**Independent NI 43-101 Technical Report**

# An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits

## Maracás Menchen Project, Bahia State, Brazil

Prepared by **GE21 Consultoria Mineral Ltda**. for:

**Largo Inc.**

**Project GE21 nº** 230213 OS8 / OS9
**Effective date**: January 30th, 2024


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# Independent NI 43-101 Technical Report
# Maracás Menchen Project, Bahia State, Brazil

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| **GE21 Project nº**: | 230213 OS8 / OS9 |
| **Effective date:** | January 30th, 2024 |
| **Issue date:** | November 26th, 2024 |
| **Version:** | Initial Issue |
| **Work directory:** | S:\Projetos\Largo\230213OS09-Update-Reservas |
| **Copies:** | Largo Inc.<br>GE21 Consultoria Mineral Ltda. |

| Version | Description | Author(s) | Date |
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# DATE AND SIGNATURE

This Report, titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits, Maracás Menchen Project, Bahia, Brazil**, having an effective date of January 30, 2024, was prepared and signed by the following authors.

Dated in Belo Horizonte, Brazil, on November 26th, 2024.

***<Signed & sealed in the original>***

Porfirio Cabaleiro Rodriguez, B.Sc (Min Eng), FAIG

***<Signed & sealed in the original>***

Paulo Roberto Bergmann, B.Sc (Min Eng), FAusIMM

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Fábio Valério Xavier, B.Sc (Geo), MAIG

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Guilherme Gomides Ferreira, B.Sc (Min Eng), MAIG

***<Signed & sealed in the original>***

Branca Horta Abrantes, B.Sc (Geogr), MBA, MAIG

## QP CERTIFICATE OF PORFIRIO CABALEIRO RODRIGUEZ

a) I, Porfirio Cabaleiro Rodriguez, am a Mining Engineer and Director of GE21 Consultoria Mineral Ltda., located at Avenida Afonso Pena, 3130, 9th, 12th and 13th floors, Belo Horizonte, MG, Brazil, CEP 30.130-910.

b) This certificate applies to the Technical Report titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits–Maracás Menchen Project, Bahia State, Brazil**, prepared for Largo Inc., dated November 26th, 2024, with an effective date of January 30, 2024.

c) I hold the academic qualification of a B.S.C. in Mining Engineering from the Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil.

d) I am a professional Mining Engineer with over 45 years of experience in the mining industry. My relevant experience for this Technical Report includes:

- 1986 to 2015 – Consultant, manager, and director with consulting engineering firms that specialize in technical studies and audits of Mineral Resource and Reserves, mine planning, geometallurgy, pit optimization, and analysis of economic viability for many types of mineral deposits, including gold projects in their exploration and development phases, as well as producing gold mines.
- 2015 to present – Director of GE21 Consultoria Mineral Ltda., providing advice, assistance, and audits for the entire mining cycle, from defining strategies, generating and selecting targets and investments, mineral exploration, project development, geological assessments, Mineral Resource and Reserve estimation for JORC and NI 43-101 reports, conceptual technical and economic studies, and economic feasibility.

e) I am a fellow of the Australian Institute of Geoscientists (FAIG #3708).

f) I meet all the education, work experience, and professional registration requirements of a "qualified person" as defined in Section 1.1 of National Instrument 43-101.

g) I inspected the property that is the subject of this Technical Report between February 6 to 10, 2023, and March 13 to 14, 2023.

h) I am responsible for this Technical Report. I have supervised the production of all sections of the document, and I am solely responsible for Sections 2, 3, 16.1, 19 and 22, and jointly responsible for Sections 1, 12, 24, 25 and 26.

i) I am independent of the Issuer, Largo Inc. applying the test set out in Section 1.5 of National Instrument 43-101.

j) I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is acting as QP for the technical reports titled "Updated Life of Mine (LOMP) for Campbell Pit and Pre-Feasibility Study for Novo Amparo Norte (NAN) and Gulçari A Norte (GAN) Deposits, Maracás Menchen Project, Bahia, Brazil" dated December 16, 2021, with an effective date of October 10, 2021 and "An Updated Mine Plan, Mineral Reserve and Preliminary Economic Assessment of Inferred Resource" for the Maracás Menchen Project, Bahia, Brazil dated October 26, 2017, with an effective date of May 2, 2017.

k) I have read National Instrument 43-101, and the Technical Report has been prepared in compliance with this Instrument, including the CIM Definition Standards on Mineral Resources and Mineral Reserves.

l) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Belo Horizonte, Brazil, on November 26th, 2024.

*<Signed and sealed in the original>*
**Porfirio Cabaleiro Rodriguez**

## QP CERTIFICATE OF GUILHERME GOMIDES FERREIRA

a) I, Guilherme Gomides Ferreira, am a Mining Engineer for GE21 Consultoria Mineral Ltda., located at Avenida Afonso Pena, 3130, 9th, 12th and13th floor, Belo Horizonte, MG, Brazil, CEP 30.130-910.

b) This certificate applies to the Technical Report titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits–Maracás Menchen Project, Bahia State, Brazil**, prepared for Largo Inc., dated November 26th, 2024, with an effective date of January 30, 2024.

c) I hold the academic qualifications of a B.S.C. in Mining Engineering from the Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil.

d) I am a professional Mining Engineer with over 19 years of experience in the mining industry. My relevant experience for this Technical Report includes:

- 2006 to 2017 – Mining Engineer at mining companies, developing technical studies of Mineral Reserves, mine planning, pit optimization, and economic analysis, as well as producing iron ore and gold mine.
- 2017 to present – Manager of GE21 Consultoria Mineral Ltda., providing advice, assistance, and audits for the entire mining cycle, from defining strategies, generating and selecting targets and investments, mineral exploration, project development, geological assessments, Mineral Resource and Reserve estimation for JORC and NI 43-101 reports, conceptual technical and economic studies, and economic feasibility.

e) I am a member of the Australian Institute of Geoscientists (MAIG #7586).

f) I meet all the education, work experience, and professional registration requirements of a “qualified person” as defined in Section 1.1 of National Instrument 43-101.

g) I inspected the property that is the subject of this Technical Report between January 23 and 24, 2024.

h) I am solely responsible for Sections 15 and 18, and jointly responsible for Sections 1, 12, 16, 21, 25 and 26 of this Technical Report.

i) I am independent of the Issuer, Largo Inc. applying the test set out in Section 1.5 of National Instrument 43-101.

j) I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is acting as QP for the technical report titled “Updated Life of Mine (LOMP) for Campbell Pit and Pre-Feasibility Study for Novo Amparo Norte (NAN) and Gulçari A Norte (GAN) Deposits, Maracás Menchen Project, Bahia, Brazil” dated December 16, 2021, with an effective date of October 10, 2021.I have read National Instrument 43-101, and the parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument, including the CIM Definition Standards on Mineral Resources and Mineral Reserves.

k) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of the Technical Report for which I am responsible for, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Belo Horizonte, Brazil, on November 26th, 2024.

*<Signed and sealed in the original>*
**Guilherme Gomides Ferreira**

## QP CERTIFICATE OF FÁBIO VALÉRIO CÂMARA XAVIER

a) I, Fábio Valério Câmara Xavier, am a Geologist for GE21 Consultoria Mineral Ltda., located at Avenida Afonso Pena, 3130, 9th, 12th and 13th floor, Belo Horizonte, MG, Brazil, CEP 30.130-910.

b) This certificate applies to the Technical Report titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits – Maracás Menchen Project, Bahia State, Brazil**, prepared for Largo Inc., dated November 26th, 2024, with an effective date of January 30, 2024.

c) I hold the academic qualification of a B.S.C. in Geology from the Federal University of Rio Grande do Norte (UFRN), Natal, Brazil.

d) I am a professional Geologist with more than 21 years of experience in the mining industry. My relevant experience for the purpose of this Technical Report includes:

- 7 years as a specialist geologist on geotechnologies applied to mineral exploration.
- 14 years in Mineral Resource Estimation. My experience includes open pit and underground mines and considerable experience dealing with various commodities, such as phosphate, iron ore, gold, copper ore, vanadium, and rare earth elements, among others.

e) I am a member of the Australian Institute of Geoscientists (MAIG #5179).

f) I meet all the education, work experience, and professional registration requirements of a “qualified person” as defined in Section 1.1 of National Instrument 43-101.

g) I inspected the property that is the subject of this Technical Report between February 6th to 10th, 2023, and January 23 to 24, 2024.

h) I am solely responsible for Sections 4, 5, 6, 7, 8, 9, 10, 11, and 14, and jointly responsible for Sections 1, 12, 25, and 26 of this Technical Report.

i) I am independent of the Issuer, Largo Inc. applying the test set out in Section 1.5 of National Instrument 43-101.

j) I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is acting as QP for the technical reports titled “Updated Life of Mine (LOMP) for Campbell Pit and Pre-Feasibility Study for Novo Amparo Norte (NAN) and Gulçari A Norte (GAN) Deposits, Maracás Menchen Project, Bahia, Brazil” dated December 16, 2021, with an effective date of October 10, 2021 and “An Updated Mine Plan, Mineral Reserve and Preliminary Economic Assessment of Inferred Resource” for the Maracás Menchen Project, Bahia, Brazil dated October 26, 2017, with an effective date of May 2, 2017. I have read National Instrument 43-101 and the parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument, including the CIM Definition Standards on Mineral Resources and Mineral Reserves.

k) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of the Technical Report for which I am responsible for, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Belo Horizonte, Brazil, on November 26th, 2024.

*<Signed and sealed in the original>*

**Fábio Valério Câmara Xavier**

**QP CERTIFICATE OF PAULO ROBERTO BERGMANN MOREIRA**

a) I, Paulo Roberto Bergmann Moreira, am a Mining Engineer for GE21 Consultoria Mineral Ltda., located at Avenida Afonso Pena, 3130, 9th, 12th and 13th floor, Belo Horizonte, MG, Brazil, CEP 30.130-910.

b) This certificate applies to the Technical Report titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits – Maracás Menchen Project, Bahia State, Brazil**, prepared for Largo Inc., dated November 26th, 2024, with an effective date of January 30, 2024.

c) I hold the academic qualification of a B.S.C. in Mining Engineering from the Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil.

d) I am a professional Mining Engineer with more than 40 years of experience in the mining industry. My relevant experience for the purpose of this Technical Report includes:

- 30 years in mining and plant operation management, including positions at AngloGold, Yamana, Jaguar Mining, and Buritirama Mineração.
- 10 years as engineering development and consultancy in the mining industry, including work at Yamana and GE21 Mining Consulting Ltda., covering gold, iron ore, manganese, rare earth elements, and other commodities.

e) I am a fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM #333121).

f) I meet all the education, work experience, and professional registration requirements of a “qualified person” as defined in Section 1.1 of National Instrument 43-101.

g) I inspected the property that is the subject of this Technical Report from March 13 to 14, 2024.

h) I am solely responsible for Sections 13 and 17, and jointly responsible for Sections 1, 12, 21, 24, 25 and 26 of this Technical Report.

i) I am independent of the Issuer, Largo Inc. applying the test set out in Section 1.5 of National Instrument 43-101.

j) I have had no prior involvement with the property that is the subject of the Technical Report. I have read National Instrument 43-101, and the parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument, including the CIM Definition Standards on Mineral Resources and Mineral Reserves.

k) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of the Technical Report for which I am responsible for, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Belo Horizonte, Brazil, on November 26th, 2024.

*<Signed and sealed in the original>*
**Paulo Roberto Bergmann Moreira**

## QP CERTIFICATE OF BRANCA HORTA DE ALMEIDA ABRANTES

a) I, Branca Horta de Almeida Abrantes, am a Geographer for GE21 Consultoria Mineral Ltda., located at Avenida Afonso Pena, 3130, 9th, 12th and 13th floor, Belo Horizonte, MG, Brazil, CEP 30.130-910.

b) This certificate applies to the Technical Report titled **An Updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) Deposits – Maracás Menchen Project, Bahia State, Brazil**, prepared for Largo Inc., dated November 26th, 2024, with an effective date of January 30, 2024.

c) I hold the following academic qualifications: a B.A.Sc. in Geography and Environmental Analysis from Centro Universitário de Belo Horizonte (UNI-BH), Belo Horizonte, Brazil, and an MBA in Project Management from Fundação Getúlio Vargas (FGV), Brazil.

d) I am a professional with 19 years of experience in the environmental sector. Throughout my career, I have been involved in the environmental assessment of studies of Mineral Resources and Mineral Reserves, including numerous mining processes in Brazil.

e) I am a member of the Australian Institute of Geoscientists (MAIG #8145).

f) I meet all the education, work experience, and professional registration requirements of a “qualified person” as defined in Section 1.1 of National Instrument 43-101.

g) I have not visited the Project site to date.

h) I am solely responsible for Section 20, and jointly responsible for Sections 1, 25, and 26 of this Technical Report.

i) I am independent of the Issuer, Largo Inc. applying the test set out in Section 1.5 of National Instrument 43-101.

j) I have had no prior involvement with the property that is the subject of the Technical Report.

k) I have read National Instrument 43-101, and the parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument, including the CIM Definition Standards on Mineral Resources and Mineral Reserves.

l) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of the Technical Report for which I am responsible for, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Belo Horizonte, Brazil, on November 26th, 2024.

*<Signed and sealed in the original>*
**Branca Horta de Almeida Abrantes**

# IMPORTANT NOTICE

This Report was prepared as a National Instrument 43-101 Technical Report for Largo Inc. (Largo or the Company) by GE21 Consultoria Mineral Ltda. (GE21) as part of a team of consultants contracted by Largo. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in the Report authors' 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 Largo, subject to terms and conditions of its individual contracts with the Report authors and to the relevant securities legislation. The contracts between Largo and the authors allow Largo to file this Report as a Technical Report with Canadian securities regulatory authorities, pursuant to National Instrument 43-101 (2011), Standards of Disclosure for Mineral Projects. Except for the purposes legislated under Canadian provincial and territorial securities laws, any other use of this Report by any third party is at that party's sole risk. The responsibility for this disclosure remains with Largo. GE21 is under no obligation to update this Technical Report, except as may be agreed to between Largo and GE21 by contract from time to time. 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.

Currency is expressed in U.S. dollars, and metric units are used unless otherwise stated.

# CAUTIONARY NOTE TO UNITED STATES INVESTORS

Disclosure regarding the Company's mineral properties, including with respect to Mineral Reserve and Mineral Resource estimates included in this technical report, was prepared in accordance with NI 43-101. NI 43-101 is a rule developed by the Canadian Securities Administrators that establishes standards for all public disclosure an issuer makes of scientific and technical information concerning mineral projects.

The terms “Mineral Reserve”, “Proven Mineral Reserve” and “Probable Mineral Reserve” are Canadian mining terms as defined in accordance with NI 43- 101 and the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) – CIM Definition Standards on Mineral Resources and Mineral Reserves (the “CIM Definition Standards”), adopted by the CIM Council, as amended.

The United States Securities and Exchange Commission (SEC) adopted amendments to its disclosure rules (the “SEC Modernization Rules”) to modernize the mineral property disclosure requirements for issuers whose securities are registered with the SEC under the U.S. Securities Exchange Act of 1934 (the “U.S. Exchange Act”), which are codified in Regulation S-K subpart 1300. Under the SEC Modernization Rules, the historical property disclosure requirements for mining registrants included in SEC Industry Guide 7 have been replaced. As a foreign private issuer under United States securities laws that files its annual report on Form 40-F with the SEC pursuant to the multi-jurisdictional disclosure system (MJDS), the Company is not required to provide disclosure on its mineral properties under the SEC Modernization Rules and will continue to provide disclosure under NI 43-101 and the CIM Definition Standards. If the Company ceases to be a foreign private issuer or loses its eligibility to file its annual report on Form 40-F pursuant to the MJDS, then the Company will be subject to the SEC Modernization Rules.

The SEC Modernization Rules include the adoption of terms describing Mineral Reserves and Mineral Resources that are substantially similar to the corresponding terms under the CIM Definition Standards. As a result of the adoption of the SEC Modernization Rules, the SEC now recognizes estimates of “Measured Mineral Resources”, “Indicated Mineral Resources” and “Inferred Mineral Resources”. In addition, the SEC has amended its definitions of “Proven Mineral Reserves” and “Probable Mineral Reserves” to be substantially similar to the corresponding CIM Definition Standards.

Shareholders resident in the United States are cautioned that while terms are substantially similar to CIM Definition Standards, there are differences in the definitions and standards under the SEC Modernization Rules and the CIM Definition Standards. Accordingly, there is no assurance any Mineral Reserves or Mineral Resources that the Company may report as “Proven Reserves”, “Probable Reserves”, “Measured Mineral Resources”, “Indicated Mineral Resources” and “Inferred Mineral Resources” under NI 43-101 will be the same as the Reserve or Resource estimates prepared under the standards adopted under the SEC Modernization Rules.

Shareholders resident in the United States are also cautioned that while the SEC now recognizes "Measured Mineral Resources", "Indicated Mineral Resources" and "Inferred Mineral Resources", investors should not assume that any part or all of the mineralization in these categories will ever be converted into a higher category of Mineral Resources or into Mineral Reserves. Mineralization described using these terms has a greater amount of uncertainty as to their existence and feasibility than mineralization that has been characterized as "Reserves". Accordingly, investors are cautioned not to assume that any "Measured Mineral Resources", "Indicated Mineral Resources", or "Inferred Mineral Resources" on the Company's projects are or will be economically or legally mineable.

Further, "Inferred Resources" have a greater amount of uncertainty as to their existence and as to whether they can be mined legally or economically. Therefore, shareholders resident in the United States are also cautioned not to assume that all or any part of the Inferred Resources exist. In accordance with Canadian rules, estimates of "Inferred Mineral Resources" cannot form the basis of feasibility or other economic studies, except in limited circumstances where permitted under NI 43-101.

Accordingly, the information contained in this Technical Report describing mineral deposits may not be comparable to similar information made public by United States companies subject to the reporting and disclosure requirements under United States federal securities laws and the rules and regulations thereunder. Shareholders resident in the United States are urged to consider closely the disclosure on technical terminology under NI 43-101.

# UNITS, SYMBOLS, AND ABBREVIATIONS

| Units and Symbols | |
|---|---|
| " | Inches |
| °C | Celsius |
| % | Percentage |
| Ø | Dimeter |
| Au g/t | Grams of Gold per Tonne |
| Au | Gold |
| cm | Centimetre(s) |
| E | East |
| Ga | Gigaannum |
| g/t | Grams per Tonne |
| ha | Hectare(s) |
| hp | Horsepower |
| hr | Hour |
| k | Thousands |
| kg | Kilogram |
| kgf | Kilogram-force |
| km | Kilometre(s) |
| kt | Thousands of Tonnes |
| ktpy | Thousands of Tonnes per Year |
| kV | Kilovolt |
| l | Litre |
| m | Metres |
| $m^3/h$ | Cubic Metres per Hour |
| Mt | Megatonne |
| M | Millions |
| masl | masl meters above sea level |
| Mtpa | Million Tonnes per Annum |
| mg | Milligram |
| NE | Northeast |
| NW | Northwest |
| t/h | Tonnes per Hour |
| tpd | Tonnes per Day |
| US$ | United States Dollars |
| V | Volts |
| w/v | Weight by volume |

| Abbreviations | |
|---|---|
| 3D | Three Dimensional |
| AA | Atomic Absorption |
| ABA-M | Associação Brasileira de Agroecologia – Regional Minas Gerais |
| ADAB | Agência de Defesa Agropecuária da Bahia |
| ANA | Brazilian National Waters Agency |
| ANM | National Mining Agency of Brazil |
| ARD | Acid Rock Draining |
| BNDES | Banco Nacional de Desenvolvimento |
| BNM | Non-Magnetic Tailings Ponds |

| Abbreviations | |
|---|---|
| BOD | Biochemical Oxygen Demand |
| CDN | Canadian |
| CFEM | Financial Compensation for Exploitation of Mineral Resources |
| Chl | Chlorite |
| CIM | Canadian Institute of Mining, Metallurgy and Petroleum |
| CONAMA | National Environmental Council |
| CRM | Certified Reference Material |
| DGPS | Differential Global Positioning System |
| DNPM | National Department of Mineral Production |
| DT | Davis Tube |
| DWT | Drop Weight Test |
| EBDA | Empresa Baiana de Desenvolvimento Agrícola |
| EIA | Environmental Impact Study |
| ESG | Environmental Social Health and Safety and Governance |
| Esp | Sphalerite |
| ETA | Water Treatment Plant |
| ETS | Effluent Treatment System |
| FA | Fire Assay |
| FS | Feasibility Study |
| GE21 | GE21 Consultoria Mineral |
| GPS | Global Positioning System |
| GRG | Gravity Recoverable Gold Tests |
| Hem | Hematite |
| IBGE | Brazilian Institute of Geography and Statistics |
| ICU | Intensive Cyanidation Unity |
| IFC | International Finance Corporation |
| Iphan | National Institute of Historical and Artistic Heritage |
| Incra | National Institute of Colonization and Agrarian Reform |
| Inema | Institute of Environment and Water Resources |
| IUCN | International Union for Conservation of Nature |
| JV | Joint Venture |
| LI | Installation License |
| LO | Operation License |
| LOM | Life of Mine |
| LP | Preliminary License |
| LPG | Liquefied Petroleum Gas |
| Mag | Magnetite |
| MAR | Metarenites |
| MEE | Mineral Engineering and Environment |
| MGL | Metaconglomerate |
| MMA | Ministry of Environment and Climate Change |
| MVA | Ammonium Metavanadate |
| MYL | Upper Schist and Schist |
| NAG | Non-Acid Generating |
| NI 43-101 | National Instrument 43-101 |
| NPR | Neutralization Potential Ratio |
| NSR | Net Smelter Revenue |
| PAG | Potentially Acid Generating |

| Abbreviations | |
|---|---|
| PRAD | Degraded Area Recovery Program |
| Py | Pyrite |
| P80 | Passing 80% |
| QA/QC | Quality Assurance and Quality Control |
| QP | Qualified Person |
| Qtz | Quartz |
| RIMA | Environmental Impact Report |
| ROM | Run of Mine |
| Sd | Siderite |
| SECA | Climate and Environmental Studies System |
| SEMARH | Secretary of State for the Environment and Water Resources |
| Ser | Sericite |
| SISNAMA | National Environmental System |
| $SO_2$ | Sulfur dioxide |
| SPI | SAG power index and |
| SR | Stripping Ratio |

# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# 1 EXECUTIVE SUMMARY

## 1.1 Introduction

Largo Inc. is a globally recognized vanadium company known for its high-quality VPURE™ and VPURE+™ products, sourced from its Maracás Menchen Mine in Brazil. It is listed on the TSX (TSX: LGO) and NASDAQ (NASDAQ: LGO).

Largo hired GE21 to prepare an updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and conduct a Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN), and São José (SJO) deposits. The Maracás Menchen Project (Project) is within the greater municipality of Maracás in eastern Bahia State, Brazil. Maracás lies about 250 km southwest of the City of Salvador, the capital of Bahia.

This Report is titled **An Updated Life of Mine Plan for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Gulçari A Norte (GAN), Novo Amparo (NAO), Novo Amparo Norte (NAN) and São José (SJO) deposits, Maracás Menchen Project, Bahia, Brazil**. The Company has undertaken a comprehensive optimization study for the Project, aiming to enhance forecast vanadium production and titanium dioxide efficiency while extending the mining life. Drilling work carried out on the Gulçari A Sul (GAS), Jacaré (JAC), and Rio de Contas (RIOCON) deposits has supported their inclusion in the updated Mineral Resources category.

The Project consists of 37 concessions covering a total area of 48,953.7 ha, including 34 Mineral Exploration Licenses and 3 Exploitation Licenses (1 granted and 2 requested). These concessions are held by Vanádio de Maracás S.A., which is 99.9% controlled by Largo.

## 1.2 Qualified Persons, Experience, and Independence

GE21 is an independent mineral consulting firm based in Brazil formed by a team of professionals accredited by the Australian Institute of Geoscientists (AIG) as Qualified Persons for the declaration of Mineral Resources and Mineral Reserves following NI 43-101.

The principal QP concerning the objectives of this Report is Mining Engineer Porfírio Cabaleiro Rodriguez. Mr. Rodriguez is a mining engineer who has 45 years of experience in Mineral Resource and Reserve estimation. He possesses considerable experience dealing with various commodities, such as phosphate, iron, uranium, gold, and nickel ore, besides vanadium, among others. Mr. Rodriguez is a Fellow of the Australian Institute of Geoscientists (FAIG).

The independent QP responsible for this Report's content on issues related to Exploration and Mineral Resource Estimative is Fábio Valério Câmara Xavier (MAIG, B.Sc.), a Geologist, who has at least 21 years of experience in the Mineral Industry. Mr. Xavier is a member of the Australian Institute of Geoscientists (MAIG).

The independent QP responsible for this Report's content on issues related to mine planning (pit optimization, mining scheduler and fleet), economic analysis, (CAPEX/OPEX, DCF), risk analysis, and Mineral Reserve estimates is Guilherme Gomides Ferreira (MAIG, B.Sc.), a Mining Engineer, who has at least 19 years of experience in mineral Industry. Mr. Ferreira is a member of the Australian Institute of Geoscientists (MAIG).

The independent QP responsible for this Report's content on issues related to the metallurgic process is Paulo Roberto Bergmann Moreira (FAusIMM, B.Sc.), a Mining Engineer, who has at least 40 years of experience in management and management of engineering companies and mining projects, technical reports, geometallurgical studies, due diligence, and audits. Mr. Moreira is a member of the Australasian Institute of Mining and Metallurgy (AusIMM).

The independent QP responsible for this Report's content on issues related to environmental assessment is Branca Horta de Almeida Abrantes (MAIG, B.Sc.), a geographer, who has at least 19 years of experience in the industrial, mining, energy, and sanitation sectors. Ms. Abrantes is a member of the Australian Institute of Geoscientists (MAIG).

## 1.3 Reliance on Other Experts

The authors of this Report are Qualified Persons (QPs) as defined under NI 43-101, with relevant experience in mineral exploration, data validation, Mineral Resource and Reserves estimation, and environmental impacts.

The QPs have fully relied on information supplied by Largo's staff and experts retained by Largo concerning the status of the current Surface Rights. The information presented regarding tenure, status, and permitted activities by permit type within the Largo property in Section 4, "Property Description and Location", is based on information published by the National Mining Agency of Brazil (Agência Nacional de Mineração, ANM) as of the effective date of May 14th, 2024, available to the public, and information provided by Largo.

The QPs have relied on and disclaim responsibility for information on vanadium sources and resources, global production and consumption, supply-demand outlook, historical and price forecasts, a review of production by country, uses of vanadium, and an overview of the international market provided by Largo, obtained from Project Blue. Project Blue is considered a leader in independent, international metals and minerals research, producing 75 market reports, data books, and newsletters designed for formulating company strategies, following industry trends, competitor analysis, and gaining a complete overview of a single industry. The information presented in Section 19 was obtained from the following document: "Outlook to 2030, 19th ed.", published in 2021.

The environmental licensing status information and work plans related to community and social outreach included in Section 20, "Environmental Studies, Permitting and Social or Community Impact", were prepared by Largo and their consultants and reviewed by GE21. The QPs have fully relied on and disclaim responsibility for information received from Largo's staff.

Other information regarding the status of environmental licensing procedures, market conditions, and contracts is based on information described by or obtained from Largo.

## 1.4 Property Description and Location

The Project is in the greater municipality of Maracás in Bahia State, in eastern Brazil. Maracás is approximately 250 km southwest of Bahia's capital city, Salvador. The City of Maracás has a population of approximately 27,620 inhabitants (IBGE 2022 Census) engaged primarily in the agriculture and livestock industries, and a skilled labor force for mining activities.

Mineral exploration and mining licenses are independent from land ownership. If Largo requires additional surface or access rights for the Project, it must negotiate directly with the owner or lessee of the relevant portion of land.

## 1.5 Accessibility, Climate, Local Resources, Infrastructure, and Physiography

The town of Maracás is accessible by a paved secondary highway from the main Brazilian coastal highway through Bahia State. It is approximately 405 road kilometers from Salvador (population: 2.4 million (2022)). The Project is accessed by a 29 km paved secondary highway west of Maracás, followed by a 20 km gravel road that leads to a ranch gate. The Project is on the ranch and a 2.5-km sand and gravel trail leads to the Campbell Pit.

The local climate has two distinct seasons, one is typically hot and humid and the other during the winter is dry. The climate does not create any problems for exploration with diamond drilling or other geological/geochemical work. Tropical weathering can create specific issues for geochemistry and mapping. There are no difficulties in conducting exploration at any time.

Domestic power and telephone service are available both at the Property and in the town of Maracás, which is linked to the power grid. Maracás has a population of approximately 27,620 (IBGE 2022 Census). The water supply is available from several rivers and creeks which drain into the general area.

The Maracás Property is in the region between the coast and the high plateau, in an area of moderate to low-lying relief. At the Project itself site, the maximum relief is about 30 m. The surrounding terrain is a typical ranch/farm with low trees and shrubs and comprises several relatively flat plateaus adjacent to a series of creeks and ponds.

The primary use of the local land at the Project is for agriculture, with ranching and grazing as the main activities, while also allowing mining and exploration activities.

## 1.6 History

Exploration of the Rio Jacaré mafic to ultramafic intrusion by CBPM started in 1980 during a regional geological survey. This work led to the discovery of the vanadium-rich titaniferous magnetite occurrence on what is now part of the Maracás Property. In 1981, CBPM conducted an exploration program that included geological mapping, ground geophysical surveys (magnetic and VLF electromagnetic surveys), test pitting and trenching, and diamond drilling of two holes totaling 147 m. In 1983, CBPM continued work and focused on the Campbell deposit when it completed an additional 12 holes totaling 985 m.

Over the past 40 years, the Maracás Menchen Mine has undergone several additional phases of exploration and economic evaluation, including geophysical surveys, prospecting, trenching, diamond drilling programs, geological studies, Mineral Resource estimates, petrographic studies, metallurgical studies, mining studies and economic analysis. These studies have advanced the Project to its present status of mine and to the development of exploration campaigns in target areas along the Rio Jacaré Intrusion.

The Project began mining operations in 2013, on the Gulçari A Deposit, now known as the Campbell Pit, with the first $V_2O_5$ production commencing in August 2014. It is the only vanadium mine in Latin America.

In 2018, the Company started an expansion process in the production plant to reach a capacity of 12 thousand tonnes per year. In July 2019, the Project achieved a monthly production record of 1,042 tonnes of vanadium pentoxide ($V_2O_5$). Also, in 2019, research and test projects were undertaken to recover titanium (pilot phase) and $V_2O_3$ conversion. The Company completed construction of its $V_2O_3$ plant in Q4 2021 with a production capacity of 14 tonnes per day. In March 2021, the Board approved the construction of the Company's ilmenite concentrate plant. Construction was subsequently completed in Q2 2023, and a gradual ramp-up cycle of production began thereafter.

## 1.7 Geological Setting and Mineralization

The Rio Jacaré Intrusion, which hosts the Project's vanadium mineralization, is in the south-central part of Bahia state in northeastern Brazil. It lies within the Archean São Francisco craton, which in this area is composed of the Contendas-Mirante Complex and the Gavião and Jequié blocks. The intrusion is on the eastern edge of the Contendas-Mirante supracrustal sequence, which forms a large anticlinorium trending approximately north-south.

The Rio Jacaré mafic-ultramafic intrusion consists mainly of gabbro. It is a linear sheet-like structure that strikes almost north-south, with a length of approximately 70 km, an average width of 1.2 km, and a dip of 70° E.

Geologists have defined several discrete deposits or areas containing vanadium-rich titanomagnetite bodies along the strike of the Rio Jacaré Intrusion within the property. These include the Gulçari A (Campbell Pit) deposit, the Gulçari A North (GAN) deposit, the Gulçari B deposit (currently part of GAN), the São Jose deposit (SJO), the Novo Amparo (NAO) deposit, and the Novo Amparo North (NAN) deposit. Each of these deposits is at various stratigraphic heights within the Rio Jacaré Intrusion and thus occurs within different cyclic units.

Within all deposits, mineralized bodies comprise magnetitite layers or magnetite pyroxenite layers formed as cyclic magmatic units associated with the surrounding gabbro. Typically, magnetite-enriched units have sharp magmatic contacts with units below and gradational contacts with the units above.

Elements of interest in the Project are vanadium and titanium. Vanadium is hosted within titaniferous magnetite, which is the major oxide phase found within the deposit. Ilmenite forms a second oxide phase which is commonly present, and which hosts titanium mineralization.

Besides the vanadium and titanium that form the focus of exploration and mining at the Maracás Mine, elevated platinum and palladium values have been found associated with magnetite-rich zones in the Rio Jacaré Intrusion.

## 1.8 Deposit Types

Vanadiferous titano-magnetite (VTM) mineralization at the Project shows similarities to other magmatic VTM or ilmenite deposits associated with layered mafic intrusive complexes including the Bushveld Complex (South Africa), the Lac Doré Complex (Quebec, Canada) and the Skaergard Intrusion (Greenland). In these layered complexes, VTM and ilmenite deposits typically form in the upper portions of the magmatic stratigraphy. Geologists believe that magnetite crystallization begins when the evolving magma becomes sufficiently iron-enriched to form oxide minerals.

Since vanadium is compatible with the magnetite crystal structure, this mineral incorporates it, depleting the magma in vanadium. This process will cause magnetite-carrying units having the highest $V_2O_5$ values, with the vanadium content of the magnetite gradually decreasing in the upper parts of the stratigraphy as the mineral density increases and it becomes concentrated in the lower layers. Titanium is less compatible with the magnetite structure, enriching the residual magma. This process handles an overall decrease in the $V_2O_5$ / $TiO_2$ ratio of the upper stratigraphy units observed in the Project.

## 1.9 Exploration

Since the 1980s, researchers have studied the area using several methodologies such as regional and detailed geological mapping, geophysical survey with magnetometers, soil geochemistry campaigns, chemical analysis of rock (borehole and drill core), exploratory drilling on other targets, infill drilling and deep drilling on the target, topographic surveys, and petrographic studies.

From 2021 to 2023, a soil geochemistry campaign was conducted to define the geochemical signatures for iron-titanium-vanadium deposits along the Rio Jacaré Sill (SRJ). Thus, between 2021 and 2023, 4,102 soil samples were collected.

Between 2021 and 2023, geophysical airborne survey data were revisited to create new maps that could support the exploration program and integrate with geological data and soil geochemistry data.

A geological model was developed (interpreted) over an extension of 27 km. This model was generated based on information from geology, geophysics, geochemistry, and both historical and current drilling data.

The effective date of the Campbell Pit topography survey was January 30th, 2024.

## 1.10 Drilling

The initial geological research campaigns in the Vanadium Maracás Project were conducted by CBPM and Odebrecht in the 1980s at the Gulçari A (Campbell Pit), Gulçari A North (GAN), and Novo Amparo Norte (NAO) targets. Since the acquisition of the Project, in 2007, Largo has conducted a series of drilling programs on the surface and underground at the Campbell Pit and other exploratory targets, aligned along the regional trend of the Serra do Jacaré. The drill cores from these drill holes were described, sampled, and analyzed. They are stored and available for consultation in the core storage shed. These drilling campaigns were conducted with various objectives, including geological exploration, infill drilling, and Resource conversion.

Table 1-1 summarizes the drilling campaigns of the Project.

**Table 1-1 – Summary of the drilling campaigns of the Vanadium Maracás Project**

| Target | Type | Nº Drill hole | Drilling (m) | Number of samples | Meterage (m) |
|---|---|---|---|---|---|
| Gulçari A (Campbell Pit) | DD | 243 | 45,411.68 | 15,884 | 15,356.53 |
| | RC | 141 | 7,739.00 | 4,547 | 4,547.00 |
| **Total** | | **384** | **53,150.68** | **20,431** | **19,903.53** |
| **Gulçari A Norte (GAN)** | **DD** | 120 | 21,054.05 | 9,433 | 9,166.97 |
| **Novo Amparo Norte (NAN)** | **DD** | 248 | 43,428.52 | 8,711 | 8,405.69 |
| **Novo Amparo Oeste (NAO)** | **DD** | 59 | 9,770.05 | 4,260 | 4,156.46 |
| **São José (SJO)** | **DD** | 61 | 19,572.09 | 5,159 | 5,072.30 |
| **Jacaré (JAC)** | **DD** | 28 | 3,943.22 | 2,079 | 2,078.77 |
| **Gulçari A Sul (GAS)** | **DD** | 19 | 5,125.96 | 1,352 | 1,323.42 |
| **Riocon** | **DD** | 10 | 1,503.65 | 284 | 254.11 |
| **Água Branca** | **DD** | 7 | 1,346.51 | 570 | 570.54 |
| **Braga** | **DD** | 28 | 5,419.92 | 1,996 | 1,976.87 |
| **Ilha Grande** | **DD** | 6 | 1,135.90 | 714 | 709.73 |
| **Total** | | **1,354** | **165,450.55** | **75,420** | **73,521.92** |

Source: GE21, 2024.

In 2023, Largo conducted a review of its historical drilling database and re-sampled cores from previous campaigns. It conducted this review while implementing the MX Deposit drilling database management system by Seequent. The existing drilling information was validated by comparing it with topography, verifying geological descriptions in drill cores, and reviewing analytical results from laboratory certificates, with validation by Largo and GE21. During this process, intervals of host lithologies for mineralization were identified that were either unsampled or had incomplete chemical information. A postmortem analytical campaign was conducted to complete these chemical analyses, resulting in the collection of 5,097 samples.

## 1.11 Sample Preparation, Analysis, and Security

Largo's sampling procedures are well-defined and in line with the industry's best practices. GE21 evaluated the sample collection, analysis and security methods, as well as the procedures used by Largo's internal laboratory.

Since 2009 Largo has implemented a QA/QC program on all drilling programs. This quality control allows for the confirmation of the precision and accuracy of $\%V_2O_5$, $\% TiO_2$ and other elements (platinum and palladium contents) reported in the previous Mineral Resource estimation.

The analysis of quality control, transportation to the laboratory, sample preparation and storage conditions in prior reports performed by the former owners and Largo allowed us to assume that the historical data is acceptable for a more current Mineral Resource estimate. GE21's QP has validated all current procedures.

The primary and secondary labs involved in all drilling programs use the same control procedures as noted above and acknowledged as "best practice" by the QP in this Report. Therefore, it also attests to its acceptability for Mineral Resource analysis.

After the consolidation and understanding of all data received, such as data acquisition procedures, analytical results (chemical results and geophysical survey points) together with their corresponding quality control programs, the QP attests the data is suitable for the Mineral Resource estimate.

## 1.12 Data Verification

The QPs have conducted periodic field visits to the Largo Operations since 2017 to personally inspect the site infrastructure, the procedures used in data collection for Mineral Resource and Reserve estimation, and the results got from activities conducted by the Largo team.

