



Technical Report Summary

Serra Sul Complex
Brazil

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1. Executive Summary

1.1. Introduction

VALE S.A. (VALE) prepared this Technical Report Summary on the Serra Sul Mine Complex, located in the state of Pará, Brazil. This report is intended to support the disclosure of Mineral Resource and Mineral Reserve estimates for the Serra Sul Complex as of December 31, 2023. This Technical Report Summary complies with the United States Securities and Exchange Commission's (SEC) Modernized Property Disclosure Requirements for Mining Registrants as described in Subpart 229.1300 of Regulation S-K, Disclosure by Registrants Engaged in Mining Operations (S-K 1300) and Item 601 (b)(96), Technical Report Summary.

VALE is one of the largest mining companies globally, a prominent Brazilian exporter, and one of the major private companies in Brazil. Operating in five continents, the company has a global and diversified shareholder base, with shares traded on the main stock exchanges around the world.

A world leader in iron ore pellet and nickel production, VALE also produces manganese, ferroalloys, copper, gold, silver, cobalt, and platinum group metals. Our top-quality ores are produced to meet customers' needs in steel mills worldwide.

To optimize product delivery, VALE operates a globally integrated and efficient logistics chain that includes railways, maritime terminals and ports, in addition to floating transfer stations and distribution centers.

VALE also invests in the energy and steel industries, both directly and through affiliates and joint ventures.

The Serra Sul Complex is part of the Northern System in the southeast of the State of Pará in Northern Brazil. This region underwent various geological processes, resulting in large deposits of iron but also manganese, gold, copper, palladium, platinum, and nickel. This mineral wealth makes the Carajás region the most geologically important and well-studied area in Northern Brazil.

1.2. Property description and location

The Serra Sul Complex is included in mining right 813.684/1969, which is in the Mining Concession phase. Part of the mining operations are located within the National Forest of Carajás (FLONACA) and the Campos Ferruginosos National Park. The other part of the mining process, where the beneficiation plant and facilities are located, is mostly in properties owned by VALE. Only two surface real properties are not owned by VALE, but both are covered in the mining easement report issued by the National Mining Agency (ANM). These surface properties are owned by the Brazilian Government.

The Serra Sul Complex includes three contiguous easement areas which form a single perimeter encompassing all current and future industrial installations required for the Serra Sul life of mine.

1.3. History

Geological surveys in Serra dos Carajás began in 1922, but iron formations were not mentioned until 1933. In *Carta do Brasil ao Milionésimo*, published by IBGE in 1960, Serra Sul orebodies C and D can be seen in the aerial photograph, but they were not detailed surveys were undertaken on the different areas known as Serra Norte, Serra Sul, and Serra Leste.

In 1977, VALE (at the time Companhia Vale do Rio Doce - CVRD) acquired the shares held by United States Steel (USS) and became the sole shareholder of the Carajás project. In 1979, the construction of the complex began, including the mine, railroad, and port for the Carajás Iron Project. In February 1985, the São Luiz. Carajás railroad was completed. Iron ore production

began in 1985 in the Serra Norte Complex, while mining operations in the Serra Sul complex started in 2016.

1.4. Geological setting and mineralization

The main Carajás iron ore deposits are associated with plateaus, usually on elevated areas at 650-800 meters of altitude along two main morphological lines called Serra Norte and Serra Sul. These lineaments are the limbs of the Carajás Syncline.

The Serra Sul Complex corresponds to the normal limb domain of the Carajás Syncline, characterized by a lower degree of deformation when compared to the inverse limb, which is reflected in the greater continuity of the iron formations.

The S11 deposit corresponds to the largest plateau and the main mineralized body of Serra Sul. This plateau extends for 28 km NW-SE. It is segmented with sharp variations between N-S and E-W, which configures a kink-type pattern. The deposit includes bodies A, B, C, and D, the latter of which is the one with the highest economic interest. The rock types in the plateaus are mainly from the Carajás and Igarapé Cigarra formations, interfacing with the Parauapebas Formation to the south and the Águas Claras Formation to the north. The layers present variable dips and azimuths shifting between north and east orientation, in a normal stratigraphic stacking.

At the eastern portion of the S11 plateau, where the active part of the S11D mine is located, geological data was obtained from mapping on a 1:2,000 scale, diamond drilling, trenches and channels.

Therefore, most of the geological information on the plateau was obtained from diamond drill cores and surface mapping of weathered materials. Due to the strong/deep weathering and the absence of cuts and excavations, outcrops were scarce.

The Carajás Formation corresponds to the thickest domain of the iron formations. It coincides with the highest elevations. The iron formations in the Carajás Formation domain occur in a tabular layer with medium to low dip angle to the north in the EW-oriented bodies, such as S11D, and medium to high-dip angle to the east and northeast in the NS-oriented bodies, such as SSC. Actual thickness has not been determined; however, it can exceed 450 m depth (section) and vary between 200 and 1,200 m (plan).

The S11 iron formation layout presents strong structural control. Faults and folds condition the thickness and continuity of the iron formations. The structures correlate with the Transamazonian and Brazilian tectonic events, such as: the nucleation of the Carajás Syncline, folds with sub-horizontal axes of NW-SE orientation verging towards SW, the development of faults that created the kinked segmentation of the SS11 plateau, the formation of discontinuities filled by mafic dikes with NW-SE orientation, and the establishment of normal faults that generated a horsts and grabens system, lifting localized jaspilite bodies.

Friable hematite is the most representative lithology of the mineralization, occurring from near the surface to depths greater than 450 m with average Fe grades around 68.8%, with relatively low levels of phosphorus, silica, alumina, and loss on ignition.

Canga soils occur widely on the surface of Plateau SS11 as a result of weathering of different rocks in the region. Thus, they differ depending on the substrate and can be split into chemical canga, which includes mafic rocks, enclosing or intrusive in the iron formation; and structured canga, which develops directly over the iron formations and is economically viable. Fe content of this lithotype is 64.2% in average, and the main contaminants are alumina and phosphorus in addition to high values of loss on ignition.

1.5. Exploration

1.5.1. Exploration

Exploration work was initially based on details of a regional mapping on a scale of 1:100,000 produced by the Geological Survey of Brazil (CPRM). VALEq • Å c ^ æ{ Å å-depth work with Å ã } mapping at different scales and drilling.

In and around the mine areas, geophysical anomalies are detailed by mapping and drilling. Geological mapping at a 1:2,000 scale is performed by the short-term geology team and updated monthly. The work is done using precision GPS and the mapped lithologies are classified according to visual classification and compaction.

