mineralogy

Testwork method summaries are provided in paragraph 3 with paragraph 4 containing the summary results of the individual testwork methods provided. Sample photos and worksheets and other information relating to the test program are provided in the appendices.

Testwork results were communicated to the client when available to enable the testwork program to progress on a fully informed basis.

This report summarizes key results from the test program, using data summaries and graphical displays.

Wayne Turner
Mineral Division

2 SAMPLE INFORMATION

A total of 13 samples were submitted for testwork during the period 2017 to October 2021 as per following table:

Job Number	Sample Identification
GTK.00100A	KBK_Peakindo_1
GTK.00262	10254a
GTK.00262	10252a
GTK.00262	10255a
GTK.00262	10256a
GTK.00262	10253a
GTK.00262	10251a
GTK.00266	10263 KDD 026
GTK.00266	10265 KDD 022
GTK.00266	10259 KDD 034
GTK.00268	10267 KDD032
GTK.00275	10269
GTK.00275	10270

Table 12 – Sample Identification

3 TEST WORK METHOD SUMMARIES

The following method summaries were applied to the client samples for the project period 2017-2021

3.1 Testwork 1 - Geotechnical

3.1.1 GT0231 - ASTM C566 Water Content Total Evaporable

This test method covers the determination of the percentage of evaporable moisture in a sample of aggregate by drying both surface moisture and moisture in the pores of the aggregate. Some aggregate may contain water that is chemically combined with the minerals in the aggregate. Such water is not evaporable and is not included in the percentage determined by this test method.

3.1.2 GT0220 - ASTM C136 Sieve Analysis of Fine and Coarse Aggregates

This test method covers the determination of the particle size distribution of fine and coarse aggregates by sieving. Some specifications for aggregates which reference this test method contain grading requirements including both coarse and fine fractions. Instructions are included for sieve analysis of such aggregates.

3.1.3 GT0226 - ASTM C127 Density, Relative Density and Absorption of Coarse Aggregate

This test method covers the determination of the average density of a quantity of coarse aggregate particles (not including the volume of voids between the particles), the relative density (specific gravity), and the absorption of the fine aggregate. Depending on the procedure used, the density (kg/m3(lb/ft3)) is expressed as oven-dry (OD), saturated surface-dry (SSD), or as apparent density. Likewise, relative density (specific gravity), a dimensionless quantity, is expressed as OD, SSD, or as apparent relative density (apparent specific gravity). The OD density and OD relative density are determined after drying the aggregate. The SSD density, SSD relative density, and absorption are determined after soaking the aggregate in water for a prescribed duration.

3.1.4 GT0238A - BS 812: Part 105.2 : 1990 Methods for Determination of Particle Shape – Elongation Index of Coarse Aggregates

Aggregate particles are classified as elongated when they have a length (greatest dimension) of more than 1.8 of their mean test sieve size, this size being taken as the mean of the limiting sieve apertures used for determining the size fraction in which the particles occur. The elongation index is determined by separating the elongated particles and expressing their mass as a percentage of the mass of sample tested. The test is inapplicable to material passing a 6.3 mm test sieve or retained on a 50 mm test sieve.

3.1.5 GT0238B - BS 812: Part 105.1: 1989 - GT0238A Methods for Determination of Particle Shape – Flakiness Index

Aggregate particles are classified as flaky when they have a thickness (smallest dimension) of less than 0.6 of their mean sieve size, this size being taken as the mean of the limiting sieve apertures used for determining the size fraction in which the particle occurs. The flakiness index of an aggregate sample is found by separating the flaky particles and expressing their mass as a percentage of the mass of the sample tested. The test is not applicable to material passing a 6.30 mm BS test sieve or retained on a 63.0 mm BS test sieve.

3.1.6 GT0233 - ASTM C131-06 - Los Angeles Abrasion

This test method covers a procedure for testing sizes of coarse aggregate smaller than 37.5 mm (11⁄2 in.) for resistance to degradation using the Los Angeles testing machine. The method measures degradation of aggregates resulting from a combination of abrasion, attrition, impact and grinding in rotating steel drum.

3.1.7 GT0237; GT0238 - ASTM D 4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

Aggregate particles are classified as flaky when they have a thickness (smallest dimension) of less than 0.6 of their mean test sieve size, this size being taken as the mean of the limiting sieve apertures used for determining the size fraction in which the particles occur. The flakiness index of an aggregate sample is determined by separating the flaky particles and expressing their mass as a percentage of the mass of the sample tested. The test is inapplicable to material passing a 6.3 mm test sieve or retained on a 63 mm test sieve.
Aggregate particles are classified as elongated when they have a length (greatest dimension) of more than 1.8 of their mean test sieve size, this size being taken as the mean of the limiting sieve apertures used for determining the size fraction in which the particles occur. The elongation index is determined by separating the elongated particles and expressing their mass as a percentage of the mass of sample tested. The test is inapplicable to material passing a 6.3 mm test sieve or retained on a 50 mm test sieve.

3.1.8 GT0133 - ASTM D 7012-C-10 - Unconfined Compressive Strength

This test method covers the determination of the strength of intact rock core specimens in uniaxial compression and confined compression. Methods in this standard as follows: Method C (D2938) A rock core sample is cut to length and the ends are machined flat. The specimen is placed in a loading frame and, if required, heated to the desired test temperature. Axial load is continuously increased on the specimen until peak load and failure are obtained.

3.1.9 GT0130 - ASTM 7263-09 – Rock Physical Properties

Rock physical properties determined by test the rock samples with dessicator and vacuum pump for 24 hours, and then weigh the specimens, to get density, specific gravity, porosity, and other physical properties.

3.2 Testwork 2 - Chemical Analysis

3.2.1 XRFFWR – Whole Rock Analyte Determination

A calcined or ignited sample is added to Lithium Borate Flux, mixed well and fused between 1050 - 1100°C. A flat molten glass disc is prepared from the resulting melt. The fused-glass disk specimen is irradiated by a high-energy X-ray beam. Concentrations of the elements are determined by relating the measured radiation of unknown specimens to analytical curves prepared from reference materials of known composition.

XRFFWR Whole Rock XRF 14 Element Suite - Al_2O_3, BaO, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, SO_3, SrO, TiO_2 + LOI

3.2.2 LECO_SO1 – Total Sulfur Determination

The sample is analysed for Total Sulfur using a combustion furnace. The sample (0.01 to 0.1 g) is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is calculated.

3.2.3 MET_SO4 _HCL - Sulfate Sulfur

A prepared sample (0.2 to 1.0 g) is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid insoluble materials are removed by filtration. The filtrate is read by ICPOES for %S (of the HCl-leachable sulfate) in the original sample and calculated as SO4 content. Note may be little or no dissolution of $BaSO_4$ and $SrSO_4$ minerals.

3.3 Testwork 3 - Mineralogy – XRD

The XRD technique is non-destructive that involves placing a powdered sample in a holder, then illuminate with x-rays of a fixed wave-length. X-ray diffraction relies on the dual wave/particle nature of X-rays to obtain information about the structure of crystalline materials. Qualitative analysis is performed using Reitveld Correction with Bruker Diffrac Suite Search/Match software with the ICDD PDF-4 database.

4.0 INDIVIDUAL JOB SUMMARIES

4.1 Job Number GTK.00100

Testwork Parameter	Unit	Sample ID
		KBK_Peakindo_1
Physical Properties		
Natural Density (ρn)		2.47
Saturated Density (ρs)		2.53
Dry Density (ρd)		2.44
Apparent Specific Gravity (S.Gapp)		2.44
True Specific Gravity (S.Gtr)		2.68
Natural Water Content (W)	%	1.09
Saturated Water Content - Absorption, (A)	%	3.71
Saturated Degree (S)	%	29.29
Porosity (n)	%	9.05
Void Ratio (e)		0.10
Unconfined Compression Strength		
Compressive Strength (σ)	kg/cm^3	314.44
E Axial	kg/cm^3	44273.18
LA Abrasion		
-19.0+12.5 mm		
Abrasion after 100 rotation	%Loss	12.33
Abrasion after 500 rotation	%Loss	62.24
-12.5+9.5 mm		
Abrasion after 100 rotation	%Loss	11.32
Abrasion after 500 rotation	%Loss	53.36
Soundness		NA
Sieving Analysis		NA
Note: NA - The test was cancel due the limitation of the sample received		

Table 13 – Job GTK.00100 – Result Summary Table

4.2 Job number GTK.00262

4.2.1 Geotechnical Results

Sample ID:	10254a	10252a	10255a	10256a	10253a	10251a	
GEOTECHNICAL TESTWORK							**Unit**
Water Content Total Evaporable							
Water Content	0.73	1.03	0.96	0.84	1.03	1.33	%
Sieve Analysis of Fine and Coarse Aggregates (Gradation)							
D10	5.05	5.81	5.46	5.39	5.96	5.27	mm
D50	20.04	21.10	20.76	18.89	21.20	19.95	mm
D80	26.59	28.23	27.11	26.57	29.15	26.89	mm
D90	32.16	32.79	32.17	32.63	33.29	32.05	mm
Flakiness & Elongation Test							
Unflat & Unelongated Particles	92.60	94.26	96.92	93.43	91.27	96.67	%
Flat & Elongated Particles	7.40	5.74	3.08	6.57	8.73	3.33	%
Density, Relative Density and Absorption of Fine Aggregate							
Bulk Density	2509.22	2552.85	2485.73	2493.09	2476.79	2478.89	kg/m^3
Absorption	2.51	2.01	2.92	2.81	3.03	2.89	%
Los Angeles Abrasion							
-37.5+9.5 mm x 100 Rotation	5.60	5.02	5.40	8.59	5.80	7.12	%
-37.5+9.5 mm x 500 Rotation	27.58	24.37	28.35	38.76	30.38	33.42	%

Table 14 - Job GTK.00262 – Geotechnical Result Summary Table

4.2.2 Chemical Analysis

No	Sample ID	X Ray Fluorescence - Whole Rock - Major Element -	Total Sulphur	Sulphate Sulphur
1	10254a	SiO2	0.16	0.04
2	10252a	SiO2	0.12	0.02
3	10255a	SiO2	0.07	0.03
4	10256a	SiO2	0.13	0.06
5	10253a	SiO2	0.06	0.03
6	10251a	SiO2	0.11	0.03
Unit			%	%

Table 15 - Job GTK.00262 – Chemical Analysis Result Summary Table

4.2.3 XRD Mineralogy

			JOB NUMBER		GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262	GTK.00262
Scheme	AnalyteCode	AnalyteName	Unit	DL	10254a	10252a	10255a	10256a	10253a	10251a
MLG_XRD_RPT	**AB**	**Albite**	**%**	**0.1**	33.5	28.1	30.6	31.8	29.4	33.5
MLG_XRD_RPT	**ANT**	**Anatase**	**%**	**0.1**	0.6	0.5	0.6	0.7	0.5	0.2
MLG_XRD_RPT	**CAL**	**Calcite**	**%**	**0.1**	4.1	4.8	5.1	6	5.9	5.7
MLG_XRD_RPT	**CHL**	**Chlorite**	**%**	**0.1**	9.6	10.4	11.8	11.7	10.6	10.6
MLG_XRD_RPT	**DOL**	**Dolomite**	**%**	**0.1**	0.6	0.8				
MLG_XRD_RPT	**DSN**	**Dawsonite**	**%**	**0.1**						
MLG_XRD_RPT	**ILL_AL**	**Illite**	**%**	**0.1**						
MLG_XRD_RPT	**ILL_FE**	**Illite**	**%**	**0.1**	9.7	13.4	11.5	11.1	13	9.6
MLG_XRD_RPT	**KLN**	**Kaolinite**	**%**	**0.1**						
MLG_XRD_RPT	**MAG**	**Magnetite**	**%**	**0.1**	0.5	0.7	0.6	0.6	0.7	
MLG_XRD_RPT	**MC**	**Microcline**	**%**	**0.1**	6.1	8.1	5.7	6.3	4.3	7.1
MLG_XRD_RPT	**MNT**	**Montmorillonite**	**%**	**0.1**	1.1	1.1	1.5	1.5	1.8	1.3
MLG_XRD_RPT	**MS**	**Muscovite**	**%**	**0.1**						
MLG_XRD_RPT	**PLG**	**Palygorskite**	**%**	**0.1**						
MLG_XRD_RPT	**PY**	**Pyrite**	**%**	**0.1**						
MLG_XRD_RPT	**QZ**	**Quartz**	**%**	**0.1**	33.8	31.9	32.3	30	33.6	31.6
MLG_XRD_RPT	**SD**	**Siderite**	**%**	**0.1**						

Table 16 - Job GTK.00262 – XRD Mineralogy Result Summary Table

4.3 Job Number GTK.00266

4.3.1 Geotechnical Results

Sample ID:		10263 KDD 026	10265 KDD 022	10259 KDD 034	
GEOTECHNICAL TESTWORK					Unit
Water Content Total Evaporable					
Water Content		1.62	1.56	1.13	%
Sieve Analysis of Fine and Coarse Aggregates (Gradation)					
D10		-	-	5.08	mm
D50		17.77	17.40	20.69	mm
D80		24.79	23.83	28.00	mm
D90		30.06	26.60	32.67	mm
Flakiness & Elongation Test					
Unflat & Unelongated Particles		96.68	97.40	94.05	%
Flat & Elongated Particles		3.32	2.60	5.95	%
Density, Relative Density and Absorption of Fine Aggregate					
Bulk Density		2542.67	2525.56	2587.30	kg/m^3
Absorption		2.51	2.33	1.85	%
Los Angeles Abrasion					
-37.5+9.5 mm	x 100 Rotation	7.60	5.89	4.88	%
	x 500 Rotation	37.91	31.38	23.96	%

Table 17 – Job GTK.00266 – Geotechnical Result Summary Table

4.3.2 Chemical Analysis

No	Sample ID	X Ray Fluorescence - Whole Rock - Major Element -	Total Sulphur	Sulphate Sulphur
1	10263 KDD 026	SiO_2	0.08	0.03
2	10265 KDD 022	SiO_2	0.07	0.02
15	10259 KDD 034	SiO_2	0.11	0.03
Unit			%	%

Table 18 - Job GTK.00266 – Chemical Analysis Result Summary Table

4.3.3 XRD Mineralogy

			JOB NUMBER		GTK.00266	GTK.00266	GTK.00266
Scheme	**AnalyteCode**	**AnalyteName**	**Unit**	**DL**	**10263 KDD 026**	**10265 KDD 022**	**10259 KDD 034**
MLG_XRD_RPT	AB	Albite	%	0.1	25.9	27.8	22.9
MLG_XRD_RPT	ANT	Anatase	%	0.1	0.2	0.6	0.2
MLG_XRD_RPT	CAL	Calcite	%	0.1	2.5	7.5	1.5
MLG_XRD_RPT	CHL	Chlorite	%	0.1		9	
MLG_XRD_RPT	DOL	Dolomite	%	0.1	9.4	1	11.7
MLG_XRD_RPT	DSN	Dawsonite	%	0.1			
MLG_XRD_RPT	ILL_AL	Illite	%	0.1	16.1	15.2	16.3
MLG_XRD_RPT	ILL_FE	Illite	%	0.1			
MLG_XRD_RPT	KLN	Kaolinite	%	0.1	2.4		4.6
MLG_XRD_RPT	MAG	Magnetite	%	0.1			
MLG_XRD_RPT	MC	Microcline	%	0.1	2.3	2.9	2
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1			
MLG_XRD_RPT	MS	Muscovite	%	0.1			
MLG_XRD_RPT	PLG	Palygorskite	%	0.1			
MLG_XRD_RPT	PY	Pyrite	%	0.1			
MLG_XRD_RPT	QZ	Quartz	%	0.1	37.4	35.9	37
MLG_XRD_RPT	SD	Siderite	%	0.1	3.8		3.8

Table 19 - Job GTK.00266 – XRD Mineralogy Result Summary Table

4.4 Job Number GTK.00268

4.4.1 Geotechnical Results

Sample ID:		10267 KDD032	
GEOTECHNICAL TESTWORK			**Unit**
Water Content Total Evaporable			
Water Content		**1.37**	%
Sieve Analysis of Fine and Coarse Aggregates (Gradation)			
D10		**6.23**	mm
D50		**20.57**	mm
D80		**24.28**	mm
D90		**27.89**	mm
Flakiness & Elongation Test			
Unflat & Unelongated Particles		**94.13**	%
Flat & Elongated Particles		**5.87**	%
Density, Relative Density and Absorption of Fine Aggregate			
Bulk Density		**2575.80**	kg/m^3
Absorption		**1.98**	%
Los Angeles Abrasion			
-37.5+9.5 mm	x 100 Rotation	**6.45**	%
	x 500 Rotation	**30.40**	%

Table 20 – Job GTK.00268 – Geotechnical Result Summary Table

4.4.2 Chemical Analysis Results

No	Sample ID	X Ray Fluorescence - Whole Rock - Major Element -	Total Sulphur	Sulphate Sulphur
1	10267 KDD032	SiO_2	0.07	0.02
Unit			%	%

Table 21 – Job GTK.00268 – Chemical Analysis Result Summary Table.