The most recent visits conducted by the QP team are listed below:

- The Mining Engineer Porfirio Rodriguez and Geologist Fábio Xavier visited the site from February 6 to 10, 2023.
- Mr. Xavier and Mining Engineer Guilherme Gomides visited the site on January 23 and 24, 2024.

- Mr. Rodriguez and Mining Engineer Paulo Bergmann visited the site on March 13 and 14, 2024.

During the technical visits, the following points were verified:

- Topographic survey.
- Drilling Database.
- Core Shed.
- QA/QC and Density procedures.
- Internal Laboratory.

After the consolidation and understanding of all data received, such as data acquisition procedures, and analytical results together with their corresponding quality control programs, the technical responsible for revision considers that the data is appropriate for the Mineral Resource estimate.

A site visit was held on March 13th, 2024, to the mine in Maracás, B.A. and, in the sequence, in the pilot plant in Salvador, the capital of the state. The purpose of the visit, attended by the QPs Porfirio Cabaleiro, FAIG, and Paulo Bergmann, FAusIMM, was to collect information regarding the ilmenite concentration and proposed Pigment Plant and inspect installations and check procedures.

The engineering QPs received access to the mining and concentration plan in Maracás, and full access to the pigment pilot plant in Camaçari. They found the data regarding Largo's operation and concentration plant operation reliable and appropriate to declare as Mineral Reserves for vanadium and ilmenite. The visit to the pilot plant in Camaçari was important to clarify the pigment process and ensure that Largo is capable, and already has technical knowledge, to produce commercial $TiO_2$ pigment.

## 1.13 Mineral Processing and Metallurgical Testing

Research on metallurgical tests was performed to evaluate the amenability of the existing process vanadium plant to recover vanadium and titanium from the Gulçari A (Campbell Pit), Novo Amparo Norte (NAN), São José (SJO), Novo Amparo Norte (NAO), and Gulçari A Norte (GAN) deposits. Largo completed significant metallurgical test work. Results indicate the viability of recovering titanium from these deposits by desliming and flotation to treat the wet non-magnetic tailings. The grade of $TiO_2$ in the concentrate was higher than 45% for all test works.

## 1.14 Mineral Resource Estimates

The QP validated geological models received from Largo and then adjusted these models, when necessary, to produce updated block models and consequently declare the Mineral Resource estimates for Campbell Pit, GAN, SJO, NAO, NAN, GAS, JAC, and RIOCON deposits using current topographic and drilling data. Table 1-2 summarizes the databases for the Project.

**Table 1-2 – Summary of Databases for the Project**

| Target | Nº Drill hole | Drilling (m) | Number of Samples | Total Size of Samples (m) |
|---|---|---|---|---|
| **Gulçari A (Campbell Pit)** | 232 | 41,098.88 | 15,884 | 15,356.53 |
| **Gulçari A Norte (GAN)** | 117 | 20,154.80 | 9,433 | 9,166.97 |
| **Novo Amparo Norte (NAN)** | 124 | 21,714.26 | 8,711 | 8,405.69 |
| **Novo Amparo Oeste (NAO)** | 59 | 9,770.05 | 4,260 | 4,156.46 |
| **São José (SJO)** | 61 | 10,718.85 | 5,159 | 5,072.30 |
| **Jacaré (JAC)** | 28 | 3,943.22 | 2,079 | 2,078.77 |
| **Gulçari A Sul (GAS)** | 19 | 5,125.96 | 1,352 | 1,323.42 |
| **Rio de Contas (RIOCON)** | 10 | 1,503.65 | 284 | 254.11 |
| **Total** | **650** | **114,029.67** | **47,162** | **45,814.25** |

Source: GE21, 2024.

The Rio Jacaré Intrusion is a mineralized mafic-ultramafic formation with a sheet-like structure running approximately 70 km north-south, an average width of 1.2 km, and a dip of 70° E. Detailed studies by Largo have subdivided the intrusion within the Project area into several cyclic units. Cycles C1 to C4 are interpreted as the feeder zone of the intrusion, showing limited lateral continuity. In contrast, cycles C5 to C10 form the upper portions of the deposit and extend laterally over the entire strike length of the Rio Jacaré Intrusion. Cycles C5 to C10 were modelled by differentiating each magmatic cycle, while cycles C1 to C4 were modelled together.

Results from Davis Tube (%DT) and geological description were used to define the types of lithologies: Massive and banded Magnetite (MAG), Magnetite-pyroxenite (MPXT), Magnetite Gabbro (MGB), Pyroxenite with Magnetite (PXTM), Gabbro with Magnetite (GCM), Pyroxenite (PXT) and Gabbro (GAB). Grade shells at 0.3% of $V_2O_5$ and 1% of $TiO_2$ were used to constrain the mineralized zones. Waste typologies such as pegmatite, gabbro, anorthosite, granite, and soils were also modelled using the implicit method.

The modelled geological domains resulted from the intersection of magmatic cycles with lithological types. The Ordinary Kriging (OK) estimation method was used to estimate the contents (Head and Concentrate) for % $V_2O_5$, % $TiO_2$, %Fe, % $SiO_2$, and % DT got for all delimited domains by magmatic cycle. The estimates were separated for each domain, respecting the composites of each domain, using the Hard Boundary Concept. The estimate was made using four steps, varying the neighbouring search main radius, which was defined based on the range of the variogram modelled for each domain.

The QP recognizes this choice of estimation method as adequate and considers it to be in line with industry best practices. The QP classified the Mineral Resources based on GE21 internal criteria and following CIM definitions. The data collected was evaluated in terms of both quality and quantity data.

The Mineral Resource cut-off grade is 0.3% of $V_2O_5$ and 1% of $TiO_2$. Only MAG, MPXT, and MGB domains were considered eligible for classification as Mineral Resources.

Table 1-3 summarizes the Mineral Resources of the Project.

**Table 1-3 – Mineral Resource of Maracás Menchen Project**

| Target | Classification | Mass | Head | | Magnetic Concentrate | | | Material Content | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_2O_5$ | $TiO_2$ | DT | $V_2O_5$ | $TiO_2$ | $V_2O_5$ | $TiO_2$ |
| | | (Mt) | (%) | | | | | (kt) | |
| **Campbell Pit + GAN** | *Measured* | 30.28 | 0.71 | 7.64 | 22.21 | 2.40 | 3.48 | 215.73 | 2,313.22 |
| | *Indicated* | 21.09 | 0.54 | 7.28 | 18.51 | 2.14 | 2.73 | 114.50 | 1,536.38 |
| | ***Measured + Indicated*** | **51.37** | **0.64** | **7.49** | **20.69** | **2.30** | **3.17** | **330.23** | **3,849.60** |
| | *Inferred* | 29.94 | 0.54 | 7.46 | 18.52 | 2.00 | 2.31 | 162.2 | 2,232.6 |
| **SJO** | *Indicated* | 17.92 | 0.58 | 8.77 | 22.78 | 1.90 | 2.86 | 104.4 | 1,571.6 |
| | ***Measured + Indicated*** | ***17.92*** | ***0.58*** | ***8.77*** | ***22.78*** | ***1.90*** | ***2.86*** | ***104.39*** | ***1,571.57*** |
| | *Inferred* | 15.19 | 0.52 | 7.43 | 19.02 | 1.89 | 2.53 | 78.9 | 1,127.9 |
| **NAO** | *Indicated* | 7.13 | 0.58 | 10.06 | 27.29 | 1.72 | 3.06 | 41.4 | 717.2 |
| | ***Measured + Indicated*** | ***7.13*** | ***0.58*** | ***10.06*** | ***27.29*** | ***1.72*** | ***3.06*** | ***41.38*** | ***717.16*** |
| | *Inferred* | 4.09 | 0.59 | 8.61 | 23.34 | 1.83 | 3.03 | 24.0 | 351.8 |
| **NAN** | *Measured* | 19.44 | 0.64 | 9.02 | 22.88 | 2.14 | 2.83 | 123.7 | 1,753.6 |
| | *Indicated* | 8.93 | 0.60 | 9.14 | 21.90 | 2.14 | 2.63 | 53.9 | 815.6 |
| | ***Measured + Indicated*** | ***28.37*** | ***0.63*** | ***9.06*** | ***22.57*** | ***2.14*** | ***2.77*** | ***177.54*** | ***2,569.17*** |
| | *Inferred* | 6.88 | 0.66 | 9.16 | 22.69 | 2.28 | 2.68 | 45.7 | 630.0 |
| **GAS** | *Inferred* | 11.30 | 0.58 | 8.48 | 18.36 | 2.31 | 2.22 | 66.0 | 958.7 |
| **JAC** | *Inferred* | 21.16 | 0.47 | 7.78 | 18.57 | 1.74 | 4.65 | 98.9 | 1,645.3 |
| **RIOCON** | *Inferred* | 13.27 | 0.41 | 7.23 | 16.15 | 1.63 | 3.86 | 55.0 | 959.3 |
| **Total** | **Measured** | **49.72** | **0.68** | **8.18** | **22.47** | **2.30** | **3.22** | **339.39** | **4,066.84** |
| | **Indicated** | **55.06** | **0.57** | **8.43** | **21.58** | **2.01** | **2.80** | **314.15** | **4,640.66** |
| | ***Measured + Indicated*** | **104.78** | **0.62** | **8.31** | **22.01** | **2.15** | **3.00** | **653.54** | **8,707.50** |
| | **Inferred** | **101.82** | **0.52** | **7.76** | **18.75** | **1.93** | **3.08** | **530.79** | **7,905.60** |

Notes:
1. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
2. Mineral Resources were estimated by Fábio Xavier, BSc. (Geo), MAIG, a GE21 Associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
3. The Mineral Resource estimates were prepared under the CIM Standards and the CIM Guidelines, using geostatistical, economic, and mining parameters appropriate to the deposits.
4. Presented Mineral Resources are inclusive of Mineral Reserves. All figures have been rounded to the relative accuracy of the estimates. Summed amounts may not add due to rounding.
5. The Campbell Pit topography survey effective date is January 30th, 2024.
6. The Mineral Resource is reported on an effective date of January 30th, 2024.
7. A cut-off grade of 0.3% $V_2O_5$ head is applied in $V_2O_5$ Mineral Resource.
8. A cut-off grade of 1% $TiO_2$ head, derived from an economic function, is associated to $TiO_2$ Mineral Resource.
9. Geometric and economic parameters include:
    - Mine Recovery of 100% and dilution 0%.
    - $V_2O_5$ selling price of $16 per lb.
    - $TiO_2$ pigment selling price of $4,000.00 per tonne.
    - Mining costs of $2.93 per tonne for mineralization and waste.
    - Vanadium processing costs of $34.60 per tonne of ore feed.
    - Ilmenite concentrate costs $5.74 per tonne processed.
    - $TiO_2$ pigment costs of $1,733.00 per tonne of pigment produced.
    - General and Administrative (G&A) costs of $0.27 per lb of $V_2O_5$.
10. Exchange rate: $1.00 = R$5.10.
11. Specific values for each Deposit:
    - Campbell Pit + GAN: Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ concentrate recovery of 70.50% to 78.86%. $TiO_2$ overall recovery of 32.78% to 43.44%.
    - NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%.
    - SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.
    - NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.

Source: GE21, 2024.

The Non-Magnetic Ponds Resource Estimate used the mass of material allocated in the ponds as surveyed on January 30th, 2024, along with the average $TiO_2$ grade from all chemical assays reported up to that date. Considering the precision of the measurements and the variability observed in the volume and grade during validation, the Mineral Resource was classified as Indicated. Table 1-4 summarizes the Mineral Resources of the Project.

**Table 1-4 – Non-Magnetic Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal content (kt) |
|---|---|---|---|---|
| **BNM 02** | Indicated | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Indicated | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Indicated | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Resources** | **Indicated** | **5,218.43** | **10.54** | **550.25** |

Notes:
1. Stock of "Non-Magnetic concentrate" available in the tailing's ponds.
2. Mineral Resources in ponds were estimated based on monthly processing and validated through topographic surveys (primitive data and current data) and reconciliation data.
3. Effective Date: January 30th, 2024.
4. Recovery is 100% and no dilution was applied to these Mineral Resources.

Source: GE21, 2024.

## 1.15 Mineral Reserve Estimates

Mineral Reserves are an assessment of the economic portions of Measured and Indicated Resources that can be economically mined and processed. GE21 estimated the Mineral Reserves for Campbell Pit, NAN, GAN, SJO and NAO with an effective date of January 30th, 2024, based on CIM guidelines.

To convert Mineral Resources into Mineral Reserves consideration was given to metallurgical recoveries, mining dilution and ore loss factors, mining costs, processing costs, SG&A and logistics, as well as the forecasts and estimates of prices for vanadium and titanium products.

The ultimate pit design and mining plan have been developed based on the Proven and Probable Reserves. The summary of Mineral Reserves for the Campbell Pit, GAN, NAN, SJO and NAO is presented in Table 1-5.

In addition to the Mineral Reserves from the ultimate pit, three ancient tailing ponds containing titanium-enriched material from pre-processed, non-magnetic flows of the magnetic separation operation have been estimated separately as Probable Reserves, as shown in Table 1-6, were details on the $TiO_2$ Mineral Reserves from these ponds are provided.

**Table 1-5 – Maracás Menchen Project – Mineral Reserves Estimate (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | %Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\%V_2O_5$ | $\%TiO_2$ | Mag (Mt) | $\%V_2O_5$ | $\%TiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ in Non-Magnetic Concentrate (kt) |
| Campbell Pit I | | | | | | | | | |
| Proven | 16.16 | 22.42 | 0.86 | 6.35 | 3.62 | 3.15 | 5.05 | 114.23 | 842.94 |
| Probable | 5.47 | 18.75 | 0.76 | 5.60 | 1.03 | 3.23 | 4.60 | 33.14 | 259.09 |
| ***Total Campbell Pit Reserve*** | **21.63** | **21.49** | **0.83** | **6.16** | **4.65** | **3.17** | **4.95** | **147.37** | **1,102.03** |
| GAN II | | | | | | | | | |
| Proven | 12.96 | 18.44 | 0.45 | 7.66 | 2.39 | 1.80 | 2.93 | 43.94 | 922.31 |
| Probable | 11.34 | 16.88 | 0.42 | 7.16 | 1.91 | 1.79 | 2.53 | 34.23 | 763.94 |
| ***Total GAN Reserve*** | **24.29** | **17.71** | **0.44** | **7.42** | **4.30** | **1.79** | **2.75** | **77.17** | **1,685.25** |
| NAN III | | | | | | | | | |
| Proven | 19.55 | 21.02 | 0.58 | 8.25 | 4.11 | 2.05 | 3.33 | 84.22 | 1,474.91 |
| Probable | 6.40 | 21.14 | 0.56 | 8.63 | 1.35 | 1.98 | 3.04 | 27.84 | 511.05 |
| ***Total NAN Reserve*** | **25.95** | **21.05** | **0.58** | **8.34** | **5.46** | **2.03** | **3.26** | **111.06** | **1,985.96** |
| SJO IV | | | | | | | | | |
| Proven | - | - | - | - | - | - | - | - | - |
| Probable | 22.41 | 18.12 | 0.44 | 7.48 | 4.06 | 1.76 | 2.99 | 71.32 | 1,555.47 |
| ***Total SJO Reserve*** | **22.41** | **18.12** | **0.44** | **7.48** | **4.06** | **1.76** | **2.99** | **71.32** | **1,555.47** |
| NAO V | | | | | | | | | |
| Proven | - | - | - | - | - | - | - | - | - |
| Probable | 6.74 | 24.98 | 0.53 | 9.17 | 1.68 | 1.69 | 3.33 | 28.39 | 562.27 |
| ***Total NAO Reserve*** | **6.74** | **24.98** | **0.53** | **9.17** | **1.68** | **1.69** | **3.33** | **28.39** | **562.27** |
| **Total Maracás Menchen Mine Proven and Probable Reserves** | | | | | | | | | |
| Proven | 48.67 | 20.80 | 0.64 | 7.46 | 10.12 | 2.38 | 3.85 | 241.39 | 3,240.16 |
| Probable | 52.36 | 19.17 | 0.50 | 7.57 | 10.03 | 1.93 | 3.13 | 193.92 | 3,650.82 |
| ***Total*** | **101.03** | **19.95** | **0.56** | **7.52** | **20.15** | **2.16** | **3.49** | **435.31** | **6,890.99** |

**Notes:**

1. Mineral Reserves estimates were prepared under the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a “Qualified Person” as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. The Campbell Pit topography survey effective date is January 30th, 2024.
5. Mineral Reserves are reported effective date January 30th, 2024.
6. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
7. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from the non-magnetic portion.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters.
9. Geometric and economic parameters include:
   - Mine Recovery of 97% and dilution of 10%.
   - $V_2O_5$ selling price (standard purity >98%) of \$8.50/lb, with an additional premium of \$1.00/lb for high purity (>99.5%) product.
   - $TiO_2$ pigment selling price (purity >94%) of \$3,528.00 per tonne.
   - Mining costs of \$2.93 per tonne for mineralization and waste.
   - Vanadium processing costs of \$34.60 per tonne of ore feed.
   - Ilmenite concentrate costs \$5.74 per tonne processed.
   - $TiO_2$ pigment costs of \$1,733.00 per tonne of pigment produced.
   - General and Administrative (G&A) costs of \$0.27 per lb of $V_2O_5$.
10. Exchange rate: \$1.00 = R\$5.10.
11. Specific values for each Deposit:
    I. Campbell Pit: Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ concentrate recovery of 78.86%. $TiO_2$ overall recovery of 43.44%. Strip Ratio 3.25 (tonnes per tonne).
    II. GAN: Pit slope angles ranging from 40° to 64. $V_2O_5$ concentrate recovery of 70.50%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.17 (tonnes per tonne).
    III. NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%. Strip Ratio 5.75 (tonnes per tonne).
    IV. SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 4.23 (tonnes per tonne).
    V. NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.98 (tonnes per tonne).

Source: GE21, 2024.

**Table 1-6 – Maracás Menchen Project – Non-Magnetic Reserves in Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal Content (kt) |
|---|---|---|---|---|
| **BNM 02** | Probable | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Probable | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Probable | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Reserves** | **Probable** | **5,218.43** | **10.54** | **550.25** |

Notes:
1. Stock of "Non-Magnetic concentrate" available in the tailing's ponds.
2. Mineral Reserves in ponds were estimated based on monthly processing and validated with topographic surveys (primitive data and current data) and reconciliation data.
3. Effective Date: January 30th, 2024.
4. Recovery is 100% and no dilution was applied to these Reserves

Source: GE21, 2024.

## 1.16 Mining Methods

The Project comprises five open-pit mining operations employing a contract mining fleet of hydraulic excavators, front-end loaders, and 45-tonne haul trucks. Other equipment has been selected and sized following the specifications of these trucks and excavators. All mining fleets have been chosen and sized for both ore extraction and waste removal purposes.

The mining will produce 3.4 Mtpa of ROM material. Initial mining will focus on the Campbell Pit for the first nine years. Subsequently, the mining sequence will shift to the NAN, SJO, NAO, and GAN pits. The modifying factors for all mines are 10% dilution and 97% mining recovery, estimated from historical operation data. Geotechnical studies provided the basis for slope angle definition at the Campbell Pit, and these values were extended to the NAN, GAN, SJO, and NAN deposits. The geotechnical studies for satellite deposits are still under development.

The Company's strategy is to continue to seek ways to expand its vanadium and titanium Mineral Reserves through development in the NAN, SJO, NAO, and GAN deposits, along with the potential establishment of a $TiO_2$ Pigment Plant in Camaçari City. Key projects and production capacities are detailed as follows:

- Ilmenite Concentration Plant (Ilmenite Plant): This plant, initially capable of producing 100 ktpy of ilmenite concentrate from the non-magnetic concentrate of the Campbell Pit, was completed in 2023. Initial production commenced in August 2023.
- $TiO_2$ Pigment Plant (Pigment Plant): Proposed for implementation in 2029 in Camaçari, Bahia, Brazil, the Pigment Plant would be designed to produce 100 ktpy of $TiO_2$ pigment. The ramp-up phase would begin in 2029 with 30 ktpy, increase to 60 ktpy in 2030, and would be anticipated to achieve full capacity by 2031.
- Ilmenite Plant Expansion: To support the demand for the proposed Pigment Plant, the Ilmenite Plant will expand its nameplate capacity from 100 ktpy to 265 ktpy. This expansion is expected to ramp-up by 2025 and reach full capacity by 2029.

### *1.16.1 Detailed Timeline*

Campbell Pit Development (Years 1-9):

- Focus on extracting vanadium-rich ore to meet the production target of 2.6 Mtpa.
- Initial production primarily sourced from the Campbell Pit.

Subsequent Pits Development (Post-Year 9):

- Sequential transition of mining activities to the NAN, SJO, NAO, and GAN pits.
- Ensure continuous feed of 3.4 Mtpa to the processing plant.

Ilmenite Concentration and Pigment Production:

- 2023: Ilmenite Plant begins production at 100 ktpy.
- 2025: Ilmenite Plant production increases to 122 ktpy.
- 2026: Ilmenite Plant production reaches 196 ktpy.
- 2029: Expansion of the Ilmenite Plant starts ramp-up to 265 ktpy.
- 2029: Implementation of the proposed Pigment Plant begins, with ramp-up initiated at 30 ktpy.
- 2030: Proposed Pigment Plant increases to 60 ktpy.
- 2031: Proposed Pigment Plant achieves full operational capacity of 100 ktpy.

The mining production schedule spans for 31 years, outlining the sequence and duration of mining activities across multiple pits at the Project. The 31-year mining schedule ensures that the Project maintains consistent production rates while strategically transitioning between pits. Using mobile crushing units for NAN, SJO, and NAO pits facilitates efficient ore processing, supporting the long-term objectives of maximizing Resource utilization and maintaining production stability. Figure 1-1 summarizes the Mining Production Schedule, visually depicting the transition and production volume of each pit.

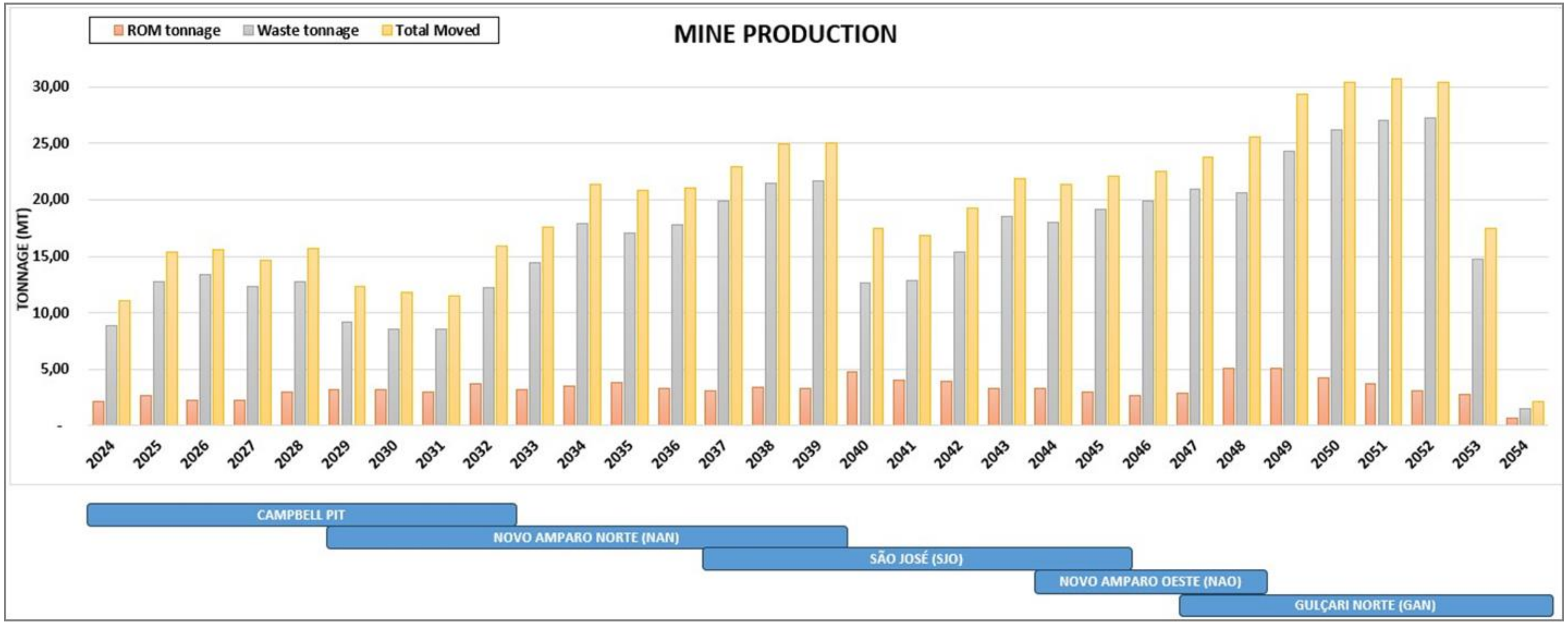



**Figure 1-1 – Maracás Menchen Project – Mining Schedule**

Source: GE21, 2024.

## 1.17 Recovery Methods

The current process at Maracá's mine comprises three stages of crushing, one stage of grinding, two stages of magnetic separation, magnetic concentrate roasting, vanadium leaching, ammonium meta-vanadate (AMV) precipitation, AMV filtration and from this step to a reactor to remove ammonia and produce $V_2O_3$ or $V_2O_5$, both in powder. For $V_2O_5$ concentrate, it is possible to send the reactor product to a furnace to fuse the $V_2O_5$ into flakes. $V_2O_3$ powder, $V_2O_5$ powder and $V_2O_5$ flakes are the final products.

The future process route for titanium concentrate production involves several key steps. First, the flotation of wet nonmagnetic tailings generated at Largo's vanadium plant will be conducted to produce an ilmenite concentrate. This concentrate will then be sent to a $TiO_2$ chemical plant. Next, the ground concentrate will undergo digestion with sulfuric acid to leach the titanium from the ilmenite. The resulting liquor will be directed to a crystallization system to remove iron. Following this, the liquor will be subjected to thermal hydrolysis to precipitate titanium in hydroxide form. The hydroxide will then be calcined in a rotary kiln to produce $TiO_2$ pigment. Finally, a polishing step will ensure that the pigment meets commercial specifications.

## 1.18 Project Infrastructure

The current infrastructure comprises administrative buildings, mine structures (stockpiles, roads, explosive magazine, fuel and lubricant storage) and plant structures (industrial areas, laboratory, sheds, compressed air, heating). Additionally, the development of a Pigment Plant in Camaçari City is being considered. To sustain the production process in the mining area, it would be necessary to expand and/or construct new structures, including additional stockpiles, waste piles, and tailing impoundment. Figure 1-2 below shows the mine structures.

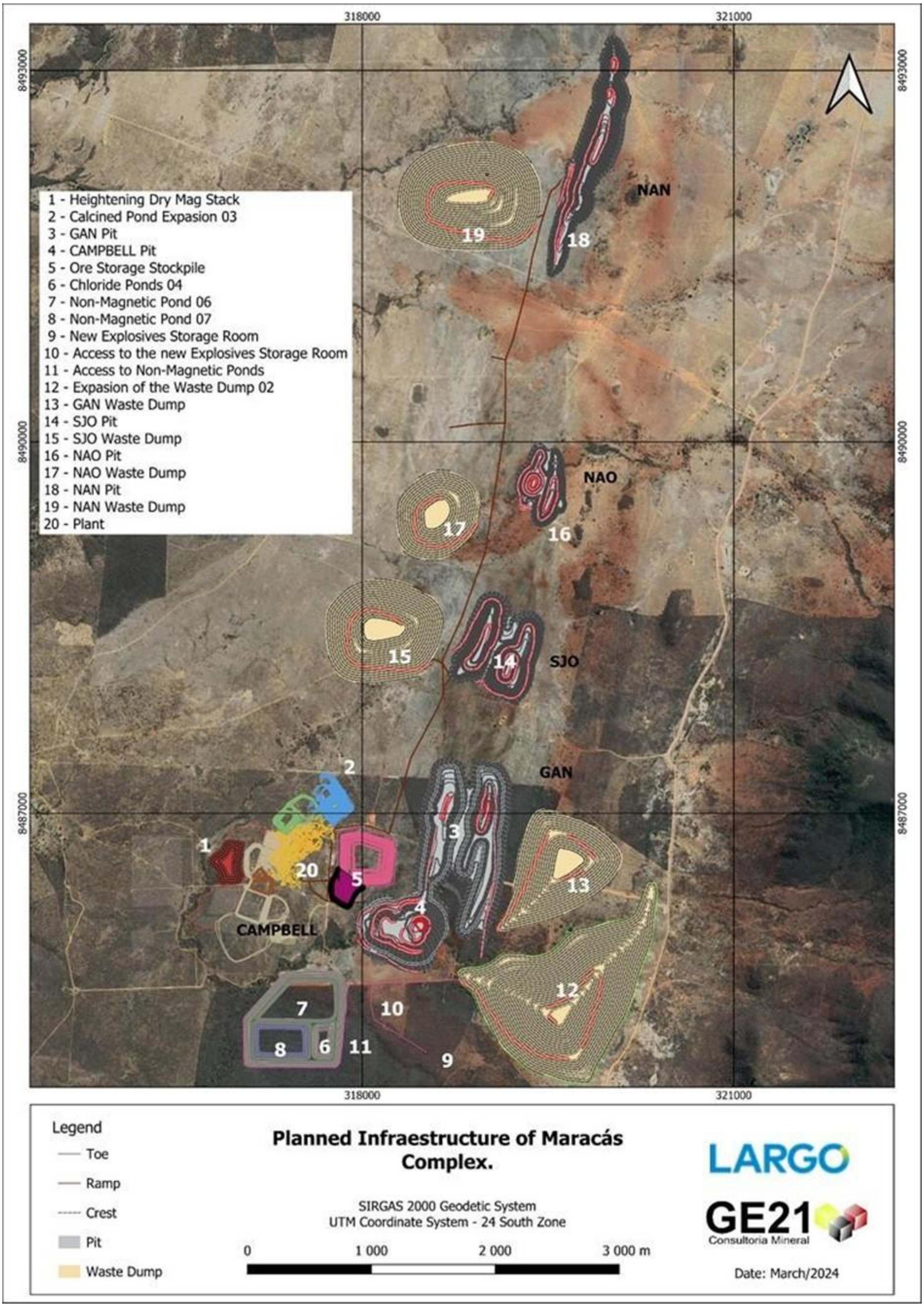



**Figure 1-2 – Planned Infrastructure of Maracás Complex**

Source: GE21, 2024.

## 1.19 Market Studies and Contracts

The vanadium market is characterized by its relative opacity and modest size compared to other commodities. Supply is notably constrained, concentrated primarily in four countries: China, Russia, Brazil, and South Africa. In 2023, the total global production of vanadium reached approximately 127,000 tonnes of pure vanadium, while global consumption was about 118,000 tonnes. This supply-demand dynamic illustrates a relatively balanced market with a slight production surplus for 2023, which continues to persist in 2024.

China dominates the global vanadium market, accounting for around 83,000 tonnes, or approximately 65% of total world production. Russia is also a significant player, contributing an estimated 15-20% of global output.

Vanadium is produced through three primary methods: primary production, secondary production, and co-production. Primary production, which is approximately 17% of global supply, involves extracting vanadium directly from mineral deposits. This method is predominantly used in Brazil, China, and South Africa. In China, the process of primary production involves the exploitation of a unique ore type known as “coalstone” which requires roasting, water leaching, and large quantities of caustic gases. This method has a relatively low recovery rate of approximately 45% and poses significant environmental challenges.

Secondary production, accounting for approximately 13% of global supply, is derived from recycling spent catalysts, residues from alumina or uranium production, or ash from burning vanadium-bearing coal or petroleum. The United States is the largest producer in this category, with significant contributions from South Korea and other Asian countries.

Co-production remains the most dominant method, contributing to approximately 70% of global vanadium supply. This process involves the recovery of vanadium as a by-product during the production of steel from vanadiferous titanomagnetite (VTM) ore, a type of iron ore. Vanadium in this process is initially separated into slag, which is then further processed to produce vanadium products. Co-production primarily occurs in China and Russia.

### *1.19.1 Demand*

Vanadium demand is primarily driven by four key end-use sectors: steel production (especially rebar), defense and aerospace alloys, chemical catalysts, and vanadium-based energy storage systems. Most of the vanadium produced globally, approximately 83.2% according to Vanitec (Q1, 2024), is consumed in the steel industry. In this sector, vanadium is typically used in the form of ferrovanadium – vanadium and iron alloy – made from standard-grade vanadium (95-96% $V_2O_5$). High-purity vanadium (minimum 99% $V_2O_5$), which has more limited global supply with major producers in Brazil and South Africa, caters to more specialized applications such as aerospace alloys, catalysts, ceramics, dyes, electronics, and batteries.

The steel industry's demand for vanadium is expected to grow further, particularly considering China's enforcement of mandatory rebar standards requiring higher vanadium content. This is expected to increase vanadium demand by approximately 20% annually (Vanitec). This regulatory shift is significant, given that China is a leading consumer and producer of steel, impacting global vanadium dynamics substantially.

Besides its traditional uses, vanadium is increasingly critical to the renewable energy sector, specifically in vanadium redox flow batteries (VRFB). These batteries offer energy storage solutions, ideal for supporting the global shift towards renewable energy. The demand for vanadium in VRFBs has experienced a substantial rise over recent years. Global consumption from the energy storage sector surged from approximately 1,800 tonnes in 2020 to around 8,000 tonnes in 2023, marking an increase of nearly 350%. This growth is particularly notable in China, which has rapidly advanced VRFB technology, now holding over 85% of the world's installed VRFB capacity with a cumulative installed capacity reaching 800 MWh as of 2023. Figure 1-3 shows the VRFB Installations and demand for the next years. Looking forward, the demand for vanadium is projected to rise significantly. According to the International Monetary Fund (IMF), achieving net-zero emissions by 2050 could need a over 200% increase in vanadium production.

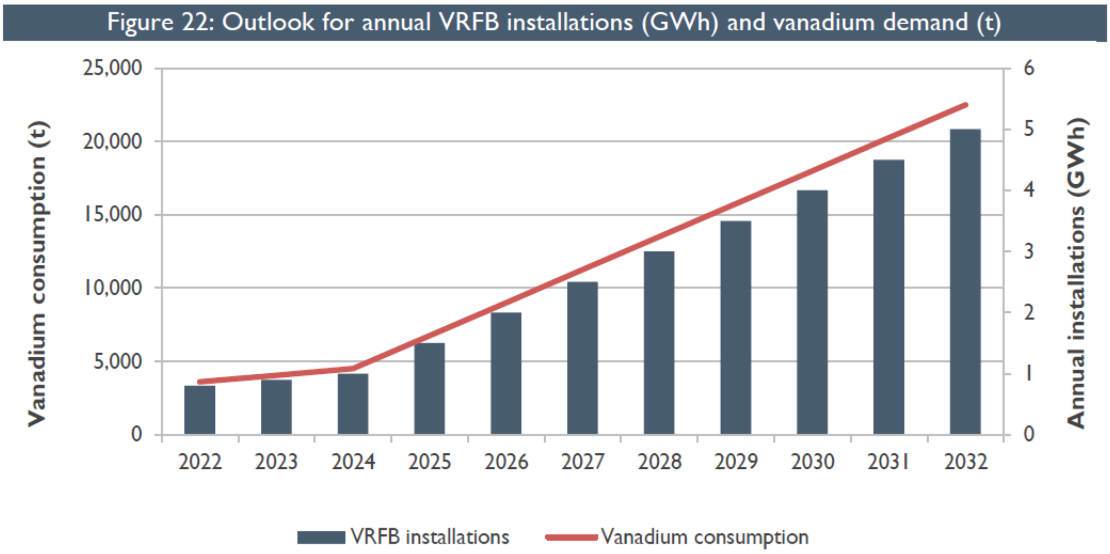



**Figure 1-3 – Outlook for Annual VRFB Installations (GWh) and Vanadium Demand (t)**

Source: Project Blue, 2022.

### *1.19.2 Vanadium Prices*

Ferrovanadium and vanadium pentoxide are the principal commercially traded vanadium products. Neither these nor any other vanadium products are traded through an exchange or terminal market, such as the London Metal Exchange or COMEX Division of the New York Mercantile Exchange (NYMEX).

Transactions are usually negotiated under 12-month contracts between producers and consumers or trading houses. Prices are quoted in terms of US dollars per pound or per kilogram gross weight of contained vanadium pentoxide or vanadium units.

Figure 1-4 illustrates the trend in vanadium pentoxide prices over the past 12 years.

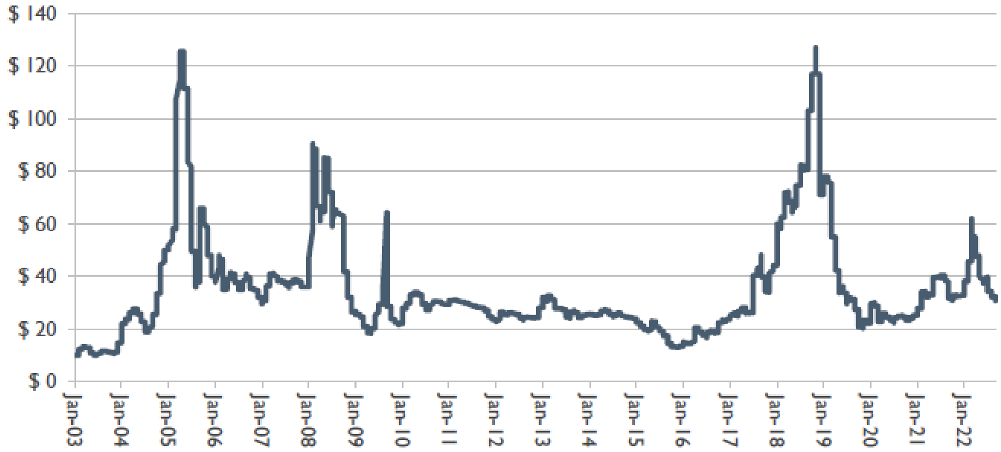



**Figure 1-4 – Ferrovanadium Price Trend – Europe (US$/kg $V_2O_5$)**

Source: Project Blue, 2024.

Over the past 20 years, real prices peaked at US$29.15/lb $V_2O_5$ in 2018 and hit a low of US$2.25 /lb $V_2O_5$ in 2015. In a 2022 report commissioned by Largo, Project Blue predicts that $V_2O_5$ prices will remain elevated in the coming years due to favorable supply and demand dynamics as shown in Figure 1-5, below.

Table 1: Forecast vanadium pentoxide prices (Europe) (US$/lb)

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|
| Real | 7.50 | 8.20 | 8.15 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 |
| Nominal | 7.68 | 8.59 | 8.72 | 8.84 | 9.02 | 9.21 | 9.39 | 9.58 | 9.78 | 9.98 |

**Figure 1-5 – Forecast Vanadium Pentoxide Prices (Europe) (US$/lb)**

Source: Project Blue, 2022.