1.5.2. Drilling

The exploration work in Carajás began in the late 1960s and early 1970s, covering areas of Serra Norte, Serra Sul, Serra Leste, and São Félix do Xingu, all with great potential for iron ore.

Recent works in Serra Sul incorporated approximately 82,000 meters of drilling in 2017 and 79,000 meters in 2020. There is a 200 by 200 m grid for S11C which defines the optimal drilling grid for resource definition. In S11D, long-term and short-term drilling programs were performed with the purpose of defining the resources (100x100 m) and ore control (50x50 m).

A summary of drilling per area is presented in Table 1-1.

Table 1-1 - Summary of drilling in the Serra Sul Complex

Orebody	# Drillholes	Meters (m)
S11D	1,901	326,313.83
S11C	188	40,375.01
TOTAL	2,089	366,688.84

1.5.3. Hydrology

Groundwater models were prepared using industry-standard water modelling software to support dewatering permits. Hydrogeological models are tools used to simplify the representation of groundwater dynamics and enable the simulation of different scenarios.

The numerical model developed in MODFLOW (MDGEO, 2020) and revised by the VALE team in 2022 was used for drawdown simulation. The simulated outflow is estimated at 1,032 m³/h, of which 215 m³/h come from the pit in orebody C and 817 m³/h from the pit in orebody D. To calibrate the model, 92 instruments were used, and the resulting root mean square error (nRMS) was 4.4%.

The database was deemed satisfactory for its main purpose, which was to build, calibrate and simulate future mining scenarios in a groundwater numerical model, providing water level data to be inputted into the geotechnical stability analysis to guarantee dry mining operations and depressurized slopes.

1.5.4. Geotechnics

The final slope design geotechnical assessment is conducted by VALE's geomechanical and hydrogeological teams in accordance with the procedures expounded in Section 14.4.1. To substantiate the Serra Sul project geotechnical assessments, a compendium of previous studies has been drawn upon, including those conducted by VALE (2022), VOGBR (2008), Golder (2012 and 2013), Geominas (2017), SRK (2020), MDGEO (2020), and TEC3 (2020).

1.5.5. Sampling

Core sampling follows corporate governance procedures and mining industry standards. The efficiency of sampling and laboratory analysis processes applied in the Serra Sul Complex operations is ensured by periodic reviews and/or audits.

1.5.6. Density Determinations

The density database comprises samples collected by conventional methods, such as volume displacement, volume filling, sand flask, and hydrostatic weighing as well as geophysical survey data (gamma-gamma). These data are combined with normative mineralogical calculation techniques to assign the final density values to the geological model.

The Serra Sul Complex mines tonnage is reported in wet basis, so it is very important to determine the average moisture values for each lithology. Such values are obtained by drying a fraction of the sample and comparing the dry and wet sample masses.

1.5.7. Sample preparation and analyses

The 1970s drill holes were prepped and assayed at the Serra Norte laboratory and the Companhia Vale do Rio Doce laboratory in Belo Horizonte. Only global assays were done for Fe, SiO₂, P, Al₂O₃, Mn, FeO and LOI (Loss on ignition). Measurements of magnetite percentage in the ore were also taken using Satmagan equipment.

The assay of RC drilling programs from 2003 to 2005 was undertaken by the GADIN Chemical Analysis Laboratory of the Carajás Iron Mine, Brazil. In 2005 and 2006, VALE engaged the ALS Chemex Laboratory in Vancouver, Canada exclusively for the analysis of 5% checks on duplicates of pulverized material to evaluate the performance of the GADIN Chemical Laboratory. The following analytes were assayed: Fe%, SiO₂%, Al₂O₃%, P%, Mn%, MgO%, TiO₂%, CaO% and Cu ppm.

Starting in 2013, Fe assays are wet for all fractions. The other analytes are determined by X-ray fluorescence, except for Loss on Ignition, for which gravimetry was used. From 2009 onwards, no more assays were made for Cu.

1.5.8. Quality Assurance and Quality Control

Treatment and evaluation of historical (prior to 2012) QA/QC data on control samples, twin samples, field duplicates, crushed material duplicates, pulverized material duplicates, external duplicates and standards did not reveal issues (in terms of frequency and/or magnitude) regarding precision and accuracy (of sampling and chemical assays) that could compromise databases applied to geological modeling and resource estimation, resources and reserves classification of areas and mines in the Serra Norte and Serra Sul Complexes of the Carajás Mineral Province.

Upon assessment of QA/QC results from 2012 to 2019, sampling/chemical assay accuracy is good and analytical biases/flaws are small or insignificant when compared to the grade ranges involved. The accountable teams (geology teams and laboratories involved) have already been requested to investigate the most relevant points of attention. Non-compliance, precision, and accuracy indicators from QA/QC data were generally deemed satisfactory and not compromising to their respective databases.

1.6. Data verification

VALE had data collection procedures in place that included several verification steps to ensure database integrity. VALE staff also conducted regular logging, sampling, laboratory, and database reviews. All technical records related to borehole, spatial and geophysical trajectory logs, core box photographs, descriptions, density tests, samples, petrography, physical and chemical results, among others, are kept in adequate repositories and/or information technology systems and available for checks and/or investigations whenever necessary.

Mineral resources and reserves are estimated in accordance with Global and VALE Ferrous Guidelines and Standards for Mineral Resource and Mineral Reserve Reporting protocols. Consequently, each topic is handled by qualified / competent persons from each department: resources, reserves, mineral processing, geotechnics (pit, project and dam), hydrogeology, production, strategy, environmental, speleology, finance, mining rights, mining future use and engineering.

Alongside mining operations activities, each site conducts periodic reconciliations. Annual consolidated results reports comparing short-term models, mineral resources and reserves models, production grades and tonnage are discussed in annual technical meetings to promote continuous improvement for all functions involved.

1.7. Mineral resource estimates

1.7.1. Estimation Methodology

VALE has a set of protocols and guidelines in place to support the estimation process, which the estimators must follow. These include: comprehensive lithological and mineralization domain characterization; selection of all representative samples within the domain(s); compositing of drill hole information on a consistent support size (length, density, recovery), statistic validation of lengths and variables before and after compositing; comprehensive understanding of the statistical characters in each estimation domain and at the contacts between domains; characterization of the spatial continuity of each modelled variable (variograms); understanding of the influence of outliers and variables with highly skewed distributions and selection of an appropriate handling strategy (restricted neighborhood); spatial distribution of drillhole and sample data, mining method and production rates under consideration; selection of an appropriate modelling technique and definition of proper parameters and options to be used (e.g., kriging plan, search strategy, variogram models, post-processing methods); validation of the estimates (visual inspection, global and local bias checks, kriging plan confirmation, and a check on the degree of grade smoothing resulting from the interpolation); and confidence classification.

