# NI 43-101 Pre-Feasibility Technical Report Cerrado Verde Project, Minas Gerais, Brazil

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# 1. Summary

## 1.1 Introduction

Verde AgriTech Plc ("Verde AgriTech", "VERDE" or the "Company") commissioned BNA Mining Solutions (BNA) to prepare a Technical Report compliant with Canadian National Instrument 43-101 (NI 43-101) for a Pre-Feasibility Study (PFS) of the Cerrado Verde Project (the Project) located in Brazil.

The contract allows VERDE to file this report as a Technical Report with the Canadian Securities regulatory authorities pursuant to NI 43-101, Standards of Disclosure for Mineral Projects. Except for the purposes legislated under provincial securities law, any other uses of this report by any third party is done at that party's sole risk. The responsibility for any disclosure remains with VERDE. The user of this document should ensure that this is the most recent Technical Report for the property, as it is not to be considered valid if a new Technical Report has been issued.

This report provides mineral resource and mineral reserve estimates, as well as a classification of resources and reserves in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves: Definitions and Guidelines, May 10, 2014 (CIM).

This PFS supplants the Pre-Feasibility Study completed by BNA Consultoria e Sistemas ("BNA") and Andes Mining Services Limited (AMS) on December 2017 (the "2017 PFS"), with the objective of updating the information from the 2017 PFS regarding Verde's multinutrient potassium fertilizers, K Forte®, sold internationally as Super Greensand® (the "Product"), source of potash ("Potassium Oxide" or "$K_2O$"). Sulphur ("S"), and the micronutrients zinc, boron, copper and manganese (the "Micronutrients" or "Zn, B, Cu and Mn") are added to the Product to produce BAKS®, launched by the Company on December 15, 2020, which has a higher selling point. The additional elements contained in BAKS® allow VERDE to meet the specific demands for different crops and soil conditions, thereby boosting the overall Brazilian market serviceable by the Company's Products.

The mineral resource estimate completed in 2014 remains unchanged. The mining plan has been modified and covers three independent scenarios, to produce 10 million tonnes per year ("Mtpy"), 23 Mtpy and 50 Mtpy of the Product.

## 1.2 Property Description and Location

The Cerrado Verde Project is located in the Alto Paranaiba region of Minas Gerais State, Brazil, approximately 39 km to the east of the city of São Gotardo. São Gotardo is located approximately 320 km west of Belo Horizonte (the capital of the state of Minas Gerais) and is connected via a high-quality paved road (BR-262). From São Gotardo, the project area is accessed via secondary gravel roads which connect with the nearby farming region. Some of these will be paved with asphalt.

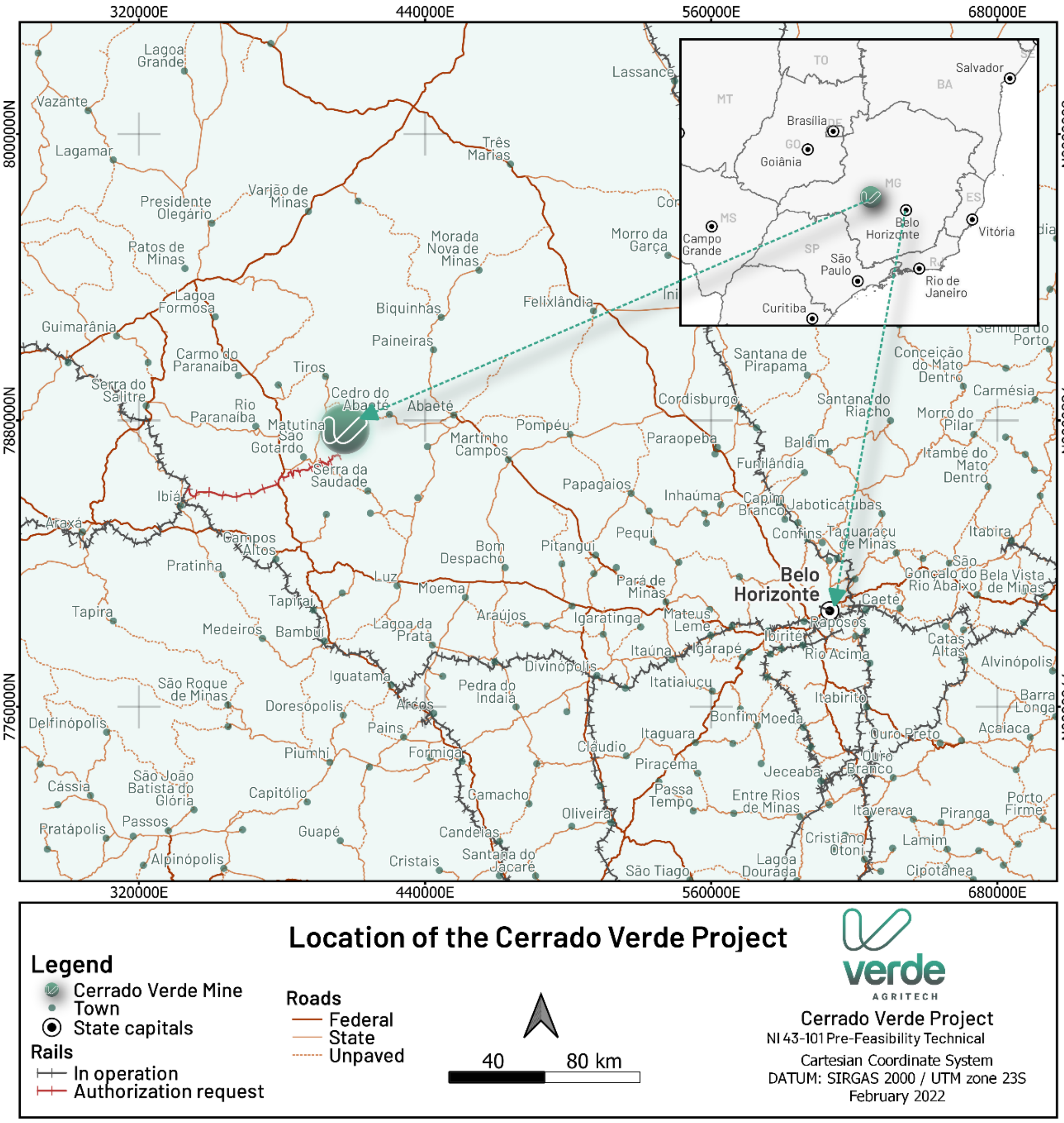


**Figure 1.2-1: Location Map of the Cerrado Verde Project**

The permit boundaries are defined by UTM coordinates with WGS84 datum (Zone 23S). The coordinates for a central point within the Cerrado Verde permits are: 7,856,500 N and 394,500 E.

The mineralized zones of the Cerrado Verde Project are composed of glauconitic siltstone units ("Ore") from the Serra da Saudade Formation, in the Bambuí Group. VERDE holds the permits that cover the area where the known mineralization is located.

## 1.3 Permit Status and Ownership

The area of the Cerrado Verde Project comprises a total of 30 granted exploration permits covering a total area of 45,734 ha. An application has been submitted for a permit for 2 additional areas, covering an additional area of 2,802 ha.

VERDE owns 100% of the Project through its Brazilian subsidiary companies (Verde Fertilizantes LTDA. and FVS Mineração LTDA). There was no previous ownership of the permits immediately before VERDE submitted its applications, with exception of the full transfer of the mining permits related to exploration permit number 830.383/2008. The company subsequently filed the necessary applications to obtain the rights to explore its permits.

## 1.4 Geology and Mineralization

The Cerrado Verde Project region is mainly underlain by Neoproterozoic and Cretaceous rock units, which are partially covered by Cenozoic sandstones, lateritic sediments and soils.

The thickness of the Ore varies between 15 m to 80 m, in the southernmost domain, to over 50 m, in the northern half of the Serra da Saudade range.

VERDE's permits run for the entire 120 km strike length and reach a potential width of up to 500 m.

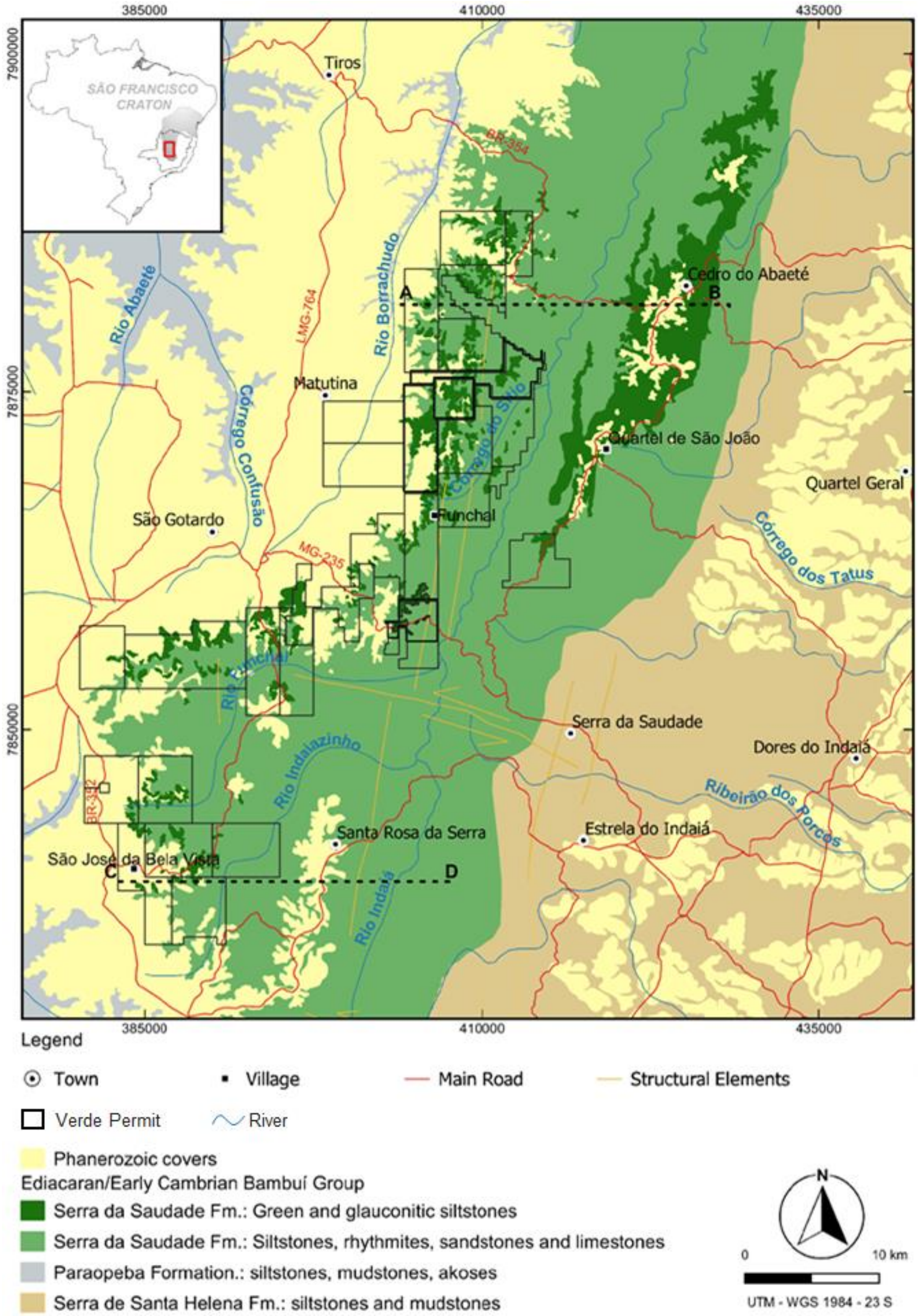


**Figure 1.4-1 Cerrado Verde regional geological setting (VERDE, February 24, 2022)**

Detailed mineralogical studies were performed using a combination of optical microscopy, X-ray diffraction, electron microprobe analysis and scanning electron microscopy, these determined that the Ore is a silty-clayed sedimentary rock. Despite the folds found in outcrops, no minerals, metamorphic structures or evidence of deformation were identified in the thin sections. The natural fragmentation in the outcrops is due to the fractures and bedding surfaces.

The Ore shows millimetric to centimetric-thick bands that are rich in glauconite, these are dark green in color and interbedded with quartz-rich layers.

Studies of thin cross sections of fresh samples of Ore identified: glauconite (40%-80%), K-feldspar (10%-15%), quartz (10%-60%), muscovite-sericite (5%), biotite (2%), titanium oxide (<1%), manganese oxide (<1%), goethite (<1%), barium phosphate and rare-earth element phosphates (trace amounts).

Enriched levels of potassium with $K_2O$ grades from 8% to 12% are associated with the glauconitic levels, which are dark green in color.

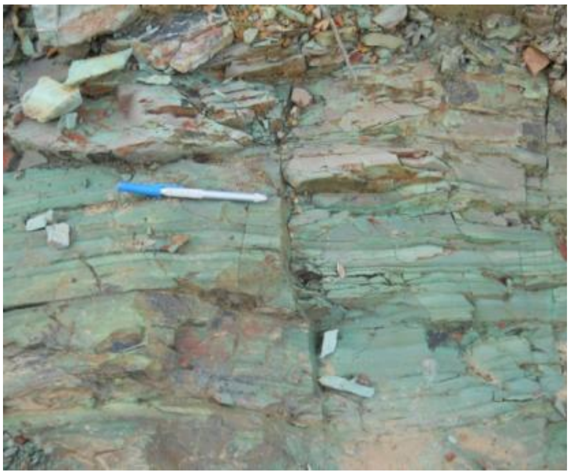

**Figure 1.4-2 Mineralized Glauconitic Siltstone Unit**

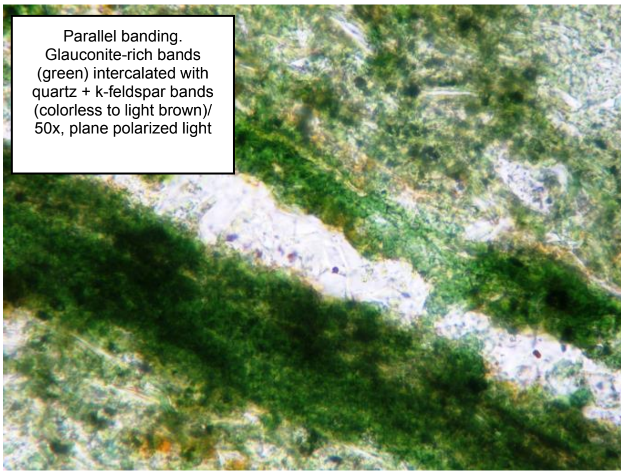


**Figure 1.4-3 Photomicrograph of sample CV DH 05 (32m – 34m)**

## 1.5 Exploration and Drilling

Until 2011, exploration work was focused on mineralized units across the Cerrado Verde permit areas, which are known as Target 1, Target 2, Target 3, Target 4, Target 5, Target 6, Target 7, Target 10, Target 11, Target 12, Target 13, Target 14, Target 16 and Target 17.

In 2012, exploration activities were concentrated on a select number of higher-grade $K_2O$ targets. Four specific areas were chosen based on the preliminary $K_2O$ grades from exploration drilling: target areas 7, 10 and 12 were selected, plus the area under permit number 830.383/2008, which was acquired by VERDE from a third party. Geological mapping suggests that these four target areas belong to a single Ore 'domain'. Subsequently, these 4 individual target areas were collectively grouped into a single target area known as Target 7.

A total of four drilling campaigns were completed across the areas covered by VERDE's exploration permits. VERDE drilled a total of 695 Reverse Circulation ("RC") holes totaling 40,225 m and 25 diamond core ("DC") holes totaling 1,717 m. Exploration drilling conducted throughout the 2012 field campaign focused entirely on testing $K_2O$ mineralization within the Target 7 mineralized domain.

## 1.6 Mineral Resource Estimate

The Cerrado Verde Project mineral resource estimate is based on 435 drill holes (26,609 m) drilled at a nominal spacing of approximately 200 m by 200 m (Figure 1.6-1). A total of 420 reverse circulation drill holes (25,563 m) and 15 diamond drill holes (1,046 m) have been completed.

The mineral resource estimate was focused on a flat-lying, sub-horizontal mineralized domain which has been defined at the surface and drill tested to the depth of the mineralization using a 6% $K_2O$ grade cut-off to guide the wireframe processing, as shown for Target 7 in Figure 1.6-1.

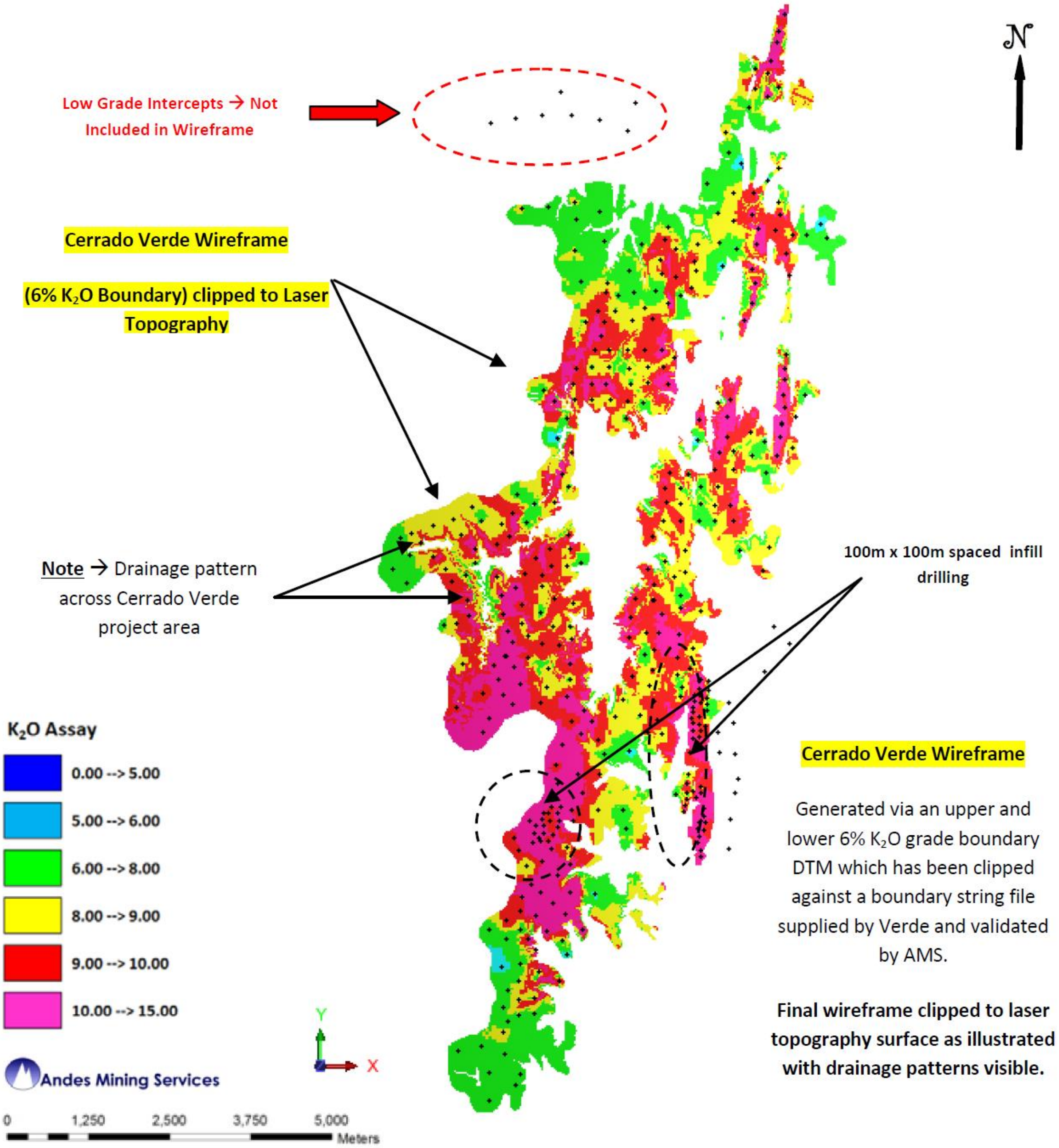


**Figure 1.6-1: Cerrado Verde Block Model Target 7– Coded by $K_2O$ Grade (Estimate) (AMS, March 28, 2014)**

A combined mineral resource statement that incorporates previously reported mineral resources completed by SRK Consulting ("SRK") has been prepared for the Cerrado Verde Project. A combined measured and indicated mineral resource of 1,472 Mt at 9.28% $K_2O$ (using a 7.5% $K_2O$ cut-off) and an inferred mineral resource of 1,850 Mt at 8.60% $K_2O$ (using a 7.5% $K_2O$ cut-off grade) (Figure 1.6-1) are reported for the Cerrado Verde Project.

The statement has been classified by Qualified Person Bradley Ackroyd (MAIG), in accordance with NI 43-101 and accompanying documents 43-101.F1 and 43-101.CP. It has an effective date of March 31, 2014.

**Table 1.6-1 Cerrado Verde Project – Measured, Indicated and Inferred Mineral Resource Grade Tonnage Report (AMS & SRK Consulting)**

| Target | Cut-Off (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| **Measured Resource Category** | | | |
| Target 7 | 7.5 | 83 | 10.13 |
| **Total Measured** | | **83** | **10.13** |
| **Indicated Resource Category** | | | |
| Target 6 | 7.5 | 23 | 8.83 |
| Target 7 | 7.5 | 1,366 | 9.24 |
| **Total Indicated** | | **1,389** | **9.23** |
| **Total Measured & Indicated** | | **1,472** | **9.28** |
| **Indicated Resource Category** | | | |
| Target 1 | 7.5 | 236 | 8.72 |
| Target 2 | 7.5 | 12 | 8.54 |
| Target 3 | 7.5 | 126 | 8.72 |
| Target 4 | 7.5 | 147 | 9.03 |
| Target 5 | 7.5 | 27 | 8.31 |
| Target 6 | 7.5 | 48 | 8.84 |
| Target 7 | 7.5 | 305 | 8.89 |
| Target 11 | 7.5 | 47 | 8.27 |
| Target 13 | 7.5 | 168 | 8.50 |
| Target 14 | 7.5 | 325 | 8.65 |
| Target 16 | 7.5 | 257 | 8.15 |
| Target 17 | 7.5 | 151 | 8.19 |
| **Total Inferred** | | **1,850** | **8.60** |

Mineral resources are not mineral reserves and do not have demonstrated economic viability.
Effective Date of the mineral resource estimate is March 31, 2014

## 1.7 Mineral Reserve Estimate

BNA studied the Cerrado Verde Project as a conventional open pit operation, with the following characteristics:

- Mining of both Ore and waste rock will be performed using hydraulic excavators. As a precautionary measure, it has been assumed that 80% of the Ore and waste rock will be mined after a drilling and blasting operation.
- Loading and hauling operations, including equipment maintenance, will be conducted by a mining contractor.

A series of economic pit shells were calculated using the Lerchs-Grossman algorithm through the application of the Revenue Adjustment Factor (RAF). This factor is applied to the selling price(s) of the product(s), in such a manner that a mathematical pit is generated for each applied factor. The selection of a final pit shell for mine design was based on an NPV maximization strategy.

The Project was divided into three distinct scenarios, with the following respective production rates and duration:

- Plant 3 Scenario: 10 Mt of final product per year, for 72 years.
- 23 Mtpy Scenario: 23 Mt of final product per year, for 31 years
- 50 Mtpy Scenario: 50 Mt of final product per year, for 26 years.

The expected mass recovery is 98%.

The Mineral Resources include the Mineral Reserves.

**Table 1.7-1 Mineable Reserve Results – 10 Mt Scenario and 23 Mt Scenario**

| | Proven Reserves | Probable Reserves | Total Reserves |
|---|---|---|---|
| **Tonnes (Mt)** | **68.45** | **647.22** | **715.67** |
| **$K_2O$ Grade (%)** | **10.44** | **9.96** | **10.01** |

(1) As of May 12, 2022.
(2) A cutoff grade of 9.0% $K_2O$ was used to report reserves.
(3) Overall strip ratio of 0.51 to 1.
(4) Waste contains inferred resources, which have the potential to be upgraded to higher category resources, and possibly reserves, after sufficient definition work has been completed.
(5) Based on 100% mining recovery.

**Table 1.7-2 Mineable Reserve Results – 50 Mt Scenario**

| | Proven Reserves | Probable Reserves | Total Reserves |
|---|---|---|---|
| **Tonnes (Mt)** | **80.63** | **1,217.037** | **1,297.66** |
| **$K_2O$ Grade (%)** | **9.96** | **9.14** | **9.19** |

(1) As of May 12, 2022.
(2) A cutoff grade of 7.5% $K_2O$ was used to report reserves.
(3) Overall strip ratio of 0.36 to 1.
(4) Waste contains inferred resources, which have the potential to be upgraded to higher category resources, and possibly reserves, after sufficient definition work has been completed.
(5) Based on 100% mining recovery.

## 1.8 Recovery Methods

The following items will describe the processes adopted for each of the 10 Mtpy, 23 Mtpy and 50 Mtpy scenarios. In all scenarios, the mined Ore will have a top size of 500 mm.

In these scenarios, the fertilizer production process consists of the comminution of Ore, which may or may not include other feedstocks. Sulphur and other micronutrients are added to the Product prior to milling, in different crop-specific proportions, to produce BAKS®, a mixed mineral fertilizer, using an exclusive elemental sulphur micronization technology called Micro S Technology®. The hammer mill performs the Ore's comminution in to powder granulometry and, where applicable, mixes additional raw materials, resulting in a uniform product in granulometric and chemical terms. After passing through the hammer mill's screens, the particles exit the process with a powder granulometry.

## 1.9 Market Study

The Market Study calculated the potential Brazilian agricultural market for $K_2O$, Sulphur, and Micronutrients. Sulphur and Micronutrients are added to the Product to produce BAKS®, a product launched by the Company on December 15, 2020, which has a higher selling point. The additional elements contained in BAKS® allow VERDE to meet the specific demands of different crops and soil conditions, thereby boosting the overall Brazilian market serviceable by the Product.

Future demand estimates for nutrients relied on the parameters of total planted area, type of crop and productivity. In addition, the study also considered the percentage of producers that apply each nutrient, considering crop requirements, supply and fertilization alternatives. These criteria were used to calculate the demand for potash, sulphur, and micronutrients in each state in Brazil.

The study detailed the share of the Brazilian potash market that the project would be able to supply. VERDE would supply 13.51%, 31.07% and 54.97% of the Brazilian potash market under Plant 3 Scenario, 23 Mtpy Scenario and 50 Mtpy Scenario, respectively. Table 1.9-1 presents a history of $K_2O$ consumption in Brazil from 2000 to 2020, along with projected consumption in 2030 and 2070.

**Table 1.9-1 Historical $K_2O$ consumption in Brazil**

| Year | $K_2O$ Consumption in Brazil (tonnes) |
|---|---|
| 2000 | 2,713,562 |
| 2010 | 3,999,706 |
| 2020 | 6,810,773 |
| 2030 | 8,358,971 |
| 2070 | 12,499,412 |

Sources: ANDA (Potash consumption from 2000 to 2020) and Tec-Fértil, 2022 (Potash demand forecast up to 2070)

According to the study, the project would be able to supply 11.61% of the Brazilian Sulphur market in the Plant 3 Scenario, 27.32% in the 23 Mtpy Scenario and 53.78% in the 50 Mtpy Scenario. Table 1.9-2 presents an estimated consumption figure for Sulphur in 2020, along with projected consumption through to 2070, according to agribusiness growth forecasts.

**Table 1.9-2 Sulphur consumption in Brazil**

| Year | Sulphur consumption in Brazil (tonnes) |
|---|---|
| 2020 | 1,794,297 |
| 2030 | 2,239,164 |
| 2070 | 3,348,286 |

Source: Tec-Fértil, 2022 (Calculation of sulphur consumption in 2020 and sulphur demand forecast for 2070)

The study detailed the share of the Brazilian market for micronutrients that the project will be able to supply in the three production scenarios, as shown in Table 1.9-3.

**Table 1.9-3 Targeted market share for Zn, B, Cu and Mn in Brazil**

| Micronutrient | | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|
| Market share | Plant 3 Scenario (10 Mtpy) | 12.94% | 18.02% | 12.53% | 8.87% |
| | 23 Mtpy Scenario (23 Mtpy) | 29.32% | 37.77% | 30.35% | 24.49% |
| | 50 Mtpy Scenario (50 Mtpy) | 55.73% | 62.68% | 54.77% | 56.06% |

Source: Tec-Fértil, 2022.

Table 1.9-4 presents an estimated consumption figure for Micronutrients in 2020, along with projected consumption through to 2070, according to agribusiness growth forecasts.

**Table 1.9-4 Micronutrients consumption in Brazil**

| Year | Brazilian Consumption (tonnes) | | | |
|---|---|---|---|---|
| | Zinc | Boron | Copper | Manganese |
| 2020 | 25,315 | 26,831 | 5,382 | 10,310 |
| 2030 | 31,967 | 34,301 | 6,793 | 13,265 |
| 2070 | 47,801 | 51,291 | 10,158 | 19,836 |

Sources: Tec-Fértil, 2022 (Calculation of micronutrients consumption in 2020 and micronutrients demand forecast for 2070).

The value of the Product's $K_2O$ content was calculated based on the cost of KCl, considering the applicable logistic costs from its arrival at Brazilian ports through to delivery to the final customer. The estimated price for KCl CFR Brazil port adopted for the study was US$368.65. The average cost for KCl delivered to farmers was calculated at US$539.16.

**Table 1.9-5 Breakdown of KCl cost per tonne delivered to the farmer**

| Description | Weighted Average for Brazil | |
|---|---|---|
| | Amount in US$ | Amount in R$ |
| FOB Long-term price (Baltic Sea/ Vancouver/ Ashdod) | 333.65 | 1,768.35 |
| Sea freight long-term | 35.00 | 185.50 |
| **Subtotal - CFR Brazil Port Price** | **368.65** | **1,953.85** |
| Brazil Port costs[1] | 25.07 | 132.87 |
| Demurrage | 6.00 | 31.80 |
| AFRMM[2] Tax | 8.75 | 46.38 |
| Cost of transportation from ports in Brazil to distributors | 37.21 | 197.22 |
| Average added by dealer / distributor | 81.48 | 431.85 |
| Average distributor - producer transportation cost | 12,00 | 63.60 |
| **Total - Weighted average delivered to farmers** | **539.16** | **2,857.57** |

Source: Tec-Fértil, 2022

[1] The port costs of and transport costs from the port to the distributor, are represented by the weighted average, considering the demand in tonnes at each port in Brazil

[2] Additional Freight for the Renewal of the Merchant Marine. This is an additional charge on freight levied by Brazilian and foreign shipping companies operating in Brazilian ports based on the bill of lading and the cargo manifest. It concerns long-haul navigation, cabotage, river and lake navigation and deals exclusively with transportation of bulk cargoes in the North and Northeast regions.

Despite the Product's inherent qualities as a multi-nutrient product, the calculation of the price per tonne of Product was based on its $K_2O$ content equivalent, without contemplating the additional nutrients and benefits that it delivers. KCl has 60% $K_2O$ content, whereas the product has a 10% $K_2O$ content. Therefore, considering the concentration of potash in the product, a farmer would pay approximately 6 times less per tonne of product than they would pay per tonne of KCl. As a result, farmers would pay US$89.86 per tonne of the Product.

**Table 1.9-6 Product price x KCl price**

| Product | KCl | The Product Plant 3 Scenario | The Product 23 Mtpy Scenario | The Product 50 Mtpy Scenario |
|---|---|---|---|---|
| **Composition** | 60% $K_2O$ | 10% $K_2O$ | 10% $K_2O$ | 9.19% $K_2O$ |
| **Price per tonne** | US$ 539.16 | US$89.86 | US$89.86 | US$82.58 |

Source: Tec-Fértil, 2022.

For the purposes of the PFS, the Company has assumed pricing for the Product's $K_2O$ content at a 5% discount compared with conventional KCl. Additionally, a discount factor was applied depending on the cost of applying the Product, as part of VERDE's market strategy to accelerate Product trial and adoption across different crops in Brazil's market.

The value of the Product's sulphur content was calculated based on the sale price of sulphur from S-bentonite, a widely available source of sulphur. The price for the Study was estimated at US$ 410.40 per tonne of S-bentonite. The feedstock purchased and beneficiated by Verde to produce fertilizer grade sulphur is elemental sulphur (S-Elemental). The price for the Study was estimated at US$ 263.97 per tonne for the feedstock.

**Table 1.9-7 Long-term Price composition of the feedstock and similar source of sulphur**

| Description | Feedstock product | Similar product |
|---|---|---|
| Material | Elemental sulphur | S-bentonite |
| Concentration of nutrient (%) | 99.99 | 90.00 |
| **Price (US$ / per percentage point per tonne of fertilizer, "ppt")** | **2.34** | **4.56** |

Source: Tec-Fértil, 2022.

The micronutrient pricing was based on the average individual amounts of each micronutrient, in kilograms per hectare, as applied for different crops in different regions of Brazil based on fertilization needs and alternatives. Soybeans, corn, coffee, cotton and sugarcane, require a large number of micronutrients.

**Table 1.9-8 Micronutrients' feedstock sources for the Product**

| Description | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|
| Feedstocks | Zinc oxide | Ulexite | Copper oxide | Manganese oxide |
| Concentration of nutrient (%) | 20.00 | 10.00 | 20.00 | 55.00 |
| **Cost (US$/ppt)** | **17.14** | **40.00** | **111.76** | **10.70** |

Source: Tec-Fértil, 2022.

**Table 1.9-9 Long-term cost of similar sources of micronutrients including soil application cost**

| Description | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|
| Similar products | Zinc | Boron | Copper | Manganese |
| Concentration (%) | 10.00 | 10.00 | 20.00 | 10.00 |
| **Price (US$/ppt)** | **40.00** | **113.0** | **135.00** | **12.00** |

Source: Tec-Fértil, 2022.

The amount paid by farmers per tonne of Product as a source of $K_2O$ plus sulphur and micronutrients varies according to the intended concentration of each nutrient. A weighted average price assumed for this Product as a source of $K_2O$ plus sulphur and micronutrients delivered to farms wasUS$109.19 per tonne.

## 1.10 Indicative Economics

As part of the verification process for the reserves presented in this report, BNA conducted an economic valuation of the Cerrado Verde Project for the material classified as reserves. This section outlines the capital and operating costs considered in this valuation. All costs are based on a conversion rate of US$1.00 = R$5.30.

The PFS covers three distinct production scenarios:

- Annual production of 10 Mtpy ("Plant 3 Scenario"), representing 13.51% of the Brazilian potash market demand projected for 2025.
- Annual production of 23 Mtpy ("23 Mtpy Scenario"), representing 31.07% of the Brazilian potash market demand projected for 2025.
- Annual production of 50 Mtpy ("50 Mtpy Scenario"), representing 54.97% of the Brazilian potash market demand projected for 2030.

The total capital cost for the project (with a nominal accuracy of -25% to +25% and including a 15% contingency) is estimated at US$ 52.77 million for the Plant 3 Scenario, US$ 129.84 million for the 23 Mtpy Scenario and US$ 553.99 million for the 50 Mtpy Scenario, as summarized in Table 1.10-1.

**Table 1.10-1 Capital Cost Summary**

| Description | Investment (US$ million) | | |
|---|---|---|---|
| | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
| **Processing plant** | | | |
| Plants | 29.38 | 70.60 | 111.17 |
| Belt Conveyor and loading wagons | N/A | N/A | 28.49 |
| Unloading of wagons | N/A | N/A | 19.12 |
| **Processing subtotal** | **29.38** | **70.60** | **158.78** |
| Road improvement | 10.57 | 30.88 | 6.80 |
| Railway branch line | N/A | N/A | 283.02 |
| Owner’s cost | 5.93 | 11.42 | 33.13 |
| **Subtotal** | **45.89** | **112.90** | **481.73** |
| Contingencies (15%) | 6.88 | 16.93 | 72.26 |
| **TOTAL CAPEX** | **52.77** | **129.84** | **553.99** |

Source: MINALAC, 2022

Operating costs were estimated based on preliminary mine and process design criteria and engineering, as well as on budgetary quotes. Operating costs are calculated to a PFS-level of accuracy and are expected to have an accuracy of ±25%, including a 15% contingency. A summary of expected operating costs for each Scenario is presented on Table 1.10-2. Table 1.10-3 to Table 1.10-5 present a summary of a financial-economic analysis of the three Scenarios.

**Table 1.10-2 Operating Cost Summary**

| Description | Operating Costs (US$/tonne of Product) | | |
|---|---|---|---|
| | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
| Mining | 4.55 | 4.24 | 4.48 |
| Processing | 2.07 | 2.38 | 2.01 |
| Sales and marketing expenses | 3.08 | 2.16 | 1.59 |
| General Expenses | 1.12 | 0.66 | 0.41 |
| Others | 0.34 | 0.29 | 0.26 |
| Contingency (15%) | 1.67 | 1.46 | 1.31 |
| **Total** | **12.83** | **11.18** | **10.07** |

Source: BNA, MINALAC, U&M, VERDE, 2022

**Table 1.10-3 Summary of the financial-economic analysis for the Plant 3 Scenario**

| Plant 3 Scenario | | | | |
|---|---|---|---|---|
| **Description** | **Unit** | **Value** | | |
| Proven and probable reserves | million tonnes | 715.67 | | |
| $K_2O$ grade | % | 10.01 | | |
| CAPEX | US$ million | 52.77 | | |
| Operating cost | US$/tonne of Product | 12.83 | | |
| Sustaining capital | US$/tonne of Product | 0.50 | | |
| | | | | |
| **Product composition** | **Unit** | **$K_2O$** | **$K_2O$ + S** | **$K_2O$ + S + Micronutrients** |
| Product Sale Price | US$/tonne of Product | 80.75 | 91.54 | 100.21 |
| NPV after-tax | US$ billion | 2.91 | 3.41 | 3.97 |
| NPV discount rate | % | 8.00 | 8.00 | 8.00 |
| IRR after-tax | % | 427.17 | 482.93 | 560.86 |
| Cumulative Cash Flow | US$ billion | 17.05 | 19.97 | 23.22 |

**Table 1.10-4 Summary of the financial-economic analysis for the 23 Mtpy Scenario**

| 23 Mtpy Scenario | | | | |
|---|---|---|---|---|
| **Description** | **Unit** | **Value** | | |
| Proven and probable reserves | million tonnes | 715.67 | | |
| $K_2O$ grade | % | 10.01 | | |
| CAPEX | US$ million | 129.84 | | |
| Operating cost | US$/tonne of Product | 11.18 | | |
| Sustaining capital | US$/tonne of Product | 0.50 | | |
| | | | | |
| **Product composition** | **Unit** | **$K_2O$** | **$K_2O$ + S** | **$K_2O$ + S + Micronutrients** |
| Product Sale Price | US$/tonne of Product | 80.72 | 91.66 | 99.90 |
| NPV after-tax | US$ billion | 5.81 | 6.84 | 7.95 |
| NPV discount rate | % | 8.00 | 8.00 | 8.00 |
| IRR after-tax | % | 387.11 | 437.95 | 505.02 |
| Cumulative Cash Flow | US$ billion | 16.14 | 19.02 | 22.07 |

**Table 1.10-5 Summary of the financial-economic analysis for the 50 Mtpy Scenario**

| 50 Mtpy Scenario | | | | |
|---|---|---|---|---|
| **Description** | **Unit** | **Value** | | |
| Proven and probable reserves | million tonnes | 1,297.66 | | |
| $K_2O$ grade | % | 9.19 | | |
| CAPEX | US$ million | 553.99 | | |
| Operating cost | US$/tonne of Product | 10.07 | | |
| Sustaining capital | US$/tonne of Product | 0.50 | | |
| | | | | |
| **Product composition** | **Unit** | **$K_2O$** | **$K_2O$ + S** | **$K_2O$ + S + Micronutrients** |
| Product Sale Price | US$/tonne of Product | 74.05 | 84.79 | 92.05 |
| NPV after-tax | US$ billion | 9.34 | 11.50 | 13.54 |
| NPV discount rate | % | 8.00 | 8.00 | 8.00 |
| IRR after-tax | % | 167.86 | 196.19 | 227.08 |
| Cumulative Cash Flow | US$ billion | 22.74 | 28.04 | 32.98 |

VERDE selected the 50 Mtpy Scenario for further detailing, with the Product composition of $K_2O$ + S + Micronutrients. The results of the economic-financial analysis for this scenario indicates that the project should produce the strongest results, with an average cash generation (EBITDA) corresponding to approximately 47% of the gross revenue of the enterprise during the first 10 years and an NPV discounted at 8% p.a. of 8.31 billion dollars. In addition, considering the useful life of the mine and, consequently, of the enterprise, the discounted NPV corresponds to 13.54 billion dollars. The IRR chosen for the scenario corresponds to 227.08% of the total CAPEX for the project, both for the first 10 years and for the life of the mine.

## 1.11 Conclusions and Recommendations

An update to the 2017 Pre-Feasibility evaluations has been completed for the Cerrado Verde Project in São Gotardo, Minas Gerais, Brazil. The results of the study indicate that the product can be produced at the desired purity level and that there is demand in the market for its use as a fertilizer.

Recommendations for future work programs and costs are provided below. The financial results for the project justify advancing and refining the Pre-Feasibility engineering designs to the feasibility level within the next 12 to 18 months. BNA recommends that VERDE undertakes the following activities:

- Additional RC Drilling aimed at improving the classification of portions of the indicated mineral resources to measured mineral resources in areas identified as targets for the mining start.
- A geotechnical study to evaluate the stability of the final pit and waste rock piles.
- Evaluation of the impact of the waste rock piles, which are located inside the exhausted pits, on the remaining mineral resource.
- Trade-off studies focused on new locations for the primary crusher and expansion of the belt conveyor with the goal of reducing the hauling cost.
- Extension of the existing hydrogeological study to cover the entire project area.

- A detailed study of the blasting operation for both ore and waste rock mining.
- A detailed study of the external access roads leading to the pit to minimize hauling distances and the amount of cut and fill required for their construction, taking into consideration the rugged relief of the region.
- Detailed quotes for the execution of the mining activities.
- An evaluation of the use of road trucks with trailers for ore haulage to reduce hauling costs.

BNA also recommends that the geological survey be detailed in the areas where mining is planned in the first 5 years of the project, to convert probable reserves into proven reserves. Due to the large area of the project and the rugged terrain, BNA recommends that the designs for the external roads to the pits for the chosen scenario be detailed, to reduce the average transport distances for the project. In addition, once the mining plans have been detailed, it may be possible to minimize the transport distances for the overburden by planning and detailing overburden piles located inside the exhausted pits.

Additional elements of the recommended work program include environmental permit application support, marketing studies, more comprehensive metallurgical testing and a more detailed evaluation of process equipment and infrastructure.

The cost of the recommended work programs is estimated at US$4.46 million and is presented in Table 1.11-1.

**Table 1.11-1 Feasibility Study Work Program**

| Activity | Total (US$ x 1,000) |
|---|---:|
| Engineering Studies | 3,125 |
| Administration | 375 |
| Geotechnical Drilling | 177 |
| Environmental Studies | 278 |
| Additional RC Drilling | 500 |
| **Total** | **4,455** |

It is recommended that sequencing be started in regions where the mineral reserves are classified as proven, to reduce uncertainty in the first years of operation. In this project, measured mineral resources are located entirely in the southern part of the deposit. A mining plan that initiated with and focused on these areas would thus alter the entire strategy foreseen for the project, especially for the Plant 3 Scenario. A decision has therefore been taken to continue with the planned mining strategy. For the next study planned, the Feasibility Study (FS), it is recommended that additional drilling be undertaken in the areas where mining is planned in the first years, to transform this resource into a measured resource and therefore into proven mineral reserves, after the consideration of all modifying factors.

# 2. Introduction

## 2.1. Terms of Reference and Purpose of the Report

VERDE commissioned BNA to prepare a Technical Report compliant with Canadian National Instrument 43-101 (“NI 43-101”) for a Pre-Feasibility Study (“PFS”) of the Cerrado Verde Project (or the “Project”).

The Cerrado Verde Project, located in the heart of Brazil’s largest agricultural market, is the source of naturally occurring potassium silicate rock from which the Company produces the Product. The Company remains focused on the expansion of the Cerrado Verde Project.

The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in the Consultant’s services, based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended for use by VERDE, subject to the terms and conditions of its contract with the Consultant and relevant securities legislation. The contract permits VERDE to file this report as a Technical Report with the Canadian Securities regulatory authorities pursuant to NI 43-101, Standards of Disclosure for Mineral Projects. Except for the purposes legislated under provincial securities law, any other uses of this report by any third party are at that party’s sole risk. The responsibility for this disclosure remains with VERDE. The user of this document should ensure that this is the most recent Technical Report for the property, as it is not valid if a new Technical Report has been issued.

This report provides Mineral Resource and Mineral Reserve estimates, as well as a classification of resources and reserves in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves: Definitions and Guidelines, May 10, 2014 (CIM).

The company’s Ordinary Shares trade on the Toronto Stock Exchange (“TSX”) in Canada under the symbol “NPK” and the New York Open Transparent Connected Venture Market (“OTCQB”) under the symbol “AMHPF”.

The VERDE's structure chart (Figure 2.1-1) comprises the companies Verde Fertilizantes Ltda (“Verde Fertilizantes”) and FVS Mineração Ltda (“FVS”), headquartered in Brazil, and Verde AgriTech PLC and GB01N Limited, headquartered in England. VERDE and FVS together own 100% of the Cerrado Verde Project.

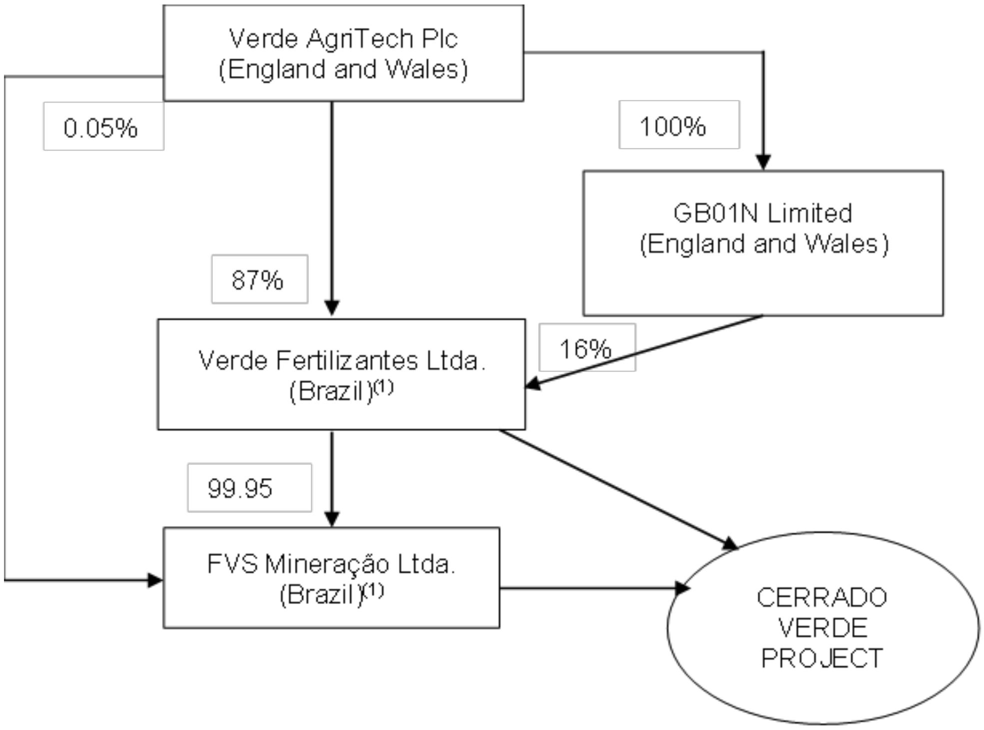


**Figure 2.1-1: Verde AgriTech PLC structure chart**

Verde AgriTech is an agri-tech company with mineral exploration and mining properties in Brazil. The principal activity of the company is the production and sale of a multinutrient potassium fertilizer marketed in Brazil as K Forte® and internationally as Super Greensand® (the Product).

In November 2017, the company concluded a PFS, which evaluated the technical and financial aspects of producing 25 million tonnes per year ("Mtpy") of the product divided into three phases: Phase 1 ("0.6Mtpy"); Phase 2 ("5Mtpy") and Phase 3 ("25Mtpy"). The proposed scalable development is predicated on production growth being financed largely from expected internal cash flow.

This new PFS updates the reserves and economic assessment, including a new product named BAKS®, which is a combination of the Product and other nutrients that can be chosen by customers according to the needs of their crops.

## 2.2. Qualifications of Consultants

The consultants preparing this technical report are specialists in the fields of geology, exploration, mineral resource and mineral reserve estimation and classification, mining, geotechnical studies and work, environmental studies and work, permitting, metallurgical testing, mineral processing, processing design, capital and operating cost estimation and mineral economics.

The following individuals, by virtue of their education, experience and professional association, are considered Qualified Persons ("QP") as defined in the NI 43-101 standard and are members in good standing of appropriate professional institutions.

- Bradley Ackroyd. B.Sc., MAIG, principal consulting geologist for AMS, responsible for the resource estimates.
- Beck Nader. D.Sc., M.Sc., FAIG, Senior Advisor at BNA, responsible for the reserve estimates, processing and economical assessment.

The Certificate of Author forms are provided in Section 30.

The responsibilities of the QPs during the preparation of the different sections of this Technical Report are shown in Table 2.2-1.

**Table 2.2-1 Authors Responsibilities**

| Author | Responsible for Preparation of Section/s |
|---|---|
| Beck Nader | 1. Summary; 2. Introduction; 3. Reliance on Other Experts; 4. Property Description and Location; 5. Accessibility, Climate, Local Resources, Infrastructure and Physiography; 6. History; 13. Mineral Processing and Metallurgical Testing; 15. Mineral Reserve Estimates; 16. Mining Methods; 17. Recovery Methods; 18. Project Infrastructure; 19. Market Studies and Contracts; 20. Environmental Studies, Permitting and Social or Community Impact; 21. Capital and Operating Costs; 22. Economic Analysis; 23. Adjacent Properties; 24. Other Relevant Data and Information; 25. Interpretation and Conclusions; 26. Recommendations; 27. References |
| Bradley Ackroyd | 7. Geological Setting and Mineralization; 8. Deposit Types; 9. Exploration; 10. Drilling; 11. Sample Preparation, Analyses and Security; 12. Data Verification; 14. Mineral Resource Estimates; 26. Recommendations; 27. References |

Other consultants who contributed to this report, including the review of the Cerrado Verde Project Pre-Feasibility Study included:

- Hudson Burgarelli. M.Sc., Mining Engineer at BNA.
- Laís Nametala, M.Sc., Mining Engineer at BNA.
- Luis Antonio Camilotti, Engineer at L.A. Camilotti ME ("MINALAC")
- José Francisco da Cunha, Agronomist at Tec-Fértil Agroconsultoria e Negócios Ltda ("Tec-Fértil")

None of the consultants or any associates employed in the preparation of this report has any beneficial interest in VERDE. The consultants are not insiders, associates or affiliates of VERDE. The results of this Technical Report are not dependent upon any prior agreements concerning the conclusions to be reached, nor are there any undisclosed understandings concerning any future business dealings between VERDE and the consultants. The consultants are being paid a fee for their work in accordance with normal professional consulting practices.

## 2.3. Details of Inspection

Mr. Bradley Ackroyd visited the Project most recently between August 7 and 10, 2012. There have been no material changes in site conditions since Mr. Ackroyd's most recent site visit.

Dr. Nader visited the site most recently on May 10, 2022. During the site visit, Dr. Nader inspected the general location of the property, site conditions, the major infrastructure and current mining and processing operations.

## 2.4. Sources of Information

Information used to support this Technical Report was derived from previous technical reports on the property, and from the reports and documents listed in the References section of this Technical Report.

BNA has used information primarily provided by VERDE or its consultants to prepare this pre-feasibility study. VERDE provided market study information. Capital and operating costs in the technical economic model are based on data provided by VERDE and/or their consultants, as well as all the processing information.

**Mineral Resources:** The mineral resource estimates included in this report were prepared by Mr. Bradley Ackroyd of Andes Mining Services (“AMS”), an independent consulting firm. Mr. Ackroyd is the principal consulting geologist for AMS with 22 years of experience in exploration and mining geology. Mr. Ackroyd is also a Member of the Australian Institute of Geosciences (“MAIG”). Mr. Ackroyd visited the site in 2012, between August 7 and August 10.

## 2.5. Effective Date

The effective date of this report is May 12, 2022.

The effective date of the Cerrado Verde mineral resource estimate is March 31, 2014.

There were no material changes to the information on the project between the effective date and the Technical Report signing date.

## 2.6. Units of Measure

The metric system has been used throughout this report for weights and other units, unless noted otherwise. All currency is in U.S. dollars (“US$”) unless otherwise stated and all geographical coordinates are expressed in UTM, WGS1984, zone 23S.

# 3. Reliance on Other Experts

The Consultants' opinion contained herein is based on information provided by VERDE over the course of the investigations undertaken. The sources of information include data and reports supplied by VERDE personnel, as well as documents referenced in Section 27. The Consultants have relied upon the work of other consultants in the project areas in support of this Technical Report.

VERDE has stated to the authors that the information provided for the preparation of this report correctly represents all material information relevant to the Cerrado Verde Project. VERDE has taken reasonable measures to ensure that permits for its properties are in good standing.

The Consultants used their experience to determine whether the information from previous reports was suitable for inclusion in this Technical Report and adjusted information that required amending. The QP Beck Nader has examined the data for the Project provided by VERDE and has relied upon that basic data to support the statements and opinions presented in this Technical Report. In the opinion of the QP, the data is present in sufficient detail, is credible and verifiable in the field and is an accurate representation of the Project.

This report includes technical information that requires subsequent calculations to derive sub-totals, and weighted averages. Such calculations inherently involve a degree of rounding and consequently can introduce a margin of error. Where these rounding errors occur, they are not considered to be material.

The authors have relied upon the work of others to describe the geology, exploration, mining operational expenditure (quotations from: U&M – U&M Mineração e Construcão S/A), hydrogeology (MDGEO Hidrogeologia e Meio Ambiente), geotechnical parameters used to define the pit slopes (Consórcio Mineiro de Engenheiros Consultores Ltda), waste pile geometric parameters (Solosconsult Engineering) and all processing subjects (Luis Antonio Camilotti, from MINALAC) and market studies (José Francisco da Cunha, from Tec-Fértil, a leading agricultural consulting company, founded in 1997). They also relied on a previously published PFS prepared by AMEC Americas Limited (AMEC), NCL Ingeniera y Construccion SpA (NCL) and Andes Mining Services Limited (AMS) in 2014 to validate the resources of the Project.

The QP for this Technical Report confirms that VERDE has completed a market study for the Product, which includes ongoing sales of the Product.

The QP also confirms that the process facility is capable of producing the Product.

# 4. Property Description and Location

## 4.1. Project Location

The Cerrado Verde Project is located in the heart of Brazil's largest agricultural market, in the Alto Paranaiba region of Minas Gerais State, Brazil, approximately 39 km to the east of the city of São Gotardo. São Gotardo is located approximately 320 km west of Belo Horizonte (the capital of the state of Minas Gerais) and is connected via a high-quality paved road (BR-262) (Figure 4.1-1). From São Gotardo, the Project area is accessed via secondary gravel roads which connect with the nearby farming region.

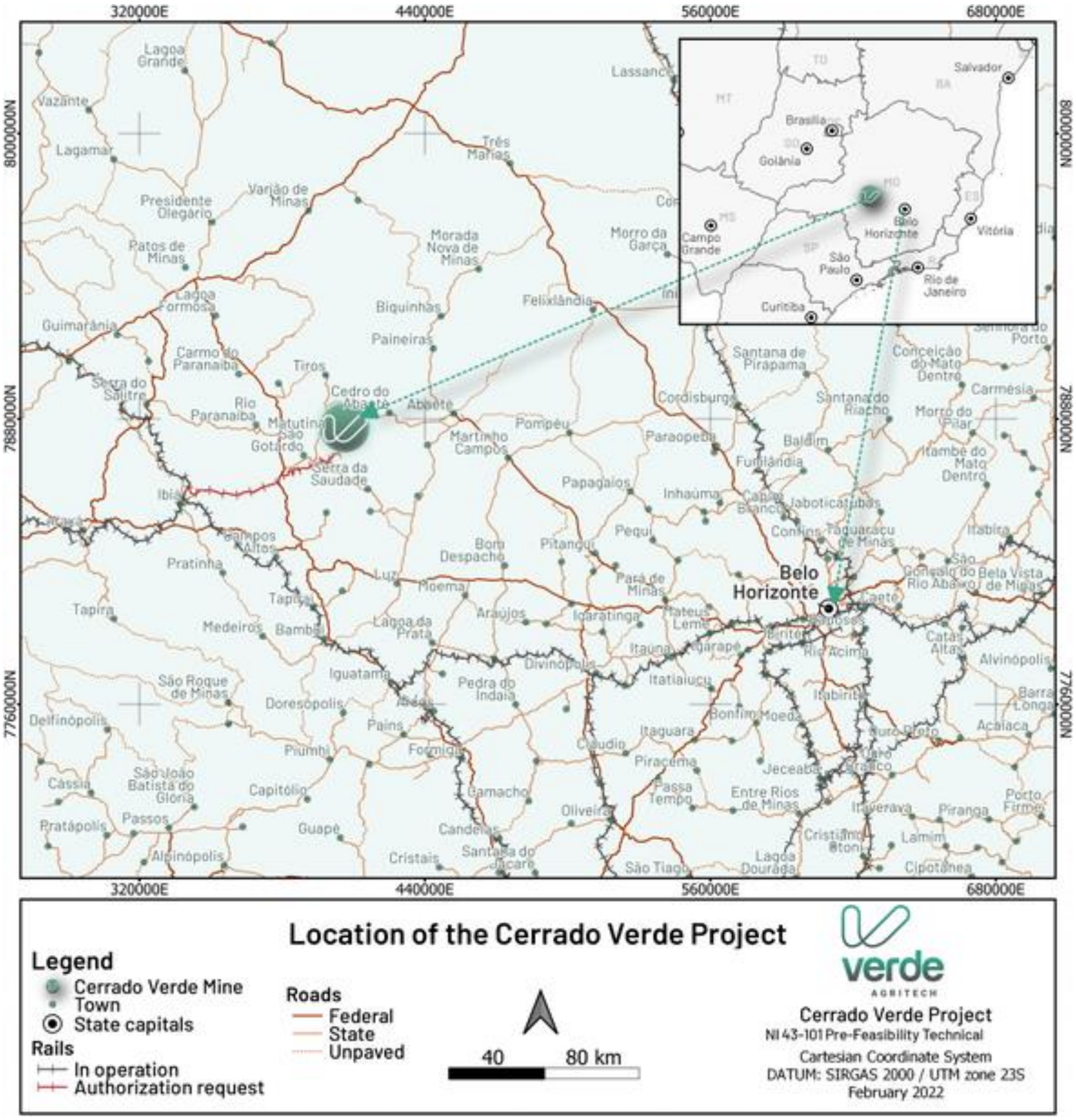


**Figure 4.1-1: Location Map of the Cerrado Verde Project**

The permit boundaries are defined by UTM coordinates with WGS84 datum (Zone 23S). The coordinates for a central point within the Cerrado Verde permits are: 7,856,500 N and 394,500 E.

The mineralized zones of the Cerrado Verde Project are composed of glauconitic siltstone ("Ore") units from the Serra da Saudade Formation, Bambuí Group. The known mineralization is located within the areas covered by the permits held by VERDE.

## 4.2. Permit Status

The National Mining Agency ("ANM"), created by Federal Law No. 13.575/2017 to replace the former National Department of Mineral Production ("DNPM"), aims to promote the planning and promotion of mineral exploration and the use of mineral resources and oversight of geological and mineral technology research, as well as ensuring, controlling and inspecting the exercising of mining activities throughout Brazil, pursuant to the Mining Code, the Mineral Water Code, the respective regulations and the legislation that complements them.

The permits throughout the Cerrado Verde Project area are owned by VERDE via their subsidiary companies Verde Fertilizantes and FVS Mineração. The Company holds mineral rights at different stages in the process towards a Mining Concession or a Mining Permit.

The Cerrado Verde Project area comprises a total of 30 granted exploration permits covering an aggregate area of 45,734 ha, as shown in Figure 4.2-1 and Table 4.2-1.

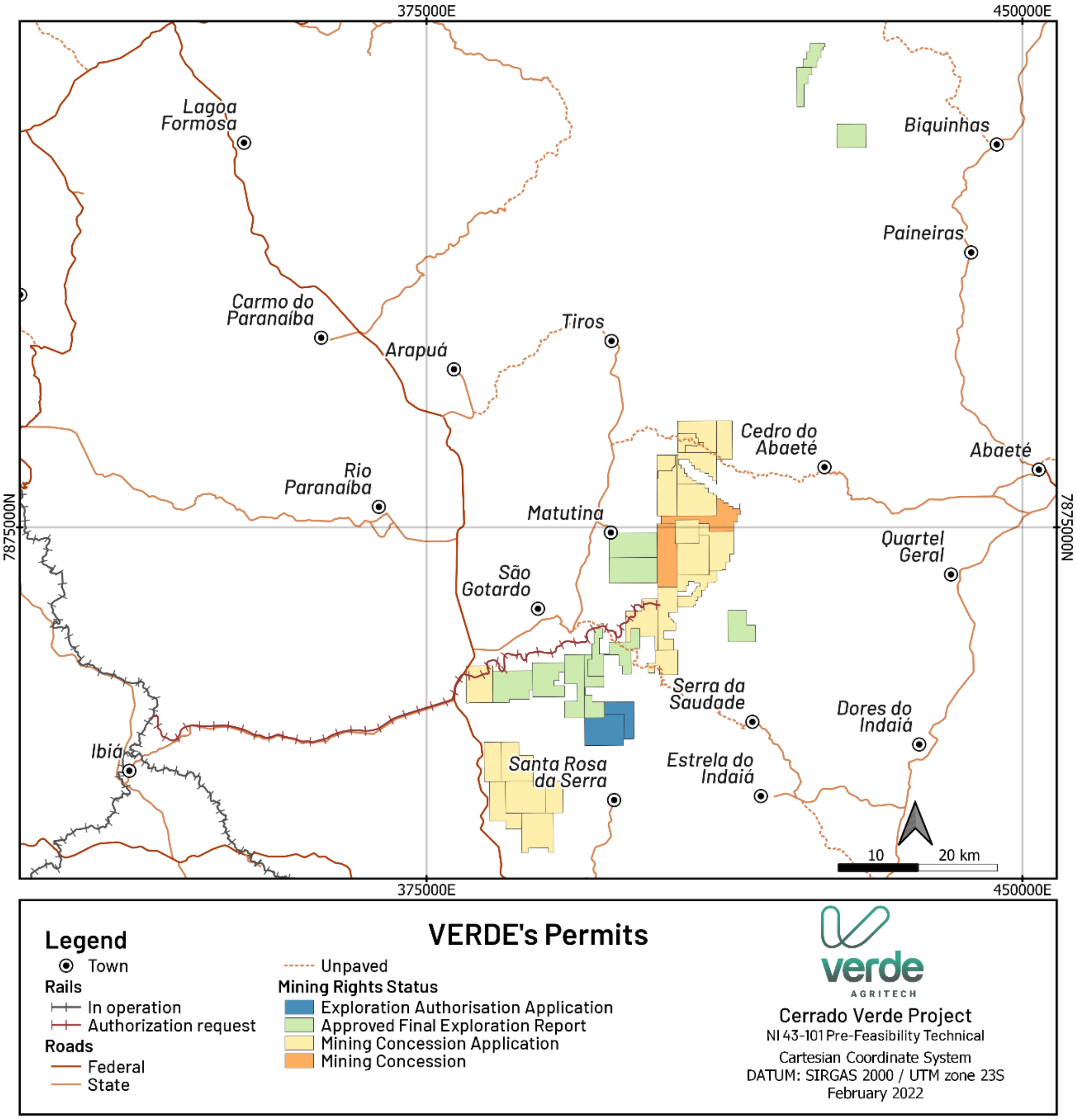


**Figure 4.2-1 VERDE Permits - Cerrado Verde Project (VERDE, May 20, 2022)**

**Table 4.2-1 Status of VERDE Permits (VERDE, May 20, 2022)**

| | Permit Number | Area (Ha) | Owner | Status of Mining Right |
|---|---|---|---|---|
| 1 | 830383/2008 | 900 | FVS | Mining Concession approved on 02/10/2022 |
| 2 | 830402/2011 | 945.16 | VERDE | Exploration Authorization Application filed on 02/11/2011 |
| 3 | 830404/2011 | 1,856.44 | VERDE | Exploration Authorization Application filed on 02/11/2011 |
| 4 | 830406/2010 | 1,548.73 | VERDE | Application for mining concession filed on 07/14/2017 |
| 5 | 830794/2010 | 1,857.56 | VERDE | Final exploration report approved on 03/23/2022 |
| 6 | 830796/2010 | 1,923.57 | VERDE | Final exploration report approved on 03/23/2022 |

| | Permit Number | Area (Ha) | Owner | Status of Mining Right |
|---|---|---|---|---|
| 7 | 830947/2011 | 1,895.73 | VERDE | Final exploration report approved on 03/23/2022 |
| 8 | 831025/2010 | 1,853.68 | VERDE | Application for mining concession filed on 07/20/2016 |
| 9 | 832543/2016 | 475.2 | VERDE | Application for mining concession filed on 07/17/2017 |
| 10 | 832544/2016 | 452.34 | VERDE | Application for mining concession filed on 07/17/2017 |
| 11 | 833257/2008 | 1,828.21 | FVS | Final exploration report approved on 10/26/2021 |
| 12 | 833259/2008 | 1,087.88 | FVS | Final exploration report approved on 10/26/2021 |
| 13 | 833263/2008 | 1,844.23 | FVS | Mining permit for 100 Ktpy approved on 02/07/2021 |
| 14 | 833264/2008 | 921.52 | FVS | Application for mining concession filed on 04/02/2019 |
| 15 | 833268/2008 | 966.82 | FVS | Application for mining concession filed on 04/01/2014 |
| 16 | 833270/2008 | 1,991.78 | FVS | Application for mining concession filed on 06/07/2013 |
| 17 | 833272/2008 | 1,587.61 | FVS | Application for mining concession filed on 04/01/2014 |
| 18 | 833274/2008 | 1,563.27 | FVS | Final exploration report approved on 10/26/2021 |
| 19 | 833276/2008 | 1,334.71 | FVS | Application for mining concession filed on 04/01/2014 |
| 20 | 833277/2008 | 1,992.24 | FVS | Final exploration report approved on 10/26/2021 |
| 21 | 833280/2008 | 1,742.04 | FVS | Application for mining concession filed on 04/01/2014 |
| 23 | 833286/2008 | 1,073.77 | FVS | Application for mining concession filed on 07/12/2021 |
| 24 | 833289/2008 | 1,928.55 | FVS | Mining Concession approved on 08/31/2015 |
| 25 | 833295/2008 | 1,571.46 | FVS | Application for mining concession filed on 06/07/2013 |
| 26 | 833305/2008 | 1,178.04 | FVS | Final exploration report approved on 10/26/2021 |
| 27 | 833306/2008 | 1,712.36 | FVS | Application for mining concession filed on 06/07/2013 |
| 28 | 833311/2008 | 894.8 | FVS | Application for mining concession filed on 07/12/2021 |
| 29 | 833315/2008 | 1,393.82 | FVS | Application for mining concession filed on 07/12/2021 |
| 30 | 833316/2008 | 1,900.42 | FVS | Application for mining concession filed on 07/12/2021 |
| 31 | 833322/2008 | 1,686.44 | FVS | Application for mining concession filed on 07/12/2021 |

| | Permit Number | Area (Ha) | Owner | Status of Mining Right |
|---|---|---|---|---|
| 32 | 833323/2008 | 1,536.42 | FVS | Mining Concession approved on 05/10/2021 |
| 33 | 833324/2008 | 1,457.10 | FVS | Application for mining concession filed on 07/14/2017 |
| 34 | 833326/2008 | 1,467.87 | FVS | Application for mining concession filed on 07/14/2017 |
| 35 | 833328/2008 | 601.43 | FVS | Final exploration report approved on 12/03/2019 |
| 36 | 833332/2008 | 524.35 | FVS | Final exploration report approved on 10/26/2021 |
| 37 | 833648/2008 | 1,093.02 | FVS | Final exploration report approved on 10/26/2021 |

**Table 4.2-2 Summary of VERDE Permits (VERDE, May 20 21, 2022). The area covered in each phase is expressed in hectares and the number of mining rights in total for each phase status is expressed in units**

| Phase | Cerrado Verde | |
|---|---|---|
| | Area (ha) | Total |
| Application for Exploration Permit | 2.802 | 2 |
| Available for Application for Mining Permit | 14,420 | 9 |
| Application for Mining Permit | 26.949 | 18 |
| Granted Mining Permit | 4.365 | 3 |
| Total | 48.535 | 32 |

The boundaries of the permits have not been surveyed because this is not a requirement of Brazil's mining code.

The chronological order of the steps is as follows: Application for Exploration Authorization, Filing of the Final Exploration Report, Application for the Mining Concession and the Granting of the Mining Concession.

VERDE applied for the mineral permits directly to the ANM. There was no previous ownership of mineral rights immediately prior to VERDE's applications. The areas were available, and VERDE made the necessary applications. The only exception is related to exploration permit number 830.383/2008, which was acquired by VERDE from a prior owner. When applying for an exploration authorization, interested parties must file an application for exploration authorization with the ANM and state their case for conducting mineral exploration activities. The Exploration Authorization Applications are analyzed in order of filing date. If the party requesting an exploration authorization meets the necessary legal requirements and an exploration authorization has not been previously issued for any part of the area in question, the ANM will grant the exploration authorization.

The Exploration Authorization (*Alvará de Pesquisa*) guarantees to the owner, be they an individual or a legal entity, the power and duty to carry out mineral research work in the entitled area. It grants the rights to conduct exploration activities for a period of between two and four years, which may be renewed for an additional period (with potential additional renewals on a case-by-case basis). An exploration authorization does not entitle the holder to extract mineral substances. During the research work, extraction will only be allowed in exceptional circumstances, by means of a specific title issued by the ANM (Mining Permit – "*Guia de Utilização*").

Once mineral exploration is completed, the holder of the mineral right must present a Final Exploration Report (*Relatório Final de Pesquisa*) based on the results obtained from the work and this report must contain a quantitative geological and technological study of the mineral deposit and demonstrate the technical-economic feasibility of a mine. The ANM performs a technical analysis of this report by means of a site visit.

If the ANM approves the report based on the potential merits of a future mining operation, the titleholder has a one-year period to prepare the Feasibility Study (*Plano de Aproveitamento Econômico – PAE*) and file the Mining Concession Application with the Ministry of Mines and Energy (*Ministério de Minas e Energia – MME*), the branch of the federal government responsible for making public policy regarding geological, mineral and energy resources and the hydroelectric, mining and metallurgic energy sectors.

While the ANM reviews the Mining Concession Application (*Requerimento de Lavra*), the owner retains the exclusive rights to this area. Mine construction and development activity can only begin after the publication of a Mining Concession (*Portaria de Concessão de Lavra*) issued by the MME and provided that the respective license is also granted pursuant to applicable Brazilian environmental laws. The Mining Concession guarantees the owner the power and duty to explore the mineral deposit until it is exhausted, with no definite term being established.

Under Brazilian law, a pit is fully permitted to mine when the Group holds both a Mining Concession/Permit and Environmental License for that area. Verde is fully permitted to mine 2,833,000 tpy and has submitted concurrent mining and environmental applications for an additional 2,500,000 tpy, still pending approval. The Group has 3 different mine pits, each at different permitting stages and targeting different volumes.

VERDE has filed the Application for Mining Permit with the respective Feasibility Study (*Plano de Aproveitamento Econômico – PAE*) for the entirety of the Cerrado Verde Project site (12 mineral permits), totaling an area of 15,676 ha.

## 4.3. Agreements and Encumbrances

### 4.3.1. Tenement Transfer

On March 30, 2012, the Company prepared and signed a contract for the full transfer of the mining permits related to exploration permit number 830.383/2008. A payment was made in the amount of R$50,000.00 and a royalty of US$0.03 per tonne of mined Ore will be due if a mine is operated in this area.

### 4.3.2. Fragata

On October 4, 2016, the Company prepared and signed a private agreement related to ANM permit number 830.383/2008 with a royalty of R$0.50 per tonne of Ore mined.

### 4.3.3. Selado

VERDE signed a lease for a property (called Fazenda Selado) with a 51 Mt Ore resource, on May 22, 2014. The payments resulting from this agreement are listed below:

- Construction of a house.
- R$10,000.00 for the renovation of the existing house.
- Monthly income for the occupants (following signature of the agreement).

- R$15,000.00 per effectively impacted hectare, due when the impact effectively occurs. The maximum impacted area will be 35 ha.

### 4.3.4. Confusão

The Company has signed a private agreement related to ANM permit number 833.264/2008. A royalty of R$0.50 per tonne of mined Ore will be due if there is any extraction in this area.

### 4.3.5. Londônia

The Company has signed a private agreement related to ANM permit number 833.263/2008. A royalty of R$0.50 per tonne of Ore mined will be due if there is any extraction in this area.

## 4.4. Taxes and Royalties

In Brazil, the ANM monitors exploration, mining and mineral processing. This regulatory agency also administers mineral exploration permits and mining concessions. Mineral exploration permits are issued by the ANM, and mining concessions are issued by the Ministry of Mines and Energy.

A mining concession carries an obligation to pay royalties to the federal government, known as Financial Compensation for the Exploitation of Mineral Resources ("CFEM"), which is established at 2% of the gross sale price of the mineral product, less taxes levied on its sale.

## 4.5. Environmental Liabilities and Permitting

The authors are unaware of any environmental liabilities to which the Cerrado Verde Project is subject.

Environmental regulations and general environmental rules and obligations in Brazil are relatively similar to those applicable in Canada. Brazilian environmental policy is the responsibility of the Ministry of the Environment and is executed at three levels: federal, state, and municipal.

## 4.6. Other Significant Factors and Risks

There are no other risks or significant factors known at this time that may affect access, title, or the right or ability to perform work on the Project.

# 5. Accessibility, Climate, Local Resources, Infrastructure and Physiography

## 5.1. Topography, Elevation and Vegetation

The peneplain developed by the Ore, i.e., the ground over which the Areado Group was deposited, undulates between an altitude of 850 m and 1,000 m. Higher elevations of peneplain development are found in the more southern parts of the Serra da Saudade range. In the middle portion of the Serra da Saudade range (location of Cerrado Verde Project), the peneplain lies between 880 m and 920 m. Therefore, it is reasonable to infer that all of the surface exposures of the Ore were the result of the Tertiary erosion cycles that stripped off the Mesozoic rocks (Mata da Corda and Areado groups) (Figure 5.1-1).

The local vegetation consists of primitive savannah (*cerrado*) relicts, still preserved between plots of land used for subsistence farming and family-based animal husbandry.

**Figure 5.1-1 Panoramic View Looking across the Cerrado Verde Project Area**

## 5.2. Climate and Length of Operating Season

The typical climate is high-altitude tropical, with two different seasons, rainy and dry. The dry season, with a total volume of 200 mm, extends from April to September. The annual rainy season, with a total volume of 1.11 mm, from October 1.11 to March, when 85% of the precipitation falls. The average annual relative humidity is 50%. Winds are predominant from the NNE in the dry season and SSE in the rainy season. The annual average figure is 1,315 mm, obtained from the A536 station, located in Dores do Indaiá, during a time frame starting in May 2007, when the station started operating, and ending in June 2021 (Figure 5.2-1). The station is located approximately 45 km in a straight line from the project location and is the closest in operation by the National Institute of Meteorology (INMET).

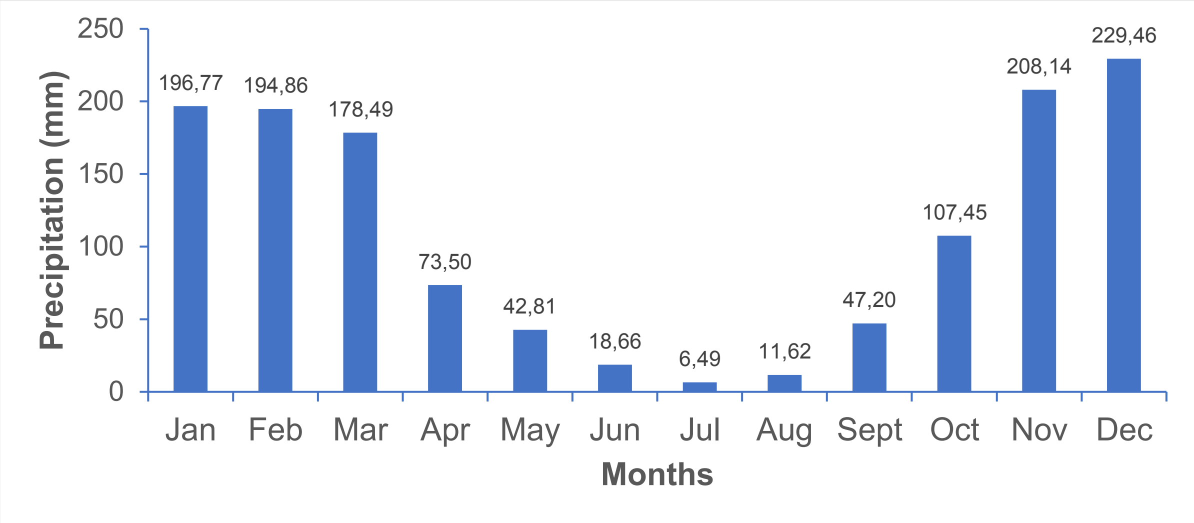


**Figure 5.2-1 Rainfall data from the A536 station (INMET, 2021)**

According to INMET data, the average annual temperature is between 19.5ºC and 24.2ºC and the annual potential evapotranspiration (PET) is around 1,187 m (calculated for the Patos de Minas region). The annual evapotranspiration (ETR) is on the order of annual evapotranspiration of 13 mm, which, according to the Turc formula, is based on the figures for annual mean and total temperature.

Exploration and mining operations can be conducted year-round.

## 5.3. Physiography

The Project is located within the hydrographic basin of the Indaiá River, a tributary river on the left-hand margin of the São Francisco River. According to the State Secretary for Science and Technology of Minas Gerais (*Secretaria do Estado de Ciência e Tecnologia de Minas Gerais - SECTES*, 1938), the Indaiá River basin is part of the geomorphological unit known as the São Francisco Plateau, where the edges of the hills and the crest points dip towards the NE with high structural controls (COSTA-FILHO et al, 2007).

The main drainages in the Project region are the rivers Indaiá, Abaeté, Borrachudo and its tributaries. These rivers have a meandering channel style morphology with predominantly dendritic drainage patterns evident in areas where pelitic rocks dominate. To the north of the Project is the Três Marias Dam, which constitutes the main confluence point of the rivers in the region.

The main topographic feature across the Project region is the Serra da Saudade ridge. The landscape can be separated into three domains, which may be correlated with the typical South American surfaces as defined by KING (1956):

- Upper Surface: Older stage of the group that has exposed the Areado Group Sandstones and the Mata da Corda Group.
- Intermediate Surface: Refers to the second stage of the group after the dissection of the Upper Surface (triggered by the resumption of the erosive process). The average altitude of the intermediate surface is 750 m to 850 m ASL. The intermediate surface presents itself as an irregular surface which stretches along a N-S strike and is developed over the Serra da Saudade Formation, represented by psammitic lithotypes; and
- Basal Surface: the youngest, bordering the São Francisco River, with elevation ranging from 570 m to 630 m. Exposure occurs in pelites of the Serra de Santa Helena and Serra da Saudade formations.

## 5.4. Access to Property

From Belo Horizonte, the State Capital, the project site is accessed by travelling 320 km along the BR-352 highway. From the closest town of São Gotardo, the project area is accessed along secondary gravel roads that traverse the farming region. The unpaved roads are in reasonable condition, although some sections require improvement.

## 5.5. Surface Rights

According to Brazilian law, surface rights are separate from mining rights. Therefore, the landowner has no title to the minerals contained in the soil or in the sub-soil, which are deemed a property of the federal government. The federal government can grant to private companies or individuals the right to explore for and mine sub-surface minerals.

Private companies or individual that are holders of an Exploration Permit are supposed to enter into an agreement with the landowner to gain access to the area and conduct exploration activities. If an agreement is not reached, the Brazilian Mining Code establishes a judicial procedure by means of which the mining company or individual may secure access to the area by paying the landowner compensation for any damages to their property and/or loss of income due to exploration activities.

VERDE has agreements in place with the relevant landowners, which allows them to undertake exploration in accordance with the permits held.

Private companies or individuals holding a Mining Permit are entitled to access the area necessary for the mine infrastructure. Such surface rights are obtained through an agreement with the landowner, which provides compensation that covers the price of the land and any additional losses caused by the occupation of said land. In the event such agreement is not reached, surface rights may be granted by the local Court once payments have been made by the mining company or individual in the amount determined by a court for such compensation.

In addition to compensation for damages, the landowner is entitled by law to a royalty equal to 50% of the Financial Compensation for the Exploitation of Mineral Resources (“CFEM”). However, there may be an agreement between the mining company and the landowner that establishes a level of compensation that is satisfactory for both (MENDO, 2009). The company is considering the purchase of all properties covered by their permits, in which case this amount would not be due, as VERDE would be the owner.

VERDE has started to negotiate agreements with landowners to gain access and has already entered into an agreement with the landowners of Fragata (Section 4.3.2) and Selado (Section 4.3.3). Between 2018 and 2019, the company acquired four properties containing ore, totaling 173.74 ha.

## 5.6. Local Resources and Infrastructure

São Gotardo, located 39 km west from the Project site, is the closest town and has a significant population of around 36,084that may provide labor for a potential mining operation. São Gotardo also has good infrastructure, with domestic power and telephone service available. Another municipality close to the Project is Matutina, with a population of 3,733. The Project is very close to Patos de Minas (129 km away), the main city in the Alto Paranaiba area, which has a strong economic, cultural, educational and social environment. The Project is 83 km from the Ibiá railway station, on the Centro Atlântica railroad.

Belo Horizonte, located about 320 km from the Project site, is the capital and the largest city in the state of Minas Gerais, with a population of over 2.5 million people. It is the center of Brazil’s mining industry, with infrastructure for mining equipment and services available. There is a large commercial airport with domestic and international flights. Several state and federal government agencies are based there, in addition to private businesses that provide services to the mining industry. Skilled labor is readily available in Belo Horizonte, as well as in the towns near the Project.

# 6. History

Section 6 summarizes the prior history of the Project. After announcing the start-up of its processing plant in July of 2018, VERDE operates Plant 1 with a capacity of 0.6 Mtpy, Plant 2 is on track for commissioning in Q3 2022 with an additional capacity of 2.4Mtpy and Plant 3 is expected to add 10 Mtpy, with construction planned for 2023.

## 6.1. Exploration History

The Ore has been known as a potential potassium resource since the 1960s, although only regional mapping has been undertaken in the areas covered by the permits held by VERDE over the years.

VERDE does not have data on past owners or any prior exploration work. VERDE is not aware of any historic resource estimation work on the property. There is no data or information available on exploration or development by previous owners.

## 6.2. Resource Estimation History

VERDE commenced drilling across the Cerrado Verde Project in late 2009.

### 6.2.1. Coffey Mining (March 2010)

In March 2010, Coffey Mining Pty Ltd ("Coffey Mining") was commissioned by VERDE to complete a mineral resource estimate.

The maiden mineral resource estimate was based upon 19 RC drill holes (997 m), which targeted only a select portion of the regional Ore within the VERDE permit areas. All holes were successful in intersecting the Ore.

Coffey Mining estimated a Mineral Resource for the Cerrado Verde Project with an effective date of February 27, 2010. All grade estimations were completed using Ordinary Kriging ("OK") for $K_2O$. The estimation was constrained within the mineralization interpretations.

A total inferred resource of 161 Mt at 8.75% $K_2O$ was determined (no cut-off grade applied) as shown in Table 6.2.1-1 below.

**Table 6.2.1-1 Cerrado Verde Project –February 27, 2010 - Inferred Grade Tonnage Report**

| Domain | Cut-Off Grade (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| Low Grade | 0 | 67.82 | 6.22 |
| | 3 | 67.82 | 6.22 |
| | 4 | 67.45 | 6.23 |
| | 5 | 55.85 | 6.41 |
| | 6 | 33.19 | 7.27 |
| | 7 | 20.24 | 7.78 |
| | 8 | 6.49 | 8.52 |
| | 9 | 1.01 | 9.43 |
| High Grade | 0 | 92.74 | 10.61 |
| | 7 | 92.74 | 10.61 |
| | 8 | 92.20 | 10.63 |
| | 9 | 86.55 | 10.76 |
| | 10 | 64.39 | 11.17 |
| | 11 | 35.71 | 11.61 |
| | 12 | 8.24 | 12.33 |
| **Total (High + Low Grade)** | | **160.56** | **8.75** |

Coffey Mining considered the permits to have the potential to host a potassium resource of very large tonnage within the Ore. This was demonstrated by the preliminary resource numbers generated from an initial drilling program, as well as regional mapping and grab sampling across the permit package.

Coffey Mining recommended that a Preliminary Economic Assessment ("PEA") be undertaken for the Cerrado Verde Project prior to undertaking any additional resource definition drilling.

### 6.2.2. SRK Consulting (September 2011)

On September 16, 2011, SRK Consulting (U.S.), Inc ("SRK"). were hired by VERDE to prepare a National Instrument 43-101 PEA for the Cerrado Verde Project.

Volodymyr Myadzel updated the overall project resources by including Targets 4, 6, 7, 10 and 11. The resources in targets 4, 6, 7, 10 and 11 were reported, in addition to the existing Funchal Norte Target resources.

A total indicated resource of 74.04 Mt at 9.22% $K_2O$ was determined (7.5% $K_2O$ cut-off grade applied) with an additional inferred resource totaling 1,135.55 Mt at 9.47% $K_2O$ (7.5% $K_2O$ cut-off grade applied, except for the Funchal Norte area with a 10% $K_2O$ cut-off grade), as shown in Table 6.2.2-1 below.

**Table 6.2.2-1 Cerrado Verde Project – September 16, 2011**

| Target | Cut-Off Grade (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| | | | **INDICATED RESOURCE** |
| Target 6 | 7.5 | 23.25 | 8.83 |
| Target 7 | 7.5 | 50.79 | 9.39 |
| **TOTAL INDICATED** | | **74.04** | **9.22** |
| | | | **INFERRED RESOURCE** |
| Target 4 | 7.5 | 74.43 | 9.20 |
| Target 6 | 7.5 | 47.85 | 8.84 |
| Target 7 | 7.5 | 873.59 | 9.45 |
| Target 10 | 7.5 | 28.50 | 10.10 |
| Target 11 | 7.5 | 46.79 | 8.27 |
| Funchal Norte | 10 | 64.39 | 11.17 |
| **TOTAL INFERRED** | | **1,135.55** | **9.47** |

Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.
Inverse Distance Weighting with power two (IDW2) estimate (Block Model – 50 mE X 50 mN X 10 mRL).
Effective date for Targets 4, 6, 7, 10 and 11 is August 3, 2011.
Effective date for Funchal Norte is March 1, 2010.

### 6.2.3. SRK Consulting (February 2012)

On February 10, 2012, SRK was commissioned by VERDE to prepare a NI 43-101 PEA for the Cerrado Verde Project.

As part of the PEA, SRK reported an updated mineral resource estimate for the Cerrado Verde Project based on drilling completed throughout 2010 and 2011.

The resource update included: Target 1, Target 2, Target 3, Target 4, Target 5, Target 6, Target 7, Target 10, Target 11, Target 12, Target 13, Target 14, Target 16 and Target 17. Funchal Norte is now referred to as Target 8 and is included in Target 7. Volodymyr Myadzel constructed the geologic and resource model for Targets 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 16 and 17. Dr. Myadzel was responsible for the resource estimation methodology and the resource statement.

A total indicated resource of 71 Mt at 9.22% $K_2O$ was determined by SRK (7.5% $K_2O$ cut-off grade applied), with an additional inferred resource totaling 2,764 Mt at 8.91% $K_2O$ (7.5% $K_2O$ cut-off grade applied), as shown Table 6.2.3-1 below.

The resource estimate has been undertaken in compliance with accepted CIM definitions for indicated and inferred resources in accordance with NI 43-101 Standards of Disclosure for Mineral Projects.

**Table 6.2.3-1 Cerrado Verde Project – December 17, 2011**

| Target | Cut-Off Grade (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| **INDICATED RESOURCE** | | | |
| Target 6 | 7.5 | 23.25 | 8.83 |
| Target 7 | 7.5 | 47.83 | 9.55 |
| **TOTAL INDICATED** | | **71.08** | **9.22** |
| **INFERRED RESOURCE** | | | |
| Target 1 | 7.5 | 235.86 | 8.72 |
| Target 2 | 7.5 | 11.63 | 8.54 |
| Target 3 | 7.5 | 126.52 | 8.72 |
| Target 4 | 7.5 | 146.67 | 9.03 |
| Target 5 | 7.5 | 27.27 | 8.31 |
| Target 6 | 7.5 | 47.85 | 8.84 |
| Target 7 | 7.5 | 955.20 | 9.50 |
| Target 10 | 7.5 | 28.50 | 10.10 |
| Target 11 | 7.5 | 46.79 | 8.27 |
| Target 12 | 7.5 | 235.68 | 8.80 |
| Target 13 | 7.5 | 168.25 | 8.50 |
| Target 14 | 7.5 | 325.20 | 8.65 |
| Target 16 | 7.5 | 257.49 | 8.15 |
| Target 17 | 7.5 | 150.89 | 8.19 |
| **TOTAL INFERRED** | | **2,763.80** | **8.91** |

Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
Effective date for Targets 1, 2, 3, 4, 5, 12, 13, 14, 16, 17 is December 21, 2011.
Effective date for Targets 4, 6, 10 and 11 is August 3, 2011.
Effective date for Target 7 is February 10, 2012.

### 6.2.4. AMS (March 2014)

In late March 2014, VERDE hired AMEC, NCL and AMS to prepare a PFS for the Cerrado Verde ThermoPotash (TK) Project.

A combined mineral resource statement that incorporates previously reported mineral resources completed by SRK has been prepared for the Cerrado Verde Project by AMS. A combined measured and indicated mineral resource of 1,472 Mt at 9.28% $K_2O$ (using a 7.5% $K_2O$ cut-off) and an inferred mineral resource of 1,850 Mt at 8.60% $K_2O$ (using a 7.5% $K_2O$ cut-off grade) (Table 6.2.4-1) are reported for the Cerrado Verde Project.

The statement has been classified by Qualified Person Bradley Ackroyd (MAIG) in accordance with NI 43-101 and accompanying documents 43-101.F1 and 43-101. CP. It has an effective date of March 31, 2014. As the latest and unmodified resource estimate, this work will be detailed in Item 14.

**Table 6.2.4-1 Cerrado Verde Project – Measured, Indicated and Inferred Mineral Resource Grade Tonnage Report (AMS & SRK Consulting)**

| Target | Cut-Off (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| **Measured Resource Category** | | | |
| Target 7 | 7.5 | 83 | 10.13 |
| **Total Measured** | | **83** | **10.13** |
| **Indicated Resource Category** | | | |
| Target 6 | 7.5 | 23 | 8.83 |

| Target | Cut-Off (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| Target 7 | 7.5 | 1,366 | 9.24 |
| **Total Indicated** | | **1,389** | **9.23** |
| **Total Measured & Indicated** | | **1,472** | **9.28** |
| **Inferred Resource Category** | | | |
| Target 1 | 7.5 | 236 | 8.72 |
| Target 2 | 7.5 | 12 | 8.54 |
| Target 3 | 7.5 | 126 | 8.72 |
| Target 4 | 7.5 | 147 | 9.03 |
| Target 5 | 7.5 | 27 | 8.31 |
| Target 6 | 7.5 | 48 | 8.84 |
| Target 7 | 7.5 | 305 | 8.89 |
| Target 11 | 7.5 | 47 | 8.27 |
| Target 13 | 7.5 | 168 | 8.50 |
| Target 14 | 7.5 | 325 | 8.65 |
| Target 16 | 7.5 | 257 | 8.15 |
| Target 17 | 7.5 | 151 | 8.19 |
| **Total Inferred** | | **1,850** | **8.60** |

Mineral resources are not mineral reserves and do not have demonstrated economic viability.
Effective Date for the mineral resource estimate is March 31, 2014

## 6.3. Reserve Estimation History

### 6.3.1. NCL (March 2014)

On March 31, 2014, VERDE hired AMEC, NCL and AMS to prepare a PFS for the Cerrado Verde ThermoPotash (TK) Project, with NCL being responsible for the reserve estimates.

NCL studied the Cerrado Verde Project as a conventional open pit operation. NCL has determined the following mining details for the project:

- Ore mining will be carried out by bulldozers while waste rock will be mined out directly by hydraulic excavators. There will be no use of explosives on the TK mine site.
- Load and haul equipment will be rented to the mining contractor and will be operated by VERDE´s personnel. Ancillary equipment will be operated by the contractor's personnel. All equipment will be maintained by the mining contractor.

A series of economic pit shells were calculated using the Lerchs-Grossman algorithm for different TK prices. The selection of a final pit shell for mine design was based on a NPV maximization strategy, taking into account factors such as external waste dump size and desired life of mine.

The LoM mining schedule feeds 233 Ktpy of fresh rock to the primary crusher. The expected mass recovery is 100%.

The Mineral Resources are inclusive of the Mineral Reserves.

**Table 6.3.1-1 Cerrado Verde Project – Mineable Reserve Summary (NCL)**

| Ore Reserves | Mass (Kt) | $K_2O$ (%) |
|---|---|---|
| Proven Reserve | 5,381 | 10.87 |
| Probable Reserve | 1,639 | 10.77 |
| **Total Reserve** | **7,020** | **10.85** |

(1) As of March 31, 2014.
(2) A variable cutoff grade was used to report reserves, between 10.2% and 10.6% $K_2O$.
(3) Numbers may not add up due to rounding.
(4) Overall strip ratio of 0.34 to 1.
(5) Waste contains inferred resources, which may potentially be upgraded to higher category resources, and possibly to reserves after sufficient definition work has been completed.
(6) Based on 100% mining recovery.

## 6.3.2. BNA (December 2017)

On December 22, 2017, VERDE hired BNA to prepare a PFS for the Cerrado Verde Project, with BNA being responsible for the reserve estimates.

BNA studied the Cerrado Verde Project as a conventional open pit operation, with the following characteristics:

- Both Ore and waste mining will be performed using hydraulic excavators. As a precautionary measure, it has been assumed that 30% of the Ore and 30% of the waste will be mined after a drilling and blasting operation.
- Loading and hauling operations, including equipment maintenance, will be conducted by a mining contractor.

A series of economic pit shells were calculated using the Lerchs-Grossman algorithm through the application of the Revenue Adjustment Factor (“RAF”). This factor is applied to the selling price(s) of the product(s), in such a manner that a mathematical pit is generated for each applied factor. The selection of a final pit shell for mine design was based on an NPV maximization strategy.

The Project was divided into three distinct phases, the respective production rates and duration of which are shown below:

- Phase 1: 600,000 t of final product per year, for the first 2 years.
- Phase 2: 5 Mt of final product per year, from year 3 to year 6.
- Phase 3: 25 Mt of final product per year for the remainder of the life of the mine.

The expected mass recovery is 100%.

The Mineral Resources are inclusive of the Mineral Reserves.

**Table 6.3.2-1 Cerrado Verde Project – Mineable Reserve Summary (BNA)**

| | Proven Reserve | Probable Reserve | Total Reserve |
|---|---|---|---|
| **Tonnes (Mt)** | 68.11 | 709.17 | 777.28 |
| **$K_2O$ Grade (%)** | 10.34 | 9.72 | 9.78 |

(1) As of December 22, 2017.
(2) A cutoff grade of 8.5% $K_2O$ was used to report reserves.
(3) Overall strip ratio of 0.29 to 1.
(4) Waste contains inferred resources, which have the potential to be upgraded to higher category resources, and possibly reserves, after sufficient definition work has been completed.
(5) Based on 100% mining recovery.

## 6.4. Mining History

The mining works were initiated on May 15, 2017, by means of a Mining Permit (*Guia de Utilização*), an exceptional mining permit with predetermined expiration date. It is granted by the ANM and allows the mineral extraction in the area before the grant of a Mining Concession (*Portaria de Concessão de Lavra*).

Under Brazilian law, a pit is fully permitted to mine when the Group holds both a Mining Concession/Permit and Environmental License for that area. Verde is fully permitted to mine 2,833,000 tpy and has submitted concurrent mining and environmental applications for an additional 2,500,000 tpy, still pending approval. The Company has 3 different mine pits, each at different permitting stages and targeting different volumes, as summarized in Table 6.4-1. Up to December 2021, a total of 797,060 tonnes of mineralized material had been extracted.

**Table 6.4-1 Summary of licenses and permits**

| Mine Pit | Fully Permitted to Produce (tpy) | Mining (tpy) | | Environmental (tpy) | |
|---|---|---|---|---|---|
| | | Granted | Pending | Granted | Pending |
| 1 | 233,000 | 233,000 | 0 | 233,000 | 0 |
| 2 | 2,600,000 | 2,600,000 | 22,500,000 | 2,600,000 | 0 |
| 3 | 0 | 49,800 | 2,500,000 | 0 | 2,500,000 |
| **Total** | **2,833,000** | **2,882,800** | **25,000,000** | **2,833,000** | **2,500,000** |

### 6.4.1. Mining Concession (Portaria de Lavra) for Mine Pit 1

For Mine Pit 1, the Company is fully permitted to extract 233,000 tpy.

### 6.4.2. Mining Concession (Portaria de Lavra) for Mine Pit 2

On March 26, 2020, the ANM approved the Feasibility Study (*Plano de Aproveitamento Econômico - PAE*) for the extraction of 25,000,000 tonnes per year ("tpy") for Mine Pit 2, as part of the Mining Concession Application process. On March 30, 2020, the Company applied for a 2,500,000 tpy Environmental License for Mine Pit 2. The 2,500,000 tpy Environmental License was approved on December 23, 2020.

On February 10, 2022, the Mining Concession for the extraction of up to 2,500,000 tpy of Product was approved by the ANM. This Mining Concession was granted to the company as an expansion of the existing 100,000 tpy Mining Permit (*Guia de Utilização*), previously granted for Mine Pit 2. In total, the Company is now permitted to extract up to 2,600,000 tpy from Mine Pit 2 alone.

### 6.4.3. Mining Concession Application (Requerimento de Lavra) for Mine Pit 3

For Mine Pit 3, the Company was fully permitted to extract 49,800 tpy, However, the Environmental License granted for Mine Pit 3 expired on November 09, 2021. The Company has applied for a further Mining Concession of 2,500,000 tpy and a further 2,500,000 tpy Preliminary, Installation and Operation Environmental License.

## 6.5. Processing Plant Development and Expansion

In March 2018, the company signed a turnkey agreement for a 45-tonne-per-hour production facility and planned to build their own processing plant in São Gotardo, Minas Gerais ("Plant 1"). In June 2018, the company obtained an environmental license for the construction and operation of Plant 1. In July 2018, the company announced the start-up of the processing plant.

In October, 2018, the Company announced its expansion plan for 2019, capable of producing an additional 600,000 tpy.

In August 2019, the company was granted an environmental license for a new plant to be built on a site adjacent to Mine Pit 2, with annual production of 890,000 tpy of product, ("Plant 2").

In October 2019, the expansion of Plant 1 was concluded, increasing its production capacity to 500,000 tpy, and to 600,000 tpy after that, due to a mill replacement.

In October 2020, the company concluded a new expansion project for Plant 1, which enabled the combination of two additional nutrients in the product in accordance with the specific needs of each customer's crop, enhancing its effectiveness.

In December 2020, the company introduced a new product to the market. This new product, named BAKS®, is a combination of the Product plus three other nutrients that can be chosen by customers in accordance with the needs of their crops. Along with the new product, VERDE also introduced two new technologies: 3D Alliance®, which was developed to transform the three-dimensional structure of the raw materials added to the fertilizer, and Micro S Technology®, an exclusive elemental sulphur micronization technology.

In June 2021, the Company launched N Keeper®, a proprietary processing technology for Ore that alters its physical-chemical properties to enable ammonia retention for use as a calibrated additive in Nitrogen fertilizers. N Keeper® leads to a reduction in nitrogen volatilization loss, which increases the efficiency of crop fertilization, mitigates environmental impacts and reduces factors that contribute to climate changes.

In August 2021, the Company started the construction of Plant 2, which is expected to achieve commercial production by Q3 2022. Plant 2 will have an operational capacity of 1,200,000 tpy and will raise VERDE's overall production capacity to 1,800,000 tpy. The Company remains focused on the expansion of the Project.

In March 2022, the Company announced that it has started working to double the capacity of its Plant 2. At the date of this PFS, VERDE also plans to upgrade local infrastructure to sustain the increased output from Plant 2 and enable a future Plant 3. Plant 2 is currently on track to start production in Q3 2022, and the enlarged production capacity is expected to be in operation early Q4 2022. VERDE expects to start construction of Plant 3 in 2023, provided the necessary permits have been issued.

# 7. Geological Setting and Mineralization

## 7.1. Regional Geology

The Serra da Saudade Formation is part of the Ediacaran/ early Cambrian Bambuí Group, a sedimentary cover of the Western São Francisco craton (DARDENNE 1978, 2000, SIAL et al. 2009, MOREIRA et al. 2020). The São Francisco Craton was one of the paleocontinents involved in the assembly of the Gondwana in late Neoproterozoic and Cambrian, surrounded by the Brasiliano/Pan-African Araçuaí-West Congo Belt to the east, the Brasília Belt to the west and the Rio Preto Belt to the north (TROMPETTE 1994, CORDANI et al. 2000).

The region is mainly underlain by Neoproterozoic and Cretaceous rock units, which are partly covered by Cenozoic sandstones, lateritic sediments and soils (Figure 7.1-1). The oldest rocks are represented by the Bambuí Group, which comprises the marine deposits of the Paraopeba Formation, the Serra de Santa Helena Formation and the Serra de Saudade Formation, including the Ore. Variegated siltstones and sandstones dominate these units.

The Serra da Saudade Formation crops out in a continuous Southwest-Northeast (SW) strip, mainly in the homonymous ridge (Figure 7.1-1) and is comprised of pelitic-sandy sedimentary rocks, including pelitic-psammitic rhythmite, sandstone with hummocky cross-stratification, green siltstone, glauconitic siltstone, phosphatic rhythmite, reworked carbonate and minor occurrences of limestone (COSTA AND BRANCO 1961, GUIMARÃES 1967, CHAVES et al. 1971, DARDENNE 1978, LIMA et al. 2007, SEER AND MORAES 2011, MOREIRA et al. 2020).

Following the deposition of the Bambuí Group and the Brasiliano Orogeny, the region was exposed to a long period of erosion during the Phanerozoic period, giving rise to the development of a mature, deeply eroded peneplain. The terrigenous sediments of the Areado Group were deposited during the Lower Cretaceous on this extensive, flat peneplain. The next stratigraphic phase is recorded by the extensive and dominantly pyroclastic kamafugitic volcanism of the Mata da Corda Group of Upper Cretaceous age.

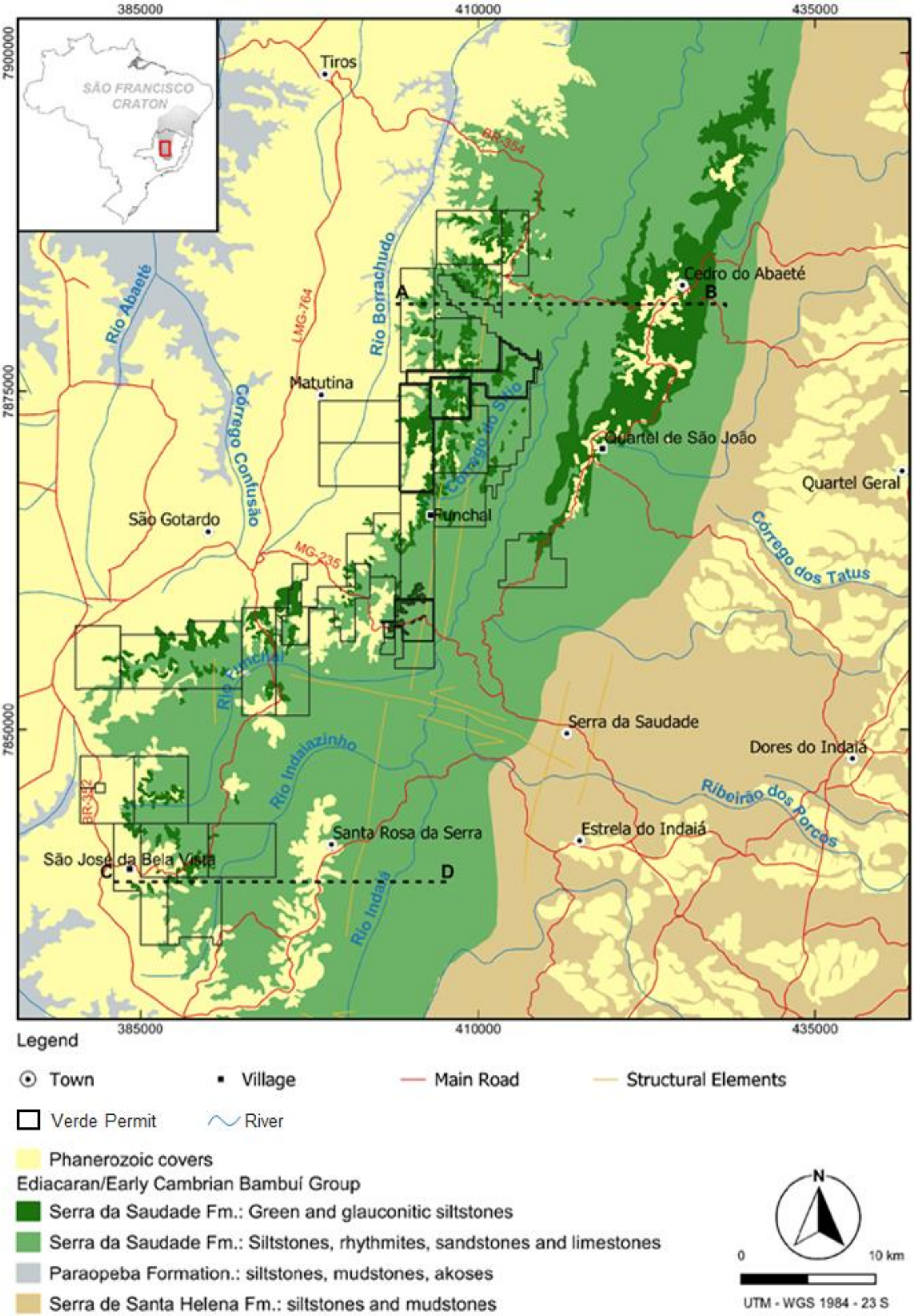


**Figure 7.1-1 Simplified Regional Geological Setting (VERDE, March 31, 2014)**

## 7.2. Local Geology

### 7.2.1. The Glauconitic Siltstone Unit

The Ore occurs mainly at the top of the Serra da Saudade Formation and underlies the Areado Group sandstone (Figure 7.2.1-1). The Ore occurs in extensive outcrops, along both banks of the Indaiá River, over an area of approximately 120 km x 20 km. It covers the regions and municipalities of Santa Rosa da Serra and São Gotardo (SW), Matutina, Quartel de São João and Cedro do Abaeté (center), Paineiras and Biquinhas (NE) in the state of Minas Gerais.

The thickness of the Ore unit varies from 15 m to 80 m in the southernmost domain, to over 50 m in the northern half of the Serra da Saudade range. The lower contact with the siltstone of the Serra da Saudade Formation is transitional (2 m to 3 m in width) and contains intercalations of limestone lenses and calciferous siltstone.

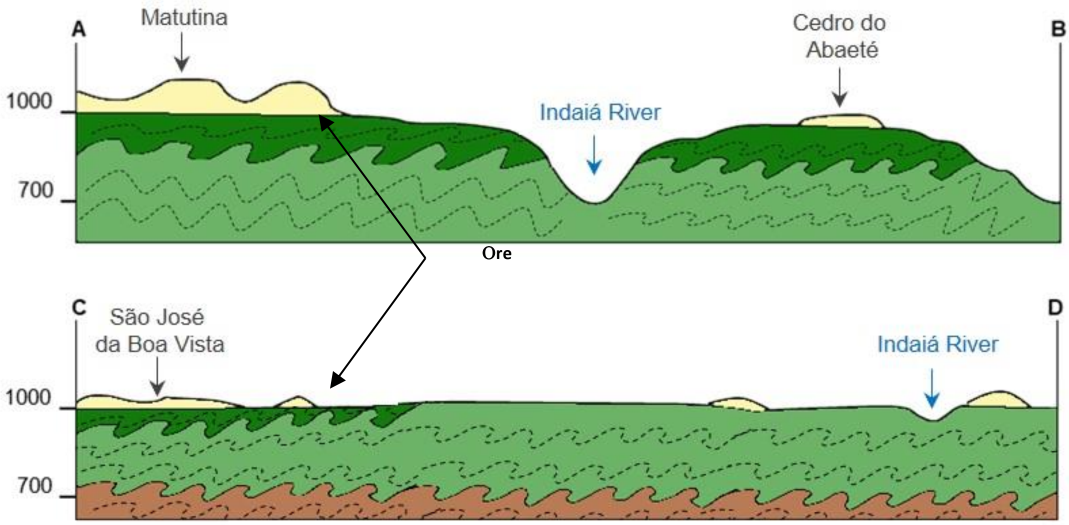


**Figure 7.2.1-1 Schematic regional cross section (see location on Figure 7.2-2) (VERDE, March 31, 2013)**

The Serra da Saudade Formation was eroded during the Gondwana Cycle (KING, 1956), probably during the Jurassic Period, and it was over this extensive peneplain that the Cretaceous sandstone beds of the Areado Group were deposited.

The upper contact is transitional with rhythmic intercalations of Ore and siltstone of various colors (predominantly pink when weathered), defined informally as the transition zone. These intercalations vary from millimeters to meters in thickness.

### 7.2.2. Structural Setting

The Ore and the transition zone have a sub-horizontal attitude, as shown in the cross sections presented in Figure 7.2.1-1. However, pervasive concentric and chevron folds were formed in the outcrops, in which the axial planes dip to the NNW (Figure 7.2.2-3 and Figure 7.2.2-4). folds were observed with nearly vertical axial planes and sub-horizontal folding axis.

Although the folds formed in the outcrops, no minerals, metamorphic structures or evidence of deformation were identified in thin sections. The natural fragmentation in the outcrops is due to the bedding surfaces and verticalized fractures in several directions.

The largest extension of the Ore occurs where erosion has been less intense, and this area is marked by the presence of remnants of the Areado Group sandstones. This occurs mainly in the central part of the Ore outcropping.

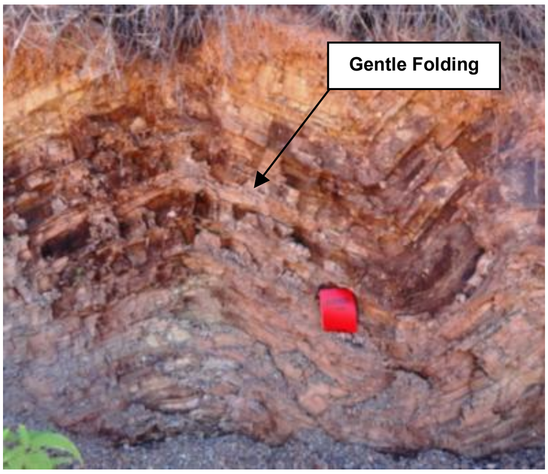


**Figure 7.2.2-3 Folding throughout transition zone**


**Figure 7.2.2-4 Chevron Folding - Ore**

### 7.2.3. Elevation and Erosion Level

The peneplain developed in the glauconitic siltstone unit, i.e., the ground over which the Areado Group was deposited, undulates between elevations of 1,000 m and 850 m. Higher elevations of peneplain development are found in the southern portions of the Serra da Saudade Formation. In the middle portion of the ridge, the peneplain is located between 880 m and 920 m. Therefore, it is fair to assume that all of the surface exposures of the Ore were the result of the Tertiary erosion cycles that stripped off the Phanerozoic rocks (Mata da Corda and Areado groups).

## 7.3. Mineralization

The first Pre-Feasibility Study (March 2014) presented the mineralization in the project area as a glauconitic meta-argillite. However, after performing detailed mineralogical studies using a combination of optical microscopy, X-ray diffraction, electron microprobe analysis and scanning electron microscopy, it was determined that the Ore is a silty-clayed sedimentary rock. Despite the presence of folds in the outcrops, no minerals, metamorphic structures or evidence of deformation were identified in the thin sections. The natural fragmentation in the outcrops is due to the fractures and bedding surfaces. Therefore, the mineralization in the project area is now referred to as a glauconitic siltstone. Despite this change in nomenclature, the project mineral resources were not affected, as the Ore deposit is homogeneous in its glauconitic siltstone content.

The Ore is the target rock type across the VERDE group of permits, as it contains a high content of $K_2O$. It is a fine-grained siltstone, usually laminated, alternating with more massive levels and a few intercalations of dark-green argillite sheets (Figure 7.3-1).

The Ore unit shows millimeter- to centimeter-thick bands that are rich in glauconite, dark green in color and interbedded with quartz-rich layers (Figure 7.3-2).

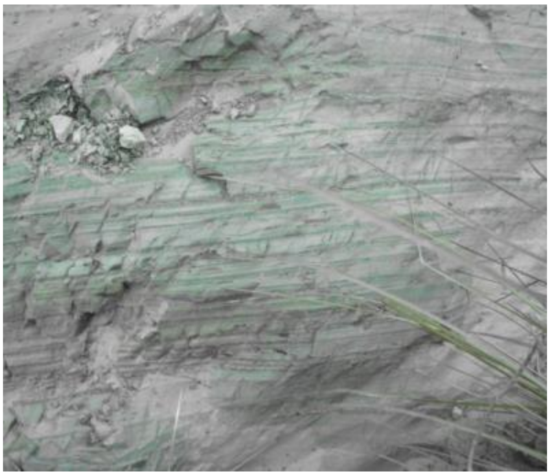

Figure 7.3-1 Layered Intercalations of Glauconitic Siltstone

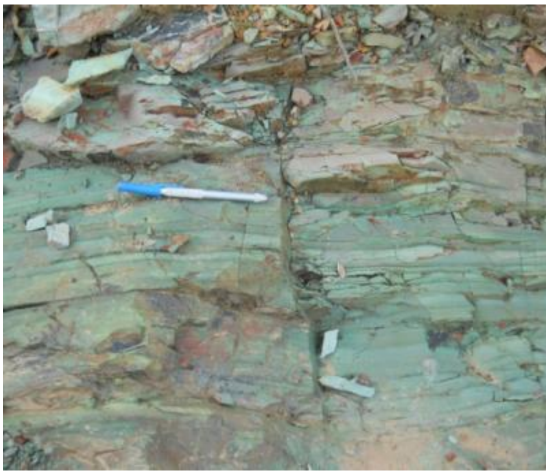

Figure 7.3-2 Mineralized Glauconitic Siltstone Unit

A petrographic study using optical microscopy, X-ray diffraction, an electron microprobe and a scanning electron microscope was carried out upon fresh samples of Ore containing more than 10% $K_2O$, collected from diamond drilling half core samples. Thin section studies detected significant quantities of K-bearing minerals and quartz (Figure 7.3-3 and Figure 7.3-4): glauconite (40%-80%), K-feldspar (10%-15%), quartz (10%-60%), muscovite-sericite (5%), biotite (2%), titanium oxide (<1%), manganese oxide (<1%), goethite (<1%), barium phosphate and rare-earth element phosphates (trace amounts).

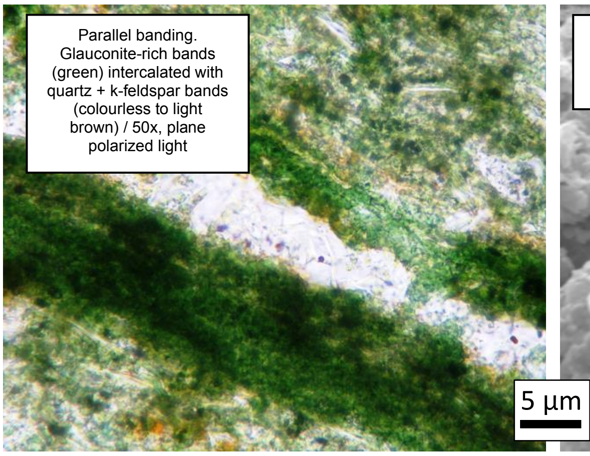


Figure 7.3-3 Photomicrograph of sample CV DH 05 (32 m – 34 m)

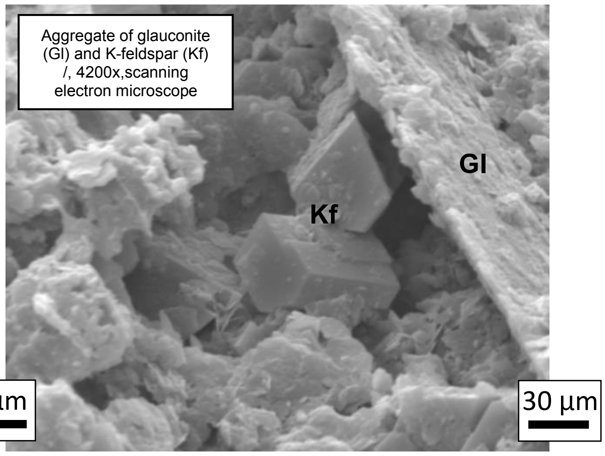


Figure 7.3-4 Photomicrograph of sample CV DH 04 (7 6m – 78 m)

### 7.3.1. Mineralized Zones

As stated previously, potassium mineralization in the ore occurs as mineral-forming elements of glauconite, K-feldspar and muscovite-sericite.

The Ore located within VERDE's permit area can be traced along the entire 120 km strike length and has a potential width of up to 500 m. Enriched levels of potassium with $K_2O$ grades from 8% to 12% are associated with the glauconitic levels, which are dark green in color. (Figure 7.3.1-1).

**Figure 7.3.1-1 Outcrop of Ore in the Cerrado Verde Project Area**

## 7.3.2. Surrounding Rock Types

To the east, there are green to yellowish sandstone beds with hummocky cross-stratification showing low-angle truncation surfaces and wavelengths of between 1 to 2 m (Figure 7.3.2-1 A) and forming beds that are between 5 cm and 2 m in thickness with a fine medium-grained sandy base and a silt-mud top Figure 7.3.2-1 B). The base of the Serra da Saudade Formation is composed of a typical gray siltstone (Figure 7.3.2-1 C). The gray siltstone grades upward into mud-silt-sand rhythmite (Figure 7.3.2-1 D), characterized by laminated rhythmite with varying proportions of mud, silt and fine sand grains. It may be intercalated with beds of fine-grained sandstone. The laminations are formed by interbedded green fine-grained siltstone and greenish gray to white, soft mudstone. These lithotypes form the transition zone.