### *1.19.3 Ilmenite Prices*

Ilmenite is a titanium-iron oxide mineral. From a commercial perspective, ilmenite is the main source of titanium dioxide, which is used in paints, printing inks, fabrics, plastics, paper, sunscreen, food and cosmetics.

Transactions are usually negotiated under 3 to 12-month contracts between producers and consumers or trading houses. Prices are quoted in terms of US dollars per tonne. Stable pricing from the current ilmenite 46% equivalent price in China for 2024 and back calculated to a FOB Brazil equivalent using US$ 70/mt freight and 13% Chinese. The price used for Ilmenite concentrate is US$213.00/t concentrate 46%, data provided by Largo.

### 1.19.4 Titanium Pigment Prices

Titanium dioxide is an inorganic compound with the chemical formula $TiO_2$. It is a white, water-insoluble solid, although mineral forms can appear black. As a pigment, it has a wide range of applications, including paint, sunscreen, and food coloring. It is estimated that titanium dioxide is used in two-thirds of all pigments, and pigments based on the oxide have been valued at $13.2 billion. Blue's projection for the long-term, made in 2021, is still aligned with the current market situation and outlook as presented in the table below (Table 1-7).

**Table 1-7 – Titanium Pigment Prices**

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| **Chinese Supplies sulfate grades (US$/t pigment) *** | 3,332.00 | 3,528,00 | 3,696.00 | 3,696.00 | 3,668.00 | 3,724.00 | 3,836.00 |

**Note:** Blue's Benchmark prices are calculated from reported import prices CIF Brazil plus import duty at the standard add of 12% rate.
Source: Project Blue, 2021.

### 1.19.5 Contracts

For the year 2024, Largo committed approximately 80% of its forecasted production under long-term, 12 months or more, agreements with vanadium end users, converters and traders in the steel, aerospace and chemical industries. The balance material will be sold in the spot market according to availability and demand from time to time. The yearly negotiations for 2025 will be conducted between September and November and are expected to be completed by mid-December 2024.

### 1.19.6 Selling Prices Adopted

After analyzing the several sources of vanadium market demand and price forecasts, the QP has assumed the selling prices for economic analysis which are presented in Table 1-8.

**Table 1-8 – Selling Price**

| Description | Unit | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|
| Average Dollar | **R$/US$** | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 |
| Vanadium - $V_2O_5$ Standard | **US$/lb** | 7.00 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| Vanadium - $V_2O_5$ Premium | **US$/lb** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Vanadium Premium - Sale Price | **US$/lb** | 8.00 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 |
| Vanadium Premium - % of Sales | **%** | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% |
| Ilmenite - Sale Price (No Tax Included) | **US$/t** | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 |
| Ilmenite - Sale Price (Tax Included) | **US$/t** | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 |
| Titanium (Pigment) - Sale Price (No Tax Included) | **US$/t** | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 |
| Titanium (Pigment) - Sale Price (Tax Included) | **US$/t** | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 |

Source: GE21, 2024.

## 1.20 Environmental Studies, Permitting and Social or Community Impact

For mineral extraction activities, environmental licensing is mandatory in Brazil and must be conducted under the National Environmental Policy. The permitting process in Bahia considers the nature and size of the projects and activities, the characteristics of the affected ecosystem, and the supporting capacity of the area being impacted.

The Project (through VMSA) produces vanadium pentoxide and vanadium trioxide ($V_2O_5$ and $V_2O_3$) and has all the licenses to conduct its operations, including those regarding the construction of the Project.

The Operational License for the Campbell Pit was published in the Official Gazette on November 8th and 9th, 2014. The renewal process was filed within the legal time limit established by the environmental agency of the State of Bahia. In May 2020, however, because of the COVID-19 pandemic, INEMA could not visit the Maracás Menchen Mine. INEMA is currently reviewing the information submitted. A formal letter from INEMA addressed to Largo confirmed that the LO has been automatically extended until INEMA completes its review and inspection process. Meetings have been held (2022 and 2023), recent discussions with INEMA's representatives show that a field inspection will occur in 2024, and the Company expects that the renewed LO will be issued shortly thereafter.

VMSA applied for the Ilmenite Project environmental license after fulfilling INEMA requirements in November 2021. The technical analysis begun by December 2021 and the license was issued by April 7th, 2022, with validity until April 7th, 2026. The Ilmenite Project is now part of the VMSA project. It is important to highlight that the Ilmenite Project is within the Project's facilities area and no archaeological impact, deforestation, new grant water, road and power line construction environmental license process were needed. No major constraints were addressed by the Environmental Agency.

Additional environmental licenses/processes for the Project's expansions (e.g. non-magnetic waste dam, calcinated dam) and new projects (e.g. NAN, GAN, SJO and NAO) will be submitted fulfilling INEMA's requirements on time and accordingly with the Project's phase/timeline.

## 1.21 Capital and Operating Costs

The Company's strategy is focused on seeking ways to increase the amount of vanadium and titanium Resources through NAN, SJO, NAO and GAN deposits, installing a new kiln to increase the capacity to process vanadium ore, expanding the ilmenite flotation plant, and potentially developing the Pigment Plant in Camaçari City.

The Project's Ilmenite Plant, with a capacity to produce 196 ktpy of ilmenite concentrate, was concluded in 2023, and initial production of ilmenite concentrate was started in August 2023.

The project to install a second kiln involves the installation of a kiln designed for a 20 t/h feed rate, increasing the nameplate capacity of the roasting area from 487.7 ktpy to 648.6 ktpy with construction starting in 2026. Ramp-up will commence in 2027, and by 2028, the plant will operate at its nameplate capacity.

The proposed Pigment Plant, with a nameplate capacity of 100 kt of $TiO_2$ per year, would be implemented in 2029 in Camaçari, Bahia, Brazil with construction beginning in 2026. Ramp-up would start in 2029 and would be completed in 2031, when the plant would operate at its nameplate capacity.

The project to expand the Ilmenite Plant involves increasing the nameplate capacity of the Ilmenite Plant from 196 ktpy to 265 ktpy to meet the demand of Largo's proposed Pigment Plant, with construction starting in 2028. Ramp-up would commence in 2029, and the plant would operate at its nameplate capacity in the same year.

The Campbell Pit will be depleted in 2032, and NAN deposit will substitute it as the main Largo's Pit. After NAN, SJO, NAO and Gan will follow respectively as the main Pit. For the NAN, SJO and NAO operations, a rented mobile crushing unit will be installed near the respective pits.

The capital cost estimate (CAPEX) was developed under the following assumptions:

- Estimated currency: US dollar (US$)
- Exchange rate: 1.00 = R$5.10

Table 1-9 summarizes the Project's CAPEX, Sustaining CAPEX, and Mine Closure estimates for the Project in their respective years.

**Table 1-9 – CAPEX summary**

| Period | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total CAPEX | 5.92 | 7.24 | 65.30 | 209.01 | 228.52 | 10.21 | - | 4.58 | 3.93 | 2.43 | - | - | 4.56 | 5.04 | 2.43 | - | - | 4.58 | 3.22 |
| Sustaining CAPEX | 13.20 | 5.70 | 8.10 | 8.73 | 8.73 | 9.89 | 11.06 | 13.39 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 |
| Total CAPEX+Sustaining CAPEX | 19.12 | 12.94 | 73.40 | 217.74 | 237.24 | 20.10 | 11.06 | 17.97 | 19.66 | 18.15 | 15.72 | 15.72 | 20.28 | 20.76 | 18.15 | 15.72 | 15.72 | 20.30 | 18.94 |
| Mine Closure | 2.78 | 4.09 | 4.39 | 4.20 | 5.53 | 7.24 | 8.52 | 10.88 | 8.90 | 8.38 | 8.57 | 8.78 | 8.49 | 8.25 | 8.29 | 8.14 | 8.03 | 7.61 | 7.59 |

| Period | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total CAPEX | 2.43 | - | - | 4.52 | 5.82 | 2.43 | - | - | 2.18 | 0.53 | 0.49 | - | - | - | - | - | - | - | - |
| Sustaining CAPEX | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | - | - | - | - | - | - | - |
| Total CAPEX+Sustaining CAPEX | 18.15 | 15.72 | 15.72 | 20.24 | 21.54 | 18.15 | 15.72 | 15.72 | 17.90 | 16.25 | 16.21 | 15.72 | - | - | - | - | - | - | - |
| Mine Closure | 7.78 | 8.24 | 8.35 | 7.82 | 7.84 | 7.72 | 7.76 | 7.84 | 8.30 | 8.61 | 7.88 | 6.39 | 5.62 | 5.62 | 5.62 | 5.62 | 5.62 | 5.62 | 4.72 |

Source: GE21, 2024.

### 1.21.1 Operating Cost Estimate

The operating cost includes the mine, process plant and general and administration (G&A) for the Project's phases. All operating costs are in US$.

Expenditures and costs were predominantly extracted or calculated from spreadsheets and information collected from Largo and reflect the actual costs collected from 2024.

### 1.21.2 Mining Cost

Largo's unit mining costs are based on the current contract with Consórcio Maracás – Dinex | EXE Mineral (CM). Loading and haulage operations are conducted by Consórcio Maracás using Sany SY750 and SY980 hydraulic excavators with bucket capacities of 4.2 and 5.5 $m^3$, respectively, for ore and waste loading. Transportation is facilitated by Mercedes Benz and Volvo 8x4 trucks, with capacities of 20, 22 and 22 $m^3$. The unit cost is determined based on loading, transportation, and haul distance, detailed in Table 1-10. Table 1-11 presents the average mining costs for projects related to Campbell Pit, NAN, SJO, NAO, and GAN mines.

**Table 1-10: Contract Loading & Haulage Costs**

| Haulage Distance (km) | Cost of Haulage, Load and Spread (US$) | |
|---|---|---|
| | Ore | Waste |
| 0 to 0.50 | 1.60 | 1.48 |
| 0.51 to 1.0 | 1.63 | 1.55 |
| 1.01 to 1.5 | 1.74 | 1.63 |
| 1.51 to 2.0 | 1.77 | 1.67 |
| 2.01 to 2.5 | 1.91 | 1.76 |
| 2.51 to 3.0 | 2.01 | 1.91 |
| 3.01 to 3.5 | 2.14 | 2.01 |
| 3.51 to 4.0 | 2.30 | 2.11 |
| 4.01 to 4.5 | 2.33 | 2.21 |
| 4.51 to 5.0 | 2.43 | 2.35 |
| 5.01 to 5.5 | 2.54 | 2.50 |
| 5.51 to 6.0 | 2.67 | 2.64 |
| 6.01 to 6.5 | 2.82 | 2.78 |
| 6.51 to 7.0 | 2.97 | 2.94 |

Source: Largo, 2024.

**Table 1-11 – Operating Costs - Mining**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| **Mining** | Transportation | **US$/ t moved** | 1.44 |
| | Diesel oil | | 0.34 |
| | Drilling | | 0.45 |
| | Blasting | | 0.35 |
| | Equipment rental | | 0.04 |
| | Labor | | 0.14 |
| | Other | | 0.16 |
| | Topography | | 0.03 |
| **Total Mining Costs** | | **US$/ t moved** | **2.94** |

Source: GE21, 2024.

### 1.21.3 Processing Cost

The OPEX estimate for the Vanadium Plant and its expansion was estimated based on current plant data. OPEX for the ilmenite and titanium plants was derived from similar operations and quotations. All OPEX estimates are summarized in Table 1-12 to Table 1-14.

**Table 1-12 – Operating Costs - Vanadium Processing**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Vanadium Processing | Reagents and Consumables | US$ / t ore fed | 16.09 |
| | Labor | | 5.16 |
| | Equipment Rental | | 1.71 |
| | Power | | 2.49 |
| | Other | | 0.89 |
| | HSE | | 1.06 |
| | Third-party service providers | | 0.95 |
| | Maintenance Spares and Tools | | 3.82 |
| | Maintenance Third-party service providers | | 1.72 |
| | Maintenance Others | | 0.06 |
| | Maintenance Equipment Rental | | 0.61 |
| **Total Vanadium Processing Costs** | | **US$ / t ore fed** | **34.56** |

Source: Largo, 2024.

**Table 1-13 – Operating Costs - Ilmenite Processing**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Ilmenite Processing | Power | US$ / t Ilmenite | 4.26 |
| | Consumables | | 38.39 |
| | Operations Contracts | | 0.8 |
| | Labor | | 5.86 |
| | Equipment Rental | | 3.61 |
| | Other | | 3.55 |
| **Total Ilmenite Processing Costs** | | **US$ / t Ilmenite** | **56.46** |

Source: GE21, 2024.

**Table 1-14 – Operating Costs - Titanium Pigment Chemical Plant**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Titanium Pigment Plant | Ilmenite as Raw Material | US$/t $TiO_2$ | 493.00 |
| | Process Cost | | 1,201.00 |
| **Total Pigment Plant - Processing Costs** | | **US$ / t $TiO_2$** | **1,694.00** |

Source: GE21, 2024.

For tailings pond recovery, the cost per tonne of material is estimated at US$1.04/t. This reclaimed material will be processed at the Ilmenite Plant from 2026 to 2032. The processing cost estimation is US$64.38/t product.

### *1.21.4 General and Administration*

General and Administration (G&A) costs include items that are not captured in the mining or the process costs. These costs encompass management and administration personnel and labor, environmental monitoring, safety, medical services, catering expenses, travel expenses, communications, shared equipment, emergency response, site-wide maintenance, insurance, legal fees, property taxes, and other miscellaneous office expenses.

The annual G&A costs are estimated to be US$6.3 million.

## 1.22 Economic Analysis

The Project estimates an NPV (7%) for Largo of US$1.1 billion post-tax and US$1.6 billion pre-tax. The economic study analyzed Largo Inc.'s Investment Plan from 2024 to 2061 as a whole and its benefits to the Company's strategy. The calculated NPV reflects the value of the Company in its current situation, along with the benefits of the projected investments.

As the Project is singular (a running project), economic parameters indicators such as IRR and Payback cannot be calculated or separated for each project phase. GE21 conducted a study aiming to present marginal results associated with the parameters. The marginal result for the Internal Rate of Return (IRR) is 18.5%.

## 1.23 Other Relevant Data and Information

The Company has several studies in evaluation or in progress that should improve future results. The main studies are the PGM evaluation, the improvement of magnetite quality, the increase of $TiO_2$ grade of flotation feed, and the implementation of recycling in vanadium production.

- Study of Platinum Group Minerals (PGM)
  - At the end of 2023, Largo plans to resume the study of Platinum Group Minerals (PGM) in tests with auger samples in its Non-Magnetic Basins (BNM) 2 and 3.
  - In March 2024, Largo announced through a News Release the identification of significant levels of Platinum-Palladium in these samples. At the same time, the Company informed the public that it intends to review the geological information and sampling data conducted in the boreholes neighboring the Campbell deposit with PGM results in its samples.
- Magnetite Concentrate Quality:
  - The magnetite concentrate from wet magnetic concentration contains small amounts of silica, which reduces plant recovery. To improve this, the Company plans to install new magnetic concentrators, high-frequency screens, and demagnetizing coils at the Maracás plant, aiming to reduce silica content and increase recovery. These improvements are expected to be completed by the end of 2024.
- Flotation Feed Concentration:
  - Largo is considering using the non-magnetic material disposed of in the ponds from 2014 to 2023 sooner than planned, starting in 2024. This material has a higher $TiO_2$ content than the ore to be mined in 2024, potentially boosting ilmenite production through increased feed rate and $TiO_2$ grade. The material will be transported to the flotation plant via a repulping system, expected to be operational by the end of 2024, alongside the completion of the Ilmenite Plant's ramp-up.
- Circular Economy Using Recycling:
  - The Company is evaluating the possibility of residues from other industries as new sources of vanadium. There are several residues in evaluation, all with a high content of vanadium. The main challenge is finding a process route that can be implemented in the Maracás plant without impacting the production from the current source, the magnetite ore. Despite this challenge, the studies already being performed are very promising. This development could not only increase vanadium production but is aligned with its strategy to assist in a greener future.

- Vanadium for Chemical Industry:
  - The Company is improving its processes in the Maracás plant to produce vanadium powder that is suitable for the chemical industry. This market demands a product with a very low content of contaminants, and Largo's plant can produce these materials with improvements that are in progress. This could represent an important increase in Largo's Market share, in the chemical sector.
- Campbell – GAS Connection:
  - The Company is assessing an exploration program to confirm the mineralization between Campbell Pit and GAS. The nineteen diamond drilling holes executed at the GAS target generated 11.3 Mt of Inferred Resources grading 0.58 of $V_2O_5$ and 8.48 of $TiO_2$, head and 2.31 of $V_2O_5$ and 2.22 of $TiO_2$ into concentrate. The distance between the Campbell Reserves Pit and the GAS Resources Pit is 800 m and can increase the tonnes of ROM near the mining facility.

## 1.24 Interpretation and Conclusions

GE21 developed a Mineral Resource for Campbell Pit, GAN, NAO, NAN, SJO, Gulçari A Sul (GAS), Jacaré (JAC) and Rio de Contas (RIOCON), and Mineral Reserve for Campbell Pit, GAN, NAO, NAN and SJO. The QP Fábio Valério Câmara Xavier (MAIG) is responsible for Mineral Resources Estimate, and Guilherme Gomides Ferreira (MAIG) is responsible for Mineral Reserves estimation. The QP Porfirio Cabaleiro Rodriguez (FAIG) supervised the entire report and is responsible for the other sections of this document.

The Mineral Resource cut-off grade is 0.3% of $V_2O_5$ and 1% of $TiO_2$. Only MAG, MPXT and MGB domains were considered eligible to classification as Mineral Resource. The Measured and Indicated Mineral Resources to Campbell Pit, GAN, NAO, NAN, SJO, Gulçari A Sul (GAS), Jacaré (JAC) and Rio de Contas (RIOCON) totalizing 104.78 Mt @0.62% $V_2O_5$ head grade and 8.31% $TiO_2$.

Mineral Reserves estimate for Campbell Pit, NAN, SJO, NAO and GAN deposits together, resulted in a total Reserves of 101.0 Mt @0.56% $V_2O_5$ head grade and 7.52% $TiO_2$ head grade. Furthermore, Non-Magnetic Tailings Ponds comprise a total Probable Reserves of 2.175 Mt @10.54% $TiO_2$.

The Project is designed as an open-pit mine utilizing a contract mining fleet of 2.5 $m^3$ bucket small-hydraulic excavators, 2.5 $m^3$ bucket front-end loaders and 36-tonne trucks. The mine plan model for Campbell Pit defined a 10% dilution and a 97% mining recovery based on reconciliation data provided by Largo.

The Company's strategy is focused on seeking ways to increase the amount of vanadium and titanium Reserves through the NAN, SJO NAO and GAN deposits, and potentially develop the Pigment Plant in Camaçari City. Key projects and production capacities are detailed below:

- Ilmenite Concentration Plant (Ilmenite Plant): This plant, with an initial capacity to produce 196 ktpy of ilmenite concentrate from the non-magnetic concentrate of the Campbell Pit, was completed in 2023. Initial production began in August 2023.
- $TiO_2$ Pigment Plant (Pigment Plant): Proposed for implementation in 2028 in Camaçari, Bahia, Brazil, this plant is designed to produce 100 ktpy of $TiO_2$ pigment. The ramp-up phase is proposed to begin in 2029, reaching full capacity in 2031.
- Ilmenite Plant Expansion: To support the demand of the proposed Pigment Plant, the Ilmenite Plant will expand its nameplate capacity from 196 ktpy to 265 ktpy. This expansion would be expected to ramp-up in 2029 and achieve full capacity by 2030.

The Campbell Pit is expected to be depleted in 2032, and the NAN deposit will substitute it as the main Largo's Pit. After NAN, SJO will be the main Pit, next to NAO and GAN. For the NAN operation, a rented mobile crusher will be installed near the NAN Pit. The projected mine life is 31 years.

To evaluate the Project, a discounted cash flow scenario was developed based on economic and financial parameters along with product generation. The Project estimates a net present value (NPV) of US$1.1 billion post-tax and US$1.6 billion pre-tax for Largo. The Project is singular (an ongoing project), and as a result, economic indicators such as the internal rate of return (IRR) and payback cannot be calculated or separated for each phase. GE21 conducted a study to present marginal results associated with these parameters. The marginal IRR result is 18.5%, which pertains to the entire Project and is not applicable for individual investments or expansions.

# 2 INTRODUCTION

Largo Inc. is a globally recognized vanadium company known for its high-quality VPURE+™ and VPURE+™ products, sourced from its Maracás Menchen Mine in Brazil. It is listed on the TSX (TSX: LGO) and NASDAQ (NASDAQ: LGO).

The Maracás Menchen Project (Project) is located within the greater municipality of Maracás in eastern Bahia State, Brazil. Maracás lies about 250 km southwest of the City of Salvador, the capital of Bahia.

Largo hired GE21 to prepare an updated Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and conduct a Pre-Feasibility Study for Novo Amparo Norte (NAN), São José (SJO), Novo Amparo Oeste (NAO), and Gulçari A Norte (GAN) deposits. The Project is within the greater municipality of Maracás in eastern Bahia State, Brazil. Maracás lies about 250 km southwest of the City of Salvador, the capital of Bahia.

The Company has undertaken a comprehensive optimization study for the Project, with the objectives of improving forecasted vanadium production and titanium dioxide efficacy to extend the mine life. The updated Mineral Resource category includes the Gulçari A Sul (GAS), Jacaré (JAC) and Rio de Contas (RIOCON) deposits as a result of a successful exploration drilling program.

The Project comprises 37 concessions with a total area of 48,953.7 ha, including 34 Mineral Exploration Licenses and 3 Exploitation Licenses, (1 granted and 2 requested). Vanádio de Maracás S.A., which is controlled 99.9% by Largo, holds the concessions.

Mining Engineer Porfirio Cabaleiro Rodriguez leads the GE21 Group. Mr. Rodriguez acts as the principal Qualified Person for the company. He is a mining engineer with over 45 years of experience in Mineral Resources and Reserves estimation. He has considerable experience dealing with various commodities, such as phosphate, iron, uranium, gold, nickel ore, and vanadium, among others. Mr. Rodriguez is a Fellow of the Australian Institute of Geoscientists (FAIG).

## 2.1 Terms of Reference

This Report updates previous NI 43-101 Technical Reports by GE21 Consultoria Mineral (GE21) and released on October 16th, 2021, titled **An Updated Life of Mine Plan (LOMP) for Campbell Pit and Pre-Feasibility Study for Novo Amparo Norte (NAN) and Gulçari A Norte (GAN) Deposits, Maracás Menchen Project, Bahia, Brazil**. This updated Technical Report documents include an updated Mineral Resource estimation of the Project and an update of the Life of Mine Plan (LOMP) for Gulçari A (Campbell Pit) and Pre-Feasibility Study for Novo Amparo Norte (NAN), São José (SJO), Novo Amparo Oeste (NAO), and Gulçari A Norte (GAN) deposits.

This Report was prepared under the requirements and guidelines set forth in NI 43-101 Companion Policy 43-101CP and Form 43-101F1 (June 2011), and the Mineral Resources and Mineral Reserves presented herein are classified according to Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards – For Mineral Resources and Mineral Reserves, prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council on May 10th, 2014.

The units of measurement used in this Report are all metrics following the International System of Units (SI). The projection system adopted was UTM – Zone 24 South, Datum SIRGAS2000.

Unless indicated otherwise, all monetary units are expressed in Brazilian Reais (R$) or United States Dollars (US$). Although some cost figures have been taken from local sources in Brazil, each of these figures was converted to US$ for the compilation and presentation of the financial analysis.

An exchange rate of R$5.10 = 1US$ was applied throughout the study.

## 2.2 Qualifications, Experience, and Independence

GE21 is an independent mineral consulting firm based in Brazil formed by a team of professionals accredited by the Australian Institute of Geoscientists (AIG) as Qualified Persons for the declaration of Mineral Resources and Mineral Reserves following NI 43-101.

Each of the authors of this Report has the appropriate qualifications, experience, competence, and independence, to be considered as a Qualified Person (QP), as defined in NI 43-101. Neither GE21 nor the authors of this Report do not have or have had no material interest in Largo or related entities. The relationship with Largo is solely professional, acting as an independent consultant. The payment of service fees is unrelated to the results of this Report.

The independent QP responsible for this Report's content on issues related to the Exploration and Mineral Resource estimative is Fábio Valério Câmara Xavier (MAIG, B.Sc.), a Geologist, who has at least 20 years of experience in the Mineral Industry. Mr. Xavier is a member of the Australian Institute of Geoscientists (MAIG).

The independent QP responsible for this Report's content on issues related to mining planning (pit optimization, mining scheduler and fleet), economic analysis, (CAPEX/OPEX, DCF), risk analysis, and Mineral Reserve estimates is Guilherme Gomides Ferreira (MAIG, B.Sc.), a Mining Engineer, who has at least 19 years of experience in mineral Industry. Mr. Ferreira is a member of the Australian Institute of Geoscientists (MAIG).

The independent QP responsible for this Report's content on issues related to the metallurgic process is Paulo Bergmann Moreira (FAusIMM, B.Sc.), a Mining Engineer, who has at least 41 years of experience in management and management of engineering companies and mining projects, technical reports, geometallurgical studies, due diligence, and audits. Mr. Moreira is a fellow of the Australasian Institute of Mining and Metallurgy (AusIMM).

The independent QP responsible for this Report's content on issues related to environmental assessment is Branca Horta de Almeida Abrantes (MAIG, B.Sc.), a geographer, who has at least 19 years of experience in the industrial, mining, energy, and sanitation sectors. Ms. Abrantes is a member of the Australian Institute of Geoscientists (MAIG).

Table 2-1 presents the summary information about QPs. The Qualified Person certificates are presented below.

**Table 2-1 – Qualified Persons**

| Company | Qualified Person | Site Visit | Section Responsibility |
|---|---|---|---|
| GE21 | Porfirio Cabaleiro Rodriguez, FAIG | 5 days duration in February 2023 and 2 days duration in March 2024 | 2, 3,19,22,23,24 and partially 1, 12, 25 and 26 |
| GE21 | Fabio Valerio Xavier, MAIG | 5 days duration in February 2023 and 2 days duration in January 2024 | 4, 5, 6, 7, 8, 9, 10, 11, 14, and partially 1, 12, 25 and 26 |
| GE21 | Guilherme Gomides Ferreira, MAIG | 2 days duration in January 2024 | 3,15,16,18, and partially 1, 12,21, 25 and 26 |
| GE21 | Paulo Bergmann, FAusIMM | 2 days duration in March 2024 | 13, 17 and partially 1, 12, 21,25 and 26 |
| GE21 | Branca Horta de Almeida Abrantes, MAIG | Ms. Abrantes did not visit the Project | 20 and partially 1, 25 and 26 |

Source: GE21, 2024.

## 2.3 Effective Date

Mineral Resources and Reserves for the Project has an effective date of January 30, 2024, for reviewed deposits.

## 2.4 Main Sources of Information

In addition to site monitoring by QPs during the last period, GE21 has been involved in the Project since 2017, participating in technical, and planning discussions, and overseeing the execution of activities conducted by Largo.

The results presented in this Study have been generated from information provided and compiled by Largo through data organized in spreadsheets, internal and third-party technical reports, and supplemental information obtained from the Largo technical team.

The information regarding the tenure, status and work permitted by permit type within the Largo property is based on information published by the National Mining Agency of Brazil (Agência Nacional de Mineração – ANM), available to the public, and information provided by Largo.

Information on the status of environmental licensing and work plans related to community and social outreach prepared by Largo and its consultants, as well as information on the status of environmental licensing procedures, market conditions and contracts.

# 3 RELIANCE ON OTHER EXPERTS

The authors of this report are Qualified Persons (QPs) as defined under NI 43-101, with relevant experience in mineral exploration, data validation, Mineral Resource and Reserves estimation, and environmental impacts.

The QPs have fully relied on information supplied by Largo's staff and experts retained by Largo concerning the status of the current Surface Rights. The information presented regarding the tenure, status, and permitted activities by permit type within the Largo property in Section 4, "Property Description and Location", is based on information published by the National Mining Agency of Brazil (Agência Nacional de Mineração, ANM) as of the effective date of May 14$^{th}$, 2024, available to the public, and information provided by Largo.

The QPs have relied on and disclaim responsibility for information on vanadium sources and resources, global production and consumption, supply-demand outlook, historical and price forecasts, a review of production by country, uses of vanadium, and an overview of the international market provided by Largo, obtained from Project Blue. Project Blue is considered a leader in independent, international metals and minerals research, producing 75 market reports, data books, and newsletters designed for formulating company strategies, following industry trends, competitor analysis, and gaining a complete overview of a single industry. The information presented in Section 19 was obtained from the following document: "Outlook to 2030, 19th ed.", published in 2021.

The environmental licensing status information and work plans related to community and social outreach included in Section 20, "Environmental Studies, Permitting and Social or Community Impact", were prepared by Largo and their consultants and reviewed by GE21. The QPs have fully relied on and disclaim responsibility for information received from Largo's staff.

Other information regarding the status of environmental licensing procedures, market conditions, and contracts is based on information described by or obtained from Largo.

# 4 PROPERTY DESCRIPTION AND LOCATION

## 4.1 Location

The Maracás Menchen Mine property totaling almost 49,000 hectares is in the municipality of Maracás, the eastern Bahia State of Brazil (Figure 4-1). The mine is located 250 km southwest of Salvador (Bahia State capital) and 813 km northeast of Brasilia (Brazil Capital). The Maracás Menchen Mine can be accessed by road from Salvador via 405 km of paved secondary road from the main costal highway in Bahia and via a direct Project access road of about 50 km west of the town of Maracás. Access to water, electric power grid and a railroad are within a reasonable distance, and a trained workforce familiar with the mining and mineral exploration industries can be found in the State of Bahia and within the country.

The City of Maracás has a population of approximately 27,620 inhabitants (IBGE 2022 Census) engaged primarily in the agriculture and livestock industries, and an experienced labor force for mining activities.

Mineral Exploration / Concession Licenses are separate from other Mining and Mineral Exploration properties.


**Figure 4-1 – Maracás Menchen Mine Location Map**

Source: Largo, 2021.

## 4.2 Mineral Title in Brazil

In Brazil, Mineral Resources are property of the Federal Government under the Federal Constitution of 1988 and are governed by the Federal Mining Code of 1967 (Mining Code), as significantly amended in 1996. Additional changes regarding the administration of the Mining Code and the royalty (CFEM) legislation applicable to mineral products were introduced in 2017, which amendments resulted in creating the National Mining Agency (ANM) to replace the former National Department of Mineral Research (DNPM) and, concerning the CFEM, the increase of the royalty from 1% NSR to 2% of gross revenue and disallowing the deduction of certain costs (such as transport and insurance costs) which had been permitted. The effects of these measures are captured in the economic projections of the assets, as described in Section 22 – Economic Analysis.

In June 2018, the Executive Branch enacted New Regulations under the Mining Code. These New Regulations did not require the approval of the legislature and focused on simplifying the process of conversion of an Exploration License to a Concession License either as permitted under the Mineral Code or through performing complimentary work after the submission of a Final Mineral Research Report. Neither the process of obtaining a Mining Rights Concession nor the investment commitments for each license were affected by the New Regulations. As of the effective date of this Report, the authors do not foresee any significant changes in Brazilian Mineral Legislation that would affect the Company’s operations.

## 4.3 Mining Legislation, Administration and Rights

ANM is the Federal Agency with the right to Manage, Regulate and Supervise mining activities in Brazil, under the coordination of the Ministry of Mines and Energy (MME). Exploration and Mining Rights are granted by the ANM to Brazilian citizens and legal entities incorporated in Brazil. In general, there are no restrictions on foreign participation in these entities.

Surface rights owners, which can be private owners or federal, state and municipal governments, are entitled to a royalty payable on extracted minerals. The CFEM varies from 1% to 3.5% depending on the mineral substance and is divided between the Federal, State and Municipal levels. If any minerals are extracted from private land that is not owned by the Project, the landowner is entitled to a royalty equivalent to 50% of the amount payable under the CFEM.

Legally, Holders of an Exploration License have the right to conduct mineral exploration activities in the licensed area, regardless of whether the Surface Rights are publicly or privately held, so long as the owner or occupant of the Surface Rights is financially compensated (lease) and the affected area is environmentally reclaimed after the research is completed. The amount of compensation payable to the Surface Rights owner (or occupant) is not fixed under the Mining Code and varies on a case-by-case basis. However, the Mining Code does state that if a Court is required to fix the values, the rent for land occupation may not exceed the maximum net profit that the owner or occupant would earn from agricultural activity on the licensed property and the indemnity may not exceed the assessed value of the area of the licensed property intended.

In response to the Brumadinho disaster, new Regulations and Laws were enacted regarding the Design, Operation and Monitoring of tailings dams as outlined. On October 1st, 2020, Law nº. 14,066/2020 was enacted, which amended the National Dam Security Policy. As at the time of this Report, the Company continues to work with ANM to assess any requirements for operational changes and or additional monitoring requirements for its tailing facilities. The authors of this Report reviewed the New Legislative Requirements and did not identify any material risk factors associated with compliance with the New Legislation or any impacts on the extraction of existing Mineral Reserves.

## 4.4 Mineral Exploration Licenses

Mineral Exploration Licenses are granted for up to three years and can be renewed for a further three years upon the approval of the ANM following an inspection and compliance with certain environmental requirements. The size of an individual license area ranges from 50 ha to 10,000 ha, depending on the State in which the License is sought.

## 4.5 Mineral Concessions

Mining Concessions are valid until such time that the Deposit for which the concession was granted is exhausted. The Concession Holder is required to comply with any additional conditions imposed by the ANM and Applicable Laws.

A Specific Type of Mining Concession is available for areas smaller than 20 ha and for Mineral Resources required for the Construction Sector, neither of which is relevant in the context of this Report.

### 4.6 Annual Fees and Reporting Requirements

Annual License fees for Exploration Licenses are based on size and are calculated at R$4.53/ha for the first License Term and R$6.78/ha in Subsequent Terms. Each license holder must submit an exploration plan, budget, and timeline, although there is no work or expenditure requirement. Licenses require an Interim Report two months before License Expiration (if an extension is to be applied for), describing Exploration Results, Interpretation and Expenditures. The renewal of a License may be granted at the discretion of the ANM, considering the exploration works undertaken by the Holder. A Final Report is due at the end of the term or upon relinquishment of the License.

Within this context of updating the laws, Largo has adapted to these main items below:

- Government royalty payments changed from 1% NSR to 2% of gross revenue.
- Align Brazil's Mineral Reserve and Research Report formats with International Reports subject to international codes, such as NI 43-101.

### 4.7 Largo Mineral Tenure

Largo's Mining Rights comprise 37 concessions, including 34 Mineral Exploration Licenses and 3 Exploitation Licenses (one granted and two requested), as highlighted in green in Figure 4-2 below, totaling 48,953.7 ha (Figure 4-3), last checked on ANM website in 14/05/2024. Table 4-1 lists the Concessions.

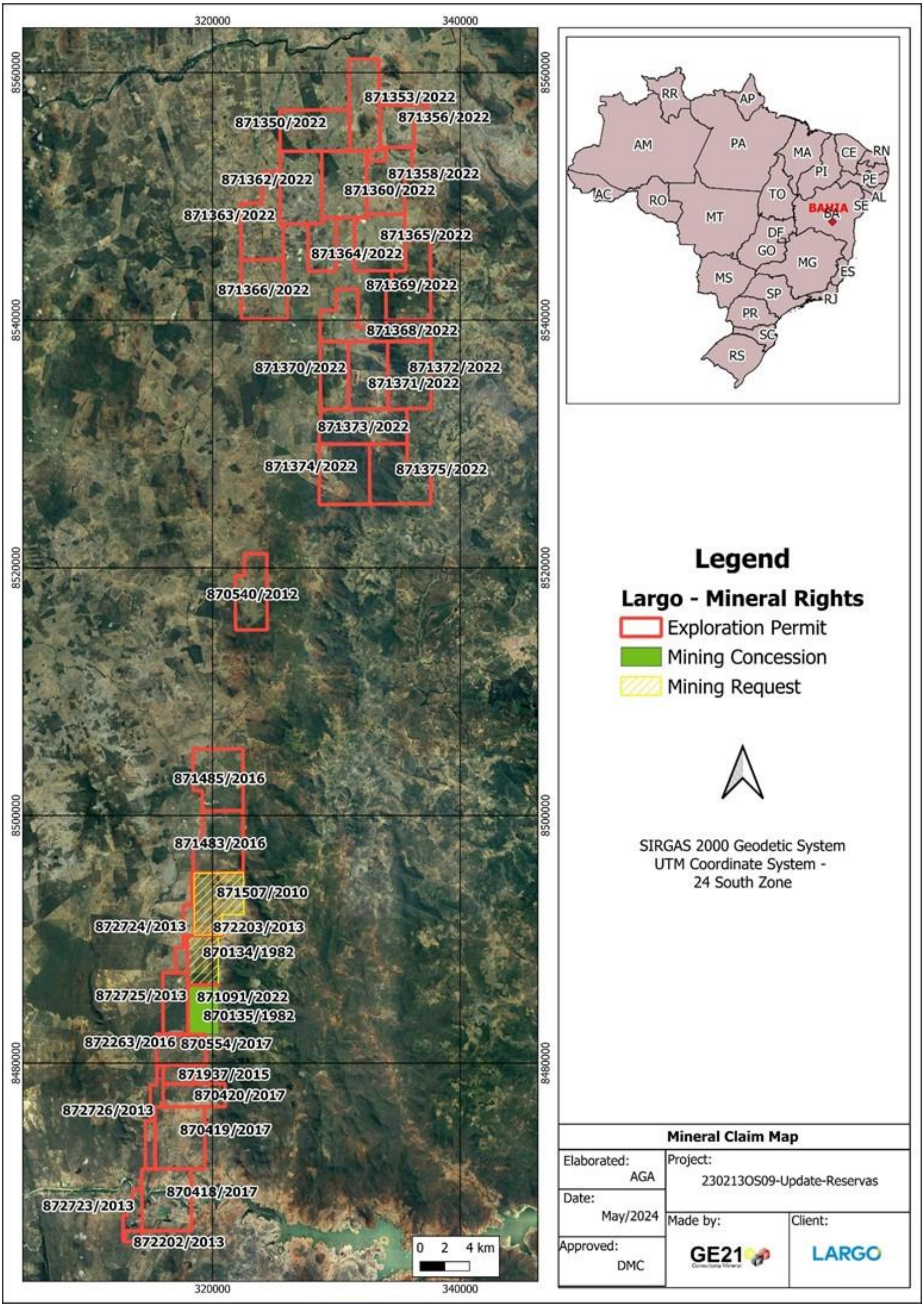



**Figure 4-2 – Largo Mineral Tenure Location Map.**

Source: GE21, 2024.