Estimation was made by VALE personnel. The mineral resource estimate is supported by core drilling. Software used in estimation include Vulcan, Leapfrog Geo and Isatis.

Block grades were estimated using ordinary kriging (OK) in Vulcan software whilst the variography is performed in Isatis software. Blocks were estimated in a single run with some post-processing corrections. Block estimation was completed on a 25 m x 25 m x 15 m block model. Classification of blocks was based on the Risk Index methodology, which combines orebody continuity and estimation error. Blocks that estimated from a single drillhole were downgraded to indicated blocks. Subsequently, this automated classification was compared with a regular geometric classification method to better assess the classification.

Mineral resources were confined within an optimized conceptual pit shell. The resulting pit extents were considered for reasonableness, such as any potential impact on planned mine infrastructure (processing facilities), suitability of the current waste piles projected capacities. Pit inter-ramp slope angles varies according to lithology and range from 22-40°.

VALE established the commodity pricing forecasts using a consensus approach based on long-term analyst and bank forecasts, supplemented with research by XCES Internal specialists. This approach is considered reasonable for mineral resource estimates.

1.7.2. Mineral Resource Statement

Mineral resources are reported using the mineral resource definitions set out in S. K1300 and are reported exclusive of the mineral resources converted into mineral reserves.

A summary of the mineral resource estimates exclusive of reserves is provided in Table 1-2 and Table 1-3. Mineral resource estimates are in metric million tons including moisture and dry %Fe grade.

Table 1-2- Measured and indicated mineral resources exclusive of mineral reserves

Complex / Deposit	Measured		Indicated	
	Tonnage (Mt)	Grade (%Fe)	Tonnage (Mt)	Grade (%Fe)
Serra Sul	542.5	66.1	407.0	64.8

Notes to accompany mineral resources tables:

1. The effective date of the estimate is 2023/Dec/31.
2. Tonnage stated as metric million tons inclusive of 6.6% of moisture content and dry %Fe grade. The point of reference used is in situ tons.
3. The mineral resource prospects of economic extraction were determined based on a long-term price of USD93/dmt for 62% iron grade.
4. Numbers have been rounded.

Table 1-3 - Inferred mineral resources exclusive of mineral reserves

Complex / Deposit	Inferred	
	Tonnage (Mt)	Grade (%Fe)
Serra Sul Complex	123.7	64.6

Notes to accompany mineral resources tables:

1. The effective date of the estimate is 2023/Dec/31.
2. Tonnage stated as metric million tons inclusive of 6.67% of moisture content and dry %Fe grade. The point of reference used is in situ tons.
3. The mineral resource prospects of economic extraction were determined based on a long-term price of USD93/dmt for 62% iron grade.
4. Numbers have been rounded.

The mineral resource estimate has changed since the previous Serra Sul Complex Technical Report Summary was filed, having increased by 82 million tons (corresponding 8% of the exclusive mineral resource) due to partial incorporation of downgraded material in mineral reserve mine design review.

Areas of uncertainty that may materially impact the mineral resource estimates include: changes in long-term metal prices and exchange rates assumptions; changes in local interpretations of mineralization geometry, structures, and continuity of mineralized zones; changes to geological and grade shape and geological and grade continuity assumptions; changes to the input assumptions used to derive the conceptual optimized open pit shell used to constrain the estimates; changes to the forecast dilution and mining recovery assumptions; variations in geotechnical slope angles, hydrogeological and mining assumptions; and changes to environmental, permitting and social license assumptions.

1.8. Mineral reserves estimate

The Serra Sul ore body is divided into four bodies: A, B, C and D. A and B are potential bodies currently under study. Only bodies C and D have estimated and officially declared models, and body D is currently in operation. Measured and indicated resources of these deposits (C and D) are converted into proven and probable after the reserves have been estimated. More details about the resources can be seen in chapters 6 and 7.

The optimized pit considered environmental constraints and some large physical structures already established in the area, processing and mining costs that take into account additional deepening increments, sales costs, commodity price curves, geotechnical parameters, mine recovery and dilution.

The cost methodology defined two phases within the optimal pit; one uses the mobile crushing method and the second uses conventional shovels and trucks. This enabled us to separate the costs for each method. A certain pit geometry was established for mobile crushing to separate this phase, and all blocks below this geometry are assessed with the conventional mining methods.

Finally, these parameters were applied to generate a family of pits and the optimal pit was picked based on the best possible economic criteria (see further details in chapters 12 and 13). After this first step, the pit was submitted first to geotechnical evaluation and again to post optimization

to incorporate some geotechnical parameter corrections. Only after this second round of optimization the pit is submitted to the implementation team and a final geotechnical analysis for final corrections according to the implementation geometry, to ensure slope safety and stability. Table 1-4 presents the results of proven and probable reserves.

Table 1-4 - Proven and Probable Mineral Reserve Statement 2023

Pit/Operation	Classification	Tonnage (Mt)	Grade
			Fe (%)
S11CD	Proven	1,506.6	65.7
	Probable	1,924.3	65.2
	Total Proven + Probable	3,430.8	65.4

Notes to accompany mineral reserves tables:

1. The effective date of the estimate is Dec 31, 2023.

2. Tonnage stated as metric million tons inclusive of 6.79% of moisture content and dry %Fe grade. The point of reference used is in situ metric tons.

2. The mineral reserve economic viability was determined based price curve with the long-term price being USD79.62/dmt for 62% iron grade.

4. Numbers have been rounded.

The mineral reserve estimate has changed, in comparison to the previous Serra Sul Complex Technical Report Summary filed due to a review study on the environmental protection buffer. This review aimed at safeguarding some maximum relevance caves, Violão and Amendoim lakes and their respective hydrological contribution area.. Therefore, we expanded our environmental constraints for pit generation, increasing the protection buffer, which resulted in a decrease in mineral reserves at Serra Sul by 418 million tons (-10%). We have reasonable expectation of the permit being granted, however, the final impact on the mineral reserve and mineral resource will depend on the size of buffer area approved by Brazilian federal environmental agencies. Additionally, the mineral reserve at Serra Sul was further reduced by 75 million tons (-2%) due to mine depletion and by 269 million tons (-6%) due to changes in mining recovery assumptions and mine design reviews. Despite these reductions, the expected exhaustion date for the Serra Sul Complex has not significantly changed after adjusting the production plan, with the impact deferred to the final years of production.