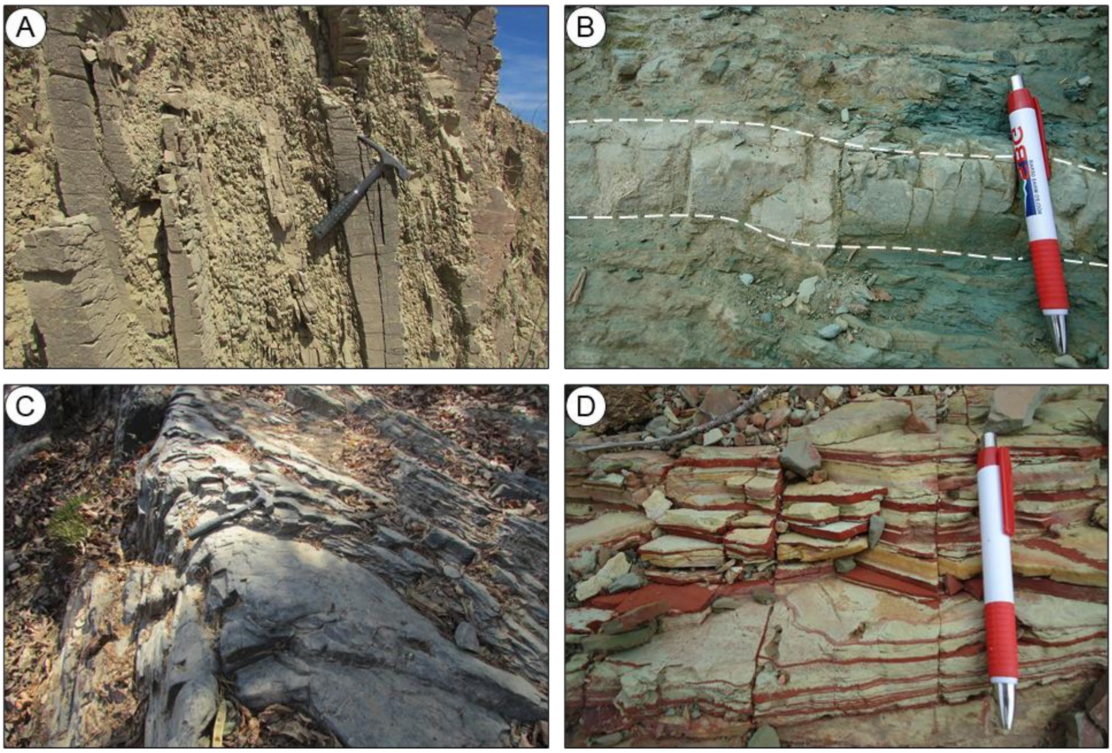


**Figure 7.3.2-1 Surrounding rock types of Ore: A) verticalized yellowish sandstone with hummocky cross-stratification; B) intercalation between green sandstone (middle) and green siltstone; C) basal gray siltstone; D) mud-sand rhythmite. Source: Moreira et al., 2021.**

# 8. Deposit Types

Glauconite is considered a diagnostic element indicative of continental shelf marine environments with slow rates of accumulation. It develops as a consequence of diagenetic alteration of sedimentary deposits, bio-chemical reduction and subsequent mineralogical changes affecting iron-bearing micas such as biotite and is also influenced by the decay process in organic matter degraded by bacteria in marine animal shells. Glauconite forms under reducing conditions in sediments (AMOROSI, 1995).

A geological model has been proposed for the Ore. It is a unique type of mineralization that is known only in the Serra da Saudade Formation, in the Bambuí Group, in the western part of the state of Minas Gerais. The Serra da Saudade Formation was deposited in a foreland basin proximal to the Brasília Belt (ALKMIM AND MARTINS-NETO 2012, REIS et al. 2017, UHLEIN et al. 2017), in which three depozones were defined and referred to as foredeep, forebulge and back-bulge (Figure 8-1). The initial deposition of the fine-grained sediments in the Serra da Saudade Formation occurred during periods of basin wide deepening and are related to a TST (Figure 8-1A). A thick interval of green siltstone suggests a period of sea level rise outpacing the sedimentary input and a maximum flooding surface positioned approximately at the richest glauconite interval, with a higher $K_2O$ content. In the foredeep, the glauconitic interval is related to the maximum deepening of the basin (Figure 8-1B). The forebulge, to the east, is marked by frequent intercalations of sandstone and carbonate. Finally, the Serra da Saudade Formation, with regressive carbonate deposition in the foredeep, is overlain by the fluvial to marine sandstone of the Três Marias Formation (Figure 8-1C) (MOREIRA et al., 2021).

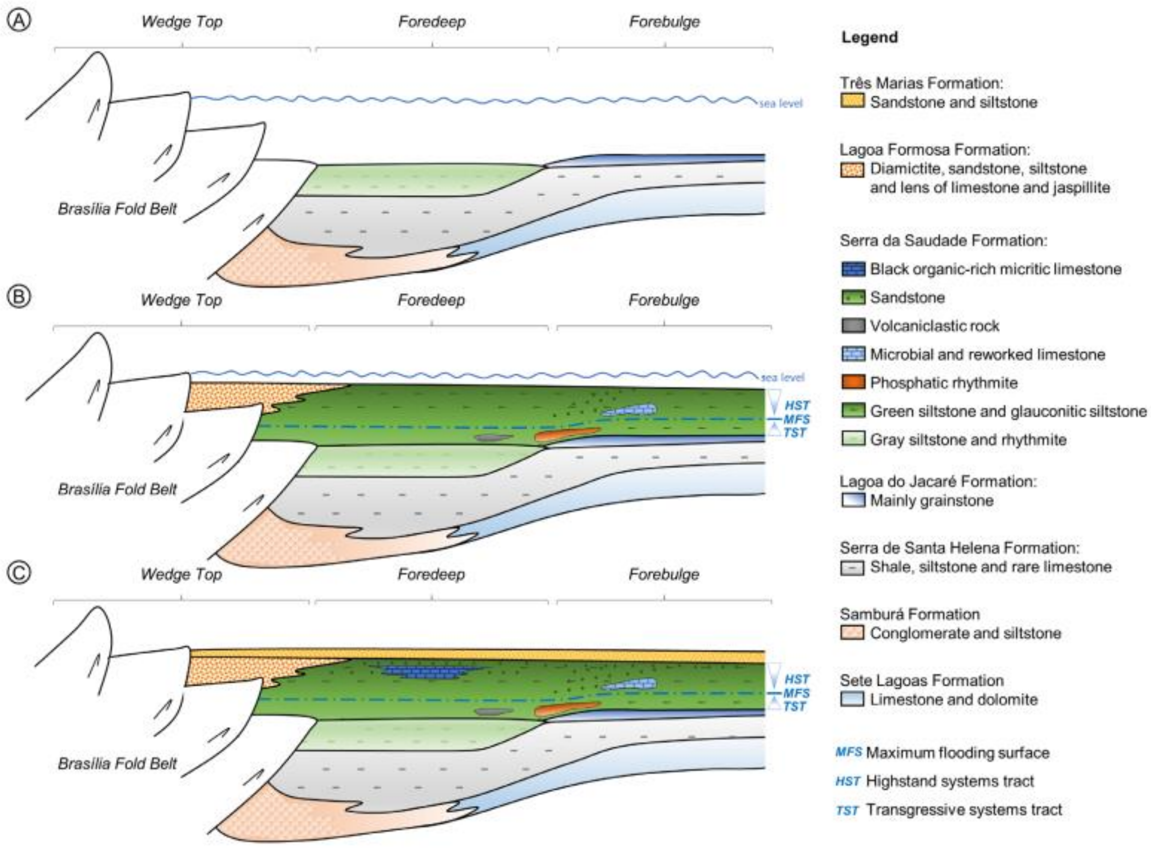


**Figure 8-1 Possible genetic setting for Cerrado Verde related to the evolution model for the Serra da Saudade Formation (MOREIRA et al., 2021): (A) Deposition of basal siltstone and rhythmite in the foredeep. (B) The Ore marks the maximum flooding surface (MFS) in the foredeep; (C) Final stage of the Serra da Saudade Formation, with regressive carbonate deposition in the foredeep, which is overlain by fluvial to marine sandstone of the Três Marias Formation.**

# 9. Exploration

## 9.1. Historical Exploration

Up until 2011, exploration work was focused upon a number of Ore units known as Target 1, Target 2, Target 3, Target 4, Target 5, Target 6, Target 7, Target 10, Target 11, Target 12, Target 13, Target 14, Target 16 and Target 17 (Figure 9.1-1 and Figure 9.1-2).

Exploration activities included field and laboratory studies, geological mapping, outcrop studies and their correlation, drilling across the Ore, systematic sampling, chemical and physical analysis of the rock samples/drill core samples, metallurgical characterization and processing test work.

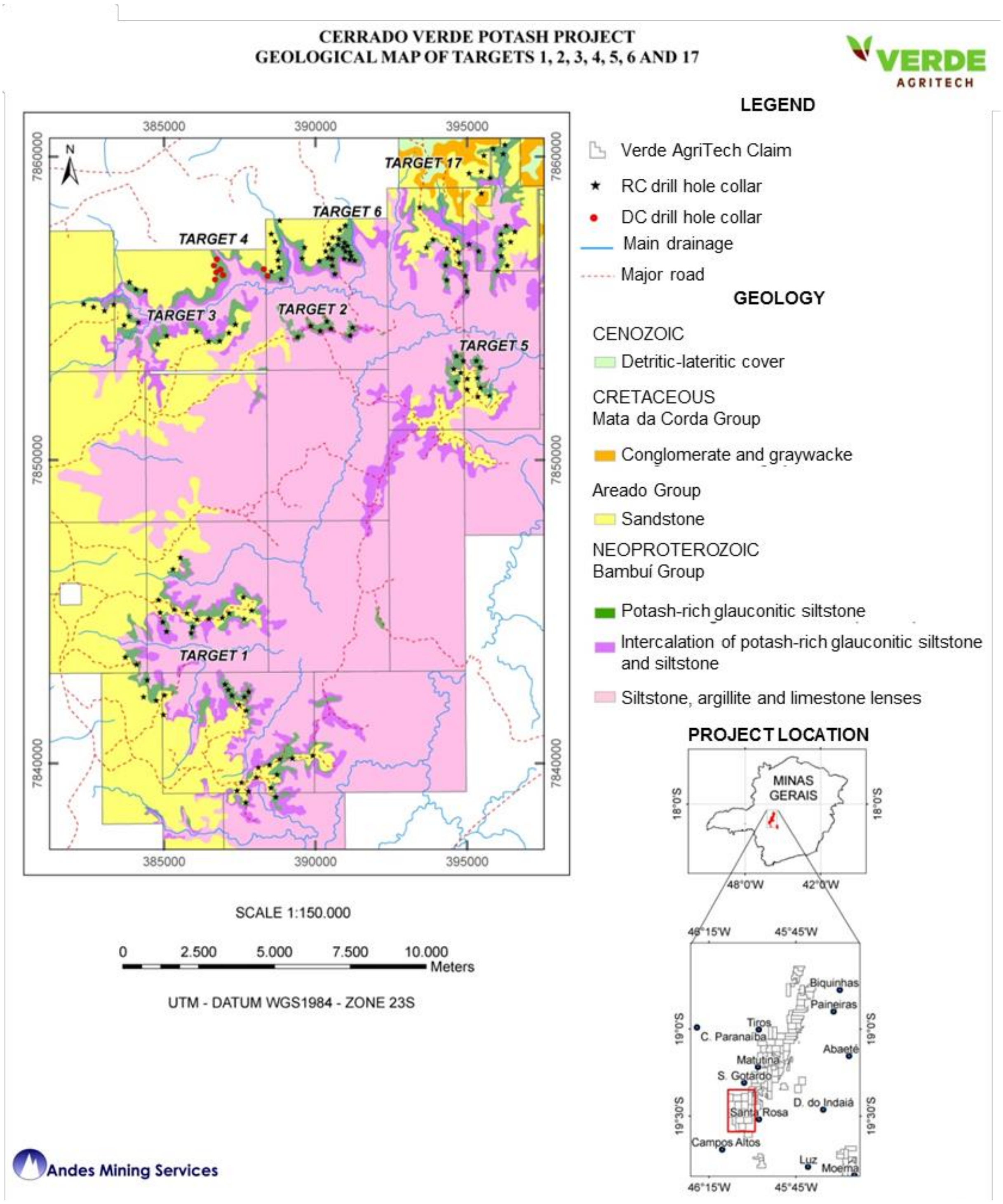


**Figure 9.1-1 2010/2011 Historical Target Areas for Drilling - Southern Targets (VERDE, March 31, 2013)**

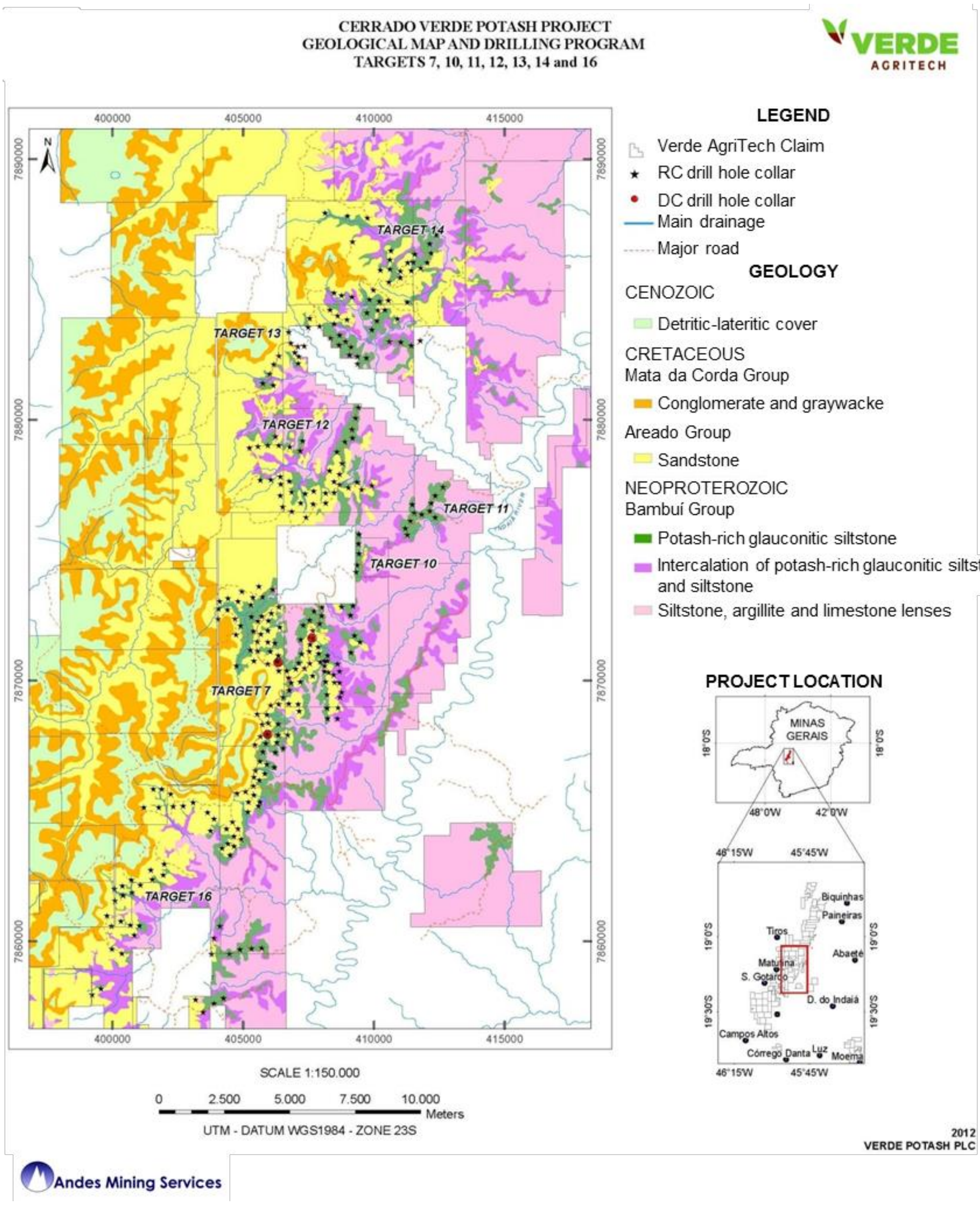


**Figure 9.1-2 2010/2011 Historical Target Areas for Drilling - Central Targets (VERDE, March 31, 2013)**

Initially, a literature review was performed upon all the material relating to the project and surrounding areas, as were studies of economic exploitation of the potassium present in silicate rocks, such as the glauconitic siltstone. This study also included technological and marketing aspects for producing and selling a potassium product.

Subsequently, the geological, geophysical and geochemical information was integrated on a regional scale, followed by an analysis and interpretation of digital satellite images for the visualization of the regional structures and occurrences of Ore across the permit areas held by VERDE.

The outcrop of the Ore can be distinguished in satellite images by its characteristic bluish color.

In the preliminary survey, the targets were defined using Google Earth images and data from the Shuttle Radar Topography Mission (SRTM). In the first program undertaken in 2008, mapping of the main rock types present in the region was performed, on a 1:25,000 scale, as was a survey of the main access, drainage systems and farms within the areas of interest. For this survey, GPS devices from Garmin®, model GPSMAP 76 CSX, were used.

A preliminary evaluation of the potassium levels in outcrop samples was performed using a portable X-ray fluorescence device, followed by chemical analysis at ALS Minerals, Bureau Veritas Brasil, FRX Service, SGS Geosol laboratories in Vespasiano and Belo Horizonte, Minas Gerais State and the University of São Paulo.

Later stages of field work involved the production of geological cross sections (regional scale), especially in the areas of Ore exposure, and semi-detailed mapping campaigns aimed at identifying the main lithofacies and stratigraphic relationships and structural aspects. During the mapping, the samples collected were used to make thin sections and subjected to lithochemical/mineralogical analysis. Structural data was collected, and some stratigraphic section surveys were performed throughout the area.

### 9.1.1. 2012 Exploration Activities

In 2012, however, exploration activities were concentrated on a select number of higher grades $K_2O$ targets. Target areas included 7, 10 and 12, and a new area located within exploration permit 830.383/2008, which was acquired by VERDE from a third party.

Geological mapping suggested these targets belonged to a single glauconitic siltstone body. Subsequently, these 4 individual target areas were collectively grouped into a single target area known as Target 7.

Geological Mapping

The Ore is the main rock-type of interest to be mapped across the VERDE permit areas and it has a marked bluish color, which can be seen in Google Earth images. Zones of glauconitic siltstone outcrops were interpreted in Google Earth images, converted into shapefiles in ArcGIS and then inserted into PDAs (Trimble and GETAC personal digital assistant) on which GPS and ArcPad programs had been installed. The topographic maps, the legal status and the existing geological maps were also inserted into the PDA units.

Geological mapping was carried out using the PDAs (Figure 9.1.1-1) into which the outcrops of glauconitic siltstone and other lithologies, float material, soil points, geological structures and lithological contacts had been inserted and then exported to ArcGIS software. Only once this had been completed was a final geological map was produced.

Glauconitic siltstone outcrops were routinely sampled and the $K_2O$ values were assayed using an Innov-X Delta portable X-ray fluorescence (XRF) spectrometer. Glauconitic siltstone zones, in which a $K_2O$ content of greater than 6% was identified, were mapped in more detail in preparation for drill testing.


**Figure 9.1.1-1 Google Earth Image – Ore outcrops marked by a typical bluish color**


**Figure 9.1.1-2 Geological Mapping using GETAC PDA's with ArcPad Software (VERDE, March 31, 2013)**

<u>Airborne Surveys</u>

VERDE contracted Geoid Laser Mapping Ltda to conduct an airborne laser scanning survey across an area measuring 116.72 km$^2$. The main objective of the survey was to cover Target 7 and its immediate surroundings in which the company plans to conduct open pit mine, concentration plant and tailings disposal area studies. A laser contour map was generated using 1 m intervals and a 1:1,000 scale map was produced and utilized to accurately plot the geology and the drill hole collar locations (Figure 9.1.1-3).

The drill holes collar coordinates were measured using a differential global positioning system (DGPS) instrument (Trimble® R4 with RTK radio system). A double frequency L1/L2 Global Navigation Satellite System of geodesic pair was utilized. The equipment collected data in real time with a horizontal accuracy of 3 mm +/- 0.1 mm and up to 3 times the horizontal accuracy for vertical measurements.

The grid system was based on Universal Transverse Mercator (UTM) coordinates, in the World Geodetic System 1984 (WGS84) applied to Zone 23S.

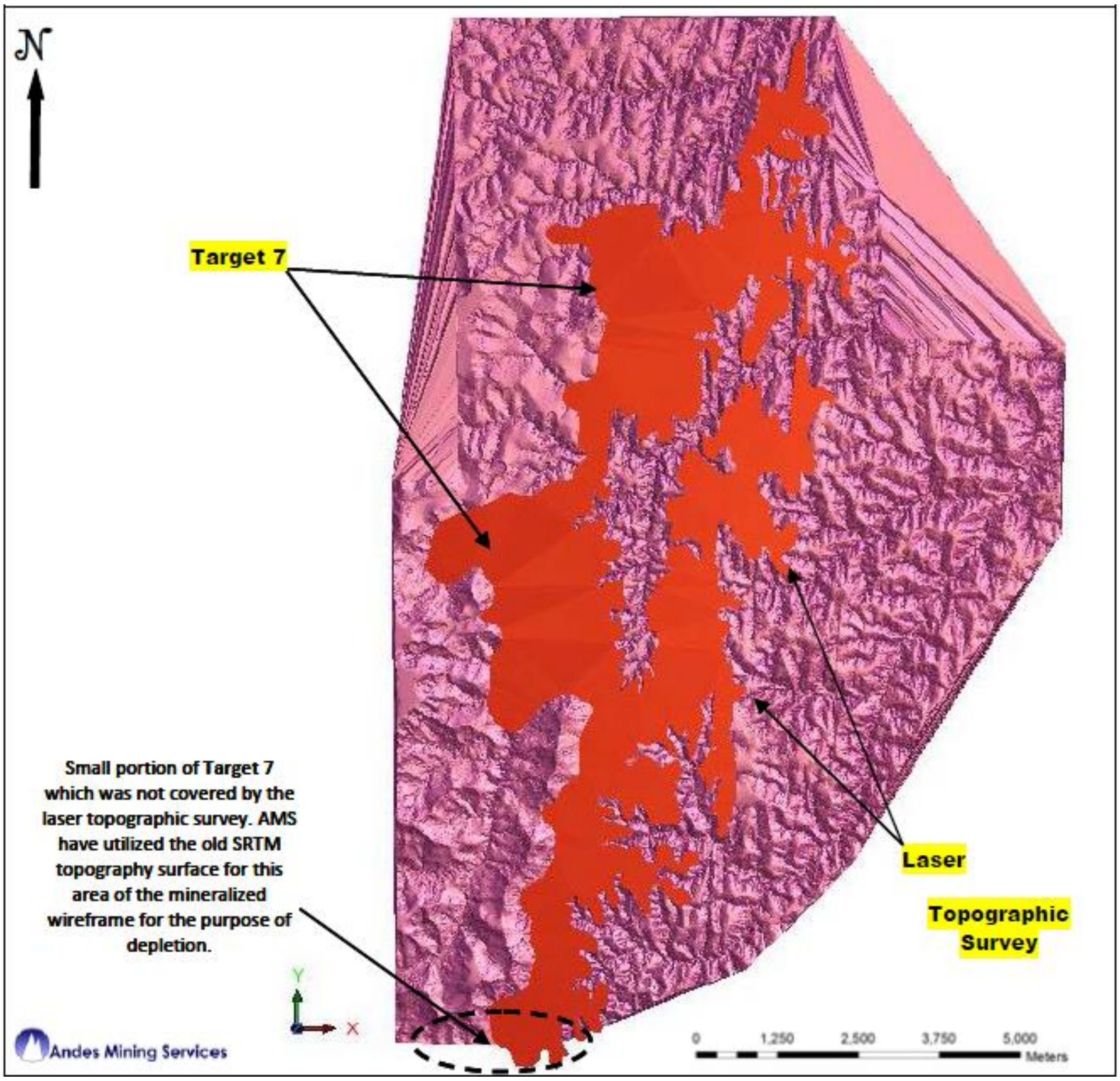


**Figure 9.1.1-3 Detailed Airborne Topographic Laser Survey (AMS, March 31, 2013)**

Reverse Circulation and Diamond Drilling

A total of four drilling campaigns were performed across the Cerrado Verde Project, with the first campaign commencing in late 2009.

The principal drilling methods utilized included rotary-percussion reverse circulation drilling (RC) and diamond core drilling (DC). Drilling was initially carried out at a nominal grid spacing of 100 m x 400 m across a number of specific target areas identified by VERDE (Figure 9.1.1-4 and Figure 9.1.1-5).

Details regarding individual RC and DC drilling programs are covered in Section 10 of this report.

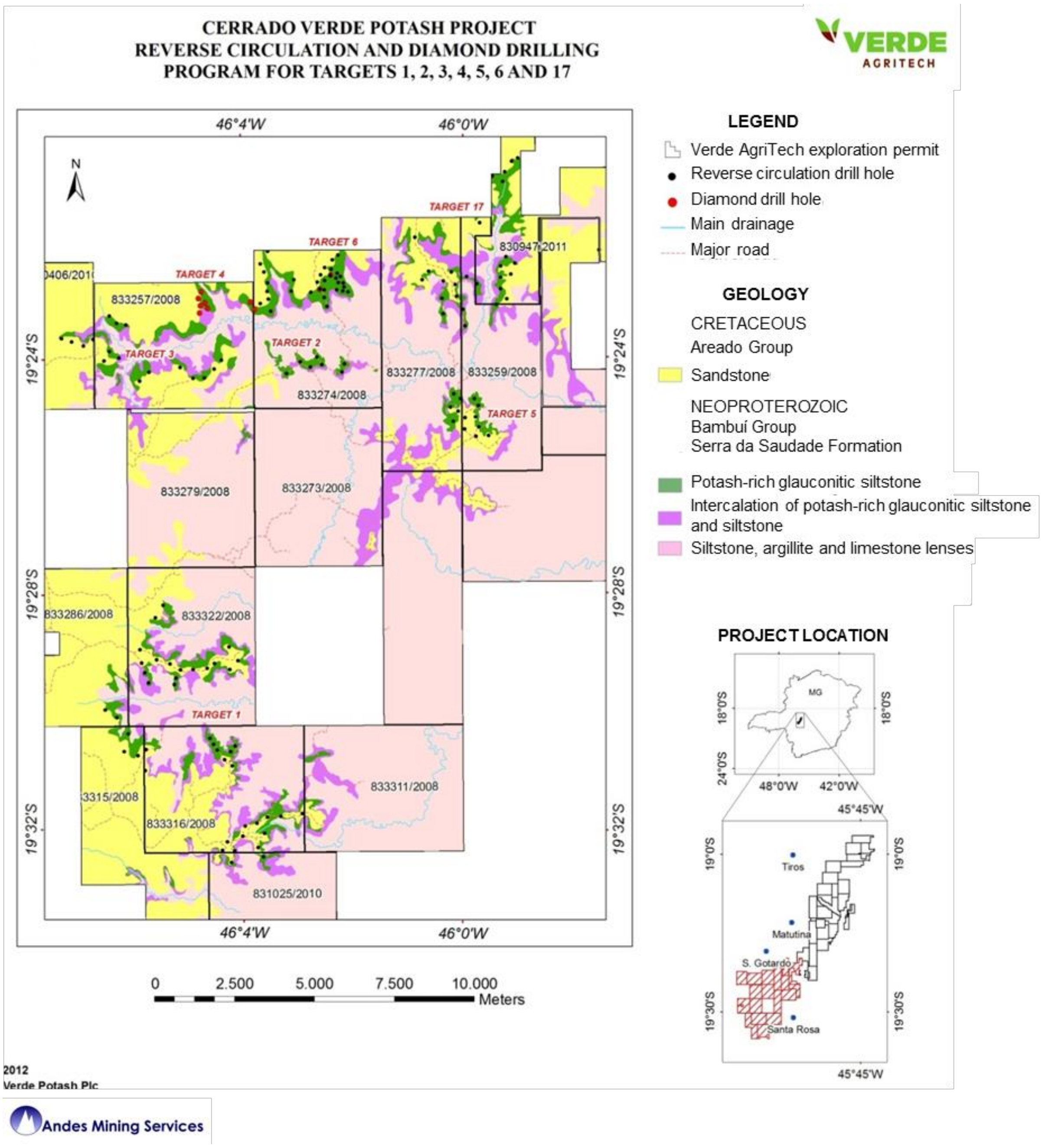


**Figure 9.1.1-4 2010/2011 Geological Map and Drilling Program for Targets 1, 2, 3, 4, 5, 6 and 17 (VERDE, March 31, 2013)**

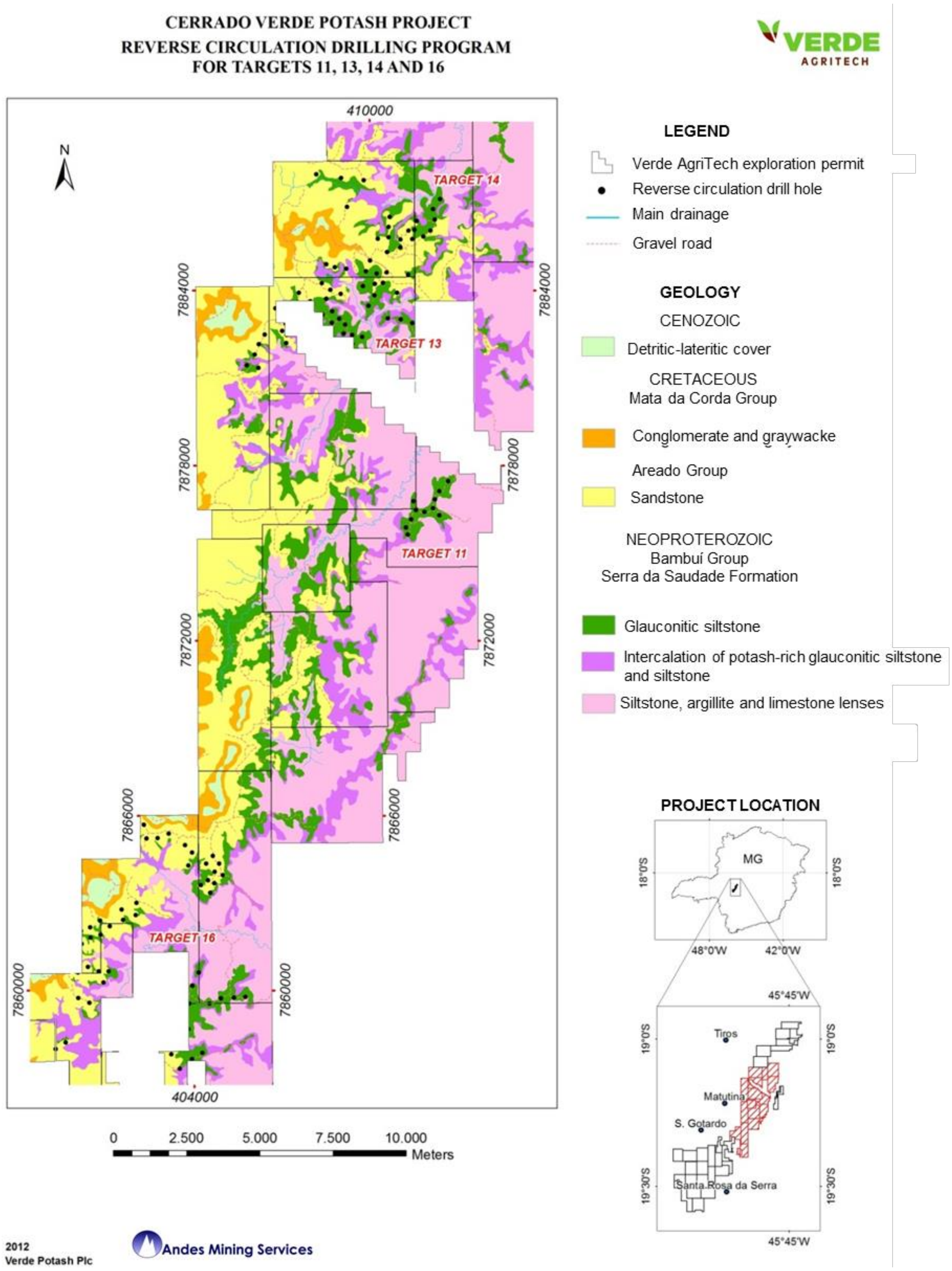


**Figure 9.1.1-5 2010/2011 Geological Map and Drilling Program for Targets 11, 13, 14 and 16 (VERDE, March 31, 2013)**

In 2012, infill drilling was completed across Target 7 down to a 100 m x 100 m grid spacing in some areas to increase the resource category confidence (Figure 9.1.1-6).

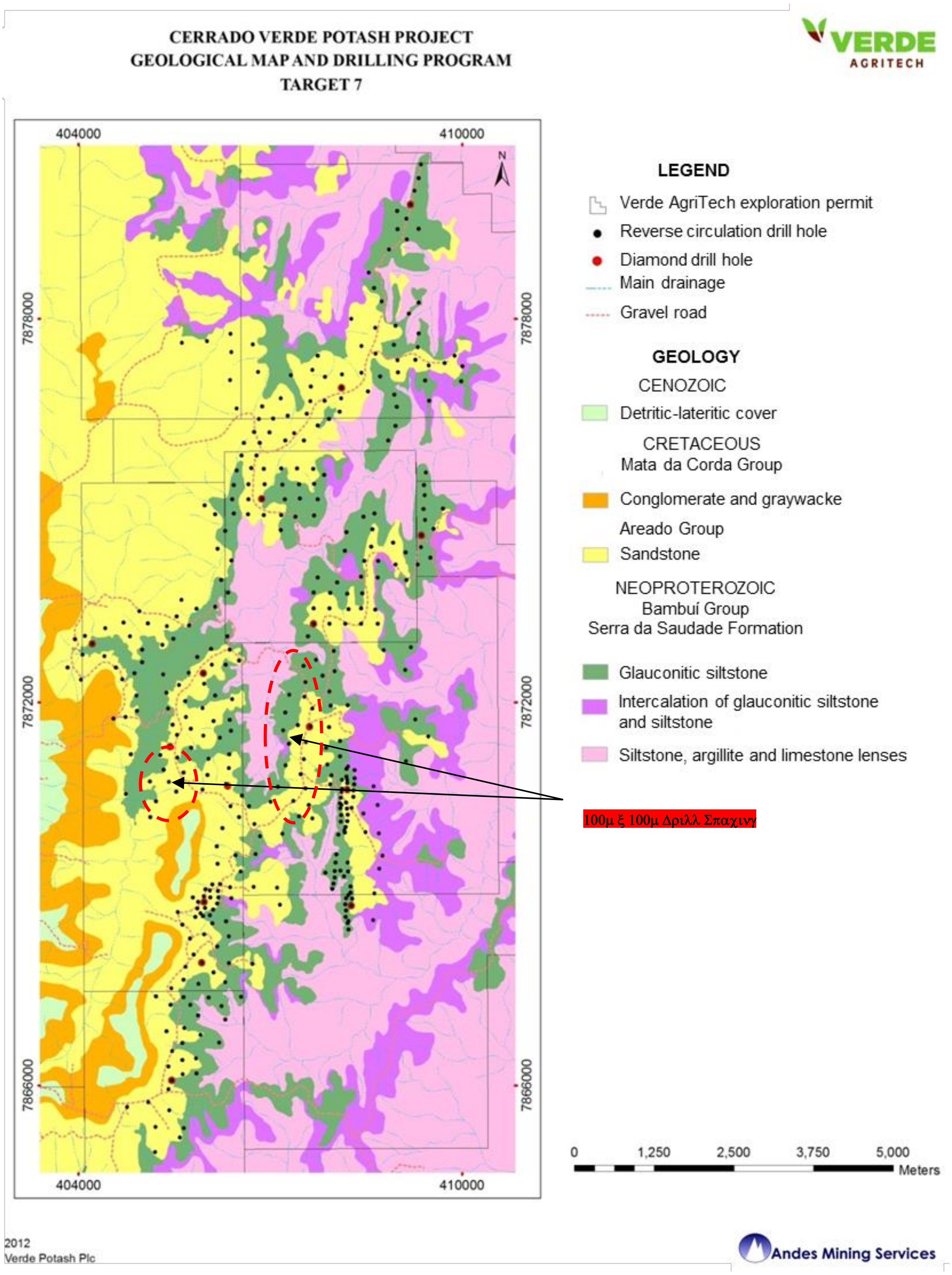


**Figure 9.1.1-6 2012 Geological Map and Infill Drilling Program for Target 7 (VERDE, March 31, 2013)**

## 9.2. Recent Exploration

In 2014 VERDE drilled four RC holes for a total of 378 m to install piezometers and water level indicators using an Atlas Copco rig belonging to *Geosedna Perfurações Especiais S/A*. RC samples of Ore were collected at 1 m intervals and samples for analysis at SGS Geosol laboratory in Vespasiano, Minas Gerais State, Brazil were collected. A total of 246 samples were analyzed by XRF for $Fe_2O_3$, $SiO_2$, $Al_2O_3$, CaO, MgO, MnO, $TiO_2$, $Na_2O$, $K_2O$, $P_2O_5$, and LOI. A total of 12 samples were analyzed using an inductively coupled mass spectrometer with multi-acid digestion for 51 elements.

# 10. Drilling

A total of four drilling campaigns were performed across the Cerrado Verde Project.

The principal drilling methods utilized include rotary-percussion reverse circulation drilling (RC) and diamond core drilling (DC). Initial drilling was carried out using a nominal grid spacing of 100 m x 400 m across the majority of the individual target areas. In 2012, infill drilling was completed across Target 7 with certain higher-grade portions selected for infill 100 m x 100 m drilling to increase the resource category confidence.

Table 10-1 highlights the number of holes, the average depth reached, and the number of meters drilled across each target area.

**Table 10-1 VERDE Drilling Summary Statistics - Cerrado Verde Project Area**

| Prospect | Number of Holes | Average Depth (m) | Meters Drilled | Number of Holes | Average Depth (m) | Meters Drilled |
|---|---|---|---|---|---|---|
| Target 1 | 44 | 54 | 2,352 | 0 | 0 | 0 |
| Target 2 | 7 | 47 | 329 | 0 | 0 | 0 |
| Target 3 | 17 | 69 | 1,172 | 0 | 0 | 0 |
| Target 4 | 10 | 66 | 662 | 8 | 65 | 520 |
| Target 5 | 13 | 57 | 738 | 0 | 0 | 0 |
| Target 6 | 22 | 57 | 1,255 | 2 | 76 | 151 |
| Target 7 | 375 | 61 | 22,805 | 15 | 70 | 1,046 |
| Target 10 | 5 | 50 | 250 | 0 | 0 | 0 |
| Target 11 | 11 | 50 | 542 | 0 | 0 | 0 |
| Target 12 | 40 | 63 | 2,508 | 0 | 0 | 0 |
| Target 13 | 45 | 49 | 2,181 | 0 | 0 | 0 |
| Target 14 | 21 | 58 | 1,218 | 0 | 0 | 0 |
| Target 16 | 54 | 50 | 2,691 | 0 | 0 | 0 |
| Target 17 | 31 | 49 | 1,522 | 0 | 0 | 0 |
| TOTAL | 695 | 56 | 40,225 | 25 | 70 | 1,717 |

## 10.1. Campaign #1 (Late 2009)

In late 2009, a drilling program was undertaken across a select portion of Target-7. A Prominas R1-H drill rig (belonging to *Fuad Rassi Engenharia Indústria e Comércio Ltda*) drilled a total of 19 vertical RC holes for a total of 997 m with an average drillhole depth of 52 m.

## 10.2. Campaign #2 (January 2011 - June 2011)

Three RC drill rigs (belonging to *Geosedna Perfurações Especiais S/A*) were used in the second campaign, which started in January 2011 and finished in June, 2011. These three rigs (Foremost, Prominas and Explorac), drilled a total of 424 vertical RC holes for a total of 24,148 m of drilling (Figure 10.2-1 and Figure 10.2-2). The RC boreholes were drilled using 4¾" and 5" hammers to an average depth of 56 m across a 400 m x 400 m grid spacing (approximately). Of the 424 holes drilled, 104 holes did not intercept the ore. These holes intercepted the transition zone (lower grade material, below 7% $K_2O$) which is the rhythmic intercalation of siltstones. These drill holes were used in the wireframe modelling to determine the mineralized area, though were not used for resource estimation purposes, given their lower grade $K_2O$ values.

**Figure 10.2-1 Foremost RC Drill Rig (Early 2011)**

**Figure 10.2-2 Explorac RC Drill Rig (Early 2011)**

## 10.3. Campaign #3 (February 2011 - August 2011)

The third drilling campaign, carried out between February 2011 and April, 2011, accounts for 5 twinned RC/DC holes totaling 412 m of drilling. All holes were drilled vertically to an average depth of 82 m. The rig used was a Diakor II (belonging to *Isoágua Perfurações Especiais Ltda*,), with HQ and NQ diameter coring.

The purpose of the twinned holes was to confirm the geology and highlight, in detail, the lithological and mineralogical variations in the intercepted units, besides providing material for bulk density measurements. In August 2011, a total of 8 DC holes were drilled into Target 4, using a Mach 1200 rig (belonging to *Rede Engenharia e Sondagens S/A*). All holes were drilled vertically with a total of 520 m drilled, for an average depth of 65 m.

## 10.4. Campaign #4 (May 2012 - September 2012)

Three RC drill rigs (belonging to *Geosedna Perfurações Especiais S/A*) were used in the fourth drilling campaign, which started in May 2012 and finished in September, 2012. These three rigs (Fordcarro and Explorac) drilled a total of 252 vertical RC holes for a total of 15,080 m of drilling (Figure 10.4-1 to Figure 10.4-4). The RC boreholes were drilled using 4¾" and 5" hammers to an average depth of 60 m in a 200 m x 200 m and 100 m x 100 m grid pattern.

Of the 252 drill holes, only 1 drill hole (CV-RC-609) did not intercept the ore. This drill hole intercepted the transition zone, which is a rhythmic intercalation of siltstones. This drill hole was used to help guide the wireframe modelling to determine the mineralized area. Drill hole assays from CV-RC-609 were used for estimation purposes to give a better estimate on the margins of the Ore.

**Figure 10.4-1 Fordcarro RC Drill Rig (May 2012)**

**Figure 10.4-2 RC Drilling #1 - CV Target 7 (August 2012)**

**Figure 10.4-3 RC Drilling #2 - CV Target 7 (August 2012)**

**Figure 10.4-4 RC Drilling #3 - CV Target 7 (August 2012)**

Between August 2012 and September, 2012, 12 DC holes were drilled in Target 7, using a Mach 1200 rig (belonging to *Rede Engenharia e Sondagens S/A*). All holes were drilled vertically and twinned with existing RC/DC holes. The average depth drilled was 65 m, for a total of 785 m of drilling. Diamond drill core samples (HQ and NQ) provided suitable material for further bulk density measurements.

## 10.5. Surveying

All holes were drilled vertically, and downhole deviation surveys are not required in view of the shallow depth to which the holes were drilled.

The drilling was carried out perpendicular to the mineralization and reflects the true thickness.

AMS completed an inspection of the historical drilling completed during a site visit in August 2012. AMS noted an excellent correlation between the historical drill collar coordinated in the field and those reported within the database.

AMS noted that reputable companies were involved in this drilling and samples were analyzed at internationally recognized laboratories. AMS had no reason to doubt the integrity of all drilling to date and, for the purpose of the mineral resource estimate, both diamond and RC drilling have been included.

**Figure 10.5-1 AMS Drill Collar Field Check**

**Figure 10.5-2 Yard Storage of RC Drill Chips**

**Figure 10.5-3 Warehouse Storage of RC Drill Chip Trays**

**Figure 10.5-4 Warehouse Storage of Diamond Drill Core**

Drillhole collars were surveyed using a Trimble® Pathfinder Pro XR DGPS. The data had post-correction validated by the IBGE with reference to the *Santiago & Cintra* station in Belo Horizonte (vertex 93,621; East 608,308.23 m, North 7,799,827.00 m, 879.06 m altitude (HAE) – recording rate: 0.5s, C/A code + L1). All azimuths, distances, areas and perimeters were calculated following the UTM planar projection system, WGS84 datum, MC –45W and 23S zone. The accuracy of the measurements (borehole and surface) is within acceptable standards, considering the type of mineralization. The accuracy is approximately 1 cm after 45 minutes of satellites tracking and meets acceptable industry standards for this style of mineralization.

The drilling data was interpreted and compiled into a 3D geological model, which is described and discussed in Section 14 of this Technical Report.

## 10.6. Logging

The RC chip samples were sieved at the project site with small amounts of chip sample retained and stored in labelled chip trays (Figure 10.6-1). Chip samples were described in terms of their lithology, color and degree of weathering and were analyzed using a portable X-ray fluorescence spectrometer.

The diamond drill cores were placed in core boxes for storage and future reference (Figure 10.6-2). The weathering, regolith and lithology, including the petrographic features were logged by the geologists, as were records of basic geotechnical observations (rock quality designation - RQD), degree of weathering and degree of impact resistance). Information was entered into a digital database (Microsoft Excel). Logging was performed in the core shed where the drill cores are stored. After being logged, the core boxes were photographed as a precaution against loss and/or deterioration.

**Figure 10.6-1 Reverse Circulation Sample Logging Box**

**Figure 10.6-2 Diamond Core Storage**

## 10.7. Recovery Calculations

For the RC drilling, the recovery determinations were calculated based on the relationship between the interval weight and the reference value, using the formula below:

$$\% \ \mathbf{Rec} = \frac{\mathbf{(x)kg} * \mathbf{100}}{\boldsymbol{C_v}}$$

Where, the cylinder volume ($C_v$) represents an average density of 2.30 g/cm$^3$:

$$\mathbf{C_v = \pi * R^2 * h = \pi * 6.35^2 * 100 = 3.1415 * 40.32 * 100 = 12{,}666.5\ cm^3 * 2.30\ g/cm^3 = 29.132\ kg}$$

For DC, recovery determinations are calculated using the sum of the length of core pieces compared with the total length of the core run.

AMS have reviewed recoveries for all diamond drilling completed across the Cerrado Verde Project area and noted excellent core recoveries throughout, with no material issues noted.

## 10.8. Diamond Drilling (DDH) Sampling

After being logged, the selected diamond drill core was cut lengthwise using a diamond core saw. One half of the core was sent for analysis and the other half was retained in the core box for future reference.

The samples, with a length of 2 m, were packed in a plastic bag, with the identification number written with a marker on the sample together with an identification tag. The bag was placed inside another, sealed with clamps and likewise identified. All data related to sampling was recorded into an Excel database for subsequent correlation with analytical results once returned from the laboratory.

## 10.9. Reverse Circulation (RC) Sampling

As part of the first drilling campaign, samples were taken on 2 m intervals and riffle split down to an approximate 3 kg sample through a 3-tier riffle splitter (1:7 splitting ratio).

For the 2011 and 2012 drilling programs, RC samples were collected every 1 m to 3 m intervals, placed in a large plastic bag and weighed on a balance scale. A small sample was taken from the bag and placed into a chip tray for visual inspection and logging by the geologist. The main water intersections encountered by drilling were also noted and entered in spreadsheets by the supervisor on the Project site. The cyclone was cleaned by compressed air after every rod drilled.

Sampling intervals were selected after a preliminary analysis by the portable Innov-X Delta X-ray fluorescence equipment (XRF). Intervals which contained greater than 6% $K_2O$ were selected for analysis. A safety margin was given for these intervals. This margin ranged from 1 m to 5 m, taking as reference the content of 6% $K_2O$ and variations up to 2% below this level. The results obtained were integrated into an excel spreadsheet and passed via a personal digital assistant (PDA) to a responsible individual at the core shed.

At the Project site, the sample was split repeatedly in a riffle splitter until a representative sample of approximately 1.3 kg was obtained. This sample was destined for preparation and laboratory analyses. The riffle splitter was beaten with a rubber mallet and cleaned with compressed air after every sample, to avoid sample contamination. The wet and moist samples were split using a hollow plastic cylinder with a sharpened tip (approximately 5%-10% of samples from the 2011 program. No wet sampling completed as part of the 2012 field program). This cylinder was projected into the sample bag, to perforate it in several different places. The material from the bag that was returned within the cylinder was then sampled. Approximately six punches were sufficient to obtain a representative sample of the 1 m to 3 m sample interval drilled based upon observations made from the site visit while drilling was in progress. These samples were transported to the laboratory facilities for further processing.

## 10.10. Bulk Density

For resource estimation, dry bulk density values were calculated for select samples of the diamond drill core. After the geological description, the drill core was sawn in half. The weathered and fresh lithological units were chosen for density measurements. Intervals of 10 cm to 15 cm were selected from the half core. The top and the base of each section of drill core were marked and the depth recorded in the density spreadsheets for each hole.

Each sample interval was wrapped in transparent film (vinyl polychloride resin) and weighed in the air (not immersed in water) using an OHAUS Adventurer® digital balance, approved by INMETRO (the National Institute of Meteorology, Normalization and Industrial Quality), with a precision of at least 0.02 g (Figure 10.10-1). The sample was then completely immersed in water by way of a suspended steel hook attached to the central beam of the balance. The immersed sample weight was then recorded.

The transparent film was removed, and the sample was placed in a labelled aluminum tray and then dried in an electric oven at a temperature of approximately 95 °C for 24 hours. After cooling, the sample was wrapped again in transparent film and weighed in the air on top of the digital balance. The sample was then completely immersed in water by way of a suspended steel hook attached to the central beam of the balance (Figure 10.10-2). The immersed weight was then recorded.

**Figure 10.10-1 Wrapped Sample Weighed in Air**

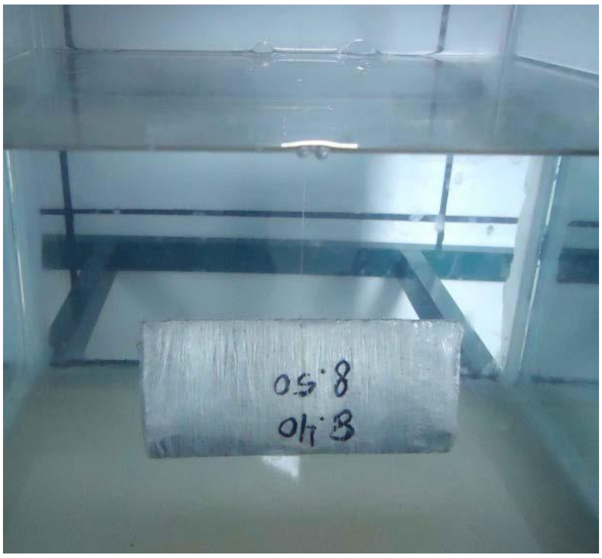

**Figure 10.10-2 Wrapped Sampled Weighed in Water**

Thereafter, the sample was returned to its respective place in the drill core box. The wet and dry density calculations were made using the Archimedes Principle.

During the 2011 diamond drilling campaign, only dry density measurements of the glauconitic siltstone were taken of holes drilled into Targets 4, 6 and 7. As part of the 2012 drill program, wet and dry measurements of the glauconitic siltstone samples were completed on the diamond drill cores for Target 7. Table 10.10-1 displays the average figures for the weathered and fresh glauconitic siltstone samples obtained from Targets 4, 6 and 7. Figure 10.10-3 and Figure 10.10-4 illustrate the bulk density distribution of samples taken from both fresh and weathered material across Target 7.

**Table 10.10-1 Drill Core Density Measurements (Targets 4, 6 and 7)**

| Lithological Unit | Type of Density | Target 4 | Target 6 | Target 7 |
|---|---|---|---|---|
| Weathered Glauconitic siltstone | Wet Density (g/cm$^3$) | - | - | 1.74 (14 samples) |
| | **Dry Density (g/cm$^3$)** | **1.52 (28 samples)** | **1.43 (4 samples)** | **1.64 (15 samples)** |
| Fresh Glauconitic siltstone | Wet Density (g/cm$^3$) | - | - | 2.29 (123 samples) |
| | **Dry Density (g/cm$^3$)** | **2.14 (33 samples)** | **2.08 (10 samples)** | **2.18 (178 samples)** |

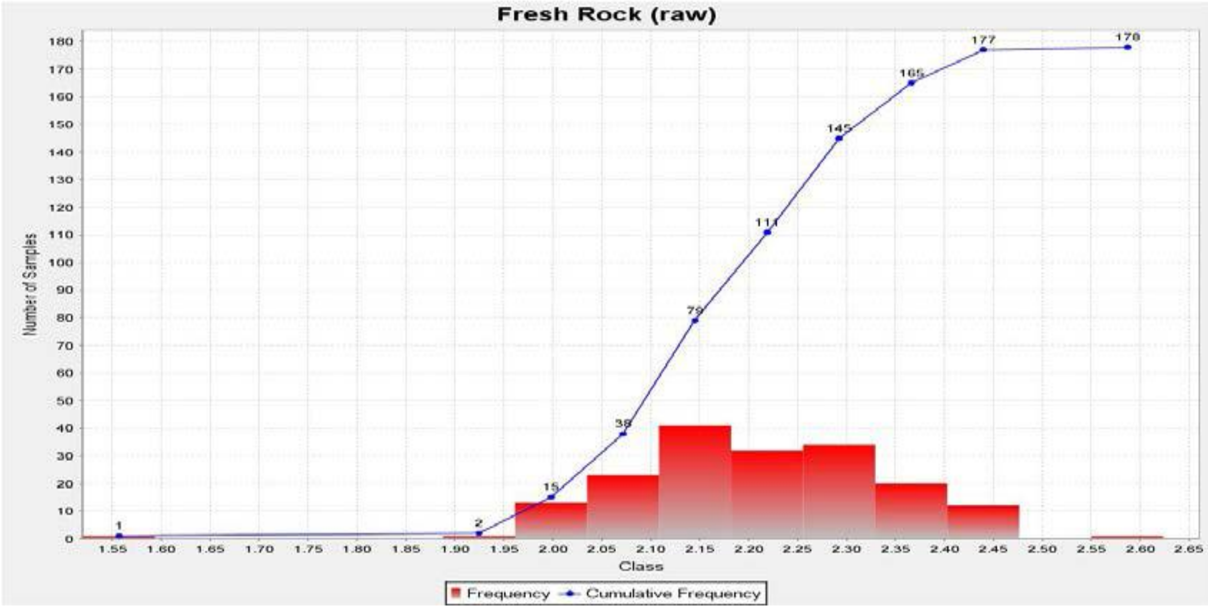


**Figure 10.10-3 Density Measurement Histogram – Fresh Rock Material from Target 7 (average 2.18 g/cm³)**

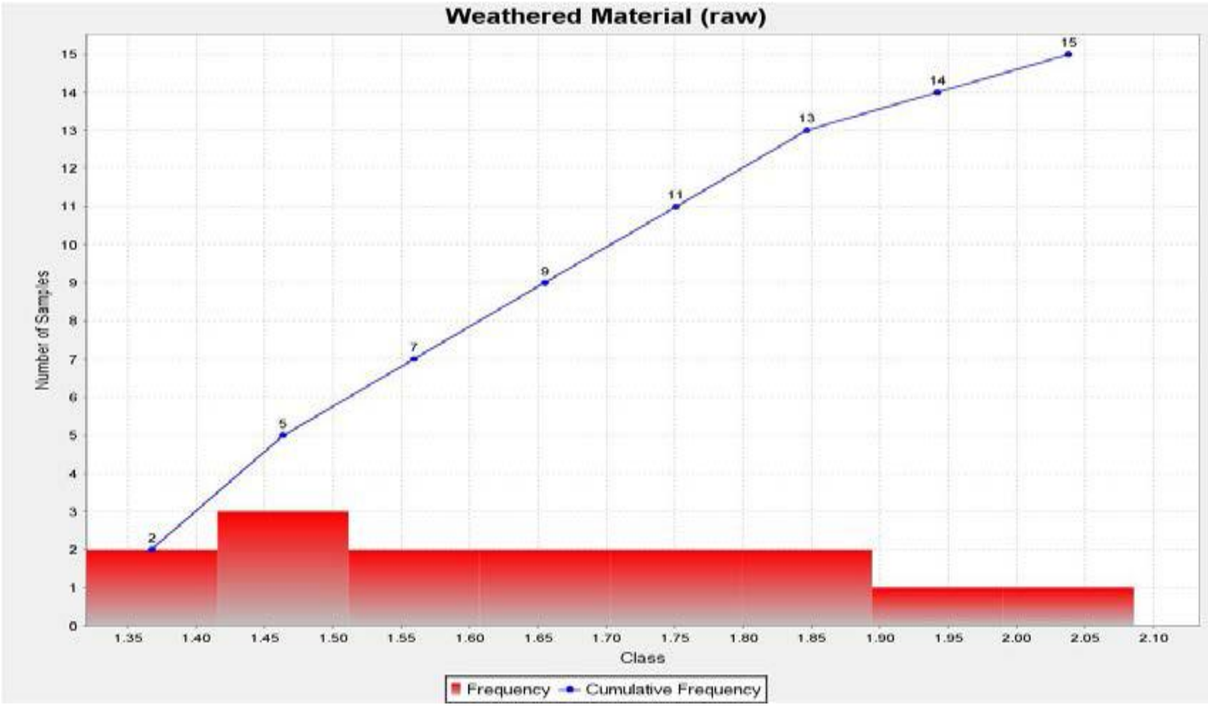


**Figure 10.10-4 Density Measurement Histogram – Weathered Material from Target 7 (average 1.64 g/cm³)**

Density determinations were calculated based on a number of diamond drill core samples selected from Target 7. A total of 178 samples were collected from the "fresh" glauconitic siltstone material with an average bulk density value of 2.18 g/cm³ recorded. In addition, a further 15 samples were collected from the "weathered" glauconitic siltstone material and the average bulk density recorded for these was 1.64 g/cm³.

# 11. Sample Preparation, Analysis and Security

## 11.1. Sampling Method

Samples for laboratory analyses were prepared at the project site by VERDE technicians and sent in a VERDE vehicle to the respective laboratories. A summary of the drilling completed by VERDE, along with the laboratories utilized for each phase of drilling is shown in Table 11.1-1 below.

**Table 11.1-1 Laboratories Used in Analyzing VERDE Drilling**

| Year | Company Name | Type of Drilling | Number of Holes | Meters Drilled | Lab Used |
|---|---|---|---|---|---|
| 2009 | VERDE | RC | 19 | 997 m | Bureau Veritas (Brazil) |
| 2011 | VERDE | RC / DDH | 452 | 26,609 m | SGS Geosol |
| 2012 | VERDE | RC / DDH | 264 | 15,865 m | SGS Geosol |

## 11.2. Sample Preparation and Assaying Methods

### 11.2.1. 2009 Program

For the initial RC drilling program, samples were taken at 2 m intervals and then riffle split down to 3 kg samples for submission.

Samples were sent to Bureau Veritas laboratory in Vespasiano, Minas Gerais, Brazil. This laboratory is part of the international chain of laboratories owned by Bureau Veritas which has ISO 14001 certification. The samples were received, dried, crushed to 2mm, riffle split and analyzed using XRF for $Fe_2O_3$, $SiO_2$, $Al_2O_3$, CaO, MgO, MnO, $TiO_2$, $Na_2O$, $K_2O$, BaO, $P_2O_5$, $Cr_2O_3$, SrO and LOI.

While no quality control was undertaken by VERDE for this initial drilling program, Bureau Veritas inserted duplicates, blanks and certified standards at a rate of 5% to maintain their own quality control.

### 11.2.2. 2011 and 2012 Programs

RC samples were generally taken at 1 m to 3m intervals and then riffle split down to 1.3 kg samples for submission. DC samples were taken at 2 m intervals (half core samples collected) and submitted to the laboratory.

Approximately 96% of the total meters drill are accounted for by RC drilling, of which a total of 12% were drilled moist and further 4.7% were drilled wet (Table 11.2.2-1). AMS have reviewed the sampling procedure, quantity and spatial location of the wet drill samples across the Cerrado Verde Project area and believe there to be no significant bias within the database, which is material to the overall resource reported. In addition, AMS makes note of a number of DDH twin holes beside the original RC drilling (include moist and wet sampling) and note no significant bias between the DDH and RC sampling. A full discussion of the study completed for twin hole drilling is covered in Section 12.2.4 of this report.

**Table 11.2.2-1 RC and DDH Sampling (2011 and 2012 Programs - Wet vs Dry Sampling)**

| | Drill Type | | | |
|---|---|---|---|---|
| | DDH | % | RC | % |
| Holes | 15 | 3.55 | 408 | 96.45 |
| Meters (m) | 1,046.4 | 4.09 | 24,566 | 95.91 |
| Drill Type | % of Database | Sample Quality | | |
| | | Dry (%) | Moist (%) | Wet (%) |
| RC | 95.91 | 83.35 | 11.96 | 4.69 |
| DDH | 4.09 | 100.00 | 0.00 | 0.00 |

RC Drilling

For the 2011 and 2012 drilling programs, RC samples were collected at 1 m to 3 m intervals, placed in a large plastic bag and weighed on a balance scale. A small sample was taken from the bag and placed into a chip tray for visual inspection and logging by the geologist. The main water intersections encountered by drilling were also noted and entered into spreadsheets by the supervisor on the project site. The cyclone was cleaned using compressed air after every rod had been drilled.

Sampling intervals were selected after a preliminary analysis using portable Innov-X Delta X-ray fluorescence equipment (XRF) (Figure 11.2.2-1). Intervals which contained greater than 6% $K_2O$ were selected for analysis, with a length of material kept as a safety margin surrounding these intervals. This margin ranged from 1 m to 5 m, using a content $K_2O$ of 6% as reference and variations up to 2% below this level. The results obtained were integrated into an Excel spreadsheet and passed via a personal digital assistant (PDA) to a responsible individual at the core shed.

**Figure 11.2.2-1 XRF Analysis of Powdered Dry RC Samples (August 2012)**

At the Project site, the sample was split repeatedly in a riffle splitter until a representative sample of approximately 1.3 kg was obtained (Figure 11.2.2-2 to Figure 11.2.2-5). This sample was then sent for preparation and laboratory analyses. The riffle splitter was beaten with a rubber mallet and cleaned using compressed air after every sample to avoid sample contamination.

The wet and moist samples were split using a hollow plastic cylinder with a sharpened tip. This cylinder was projected into the sample bag, to perforate it in several different places. The material from the bag that was returned into the cylinder was then sampled. Approximately six punches are sufficient to obtain a representative sample of the 1 m to 3 m interval sample drilled. These samples were transported to the laboratory facilities for further processing.

**Figure 11.2.2-2 Cleaning the Riffle Splitter**

**Figure 11.2.2-3 Preparing Samples for Submission**

**Figure 11.2.2-4 Preparing RC Samples for dispatch**

**Figure 11.2.2-5 Riffle Splitting RC Samples**

Diamond Drilling (DDH) Sampling

After being logged, the selected diamond drill core was cut lengthwise using a diamond core saw. One half of the core was sent for analysis and the other half was retained in the core box for future reference.

The samples, with a length of 2 m, were packed in a plastic bag, with the identification number written using a marker on the sample together with an identification tag. The bag was placed inside another, sealed with clamps and likewise identified. All data related to sampling was recorded in an Excel database for subsequent correlation with analytical results once they had been returned from the laboratory.

Sample Submission

Both RC and DC samples were sent to SGS Geosol Laboratórios Ltda (SGS) laboratory in Vespasiano, Minas Gerais, Brazil. SGS maintains ISO 9001:2008 and ISO 14001:2004 certifications. The samples were received, dried, crushed to 2mm, riffle split and analyzed using XRF for $Fe_2O_3$, $SiO_2$, $Al_2O_3$, CaO, MgO, MnO, $TiO_2$, $Na_2O$, $K_2O$, BaO, $P_2O_5$, and LOI. AMS did not undertake a laboratory site visit as part of the site visit conducted in early August 2012.

Once received by the laboratory, samples were manually checked for sequential numbering before being logged into the laboratory system for tracking. Physical preparation quality controls were introduced by the laboratory, which included a preparation blank (quartz) and duplicate for every 20 samples. Samples were dried at 105 °C ± 5 °C and passed through a crusher, with 95% of the sample passing at 2 mm. Once crushed, the sample was fractionated to approximately 600 g. The pulverizing of the 600 g sample was done so that 95% would pass through 150 mesh (110 micron) screen, forming the laboratory aliquot (500 g) and the reserved pulp. At this stage, the laboratory quality control featured the inclusion of a reagent blank, certified reference materials and a laboratory duplicate within each analytical run. The blank was inserted at the beginning, standards at 20-sample intervals and a duplicate was inserted at random intervals. All data gathered for quality control samples was automatically captured by the laboratory software, sorted and retained in the quality assurance/quality control (QA/QC) database. The SGS quality management system complies with the requirements of International Standards ISO 9001:2008.

After the loss on ignition (LOI) analysis, the analytical aliquot was prepared by means of fusion with lithium tetraborate in the fusion machine using an oxygen enriched flame – Phoenix® (XRF Scientific). Through this method, a calcined sample (0.5 g) is added to the lithium borate fusion (50% $Li_2B_4O_7$ – 50% $LiBO_2$), mixed and fused at between 1,050 °C and 1,100 °C. The machine uses a mold which incorporates a crucible shape in which both mixing and molding is performed. When mixing is complete, the molten material is cooled in the mold and the bead was removed using a suction cup. The analysis of the fused tablet was conducted using an X-Ray Fluorescence Spectrometer – AxiosmAX-Minerals® (PANalytical). The samples were analyzed for $Fe_2O_3$, $SiO_2$, $Al_2O_3$, CaO, MgO, MnO, $TiO_2$, $Na_2O$, $K_2O$, $P_2O_5$, and LOI. The detection limits for XRF analysis completed by SGS are highlighted in Table 11.2.2-2 below.

**Table 11.2.2-2 Detection Limits of XRF Analysis**

| Item | $Al_2O_3$ | CaO | $Fe_2O_3$ | $K_2O$ | MgO | MnO | $Na_2O$ | $P_2O_5$ | $SiO_2$ | $TiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Limit of Detection | <0.10 | <0.01 | <0.01 | <0.01 | <0.10 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

## 11.3. Quality Controls and Quality Assurance

Prior to May 2010, the company did not have appropriate internal QA/QC systems for the drilling campaign.

In May 2010, VERDE introduced a QA/QC program. For the internal control reference, at 20-routine-sample intervals, a certified standard, a powder blank and a duplicate were inserted and sent to the laboratory. In this program, as the analytical results were received, they were immediately imported into the respective sampling spreadsheets, where any undesirable analytical deviations of standards, blanks, duplicates or inconsistencies between the sample result and its respective lithology could be easily compared. Simple inversions of sample results and typographical errors in the spreadsheets compiled after receiving the assay certificates were common. As a result, all the results from all samples in this program were checked one by one by VERDE personnel (database manager).

Figure 11.3-1 RC Samples ready for Dispatch

Figure 11.3-2 Blanks and Standards Included for Submission

Initially, duplicates were prepared following the splitting of the previous sample pulps. After analysis at the SGS laboratory, the pulps were returned and forwarded for analysis at the ALS Brasil Ltda laboratory, located at Vespasiano, Minas Gerais. From there, the pulps were sent to the ALS laboratory located in Lima, Peru for analysis. The pulps were analyzed using XRF and LOI. The ALS quality management system complies with the requirements of the International Standards ISO 9001:2008 and ISO/IEC 17025:2005. Quality control samples were inserted into each analytical run. For XRF methods, the minimum numbers of QA/QC samples are 2 standards, 1 duplicate and 1 blank, introduced every 39 samples. The blank was inserted at the beginning, standards were inserted at random intervals, and duplicates were analyzed at end of the batch. Every batch of samples analyzed undergoes a dual approval and review process. The individual analytical runs were monitored and approved by the analyst. The results were compared with the initial SGS figures in graphs for duplicate controls such as Thompson and Howarth, QQ and Correlation plots. This procedure was employed through to sample CV-RCS-2151 (March 2011).

From March 2011 onwards, starting with the sample CV-RCS-2171, the duplicate was obtained by quartering the routine sample prepared by VERDE personnel in the field to assist in the verification of the entire laboratory sample preparation process.

For the accuracy control, the Australian GeoStats Pty Ltd certified reference material and IPT - Brazilian *Instituto de Pesquisas Tecnológicas* reference material were used. These were submitted to SGS for conventional XRF analysis. The standards certificates are attached at the end of this report.

The blank material was prepared from pulverized quartz obtained from the Brazilian laboratory Sulfal Química Ltda. At the time, the company did not have appropriate internal contamination control. Gravel blanks composed of quartz were suggested as a suitable alternative for the verification of the contamination of the sample preparation stage of sample processing.

For the external control reference, following analysis at the SGS laboratory, pulps were selected at 20 routine sample intervals, and sent for analysis at ALS Minerals laboratory or at Bureau Veritas Brazil.

Further details regarding the QA/QC protocol are discussed in Section 12 of this report.

## 11.4. Adequacy of Procedures

Regular inspections of the Geosol SGS laboratory are undertaken by VERDE personnel. These inspections include a check for sample preparation, assaying methods, equipment calibration and QA/QC analysis, which proved to be satisfactory. The preparation rooms and equipment are kept clean, and, upon the completion of each shift, these rooms are thoroughly cleaned. All laboratories and equipment are equipped with a ventilation system and exhaust fans. All instruments are in serviceable condition. The laboratory operates according to international standards and the risk of error in chemical analysis can be assessed as low.

The VERDE sampling methods, chain of custody procedures and analytical techniques are all considered appropriate and are compatible with accepted industry standards.

## 11.5. Sample Security

VERDE diamond drill core and reverse circulation drill cuttings are currently stored in a facility in the town of Matutina that VERDE has rented (Figure 11.5-1). After being logged, core samples are marked for splitting and sampling by VERDE geologists. Each RC and diamond core sample is placed in a plastic bag, which in turn is placed in a nylon bag for transportation via truck to the ALS or SGS Geosol sample preparation laboratories in Belo Horizonte.

AMS considers the sampling security implemented by VERDE to be in line with current industry best practices.

**Figure 11.5-1 VERDE Office and Sample Storage Yard/Preparation Area (Matutina) (August 2012)**

# 12. Data Verification

Quality control and quality assurance programs (QA/QC) were limited during early exploration programs conducted across Cerrado Verde target areas. Quality control procedures implemented during the 2009 drilling campaign were essentially internal laboratory QA/QC procedures. Routine laboratory QA/QC procedures included the addition of certified analytical standards, duplicates and blanks in the sample sequence.

Bureau Veritas used the following certified reference standard materials:

- **IPT 146** – Iron Ore VALE (low FeO content);
- **IPT 53** – K-feldspar;
- **Composite Standard**: IPT 53 + IPT 146.

For every 20 samples submitted, 4 control samples were inserted by the laboratory. These included, 1 certified reference material, 1 blank (quartz), 1 preparation blank ($Li_2B_4O_7$ chip) and one duplicate sample.

In May 2010 (following the completion of the first drilling program), VERDE introduced an internal QA/QC program. For reference as an internal control, a certified standard, a powder blank and a duplicate sample were inserted at 20-routine-sample intervals by VERDE into the sample sequence.

Current QA/QC practices employed by VERDE include the addition of duplicates, gravel blanks, certified reference materials and a program of umpire laboratory check samples. As part of the most recent drilling program(s) completed in 2012, as soon as analytical results were received, they were immediately imported into the respective sampling spreadsheets and any undesirable analytical deviation of standards, blanks, duplicates or inconsistency between the sample result and respective lithology were easily compared. Simple inversions of sample results due to typing errors in the spreadsheets after receiving the certificates were also common and, therefore, all the results from all the samples, not only those from the control samples introduced, were checked one by one.

Further details regarding the integrity of the VERDE database are provided below in Sections 12.1 and 12.2.

## 12.1. Geological Database

The drill hole information was organized on the personal digital assistant (PDA) and the data were exported directly to the database in *.xls format. The results of the chemical analysis were received in *.xls format and compiled for each drill hole with a reference made to the respective log sheet. It was a double checked against the data compiled by the database manager (VERDE employee). The local data validation was performed by VERDE.

VERDE have provided AMS with an Excel database, complete with collar, survey, geology and assay information. AMS have validated the database using the database audit tools, with no material inconsistencies having been noted. In addition, AMS have performed a manual check of the database and any minor inconsistencies noted were promptly rectified by VERDE personnel.

The following checks were performed:

- Holes that had no collar data.
- Overlaps in sample intervals.

- Gaps in sample intervals.
- Matching the geological logging length to the drill hole sample length.
- The first sample does not correspond to 0 m in the database analysis.
- The azimuth is not in the range from 0 to 360 degrees.
- The dip angle is not in the range from 0 to 90 degrees.
- Azimuth or dip angle of the drill hole is missing; and
- The drill hole total depth is less than the depth of the last sample.

There were no material errors noted within the database. Only two overlapping samples were noted, and these were corrected by AMS before importing the database into Access.

The Excel database was converted into an Access format database, which is compatible with most commercial geological modelling software and allows key relationship-based changes/modifications to be made easily (for example – application of average density grades across geological boundaries).

Hardcopy assay data from SGS and ALS were made available to AMS and a comparison of these results with the data supplied in the VERDE database was performed as part of the validation checks. AMS checked a total of 10% of the VERDE drill holes for validation purposes. No material errors were identified between the original log and the digital database.

## 12.2. Quality Analysis/Quality Control (QA/QC)

VERDE has put in place a QA/QC program for reverse circulation and diamond drilling programs which includes the submission of blanks, duplicates (field and pulp), certified standards and umpire assays.

VERDE has undertaken quality control for approximately 5% of the total samples prepared. This includes the submission of approximately 5% duplicates (field and pulp), 5% certified standards and 5% blanks. Blanks and standards are inserted routinely into the prepared samples for dispatch to the laboratory. In addition, umpire assays have also been completed on approximately 10% of the total samples prepared and assayed.

All QA/QC results returned from the laboratory to date have been made available to AMS for review. QA/QC results and graphs were compared with original hardcopy data from both the SGS and ALS laboratories.

### 12.2.1. 2009 Drilling Program

During the 2010 drilling campaign, VERDE did not carry out a proper QA/QC program. The QA/QC analysis took the form of the internal Bureau Veritas Brazil program. To undertake an umpire sample analysis, 5% of samples sent to the Bureau Veritas Brazil were then sent to SGS in Belo Horizonte. The accuracy, precision and contamination level of the analysis was evaluated. VERDE personnel have reviewed the QA/QC results returned by Bureau Veritas Brazil and these are presented below in Table 12.2.1-1.

**Table 12.2.1-1 Standards Utilized by Bureau Veritas Brazil**

| Standard | Expected Value ($K_2O$ %) | +/- 10% (EV) | Failed | No. of Analyses | Minimum (%) | Maximum (%) | Mean (%) |
|---|---|---|---|---|---|---|---|
| IPT 146 | 0.04 | 0.034 and 0.042 | 5 | 6 | 0 | 0.07 | 0.05 |
| IPT 53 | 12.10 | 10.89 and 13.31 | 0 | 6 | 11.95 | 12.61 | 12.18 |

| Standard | Expected Value ($K_2O$ %) | +/- 10% (EV) | Failed | No. of Analyses | Minimum (%) | Maximum (%) | Mean (%) |
|---|---|---|---|---|---|---|---|
| IPT 53 + IPT 146 | 6.07 | 5.46 and 6.67 | 0 | 6 | 5.84 | 6.36 | 6.07 |
| Pulp Blanks | 0 | <0.30 | 2 | 30 | - | - | - |

With the exclusion of IPT 146 (which is less than the quoted detection limit for $K_2O$), all blanks and standards inserted by Bureau Veritas Brazil are within a 10% tolerance level.

Sampling Precision

Pulp duplicate samples were taken by Bureau Veritas Brazil every 20 samples. The results of these duplicates are shown below in Figure 12.2.1-1.

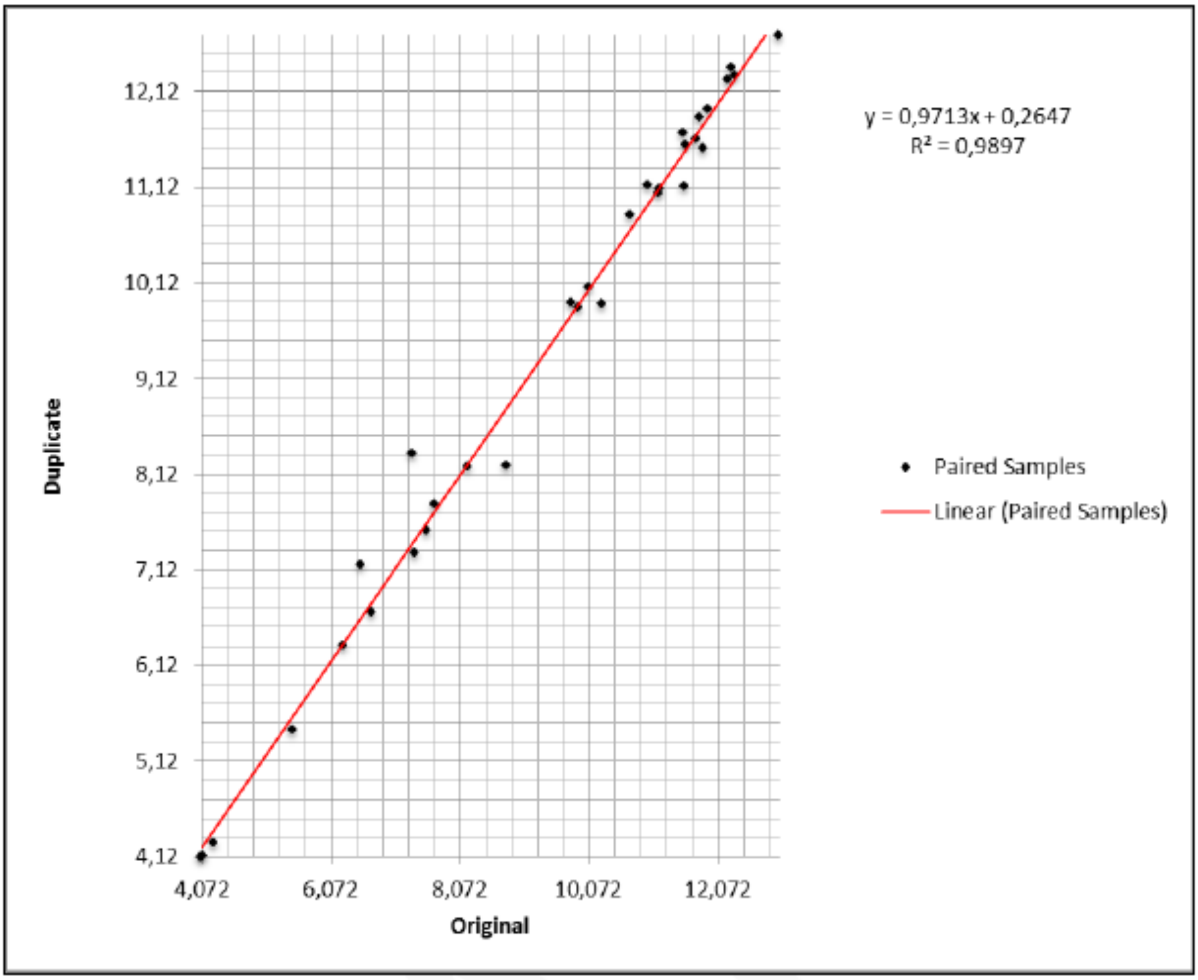


**Figure 12.2.1-1 Pulp Duplicate Samples - 2009 RC Drilling Campaign**

Inaccuracy

At the time of the 2009 drilling program, no QA/QC data was supplied by VERDE. It was recommended that VERDE adopt a QA/QC program which includes the use of certified standards, blanks and pulp duplicates. In addition, it was recommended that field duplicates be taken, which would require the re-splitting of the RC field reject sample and submission at a rate of approximately 5%.

Conclusions

The results show excellent precision for $K_2O$ with 97% of the data being within 10% HARD. The Bureau Veritas Brazil QA/QC data shows good precision and accuracy, despite the limited QA/QC performed for the field campaign.

### 12.2.2. 2011 Drilling Program

In May 2010, VERDE introduced an internal QA/QC program. For reference as an internal control, at 20-routine-sample intervals, a CRM, a powder blank and a duplicate sample were inserted by VERDE.

Sampling Precision

SGS was used as the main laboratory by VERDE for the Cerrado Verde Project.

The sampling precision was evaluated using the method of repeated analysis of field duplicates for $K_2O$, $P_2O_5$, CaO, $Al_2O_3$, $Fe_2O_3$, $SiO_2$, MgO, $TiO_2$, MnO, $Na_2O$ and LOI. From a total of 3,244 samples, 66 were re-examined, representing 2% of the total number of tests.

One of the parameters used in the analysis of the results was precision. Precision is a measure of how well the Y value represents the X value. It is most commonly used in assay quality control, where X is the first assay value and Y is the matching repeated assay. A perfect result has a precision of zero. Values of greater than zero represent an increasing amount of deviation; for example, a precision of 10% indicates that the difference between X and Y varies by around 10% of X. The tests for $K_2O$, $P_2O_5$, $Al_2O_3$, $Fe_2O_3$, $SiO_2$, MgO and $TiO_2$ displayed high quality and accuracy in the statistical analysis, with a precision accuracy of less than 5%. For MnO and $Na_2O$, the tests showed a precision accuracy of less than 15%, and for CaO, the tests showed a precision accuracy of over 15%. The number of tests provided are considered sufficient to be statistically representative.

Precision of the Chemical Analysis

The sampling precision was evaluated using the repeated analysis method for $K_2O$, $P_2O_5$, CaO, $Al_2O_3$, $Fe_2O_3$, $SiO_2$, MgO, $TiO_2$, MnO, $Na_2O$ and LOI. Of a total of 3,244 samples, 108 were re-examined, representing 3.3% of the total number of tests.

Information on internal quality control was presented as a single data batch, without separation of the samples by grade ranges. Two evaluation methods were used: simple linear regression and QQ (Quantile Quantile) plot.

In general, the tests for $K_2O$, $Al_2O_3$, $Fe_2O_3$, MgO, $TiO_2$ and $SiO_2$ displayed high quality and accuracy in the statistical analysis, with an accuracy level of over 5%. For $P_2O_5$, CaO, MnO and $Na_2O$, tests showed a precision of up to 12%.

The correlation coefficient of the regular control sample values is over 0.9, confirming that the tests for the most important elements in the mineralization were conducted with a satisfactory and acceptable level of accuracy.

Inaccuracy

The inaccuracy was determined as the difference in the $Fe_2O_3$, $SiO_2$, $Al_2O_3$, $P_2O_5$, MnO, $TiO_2$, CaO, MgO, $K_2O$, $Na_2O$ and LOI samples between the values determined by SGS and those determined by the independent laboratory ALS.

The external control was conducted for the purpose of determining systematic inaccuracy in the results from the principal analytical laboratory. The figure for systematic inaccuracy was estimated using the same formula as was used for the internal control.

The number of repeated tests is 119, which is 3.6% of the total number of 3,244 tests. In summary, the analysis of data from each laboratory demonstrated good data precision with a high correlation coefficient of $R > 0.98$.

The total number of external control tests is considered sufficient to be statistically representative. According to an analysis of external control data, the accuracy of the principal laboratories is considered satisfactory.

Standards

For quality control purposes, 174 standard samples were used, which represent 5.3% of the total number of samples analyzed.

- Standard GPO-11 (53 analysis results / 9 samples outside tolerance limits)
- Standard GPO-12 (52 analysis results / 16 samples outside tolerance limits)
- Standard GPO-13 (87 analysis results / 0 samples outside tolerance limits)
- Standard GIOP-27 (29 analysis results / 1 samples outside tolerance limits)
- Standard IPT-18B (89 analysis results / 3 samples outside tolerance limits)
- Standard IPT-53 (84 analysis results / 0 samples outside tolerance limits); and
- Standard IPT-72 (43 analysis results / 43 samples outside tolerance limits)

Seven types of standards were analyzed, and the results were analyzed using the Shewhart Control Chart. Statistical analysis was performed for the following elements $Fe_2O_3$, $SiO_2$, $Al_2O_3$, $P_2O_5$, MnO, $TiO_2$, CaO, MgO, $K_2O$ and $Na_2O$.

The analyzed results provided by SGS present problems when compared with known results. It was reported by VERDE that inadequate results were being produced before March 2011 due to XRF equipment that was poorly calibrated during this period. In almost all cases, standard results were reported as being lower than the reference material results. An example from standard reference material GPO-12 is presented below in Figure 12.2.2-1.

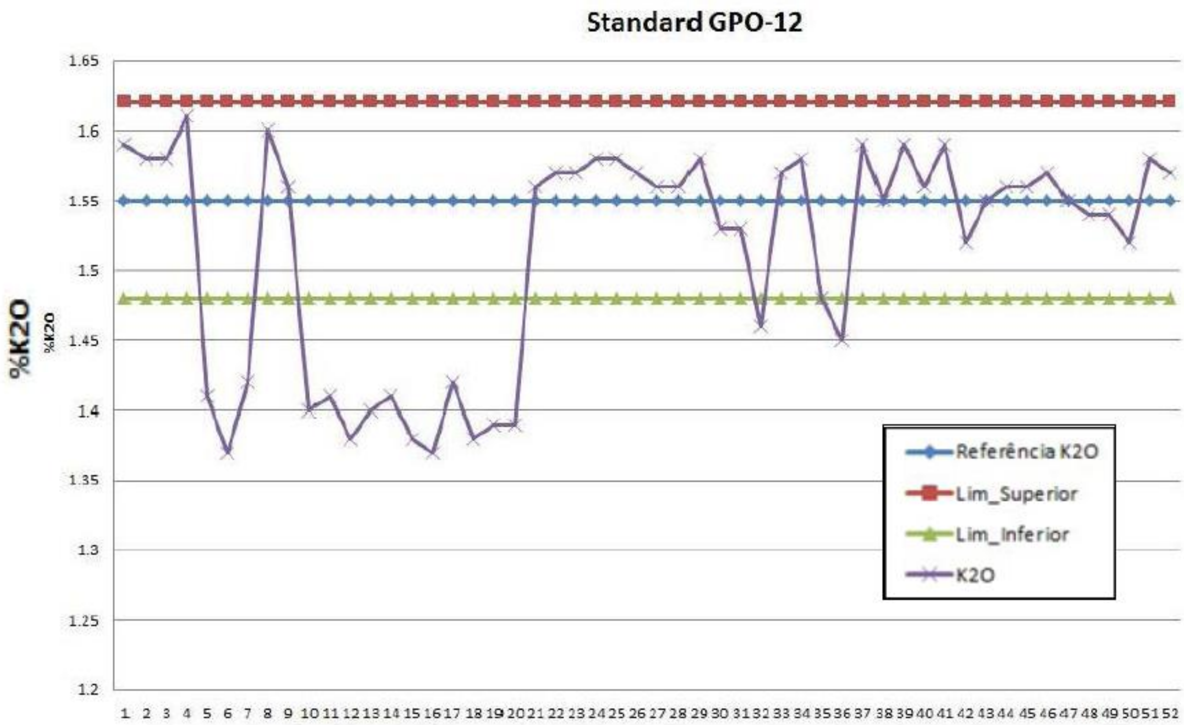


**Figure 12.2.2-1 Standard GPO-12 Samples Results (Purple Line) - 2011 Drilling Campaign**

<u>Blank Samples</u>

For quality control purposes, 174 blank samples were used, representing 5.3% of the total number of samples analyzed.

When discussing the methodologies employed for the blank samples with the VERDE team, it was confirmed that powdered material was sent to the laboratory.

The purpose of using blank samples is to attempt to quantify the contamination of samples during the sample preparation process. This objective was not achieved, as the blank samples were sent to a laboratory as powder, not subject to potential contamination involved in the preparation process and reduction of other samples. This eliminated the need to analyze the results obtained for the blank samples for the purpose of quantifying possible errors in the preparation of other samples.

<u>Conclusions</u>

It was certified that the tests related to duplicate samples were conducted with an acceptable and satisfactory level of accuracy for the most important elements of the mineralization under study.

### 12.2.3. 2012 Drilling Program

<u>Summary</u>

For the 2012 drilling campaign, all assay results are derived from analyses performed at SGS Geosol (Belo Horizonte) and ALS (Lima) laboratories. The control samples, inserted into every batch of 20 routine samples, were:

- 1 field duplicate.
- 1 pulp duplicate.
- 1 certified standard.
  - GPO-11.

- ITAK-904.
- ITAK-905.

- 1 blank (chipped quartz, crushed, homogenized and certified by Bureau Veritas, without $K_2O$ contents).
- 1 umpire (pulp sample re-analyzed at ALS).

The standards were submitted as 10 g sachets for conventional XFR analysis. The assay data for all standards show acceptable results within 3 standard deviations. The precision of the duplicates for the XRF method is considered very good. The assay data for all duplicates show acceptable results within a 10% accuracy range.

Methodology

QA/QC for standard samples was performed considering a limit of 3 standard deviations. Shewhart control charts were used to evaluate accuracy and dispersion. The analysis of duplicates and umpires was conducted in accordance with the orientation given by the SGS Geosol. The maximum acceptable value for the difference between the result of the routine sample (V1) and its duplicate (V2) is arrived at using the following equations;

$$Precision = \frac{100 * LDE}{Mean\ (V1{:}V2)} + LR$$

Where LDE is the Statistic Detection Limit (0.025% for $K_2O$) and LR is the repeatability limit (7% for $K_2O$). The relative percentage difference between V1 and V2 is arrived at using the equation;

$$\%\ Diff_{V1,V2} = Abs\ \frac{V1 - V2}{Mean\ (V1{:}V2)} * 100$$

If $\%Diff_{V1\&V2}$ is bigger than the maximum acceptable value ("Precision" in the equation above), the duplicate result is an "inadequate" result. This relative difference was also analyzed considering a tolerance of 5% or 10% and using linear regression plots.

DDH

A total of 12 DDH for 785.40 m were drilled as part of the 2012 drilling program. A total of 257 drill core samples were submitted to SGS for analysis, with the inclusion of an additional 12 CRMs, 12 field duplicates, 12 pulp duplicates, 12 blanks and a further 12 umpire assays as part of standard QA/QC implemented by VERDE.

The results for the CRMs submitted to the laboratory for analysis are presented below in Table 12.2.3-1 and Figure 12.2.3-1 to Figure 12.2.3-3.

**Table 12.2.3-1 CRMs Submitted by VERDE to SGS Laboratories (Diamond Drilling)**

| CRM Id | Supplier | $K_2O$ (Max) | $K_2O$ (Min) | $K_2O$ (Mean) | Number | Outside +/- 3 x SD Limits |
|---|---|---|---|---|---|---|
| **GPO-11** | Geostats | 3.06 | 3.01 | 3.03 | 4 | 0 |
| **ITAK-904** | ITAK | 7.47 | 7.43 | 7.45 | 4 | 0 |
| **ITAK-905** | ITAK | 10.30 | 10.10 | 10.18 | 4 | 0 |

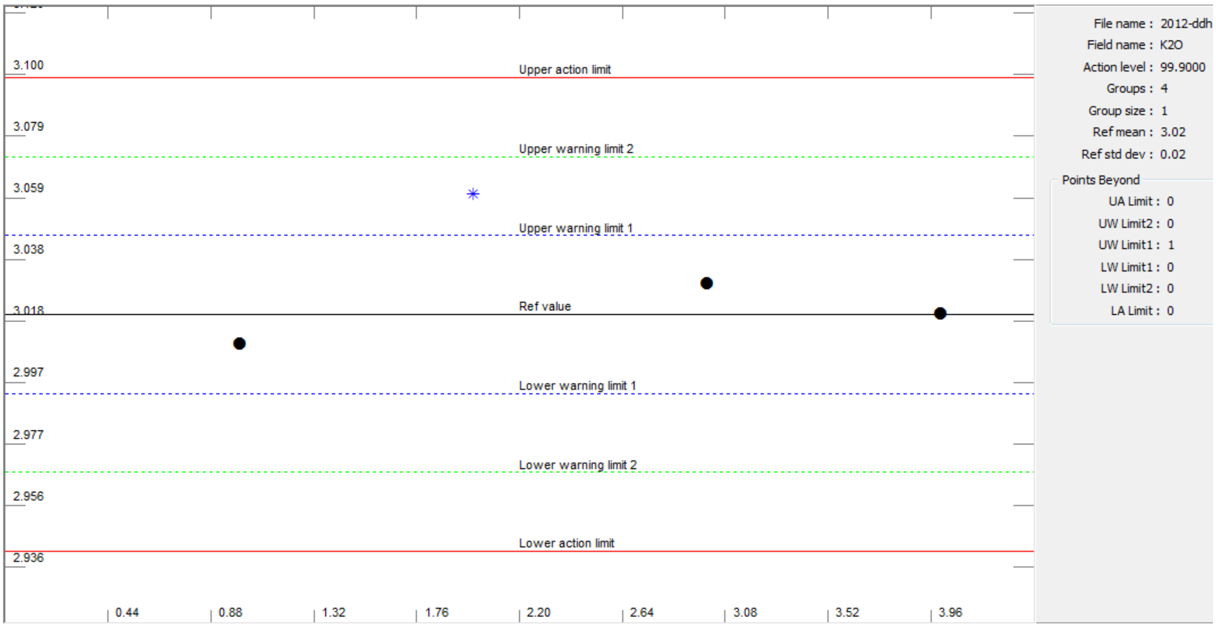


**Figure 12.2.3-1 Shewhart Control Chart for Standard GPO-11**

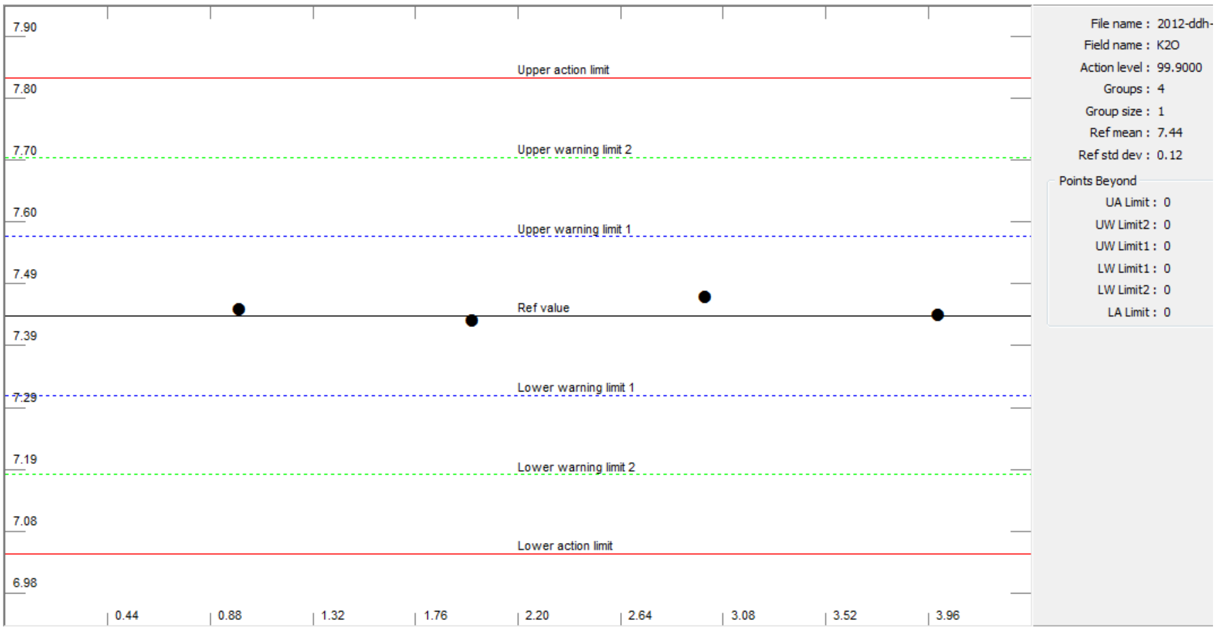


**Figure 12.2.3-2 Shewhart Control Chart for Standard ITAK-904**

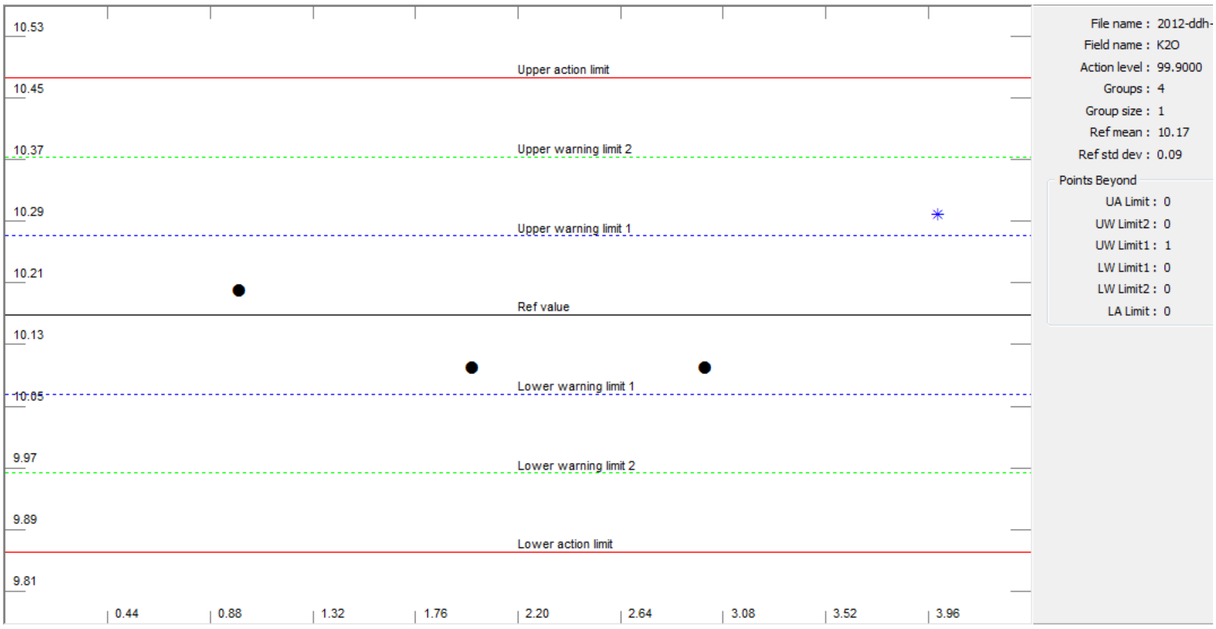


**Figure 12.2.3-3 Shewhart Control Chart for Standard ITAK-905**

On the whole, the CRMs submitted by VERDE display excellent accuracy levels, with no outstanding issues that require attention. AMS is satisfied with the current procedure in place for the submission of certified standards.

A total of 12 field duplicates were submitted by VERDE based on the recent diamond drilling program. The objective of this was to determine relative precision levels between various sets of assay pairs and the quantum of relative error. This directly reflects on the precision of the sampling technique utilized.

Based on the analysis, AMS has concluded that the precision of the field duplicates is acceptable, as is shown in Table 12.2.3-2 and Figure 12.2.3-4 below.

**Table 12.2.3-2 Field Duplicates Submitted by VERDE to SGS Laboratory (Diamond Drilling)**

| Population | 12 | |
|---|---|---|
| Correlation Coefficient | 0.997417255 | |
| Covariance | 2.155931818 | |
| Precision | 1.26% | |
| | Original (X) | Duplicate (Y) |
| Mean | 9.73 | 9.76 |
| Variance | 2.07 | 2.25 |
| Standard Deviation | 1.44 | 1.50 |
| Max | 11.30 | 11.60 |
| Min | 7.18 | 7.09 |

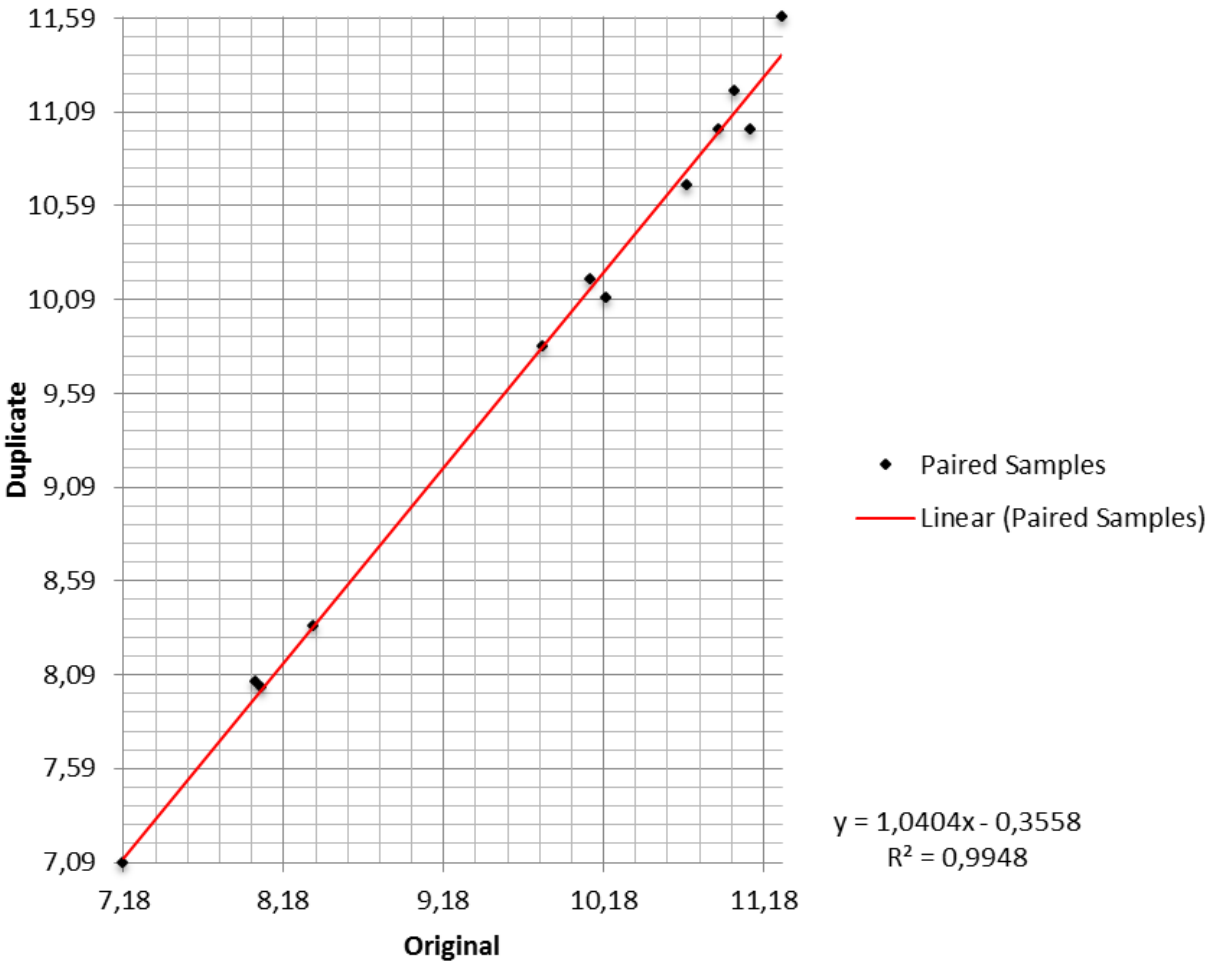


**Figure 12.2.3-4 Linear Regression for Field Duplicates (Diamond Drilling)**

All blank samples returned $K_2O$ values that are consistent with the certificate provided by Bureau Veritas.

RC

A total of 252 RC drillholes for a total of 15,080 m were drilled as part of the 2012 drilling program. A total of 4,733 RC samples were submitted to SGS for analysis, with the inclusion of an additional 250 standards, 250 field duplicates, 242 pulp duplicates, 250 blanks and further 254 umpire assays as part of standard QA/QC implemented by VERDE.

The results for the standards submitted to the laboratory for analysis are presented below in Table 12.2.3-3 and Figure 12.2.3-5 to Figure 12.2.3-7.

**Table 12.2.3-3 Standards Submitted by VERDE to SGS Laboratories (Reverse Circulation Drilling)**

| Standard Name | Supplier | $K_2O$ (Max) | $K_2O$ (Min) | $K_2O$ (Mean) | Number | Outside +/- 3 x SD Limits |
|---|---|---|---|---|---|---|
| **GPO-11** | Geostats | 3.08 | 2.96 | 3.02 | 74 | 0 |
| **ITAK-904** | ITAK | 7.56 | 7.28 | 7.42 | 89 | 0 |
| **ITAK-905** | ITAK | 10.30 | 9.95 | 10.15 | 87 | 0 |

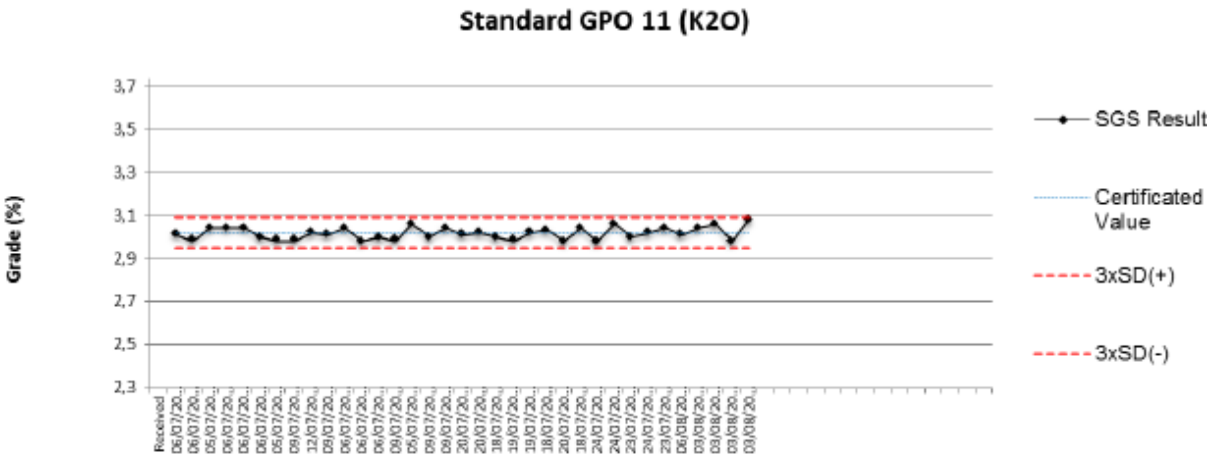


**Figure 12.2.3-5 Shewhart Control Chart for Standard GPO-11**

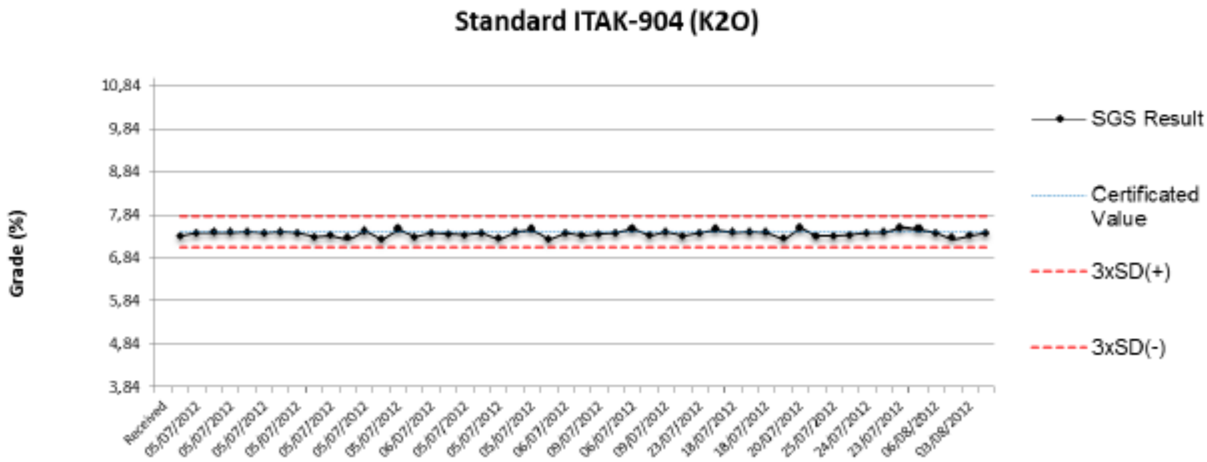


**Figure 12.2.3-6 Shewhart Control Chart for Standard ITAK-904**

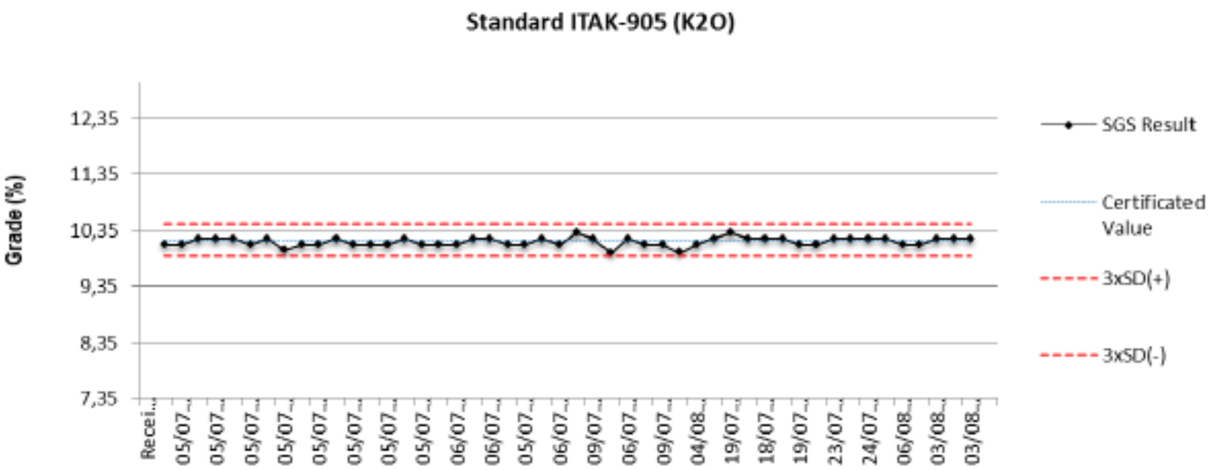


**Figure 12.2.3-7 Shewhart Control Chart for Standard ITAK-905**

A total of 250 field duplicates were submitted by VERDE based on the recent reverse circulation drilling program.

Based on the analysis, AMS concluded that the precision of the field duplicates is acceptable, as is shown in Table 12.2.3-4 and Figure 12.2.3-8 below.

**Table 12.2.3-4 Field Duplicates Submitted by VERDE to SGS Laboratory (Reverse Circulation Drilling)**

| Population | 250 | |
|---|---|---|
| Correlation Coefficient | 0.994492172 | |
| Covariance | 2.257993116 | |
| Precision | 1.64% | |
| | Original (X) | Duplicate (Y) |
| Mean | 9.69 | 9.68 |
| Variance | 2.29 | 2.25 |
| Standard Deviation | 1.51 | 1.50 |
| Max | 12.00 | 11.90 |
| Min | 5.72 | 5.56 |

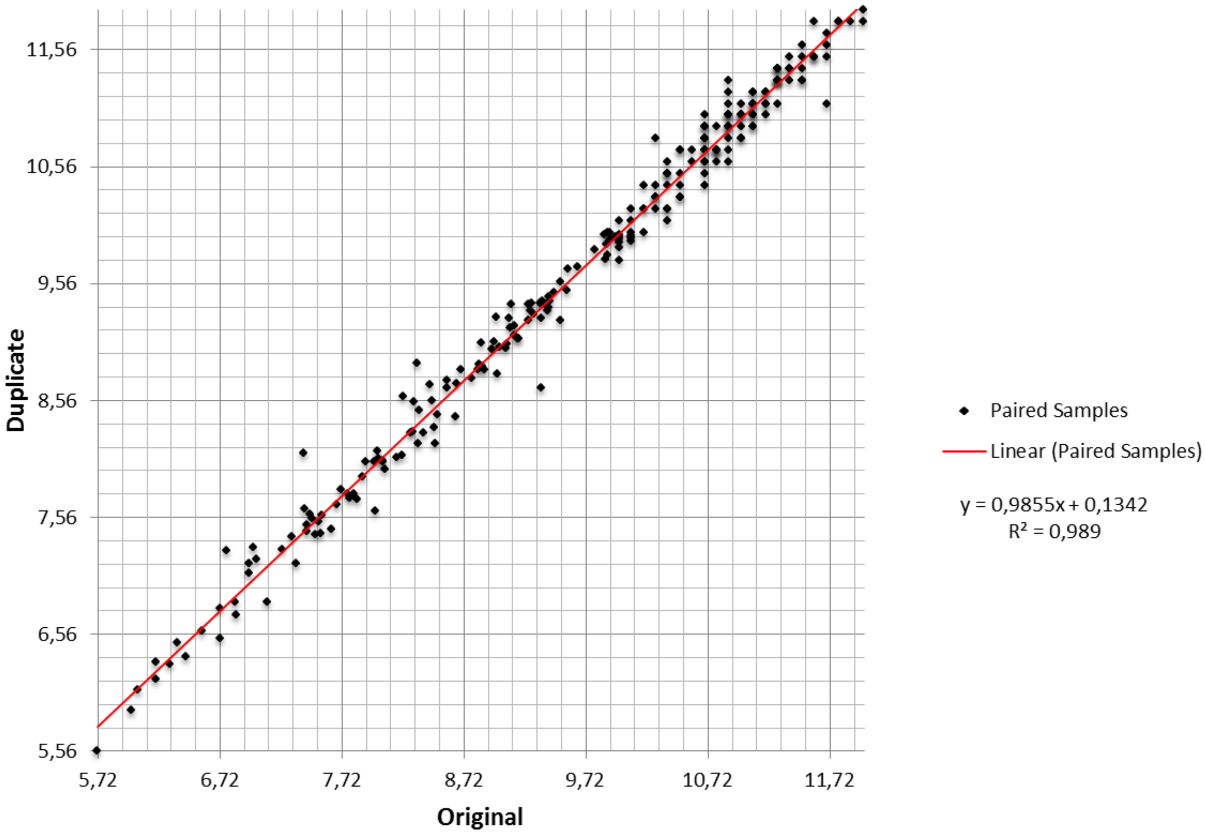


**Figure 12.2.3-8 Linear Regression for Field Duplicates (Reverse Circulation Drilling)**

All field duplicates are within the 10% tolerance level.

A total of 242 pulp duplicates were submitted by VERDE based on the recent reverse circulation drilling program.

Based on the analysis, AMS has concluded that the precision of the pulp duplicates is acceptable, as is shown in Table 12.2.3-5 and Figure 12.2.3-9.

**Table 12.2.3-5 Pulp Duplicates Submitted by VERDE to SGS Laboratory (Reverse Circulation Drilling)**

| Population | 242 | |
|---|---|---|
| Correlation Coefficient | 0.996531627 | |
| Covariance | 2.290954549 | |
| Precision | 1.31% | |

| Population | 242 | |
|---|---|---|
| | Original (X) | Duplicate (Y) |
| Mean | 9.68 | 9.81 |
| Variance | 2.29 | 2.31 |
| Standard Deviation | 1.51 | 1.52 |
| Max | 12.00 | 12.10 |
| Min | 5.72 | 5.84 |

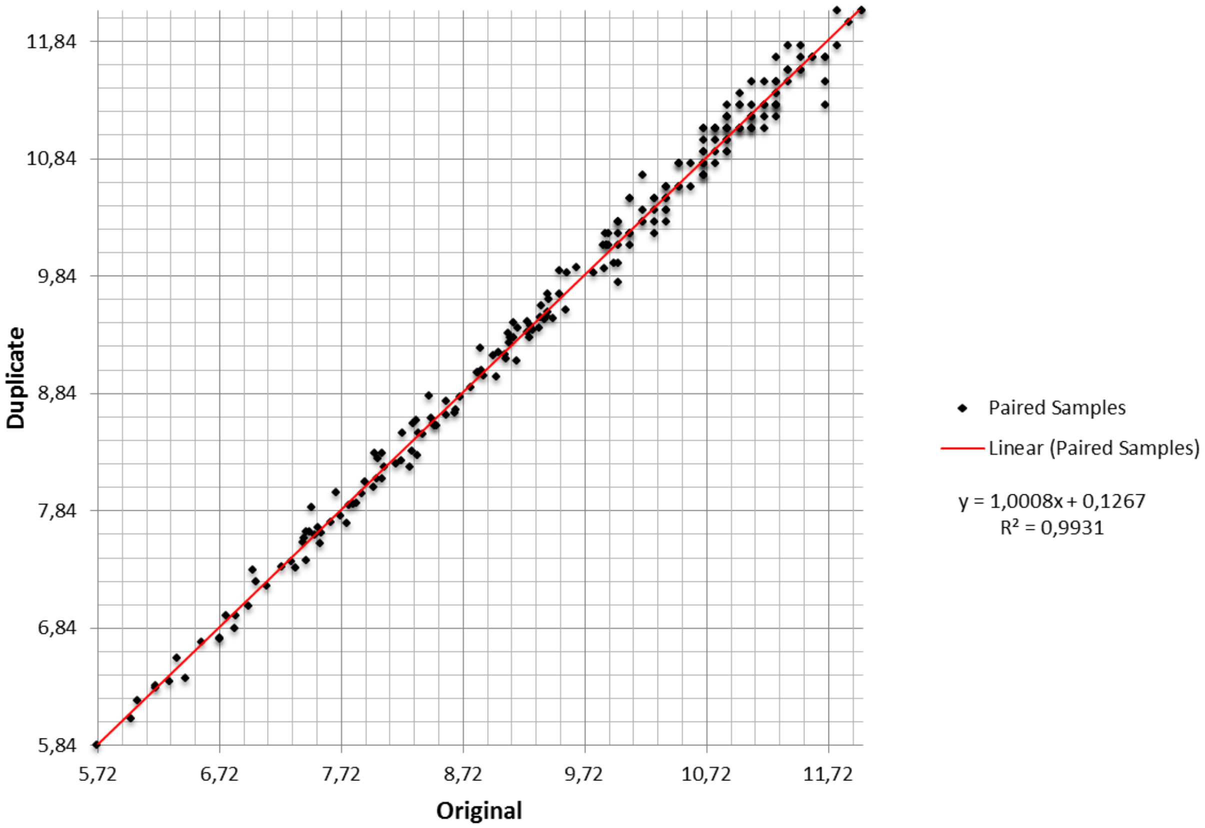


**Figure 12.2.3-9 Linear Regression for Pulp Duplicates (Reverse Circulation Drilling)**

All pulp duplicates are within the 10% tolerance level.

A total of 242 umpire assay samples were submitted by VERDE based on the recent reverse circulation drilling program.

Based on the analysis, AMS has concluded that the precision of the assay results of both laboratories is acceptable, as is shown in Table 12.2.3-6 and Figure 12.2.3-10 below.