**Table 4-1 – Largo Mineral Tenure**

| Holder | ANM Mineral Right number | Publication Date | Substance | Granted Area (ha) | Status | Research deadline | Deadline for the Final Research Report (Resolution 55) (1) | Municipality |
|---|---|---|---|---|---|---|---|---|
| **VMSA** | 870.134/1982 | 07/15/1983 | V, Ag | 1,000.00 | Mining Request | R.F.P.P.A. (3) | Not applied | Maracás |
| **VMSA** | 870.135/1982 | 03/02/1983 | V, Fe, Ag, Ti, Pt | 1,000.00 | Mining Concession | Not applied | Not applied | Maracás |
| **VMSA** | 872.202/2013 | 03/20/2017 | V | 115.59 | Exploration Permit | 3 years | 09/29/2024 | Manoel Vitorino |
| **VMSA** | 872.203/2013 | 10/18/2018 | V, Ti | 6.42 | Exploration Permit | R.F.P.P. (2) | Not Applied | Maracás |
| **VMSA** | 872.723/2013 | 10/18/2018 | V, Ti | 413.71 | Exploration Permit | R.F.P.P. | Not applied | Iramaia and Manoel Vitorino |
| **VMSA** | 872.724/2013 | 10/18/2018 | V, Ti | 495.75 | Exploration Permit | R.F.P.P. | Not applied | Maracás |
| **VMSA** | 872.725/2013 | 10/18/2018 | V, Ti | 988.46 | Exploration Permit | R.F.P.P. | Not applied | Maracás |
| **VMSA** | 872.726/2013 | 10/18/2018 | V, Ti | 593.75 | Exploration Permit | 3 years | Not applied | Iramaia and Maracás |
| **VMSA** | 871.507/2010 | 09/05/2013 | Fe, V | 1,713.65 | Mining Request | R.F.P.P.A. | Not applied | Maracás |
| **VMSA** | 870.540/2012 | 03/16/2017 | V | 1,439.15 | Exploration Permit | R.F.P.P. | Not applied | Maracás |
| **VMSA** | 871.485/2016 | 10/17/2016 | Fe, V | 1,887.73 | Exploration Permit | 3 years | 09/30/2024 | Maracás |
| **VMSA** | 871.483/2016 | 08/03/2020 | Fe, V | 1,833.58 | Exploration Permit | 3 years | 09/30/2024 | Maracás |
| **VMSA** | 871.937/2015 | 03/14/2016 | V | 375.87 | R.F.P.P. | 3 years | 03/30/2024 | Maracás |
| **VMSA** | 872.263/2016 | 03/30/2017 | V | 11.11 | Exploration Permit | 3 years | 09/30/2024 | Maracás |
| **VMSA** | 870.418/2017 | 12/06/2017 | V, Fe, Ti, Pt, P | 1,999.81 | Exploration Permit | 3 years | 09/30/2024 | Iramaia, Maracás, Barra da Estiva and Manoel Vitorino |
| **VMSA** | 870.419/2017 | 12/06/2017 | V, Fe, Ti, Pt, P | 1,999.56 | Exploration Permit | 3 years | 09/30/2024 | Iramaia and Maracás |
| **VMSA** | 870.420/2017 | 12/06/2017 | V, Fe, Ti, Pt, P | 926.91 | Exploration Permit | 3 years | 09/30/2024 | Maracás |
| **VMSA** | 870.554/2017 | 06/27/2017 | V, Fe, Ti, Pt, P | 981.52 | Exploration Permit | 3 years | 09/30/2024 | Maracás |
| **VMSA** | 871.091/2022 | 10/05/2022 | V, Fe, Pt, Ti | 0.56 | R.F.P.P. | 3 years | 10/05/2025 | Maracás |
| **VMSA** | 871.356/2022 | 08/03/2024 | Fe, V, Ti, Pt | 1,001.42 | Exploration Permit | 3 years | 08/03/2027 | Marcionílio Souza |
| **VMSA** | 871.375/2022 | 09/01/2023 | Fe, V, Ti, Pt | 1,967.96 | Exploration Permit | 3 years | 01/09/2026 | Maracás |
| **VMSA** | 871.360/2022 | 09/01/2023 | Fe, V, Ti, Pt | 1,948.79 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza |
| **VMSA** | 871.374/2022 | 09/01/2023 | Fe, V, Ti, Pt | 1,948.79 | Exploration Permit | 3 years | 01/09/2026 | Maracás |
| **VMSA** | 871.358/2022 | 03/08/2024 | Fe, V, Ti, Pt | 1,630.52 | Exploration Permit | 3 years | 03/08/2027 | Marcionílio Souza |
| **VMSA** | 871.353/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,807.60 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza |
| **VMSA** | 871.365/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,839.43 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza |
| **VMSA** | 871.372/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,894.69 | Exploration Permit | 3 years | 01/09/2026 | Maracás |
| **VMSA** | 871.362/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,972.30 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza |
| **VMSA** | 871.370/2022 | 03/08/2024 | Fe, V, Ti, Pt | 1,243.72 | Exploration Permit | 3 years | 03/08/2027 | Maracás |
| **VMSA** | 871.371/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,735.85 | Exploration Permit | 3 years | 01/09/2026 | Maracás |
| **VMSA** | 871.350/2022 | 03/08/2024 | Fe, V, Ti, Pt | 1,866.29 | Exploration Permit | 3 years | 03/08/2027 | Marcionílio Souza |
| **VMSA** | 871.363/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,887.31 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza |
| **VMSA** | 871.364/2022 | 03/08/2024 | Fe, V, Ti, Pt | 925.76 | Exploration Permit | 3 years | 03/08/2027 | Marcionílio Souza |
| **VMSA** | 871.369/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,861.20 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza, Maracás and Planaltino |
| **VMSA** | 871.368/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,944.82 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza and Maracás |
| **VMSA** | 871.366/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,722.02 | Exploration Permit | 3 years | 01/09/2026 | Marcionílio Souza, Maracás and Planaltino |
| **VMSA** | 871.373/2022 | 01/09/2023 | Fe, V, Ti, Pt | 1,972.10 | Exploration Permit | 3 years | 01/09/2026 | Maracás |

Notes:
1. As noted earlier in this section, if a Concession Holder files a negative Final Research Report on an Exploration Concession or, in the case of a Positive Report, does not apply for the extension or conversion into a Mining Concession, the Exploration Concession will expire.
2. R.F.P.P. = Final Research Report Filed
3. R.F.P.P.A. = Final Research Report Filed and Approved

Source: Largo, 2024.

Largo reports that most Mining Rights are registered as Mineral Exploration Licenses. A Mining Concession was granted to ANM nº 870.135/1982. Mining Concession ANM nº 870.134/1982 is still pending, but the Installation Permit (LI) has been granted. There is no tax on Mineral Exploration Licenses until an Exploration License is granted.

Largo executed an Agreement with Companhia Baiana de Pesquisa Mineral (CBPM) to acquire 90% of the stakes in Mining Rights (ANM nº 870.135/1982 and ANM nº 870.134/982). In this Agreement, Largo was required to maintain the Exploration Licenses in good regulatory condition. On December 22nd, 2012, VMSA purchased the Decrees from Vale and Odebrecht, giving Largo 100% ownership of Mining Rights. The other mineral rights were got by Mineral Concurrence following the rules defined by the ANM.

The Geological Service of Bahia (CBPM) owns the Mining Rights of most of the adjacent Deposits, other than Novo Amparo Norte (NAN), which is wholly owned by Largo. In the Agreement between Largo and CBPM (document named “Royalties Agreement #09/2013”, signed on 07/26/2013), there is a Royalty Clause stating that 3% of Gross Sales Revenue will be allocated to CBPM.

The Project’s activities are conducted on 41 properties enrolled on at the Real Estate Registry Office of Maracás. These properties are registered under the name of Banco Econômico S.A., which is a party to a Free Lease Agreement (Contrato de Comodato) with Econômico Agropastoril e Industrial S.A. (EAP) and an intervening consenting party to the Rural Lease Agreement and Easement Right mentioned below. Largo’s surface and access rights to the properties are held under a Rural Lease Agreement (Contrato Particular de Arrendamento) and Public Deed of Easement (Escritura de Servidão) dated May 30th, 2011, among VMSA, Mineração Campo Alegre de Lourdes Ltda. (a Largo controlled subsidiary), EAP and Banco Econômico S.A.

In addition to the required Surface Rights for the mined areas, Largo has negotiated Access Rights and the necessary Surface Rights for its Exploration Concessions. The Company intends to enter negotiations with individual landowners or leases for Surface Rights required to undertake mining activities at Novo Amparo Norte (NAN), Gulçari A Norte (GAN), São José (SJO) and Novo Amparo (NAO) significantly before 2032. Should any of such negotiations be unsuccessful, Largo may apply to the Local Court to establish a compensation fee to be paid to the Surface Rights Holder in exchange for the Surface Rights required to perform the mining activity.

Figure 4-3 shows the sketch of the Non-Mining Rights of the Property.

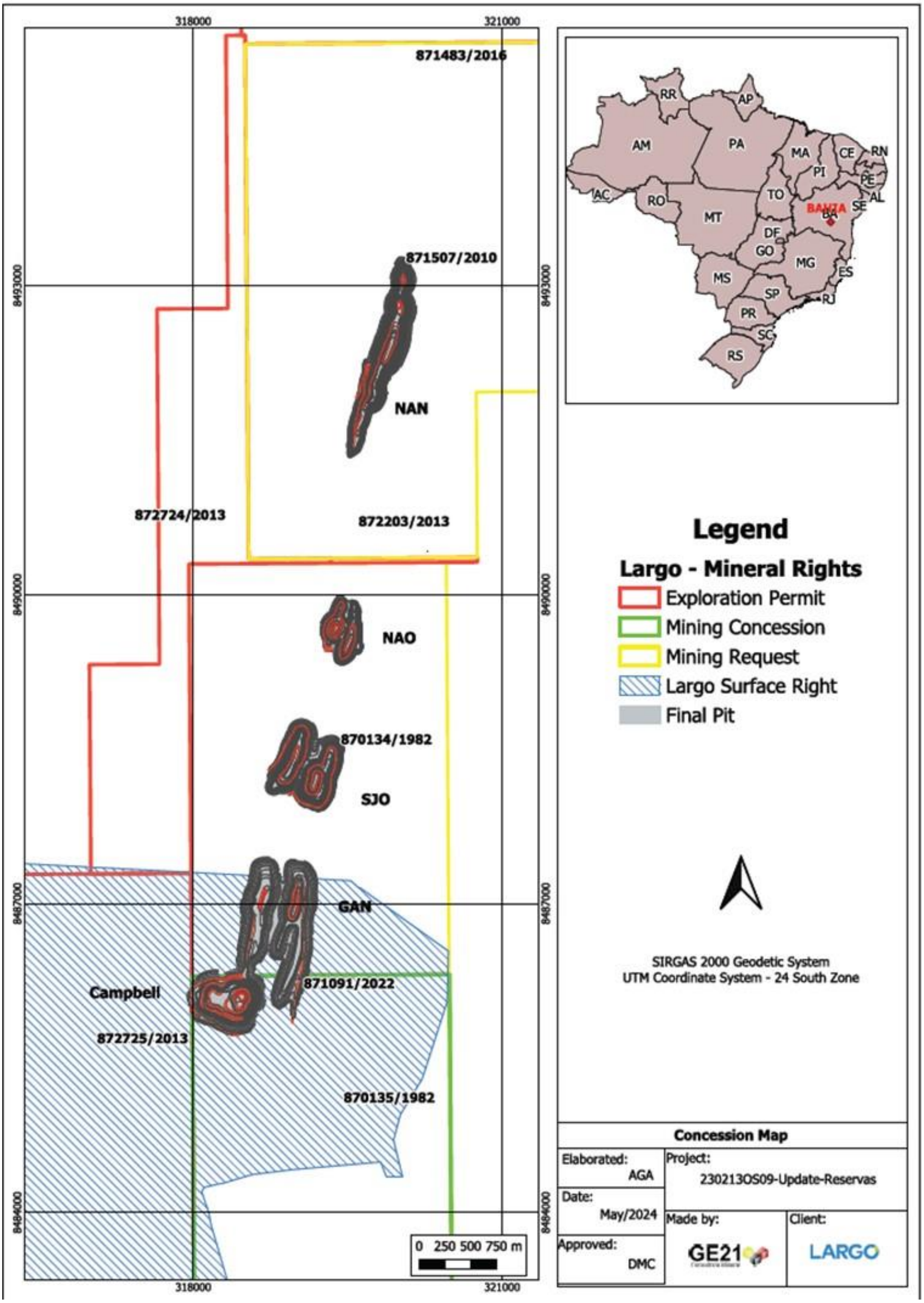



**Figure 4-3 – Property area related to Mineral Rights**

Source GE21, 2024.

## 4.8 Environmental Liabilities and Permits

Largo's Environmental Liabilities are currently related to the Campbell Pit operation. The Environmental reclamation of these activities is supervised by the Bahia State Institute of Environment and Water Resources (Instituto do Meio Ambiente e Recursos Hídricos – Inema), which is a government-run entity overseen by the Secretariat of Environment of the State of Bahia.

GE21 identified no significant factors or risks that could jeopardize the Logistics, Surface Rights, Mining Rights and/or Experience required to perform work on Largo Mining Rights.

Largo filed the renewal of the Campbell Pit Environmental License, and this action considers this LO in effect until the Regulatory Authority has issued its opinion. Mine Expansion Plan also requested a Production Change. Table 4-2 summarizes Largo's current Environmental Permits.

Largo has all the necessary Permits and Licenses to conduct its current activities and has applied to ANM to add $TiO_2$ to the list of elements authorized for exploitation under the Mining Concessions covering the Campbell Pit. The Company plans to convert its current Exploration Licenses covering the relevant portions of the NAN, GAN, SJO and NAO Deposits into Mining Concessions before the beginning of mining at such Deposits in 2033. A further discussion of the Company's timeline for applying for the necessary Environmental Permits and Licenses is set out in Section 20.

### Table 4-2 – Largo Environmental Permit

| Environmental Licenses | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Process number** | **Opening date** | **Status** | **Formation date** | **Ordinance/Certified** | **License** | **Issuance date** | **Expiration date** |
| **2019.001.005745/INEMA/LIC-05745** | 18/10/2018 | Formed | 43 721 | 22 245 | Granting the use of water resources | 02/05/2021 | 02/05/2025 |
| **2019.001.007534/INEMA/LIC-07534** | 21/08/2019 | Formed | 11/21/2019 | 21 302 | Alteration License (LA) – Waste rock stack 2 and BCl03 and Vegetation Suppression Authorization (ASV) | 8/26/2020 | 08/26/2022 |
| **2020.001.001535/INEMA/LIC-01535** | 09/12/2019 | Formed | 03/04/2020 | N/A | FeV alteration license | N/A | N/A |
| **2020.001.003148/INEMA/LIC-03148** | 11/03/2020 | Formed | 06/01/2020 | 21 121 | $V_2O_3$ Modification License | 07/29/2020 | 07/29/2022 |
| **2020.001.006773/INEMA/LIC-06773** | 18/05/2020 | Formed | 12/04/2020 | N/A | Renewal of Operating License | N/A | N/A |
| **2021.001.008493/INEMA/LIC-08493** | 10/05/2021 | Formed | 12/02/2021 | N/A | Ilmenite alteration license | N/A | N/A |
| **2021.001.006045/INEMA/LIC-06045** | 09/04/2020 | Formed | 09/02/2021 | 2021.001.001855/DTRP | Hazardous Waste Transport Declaration (DTRP) | 09/02/2021 | 09/02/2022 |
| **2021.001.000158/INEMA/JUR-00158** | 16/07/2021 | Formed | 07/16/2021 | 23 486 | Alteration of ALRS Corporate Name | 07/19/2021 | N/A |
| **2021.001.000660/INEMA/LIC-00660** | 06/11/2020 | Formed | 02/12/2021 | N/A | Alteration License BNM04 | N/A | N/A |
| **2021.001.026926 /INEMA/REQ** | 25/03/2021 | Formed | N/A | N/A | Vegetation Suppression Authorization (ASV) of concession 872.726/2013 | N/A | N/A |
| **2021.001.047248 /INEMA/REQ** | 04/06/2021 | Formed | N/A | N/A | Fauna Management Authorization – AMF | N/A | N/A |
| **2022.001.003356/INEMA/LIC-03356** | 16/02/2022 | Formed | 16/05/2022 | 28.426 | Vegetation Suppression Authorization (ASV), Fauna Management Authorization - AMF, Alteration License BNM6, BNM07, BCAL04, BNM6 Support Structure, Residues (NaSO4) Unite, Explosives Magazine, access roads to explosives magazine. Expansion of Warehouse A, B and C; Expansion of third-party patio; Expansion of parking A and B; Waste Center | 21/04/2023 | 21/04/2026 |
| **2022.001.005971/INEMA/LIC-05971** | 03/06/2022 | Formed | 24/08/2022 | N/A | Well drilling authorization | 22/08/2023 | 22/08/2025 |
| **2022.001.234856/INEMA/REQ** | 27/05/2022 | Requirement Docketed | | 2022.001.005971/INEMA/LIC-05971 | Vegetation Suppression Authorization (ASV) 419, 554 and 263 | N/A | N/A |
| **2022.001.002299/INEMA/INEXIG** | 16/12/2022 | Formed | | 2022.001.006761/INEMA/INEXIG | License exemption – Support structure for BNM06 – Master Plan | 16/12/2023 | N/A |
| **2022.001.002352 /INEMA/INEXIG** | 04/01/2023 | Formed | 04/01/2023 | 2.023.001.008.551 | License exemption – construction of fords that do not interfere with the quantity, or flow regime of the waters | 04/01/2023 | N/A |
| **2022.001.002353/INEMA/INEXIG** | 04/01/2023 | Formed | 04/01/2023 | 2.023.001.008.550 | License exemption – construction of fords that do not interfere with the quantity, or flow regime of the waters | 04/01/2023 | N/A |
| **2023.001.007731/INEMA/LIC-07731** | 28/06/2023 | Formed | 09/08/2023 | 30.783 | Alteration license – Raising of Phase 2 of Waste Pile 2 and Implementation of Chlorinated Basin 4 in parts of Non-Magnetic Basin 7 | 11/04/2024 | 11/04/2027 |

Source: Largo, 2024.

# 5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

Most of this section has been reproduced in its entirety from the report **A Preliminary Assessment of The Maracás Vanadium Project** (Hennessey, 2007), Bahia State, Brazil by Micon, as fully cited in Section 27 (References). GE21 has verified the accuracy and completeness of the information contained herein and updated it as required.

## 5.1 Access

The town of Maracás is accessible by a paved secondary highway from the main Brazilian coastal highway through Bahia State. It is approximately 405 road kilometers from Salvador (population: 2.4 million – 2022). The Project is accessed by a 29 km paved secondary highway west of Maracás, followed by a 20 km gravel road that leads to a ranch gate. The Project is on the ranch and a 2.5 km sand and gravel road leads to the Campbell Pit on a small hill.

Maracás has a small general aviation airstrip but no commercial air service. Salvador, being the state capital and one of the larger cities in Brazil, is served by an international airport with several daily flights from São Paulo and Brasilia.

## 5.2 Infrastructure

Domestic power and telephone service are available both at the Property and in the town of Maracás, which is linked to the power grid. Maracás has a population of approximately 27,620 (IBGE 2022 Census). The water supply is available from several rivers and creeks which drain into the general area.

Brazil has a large and highly active mining industry. Infrastructure for mining equipment, services and personnel are available in several centres, including São Paulo, Belo Horizonte, and Cuiabá. The Jacobina gold mine is located 275 km to the north of Maracás. There are several other small active mines in the general area and thus some local mining services are available in Salvador. There is a rail line close to the property and deep-water port facilities are also available. The Porto Alegre village is located south of the Project.

## 5.3 Climate

The local climate has two distinct seasons, one is typically hot and humid and the other during the winter is dry. This climate occurs predominantly in the state's countryside. The average daytime temperature in the countryside is near 30 °C. The temperatures drop in May and June when minimum daytime temperatures remain above 10 °C. Daytime temperatures rise to 40 °C in January and February. The average rainfall is about 1000 mm/year.

The rainy season runs from November to March. During that time, the rains are intense, and the temperatures are high. Some low-lying areas can experience flooding. The dry season is from July to September. The climate does not present any problem for the exploration with diamond drilling or other geological / geochemical work. Tropical weathering can create specific issues for geochemistry and mapping. There are no difficulties in conducting exploration at any time.

### 5.4 Landscape

Approximately 23% of the State of Bahia lies at less than 300 masl, 70% is between 300 to 900 masl and 7% is above 900 masl. There are three types of relief observed: high plateau, coastal, and areas extending between the coast and the high plateau.

The Maracás Property is in the region between the coast and the high plateau, in an area of moderate to low-lying relief.

At the Project site itself, the maximum relief is about 30 m. The surrounding terrain is a typical ranch / farm with low trees and shrubs and comprises several relatively flat plateaus next to a series of creeks and ponds. The property is bounded to the east by a steep cliff that rises 300 m to an area of higher land where the town of Maracás is located. Figure 5-1 is a photograph of the Maracás Property with the hill on which is possible to see the Campbell outcrops in the background.

**Figure 5-1 – Maracás Menchen Mine with Campbell Hill in Background**

Source: Largo, 2021.

Occasional outcrops of pegmatite dike and gabbro are present on the property. The local overburden, which comprises residual soils, lesser alluvial and colluvial soils, ranges from 3 to 10 m in thickness.

The local land is primarily used for agriculture with ranching and grazing being the primary activity on the land at the Project where both mining and exploration activities are permitted.

## 5.5 Vegetation

Central Bahia Region can be characterized as having caatinga-type vegetation, of low thorny plants and bushes adapted to the extremely arid climate. Predominant plants in the mining and development areas include cacti such as the mandacaru and xique-xique, as well as baraúna and umburana trees and bromeliads. The Central Bahia Region vegetation ranges from shrubby, sparsely vegetated type to rocky, savanna type and typically ranges from 10% to 60% cover with lesser coverage typically associated with areas of goat farming activity and subsistence agriculture.

# 6 HISTORY

The history of the Maracás Property has been previously described by Menezes (2005) with a Feasibility Study Summary. The information in this section was taken from research by Brito et al. (1981), Galvão et al. (1984), Brito (2000), Menezes (2005) and other unpublished internal documents from previous operators. Later, more information about the deposit and research was also got from more recent publications such as Arsenault et al. (2013), Costa (2014), Largo Resources Ltd. (2015), Largo Resources Ltd. (2016), Lordão (2020) and other internal performance reports. Much of the following section has been taken from the Micon 2007 NI 43-101 Technical Report (Hennessey et al., 2007).

## 6.1 Summary

Exploration of the Rio Jacaré mafic to ultramafic intrusion by the geologists of CBPM started in 1980 during a regional geological survey. This work led to the discovery of the vanadium-rich titaniferous magnetite occurrence on what is now part of the Maracás Property. In 1981, CBPM conducted an exploration program that included geological mapping, ground geophysical surveys (magnetic and VLF electromagnetic surveys), test pitting and trenching, and diamond drilling of two holes totaling 147 m. In 1983, CBPM continued work and focused on the Campbell deposit when it completed an additional 12 holes totaling 985 m.

Over the past 40 years, the Maracás Menchen Mine has undergone several additional phases of exploration and economic evaluation, including geophysical surveys, prospecting, trenching, diamond drilling programs, geological studies, Mineral Resource estimates, petrographic studies, metallurgical studies, mining studies and economic analyses. These studies have advanced the Project to its present status of mine and to the development of exploration campaigns in target areas along the Rio Jacaré Sill (Table 6-1).

**Table 6-1 – Mineral Exploration areas**

| Pit | Areas | Acronyms of holes |
|---|---|---|
| North of the Pit | Gulçari A – GA – Campbell | FGA, FDGA |
| | Gulçari A Norte – GAN | FGAN, FGB, FGBS, EXP-03 |
| | São José – SJO | FSJ, EXP-01, EXP-02 |
| | Novo Amparo – NAO | FNA |
| | Novo Amparo Norte – NAN | FNAN |
| | Capivara | FC |
| South of the Pit | Gulçari A Sul – GAS | FGAS, EXP-04, EXP-05 |
| | Água Branca | FAB |
| | Jacaré | FJ |
| | Braga | FB |

Source: Largo, 2021.

The Maracás Menchen Mine (Campbell Pit) began mining operating in 2013 with the first $V_2O_5$ production in August 2014, making it the only vanadium miner in Latin America. The mine has seen constant increases in production since that time reaching record production levels in 2020 (Table 6-2).

**Table 6-2 – Historic Production Statistic for the Maracás Menchen Mine**

| Year | Tonnes Mined ('000) | Concentrate Grade ($V_2O_5$%) | $V_2O_5$ Produced (tonnes) |
|---|---|---|---|
| 2014* | 1,022 | 3.23 | 1,032 |
| 2015 | 1,026 | 3.13 | 5,810 |
| 2016 | 1,045 | 3.38 | 7,966 |
| 2017 | 1,114 | 3.38 | 9,297 |
| 2018 | 991 | 3.41 | 9,830 |
| 2019 | 1,156 | 3.29 | 10,577 |
| 2020 | 1,088 | 3.28 | 11,825 |

Note:
* Sept 2013 to Dec 2014 includes start-up and stockpile management.
Source: Largo, 2021.

In 2018, the Company started an expansion process in the production plant to reach a capacity of 12,000 tonnes per year. In July 2019, the Company achieved a monthly production record of 1,042 tonnes of vanadium pentoxide ($V_2O_5$). Also, in 2019, research and test projects were undertaken to recover titanium (pilot phase) and $V_2O_3$ conversion.

The following is a historical summary of the exploration work that has taken place since CBPM involvement, taken, in part, from the reports by CBPM (1981 and 1984), a report by Menezes (2005). Since Largo's involvement several NI 43-101 Technical Reports and internal reports, including Micon 2006, Micon 2007, Akers 2009, RungePincockMinarco 2012, Micon 2016 and finally GE21, 2017.

## 6.2 Exploration History

Between 1981 and 1983, CBPM conducted 14 exploratory holes totaling 1132 m. In 1984, CBPM formed a joint venture with the Odebrecht Group, after a pre-feasibility study completed by CEPED, the State of Bahia Research and Engineering Centre. The joint venture formed a new company, Vanádio de Maracás Ltda., to explore and develop a mine and metallurgical plant to exploit the vanadium-bearing titaniferous magnetite deposit.

During that year, Odebrecht S.A. conducted systematic exploration work, including 1,492 m of diamond drilling in 18 holes on the Campbell deposit. Over the next 3 years (1985 to 1987), Odebrecht completed three more drilling programs to further define the Mineral Resource at Campbell including nine holes (1985) totaling 971 m, eight holes (1986) totaling 1,136 m and four holes (1987) for 421 m, respectively. An additional 24 vertical holes totaling 648 m were drilled for geotechnical information regarding open-pit boundaries and overburden. These holes were not analyzed or included in the database used for the Mineral Resource estimate presented in this Report. Odebrecht also conducted an exploration program testing the three other prospects on the property (Gulçari B, São José and Nova Amparo), which included geological mapping, ground geophysical surveys (magnetics and VLF), trenching, and diamond drilling of 13 holes totaling 661 m.

In 1986, CBPM and Odebrecht Group completed a "reserve" estimate for the Campbell deposit. The holes of 1987 and geotechnical holes were not considered for this estimate.

Odebrecht S.A. conducted several petrographic studies, metallurgical tests and feasibility studies intermittently from 1984 to 1988. These were performed with recognized engineering companies such as CEPED from Brazil, Lurgi GMBH and Gesellschaft für Elektrometallurgie (GFE) from Germany, Mintek from South Africa, Rautaruukki Oyj from Finland, Jaakko Pöyry Engineering and Engenharia e Consultoria Mineral S.A. (ECM), both from Brazil. The conclusion of these studies in 1990 resulted in what was determined to be a feasible project to produce 4000 t/a of vanadium pentoxide ($V_2O_5$) with part converted to ferrovanadium as a final, value-added product. Because of the evaluation, the joint venture decided to contract Finnish company Rautaruukki Oyj for implementing final pilot plant tests and basic engineering design for the Project.

Early in the 1990s, Odebrecht S. A., owning 93% of Vanádio de Maracás shares, decided to restructure the joint venture on a 50/50 basis with CAEMI (VALE) intending to bring to the Project expertise in mining, metallurgy and marketing.

In 1990, a sampling program of the drill core from Maracás was conducted. The samples were also analyzed for platinum and palladium. A total of 167 samples from 10 drill holes were selected for analysis. Ninety-six samples were from magnetitite (a magnetite layer) and 71 samples were from pyroxenite. The results indicated potentially significant platinum and palladium values associated with high-grade $V_2O_5$ values.

The following is a list of studies completed on the property by the above-listed companies:

- CBPM Geological Study.
- Lurgi GMBH Feasibility Study.
- Rautaruukki Oyj Feasibility Study.
- Jaakko Pöyry Feasibility Study.
- Natron Environmental Impact Study.
- ECM Feasibility Study.
- CAEMI (VALE) (VALE) / MBR 1996 Revision of Feasibility Study.
- CRU Market Study.
- CRA Market Study.
- IMS Processing Plant Study.
- MINTEK Test Reports.
- Paulo Abib Geo-Statistical Evaluation & Mining Plan.
- VMSA – National Department of Mineral Production (DNPM) Economic Development Plan.
- 1996 CAEMI (now VALE S.A.) Feasibility Study.
- 1999 Economic Update Report of 1996 Study.

In 2006, Largo signed an agreement with Odebrecht and CAEMI (now VALE) for the Maracás property. Largo conducted a re-sampling program to analyze a portion (approximately 10%) of the old drill core (CBPM and Odebrecht) to verify the past analytical database on the property (see Section 11). Analyses were done at SGS Minerals (SGS) laboratories, both in Belo Horizonte, Brazil and Lakefield, Ontario. Chemical analyses were validated for FeO, $Fe_2O_3$, $SiO_2$, $TiO_2$ and $V_2O_5$ by the XRF method and for platinum and palladium by a 50 g fire assay technique. Based on the verification of the database, Largo completed a revised block model and NI 43-101 compliant Mineral Resource estimate, which was the subject of a Hennessey (2006) report.

Between 2007 and 2020, the following works was conducted:

- geological mappings and refinements to existing maps;
- geophysical survey with magnetometers;
- soil geochemistry campaigns;
- chemical analysis of rock (borehole and field testimonies);
- exploratory drilling on other targets;
- drill mesh refinements;
- infill drilling and deep drilling on the Campbell Pit (Gulçari A) target;
- topographic surveys;
- petrographic studies.

An integrated geological map was prepared between 2011 and 2015, which highlighted the geological targets: NAO, NAN, GA and SJO. These geological plans are presented in Section 7 of this Report, in item 7.2.2 “Near Mine Targets”.

In 2019, a geotechnical study of the Campbell Pit was conducted recording four main structures: Foliation N101/63; NW-SE sub-vertical fracture plane; fracture plane N287/38 and sub-horizontal fracture plane N204/03.

Also, in 2019, a re-logging campaign was undertaken to re-describe old holes to get further clarification on the stratigraphy of the Rio Jacare Sill. Over 18,000 m of the drill core were re-described. These data supported the concept of cycles within the Rio Jacaré Sill, including key marker layers and brought greater detail to the understanding of the current genesis of the deposit.

Between 2007 and 2017, the Company drilled 263 drill holes totaling 50,088.71 m for Mineral Resource calculation and exploration. The table below shows the number of holes, and the meters drilled for the companies CBPM, Odebrecht and VMSA for Campbell Pit and for the satellite deposits. Considering up to the year 2020, the technical inventory has around 651 holes totaling over 104,000 m drilled (Table 6-3).

**Table 6-3 – Summary of Total Drill Holes and Meters Drilled**

| Areas | CBPM | | Odebrecht | | VMSA | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Holes | Total (m) | Holes | Total (m) | Holes | Total (m) | Holes | Total (m) |
| **Campbell** | 14 | 1,132.98 | 39 | 4,020.18 | 214 | 36,596.88 | 267 | 41,750.04 |
| **Targets** | | | 13 | 661 | 371 | 61,877.41 | 384 | 62,538.41 |
| **Total** | **14** | **1,132.98** | **52** | **4,681.18** | **585** | **98,474.29** | **651** | **104,288.55** |

Source: Largo, 2021.

Examples of some of the work developed in recent years are:

- Platinum Group Element (PGE) Mineralization Associated with Fe-Ti-V Deposit, Rio Jacaré Intrusion, Bahia State, Brazil (Campbell, 2012).
- Magnetic Pre-Concentration of Magnetite-Pyroxenite from Vanadium from Maracás S.A. (Costa, 2014).
- Petrographic and Geochemical Characterization of Phosphorus Mineralizations in Apatite of Novo Amparo Norte Target in Sill Do Rio Jacaré – Maracás/Ba (Vasconcellos, 2015).
- Petrographic and Geochemical Characterization of Titanium Mineralizations in the Target Gulçari North of the Sill Do Rio Jacaré – Maracás – Bahia (Fróes, 2015).
- Petrographic and Geochemical Characterization of Magnetites in the Upper Zone of the Capivara Complex, Maracás – Bahia (Knuppel, 2017).
- Petrographic and Geochemical characterization of the mineralizations of elements of the Platinum Group in the Novo Amparo Norte deposit, Maracás-Bahia (Almeida, 2018).
- Integration of geological and geophysical data from the Ti-Magnetite Vanadifera 71eposito f Novo Amparo Norte, Sill do Rio Jacaré, Maracás – Ba (Carvalho, 2018).
- *Integração de dados geológicos e geofísicos do depósito de Ti-Magnetita Vanadífera de Novo Amparo Norte, Sill do Rio Jacaré, Maracás – BA*. Santos, 2018a).
- Descriptive model of chromium mineralizations in the Capivara Complex – Maracás, Bahia and Metallogenetic Implications (Santos, 2018b).
- Geological-Geophysical Characterization of the Sill of the Jacaré River in the São José Target – Maracás-Ba (Jesus, 2019).
- Mapping and Petrographic Characterization of the Titano-Magnetite Vanadiferous Deposit of the Gulçari Target in the South, Maracás/Ba – Contribution to the Understanding of the Economic Geology of the Sill of the Jacaré River (Santos, 2020).
- Mapping and Petrographic Characterization of the Vanadiferous Titano-Magnetite Deposit of the Gulçari Target North, Maracás/Ba-Contribution to the understanding of the economic geology of the Rio Jacaré Sill (Pereira, 2020).
- Stratigraphic Compartmentation of the Mafic-Ultramafic Complex of the Sill of Rio Jacaré in the Campbell Sector and its Implication for Vanadium Mineralization/Maracás-BA (Lordão, 2020).

### 6.3 Historical Drilling

Between 1981 and 1987, CBPM / Odebrecht S.A. drilled 66 holes totaling 5,814 m, testing four deposits on the Maracás property ranging from south to north, Gulçari A (Campbell Pit), Gulçari B (now part of the GAN deposit), São José and Nova Amparo deposit. Table 6-4 sets out a summary of the complete drilling.

**Table 6-4 – Summary of Diamond Drilling – Maracás Property**

| Deposit | Nº of Holes | Length (m) |
|---|---|---|
| **Gulçari A (Campbell Pit)** | 53 | 5,153 |
| **Gulçari B** | 4 | 169 |
| **Sao Jose** | 2 | 115 |
| **Nova Amparo** | 7 | 377 |
| **Total** | **66** | **5,814** |

Source: Largo, 2021.

Most of the work to this point was focused on the Campbell deposit. Previous diamond drilling on the Gulçari A deposit (Campbell Pit), completed by CBPM and Odebrecht S.A. is summarized in Table 6-5. The analytical results from the diamond drilling form the basis for the subsequent, historical "reserve" estimates and metallurgical and feasibility studies on the deposit.

**Table 6-5 – Historical Diamond Drilling Gulçari A deposit (1981-1987)**

| Company | Period | Nº of Holes | Length (m) |
|---|---|---|---|
| **CPBM** | 1981 | 2 | 147.2 |
| **CPBM** | 1983 | 12 | 985.4 |
| **CPBM / Odebrecht** | 1984 | 18 | 1,492.6 |
| **CPBM / Odebrecht** | 1985 | 9 | 971.2 |
| **CPBM / Odebrecht** | 1986 | 8 | 1,135.9 |
| **CPBM / Odebrecht** | 1987 | 4 | 421.3 |
| **Total** | | **53** | **5,153.6** |

Source: Largo, 2021.

Besides Gulçari A, other deposits that are the focus of this Report are NAN and GAN. As of 1987, the NAN deposit had not yet been drilled and the GAN deposit (integration of GAN, GB and GBS) had only 4 holes measuring about 169 m. In 2007, Largo initiated several drilling campaigns to define additional Mineral Resources at the Project.

Between 2007 and 2017, the Company drilled 263 drill holes totaling 50,088.71 m for exploration and Resource development. In addition, metallurgical and geotechnical holes were also completed. For Gulçari A, 160 holes were drilled, totaling approximately 27,594 m drilled. Of these, 103 holes with 12,959.82 m of core were drilled as part of an infill campaign conducted between 2012 and 2013. A new infill drilling campaign was conducted in 2018 with 31 holes totaling 2,323.7 m of core.

Table 6-6 below shows the number and total of holes per target in detail. More details are presented in Section 10 of this Report.

During 2018, Largo completed a drilling campaign with a further 24 holes in NAN with 4,223.30 m core and 14 holes in the South Block (Braga-Jacaré-Água Branca) with 2,218.70 m drilled.

In 2019, Largo drilled 71 holes over three main areas. At Campbell, the Company drilled a total of 1,924.65 m, at GAN 3,050.95 m were drilled and in NAN 4,404.15 m of drilling were completed. At other targets named GAS, SJO and NAO, approximately 57 holes were drilled totaling 9,475 m of core drilled.

In 2020, Largo drilled 94 holes over three areas. At Campbell, 4,755.3 m of core were drilled; at GAN, 6,899.00 m of cored were drilled; and, at NAN, 8,187.65 m of core were drilled. At other targets, 30 holes were drilled, totalling approximately 4,923.80 m of core. Table 6-6 shows the details of this drilling by operator, year and target.

**Table 6-6 – Summary of Historical Drilling by Target**

| Areas | Type / Purpose | 2007-2017 | | 2018 | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Holes | Total (m) | Holes | Total (m) | Holes | Total (m) | Holes | Total (m) |
| **Campbell** | Exploration | 57 | 14,634.03 | | | 5 | 1,924.65 | 18 | 4,755.30 |
| **Campbell** | In Fill | 103 | 12,959.82 | 31 | 2,323.08 | | | | |
| **Gulçari A North (GAN, GB & GBS)** | Exploration | 34 | 5,622.77 | | | 20 | 3,050.95 | 45 | 6,899.00 |
| **Novo Amparo North** | Exploration | 17 | 3,283.50 | 24 | 4,223.30 | 46 | 5,404.15 | 32 | 8,187.65 |
| **Novo Amparo** | Exploration | 13 | 6,149.44 | | | 24 | 4,646.40 | 14 | 2,260.60 |
| **São José** | Exploration | 25 | 5,031.15 | | | 18 | 2,812.60 | 15 | 2,474.95 |
| **Gulçari A South** | Exploration | 2 | 261.00 | | | 15 | 2,016.00 | 1 | 188.25 |
| **South Block (Braga-Jacaré-Água Branca)** | Exploration | 4 | 628.95 | 14 | 2,218.70 | | | | |
| **Capivara** | Exploration | 8 | 1,518.05 | | | | | | |
| **Total** | **-** | **263** | **50,088.71** | **69** | **8,765.08** | **128** | **19,854.75** | **125** | **24,765.75** |

Source: Largo, 2021.