4.4.3 XRD Mineralogy

			JOB NUMBER		GTK.00268
Scheme	AnalyteCode	AnalyteName	Unit	DL	10267 KDD032
MLG_XRD_RPT	AB	Albite	%	0.1	22.9
MLG_XRD_RPT	ANT	Anatase	%	0.1	0.2
MLG_XRD_RPT	CAL	Calcite	%	0.1	0.5
MLG_XRD_RPT	CHL	Chlorite	%	0.1	
MLG_XRD_RPT	DOL	Dolomite	%	0.1	11.3
MLG_XRD_RPT	DSN	Dawsonite	%	0.1	
MLG_XRD_RPT	ILL_AL	Illite	%	0.1	15.8
MLG_XRD_RPT	ILL_FE	Illite	%	0.1	
MLG_XRD_RPT	KLN	Kaolinite	%	0.1	2.3
MLG_XRD_RPT	MAG	Magnetite	%	0.1	
MLG_XRD_RPT	MC	Microcline	%	0.1	2.1
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1	
MLG_XRD_RPT	MS	Muscovite	%	0.1	
MLG_XRD_RPT	PLG	Palygorskite	%	0.1	
MLG_XRD_RPT	PY	Pyrite	%	0.1	
MLG_XRD_RPT	QZ	Quartz	%	0.1	40.7
MLG_XRD_RPT	SD	Siderite	%	0.1	4.1

Table 22 - Job GTK.00268 – XRD Mineralogy Result Summary Table

4.5 Job Number GTK.00275

4.5.1 Geotechnical Results

Sample ID:		10269	10270	
GEOTECHNICAL TESTWORK				**Unit**
Water Content Total Evaporable				
Water Content		2.12	1.87	%
Sieve Analysis of Fine and Coarse Aggregates (Gradation)				
D10		--	6.10	mm
D50		19.60	24.20	mm
D80		31.73	34.59	mm
D90		35.97	38.60	mm
Density, Relative Density and Absorption of Fine Aggregate				
Bulk Density		1631.84	2242.45	kg/m^3
Absorption		15.58	7.58	%
Flakiness & Elongation Index				
Flakiness Index		27.32	34.46	%
Elongation Index		33.71	35.96	%
Los Angeles Abrasion				
-37.5+9.5 mm	x 100 Rotation	15.06	10.08	%
	x 500 Rotation	53.70	40.58	%

Table 23 – Job GTK.00275 – Geotechnical Result Summary

4.5.2 Chemical Assay Results

No	Sample ID	X Ray Fluorescence - Whole Rock - Major Element -	Total Sulphur	Sulphate Sulphur
1	10269	SiO_2	0.04	0.04
2	10270	SiO_2	0.12	0.01
Unit			%	%

Table 24 – Job GTK.00275 – Chemical Analysis Result Summary

4.5.3 XRD Mineralogy

			JOB NUMBER		GTK.00275	GTK.00275
Scheme	AnalyteCode	AnalyteName	Unit	DL	10269	10270
MLG_XRD_RPT	AB	Albite	%	0.1	3.7	6.8
MLG_XRD_RPT	ANT	Anatase	%	0.1		
MLG_XRD_RPT	CAL	Calcite	%	0.1		
MLG_XRD_RPT	CHL	Chlorite	%	0.1		
MLG_XRD_RPT	DOL	Dolomite	%	0.1	10.8	13.1
MLG_XRD_RPT	DSN	Dawsonite	%	0.1	7.1	2.1
MLG_XRD_RPT	ILL_AL	Illite	%	0.1		
MLG_XRD_RPT	ILL_FE	Illite	%	0.1	23.3	23.8
MLG_XRD_RPT	KLN	Kaolinite	%	0.1	3.6	3.4
MLG_XRD_RPT	MAG	Magnetite	%	0.1		
MLG_XRD_RPT	MC	Microcline	%	0.1	4.5	4.6
MLG_XRD_RPT	MNT	Montmorillonite	%	0.1		
MLG_XRD_RPT	MS	Muscovite	%	0.1	7.6	7.8
MLG_XRD_RPT	PLG	Palygorskite	%	0.1	1.3	2.1
MLG_XRD_RPT	PY	Pyrite	%	0.1	0.5	0.4
MLG_XRD_RPT	QZ	Quartz	%	0.1	32.1	30.6
MLG_XRD_RPT	SD	Siderite	%	0.1	5.7	5.4

Table 25 - Job GTK.00275 – XRD Mineralogy Result Summary

APPENDICES

Appendix A – Sample Photos

Job Number - GTK.00100

Photo 1 – Job GTK.00100 Received Sample Photos

Job Number – GTK.00262

Photo 2 - Job GTK.00262 Received Sample Photos

Job Number – GTK.00266

Photo 3 – Job GTK.00266 Received Sample Photos

Job Number – GTK.00268

Photo 4 – Job GTK.00268 Received Sample Photos

Job Number – GTK.00275

Photo 5 – Job GTK.00275 Received Sample Photos

Appendix B – Individual Geotechnical Job Testwork Worksheets

Appendix B.1 Job GTK.00100 Worksheets

Job GTK.00100 - Physical Properties

PT. Geoservices
Geotechnical Laboratory

WORK SHEET
PHYSICAL PROPERTIES TEST RESULT
(POROSITY, DENSITY, S.G, SATURATION DEGREE)

Sample Code	: KBK_Peakindo_1	Tested By	: Yogi, Richi
Sample Type	: Rock	Checked By	: Icha
Location	: -	Test Date	: 12-04-2017

No	Parameter	KBK_Peakindo_1	KBK_Peakindo_1 DUP	Average
1	Natural Mass, Wn (gr)	54.800	56.900	55.850
2	Saturated Mass, Ww (gr)	56.200	58.400	57.300
3	Submerged Mass, Ws (gr)	34.000	35.300	34.650
4	Dry Mass, Wo (gr)	54.200	56.300	55.250
5	Natural Density pn = Wn / (Ww - Ws)	2.468	2.463	2.466
6	Saturated Density, ps = Ww / (ww - Ws)	2.532	2.528	2.530
7	Dry Density, pd = Wo / (Ww - Ws)	2.441	2.437	2.439
8	Apparent S.G. S.Gapp = (Wo / (Ww - Ws)) / Water Density	2.441	2.437	2.439
9	True S.G, S.Gtr = (Wo / (Wo-Ws)) / Water Density	2.683	2.681	2.682
10	Natural Water Content, W = ((Wn- Wo) / Wo) x 100 %	1.107	1.066	1.086
11	Saturated Water Content (Absorption), A = ((Ww - Wo) / Wo) x 100 %	3.690	3.730	3.710
12	Saturated Degree, S = ((Wn - Wo) / (Ww - Wo)) x 100 %	30.000	28.571	29.286
13	Porosity, n = ((Ww - Wo) /(Ww - Ws)) x 100 %	9.009	9.091	9.050
14	Void Ratio, e = n / (1 - n)	0.099	0.100	0.100

Worksheet 1 – Job GTK.00100 – Physical Properties Worksheet

Job GTK.00100 - Los Angeles Abrasion

PT. Geoservices
Geotechnical Laboratory

PENGUJIAN DAYA TAHAN AGGREGATE
DENGAN BEJANA LOS ANGELES / ABRASION LOS ANGELES

Client Name	: PT Kaltara Batu Konstruksi	Date of te	: 19-Apr-17
Job ID	: GTK.00100	Tested by	: Yogi, Richi
Location	: -	Checked I	: Wayne Turner

NO.	Sieve hole		Dry weight of oven	Weight after turned around	Difference	Abrasion	/Remark
	Trough	Left behind					
	mm	mm	g	g	g	%	
1	KBK_Peakindo_1						
	-19	+12.5	2504.8	2196.0	308.8	12.33	x 100 Rotation
	-19	+12.5	2504.8	945.9	1558.9	62.24	x 500 Rotation
2	KBK_Peakindo_1						
	-12.5	+9.5	2500.8	2217.8	283	11.32	x 100 Rotation
	-12.5	+9.5	2500.8	1166.4	1334.4	53.36	x 500 Rotation

Worksheet 2 – Job GTK.00100 – Los Angeles Abrasion Worksheet

Job GTK.00100 - Unconfined Compressive Strength

PT. Geoservices
Geotechnical Laboratory

UNCONFINED COMPRESSION STRENGTH

ASTM D7012-C10 / SNI 03-2825-1992

Request from	: PT Kaltara Batu Konstruksi		**Tested date**	: 02-Mei-2017
Job ID	: GTK.00100		**Tested by**	: Heri Cs.
Sample ID	: KBK_Peakindo_01		**Checked by**	: Said Saleh, BSc.

Test Condition	: Natural				**Weight**	: 652.3	gr
Size of speciment	: **Height**	:	11.05	cm	**γ n**	: 2.503	
	Diameter	:	5.48	cm			
	Area	:	23.59	cm^2			
L/D Correction	: 1.009443423						

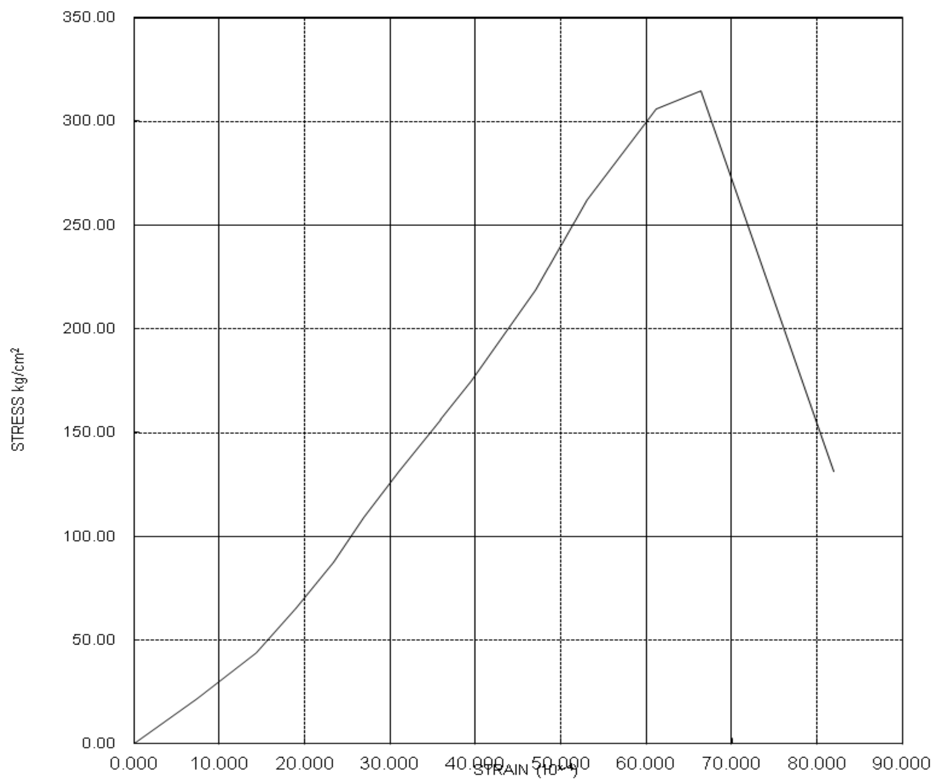
No.	LOAD	STRESS	DIAL READING ($X10^{-3}$)mm				STRAIN ($x10^{-4}$)	
			AXIAL		DIAMETRAL		AXIAL	DIAMETRAL
	(kg)	(kg/cm²)	d	d.1	d	d.1	a	d + d1
1	0	0.00	0				0.00	
2	500	21.84	82				7.42	
3	1,000	43.67	158				14.30	
4	1,500	65.51	210				19.00	
5	2,000	87.34	259				23.44	
6	2,500	109.18	298				26.97	
7	3,000	131.02	342				30.95	
8	4,000	174.69	436				39.46	
9	5,000	218.36	520				47.06	
10	6,000	262.03	587				53.12	
11	7,000	305.71	675				61.09	
12	7,200	314.44	733				66.33	
13	3,000	131.02	906				81.99	

REMARK : SAMPLE FAILURE AT : **σC** = **314.440** kg/cm²

\- **E Axial** = **4.43E+04** kg/cm²

UN-

UNCONFINED GRAPH



Worksheet 3 – Job GTK.00100 – Unconfined Compressive Strength Worksheet.

Appendix B.2 – Job GTK.00262 Worksheets

Job GTK.00262 – Moisture Content

PT. Geoservices
Geotechnical Laboratory

MOISTURE CONTENT TEST

ASTM C566 (GT0231)

Client Name : PT Kaltara Batu Konstruksi | **Tested date** : 29-04-2021
Job ID : GTK.00262 | **Tested by** : Saenu

Sample Code	10256a					
	1	2	3	4	5	6
Tray Weight, Wc (gr)	486.00	476.00	485.00	482.00	486.00	476.00
Mass of tray + wet sample, W_1 (gr)	11217.00	14087.00	12362.00	12988.00	11217.00	14087.00
Mass of tray + dry sample, W_2 (gr)	11123.00	13970.00	12275.00	12888.00	11123.00	13970.00
Mass of sample ($Wt = W_1 - W_c$)	10731.00	13611.00	11877.00	12506.00	10731.00	13611.00
Mass of dry sample, ($Wd = W_2 - Wc$)	10637.00	13494.00	11790.00	12406.00	10637.00	13494.00
Mass of water ($Ww = W_t - W_d$)	94.00	117.00	87.00	100.00	94.00	117.00
Moisture Content (%)	0.88	0.87	0.74	0.81	0.88	0.87
Average (%)	**0.84**					

Sample Code	10254a			10252a		
	1	2	3	1	2	3
Tray Weight, Wc (gr)	122.00	123.00	123.00	116.00	118.00	489.00
Mass of tray + wet sample, W_1 (gr)	3972.00	4238.00	2283.00	3580.00	3032.00	5059.00
Mass of tray + dry sample, W_2 (gr)	3935.00	4209.00	2272.00	3562.00	2995.00	5001.00
Mass of sample ($Wt = W_1 - W_c$)	3850.00	4115.00	2160.00	3464.00	2914.00	4570.00
Mass of dry sample, ($Wd = W_2 - Wc$)	3813.00	4086.00	2149.00	3446.00	2877.00	4512.00
Mass of water ($Ww = W_t - W_d$)	37.00	29.00	11.00	18.00	37.00	58.00
Moisture Content (%)	0.97	0.71	0.51	0.52	1.29	1.29
Average (%)	**0.73**			**1.03**		

Sample Code	10255a		10253a			
	1	2	1	2	3	4
Tray Weight, Wc (gr)	176.00	175.00	119.00	121.00	121.00	122.00
Mass of tray + wet sample, W_1 (gr)	6042.00	5053.00	1981.00	2987.00	3095.00	2203.00
Mass of tray + dry sample, W_2 (gr)	5986.00	5007.00	1951.00	2963.00	3068.00	2188.00
Mass of sample ($Wt = W_1 - W_c$)	5866.00	4878.00	1862.00	2866.00	2974.00	2081.00
Mass of dry sample, ($Wd = W_2 - Wc$)	5810.00	4832.00	1832.00	2842.00	2947.00	2066.00
Mass of water ($Ww = W_t - W_d$)	56.00	46.00	30.00	24.00	27.00	15.00
Moisture Content (%)	0.96	0.95	1.64	0.84	0.92	0.73
Average (%)	**0.96**		**1.03**			

Sample Code	10251a			
	1	2	3	4
Tray Weight, Wc (gr)	177.00	175.00	175.00	178.00
Mass of tray + wet sample, W_1 (gr)	2883.00	3216.00	1890.00	3606.00
Mass of tray + dry sample, W_2 (gr)	2836.00	3178.00	1871.00	3567.00
Mass of sample ($Wt = W_1 - W_c$)	2706.00	3041.00	1715.00	3428.00
Mass of dry sample, ($Wd = W_2 - Wc$)	2659.00	3003.00	1696.00	3389.00
Mass of water ($Ww = W_t - W_d$)	47.00	38.00	19.00	39.00
Moisture Content (%)	1.77	1.27	1.12	1.15
Average (%)	**1.33**			