**Table 12.2.3-6 Umpire Samples Submitted by VERDE to ALS Laboratory (Reverse Circulation Drilling)**

| Population | 242 | |
|---|---|---|
| Correlation Coefficient | 0.996077628 | |
| Covariance | 2.557619772 | |
| Precision | 1.49% | |
| | Original (X) | Duplicate (Y) |
| Mean | 9.57 | 9.62 |
| Variance | 2.53 | 2.59 |
| Standard Deviation | 1.59 | 1.61 |
| Max | 12.16 | 12.10 |
| Min | 5.42 | 5.29 |

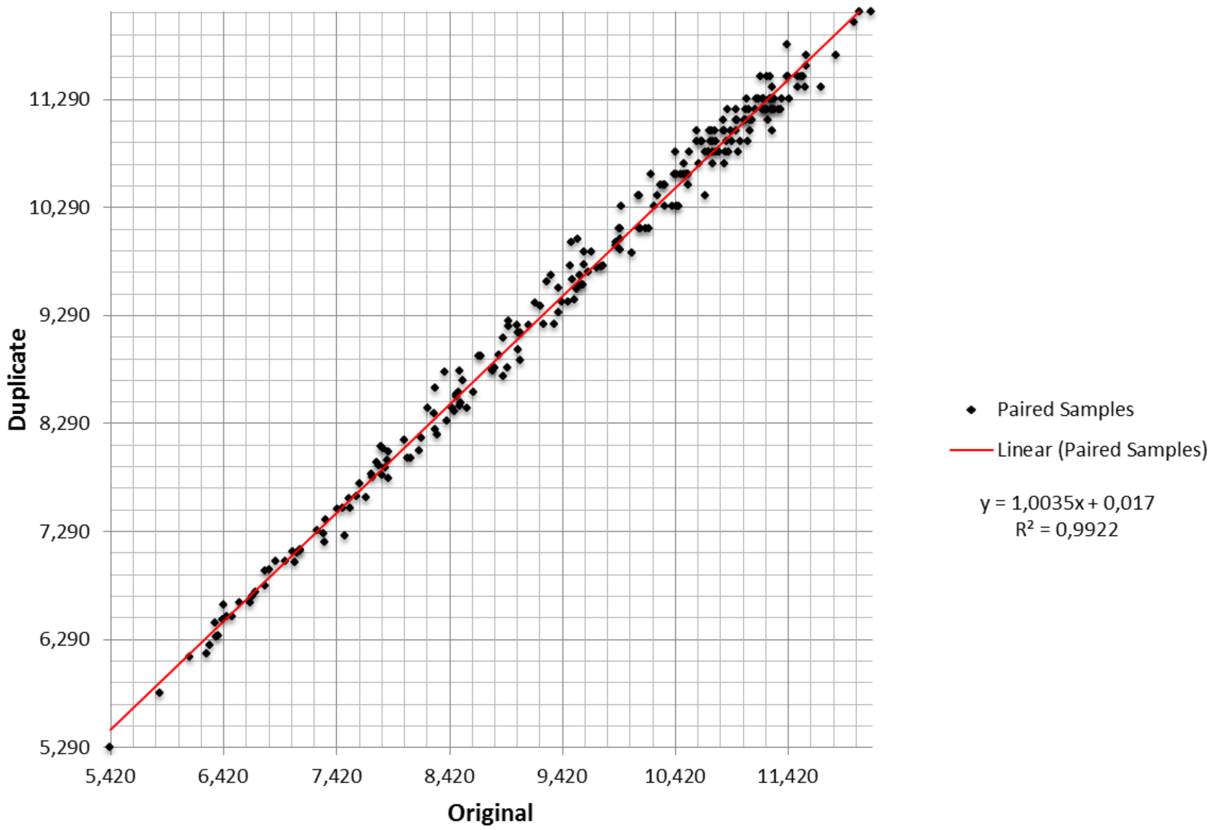


**Figure 12.2.3-10 Linear Regression for Umpire Samples (Reverse Circulation Drilling)**

All umpire assay results are within a 5% tolerance limit.

All blank samples returned $K_2O$ values consistent with the certificate provided by Bureau Veritas (Figure 12.2.3-11). A minor variation was noted, with 7 samples reporting slightly anomalous results of 0.02% $K_2O$. However, it is the opinion of AMS that this is not material to the overall resource estimate.

VERDE should ensure that SGS maintains best practice sample preparation techniques going forward to minimize the effects of any sample preparation contamination.

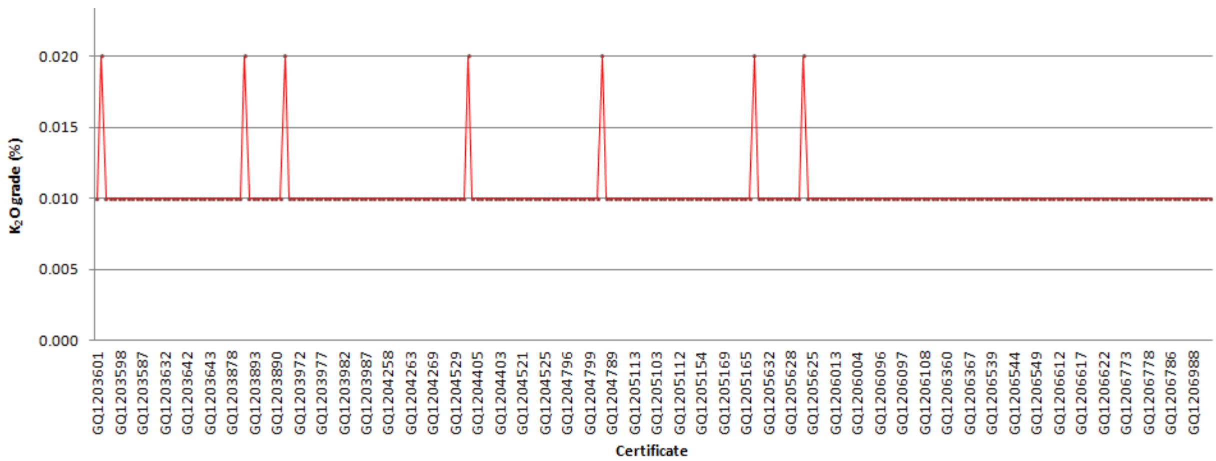


**Figure 12.2.3-11 Blank Samples Submitted (Reverse Circulation Drilling)**

## 12.2.4. Twin Hole Comparisons

Twelve reverse circulation (RC) and diamond drill holes (DH) were drilled at intervals of between 1 m and 3.5 m. The objective was to compare the lithological descriptions and the analytical results of both drilling techniques, given that a number of RC holes were drilled either moist or wet. A total of 785 m drilled into Target 7 between August and September of 2012 were sampled at intervals of 2 m and sent for assays at SGS Geosol lab. Due to the low $K_2O$ results obtained from the CV-RC-575C and CV-DH-34 pair (average grade of 5% $K_2O$) those holes were not used in the comparison. The lithologies logged are equivalent on both core samples. The difference in $K_2O$ grades between both drilling techniques are shown in Table 12.2.4-1.

**Table 12.2.4-1 Twin Hole Comparisons (DDH vs RC Drilling)**

| Holes | UTM WGS84 23S | | Distance Between Holes | Elevation (m) | % $K_2O$ (Ore) | % Difference |
|---|---|---|---|---|---|---|
| | X | Y | | | | |
| CV-RC-535 | 404219.48 | 7872932.95 | 1.0 m | 936.73 | 6 m-32 m @ 9.65% $K_2O$ | 0.2% |
| CV-DH-28 | 404219.60 | 7872933.91 | | 936.83 | 6 m-32 m @ 9.63% $K_2O$ | -0.2% |
| CV-RC-553 | 405958.82 | 7872458.65 | 2.1 m | 941.19 | 30 m-88 m @ 10.08% $K_2O$ | -0.7% |
| CV-DH-29 | 405958.46 | 7872458.37 | | 941.39 | 30 m-88 m @ 10.15% $K_2O$ | +0.7% |
| CV-RC-563 | 405434.59 | 7871312.26 | 2.9 m | 964.40 | 30 m-70 m @ 10.69% | -1.2% |
| CV-DH-30 | 405433.44 | 7871309.65 | | 964.26 | 30 m-70 m @ 10.82% | +1.2% |
| CV-RC-607 | 409368.90 | 7874619.64 | 2.2 m | 909.32 | 0 m-46 m @ 10.86% | +1.8% |
| CV-DH-26 | 409368.77 | 7874621.81 | | 909.08 | 0 m-46 m @ 10.66% | -1.8% |
| CV-RC-621 | 408211.46 | 7870647.59 | 0.9 m | 952.03 | 15 m-85 m @ 10.20% | -0.8% |
| CV-DH-31 | 408211.26 | 7870648.42 | | 952.35 | 15 m-85 m @ 10.28% | +0.8% |
| CV-RC-648 | 408271.18 | 7868815.12 | 2.5 m | 927.48 | 9 m-51 m @ 9.57% | -2% |
| CV-DH-33 | 408268.83 | 7868815.89 | | 927.22 | 9 m-51 m @ 9.76 % | +2% |
| CV-RC-669 | 405967.04 | 7868889.22 | 1.1 m | 968.81 | 18 m-68 m @ 10.20% | -1.2% |
| CV-DH-32 | 405967.35 | 7868890.26 | | 968.78 | 18 m-68 m @ 10.32% | +1.2% |
| CV-RC-680 | 409216.66 | 7879790.43 | 3.5 m | 894.71 | 0 m-30 m @ 10.57% | -1.2% |
| CV-DH-23 | 409219.95 | 7879789.17 | | 895.49 | 0 m-30 m @ 10.70% | +1.2% |
| CV-RC-711 | 406866.85 | 7875195.04 | 2.4 m | 921.24 | 12 m-56 m @ 10.13% | -2.3% |
| CV-DH-25 | 406866.85 | 7875192.62 | | 921.50 | 12 m-56 m @ 10.36% | +2.3% |
| CV-RC-721 | 407679.56 | 7873233.78 | 2.0 m | 943.10 | 16 m-42 m @ 8.71% | -2.3% |
| CV-DH-27 | 407677.64 | 7873234.57 | | 942.87 | 18 m-40 m @ 8.91% | +2.3% |
| CV-RC-789 | 408118.71 | 7876931.67 | 2.2 m | 923.86 | 13 m-37 m @ 8.73% | -3.6% |
| CV-DH-24 | 408120.77 | 7876932.62 | | 924.13 | 13 m-37 m @ 9.04% | +3.6% |

The results show a good comparison of grades between moist/wet RC samples and dry diamond drilling. The results strongly suggest that reverse circulation drilling is suitable for inclusion in the resources estimate for the Cerrado Verde Project.

### 12.2.5. Data Quality Summary

As part of the 2011/2012 work program undertaken across the Cerrado Verde Project area, VERDE implemented an internal QA/QC protocol, which includes the insertion of reference materials into the sample series (certified analytical standards and blanks). The QA/QC program also included analysis of field and pulp duplicates on a systematic basis and the re-analysis of selected sample pulp duplicates in a second analytical laboratory for verification (umpire assays).

The reported results for the 2011 program highlighted several issues with respect to the submitted standards and blanks. Upwards of 10% - 20% of standards plot outside tolerance levels set by VERDE. This has been attributed to poor calibration of the XRF equipment by the laboratory (SGS). AMS made note of the fact that in almost all cases, the standard laboratory results returned were reporting lower than the standard certified reference material values. In addition to this, it was noted that powdered blank material was submitted throughout the 2011 drilling campaign. AMS considers this material to be ineffective when testing for sample preparation contamination issues as part of the sample submission process implemented by VERDE.

Significant QA/QC improvements were noted during the 2012 drilling campaign, with reported results for the certified analytical standards showing a very good correlation for all three standards utilized. There were no reported issues with any of the standard results returned from the laboratory.

Additionally, all blank samples returned $K_2O$ values of <0.02% $K_2O$, with previous issues regarding the submission of powdered blank samples having been rectified during the 2012 drilling campaigns through the use of a quartz gravel blank.

The results of the duplicate test work completed (both field and pulp duplicates) show a good correlation with the original analytical values and provide acceptable data variance.

The re-analysis of pulp duplicates from selected mineralized samples (umpire assays) showed an excellent correlation, which indicates very little laboratory bias between both the ALS and SGS laboratories.

It is the author's opinion that, despite some QA/QC concerns for the 2011 drilling campaign, VERDE is now operating in accordance with industry standards with respect to the QA/QC protocol for the insertion of controlled reference material into the stream of samples submitted for the Cerrado Verde Project.

The overall data package is considered to be of sufficient quality to be used for mineral resource estimation.

# 13. Mineral Processing and Metallurgical Testing

All required metallurgical tests to the Product were performed with the Ore. On February 2022, a test was performed to determine the basic parameters for comminution applications to rate the feasibility of the installation of HAZEMAG hammer mills.

The test program carried out confirmed that the HAZEMAG Range of Hammer Mill is applicable based on the Abrasion Index of the raw material. Crushability of the ore does indicate that capacity expectation can be exceeded compared to limestone. Based on this estimate an economic operation will be feasible. Table 13-1 summarizes the test results.

**Table 13-1 Summary lab scale testing done by Hazemag**

| Material Type | | Sample 1 |
|---|---|---|
| | | Glauconite |
| Weight | | 40 kg |
| Visual appearance | Soil, Rock, Mixture | Rock |
| | Color | Green |
| | Shape | Subangular |
| | Structure | Homogenous |
| | Fracture | Uneven or Irregular |
| | Tenacity | Brittle |
| | Moisture condition | Dry |
| Approx. Particle size | | 0 - 50 mm |
| Bulk density | | 1.19 t/m³ |
| Moisture content | | 0.75% |
| UCS | Max. | 1 MPa |
| | Average | 1 MPa |
| | Min. | 1 MPa |
| Abrasion test - AI 8mm product | | 91.02% |
| Laboratory Impactor i1 | | 6.2 |
| Laboratory Impactor i10 | | 27.19 |
| Tendency of clogging in laboratory Impactor | | NO |
| Rating crushability | | very easy |
| Abrasion test - Abrasion Index AI | | 0.0103 g |
| Laboratory Impactor m10 | | 0.23 g |
| Rating of Wear characteristic | | Very low wear |

Source: Hazemag, 2022

# 14. Mineral Resource Estimate

## 14.1. Introduction

AMS has estimated the Mineral Resource for Target 7 for the Project using drilling data collected by VERDE during the 2011 and 2012 field campaigns. In addition, a small number of drill holes have been included from a drill program undertaken in late 2009. The final database used to produce the mineral resource estimate totals 435 drill holes, which comprise 420 reverse circulation drill holes and a further 15 diamond drill holes.

The mineral resource estimate is derived from a computerized resource block model. The construction of the block model starts with the modelling of 3D wireframe envelopes or solids of the mineralization using drill hole $K_2O$ analytical data and lithological information. Once the modelling has been completed, the analytical data contained within the wireframe solids is normalized to generate fixed length composites. The composite data is used to interpolate the grade of blocks regularly spaced on a defined grid that fills the 3D wireframe solids. The interpolated blocks located above the bedrock interface and outside the default waste solid comprise the mineral resources. The blocks are then classified based on confidence level using proximity to composites, composite grade variance and mineralized solids geometry. The 3D wireframe modelling was initially interpreted by VERDE, and then modified by the author based on final assay results. The block model and mineral resource estimation were conducted by AMS based on information provided by VERDE.

All grade estimation was completed using Ordinary Kriging (OK) for $K_2O$ as well as for $Al_2O_3$, CaO, $Fe_2O_3$, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$, $TiO_2$ and LOI. This estimation approach was considered appropriate based on a review of a number of factors, including the quantity and spacing of available data, the interpreted controls on mineralization, as well as the style of mineralization under consideration.

The estimation was constrained entirely within the fresh rock and weathered domains. Weathered regolith is generally well developed across the Cerrado Verde Project area (typically 5 m-20 m in depth), with all 435 drill holes noted to intersect significant $K_2O$ mineralization within fresh rock and to a lesser extent, weathered material across the project area. Drilling into the fresh rock across the Cerrado Verde Project area almost always results in a sharp increase in the $K_2O$ grades across the regolith boundary (weathered to fresh rock).

The Cerrado Verde Project mineral resource estimate is based on 435 drill holes (26,609 m) drilled at a nominal spacing of approximately 200 m by 200 m. A total of 420 reverse circulation drill holes (25,563 m) and 15 diamond drill holes (1,046 m) have been completed across the resource area. DDH have been completed as twin holes to pre-existing reverse circulation drilling to provide suitable QA/QC comparison test work. Infill drilling to a 100 m by 100 m spacing has been completed in two separate areas of the resource in an effort to increase the resource category confidence and provide suitable vectors from variographic studies.

Drilling included within the Cerrado Verde Project is listed below in Table 14.1-1 and illustrated in Figure 14.1-1.

**Table 14.1-1 Cerrado Verde Resource - Drilling Summary Statistics**

| Year | Drilling Technique | Summary |
|---|---|---|
| 2009 | - | - |
| | RC | 19 Holes (997 m Total) |
| **2010*** | - | - |

| Year | Drilling Technique | Summary |
|---|---|---|
| | - | - |
| **2011** | DHH | 3 Holes (261 m Total) |
| | RC | 149 Holes (9,486 m Total) |
| **2012** | DHH | 12 Holes (785.4 m Total) |
| | RC | 252 Holes (15,080 m Total) |

*No drilling was completed by VERDE during 2010.

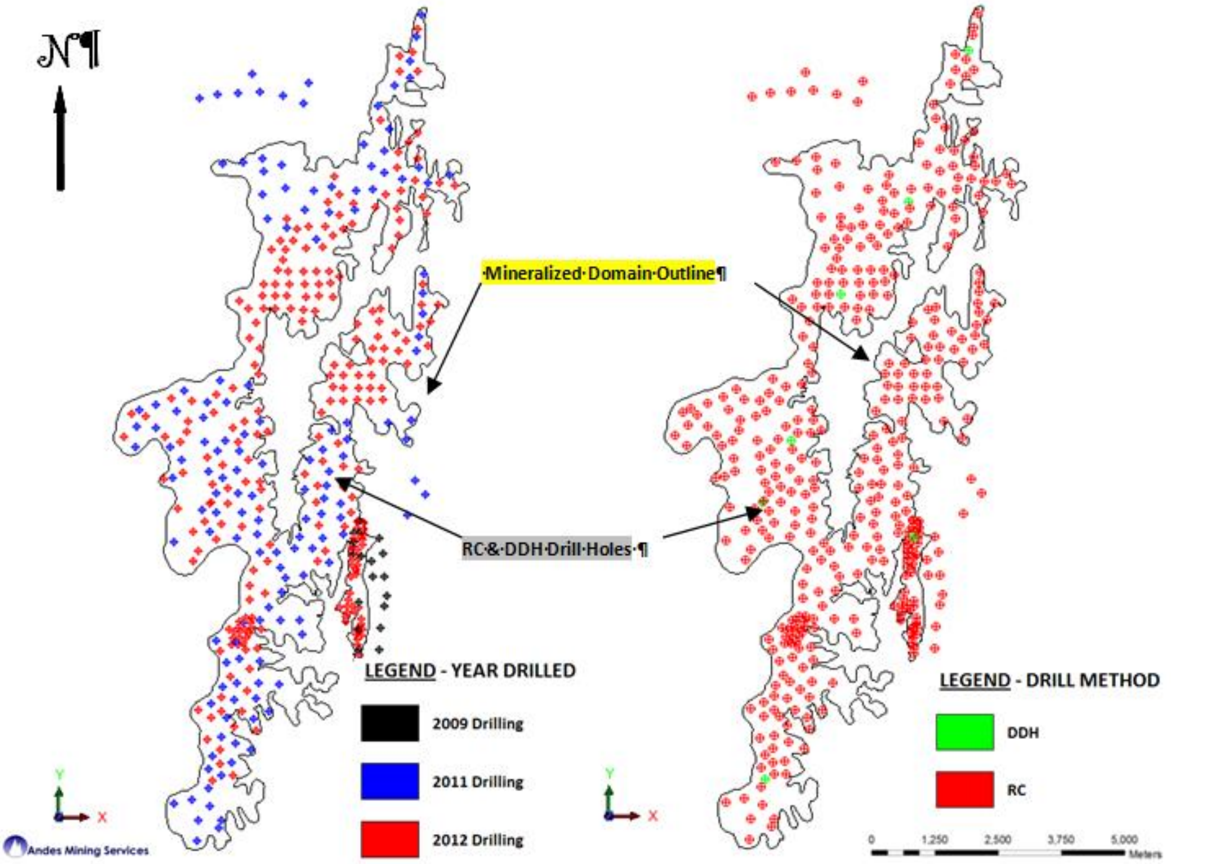


**Figure 14.1-1 Plan View of Mineralized Domain Outline (Target 7) with Drillholes (AMS, March 31, 2013)**

## 14.2. Geological Modelling

Given the extensive number of drill holes across the Cerrado Verde Project, a detailed geological model has been developed by VERDE personnel as a basis for resource estimation work completed by AMS.

AMS noted that the majority of drilling completed by VERDE has been within the fresh rock profile of the Ore where the $K_2O$ is enriched, and subsequent geological modelling has focused on mineralized intervals within this fresh rock unit.

AMS have generated a mineralized domain for the Cerrado Verde Project area based upon an interpretation of drill hole data, as well as geological mapping data supplied by VERDE personnel. AMS and VERDE have interpreted a mineralized $K_2O$ domain (which has been used for the estimation of $Al_2O_3$, CaO, $Fe_2O_3$, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$, $TiO_2$ and LOI) using a 6% $K_2O$ lower grade limit to guide the interpretation (Figure 14.2-1 to Figure 14.2-4).

An upper and lower digital terrain model (DTM) surface was generated for the 6% $K_2O$ grade boundary based on the 435 drill holes included in the database. Some lower grades were selectively included within the mineralized boundary, where the grade data was logically interpreted to form part of the mineralized shape.

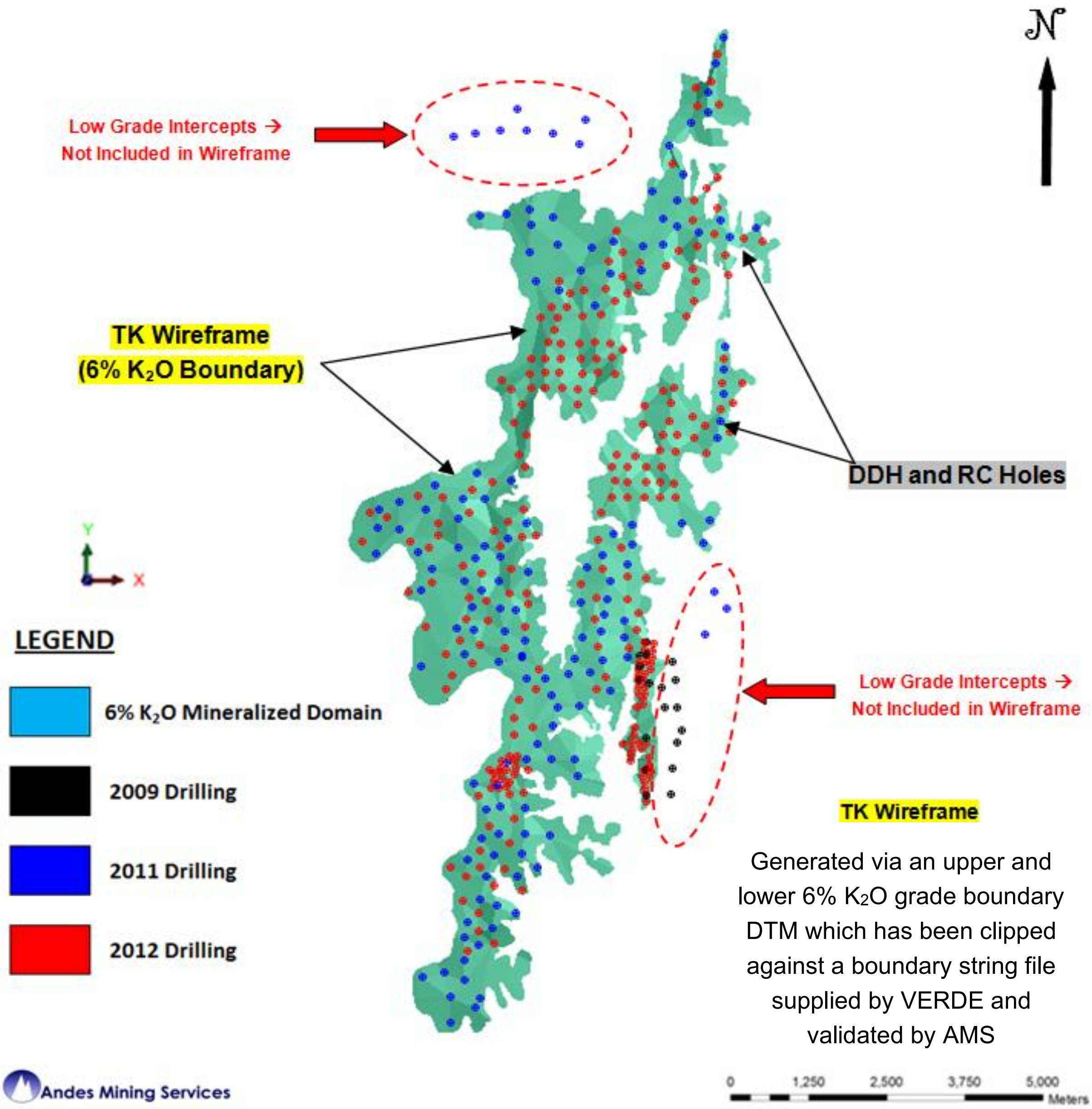


**Figure 14.2-1 Plan View of Cerrado Verde Wireframe (AMS, March 31, 2013)**

Upper and lower DTM surfaces representing a 6% $K_2O$ mineralized package were then clipped to a mineralized boundary surface supplied by VERDE, which has been generated from a ground-based survey of Ore outcroppings, in conjunction with satellite imagery.

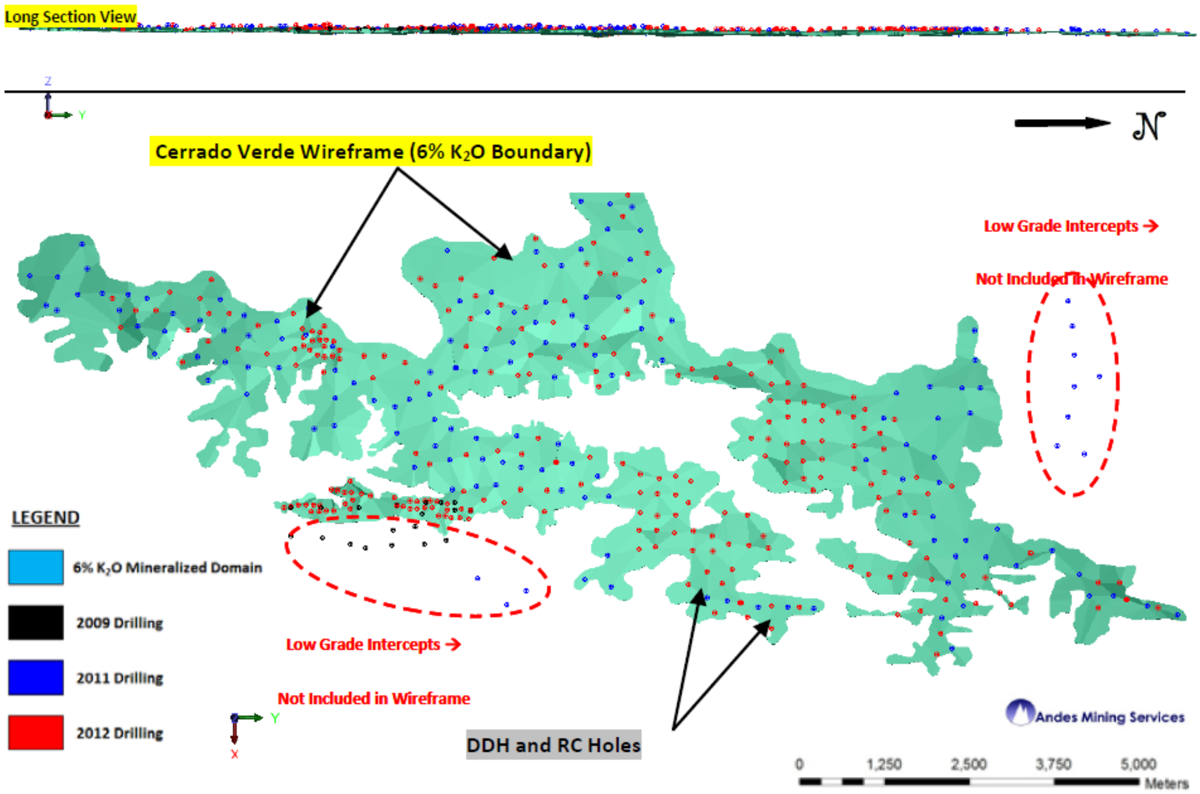


**Figure 14.2-2 Long Section and Plan View of the Cerrado Verde Wireframe (AMS, March 31, 2013)**

In addition to a 6% $K_2O$ mineralized domain, AMS generated a DTM surface between weathered material and the underlying fresh rock material to take into consideration differences in bulk density (Figure 14.2-3 and Figure 14.2-4). As well as a significant density difference between weathered and fresh rock material, there is a sharp increase in $K_2O$ grades across this boundary.

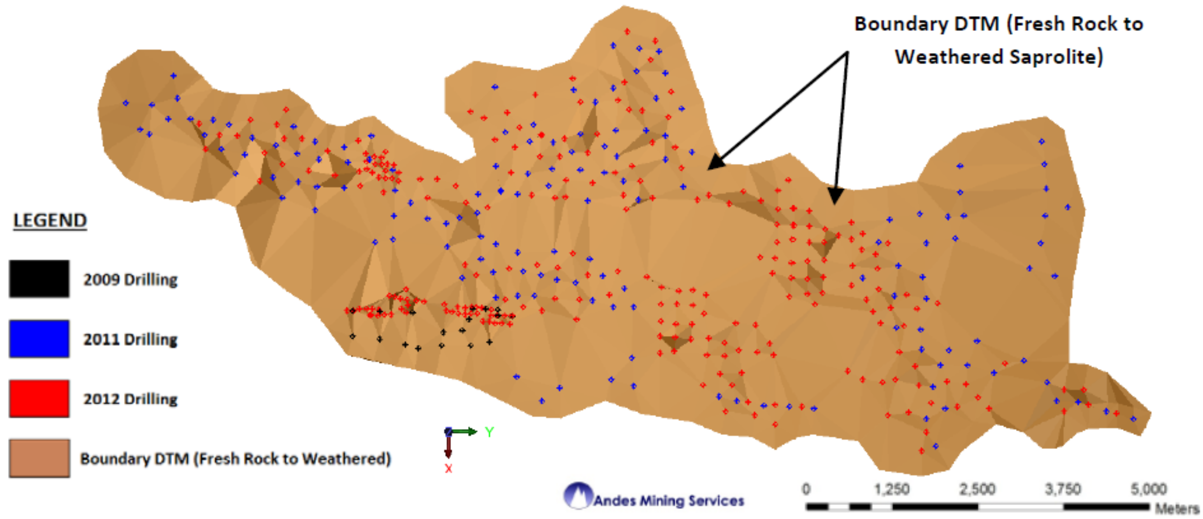


**Figure 14.2-3 Bounding DTM Surface between Fresh Rock and Weathered Material (AMS, March 31, 2013)**

AMS utilized a recently detailed airborne laser scanning topographical survey of the Cerrado Verde Project area as an upper boundary surface for the Cerrado Verde wireframe (Figure 14.2-4). Drill holes were adjusted to the topographic surface before wireframing commenced.

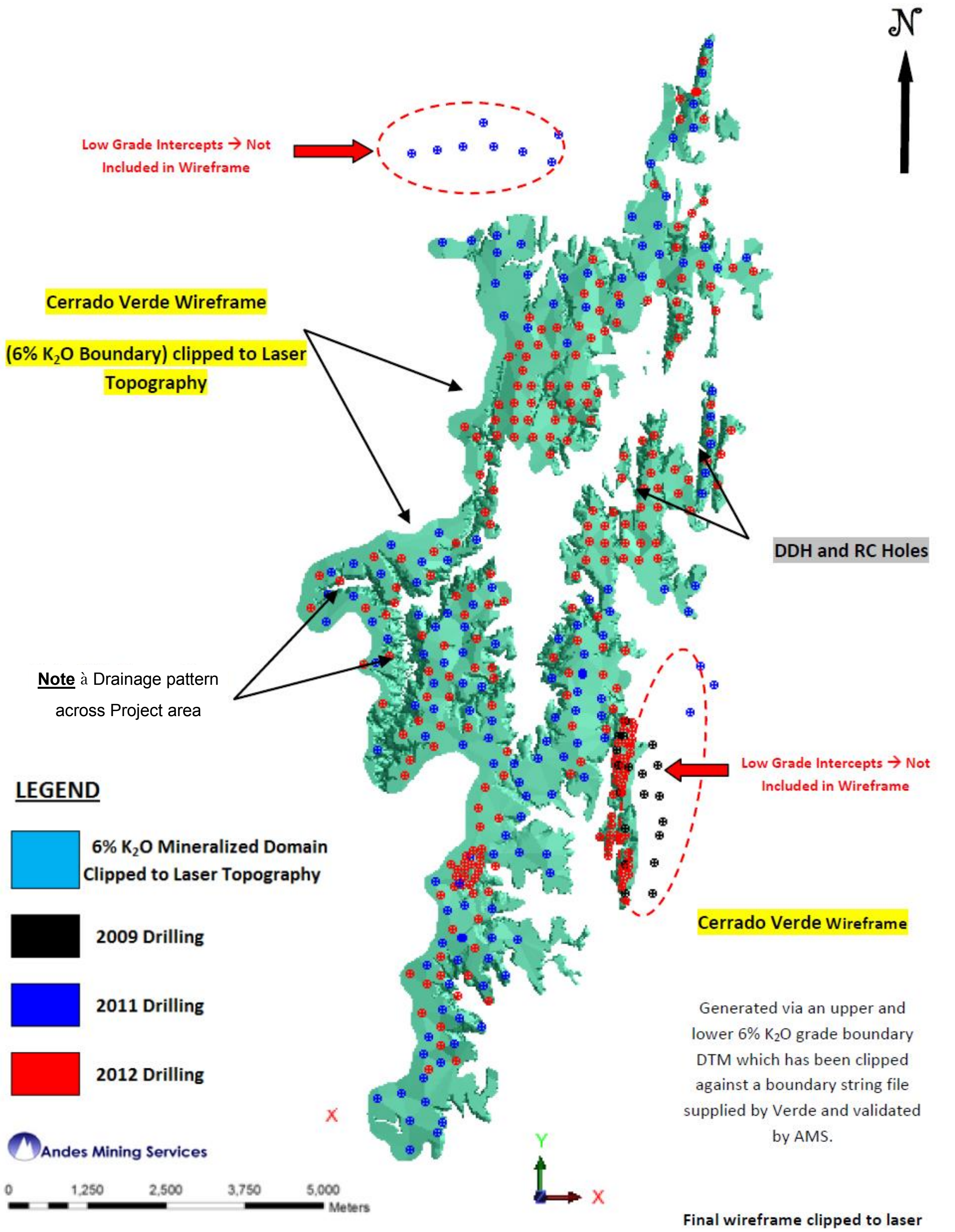


**Figure 14.2-4 Plan View of Cerrado Verde Wireframe and Drilling clipped to Topography (AMS, March 31, 2013)**

Density values were assigned appropriately downhole with an average value of 2.18 g/cm$^3$ assigned to the fresh rock material, while all other weathered material (saprolite and colluvium) was assigned a density value of 1.64 g/cm$^3$, as is discussed in Section 10.10.

It is quite clear that $K_2O$ values are more elevated within the fresh rock glauconitic siltstone material, as is shown in the cross section below (Figure 14.2-5).

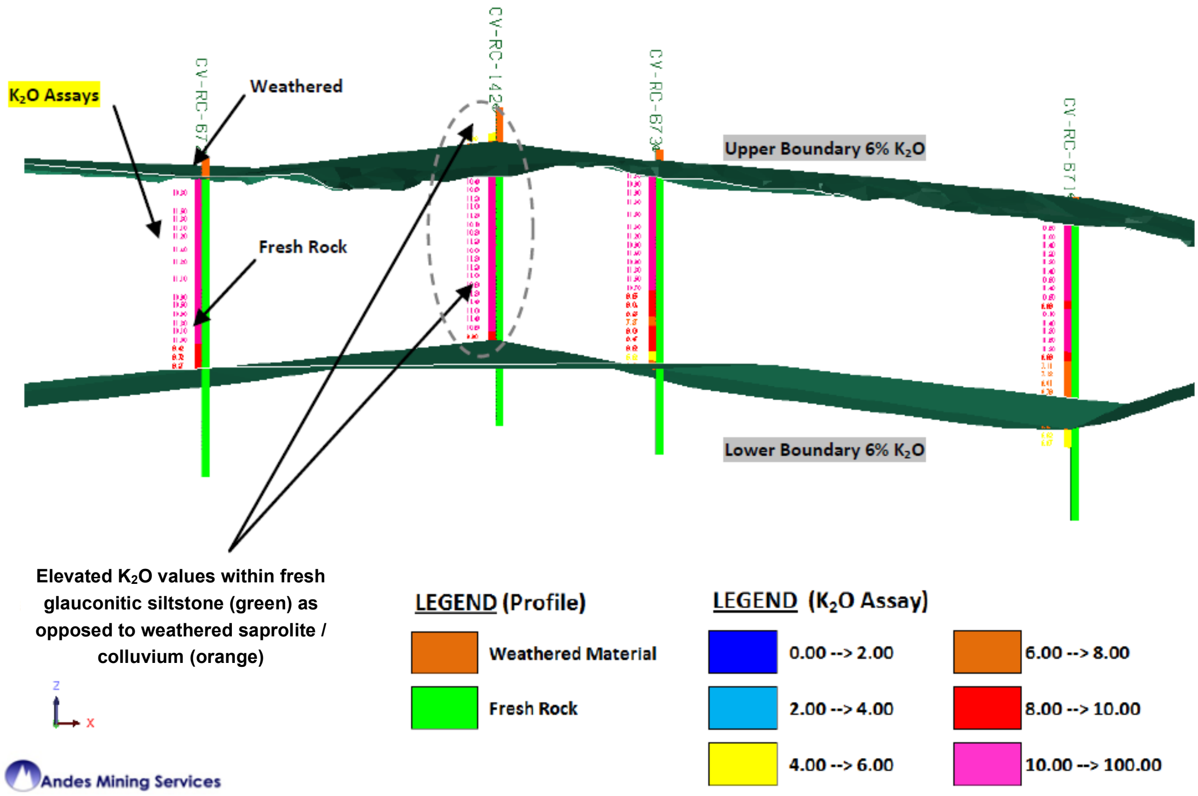


**Figure 14.2-5 Cross Section View of Wireframe & Drill Holes at 7,868,700 N (+/-50 m) (AMS, March 31, 2013)**

## 14.3. Sample Selection and Sample Compositing

Samples were selected for the mineral resource estimate from within the mineralized wireframe generated from the geological and grade-based domain. Samples intervals were assigned a nominal 'intersection code', which reflected the mineralized domain from which those intervals were derived. The average sample length utilized for Cerrado Verde is 2 m (Figure 14.3-1).

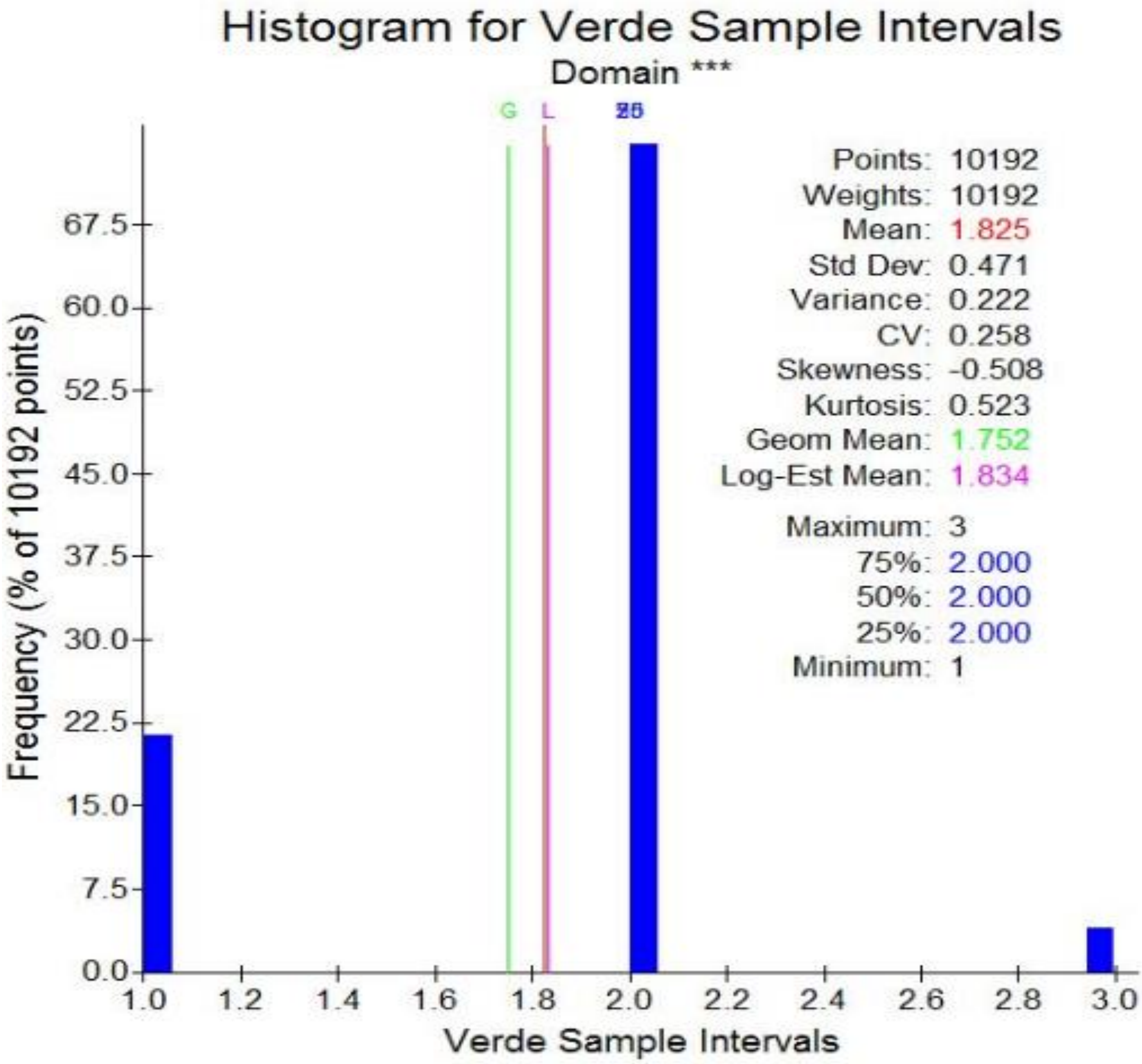


**Figure 14.3-1 Average Sample Length Graph – Cerrado Verde Drilling Program(s)**

Selected samples were visually compared against the interpretation to ensure that the flagging was correct and appropriate.

Block model grade interpolation was conducted on composited analytical data. Selected sample intervals were composited downhole to 5m intervals, which AMS considers is the likely mining bench height for a large-scale open pit mining operation of this geometry and grade variability.

Composites were generated to 5 m intervals based on a "best fit" approach and, hence, no residual samples were discarded. Given the bulk mining approach that will be adopted, this method of generating composites was considered appropriate.

No capping was applied to the assays before compositing.

The composite file was used as the basis for geostatistics and 3D modelling and estimation.

## 14.4. Statistical Analysis

The drillhole database was composited to a 5 m down-hole composite interval, with the 5 m composite used for all statistical, geostatistical and grade estimation studies. A statistical analysis of 5 m composites from the mineralized domain is presented below in Table 14.4-1.

**Table 14.4-1 Summary of Statistics – 5m Composites within the Cerrado Verde Mineralized Domain**

| | Element | Count | Minimum | Maximum | Mean | Std. Dev. | CV |
|---|---|---|---|---|---|---|---|
| Mineralized Domain "TARGET 7" | $Al_2O_3$ | 3256 | 5.05 | 19.31 | 15.56 | 1.36 | 0.09 |
| | CaO | 3256 | 0.01 | 21.84 | 0.50 | 1.19 | 2.38 |
| | $Fe_2O_3$ | 3256 | 2.53 | 10.60 | 6.86 | 0.62 | 0.09 |
| | $K_2O$ | 3387 | 2.50 | 12.89 | 9.27 | 1.71 | 0.18 |
| | LOI | 3150 | 1.28 | 29.93 | 3.50 | 1.26 | 0.36 |
| | MgO | 3256 | 1.40 | 13.03 | 2.90 | 0.46 | 0.16 |
| | MnO | 3150 | 0.02 | 1.45 | 0.13 | 0.06 | 0.46 |
| | $Na_2O$ | 3150 | 0.05 | 1.99 | 0.19 | 0.25 | 1.33 |
| | $P_2O_5$ | 3150 | 0.01 | 3.44 | 0.14 | 0.10 | 0.70 |
| | $SiO_2$ | 3256 | 23.15 | 77.10 | 59.79 | 3.01 | 0.05 |
| | $TiO_2$ | 3150 | 0.30 | 2.93 | 0.82 | 0.10 | 0.12 |

No top cut has been applied to the $K_2O$ and $Al_2O_3$ composite data based on a review of the histogram and log probability curves shown below (Figure 14.4-1 and Figure 14.4-2, respectively). Top cuts have been applied to all other elements, which include CaO, $Fe_2O_3$, LOI, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$ and $TiO_2$, based on a review of the histogram and log probability curves shown below (Figure 14.4-3 to Figure 14.4-11).

Individual top cuts applied to each element are presented below in Table 14.4-2.

**Table 14.4-2 Top Cuts Applied to 5m Composite Data for Cerrado Verde**

| | Element | Count | Minimum | Maximum | Mean | Top Cut Applied (%) |
|---|---|---|---|---|---|---|
| Mineralized Domain "TARGET 7" | $Al_2O_3$ | 3256 | 5.05 | 19.31 | 15.56 | No Top Cut Applied |
| | CaO | 3256 | 0.01 | 21.84 | 0.50 | 8.0 |
| | $Fe_2O_3$ | 3256 | 2.53 | 10.60 | 6.86 | 9.0 |
| | $K_2O$ | 3387 | 2.50 | 12.89 | 9.27 | No Top Cut Applied |
| | LOI | 3150 | 1.28 | 29.93 | 3.50 | 10.5 |
| | MgO | 3256 | 1.40 | 13.03 | 2.90 | 3.8 |
| | MnO | 3150 | 0.02 | 1.45 | 0.13 | 0.58 |
| | $Na_2O$ | 3150 | 0.05 | 1.99 | 0.19 | 1.6 |
| | $P_2O_5$ | 3150 | 0.01 | 3.44 | 0.14 | 0.8 |
| | $SiO_2$ | 3256 | 23.15 | 77.10 | 59.79 | 73.0 |
| | $TiO_2$ | 3150 | 0.30 | 2.93 | 0.82 | 1.3 |

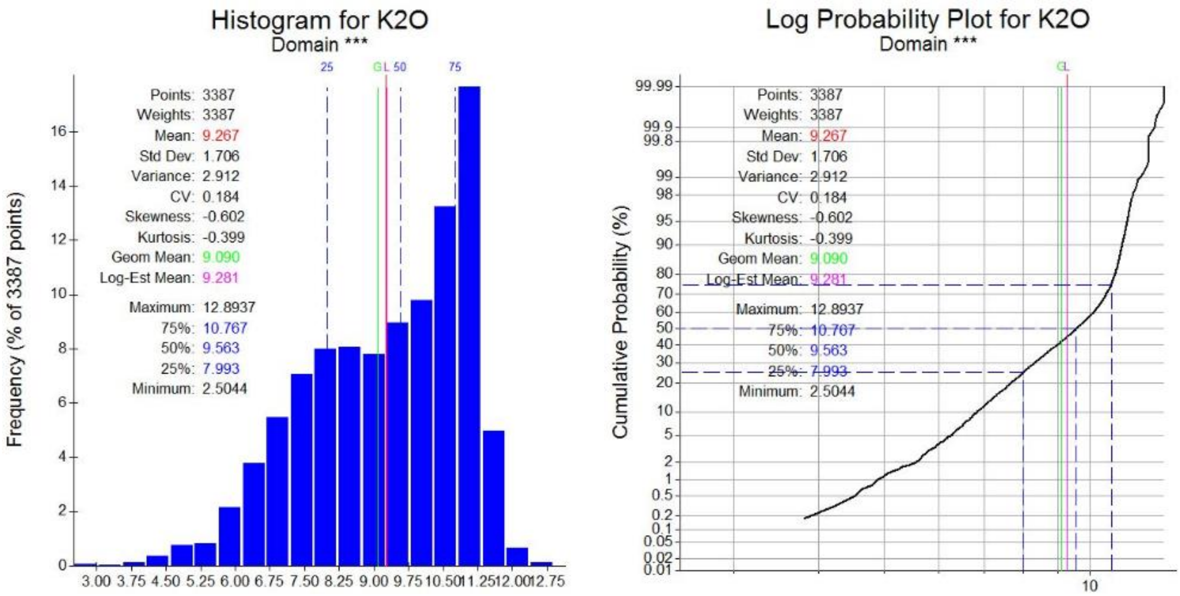


**Figure 14.4-1 Histogram and Log Probability Plot – $K_2O$ Composite Data (5 m)**

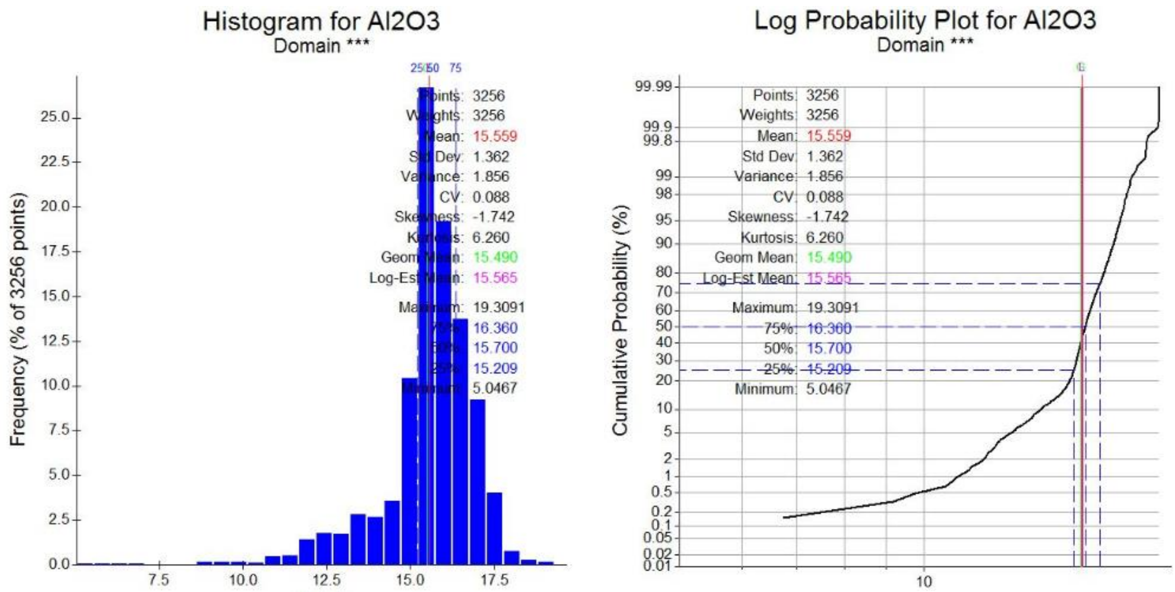


**Figure 14.4-2 Histogram and Log Probability Plot – $Al_2O_3$ Composite Data (5 m)**

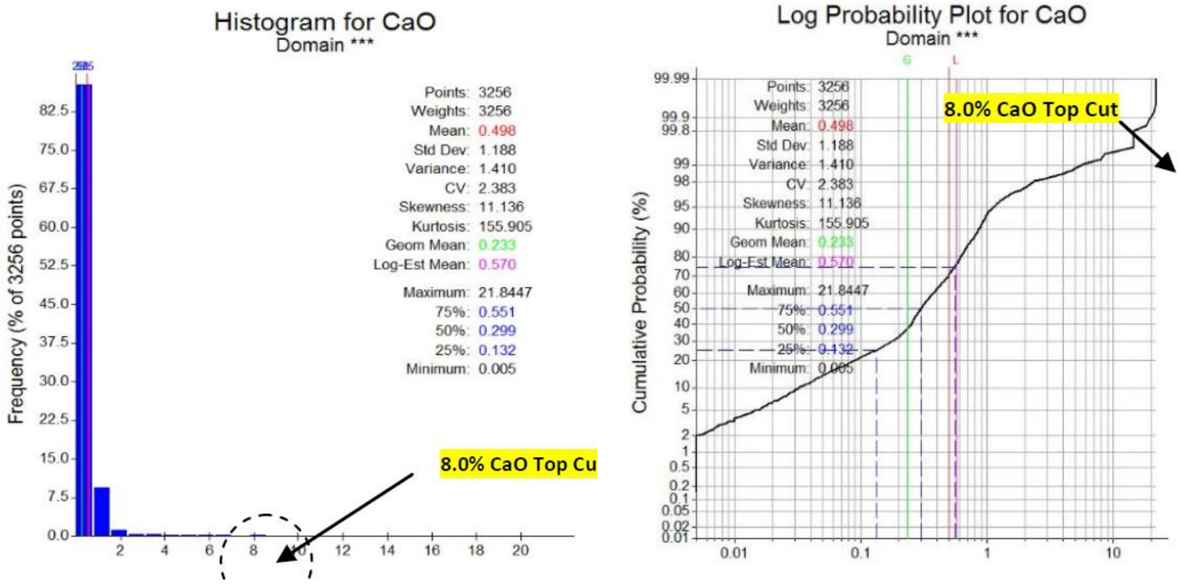


**Figure 14.4-3 Histogram and Log Probability Plot – CaO Composite Data (5 m)**

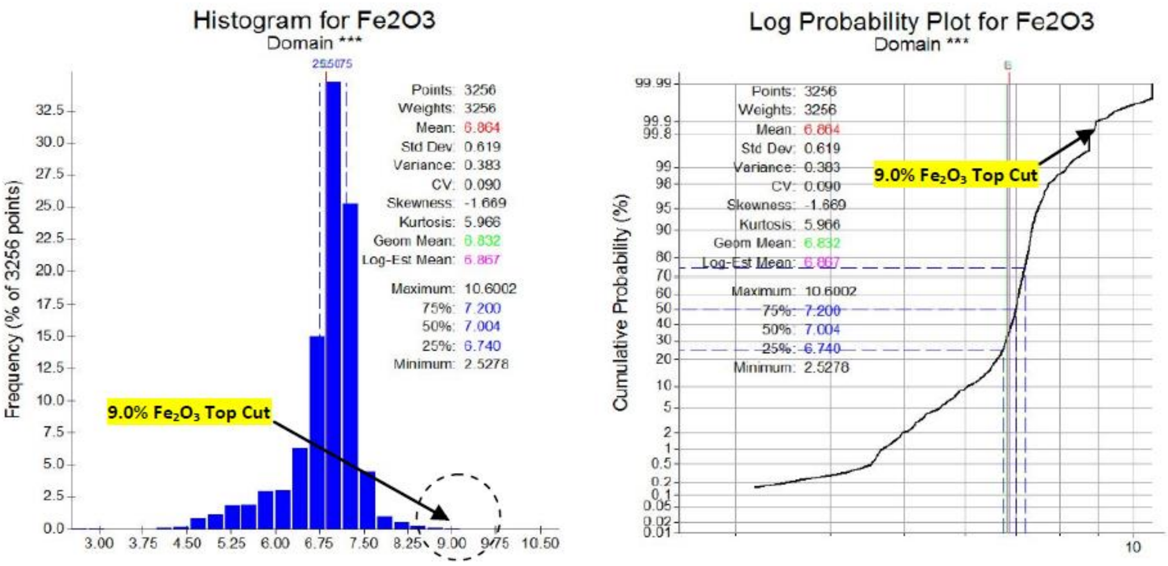


**Figure 14.4-4 Histogram and Log Probability Plot – $Fe_2O_3$ Composite Data (5 m)**

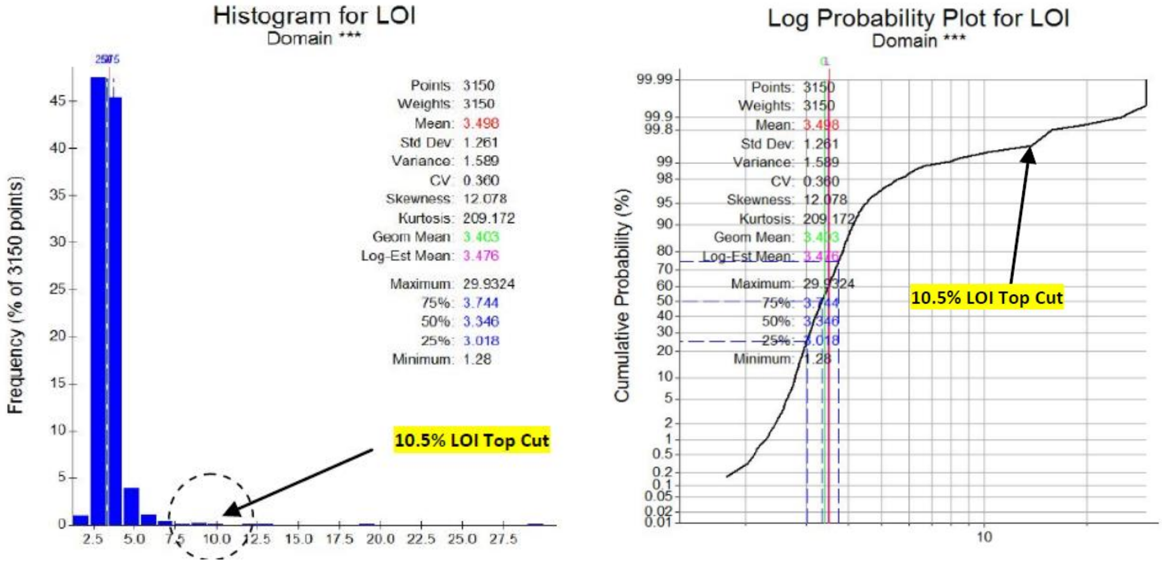


**Figure 14.4-5 Histogram and Log Probability Plot – LOI Composite Data (5m)**

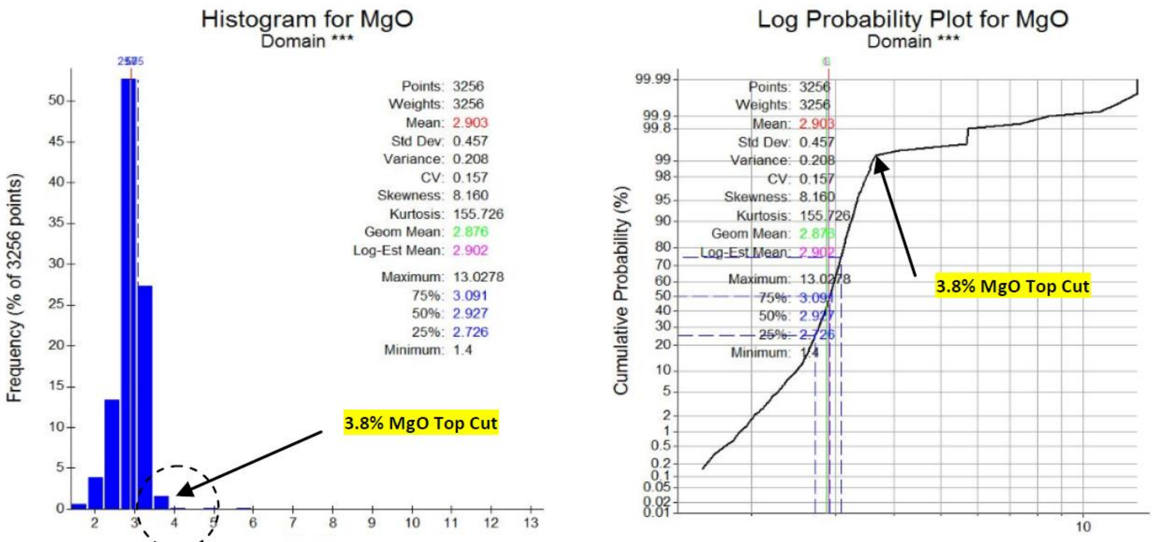


**Figure 14.4-6 Histogram and Log Probability Plot – MgO Composite Data (5 m)**

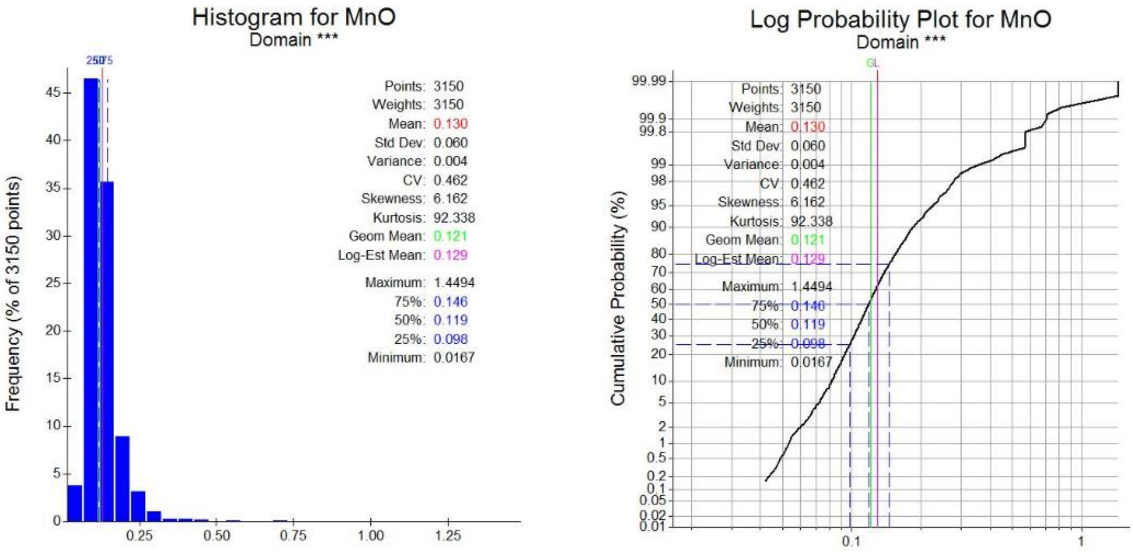


**Figure 14.4-7 Histogram and Log Probability Plot – MnO Composite Data (5 m)**

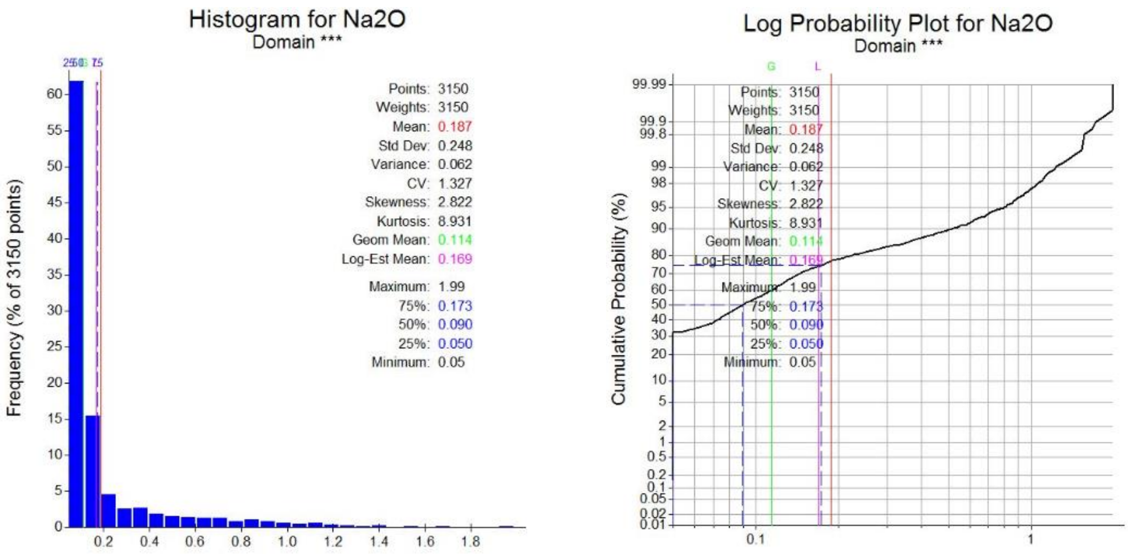


**Figure 14.4-8 Histogram and Log Probability Plot – $Na_2O$ Composite Data (5 m)**

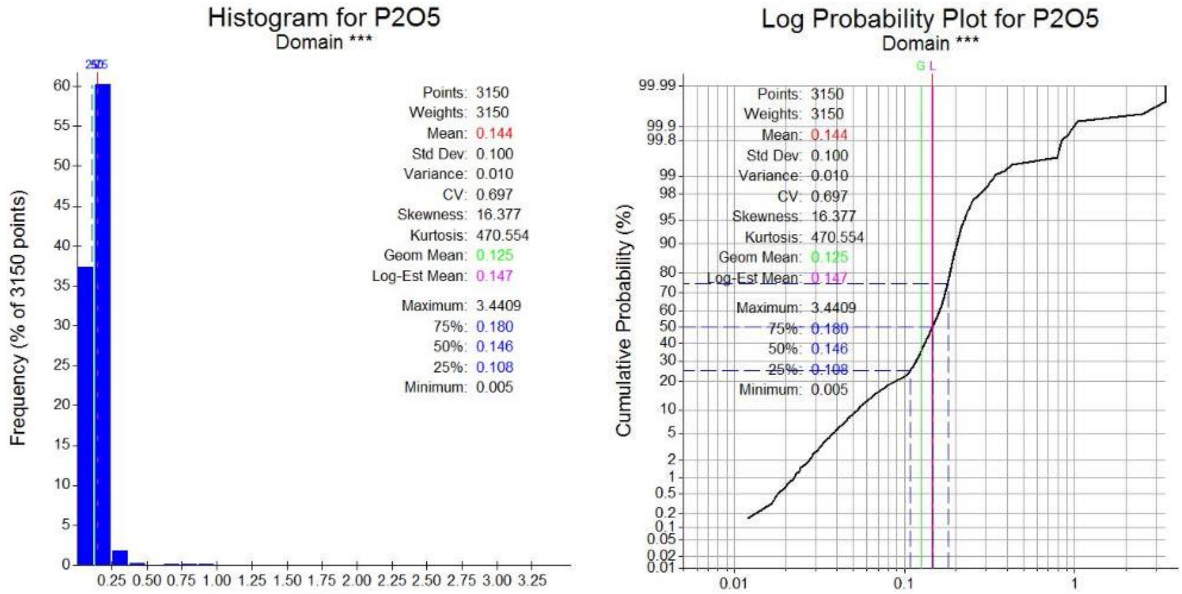


**Figure 14.4-9 Histogram and Log Probability Plot – $P_2O_5$ Composite Data (5 m)**

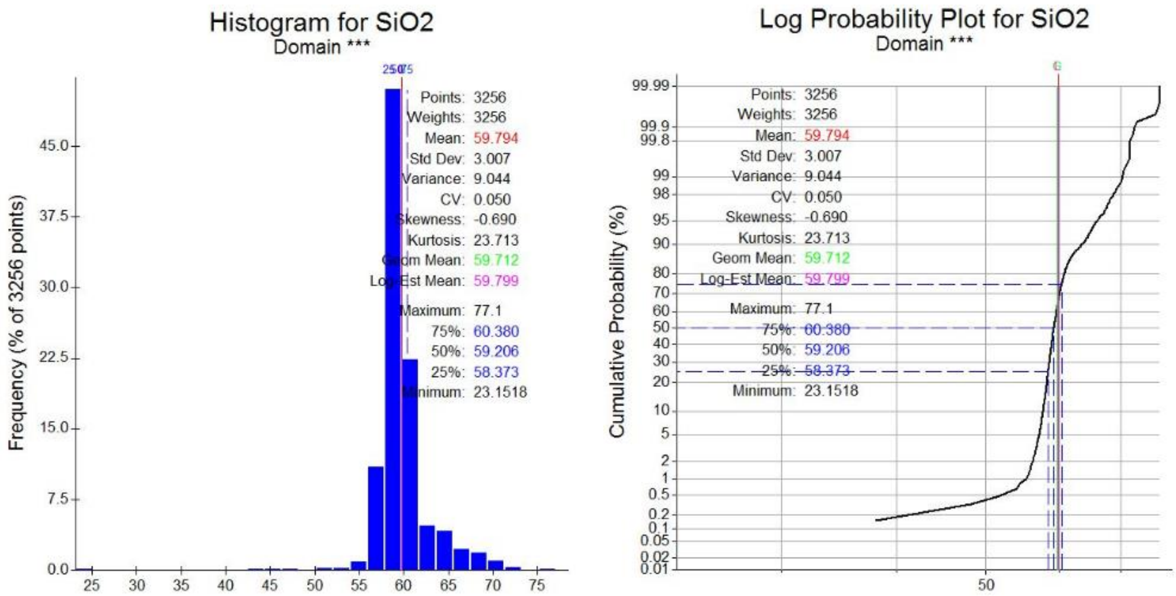


**Figure 14.4-10 Histogram and Log Probability Plot – $SiO_2$ Composite Data (5 m)**

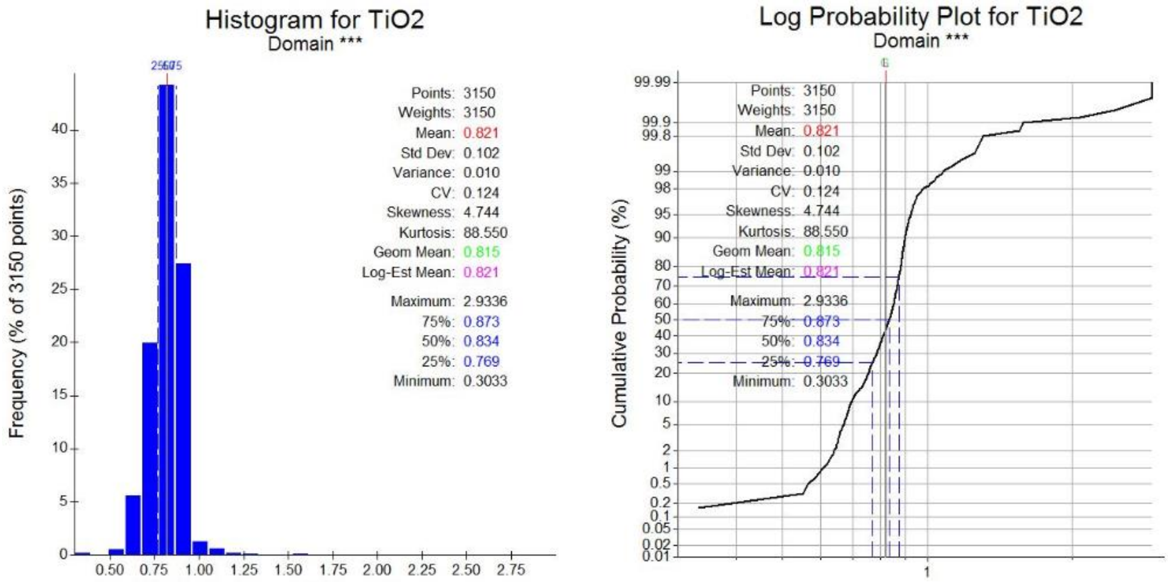


**Figure 14.4-11 Histogram and Log Probability Plot – $TiO_2$ Composite Data (5 m)**

## 14.5. Variography

The spatial continuity of composite grades for $K_2O$, as well as $Al_2O_3$, CaO, $Fe_2O_3$, LOI, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$ and $TiO_2$ were assessed by means of a variety of types of variograms.

Normal variograms were not stable. Therefore, pairwise relative variograms were computed and modelled for the 5 m composites. Variogram fans were analyzed for $K_2O$ to identify potential anisotropies in the grade continuity within the modelled mineralized envelope. The variogram parameters determined for $K_2O$ were applied to all the other elements.

Table 14.5-1 below presents the variogram model for $K_2O$ and Figure 14.5-1 shows the pairwise relative variogram graph for $K_2O$.

**Table 14.5-1 Variogram Model for $K_2O$ Grade for 5m Composites**

| Nugget Effect | First Spherical Variogram Component | | | | | | | Second Spherical Variogram Component | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sill (C) | Ranges (in meters) | | | Orientation (in degrees) | | | Sill (C) | Ranges (in meters) | | | Orientation (in degrees) | | |
| | | Max | Interm. | Min | Azi | Dip | Spin | | Max | Interm. | Min | Azi | Dip | Spin |
| Ore Domain (Target 7) | | | | | | | | | | | | | | |
| 0.21 | 0.48 | 290 | 290 | 72.5 | 0 | 0 | 0 | 0.31 | 620 | 620 | 155 | 0 | 0 | 0 |
| 21% | 48% | | | | | | | 31% | | | | | | |

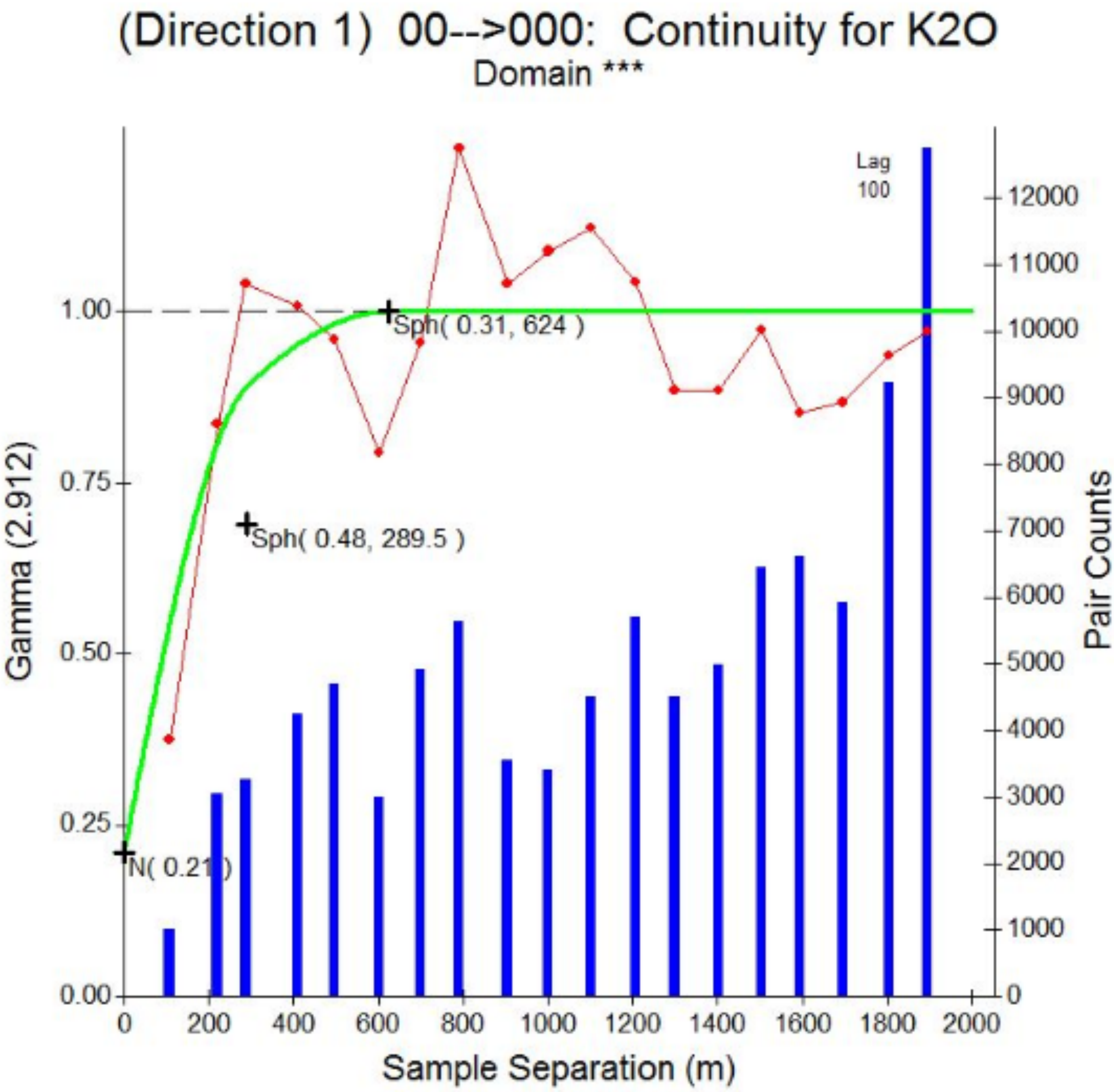


**Figure 14.5-1 Pairwise Relative Variogram Graph for $K_2O$**

Generally, the variography suggests some anisotropy at relatively short distances (less than 300 m) but is isotropic at longer distances (upwards to 600 m – 650 m) (Figure 14.5-2). The best continuity in the analytical data was observed on a horizontal plane (azimuth 0° and dip at 0°), while the direction of least continuity was perpendicular to the plane of best continuity (azimuth 90° and dipping towards 90°). The nugget effect is low (21%), which is normal for deposits of this style and nature.

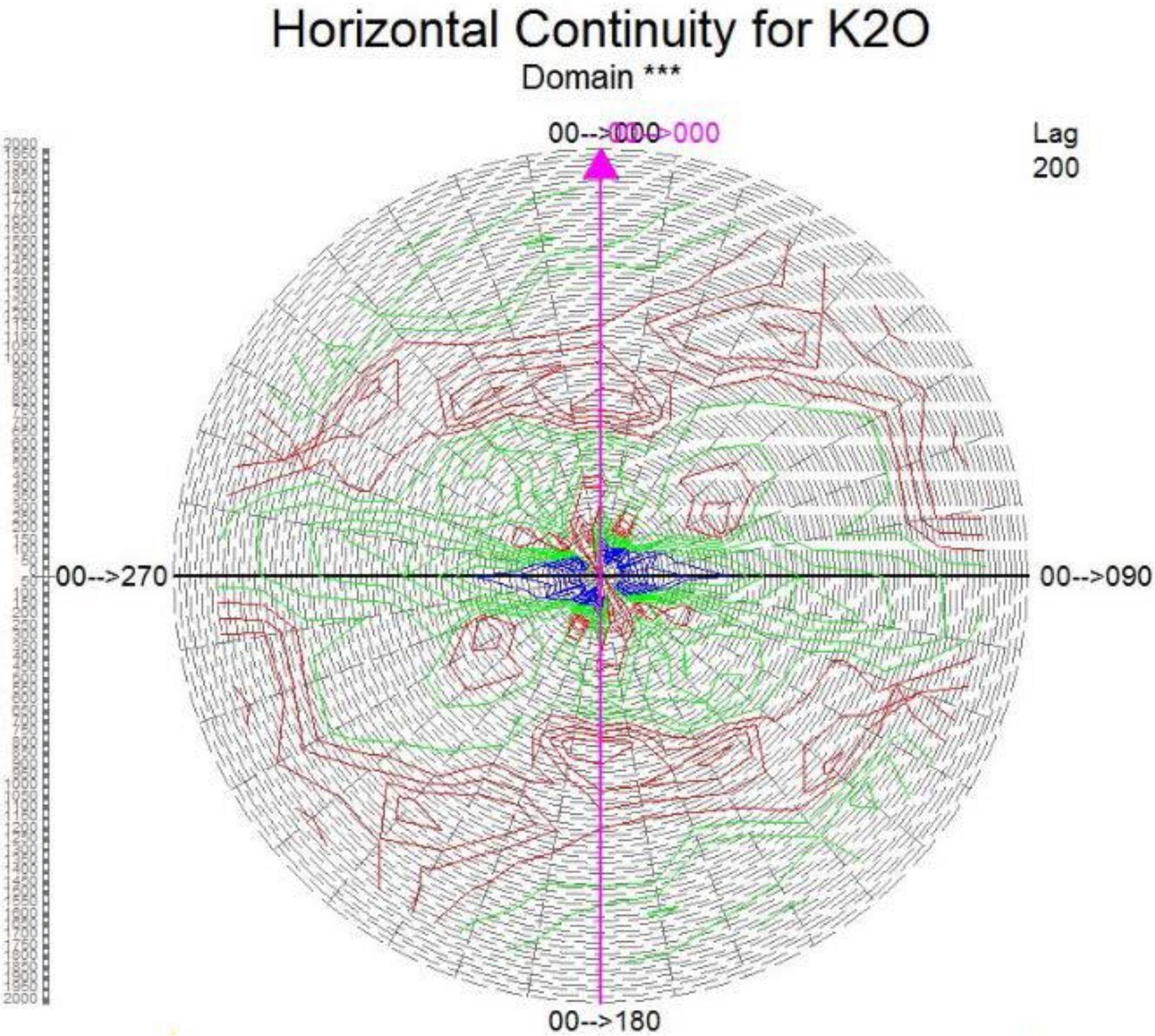


**Figure 14.5-2 Horizontal Continuity Plot for $K_2O$**

## 14.6. Block Model Development

A three-dimensional block model was defined for the Cerrado Verde Project. This model covers the interpreted $K_2O$ mineralized domain. A parent block size of 50 mE x 50 mN x 5 mRL was used, with variable sub-blocking utilized to capture the relatively thin nature of the interpreted sub-horizontal Ore. A sub-block size of 6.25 mN x 6.25 mE x 1.25 mRL was utilized. Estimation was only carried out for parent blocks, with the sub-blocks assigned the parent cell grade estimates.

Table 14.6-1 below shows a summary of the 3D block model created for the Cerrado Verde Project.

**Table 14.6-1 Block Model Summary – Cerrado Verde Project**

| | Y | X | Z |
|---|---|---|---|
| **Minimum Coordinates** | 7864000 | 403000 | 600 |
| **Maximum Coordinates** | 7881000 | 410700 | 1100 |
| **User Block Size** | 50 | 50 | 5 |
| **Sub-Block Size** | 6.25 | 6.25 | 1.25 |
| **Rotation** | 0 | 0 | 0 |

A visual review of the wireframe solids and the block model indicates robust flagging of the block model (Figure 14.6-1).

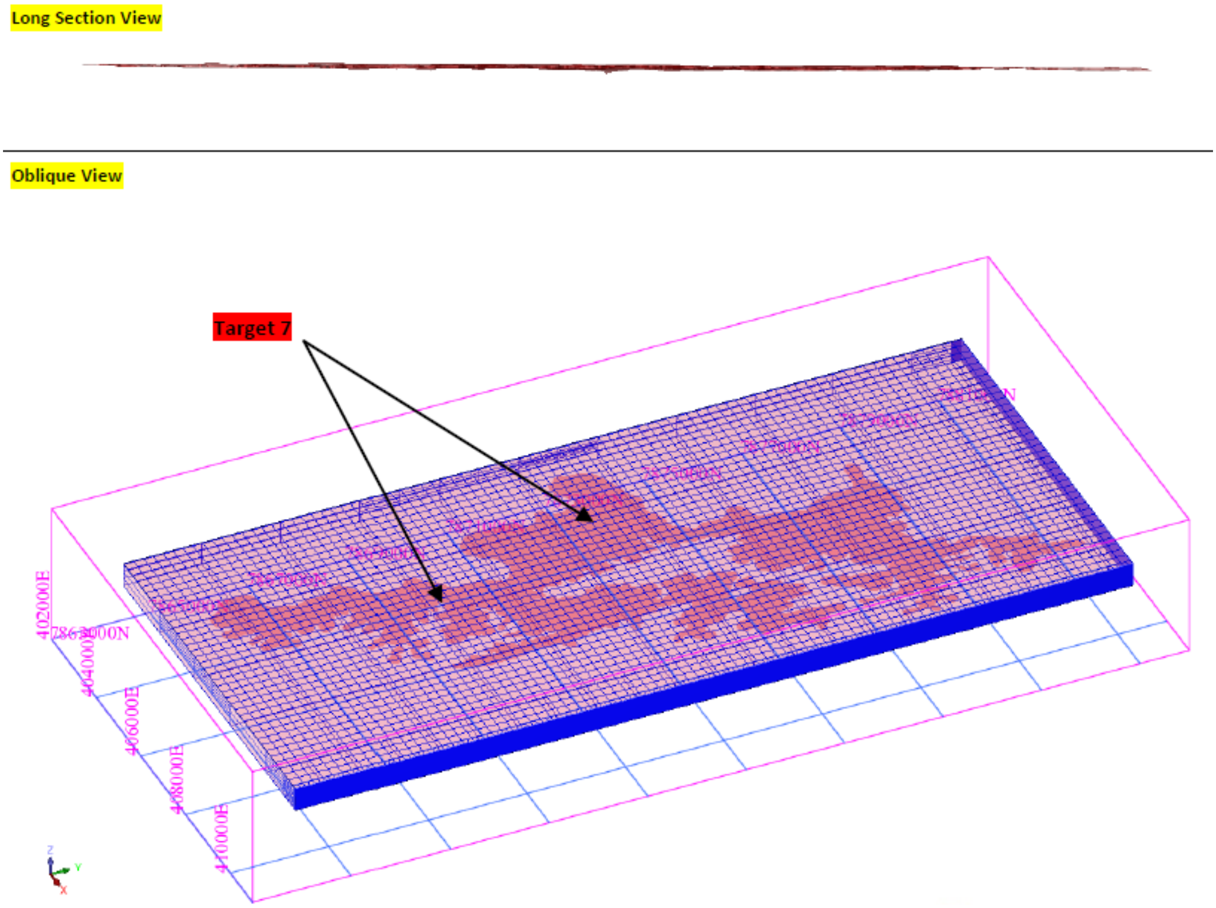


**Figure 14.6-1 Block Model for the Cerrado Verde Project**

AMS also completed basic volume checks upon the mineralized wireframe domain and the reported block model volume, with the results presented below in Table 14.6-2.

**Table 14.6-2 Volume Check - Mineralized Wireframe vs Block Model Ore Domain**

| | Reported Volume (bcm) | | |
|---|---|---|---|
| | **Ore Wireframe** | **Block Model Domain** | **% Difference** |
| **Cerrado Verde Ore Zone** | 1,127,912,679 | 1,127,806,006 | 0.01 |

The attributes coded into the block models include all elements ($K_2O$, $Al_2O_3$, CaO, $Fe_2O_3$, LOI, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$ and $TiO_2$), density, topography, weathering, resource category, domain code, as well as a number of kriging attributes and sample variance data.

A full list of attributes coded to the model is listed below in Table 14.6-3.

**Table 14.6-3 Attributes Assigned to 3D Model – Cerrado Verde Project (AMS, March 31, 2013)**

| Attribute Name | Type | Decimal | Background | Description |
|---|---|---|---|---|
| al2o3 | Real | 6 | 0 | Aluminum (Oxide) |

| Attribute Name | Type | Decimal | Background | Description |
|---|---|---|---|---|
| avg_dist_k2o | Real | 1 | -99 | Average Distance to Find Samples |
| cao | Real | 6 | 0 | Calcium (Oxide) |
| density | Real | 6 | 0 | Density Value (Assigned) |
| domain | Character | - | waste | Ore Domain Assigned |
| fe2o3 | Real | 6 | 0 | Iron (Oxide) |
| $K_2O$ | Real | 6 | 0 | Potassium (Oxide) |
| loi | Real | 6 | 0 | Loss On Ignition (LOI) |
| mgo | Real | 6 | 0 | Magnesium (Oxide) |
| min_dist_K2O | Real | 1 | -99 | Minimum Distance to Find Samples |
| mno | Real | 6 | 0 | Manganese (Oxide) |
| na2o | Real | 6 | 0 | Sodium (Oxide) |
| num_samp_K2O | Integer | - | -99 | Number of Samples for Estimate |
| p2o5 | Real | 6 | 0 | Phosphorous (Oxide) |
| pass_no | Integer | - | 0 | Pass Number (1, 2 or 3) |
| pass_no_K2O | Integer | - | 0 | Pass Number for K2O Estimate |
| pod | Character | - | 999 | Pod Number |
| rescat | Character | - | none | Measured, Indicated, or Inferred |
| sio2 | Real | 6 | 0 | Silica (Oxide) |
| permit_status | Character | - | outside | Either Inside or Outside |
| tio2 | Real | 6 | 0 | Titanium (Oxide) |
| topo | Integer | - | 0 | Assign 1 if Underneath Laser Topo |
| weathering | Character | - | none | Either Fresh or Weathered |

## 14.7. Grade Estimation

The grade interpolation for all elements of the Cerrado Verde Project was estimated using Ordinary Kriging (OK). Anisotropic search ellipsoids were selected for the grade interpolation process based on an analysis of the spatial continuity of $K_2O$, $Al_2O_3$, CaO, $Fe_2O_3$, LOI, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$ and $TiO_2$ grades using variography and on the general geometry of the modelled mineralized saprolite envelope. Limits were set for the minimum and maximum number of composites used per interpolation pass and restriction were applied on the maximum number of composites used from each hole.

The interpolation process was conducted using 3 successive passes with relaxed search conditions from one pass to the next until all blocks had been interpolated. The orientation of the search ellipsoids, which is identical for each interpolation pass, is 0° azimuth, 0° dip and 0° plunge, which is consistent with a relatively uniform, sub-horizontal (flat lying) mineralized domain (Table 14.7-1).

In the first pass, the search ellipsoid distance was 200 m (long axis) by 200 m (intermediate axis) by 20 m (short axis). Search conditions were defined with a minimum of 8 composites and a maximum of 16 composites with a maximum of 2 composites selected from each hole. For the second pass, the search distance was increased to 400 m (long axis) by 400 m (intermediate axis) by 20 m (short axis) and composites selection criteria were kept the same as those used for the first pass, though with the minimum number of samples required to make an estimate lowered to 6. Finally, the search distance of the third pass was increased to 1500 m (long axis) by 1500 m (intermediate axis) by 60 m (short axis) and, once again, the same composites selection criteria were applied, and the minimum number of samples was lowered to 4.

All blocks within the Cerrado Verde mineralized domain were estimated as part of the three-pass estimate.

Table 14.7-1 outlines the search direction and parameters used for the 3-pass interpolation, while Table 14.7-2 highlights the percentage of blocks estimated within each of the estimation passes completed.

**Table 14.7-1 Summary of Search Direction and Parameters for 3-Pass Interpolation**

| Zone | Search Directions | | | |
|---|---|---|---|---|
| | Strike (degrees) | | | Dip / Dip Direction (degrees) |
| $K_2O$ Ore Domain | 000 | | | 0 / 000 |
| | 1 Pass | 2 Pass | 3 Pass | Discretization |
| X | 200m | 400m | 1500m | 4 |
| Y | 200m | 400m | 1500m | 4 |
| Z | 20m | 20m | 60m | 2 |
| MIN SAMPLE | 8 | 6 | 4 | - |
| MAX SAMPLE | 16 | 16 | 16 | - |

**Table 14.7-2 Percentage of Blocks Estimated for 3-Pass Interpolation**

| Pass # | Percentage of Blocks Estimated |
|---|---|
| 1 Pass | 19.9% |
| 2 Pass | 74.5% |
| 3 Pass | 5.6% |

The search ellipse was configured to match the main mineralization direction, which was sub-horizontal, given the geological understanding at the time of this mineralization. Figure 14.7-1 provides a visual representation of the interpolation results for the three respective passes across the Cerrado Verde Project area.

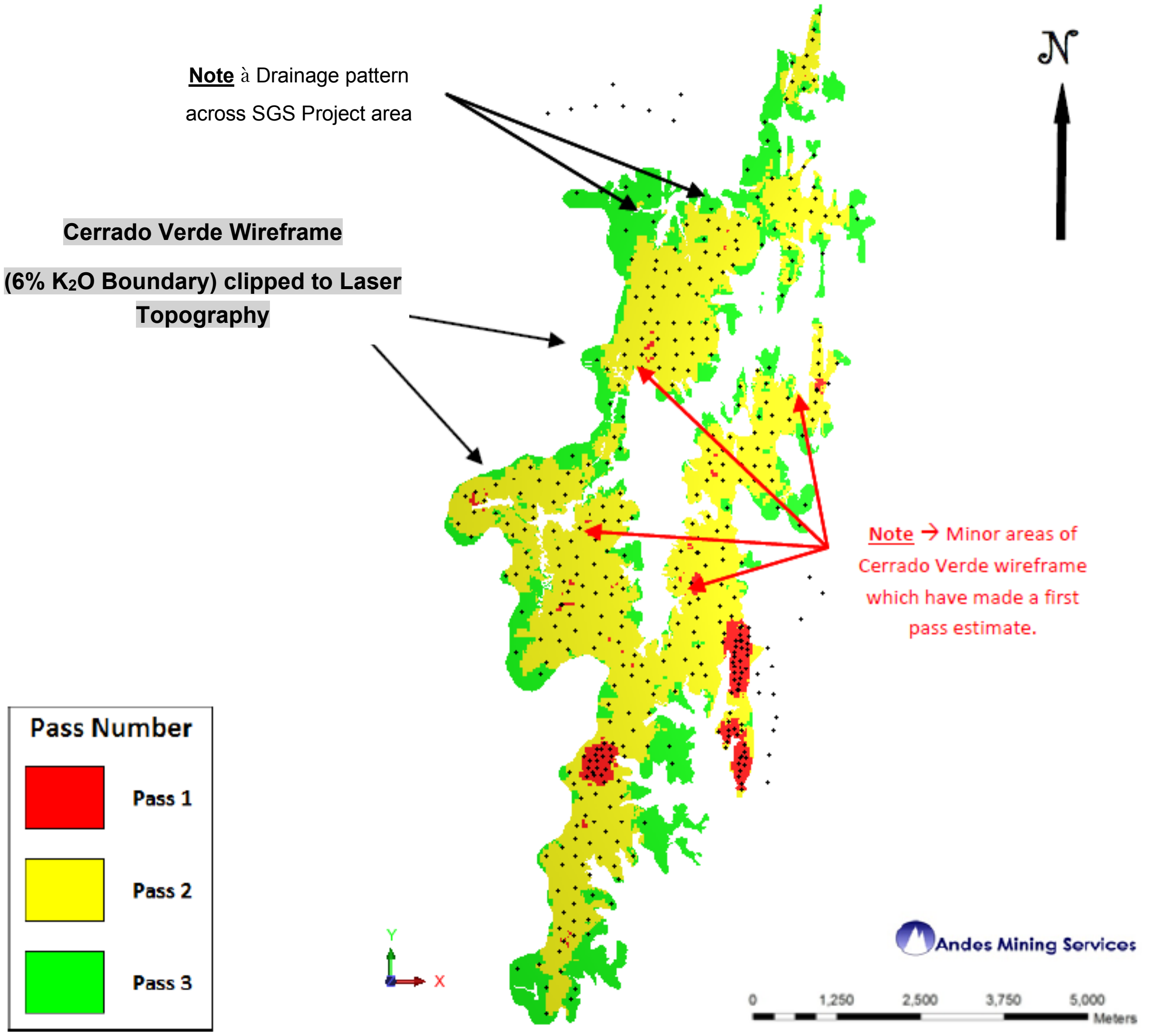


**Figure 14.7-1 Cerrado Verde Block Model – Coded according to the Pass Number with Drill Holes (AMS, March 31, 2013)**

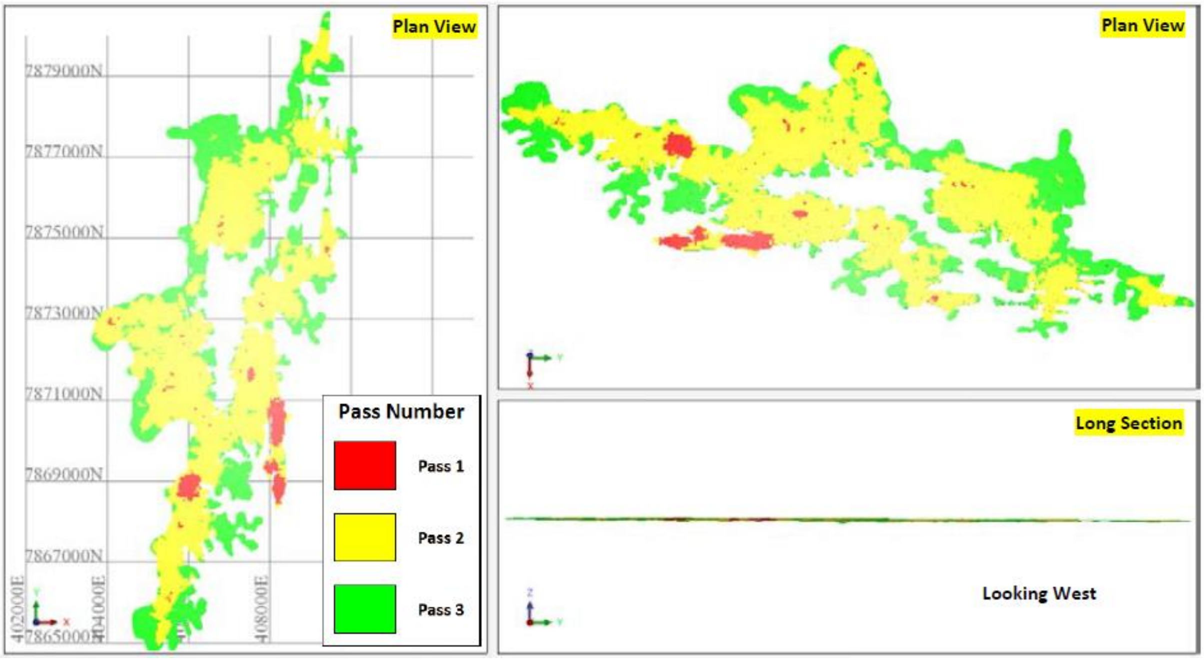


**Figure 14.7-2 Cerrado Verde Block Model Composite – Coded according to the Pass Number (Estimate) (AMS, March 31, 2013)**

Figure 14.7-3 and Figure 14.7-4 below illustrate grade variations across the block model (mineralized domain) for $K_2O$.

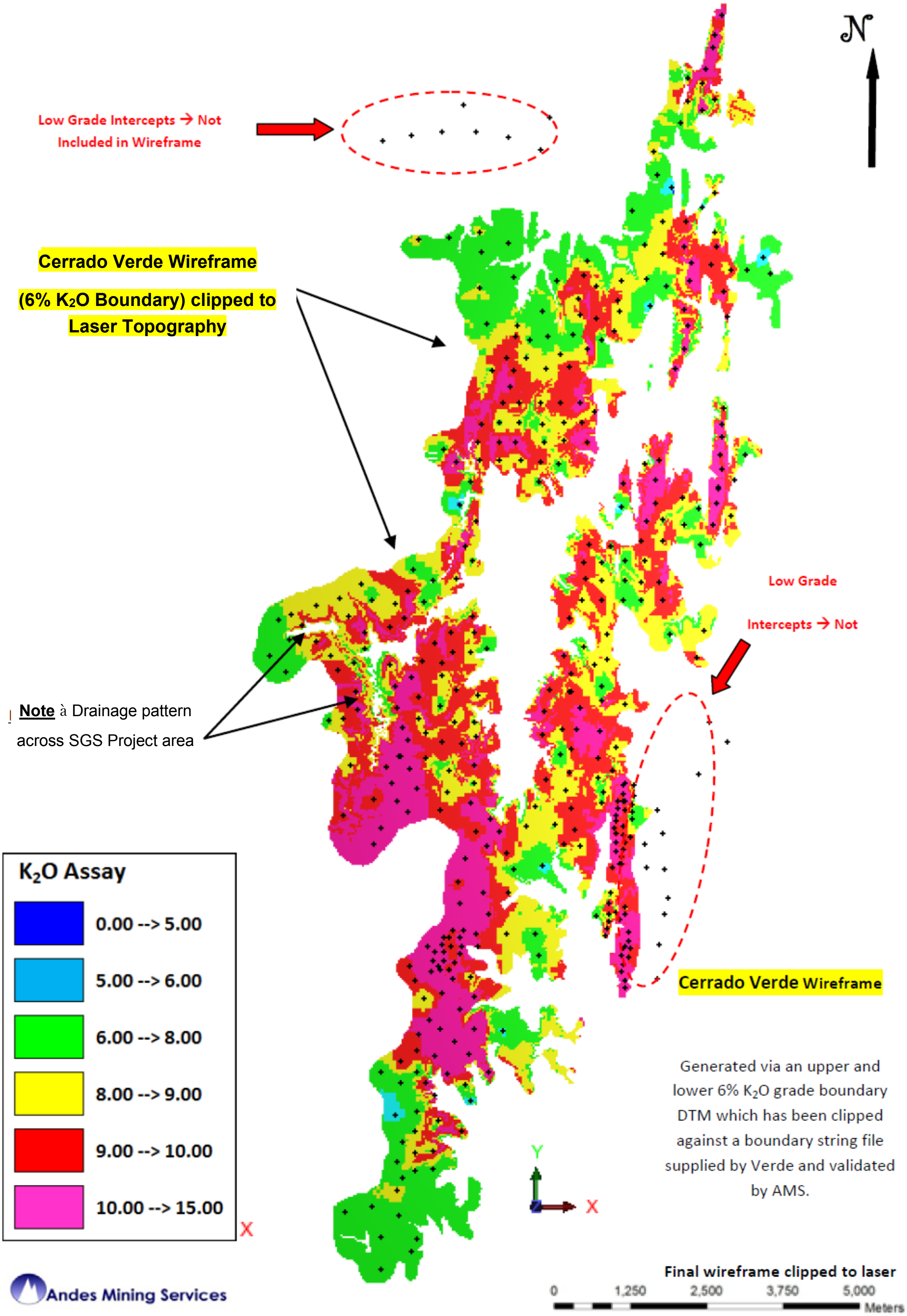


**Figure 14.7-3 Cerrado Verde Block Model – Coded by $K_2O$ Grades (Estimate) (AMS, March 31, 2013)**

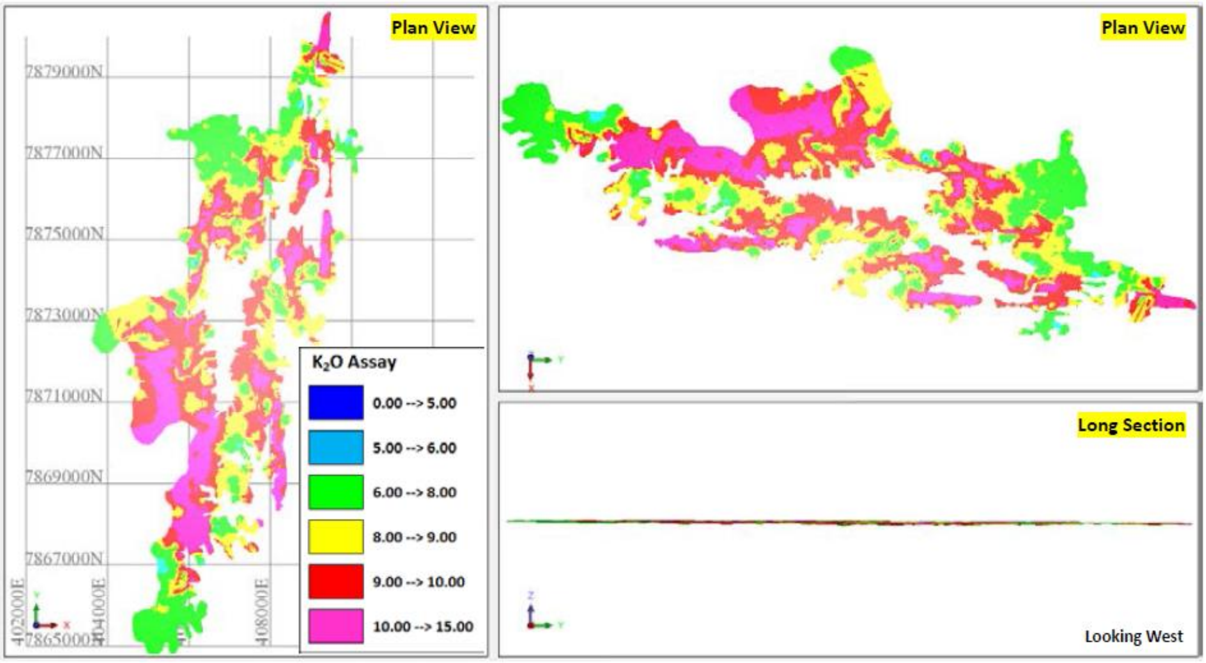


**Figure 14.7-4 Cerrado Verde Block Model – Coded by $K_2O$ Grades (Estimate) (AMS, March 31, 2013)**

## 14.8. Model Validation

A validation of the mineral resource $K_2O$ grade, as well as all other elements ($Al_2O_3$, CaO, $Fe_2O_3$, LOI, MgO, MnO, $Na_2O$, $P_2O_5$, $SiO_2$ and $TiO_2$), was conducted as part of the verification process. The validation includes: 1) a visual comparison of the color-coded block values versus the composites data in the vicinity of the interpolated blocks, and 2) a comparison of the average grade parameters for the composite data and the block model data.

Table 14.8-1 summarizes the comparative statistics for the composite and block model datasets, without any cut-off grades.

**Table 14.8-1 Comparative Statistics of the Composite and Block Model Datasets**

| Dataset | Count | Average Grade (%) - Composites vs Block Model Comparison | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $Al_2O_3$ | CaO | $Fe_2O_3$ | $K_2O$ | LOI | MgO | MnO | $Na_2O$ | $P_2O_5$ | $SiO_2$ | $TiO_2$ |
| Composites | 3387* | 15.56 | 0.50 | 6.86 | 9.27 | 3.50 | 2.90 | 0.13 | 0.19 | 0.14 | 59.79 | 0.82 |
| Block Model | 2958191 | 15.52 | 0.54 | 6.80 | 8.95 | 3.51 | 2.86 | 0.13 | 0.21 | 0.15 | 60.06 | 0.81 |

* Various numbers of composites available for each element. See Table 14.4-1 for details.

The variation in grade from the average composite value of 9.27% $K_2O$ to the block model grade of 8.95% $K_2O$ is reflected in the tendency for drilling to be more tightly spaced across the highest-grade portions of the mineral resource. The effect of this is to produce an overall average composite grade that is biased on the high side due to the uneven spread of assay data. A slightly lower block model grade is to be expected, given that a tightly controlled search ellipse acts to limit the spread of higher-grade samples concentrated in a number of small areas and the OK interpolation process effectively declusters the data.

To check that the estimation had worked correctly, the model was validated by means of a visual comparison of down hole drilling grades (assays) and estimated blocks in close proximity to the drill holes. A total of 20 east-west vertical cross sections were generated and used to validate the block model.

An example of the visual validation is shown below, with a cross section of the block model (7,875,400 N) compared against the drill hole results. There is an excellent correlation in block grades with down hole drilling assays for $K_2O$, with grade spreading, both laterally and vertically, found to be consistent with the input parameters for the block modelling.

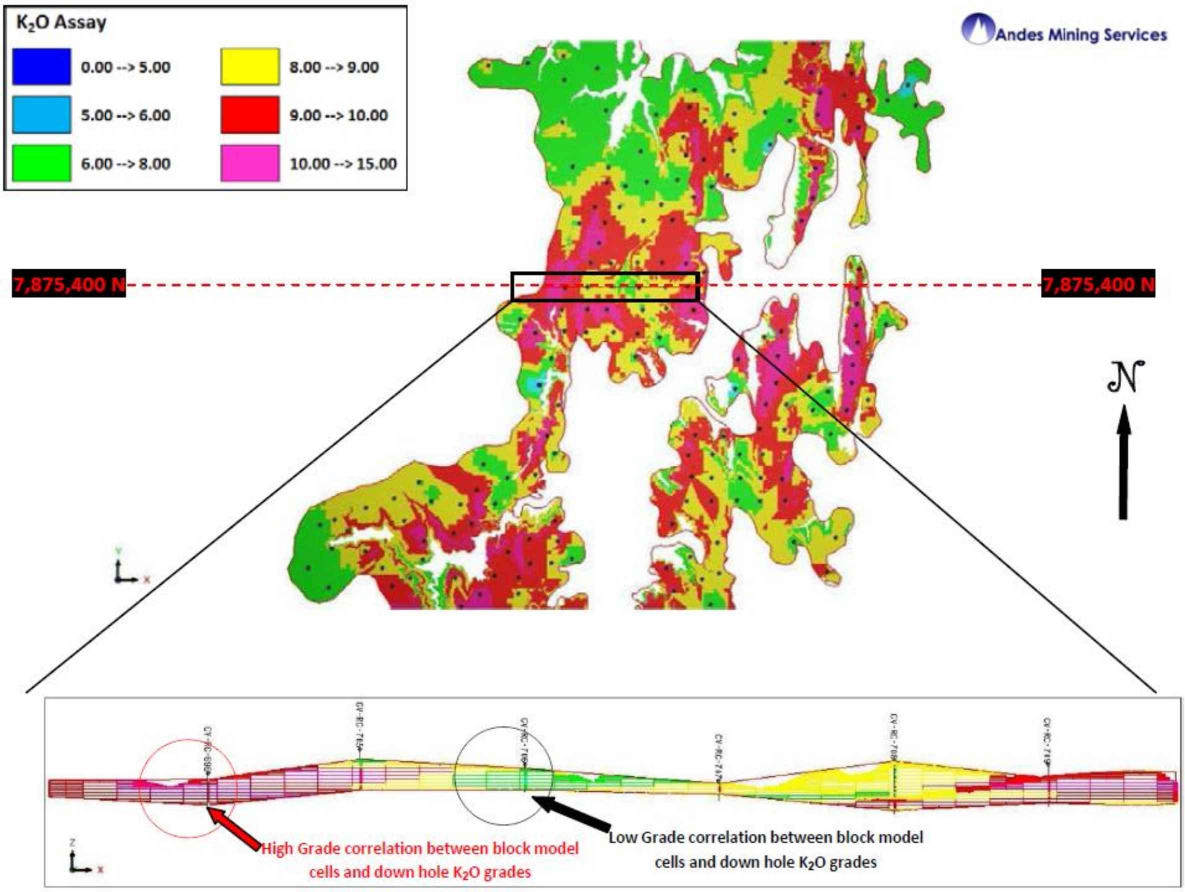


**Figure 14.8-1 Block Model Validation against Drilling – Cross Section at 7,875,400 N (AMS, March 31, 2013)**

## 14.9. Mineral Resource Classification

The mineral resources at the Cerrado Verde Project have been classified as measured, indicated and inferred. The parameters used to determine the mineral resource classification include, but are not limited to: drilling density, estimation pass number and the number of samples used to make a block estimate, as well as the average distance used to find samples to make a block estimate.

Table 14.9-1 below highlights some of the specific factors considered in the classification of the Cerrado Verde Project resource.

Figure 14.9-1 and Figure 14.9-2 show the resource classification across the Cerrado Verde Project area.

**Table 14.9-1 Resource Classification Considerations - Cerrado Verde Project**

| Resource | Considerations | % Estimated |
|---|---|---|
| Measured | Block MUST be estimated in 1 Pass and have a minimum 8 composites to be considered applicable. In addition, drill density in the immediate vicinity of the applicable blocks must feature spacing on the order of 100 m x 100 m in order for the blocks to classify as "MEASURED" | 4.29 |
| Indicated | Block must be estimated within either the 1st or 2nd Pass to be considered “INDICATED”. Blocks already classified as MEASURED resources were excluded. | 75.82 |
| Inferred | Any block that was estimated in the three passes, but has not yet been assigned Measured or Indicated Status has been designated as “INFERRED” | 19.89 |
| Unclassified | Any block that was not estimated in the 3 Passes has been designated as “UNCLASSIFED” | 0.00 |

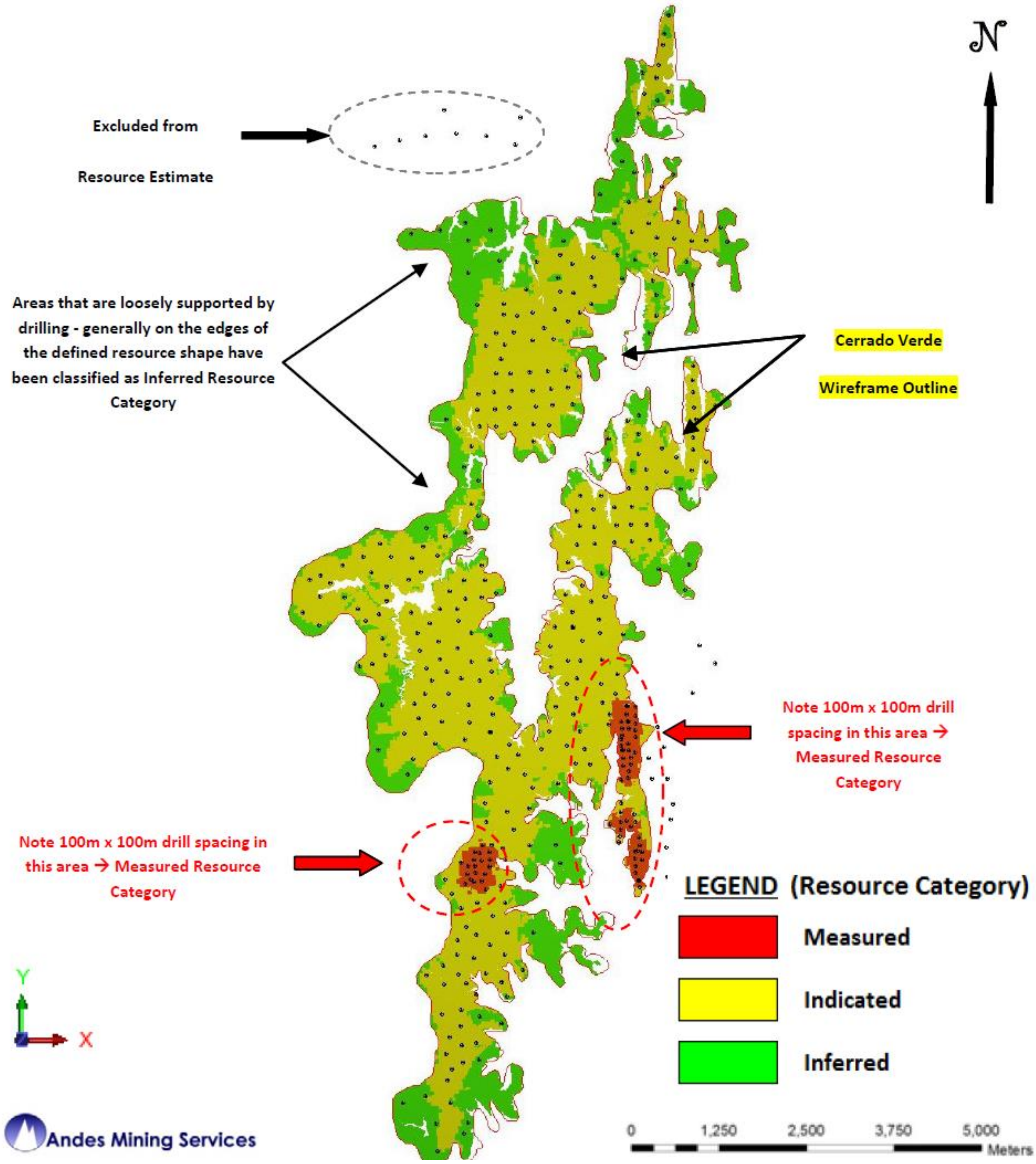


**Figure 14.9-1 Cerrado Verde Block Model – Resource Classification (AMS, March 31, 2013)**

The lateral extent of both measured and indicated resources for the Cerrado Verde Project is highlighted below in Figure 14.9-2 and Figure 14.9-3. With both the indicated and inferred resource categories removed, Figure 14.9-3 shows the true extent of the measured resource categories and highlights the closely spaced 100 m x 100 m drilling pattern in these areas.

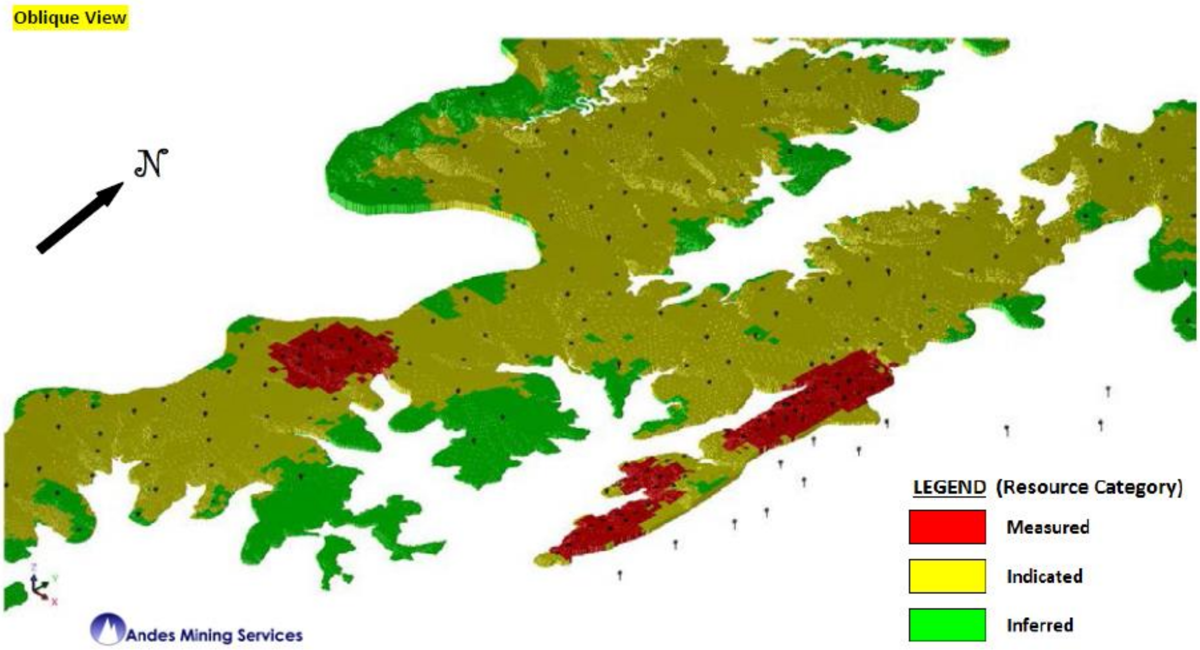


**Figure 14.9-2 Measured, Indicated and Inferred Resource Classification – Cerrado Verde (AMS, March 31, 2013)**


**Figure 14.9-3 Cerrado Verde Block Model – Measured Resource Classification (AMS, March 31, 2013)**

## 14.10. Mineral Resource Reporting

The grade estimates for the Cerrado Verde Project have been classified as measured, indicated and inferred mineral resources in accordance with NI 43-101 guidelines, based on the confidence levels of the key criteria that were considered during the mineral resource estimation. Key criteria are tabulated below in Table 14.10-1.