## 6.4 Historical Resource Estimates – Odebrecht, 1986

The historical Mineral Reserve in 1986 per Odebrecht for the project was based on: Detailed geological mapping, geological sections incorporating structural geology and mineralogical and analytical results, sampling of 46 trenches totaling 1,950 m and 53 diamond drill holes totaling 5,153 m, density tests and ore microscopy. The work was prepared by staff geologists from both CBPM and Odebrecht.

The Odebrecht "geological reserve" had a kriging estimation done on a block model of 5 m x 5 m x 15 m. At the time, the mineral inventory was classified as measured Reserves above 150 m of vertical depth. This historical "reserve" estimate, as summarized in Menezes (2005), is set out in Table 6-7. This historical estimate was reported at various cut-off grades as shown in Table 6-8 and is not considered to be compliant with NI 43-101 and should not be taken as supporting data. The qualified person failed to properly classify this historical estimate as current Mineral Resources or Mineral Reserves, therefore, the historical estimate is not being treated as current Mineral Resources or Mineral Reserves by the issuer.

**Table 6-7 – Historical "Reserve" Estimate (1986) – Campbell**

| Cut-off Grade (% $V_2O_5$) | Average Grade (% $V_2O_5$) | Tonnes (millions) |
|---|---|---|
| 0.0 | 1.13 | 13.2 |
| 0.1 | 1.13 | 13.1 |
| 0.2 | 1.14 | 13.0 |
| 0.3 | 1.19 | 12.4 |
| 0.4 | 1.28 | 11.4 |
| 0.5 | 1.37 | 10.4 |
| 0.6 | 1.45 | 9.6 |
| 0.7 | 1.53 | 8.8 |
| 0.8 | 1.62 | 7.9 |
| 0.9 | 1.72 | 7.1 |
| 1.0 | 1.82 | 6.4 |

Source: Largo, 2021.

Largo's program intended to verify the database and provide a Mineral Resource estimate for the deposit following CIM NI 43-101 (Hennessey, 2006), which was updated in 2007 (Hennessey, 2007).

From the information provided above, Paulo Abib Engenharia S.A. built a complete geological and analytical database in the 1990s. This database was used in a geostatistical study of the deposit, where grades were interpolated into a block model by ordinary kriging. The geostatistics were also used to generate a variographic analysis of the deposit.

Within the historical context still, there were two validations of the Mineral Resource estimate in 2009 (Asker Solutions) and 2012 (RungePincockMinarco).

In 2017, Largo retained GE21 to review the optimized mine plan and plant feed schedule for the Maracás Menchen Mine based on the new pit slope and on two proposed expansions that would increase the production rate to 11,520 tonnes per annum of $V_2O_5$ in 2019, and to 13,200 per annum of $V_2O_5$ for 2020 through to the end of the life of mine.

**Table 6-8 – Historical Reserve Estimate – Campbell**

| Class | Tonnage (kt) | % $V_2O_5$ Head | % Magnetics | % $V_2O_5$ Concentrate | $V_2O_5$ Contained (kt) |
|---|---|---|---|---|---|
| Proven | 17.57 | 1.14 | 29.66 | 3.21 | 167.3 |
| Probable | 1.44 | 1.26 | 33.89 | 3.20 | 15.6 |
| **Total** | **19.01** | **1.15** | **29.98** | **3.21** | **182.9** |

Notes:
1. Block 5 m x 5 m x 5 m.
2. Mining Recovery 100%.
3. Dilution 5%.
4. Effective date May 2nd, 2017.

Source: GE21, 2017.

GE21 estimated the Mineral Resources for the Campbell Pit, GAN, and NAN deposits in 2021 following CIM NI 43-101 standards, by the QP Marlon Sarges, MAIG. Table 6-9 summarizes the Mineral Resources of the Gulçari A (Campbell Pit), GAN, and NAN deposits.

**Table 6-9 – Mineral Resources Estimate – Campbell**

| Classification | Mass (Mt) | *Head* | | *Magnetic Concentrate* | | | *Metal Content* | |
|---|---|---|---|---|---|---|---|---|
| | | %$V_2O_5$ | %$TiO_2$ | %MAG | %$V_2O_5$ | %$TiO_2$ | $V_2O_5$ (kt) | $TiO_2$ (kt) |
| **Campbell Pit [a, i]** | | | | | | | | |
| Measured (M) | 16.36 | 1.23 | 7.98 | 31.84 | 3.15 | 5.04 | 201.2 | 1,305.6 |
| Indicated (I) | 3.07 | 0.98 | 7.97 | 28.2 | 2.69 | 4.45 | 30.1 | 244.5 |
| ***Total Campbell Pit M+I*** | ***19.43*** | ***1.19*** | ***7.98*** | ***31.27*** | ***3.08*** | ***4.95*** | ***231.3*** | ***1,550.1*** |
| **GAN [b, ii]** | | | | | | | | |
| Measured (M) | 12.11 | 0.49 | 7.55 | 17.70 | 1.88 | 1.93 | 59.8 | 914.5 |
| Indicated (I) | 9.25 | 0.58 | 8.28 | 21.13 | 2.08 | 2.27 | 54.1 | 766.5 |
| ***Total GAN M+I*** | ***21.37*** | ***0.53*** | ***7.87*** | ***19.18*** | ***1.97*** | ***2.07*** | ***113.8*** | ***1,681.0*** |
| **NAN [c, iii]** | | | | | | | | |
| Measured (M) | 17.48 | 0.7 | 8.73 | 23.43 | 2.38 | 2.97 | 122.4 | 1,526.0 |
| Indicated (I) | 5.41 | 0.74 | 8.76 | 23.51 | 2.48 | 2.78 | 40.1 | 474.1 |
| ***Total NAN M+I*** | ***22.89*** | ***0.71*** | ***8.74*** | ***23.45*** | ***2.40*** | ***2.92*** | ***162.4*** | ***2,000.1*** |
| **Total Maracás Menchen Mine M+I** | | | | | | | | |
| Measured (M) | 45.95 | 0.83 | 8.15 | 24.91 | 2.52 | 3.43 | 383.3 | 3,746.1 |
| Indicated (I) | 17.73 | 0.70 | 8.37 | 23.08 | 2.31 | 2.80 | 124.2 | 1,485.1 |
| ***Total M+I*** | ***63.69*** | ***0.80*** | ***8.21*** | ***24.40*** | ***2.46*** | ***3.26*** | ***507.6*** | ***5,231.2*** |
| Campbell Pit Inferred | 5.10 | 0.92 | 8.20 | 26.68 | 2.63 | 3.98 | 47.0 | 418.6 |
| GAN Inferred | 4.52 | 0.64 | 8.40 | 22.37 | 2.15 | 2.49 | 29.0 | 380.1 |
| NAN Inferred | 5.90 | 0.67 | 7.75 | 21.01 | 2.47 | 2.89 | 39.5 | 456.9 |
| ***Total Maracás Menchen Mine Inferred*** | ***15.52*** | ***0.74*** | ***8.09*** | ***23.27*** | ***2.44*** | ***3.13*** | ***115.5*** | ***1,255.6*** |

Notes:
1. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
2. Mineral Resources were estimated by Marlon Sarges Ferreira, BSc. (Geo), MAIG, a GE21 Associate, meet the requirements of a “Qualified Person” as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
3. The Mineral Resource estimates were prepared under the CIM Standards, and the CIM Guidelines, using geostatistical, plus economic and mining parameters appropriate to the deposit:
   a. Ordinary kriging inside 5m x 5m x 5m block size.
   b. Ordinary kriging inside 10m by 10m by 5m block size.
   c. Ordinary kriging inside 20m by 20m by 5m block size.
4. Presented Mineral Resources inclusive of Mineral Reserves. All figures have been rounded to the relative accuracy of the estimates. Summed amounts may not add due to rounding.
5. Mineral Resource is reported with an effective date of July 12th, 2021.
6. A cut-off grade of 0.3% $V_2O_5$ head is applied in $V_2O_5$ Mineral Resource.
7. A cut-off grade of 1% $TiO_2$ head, derived from an economic function is associated with $TiO_2$ Mineral Resource.

8. Mineral Resources were limited by an economic pit built in Geovia Whittle 4.3 software and following the geometric and economic parameters:
   I. Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ long-term price of $15.60/lb, with an additional premium of $5.50/lb for high purity product. $TiO_2$ pigment selling price of $7,382/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs $37.80/tonne of ore feed. $V_2O_5$ concentrate recovery of 80.5%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 37.9%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.
   II. Pit slope angles ranging from 40.0° to 64°. $V_2O_5$ long-term price of $15.60/lb, with an additional premium of $5.50/lb for high purity product. $TiO_2$ pigment selling price of $7,382/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs $37.80/tonne of ore feed. $V_2O_5$ concentrate recovery of 79.2%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 40.25%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.
   III. Pit slope angles ranging from 40.0° to 64°. $V_2O_5$ long-term price of $15.60/lb, with an additional premium of $5.50/lb for high purity product. $TiO_2$ pigment selling price of $7,382/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs $37.80/tonne of ore feed. $V_2O_5$ concentrate recovery of 70.0%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 38.25%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.

Source: GE21, 2021.

This allowed three of Largo's $TiO_2$ tailing dams to be considered as an Indicated Mineral Resource. The Mineral Resource in the tailings dam were estimated based on topographic surveys and validated with monthly process and reconciliation data from mine production Tailing material data was sampled once every 8 hours, with an average $TiO_2$ content of 11.35%. Table 6-10 shows $TiO_2$ Resources in Non-Magnetic Tailings.

**Table 6-10 – $TiO_2$ Mineral Resources in Non-Magnetic Tailings**

| Pond | Resource Class | Volume (km$^3$) | Density (t/m$^3$) | Resource in Stock (kt) | $TiO_2$ (%) | Contained Metal (kt) |
|---|---|---|---|---|---|---|
| **BNM04** | Indicated | 830 | 1.8 | 1,494 | 11.35 | 170 |
| **BNM02** | Indicated | 640 | 1.8 | 1,153 | 11.35 | 131 |
| **BNM03** | Indicated | 521 | 1.8 | 938 | 11.35 | 106 |
| **Total** | | **1,991** | **1.8** | **3,584** | **11.35** | **407** |

Notes:
1. Stock of "Non-Magnetic" material available in the pounds.
2. Mineral Resources in pounds were estimated based on topographic surveys (primitive data and current data) and validated with monthly process and reconciliation data.
3. Tailing material data was sampled once every 8 hours, with an average $TiO_2$ content of 11.35%.
4. No dilution was applied to the Resource.
5. Mineral Resource estimated by Marlon Sarges Ferreira, BSc. (Geo), MAIG.

Source: GE21, 2021.

Mineral Reserves for Campbell Pit, GAN Deposit and NAN Deposit have an effective date of October 10$^{th}$, 2021.

The Mineral Reserves summary for Campbell Pit, GAN Deposit and NAN Deposit are presented in Table 6-11. Aside from Mineral Reserves from the ultimate pit, three tailings' ponds bearing titanium-enriched material from pre-processed non-magnetic tailings of the vanadium magnetic separation process are estimated separately as Probable Reserves. Mineral Reserves were estimated under the supervision of the QP Mr. Guilherme Gomides Ferreira.

**Table 6-11 – Mineral Resources Estimate – Campbell**

| Category | Tonnage (Mt) | % Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | Mag (Mt) | % $V_2O_5$ | % $TiO_2$ | $V_2O_5$ in Magnetic Concentrate (t) | $TiO_2$ in Non-Magnetic Concentrate (t) |
| **Campbell Pit[i]** | | | | | | | | | |
| Proven | 15.64 | 31.91 | 1.22 | 8.02 | 4.99 | 3.14 | 5.04 | 156,686 | 1,002,650 |
| Probable | 2.21 | 29.77 | 1.02 | 8.22 | 0.66 | 2.69 | 4.54 | 17,677 | 151,610 |
| ***Total Campbell Pit Reserve*** | ***17.85*** | ***31.65*** | ***1.20*** | ***8.04*** | ***5.65*** | ***3.09*** | ***4.98*** | ***174,363*** | ***1,154,260*** |

| Category | Tonnage (Mt) | % Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | Mag (Mt) | % $V_2O_5$ | % $TiO_2$ | $V_2O_5$ in Magnetic Concentrate (t) | $TiO_2$ in Non-Magnetic Concentrate (t) |
| **GAN[ii]** | | | | | | | | | |
| Proven | 12.1 | 17.75 | 0.49 | 7.57 | 2.15 | 1.88 | 1.94 | 40,375 | 874,242 |
| Probable | 8.06 | 21.15 | 0.57 | 8.33 | 1.71 | 2.04 | 2.29 | 34,790 | 632,616 |
| ***Total GAN Reserve*** | ***20.16*** | ***19.11*** | ***0.52*** | ***7.87*** | ***3.85*** | ***1.95*** | ***2.08*** | ***75,165*** | ***1,506,858*** |
| **NAN[iii]** | | | | | | | | | |
| Proven | 17.43 | 23.22 | 0.7 | 8.71 | 4.05 | 2.36 | 2.95 | 95,538 | 1,399,099 |
| Probable | 4.92 | 23.38 | 0.72 | 8.76 | 1.15 | 2.44 | 2.78 | 28,059 | 398,901 |
| ***Total NAN Reserve*** | ***22.35*** | ***23.26*** | ***0.7*** | ***8.72*** | ***5.2*** | ***2.38*** | ***2.91*** | ***123,598*** | ***1,798,000*** |
| **Total Maracás Menchen Mine Proven and Probable Reserves** | | | | | | | | | |
| Proven | 45.17 | 24.76 | 0.82 | 8.17 | 11.19 | 2.62 | 3.4 | 292,599 | 3,275,992 |
| Probable | 15.19 | 23.12 | 0.68 | 8.45 | 3.51 | 2.29 | 2.78 | 80,526 | 1,183,126 |
| ***Total*** | ***60.36*** | ***24.35*** | ***0.79*** | ***8.24*** | ***14.7*** | ***2.54*** | ***3.25*** | ***373,125*** | ***4,459,118*** |

Notes:
1. Mineral Reserves estimates were prepared under the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (Meng), MAIG, a GE21 associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. Mineral Reserves is reported effective date October 10th, 2021.
5. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
6. Vanadium product comes from magnetic concentrate, while $TiO_2$ product from non-magnetic portion.
7. Exchange rate $1.00 = R$5.10.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
   I. Recovery 100% and dilution 3%. Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ long-term price of $7.80/lb, with an additional premium of $2.50/lb for high purity product. $TiO_2$ pigment selling price of $3,691/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs of $37.80/tonne ore feed. $V_2O_5$ concentrate recovery of 80.5%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs of $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 37.9%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.
   II. Recovery 95% and dilution 5%. Pit slope angles ranging from 40° to 64°. $V_2O_5$ long-term price of $7.80/lb, with an additional premium of $2.50/lb for high purity product. $TiO_2$ pigment selling price of $3,691/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs of $37.80/tonne ore feed. $V_2O_5$ concentrate recovery of 79.2%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs of $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 40.25%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.
   III. Recovery 95% and dilution 5%. Pit slope angles ranging from 40° to 64°. $V_2O_5$ long-term price of $7.80/lb, with an additional premium of $2.50/lb for high purity product. $TiO_2$ pigment selling price of $3,691/tonne. Mining costs of $1.60/tonne for mineralization and waste. Vanadium processing costs of $37.80/tonne ore feed. $V_2O_5$ concentrate recovery of 70.0%. Ilmenite concentrate costs of $55.00/tonne processed. $TiO_2$ pigment costs of $1,374/tonne of Ilmenite concentrate. $TiO_2$ overall recovery of 38.25%. General and Administrative (G&A) costs of $0.16/lb $V_2O_5$.

Source: GE21, 2021.

## 6.5 Historical Technical and Environmental Studies

In 2008, Aker Solutions were retained by Largo to complete a Definitive Feasibility Study (DFS) for the Maracás Vanadium Project. The results were presented in a NI 43-101 Technical Report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project, Brazil**, amended version dated May 2009.

Since the completion of this DFS, Largo has continued to advance the Project. Additional studies and technical effort have been completed in the following areas:

- Pilot-scale metallurgical testing at Fundação Gorceix, Ouro Preto, August-September 2010.

- Conceptual design of alternatives for disposal of non-magnetic tailings, Ausenco Minerals, May-June 2010.
- Dry stacking feasibility study, Ausenco Minerals, September 2010
- Land Agreement with Banco Econômico S.A. to secure land rights for mining and project development at São Conrado and São Pedro da Goiania lands, July 2011.
- Environmental permit issuing:
  - Localization license – CEPRAM Resolution nº 3941, 10/10/2008.
  - Installation (Construction) license – Inema Resolution nº 1286, 10/20/2011.
  - Grant of Water Rights – ANA resolution nº 684, 09/16/2011.
  - Air pollutant emissions modeling and simulation by SECA, February 2012.
  - 13,401 m of additional Resource drilling in Campbell and B trends.
  - Promon Engenharia – basic engineering work for a hydrometallurgical plant, including infrastructure, process flowsheet re-evaluation and design, infrastructure engineering, capital and operating cost updates, production throughout review, March-November 2011.
  - HYDROS Engineering – basic engineering work for water pipeline and capital and operating costs estimates, May-November 2011.
  - VOGBR, basic engineering of main geotechnical structures, waste dump, tailings facility, site drainage design, hydrogeological studies and costs estimates, May-November 2011.
  - RPM, basic mine design, with CAPEX and OPEX estimates, May-November 2011.
  - Project financed by Bank ITAÚ BBA.
  - Construction began in June 2012.
  - Commissioning began in March 2014.
  - Mining started in September 2013.
  - Ramp-up to full production on the expanded case started in August 2014 and in May 2016 were 97.5% of nameplate production (800 tonnes $V_2O_5$/month).

This Technical Report includes the results of the updated engineering and environmental studies, and everything described above.

# 7 GEOLOGICAL SETTING AND MINERALIZATION

Sections 7.1 – Regional Geology – and 7.2 – Rio Jacaré Intrusion – have been reproduced from the NI 43-101 compliant Technical Report titled **Maracás Vanadium Project, 1.4 Million Tonnes per Year Processing Plant,** dated March 4$^{th}$, 2013, prepared for Largo Resources Ltd. by RungePincockMinarco (as fully cited in Section 27, References). The rest of the information on which this section is based is taken from internal documents provided to GE21 by Largo Inc. GE21 has reviewed such information and is confident as to its accuracy and completeness.

## 7.1 Regional Geology

Brito (2000), Sá et al. (2005) and Teixeira et al. (2000) have described the regional geological setting for the Maracás property. These references give a detailed description of the geotectonic evolution of the São Francisco craton. The following is a summary of their work. The Rio Jacaré Intrusion, which hosts the Project vanadium mineralization, is in the south-central part of Bahia state in northeastern Brazil. It lies within the Archean São Francisco craton, which in this area is composed of the Contendas-Mirante Complex and the Gavião and Jequié blocks (Figure 7-1).

The intrusion is on the eastern edge of the Contendas-Mirante supracrustal sequence, which forms a large anticlinorium trending north-south. The supracrustal rocks are between the early Archean Gavião block to the west, which is composed predominantly of tonalite-trondhjemite granodiorite, and the Archean Jequié block to the east, which is composed predominantly of charnockite and enderbite intrusive rocks with strong calc-alkaline affinities and granulite facies metamorphic rocks (Teixeira et al., 2000).

The Contendas-Mirante Sequence is thought to be younger than the adjacent Gavião and Jequié blocks and comprises an Archean basal volcanic unit overlain by a Paleoproterozoic member containing flysch and metavolcanic rocks that are overlain by a clastic member. A Rb/Sr age of 2.0 Ga for the granite, derived from the melting of the Contendas-Mirante metapelites, corresponds to the timing of the Tran Amazonian orogeny (2.14 to 1.94 Ga; Teixeira et al., 2000). The Contendas-Mirante Sequence was deformed by the collision of the Gavião and Jequié blocks during the Tran Amazonian orogeny and is now along part of the major Contendas-Jacobina lineament (Teixeira et al., 2000).

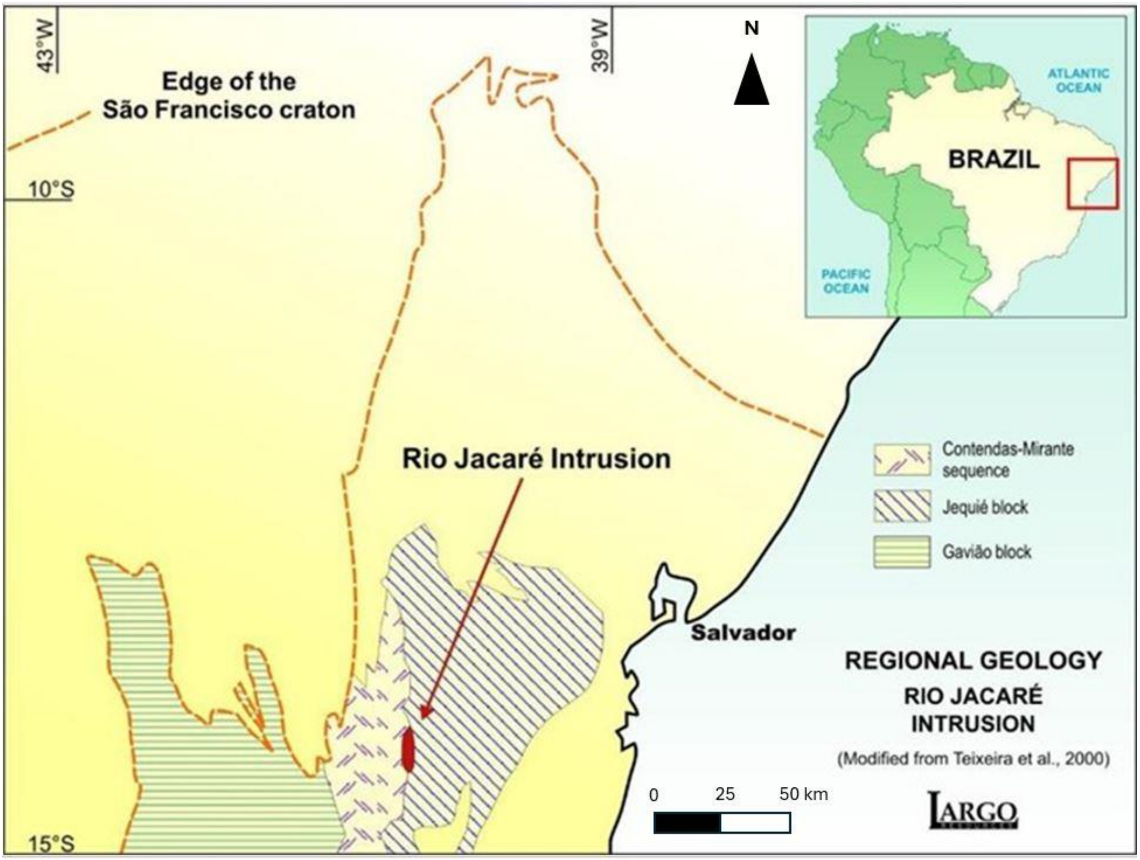



**Figure 7-1 – Maracás Area Simplified Regional Geology Map**

Source: Largo, 2017.

## 7.2 Rio Jacaré Intrusion

The Rio Jacaré mafic-ultramafic Intrusion (Figure 7-2) is composed of gabbro. It is a linear sheet-like structure that strikes north-south, with a length of approximately 70 km, an average width of 1.2 km, and a dip of 70° E. The intrusion has been described previously as a sill intruded into the volcanic rocks of the lower unit of the Contendas-Mirante gneissic complex (Brito, 1984; Galvão et al., 1986). However, the Rio Jacaré Intrusion is fault bounded to the east and west, and, therefore, its contacts with both the Contendas-Mirante Sequence and Jequié block are tectonic. The age of the intrusion is poorly known. Whole rock dating of rocks from the intrusion itself includes a Pb/Pb age of 2.47 Ga ±72 Ma, a Sm/Nd age of 2.8 Ga ± 68 Ma, and a zircon age of 2.64 Ga ± 5 Ma (Brito et al., 2001).

The intrusion is cut by granitic pegmatite veins that are closely related to a granite intrusion that has an age of 1.94 Ga ±54 Ma (Brito et al., 2001). Metamorphism and deformation have modified many of the igneous textures and minerals of the intrusion. Relict minerals are rare, but some igneous textures are still preserved such as olivine cumulate textures and layering between pyroxenite and gabbro. The pyroxene in these rock types is now largely altered to hornblende, which is replaced by actinolite, tremolite and chlorite in many samples. The presence of amphibole and garnet in the gabbro and magnetitite (an igneous rock composed of magnetite) in the Rio Jacaré Intrusion indicates amphibolite grade metamorphism.

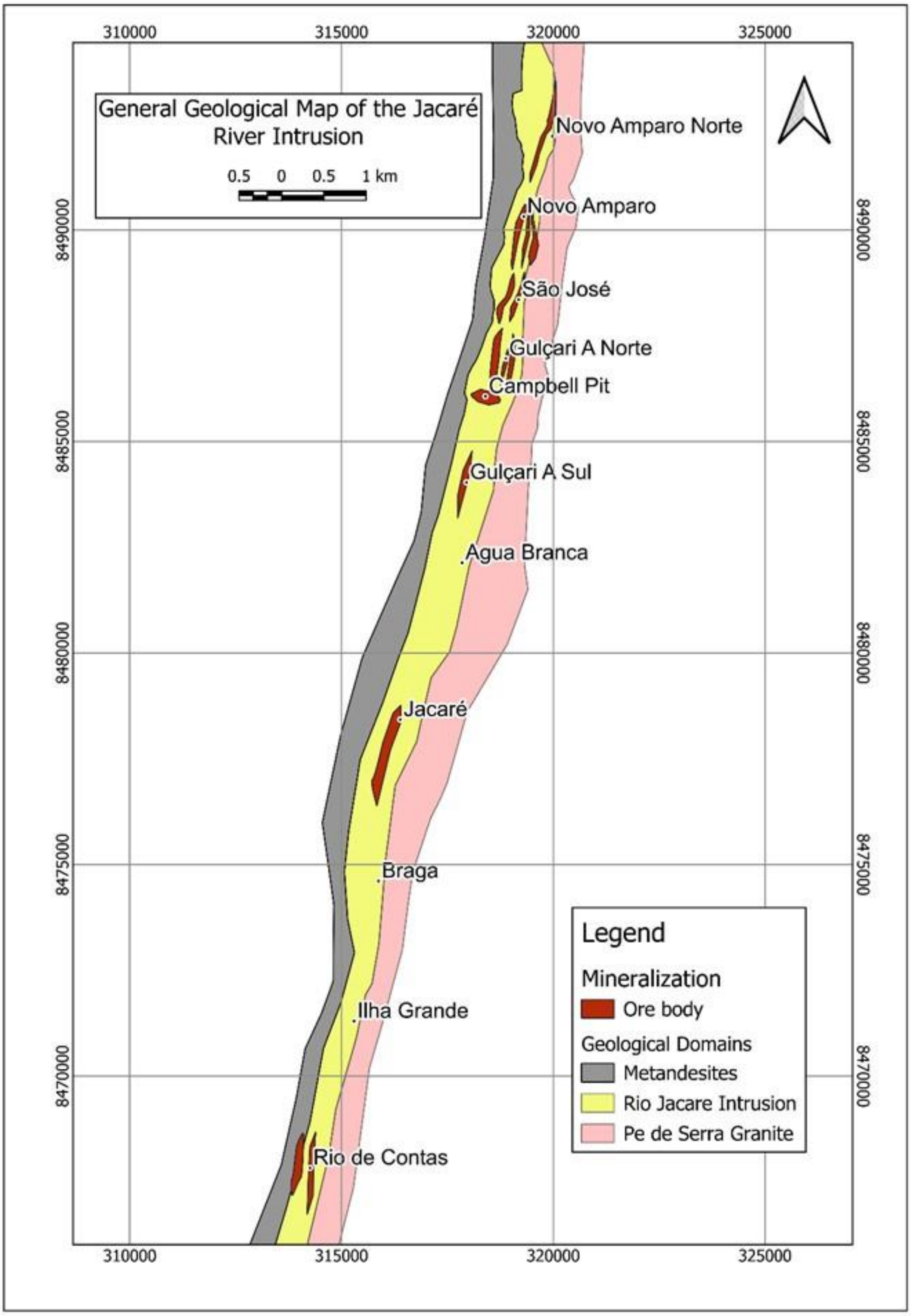



**Figure 7-2 – Geological Geology Map of the Rio Jacaré mafic-ultramafic Intrusion in the general vicinity of the Maracás Menchen Mine showing the Gulçari A Deposit (Campbell Pit) and the other Near Mine Targets**

Source: Largo, 2024.

The gabbro is massive, coarse grained, and slightly foliated, whereas the diorite is massive and mainly fine grained. The primary igneous mineralogy of the gabbro comprised plagioclase and orthopyroxene as cumulate phases, with interstitial clinopyroxene. The orthopyroxene, clinopyroxene and olivine mineralogy has been examined in detail by Brito (2000). Quartz and biotite are present as minor phases, and apatite and titanite are common accessory phases. Within the Lower zone, there are lenses of magnetite-rich rocks. The outer margins of the lenses comprise magnetite-bearing pyroxenite with 30% to 70% opaque minerals. The centers of the lenses comprise massive magnetite (magnetitite). These bodies were previously described as forming pipes and plugs intruded into the gabbro of the Lower zone (Brito, 1984). However, the contact relationships with the gabbro are not clear, because the bodies are usually bounded by faults and are poorly exposed. They are described in greater detail below. The Upper zone has an average thickness of 600 m and is formed of layered gabbro, varying from leucogabbro to melagabbro with some cyclic units of gabbro, pyroxenite, magnetite-bearing pyroxenite, and magnetitite. The pyroxenite comprises thin layers, typically a few centimetres to less than 1 m in thickness, and which are many times associated with the magnetite bodies.

## 7.3 Property Geology

The north-south trending Rio Jacaré Intrusion underlying the Maracás Mine property and can be traced for the full 8 km strike length which occurs on the property to the north of Campbell Pit, and for over 25 km to the south. Recent work by Largo Inc. has resulted in a detailed subdivision of the Upper Zone of the Rio Jacaré Intrusion within the Project area into several cyclic units. These cyclic units are as follows (lowermost to uppermost) (Table 7-1, Figure 7-3).

**Table 7-1 – Description of cyclic units of Rio Jacaré Intrusion**

| Cycle | Description |
|---|---|
| **TZ (Transition Zone)** | The TZ comprises a thick layer of leucogabbro (70-110 m) interspersed with pyroxenites (3-10 m) and magnetite pyroxenites (1-5 m). The TZ is the lowermost stratigraphic unit within the Rio Jacaré Intrusion containing modal magnetite, although it is only weakly mineralized. Note that the Lower Zone, which lies below the TZ, has not been described in detail as no magnetite mineralization is known to occur within it. |
| **C1** | C1 – The base of the C1 cycle is market by a massive magnetitite layer ~ 1-3 m thick, that grades upwards into magnetite pyroxenite or pyroxenite with magnetite, and then into a biotite gabbro with sparse disseminated magnetite and thin pyroxenite bands.<br>The $SiO_2$ values increase to the top of the cycle, defining a modal stratification that shows the crystallization sequence of the magma depleting in modal magnetite and enriching in plagioclase. |
| **C2** | The C2 cycle is thin (maximum 5-20 m) and laterally discontinuous, comprising a thin basal magnetitite (1-3 m), grading into a magnetite pyroxenite and an upper biotite gabbro. |
| **C3** | The C3 cycle contains the most well-developed magnetite mineralization within the Project area and hosts the bulk of the mineralized material at the Campbell Pit. It comprises a lower magnetite pyroxenite, grading into a ~20-40 m thick magnetite layer unit, followed by another magnetite pyroxenite, a magnetite gabbro and an upper band of unmineralized gabbro. The magnetitite is interspersed with magnetite pyroxenite, and unlike the upper cycles where igneous rocks form laterally continuous stratigraphic units, the magnetitite within the C3 cycle does not appear laterally continuous and pinches out to the north and to the south. Some portions of the rock have a cumulative texture (pyroxene crystals and opaque minerals immersed in hornblende). Another important characteristic of this cycle is anomalous PGE values with Pd and Pt values up to 700 ppb. |
| **C4** | This cycle comprises a basal magnetite pyroxenite, overlain by magnetite gabbro and gabbro and leucogabbro containing disseminated magnetite. These gabbroic units display compositional macro-layering. The upper part of this cycle is marked by a ~ 3 m anorthosite unit. AT the GAN and SJO deposits, additional magnetite gabbro and magnetite pyroxenite units are observed within the cycle that are not observed elsewhere.<br>In the contact of C4 with C5, a titano-biotite-gabbro occurs with well-developed biotite and mylonitization features. In a more current analysis, this is considered the last cycle to present the biotite-gabbro lithotype (occurring from TZ to C4). |

| Cycle | Description |
|---|---|
| **C5** | A unit of gabbro with a band of magnetite gabbro and magnetite pyroxenite, and an upper pyroxenite overlain by an anorthosite band. This magnetite metagabbro layer is one of the main layers of the Novo Amparo Norte target. In the São José target, a layer of metamagnetitite is common in the middle of the cycle. Occurrences of PGE in the ore at the base of the cycle. |
| **C6** | The cycle is described as a metamagnetitite layer with an approximate thickness of ten meters grading into magnetite-gabbro and enriching in plagioclase towards the top. This defines the following stratigraphic sequence: Metamagnetitite>magnetite metagabbro> gabbro with magnetite> metagabbro> metanorthosite. This cycle represents a significant resource for the company due to the geological continuity and the occurrence of high grades of $V_2O_5$ in the targets Novo Amparo Norte and São José. |
| **C7** | This cycle is characterized from the bottom to the top, by metamagnetitites, magnetite metagabbro and metagabbro, showing a reduction in magnetite and an increase in plagioclase to the top. This cycle has elevated levels of $TiO_2$ (15 to 25 wt%) in the metamagnetitite and magnetite metagabbro. The C7 cycle is also noted for cumulus apatite, which appears immediately above the magnetite-enriched lower portion, within the lower part of the gabbro or magnetite gabbro unit. |
| **C8** | This thick cyclic unit contains a lower zone of magnetite gabbro grading into a ~20 m thick magnetitite overlain by a 2-3 m mottled anorthosite with clinopyroxene oikocrysts and a ~130 m thick package of gabbro and leucogabbro. The gabbro displays distinctive plagioclase phenocrysts, and the base of the sequence (with a gradation upwards from magnetite gabbro to magnetitite) differs from typical sequences with basal magnetitite units having sharp lower contacts. Anomalous copper values (of up to 3000 ppm) are also noted in this cycle. |
| **C9** | This is a broad cycle with a ~30 m magnetite gabbro package at the base, overlain by gabbro, anorthosite and magnetite leucogabbro, and characterised by a thick (40-150 m) unit of anorthosite making up the uppermost portion of the cycle. This anorthosite has a cumulus texture and distinctive pyroxene oikocrysts near the top of the cycle. |
| **C10** | The uppermost cyclic unit observed at the Rio Jacaré Intrusion comprises a ~5-20 m thick magnetite gabbro grading upwards into gabbro, leucogabbro and anorthosite. The upper contact of the C10 cycle with the Pé de Serra Gneiss is a tectonic contact. |

Source: Largo, 2021.

Different areas of the sequence (Figure 7-3) are present in different areas of the Project – the lowermost stratigraphic units (TZ, C1, C2, C3, C4) are only observed in the Campbell Pit, whereas the upper portions of the sequence (C5 to C10) are observed elsewhere through the deposit.

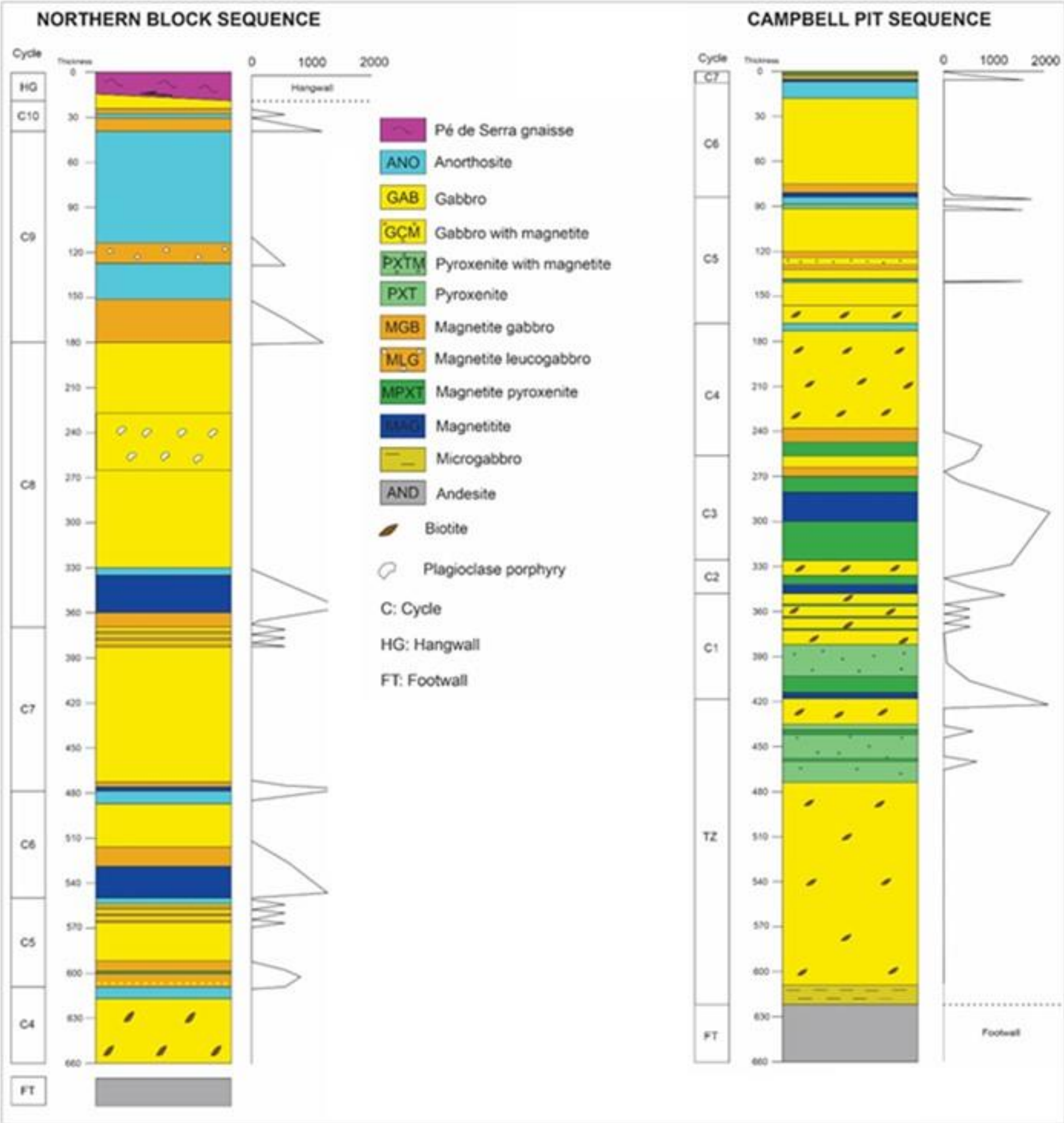



**Figure 7-3 – Stratigraphic sequence of the magmatic pulses' proposal according to last work of Largo**

Source: Largo, 2021.