1.9. Mining methods

The Serra Sul mine uses the open pit method. The mine operation is split into favorable mining zones, belt operations and high geometric complexity zones operated by the conventional Truck and Shovel system.

In the areas that allow belt operations, mining is carried out by electric rope/hydraulic shovels that feed the mobile crushers. These materials, whether ore or waste, are reduced to particle sizes that can be fed into the belt conveyors and taken to the processing plants or waste piles. Materials are separated in transfer houses and placed on the belts that correspond to their destination.

In addition to rope/hydraulic shovels and mobile crushers, flexibility in operations is ensured by wheel loaders and various cleaning and backup jobs for the shovels, when necessary. A fleet of haul trucks is used for situations where truckless mining is not possible. Bulldozers are in charge of clearing production areas and benches. Wheel tractors, graders and water trucks make up the remaining auxiliary fleet.

The current estimated production target is 90 Mtpy; planned expansions should raise this to 120 Mtpy, considering that is necessary to implement a semi mobile crusher and the new long distance conveyor belt from the mine to the plant.

The geotechnical parameters used in the pits are validated and provided by the contracted and in-house geotechnical teams. Periodic inspection procedures verify the stability of slopes, waste rock piles, dams, dikes and drainage systems in order to guarantee the safety and continuity of operations.

1.10. Processing and Recovery Methods

The Serra Sul mill is a conventional crushing and screening facility with 90 Mtpa installed capacity. The expansion of the S11 project to 120 Mtpa includes the implementation of new crushing and screening stages, as well as a new long distance conveyor belt for transporting ore from extraction points to processing. All ROM is processed at natural moisture. There is no concentrator, and all plant throughput is recovered as final product. The primary operations include:

- < Primary cone crushing.
- < Primary vibrating banana-type screen.
- < Secondary cone crushing.
- < Secondary vibrating banana-type screen.
- < Tertiary cone crushing.

Ore is crushed in three stages to 100% passing (P_{100}) 19 mm using cone crushers with vibrating screens.

Secondary crusher throughput and primary screen undersize are collected in an intermediate stockpile with a total capacity of 1 Mt, or three days of normal operation. The ore from this stockpile is reclaimed and fed to the tertiary cone crushers. The final product is shipped by railway to the São Luiz port.

1.11. Infrastructure

Most of the support infrastructure for mining operations is in place. There is a temporary accommodation camp on site to accommodate workers involved in expansion projects. Most of the workforce resides in Canaã dos Carajás.

Water can be abstracted from permitted streams and downgradient wells. The process replacement water comes from the same sources already mentioned in the text. Potable water also comes from wells located in the mine and is treated onsite at a WTP - Water Treatment Plant. The Serra Sul operations team monitors water level, flow and balance regularly.

Electric power is supplied by the NIS - National Interconnected System at 230 KV. Part of the power (around 6% of energy consumption) is captured from the Δ ^ | c Á & [] egeneration • q Á system.

The internal distribution system runs through VALE's own 34.5 kV electrical networks.

In 2023, the plant and mine consumed about 303,301MWh, 56% of which fed the mineral processing plants, 35% were consumed at the mine and the remaining 8% were consumed by other supporting facilities.

1.12. Market studies

Iron ore is one of the core products sold by VALE globally. Its price and premiums can fluctuate along the year following supply and demand balance and short-term market sentiment trends.

The global iron ore and iron ore pellet markets are highly competitive. The main factors affecting competition are price, quality and range of products offered, reliability, operating costs and shipping costs.

VALE established the commodity pricing forecasts using a consensus approach based on long-term forecasts by analysts and banks. The sole purpose these figures is to demonstrate the economic viability of the mineral reserve, therefore they can differ from other data we publish and should not be construed as guidance.

At the time this report was prepared, the analyst consensus price for 62% Fe iron ore in 2023 was USD114/t, trending downward until prices reach the long-term level of around USD80/t; the analyst consensus price for 65% Fe iron ore in 2023 was USD126/t, trending downward until prices reach the long-term level of around USD90/t. Additionally, we believe that the production our iron ore reserves predict for the future can be absorbed by the market in the long term if we consider the demand expected by market analysts.

1.13.Environmental, Permitting and Social Considerations

Serra Sul has been granted the required operating permits. Environmental monitoring protocols include biological, air quality, soil, climate, iron ore pits, surface and groundwater, dust control, and other protocols required to meet regulatory compliance.

Additional environmental and social studies are in due course to support future licensing requirements for the continuity of operations.

The permitting process to increase production capacity from 90 to 120 Mtpa is underway with the Brazilian regulatory agency. The Installation Permits (LI) for both projects S11D +10 Mtpy and +20 Mtpy were obtained. A revision of the Carajás National Forest Management Plan to allow mining in certain areas is under discussion.

1.14.Capital and operating costs

1.14.1. Capital costs estimates

Economic valuations cash flows include sustaining CapEx, necessary for maintaining existing assets / operations, and capital projects to maintain and/or increase productive capacity. Sustaining CapEx can be classified into routine and non-routine.

Routine sustaining CapEx is related to projects to maintain operational capacity of the assets, including acquisition and replacement of equipment and readjustment of operating structures. It is estimated based on the Engineering cost estimates, the asset base, and maintenance backlog and investment targets the company has established for future years.

Non-routine sustaining CapEx refers to projects that support the business strategy, ensuring compliance with the production plan, but which do not occur frequently. These include pit, waste and tailings disposal expansion projects, process and technology changes in the plants, among others. It is estimated based on the expected needs of each operation or production complex over the Horizon being assessed. After considering those needs, VALE's multidisciplinary teams estimate the cash flow investments of the economic evaluations.

The sole purpose of these figures is to demonstrate the mineral reserve economic viability. They can differ from other information published by VALE and should not be construed as guidance.

Additionally, economic assessments of reserves consider capital projects that aim to maintain and/or increase productive capacity. The overall LOM or assessed period capital cost estimate is USD15,573 million, as shown in Table 1-5.