**Table 14.10-1 Confidence Levels of Key Categorization Criteria – Cerrado Verde Project**

| Items | Discussion | Confidence |
|---|---|---|
| Drilling Techniques | Diamond drilling is industry standard with good recoveries exhibited throughout. | High |
| Logging | Standard nomenclature used. Minor overlaps noted within database. | High |
| Drill Sample Recovery | Excellent recoveries recorded for new drilling. Moderate recovery levels noted for RC drilling programs completed in 2009. | High |
| Sub-sampling Techniques & Sample Preparation | DC sampling completed on 2 m intervals or to geological boundaries where they exist. Majority of RC sampling completed on 2 m sample intervals, however early programs (2009 and portions of 2011) completed on both 1m and 3m sample intervals. Sample preparation has been completed to industry standards. | High |
| Quality of Assay Data | Excellent for standards, blanks and duplicates (2012 Program). Umpire assay test work is excellent with no bias observed between laboratories. | Moderate / High |
| Verification of Sampling and Assaying | Duplicate sample data shows excellent correlation (coarse reject duplicates). DDH twin hole drilling with pre-existing RC holes shows excellent correlation for grade with no grade bias observed. | High |
| Location of Sampling Points | A detailed laser topography survey has been completed by VERDE with excellent accuracy. Drill hole collar locations have been surveyed (DGPS pick-up). | High |
| Data Density and Distribution | Drill spacing of approximately 200 m by 200 m. Within three areas of the resource, drill spacing has been reduced to 100 m by 100 m in an effort to increase the resource category confidence in these areas. | Moderate / High |
| Audits or Reviews | AMS completed a site visit and resource update for the Cerrado Verde Project between 7 and 10 of August 2012. No further reviews / audits have been completed since this time. | N/A |
| Database Integrity | Only DDH and RC holes are considered for the resource. VERDE completed initial handheld XRF assay test work on samples. Samples which assayed >6% $K_2O$ via handheld were sent to laboratory for complete XRF analysis. AMS have included a small number of drill holes in the resource which are ONLY supported by handheld XRF results. This was necessary to give a representative estimate for the entire mineralized domain (Ore). | Moderate / High |
| Geological Interpretation | Entirely within saprolite and fresh rock. Strong geological understanding with much of the mineralized domain outcropping at surface. Orebody is visual (green appearance on satellite photos). | High |
| Estimation and Modelling Techniques | Ordinary Kriging (OK) utilized which is appropriate given the distributions observed in the data. | High |
| Cut-Off Grades | A 7.5% $K_2O$ cut-off grade has been applied to the final reported resource numbers. This is consistent with the 7.5% cut-off grade used by SRK consulting for the February 2012 resource estimate which formed part of a Preliminary Economic Assessment (PEA). Recent metallurgical test work has proven this cut-off grade to be economic. | High |
| Mining Factors or Assumptions | 50 mE by 50 mN by 5 mRL SMU. | High |

A detailed summary (various cut-off grades) of the estimated measured, indicated and inferred mineral resources for the Cerrado Verde Project is provided below in Table 14.10-2.

The statement has been classified by Qualified Person Bradley Ackroyd (MAIG) in accordance with the NI 43-101guidelines. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

**Table 14.10-2 Confidence Levels of Key Categorization Criteria – Cerrado Verde Project**

| Cut-Off (% $K_2O$) | Tonnes (Mt) | $K_2O$ | $P_2O_5$ | CaO | $Al_2O_3$ | $Fe_2O_3$ | $SiO_2$ | MgO | $TiO_2$ | MnO | $Na_2O$ | LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Measured Resource Category | | | | | | | | | | | | |
| 7.5 | 83 | 10.13 | 0.13 | 0.33 | 15.73 | 6.99 | 58.93 | 2.90 | 0.83 | 0.13 | 0.10 | 3.31 |
| Indicated Resource Category | | | | | | | | | | | | |
| 7.5 | 1,365 | 9.24 | 0.14 | 0.49 | 15.61 | 6.85 | 59.83 | 2.90 | 0.81 | 0.13 | 0.17 | 3.47 |
| Measured and Indicated Mineral Resource (7.5% Cut-Off $K_2O$) * | | | | | | | | | | | | |
| 7.5 | 1,448 | 9.30 | 0.14 | 0.48 | 15.61 | 6.86 | 59.78 | 2.90 | 0.81 | 0.13 | 0.16 | 3.46 |
| Inferred Resource Category | | | | | | | | | | | | |
| 7.5 | 305 | 8.89 | 0.14 | 0.59 | 15.61 | 6.84 | 59.86 | 2.87 | 0.81 | 0.13 | 0.23 | 3.56 |
| Inferred Mineral Resource (7.5% Cut-Off $K_2O$) * | | | | | | | | | | | | |
| 7.5 | 305 | 8.89 | 0.14 | 0.59 | 15.61 | 6.84 | 59.86 | 2.87 | 0.81 | 0.13 | 0.23 | 3.56 |

**Mineral resources are not mineral reserves and do not have demonstrated economic viability.*
*Appropriate rounding has been applied*
*It has an effective date of March 31, 2014.*

The mineral resource estimate was focused on a flat-lying, sub-horizontal mineralized domain, which has been defined at the surface and drill tested to define the depth of the mineralization. A nominal 6% $K_2O$ grade cut-off was used to guide the wireframing process.

An independent mineral resource was estimated for the Cerrado Verde Project. This estimated resource is comprised of a combined measured and indicated mineral resource of 1,448 Mt at 9.30% $K_2O$ (using a 7.5% $K_2O$ cut-off) and an inferred mineral resource of 305 Mt at 8.89% $K_2O$ (using a 7.5% $K_2O$ cut-off grade).

Grade tonnage curves for the measured, indicated and inferred portions of the Cerrado Verde Project are shown below in Figure 14.10-1 to Figure 14.10-3, respectively.

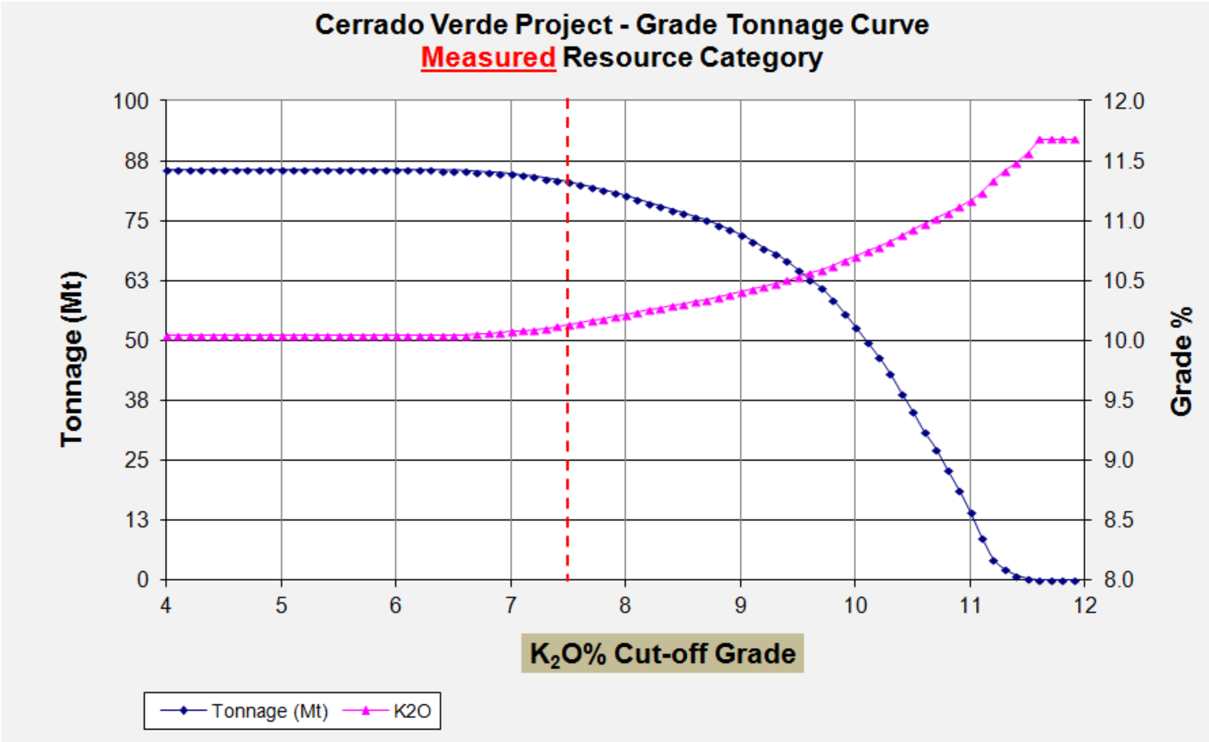


**Figure 14.10-1 Grade Tonnage Curve – Measured Resource Category (AMS, March 31, 2013)**

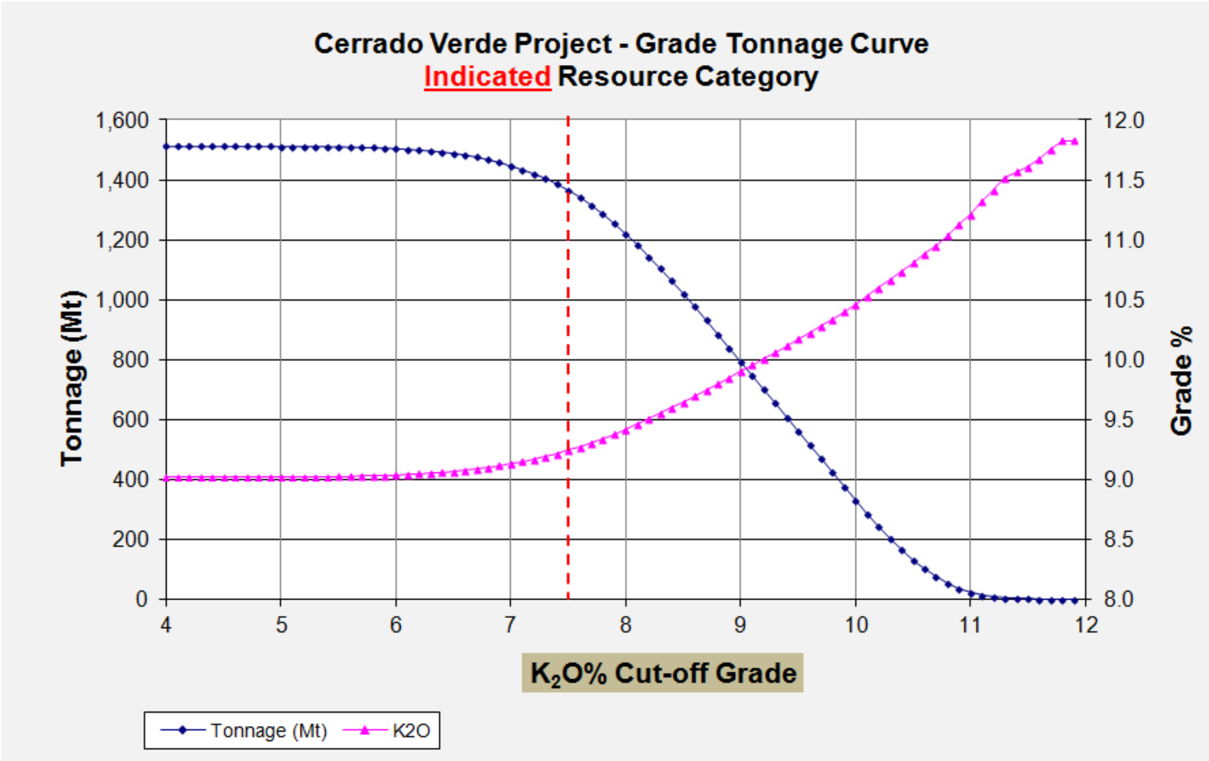


**Figure 14.10-2 Grade Tonnage Curve – Indicated Resource Category (AMS, March 31, 2013)**

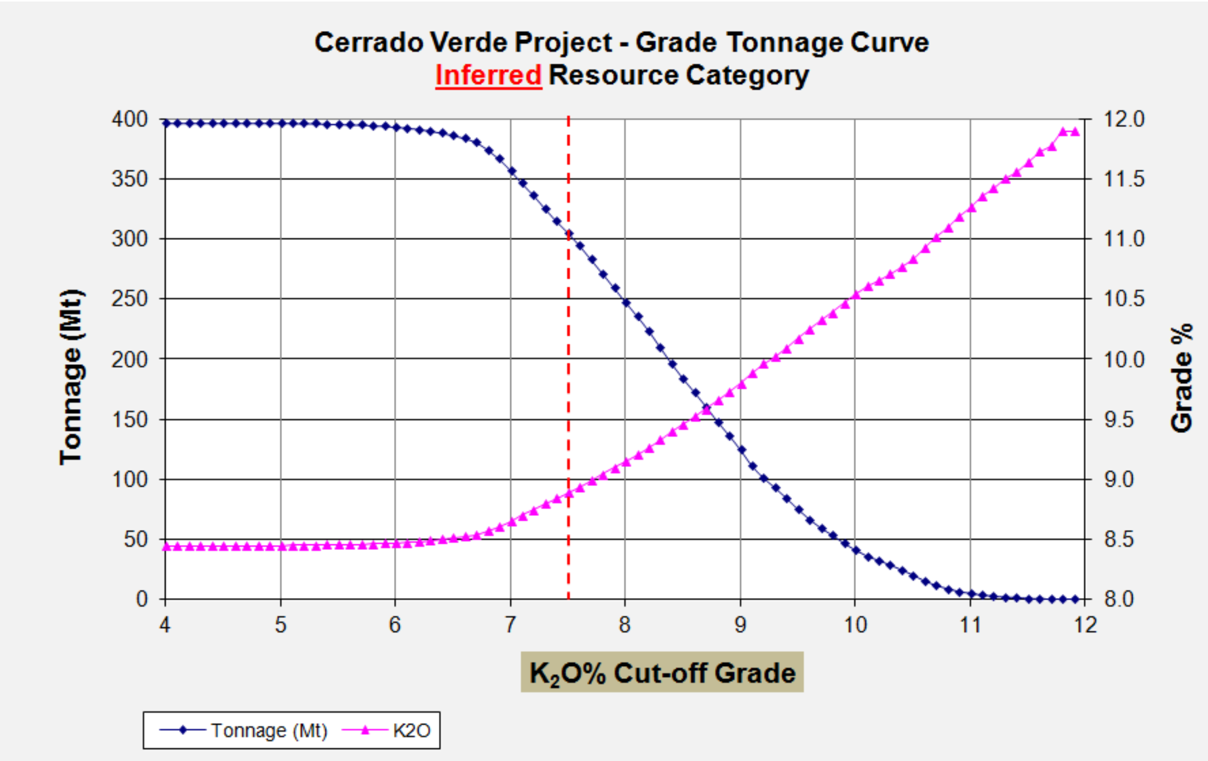


**Figure 14.10-3 Grade Tonnage Curve – Inferred Resource Category (AMS, March 31, 2013)**

Additional grade tonnage curves for combined Measured and Indicated as well as the total combined resource are presented in Figure 14.10-4 and Figure 14.10-5.

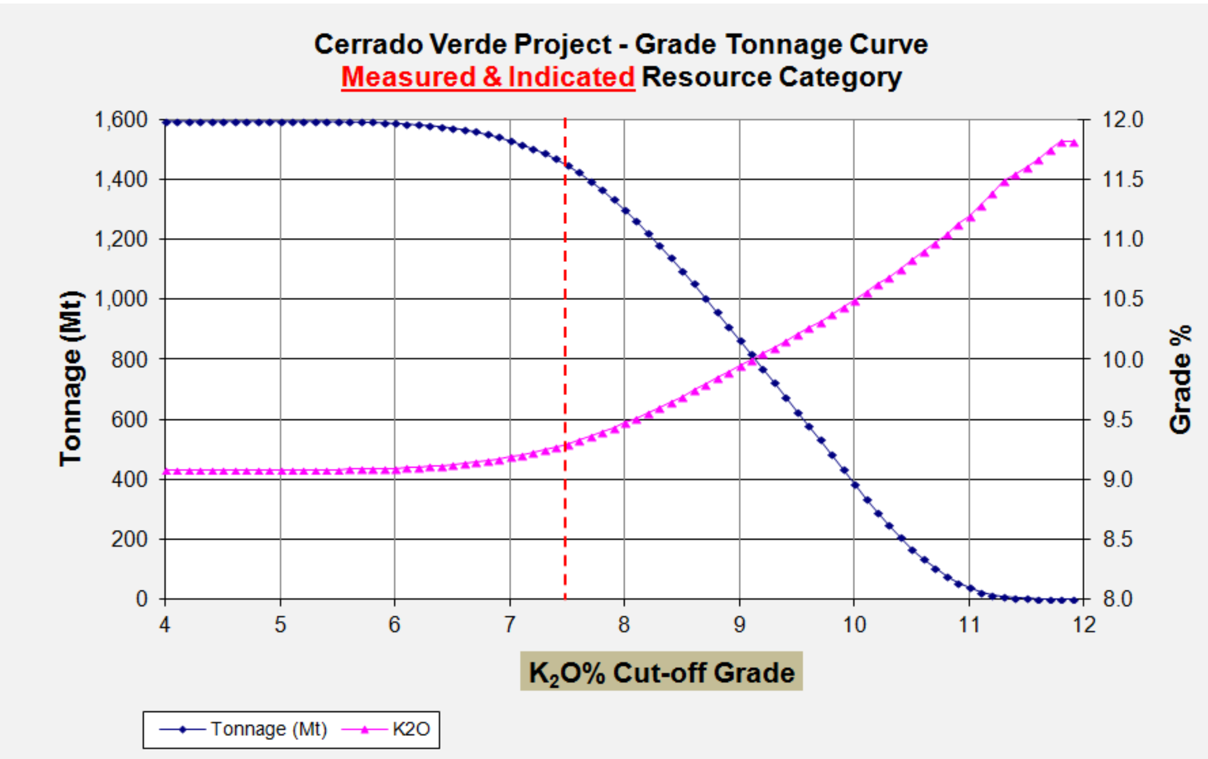


**Figure 14.10-4 Grade Tonnage Curve – Measured and Indicated Resource Category (AMS, March 31, 2013)**

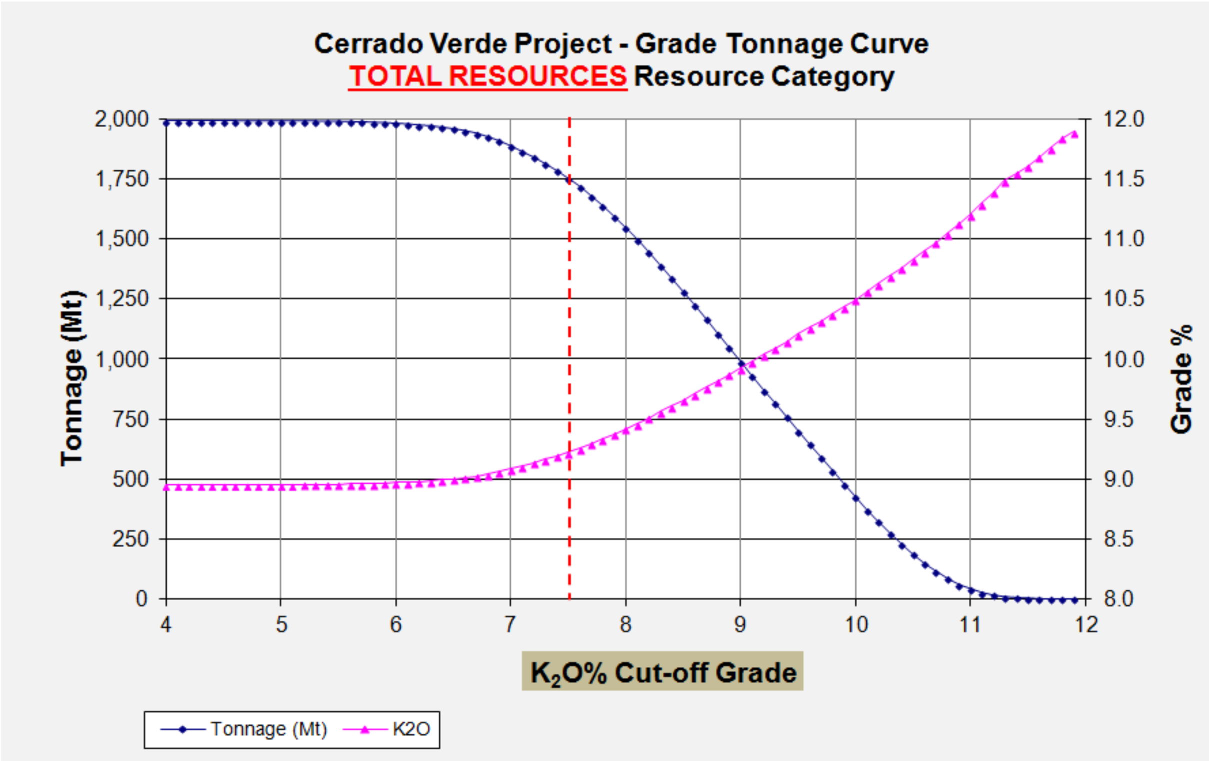


**Figure 14.10-5 Grade Tonnage Curve – Total Resource Category (AMS, March 31, 2013)**

A combined mineral resource statement which incorporates previously reported resources completed by SRK has been prepared for the Cerrado Verde Project. A combined measured and indicated mineral resource of 1,472 Mt at 9.28% $K_2O$ (using a 7.5% $K_2O$ cut-off), and an inferred mineral resource of 1,850 Mt at 8.60% $K_2O$ (using a 7.5% $K_2O$ cut-off grade) (Table 14.10-3) is reported for the Cerrado Verde Project.

**Table 14.10-3 Measured, Indicated and Inferred Mineral Resource Grade Tonnage Report (AMS & SRK Consulting) – Ordinary Kriging (OK) & Inverse Distance Weighting with Power Two (IDW2)* – (Block Model – 50mE X 50mN X 5mRL / 10mRL)***

| Target | Cut-Off (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| **Measured Resource Category** | | | |
| Target 7 | 7.5 | 83 | 10.13 |
| **Total Measured** | | **83** | **10.13** |
| **Indicated Resource Category** | | | |
| Target 6 | 7.5 | 23 | 8.83 |
| Target 7 | 7.5 | 1,365 | 9.24 |
| **Total Indicated** | | **1,388** | **9.23** |
| **Total Measured & Indicated** | | **1,472** | **9.28** |
| **Inferred Resource Category** | | | |
| Target 1 | 7.5 | 236 | 8.72 |
| Target 2 | 7.5 | 12 | 8.54 |

| Target | Cut-Off (% $K_2O$) | Tonnes (Mt) | Average Grade (% $K_2O$) |
|---|---|---|---|
| Target 3 | 7.5 | 126 | 8.72 |
| Target 4 | 7.5 | 146 | 9.03 |
| Target 5 | 7.5 | 27 | 8.31 |
| Target 6 | 7.5 | 48 | 8.84 |
| Target 7 | 7.5 | 305 | 8.89 |
| Target 11 | 7.5 | 47 | 8.27 |
| Target 13 | 7.5 | 168 | 8.50 |
| Target 14 | 7.5 | 325 | 8.65 |
| Target 16 | 7.5 | 257 | 8.15 |
| Target 17 | 7.5 | 151 | 8.19 |
| **Total Inferred** | | **1,850** | **8.60** |

*Mineral resources are not mineral reserves and do not have demonstrated economic viability.*
** IDW2 Estimate (Block Model – 50 mE x 50 mN x 10 mRL) --> Targets 1,2,3,4,5,6,11,13,14,16 and 17*
** OK Estimate (Block Model – 50 mE x 50 mN x 5 mRL) --> Target 7*
*Appropriate rounding has been applied to Table 14.10-3*

AMS and VERDE are not aware of any factors (environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant factors) that may materially affect the viability of the mineral resource estimate. The Cerrado Verde Project is a greenfield site and therefore is not affected by any mining, metallurgical or infrastructure factors.

# 15. Mineral Reserve Estimate

Mineral reserves were classified in accordance with the CIM Definition Standards for Mineral Resources and Mineral Reserves (May 10, 2014). Only mineral resources that were classified as measured and indicated were considered the mineral reserve estimate used to demonstrate economic viability. Mineral reserves for the Cerrado Verde deposit incorporate appropriate mining recovery estimates for the open pit mining method selected.

Mineral reserves are an estimate of the tonnage and grade of Ore that can be economically mined and processed. To be considered mineral reserves the estimated sale price of the material must cover all the costs incurred during mining, processing and selling.

The Mineral reserve estimate for the Cerrado Verde deposit is based on the resource block model provided by AMS, as well as on information provided by VERDE.

## 15.1. Block Model

The mineral resource estimate was prepared by AMS based on drilling data compiled by VERDE during the 2011 and 2012 field campaigns and a small number of drill holes from a drilling program undertaken in late 2009.

The mineral resource is represented as a three-dimensional block model for Target 7. In the original AMS model, a parent block size of 50 mE x 50 mN x 5 mRL was used, with variable sub-blocking utilized to capture the relatively thin nature of the interpreted sub-horizontal Ore. A sub-block size of 6.25 mN x 6.25 mE x 1.25 mRL was utilized. Estimates were only prepared for parent blocks, with sub-blocks assigned the parent cell grade estimates. Table 15.1-1 shows the geometry of the block model.

**Table 15.1-1 Block Model Geometry.**

| | Y | X | Z |
|---|---|---|---|
| **Minimum Coordinates** | 7864000 | 403000 | 600 |
| **Maximum Coordinates** | 7881000 | 410700 | 1100 |
| **User Block Size** | 50 | 50 | 5 |
| **Sub-Block Size** | 6.25 | 6.25 | 1.25 |
| **Rotation** | 0 | 0 | 0 |
| **No. of Blocks** | 340 | 154 | 100 |

The model was delivered as a Surpac-compatible text file, which was imported into the Micromine software.

## 15.2. Topography

VERDE supplied BNA with sufficient topography for the Project infrastructure. This was obtained from an airborne laser scanning survey, which produced a contour map with 1 m intervals.

The following section outlines the procedures used to estimate the mineral reserves. The mine plan is based on the detailed mine design derived from the optimal pit shell produced by applying the Lerchs-Grossman (LG) algorithm.

## 15.3. Basic Parameters and Project Criteria

Three scenarios will be generated, varying the production scale and the average grade of the final product. For the first scenario (Plant 3 Scenario), the production scale is 10 Mt of product per year, with an average $K_2O$ grade of 10%. For the second scenario (23 Mt Scenario), the production scale is 23 Mt of product per year, with an average $K_2O$ grade of 10%. For the third scenario (50 Mt Scenario), the production scale is 50 Mt of product per year, with a minimum $K_2O$ grade of 9%.

The technical and economic parameters listed in Table 15.3-1 were used in the generation of the optimal mathematical pit, which consists of a pit that maximizes the value of the enterprise. This was obtained through the application of the Lerchs-Grossman algorithm. The tools available in the Micromine 2021 software were used to generate this mathematical pit.

The classical methodology for selecting the optimal mathematical pit consists of the generation of a set of mathematical pit shells generated through the application of the Revenue Adjustment Factor (RAF). This factor is applied to the selling price(s) of the product(s), resulting in the generation of a mathematical pit for each applied factor. The results of this set of mathematical pits are analyzed to define the ultimate mathematical pit for the project.

For haulage costs, due to the large scope of the project, the following criteria were used:

- For Ore blocks, the straight distance from the blocks to the crusher was used, multiplied by a factor of 1.5.
- For the waste rock blocks, an average distance of 3.0 to 3.5 km was used, as the waste rock disposal strategy foresees the recomposition of the exhausted pits with the waste rock.
- From these distances, an additional haulage cost was calculated based on previous quotations from outsourced companies.

A summary of the technical and economic conditions and parameters used in both scenarios is presented in Table 15.3-1 to Table 15.3-4. Since the only difference between the 10 Mt and 23 Mt Scenarios is the production scale, the final pit will be the same. Therefore, the same parameters will be used to generate the mathematical pit. The sales price used in the optimization was the transfer price defined by VERDE.

**Table 15.3-1 Technical and economic parameters used in the final pit optimization – 10 Mt and 23 Mt Scenarios.**

| Parameter | Value | Value | Unit |
|---|---|---|---|
| Production | 10.00 | 23.00 | Mtpy |
| Product selling price | 7.48 | 7.48 | US$/t product |
| Ore Cut Off | 7.50 | 7.50 | % $K_2O$ |
| Mass Recovery | 100.00 | 100.00 | % |
| Crushing Cost | 0.90 | 0.90 | R$/t ROM |
| Ore – Base Mining Cost | 0.98 | 0.98 | US$/t mined |
| Waste Rock – Base Mining Cost | 1.02 | 1.02 | US$/t mined |
| Additional Waste Rock Mining Cost (for an average haulage distance from 3.0 to 3.5 km) | 1.93 | 1.93 | US$/t mined |
| G&A Expenses | 0.16 | 0.16 | R$/t ROM |
| Dilution | 0.00 | 0.00 | % |
| Mining Recovery | 100.00 | 100.00 | % |
| Overall Slope Angle | 37.00 | 37.00 | º |

| Parameter | Value | Value | Unit |
|---|---|---|---|
| Discount rate | 8.00 | 8.00 | % Per year |

**Table 15.3-2 Additional Ore haulage cost –10 Mt and 23 Mt Scenarios.**

| Average Haulage Distance | Cost |
|---|---|
| from 0 to 500 m | 1.06 |
| from 500 to 1,000 m | 1.14 |
| from 1,000 to 1,500 m | 1.19 |
| from 1,500 to 2,000 m | 1.16 |
| from 2,000 to 2,500 m | 1.59 |
| from 2,500 to 3,000 km | 1.66 |
| from 3,000 to 3,500 km | 1.70 |
| from 3,500 to 4,000 km | 1.74 |
| from 4,000 to 4,500 km | 2.04 |
| from 4,500 to 5,000 km | 2.08 |
| from 5,000 to 5,500 km | 2.11 |
| from 5,500 to 6,000 km | 2.14 |
| from 6,000 to 6,500 km | 2.19 |
| from 6,500 to 7,000 km | 2.23 |
| from 7,000 to 7,500 km | 2.27 |
| > 7,500 km | 2.32 |

**Table 15.3-3 Technical and economic parameters used in the final pit optimization – 50 Mt Scenario.**

| Parameter | Value | Unit |
|---|---|---|
| Production | 50.00 | Mtpy |
| Product selling price | 6.03 | US$/t product |
| Ore Cut Off | 7.50 | % $K_2O$ |
| Mass Recovery | 100.00 | % |
| Crushing Cost | 0.51 | R$/t ROM |
| Ore – Base Mining Cost | 0.95 | US$/t mined |
| Waste Rock – Base Mining Cost | 1.02 | US$/t mined |
| Additional Waste Rock Mining Cost (for an average haulage distance from 3,000 to 3,500 m) | 1.56 | US$/t mined |
| G&A Expenses | 0.11 | R$/t ROM |
| Dilution | 2.00 | % |
| Mining Recovery | 98.00 | % |
| Overall Slope Angle | 37.00 | ° |
| Discount rate | 8.00 | % per year |

**Table 15.3-4 Additional Ore haulage cost –50 Mt Scenario.**

| Average Haulage Distance | Cost |
|---|---|
| from 0 to 500 m | 0.86 |
| from 500 to 1,000 m | 0.90 |

| Average Haulage Distance | Cost |
|---|---|
| from 1,000 to 1,500 m | 0.95 |
| from 1,500 to 2,000 m | 1.20 |
| from 2,000 to 2,500 m | 1.24 |
| from 2,500 to 3,000 km | 1.32 |
| from 3,000 to 3,500 km | 1.36 |
| from 3,500 to 4,000 km | 1.39 |
| from 4,000 to 4,500 km | 1.58 |
| from 4,500 to 5,000 km | 1.60 |
| from 5,000 to 5,500 km | 1.63 |
| from 5,500 to 6,000 km | 1.65 |
| from 6,000 to 6,500 km | 1.69 |
| from 6,500 to 7,000 km | 1.73 |
| from 7,000 to 7,500 km | 1.78 |
| > 7,500 km | 1.82 |

A decision was made to not use a dilution factor and a mine recovery of 100% in the 10 Mt and 23 Mt Scenarios. This was due to the fact that the size of the equipment for these scenarios will be smaller, meaning that selectivity will be greater. Furthermore, the material that will dilute most of the ore is a material with an average $K_2O$ grade of between 7.5% and 9.0%. Therefore, dilution will be minimal. For the 50 Mt Scenario, the mining recovery and dilution figures used were those listed in Table 15.3-3 Technical and economic parameters used in the final pit **optimization – 50 Mt Scenario.**

## 15.4. Optimal Pit Definition

The optimization of the final pit was performed using the Micromine 2021 geological modeling and mine planning software, which uses the Lerchs-Grossmann algorithm to generate the mathematical pits.

To generate the mathematical pits, an adjustment factor ("RAF") was used to vary the selling price of the final product, so that each value generated a different mathematical pit. This factor ranged from 0.45 to 1.20, with an increase of 0.05. In addition, a pit with an RAF of 10 was generated to assess how a very high selling price would affect the conformation of the mathematical pit.

Only the material classified as measured or indicated was considered as ore in the final pit optimization study. The results of these pits are shown in Table 15.4-1, Table 15.4-2, Figure 15.4-1 and Figure 15.4-2:

**Table 15.4-1 Results of the mathematical pit set – 10 Mt and 23 Mt Scenarios**

| | Tonnes (Mt) | | | | | | | | Percentage | | Million US$ | | | Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAF | Ore | Waste Rock | Waste Rock Cutoff 7.5 | Waste Rock Cutoff 0.0 | Waste Rock Inferred Cutoff 9.0 | Waste Rock Inferred Cutoff 7.5 | Waste Rock Inferred Cutoff 0.0 | Waste Rock Total | $K_2O$ Grade | Stripping Ratio | NPV Best | NPV CL4 | Non-Discounted NPV | Life of mine (LOM) |
| 0.45 | **1.80** | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.02** | **9.78** | **0.01** | **7.08** | **7.08** | **7.64** | **0.2** |
| 0.50 | **10.45** | 0.15 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | **0.19** | **10.02** | **0.02** | **37.35** | **37.35** | **40.46** | **1.0** |
| 0.55 | **32.75** | 1.10 | 0.17 | 0.00 | 0.09 | 0.00 | 0.00 | **1.36** | **10.06** | **0.04** | **102.07** | **102.03** | **120.12** | **3.3** |
| 0.60 | **136.72** | 3.92 | 0.62 | 0.00 | 0.16 | 0.05 | 0.00 | **4.74** | **10.09** | **0.03** | **268.36** | **268.31** | **445.77** | **13.7** |
| 0.65 | **269.28** | 27.79 | 3.19 | 0.03 | 0.55 | 0.15 | 0.00 | **31.72** | **10.12** | **0.12** | **339.95** | **338.27** | **816.57** | **26.9** |
| 0.70 | **348.93** | 47.51 | 6.72 | 0.11 | 0.77 | 0.24 | 0.00 | **55.35** | **10.10** | **0.16** | **356.36** | **352.21** | **1,010.15** | **34.9** |
| 0.75 | **436.54** | 78.32 | 10.45 | 0.19 | 1.02 | 0.37 | 0.00 | **90.35** | **10.10** | **0.21** | **363.81** | **358.88** | **1,189.38** | **43.7** |
| 0.80 | **510.94** | 113.18 | 15.58 | 0.20 | 1.27 | 0.69 | 0.00 | **130.92** | **10.09** | **0.26** | **366.44** | **361.30** | **1,315.83** | **51.1** |
| 0.85 | **567.15** | 143.68 | 22.49 | 0.27 | 1.64 | 0.74 | 0.00 | **168.82** | **10.07** | **0.30** | **367.39** | **361.99** | **1,391.31** | **56.7** |
| 0.90 | **626.87** | 176.22 | 36.80 | 0.36 | 2.43 | 1.37 | 0.00 | **217.18** | **10.05** | **0.35** | **367.73** | **362.26** | **1,445.80** | **62.7** |
| 0.95 | **664.84** | 200.99 | 45.87 | 0.50 | 2.96 | 1.67 | 0.00 | **251.99** | **10.04** | **0.38** | **367.83** | **362.25** | **1,467.74** | **66.5** |
| 1.00 | **712.59** | 218.23 | 76.61 | 0.65 | 4.03 | 1.92 | 0.00 | **301.45** | **10.01** | **0.42** | **367.84** | **362.24** | **1,476.90** | **71.3** |
| 1.05 | **729.18** | 228.50 | 84.68 | 0.78 | 4.76 | 2.28 | 0.00 | **321.00** | **10.00** | **0.44** | **367.83** | **362.21** | **1,474.00** | **72.9** |
| 1.10 | **741.37** | 238.17 | 90.31 | 0.87 | 5.26 | 2.35 | 0.00 | **336.95** | **10.00** | **0.45** | **367.80** | **362.18** | **1,467.35** | **74.1** |
| 1.15 | **754.56** | 249.40 | 97.40 | 0.99 | 5.59 | 2.46 | 0.00 | **355.84** | **9.99** | **0.47** | **367.76** | **362.14** | **1,455.15** | **75.5** |
| 1.20 | **764.63** | 259.96 | 102.42 | 1.09 | 5.80 | 2.55 | 0.00 | **371.81** | **9.99** | **0.49** | **367.72** | **362.10** | **1,442.19** | **76.5** |
| 10.00 | **846.70** | 422.07 | 193.95 | 7.77 | 13.01 | 4.34 | 0.01 | **641.14** | **9.95** | **0.76** | **366.52** | **360.85** | **919.94** | **84.7** |

**Table 15.4-2 Results of the mathematical pit set – 50 Mt Scenario**

| | Tonnes (Mt) | | | | | | Percentage | | Million US$ | | | Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAF | Ore | Waste Rock | Waste Rock Cutoff 0.0 | Waste Rock Inferred Cutoff 7.5 | Waste Rock Inferred Cutoff 0.0 | Waste Rock Total | $K_2O$ Grade | Stripping Ratio | NPV Best | NPV CL4 | Non-Discounted NPV | Life of mine (LOM) |
| 0.45 | **10.64** | 0.16 | 0.00 | 0.00 | 0.00 | **0.16** | **8.46** | **0.01** | **34.12** | **34.12** | **36.85** | **0.2** |
| 0.50 | **149.75** | 3.17 | 0.00 | 0.02 | 0.00 | **3.19** | **9.35** | **0.02** | **406.22** | **406.22** | **473.00** | **3.0** |
| 0.55 | **327.63** | 19.16 | 0.04 | 0.31 | 0.00 | **19.52** | **9.36** | **0.06** | **740.73** | **739.81** | **978.33** | **6.6** |
| 0.60 | **525.08** | 49.10 | 0.33 | 0.88 | 0.00 | **50.31** | **9.32** | **0.10** | **991.92** | **988.11** | **1,486.86** | **10.5** |
| 0.65 | **724.85** | 105.06 | 1.82 | 1.57 | 0.00 | **108.46** | **9.30** | **0.15** | **1,153.75** | **1,147.63** | **1,940.70** | **14.5** |
| 0.70 | **950.60** | 182.75 | 3.21 | 2.56 | 0.00 | **188.52** | **9.30** | **0.20** | **1,266.82** | **1,257.97** | **2,389.35** | **19.0** |
| 0.75 | **1,073.13** | 234.83 | 4.65 | 3.74 | 0.01 | **243.22** | **9.27** | **0.23** | **1,307.25** | **1,295.25** | **2,595.09** | **21.5** |
| 0.80 | **1,143.14** | 272.80 | 6.07 | 4.67 | 0.03 | **283.58** | **9.25** | **0.25** | **1,323.36** | **1,310.49** | **2,689.77** | **22.9** |
| 0.85 | **1,192.64** | 303.89 | 8.26 | 5.71 | 0.20 | **318.05** | **9.23** | **0.27** | **1,331.30** | **1,318.04** | **2,742.38** | **23.9** |
| 0.90 | **1,227.51** | 326.75 | 12.77 | 7.27 | 0.28 | **347.07** | **9.22** | **0.28** | **1,334.96** | **1,321.64** | **2,768.80** | **24.6** |
| 0.95 | **1,269.10** | 352.41 | 23.55 | 10.22 | 0.57 | **386.75** | **9.19** | **0.30** | **1,337.61** | **1,324.17** | **2,789.13** | **25.4** |
| 1.00 | **1,295.94** | 369.54 | 29.75 | 14.73 | 0.68 | **414.70** | **9.18** | **0.32** | **1,338.16** | **1,324.58** | **2,793.21** | **25.9** |
| 1.05 | **1,309.12** | 383.10 | 31.02 | 15.48 | 0.70 | **430.30** | **9.18** | **0.33** | **1,337.76** | **1,324.18** | **2,790.92** | **26.2** |
| 1.10 | **1,319.37** | 394.04 | 32.62 | 16.34 | 0.71 | **443.71** | **9.17** | **0.34** | **1,337.17** | **1,323.46** | **2,786.20** | **26.4** |
| 1.15 | **1,328.03** | 404.27 | 34.18 | 16.73 | 0.75 | **455.93** | **9.17** | **0.34** | **1,336.35** | **1,322.63** | **2,779.65** | **26.6** |
| 1.20 | **1,334.30** | 412.23 | 35.27 | 17.18 | 0.84 | **465.52** | **9.16** | **0.35** | **1,335.54** | **1,321.80** | **2,773.13** | **26.7** |
| 10.00 | **1,402.88** | 615.17 | 64.39 | 29.13 | 1.49 | **710.19** | **9.13** | **0.51** | **1,283.48** | **1,269.74** | **2,341.21** | **28.1** |

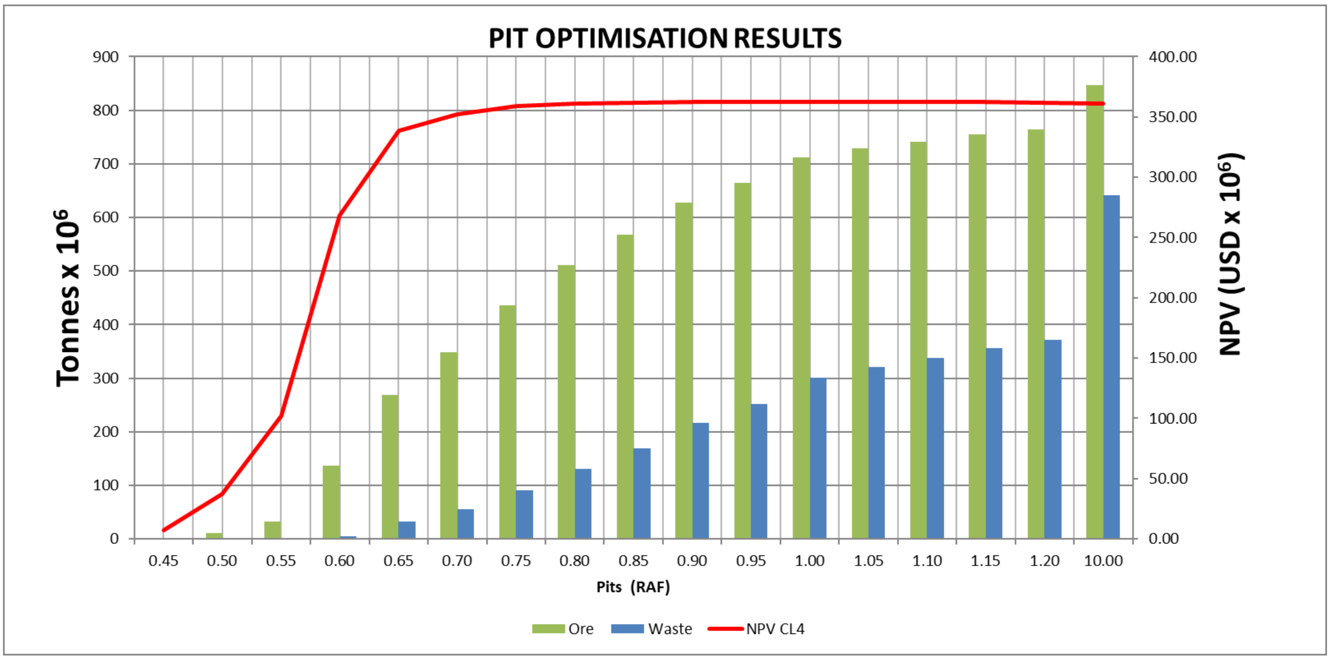


**Figure 15.4-1 Results of the set of generated mathematical pits – 10 Mt and 23 Mt Scenarios**

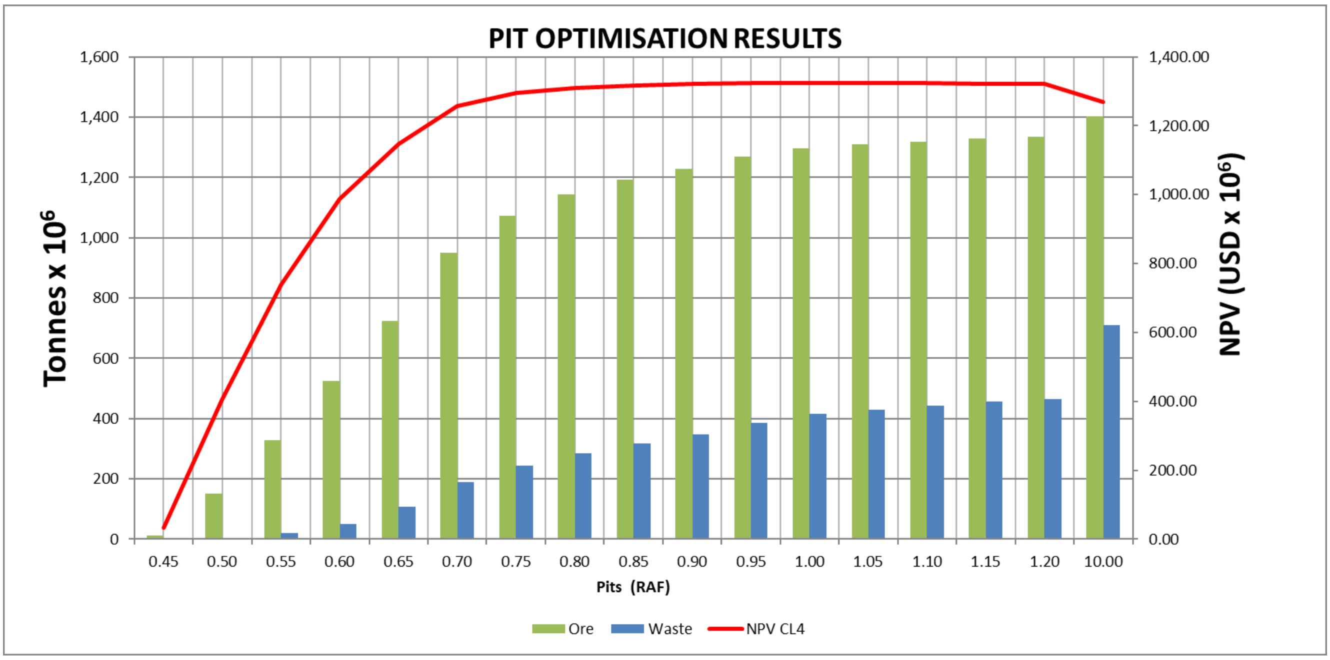


**Figure 15.4-2 Results of the set of generated mathematical pits – 50 Mt Scenario**

The waste rock was divided into:

- Waste rock.
- Waste Cutoff 7.5 – Material with a $K_2O$ grade between 7.5 and 9.0%.
- Waste Cutoff 0.0 – Material with a $K_2O$ grade between 0.0 and 7.5%.
- Waste Inferred Cutoff 9.0 – Inferred material with a $K_2O$ grade above 9.0%.
- Waste Inferred Cutoff 7.5 – Inferred material with a $K_2O$ grade between 7.5 and 9.0%.
- Waste Inferred Cutoff 0.0 – Inferred material with a $K_2O$ grade between 0.0 and 7.5%.

The following methodologies were used to calculate the NPV for the mathematical pits:

**Best Case (NPV Best)**

With this methodology it is assumed that the mathematical pits will be drawn in the sequence in which they were generated. This method favors the NPV for the pit, but the results obtained are often not operational.

**Constant Lag (NPV CL 4)**

With this methodology, it is assumed that the mathematical pits, though drawn in the sequence in which they were generated, will respect a maximum number of benches that can be mined in the same pit. For example, for a value of 4, after 4 benches are drawn from the same pit, the system will automatically advance to the next one, so that the difference between the benches drawn between two consecutive pits will never be greater than 4. Three scenarios were generated using this methodology, with a maximum value of 4 benches (NPV CL 4).

The application of different methods of calculating the NPV for the pits allows for a better evaluation when defining the optimum pit for the project. It should be noted that the calculated NPV does not consider capital costs, or any other costs not listed in Table 15.3-1, and therefore cannot be considered the NPV for the enterprise. It is to be used solely as an aid in the selection of the optimal pit for the project.

The results show an approximate stabilization of the NPV for the pits from the 0.34 RAF. Efforts to maximize the use of the resources led to the selection of the pits illustrated in Figure 15.4-3 and Figure 15.4-4 as the optimal pit for the project, for each scenario.

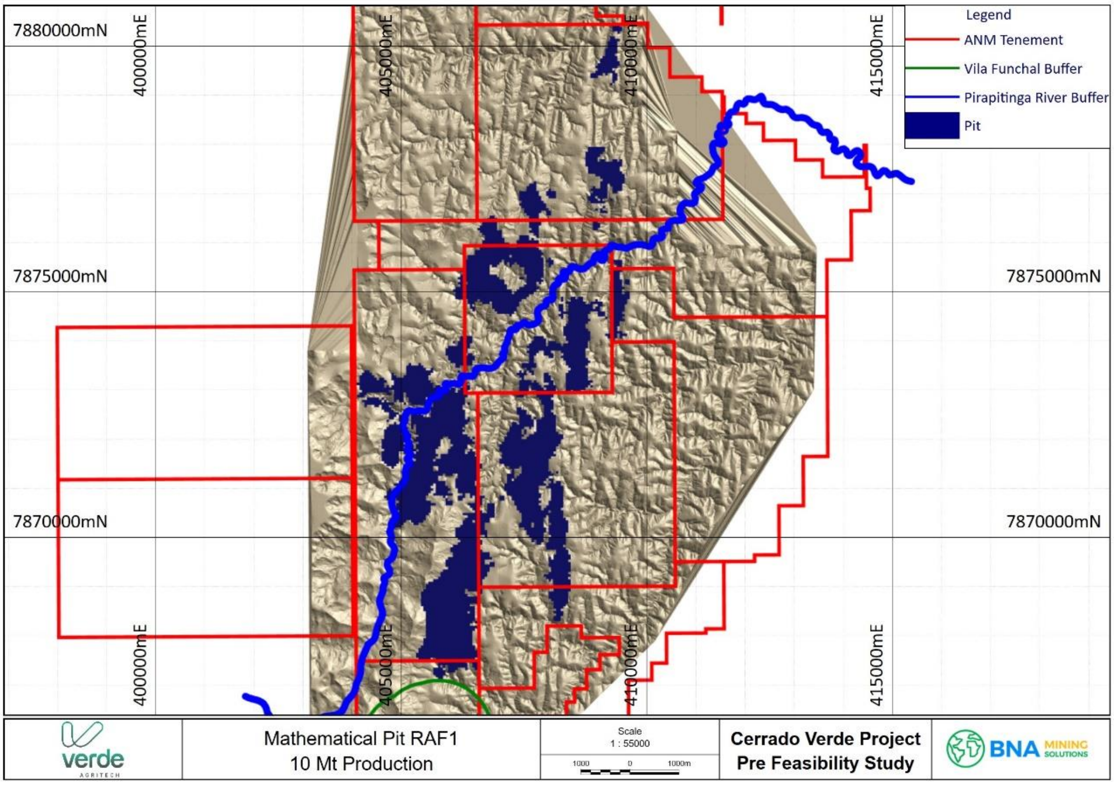


**Figure 15.4-3 Selected Mathematical Pit – RAF 1.0 – 10 Mt and 23 Mt Scenarios**

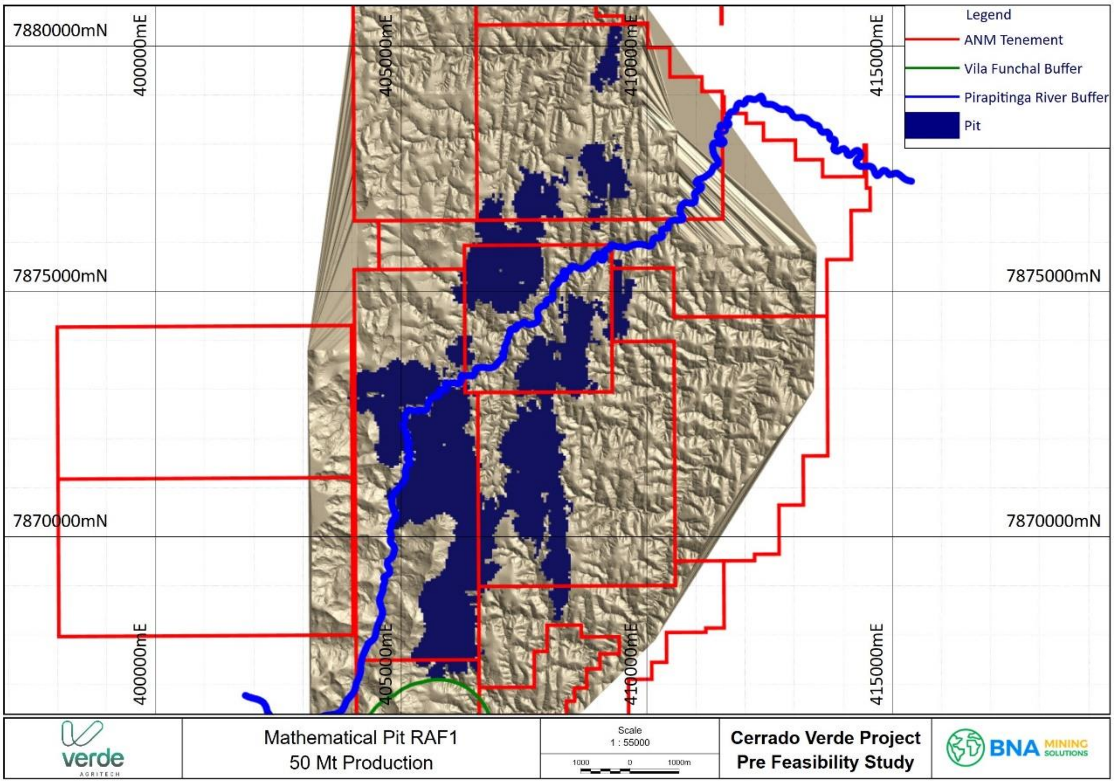


**Figure 15.4-4 Selected Mathematical Pit – RAF 1.0 – 50 Mt Scenario**

# 15.5. Final Pit Operationalization

The contours of the optimal mathematical pit were subsequently designed following the classic procedure that consists of the tracing of the toes and crests of the benches, access ramps and safety berms, thus allowing for the safe and efficient conduction of mining operations.

The technical mining parameters used for the operational mine design can be found in Table 15.5-1 and Table 15.5-2.

**Table 15.5-1 Final Pit Operationalization Parameters – 10 Mt and 23 Mt Scenarios**

| Parameters | Value | Unit |
|---|---|---|
| **Bench height** | 10.0 | meters |
| **Minimum Berm Width** | 5.0 | meters |
| **Wall Slope Angle** | 50.4 | ° |
| **Overall Slope Angle** | 37.0 | ° |
| **Access road width** | 20.0 | meters |
| **Access road angle** | 8.0 | % |
| **Annual Production Rate** | 10.0 | Mt |

**Table 15.5-2 Final Pit Operationalization Parameters – 50 Mt Scenario**

| Parameters | Value | Unit |
|---|---|---|
| **Bench height** | 10.0 | meters |
| **Minimum Berm Width** | 5.0 | meters |
| **Wall Slope Angle** | 50.4 | ° |
| **Overall Slope Angle** | 37.0 | ° |

| Parameters | Value | Unit |
|---|---|---|
| Access road width | 28.0 | meters |
| Access road angle | 8.0 | % |
| **Annual Production Rate** | 50.0 | Mt |

Figure 15.5-1, Figure 15.5-2, Table 15.5-3 and Table 15.5-4 show the result for the final operational pit that resulted from the mine design activities.

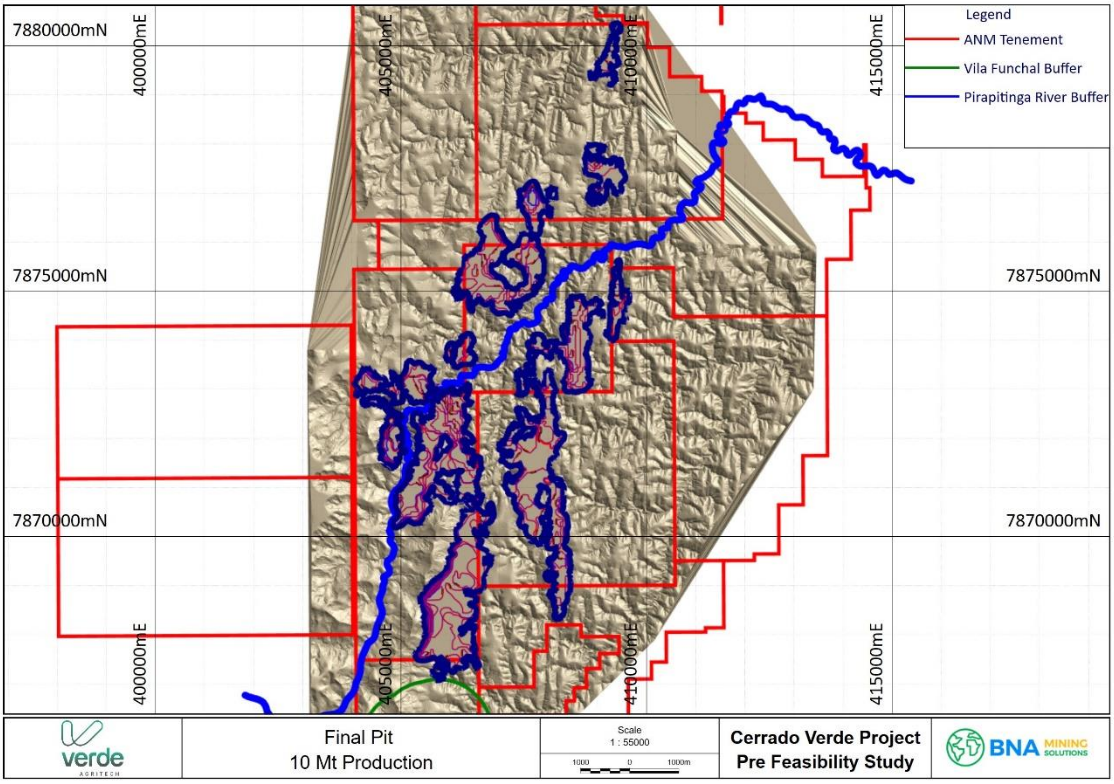


**Figure 15.5-1 Results - Final Operational Pit - 10 Mt and 23 Mt Scenarios**

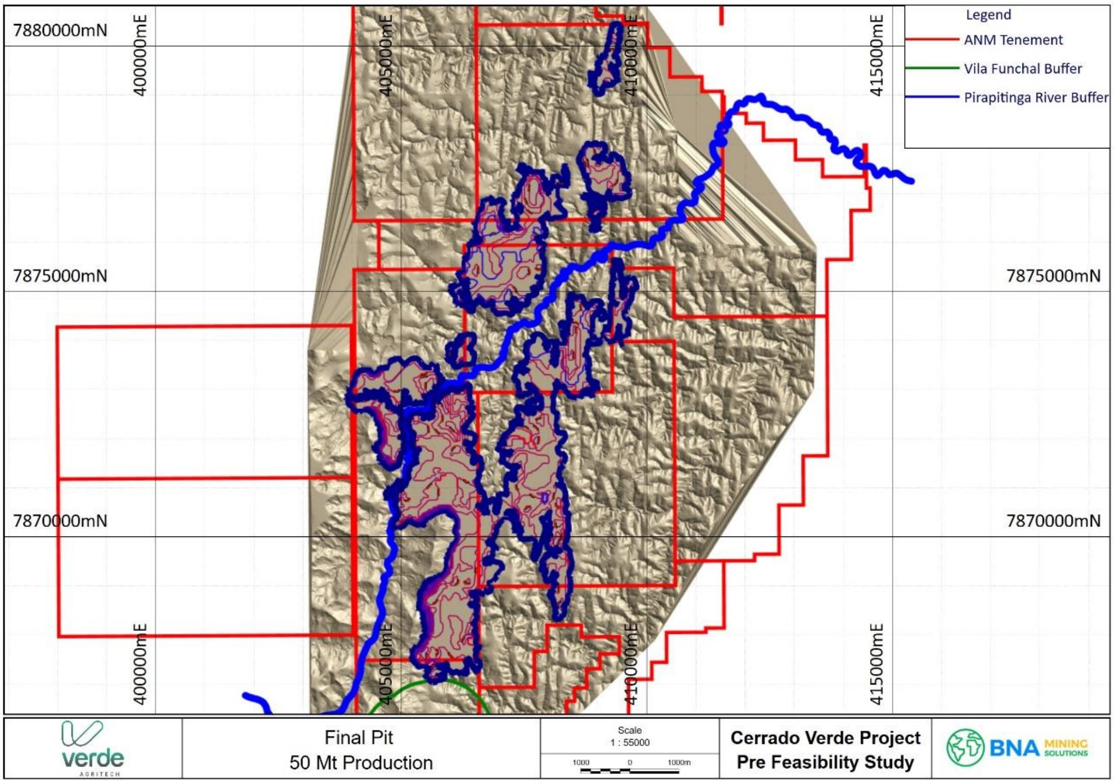


Figure 15.5-2 Results - Final Operational Pit - 50 Mt Scenario

**Table 15.5-3 Results - Final Operational Pit - 10 Mt and 23 Mt Scenarios**

| Tonnes (Mt) | | Percentage | | | | | | | | | | | | Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ore Total | Waste Rock Total | Grade $K_2O$ | Grade $P_2O_5$ | Grade CaO | Grade $Al_2O_3$ | Grade $Fe_2O_3$ | Grade $SiO_2$ | Grade MgO | Grade $TiO_2$ | Grade MnO | Grade $Na_2O$ | Grade LOI | Stripping Ratio | LOM |
| 715.67 | 362.39 | 10.01 | 0.14 | 0.36 | 15.68 | 6.93 | 59.28 | 2.91 | 0.82 | 0.13 | 0.11 | 3.32 | 0.51 | 71.6 |

**Table 15.5-4 Results - Final Operational Pit - 50 Mt Scenario**

| Tonnes (Mt) | | Percentage | | | | | | | | | | | | Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ore Total | Waste Rock Total | Grade $K_2O$ Diluted | Grade $P_2O_5$ In Situ | Grade CaO in Situ | Grade $Al_2O_3$ in Situ | Grade $Fe_2O_3$ in Situ | Grade $SiO_2$ In Situ | Grade MgO in Situ | Grade $TiO_2$ In Situ | Grade MnO in Situ | Grade $Na_2O$ in Situ | Grade LOI In Situ | Stripping Ratio | LOM |
| 1,297.66 | 471.56 | 9.19 | 0.14 | 0.46 | 15.66 | 6.88 | 59.68 | 2.91 | 0.81 | 0.13 | 0.15 | 3.46 | 0.36 | 26.0 |

Thus, for the 10 Mt and 23 Mt scenarios, the operationalized pit contains 715.7 Mt of ore and 362.4 Mt of waste rock, leading to a stripping ratio of 0.51, which results in the depletion of reserves in approximately 71.6 years. For the 50 Mt scenario, the operationalized pit contains 1,297.7 Mt of Ore and 471.6 Mt of waste rock, leading to a stripping ratio of 0.36, which results in the depletion of reserves in approximately 26.0 years.

Inferred Resources cannot be converted to reserves. Therefore, these have been listed as part of the total waste rock.

## 15.6. Conversion Factors

Mineral Reserve figures have been determined based on the mineral resource estimate by taking into account the modifying factors i.e., geological, mining, processing, legal, social, environmental and marketing considerations and are therefore classified in accordance with the CIM Definition Standards for Mineral Resources and Mineral Reserves.

For the definition of the mineable reserve, all measured and indicated ore located inside the final Project pit was considered. The measured ore was converted into a proven reserve and the indicated Ore converted into a probable reserve.

Measured and indicated resources lying outside the final pit design have not been converted into reserves.

Inferred resources have not been converted into reserves and have instead been treated as waste rock for mine planning purposes.

## 15.7. Relevant Factors

There are no known legal, political, social, environmental, or other risks that could materially affect the potential development of the mineral resources.

## 15.8. Mineral Reserve Statement

The Qualified Person for the Mineral Reserve estimate is Dr. Beck Nader, D.Sc., M.Sc., FAIG, Senior Advisor at BNA.

The results of the mineable reserve study for the project are shown in Table 15.8-1:

**Table 15.8-1 Mineable Reserve Results – 10 Mt and 23 Mt Scenarios**

| | Proven Reserves | Probable Reserves | Total Reserves |
|---|---|---|---|
| **Tonnes (Mt)** | **68.45** | **647.22** | **715.67** |
| **$K_2O$ Grade (%)** | **10.44** | **9.96** | **10.01** |

(1) As of May 12, 2022.
(2) A cutoff grade of 9.0% $K_2O$ was used to report reserves.
(3) Overall strip ratio of 0.51 to 1.
(4) Waste rock contains inferred resources, which have the potential to be upgraded to higher category resources, and possibly reserves, after sufficient definition work has been completed.
(5) Based on 100% mining recovery and no dilution.

**Table 15.8-2 Mineable Reserve Results – 50 Mt Scenario**

| | Proven Reserves | Probable Reserves | Total Reserves |
|---|---|---|---|
| Tonnes (Mt) | 80.63 | 1,217.037 | 1,297.66 |
| $K_2O$ Grade (%) | 9.96 | 9.14 | 9.19 |

(1) As of May 12, 2022.
(2) A cutoff grade of 7.5% $K_2O$ was used to report reserves.
(3) Overall strip ratio of 0.36 to 1.
(4) Waste rock contains inferred resources, which have the potential to be upgraded to higher category resources, and possibly reserves, after sufficient definition work has been completed.
(5) Based on 98% mining recovery and a 2% dilution factor.

# 16. Mining Methods

The Cerrado Verde deposit is in close proximity to the surface. Therefore, the mining method to be adopted for the Project is a traditional open pit shovel/truck operation.

## 16.1. Mine Preparation

Before production start-up, there will be a mine preparation or development stage. During this stage the mine will be prepared to ensure a continuity of Ore production that is both necessary and sufficient to feed the crusher. This step should precede the effective initiation of the crushing operation.

Mine preparation will begin with land clearance, if necessary, over the entire area for the planned development phase. The organic soil will then be removed and stored in a previously prepared place for future use in the recovery of degraded areas. Track tractors, hydraulic excavators, wheel loaders and trucks equipped with dump buckets may be used in this removal operation.

Initially, the track tractor will scrape the layer of organic soil, forming hills at locations accessible to trucks. Then, a loader or a bulldozer will load the material into the trucks, which will haul it to the storage locations where it will be unloaded.

Once the organic soil has been removed, the overburden will be stripped. This removal is planned in advance so that it results in a sufficient volume of exposed Ore to feed the crusher for a period of roughly 6 months.

The land clearance, organic soil removal and overburden stripping operations will be repeated throughout the mining operation as the pit is enlarged.

During the mine preparation phase, some Ore is usually produced and stored separately to be used later. This ore will be stocked in an area close to the crusher and will serve as a buffer stock to supply the crusher in the event of any interruption in the supply of Ore directly from the mine.

The next step is to prepare the mining fronts by opening the benches to form an initial stock of Ore sufficient for the first few months of operation, as well as to ensure the continuity of the production required to feed the crusher.

## 16.2. Sequential Mining Plan

The mine sequencing study was performed by using Micromine 2021 software. This study consisted of the establishment of annual production schedules, the definition of the Ore and waste rock block mining sequence and the evolution of the geometries throughout the life of the mine (LoM).

For the development of the production program for the Plant 3 Scenario, the areas to be mined annually were established, thus generating operational plans for years 1, 2, 3, 5, 10, 20, 22 and depletion. After the year 2022, the relocation of the processing plant is planned to reduce the haulage distances for the enterprise. Between year 22 and depletion, the blocks to be mined for years 41, 56 and exhaustion were mathematically defined.

For the development of the production program for the 23 Mt scenario, the areas to be mined annually were established, thus generating operational plans for years 1, 2, 3, 5, 10, 20 and depletion.

For the development of the production program for the 50 Mt scenario, the areas to be mined annually were established, thus generating operational plans for years 1, 2, 3, 5, 10, 15 and depletion.

This was done to maintain the $K_2O$ content within the target range for each scenario. In addition, a strategy of reclaiming the exhausted pits with the waste rock from other pits will be adopted. Therefore, the goal is to exhaust parts of the final pit as quickly as possible, to minimize the size of the waste rock pile outside the pit and minimize the environmental impact of the project. A ramp up was not considered in this study.

For the Plant 3 Scenario, in the first years it was necessary to mine more than one pit to adjust the average $K_2O$ grade to the desired target. In addition, the strategy used in the sequencing will see the mining start in the region to the north of the operational pit. When this region is exhausted, it will be available for the construction of the processing plant for this scenario, which will allow for the use of the existing infrastructure.

The 23 Mt scenario has 3 mineral processing plants: one located to the north, one central and the other south of the deposit. The respective production capacities are 3, 10 and 10 Mtpy. Thus, separate mining fronts were defined for each processing plant, due to the distance between them.

For the 50 Mt scenario, the strategy used in the sequencing will see the mining start in the region to the south of the operational pit, as it is expected that all production flow will be by rail, and the railway branch line will be located to the south of the deposit. The crushing plant will be located next to the initial pits and the crushed material will be transported by a belt conveyor to the railcar loading terminal and to the matrix grinding plant.

It is recommended that sequencing be started in regions where the mineral reserves are proved, to reduce uncertainty in the first years of operation. In this project, measured mineral resources are located entirely in the southern part of the deposit. Therefore, initiating and focusing the mining plans on these areas would change the entire strategy foreseen for the project, especially for the Plant 3 Scenario. Therefore, a decision was made to continue with the planned mining strategy. For the next planned study, the Feasibility Study (FS), it is recommended that additional drilling is made in the areas where mining is planned for the first years, to transform this resource into a measured resource and therefore in mineral proved reserves, after the consideration of all modifying factors.

The results of the operational sequencing can be found in Table 16.2-1 through Table 16.2-6 and in Figure 16.2-1 through Figure 16.2-23.

**Table 16.2-1 Operational Mine sequencing results – Plant 3 Scenario**

| Period | Tonnes (Mt) | | Percentage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ore Total | Waste Rock Total | $K_2O$ Grade | $P_2O_5$ Grade | CaO Grade | $Al_2O_3$ Grade | $Fe_2O_3$ Grade | $SiO_2$ Grade | MgO Grade | $TiO_2$ Grade | MnO Grade | $Na_2O$ Grade | LOI Grade | Stripping Ratio |
| Year 1 | 10.25 | 5.97 | 9.89 | 0.13 | 0.33 | 15.51 | 7.02 | 59.48 | 2.98 | 0.84 | 0.12 | 0.15 | 3.36 | 0.58 |
| Year 2 | 9.96 | 7.10 | 9.89 | 0.15 | 0.33 | 15.37 | 6.93 | 59.74 | 2.91 | 0.84 | 0.12 | 0.08 | 3.35 | 0.71 |
| Year 3 | 10.05 | 6.66 | 9.89 | 0.15 | 0.34 | 15.90 | 7.08 | 59.03 | 2.99 | 0.84 | 0.11 | 0.14 | 3.37 | 0.66 |
| Year 5 | 20.17 | 12.52 | 9.85 | 0.15 | 0.32 | 15.40 | 6.87 | 59.91 | 2.93 | 0.84 | 0.12 | 0.13 | 3.27 | 0.62 |
| Year 10 | 50.65 | 34.68 | 9.87 | 0.14 | 0.36 | 15.09 | 6.79 | 60.11 | 2.92 | 0.85 | 0.11 | 0.11 | 3.34 | 0.68 |
| Year 20 | 99.87 | 52.53 | 9.96 | 0.12 | 0.19 | 15.39 | 6.94 | 59.62 | 2.94 | 0.86 | 0.12 | 0.09 | 3.32 | 0.53 |
| Year 22 | 20.57 | 10.24 | 9.97 | 0.12 | 0.20 | 15.51 | 6.96 | 59.59 | 2.90 | 0.86 | 0.14 | 0.13 | 3.29 | 0.50 |
| Year 41 | 192.51 | 96.57 | 9.97 | 0.14 | 0.43 | 15.75 | 6.90 | 59.01 | 2.97 | 0.79 | 0.13 | 0.13 | 3.38 | 0.50 |
| Year 56 | 152.19 | 70.29 | 9.99 | 0.13 | 0.33 | 15.56 | 6.94 | 59.48 | 2.93 | 0.84 | 0.13 | 0.13 | 3.29 | 0.46 |
| Year 71 | 149.46 | 65.81 | 10.21 | 0.14 | 0.44 | 16.19 | 6.97 | 58.79 | 2.77 | 0.78 | 0.15 | 0.08 | 3.29 | 0.44 |

**Table 16.2-2 Operational Mine sequencing results per classification – Plant 3 Scenario**

| Period | Tonnes (Mt) | | | Percentage | | |
|---|---|---|---|---|---|---|
| | Measured Resource | Indicated Resource | Ore Total | $K_2O$ Grade Measured | $K_2O$ Grade Indicated | $K_2O$ Grade Total |
| Year 1 | - | 10.25 | 10.25 | - | 9.89 | 9.89 |
| Year 2 | - | 9.96 | 9.96 | - | 9.89 | 9.89 |
| Year 3 | - | 10.05 | 10.05 | - | 9.89 | 9.89 |
| Year 5 | - | 20.17 | 20.17 | - | 9.85 | 9.85 |
| Year 10 | - | 50.65 | 50.65 | - | 9.87 | 9.87 |
| Year 20 | - | 99.87 | 99.87 | - | 9.96 | 9.96 |
| Year 22 | - | 20.57 | 20.57 | - | 9.97 | 9.97 |
| Year 41 | - | 192.51 | 192.51 | - | 9.97 | 9.97 |
| Year 56 | 39.96 | 112.23 | 152.19 | 10.43 | 9.83 | 9.99 |
| Year 71 | 28.49 | 120.97 | 149.46 | 10.45 | 10.16 | 10.21 |

**Table 16.2-3 Operational Mine sequencing results – 23 Mt Scenario**

| Period | Mineral Processing Facility | Tonnes (Mt) | | Percentage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ore Total | Waste Rock Total | $K_2O$ Grade | $P_2O_5$ Grade | CaO Grade | $Al_2O_3$ Grade | $Fe_2O_3$ Grade | $SiO_2$ Grade | MgO Grade | $TiO_2$ Grade | MnO Grade | $Na_2O$ Grade | LOI Grade | Stripping Ratio |
| Year 1 | North | 2.96 | 1.99 | 9.82 | 0.11 | 0.34 | 15.27 | 6.91 | 59.85 | 2.96 | 0.85 | 0.13 | 0.18 | 3.27 | 0.67 |
| | Central | 10.09 | 6.17 | 10.02 | 0.09 | 0.14 | 15.66 | 6.88 | 59.60 | 2.95 | 0.83 | 0.15 | 0.13 | 3.27 | 0.61 |
| | South | 9.93 | 1.88 | 9.88 | 0.13 | 0.36 | 16.01 | 6.73 | 59.87 | 2.62 | 0.75 | 0.17 | 0.11 | 3.11 | 0.19 |
| | **Total** | **22.98** | **10.05** | **9.93** | **0.11** | **0.26** | **15.76** | **6.82** | **59.75** | **2.81** | **0.80** | **0.16** | **0.13** | **3.20** | **0.44** |
| Year 2 | North | 3.10 | 1.89 | 9.80 | 0.13 | 0.45 | 15.57 | 7.07 | 59.19 | 3.00 | 0.85 | 0.11 | 0.18 | 3.52 | 0.61 |
| | Central | 10.09 | 6.16 | 9.86 | 0.11 | 0.25 | 15.51 | 6.89 | 59.63 | 2.99 | 0.84 | 0.12 | 0.13 | 3.25 | 0.61 |
| | South | 9.96 | 2.68 | 10.22 | 0.12 | 0.40 | 16.54 | 7.06 | 58.15 | 2.75 | 0.75 | 0.17 | 0.07 | 3.37 | 0.27 |
| | **Total** | **23.15** | **10.73** | **10.01** | **0.12** | **0.34** | **15.96** | **6.99** | **58.93** | **2.89** | **0.80** | **0.14** | **0.11** | **3.34** | **0.46** |
| Year 3 | North | 3.04 | 1.80 | 10.06 | 0.14 | 0.23 | 15.83 | 7.14 | 59.01 | 2.98 | 0.83 | 0.11 | 0.11 | 3.37 | 0.59 |
| | Central | 10.05 | 7.01 | 9.88 | 0.12 | 0.29 | 15.47 | 6.70 | 60.38 | 2.80 | 0.77 | 0.13 | 0.12 | 3.12 | 0.70 |
| | South | 10.07 | 3.26 | 10.04 | 0.12 | 0.42 | 16.65 | 7.15 | 58.05 | 2.81 | 0.76 | 0.16 | 0.07 | 3.46 | 0.32 |
| | **Total** | **23.16** | **12.06** | **9.97** | **0.12** | **0.34** | **16.03** | **6.95** | **59.19** | **2.83** | **0.77** | **0.14** | **0.10** | **3.30** | **0.52** |
| Year 5 | North | 6.02 | 2.91 | 9.89 | 0.15 | 0.32 | 15.44 | 7.00 | 59.58 | 2.97 | 0.84 | 0.13 | 0.09 | 3.36 | 0.48 |
| | Central | 19.94 | 13.21 | 10.04 | 0.13 | 0.43 | 15.98 | 6.90 | 59.21 | 2.81 | 0.76 | 0.13 | 0.10 | 3.29 | 0.66 |
| | South | 20.10 | 12.73 | 10.17 | 0.12 | 0.47 | 16.42 | 6.92 | 58.51 | 2.84 | 0.72 | 0.14 | 0.07 | 3.39 | 0.63 |
| | **Total** | **46.06** | **28.85** | **10.08** | **0.13** | **0.43** | **16.10** | **6.92** | **58.95** | **2.84** | **0.75** | **0.13** | **0.09** | **3.34** | **0.63** |
| Year 10 | North | 15.06 | 11.13 | 9.89 | 0.15 | 0.33 | 15.67 | 7.00 | 59.40 | 2.95 | 0.83 | 0.11 | 0.12 | 3.34 | 0.74 |
| | Central | 49.88 | 23.53 | 9.99 | 0.14 | 0.57 | 15.79 | 6.83 | 58.69 | 3.00 | 0.76 | 0.13 | 0.12 | 3.45 | 0.47 |
| | South | 50.26 | 32.40 | 10.08 | 0.15 | 0.51 | 15.71 | 6.81 | 59.23 | 2.79 | 0.79 | 0.14 | 0.15 | 3.30 | 0.64 |
| | **Total** | **115.21** | **67.06** | **10.02** | **0.15** | **0.51** | **15.74** | **6.84** | **59.02** | **2.90** | **0.78** | **0.13** | **0.13** | **3.37** | **0.58** |
| Year 20 | North | 30.17 | 14.88 | 9.86 | 0.16 | 0.38 | 15.38 | 6.87 | 59.85 | 2.89 | 0.85 | 0.12 | 0.15 | 3.28 | 0.49 |
| | Central | 99.39 | 47.74 | 9.97 | 0.14 | 0.40 | 15.76 | 6.97 | 58.92 | 3.00 | 0.81 | 0.14 | 0.13 | 3.39 | 0.48 |
| | South | 99.87 | 37.30 | 10.21 | 0.15 | 0.40 | 16.01 | 7.00 | 58.95 | 2.81 | 0.82 | 0.15 | 0.09 | 3.28 | 0.37 |
| | **Total** | **229.42** | **99.92** | **10.06** | **0.15** | **0.40** | **15.82** | **6.97** | **59.05** | **2.90** | **0.82** | **0.14** | **0.12** | **3.33** | **0.44** |
| Year 31 | North | 33.46 | 29.74 | 9.82 | 0.15 | 0.43 | 14.67 | 6.57 | 60.89 | 2.91 | 0.84 | 0.10 | 0.11 | 3.21 | 0.89 |

| Period | Mineral Processing Facility | Tonnes (Mt) | | Percentage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ore Total | Waste Rock Total | $K_2O$ Grade | $P_2O_5$ Grade | CaO Grade | $Al_2O_3$ Grade | $Fe_2O_3$ Grade | $SiO_2$ Grade | MgO Grade | $TiO_2$ Grade | MnO Grade | $Na_2O$ Grade | LOI Grade | Stripping Ratio |
| | Central | 111.50 | 51.77 | 9.99 | 0.12 | 0.17 | 15.53 | 7.03 | 59.30 | 2.96 | 0.87 | 0.12 | 0.09 | 3.38 | 0.46 |
| | South | 110.74 | 52.21 | 9.97 | 0.14 | 0.28 | 15.49 | 6.94 | 59.67 | 2.95 | 0.84 | 0.13 | 0.12 | 3.25 | 0.47 |
| | **Total** | **255.70** | **133.73** | **9.96** | **0.13** | **0.25** | **15.40** | **6.93** | **59.67** | **2.95** | **0.85** | **0.12** | **0.11** | **3.30** | **0.52** |

**Table 16.2-4 Operational Mine sequencing results per classification – 23 Mt Scenario**

| Period | Tonnes (Mt) | | | Percentage | | |
|---|---|---|---|---|---|---|
| | Measured Resource | Indicated Resource | Ore Total | $K_2O$ Grade Measured | $K_2O$ Grade Indicated | $K_2O$ Grade Total |
| **Year 1** | 0.02 | 22.96 | **22.98** | 10.62 | 9.93 | **9.93** |
| **Year 2** | 2.94 | 20.21 | **23.15** | 10.42 | 9.95 | **10.01** |
| **Year 3** | 4.65 | 18.51 | **23.16** | 10.23 | 9.91 | **9.97** |
| **Year 5** | 0.86 | 45.20 | **46.06** | 9.38 | 10.09 | **10.08** |
| **Year 10** | 10.33 | 104.88 | **115.21** | 10.63 | 9.96 | **10.02** |
| **Year 20** | 23.11 | 206.31 | **229.42** | 10.33 | 10.03 | **10.06** |
| **Year 31** | 26.54 | 229.16 | **255.70** | 10.53 | 9.89 | **9.96** |

**Table 16.2-5 Operational Mine sequencing results – 50 Mt Scenario**

| Period | Tonnes (Mt) | | Percentage | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ore Total | Waste Rock Total | $K_2O$ Grade Diluted | $P_2O_5$ Grade in Situ | CaO Grade in Situ | $Al_2O_3$ Grade in Situ | $Fe_2O_3$ Grade in Situ | $SiO_2$ Grade in Situ | MgO Grade in Situ | $TiO_2$ Grade in Situ | MnO Grade in Situ | $Na_2O$ Grade in Situ | LOI Grade in Situ | Stripping Ratio |
| Year 1 | 50.07 | 9.99 | 9.18 | 0.14 | 0.41 | 16.04 | 6.85 | 60.06 | 2.62 | 0.77 | 0.15 | 0.10 | 3.29 | 0.20 |
| Year 2 | 49.79 | 14.01 | 9.08 | 0.15 | 0.43 | 15.66 | 6.72 | 60.66 | 2.66 | 0.78 | 0.14 | 0.17 | 3.22 | 0.28 |
| Year 3 | 50.86 | 14.96 | 9.12 | 0.16 | 0.69 | 15.66 | 6.83 | 59.46 | 2.85 | 0.80 | 0.13 | 0.22 | 3.54 | 0.29 |
| Year 4 | 50.74 | 16.43 | 9.75 | 0.11 | 0.24 | 15.43 | 7.02 | 59.19 | 3.00 | 0.86 | 0.12 | 0.10 | 3.38 | 0.32 |
| Year 5 | 50.05 | 20.59 | 9.26 | 0.14 | 0.44 | 15.74 | 6.89 | 59.60 | 2.98 | 0.79 | 0.12 | 0.16 | 3.42 | 0.41 |
| Year 10 | 249.14 | 103.87 | 9.38 | 0.15 | 0.59 | 16.01 | 6.96 | 58.88 | 2.93 | 0.80 | 0.14 | 0.15 | 3.49 | 0.42 |
| Year 15 | 251.83 | 77.19 | 9.19 | 0.14 | 0.45 | 15.91 | 6.98 | 59.20 | 3.00 | 0.81 | 0.14 | 0.17 | 3.51 | 0.31 |
| Year 26 | 545.20 | 214.51 | 9.05 | 0.14 | 0.41 | 15.35 | 6.82 | 60.22 | 2.89 | 0.83 | 0.12 | 0.15 | 3.46 | 0.39 |

**Table 16.2-6 Operational Mine sequencing Results per classification – 50 Mt Scenario**

| Period | Tonnes (Mt) | | | Percentage (Diluted) | | |
|---|---|---|---|---|---|---|
| | Measured Resource | Indicated Resource | Total Ore | $K_2O$ Grade Measured | $K_2O$ Grade Indicated | $K_2O$ Grade Total |
| Year 1 | 7.13 | 42.93 | 50.07 | 9.94 | 9.06 | 9.18 |
| Year 2 | 0.20 | 49.59 | 49.79 | 10.18 | 9.07 | 9.08 |
| Year 3 | 0.52 | 50.34 | 50.86 | 9.25 | 9.12 | 9.12 |
| Year 4 | 35.30 | 15.43 | 50.74 | 9.87 | 9.49 | 9.75 |
| Year 5 | 11.60 | 38.45 | 50.05 | 10.23 | 8.98 | 9.26 |
| Year 10 | 25.89 | 223.25 | 249.14 | 9.98 | 9.31 | 9.38 |
| Year 15 | - | 251.83 | 251.83 | - | 9.19 | 9.19 |
| Year 26 | - | 545.20 | 545.20 | - | 9.05 | 9.05 |