Worksheet 4 – Job GTK.00262 – Moisture Content

Job GTK.00262 – Los Angeles Abrasion

PT. Geoservices
Geotechnical Laboratory

RESISTANCE TO DEGRADATION OF AGGREGATE BY LOS ANGELES ABRASION

ASTM C131 (GT0233)

Client Name	: PT Kaltara Batu Konstruksi		**Date of test**	: 2-7/07 & 30/06, 21	
Job ID	: GTK.00262		**Tested by**	: Saenu	
Sample ID	: 10254a; 10252a; 10255a; 10256a; 10253a; 10251a		**Checked by**	: Irsan/Anita	

NO.	Sieve Size Passing (mm)	Sieve Size Retained on (mm)	Oven-Dry Mass (gr)	Mass after rotate (retained on the 1.70-mm) (gr)	The difference mass before and after rotate (gr)	Abrasion (%)	Remark
1	**10254a**						
	# Grade A						
	37.50	25.00	1251.90				
	25.00	19.00	1250.90				
	19.00	12.50	1250.60				
	12.50	9.50	1250.40				
			5003.80	4723.40	280.40	5.60	x 100 Rotation
				3623.90	1379.90	27.58	x 500 Rotation
2	**10252a**						
	# Grade A						
	37.50	25.00	1251.10				
	25.00	19.00	1250.90				
	19.00	12.50	1250.10				
	12.50	9.50	1250.00				
			5002.10	4751.10	251.00	5.02	x 100 Rotation
				3782.90	1219.20	24.37	x 500 Rotation
3	**10255a**						
	# Grade A						
	37.50	25.00	1250.90				
	25.00	19.00	1250.10				
	19.00	12.50	1250.60				
	12.50	9.50	1250.20				
			5001.80	4731.80	270.00	5.40	x 100 Rotation
				3583.60	1418.20	28.35	x 500 Rotation
4	**10256a**						
	# Grade A						
	37.50	25.00	1251.20				
	25.00	19.00	1250.80				
	19.00	12.50	1250.30				
	12.50	9.50	1250.30				
			5002.60	4572.80	429.80	8.59	x 100 Rotation
				3063.70	1938.90	38.76	x 500 Rotation
5	**10253a**						
	# Grade A						
	37.50	25.00	1251.20				
	25.00	19.00	1250.10				
	19.00	12.50	1250.40				
	12.50	9.50	1250.80				
			5002.50	4712.30	290.20	5.80	x 100 Rotation
				3482.60	1519.90	30.38	x 500 Rotation
6	**10251a**						
	# Grade A						
	37.50	25.00	1252.50				
	25.00	19.00	1250.90				
	19.00	12.50	1250.90				
	12.50	9.50	1250.10				
			5004.40	4648.30	356.10	7.12	x 100 Rotation
				3332.10	1672.30	33.42	x 500 Rotation

Worksheet 5 – Job GTK.00262 Los Angeles Abrasion

Job GTK.00262 – Particle Sizing Worksheets

MET-WS-013	Rev 02	DFU

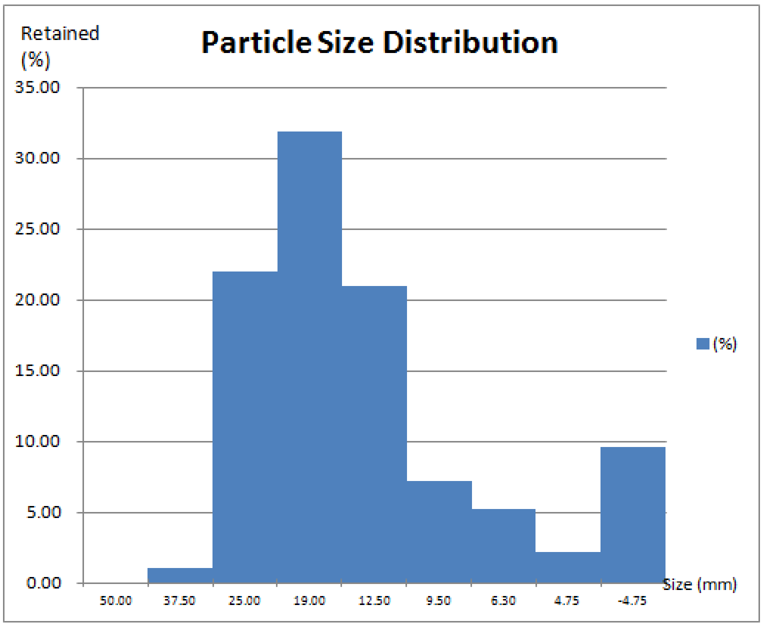
PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

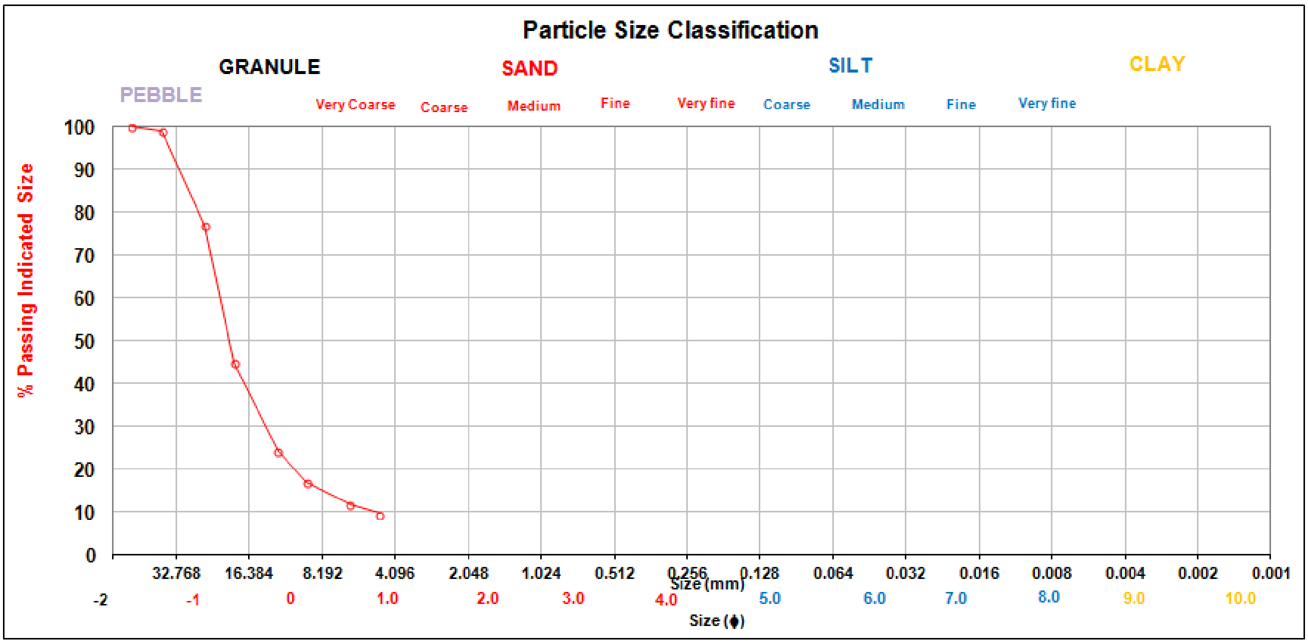
PT GEOSERVICES

Job No :	GTK.00262	Sample ID :	10254a	Date :	May 31, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13		50.00	0.00	0.00	100.00
14		37.50	97.20	1.02	98.98
15		25.00	2099.50	21.99	77.00
16		19.00	3049.50	31.93	45.06
17		12.50	1998.80	20.93	24.13
18		9.50	686.00	7.18	16.95
19		6.30	494.80	5.18	11.76
20		4.75	209.80	2.20	9.57
21	PAN	-4.75	913.50	9.57	



TOTAL	9549.10	D10 =	5.05 mm	D80 =	26.59 mm
		D50 =	20.04 mm	D90 =	32.16 mm



Worksheet 6 – Job GTK.00262 – Particle Sizing Worksheet – Sample 10254a

MET-WS-013	Rev 02	DFU

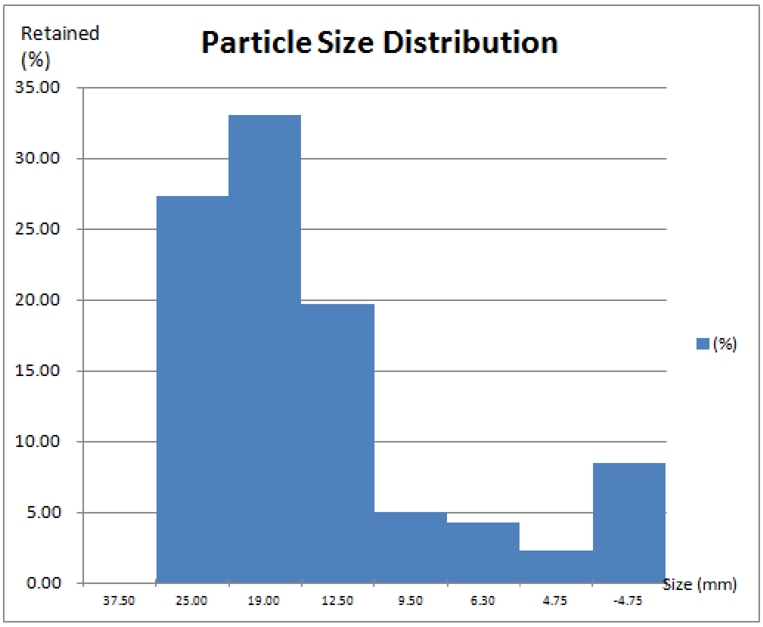
PT GEOSERVICES

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

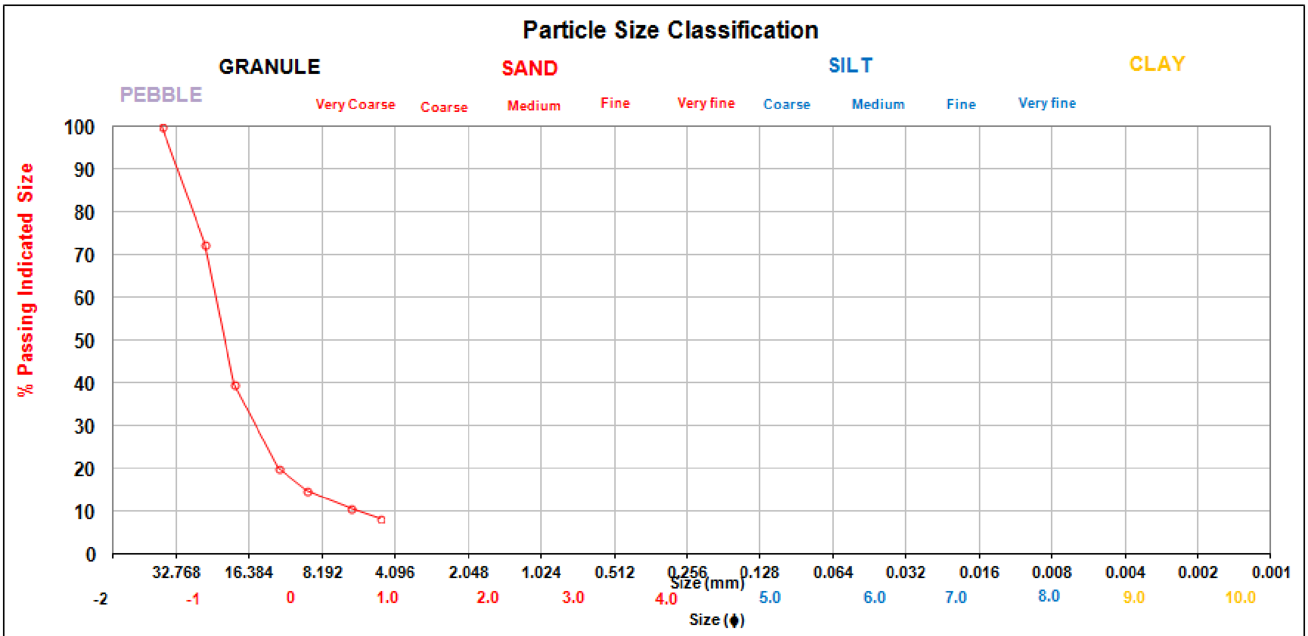
Job No :	GTK.00262	Sample ID :	10252a	Date :	June 2, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.50	0.00	0.00	100.00
15		25.00	2769.80	27.27	72.73
16		19.00	3358.20	33.07	39.66
17		12.50	1996.60	19.66	20.00
18		9.50	511.20	5.03	14.96
19		6.30	432.60	4.26	10.70
20		4.75	229.50	2.26	8.44
21	PAN	-4.75	857.50	8.44	



TOTAL 10155.40

D10 =	5.81 mm	D80 =	28.23 mm
D50 =	21.10 mm	D90 =	32.79 mm



Worksheet 7 – Job GTK.00262 – Particle Sizing Worksheet – Sample 10252a

MET-WS-013	Rev 02	DFU

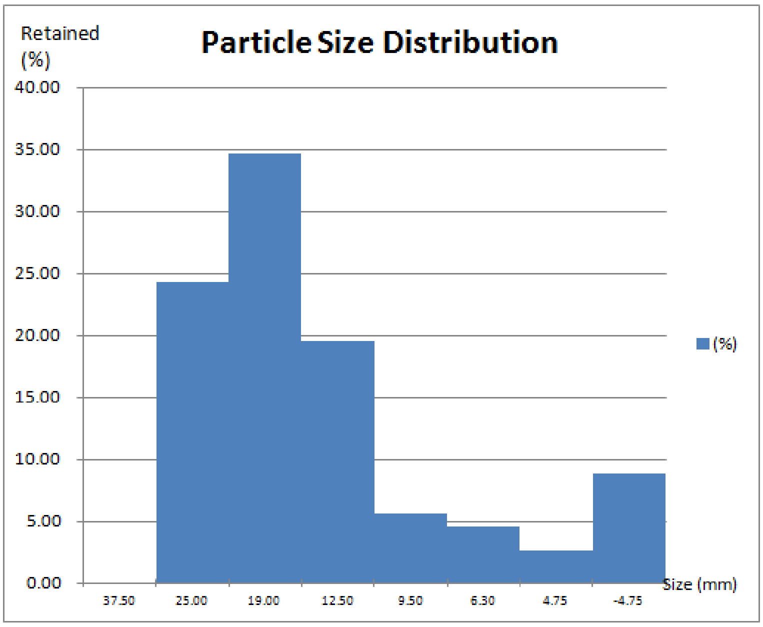
PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

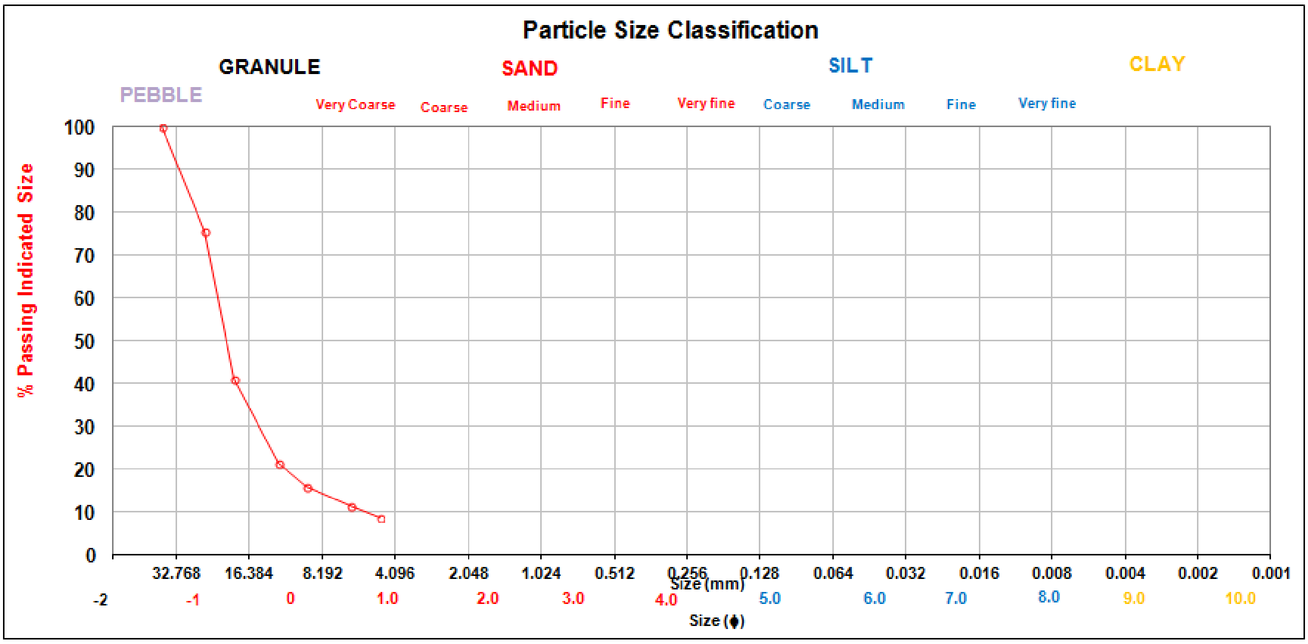
PT GEOSERVICES

Job No :	GTK.00262	Sample ID :	10255a	Date :	May 31, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.50	0.00	0.00	100.00
15		25.00	2458.10	24.33	75.67
16		19.00	3496.90	34.61	41.07
17		12.50	1976.80	19.56	21.50
18		9.50	566.90	5.61	15.89
19		6.30	454.00	4.49	11.40
20		4.75	262.40	2.60	8.80
21	PAN	-4.75	889.70	8.80	