Table 1-5. LOM capital cost estimate

Capital Cost Type	Unit	Value
Sustaining CAPEX	US\$M	10,816
Non-routine	US\$M	940
Mine and plant	US\$M	915
Waste and tailings piles	US\$M	25
Routine	US\$M	9,876
Capital projects CAPEX	US\$M	4,757
Mine and plant	US\$M	903
Logistics and Other	US\$M	3,822
Waste and tailings piles	US\$M	33
TOTAL	US\$M	15,573

Note: numbers have been rounded.

1.14.2. Operating costs estimates

Operating costs and expenses are grouped as follows:

- ◁ Mine and plant OpEx: mine and plant costs include mining, processing, storage, and shipping from the ore to the loading points.
- ◁ Logistics and distribution costs: logistics and distribution costs include railroad, ports, maritime freight, and distribution centers.
- ◁ Sales, R&D and pre-operational expenses: sales, R&D and pre-operational expenses are related to team expenses with sales and offices, expenses on research and development of solutions for projects and/or the maintenance of operations, and pre-operational expenses, when projects are undergoing implementation.

In summary, the mining OpEx considers the cost of the operation or similar operations in previous years and their respective operational indicators as a reference. Thus, future operational indicators of operations are estimated, based on long-term mine planning. In this way, estimated costs take future changes in the operational indicators of operations into account.

LOM average unit operating cost and expenses:

- ◁ Mine and plant: 6.7USD/ton of product.
- ◁ Logistics and Distribution: 17.3USD/ton of product.
- ◁ Royalties: 4.9USD/ton of product.
- ◁ Sales expenses, R&D, others: 0.2USD/ton of product.

Total average unit operating costs and expenses: 29.1USD/ton of product.

The sole purpose of these figures is to demonstrate the economic viability of the mineral reserve; they may differ from other information VALE publishes and should not be construed as guidance.

The overall costs and expenses estimate for LOM, or the assessed period, is USD99,988 million, as shown in Table 1-6.

Table 1-6. Operational Costs and Expenses

Type of costs and expenses	Unit	Value
Mine and plant	US\$M	23,006
Logistics and Distribution	US\$M	59,419
Royalties	US\$M	16,939
Sales expenses, R&D, others	US\$M	624
TOTAL	US\$M	99,988

Note: numbers have been rounded.

1.15. Economic analysis

1.15.1. Introduction

The economic evaluation presented in this chapter intends to demonstrate the economic viability of the mineral reserve and therefore the production rates, operating efficiencies, costs and expenditures, taxes and other information herein can differ from other information we publish and should not be considered as a guidance. Note that our planned production extraction may vary pursuant to continued exploration and technical studies to add new mineral reserves.

1.15.2. Methodology and Assumptions

We applied the Discounted Cash Flow (DCF) economic evaluation methodology, which is widely used by companies, investment banks and consultancies to evaluate companies, projects, operations, etc.

The forecasted cash flow consists of inflows (revenues) minus outflows (costs, expenses, taxes and capital expenses/costs) of an enterprise over a given period. This period may vary according to the size of the Mineral Reserve associated with the asset (mine, operation and logistics). When the forecasted cash flow brought to present values is positive (greater than or equal to zero), the enterprise is economically viable.

To evaluate reserves, we forecasted the cash flows a given mass of product would be able to generate. To estimate potential yearly revenues from the mining of this resource, we took into account annual processed tonnages and grades, associated process recovery and metal prices. Operating costs, logistics costs, royalties, taxes, and capital expenditures required for economic exploitation were also estimated. If the forecasted cash flow brought to present value through the discount rate is positive, it means that the Mineral Resource is economically mineable, and can be classified as a Mineral Reserve. The cash flow is documented in USD and all costs and prices are in unescalated 'real' dollars.

The forecasted exchange rate for the long term (LT) is shown in Table 1-7.

Table 1-7 . Long Term Exchange rate.

Exchange rate Æ real terms	2024	2025	2026	2027	2028	LT
R\$ / USD	5.00	5.04	5.02	4.93	4.86	4.81

The evaluated cash flow period runs through the end of reserves for the operation or project. Economic valuations of the reserves assume 100% equity, so there are no interest and debt amortization expenses in the cash flows. Revenues from economic evaluations of iron ore reserves are based on projections of international market price indicators, as follows:

- ◁ Platts IODEX 62% Fe CFR China.
- ◁ 65% Fe Index CFR China for the mass that will generate the IOCJ product.
- ◁ VIU per additional percentage point of Fe CFR China.

When assessing pellet feed (PF) operations and projects that supply our own pellet plants, we assumed that the product would be sold to third parties at market price, without taking the pelletizing process into account, that is, without the costs of pellet processing and the pellet premiums in revenue.

In summary, the planned mining OpEx considers the costs of the operation or similar operations in previous years and their respective operational indicators. That is how future operational indicators are estimated for long-term mine planning. In this way, the estimated costs are forecasted considering future changes in the operational indicators of the operations.

The overall costs and expenses estimate for LOM, or the evaluated period is USD99,988 million, as per Table 1-8.

Table 1-8 . Operational Costs and Expenses

Type of costs and expenses	Unit	Value
Mine and plant	US\$M	23,006
Logistics and Distribution	US\$M	59,419
Royalties	US\$M	16,939
Sales expenses, R&D, others	US\$M	624
TOTAL	US\$M	99,988

Note: number have been rounded.

Discount rates are re-calculated annually by the Treasury and Corporate Finance Department. To support mineral reserve statements, VALE WACC must be used. In 2023, a 7.0% WACC was calculated for VALE and used to demonstrate economic viability of mineral reserves.

1.15.3. Economic Analysis

The discounted cash flow method was used for the economic valuation model of reserves, including annual processed tonnages and grades. The associated process recovery, metal prices, operating costs, logistics costs, royalties, and capital expenditures were also considered. Economic analysis confirmed that Serra Sul is economically viable. The after-tax NPV at a 7.0% discount rate and following a mid-year convention is USD44,505M. A summary of the cash flow analysis results can be seen in Table 1-9.

Table 1-9 . Economic Evaluation.

Net present value of overall cash flow	Unit	Value
Total revenue	US\$M	111,117
Total costs and expenses	US\$M	-41,402
Mine and plant	US\$M	-9,085
Logistics and Distribution	US\$M	-24,880
Royalties	US\$M	-7,159
Sales expenses, R&D, others	US\$M	-266
Closure costs	US\$M	-13
Income Tax and working capital change	US\$M	-17,509
Operational Cash Flow	US\$M	52,205
Total CAPEX	US\$M	-7,700
Free Cash Flow	US\$M	44,505

1.15.4. Sensitivity Analysis

Price and VIU cause the most impact in the sensitivity analysis, followed by mine, plant, logistics and distribution OpEx, exchange rates and total capex.