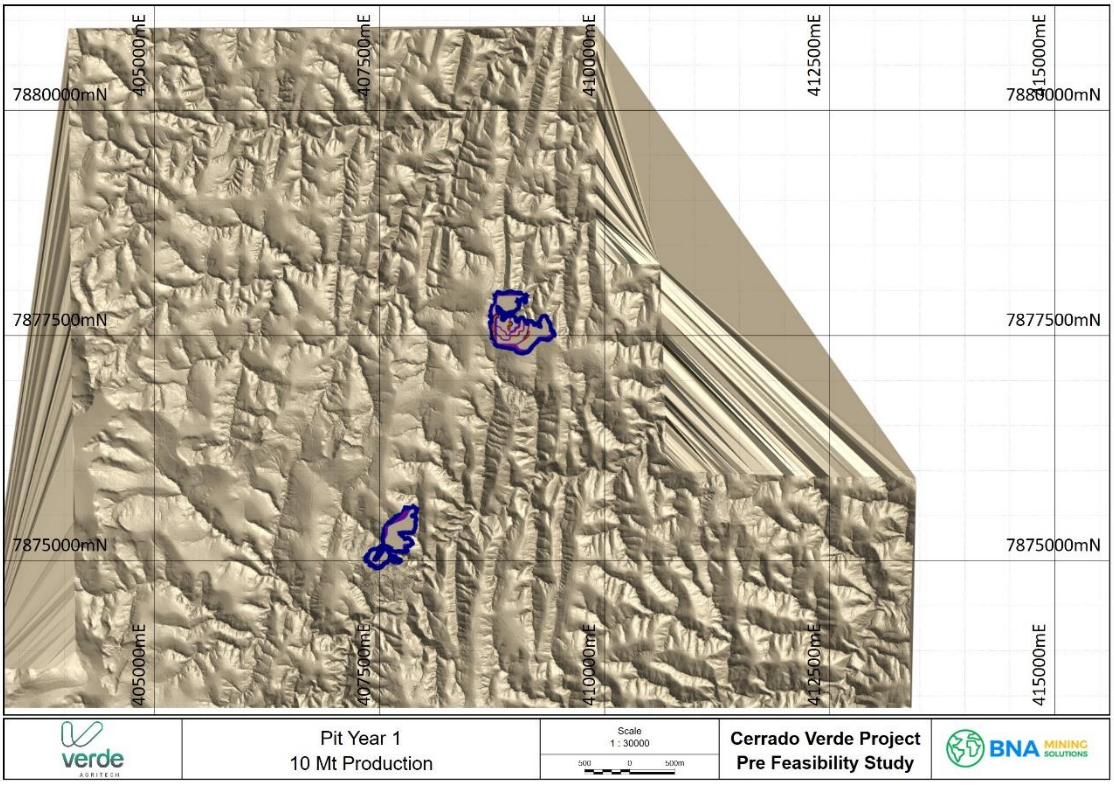


**Figure 16.2-1 Mine sequencing Year 1 – Plant 3 Scenario**

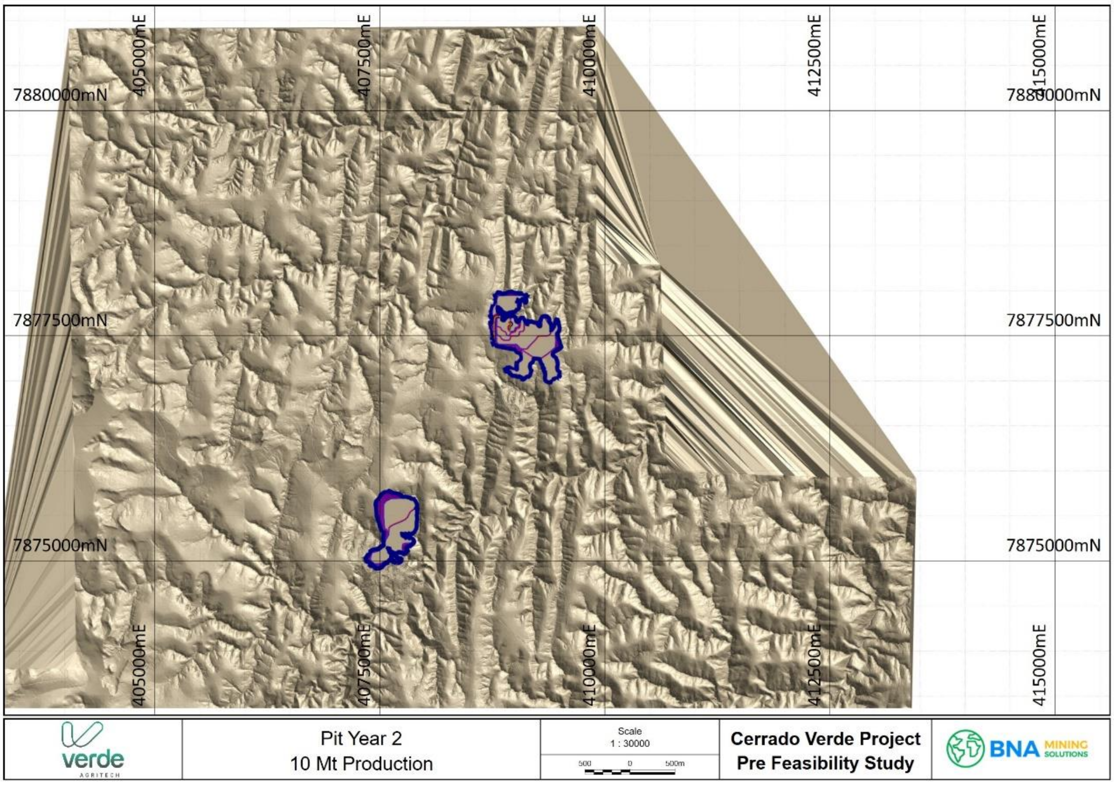


**Figure 16.2-2 Mine sequencing Year 2 – Plant 3 Scenario**

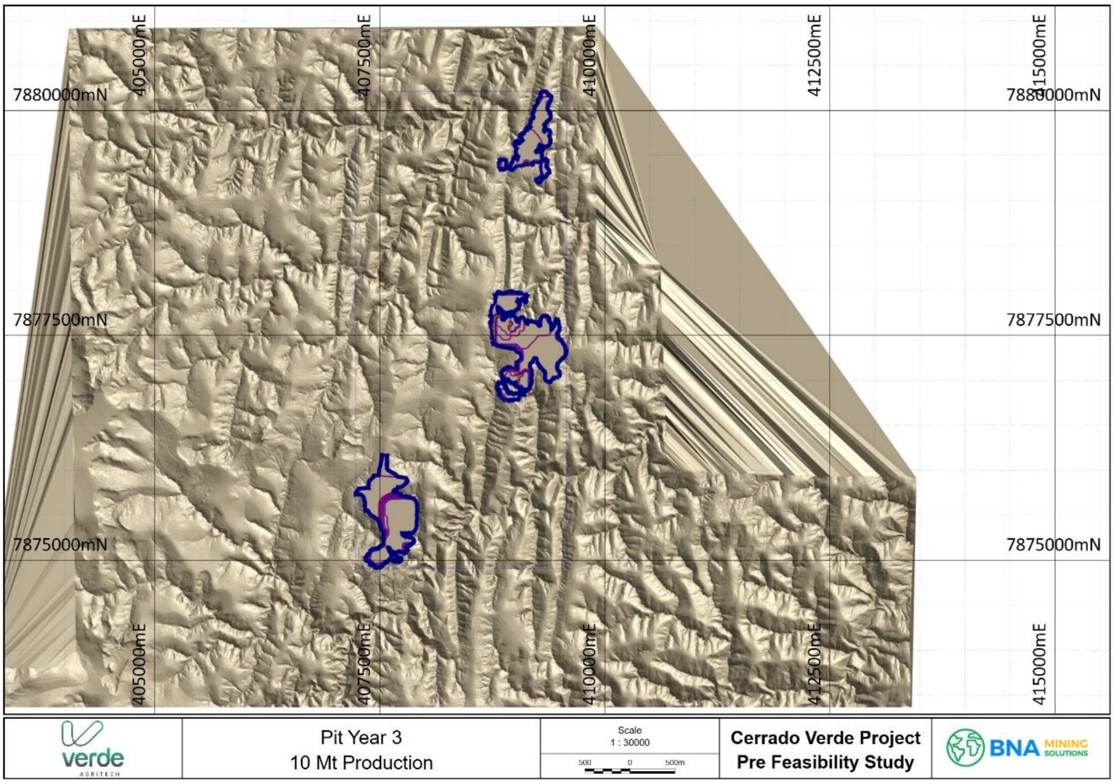


**Figure 16.2-3 Mine sequencing Year 3 – Plant 3 Scenario**

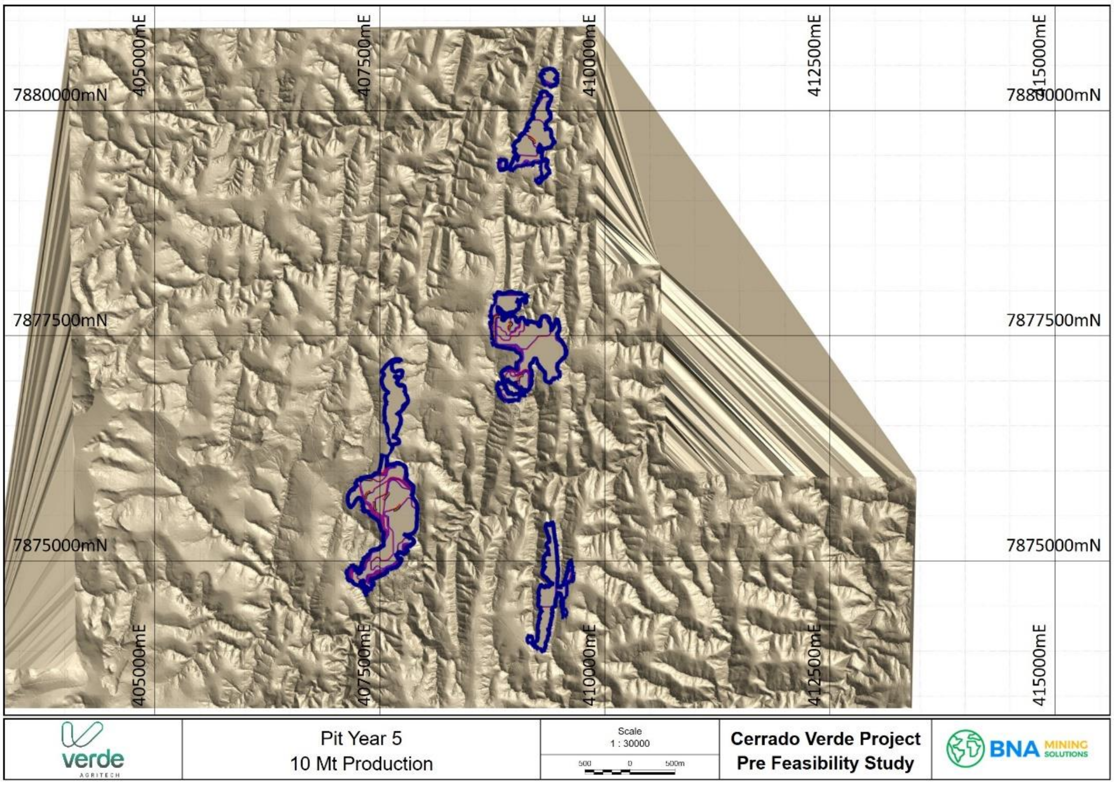


**Figure 16.2-4 Mine sequencing Year 5 – Plant 3 Scenario**

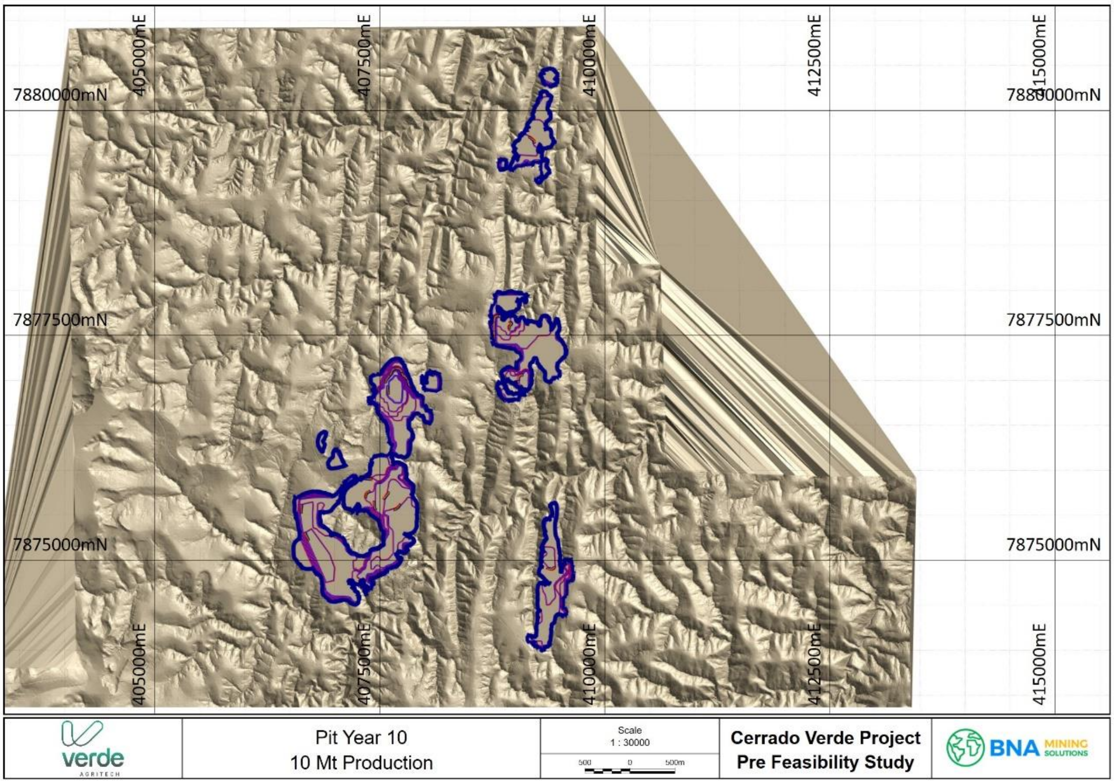


**Figure 16.2-5 Mine sequencing Year 10 – Plant 3 Scenario**

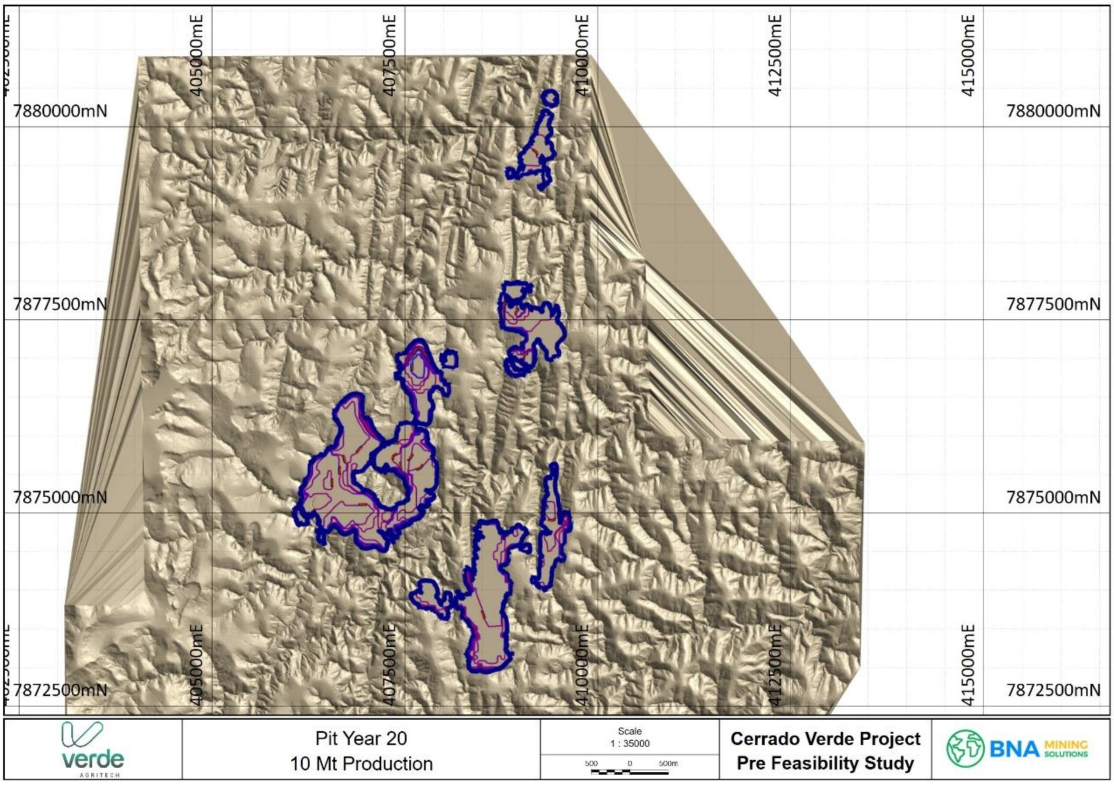


**Figure 16.2-6 Mine sequencing Year 20 – Plant 3Scenario**

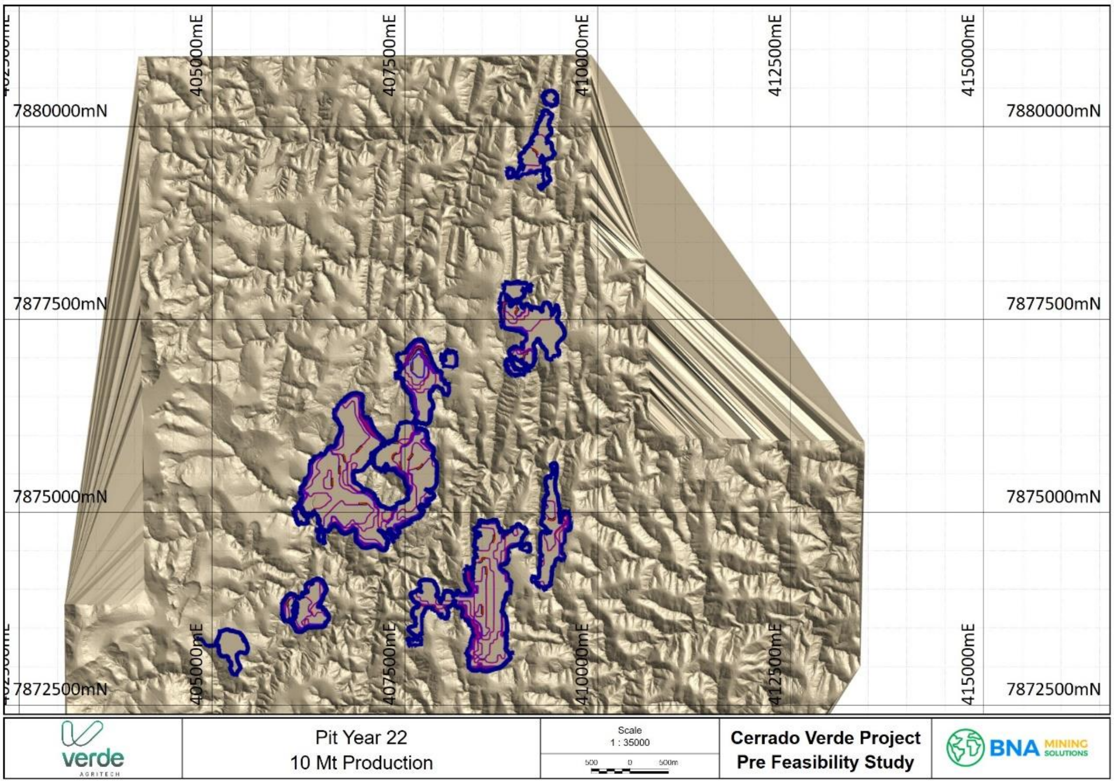


**Figure 16.2-7 Mine sequencing Year 22 – Plant 3 Scenario**

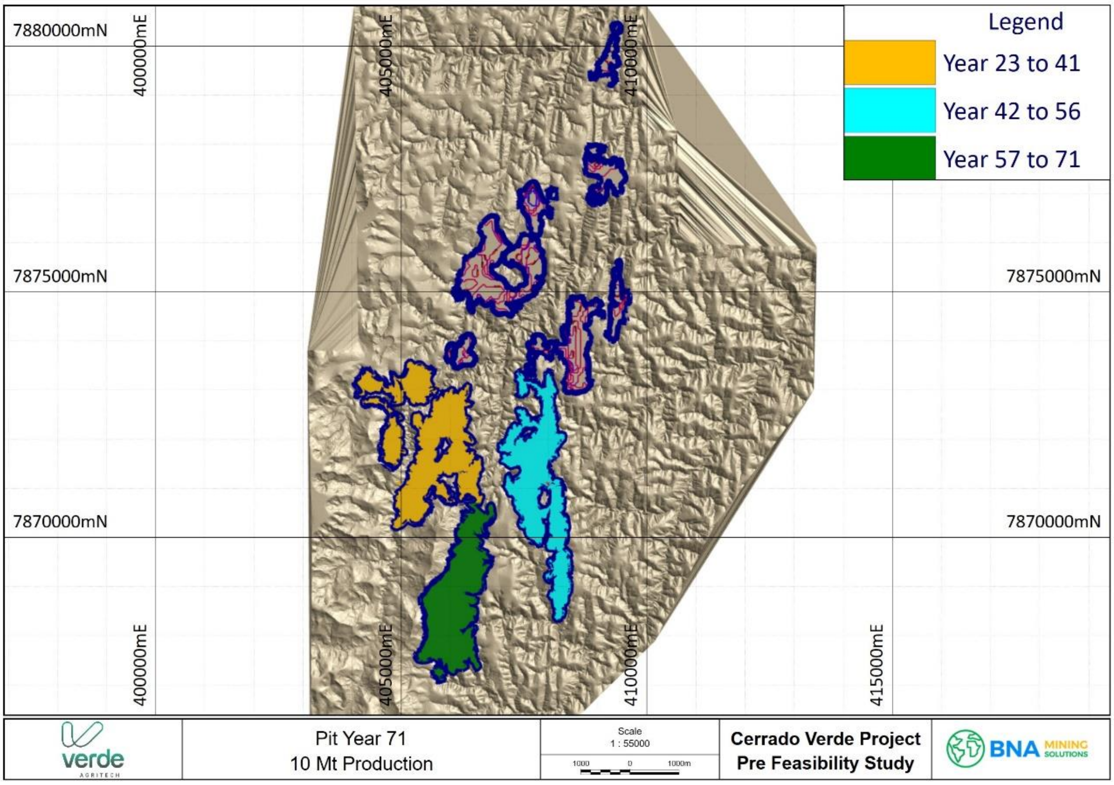


**Figure 16.2-8 Mine sequencing Year 71 – Plant 3 Scenario**

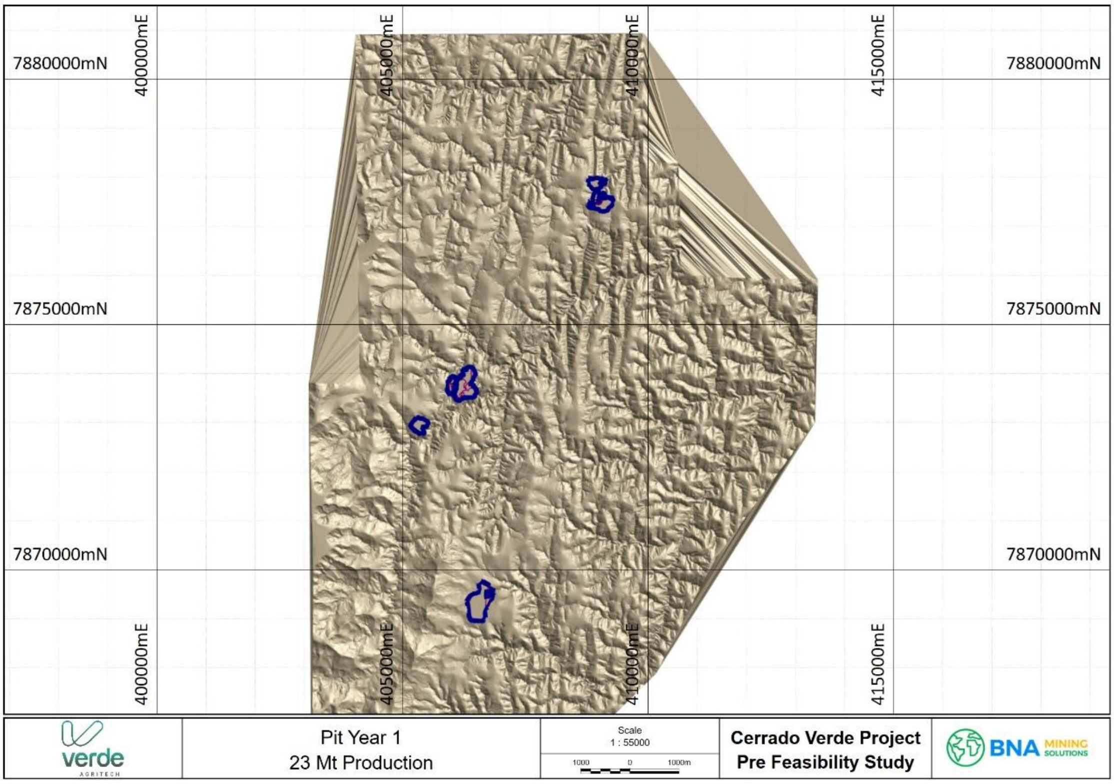


**Figure 16.2-9 Mine sequencing Year 1 – 23 Mt Scenario**

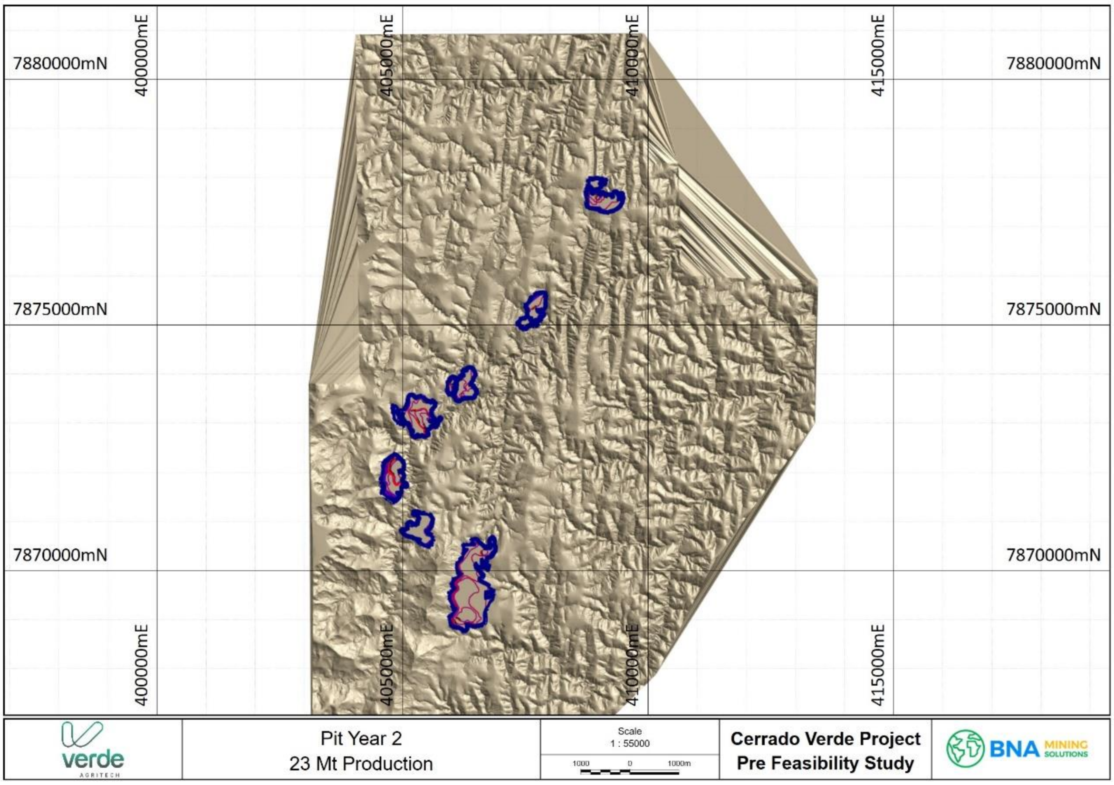


**Figure 16.2-10 Mine sequencing Year 2 – 23 Mt Scenario**

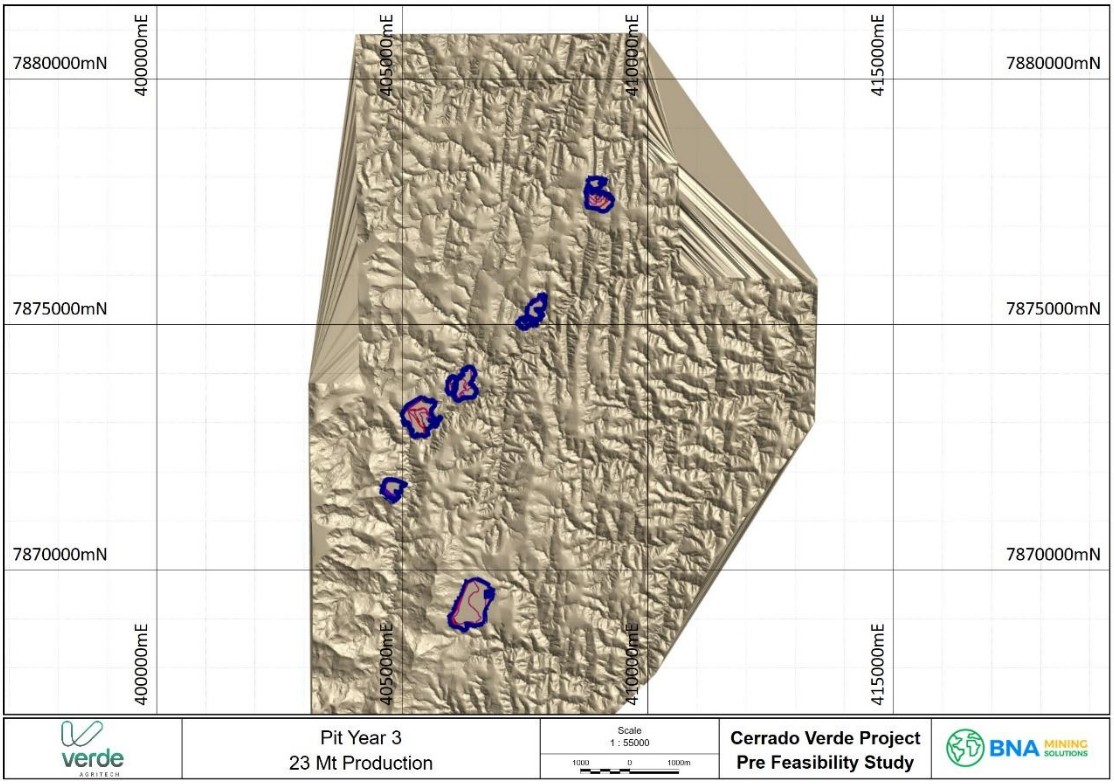


**Figure 16.2-11 Mine sequencing Year 3 – 23 Mt Scenario**

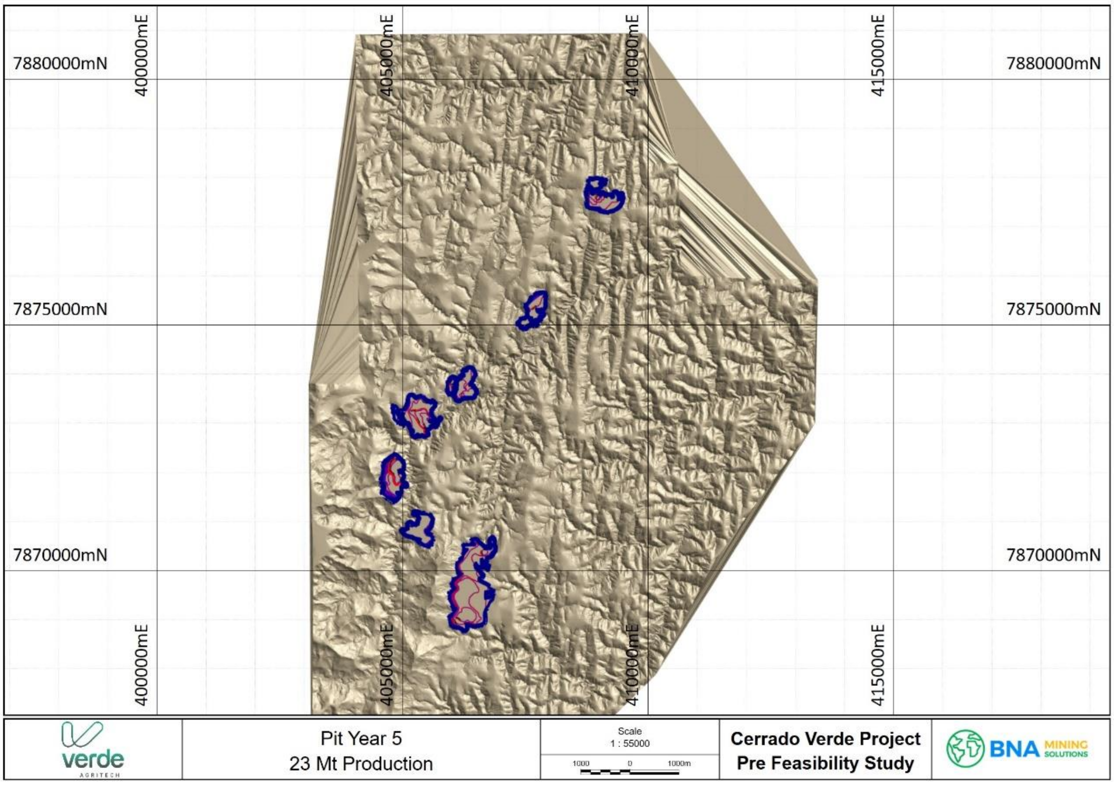


**Figure 16.2-12 Mine sequencing Year 5 – 23 Mt Scenario**

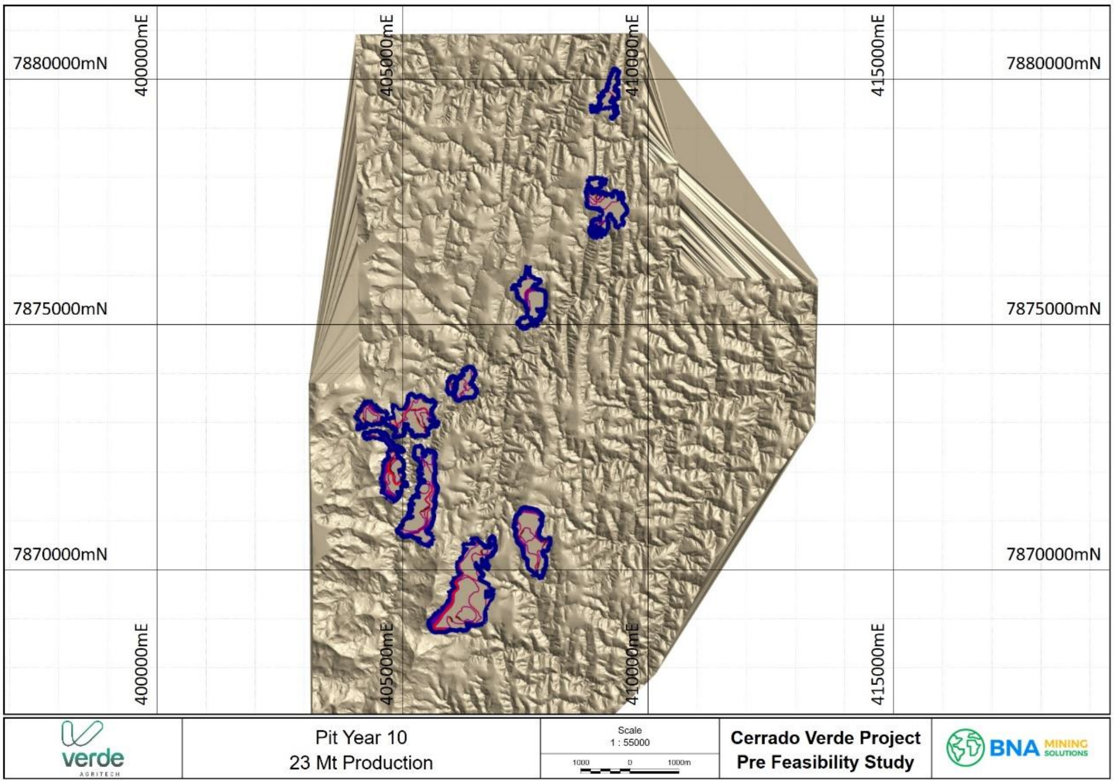


**Figure 16.2-13 Mine sequencing Year 10 – 23 Mt Scenario**

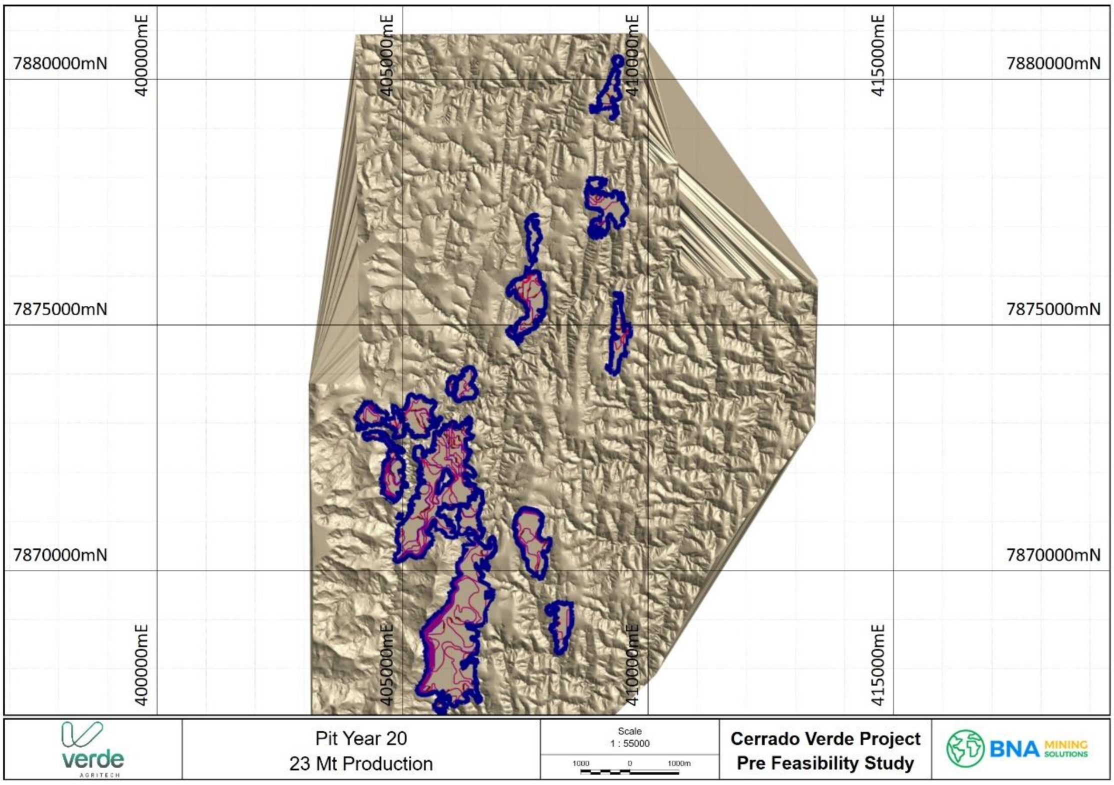


**Figure 16.2-14 Mine sequencing Year 20 – 23 Mt Scenario**

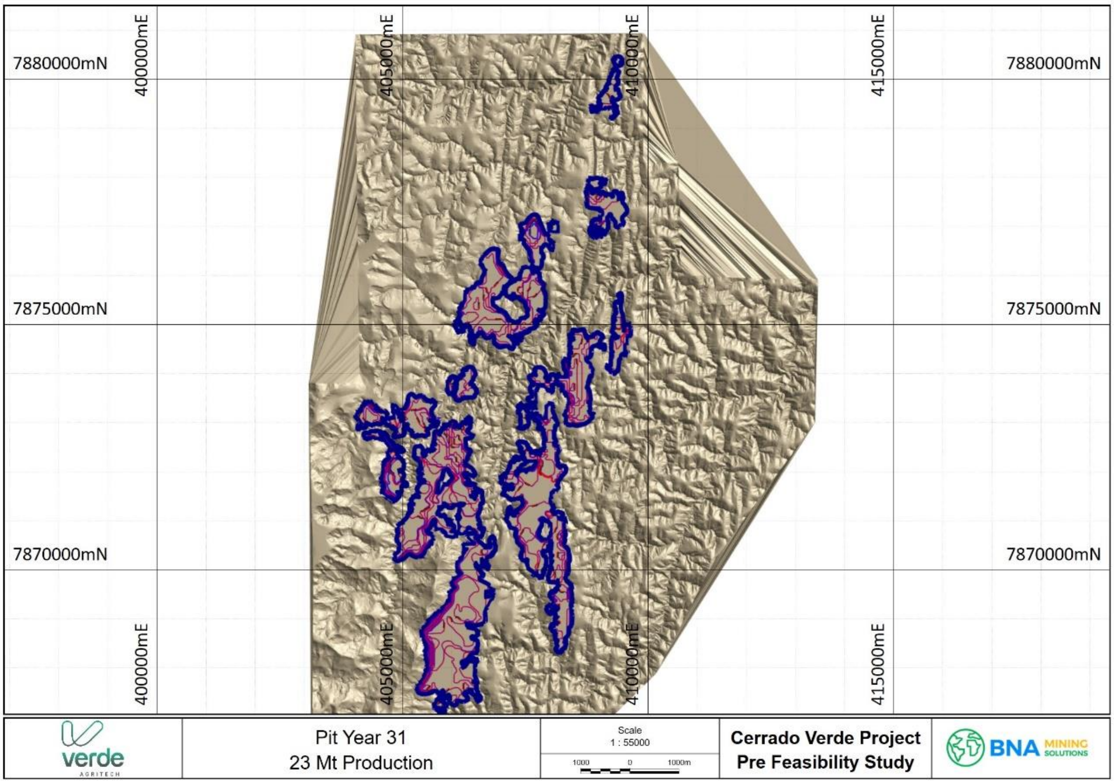


**Figure 16.2-15 Mine sequencing Year 31 – 23 Mt Scenario**

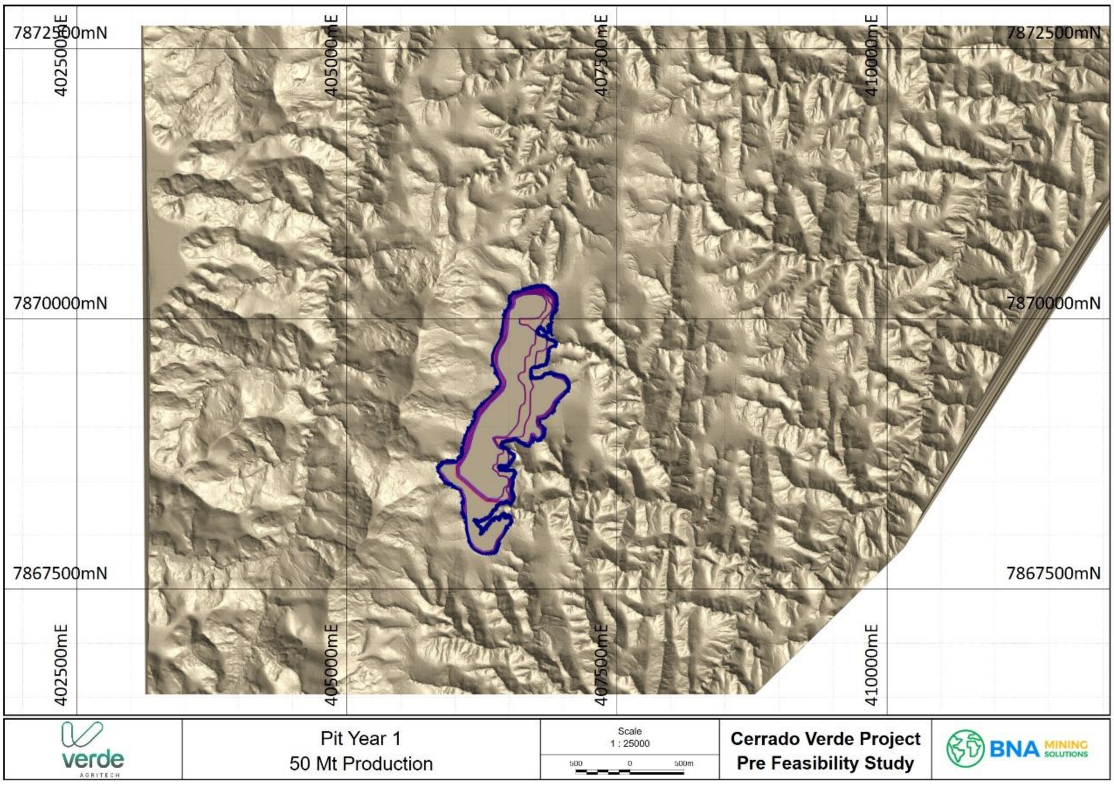


**Figure 16.2-16 Mine sequencing Year 1 – 50 Mt Scenario**

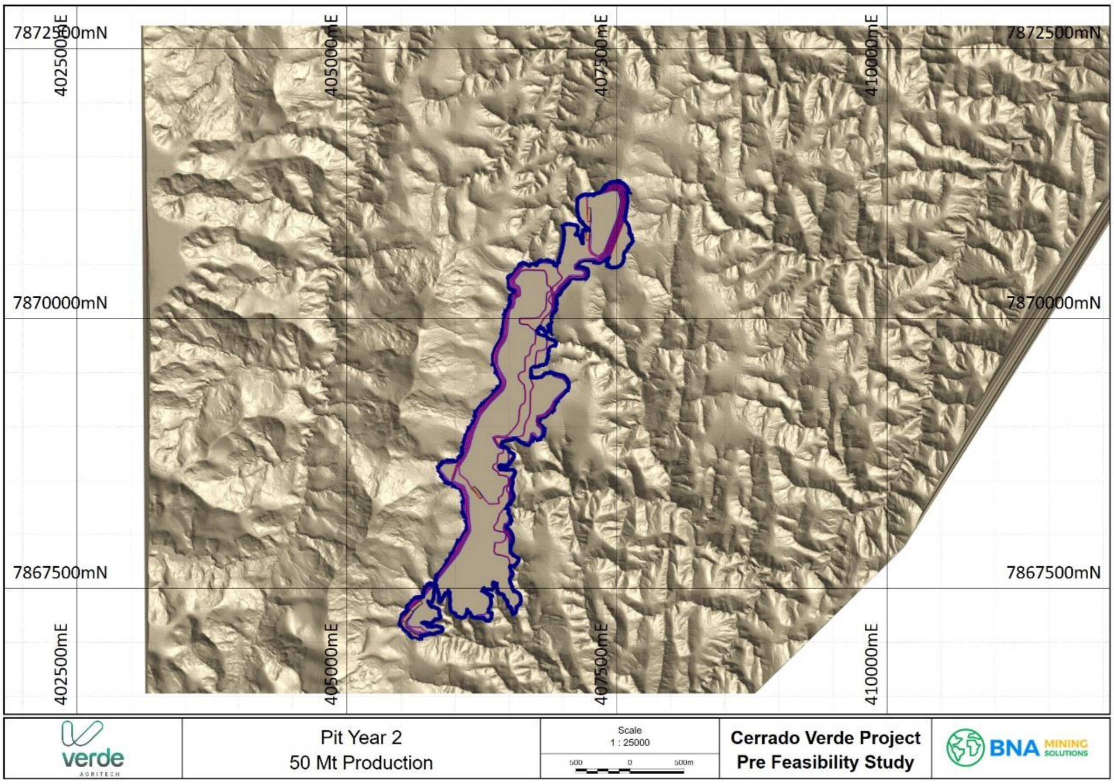


**Figure 16.2-17 Mine sequencing Year 2 – 50 Mt Scenario**

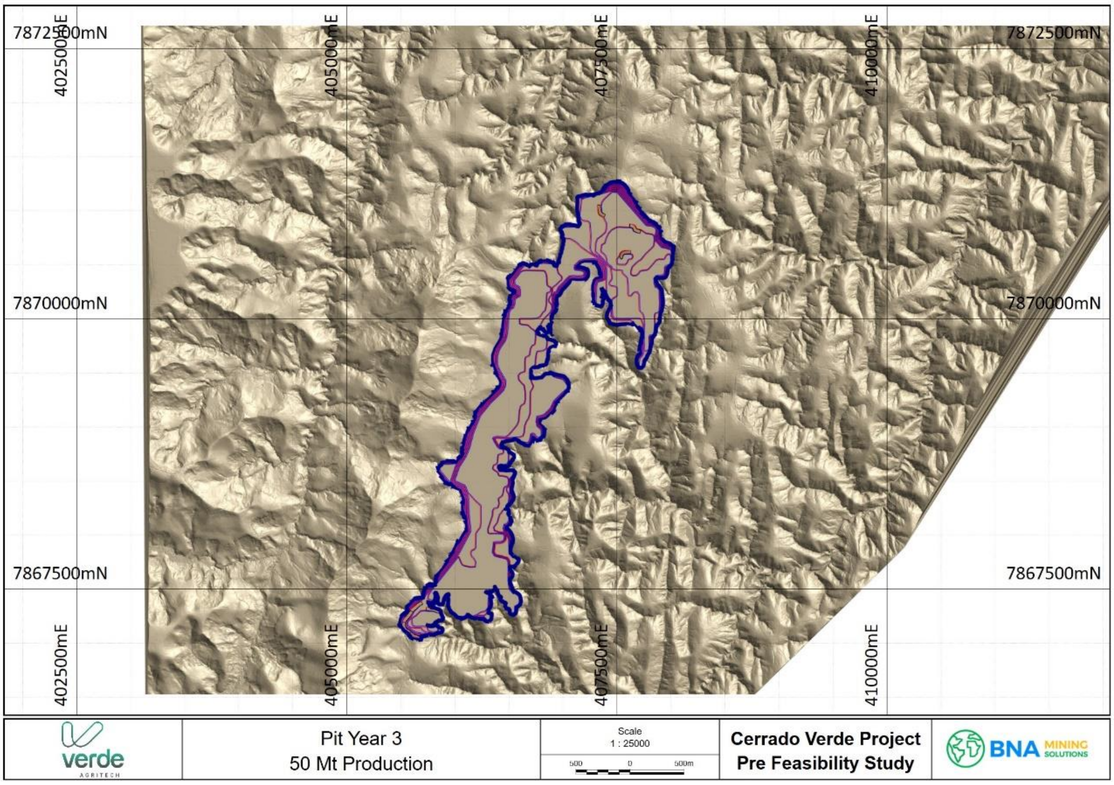


**Figure 16.2-18 Mine sequencing Year 3 – 50 Mt Scenario**

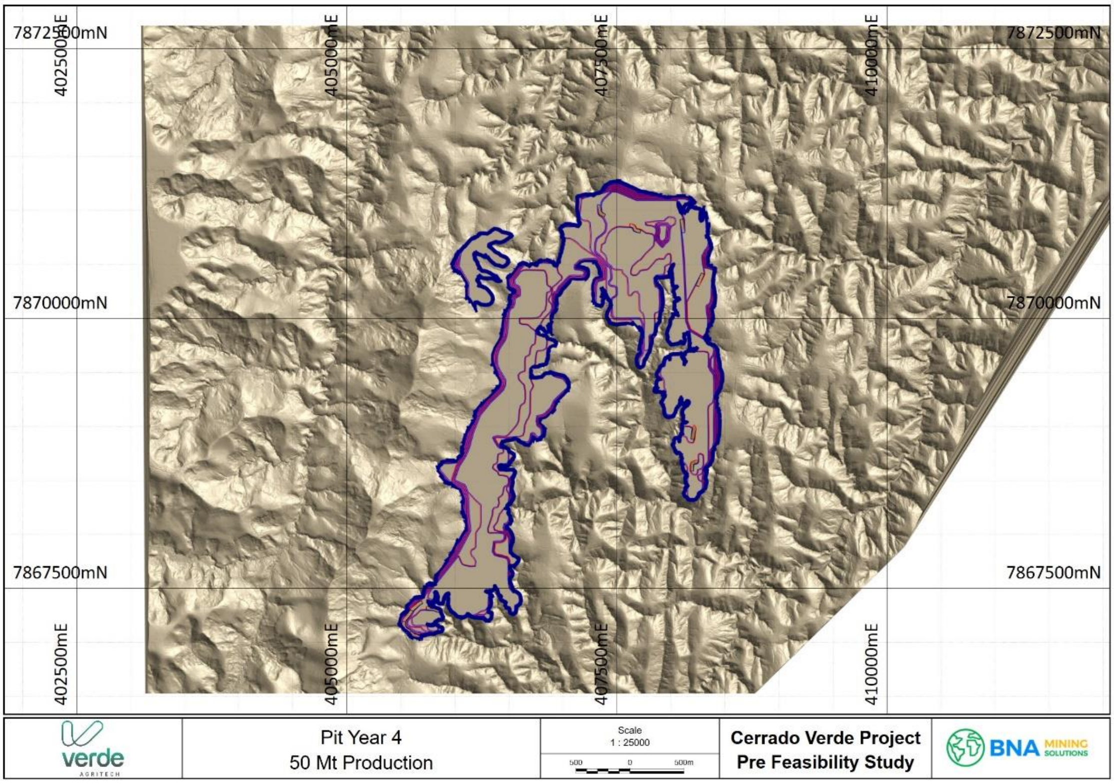


**Figure 16.2-19 Mine sequencing Year 4 – 50 Mt Scenario**

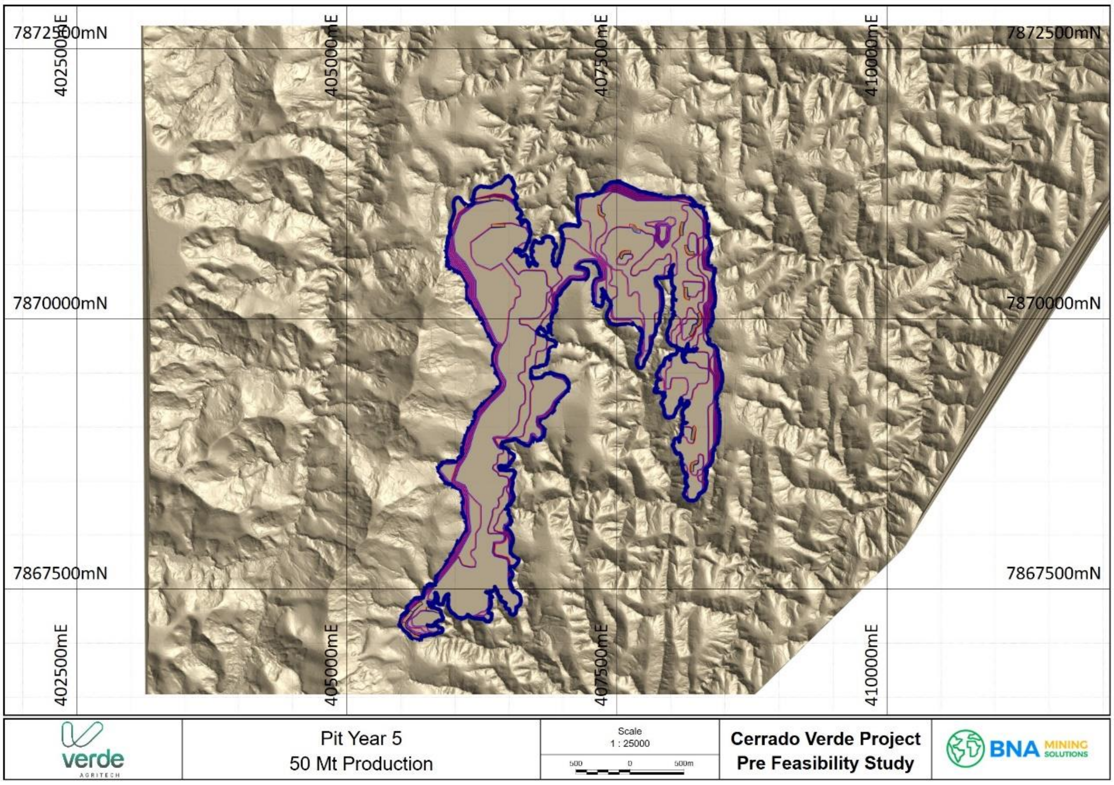


**Figure 16.2-20 Mine sequencing Year 5 – 50 Mt Scenario**

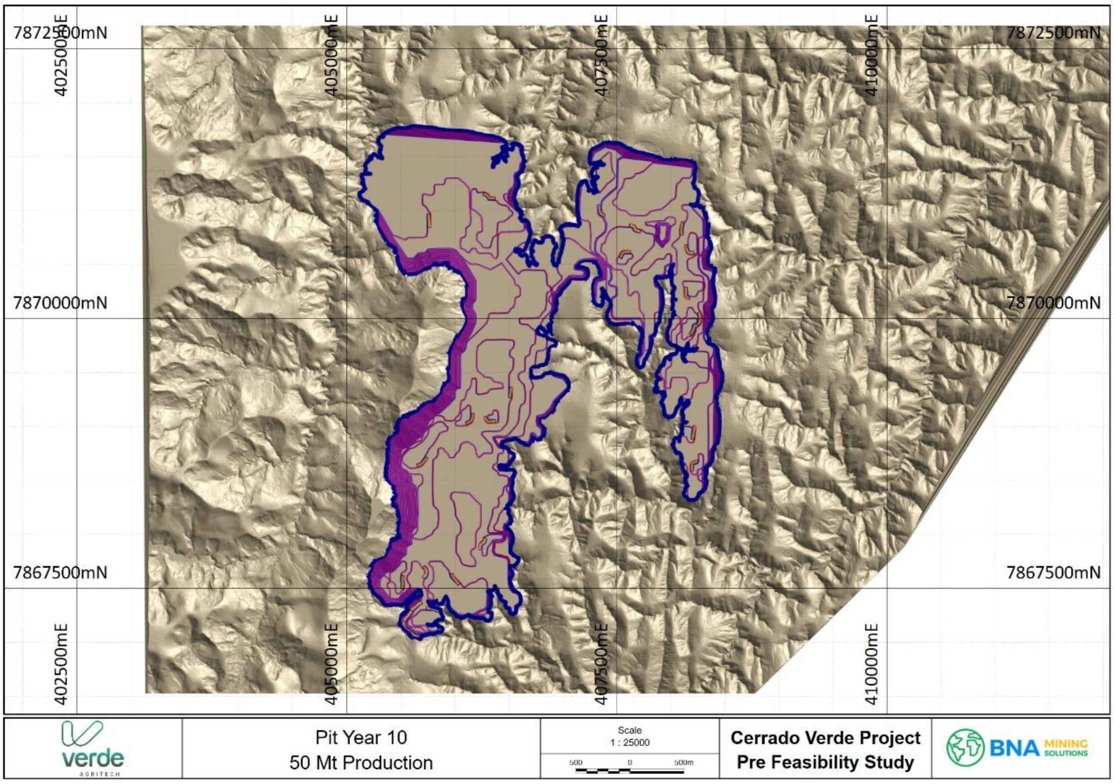


**Figure 16.2-21 Mine sequencing Year 10 – 50 Mt Scenario**

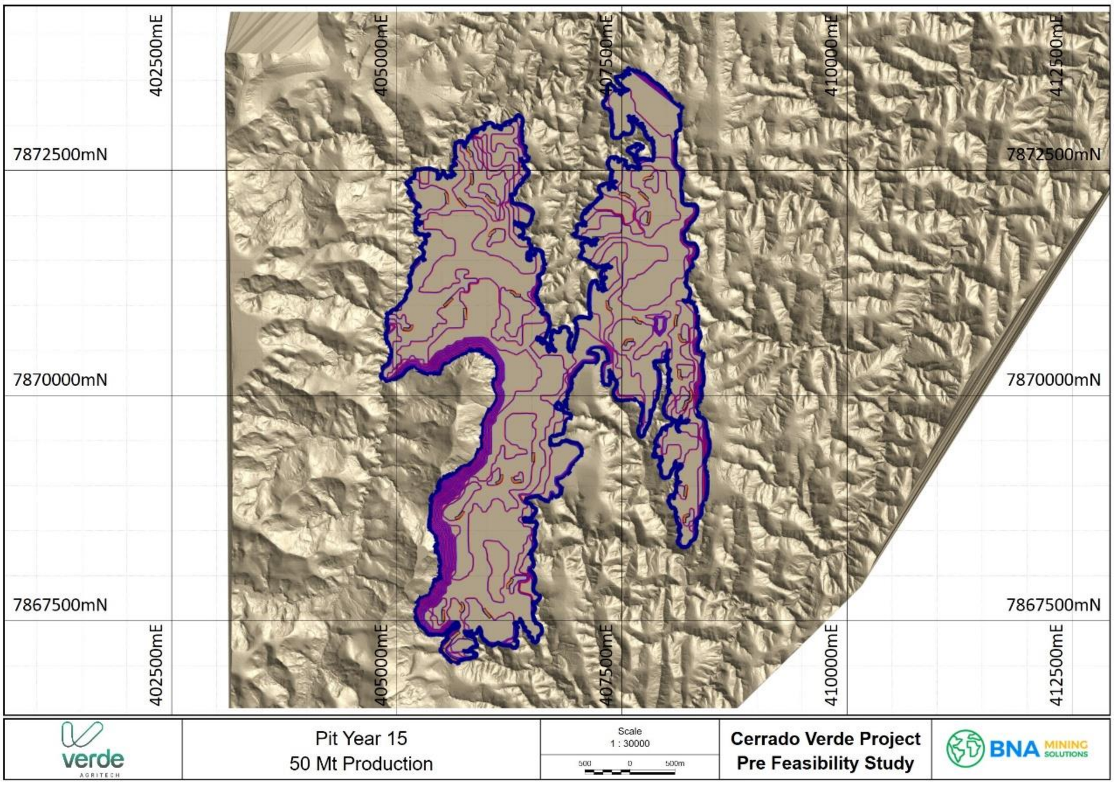


**Figure 16.2-22 Mine sequencing Year 15 – 50 Mt Scenario**

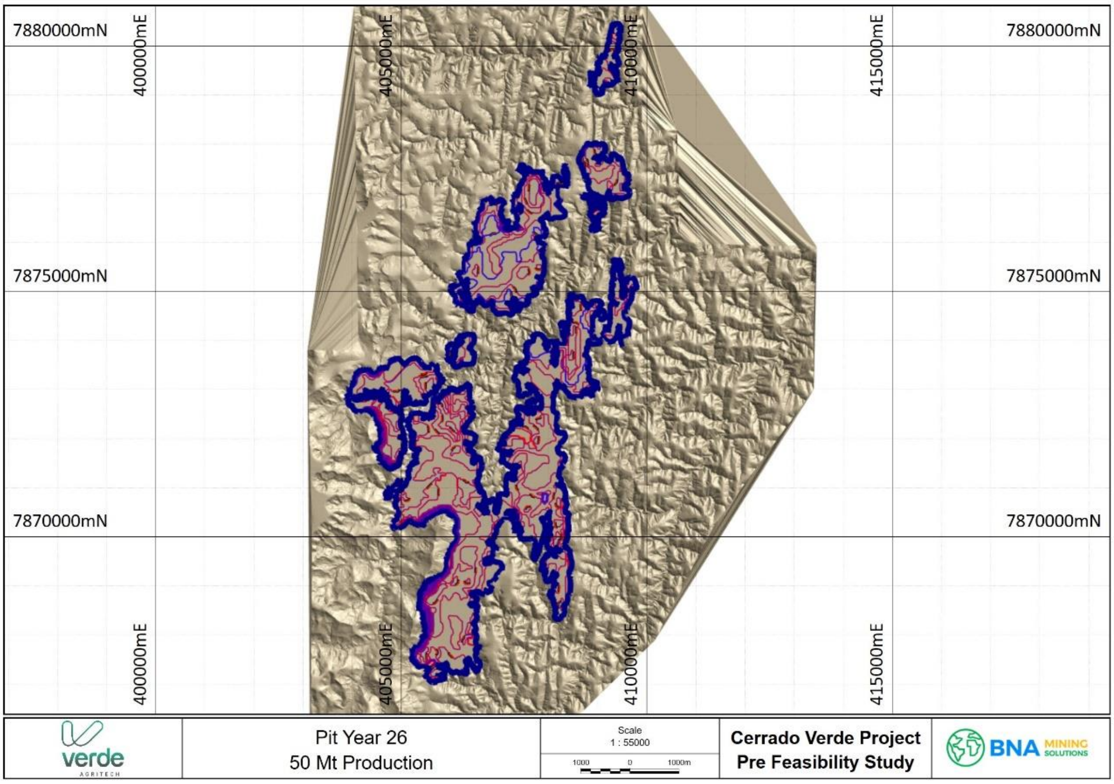


**Figure 16.2-23 Mine sequencing After Year 26 – 50 Mt Scenario**

## 16.3. Waste Rock Disposal

In an effort to minimize the environmental impact of the project, a strategy of recomposing the exhausted pits with the quarried waste rock will be adopted. Only a small pile of waste rock will be built. This pile is sufficient for the deposition of the removed waste rock until the first pit reaches the final pit configuration. For the Plant 3 Scenario, this will occur from year 2 onwards. For the 23 Mt scenario, separate waste rock piles will be created close to each mineral processing facility to minimize transport distances. Thus, in some regions, material will be deposited in the external piles in the pits until year 5. For the 50 Mt scenario, this will occur after the 5$^{th}$ month of operation.

### 16.3.1. Pile Geometry Definition

The study of the geometric parameters of the waste rock pile that supported this project is detailed in the report dated January 2013 and was carried out by *Solosconsult Engineering*.

According to the probable granulometric characteristics of the waste rock to be produced, the pile will have a geometry with the following characteristics:

- final external slope between berms (toe to slope crest): 1V: 2H (27°)
- overall pit slope: 21.3º
- maximum height between berms: 10.0 m
- minimum berm width: 6.0 m

The inclination was defined based on a retro analysis that took into consideration the estimated geotechnical parameters of the waste rock and the foundation. The results of this analysis were considered conservative.

A berm width of 6.0 m is considered the minimum for the installation of drainage ditches and protection lines, as well as for the passage of medium-sized vehicle traffic for repairs, monitoring, and maintenance.

For both scenarios, it was considered that material with a $K_2O$ grade above 7.5% (low-grade waste) will be stored separately, to enable its use in the future if this becomes technically and economically viable.

For the 50 Mt scenario, a small amount of low-grade waste rock will be mined until areas inside the pit are cleared to receive the waste. Therefore, a single pile outside the pit was planned. These piles have the following characteristics:

- Waste Rock Pile – Plant 3 Scenario
    - Maximum height: 54 m
    - Volume: 3.7 $Mm^3$
    - Affected area: 15.9 Ha
- Low-Grade Waste Pile – Plant 3 Scenario
    - Maximum height: 29 m
    - Volume: 0.9 $Mm^3$
    - Affected area: 8.6 Ha
- Waste Rock Piles – 23 Mt Scenario (all piles)
    - Maximum height: 26 m
    - Volume: 2.2 $Mm^3$
    - Affected area: 23.4 Ha
- Low-Grade Waste Piles – 23 Mt Scenario (all piles)
    - Maximum height: 52 m
    - Volume: 6.1 $Mm^3$
    - Affected area: 33.0 Ha
- Waste Rock Pile – 50 Mt Scenario
    - Maximum height: 37 m
    - Volume: 2.9 $Mm^3$
    - Affected area: 21.1 Ha

Table 16.3.1-2, able 16.3.1-3 and Figure 16.3.1-1 to Figure 16.3.1-25 illustrate the progress of the waste rock dumping through to the end of the life of the mine.

**Table 16.3.1-1 Waste Pile Volume – Plant 3 Scenario**

| Period | $Mm^3$ | |
|---|---|---|
| | Waste Rock | Low Grade Waste |
| Year 1 | 2.79 | 0.85 |
| Year 2 | 3.18 | 1.27 |
| Year 3 | 2.41 | 1.55 |
| Year 5 | 3.80 | 3.50 |
| Year 10 | 15.87 | 5.50 |
| Year 20 | 27.41 | 5.55 |
| Year 22 | 4.90 | 1.25 |
| Year 41 | 44.84 | 14.37 |

| Period | Mm³ | |
|---|---|---|
| | Waste Rock | Low Grade Waste |
| **Year 56** | 30.49 | 12.55 |
| **Year 71** | 34.02 | 7.16 |

**Table 16.3.1-2 Waste Pile Volume – 23 Mt Scenario**

| Period | Location | Mm³ | |
|---|---|---|---|
| | | Waste Rock | Low Grade Waste |
| **Year 1** | **North** | 1.18 | 0.10 |
| | **Central** | 2.10 | 1.54 |
| | **South** | 0.69 | 0.44 |
| | **Total** | **3.96** | **2.07** |
| **Year 2** | **North** | 0.60 | 0.48 |
| | **Central** | 2.84 | 0.98 |
| | **South** | 1.57 | 0.14 |
| | **Total** | **5.01** | **1.61** |
| **Year 3** | **North** | 0.87 | 0.22 |
| | **Central** | 3.59 | 0.77 |
| | **South** | 1.52 | 0.49 |
| | **Total** | **5.97** | **1.48** |
| **Year 5** | **North** | 1.18 | 0.62 |
| | **Central** | 6.30 | 1.82 |
| | **South** | 6.82 | 1.15 |
| | **Total** | **14.30** | **3.59** |
| **Year 10** | **North** | 4.48 | 2.30 |
| | **Central** | 11.56 | 2.99 |
| | **South** | 16.19 | 4.02 |
| | **Total** | **32.23** | **9.32** |
| **Year 20** | **North** | 4.10 | 4.51 |
| | **Central** | 21.28 | 7.79 |
| | **South** | 18.24 | 4.96 |
| | **Total** | **43.62** | **17.26** |
| **Year 31** | **North** | 14.91 | 3.58 |
| | **Central** | 26.22 | 6.20 |
| | **South** | 22.38 | 9.56 |
| | **Total** | **63.51** | **19.34** |

**able 16.3.1-3 Waste Pile Volume – 50 Mt Scenario**

| Period | Mm³ | |
|---|---|---|
| | Waste Rock | Waste Rock |
| **Year 1** | 5.93 | 0.41 |
| **Year 2** | 7.23 | 1.49 |
| **Year 3** | 8.77 | 0.69 |
| **Year 4** | 10.25 | 0.34 |
| **Year 5** | 10.34 | 2.43 |

| Period | Mm³ | |
|---|---|---|
| | Waste Rock | Waste Rock |
| **Year 10** | 59.03 | 6.63 |
| **Year 15** | 43.85 | 4.62 |
| **Year 26** | 128.55 | 7.26 |

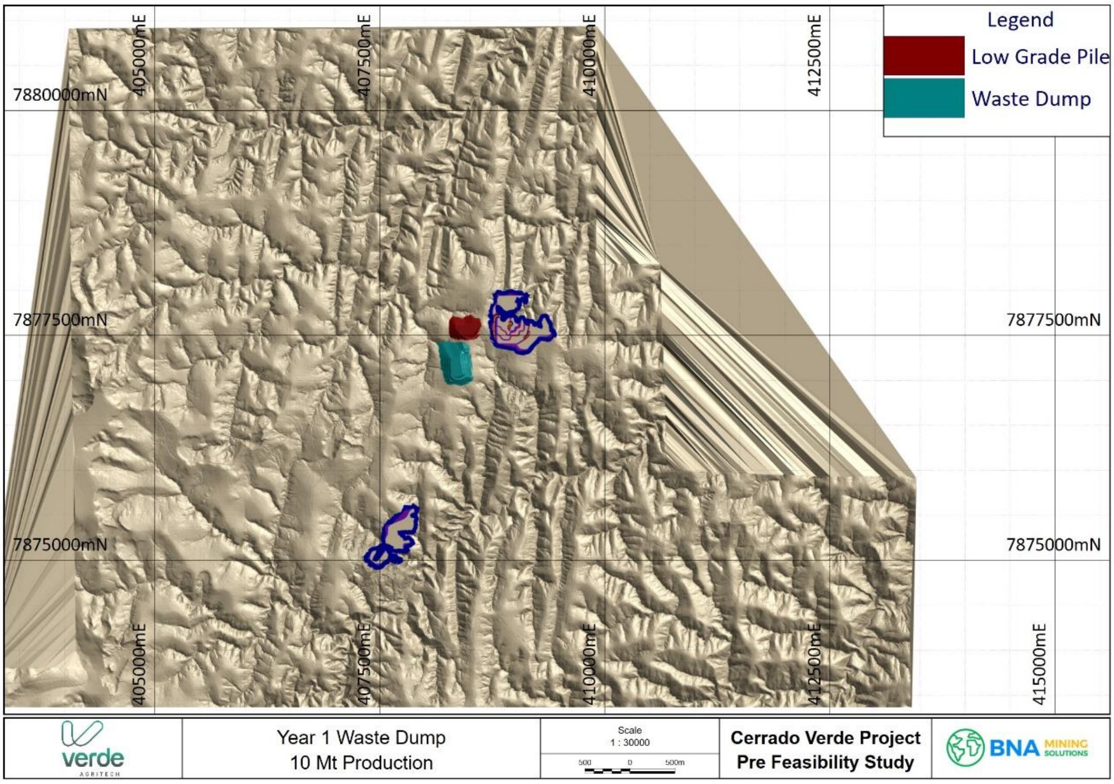


**Figure 16.3.1-1 Waste Rock disposal Year 1 – Plant 3 Scenario**

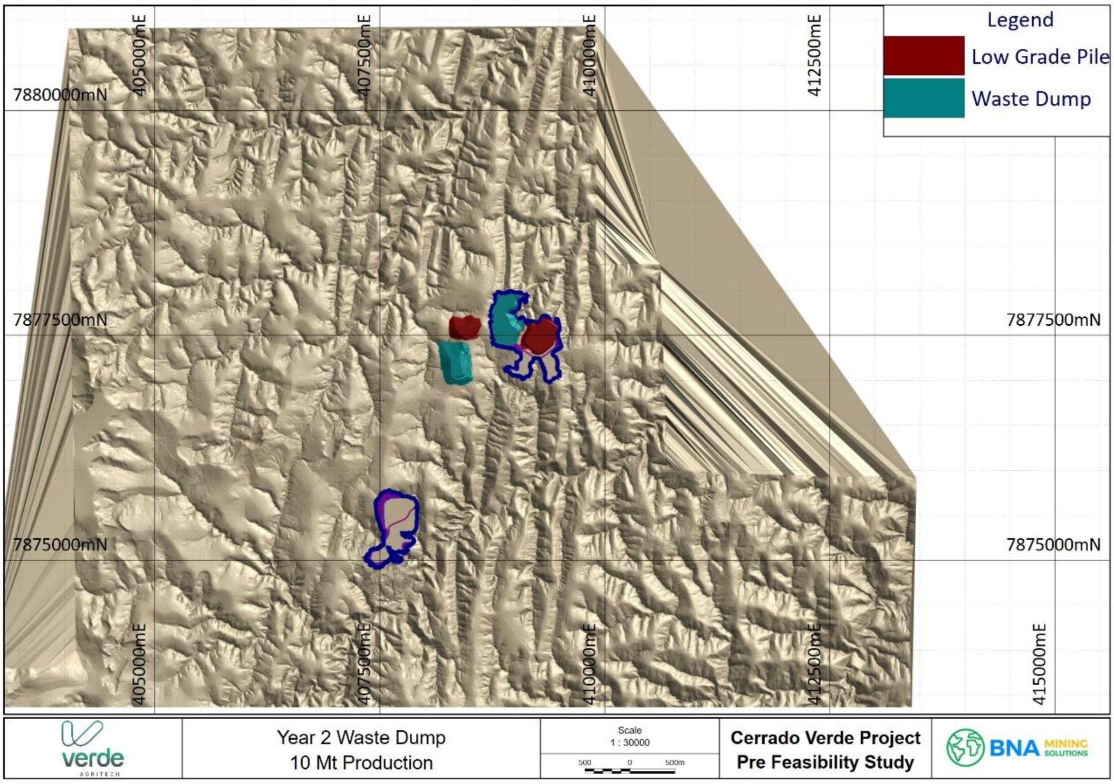


**Figure 16.3.1-2 Waste Rock disposal Year 2 – Plant 3 Scenario**

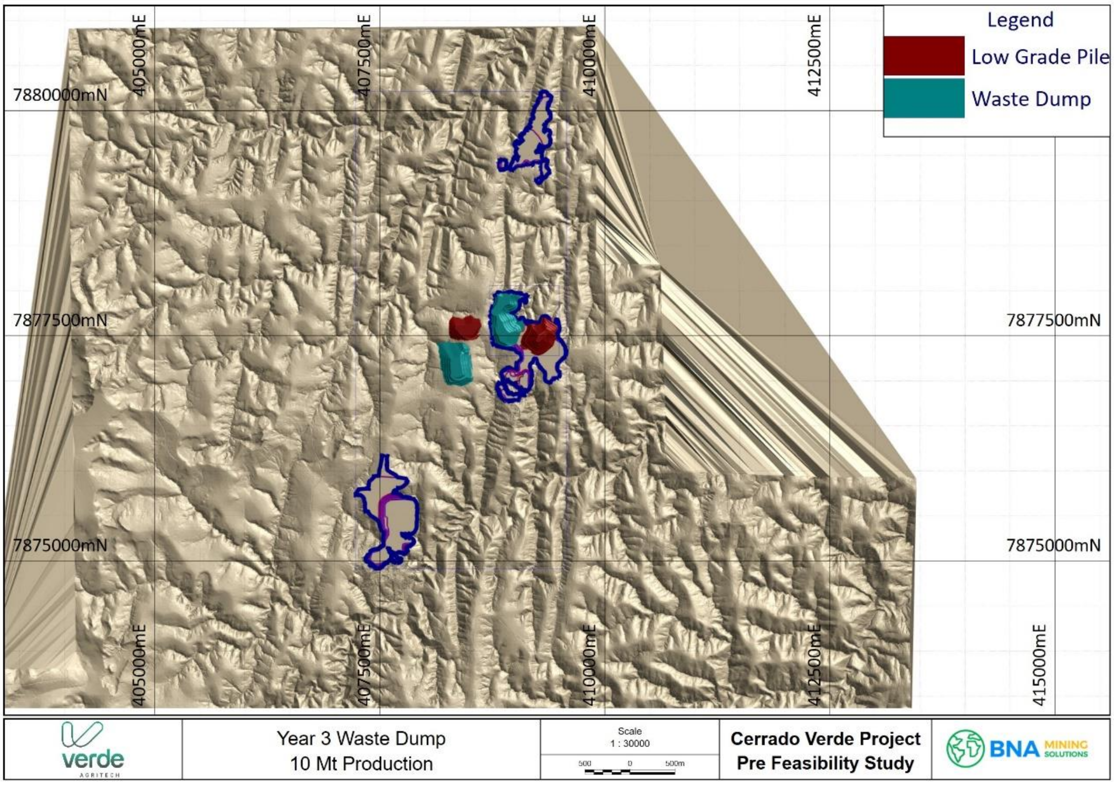


**Figure 16.3.1-3 Waste Rock disposal Year 3 – Plant 3 Scenario**

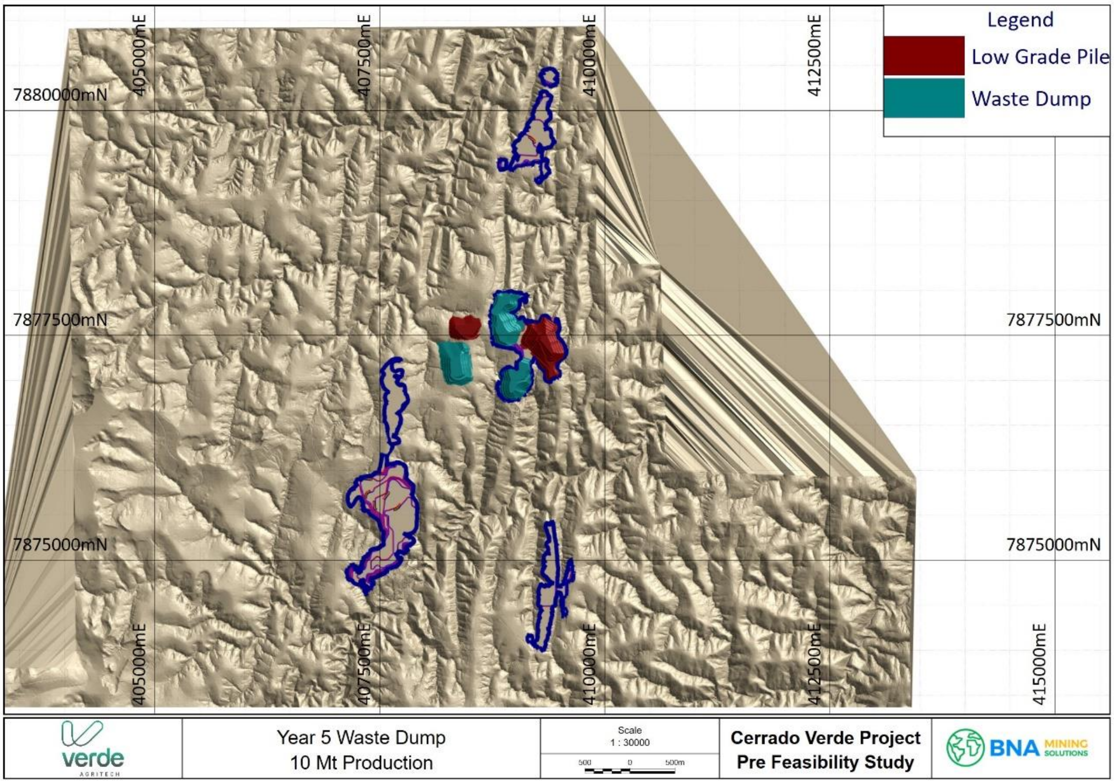


**Figure 16.3.1-4 Waste Rock disposal Year 5 – Plant 3 Scenario**

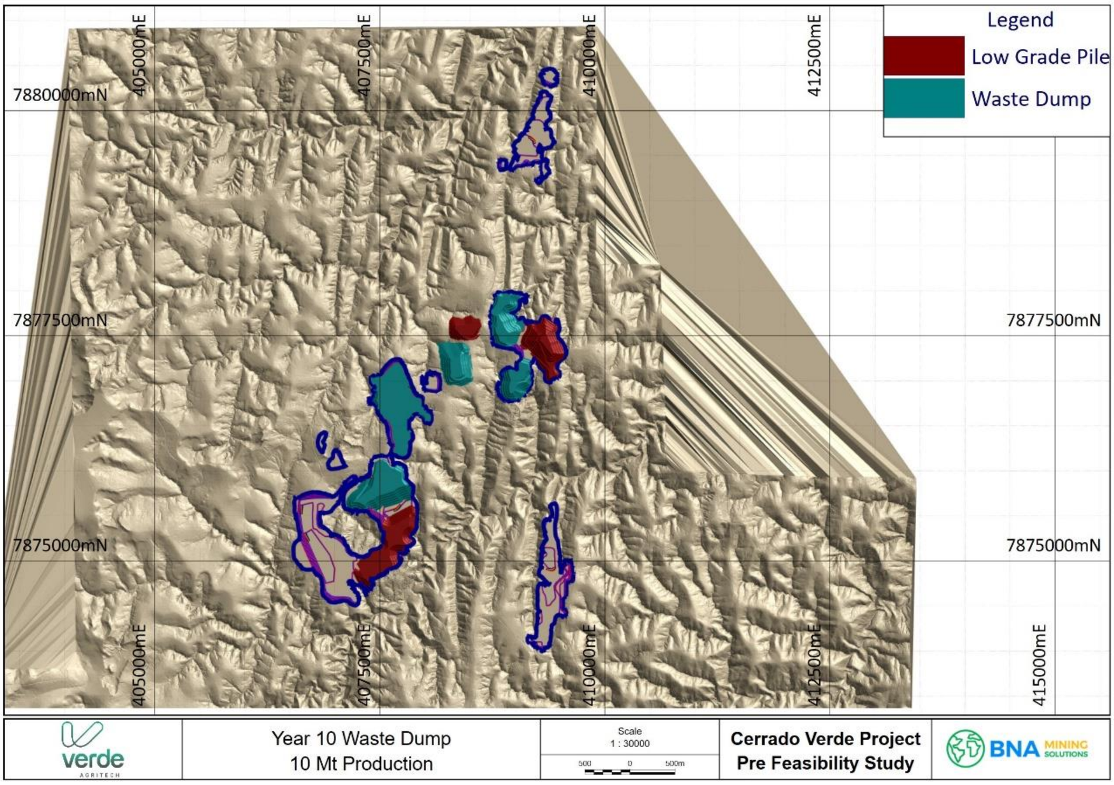


**Figure 16.3.1-5 Waste Rock disposal Year 10 – Plant 3 Scenario**

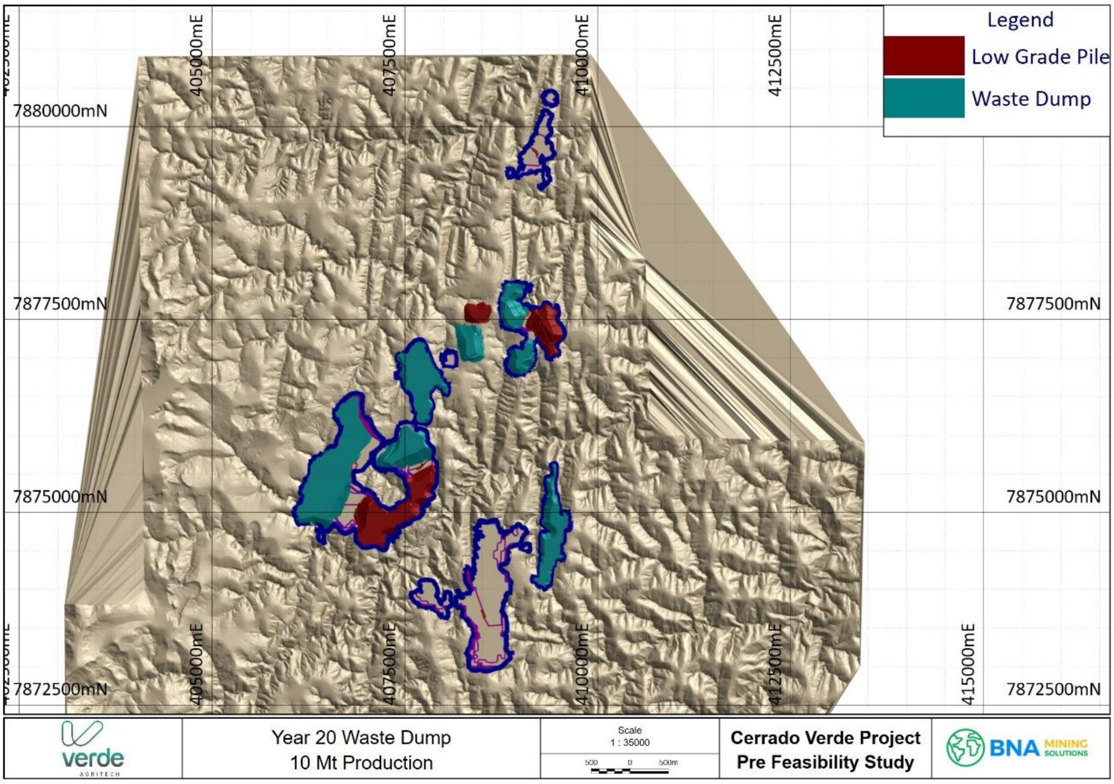


**Figure 16.3.1-6 Waste Rock disposal Year 20 – Plant 3 Scenario**

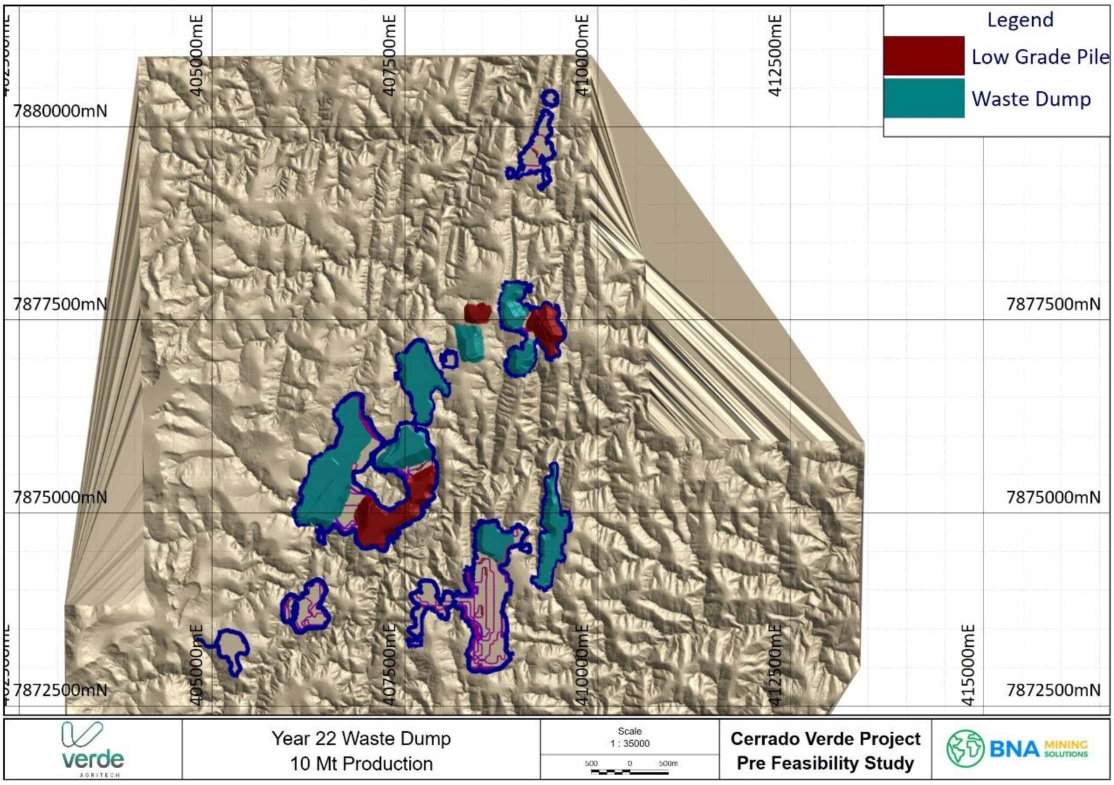


**Figure 16.3.1-7 Waste Rock disposal Year 22 – Plant 3 Scenario**

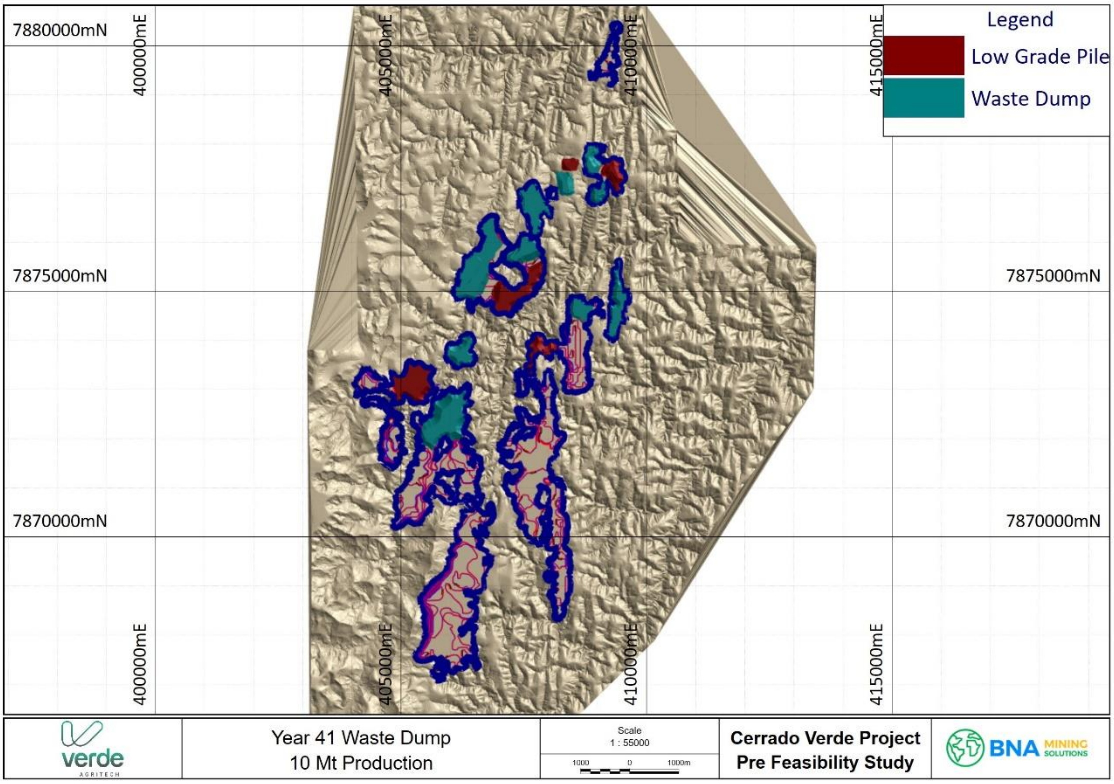


**Figure 16.3.1-8 Waste Rock disposal Year 41 – Plant 3 Scenario**

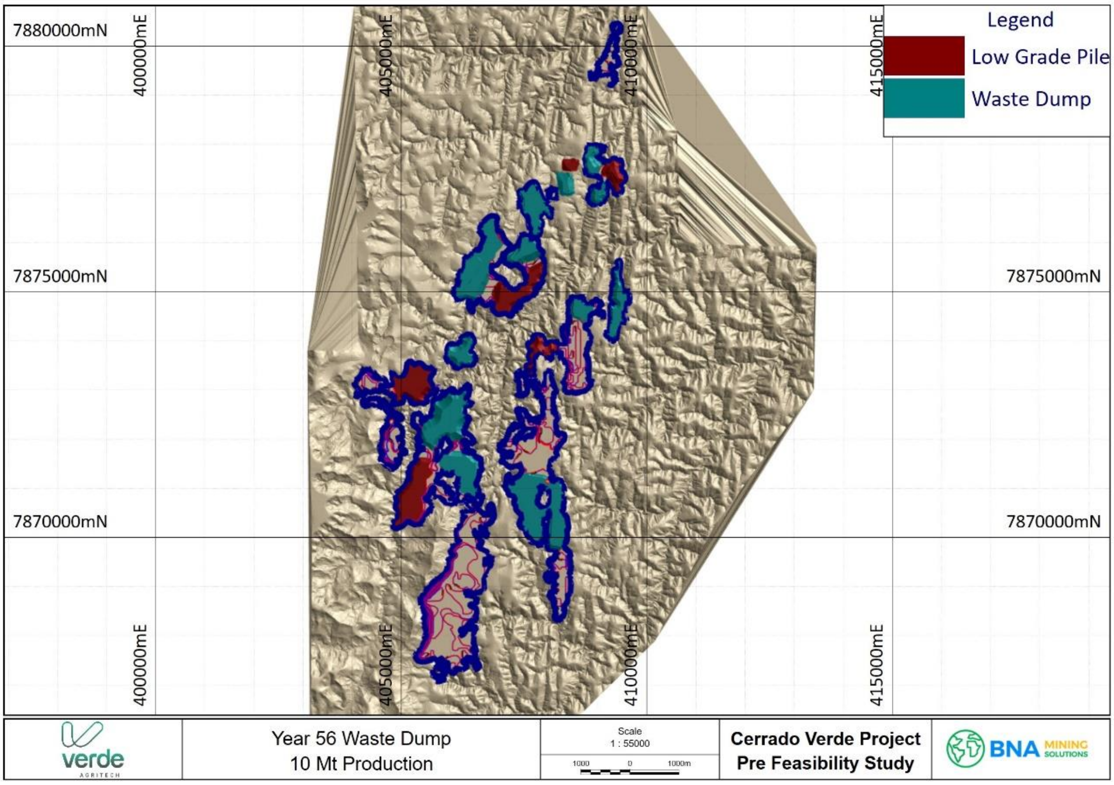


**Figure 16.3.1-9 Waste Rock disposal Year 56 – Plant 3 Scenario**

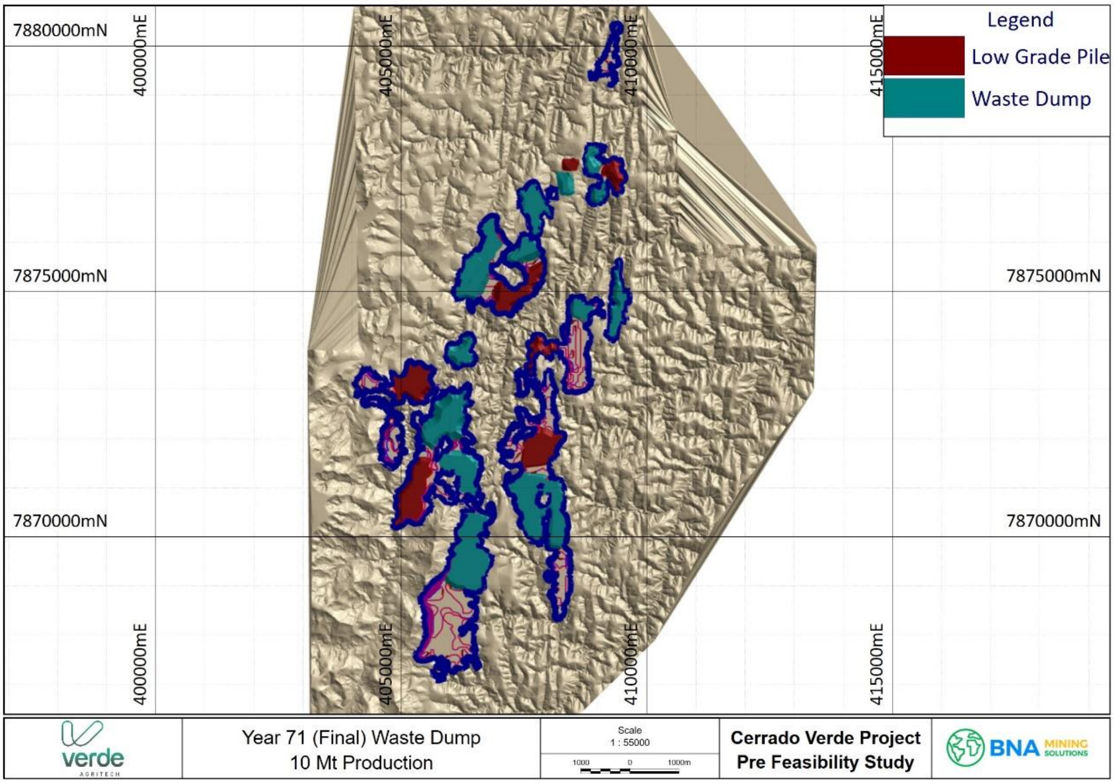


**Figure 16.3.1-10 Waste Rock disposal Year 71 (Final) – Plant 3 Scenario**

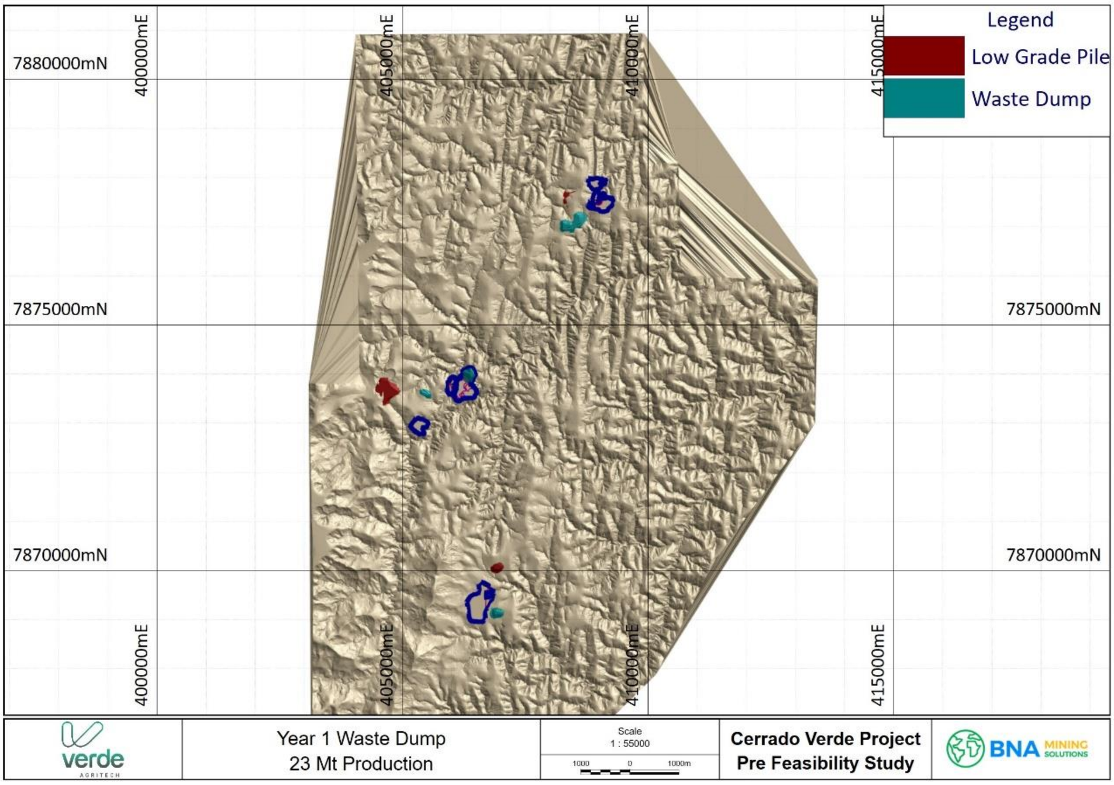


**Figure 16.3.1-11 Waste Rock disposal Year 1 – 23 Mt Scenario**

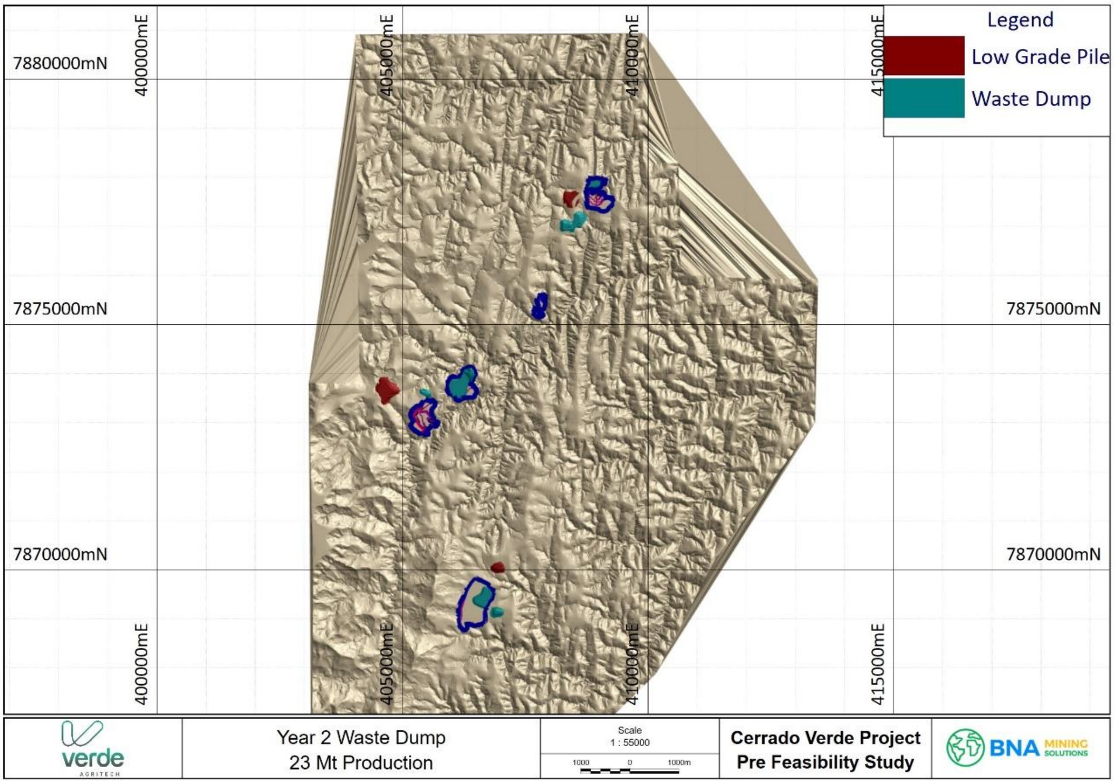


**Figure 16.3.1-12 Waste Rock disposal Year 2 – 23 Mt Scenario**

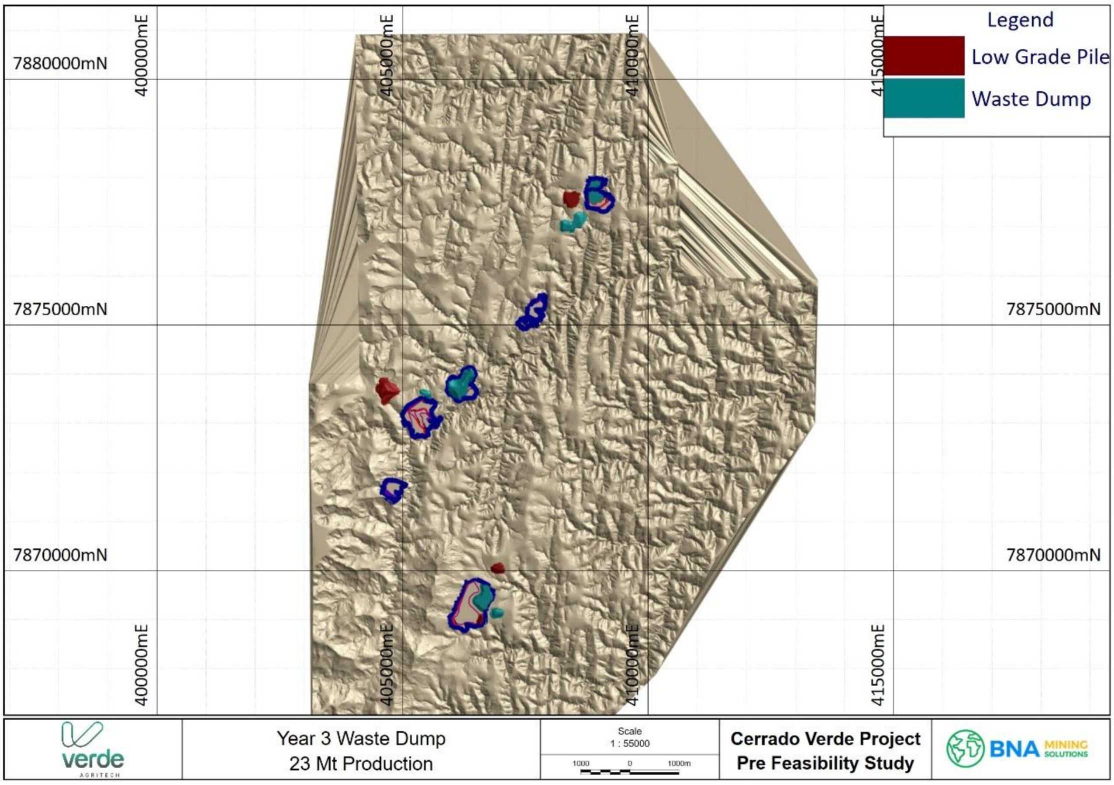


**Figure 16.3.1-13 Waste Rock disposal Year 3 – 23 Mt Scenario**

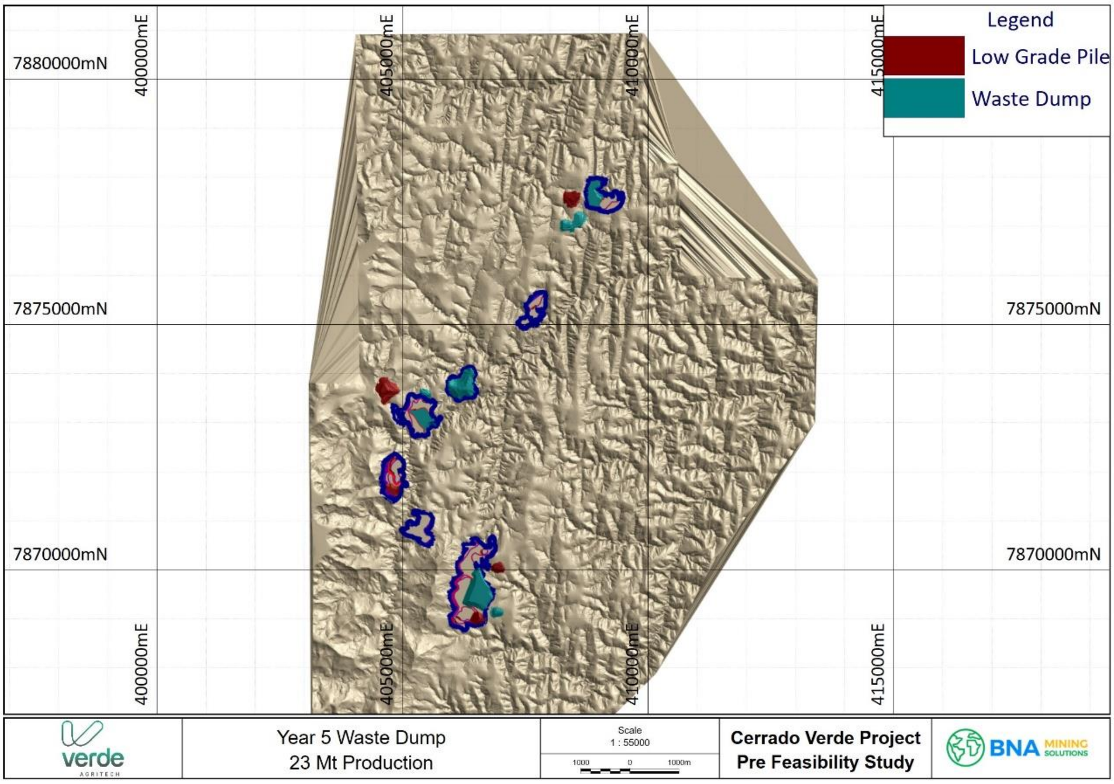


**Figure 16.3.1-14 Waste Rock disposal Year 5 – 23 Mt Scenario**

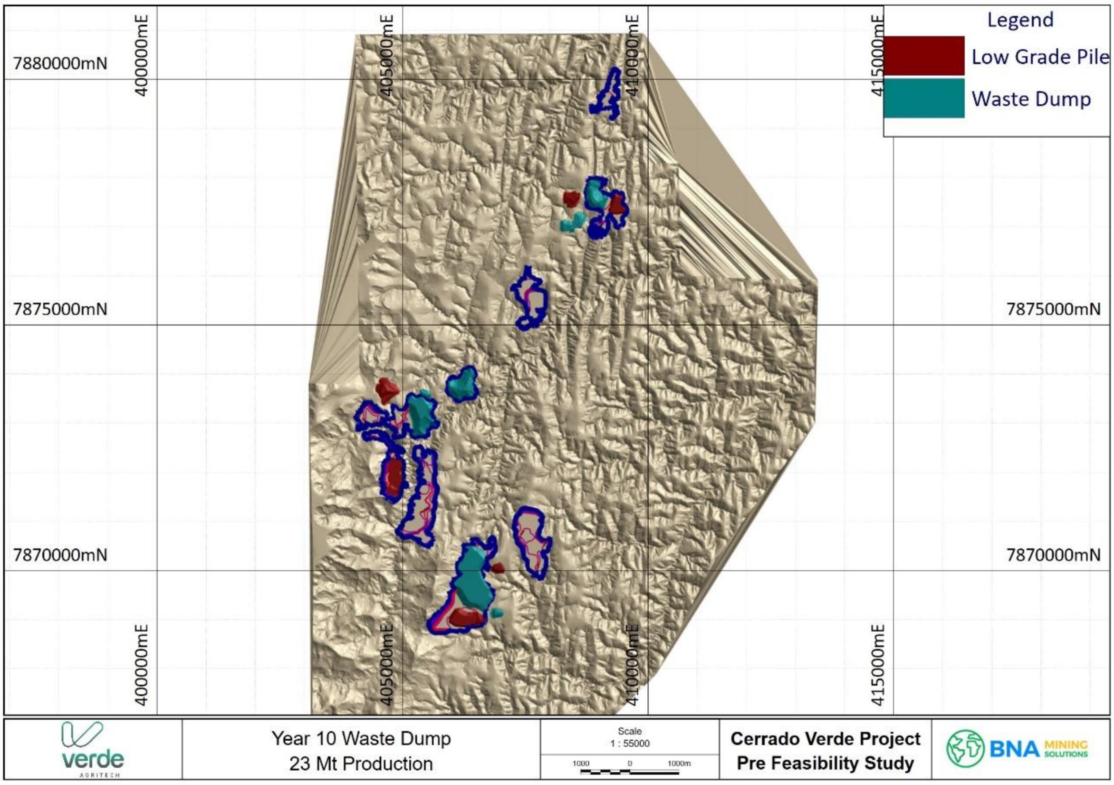


**Figure 16.3.1-15 Waste Rock disposal Year 10 – 23 Mt Scenario**

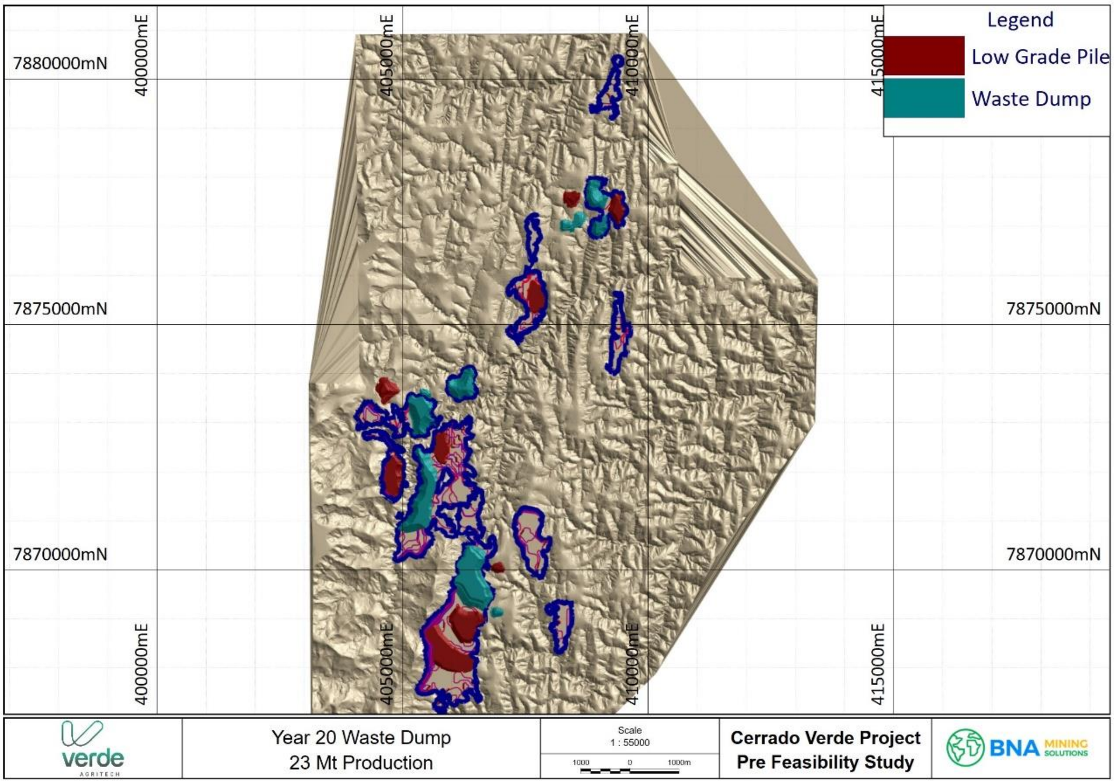


**Figure 16.3.1-16 Waste Rock disposal Year 20 – 23 Mt Scenario**

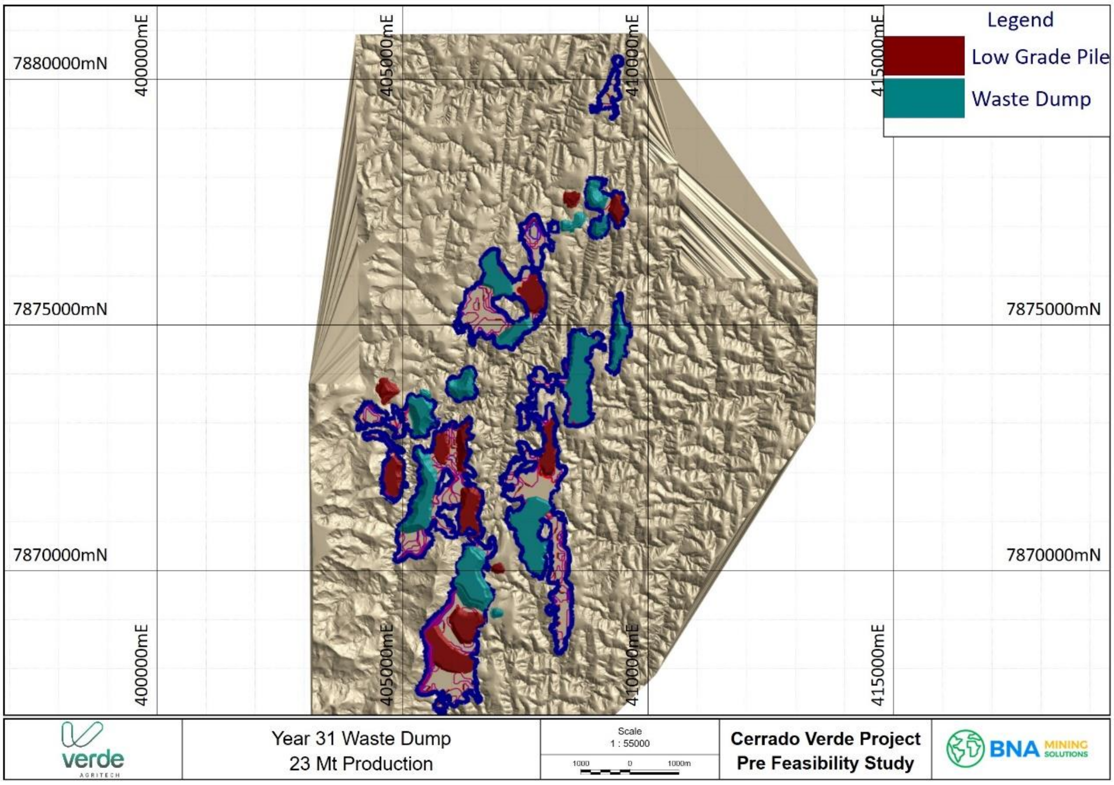


**Figure 16.3.1-17 Waste Rock disposal Year 31 (Final) – 23 Mt Scenario**

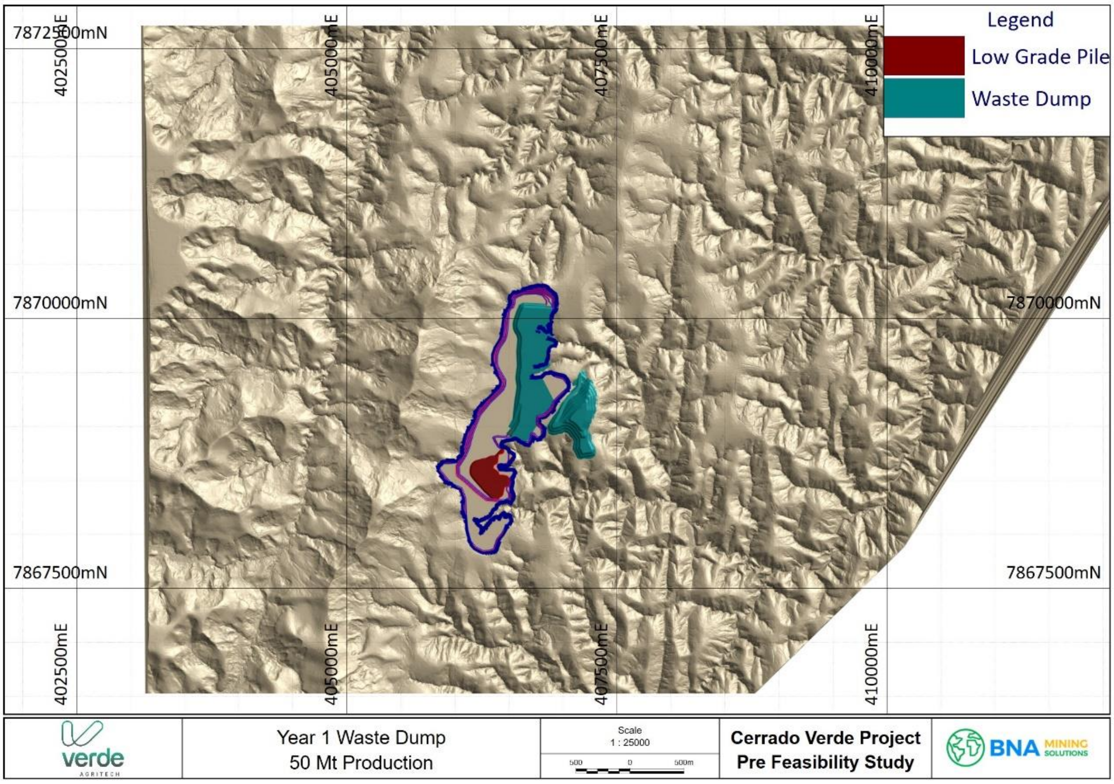


**Figure 16.3.1-18 Waste Rock disposal Year 1 – 50 Mt Scenario**

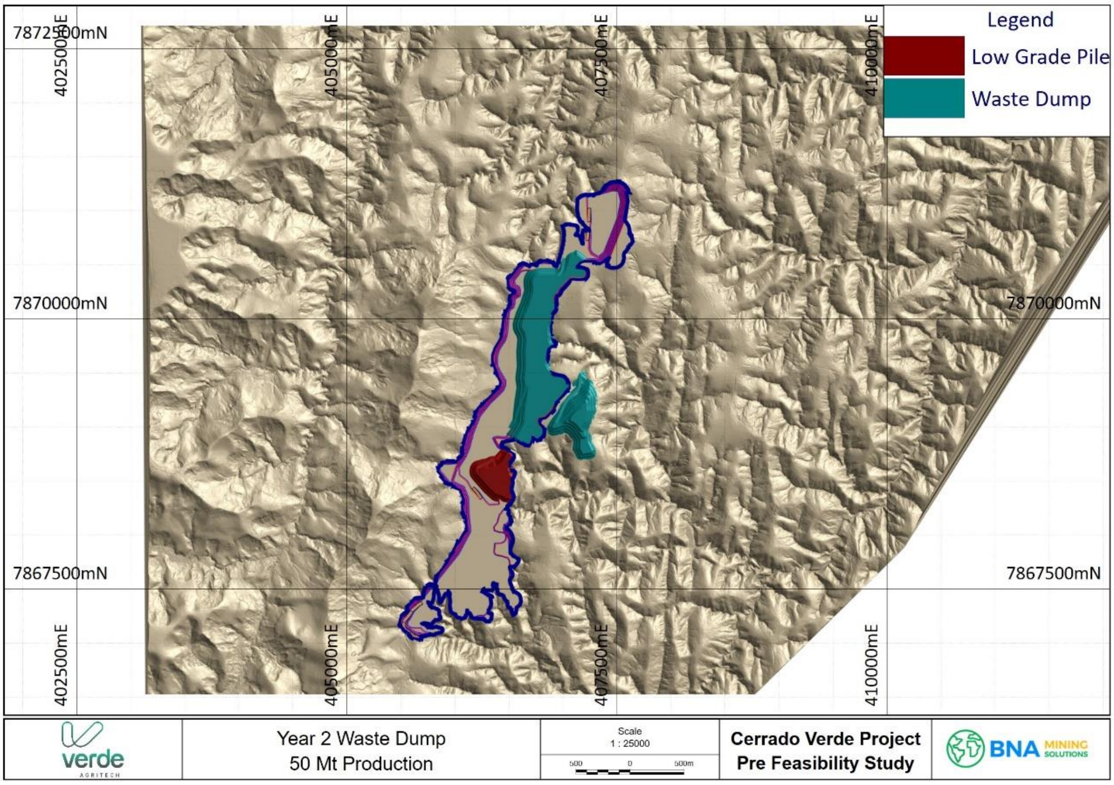


**Figure 16.3.1-19 Waste Rock disposal Year 2 – 50 Mt Scenario**

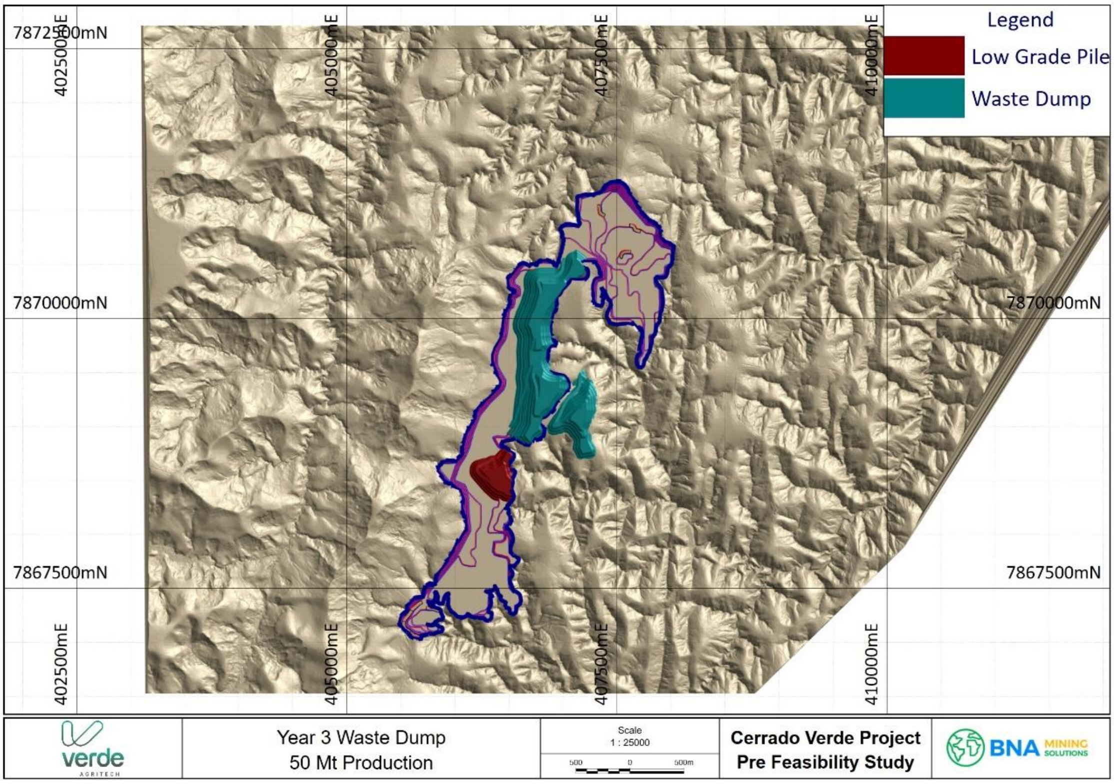


**Figure 16.3.1-20 Waste Rock disposal Year 3 – 50 Mt Scenario**

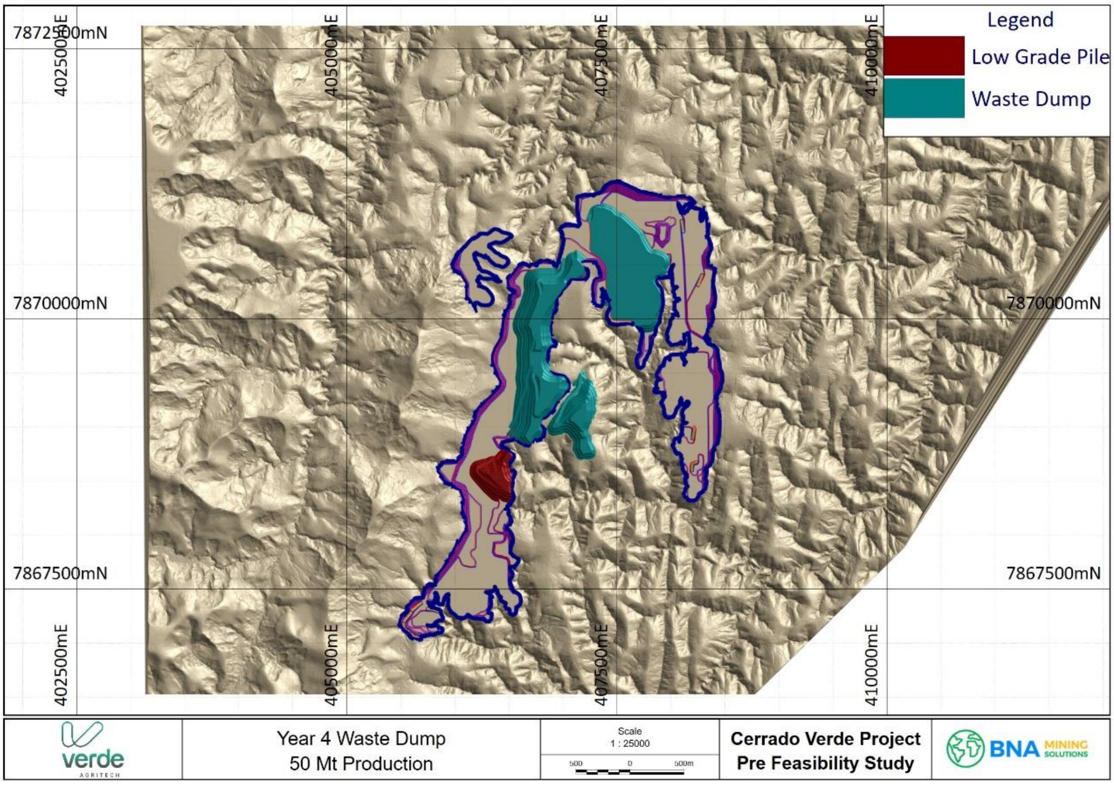


**Figure 16.3.1-21 Waste Rock disposal Year 4 – 50 Mt Scenario**

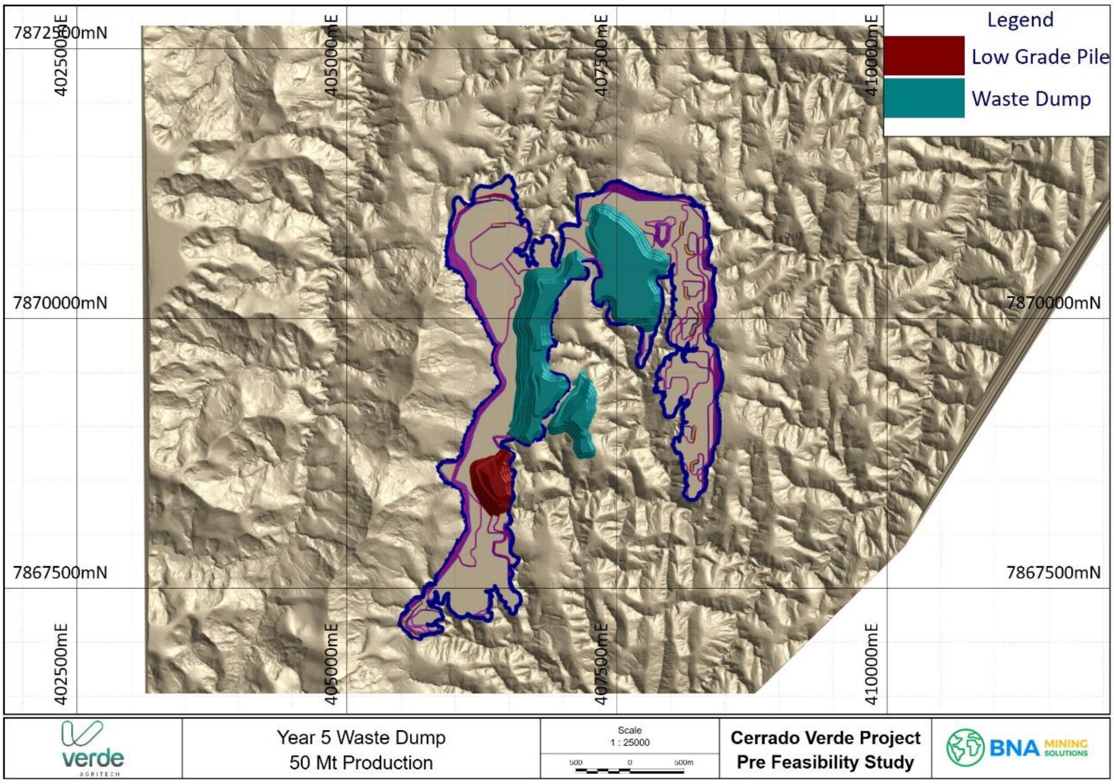


**Figure 16.3.1-22 Waste Rock disposal Year 5 – 50 Mt Scenario**

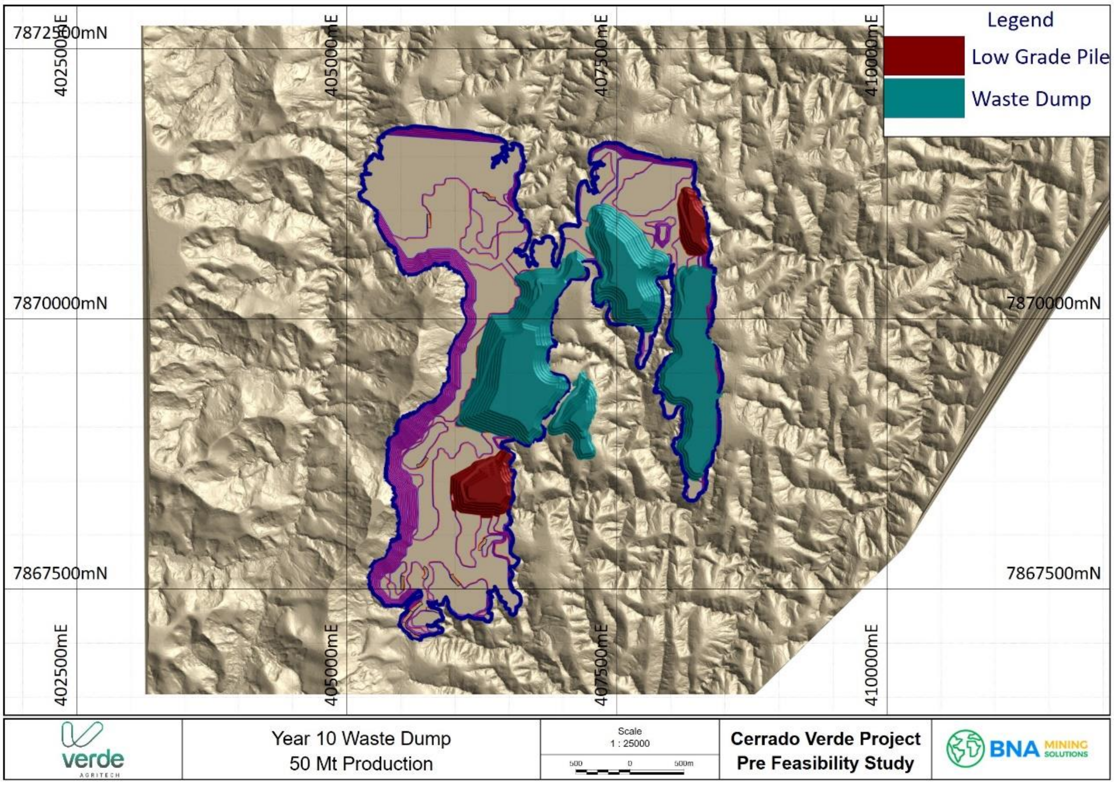


**Figure 16.3.1-23 Waste Rock disposal Year 10 – 50 Mt Scenario**

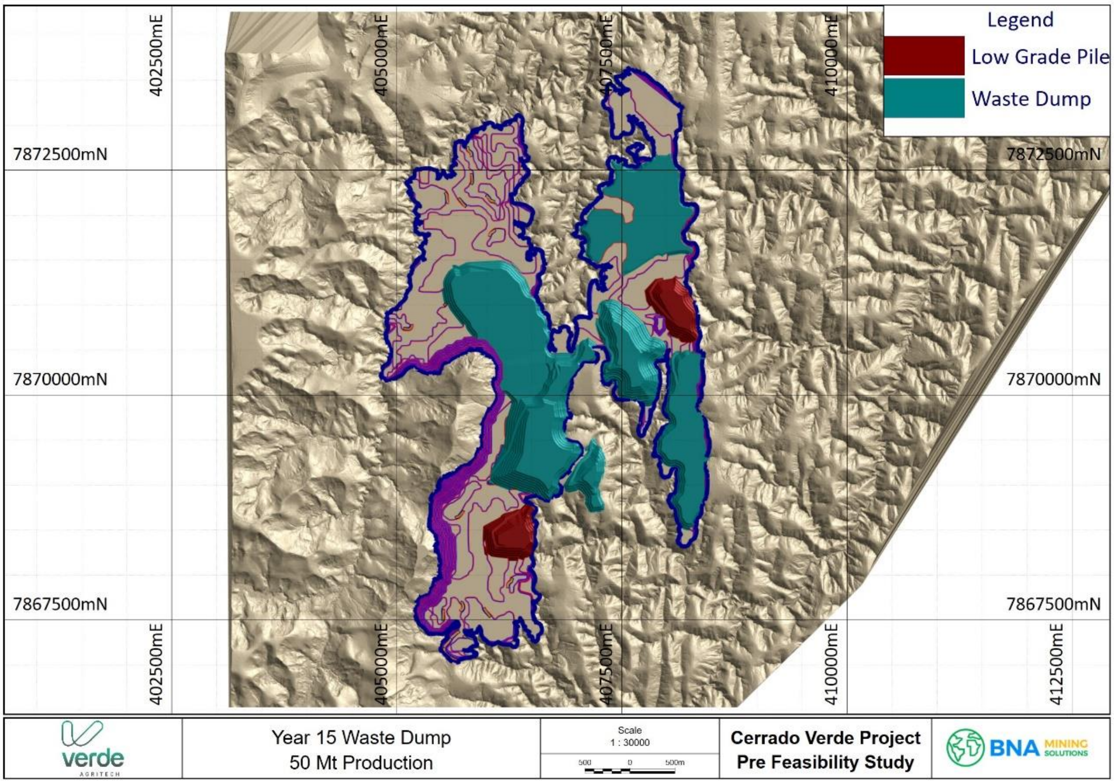


**Figure 16.3.1-24 Waste Rock disposal Year 15 – 50 Mt Scenario**

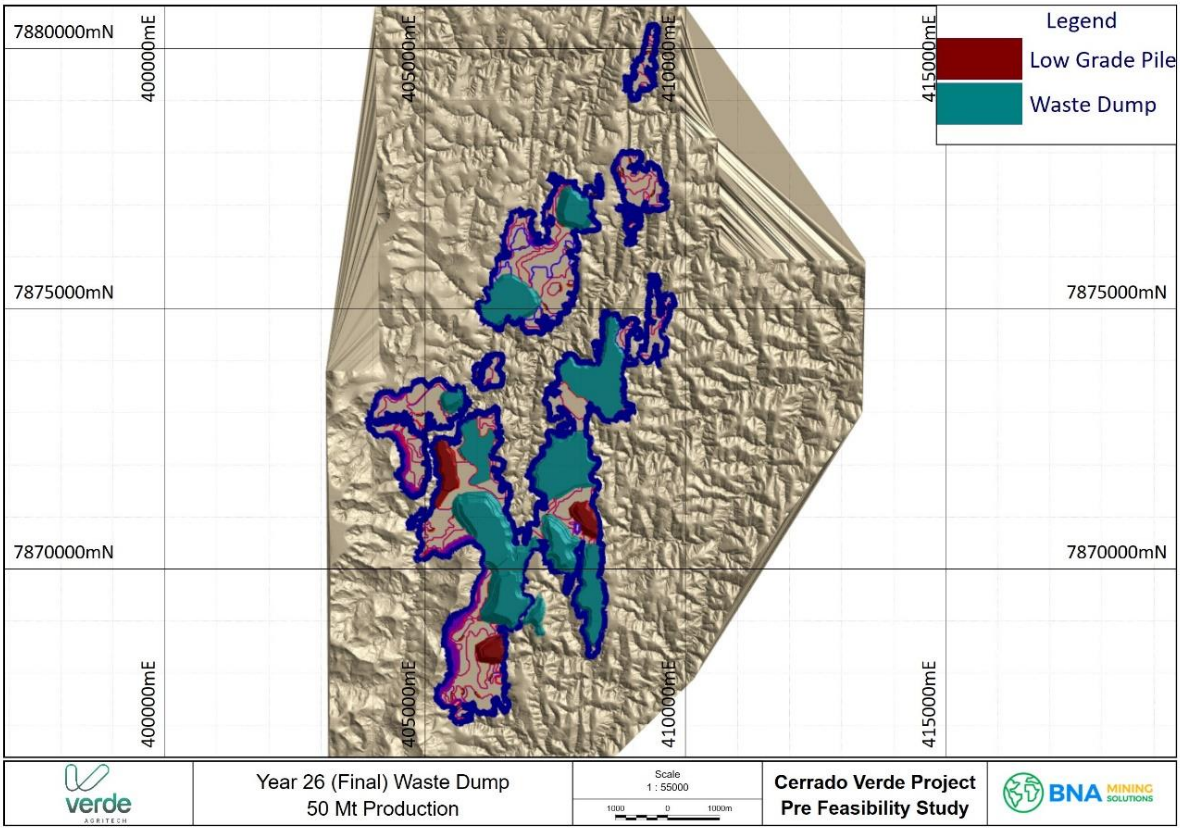


**Figure 16.3.1-25 Waste Rock disposal Year 26 (Final) – 50 Mt Scenario**

BNA recommends that additional studies be conducted to evaluate the location and stability of the projected waste rock piles, as well as their impact on the possible mining of the remaining resources, which were not mined in this study because they did not contribute to an increase in the value of the project, based on the current technical and economic parameters.

## 16.4. Hydrogeology

A hydrogeological study of part of the project area was carried out by *MDGEO Hidrogeologia e Meio Ambiente*. As this study does not encompass the entire area affected by the project, BNA recommends that this study be redone and that this new study covers the entire project area and includes an analysis of the new final pit design.

## 16.5. General Project Layout

For the Plant 3 Scenario, it is expected that the processing plant will be built in the northern region of the deposit, to take advantage of the infrastructure that already exists in that region. After year 22, the plant will be relocated to the southern region, to reduce the ore haulage distance (Figure 16.5-1).

For the 23 Mt scenario, it is expected that 3 processing plants will be built: one in the northern region, one in the central region and another in the southern region of the deposit.

For the 50 Mt scenario, it is expected that mining will start in the southern region of the deposit, as it is expected that all production flow will be by rail, and the railway branch line will be located to the south of the deposit (Figure 16.5-2). The crushing plant will be located next to the initial fronts and the material will be transported by a belt conveyor to the railcar loading terminal and matrix grinding plant.

A reallocation of the 50 Mt Ore processing plant is not planned, as the cost of this reallocation is considerably higher than the cost of reallocating the Plant 3 Scenario plant. BNA recommends that this possibility be evaluated in further studies and that these studies include a comparison of haulage and relocation costs. Another alternative that may be studied is the use of long-distance belt conveyors.

Figure 16.5-1 to Figure 16.5-3 show the general layout of the project for all three scenarios:

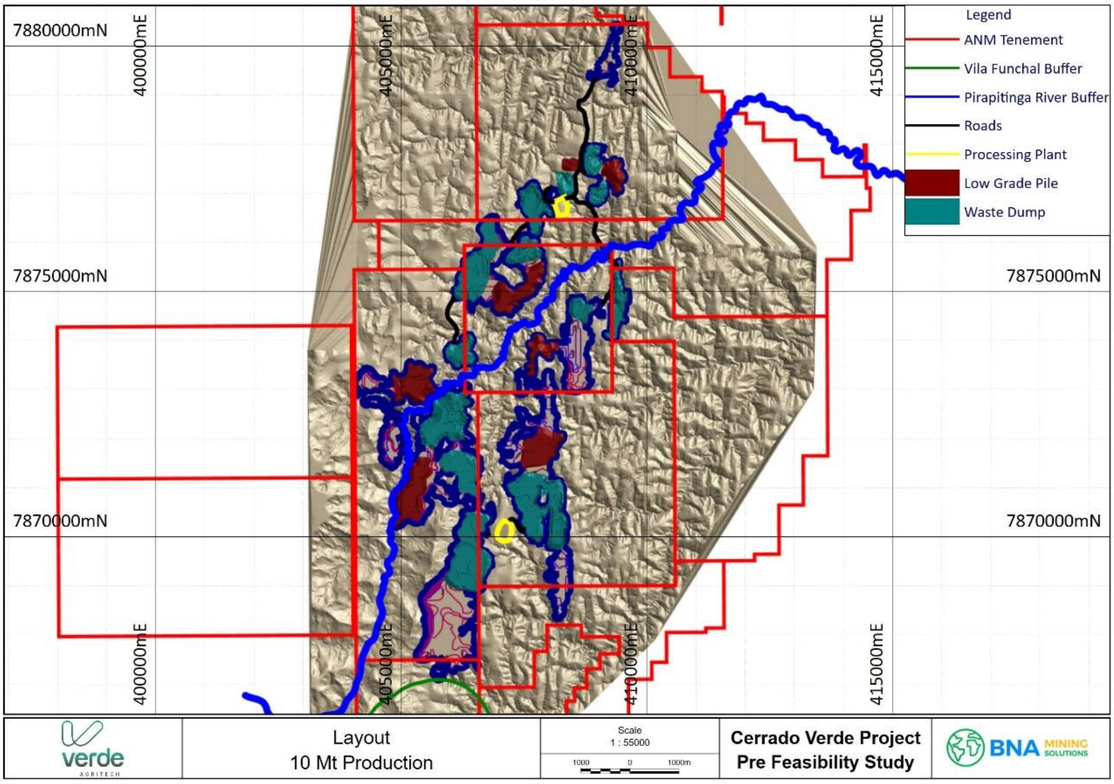


**Figure 16.5-1 General Project layout – Plant 3 Scenario**

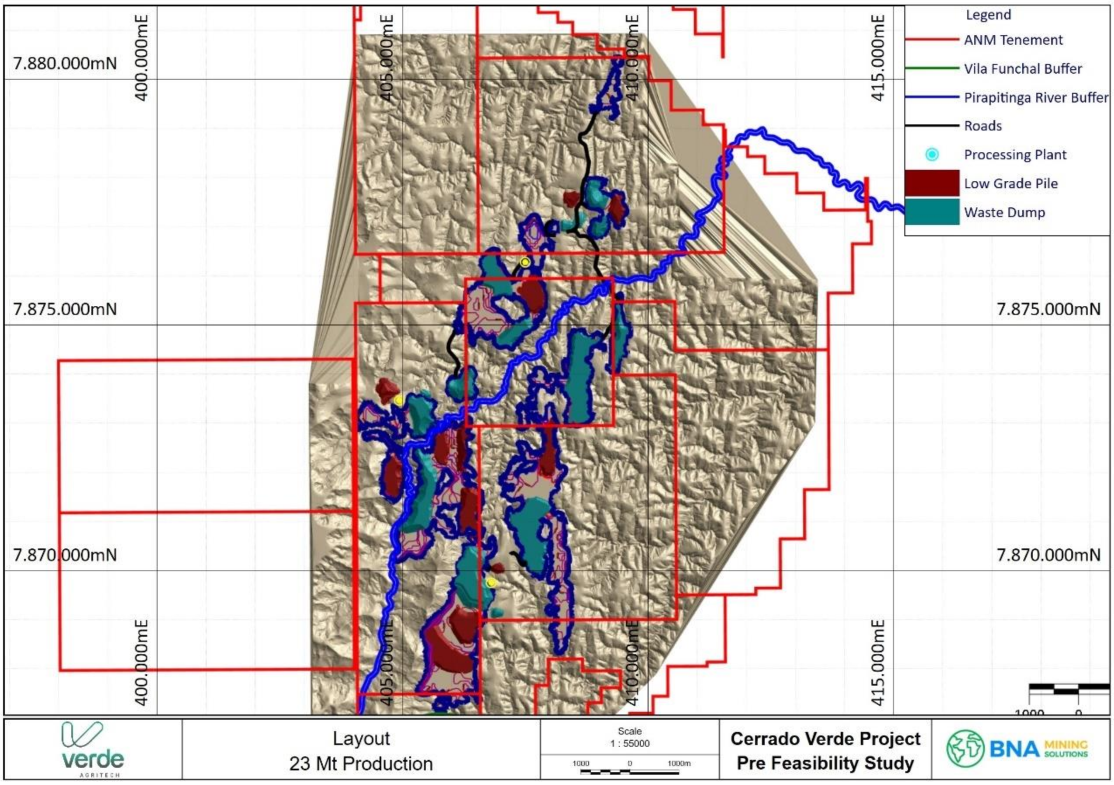


**Figure 16.5-2 General Project layout – 23 Mt Scenario**

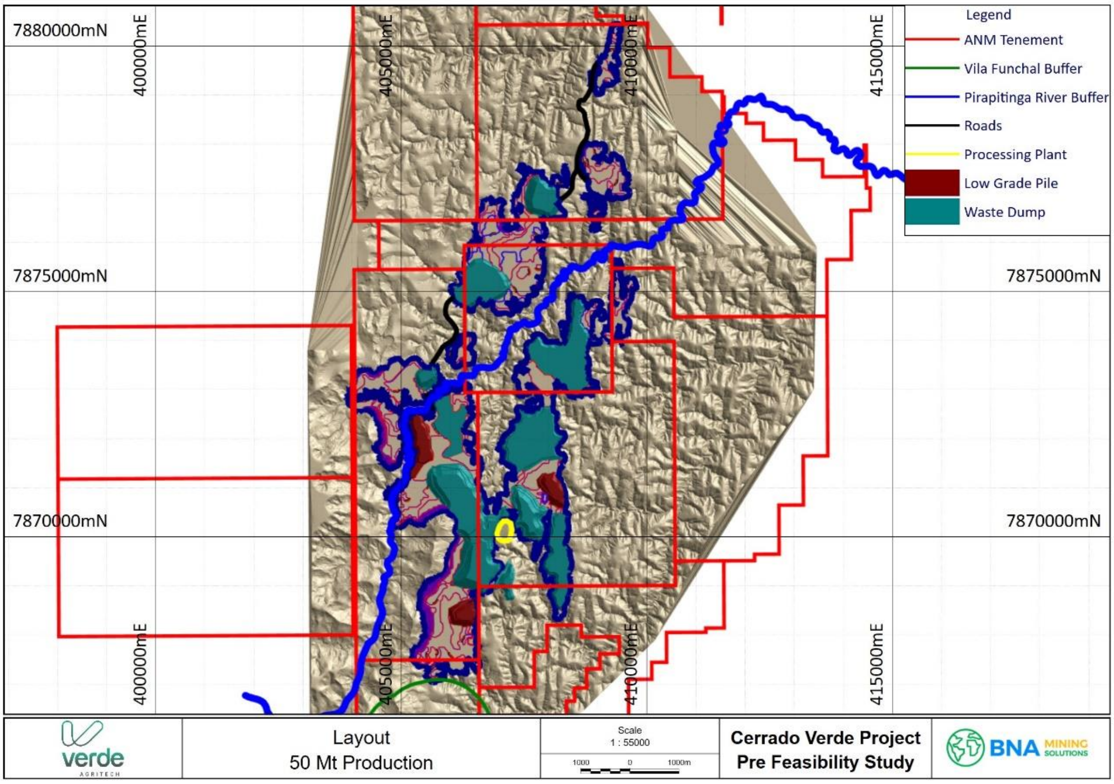


**Figure 16.5-3 General Project layout – 50 Mt Scenario**

## 16.6. Haulage Distances

The average haulage distance for the project was estimated based on the mass centers of the blocks mined annually, as shown in Table 16.6-1 and Table 16.6-3. For Ore, the destination was the Ore yard. For the waste rock, the destination was the waste rock pile. Distances were estimated based on the access roads defined in the mining plans.