TOTAL	10104.80	D10 =	5.46 mm	D80 =	27.11 mm
		D50 =	20.76 mm	D90 =	32.17 mm



Worksheet 8 - Job GTK.00262 – Particle Sizing Worksheet – Sample 10255a

MET-WS-013	Rev 02	DFU

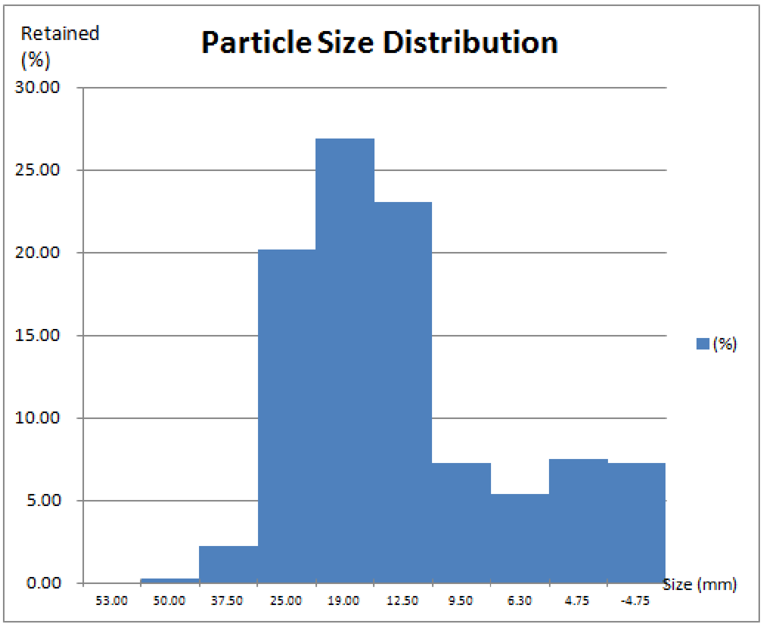
PT GEOSERVICES

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

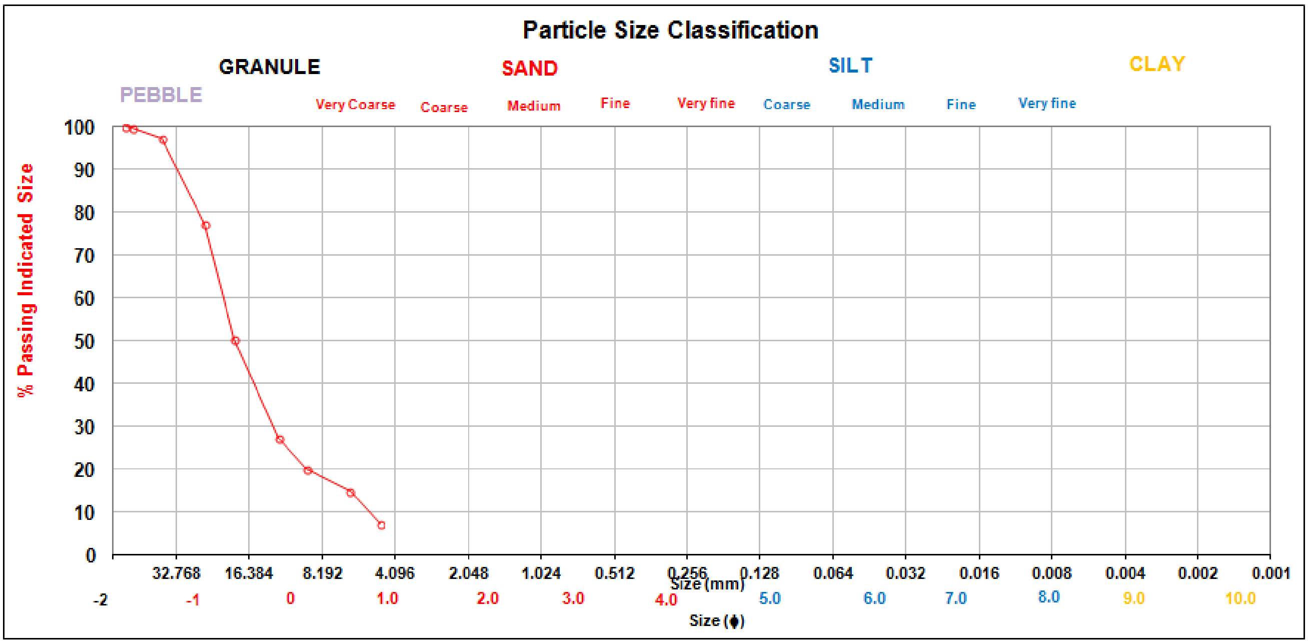
PARTICLE SIZE DISTRIBUTION

Job No :	GTK.00262	Sample ID :	10256a	Date :	May 31, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12		53.00	0.00	0.00	100.00
13		50.00	145.30	0.31	99.69
14		37.50	1042.80	2.23	97.46
15		25.00	9437.60	20.20	77.26
16		19.00	12543.00	26.85	50.41
17		12.50	10765.40	23.04	27.37
18		9.50	3360.10	7.19	20.18
19		6.30	2513.80	5.38	14.80
20		4.75	3518.20	7.53	7.27
21	PAN	-4.75	3397.00	7.27	
TOTAL			46723.20		



D10 =	5.39 mm	D80 =	26.57 mm
D50 =	18.89 mm	D90 =	32.63 mm



Worksheet 9 - Job GTK.00262 – Particle Sizing Worksheet – Sample 10256a

MET-WS-013	Rev 02	DFU

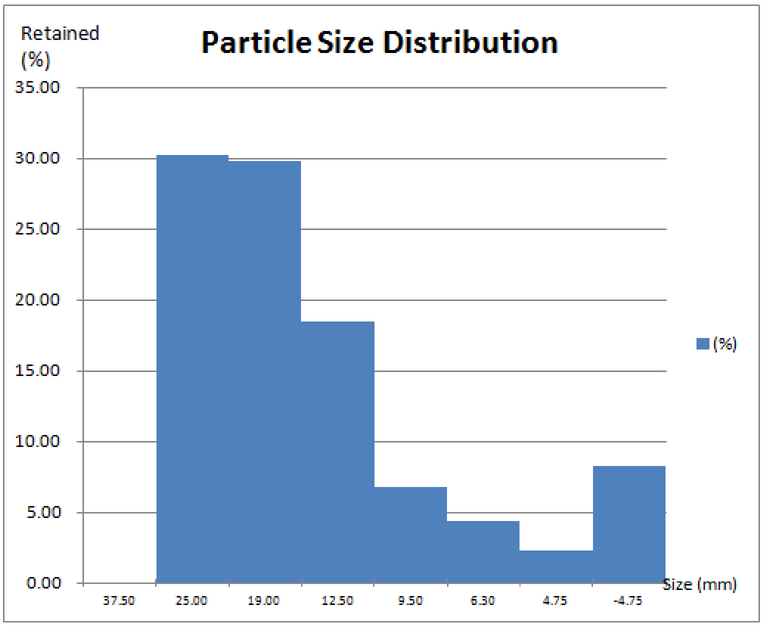
PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

PT GEOSERVICES

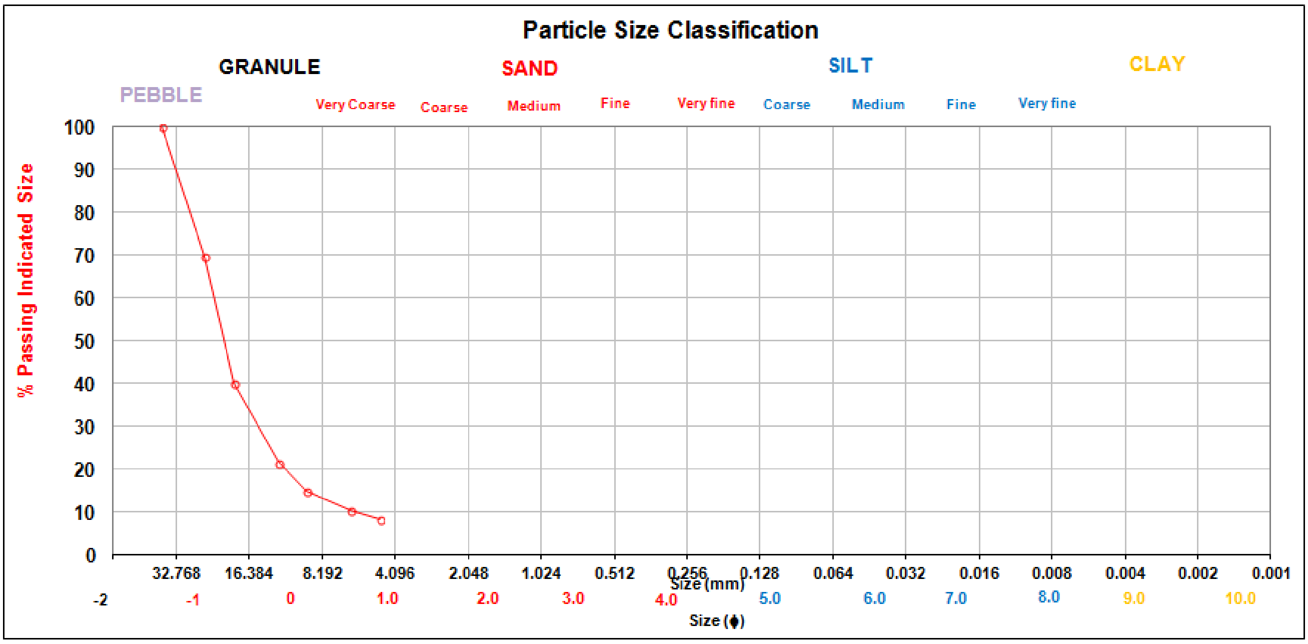
Job No :	GTK.00262	Sample ID :	10253a	Date :	June 2, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.50	0.00	0.00	100.00
15		25.00	2273.70	30.17	69.83
16		19.00	2244.10	29.78	40.05
17		12.50	1389.10	18.43	21.62
18		9.50	507.30	6.73	14.88
19		6.30	331.30	4.40	10.49
20		4.75	169.50	2.25	8.24
21	PAN	-4.75	620.80	8.24	



TOTAL 7535.80

D10 =	5.96 mm	D80 =	29.15 mm
D50 =	21.20 mm	D90 =	33.29 mm



Worksheet 10 - Job GTK.00262 – Particle Sizing Worksheet – Sample 10253a

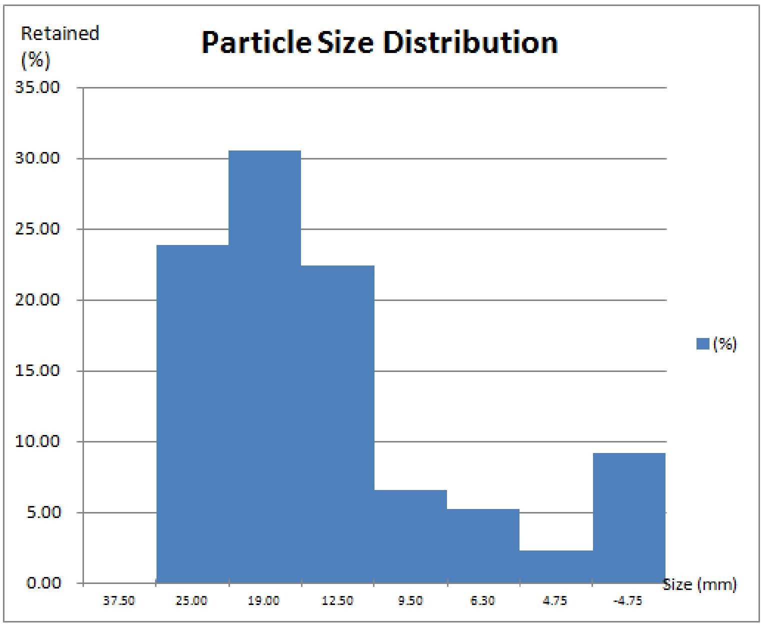
MET-WS-013	Rev 02	DFU

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

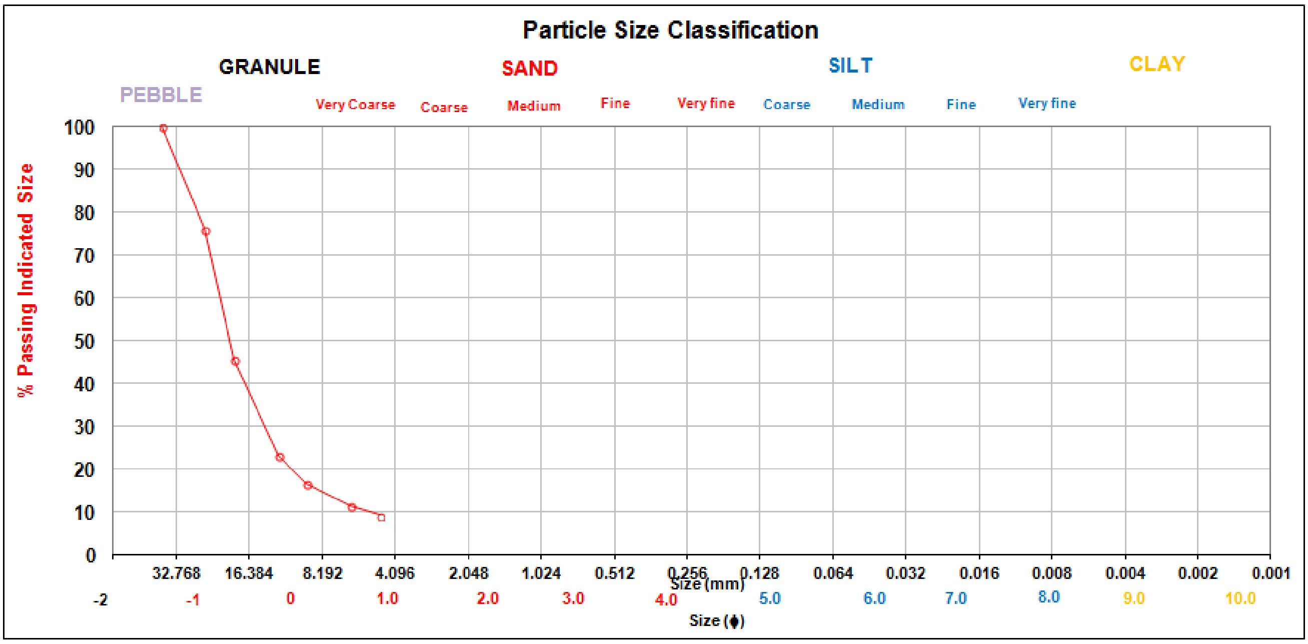
PARTICLE SIZE DISTRIBUTION

Job No :	GTK.00262	Sample ID :	10251a	Date :	June 2, 2021
Client :	Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.50	0.00	0.00	100.00
15		25.00	2865.70	23.83	76.17
16		19.00	3671.90	30.53	45.64
17		12.50	2688.20	22.35	23.29
18		9.50	787.30	6.55	16.74
19		6.30	627.10	5.21	11.53
20		4.75	279.80	2.33	9.20
21	PAN	-4.75	1106.90	9.20	
TOTAL			12026.90		