When the main variables are subject to a sensitivity analysis, NPV remains positive, which confirms the robustness of these reserves.

2. Introduction

2.1. Terms of reference and purpose

The Report was prepared to be attached as an exhibit to support mineral property disclosure, including mineral resource and mineral reserve estimates, including its material changes, for the year ending 31 December 2023, in compliance with the SEC (US Securities and Exchange Commission) ownership disclosure requirements. This obligation is outlined for mining registrants in Subpart 229 of Regulation S-K 1300 and detailed in item 601 (b) (96) Technical Report Summary.

The new SEC rules align disclosure requirements with global regulatory practices and standards, as incorporated to the standards developed by the Committee for Mineral Reserves International Reporting Standards (CRIRSCO), which VALE is accustomed to using.

The effective date of this Technical Report Summary is December 31st, 2023.

The assumptions adopted in the preparation of this report involve inherent uncertainties and risks, and the information herein does not guarantee future performance. This report contains estimates, projections, and forward-looking statements, which can be identified by the use of words related to future projections, such as 'anticipate', 'believe', 'may', 'expect', 'should', 'plan', 'intend', 'estimate', 'will be', and 'potential', among others. These estimates, projections, and statements involve some known and unknown risks and uncertainties. VALE and the QPs cannot guarantee that such forward-looking statements will prove to be accurate. The risks and uncertainties related to our estimates and projections include, without limitation, factors related to (a) economic, political and social issues in the countries in which we operate, including factors related to the coronavirus pandemic; (b) the global economy; (c) the financial and capital markets; (d) the mining and metals businesses, which are cyclical by nature, and their reliance on global industrial production, which is also cyclical; (e) mining, environmental and health and safety regulations, including regulations relating to climate change; (f) operational incidents or accidents, (g) the high degree of global competition in the markets where VALE operates, (h) information available at the time of preparing the forward-looking statements and (j) data provided by external sources.

VALE and the QPs emphasize that the actual results of VALE's mineral resources and reserves may materially differ from the plans, objectives, expectations, estimates, and projections expressed herein. VALE does not undertake any obligation to publicly update or review any forward-looking statement, whether as a result of new information or future events or for any other reason.

2.2. The Company

VALE is one of the largest mining companies in the world, a leading Brazilian exporter and one of the main private companies in Brazil. Operating on all five continents, the company has a global and diversified shareholder base, with shares traded in the main global stock exchanges. A world leader in the production of iron ore, pellets and nickel, VALE's portfolio also includes manganese, ferroalloys, coal, copper, gold, silver, cobalt, and platinum group metals. VALE's ores are of high quality and produced to competitively meet the needs of worldwide customers in the steelwork industry. To optimize product delivery, VALE operates a globally integrated and efficient logistics chain, which includes railways, maritime terminals and ports, in addition to floating transfer stations and distribution centers. VALE is publicly traded on the New York Stock Exchange (NYSE) and in Brazil on B3.

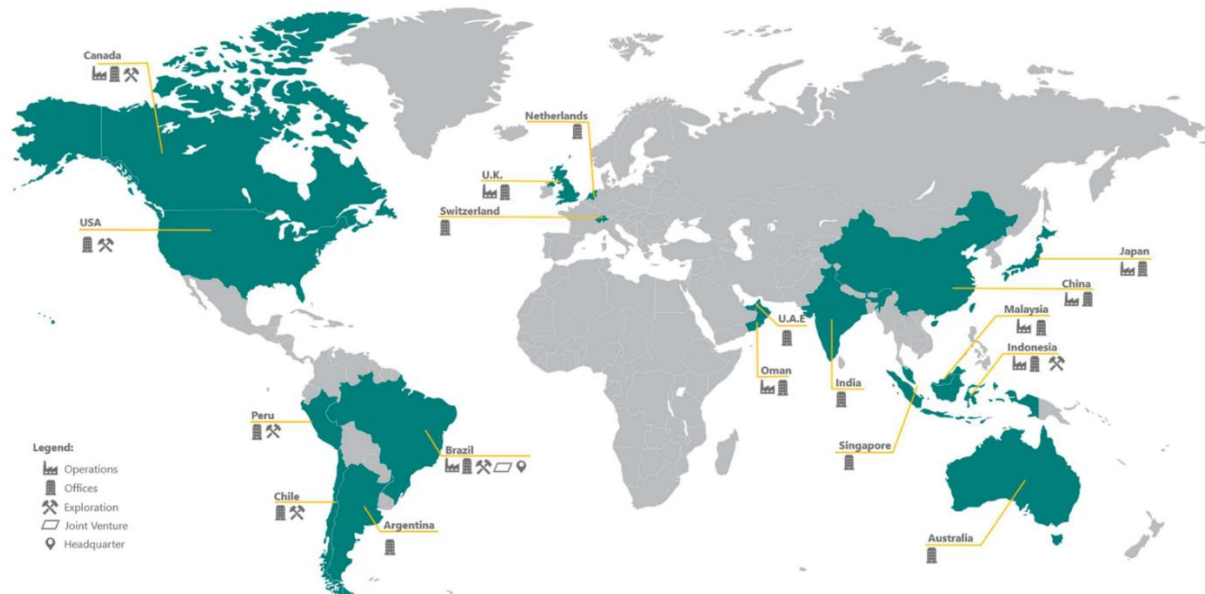


Figure 2-1 - Global Operations, Offices, Exploration, Joint Ventures, and Headquarters

2.3. Qualified Persons Site Visits

Qualified persons (QPs) involved in the estimation of mineral resources and reserves at Serra Sul are professionals with extensive experience in their fields who repeatedly visited the sites described in this report. Table 2-1 shows the latest visits and future schedule.