It is interpreted that cycles C1 to C4 represent the feeder zone of the Rio Jacaré Intrusion, and that these cycles show less lateral continuity across the entire length of the deposit and are restricted to this feeder zone. In contrast, cycles C5 to C10, which form the upper portions of the deposit, are laterally extensive over the entire strike length of the Rio Jacaré Intrusion. A schematic longitudinal section illustrating this relationship is shown in Figure 7-4.

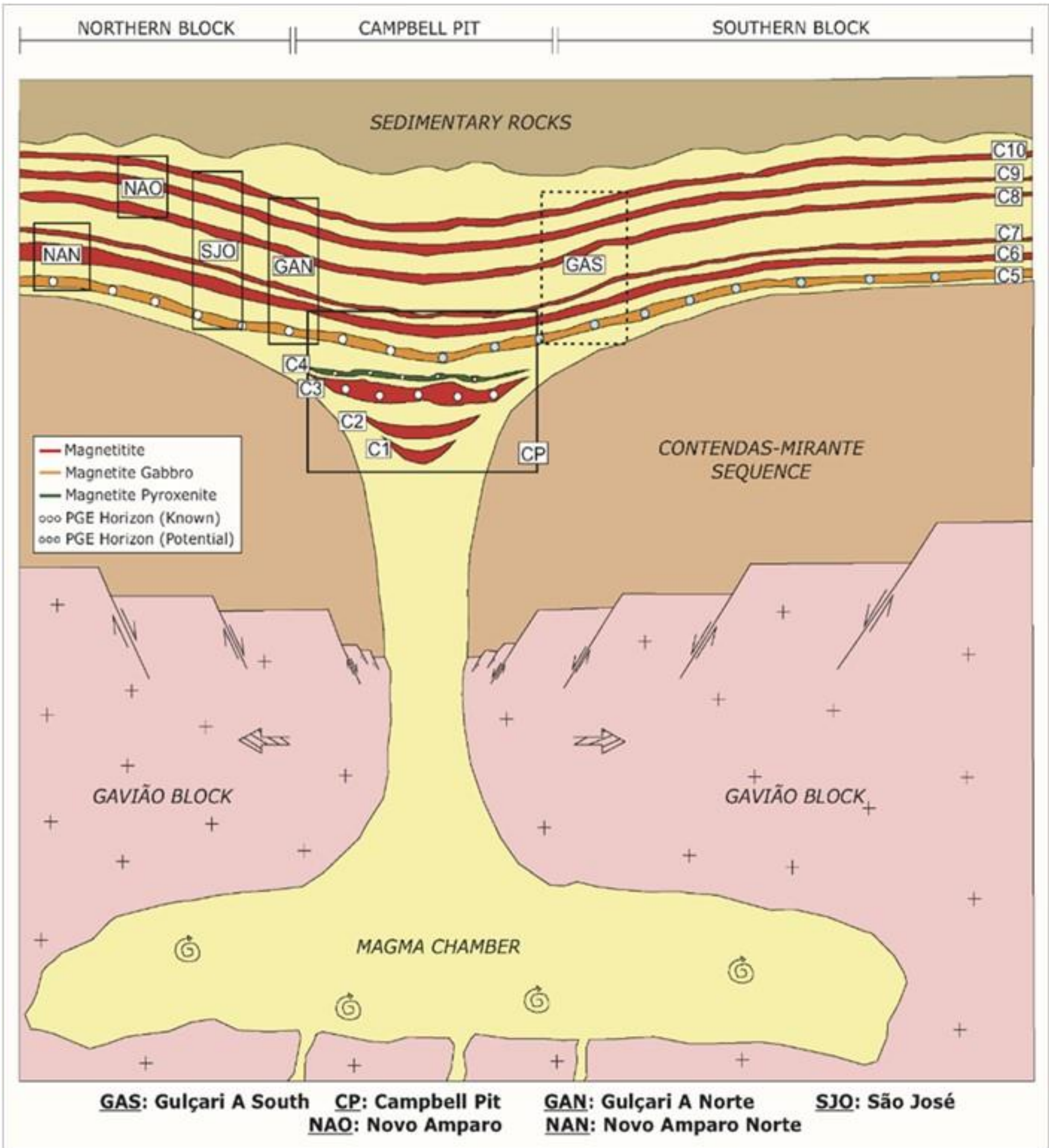



**Figure 7-4 – Schematic longitudinal section through the Rio Jacaré intrusion illustrating the continuity of various cyclic units**

Legend: note that units are not drawn to scale.
Source: Largo, 2020.

## 7.4 Individual Deposits

The NNE-striking, ~70° ESE-dipping Paleoproterozoic Rio Jacaré Intrusion occurs throughout the 40 km long Project exploration permits. Along the strike of the Rio Jacaré Intrusion within the property, several discrete deposits or areas containing vanadium-rich titanomagnetite bodies have been defined from north to south Novo Amparo North (NAN), Novo Amparo (NAO), São José (SJO), Gulçari A North (GAN), Gulçari A (Campbell Pit), Gulçari A South (GAS), Água Branca (ABR), Jacaré (JAC), Braga (BRG), Ilha Grande (ILG) and Rio de Contas (RIOCON). Each of these deposits are at various stratigraphic heights within the Rio Jacaré Intrusion, and thus occur within different cyclic units (Figure 7-5).

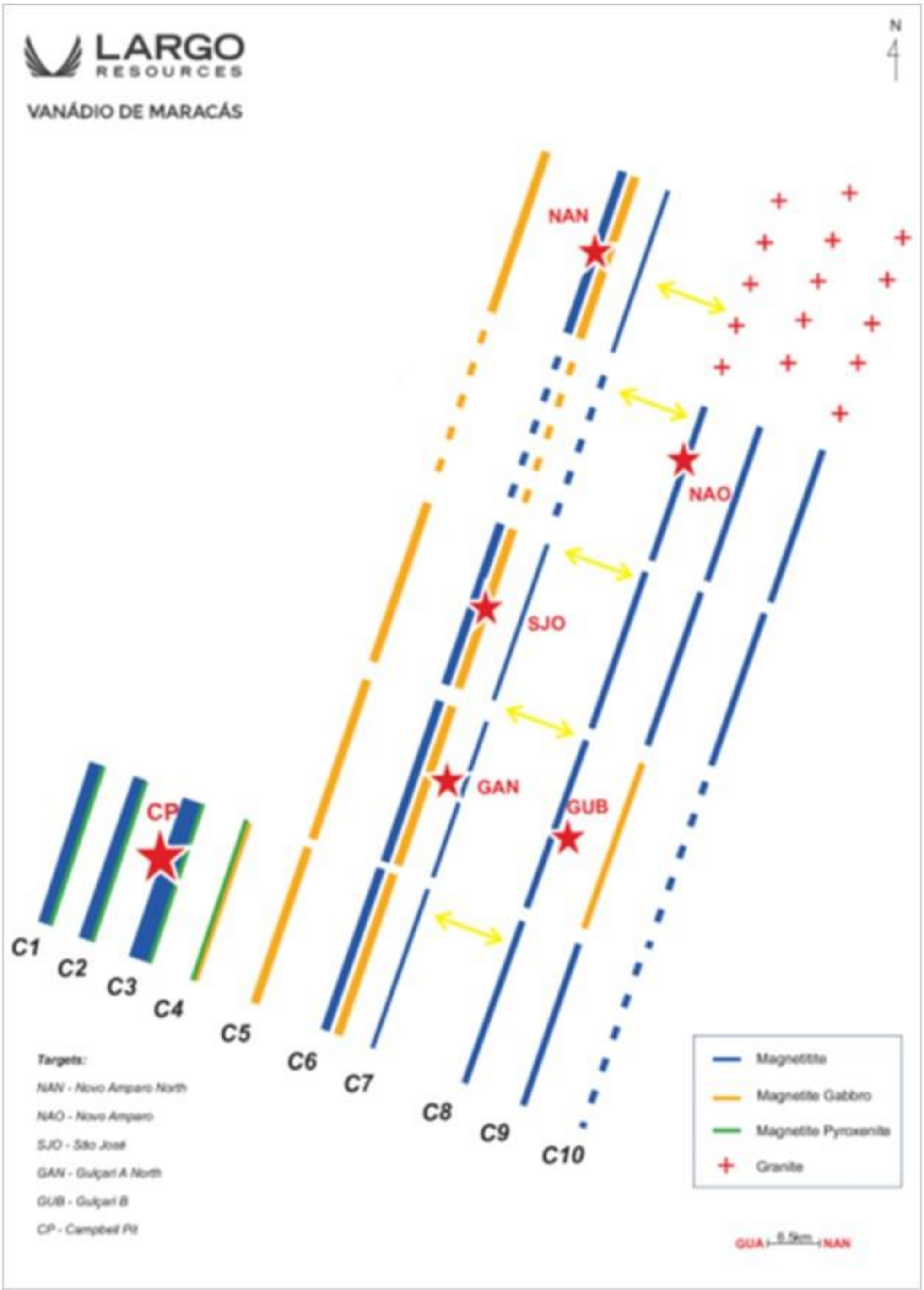



**Figure 7-5 – Schematic map of the location of the various deposits relative to cyclic units**

Source: Largo, 2021.

Within all deposits, mineralized bodies comprise magnetitite layers, magnetite pyroxenite layers and magnetite gabbro layers formed as cyclic magmatic units associated with the surrounding gabbro. Typically, magnetite-enriched units have sharp magmatic contacts with units below and gradational contacts with the units above.

The Rio Jacaré Intrusion can be described by considering the Gulçari A (Campbell Pit) as the central point, with deposits divided into North and South groups. The North deposits include Gulçari A North (GAN), São José (SJO), Novo Amparo (NAO), and Novo Amparo Norte (NAN). The South deposits include Gulçari A South (GAS), Água Branca (ABR), Jacaré (JAC), Braga (BRG), Ilha Grande (ILG), and Rio de Contas (RIOCON).

### *7.4.1 Gulçari A Deposit – Campbell*

The Gulçari A deposit (also referred to as Campbell Pit) is in the lower parts of the Upper Zone of the Rio Jacaré Intrusion, between cyclic units C1 and C9, with magnetite mineralization predominantly hosted within the C1 to C4 units (Figure 7-6). For better interpretation and continuity of the main mineralized level of the deposit, the cyclic units C1 to C4 were grouped together. This C1-C4 unit comprises medium to coarse-grained gabbro containing lenses of magnetitite, magnetite-pyroxenite, and pyroxenite. These lenses are interpreted to pinch out along strike (i.e., in a N-S direction), and it is within this C1-C4 unit that the largest concentrations of vanadium-rich magnetite known on the property are found (Brito, 1984).

The magnetite deposit extends approximately 350 m along strike, is up to 150 m wide, and has been intersected in drilling to vertical depths of at least 300 m, likely extending below these depths (Figure 7-6). Notably, magnetite mineralization is contained within the C1-C4 unit in magnetite pyroxenite and magnetitite. The topography represents the pit as of September 2020, with the original topography also indicated.

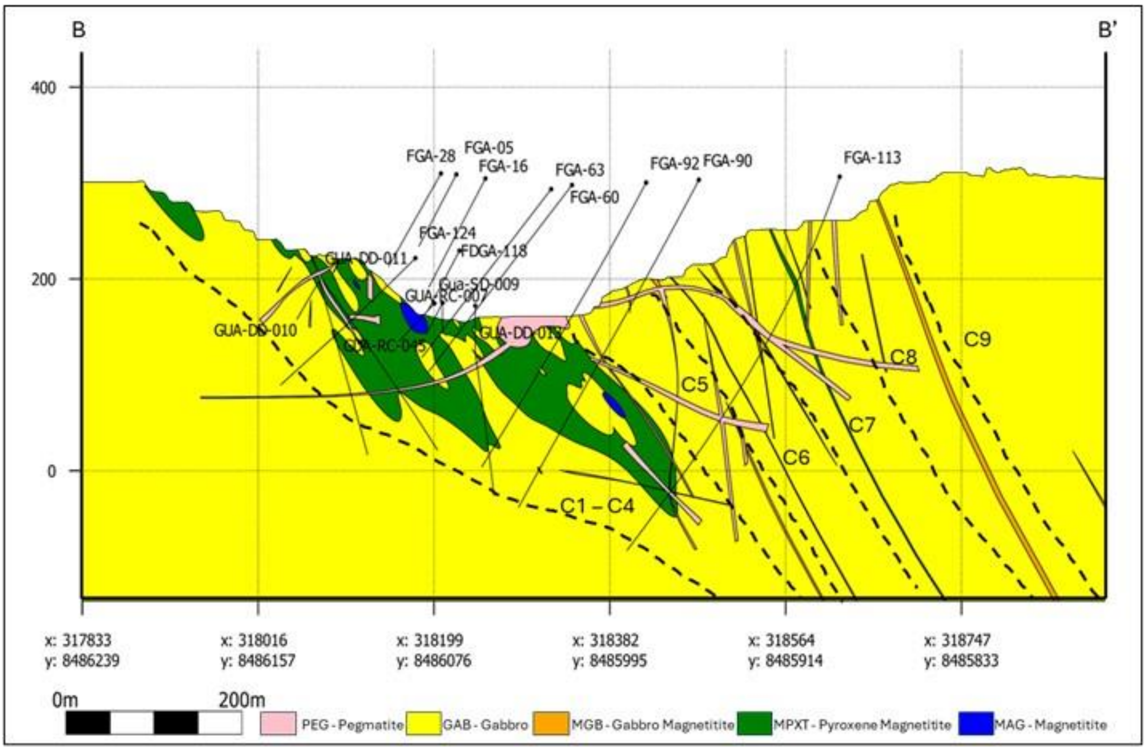



**Figure 7-6 – Cross-section (NW-SE) through the Campbell deposit, showing lithologies and their subdivision into cyclic units from TZ to C9**

Source: GE21, 2024.

The magnetite-pyroxenite body at the Campbell deposit was previously interpreted as a separate pipe-like intrusion cross-cutting the gabbro (Sá, 1992), but more recently has been understood as having formed within the feeder zone of the Rio Jacaré intrusion and representing one of the lower cyclic units (the C1-C4 unit) of this intrusion. The horizontal unit’s distribution and contact relations is show in the Figure 7-7.

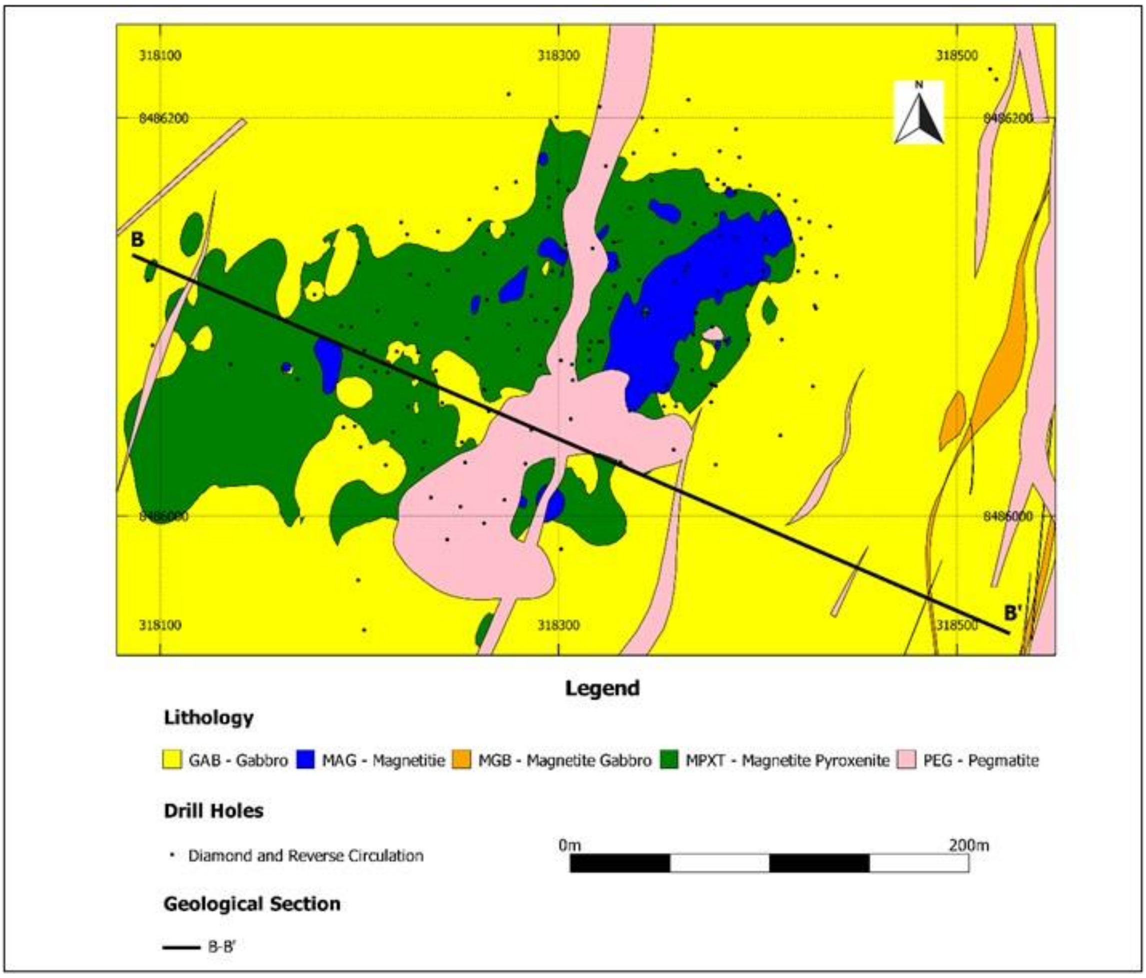



**Figure 7-7 – Geological Map of the Campbell deposit**

Source: Largo, 2024.

### *7.4.2 North Deposits*

The Campbell’s northern deposits (GAN, SJO, NAO, and NAN) exhibit some differences in the distribution of vanadium and titanium contents and the dip of the bodies. However, they are generally similar in terms of the lithological stacking of the cyclic units. All these deposits can be described within the C4 to C10 cycles. It is possible to identify the entire differentiation sequence, which starts with units richer in magnetite and pyroxene at the base. As the sequence progresses upwards, there is a depletion of these minerals, accompanied by an enrichment of plagioclase towards the top.

#### *7.4.2.1 Gulçari A North – GAN*

The GAN deposit is located immediately to the north of the Campbell deposit and is a northward continuation of the upper, more continuous cyclic zones of the Campbell deposit. The GAN deposit extends for approximately 1.2 km strike, with mineralization hosted within magnetite, magnetite gabbro and magnetite pyroxenite between the C4 and C9 cyclic units.

Lithologies comprise medium to coarse grained magnetite gabbro with local layers of massive magnetitite and fine to medium grained gabbro with narrow interlayers of magnetite gabbro, pyroxenite, and anorthosite. The massive magnetitite is black with 60-70% magnetic oxides and traces of disseminated sulfide (pyrite and chalcopyrite) as well as small interlayers of magnetite-pyroxenite and anorthosite.

The bulk of mineralization is contained within two magnetite-rich horizons (magnetitite and magnetite gabbro) in the C6 and C8 cycles, as well as within a magnetite gabbro in the C9 cycle. The C6 magnetitite is approximately 3 m in average thickness and extends for a known strike length of ~1 km. The C8 magnetitite is a layer extends for approximately 350 m along strike and has with a width of up to 20 m, averaging approximately 10 m, showing sideways gradient for magnetite gabbro. The C9 magnetite gabbro extends for a known strike of ~1.2 km and averages 30 m in thickness. The magmatic layering and mineralized zones have strike direction of 020° with a dip ranging from 60° - 65° to the southeast. In the southern part of the deposit, the main ore body is cut by a fault with a northwest / southeast strike direction. All layered magmatic rocks are cut by later pegmatite dykes with a range of orientations.

#### *7.4.2.2 São José – SJO*

The SJO Deposit is in the upper zone of the Rio Jacaré Intrusion and comprises two magnetitite units within the C6 and C8 cycles, along with an additional mineralized magnetite gabbro within the C9 cycle. The mineralized zones and other unmineralized magmatic lithologies have a strike of 020° and dip at 65° to the southeast. The magnetitite units are fine to medium-grained and massive, while the magnetite gabbro is coarse-grained and foliated, with a mineral assemblage composed of plagioclase, amphibole, garnet, and magnetite.

The C6 magnetitite unit averages 5 m in thickness and has been drill-tested along approximately 400 m of strike. The C8 magnetitite unit is narrower, approximately 3 m thick, and has been evaluated along approximately 250 m of strike. The C9 magnetite gabbro is about 30 m thick and has been evaluated over approximately 300 m of strike.

On the east side, the deposit is hosted by magnetite gabbro, characterized by a coarse-grained, foliated mineral assemblage composed of plagioclase and amphibole, with garnet, and magnetite. On the west side, the ore body is in contact with a fine-grained, strongly foliated gabbro with narrow bands of pyroxenite. The magnetitite is dark gray to black, fine to medium-grained, and massive.

*7.4.2.3 Novo Amparo – NAO*

The NAO Deposit is between the NAN and SJO deposits in the upper cyclic units from C5 to C8 of the Rio Jacare Intrusion. The main mineralized level is the magnetitite layer associated to C8 cycle. The mineralized zones and other unmineralized magmatic lithologies have a strike of 010° and dip at 65° to the southeast. The magnetitite layer is fine to medium grained and massive, and the magnetite gabbro is coarse grained and foliated, with a mineral assemblage composed of plagioclase and amphibole, with garnet and magnetite. The C8 magnetitite is discontinuous with an average thickness of 5 m, reaching locally 20 m, with approximately 350 m along strike.

The magnetite gabbro occurs in the western part of the deposit and is characterized by fine- to coarse-grained mineral assemblage of plagioclase, amphibole, titanomagnetite, and disseminated sulfide (pyrite and chalcopyrite). The deposit is cut longitudinally by bodies of quartz-feldspar pegmatite that cross the mineralized zone. These pegmatites have a strike direction of approximately 030° and dip at 60 - 70° to the northwest.

*7.4.2.4 Novo Amparo North – NAN*

The NAN Deposit is the northernmost deposit identified to date within the Project area and is the northern extension of the C4 to C7 cyclic units of the Upper Zone of the Rio Jacaré intrusion. The deposit is overlain by tertiary cover and was detected by a ground magnetometer survey conducted in 2011, which was followed-up with drilling that intersected a 7 m thick massive magnetitite layer in the first hole drilled.

The deposit extends for approximately 2.5 km of strike length and has been drilled in detail over approximately 1.8 km of this strike. Figure 7-8 shows the geological map of the NAN deposit. The geology of this deposit comprises fine to medium grained gabbro and magnetite gabbro, with layers of anorthosite, magnetite pyroxenite and magnetitite. All layers strike 020° and dip approximately 70-75° SE. Mineralization is hosted in a ~10-20 m thick magnetitite layer that grades upwards into magnetite gabbro. This layer is found within the C6 cyclic unit and comprises >60% of magnetic oxides besides pyroxene, amphibole, garnet and disseminated sulfides (pyrite). Small interbedded layers of magnetite pyroxenite, magnetite gabbro and anorthosite are observed within this magnetitite. At the northern end of the deposit, the mineralized zone is interrupted by a northwest-southeast trending fault. Figure 7-9 shows a representative cross-section of The NAN deposit.

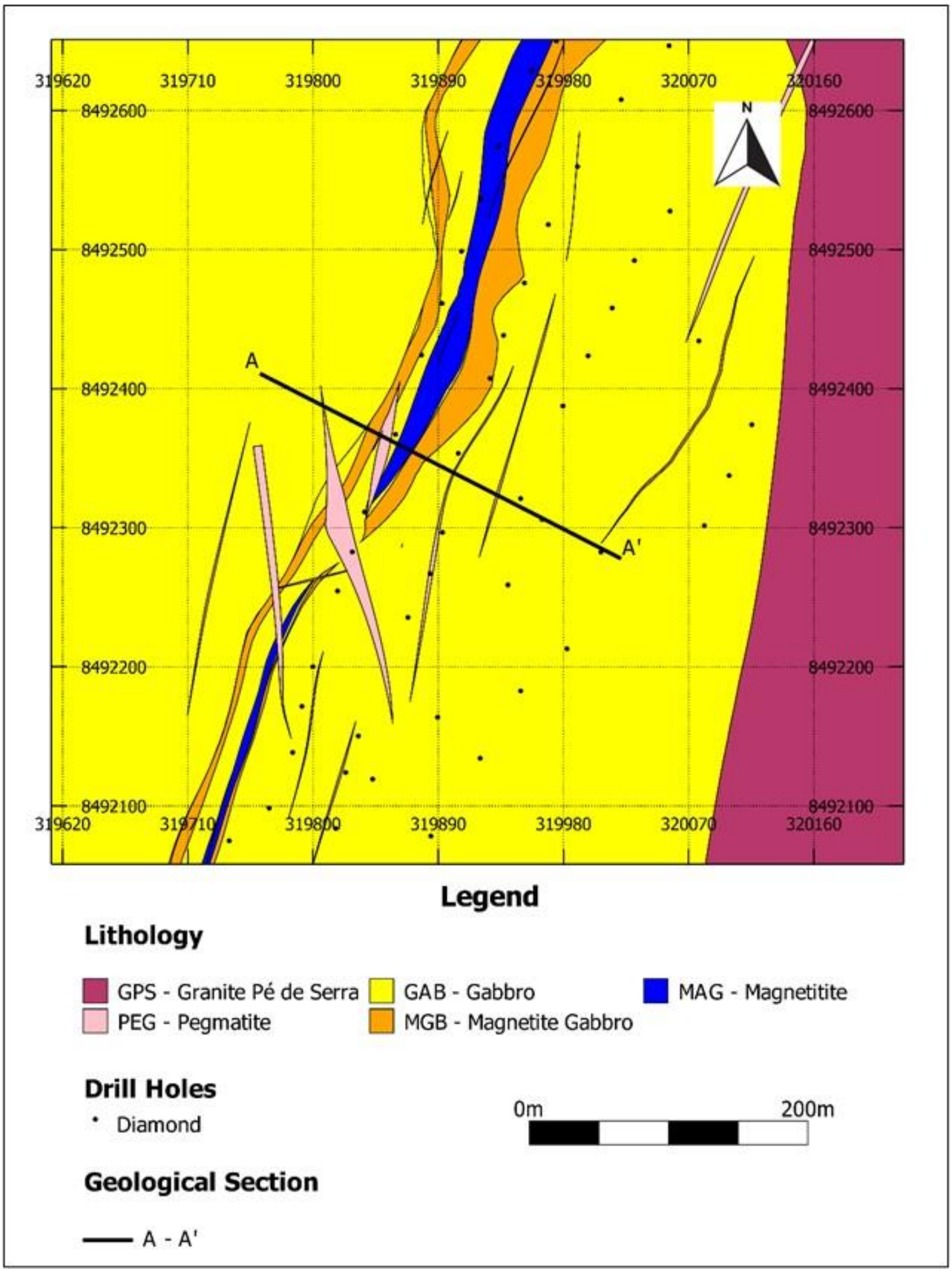



**Figure 7-8 – Geological Map of the NAN deposit**

Source: Largo, 2024.

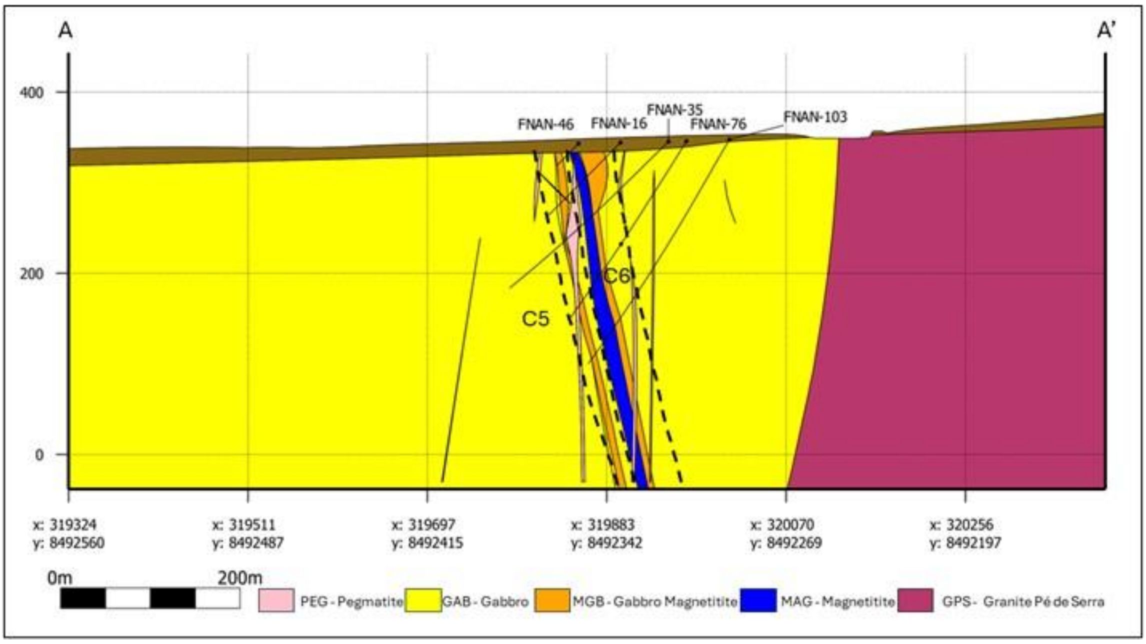



**Figure 7-9 – NW-SE cross-section (looking towards 020°) through the NAN deposit**

Source: GE21, 2024.

### *7.4.3 South Deposits*

The Campbell's southern deposits (Gulçari A Sul, Jacaré, Rio de Contas, Água Branca, Braga and Ilha Grande) has some similar characteristics, such as mineralization associated with cyclic units C5 to C9, and a body of granite Pé de Serra tectonically emplaced between cyclic units C6 and C7. In general, these deposits have thinner mineralized layers associated with magnetite gabbro and no presence of magnetitite layer.

#### *7.4.3.1 Gulçari A Sul – GAS*

The GAS Deposit is located southern Campbell Pit. It is hosted in the lower parts of the Upper Zone of the Rio Jacaré Intrusion, between cyclic units C4 and C9, with magnetite mineralization in Magnetite Gabbro. These lenses are along strike (N-S direction), and it is within concentrations of vanadium-rich magnetite gabbro. This deposit extends for approximately 2,000 m along strike and has been intersected in drilling to vertical depths of at least 300 m, and it extends below these depths. The deposit into the same trend that others deposit in the southern sector of the Rio Jacaré Intrusion. The stratigraphic position of the mineralization has been determined by the grades presented into Magnetites ($V_2O_5$ > 0.3%) and due the thin level of magnetite. There is a layer of granitoid rock (Granite Pé de Serra – GPS) between the cyclic unit C6 and C7 with a length of approximately 100 m. The mineralization occurs in a magnetitite layer to magnetite gabbro that extends for over 2,000 m along a north-northeast / south-southwest strike, with a dip of 60° SE and widths ranging from 10 m to 20 m.

*7.4.3.2 Jacaré – JAC*

Jacaré deposit is located to South of Gulçari A Sul – GAS. It is hosted in the lower parts of the Upper Zone of the Rio Jacaré Intrusion, between cyclic units C4 and C9, with magnetite mineralization associated with magnetite gabbro layers. The strike is NNE-SSW, and it is within concentrations of vanadium-rich magnetite gabbro. The deposit has approximately 3,000 m along strike (Figure 7-10). There is a layer of granitoid rock (Granite Pé de Serra – GPS) between the cyclic unit 5 and 8 with a thickness of 100 to 180 m (Figure 7-11), hosted in the northern part of the deposit. The magnetite-gabbro mineralized layers have a dip of 60° along strike varying in thickness from 6 m in cyclic units 4 to 5 and 10 m in cyclic units 8 and 9.

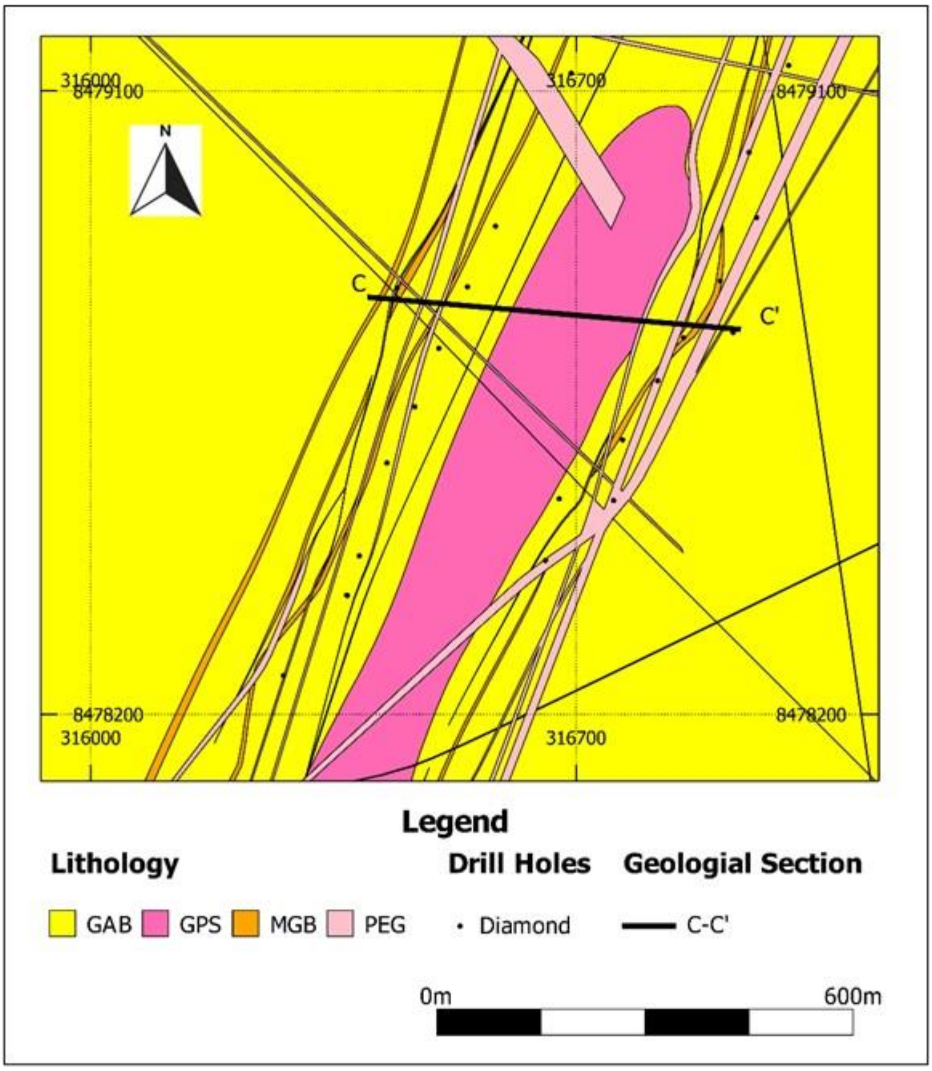



**Figure 7-10 – Geological Map of the JAC deposit**

Source: Largo, 2024.

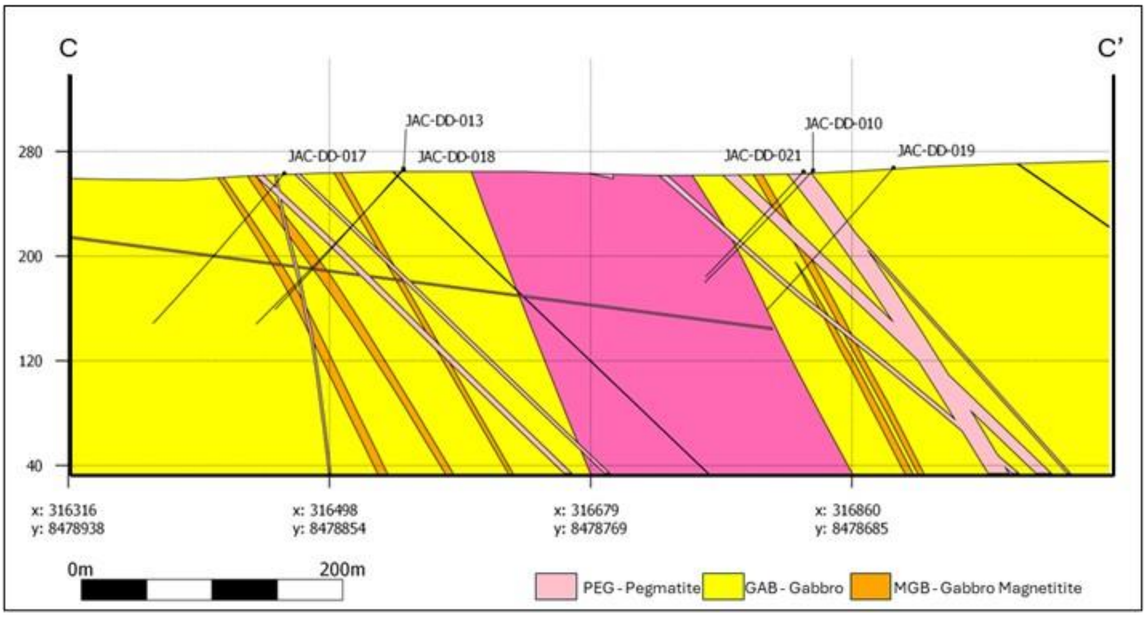



**Figure 7-11 – NW-SE cross-section (looking towards 020°) through the JAC deposit**

Source: GE21, 2024.

### *7.4.3.3 Rio de Contas – RIOCON Deposit*

Rio de Contas – RIOCON, deposit is in the extreme south of the Rio Jacaré Sill, after the south bank of the Rio de Contas. It is hosted in the lower parts of the Upper Zone of the Rio Jacaré Intrusion, between cyclic units C4 and C9, with magnetite mineralization associated with Magnetite Gabbro layers. The strike is NNE-SSW, and it is within concentrations of vanadium-rich magnetite gabbro. The deposit has approximately 1,500 m along strike. There is a layer of granitoid rock (Granite Pé de Serra – GPS) between the cyclic unit 5 and 8 with a length of approximately 100 m, hosted in the northern part of the deposit. The magnetite-gabbro mineralized layers have a dip of 60° along strike varying in thickness from 6 m in cyclic units 4 to 5 and 10 m in cyclic units 8 and 9.