**Table 16.6-1 Average Haulage Distances – Plant 3 Scenario**

| Period | Meters | |
|---|---|---|
| | Average Ore Haulage Distance | Average Waste Rock Haulage Distance |
| Year 1 | 1,594 | 1,447 |
| Year 2 | 1,888 | 1,689 |
| Year 3 | 2,369 | 2,161 |
| Year 5 | 2,462 | 2,297 |
| Year 10 | 2,411 | 2,143 |
| Year 20 | 3,065 | 1,690 |
| Year 22 | 4,103 | 2,421 |
| Year 41 | 2,912 | 2,063 |
| Year 56 | 2,499 | 1,984 |
| Year 71 | 2,402 | 2,327 |

**Table 16.6-2 Average Haulage Distances – 23 Mt Scenario**

| Period | Meters | |
|---|---|---|
| | Average Ore Haulage Distance | Average Waste Rock Haulage Distance |
| Year 1 | 1,155 | 988 |
| Year 2 | 1,191 | 1,268 |
| Year 3 | 1,418 | 1,444 |
| Year 5 | 1,641 | 1,468 |
| Year 10 | 2,043 | 1,813 |
| Year 20 | 2,565 | 2,046 |
| Year 31 | 3,257 | 2,079 |

**Table 16.6-3 Average Haulage Distances – 50 Mt Scenario**

| Period | Meters | |
|---|---|---|
| | Average Ore Haulage Distance | Average Waste Rock Haulage Distance |
| Year 1 | 978 | 900 |
| Year 2 | 1,809 | 1,563 |
| Year 3 | 1,627 | 1,811 |
| Year 4 | 2,320 | 1,557 |
| Year 5 | 1,961 | 1,610 |
| Year 10 | 1,941 | 2,556 |
| Year 15 | 2,820 | 2,318 |
| Year 26 | 6,735 | 2,578 |

## 16.7. Mine Drainage

Draining operations will be carried out throughout the life of mine, for both side hill and open pit mining operations.

With side hill mining operations, the water, whether of insurgency or rainfall in origin, will either be sent through the berms to areas outside the pits via their benches, or will be sent to sumps from where it will be pumped.

Once mining operations begin to produce pits, rainwater will be carried through ditches to collection boxes, installed at strategic locations, from where it will be continuously pumped. The water will also be dispersed by percolation and evaporation. Solids carried to the pit by rainwater will be removed during the dry season.

Regarding groundwater, hydrogeological surveys will be carried out and the best alternatives, either lowering the water table or directing the groundwater to collection boxes via ditches from where it is pumped out, will be studied.

### 16.7.1. Pit Drainage

Due to operational or blending needs and the deepening of the orebody, some sites will be mined to lower levels in the pit. As a result, the water that accumulates inside those pits will be drained.

In such cases, the water to be drained from the pits can originate from two main sources:

- Rainfall;
- The water table.

The first step in reducing the volume of rainwater is to ensure that runoff from rainfall outside the boundaries of the pits does not enter the pits. Therefore, drainage ditches and/or protection lines will be opened, and these will divert these waters to the natural drainage system.

The rainwater within the boundaries of the pits will be led through ditches to strategically located sumps from where they will be pumped out of the pits and into the natural drainage system. Particulate retention dikes will be installed in these drains. Berms will be topographically controlled in a manner that creates a slight slope, on the order of 1% to 3%, towards the crests to avoid the formation of puddles on the surface of the benches.

If groundwater reaches the pits, it will also be led through ditches to the same sumps to be pumped out. Once there is a better understanding of the behavior of the groundwater, a study of the available solutions, including water table drawdown through wells, will be conducted.

### 16.7.2. Waste Rock Pile Drainage

Before the beginning of waste rock disposal in the selected area, geotechnical and hydrogeological studies will be carried out to evaluate the need to construct drains at the base of the pile. If necessary, ditches with dimensions defined by geotechnical and hydrogeological studies will be opened. The ditches will then be filled with rocky material of different particle sizes, in descending scale from bottom to top, with the last layer consisting of pebbles up to 20 mm in diameter. Finally, a geotextile blanket will be placed over this material. This fabric should cover a safety strip on the edges, beyond the width of the ditches. The first layer of waste rock must be placed carefully to avoid shifting the blanket.

Upstream of the waste rock pile, ditches and/or protection lines will be constructed to divert runoff. In the lower parts of the pile, along the toes of the lower benches, ditches associated with protection lines will be built (the material dug to form the ditches will be arranged at the sides of the ditches) to protect against possible landslides.

The berms will have a trim, in the transversal direction, on the order of 1% to 3% towards the toe, to prevent erosion of their faces. In the longitudinal direction, the benches will have a small slope, on the order of 1.5%, in opposing directions every 25 m. At the lower ends of these slopes, concrete rainwater collection boxes fitted with pipes will be built. These pipes will have diameters dimensioned in accordance with the maximum volumes for each location, perpendicular to the face of the bench, with a slope on the order of 10%. Concrete stairs will be constructed from the ends of these pipes to allow the water to flow down. These stairs connect to the lower bench boxes, through to the last bench at the bottom of the pile. From these points the water will be led through ditches to particulate sedimentation ponds. From these ponds the water will be released into the natural drainage system. Dikes will be built at strategic points in these drains to ensure particulate retention.

### 16.7.3. Roads and Access Route Drainage

Roads and access routes will feature a narrow shoulder. Ditches will be opened along the sides of the roads for water collection and drainage. At specified distances, where possible, exits will be opened to allow the water to flow into the natural landscape. Depending on the region through which the road is passing, it may be necessary to build collection boxes and culverts to allow the water to flow to the other side of the road. When crossing valleys, culverts, dimensioned to handle the maximum expected flow in the area, will be installed.

## 16.8. Mining Operation

The main mining operations are:

- Ore and waste rock drilling and blasting;
- Excavation and loading;
- Ore haulage to the primary crusher and waste rock haulage to the waste rock pile;
- Ancillary support services.

Excavating and truck loading operations will be performed using hydraulic crawler excavators for both ore and waste. It has been estimated that 80% of the Ore and 80% of the waste rock will be mined using explosives. Trucks will haul the Ore to the primary crusher and the waste rock to the waste rock piles.

To ensure the proper and adequate performance of the main mining operations, they will be supported by ancillary services, such as the maintenance of roads and access routes, dust control, drainage, lubrication, etc. These activities will be performed by a fleet of auxiliary equipment consisting of motor graders, irrigation tanker trucks, road trains, track tractors, loaders, and utility vehicles.

## 16.9. Blast Plan

Drilling will be carried out by rock drills and compressors, with 4" diameter holes in both the Ore and waste rock. Explosive blasting will follow the standard drilling design with a 4.0-m burden and 6.0-m spacing in the Ore, and a burden of 5.0 m and spacing of 7.0 m in the waste rock. The height of the benches will be 10 m. The following table shows the parameters of the drilling and blasting operation (Table 16.9-1).

**Table 16.9-1 Blast Plan**

| Description | Unit | Ore | Waste |
|---|---|---|---|
| Mesh | | | |
| . Burden | m | 4 | 5 |
| . Spacing | m | 6 | 7 |
| Density | $t/m^3$ | 2.87 | 2.93 |
| Bench height | m | 10 | 10 |
| Blasted volume per hole | $m^3$/year (in situ) | 240 | 350 |
| Blasted mass per hole | t | 689 | 1,024 |
| Hole slope | ° | 0 | 0 |
| Overcoring | % | 10% | 10% |
| Total hole length | m | 11.00 | 11.00 |
| Hole diameter | pol. | 4 | 4 |
| | cm | 10.2 | 10.2 |
| Hole volume | $cm^3/m$ | 8,107 | 8,107 |

| Description | Unit | Ore | Waste |
|---|---|---|---|
| Stemming length | m | 1 | 1 |
| Explosive load | m | 10.0 | 10.0 |
| Explosive density | $g/cm^3$ | 1.15 | 1.15 |
| Hole filling factor | % | 95% | 95% |
| Explosive load | g | 88,572 | 88,572 |
| Loading ratio | g/t | 128 | 86 |

## 16.10. Mine Equipment Selection

A preliminary selection of the main mining equipment was carried out based on the mining method adopted, the geometric characteristics of the pit, the physical characteristics of the materials to be mined, the required production scale, the investment, and operating costs, among other considerations.

Due to the large amount of waste material expected, off-road trucks were selected to haul it. For the Ore, road trucks were selected to obtain better selectivity in the mine. The following equipment was selected:

- Plant 3 and 23 Mtpy Scenarios
  - Sandvik Pantera DP1500i Hydraulic Excavator
  - Hitachi EX 1200 Hydraulic Excavator
  - Hyundai 220 Hydraulic Breaker
  - Caterpillar 777 Off-Highway Truck (100 t class)
  - Caterpillar 980 shovel
  - Caterpillar D8 and D9 Track Tractors
  - Mercedes Axor 4144Water Truck
  - Caterpillar16H Motor Grader
- 50 Mtpy Scenario
  - Sandvik Pantera DP1500i Hydraulic Excavator
  - Hitachi EX 1200 Hydraulic Excavator
  - Hyundai 220 Hydraulic Breaker
  - Caterpillar 777 Off-Highway Truck (100 t class)
  - Caterpillar 980 shovel
  - Caterpillar D8 and D9 Track Tractors
  - Mercedes Axor 4144Water Truck
  - Caterpillar16H Motor Grader

Table 16.10-1 presents the basic parameters of the project:

**Table 16.10-1 Basic Parameters**

| Item | Unit | Value |
|---|---|---|
| **1. Work regime** | | |
| **. Mine and crushing** | | |
| . Days per year | day | 365 |

| Item | Unit | Value |
|---|---|---|
| . Shifts per day | shift | 3 |
| . Hours per shift (average) | h | 8 |
| . Meal breaks | h | 2.25 |
| . No. of teams | nº | 4 |
| . Absenteeism rate | % | 16.5% |
| **2. Materials density and moisture level of** | | |
| **Density** | | |
| . Natural Base | | |
| . Ore (Weathered) | $t/m^3$ | 1.64 |
| . Ore (Fresh Rock) | $t/m^3$ | 2.18 |
| . Waste Rock | $t/m^3$ | 1.77 |
| **3. Swelling, spreading and compaction in the pile** | | |
| **3.1. Swelling** | | |
| . Ore and Waste Rock | % | 25% |
| **3.2. Compaction of the waste rock in the pile** | % | 10% |
| **3.3. Percentage of deposited volume to be spread by the tractor** | % | 75% |
| **4. Pit parameters** | | |
| . Mined bench height | | |
| . Ore | m | 10 |
| . Waste Rock | m | 10 |
| . Maximum road ramp | % | 10% |
| **5. Blasting** | | |
| . Explosive | | |
| . Density | $g/cm^3$ | 1.15 |
| . Stemming | m | 1 |
| . Hole fill factor | % | 95% |
| . Percentage of each blasted material | | |
| . Ore | % | 80% |
| . Waste Rock | % | 80% |

# 17. Recovery Methods

This section summarizes the processing operation settings.

The project will consist of three scenarios with distinct processing rates: 10 Mtpy, 23 Mtpy and 50 Mtpy. The following items will describe the circuits adopted for each phase. The Ore from the mine will have a top size of 500 mm.

The fertilizer production process in the different scenarios consists of the comminution of Ore, which may or may not include other feedstocks. Sulphur and other micronutrients are added to the product prior to milling, in different crop-specific proportions, to produce BAKS®, a mixed mineral fertilizer, using an exclusive elemental sulphur micronization technology called Micro S Technology®. The hammer mill performs the comminution to the required powder granulometry and the mixing of added raw materials, resulting in a uniform product in granulometric and chemical terms. The particles exit with the required powder granulometry after passing through the grids of the referred-to equipment.

## 17.1. Plant 3 Scenario (10 Mtpy)

In the Plant 3 Scenario, the entire process will have the capacity to process 10 Mtpy of Ore, with the addition of other nutrients, and will have an effective performance level of 83%. The product will be transported by road from São Gotardo to farmers. The plants in this scenario, despite being modular, will be installed adjacent to each other and will transfer the crushed material to the feeder for the grinding plant and then to the mixing plant. In year 22 of the project, both plants will be relocated, with new units being built and the previous ones being deactivated. Figure 17.1-1 presents a diagram of the interaction between the plants.

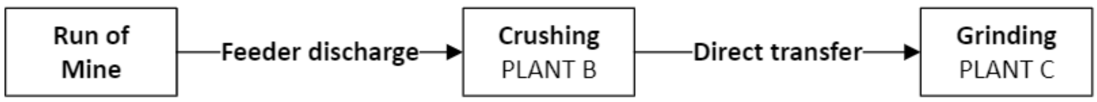


**Figure 17.1-1 Diagram for Plant 3 Scenario**

The master plan is presented in Figure 17.1-2:

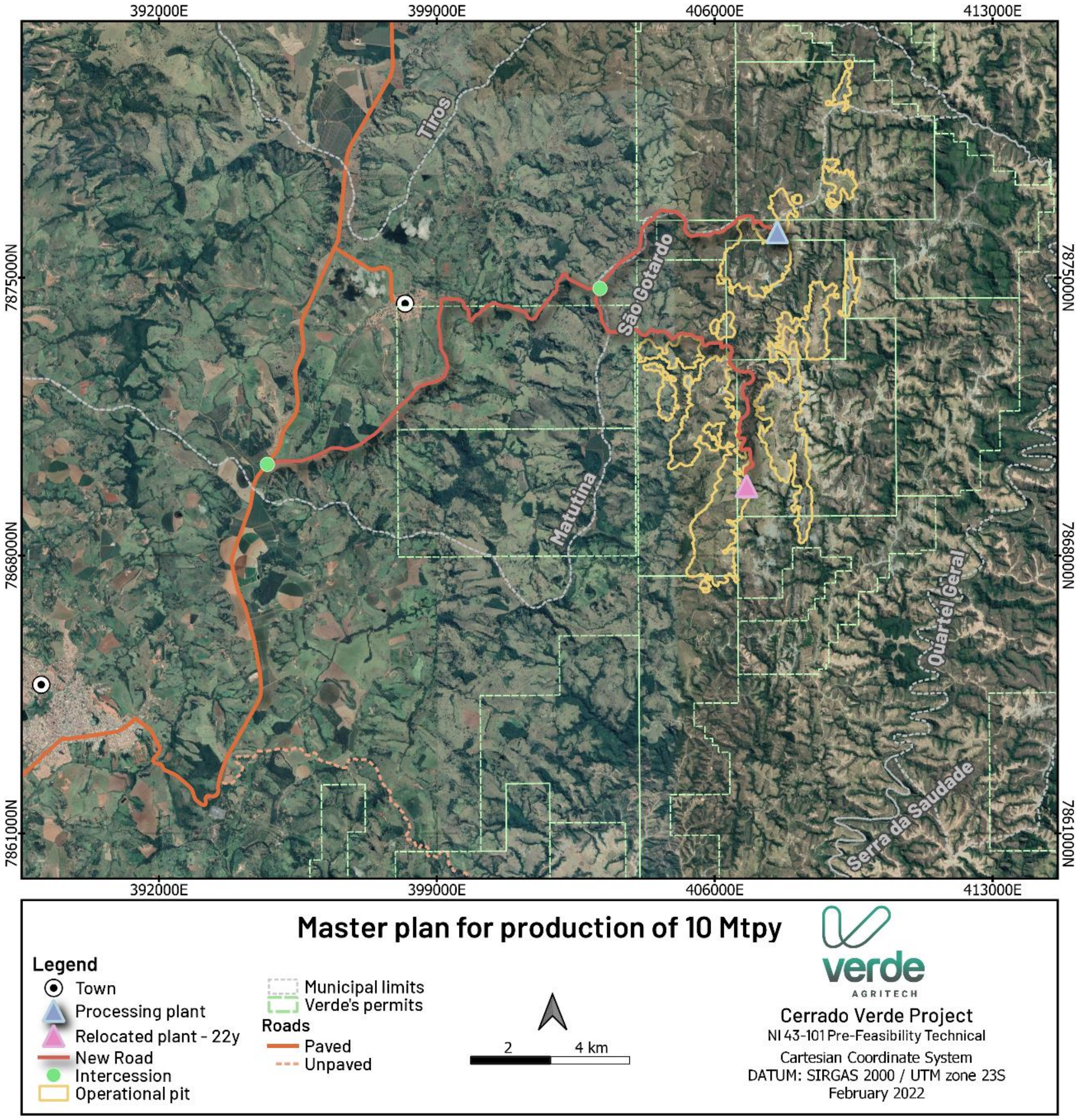


**Figure 17.1-2 Master plan for Plant 3 Scenario**

## 17.2. 23 Mtpy Scenario (23 Mtpy)

In the 23 Mtpy Scenario, the entire process will have the capacity to process 23 Mtpy of Ore, with the addition of other nutrients, and will have an effective performance level of 83%. In this scenario, three production units are planned. Two new units with a capacity to produce 10 Mtpy each along with the third unit comprise the plant under construction, which is expected to be completed in the third quarter of 2022 and which will start with a capacity of 2.5 Mtpy. This will be followed by an expansion expected to begin as planned for this scenario in 2025. This expansion will result from the deactivation and transfer of equipment from the initial unit (called plant 0) to the new production unit. The plants in this scenario, despite being modular, will be installed adjacent to each other and will transfer the crushed material to the feeder for the grinding plant and then to the mixing plant. Figure 17.2-1 presents a diagram of the interaction between the plants. The product will be transported by road from São Gotardo to farmers.

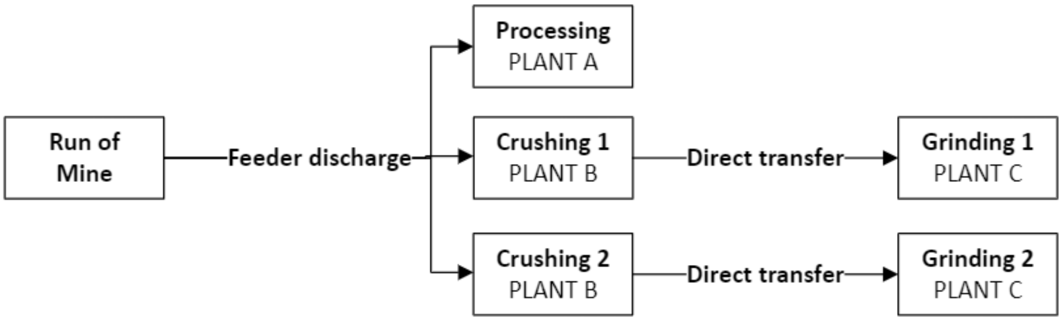


**Figure 17.2-1 Diagram for 23 Mtpy Scenario**

The master plan is presented in Figure 17.2-2:

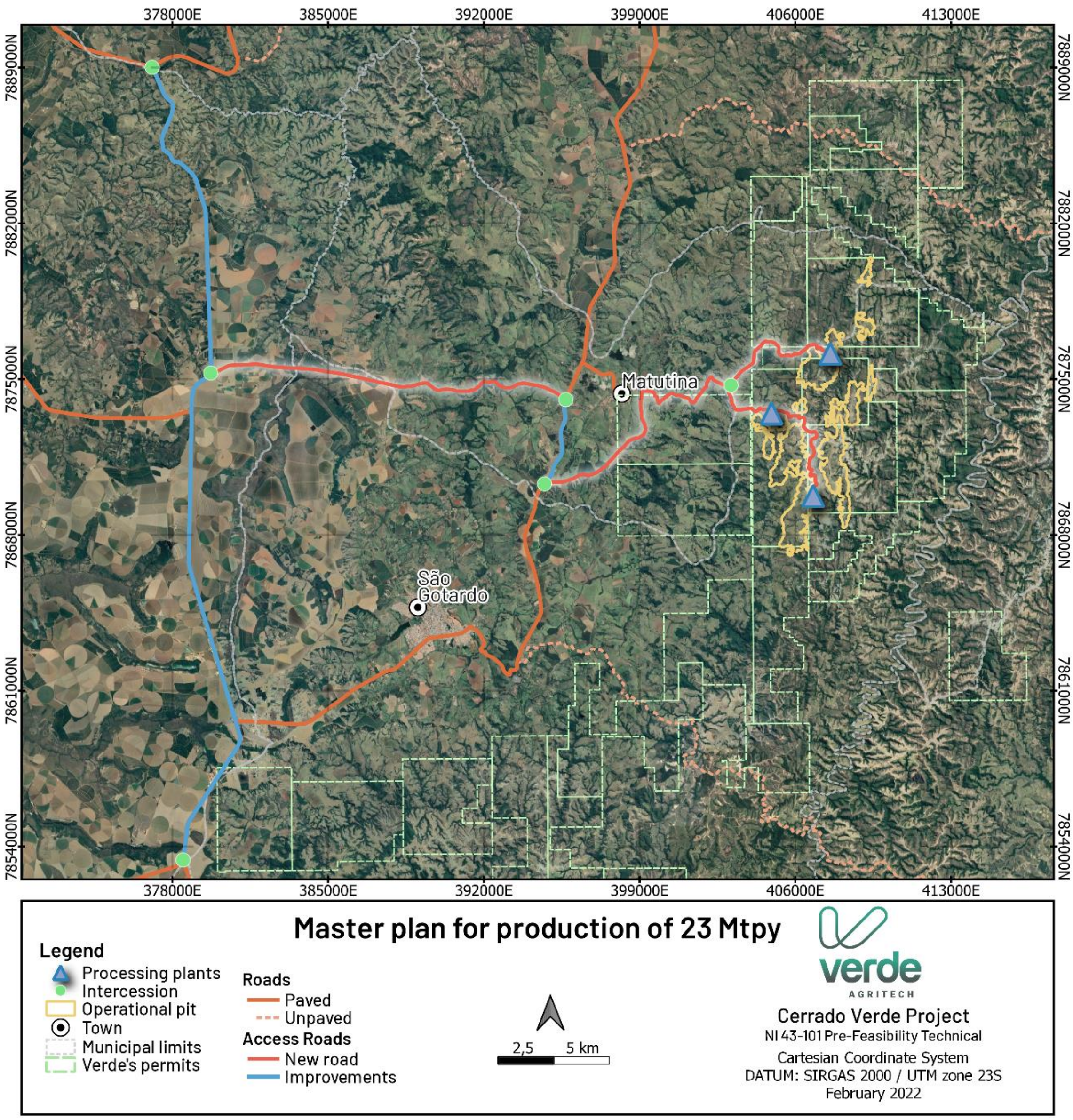


**Figure 17.2-2 Master plan for 23 Mtpy Scenario**

# 17.3. 50 Mtpy Scenario (50 Mtpy)

In the 50 Mtpy Scenario (50 Mtpy), the entire process will have the capacity to process 50 Mtpy of Ore, with the addition of other nutrients and will have an effective performance level of 83%. Only 10 Mtpy of product will be transported by road from São Gotardo to farmers, as this is the amount the current infrastructure in the region will allow. The grinding and mixing units will be split into another 5 units, with each one having 10 Mtpy of production capacity. One of these will remain in São Gotardo and the others will be located in four different cities, with the crushed material being transferred by rail. A long-distance belt conveyor will be used to feed the grinding plant and railcar loading system. Figure 17.3-1 presents a diagram of the interaction between the plants. The master plan is presented in Figure 17.3-2.

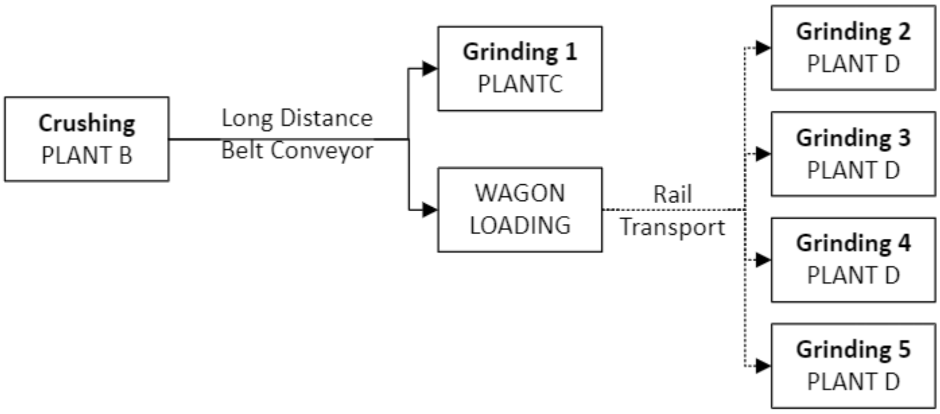


**Figure 17.3-1 Diagram for 50 Mtpy Scenario**

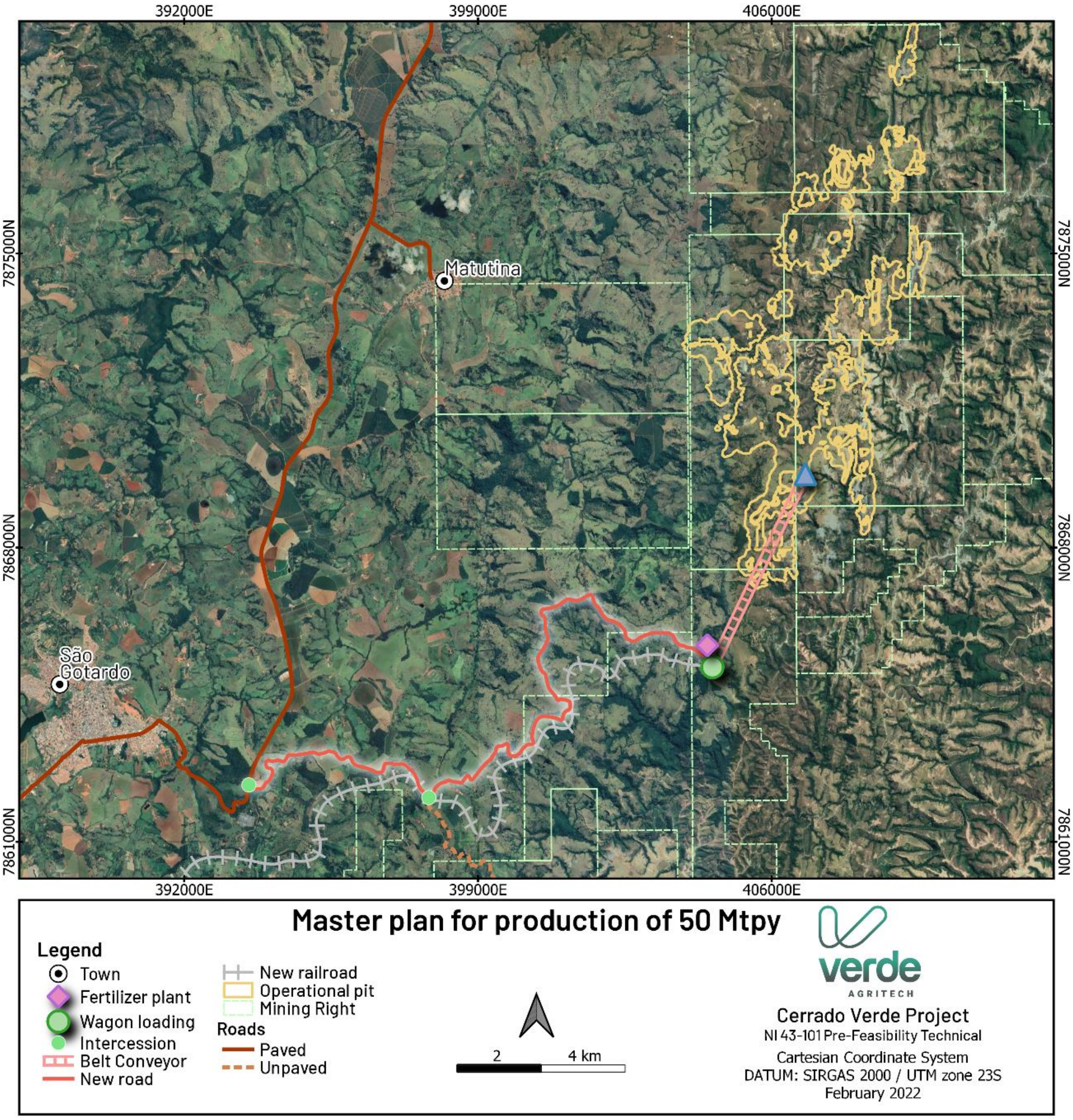


**Figure 17.3-2 Master plan for 50 Mtpy Scenario**

# 17.4. Plants

## 17.4.1. Plant A (Crushing, grinding and mixing 3 Mtpy)

Plant A is the production unit currently being constructed by the company. It is scheduled to begin operations in the third quarter of 2022. It will initially have the capacity to produce 2.4 Mtpy, with an expansion planned for before the start of this project, following the deactivation of unit 1, which has a capacity of 600 Ktpy. This will allow the promised production of 3 Mtpy to be achieved.

ROM with a maximum particle size of 500 mm is unloaded by trucks directly into a feeder. Primary crushing is performed by a crusher. Subsequently, the material is fed a vibrating screen, from where it is classified to a buffer pile or, if it is still of an inappropriate size (> 50 mm), directed to a crusher. The crushed material travels along a belt conveyor, passes through a magnetic separator, and is directed to the hammer mill and sulphur and micronutrients are added. Grinding is done in a MM480 mill, which performs the comminution to the desired specifications (<2 mm). The particles exit with the required powder granulometry after passing through the equipment screens. The material processed by the

MM480 moves along a belt conveyor to a mixer/humidifier and then is allowed to free fall, forming a pile inside the bulk product storage shed.

### 17.4.2. Plant B (Crushing 10 Mtpy)

Plant B is a crushing unit and will have the capacity to process 1,400 t/h of Ore. The ROM will be fed to the primary crusher through a 125 m³ hopper and a vibrating feeder. Before crushing, the Ore will be classified by a roller screen and belt conveyors will direct the 80mm material to the product pile, while the retained Ore is fed to the impact crusher to achieve the desired granulometry (100% < 4”). Three 60” belt conveyors carry material from the crusher. Each of these is equipped with a magnetic separator that feeds three piles of crushed product. Two reclaimers and belt conveyors will be allocated to each pile, where they will allow the feeding of silos for the bulk loading of trucks and/or directing the crushed product stock to the grinding and mixing unit. The plant is also equipped with an air compressor (approximately 10 bar) and a bag filter with a capacity of 20,000 m³/h.

### 17.4.3. Plant C (Crushing 50 Mtpy)

Plant C is a crushing unit and will have the capacity to process 7,000 t/h of Ore. The ROM will be fed through two 160 m³ hoppers and, at each of these, a vibrating feeder will feed a roller screen that will direct the <80 mm material to the stockpiles, while the retained material goes to the impact crushers to achieve the desired granulometry (100% < 4”). From there, the roller screens, using 60" belt conveyors, will feed three impact crushers. An additional three belt conveyors, also 60" in width, will lead out from the crushed product piles. Two reclaimers and belt conveyors will be allocated to each pile, where the belt conveyor will feed the material to the railcar loading system. The plant is also equipped with two air compressors (approximately 10 bar) and two dust filters with a capacity of 75,000 m³/h.

### 17.4.4. Plant D (Grinding and mixing 10 Mtpy)

Plant D is a unit to produce fertilizers via grinding and mixing and will have the capacity to process 1,400 t/h. The 100% crushed material passing through 4" screen will be received by two sets of equipment, each containing a 125 m³ hopper and a vibrating feeder. This equipment will feed four lines, with each line containing a bucket elevator that will feed two silos through a bypass valve. These silos will feed the mills.

The process of mixing Sulphur and Micronutrients will feature the use of a loader that will be fed through a hopper and vibrating feeder and a diverter valve will supply five silos (one for each nutrient to be added). Integrating scales will be used for dosing the micronutrients and sulphur that will be mixed in a mixer and fed into four 150 m³ silos, each of which will hold a certain mixture. These mixtures will then be fed into small individual silos at each mill, which will individually dose the mount required.

A belt conveyor fitted with a directing valve will feed the ground and mixed material into the 40 m³ silos that will directly load the trucks in a continuous flow. In the event of any interruption in this loading system, any surplus will be directed to storage piles and will continue to be loaded using loaders.

### 17.4.5. Plant E (Grinding and mixing 10 Mtpy – with rail operation)

Plant E is a unit for the production of fertilizers via grinding and mixing and will have the capacity to process 1,400 t/h. The process flow is the same as that for Plant D, with exception of the transfer of crushed material originating from the crushing plant, which will be carried out by rail and unloaded by wagon tippers.

# 18. Project Infrastructure

## 18.1. Introduction

The selected site for the Cerrado Verde Project is a greenfield site with limited infrastructure, including existing gravel access roads.

The mining site is located approximately 320 km from Belo Horizonte. São Gotardo is the closest town, located 39 km west from the project site. The town belongs to the Triângulo Mineiro and Alto Paranaíba Mesoregion (Patos de Minas Microregion) and is located about 312 km from the state capital, Belo Horizonte. According to IBGE data, the city of São Gotardo had an estimated population in 2020 of 35,782 inhabitants. It is expected to be the main source of labor for the project. São Gotardo also has good infrastructure, with domestic electricity and telephone service available. In addition, the project is located very close to Patos de Minas (129 km away), the main city in the Alto Paranaiba area, which has a strong economic, cultural, educational and social environment.

The proposed infrastructure will support the mining, plant site and construction operations.

## 18.2. Mining Facilities

Ore mining operations, including Ore handling and transportation, are expected to be operated by third party contractors under the supervision of VERDE that will provide all the necessary facilities for this purpose.

## 18.3. Access Roads

The 2017 PFS evaluated the technical and financial aspects of achieving production of 25 Mtpy of product following the implementation of three expansion phases: 0.6 Mtpy in Phase 1; 5 Mtpy in Phase 2 and 25 Mtpy in Phase 3. The 2017 PFS stated that rail access would be necessary to achieve the desired 25 Mtpy production level.

However, a new study to determine the maximum capacity supported by the current regional highway network has been conducted. A trade-off for investments in improvements to and expansion of the road network has also been evaluated.

The objects of study were the highways LMG764, MG235, MG187, MG230, BR354, and BR262. State highways (MG), refer to roads under the jurisdiction of the state of Minas Gerais and administered by the Department of Buildings and Highways of the State of Minas Gerais (DER/MG). Federal Highways (BR) are under the jurisdiction of the Federal government and administered by the National Department of Transport Infrastructure (DNIT). Finally, the connecting state highways (LMG) are local roads that carry state highways through cities and towns.

The feasibility of using road transport for the distribution of up to 10 Mtpy using the current road network has been studied. New investments would expand the capacity of road transport to the planned level of the 23 Mtpy.

These investments would offer great benefits to local and regional communities. Currently, the logistics between the mine and the plant, which is located at LMG764, consist of roads with a natural (unpaved) surface. These roads undergo intermittent maintenance and water is sprayed from tanker trucks to control dust.

These investments will be explained in more detail in the description of each scenario.

Plant 3 Scenario

In the Plant 3 Scenario, improvements to the current access road are planned for the traffic of 9-axle road-trains. A highway with a length of 21 km would be constructed, including an additional lane in critical locations and adequate paving for the transport of 10 Mtpy of fertilizer. The relocation of the plant is planned for year 22. It will be necessary to expand the access road by a further 9.7 km.

23 Mtpy Scenario

In the 23 Mtpy Scenario, improvements to the current access road for the traffic of 9-axle road trucks is planned. A 21 km road and a 9.7 km branch would be constructed, both of which would include an additional lane at critical locations and adequate paving for the transport of 23 Mtpy of fertilizer to LMG-764. To connect the LMG-764 with the BR-354, a road with an additional lane and paving specifications would be constructed, reaching a fertilizer transport capacity of 23 Mtpy.

50 Mtpy Scenario

In the 50 Mtpy Scenario, the construction of a 25 km-long highway for the traffic of 9-axle road trucks is planned, including an additional lane in critical locations and paving specifications necessary for the transport of 10 Mtpy of fertilizers by road. The remaining 40 Mtpy will be shipped by rail.

## 18.4. Railroads

The 50 Mtpy Scenario, which will use the railway branch line for the transfer of crushed material to the fertilizer plants, includes the construction of a new 83 km stretch that connects VERDE's facilities in São Gotardo with FCA in the city of Ibiá. Additional studies will be carried out to assess the need for investments to expand the capacity of the current FCA network (1,538 km of railways), including improvements and/or double-track railways and the expansion of current assets.

## 18.5. HV Power Supply

The Cerrado Verde Project plant will be powered by the national grid system, connected through an exclusive transmission line from an existing grid substation close to the town in question (for example, from the CEMIG substation near the municipality of São Gotardo, for the griding unit and for 10 Mt plant site in both scenarios).

The new HV transmission line will be installed adjacent to the existing access road leading to the plant. Harmonic compensation regulations and power factor systems will be forecast as cruised so that the operation of large equipment/heavy loads does not affect the basic system network and other consumers.

The energy demand for each Phase of the project is presented in

**Table** 18.5-1:

**Table 18.5-1 Estimated energy consumption for each Project Scenario**

| Scenario | Production (Mtpy) | Energy Consumption (kW) |
|---|---|---|
| 1 | 10 | 9,442 |

| | | |
|---|---|---|
| 2 | 50 | 46,723 |

## 18.6. Water Supply

The recovery methods are mainly through dry processing. The water at the Project will be required for dust control and domestic purposes and will be obtained from duly licensed rivers and wells.

## 18.7. Process Plant Facilities

VERDE will not build a large-scale plant for the different scenarios, as a modular scalable approach will be adopted. The modules will have a 10 Mtpy capacity, each with an independent CAPEX and OPEX.

The main infrastructure required for the operation of the process plant are as follows:

- Plant roads.
- Administration building.
- Maintenance workshop and warehouse building.
- Power distribution.
- Main entrance and security.
- Communications.
- Refueling facility.

### 18.7.1. Plant Roads

Plant roads will be cleared of vegetation and compacted, allowing access to the required plant areas. Drainage ditches and culverts will be installed in accordance with the site drainage requirements.

### 18.7.2. Administration Building

The administration building will be a single-story prefabricated construction. The building will include general areas for engineering, administrative personnel and a medical facility. The medical facility will allow for the treatment of any injuries.

### 18.7.3. Maintenance Workshop and Warehouse Building

This building will have a workshop equipped to enable the repair of plant equipment, as well as the fabrication of some parts. The workshop will be housed in be a steel frame building. Offices for the warehouse, maintenance and planning personnel will be provided in the form of a prefabricated building housed within the steel frame building. Washrooms and change rooms will also be provided.

### 18.7.4. Power Distribution

Power distribution consists of a main substation receiving the 13.8 kV power feed and will feature an outdoor oil-filled transformer, MCCs (Motor Control Centers), main distribution boards, local circuitry at 440 V, distribution panels and local control devices. All electrical distribution wiring/cabling will be run through cable trays and will be in the form of steel wire armored PVC cables.

The MCCs will feature a motor management system, motor starters, contactors, transformers, panels, and circuit breakers.

### 18.7.5. Main Entrance and Security

The entire process plant site will be enclosed by a fence. There will only be one main entrance gate where a weigh station will be provided for weighing incoming and outgoing delivery trucks.

### 18.7.6. Communications

A radio communication system will be provided for the initial phases of the project. VERDE will install a system that meets its needs at a later date.

### 18.7.7. Refueling Facility

A refueling facility will be installed at the plant. This refueling facility is to be supplied and operated by an external contractor.

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# 19. Market Studies and Contracts

## 19.1. Introduction

The Study calculated the potential Brazilian agricultural market for $K_2O$, Sulphur and Micronutrients. Sulphur and Micronutrients are added to the Product to produce BAKS®, which was launched by the Company on December 15, 2020, and has a higher selling point. The additional elements contained in BAKS® allow Verde to meet the specific demands of different crops and soil conditions, thereby boosting the overall Brazilian market serviceable by the Products.

BAKS® has a proprietary elemental sulphur micronization technology called MicroS Technology®. The application of micronized sulphur resulted in a higher number of pods per plant, grains per plant, and grain yield per pod compared to pelleted sulphur sources (IBANEZ, 2020).

The Ore has a high glauconite content. This mineral has been used in the United States as a fertilizer since 1760 (TEDROW, 2002). The Product has properties that aid the development and nutrition of plants, in addition to promoting improvement of the soil structure (VIOLATTI, et al., 2019; ARRIETA et a., 2020). The Product's silicon is an important nutrient that increases crop resistance to pests and diseases and protects the crop against climate change (SACALA et al., 2009; SILVA et al., 2015). The Product is free of sodium and chlorine and does not result in acidification, leaching, compaction, or increased salinity (SCI et al., 2019). In addition, it possesses a residual effect from the nutrients. It also has a large surface area and high water and ion retention capacity (TEDROW, 2002), which favors microbial development (SATINATO and ANDREOTE, 2020). It plays fundamental roles in the healthy growth of plants, in addition to contributing to the fixation of carbon in the soil, thus contributing to a reduction in the effects of climate change on the planet (FERNANDEZ-BASTERO et al., 2008).

Potassium is an essential element for plant development, it is most commonly sourced as Potassium Chloride (KCl). Together with nitrogen and phosphorus, potassium forms the trio of the most widely used primary macronutrients in agriculture. Brazil is one of the world's largest food producers and the second-largest importer of KCl (KULAIF & GÓES, 2016). KCl is not the most suitable fertilizer for tropical agriculture because it causes soil acidification and salinization. Furthermore, as it is highly soluble in water, KCl is easily leached into the deeper layers of the soil, which reduces the availability of potash for plants (KHAN et al., 2013).

Fertilization with sulphur is essential in the management of soil nutrition, as Brazilian soils contain low levels of this nutrient It is a secondary macronutrient and the fourth most consumed nutrient by plants in their growth processes. Sulphur is essential for the synthesis of amino acids, proteins, and vitamins. Hydrogen sulfide groups (-SH) are usually part of the active sites of enzyme molecules and provide plants with greater resistance to low temperatures. Sulphur has little mobility in the plant and, as a result, when deficient it causes a generalized and uniform yellowing of the youngest leaves. Additionally, the leaves can be small with a curl at the margins and the plant can suffer from necrosis, and defoliation, a reduction of internodes and flowering and less nodulation in legumes (PIAS et al., 2019).

The term “micronutrient” is therefore derived only from the small amount demanded by crops of these elements (hence the prefix “micro”), but they are equally essential as primary and secondary macronutrients, such as potash and sulphur, respectively, which are used in much larger amounts (hence the prefix “macro”). The main micronutrients used in Brazilian agriculture for soil fertilization are boron (B), copper (Cu), zinc (Zn) and manganese (Mn).

Agronomically, the main functions attributed to boron are related to carbohydrate metabolism and sugar transport. Boron affects the activity of phytohormones and plays an important role in flowering and in the growth of pollen tubes, which in some species is necessary for fertilization. Boron is also necessary for the processes of cell division, cell formation and maturation (KADYAMPAKENI, 2020). The main functions of copper and zinc are related to enzymatic activities, which are essential for plant metabolism. Copper and zinc are thus involved in many processes such as photosynthesis, respiration, carbohydrate distribution, nitrogen reduction and fixation, protein metabolism and cell wall formation (KUMAR et al., 2021). The involvement of manganese is essential for the synthesis of chlorophyll and in the photosynthetic system. It is related to the activation of enzymes, accelerates germination, and increases plant resistance (KUMAR et al., 2021).

This chapter contains the results of a market study conducted to collect information for the evaluation of three scenarios to produce fertilizers that serve as sources of Potash, Sulphur and Micronutrients.

For the Plant 3 Scenario (with a production level of 10 Mpty) and the 23 Mtpy Scenario, the product will have a guaranteed minimum content of 10% $K_2O$ and sales distribution by road transport. For the 50 Mtpy Scenario, two products are considered, with minimum guaranteed contents of 10% and 9% of $K_2O$, respectively, resulting in an average content of 9.19% $K_2O$, with sales distribution based on both road and rail.

The main objectives of this chapter are:

- Present the methodologies used in the study to define the demand projection, weighted average FOB, and selection of the company's market share.
- Carry out an assessment of the market for potash, sulphur, zinc, boron, copper, and manganese fertilizers.
- Estimate the projected size of the Brazilian market.
- Evaluate price behavior.
- Present product pricing assumed market share and FOB for both scenarios.

## 19.2. Methodology

### 19.2.1. Background

The main sources of agricultural data used as the primary source are the *Levantamento Sistemático da Produção Agrícola* (Systematic Survey of Agricultural Production – LSPA), which provides estimates of the planted area, harvested area, quantity produced and average product yields and data from the *Laboratório de Processamento de Imagens e Geoprocessamento/Universidade Federal de Goiás* (Image Processing and Geoprocessing Laboratory /Federal University of Goiás – LAPIG/UFG). The data included in this study are summarized in Table 19.2.1-1. The main crops planted in Brazil and that are the country's top five consumers of potash, sulphur, and micronutrients are soybean, corn, coffee, cotton, and sugarcane, which combined correspond to 75.75% of the planted area in the country.

**Table 19.2.1-1 Planted area and production of main crops in 2020**

| Crop | Area (ha) | Production (tonne) | Area (%) |
|---|---:|---:|---:|
| Soy | 38,186,249 | 130,307,166 | 41.50% |
| Corn | 18,459,739 | 102,904,808 | 20.10% |
| Coffee | 1,927,356 | 3,724,967 | 2.10% |
| Cotton | 1,452,770 | 5,923,567 | 1.60% |
| Sugar cane | 9,690,837 | 677,916,429 | 10.50% |
| **Subtotal 5 main crops** | **69,716,951** | **920,776,937** | 75.75% |
| Forest industry | 9,002,593 | - | 9.80% |

| Crop | Area (ha) | Production (tonne) | Area (%) |
|---|---:|---:|---:|
| Fruit | 988,622 | 15,422,331 | 1.10% |
| Bean | 2,751,967 | 2,867,528 | 3.00% |
| Wheat | 2,377,560 | 6,159,544 | 2.60% |
| Rice | 1,686,354 | 10,978,402 | 1.80% |
| Orange | 643,544 | 15,745,940 | 0.70% |
| Vegetables | 539,810 | 155,920 | 0.60% |
| Sorghum | 877,709 | 2,748,747 | 1.00% |
| Banana | 466,553 | 6,718,160 | 0.50% |
| Rubber tree | 153,185 | 332,861 | 0.20% |
| Tobacco | 343,447 | 723,226 | 0.40% |
| Potato | 123,517 | 3,843,856 | 0.10% |
| Cocoa | 629,565 | 280,661 | 0.70% |
| Sunflower | 50,947 | 83,437 | 0.10% |
| Manioc | 1,331,797 | 18,804,632 | 1.40% |
| Tomato | 55,671 | 3,956,559 | 0.10% |
| Barley | 103,702 | 378,877 | 0.10% |
| Peanut | 178,126 | 637,888 | 0.20% |
| triticale | 13,058 | 34,474 | 0.00% |
| **Subtotal main crops** | **92,034,678** | **92,034,678** | **100.00%** |
| Pastures | 175,040,000 | 175,040,000 | |
| **Total area** | **267,074,678** | **267,074,678** | |

Sources: LSPA, LAPIG/UFG and Tec-Fértil, 2022

Table 19.2.1-2 contains a breakdown of data on the area and production of grain crops (soybeans, corn, cotton, rice, sorghum, wheat, triticale, barley, peanuts, beans, and sunflowers), other temporary crops, perennial crops and pastures, by state and region, with an emphasis on the South, Southeast and Midwest regions.

**Table 19.2.1-2 Planted areas and production grouped by state and region**

| States | Yearly | | Other temporary | Perennial crops | Pastures | TOTAL |
|---|---|---|---|---|---|---|
| | Area (ha) | Production (tonne) | Area (ha) | Area (ha) | Area (ha) | Area (ha) |
| Rio Grande do Sul (RS) | 8,891,194 | 33,927,219 | 270,655 | 1,010,453 | 13,500,000 | 23,672,301 |
| Santa Catarina (SC) | 1,280,954 | 6,576,204 | 130,492 | 708,837 | 1,200,000 | 3,320,283 |
| Paraná (PR) | 9,850,700 | 39,595,100 | 276,357 | 1,672,212 | 3,300,000 | 15,099,269 |
| **Total South (S)** | **20,022,848** | **80,098,523** | **677,503** | **3,391,502** | **18,000,000** | **42,091,853** |
| Minas Gerais (MG) | 3,702,884 | 16,351,860 | 139,053 | 4,165,438 | 22,400,000 | 30,407,376 |
| Espírito Santo (ES) | 22,820 | 47,819 | 20,275 | 745,166 | 1,550,000 | 2,338,261 |
| Rio de Janeiro (RJ) | 3,078 | 9,690 | 59,444 | 131,028 | 1,680,000 | 1,873,550 |
| São Paulo (SP) | 2,450,692 | 9,569,785 | 245,019 | 7,419,482 | 6,120,000 | 16,235,193 |
| **Total Southeast (SE)** | **6,179,474** | **25,979,154** | **463,792** | **12,461,114** | **31,750,000** | **50,854,381** |
| Mato Grosso do Sul (MS) | 5,277,718 | 22,529,655 | 49,580 | 1,811,317 | 16,700,000 | 23,838,615 |
| Mato Grosso (MT) | 17,026,183 | 73,461,473 | 26,706 | 574,630 | 21,900,000 | 39,527,519 |
| Goiás (GO) | 5,912,263 | 25,837,193 | 43,650 | 1,137,175 | 13,900,000 | 20,993,088 |
| Distrito Federal (DF) | 162,600 | 836,612 | 8,973 | 1,675 | 132,000 | 305,247 |
| **Total Midwest (MW)** | **28,378,764** | **122,664,933** | **128,909** | **3,524,797** | **52,632,000** | **84,664,469** |
| Alagoas (AL) | 80,619 | 107,949 | 67,323 | 315,924 | 1,050,000 | 1,513,867 |
| Bahia (BA) | 3,103,115 | 10,660,182 | 190,606 | 1,606,944 | 17,050,000 | 21,950,665 |
| Ceará (CE) | 985,646 | 478,708 | 83,100 | 125,882 | 3,390,000 | 4,584,628 |
| Maranhão (MA) | 1,627,906 | 5,661,887 | 71,780 | 301,299 | 8,850,000 | 10,850,985 |
| Paraíba (PB) | 187,625 | 152,304 | 25,433 | 143,229 | 1,745,000 | 2,101,287 |
| Pernambuco (PE) | 371,026 | 128,664 | 73,869 | 331,919 | 2,662,000 | 3,438,814 |
| Piauí (PI) | 1,598,545 | 5,232,789 | 50,445 | 50,260 | 2,690,000 | 4,389,250 |
| Rio Grande do Norte (RN) | 114,572 | 55,365 | 31,676 | 144,295 | 1,284,000 | 1,574,543 |
| Sergipe (SE) | 164,153 | 884,531 | 21,803 | 125,116 | 1,003,000 | 1,314,071 |
| **Total Northeast (NE)** | **8,233,207** | **23,362,379** | **616,034** | **3,144,869** | **39,724,000** | **51,718,110** |
| Acre (AC) | 44,883 | 107,221 | 27,388 | 12,799 | 1,513,000 | 1,598,070 |
| Amapá (AP) | 24,610 | 55,886 | 14,004 | 71,034 | 68,000 | 177,648 |
| Amazonas (AM) | 17,061 | 28,457 | 112,021 | 41,587 | 1,105,000 | 1,275,669 |
| Pará (PA) | 977,873 | 2,917,187 | 301,421 | 487,521 | 16,000,000 | 17,766,815 |
| Rondônia (RO) | 693,829 | 2,598,235 | 24,279 | 116,652 | 6,500,000 | 7,334,760 |
| Roraima (RR) | 51,866 | 174,369 | 9,658 | 46,365 | 518,000 | 625,889 |
| Tocantins (TO) | 1,513,766 | 5,038,094 | 19,233 | 204,015 | 7,230,000 | 8,967,015 |
| **Total North (N)** | **3,323,888** | **10,919,449** | **508,004** | **979,973** | **32,934,000** | **37,745,865** |
| **Total BRAZIL** | **66,138,181** | **263,024,438** | **2,394,242** | **23,502,255** | **175,040,000** | **267,074,678** |

Sources: LSPA, LAPIG/UFG and Tec-Fértil, 2022

In addition to the parameters of planted areas, production, and productivity, qualitative fertilization values are considered based on the levels of technology applied to the crops and the fertilizer use profile, establishing dosage levels and adoption rates for each situation.

A dose is the average amount of each of the nutrients used in the fertilization of different crops, separated by state, based on the profile of the fertilizers used. The term “Adoption Rate”, on the other hand, refers to the percentage of producers who make use of each nutrient, depending on crop and supply requirements and fertilization alternatives.

### 19.2.2. Demand projection

Due to the high correlation between fertilizer use and agricultural production, demand for fertilizers, can be calculated based on estimated future agricultural production. Among the different forecasts for agricultural production, two are especially noteworthy: “Agribusiness Projections”, which is revised annually by MAPA, and “Outlook FIESP – Projections for Brazilian Agribusiness”, which is prepared by the Federation of Industries of the State of São Paulo (FIESP). Both reports were revised in 2020 and contain forecasts for the 2029/30 crop and therefore relate to expected fertilizer use in 2029. Fertilizer demand results correlated with agricultural production were projected for 2029 and were adjusted for 2030 and 2031 based on the average growth projected for the period between 2020 and 2029.

From 2030 onwards, it is assumed that the most adequate projection for agricultural production is the growth of the world population. According to the Food and Agriculture Organization (FAO), Brazil plays an important role in supporting the increased supply of food to the world, as reflected historically with a continued year-on-year growth in food exports.

The population growth rates were also used to establish long-term fertilizer demand. These forecasts are based on the best assumptions available at the time of writing this report (Q4 of 2021) and need to be revised over time. A review of previous forecasts and results demonstrates that fertilizer demand projections in Brazil are generally exceeded by actual usage rates. This can be attributed to the global strength and competitiveness of Brazilian agriculture and improvements in logistics, in addition to favorable agricultural product market factors.

A breakdown of the abovementioned demand projections is provided below

- $K_2O$ in section 19.3.4;
- Sulphur in section 19.4.4; and
- Micronutrients in section 19.5.4.

### 19.2.3. Pricing

<u>$K_2O$</u>

As the Ore’s main nutrient is $K_2O$, the long-term price for the Product was defined based on the KCl price, and this price was used as a premise for the market analysis sequence, based on the price history and the farmer's ability to purchase the fertilizer through a “Farmer Exchange Rate”.

The “Farmer Exchange Rate” is, in short, the relationship between the sale price of a bag of agricultural production and the purchase price of a tonne of inputs used to grow the crop. In this analysis, lower and upper limits were established. The price of KCl is expected to fluctuate within these limits and the average figure was assumed for the calculations.

<u>Added Sulphur</u>

Different sulphur sources were analyzed based on price history and farmers' purchasing capacity based on the “Farmer Exchange Rate”. The most adequate source for indexing the value of VERDE's product would be S-Bentonite and it is therefore this source that has been shown to provide the greatest advantages for the supply of sulphur (see section 19.4.5). The source of the sulphur raw material will be S-elemental, which is micronized using a proprietary technology called Micro S Technology®. Lower and upper price limits were established for this material. Prices are expected to fluctuate within these limits during a period of stability, and the main figure was used as the assumption for the calculations performed.

Added Micronutrients

For the pricing of additional micronutrients, main sources were considered when establishing the sale price of the Product, as they are the raw materials frequently used in NPK formulation mixtures. To estimate long-term sales prices, analyses of quotations from different suppliers, exchange ratios and the main consumption rates were considered.

To price the nutrients that will be added to the Product, sources in their rawest state, such as oxides and borates, were considered. The company will make use of its production infrastructure and know-how in processing and generating added value to these raw materials. For the definition of long-term prices, analyses were carried out based on supplier quotations, the "Farmer Exchange Rate", the London Metal Exchange (LME) index, especially for zinc and copper, and data from Brazil's Ministry of Industry, Foreign Trade and Services (MDIC) on manganese exports. Statistical tools were used to assist with data processing and interpretation to estimate the long-term price for the micronutrients added to the Product.

A breakdown of the abovementioned pricing is provided below:

- $K_2O$ in section 19.3.5;
- Sulphur in section 19.4.5; and
- Micronutrients in section 19.5.5.

### 19.2.4. Application cost

The cost of applying fertilizers differs according to its physical form, i.e., whether they are granulated or powdered. Granular fertilizers are raw materials that are structured as granules or particles of a larger size. Powdered fertilizers are composed of smaller particles.

Although the smaller particle size of powder fertilizers brings several benefits when compared with granulated and even pelleted fertilizers, this smaller size requires farmers to be more diligent when of its application, thus resulting in a higher cost of application.

As for the advantages, the smaller the particles, the greater the contact area per unit mass of fertilizer. This increases the contact of the powder fertilizer with the soil, roots, and soil microorganisms, thus increasing the efficiency of the powder fertilizer. Powder fertilizers are also more evenly distributed in the soil. This prevents some areas from receiving too many nutrients while others receive less, which would result inappropriate fertilizer absorption (HECKMAN & TEDROW, 2004).

In addition, granular fertilizers are more prone to segregation when more than one type of granulate is mixed, which is common in NPK formulations. Segregation tends to separate smaller and less dense particles according to their size. Therefore, at the time of application, the distribution of nutrients in the soil is less uniform (THAPER et al.,2022).

The cost of applying the Product was compared with the cost of applying KCl. High-performance equipment was selected for the application of granulated fertilizers and also the possible application of powdered fertilizers.

The selected equipment was the fertilizer spreader HERCULES 10000 INOX, produced and marketed by Stara, and the towing tractor was the TRACTOR JD 6115J 4X4 CAB, produced and marketed by

John Deere. Other variables were considered, such as operating cost, speed, demand, application width, flow, and operating costs for recharge, among others.

A comparison of the application cost of the Product and of KCl will determine the value to be discounted in the final value attributed to the Product. Consequently, farmers will not have to bear this additional cost.

A detailed breakdown of application costs can be seen in section 19.6.3.

### 19.2.5. FOB

This item describes the methodology for calculating freight costs. For selected destinations, the IBGE methodology was adopted. This methodology divides Brazilian states into mesoregions, which group together neighbouring municipalities. The mesoregions selected for this study are summarized in Table 19.2.5-1. Based on this definition of mesoregions, quotes were requested from several operators in selected municipalities within each mesoregion, with the objective of defining the price of KCl and, consequently, the prices of the Product.

**Table 19.2.5-1 Selected mesoregions for the study**

| REGION | STATE | MESOREGIONS | | |
|---|---|---|---|---|
| South (S) | Rio Grande do Sul (RS) | Centro Ocidental Rio-grandense | Noroeste Rio-grandense | Sudeste Rio-grandense |
| | | Centro Oriental Rio-grandense | Nordeste Rio-grandense | Metropolitana de Porto Alegre |
| | | Sudoeste Rio-grandense | | |
| | Santa Catarina (SC) | Norte Catarinense | Serrana | Grande Florianópolis |
| | | Oeste Catarinense | Vale do Itajaí | Sul Catarinense |
| | Paraná (PR) | Centro Oriental Paranaense | Norte Pioneiro Paranaense | Centro-Sul Paranaense |
| | | Oeste Paranaense | Centro Ocidental Paranaense | Sudeste Paranaense |
| | | Noroeste Paranaense | Sudoeste Paranaense | Metropolitana de Curitiba |
| | | Norte Central Paranaense | | |
| Southeast (SE) | Minas Gerais (MG) | Noroeste de Minas | Campo das Vertentes | Oeste de Minas |
| | | Norte de Minas | Central Mineira | Vale do Mucuri |
| | | Sul/Sudoeste de Minas | Jequitinhonha | Vale do Rio Doce |
| | | Triângulo Mineiro/Alto Paranaíba | Metropolitana de Belo Horizonte | Zona da Mata |
| | Espírito Santo (ES) | Litoral Norte Espírito-santense | Central Espírito-santense | Sul Espírito-santense |
| | | Noroeste Espírito-santense | | |
| | Rio de Janeiro (RJ) | Noroeste Fluminense | Centro Fluminense | Sul Fluminense |
| | | Norte Fluminense | Baixadas | Metropolitana do Rio de Janeiro |
| | São Paulo (SP) | São José do Rio Preto | Piracicaba | Itapetininga |
| | | Ribeirão Preto | Campinas | Macro Metropolitana Paulista |
| | | Araçatuba | Presidente Prudente | Vale do Paraíba Paulista |
| | | Bauru | Marília | Litoral Sul Paulista |
| | | Araraquara | Assis | Metropolitana de São Paulo |
| Midwest (MW) | Mato Grosso do Sul (MS) | Centro Norte de Mato Grosso do Sul | Pantanais Sul Mato-grossense | Leste de Mato Grosso do Sul |
| | | Sudoeste de Mato Grosso do Sul | | |
| | Mato Grosso (MT) | Nordeste Mato-grossense | Sudoeste Mato-grossense | Sudeste Mato-grossense |
| | | Norte Mato-grossense | Centro-Sul Mato-grossense | |
| | Distrito Federal (DF) | Distrito Federal | | |
| | Goiás (GO) | Noroeste Goiano | Centro Goiano | Sul Goiano |
| | | Norte Goiano | Leste Goiano | |
| Northeast (NE) | Bahia (BA) | Extremo Oeste Baiano | Nordeste Baiano | Sul Baiano |
| | | Vale São-Franciscano da Bahia | Metropolitana de Salvador | Centro Sul Baiano |
| | | Centro Norte Baiano | | |
| | Piauí (PI) | Sudoeste Piauiense | Centro-Norte Piauiense | Norte Piauiense |
| | | Sudeste Piauiense | | |
| | Maranhão (MA) | Sul Maranhense | Leste Maranhense | Centro Maranhense |
| | | Oeste Maranhense | Norte Maranhense | |
| | Pernambuco (PE) | São Francisco Pernambucano | Sertão Pernambucano | Mata Pernambucana |

| REGION | STATE | MESOREGIONS | | |
|---|---|---|---|---|
| | | Metropolitana de Recife | Agreste Pernambucano | |
| | Alagoas (AL) | Leste Alagoano | Sertão Alagoano | Agreste Alagoano |
| | Ceará (CE) | Jaguaribe | Noroeste Cearense | Centro-Sul Cearense |
| | | Sul Cearense | Sertões Cearenses | Metropolitana de Fortaleza |
| | | Norte Cearense | | |
| | Rio Grande do Norte (RN) | Central Potiguar | Leste Potiguar | Agreste Potiguar |
| | | Oeste Potiguar | | |
| | Paraíba (PB) | Sertão Paraibano | Borborema | Mata Paraibana |
| | | Agreste Paraibano | | |
| | Sergipe (SE) | Leste Sergipano | Agreste Sergipano | Sertão Sergipano |
| North (N) | Pará (PA) | Sudeste Paraense | Nordeste Paraense | Marajó |
| | | Sudoeste Paraense | Metropolitana de Belém | Baixo Amazonas |
| | Tocantins (TO) | Ocidental do Tocantins | Oriental do Tocantins | |

Source: IBGE,2021

A detailed methodology for calculation of the FOB prices is discussed in detail for each scenario in the following sections:

- Plant 3 Scenario in section 19.7.4;
- 23 Mtpy Scenario in section 19.8.4; and
- 50 Mtpy Scenario in section 19.9.4.

### 19.2.6. Target Market

<u>$K_2O$</u>

After defining the total demand for $K_2O$ between 2020 and 2070 for each mesoregion, the cost of the product is calculated. Starting with São Gotardo/MG, where the VERDE's mine is predominantly located and which is considered the point of origin for logistics, and based on the pricing of KCl, the road freight is quoted for each mesoregion. Freight figures were classified in ascending order, which resulted in the calculation of the FOB price for each destination and, consequently, the weighted average FOB. Based on this information, following the Company's strategic planning process, ten marked share alternatives were analyzed for each of the three scenarios, to conduct a tradeoff between different market share alternatives and define the best performance strategy for the Company. To compare the impact of the market share within the selected mesoregions on the number of mesoregions needed to achieve the proposed production, the weighted average freight price was used, and the weighted average FOB price for each alternative was compared.

<u>Added Sulphur and micronutrients</u>

After defining VERDE's share of the potash market and the target mesoregions, the 26 crops with the highest fertilizer demand in Brazil were used to calculate the target demands for sulphur and micronutrients. Sulphur and micronutrients consumption in the same selected mesoregions were analyzed in light of the amount that will be supplied by VERDE based on the potassium that will be delivered to each mesoregion. This resulted in the target demands and, consequently, the market share for each nutrient across the domestic market.

Further information on the target markets can be found in the sections listed below:

- Plant 3 Scenario in section 19.7.3;
- 23 Mtpy Scenario in section 19.8.3; and
- 50 Mtpy Scenario in section 19.9.3.

# 19.3. Potassium

According to the International Fertilizer Industry Association (IFA), the global use of fertilizers (N + $P_2O_5$ + $K_2O$) was estimated at 198.2 Mt for 2020/21, almost 10 Mt (5.2%) higher than in 2019/20. For 2020/21, nitrogen use increased by 4.1% (4.3 Mt), resulting in a demand of 110.0 Mt; the demand for phosphorus increased by 7.0% (3.3 Mt), reaching 49.6 Mt; and the demand for $K_2O$ increased by 6.2% (2.2 Mt) to 38.5 Mt.

Economic growth rates were higher than projected in the first quarter of 2021 in both advanced and developing economies. The fertilizers' demand growth rate is expected to remain at 0.9% for 2021/22. The global use of fertilizers is expected to reach 199.9 Mt. In the period between 2021/22 and 2025/26, the annual growth in global demand for fertilizers is expected to remain around 1%. Growth rates are expected to be slightly higher for $K_2O$ than for $P_2O_5$ and N. Global fertilizer use is predicted to reach 208 Mt of nutrients by 2025/26.

The world's main source of potassium fertilizer is KCl, which is obtained by mining large deposits of salts such as sylvite, sylvinite, and carnallite. To a lesser extent, there are occurrences of sulfates, nitrates, and polysulphate. In Brazil, the consumption of KCl has been growing in line with the growth in the use of fertilizers and agricultural production. KCl consumption has been around 27% of total fertilizers used in Brazil and remains highly correlated, which suggests that $K_2O$ consumption should remain correlated with total fertilizer use. K2O consumption should thus be proportional to the increase in the use of fertilizers resulting from the growth of agricultural production in Brazil.

## 19.3.1. Production

In Brazil, according to the National Association for the Diffusion of Fertilizers (ANDA), the fertilizer market is largely supplied by international producers, with about 75% of all inputs being imported. In addition, in 2020 the country imported over 95% of all $K_2O$ consumed internally from different sources, as is shown in Table 19.3.1-1.

**Table 19.3.1-1 Brazilian production and imports of $K_2O$-based fertilizers**

| Products | | Total $K_2O$ (tonne) | | | | |
|---|---|---|---|---|---|---|
| | | **2016** | **2017** | **2018** | **2019** | **2020** |
| **National production** | KCl | 289,468 | 281,229 | 199,518 | 238,964 | 247,660 |
| | Potassium Sulfate | 0 | 0 | 0 | 0 | 0 |
| | **Subtotal - Production** | **289,468** | **281,229** | **199,518** | **238,964** | **247.660** |
| **Imports** | KCl | 5,262,630 | 5,521,853 | 6,005,866 | 6,120,421 | 6,567,446 |
| | KCl+B Mosaic Aspire | 0 | 0 | 0 | 0 | 75,303 |
| | KCl +B+Zn K+S Boozter | 0 | 0 | 0 | 0 | 4,753 |
| | K and Mg sulfate | 1,785 | 6,300 | 8,996 | 7,871 | 10,069 |
| | Potassium Sulfate | 11,851 | 17,841 | 5,430 | 10,305 | 13,053 |
| | Potassium saltpeter | 4,889 | 4,816 | 4,918 | 4,410 | 2,989 |
| | Potassium nitrate | 3,124 | 5,995 | 9,845 | 5,983 | 7,704 |
| | Polysulphate | 7,298 | 12,228 | 19,601 | 16,784 | 19,601 |
| | Composites | 123,650 | 146,185 | 183,823 | 222,222 | 194,004 |
| | **Subtotal Imports** | **5,415,226** | **5,715,217** | **6,238,479** | **6,387,995** | **6,894,921** |
| **Total** | | **5,704,694** | **5,996,446** | **6,437,997** | **6,626,959** | **7,142,581** |
| **% Domestic production** | | **5.07%** | **4.69%** | **3.10%** | **3.61%** | **3.47%** |
| **% Imports** | | **94.93%** | **95.31%** | **96.90%** | **96.39%** | **96.53%** |

Sources: ANDA and Tec-Fértil, 2022

### 19.3.2. Dosage

The average amount of $K_2O$ in kilograms per hectare used in fertilizing the different crops in each state is presented on Table 19.3.2-1, based on the profile of fertilizers used. In addition, the percentage of producers that have adopted the use of $K_2O$ in the dosage presented, due to the requirements of each crop, supply and fertilization alternatives is also presented. The adoption rate does not reach 100% due to crop management. Crop management techniques such as rotation, corrective management and even organic fertilization can eliminate the use of $K_2O$.

**Table 19.3.2-1 Dosage and Adoption Rate of $K_2O$ for the 5 main consumer crops in Brazil by state in 2020**

| Region | State | Soybeans | | Corn 1st harvest | | Corn 2nd harvest | | Sugarcane | | Coffee | | Cotton | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate |
| South | RS | 90 | 95% | 90 | 95% | 0 | 80% | 100 | 80% | 0 | 80% | 0 | 95% |
| | SC | 90 | 95% | 90 | 95% | 0 | 80% | 100 | 80% | 0 | 80% | 0 | 95% |
| | PR | 90 | 95% | 90 | 95% | 50 | 70% | 90 | 80% | 120 | 80% | 0 | 95% |
| Southeast | MG | 90 | 95% | 90 | 85% | 60 | 70% | 140 | 85% | 280 | 80% | 160 | 95% |
| | ES | 20 | 95% | 40 | 80% | 30 | 50% | 40 | 80% | 160 | 80% | 0 | 95% |
| | RJ | 20 | 95% | 40 | 80% | 30 | 50% | 40 | 80% | 120 | 80% | 0 | 95% |
| | SP | 80 | 95% | 60 | 85% | 50 | 60% | 100 | 80% | 180 | 80% | 140 | 95% |
| Midwest | MS | 100 | 95% | 90 | 90% | 60 | 60% | 140 | 85% | 120 | 80% | 160 | 95% |
| | MT | 100 | 95% | 80 | 80% | 60 | 60% | 140 | 85% | 120 | 80% | 190 | 95% |
| | GO | 90 | 95% | 90 | 90% | 60 | 60% | 140 | 80% | 200 | 80% | 160 | 95% |
| | DF | 90 | 95% | 100 | 90% | 60 | 60% | 140 | 80% | 180 | 80% | 0 | 95% |
| Northeast | AL | 80 | 95% | 10 | 82% | 20 | 50% | 100 | 80% | 15 | 80% | 50 | 95% |
| | BA | 100 | 95% | 100 | 70% | 60 | 40% | 80 | 80% | 280 | 80% | 180 | 95% |
| | CE | 40 | 95% | 20 | 25% | 20 | 60% | 60 | 60% | 40 | 80% | 10 | 95% |
| | MA | 95 | 95% | 90 | 70% | 60 | 50% | 100 | 80% | 0 | 80% | 180 | 95% |
| | PB | 20 | 95% | 20 | 25% | 10 | 60% | 100 | 80% | 0 | 80% | 20 | 95% |
| | PE | 20 | 95% | 15 | 30% | 15 | 30% | 100 | 80% | 60 | 80% | 10 | 95% |
| | PI | 90 | 95% | 80 | 70% | 60 | 50% | 100 | 80% | 0 | 80% | 150 | 70% |
| | RN | 20 | 95% | 15 | 25% | 10 | 60% | 100 | 80% | 0 | 80% | 100 | 50% |
| | SE | 20 | 95% | 15 | 82% | 50 | 70% | 80 | 80% | 0 | 80% | 0 | 95% |
| North | AC | 15 | 95% | 10 | 50% | 20 | 40% | 40 | 60% | 60 | 80% | 0 | 95% |
| | AP | 15 | 95% | 20 | 40% | 10 | 60% | 10 | 80% | 0 | 80% | 0 | 95% |
| | AM | 20 | 95% | 15 | 40% | 10 | 60% | 60 | 80% | 40 | 80% | 0 | 95% |
| | PA | 90 | 95% | 60 | 70% | 40 | 50% | 100 | 80% | 80 | 80% | 0 | 95% |
| | RO | 90 | 95% | 60 | 70% | 40 | 40% | 80 | 80% | 120 | 80% | 0 | 95% |

| Region | State | Soybeans | | Corn 1st harvest | | Corn 2nd harvest | | Sugarcane | | Coffee | | Cotton | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate |
| | RR | 80 | 95% | 50 | 70% | 50 | 60% | 40 | 80% | 0 | 80% | 120 | 95% |
| | TO | 90 | 95% | 60 | 70% | 40 | 60% | 140 | 80% | 0 | 80% | 140 | 95% |

Source: Tec-Fértil, 2022

The consumption of $K_2O$ by crop is presented on Table 19.3.2-2, with an emphasis on the main crops (soy, corn and sugarcane) that represent almost 75% of total demand.

**Table 19.3.2-2 $K_2O$ consumption in major crops in 2020**

| Crop | $K_2O$ (t) | Share % |
|---|---|---|
| Soy | 3,400,539 | 50.31% |
| Corn | 766,431 | 11.34% |
| Sugar cane | 870,912 | 12.89% |
| Coffee | 358,549 | 5.30% |
| Cotton | 253,712 | 3.75% |
| Vegetables | 45,193 | 0.67% |
| Rice | 120,461 | 1.78% |
| Beans | 63,083 | 0.93% |
| Wheat | 106,003 | 1.57% |
| Fruits | 42,432 | 0.63% |
| Others | 731,393 | 10.82% |
| **TOTAL** | **6,758,708** | **100.00%** |

Source: Tec-Fértil, 2022

## 19.3.3. Consumption

An evaluation of supply by region and by crop provides the information necessary to evaluate the best market development strategies for the Product. According to statistical data from ANDA, in 2020, 6.76 Mt of $K_2O$ were consumed in Brazil.

Among the five Brazilian geographic regions, the North, Northeast, Midwest, Southeast, and South the domestic demand for $K_2O$ is respectively 3.86%, 10.10%, 37.64%, 21.37%, and 27.03% (Table 19.3.3-1).

**Table 19.3.3-1 $K_2O$ demand for each state and subtotals for their respective regions**

| States / Regions | Total $K_2O$ | | | | | Accumulated 5 Years | Share |
|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | | |
| RS | 718,854 | 751,472 | 748,839 | 814,261 | 843,180 | 3,876,606 | 12.71% |

| States / Regions | Total $K_2O$ | | | | | Accumulated 5 Years | Share |
|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | | |
| SC | 116,038 | 126,341 | 123,174 | 135,751 | 134,745 | 636,049 | 2.08% |
| PR | 720,617 | 717,454 | 856,781 | 719,574 | 718,266 | 3,732,692 | 12.24% |
| **Subtotal S** | **1,555,509** | **1,595,267** | **1,728,794** | **1,669,586** | **1,696,191** | **8,245,347** | **27.03%** |
| MG | 599,251 | 601,849 | 542,275 | 634,699 | 710,279 | 3,088,353 | 10.12% |
| ES | 60,619 | 65,911 | 56,983 | 61,248 | 64,094 | 308,855 | 1.01% |
| RJ | 6,681 | 6,992 | 5,368 | 7,410 | 6,251 | 32,702 | 0.11% |
| SP | 606,839 | 644,983 | 583,130 | 591,376 | 662,461 | 3,088,789 | 10.13% |
| **Subtotal SE** | **1,273,390** | **1,319,735** | **1,187,756** | **1,294,733** | **1,443,085** | **6,518,699** | **21.37%** |
| MS | 364,456 | 343,312 | 320,936 | 406,505 | 459,853 | 1,895,062 | 6.21% |
| MT | 1,211,482 | 1,254,114 | 1,379,182 | 1,352,974 | 1,565,289 | 6,763,041 | 22.17% |
| GO | 540,522 | 528,334 | 585,822 | 584,930 | 549,764 | 2,789,372 | 9.14% |
| DF | 6,843 | 7,028 | 6,910 | 6,823 | 7,208 | 34,812 | 0.11% |
| **Subtotal CO** | **2,123,303** | **2,132,788** | **2,292,850** | **2,351,232** | **2,582,114** | **11,482,287** | **37.64%** |
| AL | 19,098 | 20,440 | 21,029 | 25,072 | 26,268 | 111,907 | 0.37% |
| BA | 311,561 | 320,761 | 341,732 | 335,632 | 352,508 | 1,662,194 | 5.45% |
| CE | 2,681 | 2,216 | 2,301 | 8,341 | 6,769 | 22,308 | 0.07% |
| MA | 108,257 | 115,888 | 126,670 | 104,294 | 174,904 | 630,013 | 2.07% |
| PB | 9,727 | 10,226 | 11,072 | 12,287 | 11,609 | 54,921 | 0.18% |
| PE | 26,438 | 24,033 | 24,885 | 29,638 | 27,525 | 132,519 | 0.43% |
| PI | 60,657 | 78,738 | 90,166 | 60,103 | 106,811 | 396,475 | 1.30% |
| RN | 6,162 | 6,129 | 5,832 | 7,211 | 8,538 | 33,872 | 0.11% |
| SE | 8,031 | 8,138 | 7,775 | 6,661 | 7,157 | 37,762 | 0.12% |
| **Subtotal NE** | **552,612** | **586,569** | **631,462** | **589,239** | **722,089** | **3,081,971** | **10.10%** |
| AC | 367 | 308 | 341 | 161 | 558 | 1,735 | 0.01% |
| AP | 3,327 | 2,568 | 2,945 | 1,748 | 2,865 | 13,453 | 0.04% |
| AM | 1,280 | 1,546 | 1,770 | 812 | 1,949 | 7,357 | 0.02% |
| PA | 79,106 | 79,444 | 83,376 | 72,930 | 113,293 | 428,149 | 1.40% |
| RO | 27,172 | 19,985 | 24,258 | 31,563 | 38,000 | 140,978 | 0.46% |
| RR | 1,852 | 997 | 2,349 | 1,307 | 3,584 | 10,089 | 0.03% |
| TO | 110,497 | 114,218 | 107,927 | 88,689 | 154,980 | 576,311 | 1.89% |
| **Subtotal N** | **223,601** | **219,066** | **222,966** | **197,210** | **315,229** | **1,178,072** | **3.86%** |
| **Total BRAZIL** | **5,728,415** | **5,853,425** | **6,063,828** | **6,102,000** | **6,758,708** | **30,506,376** | **100%** |

Sources: ANDA and Tec-Fértil, 2022

### 19.3.4. Demand projection

In a long-term projection and using as a reference the growth of the world population, it is estimated that in 2040 demand will exceed nine million tonnes. The role played by Brazil regarding the importance of supplying agricultural products to the world and the growth in demand for $K_2O$ are represented in Table 19.3.4-1.

**Table 19.3.4-1 Demand projection for $K_2O$ in Brazil**

| Year | World population | | Demand - $K_2O$ (t) | |
|---|---|---|---|---|
| | (X 1.000) | Annual growth rate | Annual growth rate | $K_2O$ tonnes |
| 2000 | 6,143,494 | - | Estimated[1] | 2,713,562 |
| 2010 | 6,956,824 | 1.25% | Estimated[1] | 3,999,706 |
| 2020 | 7,794,799 | 1.14% | Estimated[1] | 6,810,773 |
| 2030 | 8,548,487 | 0.93% | Projected[2] | 8,358,971 |
| 2040 | 9,198,847 | 0.74% | 1.47%[3] | 9,674,072 |
| 2050 | 9,735,034 | 0.57% | 1.14%[3] | 10,831,256 |
| 2060 | 10,151,470 | 0.42% | 0.84%[3] | 11,775,676 |
| 2070 | 10,459,240 | 0.30% | 0.60%[3] | 12,499,412 |
| 2071 | 10,484,655 | 0.30% | 0.60%[3] | 12,574,189 |

Sources: ANDA (Potash consumption from 2000 to 2020) and Tec-Fértil (Potash demand forecast up to 2070)

[1] Estimated consumption values

[2] Projected according to agribusiness growth forecast in Brazilf

[3] Projected with twice the global population growth rate, to preserve Brazil's share in the supply of agricultural products

### 19.3.5. KCl Pricing

Table 19.3.5-1 contains the historical FOB prices for imports into Brazil recorded by the Secretary of Foreign Trade (COMEX). The data refer to the landed product and, in November 2021 still did not reflect the increased demand observed by KCl producers. In addition to the higher price of the product, costs also rise with price increases of freight. There was also an increase in prices for internalization over time.

**Table 19.3.5-1 KCl FOB price history**

| MONTH | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 442.03 | 371.62 | 525.58 | 475.73 | 325.83 | 352.81 | 271.57 | 221.74 | 268.34 | 331.80 | 285.49 | 224.11 |
| February | 408.98 | 373.07 | 522.31 | 452.31 | 299.00 | 346.89 | 282.57 | 227.06 | 273.10 | 331.12 | 269.91 | 225.40 |
| March | 387.76 | 394.30 | 514.48 | 452.12 | 294.49 | 351.08 | 267.12 | 253.24 | 273.06 | 336.62 | 256.07 | 225.14 |
| April | 376.14 | 405.39 | 503.40 | 429.24 | 300.07 | 342.01 | 236.74 | 233.43 | 275.99 | 341.01 | 246.90 | 219.56 |
| May | 364.28 | 422.76 | 504.99 | 417.50 | 300.14 | 338.62 | 220.50 | 231.59 | 280.31 | 336.49 | 227.37 | 229.82 |
| June | 370.01 | 440.48 | 492.38 | 420.88 | 316.87 | 327.42 | 218.11 | 240.74 | 287.50 | 337.44 | 221.41 | 246.32 |
| July | 357.55 | 461.36 | 496.26 | 413.68 | 317.07 | 316.45 | 217.72 | 245.48 | 291.28 | 332.96 | 213.64 | 264.06 |

| MONTH | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| August | 354.28 | 486.68 | 497.35 | 408.54 | 327.54 | 316.14 | 215.27 | 265.75 | 293.11 | 328.07 | 210.08 | 299.42 |
| September | 357.60 | 512.75 | 496.67 | 401.45 | 331.03 | 320.43 | 214.84 | 262.01 | 298.72 | 323.21 | 209.04 | 363.00 |
| October | 345.89 | 504.56 | 492.67 | 370.38 | 335.35 | 305.44 | 217.17 | 258.38 | 303.44 | 313.75 | 214.74 | 437.79 |
| November | 341.82 | 525.29 | 490.12 | 364.77 | 341.72 | 298.89 | 215.34 | 257.53 | 314.43 | 311.69 | 221.22 | 475.11 |
| December | 357.50 | 520.22 | 484.24 | 349.73 | 345.93 | 288.02 | 220.34 | 258.59 | 321.73 | 291.82 | 220.19 | Not available |
| **Annual average** | **364.84** | **456.06** | **498.53** | **408.40** | **320.03** | **321.36** | **228.51** | **247.58** | **294.58** | **326.68** | **226.93** | **291.79** |

Sources: COMEX and Tec-Fértil, 2022

Given the tendency of KCl prices to demonstrate cyclical behavior affected by supply, demand and the profitability of farmers, any expectations for future prices should be based on all the variables that would affect these price-setting drivers and current prices are expected to retreat to a more comfortable level, considering the purchasing power of farmers that has been lost this year.

The price of KCl was analyzed over a historical range and it is projected that the lower limit will be US$308.24/t. At this price large producers tend to halt less profitable operations and, as a result, supply and, consequently, prices are Increased to sustain the market profitably. On the other hand, the upper price limit can be estimated at around US$359.06/t, a figure that should attract new investors, as well as generate interest in greater gains from producers in operation, which would in turn allow them to increase production capacity, inversely affecting prices by increasing supply. Based on the analysis of these limits, the long-term FOB (Baltic Sea/ Vancouver/ Ashdod) price is defined at US$ 333.65 per tonne (Figure 19.3.5-1).

Prices are influenced by the profitability of agricultural production and, as the KCl supply market is oligopolistic is nature, producers strive to increase prices. While the market has shown itself capable of accepting new prices, this escalation is expected to continue, until it is limited by increased supply from producers who wish to realize the biggest gains.

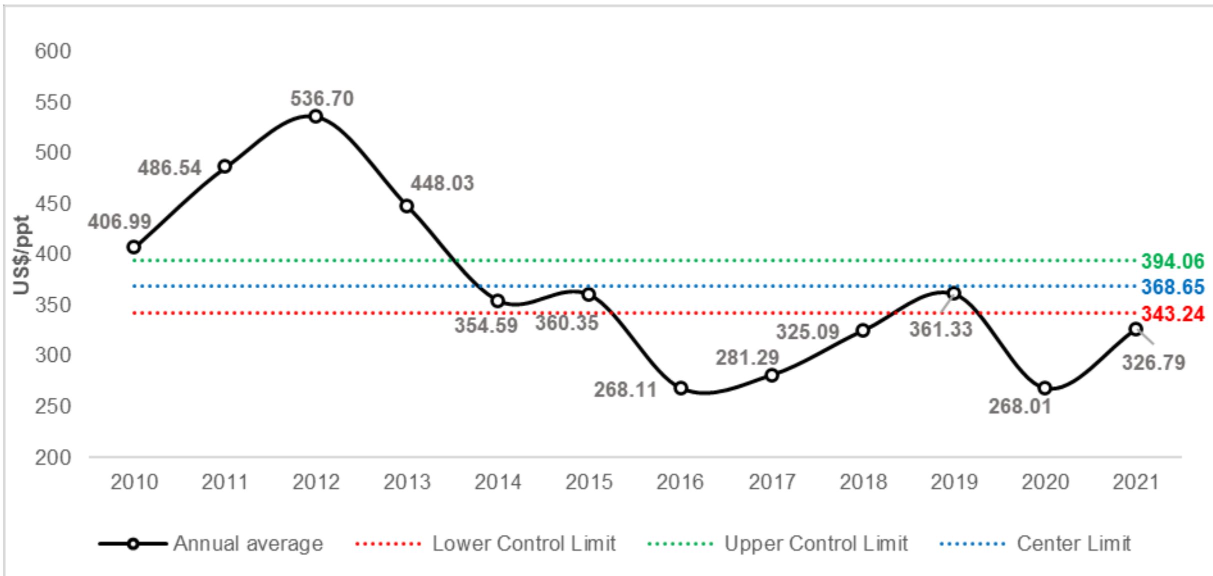


**Figure 19.3.5-1 KCl CFR Brazil port price fluctuation analysis and long-term price outlook**

It is widely recognized that domestic prices are determined by imports, foreign exchange rates and logistics costs. Considering the current state of international prices, the estimated potash prices are reflected in the following table, considering prices of around US$333.65/t FOB as the long-term price for KCl. A long-term cost for ocean freight of around US$35.00/t was assumed. Results in a CRF Brazil port price of US$368.65 per tonne of KCl, may vary between US$343.24 to 394.06 (Table 19.3.5-2).

**Table 19.3.5-2 Breakdown of KCl cost per tonne delivered in Brazil**

| Description | Amount in US$ | Amount in R$ |
|---|---|---|
| FOB Long-term price (Baltic Sea/ Vancouver/ Ashdod) | 333.65 | 1,768.35 |
| Sea freight long-term | 35.00 | 185.50 |
| **Subtotal - CFR Brazil Port Price** | **368.65** | **1,953.85** |
| Brazil Port costs | 25.07 | 132.87 |
| Demurrage | 6.00 | 31.80 |
| AFRMM Tax | 8.75 | 46.38 |
| Cost of transportation Port Brazil - distributor | 37.21 | 197.22 |
| Average added by blender/distributor | 81.48 | 431.85 |
| Average distributor - producer transportation cost | 12.00 | 63.60 |
| **Total - Weighted average delivered to the farmer** | **539.16** | **2,857.57** |

Source: Tec-Fértil, 2022

# 19.4. Sulphur

Brazil has a long history of experimentation with fertilizers involving Sulphur, beginning with the most traditional fertilizers promoted by the former Center for Research and Promotion of Ammonium Sulfate (SN), which aimed to promote the use of Ammonium Sulfate (SAM) or comparable products using Simple Superphosphate (SSP). More recently, with the expansion of new alternatives, there has been experiments with gypsum, elemental sulphur, sulphur in pellets and complex fertilizers that contain sulphur, among other. The sources of sulphur in fertilizers were products with sulfates in their composition. The sources of sulphur in fertilizers were products that contain sulfates. There is a long history of using SAM and SSP in Brazil.

With the increase in the consumption of fertilizers and the supply of other sources containing elemental sulphur, the use of these sources has been decreasing, especially SSP. This drop in usage is also seen for crops that do not require the use of nitrogen, such as soybeans, which in Brazil are the crops that consume the most fertilizers. Finally, farmers' interest in fertilizers with a higher concentration of the main nutrient, such as monoammonium phosphate (MAP) has also contributed to this reduction in the use of traditional sources sulphur.

As a result of the reduced use of SSP as a fertilizer, there was a considerable increase in the use of MAP, which does not contain sulphur. This means that its use is accompanied, when necessary, by a fertilizer product that meets the sulphur requirement, for example, MAP together with elemental sulfur or a sulfate.

## 19.4.1. Production

In Brazil, among the sources of sulphur for domestic agriculture, SSP is the main source produced domestically, with a secondary emphasis placed on Bentonite Sulphur (S-Bentonite). Regarding imports, there is a greater availability of sulphur in the form of SAM and in recent years there has been considerable growth in SSP imports in response to a decrease in the supply of products produced domestically, mainly in regions with growing logistics infrastructure to supply Midwestern markets. An analysis of this trade balance shows that domestic production only supplied 32% of domestic demand (Table 19.4.1-1).

**Table 19.4.1-1 Domestic production and imports of Sulphur-based fertilizers**

| Products | | Total S in tonnes | | | | |
|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 |
| Domestic Production | 24% SAM | 48,590 | 63,322 | 45,959 | 28,830 | 29,280 |
| | SSP | 523,474 | 468,068 | 470,791 | 468,743 | 412,093 |
| | Composites | 11,267 | 10,099 | 11,175 | 5,464 | 5,600 |
| | S-Bentonite | 64,800 | 68,400 | 72,000 | 85,500 | 103,500 |
| | **Subtotal - Production** | **648,131** | **609,889** | **599,926** | **588,537** | **550,473** |
| Imports | 24% SAM | 444,570 | 427,034 | 507,672 | 592,066 | 700,233 |
| | SSP | 86,173 | 85,944 | 123,601 | 148,815 | 127,182 |
| | Potassium Sulfate | - | - | 1,955 | 3,710 | 4,699 |
| | K and Mg Sulfate | - | - | 8,996 | 7,871 | 10,069 |
| | S-Bentonite | 34,499 | 54,215 | 66,637 | 76,876 | 96,422 |
| | Polysulphate | 9,904 | 16,595 | 26,601 | 22,778 | 26,601 |
| | Composites | 134,447 | 168,516 | **165,057** | 155,766 | 204,251 |
| | **Subtotal Imports** | **709,594** | **752,304** | **900,518** | **1,007,881** | **1,169,457** |
| **Total** | | **1,357,725** | **1,362,193** | **1,500,444** | **1,596,418** | **1,719,930** |
| **% Domestic production** | | **47.74%** | **44.77%** | **39.98%** | **36.87%** | **32.01%** |
| **% Imports** | | **52.26%** | **55.23%** | **60.02%** | **63.13%** | **67.99%** |

Source: ANDA and Tec-Fértil, 2022

## 19.4.2. Dosage

The average amount of sulphur in kilograms per hectare used in fertilizing different crops, broken down by state, is presented below. This breakdown is based on the profile of the fertilizers used, in addition to the percentage of producers that have adopted the use of sulphur in the dosage presented (adoption rate), due to the requirements of the crops, supply availability and fertilization alternatives. The adoption rate does not reach 100% due to crop management techniques such as rotation, corrective management and even organic fertilization, which can render the use of this nutrient unnecessary (Table 19.4.2-1).

**Table 19.4.2-1 Dosage and Adoption Rate of sulphur (in S) in the 5 main consumer cultures in Brazil by the state in 2020**

| Regions | State | Soybeans | | Corn 1st harvest | | Corn 2nd harvest | | Sugarcane | | Coffee | | Cotton | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate |
| South | RS | 20 | 90% | 28 | 85% | 0 | 80% | 15 | 50% | 0 | 80% | 0 | 80% |
| | SC | 20 | 90% | 32 | 85% | 0 | 80% | 15 | 50% | 0 | 80% | 0 | 80% |
| | PR | 20 | 90% | 40 | 90% | 20 | 70% | 15 | 50% | 40 | 80% | 15 | 90% |
| Southeast | MG | 24 | 90% | 30 | 85% | 20 | 60% | 20 | 50% | 50 | 80% | 45 | 90% |
| | ES | 20 | 90% | 20 | 80% | 15 | 50% | 15 | 50% | 45 | 80% | 30 | 90% |
| | RJ | 20 | 90% | 20 | 80% | 15 | 50% | 15 | 50% | 40 | 80% | 30 | 90% |
| | SP | 25 | 90% | 30 | 85% | 20 | 60% | 20 | 50% | 50 | 80% | 45 | 90% |

| Regions | State | Soybeans | | Corn 1st harvest | | Corn 2nd harvest | | Sugarcane | | Coffee | | Cotton | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate | kg/ha | Adoption rate |
| Midwest | MS | 27 | 90% | 40 | 85% | 20 | 50% | 20 | 50% | 30 | 80% | 45 | 90% |
| | MT | 27 | 90% | 30 | 80% | 20 | 50% | 20 | 50% | 30 | 80% | 50 | 90% |
| | GO | 27 | 90% | 40 | 90% | 20 | 60% | 20 | 50% | 40 | 80% | 45 | 90% |
| | DF | 27 | 90% | 40 | 90% | 20 | 60% | 20 | 50% | 40 | 80% | 40 | 90% |
| Northeast | AL | 20 | 90% | 10 | 82% | 10 | 50% | 20 | 50% | 15 | 80% | 10 | 90% |
| | BA | 30 | 90% | 40 | 70% | 20 | 30% | 20 | 50% | 50 | 80% | 50 | 90% |
| | CE | 20 | 90% | 20 | 25% | 25 | 60% | 20 | 50% | 15 | 80% | 10 | 90% |
| | MA | 26 | 90% | 30 | 70% | 20 | 50% | 20 | 50% | 0 | 80% | 45 | 90% |
| | PB | 20 | 90% | 10 | 25% | 10 | 60% | 20 | 50% | 0 | 80% | 10 | 90% |
| | PE | 20 | 90% | 10 | 30% | 10 | 30% | 20 | 50% | 15 | 80% | 10 | 90% |
| | PI | 26 | 90% | 30 | 70% | 20 | 50% | 20 | 50% | 0 | 80% | 40 | 90% |
| | RN | 20 | 90% | 10 | 25% | 10 | 60% | 20 | 50% | 0 | 80% | 10 | 90% |
| | SE | 20 | 90% | 15 | 82% | 30 | 70% | 20 | 50% | 0 | 80% | 10 | 90% |
| North | AC | 16 | 90% | 10 | 50% | 10 | 30% | 10 | 50% | 20 | 80% | 10 | 90% |
| | AP | 16 | 90% | 10 | 25% | 10 | 60% | 10 | 50% | 0 | 80% | 10 | 90% |
| | AM | 20 | 90% | 10 | 50% | 10 | 60% | 15 | 50% | 0 | 80% | 10 | 90% |
| | PA | 24 | 90% | 15 | 60% | 20 | 50% | 20 | 50% | 20 | 80% | 10 | 90% |
| | RO | 24 | 90% | 20 | 60% | 20 | 50% | 10 | 50% | 40 | 80% | 10 | 90% |
| | RR | 20 | 90% | 15 | 60% | 24 | 60% | 10 | 50% | 0 | 80% | 10 | 90% |
| | TO | 24 | 90% | 20 | 70% | 20 | 60% | 20 | 50% | 0 | 80% | 40 | 90% |

Source: Tec-Fértil, 2022

Table 19.4.2-2 contains figures on sulphur consumption by crop, with an emphasis on the main crops (soy and corn), which represent almost 65% of demand.

**Table 19.4.2-2 Sulphur demand by crop**

| Crop | Sulphur (t) | Share% |
|---|---|---|
| Soy | 839,961 | 49.30% |
| Corn | 257,126 | 15.10% |
| Sugar cane | 95,177 | 5.60% |
| Coffee | 74,039 | 4.30% |
| Cotton | 64,288 | 3.80% |

| Crop | Sulphur (t) | Share% |
|---|---|---|
| Vegetables | 47,113 | 2.80% |
| Rice | 35,544 | 2.10% |
| Beans | 33,571 | 2.00% |
| Wheat | 35,205 | 2.10% |
| Fruits | 27,632 | 1.60% |
| Others | 194,928 | 11.40% |
| **TOTAL** | **1,704,583** | **100%** |

Source: Tec-Fértil, 2022

### 19.4.3. Consumption

An evaluation of supply by region and crop provides the necessary information for an assessment of the best market development strategies for the Product. According to statistical data from ANDA (Table 19.4.3-1), in 2020, Brazil consumed 1.70 Mt of sulphur.

**Table 19.4.3-1 Sulphur demand in each state and subtotals for their respective regions**

| States / Regions | Total Sulphur | | | | | Accumulated | % Share |
|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | | |
| RS | 153,393 | 151,691 | 163,528 | 167,458 | 190,272 | 826,342 | 11.36% |
| SC | 34,806 | 33,619 | 34,816 | 34,620 | 37,502 | 175,363 | 2.41% |
| PR | 158,513 | 155,301 | 166,177 | 171,718 | 193,455 | 845,165 | 11.62% |
| **Total S** | **346,712** | **340,611** | **364,521** | **373,797** | **421,229** | **1,846,869** | **25.39%** |
| MG | 141,351 | 143,481 | 150,466 | 147,771 | 167,598 | 750,667 | 10.32% |
| ES | 19,393 | 21,406 | 20,191 | 17,730 | 19,616 | 98,335 | 1.35% |
| RJ | 6,743 | 6,707 | 6,690 | 6,897 | 7,176 | 34,213 | 0.47% |
| SP | 146,524 | 140,849 | 143,429 | 146,057 | 161,970 | 738,830 | 10.16% |
| **Total SE** | **314,011** | **312,443** | **320,776** | **318,456** | **356,359** | **1,622,045** | **22.30%** |
| MS | 72,104 | 73,864 | 83,380 | 101,422 | 119,015 | 449,785 | 6.18% |
| MT | 221,329 | 231,393 | 270,935 | 317,883 | 365,768 | 1,407,308 | 19.35% |
| GO | 103,942 | 104,183 | 118,915 | 131,766 | 143,013 | 601,818 | 8.27% |
| DF | 3,457 | 3,732 | 4,116 | 4,352 | 4,557 | 20,215 | 0.28% |
| **Total MW** | **400,832** | **413,173** | **477,346** | **555,422** | **632,353** | **2,479,125** | **34.08%** |
| AL | 4,617 | 4,489 | 5,062 | 4,577 | 5,050 | 23,794 | 0.33% |
| BA | 97,166 | 98,142 | 101,978 | 100,315 | 104,951 | 502,553 | 6.91% |
| CE | 10,575 | 10,590 | 10,156 | 9,783 | 10,237 | 51,340 | 0.71% |
| MA | 28,282 | 31,244 | 31,151 | 34,390 | 38,387 | 163,455 | 2.25% |
| PB | 3,671 | 3,497 | 3,828 | 3,442 | 3,729 | 18,165 | 0.25% |
| PE | 8,399 | 8,629 | 8,167 | 7,933 | 8,580 | 41,709 | 0.57% |
| PI | 23,949 | 24,814 | 25,051 | 29,373 | 33,233 | 136,420 | 1.88% |
| RN | 3,032 | 3,197 | 3,278 | 3,303 | 3,752 | 16,563 | 0.23% |

| States / Regions | Total Sulphur | | | | | Accumulated | % Share |
|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | | |
| SE | 6,722 | 6,022 | 5,997 | 5,946 | 6,629 | 31,316 | 0.43% |
| **Total NE** | **186,413** | **190,624** | **194,669** | **199,062** | **214,548** | **985,315** | **13.54%** |
| AC | 953 | 910 | 898 | 904 | 947 | 4,612 | 0.06% |
| AP | 862 | 923 | 914 | 844 | 866 | 4,409 | 0.06% |
| AM | 1,473 | 1,602 | 1,749 | 1,757 | 1,644 | 8,225 | 0.11% |
| PA | 21,751 | 22,360 | 22,212 | 26,090 | 27,025 | 119,437 | 1.64% |
| RO | 10,985 | 11,330 | 12,099 | 15,039 | 16,073 | 65,527 | 0.90% |
| RR | 1,032 | 1,149 | 1,223 | 1,346 | 1,365 | 6,116 | 0.08% |
| TO | 22,754 | 22,840 | 24,642 | 30,349 | 32,173 | 132,757 | 1.82% |
| **Total N** | **59,811** | **61,113** | **63,737** | **76,328** | **80,093** | **341,082** | **4.69%** |
| **Total BRAZIL** | **1,307,778** | **1,317,964** | **1,421,048** | **1,523,064** | **1,704,583** | **7,274,437** | **100%** |

Sources: Tec-Fértil, 2022

### 19.4.4. Demand projection

Based on a long-term projection and using as a reference the growth of the world population and the role attributed to Brazil in terms of its importance in supplying agricultural products to the world, the expected growth in demand for sulphur is shown in Table 19.4.4-1.

**Table 19.4.4-1 Projected demand for Sulphur in Brazil**

| YEAR | Annual growth rate | Sulphur (t) |
|---|---|---|
| 2020 | Estimated[1] | 1,794,297 |
| 2030 | Projected[2] | 2,239,164 |
| 2040 | 1.47%[3] | 2,591,447 |
| 2050 | 1.14%[3] | 2,901,428 |
| 2060 | 0.84%[3] | 3,154,415 |
| 2070 | 0.60%[3] | 3,348,286 |
| 2071 | 0.60%[3] | 3,554,073 |

Sources: ANDA (Potash consumption from 2000 to 2020) and Tec-Fértil (Potash demand forecast up to 2070)

[1] Estimated consumption figures

[2] Projected according to agribusiness growth forecast in Brazil

[3] Projected with twice the global population growth rate, to preserve Brazil's share in the supply of agricultural products

### 19.4.5. Sulphur Pricing

When the market consisted predominantly of traditional fertilizers as sources of sulphur, especially SSP and SAM, it was difficult for the market to correctly assign a price to sulphur. Farmers simply chose the source that met their fertilization needs. Examples of this are the choice of SSP for soybean fertilization and SAM for coffee fertilization.

In a new scenario in which the market began to offer sulphur supply alternatives, the direct cost of fertilization could start to be better understood. Initially, this took the form of using an alternative such as gypsum or S-bentonite along with the use of a source that did not contain sulphur to supply nitrogen or phosphorus, for example. It was thus possible to compare the cost of fertilization using traditional sources and the alternatives.

The complex fertilizer alternatives featuring S-sulfate or S-elemental enrichment represent different situations and need to be evaluated on a case-by-case basis. In general, the dosages used provide limited amounts of sulphur as the dosages applied during the fertilization when using these products are calculated to provide the required amount of phosphorus.

Therefore, given the important issue of assigning a price to sulphur, this figure is directly calculated based on the price of the S-bentonite fertilizer and, indirectly, by comparing the final cost of fertilization, considering the supply equations.

A historical analysis of the supply of traditional fertilizers (Table 19.4.5-1 and Table 19.4.5-2) that compete for the supply of sulphur was used to establish the relationship between fertilizer costs.

**Table 19.4.5-1 Nutrient concentration in each fertilizer assumed for the model**

| Fertilizer | Nutrient concentration (%) | | |
|---|---|---|---|
| | Sulphur | Phosphorus | Nitrogen |
| SSP | 11 | 19 | |
| SAM | 24 | | 21 |
| MAP | | 52 | 11 |
| TSP | | 46 | |
| Urea | | | 46 |

Source: Tec-Fértil, 2022

**Table 19.4.5-2 Average annual price considering the average delivered to the farmer/blender**

| Year | Fertilizers price (US$/t) | | | |
|---|---|---|---|---|
| | SSP | SAM | MAP | TSP |
| 2002 | 169.81 | 170.00 | 260.09 | 231.32 |
| 2003 | 173.24 | 174.90 | 287.05 | 248.89 |
| 2004 | 184.12 | 206.33 | 320.47 | 276.11 |
| 2005 | 193.53 | 219.90 | 351.44 | 289.00 |
| 2006 | 193.45 | 212.48 | 372.25 | 296.07 |
| 2007 | 232.85 | 269.16 | 495.25 | 396.47 |
| 2008 | 462.66 | 430.76 | 1,071.73 | 912.10 |
| 2009 | 334.11 | 232.93 | 620.07 | 534.92 |
| 2010 | 240.60 | 239.01 | 558.75 | 425.56 |
| 2011 | 320.70 | 331.73 | 734.98 | 588.50 |
| 2012 | 335.38 | 354.97 | 676.61 | 560.61 |
| 2013 | 301.74 | 328.70 | 603.56 | 500.40 |
| 2014 | 261.45 | 274.91 | 555.14 | 454.15 |
| 2015 | 262.98 | 287.22 | 575.29 | 468.26 |
| 2016 | 251.24 | 267.20 | 468.49 | 394.38 |
| 2017 | 254.84 | 265.30 | 462.96 | 383.96 |
| 2018 | 254.80 | 284.76 | 532.45 | 433.60 |
| 2019 | 257.48 | 274.91 | 488.70 | 430.18 |
| 2020 | 203.80 | 218.06 | 386.86 | 320.30 |
| 2021 | 269.24 | 296.41 | 657.44 | 521.23 |

Sources: MDIC/COMEX and Tec-Fértil, 2022

As SAM is also a source of nitrogen, when establishing a price for sulphur in SAM, it was necessary to first determine the amount of N contained in the product. To this end, the $N_{Urea}$ (N contained in urea) was priced, and the same figure was assigned to the $N_{SAM}$ (N contained in SAM). Sulphur is supplied by SAM and can be assumed to range from US$2.36 to US$3.51 per percentage point of sulphur (Figure 19.4.5-1). If one considers possible losses of $N_{Urea}$, this will result in an appreciation to $N_{SAM}$ and, consequently, a lower price for sulphur.

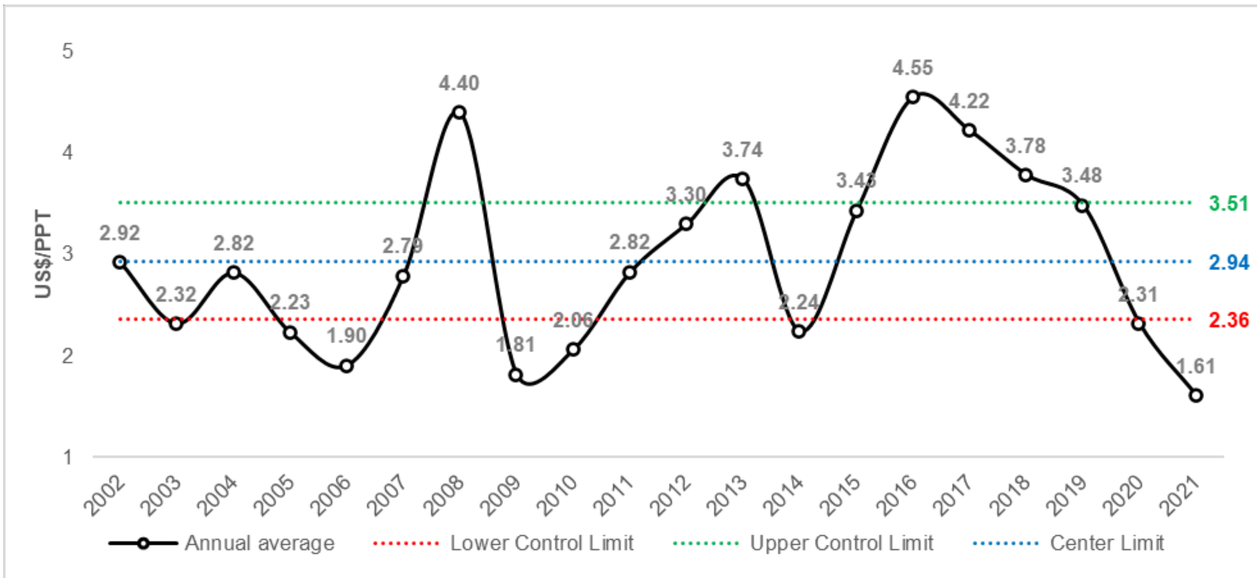


**Figure 19.4.5-1 Price fluctuation per percentage point of sulphur in the SAM**

To arrive at the price of the sulphur contained in SSP, the phosphorus present in the fertilizer was first priced so that it was possible to isolate the price of S, compared with other competing sources of phosphorus, such as MAP and TSP. As MAP is also a source of nitrogen, the same procedure was performed for N compared with Urea. As a result, when considering the price of the phosphorus in the TSP and of the nitrogen contained in the MAP, the price for the sulphur contained in the SSP is expected to fluctuate between US$5.86 and US$9.06 per percentage point (Table 19.4.5-2).

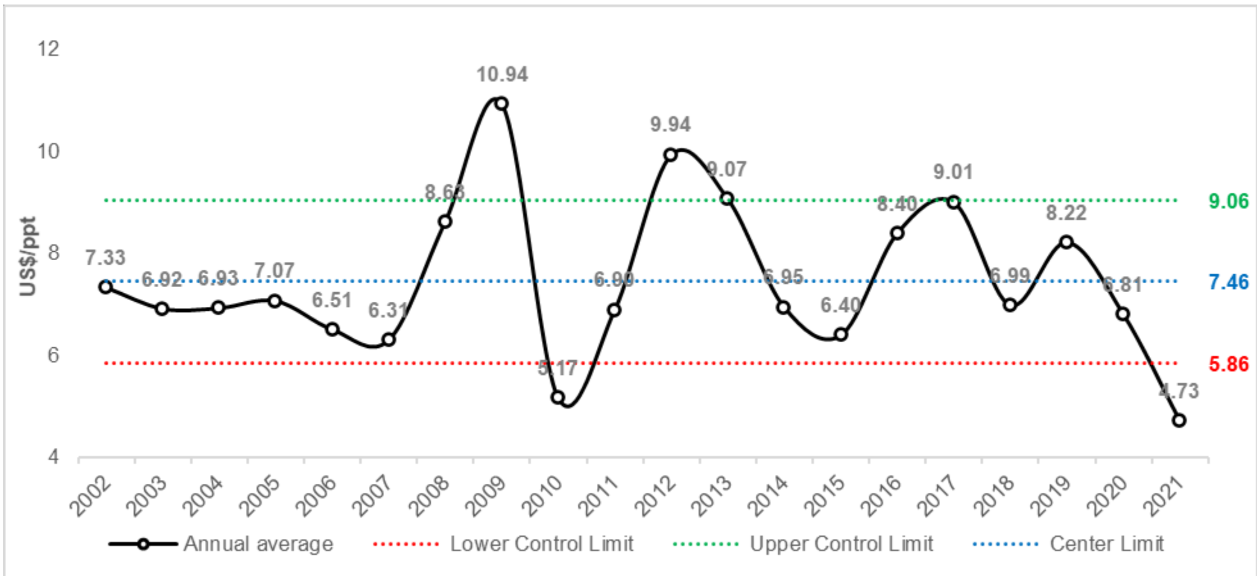


**Figure 19.4.5-2 Price fluctuation per percentage point of sulphur in the SSP**

These considerations alone do not objectively equate to the price of sulphur seen in these products for all crops, as SAM cannot be considered a cheaper source of sulphur. For example, as soybeans do not require nitrogen, the cost per sulphur point will be higher than for other crops because it includes the cost of nitrogen. Moreover, considering that SSP is as a source of phosphate fertilization, higher doses will be needed than those necessary to meet the need for sulphur, resulting in higher costs. The use of SAM is more competitive for fertilization that requires nitrogen. The dosage must be based on the sulphur fertilization and not on the nitrogen fertilization, which can result in considerably higher doses of sulphur than necessary.

In addition to pricing and comparing the price of sulphur in traditional sources, compound fertilizers that are sources of sulphur were analyzed. Using as reference the main NPK formulation for soybeans, 00-18-18, a traditional composition, will have around 6% of S. Different formulations were selected (00-18-18 SSP; 00-18-18 Polysulphate; 00-18-18 S-90 6%; 00-18-18 S-90 8%; 03-18-18 MAP 6.3%; 00-23-23 S-90 7.8%; and 5-25-25 S-90 8.3%) and these were compared with a formula that did not contain Sulphur; in this case, 00-26-26 TSP. This resulted in percentage point prices for sulphur for each composition analyzed, as shown in Table 19.4.5-3.

For the composition of the simulated formulations, MAP, TSP, and KCl were considered the sources of NPK, and SSP 20, S-90, and Polysulphate were considered the sources of sulphur.

**Table 19.4.5-3 Price comparison per percentage point of sulphur for the main formulations applied to soy**

| Formulations | Raw material proportions (%) | | | | | | | Total cost (US$) | Sulphur (%) | US$/% S |
|---|---|---|---|---|---|---|---|---|---|---|
| | MAP | TSP | KCL | SSP 20 | S-90 | Polysulphate | Charge | | | |
| | 885.00[1] | 815.00[2] | 865.00[3] | 400.00[4] | 540.00[5] | 265.00[6] | 300.00[7] | | | |
| 00-26-26 TSP | 0.00 | 56.60 | 43.40 | 0.00 | 0.00 | 0.00 | 0.00 | 836.70 | **0.00** | |
| 00-18-18 SSP | 0.00 | 15.40 | 30,00 | 54.60 | 0.00 | 0.00 | 0.00 | 603.41 | **6.20** | **3.92** |
| 00-18-18 Polysulphate | 0.00 | 39.10 | 20.60 | 0.00 | 0.00 | 40.30 | 0.00 | 603.65 | **8.00** | **3.03** |
| 00-18-18 S-90 6% | 0.00 | 39.10 | 30.00 | 0.00 | 6.20 | 0.00 | 24.60 | 685.45 | **6.00** | **17.70** |
| 00-18-18 S-90 8% | 0.00 | 39.10 | 30.00 | 0.00 | 8.50 | 0.00 | 22.40 | 691.27 | **8.00** | **14.00** |
| 03-18-18 MAP 6.3% | 12.50 | 0.00 | 30.00 | 57.50 | 0.00 | 0.00 | 0.00 | 600.13 | **6.30** | **3.31** |
| 00-23-23 S-90 7.8% | 0.00 | 46.50 | 38.30 | 8,00 | 7.20 | 0.00 | 0.00 | 781.15 | **7.80** | **5.26** |
| 5-25-25 S-90 8.3% | 47.30 | 0.00 | 41.70 | 2.10 | 9.00 | 0.00 | 0.00 | 836.31 | **8.30** | **3.83** |

Source: Tec-Fértil, 2022

[1] Monoammonium Phosphate (US$ 885.00/tonne), reference price for the year 2021

[2] Triple superphosphate (US$ 815.00/tonne), reference price for the year 2021

[3] KCl (US$ 865.00/tonne) reference price for the year 2021

[4] Single superphosphate (US$ 400.00/tonne), reference price for the year 2021

[5] Bentonite Sulphur 90% S (US$ 540.00/tonne), reference price for the year 2021

[6] Polysulphate (US$ 265.00/tonne), reference price for the year 2021

[7] Charge includes any materials approved by Brazilian rules (Annex IV of the Normative Instruction 39/2018) to use in mineral fertilizers, for example, limestone, quartz, clay, kaolinite, peat. (US$ 300.00/tonne), reference price for the year 2021

The replacement of traditional sources such as SSP and SAM is made clear by the choice to use gypsum or S-bentonite. In Brazil there is an increase in the consumption of elemental sulphur in fertilizers. This has been made possible by increased domestic production of S-bentonite and imports from the United States, South Korea and Oman. There is still a need for better data on these products in terms of their degradability and oxidation capacity. Soybean, which is the crop that requires the most fertilizer and is being planted on an ever-larger areas across Brazil, is a crop that requires a continuous supply of sulphur in the soil. Production is focused on gains in scale and a reduction in operating costs, which results in a preference for the use of fertilizers with a higher concentration of Sulphur.

In view of this situation, traditional sources such as SSP and SAM are increasingly being replaced with S-bentonite, which is a relatively new sulphur source fertilizer on the market and does not have a historical price database to support long-term studies. However, it can be assumed that the price of the product in the market would be determined by the same pattern as that of the “Farmer Exchange Rate”.

For long-term price analysis for industrial elemental sulphur, the costs must be monitored to assess the scope for the setting of prices for the supply of this nutrient. The cost of elemental sulphur is lower than the average price of the nutrient contained in fertilizers produced from this raw material, such as S-bentonite, whether coated or enriched. The average price of elemental sulphur and bentonite available in Brazil is shown in Table 19.4.5-4.

**Table 19.4.5-4 Average annual sulphur source price considering the average delivered to the farmer/blender**

| Year | Fertilizer price (US$/t) | |
|---|---|---|
| | S-Elemental | S-Bentonite |
| 2002 | 128.54 | 294.61 |
| 2003 | 156.84 | 326.44 |
| 2004 | 164.61 | 335.18 |
| 2005 | 166.45 | 337.25 |
| 2006 | 156.44 | 325.99 |
| 2007 | 181.11 | 353.75 |
| 2008 | 578.70 | 801.03 |
| 2009 | 232.66 | 411.74 |
| 2010 | 217.19 | 394.34 |
| 2011 | 311.13 | 500.02 |
| 2012 | 298.57 | 485.90 |
| 2013 | 239.22 | 419.12 |
| 2014 | 240.69 | 420.77 |
| 2015 | 248.39 | 429.44 |
| 2016 | 196.90 | 371.51 |
| 2017 | 202.10 | 377.37 |
| 2018 | 266.93 | 450.29 |
| 2019 | 221.28 | 398.94 |
| 2020 | 144.70 | 312.78 |
| 2021 | 271.17 | 455.07 |

An analysis of the historical average price per percentage point for elemental sulphur, which is linked to the exchange relations with the consuming crops, indicated that the price for elemental sulphur will fluctuate between US$ 2.03 and US$ 2.64 per percentage point (Figure 19.4.5-3). Therefore, a long-term price of US$ 2.34/ per percentage point per tonne was assumed.

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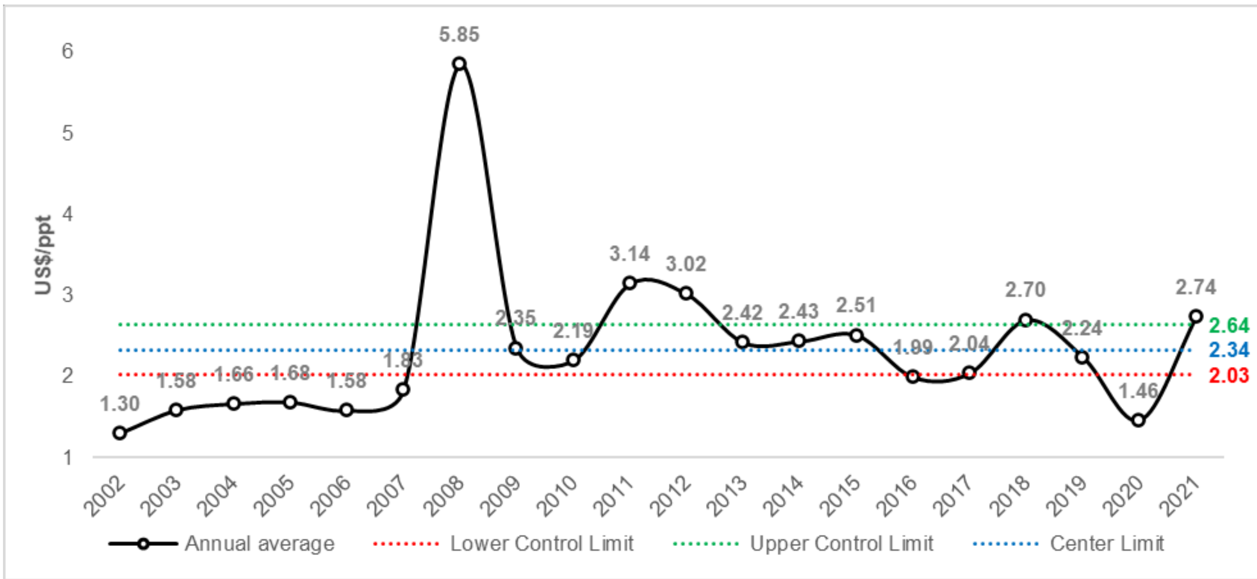


**Figure 19.4.5-3 Price fluctuation per percentage point of sulphur in the S-Industrial**

The price of bentonite sulphur will fluctuate from $4.18 to $4.93 per percentage point (Figure 19.4.5-4). A price of US$ 4.56/per percentage point per tonne was assumed for the long term.