Table 2-1 - QPs site visits

QP	Last visit	Scheduled visit
Alessandro Gomes Resende	-	First half/2024
Arnor Barbosa de Couto Junior (Mineral Reserves)	October/2023	First half/2024
Evandro Machado da Cunha Filho (Geology / Mineral Resource)	October/2023	First half/2024
Hely Simões Gurgel (Process Development)	-	First half/2024
Luciano Souza Castro (Production Plan)	December/2023	First half/2024
Teofilo Aquino Vieira Costa (Geotechnical)	December/2023	First half/2024
Wagner Castro (Geotechnical)	December/2023	First half/2024

2.4. Qualified Persons

The following VALE employees serve as Qualified Persons (QPs):

Table 2-2 - QPs list

Qualified Persons (QPs)	Role	Sections of responsibility
Alessandro Gomes Resende, PQR CBRR	Mining Rights and Mine Closure Manager	1; 2; 3; 20; 21; 22; 23; 24 and 25
Arnor B. Couto Jr., PQR CBRR	Mineral Reserves Specialist	1; 2; 4; 12; 13; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24; and 25
Evandro M. Cunha Filho, MAusIMM	Specialist Geologist	1; 2; 5; 6; 7; 8; 9; 11; 20; 21; 22; 23; 24; and 25
Luciano Souza Castro, MAusIMM	Production Plan Specialist Engineer	1; 2; 4; 12; 13; 20; 21; 22; 23; 24; and 25
Wagner Castro, PQR CBRR	Master Geotechnical Engineer	1; 2; 4; 12; 13; 20; 21; 22; 23; 24; and 25
Hely Simões Gurgel, PQR CBRR	Process Development Specialist Engineer	1; 2; 10; 14; 20; 21; 22; 23; 24; and 25
Teófilo Costa, PQR CBRR	Senior Geotechnical Specialist	1; 2; 7; 14; 20; 21; 22; 23; 24; and 25

2.5. Terms, units, and abbreviations

VALE based all measurements on the metric system and identified exceptions thereto, mainly when listing the English and the metric standards. The currencies are generally based on US Dollars (USD) and converted to Brazilian Real per US Dollar.

Unless noted otherwise, Dollars are US Dollars, and the weights are in metric tons of 1,000 kilograms (2,204.62 pounds).

Table 2-3 shows the units used in this report. Table 2-4 shows the abbreviations used in this report, and Table 2-5 shows the chemical symbols used in this report.

Table 2-3 . Units of measure used in TRS.

Unit	Abbreviation
American Dollar	USD
Bond Ball Mill Work Index (metric)	kWh/t
Brazilian Real	R\$ or BRL
Centigrade	°C
Centimeter	cm
Cubic centimeter	cm ³
Cubic meter	m ³
Cubic meters per second	m ³ /s
Day	d
Dead weight ton (imperial ton . long	Dwt

Unit	Abbreviation
Dry metric ton	dmt
Gigawatts	GW
Giga Years	Ga/Gy
Gram	g
Gram/liter	g/L
Gram/ton	g/t
Hectare	ha
Hour	h
Hours per Year	h/yr
Kilogram	kg
Kilogram per ton	kg/t
Kilometer	km
Kilopascal	kPa
Kilovolt	kV
Kilovolt amp	kVA
Kilowatt	kW
Kilowatt hour	kWh
Liter	T
Liter per second	L/s
Megawatt	MW
Megawatt per hour	MWh
Meter	m
Meter per hour	m/h
Meter per second	m/s
Metric ton	t
Metric tons per Annum	t/a
Metric tons per day	t/d
Metric tons per hour	t/h
Micron	Mm
Milligram	mg
Milligram per liter	mg/L
Millimeter	mm
Million	M
Million Dollars	USDM
Million short ton	MT
Million short ton per annum	MT/a
Million Years	Ma
Minute	min
Parts per billion	ppb
Parts per million	ppm
Percent	%
Second	s
Short ton	T
Square meters	m ²
Tons per Day	t/d
Troy ounce	Oz.
Wet metric ton	wmt

Unit	Abbreviation
Work index	WI
Year	yr

The following abbreviations are used in this report:

Table 2-4 . List of abbreviations used in this report.

Abbreviation	Acronym
AG	Clay Lithotype
ANM	National Mining Agency
BEP	Brazilian Exploration Program
BR	Breccias
BRBF	Brazilian Blend Fines
Bt	Billion Tons
CAPEX	Capital Expenditure
CDM	Mineral Development Center
CE	Structural Canga
CFEM	Financial Compensation for the Exploitation of Mineral Resources
CFR	Cost and Freight
CNM	Mineralogical Normative Calculation
CLI	Interpreted Geological Classification
CLV	Visual Lithological Classification
CO	Colluvium
CQ	Chemical Canga
CRIRSCO	Committee for Mineral Reserves International Reporting Standards
CS	Social Contribution
CPRM	Geological Survey of Brazil
CPT	Technological Research Center
CVRD	Companhia Vale do Rio Doce
DCF	Discounted Cash Flow
DIPM	Department of Mineral Exploration (VALE)
DM	Mining Rights
DNPM	National Department of Mining Production
DOU	Federal Gazette
EBIT	Earnings Before Interest and Taxes
EC	Crystalline Base
EDA	Exploratory Data Analysis
EFC	Carajás Railroad
ELM	Equilibrium Limit Method
FAC	Águas Claras Formation
FAI	Fixed Asset Investments
FEGL	Distribution of global iron grades
FIC	Igarapé Cigarra Formation
FLONACA	National Forest of Carajás
FMN	Manganiferous Iron
FP	Parauapebas Formation
FPIC	Free, Prior and Informed Consent
FOB	Free on board

FoS	Safety Factor
FRX	X-Ray Fluorescence
GDP	Gross Domestic Product
HC	Compact Hematite
HF	Friable Hematite
HGO	Goethitic hematites
HMN	Manganiferous Hematite
IBAMA	Brazilian Institute for the Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
ICM	Intrinsic Correlation Models
ICMBio	Chico Mendes Institute
IK	Indicator Kriging
IOCG	Iron Oxide Copper Gold
IOCJ	Iron Ore Carajás
IPCC	In Pit Crusher Conveyor
IR	Income Tax
IRR	Internal Rate of Return
JCS	Joint Compressive Strength
JP	Jaspilite
JRC	Joint Roughness Coefficient
LI	Installation License
LO	Operation Permit
LP	Preliminary Permit
LOI	Loss of Ignition
LOM	Life of Mine
LT	Long Term
MCI	Intrinsic Correlation Model
MD	Decomposed Mafic
MLC	Linear Coregionalization Model
MS	Fresh Mafic
MSD	Semi-decomposed Mafic
NR	Net Value Return
nRMS	Normalized Root Mean Squared
NIS	National Interconnected System
NPV	Net Present Value
OK	Ordinary Kriging
OPEX	Operating Expenditure
PF	Pellet Feed
QA/QC	Quality Assurance/Quality Control
QP	Qualified Person
RI	Risk Index
RMR	Rock Mass Rating
ROM	Run of Mine
RPM	Runge Pincock Minarco
RQD	Rock Quality Designation
SEC	United States Securities and Exchange Commission's
SEMAS-PA	Secretary of State for the Environment and Sustainability
SIN	National Interconnected System