D10 =	5.27 mm	D80 =	26.89 mm
D50 =	19.95 mm	D90 =	32.05 mm



Worksheet 11 - Job GTK.00262 – Particle Sizing Worksheet – Sample 10251a

Job GTK.00262 – Density, Relative Density and Absorption

PT. Geoservices
Geotechnical Laboratory

Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 127 (GT0226)

Client	**: PT Kaltara Batu Konstruksi**	**Tested By**	**: Saenu**
Job ID	**: GTK.00262**	**Test Date**	**: 07-06-2021**
Project	**: 10254a; 10252a; 10255a**	**Checked By**	**: Irsan/Anita**

		10254a	10252a	10255a	
Weight of oven dried specimen, B_k		7971.9	5043.0	5287.7	g
Weight of saturated surface dry specimen, Bj		8172.1	5144.6	5442.3	g
Weight of the specimen in water (Ba)		5003	3174.1	3320.4	g
Perhitungan (Results)					
Bulk	$\frac{Bk}{Bj - Ba}$	2.52	2.56	2.49	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2509.22**	**2552.85**	**2485.73**	kg/m^3
Saturated surface dry density	$\frac{Bj}{Bj - Ba}$	2.58	2.61	2.56	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2572.23**	**2604.28**	**2558.41**	kg/m^3
Apparent Density	$\frac{Bk}{Bk - Ba}$	2.69	2.70	2.69	
	$\rho_{(997.5)} \frac{Bk}{Bk - Ba}$	**2678.42**	**2691.63**	**2681.08**	kg/m^3
Absorption	$\frac{Bj - Bk}{Bk} \times 100\ \%$	**2.51**	**2.01**	**2.92**	%

Worksheet 12 - Job GTK.00262 – Density, Relative Density and Absorption

PT. Geoservices
Geotechnical Laboratory

Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 127 (GT0226)

Client	**: PT Kaltara Batu Konstruksi**	**Tested By**	**: Saenu**
Job ID	**: GTK.00262**	**Test Date**	**: 07-06-2021**
Project	**: 10256a; 10253a; 10251a**	**Checked By**	**: Irsan/Anita**

		10256a	10253a	10251a	
Weight of oven dried specimen, B_k		12214	5206.6	5120.8	g
Weight of saturated surface dry specimen, Bj		12556.8	5364.3	5268.6	g
Weight of the specimen in water (Ba)		7669.9	3267.4	3208	g
Perhitungan (Results)					
Bulk	$\frac{Bk}{Bj - Ba}$	2.50	2.48	2.49	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2493.09**	**2476.79**	**2478.89**	kg/m^3
Saturated surface dry density	$\frac{Bj}{Bj - Ba}$	2.57	2.56	2.56	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2563.06**	**2551.81**	**2550.44**	kg/m^3
Apparent Density	$\frac{Bk}{Bk - Ba}$	2.69	2.68	2.68	
	$\rho_{(997.5)} \frac{Bk}{Bk - Ba}$	**2681.16**	**2678.21**	**2670.43**	kg/m^3
Absorption	$\frac{Bj - Bk}{Bk} \times 100\ \%$	**2.81**	**3.03**	**2.89**	%

Worksheet 13 - Job GTK.00262 – Job GTK.00262 – Density, Relative Density and Absorption

PT. GEOSERVICES – GEOTECHNICAL LABORATORY

Jl Industri Selatan 2, Blok MM1, Jababeka 2, Cikarang Bekasi 17520, Indonesia

Job GTK.00262 – Aggregate Flakiness and Elongation

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT. Kaltara Batu Konstruksi	Tested Date	: 24-06-2021
Job ID	: GTK.00262	Tested By	: Ali
Sample ID	: 10254a	Checked By	: Irsan/Anita

Initial Weight : **8437.80** gram

Aggregate Size - Fraction	Retained Weight %	Retained Weight (g)	Flat Particles (FP) (g)	Flat Particles (FP) %	Elongated Particles (EP) (g)	Elongated Particles (EP) %	Unflat & Unelongated Particles (UUP) (g)	Unflat & Unelongated Particles (UUP) %	Calculation of Flat and Elongated Particles (FEP) (g)	Calculation of Flat and Elongated Particles (FEP) %	Remarks
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	0.99	93.30	0.00	0.00	0.00	0.00	93.3	100.00	0.00	0.00	< 10% retained weight
38.0 - 25.0	20.19	1899.70	0.00	0.00	116.60	6.14	1783.1	93.86	116.60	6.14	
25.0 - 19.0	33.26	3128.50	75.80	2.42	69.60	2.22	2983.1	95.35	145.40	4.65	
19.0 - 12.5	20.20	1900.40	237.80	12.51	12.80	0.67	1649.8	86.81	250.60	13.19	
12.5 - 9.5	7.44	699.50	103.20	14.75	11.20	1.60	585.1	83.65	114.40	16.35	< 10% retained weight
9.5 - 4.75	7.63	716.40	92.20	12.87	14.90	2.08	609.3	85.05	107.10	14.95	< 10% retained weight
>10% retained weight Total (Tb_{1-n})	73.7	6928.6									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			4.53		2.87		92.60		7.40		

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT. Kaltara Batu Konstruksi	Tested Date	: 24-06-2021
Job ID	: GTK.00262	Tested By	: Ali
Sample ID	: 10252a	Checked By	: Irsan/Anita

Initial Weight : **9184.50** gram

Aggregate Size - Fraction	Retained Weight %	Retained Weight (g)	Flat Particles (FP) (g)	Flat Particles (FP) %	Elongated Particles (EP) (g)	Elongated Particles (EP) %	Unflat & Unelongated Particles (UUP) (g)	Unflat & Unelongated Particles (UUP) %	Calculation of Flat and Elongated Particles (FEP) (g)	Calculation of Flat and Elongated Particles (FEP) %	Remarks
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	< 10% retained weight
50.0 - 38.0	--	--	--	--	--	--	--	--	--	--	< 10% retained weight
38.0 - 25.0	25.33	2560.40	13.20	0.52	166.80	6.51	2380.40	92.97	180.00	7.03	
25.0 - 19.0	34.46	3482.90	33.30	0.96	64.20	1.84	3385.40	97.20	97.50	2.80	
19.0 - 12.5	17.79	1797.60	172.80	9.61	0.00	0.00	1624.80	90.39	172.80	9.61	
12.5 - 9.5	6.23	629.60	110.50	17.55	1.10	0.17	518.00	82.27	111.60	17.73	< 10% retained weight
9.5 - 4.75	7.07	714.00	139.50	19.54	20.80	2.91	553.70	77.55	160.30	22.45	< 10% retained weight
>10% retained weight Total (Tb_{1-n})	77.6	7840.9									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			2.80		2.95		94.26		5.74		

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT. Kaltara Batu Konstruksi	**Tested Date**	: 24-06-2021
Job ID	: GTK.00262	**Tested By**	: Ali
Sample ID	: 10255a	**Checked By**	: Irsan/Anita

Initial Weight : **9084.20** gram

Aggregate Size - Fraction	Retained Weight		Parameter								Remarks
	%	(g)	Flat Particles (FP)		Elongated Particles (EP)		Unflat & Unelongated Particles (UUP)		Calculation of Flat and Elongated Particles (FEP)		
			(g)	%	(g)	%	(g)	%	(g)	%	
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	--	--	--	--	--	--	--	--	--	--	
38.0 - 25.0	25.65	2570.20	0.00	0.00	0.00	0.00	2570.20	100.00	0.00	0.00	
25.0 - 19.0	34.58	3464.80	9.50	0.27	33.00	0.95	3422.30	98.77	42.50	1.23	
19.0 - 12.5	17.63	1766.60	191.30	10.83	6.20	0.35	1569.10	88.82	197.50	11.18	
12.5 - 9.5	5.87	588.40	94.70	16.09	1.50	0.25	492.20	83.65	96.20	16.35	< 10% retained weight
9.5 - 4.75	6.95	694.20	92.60	13.34	16.10	2.32	585.50	84.34	108.70	15.66	< 10% retained weight
>10% retained weight Total (Tb_{1-n})	77.9	7801.6									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			2.57		0.50		96.92		3.08		

Worksheet 14 - Job GTK.00262 – Aggregate Flakiness and Elongation Worksheets

Appendix B.3 - Job GTK.00266 Worksheets

Job GTK.00266 – Moisture Content

PT. Geoservices
Geotechnical Laboratory

MOISTURE CONTENT TEST

ASTM C566 (GT0231)

Client Name : PT Kaltara Batu Konstruksi		**Tested date** : 8-06-2021	
Job ID : GTK.00266		**Tested by** : Saenu	
Sample Code	**10263 KDD 026**	**10265 KDD 022**	**10259 KDD 034**
Tray Weight, Wc (gr)	410.20	421.00	426.00
Mass of tray + wet sample, W_1 (gr)	16560.00	16464.00	14191.00
Mass of tray + dry sample, W_2 (gr)	16303.00	16217.00	14037.00
Mass of sample ($Wt= W_1-W_c$)	16149.80	16043.00	13765.00
Mass of dry sample, ($Wd = W_2- Wc$)	15892.80	15796.00	13611.00
Mass of water ($Ww = W_t-W_d$)	257.00	247.00	154.00
Moisture Content (%)	**1.62**	**1.56**	**1.13**

Worksheet 15 – Job GTK.00266 – Moisture Content

Job GTK.00266 – Los Angeles Abrasion

PT. Geoservices
Geotechnical Laboratory

RESISTANCE TO DEGRADATION OF AGGREGATE BY LOS ANGELES ABRASION

ASTM C131 (GT0233)

Client Name	: PT Kaltara Batu Konstruksi	**Date of test**	: 6-Jul-21
Job ID	: GTK.00266	**Tested by**	: Saenu
Sample ID	: 10263 KDD 026; 10265 KDD 022; 10259 KDD 034	**Checked by**	: Irsan/Anita

NO.	Sieve Size Passing (mm)	Sieve Size Retained on (mm)	Oven-Dry Mass (gr)	Mass after rotate (retained on the 1.70-mm) (gr)	The difference mass before and after rotate (gr)	Abrasion (%)	Remark
1	**10263 KDD 026**						
	# Grade A						
	37.50	25.00	1251.10				
	25.00	19.00	1250.90				
	19.00	12.50	1250.20				
	12.50	9.50	1250.60				
			5002.80	4622.60	380.20	7.60	x 100 Rotation
				3106.40	1896.40	37.91	x 500 Rotation
2	**10265 KDD 022**						
	# Grade A						
	37.50	25.00	1250.40				
	25.00	19.00	1250.00				
	19.00	12.50	1250.50				
	12.50	9.50	1250.90				
			5001.80	4707.00	294.80	5.89	x 100 Rotation
				3432.10	1569.70	31.38	x 500 Rotation
3	**10259 KDD 034**						
	# Grade A						
	37.50	25.00	1250.20				
	25.00	19.00	1250.00				
	19.00	12.50	1250.30				
	12.50	9.50	1250.50				
			5001.00	4757.00	244.00	4.88	x 100 Rotation
				3802.90	1198.10	23.96	x 500 Rotation

Worksheet 16 – Job GTK.00266 – Los Angeles Abrasion

Job GTK.00266 – Particle Sizing Worksheets

ASTM C 136 | GT0220

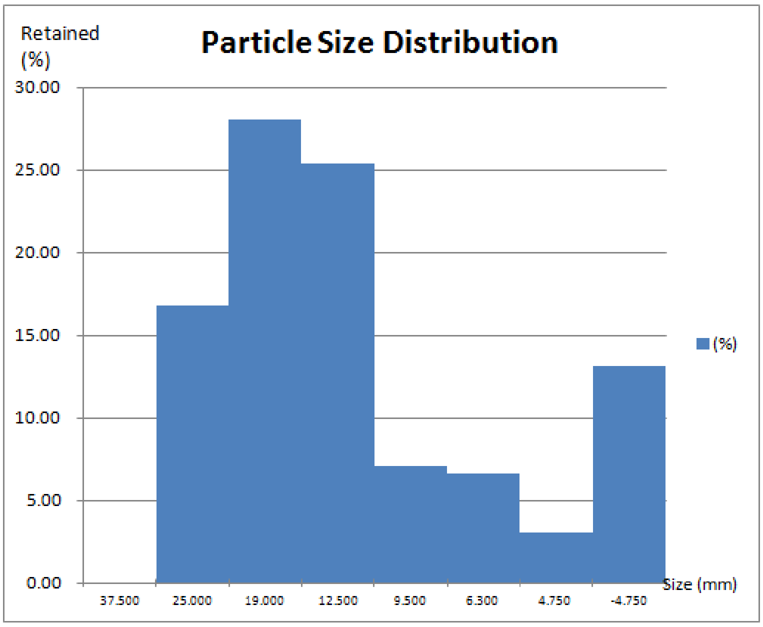
PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

PT GEOSERVICES

Job No :	GTK.00266	Sample ID :	10263 KDD 026	Date :	June 11, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.500	0.00	0.00	100.00
15		25.000	2622.50	16.78	83.22
16		19.000	4384.40	28.05	55.17
17		12.500	3970.80	25.40	29.77
18		9.500	1097.30	7.02	22.75
19		6.300	1027.30	6.57	16.18
20		4.750	471.20	3.01	13.16
21	PAN	-4.750	2057.10	13.16	

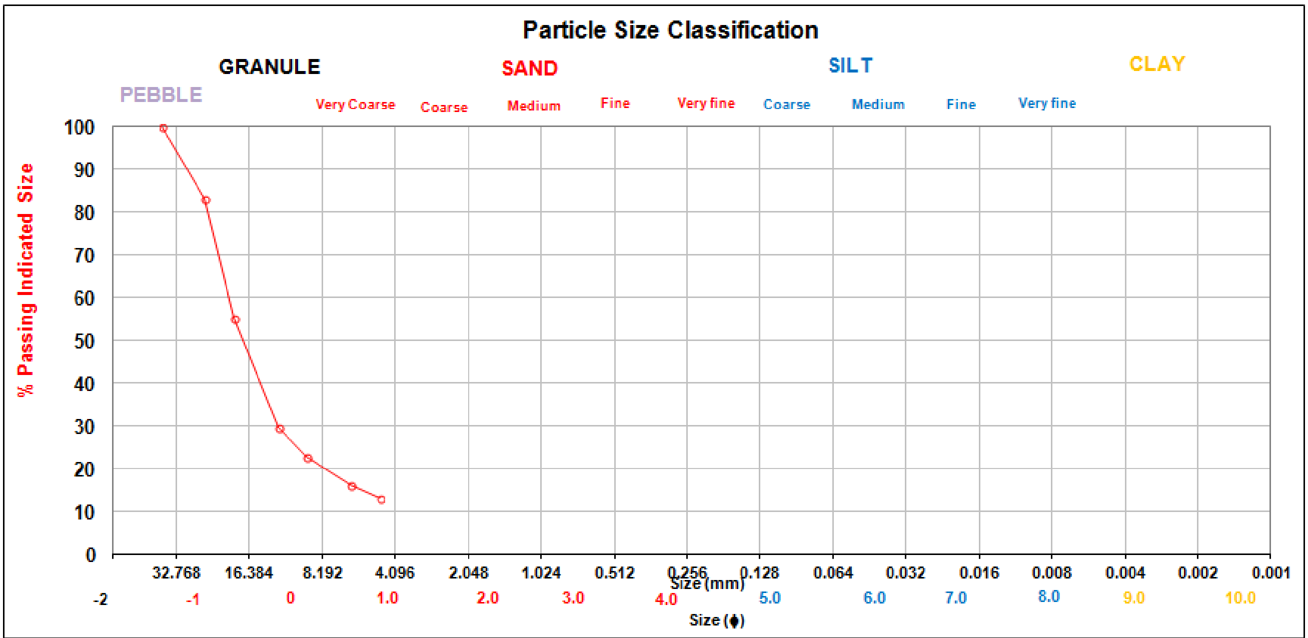


TOTAL 15630.60

D50 = 17.77 mm

D80 = 24.35 mm

D90 = 29.72 mm



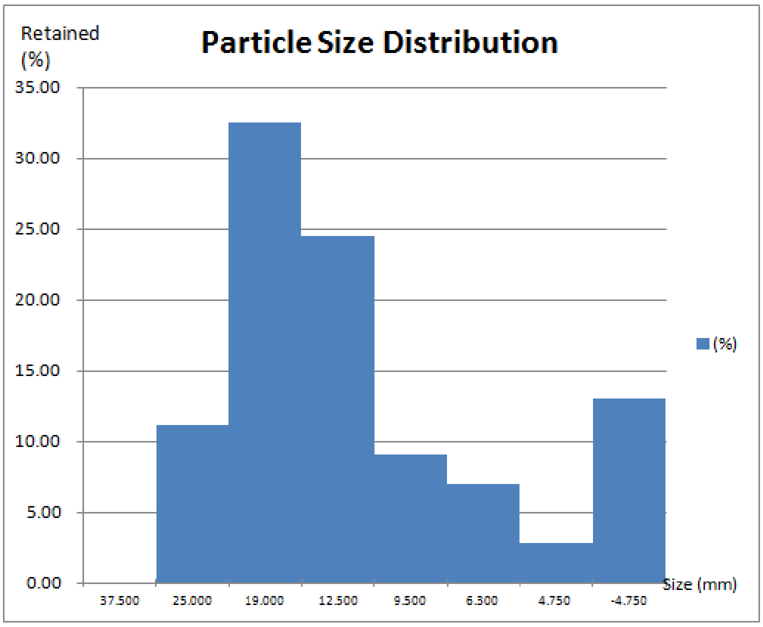
ASTM C 136	GT0220

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

Job No :	GTK.00266	Sample ID :	10265 KDD 022	Date :	June 11, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.500	0.00	0.00	100.00
15		25.000	1726.90	11.16	88.84
16		19.000	5022.40	32.46	56.37
17		12.500	3795.20	24.53	31.84
18		9.500	1405.50	9.09	22.76
19		6.300	1077.70	6.97	15.79
20		4.750	434.70	2.81	12.98
21	PAN	-4.750	2008.10	12.98	