### *7.4.3.4 Água Branca (ABR), Braga (BRG) and Ilha Grande (L)G*

The ABR, BRG and ILG are a small deposit hosted in the Campbell’s southern domain, all of those were identified by magnetometer survey.

The ABR deposit is situated to the south of GAS, was and has a different geological information base that could not support the identification the cyclic units. The mineralization layer is in levels of magnetite gabbro.

The BRG deposit is in the south of JAC and could be considered as a continuation of JAC deposit. It was described a main mineralized layer of magnetite gabbro not related necessary to one specific cyclic unit, with 600 m along strike and approximately 6 m thickness, although the density of information available is not sufficient to confirm the continuity of mineralization in depth.

The ILG deposit is 3 km to the south of BRG. Regards, the level of knowledge was not enough to identify the mineralized level within the cyclic units. There is a main mineralized layer of magnetite gabbro with 200 m along strike and approximately 5 m thickness in depth. It is necessary more information to confirm the continuity of the mineralization.

## 7.5 Mineralization

Vanadium and titanium are the elements of interest at the Maracás Mine. Vanadium is hosted within titaniferous magnetite, which is the major oxide phase found within the deposit. Ilmenite forms a second oxide phase which is commonly present, and which hosts titanium mineralization. Magnetite occurs as primary magmatic crystal grains that may be partly transformed to martite. These occur as anhedral grains, with grain sizes of between 0.3 mm and 2.0 mm, which form a polygonal mosaic together with ilmenite, which occurs as discrete anhedral magmatic crystals but may also occurs as inclusions within in the titaniferous magnetite, commonly displaying exsolution textures. Magnetite from the lower cyclic units (particularly the C3 unit at the Campbell deposit) has higher $V_2O_5$ concentrations than magnetite from the upper cyclic units – this is consistent across all deposits and is typical of layered magmatic magnetite deposits.

Massive magnetitite layers are formed by ilmenite-magnetite heterogenic cumulates that form 2 cm to 3 m thick layers containing variable amounts of clinopyroxene. They occur together with layered mafic and ultramafic cumulates, which comprise olivine-magnetite cumulates, and clinopyroxene-magnetite cumulates, and together form rhythmically micro-layered gabbro, magnetite, and magnetite-pyroxenite bands.

Besides primary magnetite, fine-grained magnetite also occurs locally as inclusions within silicate grains and results from alteration of iron-rich silicates (e.g. uralitization of pyroxene and serpentinization of olivine).

Silicate phases associated with the magnetite include augite, plagioclase, hornblende, and rare grains of clinopyroxene, olivine and spinel. Rare olivine and pyroxene grains are observed within the magnetitite, but most are altered to serpentine or chlorite. The Rio Jacaré Intrusion has been intensely metamorphosed, so the pyroxene compositions observed reflect metamorphic re-equilibration rather than original magmatic compositions. In addition, Brito (2000) also documented orthopyroxene. Garnet and biotite are present in the Gulçari B and Novo Amparo deposits.

Sulfides (chalcopyrite and pentlandite with rare pyrite and pyrrhotite) are minor and only account for up to 1% of the rock within the magnetitite layer. Chalcopyrite is more abundant than the other sulfides and is most common in the rock types containing 50% magnetite or less. It commonly occurs in association with magnetite or ilmenite enclosed by amphibole and plagioclase. Pentlandite is much less abundant and occurs within in the magnetitite layer. Minor sphalerite and galena grains are found together in the silicates, associated with the other sulfides, especially in the magnetite-poor rock types. However, the dominant trace minerals are nickel and cobalt sulfides and arsenides and cobalt-rich pentlandite. Many times, the arsenides are associated with the sulfides and appear to be alteration products of the sulfides.

Besides the vanadium and titanium that form the focus of exploration and mining at the Maracás Mine, elevated platinum and palladium values have been found associated with magnetite-rich zones in the Rio Jacaré Intrusion. They are much richer in platinum-group metals than the surrounding silicate rocks, and there are significant correlations between all the PGMs and between PGM and copper.

In the magnetite zones, palladium-rich minerals, especially bismuthides and antimonides, are the most abundant PGM minerals. Most times, these occur with interstitial silicates or within silicate inclusions in magnetite and ilmenite grains, and are associated with pentlandite and, sometimes, with arsenides. Sperrylite is the most abundant platinum mineral and is associated with silicates interstitial to magnetite and ilmenite grains. At sites where the igneous mafic minerals have been altered to amphiboles, sperrylite may be altered to platinum-iron alloys.

It is suggested that copper, nickel and PGM were concentrated in the magnetite layers by the co-precipitation of a small quantity of sulfide with the magnetite. These PGM-bearing base metal sulfides subsequently exsolved the platinum minerals. The association of palladium minerals with base metal sulfides and the minor variation in the Pt/Pd ratio (4:1) suggests that the PGMs have not been extensively remobilised in the magnetite.

The association of PGM enrichment with magnetite layers in the Rio Jacaré Intrusion has similarities with the Rincón del Tigre, Skaergaard and Stella Complexes. This enrichment is rarely associated with visible sulfides but suggests a target for PGM exploration.

## 7.6 Oxidation

In the Maracás area, the water table lies 30 m below surface. The rocks are fresh below this water table and over it they weather and oxidize to varying degrees, with deeper oxidation near faults, which may provide a conduit for fluid ingress. In weathered zones, silicate minerals weather (to clay minerals) more rapidly than oxides weather (Figure 7-12). Oxide minerals such as magnetite and ilmenite oxidize to other minerals such as maghemite, hematite, goethite, and other iron oxides. The main effect of weathering / oxidation is a potential reduction in vanadium recovery to the magnetite concentrates – since the oxidized products of magnetite (e.g., hematite) are not magnetic, increased weathering may result in a lowering of vanadium recoveries.


**Figure 7-12 – Variation of alteration zone in depth – oxidized rock to unaltered rock – Campbell**

Source: Largo, 2021.

# 8 DEPOSIT TYPES

## 8.1 Mineralization Styles

The information on which this section is based has been taken from internal documents provided to GE21 by the Company. GE21 has independently verified this information and has confidence in its accuracy and completeness.

According to Gross (1996), orthomagmatic Fe-Ti-V deposits, or Vanadiferous Titano-Magnetite (VTM) deposits are classified into two types: (i) Ilmenite type, which has ilmenite as its predominant oxide and occurs associated with anorthosite complexes, and (ii) Titanomagnetite type, in which the predominant oxide is titanomagnetite and occurs related to stratified gabbro anorthosite complexes. The largest known vanadiferous deposits are classified as type (ii) deposits, such as Bushveld in South Africa (Tegner et al., 2006), Mustavaara, in Finland (Karinen et al., 2015) and Maracás, in Brazil (Brito, 2000).

The deposits which are subjects of this Report are hosted within the Rio Jacaré Intrusion, which contains the largest known vanadium resources in the Americas. The Rio Jacaré Intrusion is composed of a series of mafic-ultramafic rocks with a strike length of 70 km along the N-S direction and 1.2 km wide in the E-W direction. The Rio Jacaré Intrusion is a layered mafic to ultramafic intrusion characterized by rhythmic and cryptic layers the deposit was described in this way by the way it was generated: an initial magmatic ore type deposit formed by concentration through liquid immiscibility.

According to Reynolds (1985), the favorable physicochemical conditions for generating large amounts of titan-vanadiferous magnetite are created from a prolonged period of fractional crystallization, concentrating elements in the residual magma. This author also suggests that the liquid $Fe_2O_3$ / FeO ratio (linked to the water content and the oxygen fugacity) is decisive in the process. The genesis of the Rio Jacaré Intrusion is also related to an open magmatic system, but with a periodic supply of three magma flows (Brito, 2000). The same attributes, therefore, the interaction between magma mixing processes and fractional crystallization as the main genetic processes of the Rio Jacaré Intrusion.

Vanadiferous titano-magnetite (VTM) mineralization at the Project shows similarities to other magmatic VTM or ilmenite deposits associated with layered mafic intrusive complexes including the Bushveld Complex (South Africa), the Lac Doré Complex (Quebec, Canada) and the Skaergaard Intrusion (Greenland). In these layered complexes, VTM and ilmenite deposits typically form in the upper portions of the magmatic stratigraphy. It suggests that magnetite crystallization is initiated when the evolving magma becomes sufficiently iron-enriched to form oxide minerals.

Knowing that vanadium is compatible in the magnetite crystal structure, it is incorporated into this mineral, depleting the magma in vanadium. This process will result in magnetite-carrying units having the highest $V_2O_5$ values, with the vanadium content of the magnetite gradually decreasing in the upper parts of the stratigraphy as the mineral density increases and it becomes concentrated in the lower layers. Titanium is incompatible with the magnetite structure, enriching the residual magma. This process is responsible for an overall decrease in the $V_2O_5$ / $TiO_2$ ratio of the upper stratigraphy units observed in the Project. Figure 8-1 (A) illustrate some of the general increase in $TiO_2$ and decrease in $V_2O_5$ in magnetite with increased stratigraphic height in the upper portions of layered mafic complexes. B: $V_2O_5$ / $TiO_2$ ratios through the Rio Jacare Intrusion. Note that lower layers (C1-C4) have higher $V_2O_5$ / $TiO_2$, and that a large change occurs through the C5 and C6 units.

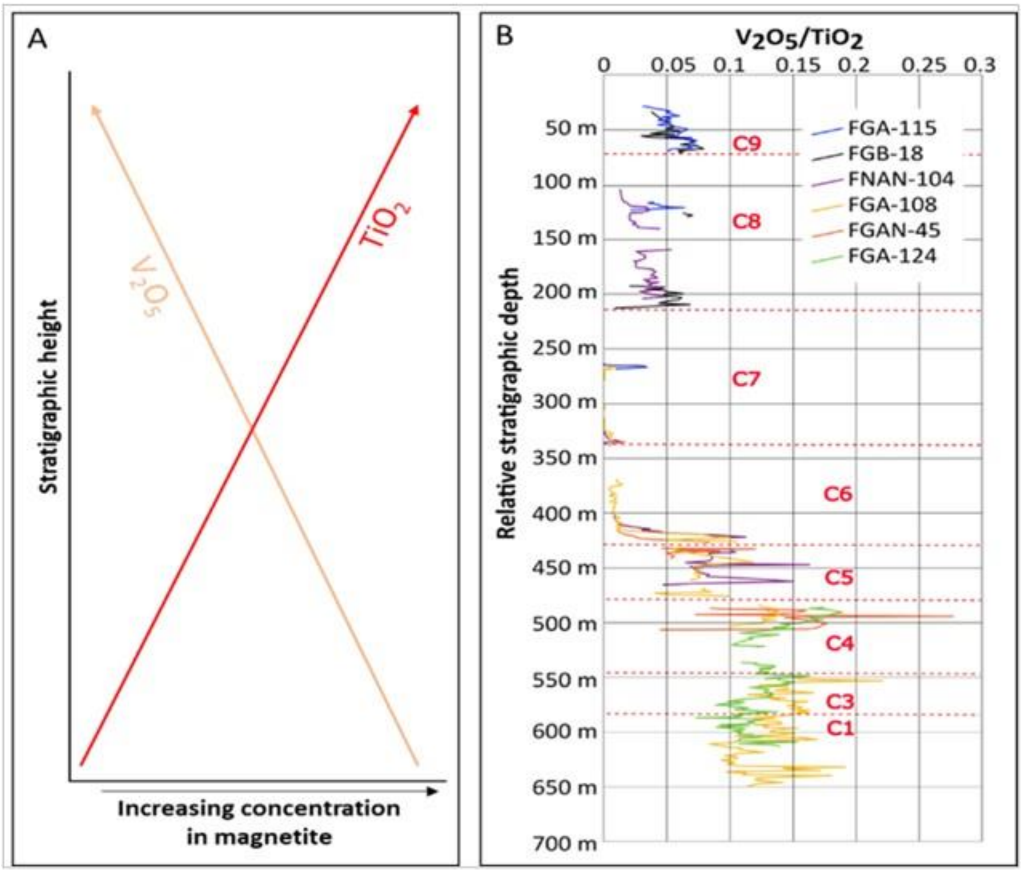



**Figure 8-1 – Relationship between $V_2O_5$ and $TiO_2$ throughout the stratigraphy**

Source: Largo, 2021.

Lower magnetitite layers and magnetite gabbro layers, such as those in the C3 cyclic unit at the Project, can locally have $V_2O_5$ contents of over 5% $V_2O_5$ in magnetite, and this drops to below 1% $V_2O_5$ in the upper layers (C8). Lower magnetite-rich horizons at Maracás layers have $TiO_2$ contents between 4-6% $TiO_2$, while upper layers can reach up to 20% $TiO_2$. Often in VTM deposits, apatite crystallization and $P_2O_5$ enrichment may be associated with upper layers enriched in $TiO_2$, and nelsonite (ilmenite + apatite) units may form locally. Nelsonites have not yet been observed in the Rio Jacaré Intrusion, but local enrichment in $P_2O_5$ has been observed in the C7 cycle at the NAN deposit.

## 8.2 Conceptual Models

The Bushveld Complex is the largest repository of mafic and ultramafic deposits in the world, and among them the Fe-Ti-V deposits of its upper zone stand out (Tegner et al., 2006; Willemse, 1969). For the authors, the magnetite's found in the deposit in question were formed by differentiation in a stagnant magmatic chamber, where the segregation of magnetite occurred through fractional crystallization and precipitation by a gravitational accumulation of magnetite and ilmenite; crystallization is initiated when the evolving magma becomes sufficiently enriched in iron to form oxides. Magnetite may crystallize and gravitationally settle, creating localized lowering of the magma density from ~2.7 to ~2.5, creating a density inversion. This density inversion results in an overturn of the magma and magma mixing, precipitating additional magnetite. The repetition of this process may lead to the formation of several stratified layers of magnetite, often with sharp bases and gradational upper contacts.

VTM deposits are typically found in the upper, more fractionated portions of layered complexes. In the Upper Zone of the Bushveld Complex, which has been extensively studied, the formation of VTM-enriched layers has been attributed several formation mechanisms – the most likely of these appears to be that magnetite crystallization is initiated when the evolving magma becomes sufficiently iron-enriched to form oxide minerals. Magnetite may crystallize and gravitationally settle, creating localized lowering of the magma density from ~2.7 to ~2.5, creating a density inversion. This density inversion results in an overturn of the magma and magma mixing, precipitating additional magnetite. The repetition of this process may lead to the formation of several stratified layers of magnetite, often with sharp bases and gradational upper contacts.

Recently, Kruger and Latypov (2020) have argued that for some magnetitites layers in the Bushveld Complex, magnetite crystallization occurs in situ on the base of the magma chamber, rather than crystals gravitationally settling, and that this solidification front moves upwards (Figure 8-2). Additional formation mechanisms that have also been suggested also include magma mixing during the influx of new magma (Harne & Von Gruenewaldt, 1995), or separation of a dense, iron-rich magma owing to large-scale silicate liquid immiscibility (Van Tongeren & Mathez, 2012). The latter mechanism (liquid immiscibility) may explain the occurrence of apatite-oxide layers in the upper portions of some layered mafic complexes. The Rio Jacaré Intrusion has not been extensively studied and does not yet have a well-defined mechanism for magnetite crystallization, but recent studies suggest a metallogenies like other complexes rich in this mineral.

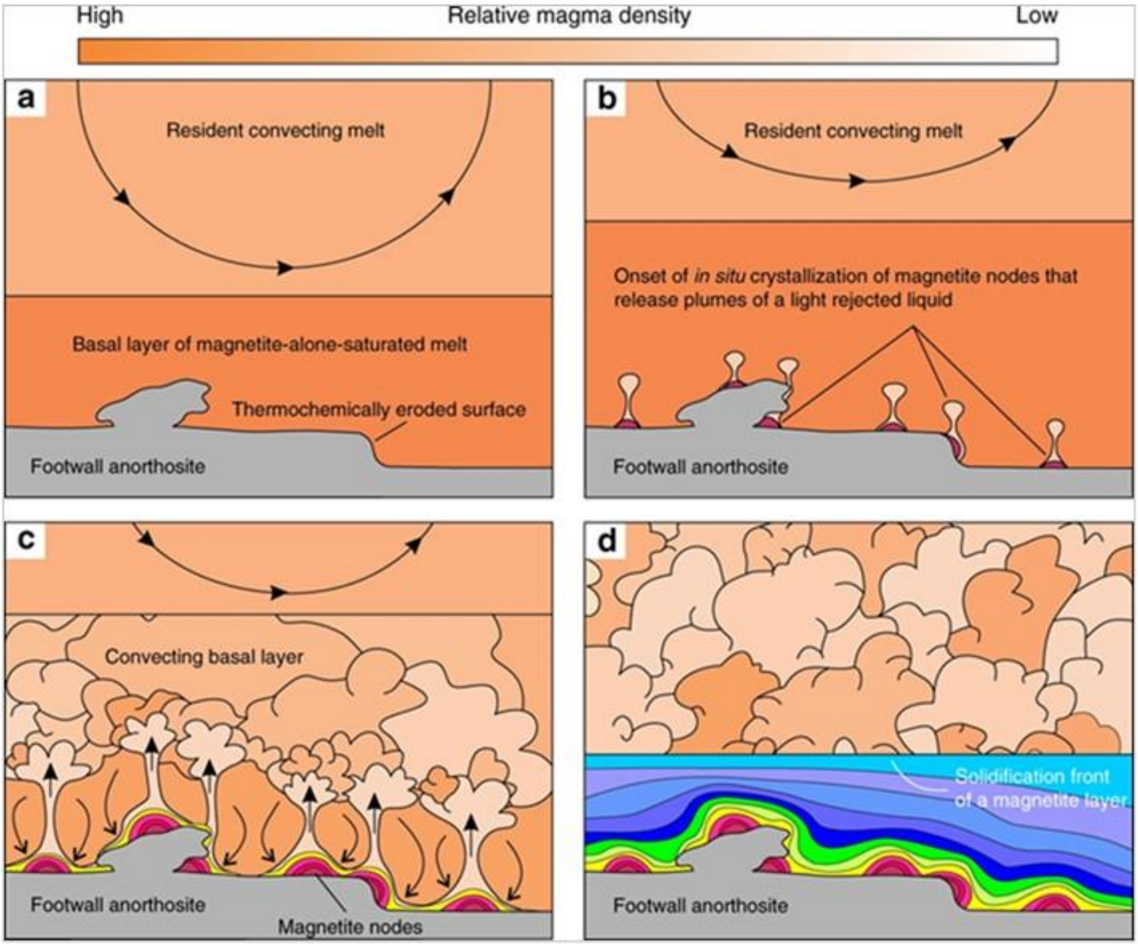



**Figure 8-2 – Illustration of *in situ* magnetite crystallization and growth of a magnetitite layer on the base of a magma chamber**

Source: Kruger & Latypov, 2020.

# 9 EXPLORATION

## 9.1 2006 Exploration Program – Largo Inc. (Micon, 2007)

Largo signed a letter of intent to acquire the Project in October 2006. Largo completed an extensive due diligence and technical audit as part of their process. Prior to completing due diligence work, a Mineral Resource estimate (Hennessy, 2006) was undertaken for the previous owners and the Largo data was excluded from this assessment.

By the end of 2006, Largo reinstated the exploration grid and had completed check surveys of drill hole collars that were marked with casing or plastic pipe.

Most of the historic drill core (CBPM and Odebrecht Group) was stored in a rented facility in the town of Maracás and was in excellent condition. Largo personnel re-logged and re-sampled much of the historic core and verified assay results for $V_2O_5$, $TiO_2$ and Platinum Group Elements (PGMs).

2006 Exploration Program – Largo Inc. In this section has been reproduced in its entirety from the report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project Brazil by Akers Solutions (2009)**, as fully cited in Section 27, “References”. GE21 has verified the accuracy of the information contained and updated as required.

In 2007, Largo conducted an exploration plan with the following steps:

- 175 km of line cutting;
- 175-km line of ground magnetic geophysical surveying;
- 136-km line of induced polarization (IP) geophysical surveying;
- geological mapping of the property at a scale of 1:2,500;
- resampling old drill holes from 1981 through 1986 for PGMs;
- surveying;
- thin section and lithogeochemical studies;
- diamond drilling, 61 holes totaling 13,876 m.

The surveying program aimed to standardize the coordinate system, both for the previous work and for the basis of future work. All holes and trenches since 1981 have been converted to UTM.

The entire property has been covered by 175 km of line cutting. The grid lines are 2.5 km long and oriented east-west with 100-m line spacing and 25-m stations along the lines. This line cutting work has been done to conduct geological mapping, sampling and ground geophysical surveys (magnetic and IP). Geological mapping was done at a scale of 1:2,500 over the entire property, concentrating on favorable areas that have a limited amount of information. These include Campbell, Gulçari B, Novo Amparo and São José. This work was completed to get a better understanding of the area’s potential prior to conducting further drill testing.

Ground magnetic surveying was completed over the entire property. It was hoped that the magnetic survey would help in understanding the geology that underlies the property and trace the magnetite-rich horizons associated with the mineralization along strike and at depth. The results were encouraging, given that the magnetite horizons are good magnetic anomalies that respond strongly.

A total of 136 km line of IP surveying has been completed on the property. IP responds well to the magnetite and disseminated sulfide mineralization found at Maracás. Geophysical surveys are considered important in this phase of work and their use will be discussed in the next section.

Data compilation, re-logging and additional resampling of previously drilled holes (1981 to 1986) were undertaken. This work was done to correlate the lithologies between holes and from section to section, and to evaluate the platinum and palladium potential of the deposit, to better understand the geological setting and help in future work plans.

Petrographic analysis was conducted on 56 polished thin sections from drill holes representing the various rock types, including highly mineralized samples from Campbell and Novo Amparo. They were used to characterize the rock types and mineralization in the immediate area around the deposits. The mineralized samples were also analyzed with inductively coupled argon plasma (ICP) multi-element package. Fresh, unaltered samples were also chosen for whole rock analysis, to characterize the intrusive rocks in the belt.

A diamond-drilling program of 61 holes totaling 13,876 m was completed in 2007 on the property.

## 9.2 Previous Geophysical Surveys

A few geophysical surveys were conducted by previous operators (CBPM, Odebrecht and CAEMI,) over the Maracás property during the period 1980 to 1986. These include magnetic and very low frequency EM (VLF) surveys. A review of this coverage is beyond the scope of this Report. Any new drill targets will be generated by the new geophysical surveys.

## 9.3 2008 Exploration Program (RungePincockMinarco, 2012)

In 2008, Largo conducted a 5,000 m drill program at Maracás, designed to evaluate IP targets other than Gulçari A. This program is described in Section 10 below.

## 9.4 2011-2012 Exploration Program (RungePincockMinarco, 2012)

In 2011 and 2012, Largo executed a diamond drilling program of approximately 13,400 m. Part of this program was still conducted at the Campbell deposit, but most of the holes were drilled at other anomalies known throughout the Project. The results of the program are described in Section 10 below.

## 9.5 2012 Infill Drill Program (Micon, 2016)

In 2012, Largo completed an additional infill diamond drilling campaign at the Campbell deposit comprising 103 vertical drill holes totaling 3,929.15 m. The aim of this campaign was to ensure the initial 2-3 years of mine operation. These holes were included in the database used in the Resource estimate. This campaign is best described in Section 10 below.

## 9.6 2018-2019 Exploration Program

Between April 15$^{th}$ and May 20$^{th}$, 2019, the Largo conducted a ground magnetometer survey on concessions 871,483/2016 and 871,485/2016, located north of the Novo Amparo Norte deposit. Figure 9-1 show the location of ground magnetometer surveys completed by Largo and the location of key deposits.

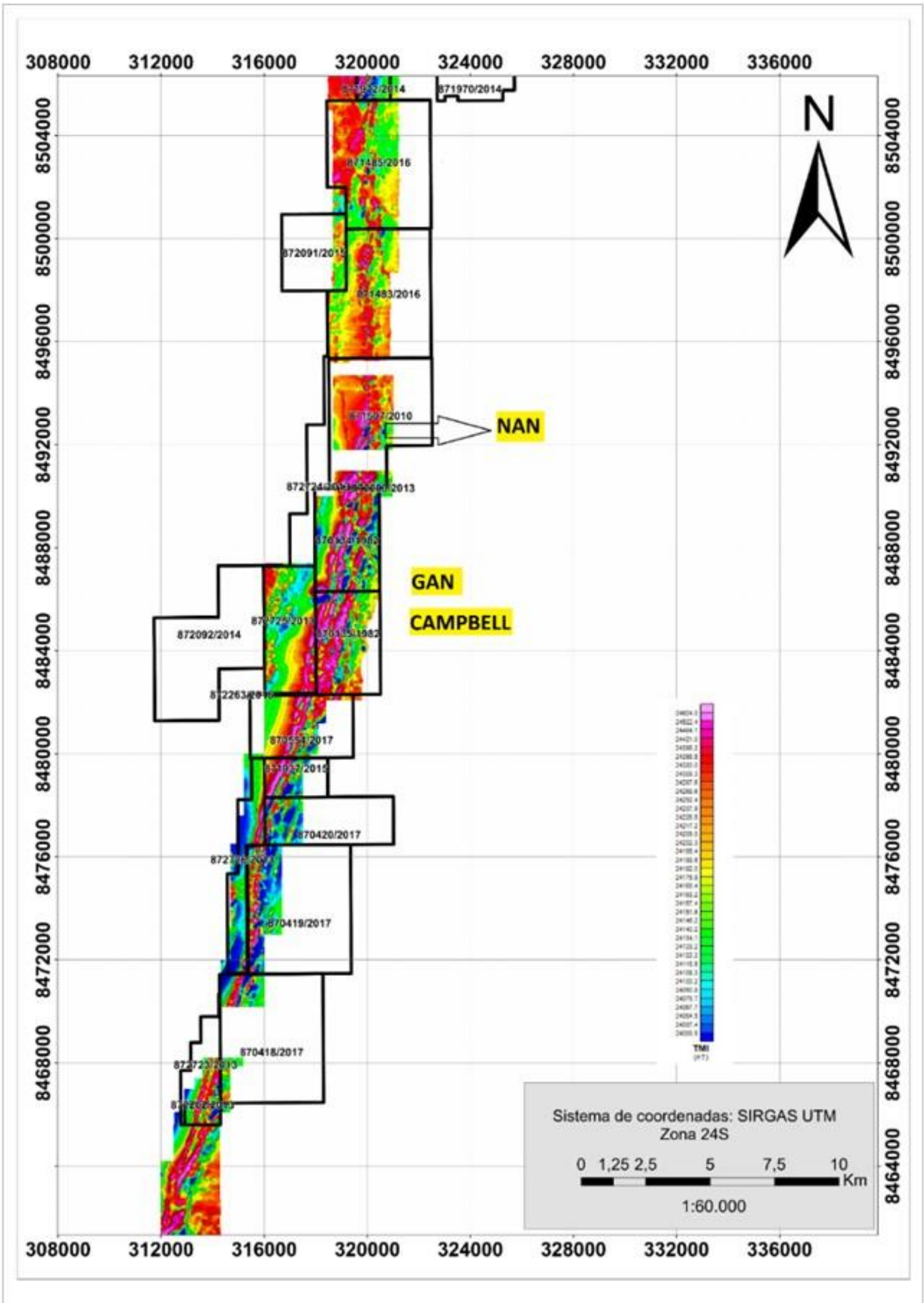



**Figure 9-1 – Largo Ground Magnetometer Survey and Key Deposits**

Source: Largo, 2021.

The survey was conducted on east-west survey lines spaced 100 m apart. In total, the surveyed area covered 99-line kilometers on concession 871.483/2016- and 123-line kilometers on concession 871.485/2016. The survey equipment was set up for continuous readings. Considering a typical walking speed (≈ 5 km/h), there is a station spacing of approximately 3 m along each survey line.

Magnetic data was acquired with Largo's GSM-19W Overhauser GEM magnetometers and a GEM GSM-19T proton precession magnetometer that was operated as a base station to provide data for daytime corrections.

The data were collected, corrected, and processed using Oasis Montaj™. All data collected were standardized in the UTM coordinate system in DATUM SIRGAS 2000 (24S). Magnetic anomalies indicate an N-S magnetic tendency.

In 2018, more detailed exploration was conducted at the NAN and Jacare deposits. At NAN (Carvalho, 2018), the field campaign was completed in 18 days and recorded 477 map data points. The methodology used comprised activities such as aerial photography interpretation, geological mapping on a scale of 1:5,000, petrographic studies, qualitative geophysical modeling through the interpretation of ground magnetometer data and structural analysis.

Exploration was also undertaken in the Jacare deposit (Santos, 2018b). Work included geological mapping focusing on understanding the geological relationship of the deposit within the Rio Jacare Intrusion. Rock units were defined based on known stratigraphy of the sill, including petrographic studies.

In 2019, mapping was conducted on the scale of 1: 10,000 in the São Jose area (Jesus, 2019) whose field campaign was conducted for 8 days totaling 650 points described. Work again focused on the stratigraphic relationship of the deposit within the Rio Jacare Intrusion. Specific lithotypes were macroscopically defined, and an attempt was made to correlate these rock units with the detailed ground magnetic data to help define stratigraphy and drill targets.

## 9.7 2020 Exploration Program

In 2020, Dr. Moraes completed the processing, presentation, interpretation, and integration of government aerial geophysical data (Gamma spectrometry and magnetometry) and Largo's detailed ground magnetic survey results.

In 2020, geological mapping, at 1:5,000 scale, and petrographic studies was conducted in the areas of GAN and GAS. In the GAN area (Pereira, 2020), the field stage lasted 10 days, with 59 outcrop points identified, in which lithologies were described macroscopically and correlated with magnetic anomalies and stratigraphy.

At GAS, the mapping was done on the scale of 1:10,000 (Santos, 2020). The field campaign was conducted over the course of 13 days with 259 survey points described. Parameters such as mineralogical composition, textures, granulometry, magnetic susceptibility, degree of metamorphism and structures were considered.

## 9.8 Exploration Program 2021-2023

Between 2021 and 2023, the drilling focused on detailing targets already identified by the independent Technical Report NI 43-101 titled **An Updated Life of Mine Plan (LOMP) for Campbell Pit and Pre-Feasibility Study for NAN and GAN Deposits Maracás Menchen Project, Bahia, Brazil, 2021**, which includes the targets Gulçari A Norte (GAN), São José (SJO), and Novo Amparo (NA). Besides executing new drillings, a re-sampling campaign of drill cores was conducted in 2022/2023, seeking to re-sample in mineralized zones not sampled in previous drilling campaigns. Besides detailed drilling, exploratory drilling focusing on the development of new targets was also conducted.

Between 2022 and 2023, the reprocessing and reinterpretation of aero geophysical data were performed, which, integrated with geological mapping and soil geochemical surveys (conducted in previous campaigns), focused on defining new mineral potentials, which were the focus of drilling campaigns between 2022 and 2023.

The exploration stages conducted during this period will be described in detail throughout this section.

### *9.8.1 Soil Geochemistry Campaign*

During this period, a soil geochemistry campaign was conducted with the objective of defining the geochemical signatures for iron-titanium-vanadium deposits along the Rio Jacaré Sill (SRJ). Thus, between 2021 and 2023, 4102 soil samples were collected (Table 9-1).

The samples were analyzed by the SGS-Geosol laboratory using the ICP14B methodology for the following elements: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sc, Se, Sn, Sr, Th, Ti, Tl, U, V, W, Y, Zn, and Zr.

**Table 9-1 – Quantification of Samples Collected Between 2021 and 2023**

| Target | Number of Samples | Year |
|---|---|---|
| **SRJ** | 702 | 2021 |
| **SRJ** | 791 | 2022 |
| **SRJ** | 2,609 | 2023 |
| **Total** | **4,102** | |

Source: Largo, 2024.

From the results of the chemical analyses, it was possible to generate soil geochemistry maps that aided in defining new research targets as well as delineating already known targets (Figure 9-2 to Figure 9-4).

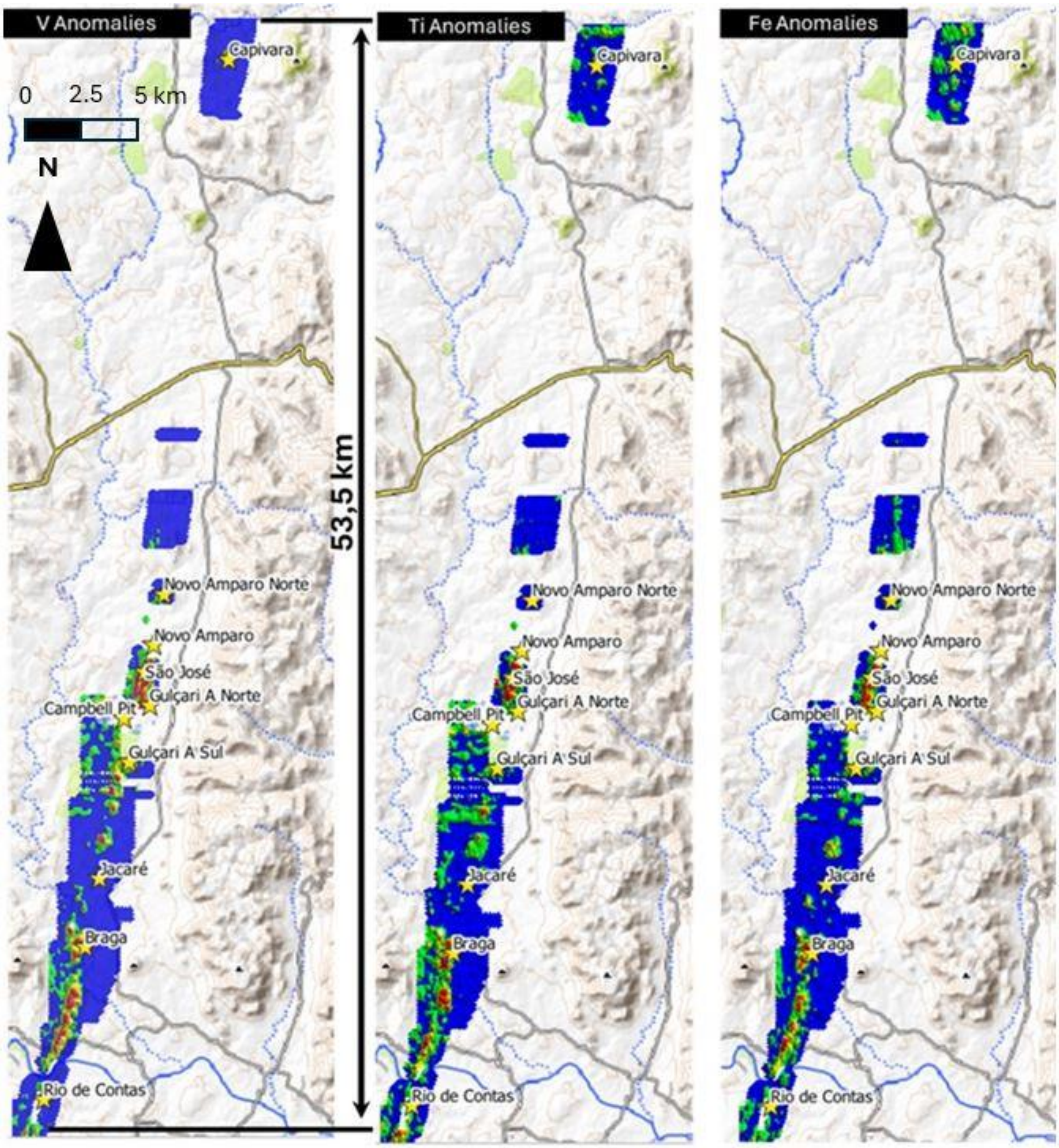



**Figure 9-2 – Geochemical Maps (Fe-V-Ti) resulting from the 2021/2023 Soil Geochemistry Campaign**

Source: Largo, 2024.

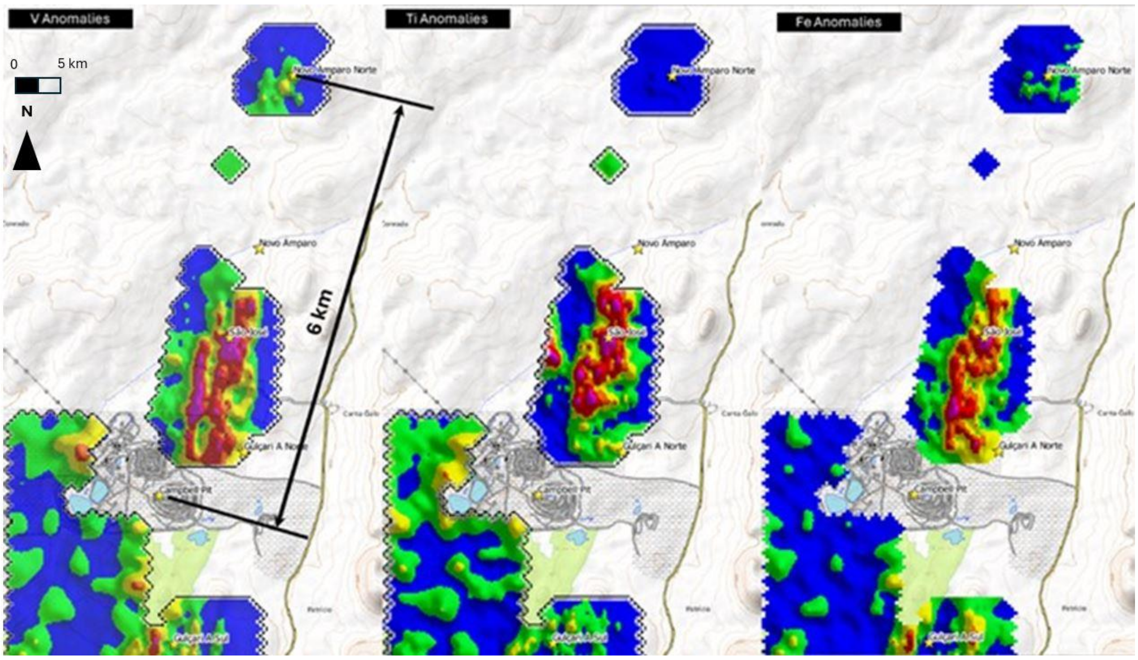



**Figure 9-3 – Geochemical Maps (Fe-V-Ti) resulting from the 2021/2023 Soil Geochemistry Campaign – Detail of the North Sector**

Source: Largo, 2024.