TMPM	Ponta da Madeira Maritime Terminal
TFRM	Control Fee Monitoring and Inspection of Research Activities, Mining, Exploration and Use of Mineral Resources
TTG	Tonalite-Trondhjemite-Granodiorite
UCS	Unconfined Compressive Strength
USS	United States Steel
UTM	Universal Transverse Mercator (coordinate system)
VIU	Value in Use
WSA	World Steel Association
WTP	Water Treatment Plant

The following chemical symbols are used in this report:

Table 2-5 - List of chemical symbols used in this report

Element	Symbol
Aluminum	Al
Calcium	Ca
Iron	Fe
Magnesium	Mg
Manganese	Mn
Oxygen	O ₂
Phosphorus	P
Potassium	K
Potassium	K
Silica	Si
Titanium	Ti

3. Property Description and Location

3.1. Location

The Serra Sul, Serra Leste, and Serra Norte Mining Complexes are located in the State of Pará, north of Brazil. The Serra Sul Mining Complex is 100% owned by VALE. The approximate coordinates of the Serra Sul Mining Complex are 574,671 E; 9,291,735 N, based on datum UTM_SAD 69.

The Serra Sul Mining Complex, also known as S11, is in the District of Canaã dos Carajás. Access to the site is mainly through the Canaã dos Carajás airport and 66 km along state highways PA-275 and PA-160, as seen in Figure 3-1.

The actual Serra Sul mine site corresponds to orebody S11 and blocks A, B, C, and D. The latter is the current operating mine area, referred to as S11D.

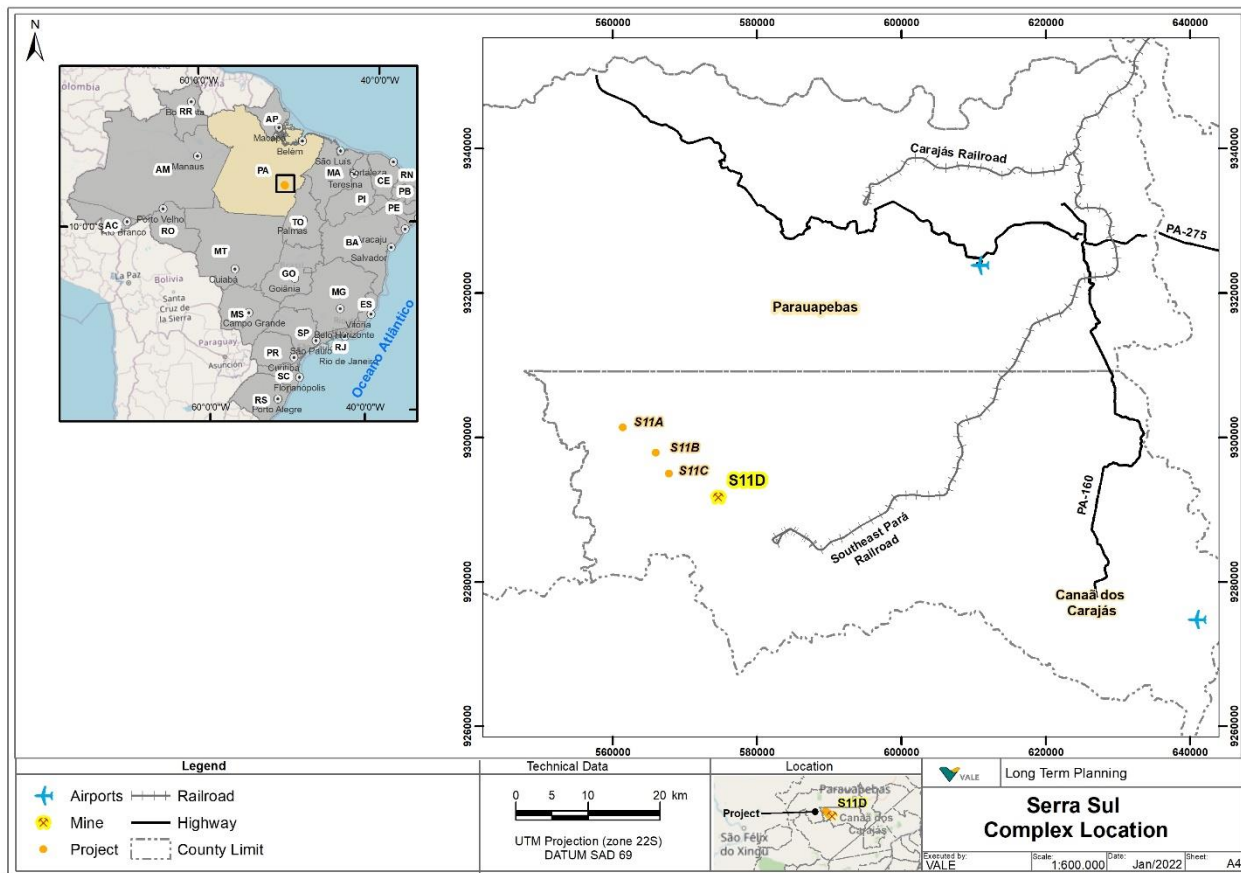


Figure 3-1 - Serra Sul Location Map.

3.2. Mineral and Surface Rights

Mineral Rights in Brazil are typically mineral exploration and mining concessions. In the North System, the original mining concessions were grouped as a single mining concession (813.684/1969) covering an area of 98,910.42 hectares, as shown in Figure 3-3 and Table 3-1. This mining concession is part of a larger Mining Group right (852.145/1976) which includes Serra Norte and Serra Leste operations.

Figure 3-2 . Serra Sul Mining Concession Right which is part of a larger Mining Group.

Table 3-1 . Serra Sul Mining Rights forming the Concession Grouping

813.684/1969	Canaã dos Carajás	98,910.42	Mining concession	06/09/1974	Iron	S11D	813.684/1969
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In 2021, VALE decided to relinquish part of the Serra Sul mining concession located in indigenous territory, reducing the area from 100,000 ha to 98,910.42 ha. By the time of this report, this reduction was pending formal acceptance by the public authorities.

According to Brazilian Mining Law, mineral rights are separate from surface real rights and the law requires that the holder of a mineral concession either reaches an agreement with the landowner or fulfills an easement procedure before starting any mining activities.

In Serra Sul, the land usage for mining purposes is granted through three mining easements and