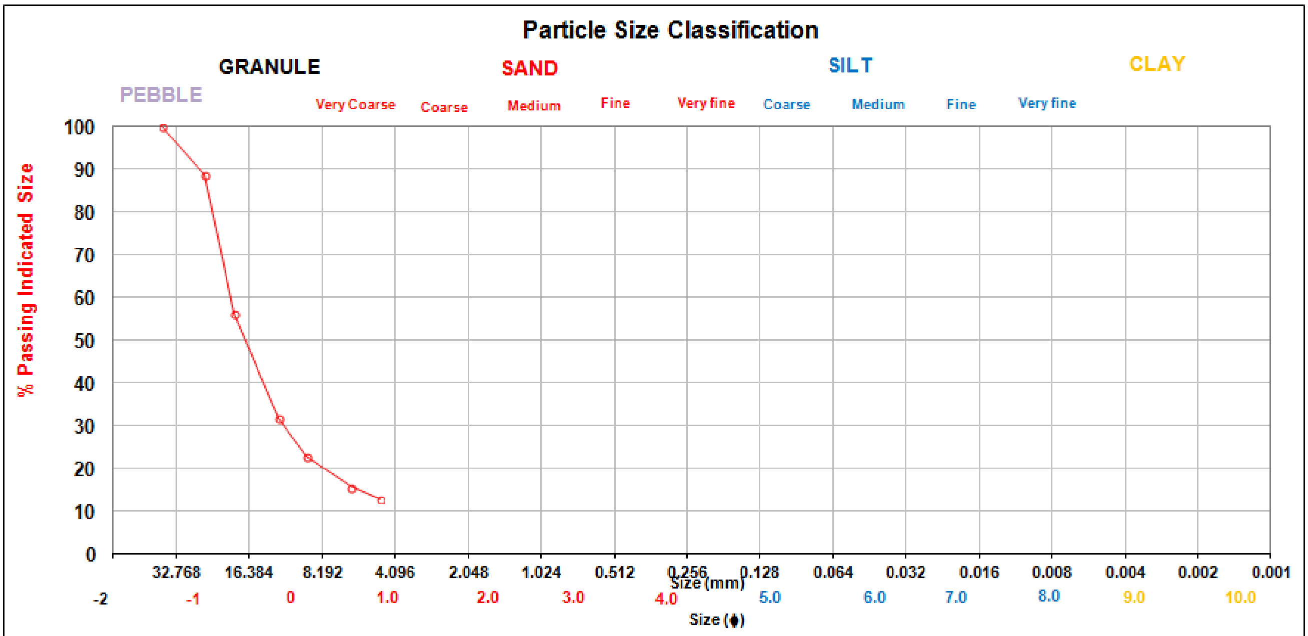


TOTAL 15470.50

D50 = 17.40 mm

D80 = 23.47 mm

D90 = 26.14 mm



ASTM C 136	GT0220

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

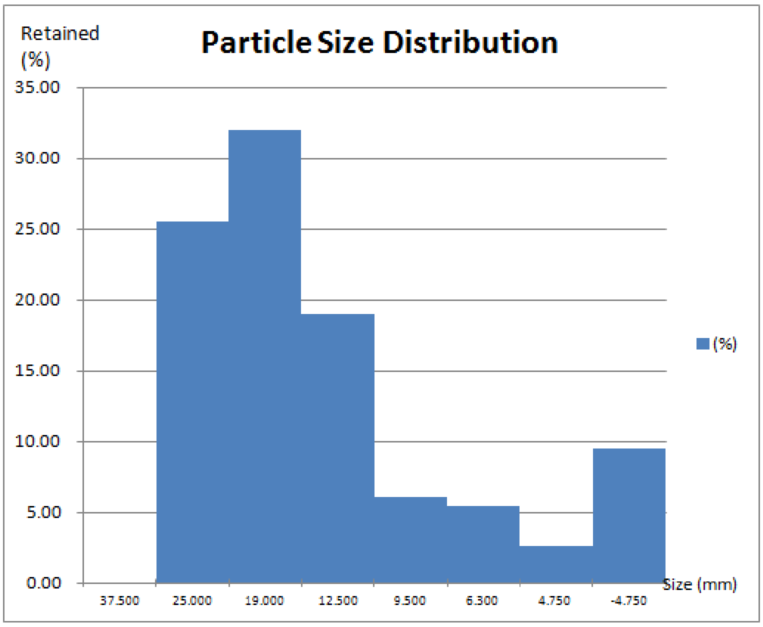
PARTICLE SIZE DISTRIBUTION

PT GEOSERVICES

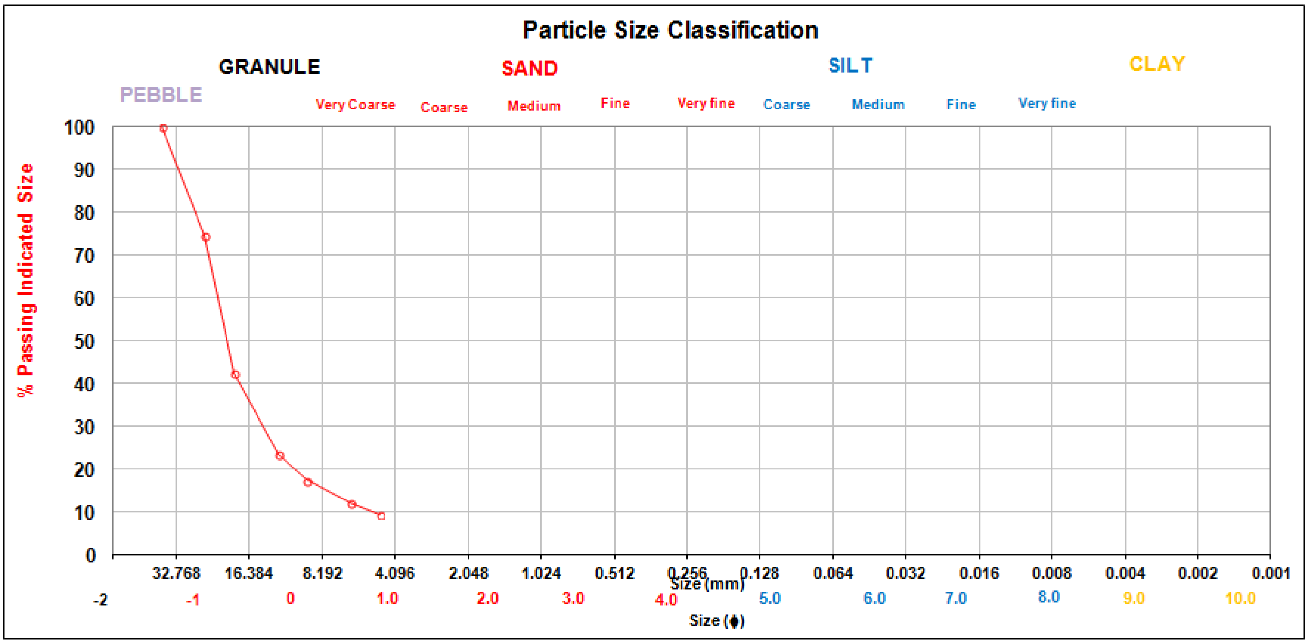
Job No :	GTK.00266	Sample ID :	10259 KDD 034	Date :	June 11, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14		37.500	0.00	0.00	100.00
15		25.000	3239.00	25.51	74.49
16		19.000	4059.50	31.97	42.52
17		12.500	2402.60	18.92	23.59
18		9.500	774.10	6.10	17.50
19		6.300	693.40	5.46	12.04
20		4.750	329.60	2.60	9.44
21	PAN	-4.750	1198.70	9.44	

TOTAL 12696.90



D10 = 5.08 mm	D50 = 20.57 mm	D80 = 27.58 mm	D90 = 32.44 mm



Worksheet 17 – Job GTK.00266 – Particle Sizing Worksheets

Job GTK.00266 – Density – Relative Density and Absorption

PT. Geoservices
Geotechnical Laboratory

Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 127 (GT0226)

Client	**: PT Kaltara Batu Konstruksi**	**Tested By**	**: Saenu**
Job ID	**: GTK.00266**	**Test Date**	**: 21-06-2021**
Project	**: Aggregate**	**Checked By**	**: Irsan/Anita**

		10263 KDD 026	10265 KDD 022	10259 KDD 034	
Weight of oven dried specimen, B_k		5707.3	5477.5	5428.8	g
Weight of saturated surface dry specimen, Bj		5850.6	5605.0	5529.0	g
Weight of the specimen in water (Ba)		3611.6	3441.6	3436.0	g
Perhitungan (Results)					
Bulk	$\frac{Bk}{Bj-Ba}$	2.55	2.53	2.59	
	$\rho_{(997.5)} \frac{Bk}{Bj-Ba}$	**2542.67**	**2525.56**	**2587.30**	kg/m^3
Saturated surface dry density	$\frac{Bj}{Bj-Ba}$	2.61	2.59	2.64	
	$\rho_{(997.5)} \frac{Bk}{Bj-Ba}$	**2606.51**	**2584.35**	**2635.06**	kg/m^3
Apparent Density	$\frac{Bk}{Bk-Ba}$	2.72	2.69	2.72	
	$\rho_{(997.5)} \frac{Bk}{Bk-Ba}$	**2716.53**	**2683.73**	**2717.40**	kg/m^3
Absorption	$\frac{Bj-Bk}{Bk}$ x 100 %	**2.51**	**2.33**	**1.85**	%

Worksheet 18 – Job GTK.00266 – Density, Relative Density and Adsorption

Job GTK.00266 – Aggregate Flakiness and Elongation

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT.Kaltara Batu Konstruksi	Tested Date	: 28-06-2021
Job ID	: GTK.00266	Tested By	: Ali
Sample ID	: 10263 KDD 026	Checked By	: Irsan/Anita

Initial Weight : 13423.0 gram

Aggregate Size - Fraction	Retained Weight		Parameter								Remarks
	%	(g)	Flat Particles (FP)		Elongated Particles (EP)		Unflat & Unelongated Particles (UUP)		Calculation of Flat and Elongated Particles (FEP)		
			(g)	%	(g)	%	(g)	%	(g)	%	
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	--	--	--	--	--	--	--	--	--	--	
38.0 - 25.0	15.57	2420.50	0.0	0.0	170.5	7.04	2250.0	92.96	170.5	7.04	
25.0 - 19.0	29.36	4565.30	35.8	0.8	0.0	0.00	4529.5	99.22	35.8	0.78	
19.0 - 12.5	23.37	3633.60	145.9	4.0	0.0	0.00	3487.7	95.98	145.9	4.02	
12.5 - 9.5	8.65	1345.50	114.5	8.5	2.2	0.2	1228.8	91.3	116.7	8.7	< 10% retained weight
9.5 - 4.75	9.39	1458.10	102.4	7.0	39.0	2.7	1316.7	90.3	141.4	9.7	< 10% retained weight
>10% retained Total (Tb_{1-n})	68.3	10619.4									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			1.71		1.61		96.68		3.32		

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT.Kaltara Batu Konstruksi	Tested Date	: 28-06-2021
Job ID	: GTK.00266	Tested By	: Ali
Sample ID	: 10265 KDD 022	Checked By	: Irsan/Anita

Initial Weight : 13275.20 gram

Aggregate Size - Fraction	Retained Weight		Parameter								Remarks
	%	(g)	Flat Particles (FP)		Elongated Particles (EP)		Unflat & Unelongated Particles (UUP)		Calculation of Flat and Elongated Particles (FEP)		
			(g)	%	(g)	%	(g)	%	(g)	%	
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	--	--	--	--	--	--	--	--	--	--	
38.0 - 25.0	9.35	1443.50	0.0	0.0	0.0	0.00	1443.5	100.00	0.0	0.00	< 10% retained weight
25.0 - 19.0	31.82	4913.30	13.3	0.3	0.0	0.00	4900.0	99.73	13.3	0.27	
19.0 - 12.5	25.40	3921.60	99.0	2.5	22.6	0.58	3800.0	96.90	121.6	3.10	
12.5 - 9.5	9.22	1423.20	108.5	7.6	12.6	0.9	1302.1	91.5	121.1	8.5	< 10% retained weight
9.5 - 4.75	10.19	1573.60	102.7	6.5	33.1	2.1	1437.8	91.4	135.8	8.6	
>10% retained weight Total (Tb_{1-n})	67.4	10408.5									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			2.07		0.54		97.40		2.60		

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT.Kaltara Batu Konstruksi	Tested Date	: 24-06-2021
Job ID	: GTK.00266	Tested By	: Ali
Sample ID	: 10259 KDD 034	Checked By	: Irsan/Anita

Initial Weight : 11442.50 gram

Aggregate Size - Fraction	Retained Weight		Parameter								Remarks
	%	(g)	Flat Particles (FP)		Elongated Particles (EP)		Unflat & Unelongated Particles (UUP)		Calculation of Flat and Elongated Particles (FEP)		
			(g)	%	(g)	%	(g)	%	(g)	%	
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	--	--	--	--	--	--	--	--	--	--	
38.0 - 25.0	24.29	3069.40	0.0	0.0	342.4	11.16	2727.0	88.84	342.4	11.16	
25.0 - 19.0	32.08	4055.00	35.8	0.9	34.7	0.86	3984.5	98.26	70.5	1.74	
19.0 - 12.5	17.93	2265.70	145.9	6.4	0.0	0.00	2119.8	93.56	145.9	6.44	
12.5 - 9.5	7.78	982.90	114.5	11.6	0.0	0.0	868.4	88.4	114.5	11.6	< 10% retained weight
9.5 - 4.75	8.46	1069.50	116.5	10.9	27.7	2.6	925.3	86.5	144.2	13.5	< 10% retained weight
>10% retained weight — Total (Tb_{1-n})	74.3	9390.1									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			1.94		4.02		94.05		5.95		

Worksheet 19 – Job GTK.00266 – Aggregate Flakiness and Elongation

Appendix B.4 – Job GTK.00268 Worksheets

Job GTK.00268 – Moisture Content

PT. Geoservices
Geotechnical Laboratory

MOISTURE CONTENT TEST

ASTM C566 (GT0231)

Client Name : PT Kaltara Batu Konstruksi
Job ID : GTK.00268
Tested date : 11-06-2021
Tested by : Saenu