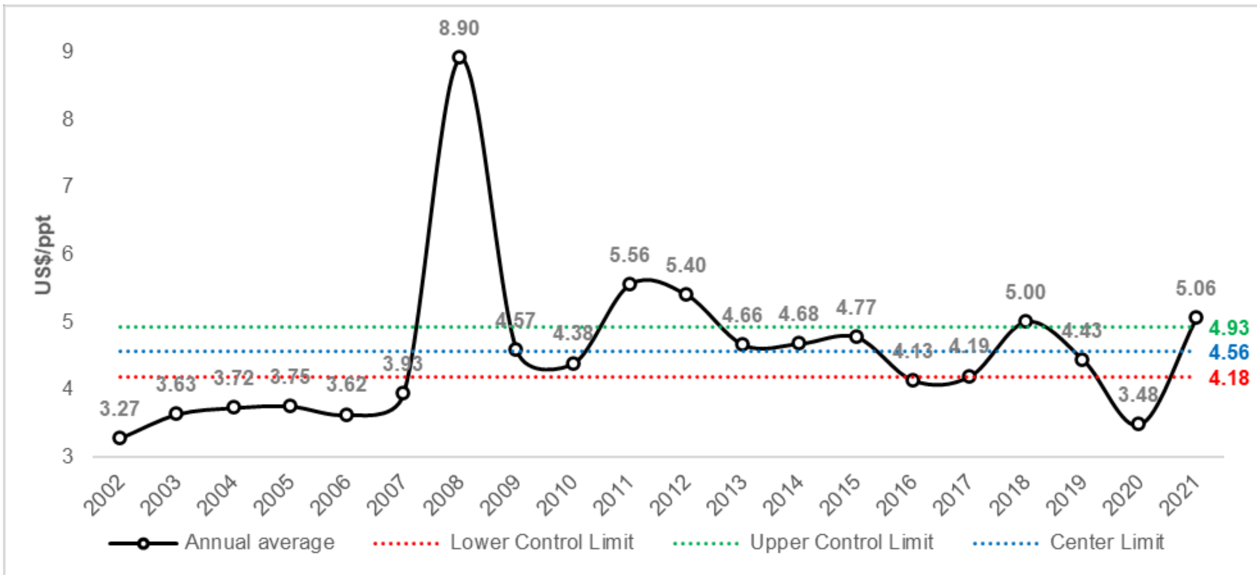


**Figure 19.4.5-4 Price fluctuation per percentage point of sulphur in the S-Bentonite**

## 19.5. Micronutrients

Since the 1950s, micronutrient deficiencies in Brazilian soils have been widely known. The adoption of zinc in fertilization and the beginning of the occupation of the *cerrado* ecoregion in the 1970s were the main drivers behind the use of these elements by fertilizer companies and their customers.

The 2000s were a milestone for the micronutrient market in Brazil, as this decade represented the period in which sales of these products surpassed 200,000 tonnes. Currently, yearly consumption of micronutrients exceeds 440,000 tonnes and corresponds to a turnover of more than R$ 900 million.

### 19.5.1. Production

Zinc

The main sources of zinc authorized by MAPA for the manufacture of fertilizers are shown in Table 19.5.5-1. Among all the raw materials mentioned, the most accessible feedstocks is zinc oxide, though its scarcity at a cost compatible with the manufacture of fertilizers limits its use by companies.

**Table 19.5.1-1 Sources of zinc authorized by MAPA**

| Product | Zinc Content % | Other Nutrients |
|---|---|---|
| Zinc acetate | 28 | - |
| Zinc borate | 29 | Minimum of 14% B |
| Iron and zinc phosphate sludge | 3 | Minimum of 20% $P_2O_5$ and 10% Fe |
| Zinc carbonate | 49 | - |
| Zinc chloride | 24 | Minimum of 26% Chlorine (Cl) |
| Zinc formate | 25 | - |
| Zinc phosphite | 8 | Minimum 38% $P_2O_5$ as phosphite |
| Zinc nitrate | 18 | Minimum of 8% N |
| Zinc oxide | 72 | - |
| Zinc chelates | 7 | - |
| Zinc sulfate | 20 | Minimum of 9% of S |

Source: Tec-Fértil, 2022

Boron

The main sources of boron authorized by MAPA for the manufacture of fertilizers are shown in Table 19.5.1-2. This table highlights the sources used in the manufacture of fertilizers applied via soil: ulexite, hydroboracite, colemanite, and sodium pentaborate. Boric acid and sodium octaborate are also used in soil spray applications. Although not directly applied to the soil, zinc borate is used in NPK fertilizers. These are imported products in their entirety and are sourced from Bolivia, Argentina, Peru and Chile (South America), Turkey and China (Eurasia) and the United States (North America), along with products made in Guatemala (Central America).

**Table 19.5.1-2 Sources of boron authorized by MAPA**

| Product | Boron Content % | Others |
|---|---|---|
| Boric acid | 17 | - |

| Product | Boron Content % | Others |
|---|---|---|
| Monoethanolamine borate | 8 | - |
| Zinc borate | 14 | Minimum of 29% Zn |
| Borax | 10 | - |
| Colemanite | 8 | Minimum of 6% Ca |
| Hydroboracite | 7 | Minimum of 7% Ca and 4% Mg |
| Sodium octaborate | 20 | - |
| Potassium octaborate | 19 | 18% $K_2O$ |
| Sodium pentaborate | 18 | - |
| Boron chelates | 8 | - |
| Ulexite | 8 | Minimum of 7% Ca and 6% Na |

Source: Tec-Fértil, 2022

Copper

The main sources of copper authorized by MAPA for the manufacture of fertilizers are shown in Table 19.5.1-3.

**Table 19.5.1-3 Sources of copper authorized by MAPA**

| Product | Copper Content % | Others |
|---|---|---|
| Copper acetate | 23 | - |
| Copper carbonate | 48 | - |
| Cupric chloride | 20 | Minimum of 23 Cl |
| Copper formate | 35 | - |
| Ammonium copper phosphate | 32 | 34% $P_2O_5$ and 5% N |
| Copper phosphite | 3 | Minimum 7% $P_2O_5$ as phosphite |
| Copper nitrate | 22 | 9.0% of N |
| Cupric oxide | 70 | - |
| Cuprous oxide | 80 | - |
| Copper chelates | 5 | - |
| Copper sulfate | 24 | Minimum of 11% of S |

Source: Tec-Fértil, 2022

Manganese

The main sources of manganese authorized by MAPA for the manufacturing of fertilizers are described in Table 19.5.1-4.

**Table 19.5.1-4 Sources of manganese authorized by MAPA**

| Product | Manganese Content % | Others |
|---|---|---|
| Manganese acetate | 25 | - |
| Manganese carbonate | 40 | - |
| Manganese chloride | 25 | Minimum of 32% Cl |
| Manganese formate | 22 | - |
| Manganese phosphite | 8 | Minimum 28% $P_2O_5$ as phosphite |
| Manganese nitrate | 16 | 8.0% of N |
| Manganous oxide | 50 | - |
| Manganese chelates | 5 | - |
| Manganese sulfate | 26 | 16% of S |

Source: Tec-Fértil, 2022

## 19.5.2. Dosage

Dosage is based on the average amounts of individual micronutrients, in kilograms per hectare, used in the fertilization of different crops, different geographic regions, the profile of the fertilizers used, percentage of producers that adopt sulphur in the dosages presented, due to crop needs, and supply and fertilization alternatives. This results in a demand for each Micronutrient for these crops. The data is summarized in Table 19.5.2-1. The adoption rate does not reach 100% because crop management techniques such as rotation, corrective management and even organic fertilization can make the use of the nutrient unnecessary.

The crops that require the most micronutrients are soybeans, corn, coffee, cotton, forest industry and sugarcane in 2020 are responsible for 89% of consumption, while other crops account for the remaining 11%. For 2031, the projection for the main crops considered were the same as those mentioned above, then totaling 91% of consumption (Table 19.5.2-1).

**Table 19.5.2-1 Consumption of micronutrients for the main crops in 2020**

| Crop | Zinc | Boron | Copper | Manganese | Total consumption | % |
|---|---|---|---|---|---|---|
| Soy | 13,285 | 9,339 | 2,876 | 4,221 | 29,721 | 43.81% |
| Corn | 2,840 | 720 | 213 | 2,650 | 6,424 | 9.47% |
| Sugar cane | 526 | 2,229 | 258 | 525 | 3,538 | 5.22% |
| Coffee | 1,977 | 3,443 | 461 | 222 | 6,102 | 9.00% |
| Cotton | 1,423 | 3,423 | 310 | 1,222 | 6,378 | 9.40% |

| Crop | Zinc | Boron | Copper | Manganese | Total consumption | % |
|---|---|---|---|---|---|---|
| Eucalyptus | 1,205 | 5,293 | 555 | 0 | 7,053 | 10.40% |
| Orange | 363 | 899 | 0 | 73 | 1,336 | 1.97% |
| **Subtotal** | **21,619** | **25,345** | **4,673** | **8,914** | **60,552** | **89.26%** |
| Other 19 crops | 3,696 | 1,485 | 709 | 1,396 | 7,286 | 10.74% |
| **Total 26 crops** | **25,315** | **26,831** | **5,382** | **10,310** | **67,838** | **100.00%** |

Source: Tec-Fértil, 2022

### 19.5.3. Consumption

The current ranking of Brazilian states sorted according to the highest consumption of micronutrients is as follows: MT, MG, SP, BA, MS, GO, RS and PR. Together, they represent 85.2% of the total consumed, while the other states account for the remaining 14.8% (Table 19.5.3-11).

**Table 19.5.3-1 Micronutrient consumption by state in 2020**

| STATES | Zinc | Boron | Copper | Manganese | Total | % |
|---|---|---|---|---|---|---|
| RS | 1,710 | 909 | 271 | 262 | 3,152 | 4.65% |
| SC | 240 | 196 | 40 | 56 | 532 | 0.78% |
| PR | 1,235 | 807 | 225 | 287 | 2,554 | 3.77% |
| **Total South** | **3,185** | **1,912** | **536** | **606** | **6,238** | **9.20%** |
| MG | 3,735 | 5,813 | 865 | 798 | 11,212 | 16.53% |
| ES | 238 | 528 | 79 | 58 | 903 | 1.33% |
| RJ | 46 | 43 | 14 | 20 | 124 | 0.18% |
| SP | 1,696 | 4,155 | 420 | 547 | 6,819 | 10.05% |
| **Total Southeast** | **5,716** | **10,539** | **1,379** | **1,423** | **19,057** | **28.09%** |
| MS | 1,731 | 2,641 | 416 | 483 | 5,272 | 7.77% |
| MT | 6,743 | 6,537 | 1,246 | 3,959 | 18,484 | 27.25% |
| GO | 2,561 | 1,631 | 332 | 690 | 5,214 | 7.69% |
| DF | 78 | 37 | 10 | 26 | 150 | 0.22% |
| **Total Midwest** | **11,113** | **10,846** | **2,003** | **5,158** | **29,119** | **42.92%** |
| AL | 39 | 62 | 20 | 21 | 143 | 0.21% |
| BA | 2,153 | 1,806 | 635 | 1,428 | 6,023 | 8.88% |
| CE | 116 | 27 | 33 | 13 | 189 | 0.28% |
| MA | 749 | 474 | 257 | 420 | 1,900 | 2.80% |
| PB | 44 | 27 | 16 | 10 | 97 | 0.14% |
| PE | 86 | 66 | 30 | 41 | 223 | 0.33% |
| PI | 578 | 349 | 190 | 561 | 1,679 | 2.48% |
| RN | 47 | 30 | 17 | 33 | 127 | 0.19% |
| SE | 71 | 38 | 15 | 34 | 159 | 0.23% |

| STATES | Zinc | Boron | Copper | Manganese | Total | % |
|---|---|---|---|---|---|---|
| **Total Northeast** | **3,883** | **2,881** | **1,213** | **2,562** | **10,539** | **15.54%** |
| AC | 12 | 3 | 2 | 1 | 19 | 0.03% |
| AP | 13 | 14 | 7 | 0 | 34 | 0.05% |
| AM | 27 | 8 | 8 | 4 | 47 | 0.07% |
| PA | 358 | 175 | 81 | 89 | 702 | 1.04% |
| RO | 224 | 105 | 29 | 76 | 434 | 0.64% |
| RR | 12 | 5 | 2 | 2 | 22 | 0.03% |
| TO | 774 | 343 | 123 | 388 | 1,627 | 2.40% |
| **Total North** | **1,419** | **653** | **253** | **561** | **2,885** | **4.25%** |
| **Total BRAZIL** | **25,315** | **26,831** | **5,382** | **10,310** | **67,838** | **100%** |

Source: Tec-Fértil, 2022

### 19.5.4. Demand projection

Regarding long-term projections and using the growth of the world population and the role attributed to Brazil as a supplier of agricultural products to the world, the projected growth in demand for Zinc, Boron, Copper, and Manganese is presented in Table 19.5.4-1.

**Table 19.5.4-1 Demand projection for micronutrients**

| YEAR | Annual growth rate | Zinc (t) | Boron (t) | Copper (t) | Manganese (t) |
|---|---|---|---|---|---|
| 2020 | Estimated | 25,315 | 26,831 | 5,382 | 10,310 |
| 2030 | Projected | 31,967 | 34,301 | 6,793 | 13,265 |
| 2040 | 1.47% | 36,996 | 39,697 | 7,862 | 15,352 |
| 2050 | 1.13% | 41,422 | 44,446 | 8,803 | 17,189 |
| 2060 | 0.83% | 45,034 | 48,321 | 9,570 | 18,688 |
| 2070 | 0.59% | 47,801 | 51,291 | 10,158 | 19,836 |
| 2071 | 0.59% | 50,739 | 54,443 | 10,783 | 21,055 |

Source: Tec-Fértil, 2022

### 19.5.5. Micronutrient Pricing

*Micronutrient sources for crops used in pricing*

A summary of the costs and prices paid by farmers for the acquisition of micronutrients is presented in Table 19.5.5-1.

**Table 19.5.5-1 Long-term Price composition of similar sources of micronutrients**

| Description | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|
| Similar products | Zinc 10% | Boron 10% | Copper 20% | Manganese 10% |
| Cost (US$/ppt) | 40.00 | 60.00 | 135.00 | 12.00 |
| Freight/intermediaries (US$/ppt) | N/A | 3.00 | N/A | N/A |

| | | | | |
|---|---|---|---|---|
| Application cost (US$/ppt) | N/A | 50.00 | N/A | N/A |
| **Product cost applied (US$/ppt)** | **40.00** | **113.0** | **135.00** | **12.00** |

Source: Tec-Fértil, 2022

Concerning the soil fertilization micronutrient market, a group of NPK-producing companies has a significant share of the market for the supply and distribution of the micronutrients which are added to these formulations. Thus, micronutrients for soil use are distributed mainly by the NPK blending companies that add the elements to fertilizers to meet specific regional demands. Despite the increase in direct sales of boron and the increase in the number of imported fertilizers containing micronutrients, it is estimated that distribution through sales channels was maintained.

Due to the relatively low amount consumed, the micronutrients are mostly associated with other macronutrients. The pricing of the product received by farmers must therefore be based on this association. The main sources of micronutrients for fertilization are then analyzed and the main products that serve farmers with a better logistics chain and lower application cost are selected, considering micronutrients in the form of granules. It was concluded that the main sources of micronutrients for crops come from the granules of Zinc with a concentration of 10%, Boron (10%), Copper (20%) and Manganese (10%). Only for boron will the costs of freight and application be considered for frequent applications as an independent logistics chain, since farmers typically use one kilo of boron per hectare.

*Sources of feedstock micronutrients for the Products*

The sources that will be considered as micronutrient suppliers for VERDE's products will be different, as was the case with elemental sulphur. The company can process and generate value from raw products that are sources of micronutrients, such as zinc, copper and manganese oxides, in addition to borates, such as Ulexite (hydrated sodium borate, and calcium). The following is an overview of the market for each micronutrient.

Table 19.5.5-2 contains a summary of the cost for the acquisition of raw materials that are sources of micronutrients in the Product.

**Table 19.5.5-2 Feedstocks source of micronutrients for the Product**

| Description | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|
| Feedstocks | Oxide zinc | Ulexite | Oxide copper | Oxide manganese |
| Concentration (%) | 20.00 | 10.00 | 20.00 | 55.00 |
| **Nutrient value (US$/ppt)** | **17.14** | **40.00** | **111.76** | **10.70** |

Zinc

Zinc Oxide is an important source of this nutrient, with an average content of 72% Zn. Another important source of zinc for agriculture is zinc sulfate, which, on average, has a content level that is four times lower and contains sulphur. Statistical tools based on the closing price of zinc quoted on the LME, in the period between August 2007 and February 2022, were adopted to extrapolate the price of this commodity and obtain a 95% confidence interval, ranging from US$ 2,817/t to US$ 5,125/t. US$ 3,971/t was assumed as the average value and used as the long-term price for zinc with a concentration of 100% (Figure 19.5.5-1).

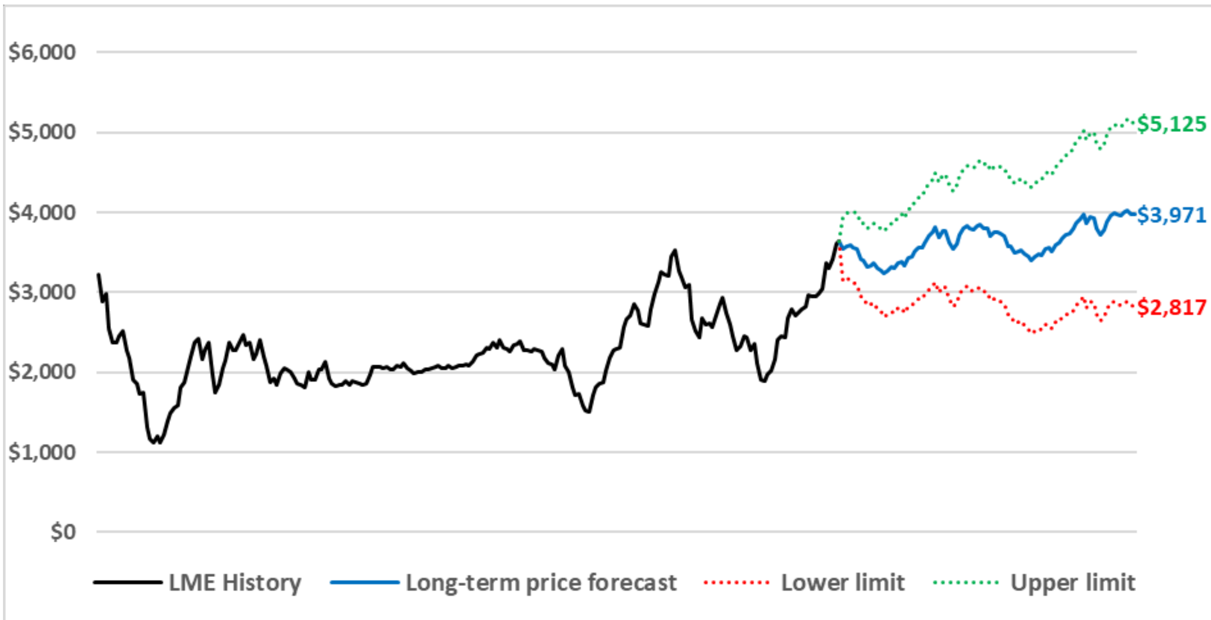


**Figure 19.5.5-1 History of LME Zinc quotations between Aug/2008 and Feb/2022**

When pricing zinc as a raw material that will provide the micronutrient for VERDE's products, an oxide with a content of 20% of zinc is assumed, as the steel market aims for higher concentrations, resulting in a factor of 40% of the LME, given the depreciation due to this lower concentration. In addition, an average freight cost for the company's blending units was also considered. This produced a long-term value for zinc as a raw material of US$ 17.14 per percentage point per tonne, or US$1.71 per kg of the nutrient (Table 19.5.5-3).

**Table 19.5.5-3 Assumptions and breakdown for long-term zinc pricing**

| Description | Unit | Value |
|---|---|---|
| Long-term commodity price | US$/t | 3,971.41 |
| Concentration considered in the LME | % | 100.00 |
| Average content intended for acquisition | % | 20.00 |
| LME indexing factor | % | 40.00 |
| Long Term Pricing | US$/t | 317.71 |
| Long term average freight for mixing units | US$/kg | 25.00 |
| **Final cost of feedstock** | **US$/t** | **342.71** |
| **Final cost of nutrient** | **US$/ppt** | **17.14** |

<u>Copper</u>

The value of copper, like that of zinc, is strongly aligned with the LME. Estimates were based on the closing price of copper quoted on the LME during the period between September 2002 and February 2022. The same methodology will be used to estimate its long-term value. A range of between US$4,994/t and US$16,787/t and a long-term value of US$10,871 for copper with a concentration of 100% was estimated (Figure 19.5.5-2).

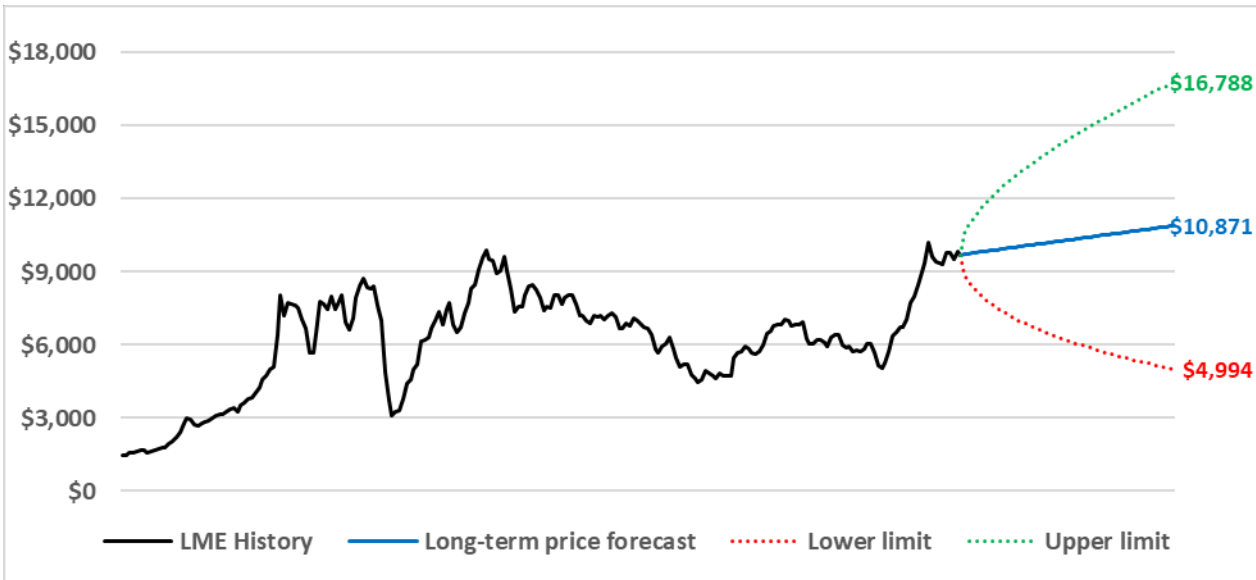


**Figure 19.5.5-2 History of LME Copper quotation between Sep/2008 to Feb/2022**

The raw material considered as the source of copper as a micronutrient for VERDE's products is a slag with a 20% copper content. Due to the scarcity of raw materials available for the manufacture of fertilizers, even in cases where the nutrient comes from residues or with low content levels, as is the case here, the cost of copper for fertilizers will remain in line with the LME value, which can be considered as being US$ 110.46 per percentage point per tonne, or US$ 11.04 per kg of the nutrient (Table 19.5.5-4).

**Table 19.5.5-4 Assumptions and breakdown for long-term copper pricing**

| Description | Unit | Value |
|---|---|---|
| Long-term commodity price | US$/t | 10,871.22 |
| Concentration considered in the LME | % | 100.00 |
| Average content intended for acquisition | % | 20.00 |
| LME indexing factor | % | 100.00 |
| Long Term Pricing | US$/t | 2,174.24 |
| Long term average freight for mixing units | US$/kg | 35.00 |
| **Final cost of feedstock** | **US$/t** | **2,209.24** |
| **Final cost of nutrient** | **US$/ppt** | **110.46** |

Manganese

The cost of manganese is associated with the price of manganese ore and oxide exported by Brazilian companies. The MDIC's export prices of 2020 and 2021 are used. Cost fluctuations are associated with consumption by the steel industry. Long-term price stabilization for this commodity at US$ 10.71 per percentage point per tonne, or US$1.07 per kg of the nutrient, was assumed (Table 19.5.5-5). Exports require higher quality standards, depending on the purpose and, for this reason, it is necessary to make an adjustment when considering supply as a raw material for micronutrients.

**Table 19.5.5-5 Assumptions and breakdown for long-term manganese pricing**

| Description | Unit | Value |
|---|---|---|
| Long-term commodity price | US$/t | 689.75 |
| Concentration considered in the MDIC | % | 60.00 |
| Average content intended for acquisition | % | 55.00 |
| MDIC indexing factor | % | 90.00 |
| Long Term Pricing | US$/t | 569.05 |
| Long term average freight for mixing units | US$/kg | 20.00 |
| **Final cost of feedstock** | **US$/t** | **589.05** |
| **Final cost of nutrient** | **US$/ppt** | **10.70** |

The Product has an average Mn content of 0.08%. When necessary, the content can be increased with the addition of manganese sulfate and this additional cost is added to the Product's price.

Boron

The main sources of boron used in the manufacture of fertilizers applied via soil are: ulexite, hydroboracite, colemanite and sodium pentaborate. Most of these materials are imported. In view of the resulting freight costs and customs tariffs, which vary in different situations, and based on quotations and an analysis of exchange rates and the logistics chain, it is estimated that any boron obtained will have a cost of US$ 40.00 per percentage point per tonne, or US$4.00 per kg of the nutrient.

# 19.6. Scenario preview

## 19.6.1. Feedstock

The pricing of nutrients sold was based either on the most competitive or the most common market sources. However, in some cases, the nutrient source for the Product differs from the one used for pricing, because suppliers that can provide nutrients requiring less subsequent processing are chosen.

Table 19.6.1-1 contains information on the source used, concentration and cost (constant value based on market research) and shows the sources of nutrients and costs that will be used by the Company in its process.

**Table 19.6.1-1 Feedstocks added to the company's products**

| Description | Unit | Nutrient | | | | |
|---|---|---|---|---|---|---|
| | | S | Zn | Bo | Cu | Mn |
| Feedstocks | - | S-Elemental | Oxide zinc | Ulexite | Oxide copper | Oxide manganese |
| Concentration | % | 99.99 | 20.00 | 10.00 | 20.00 | 55.00 |
| Nutrient value | US$/ppt | 2.34 | 17.14 | 40.00 | 111.76 | 10.70 |

### 19.6.2. Pricing

The sources of nutrients considered in the pricing of the Product were also considered. These were compared with the main sources on the market and with the value embedded in VERDE's logistics chain.

For $K_2O$ pricing, KCl with a 60% $K_2O$ content is used. A proportionality calculation is performed based on the relationship between three known values (KCl price, KCl content, and $K_2O$ content in the Product) to find the fourth previously unknown value (the value of the Product). The same methodology is used for the other nutrients. The values per kilo of nutrient are presented in Table 19.6.2-1.

**Table 19.6.2-1 Sales price of the nutrients contained in the product**

| Description | Nutrient | | | | | |
|---|---|---|---|---|---|---|
| | $K_2O$ | S | Zn | B | Cu | Mn |
| Similar Product | KCl | S-Bentonite | Zn 10% | B 10% | Cu 20% | Mn 10% |
| Concentration (%) | 60.00 | 90.00 | 10.00 | 10.00 | 20.00 | 10.00 |
| Nutrient value (US$/ppt) | **8.79** | **4.56** | **40.00** | **113.0** | **135.00** | **12.00** |

### 19.6.3. Application cost

Table 19.6.3-1 presents a comparison of the cost of application of the Company's products and KCl to discount this difference in the final value attributed to the products. Therefore, farmers will not have to bear this additional cost. The discount will be US$ 4.48 per tonne of the Product.

**Table 19.6.3-1 Breakdown of total application cost of the Product and KCl**

| Application cost per hectare assumptions | Unit | Product (10% $K_2O$) | KCl (60% $K_2O$) |
|---|---|---|---|
| Product demand | kg/ha | 1,000 | 166.67 |
| Nutrient demand | kg/ha | 100 | 100 |
| Operating cost | US$/hour | 46.84 | 51.42 |
| Speed | km/h | 7 | 18 |
| Application width | m | 16 | 16 |
| Flow rate | kg/min | 186.7[1] | 80 |
| Time applied | min/ha | 5.36 | 2.08 |
| ***Subtotal - Application cost*** | ***US$/100kg $K_2O$*** | ***6.27*** | ***1.96*** |
| *Recharge cost* | *US$/100kg $K_2O$* | 3.49 | 3.49 |
| ***Total - Application cost*** | ***US$/100kg $K_2O$*** | **9.76** | **5.28** |

[1] When considering a k2o content of the Company's product in the 50 Mtpy Scenario, the value remains unchanged. Just increasing the flow to 203.16 kg/minute

### 19.6.4. Discount

The Product has significant advantages, such as the absence of chlorine, low soil compaction levels, progressive release, the capacity to increase the ability of the soil to retain nutrients and water, the potential to reduce nitrogen losses due to leaching and volatilization and abet in carbon capture by the soil. However, considering the size and competitiveness of the business, VERDE intends to offer a product with a discount percentage, which is based on competitors' prices offered to farmers.

The FOB for each scenario evaluated will be discussed and summarized, including the intended discount rate, in section 19.10. To ensure a conservative financial analysis, a 5% discout rate will be applied for all scenarios.

## 19.7. Plant 3 Scenario

### 19.7.1. Pricing

For this scenario, a product with a 10% $K_2O$ content is considered. BAKS® will feature customized formulations based on farmers' preferences, adding the proportional price of each nutrient mixed to the formulation. The formulation contained in Table 19.7.1-1 is shown merely as an example.

**Table 19.7.1-1 Example of pricing for a multinutrient source formulation**

| Nutrient | Nutrient concentration (%) | Nutrient in one tonne (kg) | Value of the nutrient in the product (US$/t) |
|---|---|---|---|
| $K_2O$ | 9.70 | 96.99 | 87.15 |
| S | 2.32 | 23.21 | 10.63 |
| Bo | 0.04 | 0.36 | 4.12 |
| Zn | 0.05 | 0.54 | 2.15 |
| Cu | 0.01 | 0.08 | 1.01 |
| Mn | 0.01 | 0.10 | 0.12 |
| **Total** | **12.13** | **121.28** | **105.15** |

### 19.7.2. Market share

For the Plant 3 Scenario, considering the projected demand in 2025, Brazil will demand 7,402,331 t of $K_2O$. With production of 10 Mtpy with a 10% $K_2O$ content, VERDE expects to supply 13.51% of the domestic market. In this scenario, an alternative was selected that assumed a 40% market share in 41 mesoregions and a weighted average freight price of US$ 27.48, which resulted in a weighted average FOB price of US$ 62.24 per tonne, as shown in Table 19.7.2-1. For a more detailed view of each mesoregion, see section 19.7.4.

**Table 19.7.2-1 Evaluated market share considering domestic demand and weighted freight**

| Alternative | % Market Share | Number of mesoregions | Weighted freight (US$ / t) | Weighted FOB (US$ / t) |
|---|---|---|---|---|
| 1 | 10 | 137 | 41.21 | 48.38 |
| **2** | **20** | 74 | 36.93 | 53.04 |
| 3 | 30 | 51 | 30.69 | 59.02 |

| | | | | |
|---|---|---|---|---|
| **4** | **40** | **41** | **27.48** | **62.24** |
| 5 | 50 | 30 | 24.91 | 64.64 |
| 6 | 60 | 16 | 23.71 | 65.85 |
| 7 | 70 | 15 | 23.61 | 65.98 |
| 8 | 80 | 15 | 23.61 | 65.98 |
| 9 | 90 | 13 | 21.66 | 67.62 |
| 10 | 100 | 12 | 21.17 | 68.19 |

The table below contains VERDE's target market compared with the total demand in Brazil, considering each nutrient covered in this study.

**Table 19.7.2-1 VERDE's market share considering domestic demand in 2025**

| Market 2025 | Unit | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| **Brazil demand** | t | 7,402,331 | 2,060,599 | 29,072 | 30,813 | 6,181 | 11,840 |
| **Target market** | t | 240,313 | 3,769 | 5,426 | 774 | 1,025 | 240,313 |
| **Market share in Brazil** | % | 11.66 | 12.97 | 17.61 | 12.53 | 8.66 | 11.66 |

## 19.7.3. Target market

A detailed analysis of the consumption of each nutrient in each mesoregion selected for this scenario, considering a market share for the selected regions of 40%, is shown in Table 19.7.3-:

**Table 19.7.3-1 Target market mesoregions for VERDE's intended market share in Plant 3 Scenario**

| State | Mesoregion | Nutrient (t) | | | | | |
|---|---|---|---|---|---|---|---|
| | | $K_2O$ | S | Zn | B | Cu | Mn |
| MG | Central Mineira | 4,784 | 850 | 11 | 20 | 3 | 5 |
| MG | Triângulo Mineiro/Alto Paranaíba | 127,767 | 28,431 | 503 | 827 | 127 | 134 |
| MG | Oeste de Minas | 15,095 | 2,770 | 71 | 99 | 15 | 13 |
| MG | Noroeste de Minas | 39,621 | 10,099 | 185 | 262 | 44 | 54 |
| DF | Distrito Federal | 5,637 | 1,866 | 30 | 14 | 4 | 10 |
| MG | Sul/Sudoeste de Minas | 68,571 | 12,844 | 347 | 545 | 78 | 50 |
| MG | Metropolitana de Belo Horizonte | 2,338 | 908 | 13 | 28 | 3 | 4 |
| SP | Ribeirão Preto | 65,489 | 11,260 | 100 | 298 | 28 | 40 |
| SP | Araraquara | 17,638 | 3,479 | 26 | 81 | 7 | 12 |
| MG | Campo das Vertentes | 9,905 | 3,162 | 59 | 98 | 14 | 13 |
| SP | Campinas | 18,277 | 4,775 | 65 | 135 | 12 | 14 |
| SP | São José do Rio Preto | 48,020 | 9,552 | 70 | 222 | 20 | 32 |
| SP | Bauru | 36,043 | 8,744 | 81 | 211 | 20 | 27 |
| MG | Zona da Mata | 26,777 | 4,325 | 132 | 214 | 30 | 15 |
| GO | Sul Goiano | 179,368 | 47,320 | 830 | 554 | 106 | 226 |
| SP | Piracicaba | 13,721 | 2,480 | 20 | 57 | 5 | 9 |

| State | Mesoregion | Nutrient (t) | | | | | |
|---|---|---|---|---|---|---|---|
| | | $K_2O$ | S | Zn | B | Cu | Mn |
| SP | Vale do Paraíba Paulista | 687 | 334 | 4 | 8 | 1 | 1 |
| MG | Norte de Minas | 12,310 | 4,172 | 69 | 124 | 16 | 20 |
| MG | Vale do Rio Doce | 8,983 | 1,664 | 46 | 76 | 10 | 6 |
| SP | Araçatuba | 26,848 | 4,295 | 30 | 96 | 10 | 16 |
| SP | Assis | 27,948 | 5,715 | 66 | 121 | 18 | 21 |
| MG | Vale do Mucuri | 999 | 288 | 5 | 10 | 1 | 1 |
| SP | Metropolitana de São Paulo | 77 | 46 | 0 | 1 | 0 | 0 |
| SP | Macro Metropolitana Paulista | 3,938 | 1,412 | 19 | 30 | 3 | 4 |
| SP | Marília | 6,899 | 2,105 | 27 | 63 | 5 | 6 |
| ES | Central Espírito-santense | 6,114 | 2,076 | 23 | 48 | 8 | 5 |
| RJ | Metropolitana do Rio de Janeiro | 1,021 | 1,012 | 6 | 3 | 2 | 2 |
| RJ | Noroeste Fluminense | 626 | 231 | 2 | 3 | 1 | 1 |
| SP | Presidente Prudente | 22,665 | 4,138 | 34 | 97 | 10 | 15 |
| GO | Centro Goiano | 16,645 | 5,191 | 66 | 45 | 9 | 20 |
| GO | Leste Goiano | 32,220 | 12,940 | 198 | 116 | 26 | 49 |
| SP | Itapetininga | 22,333 | 7,893 | 97 | 172 | 22 | 21 |
| MG | Jequitinhonha | 3,896 | 1,089 | 21 | 40 | 5 | 4 |
| MS | Leste de Mato Grosso do Sul | 33,276 | 7,419 | 108 | 233 | 29 | 32 |
| ES | Sul Espírito-santense | 6,468 | 1,715 | 22 | 53 | 7 | 5 |
| SP | Litoral Sul Paulista | 2,214 | 1,331 | 12 | 32 | 2 | 3 |
| GO | Norte Goiano | 9,385 | 3,312 | 58 | 35 | 8 | 13 |
| GO | Noroeste Goiano | 6,194 | 2,402 | 39 | 24 | 6 | 9 |
| ES | Litoral Norte Espírito-santense | 7,367 | 2,726 | 28 | 55 | 9 | 7 |
| MS | Centro Norte de Mato Grosso do Sul | 40,195 | 8,482 | 134 | 148 | 28 | 40 |
| MT | Sudeste Mato-grossense | 96,626 | 24,367 | 503 | 576 | 94 | 297 |
| | **TOTAL** | **1,074,982** | **259,222** | **4,160** | **5,874** | **847** | **1,256** |

## 19.7.4. FOB

For the Plant 3 Scenario, the Project will serve the states of Minas Gerais, Distrito Federal, São Paulo, Goiás, Espírito Santo, Mato Grosso do Sul, Mato Grosso, Paraná, Bahia, Rio de Janeiro, and Santa Catarina. The mesoregions are sorted in ascending order by freight cost, in this scenario exclusively by road.

Table 19.7.4-1 lists the freight departing from São Gotardo to each mesoregion, along with the FOB values for three simulation alternatives (a) only potash source, (b) the first with sulphur addition and (c) the second with the addition of micronutrients, in addition to repeating the same alternatives, now considering the promotional discount policy (5% of the KCl price) and the difference in application cost.

**Table 19.7.4-1 FOB analysis for the selected mesoregions for the Plant 3 Scenario**

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| MG | Central Mineira | 16.99 | 72.83 | 80.50 | 86.86 | 63.86 | 71.52 | 77.88 |
| MG | Triângulo Mineiro/Alto Paranaíba | 17.14 | 72.74 | 82.29 | 92.19 | 63.76 | 73.31 | 83.21 |
| MG | Oeste de Minas | 17.58 | 72.07 | 79.97 | 90.24 | 63.10 | 71.00 | 81.27 |
| MG | Noroeste de Minas | 19.33 | 70.68 | 81.53 | 91.99 | 61.69 | 72.55 | 83.01 |
| DF | Distrito Federal | 20.82 | 69.51 | 83.45 | 89.19 | 60.50 | 74.45 | 80.19 |
| MG | Sul/Sudoeste de Minas | 22.84 | 65.64 | 73.60 | 85.60 | 56.73 | 64.70 | 76.69 |
| MG | Metropolitana de Belo Horizonte | 23.05 | 66.95 | 83.14 | 99.81 | 57.96 | 74.16 | 90.83 |
| SP | Ribeirão Preto | 23.81 | 65.27 | 72.58 | 78.72 | 56.33 | 63.64 | 69.78 |
| SP | Araraquara | 24.07 | 64.54 | 72.90 | 79.01 | 55.63 | 63.98 | 70.10 |
| MG | Campo das Vertentes | 25.03 | 64.58 | 77.92 | 92.39 | 55.62 | 68.95 | 83.43 |
| SP | Campinas | 25.09 | 62.71 | 73.68 | 83.84 | 53.84 | 64.81 | 74.96 |
| SP | São José do Rio Preto | 25.57 | 64.00 | 72.40 | 78.54 | 55.04 | 63.44 | 69.57 |
| SP | Bauru | 27.41 | 60.95 | 71.10 | 78.99 | 52.05 | 62.20 | 70.09 |
| MG | Zona da Mata | 27.95 | 61.75 | 68.55 | 80.47 | 52.78 | 59.58 | 71.50 |
| GO | Sul Goiano | 27.95 | 62.43 | 73.43 | 79.36 | 53.43 | 64.43 | 70.36 |
| SP | Piracicaba | 28.66 | 59.14 | 66.72 | 72.30 | 50.26 | 57.85 | 63.43 |
| SP | Vale do Paraíba Paulista | 28.72 | 58.89 | 78.69 | 93.46 | 50.02 | 69.82 | 84.59 |
| MG | Norte de Minas | 28.81 | 60.88 | 74.88 | 89.41 | 51.91 | 65.91 | 80.44 |
| MG | Vale do Rio Doce | 28.97 | 60.76 | 68.52 | 81.05 | 51.79 | 59.55 | 72.08 |
| SP | Araçatuba | 29.41 | 60.26 | 66.98 | 71.80 | 51.30 | 58.01 | 62.83 |
| SP | Assis | 31.29 | 57.62 | 66.13 | 72.56 | 48.69 | 57.20 | 63.63 |
| MG | Vale do Mucuri | 31.41 | 58.06 | 69.97 | 83.86 | 49.10 | 61.01 | 74.90 |
| SP | Metropolitana de São Paulo | 31.88 | 55.24 | 78.97 | 96.92 | 46.40 | 70.13 | 88.08 |
| SP | Macro Metropolitana Paulista | 31.89 | 55.39 | 70.07 | 80.94 | 46.54 | 61.22 | 72.09 |
| SP | Marília | 32.02 | 57.03 | 69.58 | 81.59 | 48.09 | 60.65 | 72.65 |
| ES | Central Espírito-santense | 32.10 | 57.46 | 71.38 | 82.81 | 48.50 | 62.42 | 73.85 |
| RJ | Metropolitana do Rio de Janeiro | 32.10 | 57.02 | 95.26 | 103.00 | 48.08 | 86.32 | 94.06 |
| RJ | Noroeste Fluminense | 32.10 | 57.48 | 72.56 | 80.95 | 48.52 | 63.60 | 71.98 |
| SP | Presidente Prudente | 32.12 | 57.48 | 65.08 | 70.83 | 48.52 | 56.12 | 61.87 |
| GO | Centro Goiano | 32.19 | 58.30 | 71.12 | 76.29 | 49.29 | 62.11 | 67.28 |
| GO | Leste Goiano | 32.60 | 57.58 | 73.93 | 81.14 | 48.59 | 64.94 | 72.15 |
| SP | Itapetininga | 32.76 | 55.05 | 69.50 | 80.51 | 46.17 | 60.62 | 71.64 |
| MG | Jequitinhonha | 32.86 | 56.69 | 68.20 | 82.79 | 47.73 | 59.24 | 73.83 |
| MS | Leste de Mato Grosso do Sul | 32.91 | 57.15 | 66.38 | 76.25 | 48.16 | 57.39 | 67.26 |
| ES | Sul Espírito-santense | 33.40 | 56.19 | 67.10 | 78.58 | 47.23 | 58.14 | 69.62 |
| SP | Litoral Sul Paulista | 34.53 | 53.12 | 77.01 | 95.13 | 44.25 | 68.14 | 86.26 |
| GO | Norte Goiano | 36.53 | 53.58 | 67.88 | 75.25 | 44.59 | 58.89 | 66.26 |
| GO | Noroeste Goiano | 36.64 | 53.76 | 69.42 | 77.06 | 44.75 | 60.41 | 68.05 |
| ES | Litoral Norte Espírito-santense | 36.94 | 52.51 | 67.46 | 78.31 | 43.55 | 58.51 | 69.35 |
| MS | Centro Norte de Mato Grosso do Sul | 37.16 | 53.00 | 61.65 | 67.84 | 44.01 | 52.66 | 58.84 |

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| MT | Sudeste Mato-grossense | 37.40 | 53.84 | 64.13 | 73.93 | 44.79 | 55.09 | 64.88 |
| **WEIGHTED AVERAGE** | | **27.48** | **66.80** | **72.31** | **80.74** | **53.27** | **63.34** | **71.77** |

# 19.8.23 Mtpy Scenario

## 19.8.1. Pricing

For this scenario, a product with 10% $K_2O$ is considered. BAKS® will have customized formulations according to farmers preferences, adding the proportional value of each nutrient to the formulation. The formulation shown in Table 19.8.1-1 is merely an example.

**Table 19.8.1-1 Example of pricing a multinutrient source formulation**

| Nutrient | Nutrient concentration (%) | Nutrient in one tonne (kg) | Value of the nutrient in the product (US$/t) |
|---|---|---|---|
| $K_2O$ | 9.70 | 96.96 | 87.13 |
| S | 2.37 | 23.70 | 10.81 |
| Bo | 0.04 | 0.36 | 4.06 |
| Zn | 0.05 | 0.49 | 1.96 |
| Cu | 0.01 | 0.08 | 1.07 |
| Mn | 0.01 | 0.12 | 0.15 |
| **Total** | **12.17** | **121.72** | **105.20** |

## 19.8.2. Market share

For the 23 Mtpy Scenario, considering the projected demand in 2025, Brazil will demand 7,402,331 t of $K_2O$. With a production of 10 Mtpy with 10% $K_2O$, VERDE expects to supply 31.07% of the domestic market. In this scenario, in order to present a more conservative perspective, an alternative was selected considering 60% market share in 54 mesoregions, a weighted average freight price of US$ 31.28, and a resulting weighted average FOB price of US$ 58.51 per tonne (Table 19.8.2-1). A more detailed view of each mesoregion is provided in section 19.8.4.

**Table 19.8.2-1 Evaluated market share considering domestic demand and weighted freight**

| Alternative | % Market Share | Number of mesoregions | Weighted freight (US$ / t) | Weighted FOB (US$ / t) |
|---|---|---|---|---|
| 1 | 10 | 137 | 41.21 | 48.38 |
| 2 | 20 | 137 | 41.21 | 48.38 |
| 3 | 30 | 137 | 41.21 | 48.38 |
| 4 | 40 | 74 | 36.93 | 53.04 |
| 5 | 50 | 66 | 33.40 | 56.32 |
| **6** | **60** | **54** | **31.28** | **58.41** |
| 7 | 70 | 51 | 30.69 | 59.02 |
| 8 | 80 | 45 | 28.39 | 61.29 |

| Alternative | % Market Share | Number of mesoregions | Weighted freight (US$ / t) | Weighted FOB (US$ / t) |
|---|---|---|---|---|
| 9 | 90 | 41 | 27.48 | 62.24 |
| 10 | 100 | 37 | 25.89 | 63.66 |

Table 19.8.2-2 contains VERDE's target market compared to the total demand in Brazil considering each nutrient covered in this study.

**Table 19.8.2-2 VERDE's market share considering domestic demand 2025**

| Market 2025 | Unit | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| **Brazil demand** | t | 7,402,331 | 2,060,599 | 29,072 | 30,813 | 6,181 | 11,840 |
| **Target market** | t | 2,300,000 | 562,158 | 8,557 | 11,667 | 1,883 | 2,922 |
| **Market share Brazil** | % | 31.07 | 27.28 | 29.43 | 37.87 | 30.46 | 24.68 |

## 19.8.3. Target market

Table 19.8.3-1 contains a breakdown of each mesoregion selected for this scenario and a market share in the selected regions of 60%.

**Table 19.8.3-1 Target market mesoregions for VERDE's intended market share in the 23 Mtpy Scenario**

| State | Mesoregion | Nutrient (t) | | | | | |
|---|---|---|---|---|---|---|---|
| | | $K_2O$ | S | Zn | B | Cu | Mn |
| MG | Central Mineira | 2,392 | 425 | 6 | 10 | 2 | 2 |
| MG | Triângulo Mineiro/Alto Paranaíba | 63,884 | 14,216 | 252 | 414 | 64 | 67 |
| MG | Oeste de Minas | 7,547 | 1,385 | 35 | 49 | 7 | 7 |
| MG | Noroeste de Minas | 19,810 | 5,050 | 93 | 131 | 22 | 27 |
| DF | Distrito Federal | 2,818 | 933 | 15 | 7 | 2 | 5 |
| MG | Sul/Sudoeste de Minas | 34,286 | 6,422 | 173 | 272 | 39 | 25 |
| MG | Metropolitana de Belo Horizonte | 1,169 | 454 | 7 | 14 | 2 | 2 |
| SP | Ribeirão Preto | 32,745 | 5,630 | 50 | 149 | 14 | 20 |
| SP | Araraquara | 8,819 | 1,739 | 13 | 41 | 4 | 6 |
| MG | Campo das Vertentes | 4,952 | 1,581 | 29 | 49 | 7 | 7 |
| SP | Campinas | 9,139 | 2,388 | 32 | 68 | 6 | 7 |
| SP | São José do Rio Preto | 24,010 | 4,776 | 35 | 111 | 10 | 16 |
| SP | Bauru | 18,021 | 4,372 | 41 | 106 | 10 | 13 |
| MG | Zona da Mata | 13,388 | 2,163 | 66 | 107 | 15 | 7 |
| GO | Sul Goiano | 89,684 | 23,660 | 415 | 277 | 53 | 113 |
| SP | Piracicaba | 6,860 | 1,240 | 10 | 28 | 3 | 4 |
| SP | Vale do Paraíba Paulista | 344 | 167 | 2 | 4 | 0 | 0 |
| MG | Norte de Minas | 6,155 | 2,086 | 35 | 62 | 8 | 10 |
| MG | Vale do Rio Doce | 4,492 | 832 | 23 | 38 | 5 | 3 |
| SP | Araçatuba | 13,424 | 2,147 | 15 | 48 | 5 | 8 |
| SP | Assis | 13,974 | 2,858 | 33 | 60 | 9 | 10 |

| State | Mesoregion | Nutrient (t) | | | | | |
|---|---|---|---|---|---|---|---|
| | | $K_2O$ | S | Zn | B | Cu | Mn |
| MG | Vale do Mucuri | 499 | 144 | 2 | 5 | 1 | 1 |
| SP | Metropolitana de São Paulo | 39 | 23 | 0 | 1 | 0 | 0 |
| SP | Macro Metropolitana Paulista | 1,969 | 706 | 9 | 15 | 2 | 2 |
| SP | Marília | 3,449 | 1,052 | 13 | 31 | 3 | 3 |
| ES | Central Espírito-santense | 3,057 | 1,038 | 12 | 24 | 4 | 3 |
| RJ | Metropolitana do Rio de Janeiro | 510 | 506 | 3 | 2 | 1 | 1 |
| RJ | Noroeste Fluminense | 313 | 115 | 1 | 2 | 0 | 0 |
| SP | Presidente Prudente | 11,332 | 2,069 | 17 | 48 | 5 | 7 |
| GO | Centro Goiano | 8,322 | 2,595 | 33 | 23 | 5 | 10 |
| GO | Leste Goiano | 16,110 | 6,470 | 99 | 58 | 13 | 24 |
| SP | Itapetininga | 11,167 | 3,947 | 48 | 86 | 11 | 11 |
| MG | Jequitinhonha | 1,948 | 544 | 11 | 20 | 3 | 2 |
| MS | Leste de Mato Grosso do Sul | 16,638 | 3,710 | 54 | 116 | 14 | 16 |
| ES | Sul Espírito-santense | 3,234 | 857 | 11 | 27 | 4 | 3 |
| SP | Litoral Sul Paulista | 1,107 | 665 | 6 | 16 | 1 | 1 |
| GO | Norte Goiano | 4,693 | 1,656 | 29 | 18 | 4 | 7 |
| GO | Noroeste Goiano | 3,097 | 1,201 | 20 | 12 | 3 | 4 |
| ES | Litoral Norte Espírito-santense | 3,684 | 1,363 | 14 | 27 | 5 | 4 |
| MS | Centro Norte de Mato Grosso do Sul | 20,097 | 4,241 | 67 | 74 | 14 | 20 |
| MT | Sudeste Mato-grossense | 48,313 | 12,184 | 252 | 288 | 47 | 149 |
| PR | Norte Pioneiro Paranaense | 16,831 | 4,300 | 27 | 18 | 5 | 7 |
| RJ | Centro Fluminense | 142 | 115 | 1 | 1 | 0 | 0 |
| RJ | Norte Fluminense | 741 | 482 | 3 | 2 | 1 | 2 |
| PR | Norte Central Paranaense | 29,057 | 7,184 | 44 | 29 | 8 | 10 |
| BA | Extremo Oeste Baiano | 50,911 | 11,951 | 347 | 323 | 102 | 242 |
| ES | Noroeste Espírito-santense | 3,532 | 919 | 12 | 30 | 4 | 3 |
| RJ | Baixadas | 208 | 165 | 1 | 1 | 0 | 0 |
| RJ | Sul Fluminense | 50 | 48 | 0 | 0 | 0 | 0 |
| PR | Centro Oriental Paranaense | 13,762 | 4,043 | 24 | 16 | 4 | 6 |
| MS | Sudoeste de Mato Grosso do Sul | 73,891 | 18,260 | 250 | 491 | 67 | 64 |
| PR | Noroeste Paranaense | 14,613 | 3,247 | 20 | 15 | 3 | 3 |
| PR | Centro Ocidental Paranaense | 18,526 | 4,618 | 28 | 18 | 6 | 6 |
| PR | Sudeste Paranaense | 10,236 | 3,619 | 20 | 13 | 3 | 5 |
| | **TOTAL** | **2,309,970** | **565,683** | **8,576** | **11,680** | **1,886** | **2,927** |

### 19.8.4. FOB

For the Plant 3 Scenario, the Project will serve the states of Minas Gerais, Distrito Federal, São Paulo, Goiás, Espírito Santo, Mato Grosso do Sul, Mato Grosso, Paraná, Bahia, Rio de Janeiro and Santa Catarina. The mesoregions are listed in ascending order by freight cost, which in this scenario will be exclusively by road haulage.

Table 19.8.4-1 shows the freight departing from São Gotardo to each mesoregion, along the FOB values for three simulation alternatives (a) only potash source, (b) the first with sulphur addition and (c) the second with the addition of micronutrients. This table also contains figures for these same alternatives, considering the promotional discount policy (5% of the KCl price) and the difference in application cost.

**Table 19.8.4-1 FOB analysis for the selected mesoregions in the 23 Mtpy Scenario**

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micro-nutrients | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| MG | Central Mineira | 16.99 | 72.83 | 80.50 | 86.86 | 63.86 | 71.52 | 77.88 |
| MG | Triângulo Mineiro/Alto Paranaíba | 17.14 | 72.74 | 82.29 | 92.19 | 63.76 | 73.31 | 83.21 |
| MG | Oeste de Minas | 17.58 | 72.07 | 79.97 | 90.24 | 63.10 | 71.00 | 81.27 |
| MG | Noroeste de Minas | 19.33 | 70.68 | 81.53 | 91.99 | 61.69 | 72.55 | 83.01 |
| DF | Distrito Federal | 20.82 | 69.51 | 83.45 | 89.19 | 60.50 | 74.45 | 80.19 |
| MG | Sul/Sudoeste de Minas | 22.84 | 65.64 | 73.60 | 85.60 | 56.73 | 64.70 | 76.69 |
| MG | Metropolitana de Belo Horizonte | 23.05 | 66.95 | 83.14 | 99.81 | 57.96 | 74.16 | 90.83 |
| SP | Ribeirão Preto | 23.81 | 65.27 | 72.58 | 78.72 | 56.33 | 63.64 | 69.78 |
| SP | Araraquara | 24.07 | 64.54 | 72.90 | 79.01 | 55.63 | 63.98 | 70.10 |
| MG | Campo das Vertentes | 25.03 | 64.58 | 77.92 | 92.39 | 55.62 | 68.95 | 83.43 |
| SP | Campinas | 25.09 | 62.71 | 73.68 | 83.84 | 53.84 | 64.81 | 74.96 |
| SP | São José do Rio Preto | 25.57 | 64.00 | 72.40 | 78.54 | 55.04 | 63.44 | 69.57 |
| SP | Bauru | 27.41 | 60.95 | 71.10 | 78.99 | 52.05 | 62.20 | 70.09 |
| MG | Zona da Mata | 27.95 | 61.75 | 68.55 | 80.47 | 52.78 | 59.58 | 71.50 |
| GO | Sul Goiano | 27.95 | 62.43 | 73.43 | 79.36 | 53.43 | 64.43 | 70.36 |
| SP | Piracicaba | 28.66 | 59.14 | 66.72 | 72.30 | 50.26 | 57.85 | 63.43 |
| SP | Vale do Paraíba Paulista | 28.72 | 58.89 | 78.69 | 93.46 | 50.02 | 69.82 | 84.59 |
| MG | Norte de Minas | 28.81 | 60.88 | 74.88 | 89.41 | 51.91 | 65.91 | 80.44 |
| MG | Vale do Rio Doce | 28.97 | 60.76 | 68.52 | 81.05 | 51.79 | 59.55 | 72.08 |
| SP | Araçatuba | 29.41 | 60.26 | 66.98 | 71.80 | 51.30 | 58.01 | 62.83 |
| SP | Assis | 31.29 | 57.62 | 66.13 | 72.56 | 48.69 | 57.20 | 63.63 |
| MG | Vale do Mucuri | 31.41 | 58.06 | 69.97 | 83.86 | 49.10 | 61.01 | 74.90 |
| SP | Metropolitana de São Paulo | 31.88 | 55.24 | 78.97 | 96.92 | 46.40 | 70.13 | 88.08 |
| SP | Macro Metropolitana Paulista | 31.89 | 55.39 | 70.07 | 80.94 | 46.54 | 61.22 | 72.09 |
| SP | Marília | 32.02 | 57.03 | 69.58 | 81.59 | 48.09 | 60.65 | 72.65 |
| ES | Central Espírito-santense | 32.10 | 57.46 | 71.38 | 82.81 | 48.50 | 62.42 | 73.85 |
| RJ | Metropolitana do Rio de Janeiro | 32.10 | 57.02 | 95.26 | 103.00 | 48.08 | 86.32 | 94.06 |
| RJ | Noroeste Fluminense | 32.10 | 57.48 | 72.56 | 80.95 | 48.52 | 63.60 | 71.98 |
| SP | Presidente Prudente | 32.12 | 57.48 | 65.08 | 70.83 | 48.52 | 56.12 | 61.87 |
| GO | Centro Goiano | 32.19 | 58.30 | 71.12 | 76.29 | 49.29 | 62.11 | 67.28 |
| GO | Leste Goiano | 32.60 | 57.58 | 73.93 | 81.14 | 48.59 | 64.94 | 72.15 |
| SP | Itapetininga | 32.76 | 55.05 | 69.50 | 80.51 | 46.17 | 60.62 | 71.64 |
| MG | Jequitinhonha | 32.86 | 56.69 | 68.20 | 82.79 | 47.73 | 59.24 | 73.83 |
| MS | Leste de Mato Grosso do Sul | 32.91 | 57.15 | 66.38 | 76.25 | 48.16 | 57.39 | 67.26 |
| ES | Sul Espírito-santense | 33.40 | 56.19 | 67.10 | 78.58 | 47.23 | 58.14 | 69.62 |

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micro-nutrients | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| SP | Litoral Sul Paulista | 34.53 | 53.12 | 77.01 | 95.13 | 44.25 | 68.14 | 86.26 |
| GO | Norte Goiano | 36.53 | 53.58 | 67.88 | 75.25 | 44.59 | 58.89 | 66.26 |
| GO | Noroeste Goiano | 36.64 | 53.76 | 69.42 | 77.06 | 44.75 | 60.41 | 68.05 |
| ES | Litoral Norte Espírito-santense | 36.94 | 52.51 | 67.46 | 78.31 | 43.55 | 58.51 | 69.35 |
| MS | Centro Norte de Mato Grosso do Sul | 37.16 | 53.00 | 61.65 | 67.84 | 44.01 | 52.66 | 58.84 |
| MT | Sudeste Mato-grossense | 37.40 | 53.84 | 64.13 | 73.93 | 44.79 | 55.09 | 64.88 |
| PR | Norte Pioneiro Paranaense | 37.96 | 50.97 | 61.39 | 63.61 | 42.04 | 52.45 | 54.68 |
| RJ | Centro Fluminense | 38.17 | 51.18 | 82.33 | 90.22 | 42.22 | 73.38 | 81.27 |
| RJ | Norte Fluminense | 38.17 | 51.27 | 76.76 | 83.25 | 42.32 | 67.80 | 74.29 |
| PR | Norte Central Paranaense | 39.36 | 49.97 | 60.03 | 62.05 | 41.02 | 51.08 | 53.10 |
| BA | Extremo Oeste Baiano | 39.58 | 50.13 | 59.68 | 71.95 | 41.16 | 50.71 | 62.98 |
| ES | Noroeste Espírito-santense | 39.91 | 49.57 | 60.13 | 71.78 | 40.61 | 51.17 | 62.82 |
| RJ | Baixadas | 39.91 | 49.28 | 79.89 | 86.87 | 40.34 | 70.95 | 77.93 |
| RJ | Sul Fluminense | 39.91 | 48.91 | 85.28 | 92.77 | 39.99 | 76.35 | 83.85 |
| PR | Centro Oriental Paranaense | 40.23 | 48.61 | 60.47 | 62.80 | 39.68 | 51.55 | 53.88 |
| MS | Sudoeste de Mato Grosso do Sul | 40.47 | 49.58 | 59.60 | 69.11 | 40.59 | 50.61 | 60.12 |
| PR | Noroeste Paranaense | 40.76 | 48.97 | 58.00 | 59.88 | 40.00 | 49.02 | 50.91 |
| PR | Centro Ocidental Paranaense | 41.29 | 48.26 | 58.34 | 60.35 | 39.30 | 49.38 | 51.38 |
| PR | Sudeste Paranaense | 41.54 | 47.45 | 61.60 | 64.10 | 38.51 | 52.67 | 55.16 |
| **WEIGHTED AVERAGE** | | **31.28** | **58.41** | **68.54** | **76.51** | **49.45** | **59.57** | **67.54** |

# 19.9. 50 Mtpy Scenario

## 19.9.1. Pricing

For this scenario, the product considered will initially have an average $K_2O$ content of 9.19%. BAKS® will have customized formulations according to farmers' preferences. The proportional value of each nutrient will be added to the formulation. The formulation shown in Table 19.9.1-1 is merely an example.

**Table 19.9.1-1 Example of pricing a formulation**

| Nutrient | Nutrient concentration (%) | Nutrient in one tonne (kg) | Value of the nutrient in the product (US$/t) |
|---|---|---|---|
| $K_2O$ | 8.91 | 89.09 | 80.06 |
| S | 2.33 | 23.35 | 10.65 |
| Bo | 0.03 | 0.35 | 3.90 |
| Zn | 0.04 | 0.42 | 1.67 |
| Cu | 0.01 | 0.07 | 0.97 |
| Mn | 0.01 | 0.14 | 0.17 |
| **Total** | **11.34** | **113.42** | **97.42** |

### 19.9.2. Market Share

For the 50 Mtpy Scenario, considering the projected demand in 2030, Brazil will demand 8,358,971 t of $K_2O$. With a production of 50 Mtpy and an average $K_2O$ content of 9.19%, VERDE expects to supply 54.97% of the domestic market. For this scenario, to present a more competitive set of figures, the seventh alternative was selected. This alternative is based on a 70% market share in 72 mesoregions, a weighted average freight price of U$33.14, and a resulting a weighted average price FOB of US$49.53 (Table 19.9.2-1). Section 19.9.4 contains a breakdown for each mesoregion.

For this scenario, production will be transported by road and rail (see section 16.5).

**Table 19.9.2-1 Evaluated market share considering domestic demand and weighted freight**

| Alternative | % Market Share | Number of mesoregions | Weighted freight (US$ / t) | Weighted FOB (US$ / t) |
|---|---|---|---|---|
| 1 | 10 | 137 | 35.04 | 44.28 |
| 2 | 20 | 137 | 35.04 | 44.28 |
| 3 | 30 | 137 | 35.04 | 44.28 |
| 4 | 40 | 137 | 35.04 | 44.28 |
| 5 | 50 | 137 | 35.04 | 44.28 |
| 6 | 60 | 82 | 35.34 | 47.27 |
| **7** | **70** | **72** | **33.14** | **49.53** |
| 8 | 80 | 66 | 32.29 | 50.39 |
| 9 | 90 | 66 | 32.29 | 50.39 |
| 10 | 100 | 60 | 29.89 | 52.54 |

Table 19.9.2-2 contains VERDE's target market and the total demand in Brazil considering each nutrient covered in this study.

**Table 19.9.2-2 VERDE's market share considering domestic demand 2030**

| Market 2025 | Unit | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| **Brazil demand** | t | 8,358,971 | 2,239,164 | 31,967 | 34,301 | 6,793 | 13,265 |
| **Target market** | t | 4,595,000 | 1,204,242 | 17,816 | 21,501 | 3,721 | 7,437 |
| **Market share Brazil** | % | 54.97 | 53.78 | 55.73 | 62.68 | 54.77 | 56.06 |

### 19.9.3. Target market

A detailed analysis of nutrient consumption for each mesoregion selected in this scenario, considering a market share for the selected regions of 70%, is shown in Table 19.9.3-1.

**Table 19.9.3-1 Consumption of nutrients in Brazilian mesoregions for the 50 Mtpy Scenario**

| State | Mesoregion | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| MG | Central Mineira | 9,453 | 1,679 | 23 | 39 | 6 | 9 |
| MG | Triângulo Mineiro/Alto Paranaíba | 252,489 | 56,184 | 994 | 1,634 | 252 | 264 |
| MG | Oeste de Minas | 29,830 | 5,474 | 139 | 196 | 30 | 27 |
| MG | Noroeste de Minas | 78,297 | 19,958 | 366 | 519 | 88 | 106 |
| DF | Sul/Sudoeste de Minas | 135,508 | 25,382 | 685 | 1,076 | 154 | 98 |
| MG | Metropolitana de Belo Horizonte | 4,620 | 1,795 | 26 | 55 | 7 | 7 |

| State | Mesoregion | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| SP | Campo das Vertentes | 19,574 | 6,248 | 116 | 193 | 27 | 27 |
| MG | Ribeirão Preto | 129,417 | 22,251 | 198 | 589 | 56 | 80 |
| SP | Araraquara | 34,855 | 6,875 | 51 | 160 | 14 | 23 |
| SP | Campinas | 36,118 | 9,436 | 128 | 268 | 24 | 28 |
| MG | São José do Rio Preto | 94,896 | 18,876 | 139 | 439 | 39 | 64 |
| SP | Sul Goiano | 354,460 | 93,513 | 1,640 | 1,094 | 210 | 447 |
| SP | Noroeste Goiano | 12,239 | 4,747 | 78 | 47 | 11 | 17 |
| SP | Zona da Mata | 52,915 | 8,548 | 261 | 423 | 59 | 29 |
| GO | Bauru | 71,227 | 17,279 | 160 | 417 | 39 | 53 |
| MG | Sudeste Mato-grossense | 190,948 | 48,153 | 994 | 1,139 | 186 | 587 |
| SP | Distrito Federal | 11,139 | 3,688 | 60 | 28 | 7 | 20 |
| MG | Norte de Minas | 24,327 | 8,245 | 137 | 245 | 33 | 39 |
| MG | Vale do Rio Doce | 17,753 | 3,288 | 91 | 150 | 21 | 11 |
| SP | Centro Norte de Mato Grosso do Sul | 79,431 | 16,762 | 265 | 293 | 56 | 79 |
| MG | Piracicaba | 27,114 | 4,901 | 39 | 112 | 10 | 18 |
| SP | Vale do Paraíba Paulista | 1,358 | 660 | 7 | 15 | 1 | 2 |
| ES | Araçatuba | 53,056 | 8,487 | 59 | 189 | 20 | 33 |
| SP | Norte Pioneiro Paranaense | 66,522 | 16,996 | 109 | 73 | 21 | 26 |
| SP | Vale do Mucuri | 1,974 | 570 | 9 | 20 | 2 | 2 |
| SP | Centro Goiano | 32,893 | 10,258 | 130 | 90 | 18 | 40 |
| GO | Central Espírito-santense | 12,082 | 4,102 | 46 | 96 | 15 | 11 |
| SP | Metropolitana do Rio de Janeiro | 2,017 | 2,001 | 12 | 7 | 4 | 5 |
| MS | Noroeste Fluminense | 1,236 | 456 | 4 | 7 | 1 | 1 |
| SP | Leste Goiano | 63,671 | 25,572 | 391 | 229 | 52 | 96 |
| GO | Assis | 55,229 | 11,294 | 131 | 239 | 36 | 41 |
| ES | Norte Central Paranaense | 114,842 | 28,394 | 175 | 114 | 33 | 38 |
| MG | Jequitinhonha | 7,699 | 2,152 | 42 | 79 | 10 | 8 |
| SP | Centro-Sul Mato-grossense | 20,371 | 5,705 | 103 | 95 | 19 | 58 |
| GO | Marília | 13,633 | 4,159 | 53 | 124 | 10 | 11 |
| GO | Presidente Prudente | 44,790 | 8,177 | 67 | 191 | 19 | 29 |
| MT | Sudoeste de Mato Grosso do Sul | 292,040 | 72,170 | 990 | 1,942 | 266 | 251 |
| MS | Sul Espírito-santense | 12,781 | 3,388 | 43 | 105 | 14 | 10 |
| PR | Metropolitana de São Paulo | 153 | 91 | 1 | 2 | 0 | 0 |
| ES | Macro Metropolitana Paulista | 7,782 | 2,790 | 37 | 59 | 6 | 8 |
| PR | Centro Oriental Paranaense | 54,390 | 15,979 | 96 | 63 | 17 | 24 |
| PR | Noroeste Paranaense | 57,753 | 12,835 | 79 | 58 | 12 | 12 |
| PR | Leste de Mato Grosso do Sul | 65,758 | 14,661 | 213 | 460 | 57 | 64 |
| MS | Itapetininga | 44,134 | 15,598 | 191 | 340 | 43 | 42 |
| PR | Centro Ocidental Paranaense | 73,221 | 18,250 | 112 | 70 | 22 | 25 |
| PR | Sudeste Paranaense | 40,458 | 14,303 | 78 | 52 | 12 | 19 |
| BA | Metropolitana de Curitiba | 21,394 | 7,256 | 39 | 26 | 6 | 10 |
| ES | Centro-Sul Paranaense | 60,836 | 16,901 | 104 | 67 | 19 | 26 |
| RJ | Norte Goiano | 18,547 | 6,546 | 114 | 69 | 15 | 26 |
| RJ | Litoral Sul Paulista | 4,376 | 2,629 | 25 | 63 | 5 | 6 |
| RJ | Vale do Itajaí | 9,387 | 3,279 | 20 | 18 | 2 | 5 |

| State | Mesoregion | Potash | Sulphur | Zinc | Boron | Copper | Manganese |
|---|---|---|---|---|---|---|---|
| SC | Norte Catarinense | 21,925 | 5,779 | 33 | 31 | 6 | 8 |
| PR | Oeste Paranaense | 118,064 | 28,632 | 172 | 105 | 34 | 37 |
| BA | Sudoeste Mato-grossense | 39,863 | 11,691 | 139 | 133 | 28 | 84 |
| MT | Litoral Norte Espírito-santense | 14,558 | 5,388 | 55 | 108 | 19 | 14 |
| PR | Pantanais Sul Mato-grossense | 4,030 | 1,760 | 24 | 70 | 8 | 4 |
| SC | Sudoeste Paranaense | 49,537 | 15,580 | 89 | 59 | 16 | 22 |
| BA | Centro Fluminense | 563 | 453 | 3 | 2 | 1 | 1 |
| PR | Norte Fluminense | 2,930 | 1,903 | 11 | 10 | 4 | 6 |
| SC | Extremo Oeste Baiano | 201,216 | 47,233 | 1,372 | 1,275 | 404 | 958 |
| MS | Oeste Catarinense | 49,450 | 11,390 | 73 | 52 | 13 | 15 |
| MT | Noroeste Espírito-santense | 13,961 | 3,633 | 47 | 118 | 16 | 11 |
| MT | Baixadas | 821 | 652 | 4 | 3 | 1 | 2 |
| RJ | Sul Fluminense | 196 | 188 | 1 | 1 | 0 | 0 |
| TO | Serrana | 20,507 | 4,610 | 28 | 22 | 6 | 6 |
| SC | Norte Mato-grossense | 838,424 | 256,639 | 4,259 | 4,194 | 780 | 2,586 |
| PI | Sul Catarinense | 11,010 | 4,356 | 25 | 26 | 3 | 7 |
| SC | Grande Florianópolis | 1,673 | 633 | 4 | 4 | 0 | 1 |
| SC | Sul Baiano | 34,398 | 16,214 | 163 | 177 | 56 | 85 |
| TO | Centro Sul Baiano | 27,472 | 9,324 | 145 | 175 | 42 | 87 |
| MT | Nordeste Mato-grossense | 193,475 | 51,466 | 1,026 | 828 | 187 | 529 |
| MT | Nordeste Rio-grandense | 44,853 | 11,648 | 109 | 51 | 15 | 16 |
| | **TOTAL** | **4,609,916** | **1,208,116** | **17,852** | **21,518** | **3,726** | **7,442** |

## 19.9.4. FOB

For the 50 Mtpy Scenario, the project will serve the states of Minas Gerais, São Paulo, Goiás, Espírito Santo, Mato Grosso do Sul, Mato Grosso, Paraná, Bahia, Rio de Janeiro and Santa Catarina, Tocantins, and Piauí, as well as the Federal District.

Freight costs were optimized for the 50 Mtpy Scenario, as the crushed ore will be transported by rail from São Gotardo to the regional milling units to produce the final product. From there, the product will be transported by road to farmers. Rail transport costs were based on the ANTT's maximum cost table for the fertilizer class. The long-term cost of diesel used was the World Bank's benchmark for the long-term price per gallon of oil. The CIF price, the freight cost from the $K_2O$ milling and mixing units, as well as the costs of the additional sulphur and micronutrients, were used to estimate the FOB price considered.

Table 19.9.4-1 presents the freight departing from São Gotardo to each mesoregion, along with the FOB values for three simulation alternatives: (a) only potash source, (b) the first with sulphur addition and (c) the second with the addition of micronutrients. In addition, the same alternatives also shown with the promotional discount policy (5% of the KCl price) and the difference in application costs.

### Table 19.9.4-1 FOB analysis for the selected mesoregions in the 50 Mtpy Scenario

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| MG | Central Mineira | 16.99 | 65.56 | 72.61 | 78.47 | 56.95 | 64.00 | 69.85 |
| MG | Triângulo Mineiro/Alto Paranaíba | 17.14 | 65.46 | 74.25 | 83.37 | 56.85 | 65.64 | 74.75 |
| MG | Oeste de Minas | 17.58 | 64.81 | 72.08 | 81.54 | 56.21 | 63.48 | 72.93 |
| MG | Noroeste de Minas | 19.33 | 63.39 | 73.38 | 83.02 | 54.76 | 64.76 | 74.40 |
| MG | Sul/Sudoeste de Minas | 22.84 | 58.47 | 65.80 | 76.85 | 49.92 | 57.25 | 68.30 |
| MG | Metropolitana de Belo Horizonte | 23.05 | 59.66 | 74.59 | 89.97 | 51.04 | 65.97 | 81.35 |
| MG | Campo das Vertentes | 25.03 | 57.32 | 69.61 | 82.96 | 48.72 | 61.00 | 74.36 |
| SP | Ribeirão Preto | 25.05 | 56.83 | 63.80 | 69.54 | 48.25 | 55.23 | 60.96 |
| SP | Araraquara | 25.30 | 56.13 | 64.12 | 69.83 | 47.58 | 55.56 | 61.27 |
| SP | Campinas | 26.80 | 53.89 | 64.47 | 74.01 | 45.37 | 55.95 | 65.49 |
| SP | São José do Rio Preto | 26.80 | 55.52 | 63.54 | 69.28 | 46.92 | 54.94 | 60.68 |
| GO | Sul Goiano | 27.56 | 55.50 | 66.10 | 71.66 | 46.87 | 57.46 | 63.03 |
| GO | Noroeste Goiano | 27.95 | 55.13 | 70.52 | 77.77 | 46.49 | 61.88 | 69.13 |
| MG | Zona da Mata | 27.95 | 54.48 | 60.75 | 71.72 | 45.88 | 52.14 | 63.12 |
| SP | Bauru | 28.65 | 52.56 | 62.27 | 69.65 | 44.02 | 53.72 | 61.10 |
| MT | Sudeste Mato-grossense | 28.71 | 55.14 | 65.25 | 74.52 | 46.46 | 56.57 | 65.85 |
| DF | Distrito Federal | 28.77 | 54.24 | 67.47 | 72.82 | 45.61 | 58.83 | 64.19 |
| MG | Norte de Minas | 28.81 | 53.62 | 66.52 | 79.92 | 45.01 | 57.91 | 71.32 |
| MG | Vale do Rio Doce | 28.97 | 53.49 | 60.64 | 72.18 | 44.88 | 52.03 | 63.57 |
| MS | Centro Norte de Mato Grosso do Sul | 30.09 | 52.76 | 61.20 | 67.03 | 44.14 | 52.58 | 58.40 |
| SP | Piracicaba | 30.37 | 50.31 | 57.63 | 62.86 | 41.79 | 49.11 | 54.34 |
| SP | Vale do Paraíba Paulista | 30.43 | 50.08 | 69.21 | 83.12 | 41.57 | 60.70 | 74.61 |
| SP | Araçatuba | 30.64 | 51.77 | 58.19 | 62.69 | 43.16 | 49.58 | 54.08 |
| PR | Norte Pioneiro Paranaense | 31.37 | 50.36 | 60.60 | 62.71 | 41.78 | 52.03 | 54.14 |
| MG | Vale do Mucuri | 31.41 | 50.81 | 61.79 | 74.59 | 42.22 | 53.19 | 65.99 |
| GO | Centro Goiano | 31.80 | 51.36 | 63.71 | 68.57 | 42.72 | 55.07 | 59.93 |
| ES | Central Espírito-santense | 32.10 | 50.21 | 63.03 | 73.57 | 41.61 | 54.43 | 64.97 |
| RJ | Metropolitana do Rio de Janeiro | 32.10 | 49.80 | 85.21 | 92.38 | 41.22 | 76.63 | 83.80 |
| RJ | Noroeste Fluminense | 32.10 | 50.23 | 64.12 | 71.86 | 41.63 | 55.52 | 63.26 |
| GO | Leste Goiano | 32.25 | 50.64 | 66.45 | 73.24 | 42.01 | 57.82 | 64.61 |
| SP | Assis | 32.52 | 49.18 | 57.32 | 63.34 | 40.61 | 48.75 | 54.77 |
| PR | Norte Central Paranaense | 32.77 | 49.33 | 59.22 | 61.14 | 40.74 | 50.63 | 52.55 |
| MG | Jequitinhonha | 32.86 | 49.44 | 60.04 | 73.49 | 40.84 | 51.44 | 64.89 |
| MT | Centro-Sul Mato-grossense | 32.93 | 51.65 | 62.75 | 70.53 | 42.94 | 54.03 | 61.82 |
| SP | Marília | 33.26 | 48.59 | 60.60 | 71.84 | 40.01 | 52.02 | 63.26 |
| SP | Presidente Prudente | 33.35 | 48.99 | 56.26 | 61.63 | 40.39 | 47.65 | 53.03 |
| MS | Sudoeste de Mato Grosso do Sul | 33.40 | 49.35 | 59.13 | 68.10 | 40.73 | 50.51 | 59.47 |
| ES | Sul Espírito-santense | 33.40 | 48.93 | 58.98 | 69.56 | 40.33 | 50.38 | 60.96 |
| SP | Metropolitana de São Paulo | 33.60 | 46.47 | 69.43 | 86.35 | 37.98 | 60.94 | 77.86 |
| SP | Macro Metropolitana Paulista | 33.60 | 46.61 | 60.79 | 71.01 | 38.11 | 52.29 | 62.51 |
| PR | Centro Oriental Paranaense | 33.64 | 48.00 | 59.68 | 61.89 | 39.43 | 51.12 | 53.32 |
| PR | Noroeste Paranaense | 33.69 | 48.77 | 57.58 | 59.35 | 40.16 | 48.97 | 50.74 |
| MS | Leste de Mato Grosso do Sul | 34.14 | 48.62 | 57.45 | 66.68 | 40.00 | 48.83 | 58.06 |
| SP | Itapetininga | 34.47 | 46.22 | 60.18 | 70.53 | 37.70 | 51.66 | 62.01 |
| PR | Centro Ocidental Paranaense | 34.71 | 47.59 | 57.52 | 59.42 | 38.99 | 48.92 | 50.82 |
| PR | Sudeste Paranaense | 34.95 | 46.83 | 60.77 | 63.14 | 38.26 | 52.20 | 54.57 |
| PR | Metropolitana de Curitiba | 35.89 | 45.22 | 58.59 | 60.82 | 36.68 | 50.05 | 52.28 |
| PR | Centro-Sul Paranaense | 36.17 | 45.87 | 56.87 | 59.01 | 37.29 | 48.29 | 50.42 |
| GO | Norte Goiano | 36.18 | 46.64 | 60.47 | 67.41 | 38.02 | 51.85 | 58.78 |
| SP | Litoral Sul Paulista | 36.24 | 44.31 | 67.42 | 84.51 | 35.79 | 58.91 | 76.00 |
| SC | Vale do Itajaí | 36.68 | 44.80 | 58.52 | 61.55 | 36.24 | 49.97 | 52.99 |
| SC | Norte Catarinense | 36.71 | 44.83 | 55.26 | 57.60 | 36.27 | 46.70 | 49.04 |
| PR | Oeste Paranaense | 36.79 | 45.65 | 55.27 | 57.05 | 37.04 | 46.66 | 48.44 |
| MT | Sudoeste Mato-grossense | 36.85 | 47.23 | 58.73 | 64.29 | 38.54 | 50.04 | 55.61 |
| ES | Litoral Norte Espírito-santense | 36.94 | 45.26 | 59.05 | 69.05 | 36.67 | 50.45 | 60.46 |
| MS | Pantanais Sul Mato-grossense | 37.61 | 45.46 | 62.28 | 83.21 | 36.82 | 53.64 | 74.57 |
| PR | Sudoeste Paranaense | 37.90 | 44.32 | 56.68 | 58.91 | 35.72 | 48.08 | 50.31 |
| RJ | Centro Fluminense | 38.17 | 43.94 | 72.74 | 80.05 | 35.35 | 64.15 | 71.46 |
| RJ | Norte Fluminense | 38.17 | 44.03 | 67.57 | 73.56 | 35.43 | 58.97 | 64.97 |

| State | Mesoregion | Freight (US$) | FOB price (US$) | | | Discounted FOB Price (US$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros | $K_2O$ | $K_2O$ + S | $K_2O$ + S + Micros |
| BA | Extremo Oeste Baiano | 39.23 | 43.22 | 52.45 | 63.98 | 34.61 | 43.85 | 55.37 |
| SC | Oeste Catarinense | 39.88 | 42.21 | 51.30 | 53.21 | 33.63 | 42.71 | 44.62 |
| ES | Noroeste Espírito-santense | 39.91 | 42.33 | 52.04 | 62.78 | 33.73 | 43.45 | 54.19 |
| RJ | Baixadas | 39.91 | 42.06 | 70.36 | 76.81 | 33.48 | 61.77 | 68.23 |
| RJ | Sul Fluminense | 39.91 | 41.72 | 75.38 | 82.32 | 33.15 | 66.81 | 73.75 |
| SC | Serrana | 40.26 | 41.47 | 50.33 | 52.23 | 32.90 | 41.76 | 43.66 |
| MT | Norte Mato-grossense | 41.13 | 42.58 | 54.46 | 62.54 | 33.91 | 45.79 | 53.87 |
| SC | Sul Catarinense | 42.86 | 38.79 | 54.06 | 57.57 | 30.22 | 45.49 | 49.00 |
| SC | Grande Florianópolis | 42.86 | 38.59 | 53.20 | 56.47 | 30.03 | 44.65 | 47.91 |
| BA | Sul Baiano | 43.70 | 38.02 | 55.14 | 63.71 | 29.45 | 46.57 | 55.14 |
| BA | Centro Sul Baiano | 43.98 | 37.84 | 50.31 | 60.28 | 29.27 | 41.73 | 51.71 |
| MT | Nordeste Mato-grossense | 45.10 | 37.96 | 48.26 | 55.73 | 29.33 | 39.62 | 47.09 |
| RS | Nordeste Rio-grandense | 45.47 | 36.40 | 46.49 | 48.89 | 27.82 | 37.91 | 40.31 |
| **WEIGHTED AVERAGE** | | **33.14** | **49.53** | **59.84** | **66.95** | **40.92** | **51.22** | **58.33** |

## 19.10. Summary of the scenario results

Table 19.9.4-1 consolidates the results for the three scenarios evaluated and includes the weighted average prices for the FOB for each scenario and for each alternative product simulation.

**Table 19.9.4-1 Summary of weighted values for each scenario**

| Weighted results | Unit | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
|---|---|---|---|---|
| ***Potash Market*** | | | | |
| Weighted Freight for product delivery | US$/t | 27.48 | 31.28 | 33.14 |
| Weighted FOB $K_2O$ | US$/t | 62.24 | 58.41 | 49.53 |
| Weighted FOB $K_2O$ discount [1] | US$/t | 53.27 | 49.45 | 40.92 |
| Product volume | Mt | 10.75 | 23.10 | 50.16 |
| **Annual market size FOB 1** | **US$ Millions** | **572.68** | **1,142.17** | **2,052.45** |
| Weighted CRF $K_2O$ discount [1] | US$/t | 80.75 | 80.72 | 74.05 |
| **Annual market size CFR 1** | **US$ Millions** | **868.10** | **1,864.67** | **3,714.62** |
| ***Potash and Sulphur Market*** | | | | |
| Weighted additional freight S [2] | US$/t | 0.72 | 0.81 | 0.44 |
| Weighted FOB $K_2O$ + S | US$/t | 72.31 | 68.54 | 59.84 |
| Weighted FOB $K_2O$ + S with discount [1] | US$/t | 63.34 | 59.57 | 51.22 |
| Product + S-Elemental volume | Mt | 11.01 | 23.67 | 51.37 |
| **Annual market size FOB 2** | **US$ Millions** | **697.31** | **1,409.84** | **2,631.04** |
| Weighted CRF K2O + S with discount [1] | US$/t | 91.54 | 91.66 | 84.79 |
| **Annual market size CFR 2** | **US$ Millions** | **1,007.76** | **2,169.24** | **4,355.91** |
| ***Potash, Sulphur and Micronutrients Market*** | | | | |
| Weighted additional freight Micros [2] | US$/t | 0.23 | 0.27 | 0.15 |
| Weighted FOB $K_2O$ + S + Micros [3] | US$/t | 80.74 | 76.51 | 66.95 |
| Weighted FOB $K_2O$ + S + Micros with discount [1] | US$/t | 71.77 | 67.54 | 58.33 |
| Product + S-Elemental + Oxides volume | Mt | 11.10 | 23.84 | 51.71 |
| **Annual market size FOB 3** | **US$ Millions** | **796.34** | **1,610.15** | **3,015.99** |
| Weighted CRF $K_2O$ + S + Micros with discount [1] | US$/t | 100.21 | 99.90 | 92.05 |
| **Annual market size CFR 3** | **US$ Millions** | **1,111.82** | **2,381.51** | **4,759.78** |

[1] Discount granted only to $K_2O$ (5% in relation to KCl), deducting the difference from the application cost of US$ 4.48/t for VERDE's product

[2] Additional freight for the 50 Mtpy Scenario considering the fertilizer plant as the source[3] The cost of acquiring the raw material for manganese has already been disregarded, as siltstone has a higher content than required based on demand

# 20. Environmental Studies, Permitting and Social or Community Impact

## 20.1. Environmental Permit Status

The Brazilian Environmental Policy was created in 1981 (Law No. 6938/1981) and is regulated by the CONAMA Resolution No. 01/1986, which defines the nature of the studies required for permitting for different types of activities that have the potential to cause an environmental impact.

VERDE operates under a Mining Concession and Mining Permit ("Guia de Utilização"), an exceptional mining permit with a predetermined expiration date granted by the ANM, which allows the holder to engage in mineral extraction in the area before the granting of a Mining Concession, in accordance with the environmental legislation in force.

VERDE currently has several environmental licenses and water permits that have been assessed and issued at a state level by the Environmental State Board (CONAMA – *Conselho Estadual de Política Ambiental*), through a process in the Minas Gerais Environmental and Sustainable Development Secretary (*Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável* in Portuguese). According to the DN 217/2017, for some types of activity, a formal Environmental Impact Study (*Estudo de Impacto Ambiental – EIA*) is not required. The license is authorized through a simplified environmental study.

All required environmental licenses and permits to conduct the proposed work on the properties are in good standing or are in process of being obtained. VERDE has been operating since 2018 and all relevant permits have been in place during this period. There are no identified environmental liabilities associated with the properties.

VERDE will be working on additional licenses to support expanded future extraction in line with the company's planned growth.

### 20.1.1. Land Use

According to Brazilian law, surface rights are separate from mining rights. To use an area owned by a third-party, a contract is signed for land use, with royalty payments based on production in that area (as described in 4.3. Agreements and Encumbrances). The contract also specifies that the company has the responsibility for any reclamation work.

VERDE should obtain agreements with all landowners that provide for land acquisition or compensation for the price of the land and any additional losses caused by the occupation of such land. If there is no such agreement, a lawsuit may be filed to enforce an easement on the surface area necessary for the exploration. In this case, a judge will decide the amount of compensation to be paid to the landowner.

### 20.1.2. Environmental Impacts and Mitigation Actions

During the licensing processes, VERDE concluded that negative impacts on the environment would occur during construction and operation, but that these impacts could be effectively mitigated through the implementation of environmental protection measures, compensation measures and proper monitoring.

The operation licenses contain environmental control plans appropriate for the activity being undertaken and the environmental impacts identified. These plans were prepared in accordance with Brazilian legislation. All impacts produced are monitored and addressed as required, including the submission of annual monitoring reports. The main impacts will be mitigated during the closure phase.

The programs include:

- Atmospheric Emissions and Air Quality Monitoring Program
- Degraded Areas Rehabilitation Plan
- Environmental Control Plan
- Environmental Education Program
- Erosive Process Prevention and Control Program
- Flora and Fauna Monitoring Program
- Liquid Effluent Control Program
- Noise and Vibration Monitoring and Control Program
- Proper care of emergency situations
- Solid Residue Management Program
- Surface and Underground Water Quality Monitoring Program

## 20.2. Environmental Compensations

Specific laws in Brazil consider aspects regarding forests, water resources, conservation units and special areas, such as those at the federal (Federal law No. 9.985/2000, Federal Decree No. 4.340/2002, CONAMA Resolution 369/2006, Federal law No. 11.428/2006, Federal Decree No. 6.660/2008, Federal Decree No. 45175/2009, Federal Decree No. 6.848/2009, Federal law No. 12.651/2012 and others) and state (State law No. 20.922/2013, IEF Ordinance No. 55/2012, IEF Ordinance No. 30/2015, IEF Ordinance No. 27/ 2017 and others) levels.

Federal Law No. 12.651/2012 establishes the standards for the protection and sustainable use of forests and other forms of native vegetation. This law contains definitions of aspects related to Permanent Preservation Areas (APP), Legal Reserves (LR), the need for intervention, forms of vegetation and economic instruments. The Legal Reserve and Permanent Preservation Areas can be characterized as restrictions on property rights, grounded in social functions provided for in the Federal Constitution.

According to Federal Law No. 9.985/2000, regarding to the National System of Conservational Units (*Sistema Nacional de Unidades Conservação* – SNUC), enterprises that cause significant environmental impact must commit financial resources to the implementation and maintenance of Conservation Units, which are specially protected areas, as established on the Federal Constitution (article 225, first paragraph). The quantum of environmental compensation, to be held by the environmental agency, should be based on the degree of environmental impact, calculated during the Preliminary License (LP) stage.

## 20.3. Social and Community

The municipalities of São Gotardo and Matutina are the nearest to the project site. The environmental impact studies identified the main impacts that will be generated by the Project in the socioeconomic area, such as employment, increase tax revenues, demand materials provided by local regional suppliers and services.

VERDE is developing a plan to promote social and economic development in a sustainable framework through programs aimed at generating positive impacts and minimizing negative impacts in these communities.

The end of Project will involve the community to mitigate the impacts of the mine closure, including the implementation and support of sustainable projects and educational training.

## 20.4. Mine closure requirements

Mine closure is the permanent cessation of mining operations. This process is governed by various procedures, including the presentation of a Mine Closure Plan ("*Plano de Fechamento de Mina*" – MCP) and the Erosive Processes Prevention and Control Program ("*Programa de Recuperação de Áreas Degradadas*" – PRAD), which must be prepared in accordance with Brazilian law. The environmental impact studies and analysis of mine operations allow for an understanding of the scenario in which the necessary steps for the closing of the mine will be proposed and established.

The MCP will study ways to recover and plan for future use of the area and the decommissioning facilities. This involves the preparation of a conceptual closure plan and serves as the basis for a budgetary closure cost estimate.

The MCP is a conceptual version that demonstrates that VERDE is aware of its responsibilities and that it is prepared for an eventual closure. This plan must be prepared in accordance with the characteristics of the area and the project, which are updated over time. Thus, this study will have a dynamic, interactive, and participative character and always takes into consideration the environmental agency, the ANM, the local community, government partnerships and non-governmental organizations. The MCP must be updated every 5 (five) years or when the PAE is updated, over the course the life of the mine.

To minimize the environmental impact of the project, as previously detailed in Section 16.3, VERDE will adopt the strategy of recomposing the exhausted pits with the waste rock from other pits. This is possible because the Project is comprised of several pits arranged along the entire mineralization. For the Plant 3 Scenario, two piles of 3.7 and 0.9 $Mm^3$ will be constructed. For the 23 Mt Scenario, three piles totaling 2.2 $Mm^3$ will be built up. For the 50 Mt Scenario, a pile of 2.9 $Mm^3$ will be built up. They will be sufficient for the dumping of the removed waste rock until the first pit reaches the final pit configuration, which will occur from year 2 onward, for the Plant 3 Scenario. For the 50 Mt scenario, this will occur from the 5$^{th}$ month of operation. For the 50 Mt scenario, a small amount of low-grade waste rock will be mined until areas inside the pit are cleared to receive the waste rock. Therefore, a single pile outside the pit is planned.

The PFM and the Plan for the Recovery of Degraded Areas (PRAD) will provide suitable technical solutions for soil rehabilitation and other aspects of the environment that might be degraded by mining operations.

Due to the characteristics of the Project plan, such as the fleet and blasting being outsourced, in addition to the filling of the pit with waste rock as the bottom of the pit is reached and, in sequence, all necessary activities for environmental recovery are carried out, the cost associated with closing the mine will be considered as part of the OPEX and is listed in section 21.2.5 as "Environmental Recovery".

## 20.5. Environmental licensing for the evaluated scenarios

According to Brazilian law, there are three stages of the environmental licensing process:

- Preliminary license (*Licença Prévia* – LP): issued on approval of the project design and project environmental impact assessment/studies.
- Installation License (*Licença de Instalação* – LI): required prior to construction, issued on approval of management plans to control and mitigate social and environmental impacts.
- Operating License (*Licença de Operação* – LO): required prior to operations starting, issued once the license conditions issued by regulator have been met.

For the scenarios evaluated in this PFS, an analysis of the necessary processes was carried out, in accordance with Normative Deliberation No. 217/2017, which regulates environmental licensing in the state of Minas Gerais.

For the Plant 3 Scenario, with a production of 10 Mt and flow along highways, the environmental licensing will be in the LAC 2 modality. This form of licensing involves the analysis, in a single phase, of the preliminary license (LP) and installation license (LI) for the enterprise, with subsequent analysis of the operating license (LO); or analysis of the LP with subsequent simultaneous analysis of the LI and LO stages of the enterprise.

For the 23 Mtpy Scenario, with a production of 23 Mt and flow along highways, the environmental licensing will be in the LAT modality. In this form of licensing (three-phase licensing) the Preliminary License - LP, the Installation License - LI and the Operating License - LO for the activity or enterprise are granted in successive stages. In the 50 Mtpy Scenario, with a production of 50 Mt and the transportation of Ore along railroads to the other plants, the licensing will be in the LAT modality (three-phase licensing), mainly due to the construction of a new railroad connecting the mine site to the Ibiá branch line. In this form of licensing, LP, LI and LO licenses are granted in successive stages.

The first step in the environmental licensing process is the project characterization form, filled with SEMAD, which provides guidance for completing the application requirements. Several additional ancillary licenses and certificates may be required, as part of the Brazilian environmental licensing procedure. Some examples of these are listed below:

- Agreements with landowners which allow exploitation to be undertaken
- Authorization to cut trees
- Authorization for the use of water resources
- Environmental compensation
- Environmental Education Programs (*Programas de Educação Ambiental* – PEA)
- Environmental Impact Report (*Relatório de Impacto Ambiental* – RIMA);
- Environmental Impact Study (*Estudo de Impacto Ambiental* – EIA)
- Mine Closure Plan (*Plano de Fechamento de Mina*);
- Mining compensation
- Plan for Recovery of Degraded Areas (*Plano de Recuperação de Áreas Degradadas* – PRAD);
- Public Hearing (*Audiência Pública*);
- Registrations with the local municipal governments
- Socio-Environmental Control Plans (*Planos de Controle Ambiental* – PCA)

- Specific aspects of a concession for mining called a Mining Servitude (*Servidão Minerária*), providing a legally established right-of-way that allows the company access land to exploit minerals)
- Land clearance
- Water license

A detailed EIA is required by the Brazilian government before construction and mining operations can begin. The RIMA consists of a document that lists the full content of the EIA, summarized and written in a language that is more easily understood by the community.

A public hearing is required to present the direct and indirect influence of the Project to the affected community. After presentations are made by the company, there will be an opportunity for all participants to answer questions and make and collect comments and suggestions regarding the project. The public hearing will occur in accordance with CONAMA Resolution nº. 009/1987 and the company has the responsibility to facilitate the location and transportation of the population to the event.

However, the environmental agency may establish specific procedures and require complementary documents for environmental licensing, depending on the natural characteristics of the site and on the peculiarities of the project. The agency will also guarantee that each phase of the licensing will be compatible with the planning, construction and operation stages of the licensed activity.

# 21. Capital and Operating Costs

As part of the verification process for the reserves presented in this report, BNA conducted an economic valuation of the Project for the material classified as reserve. This section outlines the capital and operating costs considered in this valuation. All costs presented in this section are based on a conversion rate of US$1.00 = R$5.30. This is a long-term projection for the dollar according to the Focus Banco Central do Brasil Report of February 18, 2022.

Furthermore, costs associated with transportation both from the mine and the product are also based on the long-term price of crude oil gallon projected at US$70.00 by the World Bank. Considering the decomposition of the Diesel distributed in Brazil price, a long-term price of US$0.79 per liter was estimated by the Study. In Brazil, road and rail freight have, respectively, 40% and 30% of their price referring to the cost of diesel.

## 21.1. CAPEX

The Project technical team prepared an estimate of the capital required to sustain the mining and processing operations. This capital estimate is broken down into the following main areas.

### 21.1.1. Mining

Mining will be performed by a contractor and therefore the purchase of production equipment will not be required.

### 21.1.2. Processing

The processing CAPEX was estimated by MINALAC, using data from suppliers' budgetary quotations and costs from similar projects.

Table 21.1.2-1 summarizes the investment in the processing for three scenarios. It should be kept in mind that scenario-A is expected to relocate in year 22 of the crushing unit and fertilizer plant to optimize the operating cost for ROM transport.

**Table 21.1.2-1 Investments - Processing**

| Investment (US$x1,000) | | |
|---|---|---|
| **Plant 3 Scenario** | **23 Mtpy Scenario** | **50 Mtpy Scenario** |
| 29,380 | 70,597 | 158,780 |

The next items summarize in greater detail the estimated costs for each scenario. Returning to the concept of plants, the units were designed based on a modular concept and there was a separation of the crushing units and fertilizer plants (grinding and mixing of other nutrients). Thus, in the next investment tables the crushing and fertilizer plants will be separated.

<u>Processing Plant 3 Scenario</u>

Investments for the processing facilities in this scenario are estimated at US$ 29,380,381 for the construction of new crushing units and fertilizer plant. These investments are summarized in the following table. Once again it should be noted that in year 22, following the relocation, the same investments, plus 15% of contingency, will be remade, these CAPEX amounts are properly considered in the economic analysis of this alternative of the study.

**Table 21.1.2-2 Summary of Investments - Processing Plant 3 Scenario**

| Description | Investment | |
|---|---|---|
| | US$x1,000 | R$x1,000 |
| **Crushing 10 Mtpy** | | |
| Topography and earthwork | 345.38 | 1,830.54 |
| Reception Area, Office and Platform Scale | 345.12 | 1,829.13 |
| Operations Area – Crushing and Stocks | 2,300.14 | 12,190.75 |
| Equipment | 6,237.68 | 33,059.69 |
| Metallic Base | 230.01 | 1,219.05 |
| Civil Base | 661.71 | 3,507.05 |
| Others | 1,878.00 | 9,953.38 |
| **Subtotal - Crushing** | **11,998.04** | **63,589.59** |
| **Fertilizer Plant 10 Mtpy** | | |
| Topography and earthwork | 259.28 | 1,374.16 |
| Reception Area, Office and Platform Scale | 257.63 | 1,365.43 |
| Operation Area – Crushing and Stockpiles | 1,815.67 | 9,623.04 |
| Equipment | 12,305.97 | 65,221.63 |
| Metallic Base | 75.33 | 399.24 |
| Civil Base | 515.57 | 2,732.50 |
| Others | 2,152.91 | 11,410.43 |
| **Subtotal – Fertilizer Plant** | **17,382.35** | **92,126.43** |
| **TOTAL INVESTIMENT** | **29,380.38** | **155,716.02** |

<u>Processing 23 Mtpy Scenario</u>

Investments for the processing facilities in this scenario are summarized in the following table. In this scenario, two new 10 Mtpy units are concomitantly planned, along with the unit currently under construction (2.4 Mtpy capacity) and a scheduled expansion (with the decommissioning and relocation of the current 600 Ktpy plant), which will result in the planned 3 Mtpy. Therefore, there will be three units capable of producing 23 Mtpy of fertilizer, in addition to the addition of other nutrients.

**Table 21.1.2-3 Summary of Investments – 23 Mtpy Scenario Processing**

| Description | Investment | |
|---|---|---|
| | US$x1,000 | R$x1,000 |
| **Crushing 50 Mtpy** | | |
| Topography and earthworks | 690.77 | 3,661.08 |
| Reception Area, Office, and Platform Scale | 690.24 | 3,658.27 |
| Operations Area – Crushing and Stockpiles | 4,600.28 | 24,381.49 |
| Equipment | 12,475.36 | 66,119.39 |
| Metallic Base | 460.02 | 2,438.10 |
| Civil Base | 1,323.41 | 7,014.10 |
| Others | 3,755.99 | 19,906.76 |
| **Subtotal - Crushing** | **23,996.07** | **127,179.18** |
| **Fertilizer Plant 10 Mtpy** | | |
| Topography and earthworks | 518.55 | 2,748.32 |
| Reception Area, Office and Platform Scale | 515.26 | 2,730.87 |
| Operations Area – Crushing and Stockpiles | 3,631.34 | 19,246.08 |
| Equipment | 24,611.94 | 130,443.26 |

| Description | Investment | |
|---|---|---|
| | US$x1,000 | R$x1,000 |
| Metallic Base | 150.65 | 798.47 |
| Civil Base | 1,031.13 | 5,464.99 |
| Others | 4,305.82 | 22,820.87 |
| **Subtotal – Fertilizer Plant** | **34,764.69** | **184,252.86** |
| **SUBTOTAL NEW PLANTS** | **58,760.76** | **311,432.04** |
| **Processing Plant - CURRENT** | | |
| Urbanization and Landscaping | 33.96 | 180.00 |
| Projects | 1,358.10 | 7,197.91 |
| Furniture and utensils | 20.28 | 107.50 |
| Machines and equipment | 2,434.60 | 12,903.38 |
| Infrastructure | 613.37 | 3,250.88 |
| Hydraulics / Plumbing | 64.53 | 342.00 |
| Electrical and Automation | 14.15 | 75.00 |
| Construction | 5,720.44 | 30,318.33 |
| Blending and humidification | 145.84 | 772.96 |
| Construction management | 311.99 | 1,653.53 |
| Labor and training | 12.81 | 67.88 |
| Others | 30.46 | 161.46 |
| Relocation and renovation of equipment from the 600Ktpy unit | 1,076.05 | 5,703.08 |
| **Subtotal current plant** | **11,836.59** | **62,733.92** |
| **TOTAL INVESTIMENT** | **70,597.35** | **374,165.96** |

Processing 50 Mtpy Scenario

Investments for the processing facilities in this scenario are summarized in the following table. It should be noted that, unlike in previous scenarios, in this scenario the crushing unit is in a different location than the fertilizer plants. From the crushing unit, strategically located in relation to the mineral reserve to optimize the ROM transport cost, a long-distance belt conveyor with a length of 5.3km is planned to transport the <80 mm product to fertilizer plant 1 (10 Mtpy unit located in São Gotardo) and the wagon loading terminal, which will feed the other four fertilizer plants by rail.

**Table 21.1.2-4 Summary of Investments – 50 Mtpy Scenario Processing**

| Description | Investment | |
|---|---|---|
| | US$x1,000 | R$x1.000 |
| **Crushing 50 Mtpy** | | |
| Topography and earthworks | 480.29 | 2,545.54 |
| Reception Area, Office and Platform Scale | 398.39 | 2,111.49 |
| Operations Area – Crushing and Stockpiles | 1,815.67 | 9,623.04 |
| Equipment | 16,361.86 | 86,717.84 |
| Metallic Base | 320.61 | 1,699.25 |
| Civil Base | 1,193.38 | 6,324.92 |
| Others | 3,690.57 | 19,560.05 |
| Long distance belt conveyor and Wagon loading system | 28,492.57 | 151,010.62 |
| **Subtotal – Crushing** | **52,753.35** | **279,592.74** |
| **Fertilizer Plant 10 Mtpy** | | |
| Topography and earthworks | 1,296.38 | 6,870.81 |

| Description | Investment | |
|---|---|---|
| | US$x1,000 | R$x1.000 |
| Reception Area, Office and Platform Scale | 1,288.15 | 6,827.17 |
| Operation Area – Crushing and Stockpiles | 9,078.34 | 48,115.19 |
| Equipment | 61,529.84 | 326,108.15 |
| Metallic Base | 376.64 | 1,996.18 |
| Civil Base | 2,577.83 | 13,662.49 |
| Others | 10,764.56 | 57,052.17 |
| Wagon tipper[1] | 19,115.04 | 101,309.73 |
| **Subtotal – Fertilizer Plant** | **106,026.77** | **561,941.88** |
| **TOTAL INVESTIMENT** | **158,780.12** | **841,534.62** |

[1] Only four wagon tippers are considered, as one of the units will be installed in São Gotardo and fed directly by the long-distance belt conveyor.

### 21.1.3. Railway Branch Line Expansion

VERDE, with the support of a partner company in the railway sector, received and validated the calculation for the construction of a new railway section. Having considered information from the conceptual studies through to the final stages of implementation, the estimated costs were:

- Cost of US$3.32 million per kilometer, using information on the Ferrogrão stretch in August 2021 as a benchmark
- For the São Gotardo/MG – Ibiá Section: 83 km
- Estimated CAPEX of US$283.02 million.

### 21.1.4. Road Improvement

Investments in road construction and improvement were estimated at around US$10.57 million for the Plant 3 Scenario, US$30.88 million for the 23 Mtpy Scenario and US$6.80 million for the 50 Mtpy Scenario, as shown from Table 21.1.4-1 to Table 21.1.4-3:

**Table 21.1.4-1 Road Improvement - Plant 3 Scenario**

| Description | Quant | Unit | Investment (US$x1,000) |
|---|---|---|---|
| ***NEW HIGHWAY*** | | | |
| Section 01 | 22 | km | 10,392.60 |
| ***BRIDGE*** | | | |
| Bridge | 1 | unit | 27.07 |
| 3-Way Intersection | 1 | unit | 152.35 |
| **Total** | | | **10,572.02** |

On year 22 an additional investment of US$4.82 million, plus 15% of contingency, for road improvement will be made and is considered in the economic analysis of the Plant 3 Scenario alternative.

**Table 21.1.4-2 Road Improvement - 23 Mtpy Scenario**

| Description | Quant | Unit | Investment (US$x1,000) |
|---|---|---|---|
| ***NEW HIGHWAY*** | | | |
| Section 01 | 22 | km | 10,392.60 |
| Section 02 | 9.7 | km | 4,643.64 |
| Section 03 | 24 | km | 13,846.51 |
| ***BRIDGE*** | | | |

| Description | Quant | Unit | Investment (US$x1,000) |
|---|---|---|---|
| Bridge | 4 | unit | 1,391.83 |
| 3-Way Intersection | 4 | unit | 609.39 |
| **Total** | | | **30,883.96** |

**Table 21.1.4-3 Road Improvement - 50 Mtpy Scenario**

| Description | Quant | Unit | Investment (US$x1,000) |
|---|---|---|---|
| ***NEW HIGHWAY*** | | | |
| Section 04 | 18 | km | 6,148.39 |
| ***BRIDGE*** | | | |
| Bridge | 1 | unit | 347.96 |
| 3-Way Intersection | 2 | unit | 304.69 |
| **Total** | | | **6,801.04** |

## 21.1.5. Owner's Costs

Most owner-related costs are included in the indirect cost estimate for processes and infrastructure. However, a provision for owner's costs for each project phase, not included elsewhere, is shown in the tables below (Table 21.1.5-1 to Table 21.1.5-3).

**Table 21.1.5-1 Owner's Cost - Plant 3 Scenario**

| Description | Cost | |
|---|---|---|
| | (US$x1,000) | (R$x1,000) |
| Licensing, Technical studies and designs/drawings | 1,997.62 | 10,587.39 |
| Equipment and personnel mobilization | 1,944.39 | 10,305.27 |
| Equipment and personnel demobilization | 588.65 | 3,119.83 |
| Other costs | 1,406.66 | 7,455.29 |
| **Total** | **5,937.32** | **31,467.78** |

On year 22 an additional investment of US$1.71 million, plus 15% of contingency, related to owner's cost will be made and is considered in the economic analysis of the Plant 3 Scenario alternative.

**Table 21.1.5-2 Owner's Cost - 23 Mtpy Scenario**

| Description | Cost | |
|---|---|---|
| | (US$x1,000) | (R$x1,000) |
| Licensing, Technical studies and designs/drawings | 5,074.07 | 26,892.55 |
| Equipment and personnel mobilization | 3,345.93 | 17,733.44 |
| Equipment and personnel demobilization | 1,593.14 | 8,443.65 |
| Other costs | 1,406.66 | 7,455.29 |
| **Total** | **11,419.80** | **60,524.93** |

**Table 21.1.5-3 Owner's Cost - 50 Mtpy Scenario**

| Description | Cost | |
|---|---|---|
| | (US$x1,000) | (R$x1,000) |
| Licensing, Technical studies and designs/drawings | 22,429.96 | 118,878.78 |
| Equipment and personnel mobilization | 4,825.58 | 25,575.56 |
| Equipment and personnel demobilization | 3,983.47 | 21,112.37 |
| Other costs | 1,892.35 | 10,029.43 |
| **Total** | **33,131.35** | **175,596.14** |

### 21.1.6. Sustaining Capital

Sustaining capital is necessary for the maintenance of the production capacity throughout the life of the enterprise. The sustaining capital was estimated considering expenditures of US$0.50 per tonne of final product. This figure is based on BNA's work on other projects.

### 21.1.7. CAPEX Summary

The total capital cost for the Project (with a nominal accuracy of -25% to +25% and including a 15% contingency) is estimated at, for an initial investment, US$ 52.77 million in the Plant 3 Scenario, US$ 129.84 million in the 23 Mtpy Scenario and US$ 553.99 million for the 50 Mtpy Scenario.

Table 21.1.7-1 shows the CAPEX summary for all scenarios.

**Table 21.1.7-1 CAPEX Summary for all Project scenarios**

| Description | | Investment (US$x1,000) | | |
|---|---|---|---|---|
| | | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
| **Processing** | | | | |
| Plants | | 29,380.38 | 70,597.35 | 111,172.50 |
| Long distance belt conveyor and Wagon loading system | | N/A | N/A | 28,492.57 |
| Wagon unloading system | | N/A | N/A | 19,115.04 |
| **Subtotal 1** | | **29,380.38** | **70,597.35** | **158,780.12** |
| **Road Improvement** | | 10,572.02 | 30,883.96 | 6,801.04 |
| **Railway Branch Line** | | N/A | N/A | 283,018.00 |
| **Owner's Cost** | | 5,937.32 | 11,419.80 | 33,131.35 |
| **Subtotal 2** | | **45,889.72** | **112,901.11** | **481,730.51** |
| Contingency | 15% | 6,883.46 | 16,935.17 | 72,259.58 |
| **TOTAL CAPEX** | | **52,773.17** | **129,836.28** | **553,990.08** |

## 21.2. OPEX

Operating costs are estimated based on preliminary mine and process design criteria and engineering, as well as on budgetary quotes. Operating costs are calculated to a PFS-level of accuracy and are expected to have an accuracy of ±25%, including a 15% contingency.

### 21.2.1. Mining

Mine operating costs were calculated as a function of the production schedule, equipment operation and consumption factors.

Mining Operation

The mining costs were obtained through budgetary quotations from companies specialized in mining operation. The values presented were taken from the quotation chosen by BNA. This quotation was submitted by *U&M Mineração e Construção S/A* on December 3, 2021.

The services refer to the provision of Ore and waste rock handling services involving excavation, loading and transport of soil and rocky material (first, second and third category), conservation of and dust control along truck traffic lanes and other auxiliary activities.

The values of the operational costs were listed by hauling distance ranges, loading and excavation or explosive dismantling. The unit cost per tonne is given in Table 21.2.1-1.