Sample Code	10267 KDD032			
	1	2	3	4
Tray Weight, Wc (gr)	123.70	121.50	120.60	127.70
Mass of tray + wet sample, W_1 (gr)	3925.10	4707.10	3854.20	3884.40
Mass of tray + dry sample, W_2 (gr)	3869.70	4645.50	3798.50	3842.10
Mass of sample ($Wt= W_1-W_c$)	3801.40	4585.60	3733.60	3756.70
Mass of dry sample, ($Wd = W_2- Wc$)	3746.00	4524.00	3677.90	3714.40
Mass of water ($Ww = W_t-W_d$)	55.40	61.60	55.70	42.30
Moisture Content (%)	**1.48**	**1.36**	**1.51**	**1.14**
Average (%)	**1.37**			

Worksheet 20 – Job GTK.00268 – Moisture Content

Job GTK.00268 – Los Angeles Abrasion

PT. Geoservices
Geotechnical Laboratory

RESISTANCE TO DEGRADATION OF AGGREGATE BY LOS ANGELES ABRASION

ASTM C131 (GT0233)

Client Name : PT Kaltara Batu Konstruksi
Job ID : GTK.00268
Sample ID : 10267 KDD 032
Date of test : 6-Jul-21
Tested by : Saenu
Checked by : Irsan/Anita

NO.	Sieve Size Passing (mm)	Sieve Size Retained on (mm)	Oven-Dry Mass (gr)	Mass after rotate (retained on the 1.70-mm) (gr)	The difference mass before and after rotate (gr)	Abrasion (%)	Remark
1	**10267 KDD 032**						
	# Grade A						
	37.50	25.00	1251.30				
	25.00	19.00	1250.70				
	19.00	12.50	1250.20				
	12.50	9.50	1250.00				
			5002.20	4679.40	322.80	6.45	x 100 Rotation
				3481.70	1520.50	30.40	x 500 Rotation

Worksheet 21 – Job GTK.00268 – Los Angeles Abrasion

Job GTK.00268 – Particle Sizing Worksheet

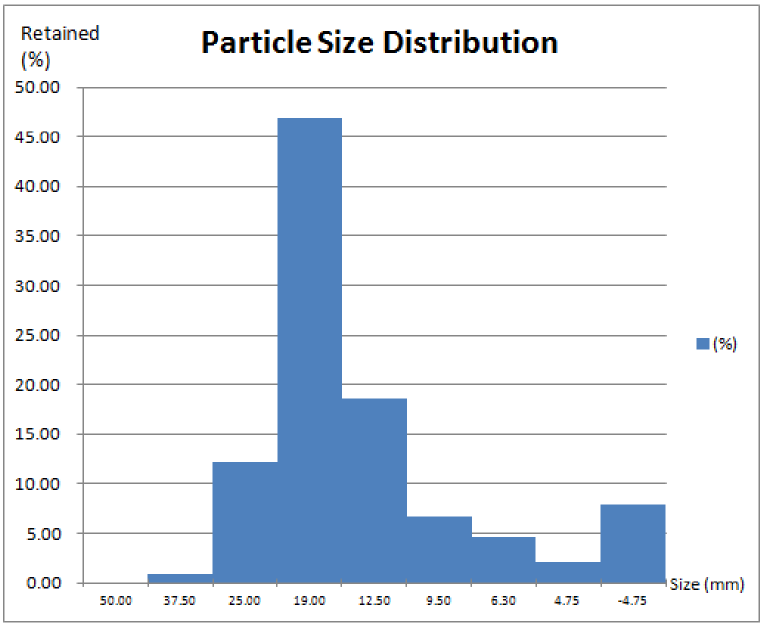
ASTM C 136	GT0220

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

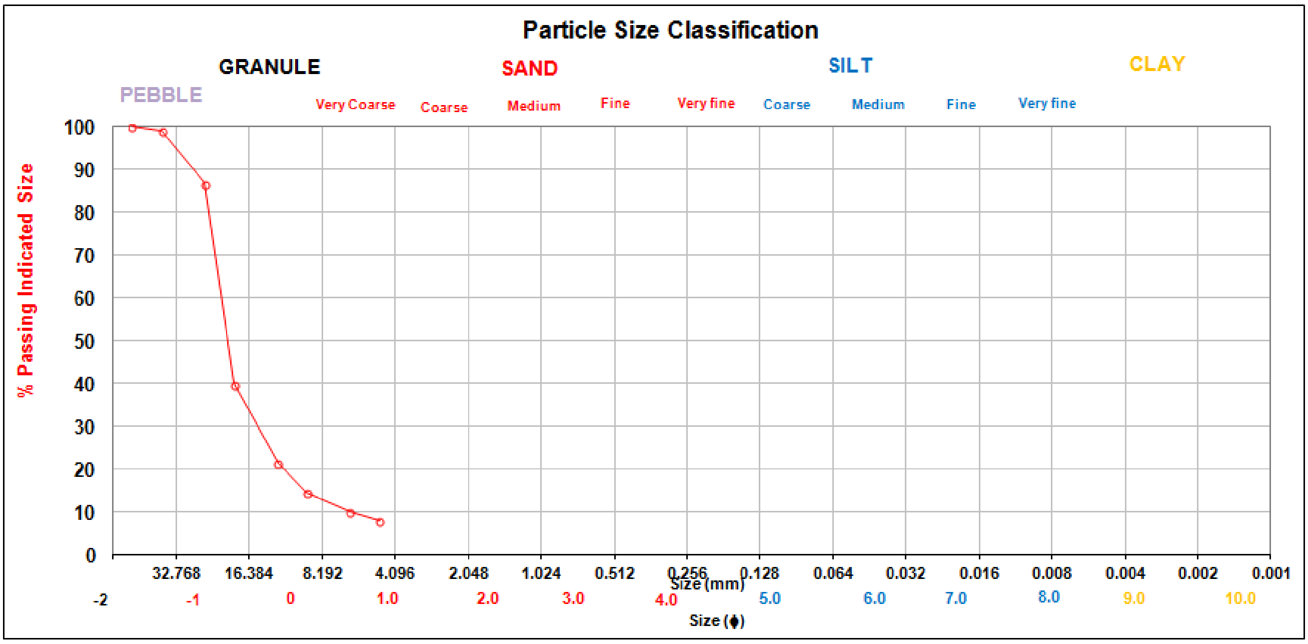
Job No :	GTK.00268	Sample ID :	10263 KDD 026	Date :	June 11, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan Mohamad

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13		50.00	0.00	0.00	100.00
14		37.50	145.00	0.95	99.05
15		25.00	1861.70	12.19	86.86
16		19.00	7167.60	46.92	39.94
17		12.50	2838.20	18.58	21.36
18		9.50	1017.20	6.66	14.71
19		6.30	703.60	4.61	10.10
20		4.75	326.80	2.14	7.96
21	PAN	-4.75	1216.00	7.96	



TOTAL 15276.10

D10 =	6.23	mm	D80 =	24.28	mm
D50 =	20.57	mm	D90 =	27.89	mm



Worksheet 22 – Job GTK.00268 – Particle Sizing Worksheet

Job GTK.00268 – Density – Relative Density and Absorption

PT. Geoservices
Geotechnical Laboratory

Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 127 (GT0226)

Client	**: PT Kaltara Batu Konstruksi**	**Tested By**	**: Ali**
Job ID	**: GTK.00268**	**Test Date**	**:23-06-2021**
Sample ID	**: 10267 KDD 032**	**Checked By**	**: Irsan/Anita**

	10267 KDD 032	
Weight of oven dried specimen, B_k	8700.9	g
Weight of saturated surface dry specimen, Bj	8873.5	g
Weight of the specimen in water (Ba)	5504.0	g

Perhitungan (Results)

Bulk	$\frac{Bk}{Bj - Ba}$	2.58	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2575.80**	kg/m^3
Saturated surface dry density	$\frac{Bj}{Bj - Ba}$	2.63	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**2626.89**	kg/m^3
Apparent Density	$\frac{Bk}{Bk - Ba}$	2.72	
	$\rho_{(997.5)} \frac{Bk}{Bk - Ba}$	**2714.86**	kg/m^3
Absorption	$\frac{Bj - Bk}{Bk}$ x 100 %	**1.98**	%

Worksheet 23 – Job GTK.00268 – Density, Relative Density and Absorption

Job GTK.00268 – Aggregate Flakiness and Elongation

PT. Geoservices
Geotechnical Laboratory

AGGREGATE FLAKINESS AND ELONGATION

ASTM D 4791 (GT0237 & GT0238)

Client	: PT.Kaltara Batu Konstruksi	**Tested Date**	: 28-07-2021
Job ID	: GTK.00268	**Tested By**	: Ali
Sample ID	: 10267 KDD 032	**Checked By**	: Irsan/Anita

Initial Weight : **13789.60** gram

Aggregate Size - Fraction	Retained Weight		Parameter								Remarks
	%	(g)	Flat Particles (FP)		Elongated Particles (EP)		Unflat & Unelongated Particles (UUP)		Calculation of Flat and Elongated Particles (FEP)		
			(g)	%	(g)	%	(g)	%	(g)	%	
a	b	c	d	e=(d/c)*100	f	g=(f/c)*100	h	i=(h/c)*100	j	k(j/c)*100	l
100.0 - 90.0	--	--	--	--	--	--	--	--	--	--	
90.0 - 75.0	--	--	--	--	--	--	--	--	--	--	
75.0 - 63.0	--	--	--	--	--	--	--	--	--	--	
63.0 - 50.0	--	--	--	--	--	--	--	--	--	--	
50.0 - 38.0	0.55	83.10	0.0	0.0	0.0	0.0	83.1	100.0	0.0	0.0	< 10% retained weight
38.0 - 25.0	27.28	4129.70	0.0	0.0	361.4	8.75	3768.3	91.25	361.4	8.75	
25.0 - 19.0	28.59	4329.20	32.9	0.8	66.4	1.53	4229.9	97.71	99.3	2.29	
19.0 - 12.5	20.80	3149.10	184.9	5.9	36.2	1.15	2928.0	92.98	221.1	7.02	
12.5 - 9.5	6.84	1035.30	84.5	8.2	5.1	0.5	945.7	91.3	89.6	8.7	< 10% retained weight
9.5 - 4.75	7.02	1063.20	83.8	7.9	18.9	1.8	960.5	90.3	102.7	9.7	< 10% retained weight
>10% retained weight — Total (Tb_{1-n})	76.7	11608.0									
Results			FP (%) $(b_1xe_1+b_2xe_2+b_3xe_3)/Tb_{1-n}$		EP (%) $(b_1xg_1+b_2xg_2+b_3xg_3)/Tb_{1-n}$		UUP (%) $(b_1xi_1+b_2xi_2+b_3xi_3)/Tb_{1-n}$		FEP (%) $(b_1xk_1+b_2xk_2+b_3xk_3)/Tb_{1-n}$		
			1.88		4.00		94.13		5.87		

Worksheet 24 – Job GTK.00268 – Aggregate Flakiness and Elongation

Appendix B.5 – Job GTK.00275 Worksheets

Job GTK.00275 – Moisture Content

PT. Geoservices
Geotechnical Laboratory

MOISTURE CONTENT TEST

ASTM C566 (GT0231)

Client Name : PT Kaltara Batu Konstruksi
Job ID : GTK.00275

Tested date : 10-08-2021
Tested by : Ali & Saenu

Sample Code	10270					
	KDD 039 (73-74)	KDD 031 (73-73.5)	KDD 039 (68-69)	KDD 039 (70-71)	KDD 031 (75.5-76)	KDD 039 (75-77)
Tray Weight, Wc (gr)	134.10	220.60	215.70	121.20	121.50	123.30
Mass of tray + wet sample, W_1 (gr)	3839.80	3151.50	3629.90	4029.00	3844.00	5148.60
Mass of tray + dry sample, W_2 (gr)	3781.80	3089.20	3578.60	3956.20	3769.60	5051.60
Mass of sample ($Wt= W_1-W_c$)	3705.70	2930.90	3414.20	3907.80	3722.50	5025.30
Mass of dry sample, ($Wd = W_2$- Wc)	3647.70	2868.60	3362.90	3835.00	3648.10	4928.30
Mass of water ($Ww = W_t-W_d$)	58.00	62.30	51.30	72.80	74.40	97.00
Moisture Content (%)	**1.59**	**2.17**	**1.53**	**1.90**	**2.04**	**1.97**
Average (%)	1.87					

Sample Code	10269			
	KDD 031 (72.35-73.00)	KDD 031 (74-75)	KDD 031 (76-77.10)	KDD 039 (72)
Tray Weight, Wc (gr)	429.30	129.00	119.20	128.20
Mass of tray + wet sample, W_1 (gr)	5076.30	4162.60	4515.10	4091.80
Mass of tray + dry sample, W_2 (gr)	4971.80	4078.30	4421.10	4019.90
Mass of sample ($Wt= W_1-W_c$)	4647.00	4033.60	4395.90	3963.60
Mass of dry sample, ($Wd = W_2$- Wc)	4542.50	3949.30	4301.90	3891.70
Mass of water ($Ww = W_t-W_d$)	104.50	84.30	94.00	71.90
Moisture Content (%)	**2.30**	**2.13**	**2.19**	**1.85**
Average (%)	2.12			

Worksheet 25 – Job GTK.00275 – Moisture Content

Job GTK.00275 – Los Angeles Abrasion

PT. Geoservices
Geotechnical Laboratory

RESISTANCE TO DEGRADATION OF AGGREGATE BY LOS ANGELES ABRASION

ASTM C131 (GT0233)

Client Name : PT Kaltara Batu Konstruksi
Job ID : GTK.00275
Sample ID : 10269; 10270

Date of test : 15-Oct-21
Tested by : Saenu
Checked by : Irsan/Anita

NO.	Sieve Size Passing (mm)	Sieve Size Retained on (mm)	Oven-Dry Mass (gr)	Mass after rotate (retained on the 1.70-mm) (gr)	The difference mass before and after rotate (gr)	Abrasion (%)	Remark
1	**10269**						
	# Grade A						
	37.50	25.00	1250.70				
	25.00	19.00	1250.20				
	19.00	12.50	1250.00				
	12.50	9.50	1250.30				
			5001.20	4248.10	753.10	15.06	x 100 Rotation
				2315.60	2685.60	53.70	x 500 Rotation
2	**10270**						
	# Grade A						
	37.50	25.00	1250.00				
	25.00	19.00	1250.00				
	19.00	12.50	1250.40				
	12.50	9.50	1250.00				
			5000.40	4496.50	503.90	10.08	x 100 Rotation
				2971.10	2029.30	40.58	x 500 Rotation

Worksheet 26 – Job GTK.00275 – Los Angeles Abrasion

Job GTK.00275 – Particle Sizing Worksheets

ASTM C 136	GT0220

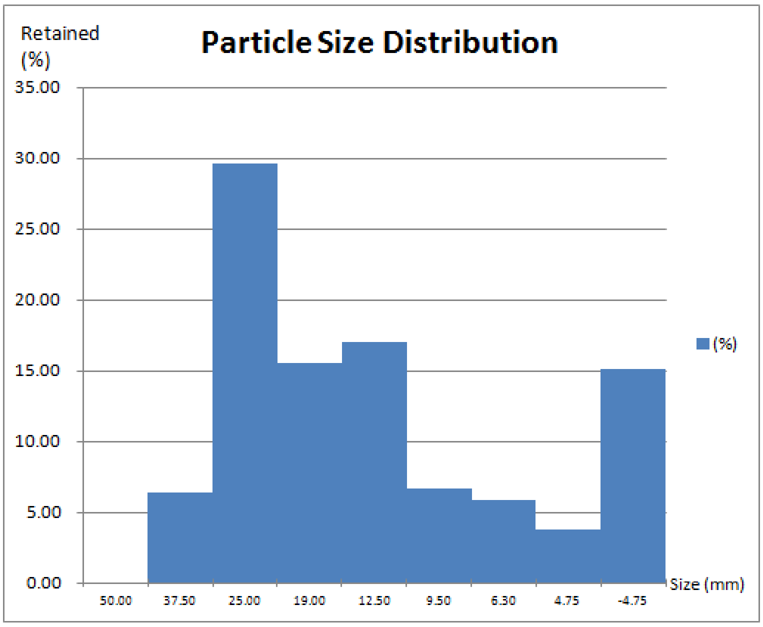
PT GEOSERVICES

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

PARTICLE SIZE DISTRIBUTION

Job No :	GTK.00275	Sample ID :	10269	Date :	August 18, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Ali, Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13		50.00	0.00	0.00	100.00
14		37.50	1045.40	6.41	93.59
15		25.00	4835.60	29.64	63.96
16		19.00	2531.60	15.52	48.44
17		12.50	2773.70	17.00	31.44
18		9.50	1095.40	6.71	24.73
19		6.30	952.80	5.84	18.89
20		4.75	617.00	3.78	15.11
21	PAN	-4.75	2465.20	15.11	

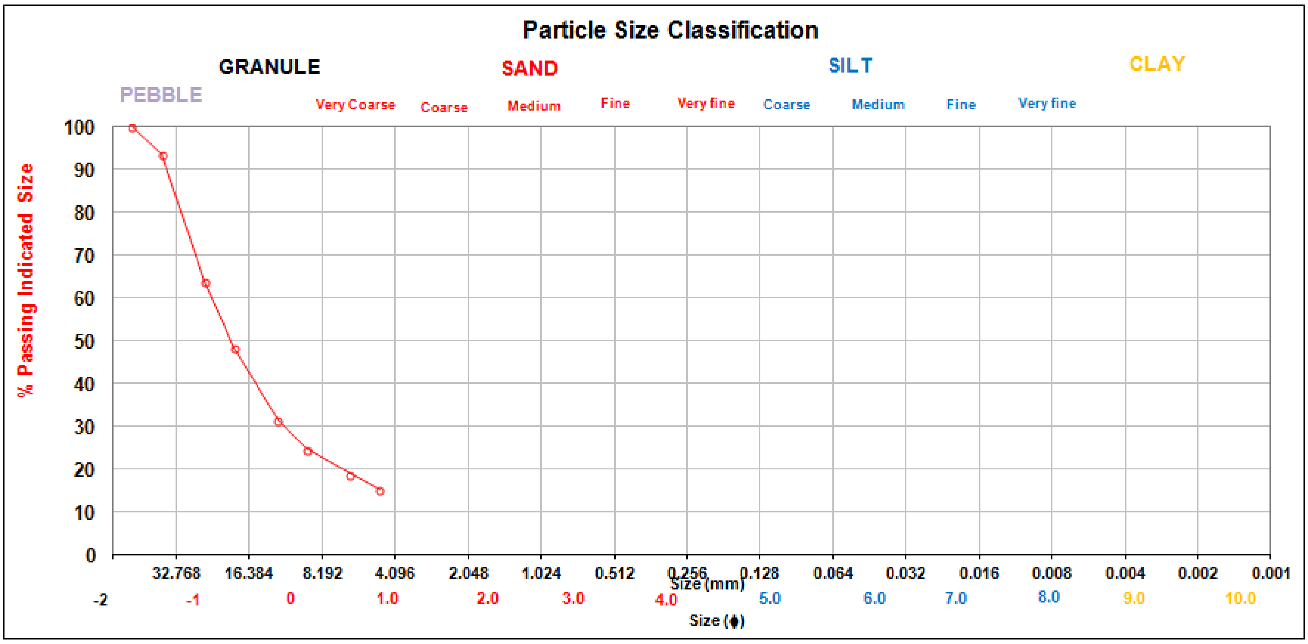


TOTAL 16316.70

D50 = 19.60 mm

D80 = 31.73 mm

D90 = 35.97 mm



ASTM C 136	GT0220

PT. GEOSERVICES - GEOTECHNICAL LABORATORY

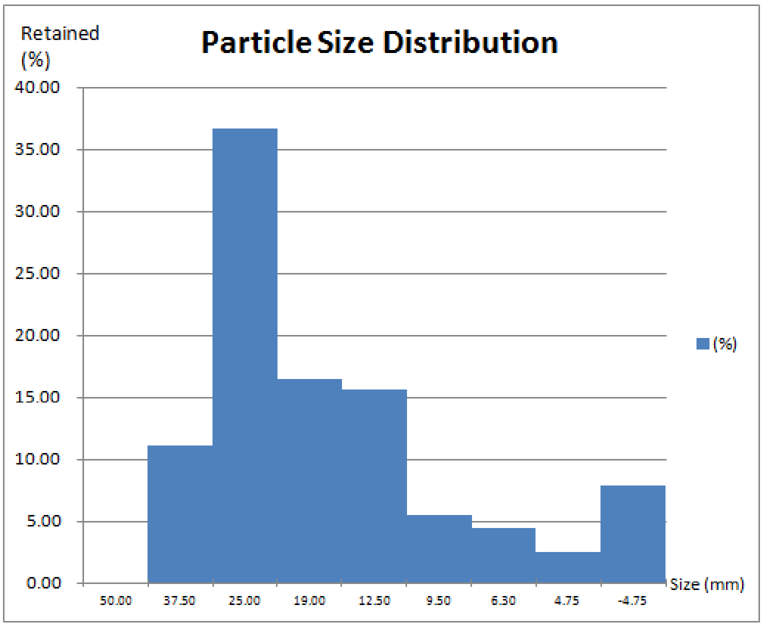
PARTICLE SIZE DISTRIBUTION

PT GEOSERVICES

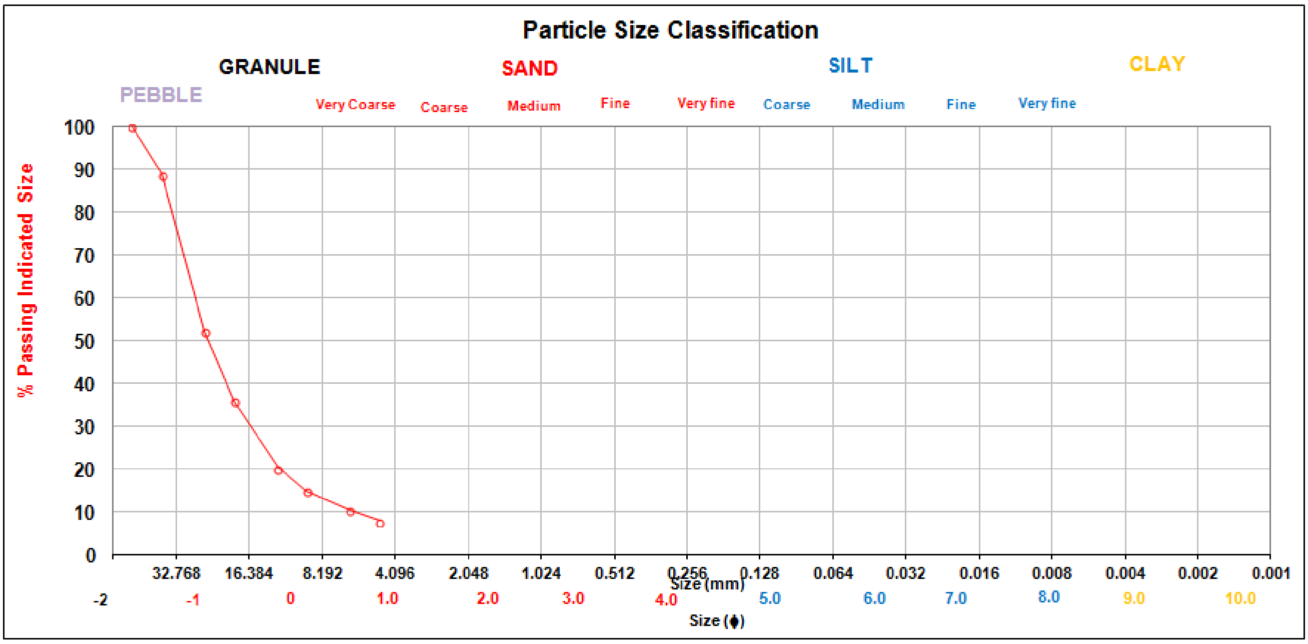
Job No :	GTK.00275	Sample ID :	10270	Date :	August 18, 2021
Client :	PT. Kaltara Batu Konstruksi	Method :	Dry	Operator :	Ali, Saenu
Project :	-	Grind Size :	As received	Checked by :	Irsan

i	Mesh #	Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)	Cumm. Passing (%)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13		50.00	0.00	0.00	100.00
14		37.50	2364.90	11.05	88.95
15		25.00	7845.70	36.67	52.28
16		19.00	3517.50	16.44	35.83
17		12.50	3332.20	15.57	20.26
18		9.50	1175.20	5.49	14.77
19		6.30	950.40	4.44	10.32
20		4.75	537.80	2.51	7.81
21	PAN	-4.75	1671.10	7.81	

TOTAL 21394.80



D10 =	6.10	mm	D80 =	34.59	mm
D50 =	24.20	mm	D90 =	38.60	mm



Worksheet 27 – Job GTK.00275 – Particle Sizing Worksheets

Job GTK.00275 – Density – Relative Density and Absorption

PT. Geoservices
Geotechnical Laboratory

Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 127 (GT0226)

Client	**: PT Kaltara Batu Konstruksi**	**Tested By**	**: Saenu**
Job ID	**: GTK.00275**	**Test Date**	**:18-10-2021**
Sample ID	**: 10269; 10270**	**Checked By**	**: Irsan/Anita**

	10269	10270	
Weight of oven dried specimen, B_k	7934.4	9280.5	g
Weight of saturated surface dry specimen, Bj	9170.5	9983.6	g
Weight of the specimen in water (Ba)	4320.4	5855.4	g

Perhitungan (Results)

	Formula	10269	10270	Unit
Bulk	$\frac{Bk}{Bj - Ba}$	1.64	2.25	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**1631.84**	**2242.45**	kg/m^3
Saturated surface dry density	$\frac{Bj}{Bj - Ba}$	1.89	2.42	
	$\rho_{(997.5)} \frac{Bk}{Bj - Ba}$	**1886.06**	**2412.34**	kg/m^3
Apparent Density	$\frac{Bk}{Bk - Ba}$	2.20	2.71	
	$\rho_{(997.5)} \frac{Bk}{Bk - Ba}$	**2189.97**	**2702.78**	kg/m^3
Absorption	$\frac{Bj - Bk}{Bk} \times 100\ \%$	**15.58**	**7.58**	%

Worksheet 28 – Job GTK.00275 – Density – Relative Density and Adsorption

Job GTK.00275 – Particle Shape – Elongation Index

PT. Geoservices
Geotechnical Laboratory

DETERMINATION OF PARTICLE SHAPE - ELONGATION INDEX

GT0238A BS 812 : Part 105.2 : 1990

Job ID	: GTK.00275		Date	:	October 5, 2021
Request from	: PT. Kaltara Batu Konstruksi		Tested by	:	Saenu
Sample ID	: 10269		Checked by	:	Irsan

Sample size : (-37.5+6.3mm)

Examination		Dry Weight = 13207.1 g
Screen Opening (mm)	Retained Weight (g)	Retained Weight (%)
63.0	0.0	0.00
50.0	0.0	0.00
37.5	1050.2	7.95
26.5	3629.7	27.48
19.0	3725.5	28.21
13.2	2214.8	16.77
10.0	1523.2	11.53
6.3	1063.7	8.05
Σ =	13207.1	100.00

Calculation									
Screen Opening	63.0	50.0	37.5	26.5	19.0	13.2	10.0	6.3	Unit
Slot			78.7	59.3	43.2	30.6	21.6	14.7	
Total Weight (M1)	13207.1								g
M2 (Total weight above 5 %)	0.0	0.0	1050.2	3629.7	3725.5	2214.8	1523.2	1063.7	g
	13207.1								
M4 F (Total weight retained the sieve of M4)	0.0	0.0	420.4	947.0	845.7	740.0	629.1	411.9	g
	3994.1								
Elongation Index (M4 F/M2) x 100	--	--	40.03	26.09	22.70	33.41	41.30	38.72	%
Average	33.71								%

PT. Geoservices
Geotechnical Laboratory

DETERMINATION OF PARTICLE SHAPE - ELONGATION INDEX

GT0238A BS 812 : Part 105.2 : 1990

Job ID	: GTK.00275		Date	:	October 5, 2021
Request from	: PT. Kaltara Batu Konstruksi		Tested by	:	Saenu
Sample ID	: 10270		Checked by	:	Irsan

Sample size : (-37.5+6.3mm)

Examination		Dry Weight = 19182.8 g
Screen Opening	Retained Weight	
(mm)	(g)	(%)
63.0	0.0	0.00
50.0	0.0	0.00
37.5	2365.3	12.33
26.5	5574.5	29.06
19.0	5787.9	30.17
13.2	2820.9	14.71
10.0	1547.1	8.07
6.3	1087.1	5.67
Σ =	**19182.8**	**100.00**

Calculation									
Screen Opening	**63.0**	**50.0**	**37.5**	**26.5**	**19.0**	**13.2**	**10.0**	**6.3**	**Unit**
Slot			78.7	59.3	43.2	30.6	21.6	14.7	
Total Weight (M1)	19182.8								g
M2 (Total Weight above 5 %)	0.0	0.0	2365.3	5574.5	5787.9	2820.9	1547.1	1087.1	g
	19182.8								
M4 F(Total weight retained the sieve of M4)	0.0	0.0	666.9	1505.9	2336.2	1024.7	691.2	426.0	g
	6650.9								
Elongation Index (M4 F/M2) x 100	--	--	**28.20**	**27.01**	**40.36**	**36.33**	**44.68**	**39.19**	**%**
Average	**35.96**								**%**

Worksheet 29 – Job GTK.00275 – Particle Shape – Elongation Index

Job GTK.00275 – Particle Shape – Flakiness Index

PT. Geoservices
Geotechnical Laboratory

DETERMINATION OF PARTICLE SHAPE - FLAKINESS INDEX

GT0238B BS 812 : Part 105.1 : 1989

Job ID	:	GTK.00275	Date	:	October 5, 2021
Request from	:	PT. Kaltara Batu Konstruksi	Tested by	:	Saenu
Sample ID	:	10269	Checked by	:	Irsan/Anita

Sample size : (-37.5+6.3mm)

Examination		Dry Weight = 13218.6 g
Screen Opening	Retained Weight	
(mm)	(g)	(%)
63.0	0.0	0.00
50.0	0.0	0.00
37.5	1050.5	7.95
26.5	3631.1	27.47
19.0	3725.8	28.19
13.2	2221.4	16.81
10.0	1524.3	11.53
6.3	1065.5	8.06
Σ =	**13218.6**	**100.00**

Calculation									
Screen Opening	**63.0**	**50.0**	**37.5**	**26.5**	**19.0**	**13.2**	**10.0**	**6.3**	Unit
Slot		100x33.9	90x26.3	80x19.7	60x14.4	50x10.2	40x7.2	30x4.9	
Total weight (M1)	13218.6								g
M2 (Total weight above 5 %)	0.0	0.0	1050.5	3631.1	3725.8	2221.4	1524.3	1065.5	g
	13218.6								
M3 F (Total weight passed the sieve of M2)	0.0	0.0	479.3	655.6	639.8	543.8	412.1	336.3	g
	3066.9								
Flakiness Index (M3 F/M2) x 100	--	--	**45.63**	**18.06**	**17.17**	**24.48**	**27.04**	**31.56**	**%**
Average	**27.32**								**%**

PT. Geoservices
Geotechnical Laboratory

DETERMINATION OF PARTICLE SHAPE - FLAKINESS INDEX

GT0238B BS 812 : Part 105.1 : 1989

JOB ID	: GTK.00275	**Date**	: October 5, 2021
Request from	: PT. Kaltara Batu Konstruksi	**Tested by**	: Saenu
Sample ID	: 10270	**Checked by**	: Irsan/Anita

Sample size : (-37.5+6.3mm)

Examination		Dry Weight = 19177.0 g
Screen Opening	**Retained Weight**	
(mm)	**(g)**	**(%)**
63.0	0.0	0.00
50.0	0.0	0.00
37.5	2365.3	12.33
26.5	5574.4	29.07
19.0	5787.4	30.18
13.2	2816.4	14.69
10.0	1547.6	8.07
6.3	1085.9	5.66
Σ =	**19177.0**	**100.00**

Calculation									
Screen Opening	**63.0**	**50.0**	**37.5**	**26.5**	**19.0**	**13.2**	**10.0**	**6.3**	
Slot		100x33.9	90x26.3	80x19.7	60x14.4	50x10.2	40x7.2	30x4.9	**Unit**
Total Weight (M1)	19177.0								g
M2 (Total weight above 5 %)	0.0	0.0	2365.3	5574.4	5787.4	2816.4	1547.6	1085.9	g
	19177.0								
M3 F (Total weight passed the sieve of M2)	0.0	0.0	1360.5	988.4	1322.3	613.0	532.9	569.5	g
	5386.6								
Flakiness Index (M3 F/M2) x 100	--	--	**57.52**	**17.73**	**22.85**	**21.77**	**34.43**	**52.44**	**%**
Average	**34.46**								**%**

Worksheet 30 – Job GTK.00275 – Particle Shape – Flakiness Index