**Table 21.2.1-1 Hauling Cost**

| Description of Average Transport Distance (DMT) | Unit Price per ton (US$) | | | |
|---|---|---|---|---|
| | Plant 3 and 23 Mtpy Scenarios | | 50 Mtpy Scenario | |
| | Ore | Waste Rock | Ore | Waste Rock |
| Average Hauling Distance up to 0.50Km | 1.02 | 1.18 | 0.82 | 0.73 |
| Average Hauling Distance from 0.51 to 1.00Km | 1.32 | 1.27 | 1.07 | 0.94 |
| Average Hauling Distance from 1.01 to 1.50Km | 1.35 | 1.51 | 1.31 | 1.11 |
| Average Hauling Distance from 1.51 to 2.00Km | 1.65 | 1.80 | 1.53 | 1.19 |
| Average Hauling Distance from 2.01 to 2.50Km | 1.68 | 1.83 | 1.59 | 1.36 |
| Average Hauling Distance from 2.51 to 3.00Km | 1.74 | 1.91 | 1.80 | 1.56 |
| Average Hauling Distance from 3.01 to 3.50Km | 1.76 | 2.14 | 1.85 | 1.58 |
| Average Hauling Distance from 3.51 to 4.00Km | 2.01 | 2.15 | 2.04 | 1.60 |
| Average Hauling Distance from 4.01 to 4.50Km | 2.02 | 2.18 | 2.07 | 1.62 |
| Average Hauling Distance from 4.51 to 5.00Km | 2.03 | 2.19 | 2.26 | 1.63 |
| Average Hauling Distance from 5.01 to 5.50Km | 2.05 | 2.20 | 2.29 | 1.77 |
| Average Hauling Distance from 5.51 to 6.00Km | 2.05 | 2.21 | 2.32 | 1.78 |
| Average Hauling Distance from 6.01 to 6.50Km | 2.07 | 2.44 | 2.34 | 1.81 |
| Average Hauling Distance from 6.51 to 7.00Km | 2.09 | 2.47 | 2.52 | 1.83 |
| Average Hauling Distance from 7.01 to 7.50Km | 2.12 | 2.50 | 2.54 | 1.99 |
| Average Hauling Distance from 7.51 to 8.00Km | 2.38 | 2.54 | 2.56 | 2.02 |

**Table 21.2.1-2 Operational Cost**

| Activity description | Unit Price per ton (US$) | | | |
|---|---|---|---|---|
| | Plant 3 and 23 Mtpy Scenarios | | 50 Mtpy Scenario | |
| | Ore | Waste Rock | Ore | Waste Rock |
| Drilling | 0.13 | 0.14 | 0.11 | 0.12 |
| Blasting | 0.33 | 0.31 | 0.33 | 0.31 |
| Excavation and Loading | 0.47 | 0.41 | 0.45 | 0.40 |
| Spreading waste rock | 0.00 | 0.20 | 0.00 | 0.17 |

**Table 21.2.1-3 Site Maintenance Cost**

| Site maintenance (U&M) | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
|---|---|---|---|
| Unit Price per month (K US$) | 25.06 | 29.94 | 33.20 |
| Unit Price per year (K US$) | 300.78 | 359.32 | 398.35 |

**Table 21.2.1-4 Mining OPEX Summary – Plant 3 Scenario**

| Item | Description | Unit | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 and 5 | 6 to 10 | 11 to 20 | 21 and 22 | 23 to 41 | 42 to 56 | 57 to 71 |
| **1** | **MINING PARAMETERS** | | | | | | | | | | | |
| 1.1 | Ore | Mt | 10.25 | 9.96 | 10.05 | 20.17 | 50.65 | 99.87 | 20.57 | 192.51 | 152.19 | 149.46 |
| 1.2 | Waste Rock | Mt | 5.97 | 7.10 | 6.66 | 12.52 | 34.68 | 52.53 | 10.24 | 96.57 | 70.29 | 65.81 |
| 1.3 | Stripping Ratio | | 0.58 | 0.71 | 0.66 | 0.62 | 0.68 | 0.53 | 0.50 | 0.50 | 0.46 | 0.44 |
| 1.4 | Explosive dismantling | % | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| 1.5 | Long-term diesel cost | US$/L | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| | | | | | | | | | | | | |
| **2** | **MINING COSTS** | | | | | | | | | | | |
| ***2.1*** | ***Ore*** | | | | | | | | | | | |
| 2.1.1 | Explosive dismantling | US$/t | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| 2.1.2 | Mechanical dismantling | US$/t | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| ***2.2*** | ***Waste Rock*** | | | | | | | | | | | |
| 2.2.1 | Explosive dismantling | US$/t | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| 2.2.2 | Mechanical dismantling | US$/t | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 |
| | | | | | | | | | | | | |
| **3** | **HAULAGE COSTS** | | | | | | | | | | | |
| ***3.1*** | ***Ore*** | | | | | | | | | | | |
| 3.1.1 | DMT | m | 1,594 | 1,888 | 2,369 | 2,462 | 2,411 | 3,065 | 4,103 | 2,912 | 2,499 | 2,402 |
| 3.1.2 | Diesel | US$/t | 0.25 | 0.30 | 0.38 | 0.39 | 0.38 | 0.49 | 0.65 | 0.46 | 0.40 | 0.38 |
| 3.1.3 | Haulage | US$/t | 1.65 | 1.65 | 1.68 | 1.68 | 1.68 | 1.76 | 2.02 | 1.74 | 1.68 | 1.68 |
| 3.1.4 | Total haulage cost | US$/t | 1.90 | 1.95 | 2.06 | 2.07 | 2.07 | 2.25 | 2.67 | 2.20 | 2.08 | 2.06 |
| ***3.2*** | ***Waste Rock*** | | | | | | | | | | | |
| 3.1.1 | DMT | m | 1,447 | 1,689 | 2,161 | 2,297 | 2,143 | 1,690 | 2,421 | 2,063 | 1,984 | 2,327 |
| 3.1.2 | Diesel | US$/t | 0.23 | 0.27 | 0.34 | 0.36 | 0.34 | 0.27 | 0.38 | 0.33 | 0.31 | 0.37 |
| 3.1.3 | Haulage | US$/t | 1.51 | 1.80 | 1.83 | 1.83 | 1.83 | 1.80 | 1.83 | 1.83 | 1.80 | 1.83 |
| 3.1.4 | Total haulage cost | US$/t | 1.74 | 2.06 | 2.18 | 2.20 | 2.17 | 2.06 | 2.22 | 2.16 | 2.11 | 2.20 |

| Item | Description | Unit | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 and 5 | 6 to 10 | 11 to 20 | 21 and 22 | 23 to 41 | 42 to 56 | 57 to 71 |
| **4** | **MINING COST** | | | | | | | | | | | |
| 4.1 | Ore | US$/t | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| 4.2 | Waste Rock | US$/t | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 |
| | | | | | | | | | | | | |
| **5** | **ANNUAL COST** | | | | | | | | | | | |
| 5.1 | Annual Cost | US$ million | 44.14 | 49.17 | 49.97 | 49.07 | 51.09 | 46.62 | 52.29 | 46.63 | 43.92 | 42.72 |

**Table 21.2.1-5 Mining OPEX Summary – 23 Mtpy Scenario**

| Item | Description | Unit | Years | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 and 5 | 6 to 10 | 11 to 20 | 21 to 31 |
| **1** | **MINING PARAMETERS** | | | | | | | | |
| 1.1 | Ore | Mt | **22.98** | **23.15** | **23.16** | **46.06** | **115.21** | **229.42** | **255.70** |
| 1.2 | Waste Rock | Mt | **10.05** | **10.73** | **12.06** | **28.85** | **67.06** | **99.92** | **133.73** |
| 1.3 | Stripping Ratio | | | | | | | | |
| 1.4 | Explosive dismantling | % | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| 1.5 | Long-term diesel cost | US$/L | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| | | | | | | | | | |
| **2** | **MINING COSTS** | | | | | | | | |
| ***2.1*** | ***Ore*** | | | | | | | | |
| 2.1.1 | Explosive dismantling | US$/t | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| 2.1.2 | Mechanical dismantling | US$/t | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| ***2.2*** | ***Waste Rock*** | | | | | | | | |
| 2.2.1 | Explosive dismantling | US$/t | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| 2.2.2 | Mechanical dismantling | US$/t | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 |
| | | | | | | | | | |
| **3** | **HAULAGE COSTS** | | | | | | | | |
| ***3.1*** | ***Ore*** | | | | | | | | |

| Item | Description | Unit | Years | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 and 5 | 6 to 10 | 11 to 20 | 21 to 31 |
| 3.1.1 | DMT | m | 1,155 | 1,191 | 1,418 | 1,641 | 2,043 | 2,565 | 3,257 |
| 3.1.2 | Diesel | US$/t | 0.18 | 0.19 | 0.22 | 0.26 | 0.32 | 0.41 | 0.52 |
| 3.1.3 | Haulage | US$/t | 1.31 | 1.31 | 1.31 | 1.53 | 1.59 | 1.80 | 1.85 |
| 3.1.4 | Total haulage cost | US$/t | 1.49 | 1.50 | 1.53 | 1.79 | 1.92 | 2.21 | 2.37 |
| ***3.2*** | ***Waste Rock*** | | | | | | | | |
| 3.1.1 | DMT | m | 988 | 1,268 | 1,444 | 1,468 | 1,813 | 2,046 | 2,079 |
| 3.1.2 | Diesel | US$/t | 0.16 | 0.20 | 0.23 | 0.23 | 0.29 | 0.32 | 0.33 |
| 3.1.3 | Haulage | US$/t | 0.94 | 1.11 | 1.11 | 1.11 | 1.19 | 1.36 | 1.36 |
| 3.1.4 | Total haulage cost | US$/t | 1.10 | 1.31 | 1.34 | 1.34 | 1.47 | 1.68 | 1.69 |
| | | | | | | | | | |
| **4** | **MINING COST** | | | | | | | | |
| 4.1 | Ore | US$/t | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| 4.2 | Waste Rock | US$/t | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 |
| | | | | | | | | | |
| **5** | **ANNUAL COST** | | | | | | | | |
| 5.1 | Annual Cost | US$ million | 101.77 | 165.54 | 169.78 | 183.38 | 193.91 | 196.43 | 275.92 |

**Table 21.2.1-6 Mining OPEX Summary – 50 Mtpy Scenario**

| Item | Description | Unit | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 to 10 | 11 to 15 | 16 to 26 |
| **1** | **MINING PARAMETERS** | | | | | | | | | |
| 1.1 | Ore | Mt | **50.07** | **49.79** | **50.86** | **50.74** | **50.05** | **249.14** | **251.83** | **545.20** |
| 1.2 | Waste Rock | Mt | **9.99** | **14.01** | **14.96** | **16.43** | **20.59** | **103.87** | **77.19** | **214.51** |
| 1.3 | Stripping Ratio | | | | | | | | | |
| 1.4 | Explosive dismantling | % | 0 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| 1.5 | Long-term diesel cost | US$/L | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| | | | | | | | | | | |

| Item | Description | Unit | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 to 10 | 11 to 15 | 16 to 26 |
| **2** | **MINING COSTS** | | | | | | | | | |
| ***2.1*** | ***Ore*** | | | | | | | | | |
| 2.1.1 | Explosive dismantling | US$/t | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| 2.1.2 | Mechanical dismantling | US$/t | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| ***2.2*** | ***Waste Rock*** | | | | | | | | | |
| 2.2.1 | Explosive dismantling | US$/t | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| 2.2.2 | Mechanical dismantling | US$/t | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 |
| | | | | | | | | | | |
| **3** | **HAULAGE COSTS** | | | | | | | | | |
| ***3.1*** | ***Ore*** | | | | | | | | | |
| 3.1.1 | DMT | m | 978 | 1,809 | 1,627 | 2,320 | 1,961 | 1,941 | 2,820 | 6,735 |
| 3.1.2 | Diesel | US$/t | 0.16 | 0.29 | 0.26 | 0.37 | 0.31 | 0.31 | 0.45 | 1.07 |
| 3.1.3 | Haulage | US$/t | 1.07 | 1.53 | 1.53 | 1.59 | 1.53 | 1.53 | 1.80 | 2.52 |
| 3.1.4 | Total haulage cost | US$/t | 1.23 | 1.82 | 1.79 | 1.96 | 1.84 | 1.84 | 2.25 | 3.58 |
| ***3.2*** | ***Waste Rock*** | | | | | | | | | |
| 3.1.1 | DMT | m | 900 | 1,563 | 1,811 | 1,557 | 1,610 | 2,556 | 2,318 | 2,578 |
| 3.1.2 | Diesel | US$/t | 0.14 | 0.25 | 0.29 | 0.25 | 0.26 | 0.41 | 0.37 | 0.41 |
| 3.1.3 | Haulage | US$/t | 0.94 | 1.19 | 1.19 | 1.19 | 1.19 | 1.56 | 1.36 | 1.56 |
| 3.1.4 | Total haulage cost | US$/t | 1.08 | 1.43 | 1.47 | 1.43 | 1.44 | 1.96 | 1.72 | 1.97 |
| | | | | | | | | | | |
| **4** | **MINING COST** | | | | | | | | | |
| 4.1 | Ore | US$/t | 0.47 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| 4.2 | Waste Rock | US$/t | 0.61 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 |
| | | | | | | | | | | |
| **5** | **ANNUAL COST** | | | | | | | | | |
| 5.1 | Annual Cost | US$ million | 101.77 | 165.54 | 169.78 | 180.91 | 183.38 | 193.91 | 196.43 | 275.92 |

Labor

The quantity and annual labor cost for the mining activities were estimated and consist of the labor costs for the engineers, geologists, technicians, and auxiliary staff that are responsible for the exploration, geology, planning and operations areas. As the mining activities will be outsourced, there will be no labor costs associated with equipment operators. An additional 68% of the salary amounts were added to cover various charges and benefits, in accordance with Brazilian labor law and the company's policies.

**Table 21.2.1-7 Mining Labor – Number of Professionals per Phase of the Project**

| Description | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
|---|---|---|---|
| **Management** | | | |
| Manager | 1 | 2 | 2 |
| Administrative assistant | 3 | 5 | 8 |
| **Geology, Planning and Exploration** | | | |
| Geology Supervisor | 1 | 1 | 1 |
| Planning Supervisor | 1 | 1 | 1 |
| Mining Engineer | 1 | 3 | 4 |
| Geologist | 1 | 3 | 4 |
| Technician | 4 | 5 | 8 |
| Surveyor | 1 | 2 | 2 |
| **Operation and Maintenance** | | | |
| Supervisor | 2 | 5 | 8 |
| Mining Engineer | 2 | 4 | 6 |
| Environmental engineer | 1 | 2 | 3 |
| Production Controller | 1 | 3 | 4 |
| Production assistant | 1 | 3 | 4 |
| Technician | 4 | 6 | 10 |
| Assistant | 8 | 11 | 18 |
| **Plants operation** | | | |
| Supervisor | 3 | 5 | 12 |
| Process Engineer | 2 | 4 | 8 |
| Mechanic | 4 | 10 | 20 |
| Production Controller | 3 | 5 | 12 |
| Operator | 20 | 36 | 60 |
| Production Assistant | 40 | 72 | 120 |
| Security | 15 | 15 | 24 |
| **Total** | **119** | **204** | **339** |

**Table 21.2.1-8 Mining Labor – Annual Cost**

| Description | Salary (R$/month) | Salary (US$/month) | Plant 3 Scenario (US$/year) | 23 Mtpy Scenario (US$/year) | 50 Mtpy Scenario (US$/year) |
|---|---|---|---|---|---|
| **Management** | | | | | |
| Manager | 15,000 | 2,830 | 57,057 | 114,113 | 114,113 |
| Administrative assistant | 2,200 | 415 | 25,105 | 41,842 | 66,946 |
| **Geology, Planning and Exploration** | | | | | |
| Geology Supervisor | 10,500 | 1,981 | 39,940 | 39,940 | 39,940 |
| Planning Supervisor | 12,000 | 2,264 | 45,645 | 45,645 | 45,645 |
| Mining Engineer | 12,500 | 2,358 | 47,547 | 142,642 | 190,189 |
| Geologist | 9,000 | 1,698 | 34,234 | 102,702 | 136,936 |
| Technician | 2,600 | 491 | 39,559 | 49,449 | 79,118 |
| Surveyor | 4,000 | 755 | 15,215 | 30,430 | 30,430 |
| **Operation and Maintenance** | | | | | |
| Supervisor | 7,000 | 1,321 | 53,253 | 133,132 | 213,011 |
| Mining Engineer | 12,500 | 2,358 | 95,094 | 190,189 | 285,283 |
| Environmental engineer | 6,000 | 1,132 | 22,823 | 45,645 | 68,468 |
| Production Controller | 9,200 | 1,736 | 34,995 | 104,984 | 139,979 |
| Production assistant | 2,080 | 392 | 7,912 | 23,736 | 31,647 |
| Technician | 2,300 | 434 | 34,995 | 52,492 | 87,487 |
| Assistant | 2,080 | 392 | 63,295 | 87,030 | 142,413 |
| **Plants operation** | | | | | |
| Supervisor | 12,000 | 2,264 | 136,936 | 228,226 | 547,743 |
| Process Engineer | 9,000 | 1,698 | 68,468 | 136,936 | 273,872 |
| Mechanic | 3,700 | 698 | 56,296 | 140,740 | 281,479 |
| Production Controller | 9,200 | 1,736 | 104,984 | 174,974 | 419,937 |
| Operator | 2,300 | 434 | 174,974 | 314,952 | 524,921 |
| Production Assistant | 2,080 | 392 | 316,474 | 569,653 | 949,422 |
| Security | 2,300 | 434 | 131,230 | 131,230 | 209,968 |
| **Total** | **149,540** | **28,215** | **1,606,029** | **2,900,682** | **4,878,948** |

## 21.2.2. Processing Plant

Process operating costs for the Project were estimated by MINALAC, using data from suppliers' budgetary quotations and costs from similar projects.

Table 21.2.2-1 summarizes the annual operating costs for the processing plant for the three scenarios.

**Table 21.2.2-1 Summary OPEX Processing Plant**

| Description | Cost (US$/t) | | |
|---|---|---|---|
| | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
| Crushing | 0.38 | 0.38 | 0.30 |
| Fertilizer plant | 1.69 | 1.69 | 1.71 |
| Integrated Fertilizer Plant | N/A | 4.45 | N/A |
| **TOTAL** | **2.07** | **2.38**[1] | **2.01** |

[1] Weighted total. The 23 Mtpy Scenario OPEX is explained in more detail below.

Costs for processing expenses include maintenance requirements and mechanical equipment replacement parts, belt conveyors, transport equipment, electricity, and fuel consumption.

The main consumable items for the processing plant include mill and crusher coatings/linings. Consumable prices were taken from suppliers' estimates, while replacement frequencies were determined based on information available from similar operations and based on suppliers' operational experience.

An electricity cost of $ 0.11/kWh was used for the site and power consumption. Maintenance costs were factored at 8%.

Outsourced costs considered safety, cleaning, and provision of food. Non-work is not considered in this section because it is better detailed in the labor requisition section and considered separately in the financial analysis.

The detailing of the processing plant OPEX is presented for the three scenarios in the items below.

Processing Plant 3 Scenario

Process operating costs for the Plant 3 Scenario were developed using first principles and based upon the flowchart described in Section 17.1 and detailed in Table 21.2.2-2.

**Table 21.2.2-2 OPEX Processing Plant – Plant 3 Scenario**

| Items | Processing Cost | |
|---|---|---|
| | US$/t | R$/t |
| ***Crushing*** | | |
| Machine items consumption | 0.17 | 0.91 |
| Movement machines | 0.05 | 0.29 |
| Outsourced and others | 0.01 | 0.08 |
| Electricity Cost | 0.11 | 0.58 |
| Maintenance | 0.03 | 0.15 |
| Subtotal - Estimate Crushing Total Cost | **0.38** | **2.00** |
| ***Fertilizer Plant*** | | |
| Machine items consumption | 0.91 | 4.81 |
| Movement machines | 0.07 | 0.36 |
| Outsourced and others | 0.01 | 0.08 |
| Electricity Cost | 0.58 | 3.07 |
| Maintenance | 0.13 | 0.66 |
| Subtotal - Estimate griding Total Cost | **1.69** | **8.98** |
| **TOTAL** | **2.07** | **10.97** |

Processing Plants 23 Mtpy Scenario

Process operating costs for the 23 Mtpy Scenario were calculated using first principles and based upon the flowchart described in Section 17.3 and detailed in Table 21.2.2-3.

**Table 21.2.2-3 OPEX Processing Plant – 23 Mtpy Scenario**

| Items | Processing Cost | |
|---|---|---|
| | US$/t | R$/t |
| ***Crushing*** | | |
| Machine items consumption | 0.17 | 0.91 |

| Items | Processing Cost | |
|---|---|---|
| | US$/t | R$/t |
| Movement machines | 0.05 | 0.29 |
| Outsourced and others | 0.01 | 0.08 |
| Electricity Cost | 0.11 | 0.58 |
| Maintenance | 0.03 | 0.15 |
| Subtotal - Estimate Crushing Total Cost | **0.38** | **2.00** |
| ***Fertilizer Plant*** | | |
| Machine items consumption | 0.91 | 4.81 |
| Movement machines | 0.07 | 0.36 |
| Outsourced and others | 0.01 | 0.08 |
| Electricity Cost | 0.58 | 3.07 |
| Maintenance | 0.13 | 0.66 |
| Subtotal - Estimate griding Total Cost | **1.69** | **8.98** |
| **Subtotal – New Plants** | **2.07** | **10.97** |
| **Integrated Fertilizer Plant – Unit 3Mpty[1]** | | |
| Machine items consumption | 1.58 | 8.40 |
| Movement machines | 0.47 | 2.50 |
| Outsourced and others | 0.60 | 3.20 |
| Electricity Cost | 1.23 | 6.50 |
| Maintenance | 0.57 | 3.00 |
| Subtotal – Unit 3 Mtpy Total Cost | **4.45** | **23.60** |
| **TOTAL PONDERED[2]** | **2.38** | **12.62** |

[1] Unlike all other plants, this unit will have a single installation for crushing and grinding units, as well as mixing, as presented in section 17.

[2] The unit with a capacity of 3 Mtpy has as a higher OPEX than the other units. Thus, a weighting between the OPEX for each unit and its production capacity was performed.

Processing Plant 50 Mtpy Scenario

Process operating costs for the 50 Mtpy Scenario were developed using first principles and based upon the flowchart described in Section 17.3 and detailed in Table 21.2.2-4.

**Table 21.2.2-4 OPEX Processing Plant – 50 Mtpy Scenario**

| Items | Processing Cost | |
|---|---|---|
| | US$/t | R$/t |
| ***Crushing*** | | |
| Machine items consumption | 0.16 | 0.84 |
| Movement machines | 0.01 | 0.07 |
| Outsourced and others | 0.003 | 0.02 |
| Electricity Cost | 0.10 | 0.54 |
| Maintenance | 0.02 | 0.12 |
| TCLD | 0.01 | 0.05 |
| Wagon loader | 0.001 | 0.005 |
| **Subtotal - Estimate Crushing Total Cost** | **0.31** | **1.64** |
| ***Fertilizer Plant*** | | |

| Items | Processing Cost | |
|---|---|---|
| | US$/t | R$/t |
| Machine items consumption | 0.91 | 4.81 |
| Movement machines | 0.07 | 0.36 |
| Outsourced and others | 0.01 | 0.08 |
| Electricity Cost | 0.58 | 3.07 |
| Maintenance | 0.13 | 0.66 |
| Wagon tipper | 0.02 | 0.10 |
| **Subtotal - Estimate griding Total Cost** | **1.71** | **9.08** |
| **TOTAL** | **2.01** | **10.67** |

### 21.2.3. Environmental Compensation

Environmental compensation costs were allocated as operating costs. A cost of US$ 0.15 per tonne fed was considered for the recovery of degraded areas. In addition, annual costs for environmental compensation were considered in accordance with Table 21.2.3-1.

**Table 21.2.3-1 Environmental Compensation – Total Costs Estimate**

| Environmental Obligations - Mining | Legal Provision | Cost Estimate (US$x1,000) | | |
|---|---|---|---|---|
| | | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
| Compliance with the requirements for compensation for land clearance in permanent preservation areas (APP) and compensation for the removal of isolated trees | State law No. 20.922/2013, Federal law No. 12.651/2012, CONAMA Resolution 369/2006 | 212.89 | 212.89 | 282.57 |
| Compliance with the requirements for compensation for land clearance in the Atlantic Forest | Federal law No. 11.428/06, Decree 6.660/08, IEF Ordinance 30/2015. | 319.43 | 319.43 | 423.99 |
| Compliance with the requirements of the SNUC (*Sistema Nacional de Unidades Conservação*) for Environmental Compensation | Decree No. 45.629/2011 Federal law No. 9.985/2000, Federal Decree No. 6.848/2009, Federal Decree No. 4.340/2002, IEF Ordinance 55/2012 | 221.89 | 221.89 | 886.04 |
| Fulfilling the requirements for Mining Compensation | Law No. 20.922/13 and IEF Ordinance 27/ 2017 | 937.77 | 937.77 | 1,261.56 |
| **Subtotal** | | **1,691.98** | **1,691.98** | **2,854.17** |
| Contingencies (20%) | | 338.40 | 338.40 | 570.83 |
| **Estimated Total** | | **2,030.38** | **2,030.38** | **3,425.00** |
| **Annual value** | | **28.60** | **65.50** | **131.73** |

### 21.2.4. General and Administrative Costs (G&A)

The general and administrative costs (G&A) were estimated and are presented in **Table 21.2.4-1**.

**Table 21.2.4-1 G&A Costs**

| Expense | Plant 3 Scenario | 23 Mtpy Scenario | 50 Mtpy Scenario |
|---|---|---|---|
| | Total (US$x1.000) | | |
| Sales and marketing expenses | 30,807.02 | 49,525.63 | 79,793.33 |
| General Expenses | 11,181.20 | 15,143.98 | 20,605.45 |
| **Total** | **41,988.22** | **64,669.60** | **100,398.78** |
| | Total (US$/tonne) | | |
| Sales and marketing expenses | 3.08 | 2.16 | 1.59 |
| General Expenses | 1.12 | 0.66 | 0.41 |
| **Total** | **4.20** | **2.81** | **2.01** |

### 21.2.5. OPEX Summary

Table 21.2.5-1 to Table 21.2.5-3 present the total annual costs for the first 10 years of the project. In addition, a value of 15% of the costs was adopted for contingencies.

Table 21.2.5-1 to Table 21.2.5-3 summarize the operating costs of the Project for the first 10 years, for each scenario.

**Table 21.2.5-1 Annual Operating Costs – Plant 3 Scenario**

| Description | Annual Operating Cost (US$x1,000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A - Mining Labor | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 | 1,606 |
| B - Mining | 44,137 | 49,169 | 49,970 | 49,069 | 49,069 | 51,091 | 51,091 | 51,091 | 51,091 | 51,091 |
| C - Crushing | 3,862 | 3,755 | 3,789 | 3,800 | 3,800 | 3,818 | 3,818 | 3,818 | 3,818 | 3,818 |
| D - Environmental Recovery | 1,537 | 1,494 | 1,508 | 1,512 | 1,512 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 |
| E - Processing | 17,357 | 16,874 | 17,031 | 17,078 | 17,078 | 17,159 | 17,159 | 17,159 | 17,159 | 17,159 |
| F - G&A | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 | 41,988 |
| G - Environmental Compensation | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 |
| H - Maintenance of Support Facilities | 301 | 301 | 301 | 301 | 301 | 301 | 301 | 301 | 301 | 301 |
| **Subtotal** | **110,817** | **115,216** | **116,222** | **115,383** | **115,383** | **117,511** | **117,511** | **117,511** | **117,511** | **117,511** |
| Contingencies 15% | 16,623 | 17,282 | 17,433 | 17,307 | 17,307 | 17,627 | 17,627 | 17,627 | 17,627 | 17,627 |
| **TOTAL OPERATING COST** | **127,440** | **132,498** | **133,655** | **132,690** | **132,690** | **135,138** | **135,138** | **135,138** | **135,138** | **135,138** |

**Table 21.2.5-2 Annual Operating Costs – 23 Mtpy Scenario**

| Description | Annual Operating Cost (US$x1,000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A - Mining Labor | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 | 2,901 |
| B - Mining | 74,066 | 78,267 | 82,498 | 93,656 | 93,656 | 95,967 | 95,967 | 95,967 | 95,967 | 95,967 |
| C - Crushing | 11,533 | 11,620 | 11,625 | 11,558 | 11,558 | 11,565 | 11,565 | 11,565 | 11,565 | 11,565 |
| D - Environmental Recovery | 3,447 | 3,473 | 3,474 | 3,454 | 3,454 | 3,456 | 3,456 | 3,456 | 3,456 | 3,456 |
| E - Processing | 43,183 | 43,509 | 43,530 | 43,280 | 43,280 | 43,304 | 43,304 | 43,304 | 43,304 | 43,304 |
| F - G&A | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 | 64,670 |

| Description | Annual Operating Cost (US$x1,000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| G - Environmental Compensation | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| H - Maintenance of Support Facilities | 359 | 359 | 359 | 359 | 359 | 359 | 359 | 359 | 359 | 359 |
| **Subtotal** | **200,223** | **204,864** | **209,122** | **219,943** | **219,943** | **222,287** | **222,287** | **222,287** | **222,287** | **222,287** |
| Contingencies 15% | 30,034 | 30,730 | 31,368 | 32,992 | 32,992 | 33,343 | 33,343 | 33,343 | 33,343 | 33,343 |
| **TOTAL OPERATING COST** | **230,257** | **235,593** | **240,490** | **252,935** | **252,935** | **255,630** | **255,630** | **255,630** | **255,630** | **255,630** |

**Table 21.2.5-3 Annual Operating Costs – 50 Mtpy Scenario**

| Description | Annual Operating Cost (US$x1,000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A - Mining Labor | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 | 4,879 |
| B - Mining | 123,488 | 165,542 | 169,781 | 180,912 | 183,381 | 193,914 | 193,914 | 193,914 | 193,914 | 193,914 |
| C - Crushing | 15,003 | 14,919 | 15,239 | 15,203 | 14,997 | 14,931 | 14,931 | 14,931 | 14,931 | 14,931 |
| D - Environmental Recovery | 7,510 | 7,468 | 7,629 | 7,610 | 7,507 | 7,474 | 7,474 | 7,474 | 7,474 | 7,474 |
| E - Processing | 85,749 | 85,272 | 87,103 | 86,894 | 85,717 | 85,342 | 85,342 | 85,342 | 85,342 | 85,342 |
| F - G&A | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 | 100,399 |
| G - Environmental Compensation | 132 | 132 | 132 | 132 | 132 | 132 | 132 | 132 | 132 | 132 |
| H - Maintenance of Support Facilities | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 |
| **Subtotal** | **337,558** | **379,008** | **385,560** | **396,427** | **397,410** | **407,469** | **407,469** | **407,469** | **407,469** | **407,469** |
| Contingencies 15% | 50,634 | 56,851 | 57,834 | 59,464 | 59,611 | 61,120 | 61,120 | 61,120 | 61,120 | 61,120 |
| **TOTAL OPERATING COST** | **388,191** | **435,859** | **443,395** | **455,891** | **457,021** | **468,590** | **468,590** | **468,590** | **468,590** | **468,590** |

# 22. Economic Analysis

The financial results of this report are based upon work performed by BNA, AMS and VERDE and have been prepared on an annual basis. All costs are in US dollars.

## 22.1. Principal Assumptions

To assess the feasibility of the project, a simplified economic-financial analysis was carried out in which the EBTIDA – Earnings Before Rates, Interest, Depreciation and Amortization and NPV – Net Present Value indicators were analyzed. Three different final product sale price scenarios were used. These vary depending on the scenario:

Plant 3 Scenario - 10 Mt

- Price 1 ($K_2O$): US$80.75 per tonne
- Price 2 ($K_2O$ + S): US$91.54 per tonne
- Price 3 ($K_2O$ + S + Micronutrients): US$100.21 per tonne

23 Mtpy Scenario - 23 Mt

- Price 1 ($K_2O$): US$80.72 per tonne
- Price 2 ($K_2O$ + S): US$91.66 per tonne
- Price 3 ($K_2O$ + S + Micronutrients): US$99.90 per tonne

50 Mtpy Scenario - 50 Mt

- Price 1 ($K_2O$): US$74.05 per tonne
- Price 2 ($K_2O$ + S): US$84.79 per tonne
- Price 3 ($K_2O$ + S + Micronutrients): US$92.05 per tonne

Investments were depreciated/amortized on a straight-line basis over 10 years. The discount rate used was 10% p.a. The project was evaluated on the assumption that taxation would occur under the real profit regime. The following tax criteria were considered:

- ICMS: 4%;
- PIS/COFINS: exempt for fertilizers, according to the Brazilian law nº 10,925/2004 and Federal Decree nº 5630/2005;
- CFEM: 2%;
- Income Tax: 15% with an additional rate of 10% on net income exceeding R$20,000 monthly
- Social Contribution over Profit: a rate of 9% was applied over the real profit calculated for the period.

## 22.2. Cashflow Forecasts

The cash flow for all scenarios and their respective simulations are presented below.

**Table 22.2-1 Economic-financial analysis of the Project - Plant 3 Scenario Price 1**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **10.25** | **9.96** | **10.05** | **10.08** | **10.08** | **10.13** | **10.13** | **10.13** | **10.13** | **10.13** |
| Final Product (dry base) | Mt | | 10.25 | 9.96 | 10.05 | 10.08 | 10.08 | 10.13 | 10.13 | 10.13 | 10.13 | 10.13 |
| Micronutrients | Mt | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Revenue** | **$10^6$ US$** | | **827.48** | **804.46** | **811.92** | **814.18** | **814.18** | **818.04** | **818.04** | **818.04** | **818.04** | **818.04** |
| **Freight** | **106 US$** | | **281.60** | **273.76** | **276.30** | **277.07** | **277.07** | **278.39** | **278.39** | **278.39** | **278.39** | **278.39** |
| VERDE/Client freight | $10^6$ US$ | | 281.60 | 273.76 | 276.30 | 277.07 | 277.07 | 278.39 | 278.39 | 278.39 | 278.39 | 278.39 |
| **Net Revenue** | **$10^6$ US$** | | **545.88** | **530.69** | **535.62** | **537.10** | **537.10** | **539.65** | **539.65** | **539.65** | **539.65** | **539.65** |
| **Production cost** | **$10^6$ US$** | | **127.44** | **132.50** | **133.66** | **132.69** | **132.69** | **135.14** | **135.14** | **135.14** | **135.14** | **135.14** |
| OPEX | $10^6$ US$ | | 127.44 | 132.50 | 133.66 | 132.69 | 132.69 | 135.14 | 135.14 | 135.14 | 135.14 | 135.14 |
| Feedstock | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **EBTIDA** | **$10^6$ US$** | | **418.44** | **398.19** | **401.96** | **404.41** | **404.41** | **404.51** | **404.51** | **404.51** | **404.51** | **404.51** |
| | % | | 51% | 49% | 50% | 50% | 50% | 49% | 49% | 49% | 49% | 49% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 33.10 | 32.18 | 32.48 | 32.57 | 32.57 | 32.72 | 32.72 | 32.72 | 32.72 | 32.72 |
| **Operating profit** | **$10^6$ US$** | | **385.34** | **366.02** | **369.48** | **371.85** | **371.85** | **371.79** | **371.79** | **371.79** | **371.79** | **371.79** |
| CFEM | $10^6$ US$ | | 2.36 | 2.49 | 2.51 | 2.49 | 2.49 | 2.54 | 2.54 | 2.54 | 2.54 | 2.54 |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **377.70** | **358.25** | **361.70** | **364.08** | **364.08** | **363.98** | **363.98** | **363.98** | **363.98** | **363.98** |
| Income tax | $10^6$ US$ | | 94.42 | 89.56 | 90.42 | 91.02 | 91.02 | 90.99 | 90.99 | 90.99 | 90.99 | 90.99 |
| CSLL | $10^6$ US$ | | 33.99 | 32.24 | 32.55 | 32.77 | 32.77 | 32.76 | 32.76 | 32.76 | 32.76 | 32.76 |
| **Net profit** | **$10^6$ US$** | | **249.28** | **236.45** | **238.72** | **240.29** | **240.29** | **240.22** | **240.22** | **240.22** | **240.22** | **240.22** |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| Initial Investments | $10^6$ US$ | 52.77 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 5.12 | 4.98 | 5.03 | 5.04 | 5.04 | 5.07 | 5.07 | 5.07 | 5.07 |
| Working capital | $10^6$ US$ | | 31.86 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-52.77** | **222.70** | **236.60** | **239.02** | **240.54** | **240.53** | **240.46** | **240.44** | **240.44** | **240.44** | **240.44** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **1,539.89** | | | | | | | | | | |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **NPV at 8% p.a.** | **$10^6$ US$** | **2,908.49** | | | | | | | | | | |
| **IRR** | **%** | **427.17%** | | | | | | | | | | |
| **Payback** | **years** | **0.24** | | | | | | | | | | |

**Table 22.2-2 Economic-financial analysis of the Project - Plant 3 Scenario Price 2**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **10.49** | **10.20** | **10.30** | **10.32** | **10.32** | **10.37** | **10.37** | **10.37** | **10.37** | **10.37** |
| Final Product (dry base) | Mt | | 10.25 | 9.96 | 10.05 | 10.08 | 10.08 | 10.13 | 10.13 | 10.13 | 10.13 | 10.13 |
| Micronutrients | Mt | | 0.25 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| **Revenue** | $10^6$ US$ | | **960.59** | **933.87** | **942.53** | **945.15** | **945.15** | **949.63** | **949.63** | **949.63** | **949.63** | **949.63** |
| **Freight** | **106 US$** | | **288.37** | **280.34** | **282.94** | **283.73** | **283.73** | **285.08** | **285.08** | **285.08** | **285.08** | **285.08** |
| VERDE/Client freight | $10^6$ US$ | | 288.37 | 280.34 | 282.94 | 283.73 | 283.73 | 285.08 | 285.08 | 285.08 | 285.08 | 285.08 |
| **Net Revenue** | **$10^6$ US$** | | **672.23** | **653.52** | **659.59** | **661.42** | **661.42** | **664.56** | **664.56** | **664.56** | **664.56** | **664.56** |
| **Production cost** | **$10^6$ US$** | | **185.06** | **188.52** | **190.20** | **189.39** | **189.39** | **192.10** | **192.10** | **192.10** | **192.10** | **192.10** |
| OPEX | $10^6$ US$ | | 127.44 | 132.50 | 133.66 | 132.69 | 132.69 | 135.14 | 135.14 | 135.14 | 135.14 | 135.14 |
| Feedstock | $10^6$ US$ | | 57.62 | 56.02 | 56.54 | 56.70 | 56.70 | 56.97 | 56.97 | 56.97 | 56.97 | 56.97 |
| **EBTIDA** | **$10^6$ US$** | | **487.16** | **465.00** | **469.39** | **472.03** | **472.03** | **472.45** | **472.45** | **472.45** | **472.45** | **472.45** |
| | % | | 51% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 38.42 | 37.35 | 37.70 | 37.81 | 37.81 | 37.99 | 37.99 | 37.99 | 37.99 | 37.99 |
| **Operating profit** | **$10^6$ US$** | | **448.74** | **427.65** | **431.69** | **434.22** | **434.22** | **434.47** | **434.47** | **434.47** | **434.47** | **434.47** |
| CFEM | $10^6$ US$ | | 2.36 | 2.49 | 2.51 | 2.49 | 2.49 | 2.54 | 2.54 | 2.54 | 2.54 | 2.54 |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **441.10** | **419.88** | **423.90** | **426.46** | **426.46** | **426.65** | **426.65** | **426.65** | **426.65** | **426.65** |
| Income tax | $10^6$ US$ | | 110.27 | 104.97 | 105.98 | 106.62 | 106.62 | 106.66 | 106.66 | 106.66 | 106.66 | 106.66 |
| CSLL | $10^6$ US$ | | 39.70 | 37.79 | 38.15 | 38.38 | 38.38 | 38.40 | 38.40 | 38.40 | 38.40 | 38.40 |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Net profit** | **$10^6$ US$** | | **291.12** | **277.12** | **279.78** | **281.46** | **281.46** | **281.59** | **281.59** | **281.59** | **281.59** | **281.59** |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| Initial Investments | $10^6$ US$ | 52.77 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 5.25 | 5.10 | 5.15 | 5.16 | 5.16 | 5.19 | 5.19 | 5.19 | 5.19 |
| Working capital | $10^6$ US$ | | 46.27 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-52.77** | **250.13** | **277.15** | **279.95** | **281.59** | **281.58** | **281.70** | **281.68** | **281.68** | **281.68** | **281.68** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **1,802.74** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **3,406.39** | | | | | | | | | | |
| **IRR** | **%** | **482.93%** | | | | | | | | | | |
| **Payback** | **years** | **0.21** | | | | | | | | | | |

**Table 22.2-3 Economic-financial analysis of the Project - Plant 3 Scenario Price 3**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **10.57** | **10.28** | **10.37** | **10.40** | **10.40** | **10.45** | **10.45** | **10.45** | **10.45** | **10.45** |
| Final Product (dry base) | Mt | | 10.25 | 9.96 | 10.05 | 10.08 | 10.08 | 10.13 | 10.13 | 10.13 | 10.13 | 10.13 |
| Micronutrients | Mt | | 0.33 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 |
| **Revenue** | $10^6$ US$ | | **1,059.48** | **1,030.00** | **1,039.56** | **1,042.45** | **1,042.45** | **1,047.39** | **1,047.39** | **1,047.39** | **1,047.39** | **1,047.39** |
| **Freight** | **106 US$** | | **290.53** | **282.45** | **285.07** | **285.86** | **285.86** | **287.22** | **287.22** | **287.22** | **287.22** | **287.22** |
| VERDE/Client freight | $10^6$ US$ | | 290.53 | 282.45 | 285.07 | 285.86 | 285.86 | 287.22 | 287.22 | 287.22 | 287.22 | 287.22 |
| **Net Revenue** | **106 US$** | | **768.94** | **747.55** | **754.49** | **756.58** | **756.58** | **760.17** | **760.17** | **760.17** | **760.17** | **760.17** |
| **Production cost** | **106 US$** | | **207.24** | **210.08** | **211.95** | **211.21** | **211.21** | **214.03** | **214.03** | **214.03** | **214.03** | **214.03** |
| OPEX | $10^6$ US$ | | 127.44 | 132.50 | 133.66 | 132.69 | 132.69 | 135.14 | 135.14 | 135.14 | 135.14 | 135.14 |
| Feedstock | $10^6$ US$ | | 79.80 | 77.58 | 78.30 | 78.52 | 78.52 | 78.89 | 78.89 | 78.89 | 78.89 | 78.89 |
| **EBTIDA** | **$10^6$ US$** | | **561.70** | **537.47** | **542.53** | **545.38** | **545.38** | **546.14** | **546.14** | **546.14** | **546.14** | **546.14** |
| | % | | 53% | 52% | 52% | 52% | 52% | 52% | 52% | 52% | 52% | 52% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| ICMS | $10^6$ US$ | | 42.38 | 41.20 | 41.58 | 41.70 | 41.70 | 41.90 | 41.90 | 41.90 | 41.90 | 41.90 |
| **Operating profit** | **$10^6$ US$** | | **519.32** | **496.27** | **500.95** | **503.68** | **503.68** | **504.25** | **504.25** | **504.25** | **504.25** | **504.25** |
| CFEM | $10^6$ US$ | | 2.36 | 2.49 | 2.51 | 2.49 | 2.49 | 2.54 | 2.54 | 2.54 | 2.54 | 2.54 |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **511.68** | **488.51** | **493.16** | **495.91** | **495.91** | **496.43** | **496.43** | **496.43** | **496.43** | **496.43** |
| Income tax | $10^6$ US$ | | 127.92 | 122.13 | 123.29 | 123.98 | 123.98 | 124.11 | 124.11 | 124.11 | 124.11 | 124.11 |
| CSLL | $10^6$ US$ | | 46.05 | 43.97 | 44.38 | 44.63 | 44.63 | 44.68 | 44.68 | 44.68 | 44.68 | 44.68 |
| **Net profit** | **$10^6$ US$** | | **337.71** | **322.41** | **325.49** | **327.30** | **327.30** | **327.65** | **327.65** | **327.65** | **327.65** | **327.65** |
| Depreciation and amortization | $10^6$ US$ | | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 | 5.28 |
| Initial Investments | $10^6$ US$ | 52.77 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 5.29 | 5.14 | 5.19 | 5.20 | 5.20 | 5.23 | 5.23 | 5.23 | 5.23 |
| Working capital | $10^6$ US$ | | 51.81 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-52.77** | **291.18** | **322.41** | **325.63** | **327.39** | **327.38** | **327.72** | **327.70** | **327.70** | **327.70** | **327.70** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **2,105.68** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **3,971.54** | | | | | | | | | | |
| **IRR** | **%** | **560.86%** | | | | | | | | | | |
| **Payback** | **years** | **0.18** | | | | | | | | | | |

**Table 22.2-4 Economic-financial analysis of the Project - 23 Mtpy Scenario Price 1**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **22.98** | **23.15** | **23.16** | **23.03** | **23.03** | **23.04** | **23.04** | **23.04** | **23.04** | **23.04** |
| Final Product (dry base) | Mt | | 22.98 | 23.15 | 23.16 | 23.03 | 23.03 | 23.04 | 23.04 | 23.04 | 23.04 | 23.04 |
| Micronutrients | Mt | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Revenue** | $10^6$ US$ | | **1,854.70** | **1,868.71** | **1,869.60** | **1,858.86** | **1,858.86** | **1,859.88** | **1,859.88** | **1,859.88** | **1,859.88** | **1,859.88** |
| **Freight** | **106 US$** | | **718.72** | **724.15** | **724.49** | **720.33** | **720.33** | **720.73** | **720.73** | **720.73** | **720.73** | **720.73** |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| VERDE/Client freight | $10^6$ US$ | | 718.72 | 724.15 | 724.49 | 720.33 | 720.33 | 720.73 | 720.73 | 720.73 | 720.73 | 720.73 |
| **Net Revenue** | **106 US$** | | **1,135.98** | **1,144.56** | **1,145.10** | **1,138.53** | **1,138.53** | **1,139.15** | **1,139.15** | **1,139.15** | **1,139.15** | **1,139.15** |
| **Production cost** | **106 US$** | | **230.26** | **235.59** | **240.49** | **252.93** | **252.93** | **255.63** | **255.63** | **255.63** | **255.63** | **255.63** |
| OPEX | $10^6$ US$ | | 230.26 | 235.59 | 240.49 | 252.93 | 252.93 | 255.63 | 255.63 | 255.63 | 255.63 | 255.63 |
| Feedstock | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **EBTIDA** | **$10^6$ US$** | | **905.72** | **908.97** | **904.61** | **885.59** | **885.59** | **883.52** | **883.52** | **883.52** | **883.52** | **883.52** |
| | % | | 49% | 49% | 48% | 48% | 48% | 48% | 48% | 48% | 48% | 48% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 74.19 | 74.75 | 74.78 | 74.35 | 74.35 | 74.40 | 74.40 | 74.40 | 74.40 | 74.40 |
| **Operating profit** | **$10^6$ US$** | | **831.53** | **834.22** | **829.83** | **811.24** | **811.24** | **809.13** | **809.13** | **809.13** | **809.13** | **809.13** |
| CFEM | $10^6$ US$ | | 3.97 | 4.08 | 4.19 | 4.47 | 4.47 | 4.53 | 4.53 | 4.53 | 4.53 | 4.53 |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **814.58** | **817.15** | **812.66** | **793.78** | **793.78** | **791.62** | **791.62** | **791.62** | **791.62** | **791.62** |
| Income tax | $10^6$ US$ | | 203.64 | 204.29 | 203.16 | 198.45 | 198.45 | 197.90 | 197.90 | 197.90 | 197.90 | 197.90 |
| CSLL | $10^6$ US$ | | 73.31 | 73.54 | 73.14 | 71.44 | 71.44 | 71.25 | 71.25 | 71.25 | 71.25 | 71.25 |
| **Net profit** | **$10^6$ US$** | | **537.62** | **539.32** | **536.35** | **523.90** | **523.90** | **522.47** | **522.47** | **522.47** | **522.47** | **522.47** |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| Initial Investments | $10^6$ US$ | 129.84 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 11.49 | 11.58 | 11.58 | 11.51 | 11.51 | 11.52 | 11.52 | 11.52 | 11.52 |
| Working capital | $10^6$ US$ | | 57.56 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-129.84** | **493.04** | **540.82** | **537.76** | **525.30** | **525.37** | **523.94** | **523.93** | **523.93** | **523.93** | **523.93** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **3,384.62** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **5,808.29** | | | | | | | | | | |
| **IRR** | **%** | **387.11%** | | | | | | | | | | |
| **Payback** | **years** | **0.26** | | | | | | | | | | |

**Table 22.2-5 Economic-financial analysis of the Project - 23 Mtpy Scenario Price 2**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **23.54** | **23.72** | **23.73** | **23.59** | **23.59** | **23.60** | **23.60** | **23.60** | **23.60** | **23.60** |
| Final Product (dry base) | Mt | | 22.98 | 23.15 | 23.16 | 23.03 | 23.03 | 23.04 | 23.04 | 23.04 | 23.04 | 23.04 |
| Micronutrients | Mt | | 0.56 | 0.57 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 |
| **Revenue** | $10^6$ US$ | | **2,157.54** | **2,173.84** | **2,174.88** | **2,162.38** | **2,162.38** | **2,163.58** | **2,163.58** | **2,163.58** | **2,163.58** | **2,163.58** |
| **Freight** | **106 US$** | | **736.29** | **741.85** | **742.20** | **737.94** | **737.94** | **738.34** | **738.34** | **738.34** | **738.34** | **738.34** |
| VERDE/Client freight | $10^6$ US$ | | 736.29 | 741.85 | 742.20 | 737.94 | 737.94 | 738.34 | 738.34 | 738.34 | 738.34 | 738.34 |
| **Net Revenue** | **106 US$** | | **1,421.26** | **1,432.00** | **1,432.68** | **1,424.45** | **1,424.45** | **1,425.23** | **1,425.23** | **1,425.23** | **1,425.23** | **1,425.23** |
| **Production cost** | **106 US$** | | **361.67** | **368.00** | **372.96** | **384.64** | **384.64** | **387.41** | **387.41** | **387.41** | **387.41** | **387.41** |
| OPEX | $10^6$ US$ | | 230.26 | 235.59 | 240.49 | 252.93 | 252.93 | 255.63 | 255.63 | 255.63 | 255.63 | 255.63 |
| Feedstock | $10^6$ US$ | | 131.41 | 132.41 | 132.47 | 131.71 | 131.71 | 131.78 | 131.78 | 131.78 | 131.78 | 131.78 |
| **EBTIDA** | **$10^6$ US$** | | **1,059.59** | **1,064.00** | **1,059.72** | **1,039.80** | **1,039.80** | **1,037.82** | **1,037.82** | **1,037.82** | **1,037.82** | **1,037.82** |
| | % | | 49% | 49% | 49% | 48% | 48% | 48% | 48% | 48% | 48% | 48% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 86.30 | 86.95 | 87.00 | 86.50 | 86.50 | 86.54 | 86.54 | 86.54 | 86.54 | 86.54 |
| **Operating profit** | **$10^6$ US$** | | **973.29** | **977.04** | **972.72** | **953.31** | **953.31** | **951.28** | **951.28** | **951.28** | **951.28** | **951.28** |
| CFEM | $10^6$ US$ | | 3.97 | 4.08 | 4.19 | 4.47 | 4.47 | 4.53 | 4.53 | 4.53 | 4.53 | 4.53 |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **956.33** | **959.98** | **955.55** | **935.86** | **935.86** | **933.77** | **933.77** | **933.77** | **933.77** | **933.77** |
| Income tax | $10^6$ US$ | | 239.08 | 239.99 | 238.89 | 233.96 | 233.96 | 233.44 | 233.44 | 233.44 | 233.44 | 233.44 |
| CSLL | $10^6$ US$ | | 86.07 | 86.40 | 86.00 | 84.23 | 84.23 | 84.04 | 84.04 | 84.04 | 84.04 | 84.04 |
| **Net profit** | **$10^6$ US$** | | **631.18** | **633.58** | **630.66** | **617.66** | **617.66** | **616.29** | **616.29** | **616.29** | **616.29** | **616.29** |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| Initial Investments | $10^6$ US$ | 129.84 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 11.77 | 11.86 | 11.86 | 11.80 | 11.80 | 11.80 | 11.80 | 11.80 | 11.80 |
| Working capital | $10^6$ US$ | | 90.42 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-129.84** | **553.74** | **634.80** | **631.79** | **618.78** | **618.85** | **617.47** | **617.47** | **617.47** | **617.47** | **617.47** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **3,982.56** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **6,840.23** | | | | | | | | | | |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **IRR** | **%** | **437.95%** | | | | | | | | | | |
| **Payback** | **years** | **0.23** | | | | | | | | | | |

**Table 22.2-6 Economic-financial analysis of the Project - 23 Mtpy Scenario Price 3**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **23.71** | **23.89** | **23.90** | **23.76** | **23.76** | **23.77** | **23.77** | **23.77** | **23.77** | **23.77** |
| Final Product (dry base) | Mt | | 22.98 | 23.15 | 23.16 | 23.03 | 23.03 | 23.04 | 23.04 | 23.04 | 23.04 | 23.04 |
| Micronutrients | Mt | | 0.73 | 0.74 | 0.74 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 |
| **Revenue** | $10^6$ US$ | | **2,368.35** | **2,386.25** | **2,387.38** | **2,373.67** | **2,373.67** | **2,374.98** | **2,374.98** | **2,374.98** | **2,374.98** | **2,374.98** |
| **Freight** | **106 US$** | | **741.56** | **747.17** | **747.52** | **743.23** | **743.23** | **743.64** | **743.64** | **743.64** | **743.64** | **743.64** |
| VERDE/Client freight | $10^6$ US$ | | 741.56 | 747.17 | 747.52 | 743.23 | 743.23 | 743.64 | 743.64 | 743.64 | 743.64 | 743.64 |
| **Net Revenue** | **106 US$** | | **1,626.79** | **1,639.08** | **1,639.86** | **1,630.44** | **1,630.44** | **1,631.34** | **1,631.34** | **1,631.34** | **1,631.34** | **1,631.34** |
| **Production cost** | **106 US$** | | **409.44** | **416.13** | **421.11** | **432.52** | **432.52** | **435.31** | **435.31** | **435.31** | **435.31** | **435.31** |
| OPEX | $10^6$ US$ | | 230.26 | 235.59 | 240.49 | 252.93 | 252.93 | 255.63 | 255.63 | 255.63 | 255.63 | 255.63 |
| Feedstock | $10^6$ US$ | | 179.18 | 180.53 | 180.62 | 179.58 | 179.58 | 179.68 | 179.68 | 179.68 | 179.68 | 179.68 |
| **EBTIDA** | **$10^6$ US$** | | **1,217.35** | **1,222.95** | **1,218.75** | **1,197.92** | **1,197.92** | **1,196.03** | **1,196.03** | **1,196.03** | **1,196.03** | **1,196.03** |
| | % | | 51% | 51% | 51% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 94.73 | 95.45 | 95.50 | 94.95 | 94.95 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 |
| **Operating profit** | **$10^6$ US$** | | **1,122.62** | **1,127.50** | **1,123.26** | **1,102.98** | **1,102.98** | **1,101.03** | **1,101.03** | **1,101.03** | **1,101.03** | **1,101.03** |
| CFEM | $10^6$ US$ | | 3.97 | 4.08 | 4.19 | 4.47 | 4.47 | 4.53 | 4.53 | 4.53 | 4.53 | 4.53 |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **1,105.66** | **1,110.44** | **1,106.08** | **1,085.52** | **1,085.52** | **1,083.52** | **1,083.52** | **1,083.52** | **1,083.52** | **1,083.52** |
| Income tax | $10^6$ US$ | | 276.42 | 277.61 | 276.52 | 271.38 | 271.38 | 270.88 | 270.88 | 270.88 | 270.88 | 270.88 |
| CSLL | $10^6$ US$ | | 99.51 | 99.94 | 99.55 | 97.70 | 97.70 | 97.52 | 97.52 | 97.52 | 97.52 | 97.52 |
| **Net profit** | **$10^6$ US$** | | **729.74** | **732.89** | **730.01** | **716.45** | **716.45** | **715.12** | **715.12** | **715.12** | **715.12** | **715.12** |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Depreciation and amortization | $10^6$ US$ | | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 | 12.98 |
| Initial Investments | $10^6$ US$ | 129.84 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 11.85 | 11.94 | 11.95 | 11.88 | 11.88 | 11.89 | 11.89 | 11.89 | 11.89 |
| Working capital | $10^6$ US$ | | 102.36 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-129.84** | **640.36** | **734.02** | **731.05** | **717.48** | **717.55** | **716.22** | **716.22** | **716.22** | **716.22** | **716.22** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **4,634.69** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **7,950.56** | | | | | | | | | | |
| **IRR** | **%** | **505.02%** | | | | | | | | | | |
| **Payback** | **years** | **0.20** | | | | | | | | | | |

**Table 22.2-7 Economic-financial analysis of the Project - 50 Mtpy Scenario Price 1**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **50.07** | **49.79** | **50.86** | **50.74** | **50.05** | **49.83** | **49.83** | **49.83** | **49.83** | **49.83** |
| Final Product (dry base) | Mt | | 50.07 | 49.79 | 50.86 | 50.74 | 50.05 | 49.83 | 49.83 | 49.83 | 49.83 | 49.83 |
| Micronutrients | Mt | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| **Revenue** | $10^6$ US$ | | **3,707.45** | **3,686.79** | **3,765.98** | **3,756.94** | **3,706.03** | **3,689.82** | **3,689.82** | **3,689.82** | **3,689.82** | **3,689.82** |
| **Freight** | **106 US$** | | **1,658.71** | **1,649.47** | **1,684.90** | **1,680.86** | **1,658.08** | **1,650.83** | **1,650.83** | **1,650.83** | **1,650.83** | **1,650.83** |
| FVS/VERDE freight | $10^6$ US$ | | 778.04 | 773.70 | 790.32 | 788.42 | 777.74 | 774.34 | 774.34 | 774.34 | 774.34 | 774.34 |
| VERDE/Client freight | $10^6$ US$ | | 880.68 | 875.77 | 894.58 | 892.43 | 880.34 | 876.49 | 876.49 | 876.49 | 876.49 | 876.49 |
| **Net Revenue** | **106 US$** | | **2,048.73** | **2,037.32** | **2,081.08** | **2,076.08** | **2,047.95** | **2,038.99** | **2,038.99** | **2,038.99** | **2,038.99** | **2,038.99** |
| **Production cost** | **106 US$** | | **388.19** | **435.86** | **443.39** | **455.89** | **457.02** | **468.59** | **468.59** | **468.59** | **468.59** | **468.59** |
| OPEX | $10^6$ US$ | | 388.19 | 435.86 | 443.39 | 455.89 | 457.02 | 468.59 | 468.59 | 468.59 | 468.59 | 468.59 |
| Feedstock | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **EBTIDA** | **$10^6$ US$** | | **1,660.54** | **1,601.46** | **1,637.69** | **1,620.19** | **1,590.93** | **1,570.40** | **1,570.40** | **1,570.40** | **1,570.40** | **1,570.40** |
| | % | | 45% | 43% | 43% | 43% | 43% | 43% | 43% | 43% | 43% | 43% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 148.30 | 147.47 | 150.64 | 150.28 | 148.24 | 147.59 | 147.59 | 147.59 | 147.59 | 147.59 |
| **Operating profit** | **$10^6$ US$** | | **1,512.25** | **1,453.99** | **1,487.05** | **1,469.91** | **1,442.69** | **1,422.81** | **1,422.81** | **1,422.81** | **1,422.81** | **1,422.81** |
| CFEM | $10^6$ US$ | | 6.37 | 7.43 | 7.55 | 7.83 | 7.89 | 8.15 | 8.15 | 8.15 | 8.15 | 8.15 |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **1,450.48** | **1,391.16** | **1,424.10** | **1,406.68** | **1,379.40** | **1,359.26** | **1,359.26** | **1,359.26** | **1,359.26** | **1,359.26** |
| Income tax | $10^6$ US$ | | 362.62 | 347.79 | 356.02 | 351.67 | 344.85 | 339.82 | 339.82 | 339.82 | 339.82 | 339.82 |
| CSLL | $10^6$ US$ | | 130.54 | 125.20 | 128.17 | 126.60 | 124.15 | 122.33 | 122.33 | 122.33 | 122.33 | 122.33 |
| **Net profit** | **$10^6$ US$** | | **957.31** | **918.16** | **939.90** | **928.41** | **910.41** | **897.11** | **897.11** | **897.11** | **897.11** | **897.11** |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| Initial Investments | $10^6$ US$ | 553.99 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 25.03 | 24.89 | 25.43 | 25.37 | 25.02 | 24.91 | 24.91 | 24.91 | 24.91 |
| Working capital | $10^6$ US$ | | 97.05 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-553.99** | **915.66** | **948.53** | **970.41** | **958.38** | **940.44** | **927.49** | **927.60** | **927.60** | **927.60** | **927.60** |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **5,742.44** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **9,343.66** | | | | | | | | | | |
| **IRR** | **%** | **167.86%** | | | | | | | | | | |
| **Payback** | **years** | **0.61** | | | | | | | | | | |

**Table 22.2-8 Economic-financial analysis of the Project - 50 Mtpy Scenario Price 2**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **51.27** | **50.99** | **52.08** | **51.96** | **51.25** | **51.03** | **51.03** | **51.03** | **51.03** | **51.03** |
| Final Product (dry base) | Mt | | 50.07 | 49.79 | 50.86 | 50.74 | 50.05 | 49.83 | 49.83 | 49.83 | 49.83 | 49.83 |
| Micronutrients | Mt | | **1.21** | **1.20** | **1.23** | **1.22** | **1.21** | **1.20** | **1.20** | **1.20** | **1.20** | **1.20** |
| **Revenue** | $10^6$ US$ | | **4,347.42** | **4,323.20** | **4,416.06** | **4,405.45** | **4,345.76** | **4,326.75** | **4,326.75** | **4,326.75** | **4,326.75** | **4,326.75** |
| **Freight** | **106 US$** | | **1,679.93** | **1,670.57** | **1,706.45** | **1,702.35** | **1,679.28** | **1,671.94** | **1,671.94** | **1,671.94** | **1,671.94** | **1,671.94** |
| FVS/VERDE freight | $10^6$ US$ | | 778.04 | 773.70 | 790.32 | 788.42 | 777.74 | 774.34 | 774.34 | 774.34 | 774.34 | 774.34 |
| VERDE/Client freight | $10^6$ US$ | | 901.89 | 896.86 | 916.13 | 913.93 | 901.54 | 897.60 | 897.60 | 897.60 | 897.60 | 897.60 |
| **Net Revenue** | **106 US$** | | **2,667.49** | **2,652.63** | **2,709.61** | **2,703.10** | **2,666.47** | **2,654.81** | **2,654.81** | **2,654.81** | **2,654.81** | **2,654.81** |
| **Production cost** | **106 US$** | | **670.36** | **716.46** | **730.02** | **741.83** | **739.08** | **749.42** | **749.42** | **749.42** | **749.42** | **749.42** |
| OPEX | $10^6$ US$ | | 388.19 | 435.86 | 443.39 | 455.89 | 457.02 | 468.59 | 468.59 | 468.59 | 468.59 | 468.59 |
| Feedstock | $10^6$ US$ | | 282.17 | 280.60 | 286.62 | 285.94 | 282.06 | 280.83 | 280.83 | 280.83 | 280.83 | 280.83 |
| **EBTIDA** | **$10^6$ US$** | | **1,997.13** | **1,936.17** | **1,979.59** | **1,961.27** | **1,927.39** | **1,905.39** | **1,905.39** | **1,905.39** | **1,905.39** | **1,905.39** |
| | % | | 46% | 45% | 45% | 45% | 44% | 44% | 44% | 44% | 44% | 44% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 173.90 | 172.93 | 176.64 | 176.22 | 173.83 | 173.07 | 173.07 | 173.07 | 173.07 | 173.07 |
| **Operating profit** | **$10^6$ US$** | | **1,823.24** | **1,763.25** | **1,802.95** | **1,785.06** | **1,753.56** | **1,732.32** | **1,732.32** | **1,732.32** | **1,732.32** | **1,732.32** |
| CFEM | $10^6$ US$ | | 6.37 | 7.43 | 7.55 | 7.83 | 7.89 | 8.15 | 8.15 | 8.15 | 8.15 | 8.15 |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **1,761.47** | **1,700.42** | **1,740.00** | **1,721.83** | **1,690.28** | **1,668.77** | **1,668.77** | **1,668.77** | **1,668.77** | **1,668.77** |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Income tax | $10^6$ US$ | | 440.37 | 425.10 | 435.00 | 430.46 | 422.57 | 417.19 | 417.19 | 417.19 | 417.19 | 417.19 |
| CSLL | $10^6$ US$ | | 158.53 | 153.04 | 156.60 | 154.96 | 152.12 | 150.19 | 150.19 | 150.19 | 150.19 | 150.19 |
| **Net profit** | **$10^6$ US$** | | **1,162.57** | **1,122.27** | **1,148.40** | **1,136.40** | **1,115.58** | **1,101.39** | **1,101.39** | **1,101.39** | **1,101.39** | **1,101.39** |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| Initial Investments | $10^6$ US$ | 553.99 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 25.64 | 25.49 | 26.04 | 25.98 | 25.63 | 25.51 | 25.51 | 25.51 | 25.51 |
| Working capital | $10^6$ US$ | | 167.59 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-553.99** | **1,050.38** | **1,152.04** | **1,178.30** | **1,165.76** | **1,145.00** | **1,131.16** | **1,131.27** | **1,131.27** | **1,131.27** | **1,131.27** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **7,051.80** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **11,499.24** | | | | | | | | | | |
| **IRR** | **%** | **196.19%** | | | | | | | | | | |
| **Payback** | **years** | **0.53** | | | | | | | | | | |

**Table 22.2-9 Economic-financial analysis of the Project - 50 Mtpy Scenario Price 3**

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Production** | | | **51.60** | **51.31** | **52.41** | **52.28** | **51.58** | **51.35** | **51.35** | **51.35** | **51.35** | **51.35** |
| Final Product (dry base) | Mt | | 50.07 | 49.79 | 50.86 | 50.74 | 50.05 | 49.83 | 49.83 | 49.83 | 49.83 | 49.83 |
| Micronutrients | Mt | | **1.53** | **1.52** | **1.55** | **1.55** | **1.53** | **1.52** | **1.52** | **1.52** | **1.52** | **1.52** |
| **Revenue** | $10^6$ US$ | | **4,749.41** | **4,722.94** | **4,824.39** | **4,812.80** | **4,747.59** | **4,726.82** | **4,726.82** | **4,726.82** | **4,726.82** | **4,726.82** |
| **Freight** | **106 US$** | | **1,685.61** | **1,676.22** | **1,712.22** | **1,708.11** | **1,684.97** | **1,677.59** | **1,677.59** | **1,677.59** | **1,677.59** | **1,677.59** |
| FVS/VERDE freight | $10^6$ US$ | | 778.04 | 773.70 | 790.32 | 788.42 | 777.74 | 774.34 | 774.34 | 774.34 | 774.34 | 774.34 |
| VERDE/Client freight | $10^6$ US$ | | 907.57 | 902.52 | 921.90 | 919.69 | 907.23 | 903.26 | 903.26 | 903.26 | 903.26 | 903.26 |
| **Net Revenue** | **106 US$** | | **3,063.79** | **3,046.72** | **3,112.17** | **3,104.69** | **3,062.62** | **3,049.22** | **3,049.22** | **3,049.22** | **3,049.22** | **3,049.22** |
| **Production cost** | **106 US$** | | **761.85** | **807.43** | **822.95** | **834.53** | **830.53** | **840.47** | **840.47** | **840.47** | **840.47** | **840.47** |
| OPEX | $10^6$ US$ | | 388.19 | 435.86 | 443.39 | 455.89 | 457.02 | 468.59 | 468.59 | 468.59 | 468.59 | 468.59 |
| Feedstock | $10^6$ US$ | | 373.65 | 371.57 | 379.55 | 378.64 | 373.51 | 371.88 | 371.88 | 371.88 | 371.88 | 371.88 |
| **EBTIDA** | **$10^6$ US$** | | **2,301.95** | **2,239.29** | **2,289.22** | **2,270.16** | **2,232.09** | **2,208.76** | **2,208.76** | **2,208.76** | **2,208.76** | **2,208.76** |

| Description | Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | % | | 48% | 47% | 47% | 47% | 47% | 47% | 47% | 47% | 47% | 47% |
| Royalties | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIS/COFINS | $10^6$ US$ | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ICMS | $10^6$ US$ | | 189.98 | 188.92 | 192.98 | 192.51 | 189.90 | 189.07 | 189.07 | 189.07 | 189.07 | 189.07 |
| **Operating profit** | **$10^6$ US$** | | **2,111.97** | **2,050.37** | **2,096.24** | **2,077.65** | **2,042.19** | **2,019.68** | **2,019.68** | **2,019.68** | **2,019.68** | **2,019.68** |
| CFEM | $10^6$ US$ | | 6.37 | 7.43 | 7.55 | 7.83 | 7.89 | 8.15 | 8.15 | 8.15 | 8.15 | 8.15 |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| **Profit Before Income Tax** | **$10^6$ US$** | | **2,050.20** | **1,987.54** | **2,033.29** | **2,014.41** | **1,978.90** | **1,956.14** | **1,956.14** | **1,956.14** | **1,956.14** | **1,956.14** |
| Income tax | $10^6$ US$ | | 512.55 | 496.89 | 508.32 | 503.60 | 494.73 | 489.03 | 489.03 | 489.03 | 489.03 | 489.03 |
| CSLL | $10^6$ US$ | | 184.52 | 178.88 | 183.00 | 181.30 | 178.10 | 176.05 | 176.05 | 176.05 | 176.05 | 176.05 |
| **Net profit** | **$10^6$ US$** | | **1,353.13** | **1,311.78** | **1,341.97** | **1,329.51** | **1,306.07** | **1,291.05** | **1,291.05** | **1,291.05** | **1,291.05** | **1,291.05** |
| Depreciation and amortization | $10^6$ US$ | | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 | 55.40 |
| Initial Investments | $10^6$ US$ | 553.99 | | | | | | | | | | |
| Sustaining Capital | $10^6$ US$ | | | 25.80 | 25.65 | 26.21 | 26.14 | 25.79 | 25.68 | 25.68 | 25.68 | 25.68 |
| Working capital | $10^6$ US$ | | 190.46 | | | | | | | | | |
| **Cash Balance** | **$10^6$ US$** | **-553.99** | **1,218.07** | **1,341.38** | **1,371.72** | **1,358.71** | **1,335.33** | **1,320.66** | **1,320.77** | **1,320.77** | **1,320.77** | **1,320.77** |
| **NPV at 8% p.a. (First 10 Years)** | **$10^6$ US$** | **8,309.24** | | | | | | | | | | |
| **NPV at 8% p.a.** | **$10^6$ US$** | **13,538.19** | | | | | | | | | | |
| **IRR** | **%** | **227.08%** | | | | | | | | | | |
| **Payback** | **years** | **0.45** | | | | | | | | | | |

**Table 22.2-10 NPV Summary**

| Scenario | Sales price | NPV (USD x $10^6$) | |
|---|---|---|---|
| | | First 10 years | Life of Mine |
| Plant 3 Scenario (10 Mtpy) | Price 1 ($K_2O$) | 1,539.89 | 2,908.49 |
| | Price 2 ($K_2O$ + S) | 1,802.74 | 3,406.39 |
| | Price 3 ($K_2O$ + S + micronutrients) | 2,105.68 | 3,971.54 |
| 23 Mtpy Scenario | Price 1 ($K_2O$) | 3,384.62 | 5,808.29 |
| | Price 2 ($K_2O$ + S) | 3,982.56 | 6,840.23 |
| | Price 3 ($K_2O$ + S + micronutrients) | 4,634.69 | 7,950.56 |
| 50 Mtpy Scenario | Price 1 ($K_2O$) | 5,742.44 | 9,343.66 |
| | Price 2 ($K_2O$ + S) | 7,051.80 | 11,499.24 |
| | Price 3 ($K_2O$ + S + micronutrients) | 8,309.24 | 13,538.19 |

The scenario chosen by VERDE for its future detailing was the scenario with production of 50 Mt of product, with the final product being $K_2O$, S and micronutrients (sales price 3). The economic-financial analysis for this scenario shows that the Project should have very attractive results, with an average cash generation (EBITDA) corresponding to approximately 47% of the gross revenue of the enterprise during the first 10 years of the enterprise and an NPV discounted at 8% p.a. of 8.31 billion dollars. In addition, considering the useful life of the mine, and consequently of the enterprise, the discounted NPV corresponds to 13.54 billion dollars.

## 22.3. Project Sensitivity Analysis

A sensitivity analysis of the project's NPV was carried out, varying the CAPEX, operating cost, and sales price of the products. The results are shown in Table 22.3-1 and Figure 22.3-1 to Figure 22.3-9:

**Table 22.3-1 Summary of Project NPV Sensitivity Analysis**

| Scenario | Variation | Unit | % Variation | | | | |
|---|---|---|---|---|---|---|---|
| | | | -20% | -10% | 0% | 10% | 20% |
| Plant 3 Scenario Price 1 | NPV CAPEX | US$ x 10^6 | 2,918.16 | 2,914.08 | 2,908.49 | 2,905.94 | 2,901.86 |
| | NPV OPEX | US$ x 10^6 | 3,130.63 | 3,019.56 | 2,908.49 | 2,797.42 | 2,686.35 |
| | NPV Sales Price | US$ x 10^6 | 1,623.97 | 2,266.23 | 2,908.49 | 3,550.75 | 4,193.01 |
| Plant 3 Scenario Price 2 | NPV CAPEX | US$ x 10^6 | 3,416.05 | 3,411.98 | 3,406.39 | 3,403.83 | 3,399.76 |
| | NPV OPEX | US$ x 10^6 | 3,724.36 | 3,565.38 | 3,406.39 | 3,247.40 | 3,088.41 |
| | NPV Sales Price | US$ x 10^6 | 1,915.23 | 2,660.81 | 3,406.39 | 4,151.97 | 4,897.55 |
| Plant 3 Scenario Price 3 | NPV CAPEX | US$ x 10^6 | 3,981.20 | 3,977.13 | 3,971.54 | 3,968.98 | 3,964.91 |
| | NPV OPEX | US$ x 10^6 | 4,326.39 | 4,148.97 | 3,971.54 | 3,794.11 | 3,616.68 |
| | NPV Sales Price | US$ x 10^6 | 2,326.88 | 3,149.21 | 3,971.54 | 4,793.87 | 5,616.20 |
| 23 Mtpy Scenario Price 1 | NPV CAPEX | US$ x 10^6 | 5,828.33 | 5,818.31 | 5,808.29 | 5,798.26 | 5,788.24 |
| | NPV OPEX | US$ x 10^6 | 6,191.79 | 6,000.04 | 5,808.29 | 5,616.53 | 5,424.78 |
| | NPV Sales Price | US$ x 10^6 | 3,132.12 | 4,470.20 | 5,808.29 | 7,146.37 | 8,484.45 |
| | NPV CAPEX | US$ x 10^6 | 6,860.27 | 6,850.25 | 6,840.23 | 6,830.21 | 6,820.18 |
| | NPV OPEX | US$ x 10^6 | 7,427.33 | 7,133.78 | 6,840.23 | 6,546.67 | 6,253.12 |

| Scenario | Variation | Unit | % Variation | | | | |
|---|---|---|---|---|---|---|---|
| | | | -20% | -10% | 0% | 10% | 20% |
| 23 Mtpy Scenario Price 2 | NPV Sales Price | US$ x 10^6 | 3,727.08 | 5,283.65 | 6,840.23 | 8,396.80 | 9,953.37 |
| 23 Mtpy Scenario Price 3 | NPV CAPEX | US$ x 10^6 | 7,970.60 | 7,960.58 | 7,950.56 | 7,940.53 | 7,930.51 |
| | NPV OPEX | US$ x 10^6 | 8,611.67 | 8,281.11 | 7,950.56 | 7,620.00 | 7,289.44 |
| | NPV Sales Price | US$ x 10^6 | 4,533.23 | 6,241.89 | 7,950.56 | 9,659.22 | 11,367.89 |
| 50 Mtpy Scenario Price 1 | NPV CAPEX | US$ x 10^6 | 9,429.18 | 9,386.42 | 9,343.66 | 9,300.90 | 9,258.14 |
| | NPV OPEX | US$ x 10^6 | 10,038.06 | 9,690.86 | 9,343.66 | 8,996.47 | 8,649.27 |
| | NPV Sales Price | US$ x 10^6 | 4,268.45 | 6,806.06 | 9,343.66 | 11,881.27 | 14,418.88 |
| 50 Mtpy Scenario Price 2 | NPV CAPEX | US$ x 10^6 | 11,584.76 | 11,542.00 | 11,499.24 | 11,456.48 | 11,413.72 |
| | NPV OPEX | US$ x 10^6 | 12,607.15 | 12,053.19 | 11,499.24 | 10,945.28 | 10,391.32 |
| | NPV Sales Price | US$ x 10^6 | 5,547.94 | 8,523.59 | 11,499.24 | 14,474.88 | 17,450.53 |
| 50 Mtpy Scenario Price 3 | NPV CAPEX | US$ x 10^6 | 13,623.71 | 13,580.95 | 13,538.19 | 13,495.43 | 13,452.67 |
| | NPV OPEX | US$ x 10^6 | 14,780.17 | 14,159.18 | 13,538.19 | 12,917.19 | 12,296.20 |
| | NPV Sales Price | US$ x 10^6 | 7,036.61 | 10,287.40 | 13,538.19 | 16,788.98 | 20,039.77 |

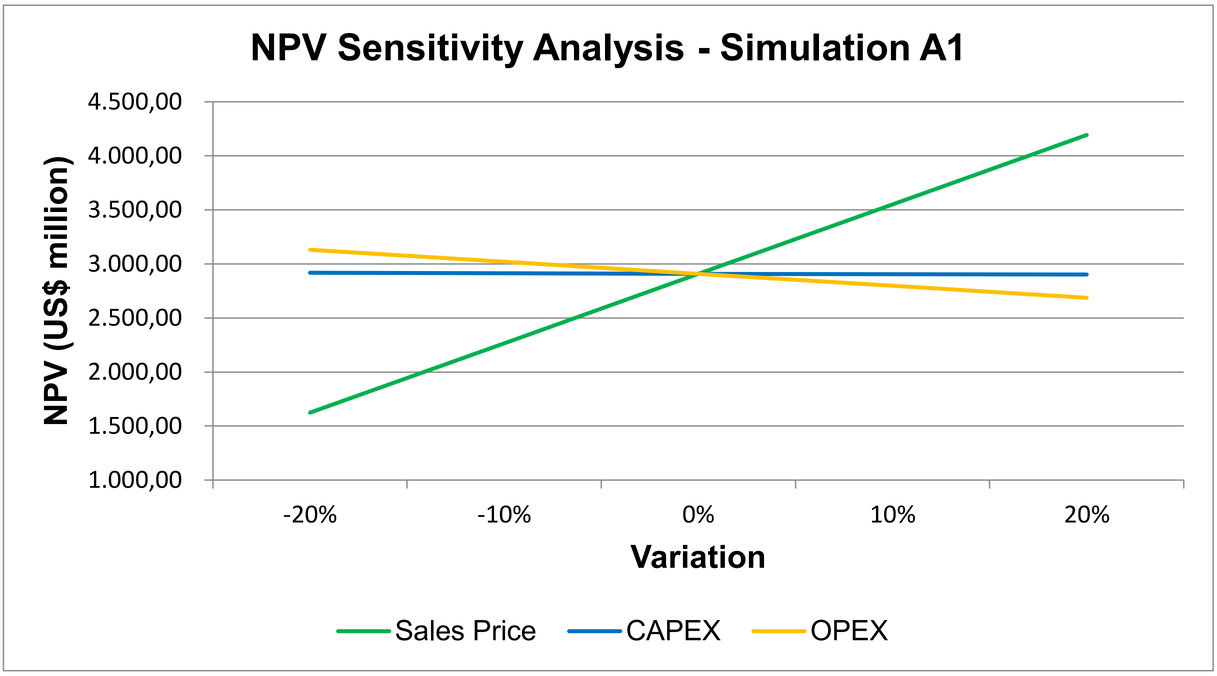


**Figure 22.3-1 Sensitivity Analysis of the Project NPV for the Plant 3 Scenario Price 1**

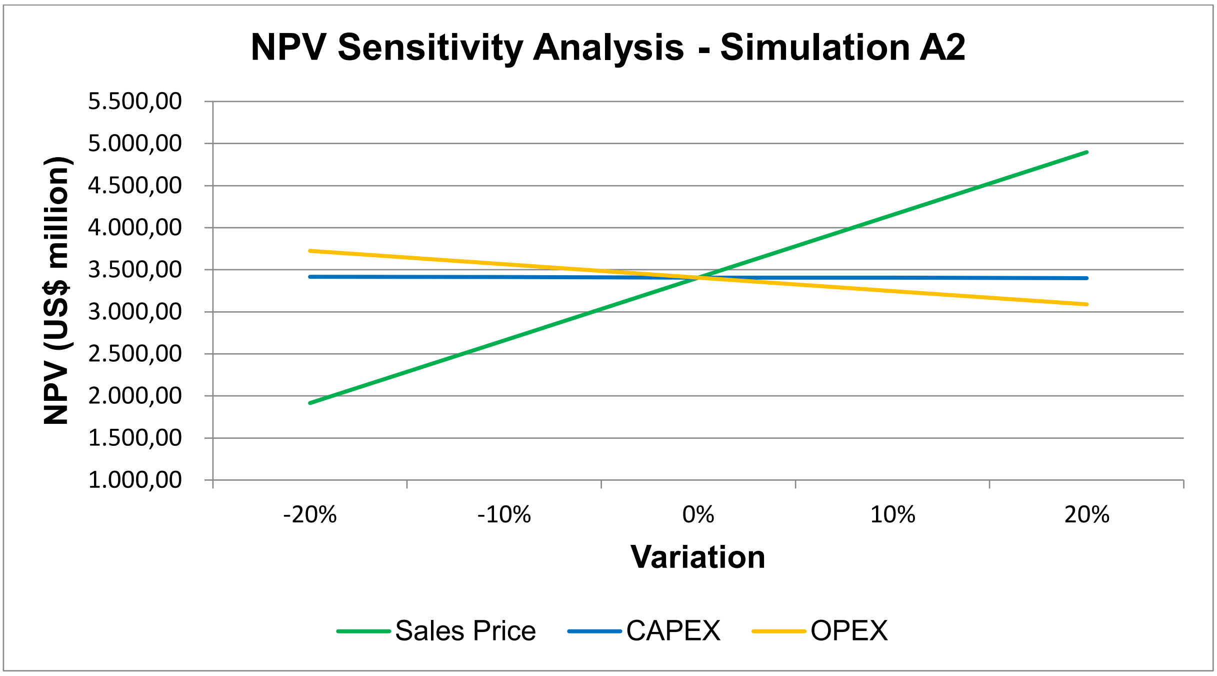


**Figure 22.3-2 Sensitivity Analysis of the Project NPV for the Plant 3 Scenario Price 2**

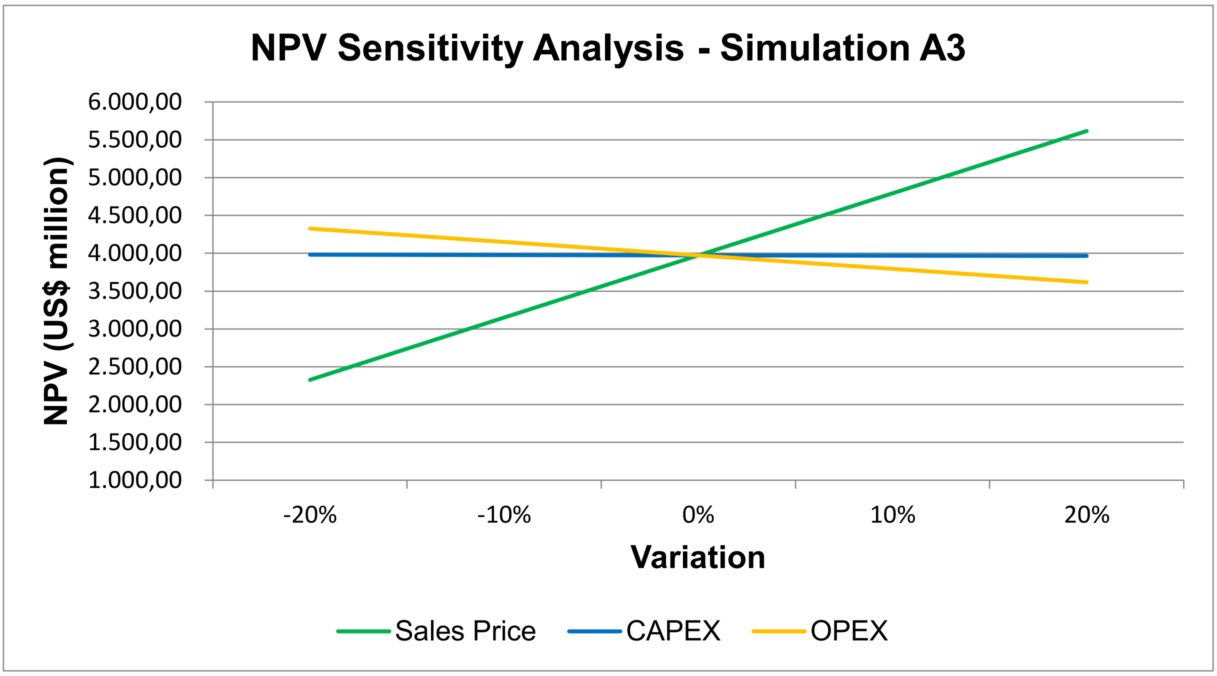


**Figure 22.3-3 Sensitivity Analysis of the Project NPV for the Plant 3 Scenario Price 3**

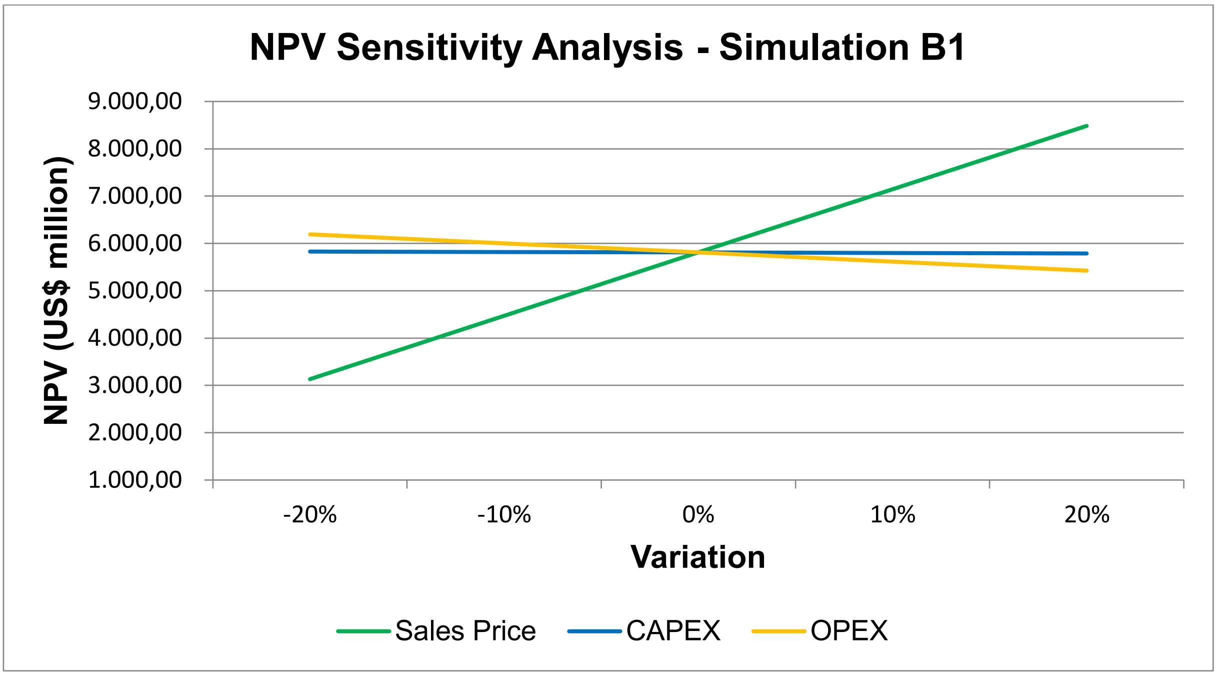


**Figure 22.3-4 Sensitivity Analysis of the Project NPV for the 23 Mtpy Scenario Price 1**

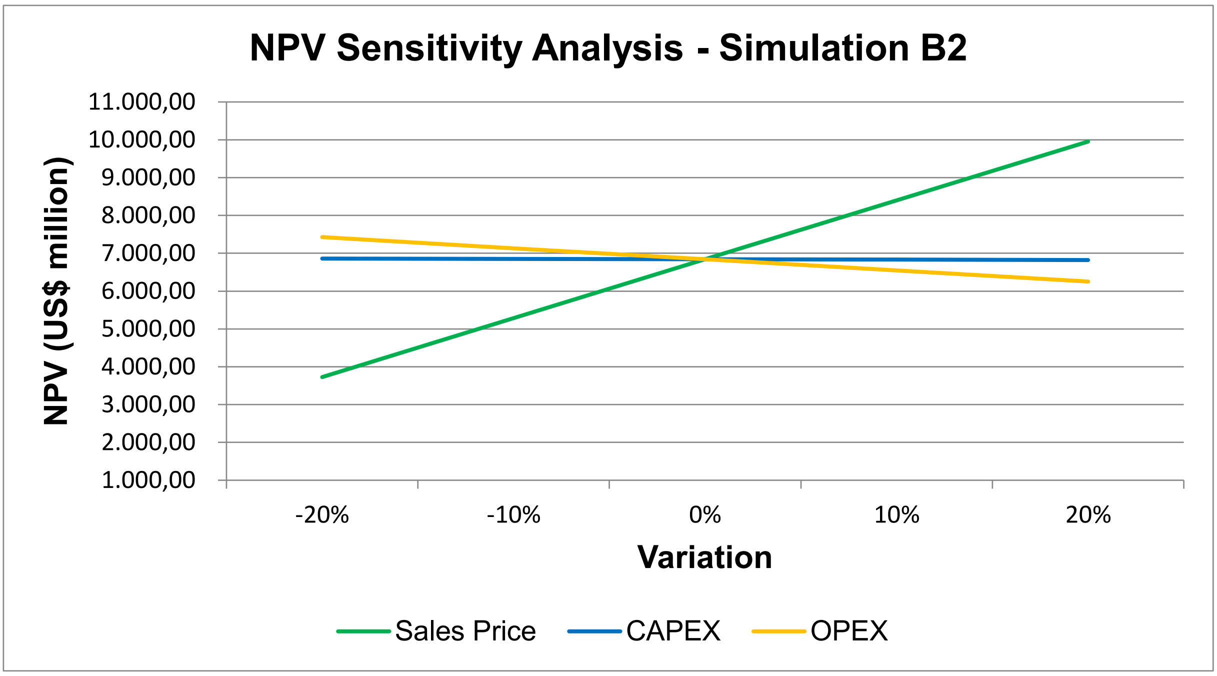


**Figure 22.3-5 Sensitivity Analysis of the Project NPV for the 23 Mtpy Scenario Price 2**

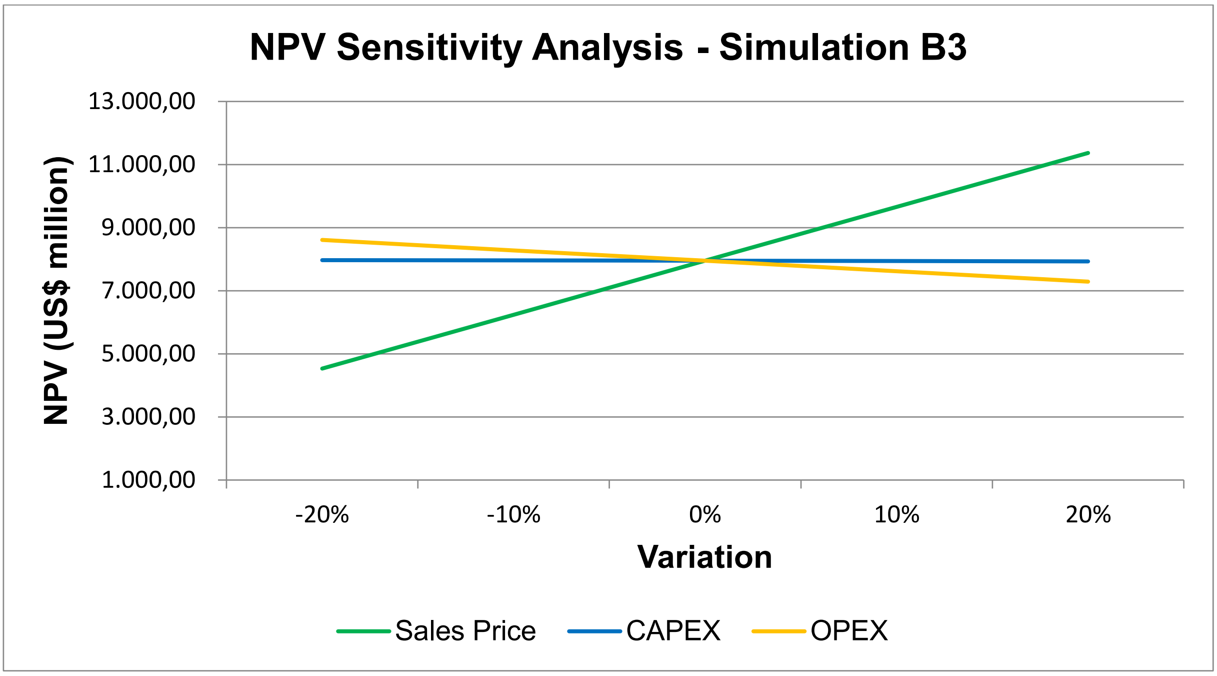


**Figure 22.3-6 Sensitivity Analysis of the Project NPV for the 23 Mtpy Scenario Price 3**

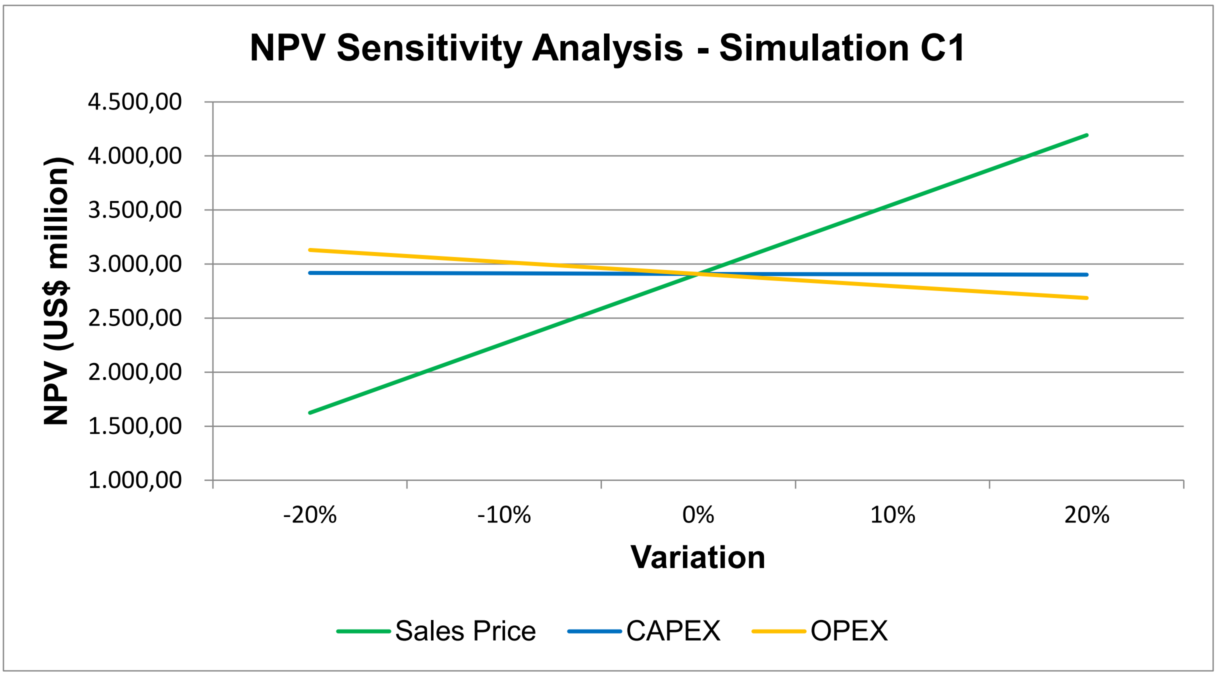


**Figure 22.3-7 Sensitivity Analysis of the Project NPV for the 50 Mtpy Scenario Price 1**

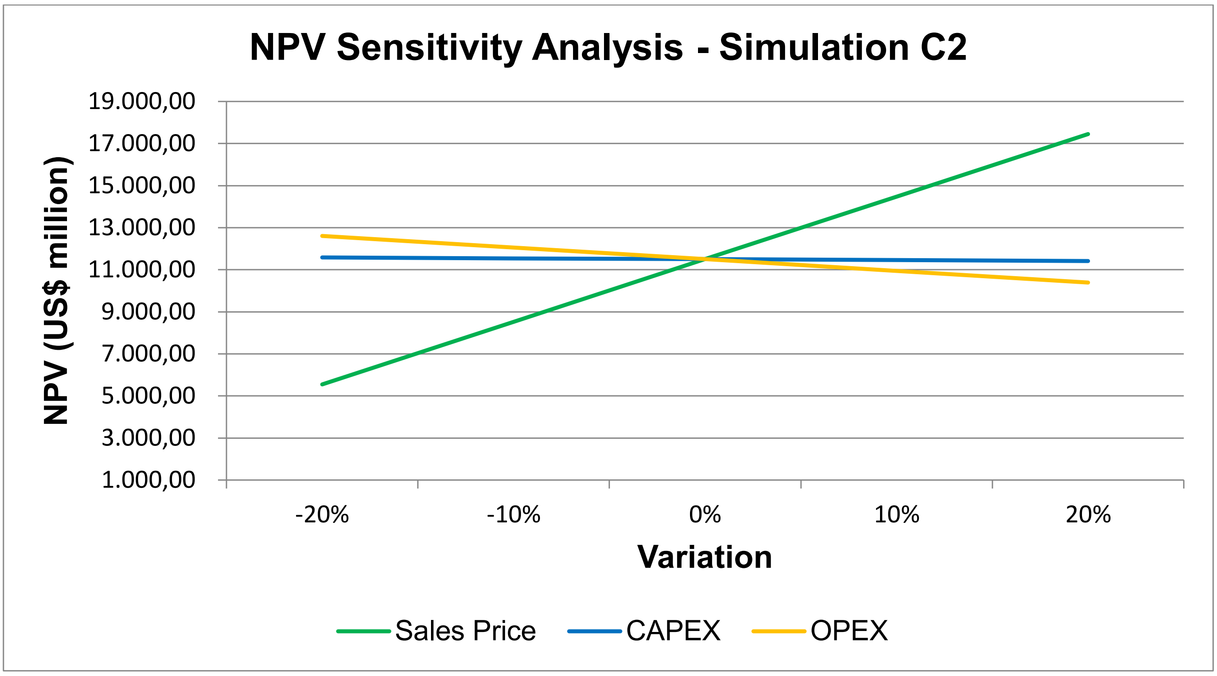


**Figure 22.3-8 Sensitivity Analysis of the Project NPV for the 50 Mtpy Scenario Price 2**

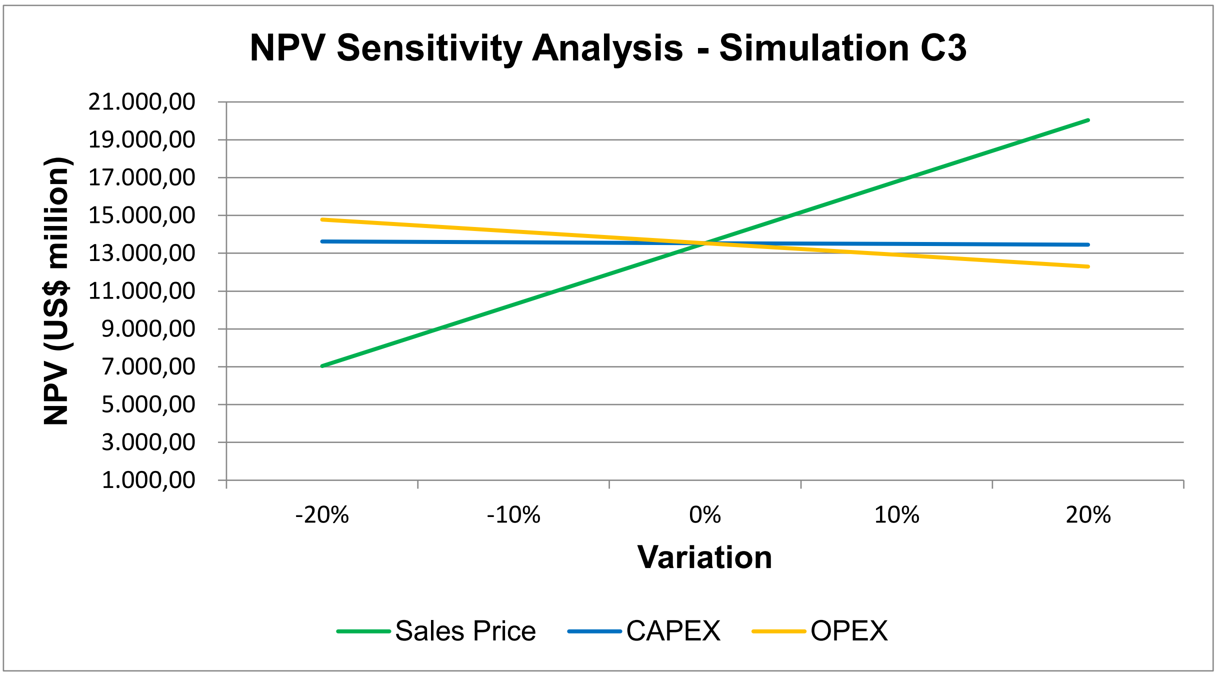


**Figure 22.3-9 Sensitivity Analysis of the Project NPV for the 50 Mtpy Scenario Price 3**

# 23. Adjacent Properties

To the best of the authors’ knowledge, there are no other advanced potash projects in the immediate vicinity of the Cerrado Verde Project.

# 24. Other Relevant Data and Information

The authors are not aware of any other relevant data and or information pertaining to the Cerrado Verde Project area that has not been presented within the appropriate sections of this report.

# 25. Interpretation and Conclusions

This section summarizes the results of this PFS, and the risks and uncertainties associated with the project.

## 25.1. Results

The results of this PFS evaluation indicate that VERDE can produce $K_2O$ in the desired purity and that there is demand in the market for its use as a fertilizer.

In recent years extensive geological and technological research work has been carried out in the areas considered in this study. The activities were carried out using to high operational standards complied with strict safety criteria and respect for the environment and communities.

Several scenarios were evaluated, with the production rate and the type of final product generated varying in each one. The results of the work show total mineable resources of 657.46 Mt, with an average grade of 9.69% $K_2O$, in a stripping ratio of 0.40.

The 50 Mtpy Scenario chosen by VERDE for its future detailing was the scenario with production of 50 million tonnes of product, with the final product being $K_2O$, S and micronutrients (sales price 3). The results of the chosen scenario show total mineable resources of 1,298.46 Mt, with an average grade of 9.19% of $K_2O$, and a sterile ore ratio of 0.36.

The scenario chosen by VERDE for its future detailing was the scenario with production of 50 Mt of product, with the final product being $K_2O$, S and micronutrients (sales price 3). The economic-financial analysis for this scenario shows that the project should have very attractive results, with an average cash generation (EBITDA) corresponding to approximately 47% of the gross revenue of the enterprise during the first 10 years of the enterprise and an NPV discounted at 8% p.a. of 8.31 billion dollars. In addition, considering the useful life of the mine, and consequently of the enterprise, the discounted NPV corresponds to 13.54 billion dollars. The IRR chosen for the scenario corresponds to 227.08% of the total CAPEX for the project, both for the first 10 years and for the life of the mine.

## 25.2. Significant Risks and Uncertainties

### 25.2.1. Exploration

There are no significant risks or uncertainties associated with the exploration of the project area.

### 25.2.2. Mineral Resource Estimate

There are no significant risks or uncertainties associated with the mineral resources. The mineral resource estimate is adequate to support the current study.

### 25.2.3. Mineral Reserve Estimate

There are no significant risks or uncertainties associated with the mineral reserves. The reserve estimate is adequate to support the current study.

### 25.2.4. Processing

There are no significant risks or uncertainties associated with the mineral processing for the project.

### 25.2.5. Environmental

There are no significant risks or uncertainties associated with the environmental aspects of the project.

### 25.2.6. Projected Economic Outcomes

The economic analysis shows positive results, which would indicate that the Project may move to the next phase of development.

# 26. Recommendations

Recommendations for future work programs and costs are provided below. The financial results for the Project justify advancing and refining the Pre-Feasibility engineering designs to the feasibility level within the next 12 to 18 months. BNA recommends that VERDE undertakes the following activities:

- Additional RC Drilling aiming at improving the classification of portions of the indicated mineral resources to measured mineral resources in areas identified as targets for the mining start.
- A geotechnical study to evaluate the stability of the final pit and waste rock piles.
- Evaluation of the impact of the waste rock piles, which are located inside the exhausted pits, on the remaining mineral resource.
- Trade-off studies focused on new locations for the primary crusher and expansion of the belt conveyor with the goal of reducing the hauling cost.
- Extension of the existing hydrogeological study to cover the entire project area.
- A detailed study of the blasting operation for both ore and waste rock mining.
- A detailed study of the external access roads leading to the pit to minimize hauling distances and the amount of cut and fill required for their construction, taking into consideration the rugged relief of the region.
- Detailed quotes for the execution of the mining activities.
- An evaluation of the use of road trucks with trailers for ore haulage to reduce hauling costs.

BNA also recommends that the geological survey be detailed in the areas planned to be mined in the first 5 years of the project, to convert probable reserves into proven reserves. Due to the large area of the Project and the rugged terrain, BNA recommends that the designs for the external roads to the pits for the chosen scenario be detailed, to reduce the average transport distances for the project. In addition, with the detailing of the mining plans, it may be possible to minimize the transport distances for the overburden, with the detailing of the overburden piles located inside the exhausted pits.

Additional elements of the recommended work program include environmental permit application support, marketing studies, more comprehensive metallurgical testing and a more detailed evaluation of process equipment and infrastructure.

The cost of the recommended work programs is estimated at US$ 4.46 million, as shown in Table 26-1.

**Table 26-1 Feasibility Study Work Program**

| **Activity** | **Total (US$ x 1,000)** |
|---|---:|
| Engineering Studies | 3,125 |
| Administration | 375 |
| Geotechnical Drilling | 177 |
| Environmental Studies | 278 |
| Additional RC Drilling | 500 |
| **Total** | **4,455** |

It is recommended that sequencing be started in regions where the mineral reserves are proved, to reduce uncertainty in the first years of operation. In this project, measured mineral resources are located entirely in the southern part of the deposit. Therefore, initiating and focusing the mining plans on these areas would change the entire strategy foreseen for the project, especially for the Plant 3 Scenario. Therefore, a decision was made to continue with the planned mining strategy. For the next planned study, the Feasibility Study (FS), it is recommended that additional drilling is made in the areas where mining is planned for the first years, to transform this resource into a measured resource and therefore in mineral proved reserves, after the consideration of all modifying factors.

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# 28. Glossary

## 28.1. Mineral Resources

The mineral resources and mineral reserves have been classified according to the “CIM Standards on Mineral Resources and Reserves: Definitions and Guidelines” (May 10, 2014). Accordingly, the resources have been classified as measured, indicated or inferred, the reserves have been classified as proven or probable based on the measured and indicated resources, as defined below.

A mineral resource is a concentration or occurrence of natural, solid, inorganic or fossilized organic material in or on the Earth’s crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a mineral resource are known, estimated or interpreted from specific geological evidence and knowledge.

An ‘inferred mineral resource’ is that part of a mineral resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes.

An ‘indicated mineral resource’ is that part of a mineral resource for which quantity, grade or quality, densities, shape and physical characteristics can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and the evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely together enough for geological and grade continuity to be reasonably assumed.

A ‘measured mineral resource’ is that part of a mineral resource for which quantity, grade or quality, densities, shape, physical characteristics are so well established that they can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely together enough to confirm both geological and grade continuity.

## 28.2. Mineral Reserves

A mineral reserve is the economically mineable part of a measured or indicated mineral resource demonstrated by at least a Preliminary Feasibility Study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A mineral reserve includes diluting materials and allowances for losses that may occur when the material is mined.

A ‘probable mineral reserve’ is the economically mineable part of an indicated, and in some circumstances, a measured mineral resource demonstrated by at least a Preliminary Feasibility Study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified.

A ‘proven mineral reserve’ is the economically mineable part of a measured mineral resource demonstrated by at least a Preliminary Feasibility Study. This study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction is justified.

## 28.3. Abbreviations

The following abbreviations may be used in this report.

**Table 28.3-1 Abbreviations**

| Abbreviation | Unit or Term |
|---|---|
| " | Inches |
| % | Percent Or Percentage |
| ° | Degrees |
| °C | Degrees Centigrade |
| µm | Microns |
| 3D | Tridimensional |
| AMS | Andes Mining Services |
| ANDA | *Associação Nacional Para Difusão De Adubos* |
| ANM | National Agency of Mining |
| ANTT | Agência Nacional de Transportes Terrestres |
| ASL | Above Sea Level |
| CAPEX | Capital Expenditure |
| CFEM | Financial Compensation for The Exploitation of Mineral Resources |
| CFR | Cost And Freight |
| CIM | Canadian Institute of Mining, Metallurgy and Petroleum |
| cm | Centimeter |
| $cm^3$ | Cubic Centimeter |
| CMEC | *Consórcio Mineiro De Engenheiros Consultores Ltda* |
| COFINS | *Contribuição Para o Financiamento Da Seguridade Social* |
| CONAMA | *Conselho Nacional Do Meio Ambiente* |
| CRM | Certified Reference Material |
| CSLL | *Contribuição Social Sobre o Lucro Líquido* (Brazilian Federal Tax Levied over the Net Income of the Base Period, Before the Provision for Income Tax) |
| DC | Diamond Core Drilling |
| DDH | Diamond Drill Hole |
| DGPS | Differential Global Positioning System |
| DNPM | National Department of Mineral Production |
| DTM | Digital Terrain Model |
| E | East |
| EBITDA | Earnings Before Interest, Depreciation and Amortization |
| EIA | Environmental Impact Study |
| FAIG | Fellow of the Australian Institute of Geoscientists |
| FAO | Food and Agriculture Organization of the United Nations |
| FIESP | Federation of Industries of the State of São Paulo |
| FOB | Free On Board |
| ft | Foot |
| g | Grams |
| $g/cm^3$ | Grams Per Cubic Centimeter |
| GDP | Gross Domestic Product |
| G&A | General and Administrative Cost |
| Gl | Glauconite |
| GPS | Global Positioning System |
| h | Hour |
| ha | Hectare |
| hp | Horsepower |
| HV | High-Voltage |

| Abbreviation | Unit or Term |
|---|---|
| IBGE | Brazilian Institute of Geography and Statistics |
| ICMS | *Imposto Sobre Circulação De Mercadorias E Prestação De Serviços* |
| IDW2 | Inverse Distance Weighting with Power Two |
| IEF | *Instituto Estadual De Florestas* |
| IFA | International Fertilizer Industry Association |
| INMETRO | National Institute of Meteorology, Normalization and Industrial Quality |
| IPT | *Instituto De Pesquisas Tecnológicas* |
| IRR | Internal Rate of Return |
| K | Potassium |
| $K_2O$ | Potassium Oxide or Potash |
| KCl | Potassium Chloride |
| Kf | K-Feldspar |
| kg | Kilogram |
| km | Kilometers |
| $km^2$ | Square Kilometers |
| Kt | Kilotonnes |
| Ktpy | Kilotonnes Per Year |
| kV | Kilovolts |
| Kw | Kilowatts |
| LAPIG/UFG | Laboratory of Image Processing and Geoprocessing of the Federal University of Goiás |
| lb | Pounds |
| LDBC | Long-Distance Belt Conveyor |
| LG | Lerchs-Grossman |
| LI | Construction Permit |
| LO | Operational Permit |
| LOI | Loss On Ignition |
| LoM | Life of Mine |
| LP | Preliminary Permit |
| LR | Legal Reserve |
| LSPA | Systematic Survey of Agricultural Production |
| m | Meters |
| $m^3$ | Cubic Meters |
| $Mm^3$ | Million Cubic Meters |
| MAIG | Member of the Australian Institute of Geoscientists |
| MCC | Motor Control Center |
| MCP | Mine Closure Plan |
| Mg | Magnesium |
| mm | Millimeters |
| Mt | Million Tonnes |
| Mtpy | Million Tonnes Per Year |
| My | Million Years |
| N | North |
| N | Nitrogen |
| Na | Sodium |
| NE | Northeast |
| NI 43-101 | Canadian National Instrument 43-101 |
| NNW | North-Northwest |
| NPK | Nitrogen (N), Phosphorus (P), And Potassium (K) |
| NPV | Net Present Value |
| OK | Ordinary Kriging |
| OPEX | Operational Expenditure |
| OTCQB | New York Open Transparent Connected Venture Market |
| PAE | Economic Development Plan |

| Abbreviation | Unit or Term |
|---|---|
| PCA | Environmental Control Plan |
| PDA | Personal Digital Assistant |
| PEA | Preliminary Economic Assessment |
| PFS | Pre-Feasibility Study |
| PIS | *Programa De Integração Social* |
| ppt | Percentage point per tonne |
| PRAD | Plan for Recovery of Degraded Areas |
| psi | Pound Force per Square Inch |
| PVC | Polyvinyl Chloride |
| QA/QC | Quality Assurance/Quality Control |
| QP | Qualified Person |
| QQ | Quantile |
| R | Coefficient of Correlation |
| R$ | Brazilian Reais |
| RAF | Revenue Adjustment Factor |
| RC | Rotary-Percussion Reverse Circulation Drilling |
| RC | Rotary-Percussion Reverse Circulation Drilling |
| RIMA | Environmental Impact Report |
| RL | Relative Level |
| ROM | Run-Of-Mine |
| RQD | Rock Quality Designation |
| S | South |
| s | Second |
| SECTES | *Secretaria Do Estado De Ciência E Tecnologia De Minas Gerais* |
| SEMAD | *Secretaria De Estado De Meio-Ambiente E Desenvolvimento Sustentável* |
| Si | Silicon |
| SNUC | *Sistema Nacional De Unidades Conservação* |
| SOP | Potassium Sulfate |
| SRTM | Shuttle Radar Topography Mission |
| SUPRAM | *Superintendência Regional De Meio Ambiente* |
| SW | Southwest |
| t | Metric Tonnes |
| t/d | Tonnes per Day |
| t/h | Tonnes per Hour |
| tpy | Tonnes per Year |
| TDS | Total Dissolved Solids |
| Tonne | Metric Tonne |
| TK | Thermopotash |
| TSX | Toronto Stock Exchange |
| US$ | United States Dollar |
| UTM | Universal Transverse Mercator Coordinate System |
| V | Volts |
| W | West |
| WGS84 | World Geodetic System 1984 |
| XRF | X-Ray Fluorescence |
| Y | Years |

# 29. Date and Signature Page

The “qualified person” (within the meaning of NI43-101) for the purposes of this report is Beck Nader, who is an employee of BNA Consultoria e Sistemas. The effective date of this Technical Report titled “NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil” is May 12, 2022.

“Signed and sealed”

Beck Nader, D.Sc., M.Sc. Mining Engineer, Fellow (FAIG - 4472)

Dated May 26, 2022

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The “qualified person” (within the meaning of NI43-101) for the purposes of this report is Bradley Ackroyd, who is an employee of Andes Mining Services Ltd. The effective date of this Technical Report titled “NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil” is May 12, 2022.

“Signed and sealed”

Bradley Ackroyd, B.Sc. Geol. Member (MAIG - 3565)

Dated May 26, 2022

# 30. Certificates of Qualified Persons

**CONSENT OF QUALIFIED PERSON**

Filed by SEDAR

TO: Verde AgriTech Plc
British Columbia Securities Commission
Alberta Securities Commission
Saskatchewan Financial Services Commission
The Manitoba Securities Commission
Ontario Securities Commission
Nova Scotia Securities Commission
Financial and Consumer Services Commission, New Brunswick
Office of the Superintendent of Securities, Prince Edward Island
Office of the Superintendent of Securities, Government of Newfoundland and Labrador
Office of the Yukon Superintendent of Securities
Office of the Superintendent of Securities, Government of the Northwest Territories
Office of the Superintendent of Securities, Nunavut

**RE:** Verde AgriTech **-** NI 43-101 – Pre-Feasibility Study (PFS) – Cerrado Verde Project, dated May 26, 2022

This letter is being filed as the consent of Beck Nader to being named in the Disclosure and to the use and public filing of the report titled "*NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil*" dated May 26, 2022 (the "Technical Report") by Verde AgriTech Plc in connection with the filing of the Disclosure and to the inclusion of the written disclosure of the Technical Report and of extracts from or a summary of the Technical Report in the written disclosure contained in the Disclosure or incorporated by reference therein.

I hereby confirm that I have read the Technical Report, including the written disclosure and extracts from or a summary of the Technical Report contained in the Disclosure or incorporated by reference therein and that it fairly and accurately represents the information in the Technical Report.

Dated this 26th day of May 2022.

Beck Nader DSc, MSc (Mining Engineer); Fellow (FAIG #4472)
Senior Technical Advisor – Mining Solutions Consultant

**CERTIFICATE OF QUALIFIED PERSON**

I, Beck Nader, do hereby certify that:

1. I have been working since 2012 as a Senior Technical Advisor for the firm BNA Mining Solutions, located at Rua Desembargador Leão Starling, 200, Bairro Ouro Preto, Belo Horizonte, Minas Gerais, Brazil. My residential address is Rua Três, 640, Bairro Chácara Novo Horizonte, Contagem, Minas Gerais, Brazil.

2. I am a practicing mining engineer with more than 40 years of mining experience. I have worked in Brazil. I am a fellow of the Australian Institute of Geoscientists (FAIG #4472) and a registered member of CREA-MG, the Regional Council of Engineering and Agronomy of the Minas Gerais State.

3. I am a graduate of the Universidade de São Paulo and hold a Bachelor of Science Degree in Mining Engineering (Hons) (1981). In addition, I have obtained a Mineral Technology MSc title from the Universidade Federal de Minas Gerais (2004) and a DSc title from the Universidade de São Paulo in Mineral Engineering (2012).

4. I have practiced my profession continuously since 1982.

5. I am a "qualified person" as that term is defined in National Instrument 43-101 Standards of Disclosure for Mineral Projects (the "Instrument").

6. I visited the Cerrado Verde Project on 10th of November 2017, and on 10th of May 2022.

7. I am responsible for sections 1 to 3, 6, 13 and 15 to 27, of this technical report, dated effective May 26, 2022 and titled "NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil" (the "Report").

8. I am independent of Verde AgriTech Plc pursuant to section 1.5 of the Instrument.

9. I have read the Instrument and Form 43-101F1 (the "Form") and the sections of the Report for which I am responsible have been prepared in compliance with the Instrument and the Form.

10. I do not have, nor do I expect to receive a direct or indirect interest in the Cerrado Verde Project of Verde AgriTech Plc and I do not beneficially own, directly or indirectly, any securities of Verde AgriTech Plc or any associate or affiliate of such company.

11. I have not had any prior involvement with the Cerrado Verde Project of Verde AgriTech Plc.

12. As of the effective date of this report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

"Signed and sealed"

**Beck Nader**
D.Sc., M.Sc., Mining Engineer, Fellow (FAIG #4472)
Registered Member of CREA-MG
Senior Technical Advisor, BNA.
Dated May 26, 2022

**CONSENT OF QUALIFIED PERSON**

Filed by SEDAR

TO: Verde AgriTech Plc
British Columbia Securities Commission
Alberta Securities Commission
Saskatchewan Financial Services Commission
The Manitoba Securities Commission
Ontario Securities Commission
Nova Scotia Securities Commission
Financial and Consumer Services Commission, New Brunswick
Office of the Superintendent of Securities, Prince Edward Island
Office of the Superintendent of Securities, Government of Newfoundland and Labrador
Office of the Yukon Superintendent of Securities
Office of the Superintendent of Securities, Government of the Northwest Territories
Office of the Superintendent of Securities, Nunavut

**RE:** Verde AgriTech **-** NI 43-101 – Pre-Feasibility Study (PFS) – Cerrado Verde Project, dated May 26, 2022

This letter is being filed as the consent of Bradley Ackroyd to being named in the Disclosure and to the use and public filing of the report titled "*NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil*" dated May 26, 2022 (the "Technical Report") by Verde AgriTech Plc in connection with the filing of the Disclosure and to the inclusion of the written disclosure of the Technical Report and of extracts from or a summary of the Technical Report in the written disclosure contained in the Disclosure or incorporated by reference therein.

I hereby confirm that I have read the Technical Report, including the written disclosure and extracts from or a summary of the Technical Report contained in the Disclosure or incorporated by reference therein and that it fairly and accurately represents the information in the Technical Report.

Dated this 26th day of May 2022.

ANDES MINING SERVICES SAC
Bradley J. Ackroyd
Gerente General

Bradley Ackroyd BSc (Geo) Member (MAIG#3565)
Principal Consulting Geologist

**CERTIFICATE OF QUALIFIED PERSON**

I, Bradley Ackroyd, do hereby certify that:

1. I have been working since 2012 as a Principal Consulting Geologist with the firm Andes Mining Services Ltd. of Avenue Diagonal 550, Departmento 203, Miraflores, Lima, Peru 18. My residential address is 8 Hakea Court, Forrestfield, 6058, Western Australia.

2. I am a practicing geologist with 22 years of Mining and Exploration geological experience. I have worked in Australia, PNG, West Africa and the Americas. I am a member of the Australian Institute of Geoscientists - Member (MAIG #3565).

3. I am a graduate of the University of Western Australia (UWA) and hold a Bachelor of Science Degree in Geology (Hons) (2000).

4. I have practiced my profession continuously since 2000.

5. I am a “qualified person” as that term is defined in National Instrument 43-101 Standards of Disclosure for Mineral Projects (the “Instrument”).

6. I visited the Cerrado Verde Project between the 7th and 10th of August 2012.

7. I am responsible for sections 4, 5, 7, 12 and 14 of this technical report, dated effective May 26, 2022, and titled “NI 43-101 Pre-Feasibility Technical Report – Cerrado Verde Project, Minas Gerais, Brazil” (the “Report”).

8. I am independent of Verde AgriTech Plc pursuant to section 1.5 of the Instrument.

9. I have read the Instrument and Form 43-101F1 (the “Form”) and the sections of the Report for which I am responsible have been prepared in compliance with the Instrument and the Form.

10. I do not have, nor do I expect to receive a direct or indirect interest in the Cerrado Verde Project of Verde AgriTech Plc and I do not beneficially own, directly or indirectly, any securities of Verde AgriTech Plc or any associate or affiliate of such company.

11. I have not had any prior involvement with the Cerrado Verde Project of Verde AgriTech Plc.

12. As of the effective date of this report, to the best of my knowledge, information and belief, the Report contains all scientific and technical information that is required to be disclosed to make the Report not misleading.

“Signed and sealed”

**Bradley Ackroyd**
BSc (Geo) Member (MAIG - 3565)
Principal Consulting Geologist, AMS.
Dated May 26, 2022