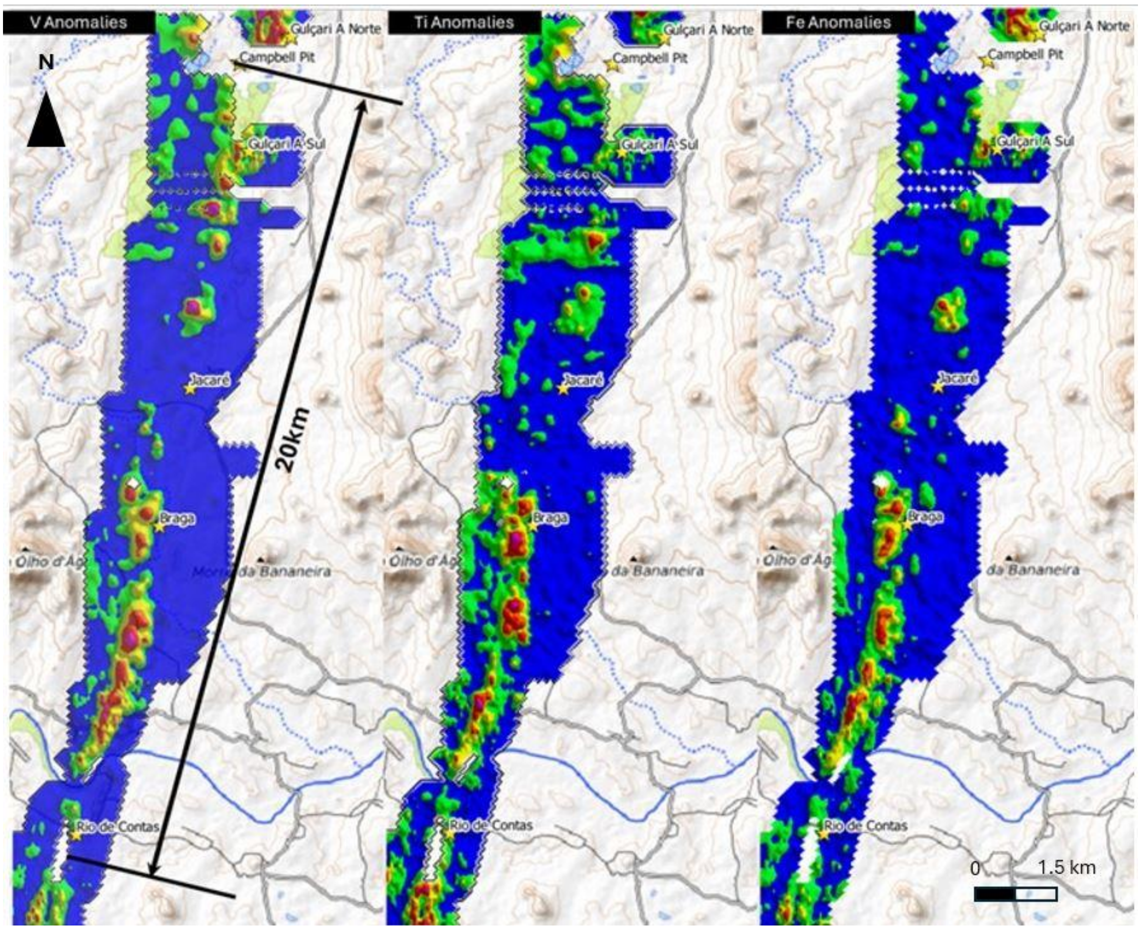



**Figure 9-4 – Geochemical Maps (Fe-V-Ti) resulting from the 2021/2023 Soil Geochemistry Campaign – Detail of the South Sector**

Source: Largo, 2024.

The Rio Jacaré Sill region exhibits a wide diversity of V, Ti, and Fe anomalies, as observed in the soil geochemical survey, which supported the exploration program and demonstrate the mineral potential of the area where Largo Inc. holds its mining rights.

Besides the main elements (V, Ti, and Fe), there are other elements associated with Iron-Vanadium-Titanium mineralization that support mineral exploration. Copper proved to be an excellent marker, as chalcopyrite mineralization associated with Vanadium-Titanium mineralization can be observed at the Campbell Pit.

### *9.8.2 Review of Aero Geophysical Data*

Between 2021 and 2023, geophysical airborne survey data were revisited to create new maps that could support the exploration program, integrate with geological data, and soil geochemistry data.

#### *9.8.2.1 Magnetometry*

All aeromagnetic data were reprocessed to get more signatures from this potential method. Several products were generated that supported the interpretations and integrations of the information. The products generated included: Total Magnetic Intensity (TMI), Tilt Derivative (TDR), Analytic Signal Amplitude (ASA), Euler Deconvolution, and First Vertical Derivative (1DV) (Figure 9-5 to Figure 9-7).

These processing helps to define the magnetic susceptibility present in structures and magnetic bodies, delimitation of these signals, definition of structures that form mineralization, depth, and modeling of these same structures.

In Figure 9-5, a regional structure can be observed that controls the Fe-V-Ti mineralization and, consequently, the magmatic intrusion of the Rio Jacaré Sill. This is a piece of data that supports the definition of the entire mineral exploration program of the SRJ. Regarding TMI (Total Magnetic Intensity), it is observed that the main mineral occurrences are associated with dipole anomalies.

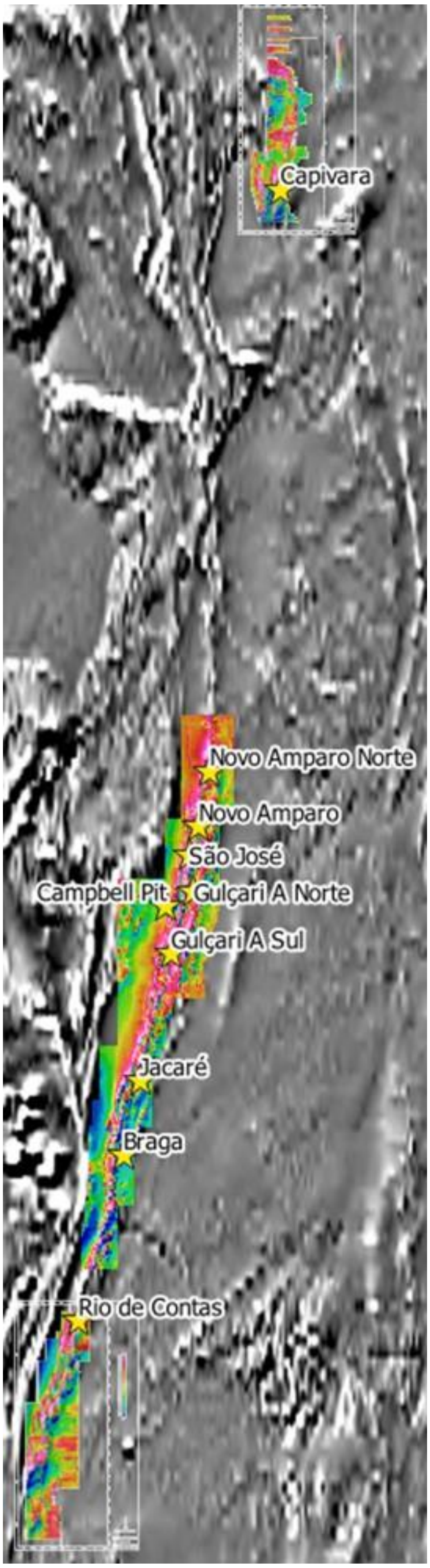



**Figure 9-5 – Integration of Aerial Magnetometry Data: First Vertical Derivative (gray basemap) and Total Magnetic Intensity (TMI – colored)**

Source: Largo, 2024.

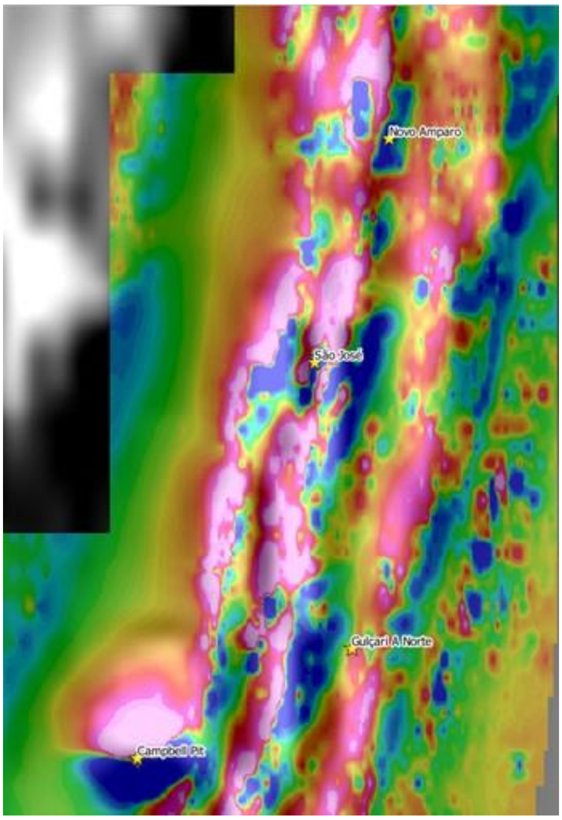



**Figure 9-6 – Magnetometric Map of the Northern Portion of the Rio Jacaré Sill: First Vertical Derivative (gray basemap) overlaid by the Total Magnetic Intensity (TMI – colored)**

Source: Largo, 2024.

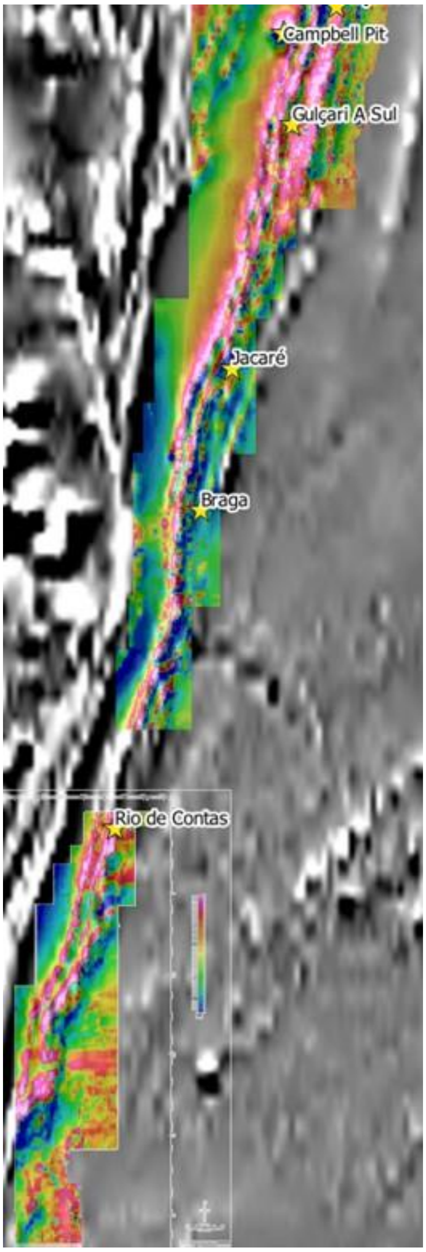



**Figure 9-7 – Magnetometric Map of the Southern Portion of the Rio Jacaré Sill: First Vertical Derivative (gray basemap) overlaid by the Total Magnetic Intensity (TMI – colored)**

Source: Largo, 2024.

The analytic signal data, which better delineate the magnetic bodies and structures, were also reviewed. This information, integrated with other data, provides a better definition of the targets that were investigated between the years 2021 and 2023 (Figure 9-8).

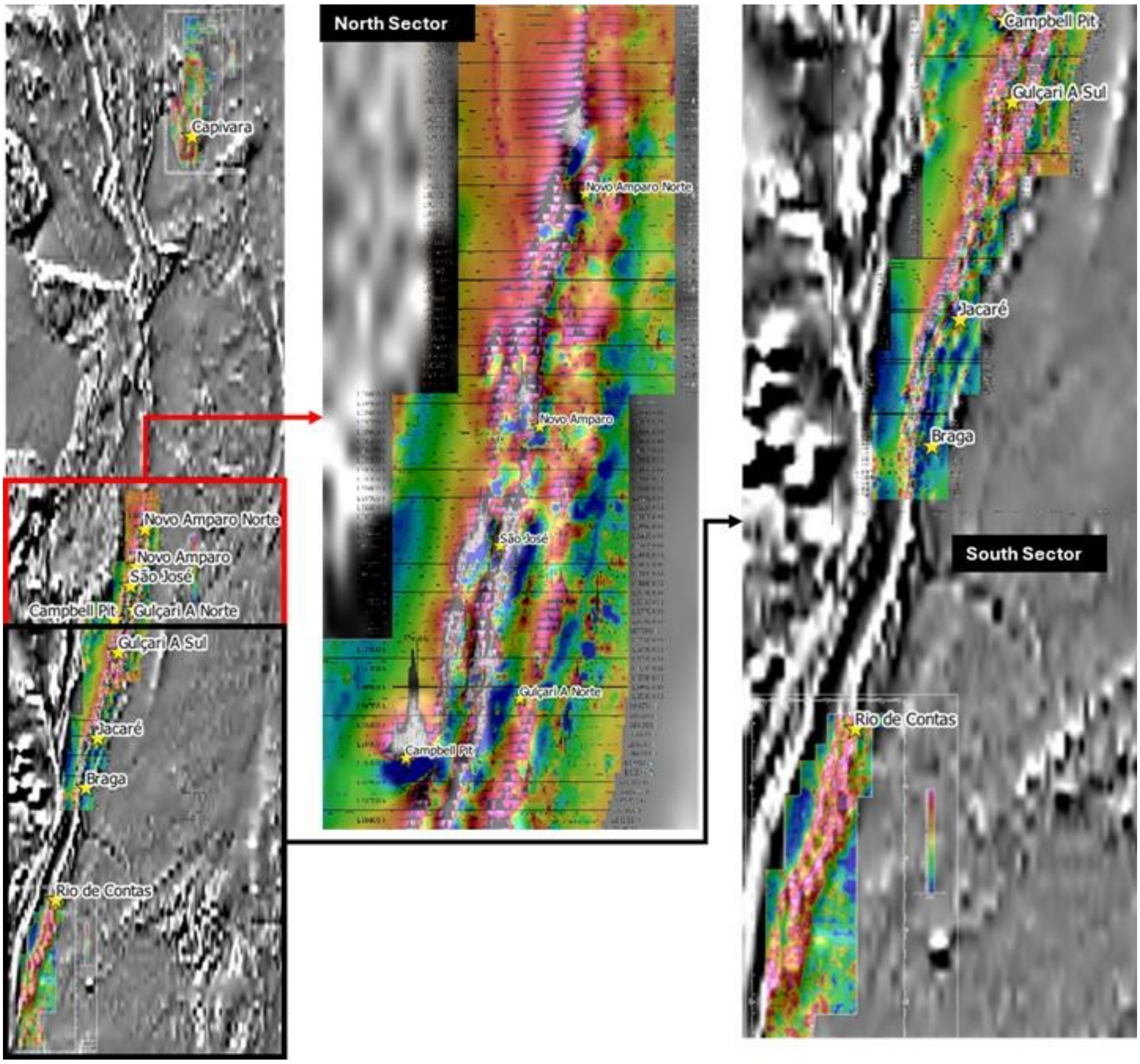



**Figure 9-8 – Analytic Signal Map (magnetometry) of the Rio Jacaré Sill: First Vertical Derivative (gray basemap) overlaid by the Analytic Signal (ASA – colored)**

Source: Largo, 2024.

With this review of the aeromagnetometry data, the drilling program was redefined and demonstrates the high mineral potential of the Rio Jacaré Sill.

### *9.8.2.2 Gamma Spectrometry*

The aerogammaspectrometry data demonstrate that the mineralized bodies are associated with low gammaspectrometry zones, which are linked to mafic-ultramafic rocks that host the Fe-V-Ti mineralization (Figure 9-9). These low gammaspectrometry zones are between high gammaspectrometry zones associated with the Pé de Serra granite and intermediate zones indicating geological units of the Contendas-Mirante complex (volcano-sedimentary sequence).

In Figure 9-10, it can be observed that the mineralized zones are associated with a region of low radiometric thorium values, which is a good indicator for defining mineral exploration targets.

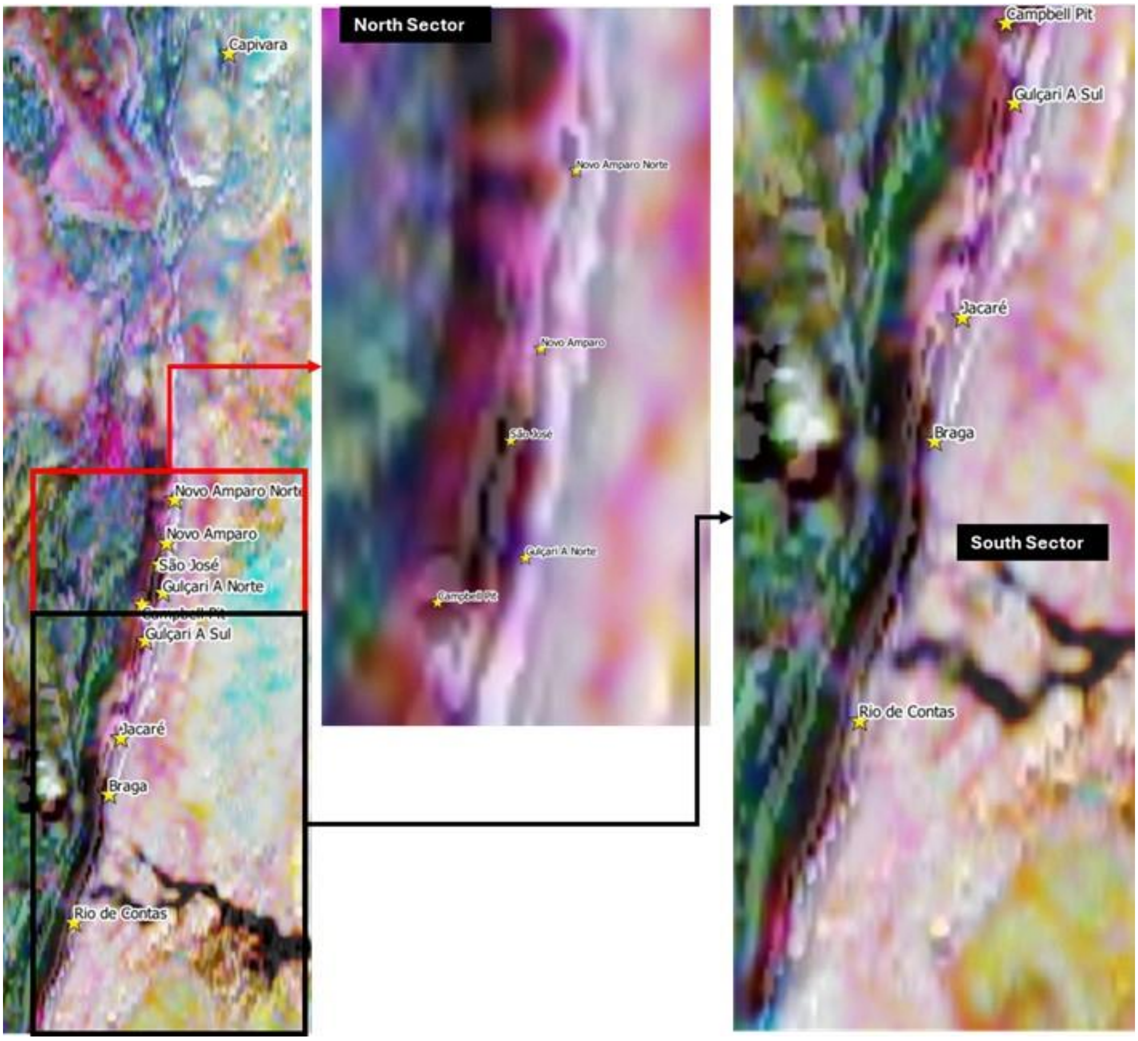



**Figure 9-9 – Ternary Gamma Spectrometric Map**

Source: Largo, 2024.

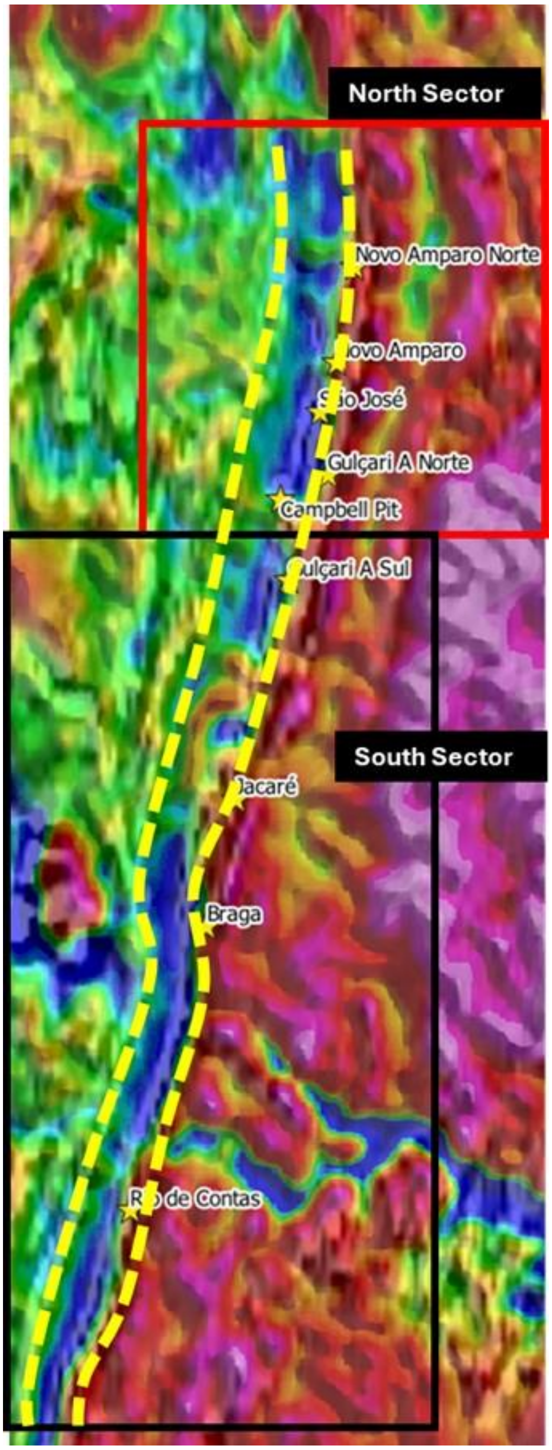



**Figure 9-10 – Equivalent Thorium Gamma Spectrometric Map. Low Thorium zones mark the region of Fe-V-Ti mineralization in mafic / ultramafic rocks**

Source: Largo, 2024.

### *9.8.3 Data Integration of Exploration*

In this stage, maps with overlaid (integrated) information will be presented that supported the definition of targets (known or unknown), their extensions, support for the current exploration program, and the entire drilling plan conducted between the years 2021 and 2023. This integration utilized all available historical data and new data.

Geophysical data such as Euler deconvolution (estimation of the depth of magnetic signals) aided in the interpretation of deep structures that control the mineralization.

Thus, all available information was used to revise the exploratory geological model and to generate mineral exploration targets.

A geological model was developed (interpreted) over an extension of 27 km. This model was generated based on information from geology, geophysics, geochemistry, and both historical and current drilling data (Figure 9-11).

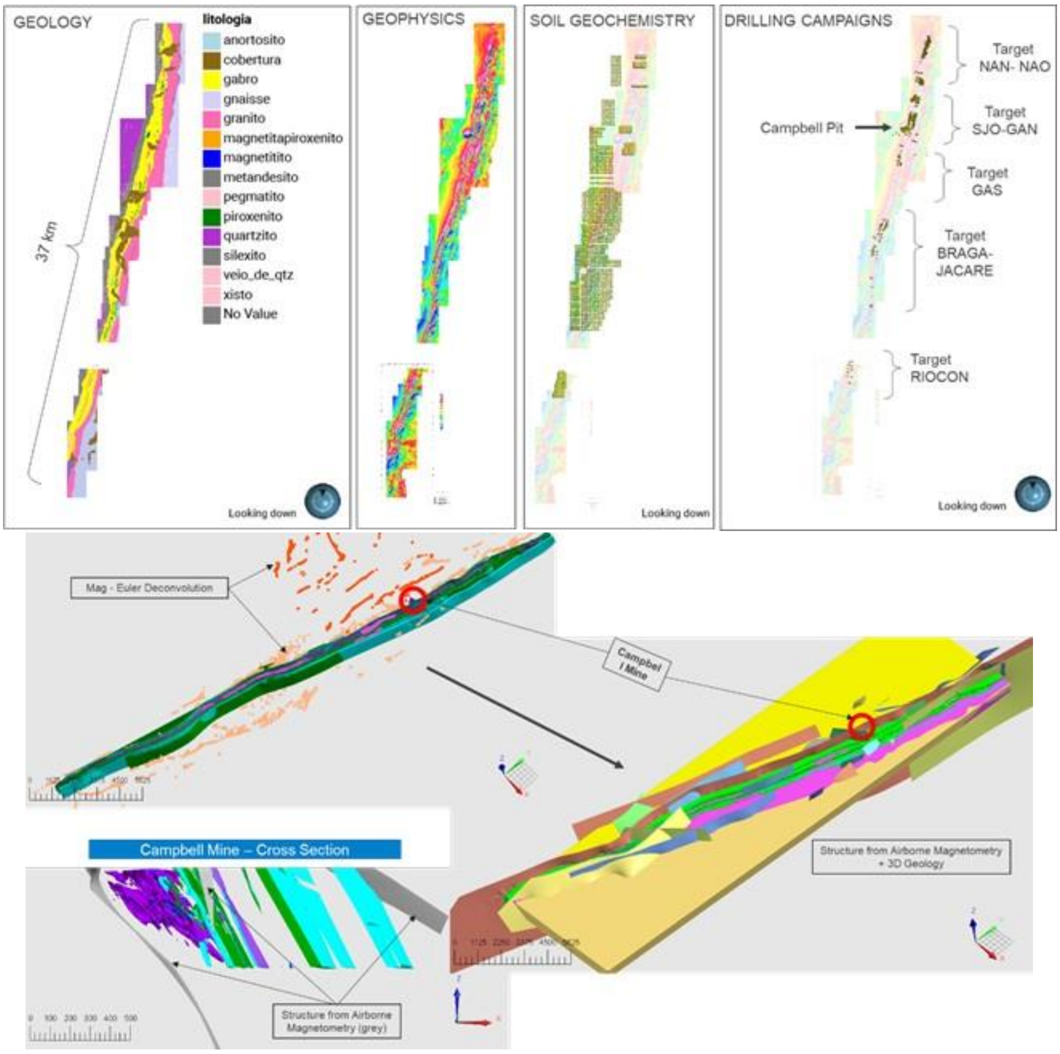



**Figure 9-11 – Exploratory Geological Model generated from aerial geophysical data, soil geochemistry, and drilling information (historical and current)**

Source: Largo, 2024.

## 9.9 Topography Survey

Topographic survey was conducted at the Campbell Pit deposit using Trimble R8s receivers, including two integrated Maxwell™ 6 chips and 440 GNSS channels, capable of tracking a wide range of satellite systems including GPS, GLONASS, Galileo, BeiDou and QZSS. All these functions, coupled with the CMRx communication protocol, provide the user with different data correction and compression tools.

The effective date of the Campbell Pit topography survey was January 30th, 2024.

For the other areas considered in this Technical Report, including the GAN, NAN, SJO, and NAO pits and the southern targets (Jacaré, RIOCON, and Água Branca), a topographic survey was conducted of all areas involved in this Report.

The work was conducted between July 1-15, 2023, involving a survey using orthorectified aerial photography with a resolution of 5.00 cm per pixel, georeferenced to the official marker of the mining company in the SIRGAS2000 datum, in the UTM metric system, and orthometric height. For georeferencing the basic support points, GPS with 40 L1 and L2 channels was used, post-processed via PPP-IBGE.

# 10 DRILLING

The initial geological research campaigns in the Project were conducted by CBPM and Odebrecht in the 1980s at the Gulçari A (Campbell Pit), Gulçari A North, and NAO targets. Since the acquisition of the Project in 2007, Largo has conducted a series of drilling programs on surface and underground at the Campbell Pit and other exploratory targets, aligned along the regional trend of the Serra do Jacaré. The drill cores from these drill holes were described, sampled, analyzed, and are stored and available for consultation in the core storage shed. These drilling campaigns were conducted with various objectives, including geological exploration, infill drilling, and Resource conversion.

The drilling campaigns of the Project are summarized in Table 10-1 and their location is shown in Figure 10-1. The complete list of all drill holes is included at the deposits and research targets with their coordinates, final depth, and year in Appendix A.

**Table 10-1 – Summary of the drilling campaigns of the Vanadium Maracás Project**

| Target | Type | Nº Drill hole | Drilling (m) | Number of samples | Meterage (m) |
|---|---|---|---|---|---|
| Gulcari A (Campbell Pit) | DD | 243 | 45 411.68 | 15 884 | 15 356.53 |
| | RC | 141 | 7 739.00 | 4 547 | 4 547.00 |
| **Total** | | **384** | **53 150.68** | **20 431** | **19 903.53** |
| Gulçari A Norte (GAN) | DD | 120 | 21 054.05 | 9 433 | 9 166.97 |
| Novo Amparo Norte (NAN) | DD | 248 | 43 428.52 | 8 711 | 8 405.69 |
| Novo Amparo Oeste (NAO) | DD | 59 | 9 770.05 | 4 260 | 4 156.46 |
| São José (SJO) | DD | 61 | 19 572.09 | 5 159 | 5 072.30 |
| Jacaré (JAC) | DD | 28 | 3 943.22 | 2 079 | 2 078.77 |
| Gulçari A Sul (GAS) | DD | 19 | 5 125.96 | 1 352 | 1 323.42 |
| RIOCON | DD | 10 | 1 503.65 | 284 | 254.11 |
| Água Branca | DD | 7 | 1 346.51 | 570 | 570.54 |
| Braga | DD | 28 | 5 419.92 | 1 996 | 1 976.87 |
| Ilha Grande | DD | 6 | 1 135.90 | 714 | 709.73 |
| **Total** | | **1 354** | **165 450.55** | **75 420** | **73 521.92** |

Source: GE21, 2024.

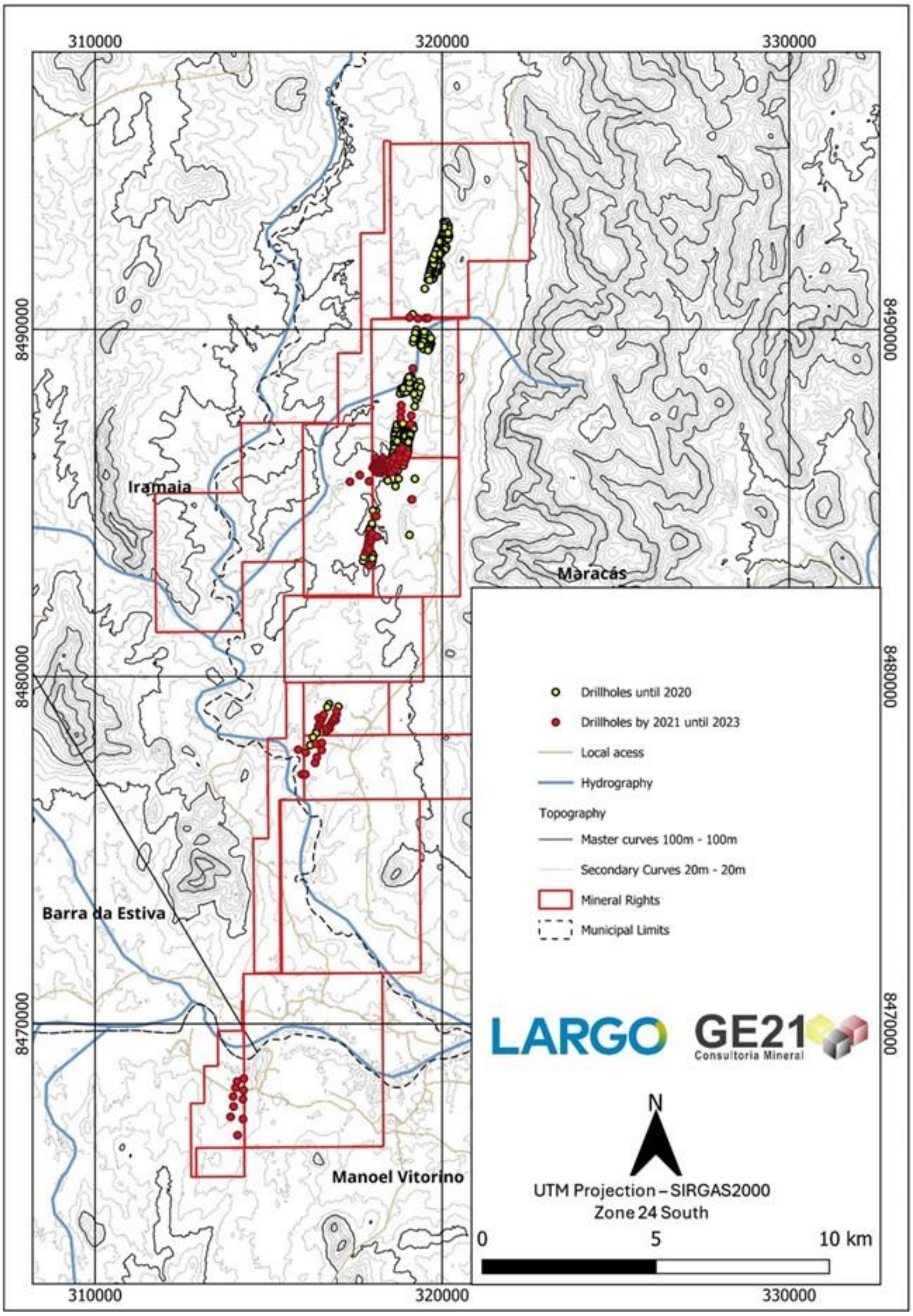



**Figure 10-1 – Location of drilling**

Source: GE21, 2024.

## 10.1 Drilling by Previous Operators (Micon 2006 and 2007)

CBPM and Odebrecht Group completed a first drilling campaign in 1986 at Campbell's deposit.

Between 1981 and 1987, previous CBPM/Odebrecht drilled 66 holes totaling 5,814 m, testing four deposits on the Maracás property, namely, ranging from south to north, Campbell, Gulçari B, São José and Nova Amparo deposits.

### 10.2 Largo Drill Program – 2007

This sub-section has been reproduced in its entirety from the **Technical Report for the Feasibility Study for the Maracás Vanadium Project (2009), Bahia State, Brazil** by Akers Solutions, as fully cited in Section 27, “References”. GE21 has verified the accuracy of the information contained herein and updated as required.

During 2007, Largo completed a drilling program consisting of 61 holes totaling 13,876 m.

Boart Longyear (Geoserv Pesquisas Geológicas S.A.) began the program with one drill rig on February 15th, 2007, and added a second drill rig on March 5th, 2007. Two rigs continued on the property until August 19th, 2007, at which time drilling was completed on the Campbell deposit. One rig was released, and the second drill went to Novo Amparo where 11 holes totaling 1,852 m were completed. The drill rig then cored five regional holes testing geophysical deposits totaling 827.40 m. Drilling was completed on October 29th, 2007.

The drilling at Novo Amparo was designed to test and characterize the mineralization 4 km to the north, along strike of Campbell and the sulfide content and PGM potential of the mineralization. Finally, after the ground magnetic survey was completed, five deposits that had not been previously tested were selected. These showings occur along magnetic trends that can be traced across the property for 4 km from Novo Amparo in the north to Campbell in the south.

At the time, the Campbell deposit, as outlined from the drilling programs, extended 400 m along strike, to a vertical depth of over 320 m with true widths ranging from 11 to 100 m with an average width of about 40 m. This deposit is part of a mineralizing system that extends for 8 km across the property. All the results from the drilling program up to hole FGA-99 (the 2007 drilling program) were completed and incorporated in the block model at that time.

### 10.3 Largo Drill Program – 2008

This sub-section has been reproduced in its entirety from the Technical Report for the Largo Project, **1 Million Tonnes per Year Processing Plant (2012), Brazil** by RungePincockMinarco, as fully cited in Section 27, “References”. GE21 has verified the accuracy of the information contained herein and updated as required.

In May 2008, Largo began a 5,000-m drill campaign to test high-priority IP targets for PGM mineralization. Boart Longyear (Geoserv Pesquisas Geológicas S.A.) began the program with one drill rig on May 28th, 2008, and continued until September 19th, 2008, at which time the drilling program was terminated due to the capital market collapse. It was decided that it was more prudent to discontinue drilling and save the resources. At the time the program was suspended, Largo had completed 16 holes totaling 3,842.7 m.

## 10.4 Largo Drill Program (RungePincockMinarco, 2012) – 2011-2012

This sub-section has been reproduced, with minor changes, from the NI 43-101 Technical Report titled **Amended: Technical Report for the Largo Maracás Vanadium Project, 1 Million Tonnes per Year Processing Plant, Brazil** by RungePincockMinarco (2012) as fully cited in Section 27, "References". GE21 has verified the accuracy of the information contained herein and updated as required.

Between May 16th, 2011, and February 16th, 2012, Largo completed a drill campaign consisting of 72 holes totaling 13,401 m.

Layne Christensen (Layne do Brasil Sondagens Ltda.) began the program with one drill rig on May 16th, 2011, and added a second drill rig on June 1st, 2011. Two rigs continued on the property until December 20th, 2011, at which time one was released, and the second drill went to Gulçari A Norte where 8 holes totaling 1,006.55 m were completed. Drilling was completed on February 5, 2012. Layne Christensen drilled with NQ-sized rods and an average of 900 m per rig / month. Core recovery was good with a reported average of about 90%.

The diamond drilling program focused on further delineating additional resources on the Maracás property. The area encompassed by the drilling includes a 6.5-km strike length from, south to north, Gulçari A Norte to Novo Amparo Norte and a 1.5-km strike length on the east side from São José to Gulçari B Sul (RungePincockMinarco, 2012).

There has been sufficient drilling in this area to demonstrate the continuity of the magnetite-rich horizons which is also supported by the ground magnetic survey that traces the known zones on surface. The ground magnetic survey also has identified several deposits that had not been previously tested.

## 10.5 Largo Infill Drill Program – 2012

Most part of this sub-section has been reproduced in its entirety from the Technical Report **An Updated Mine Plan and Mineral Reserve for the Maracás Menchen Project, Bahia State, Brazil**, July 8th, 2016, as fully cited in Section 27, "References". GE21 has verified the accuracy of the information contained herein and updated as required.

Between September 10th, 2012, and January 21st, 2013, Largo completed an infill drilling campaign consisting of 103 vertical holes totaling 3,929.35 m.

Layne Christensen (Layne do Brasil Sondagens Ltda.) began the program with one drill rig on September 10th, 2012. The rig continued the property until January 21st, 2013, at which time it had completed the drilling on Campbell. Layne Christensen drilled with NQ-sized rods and an average of 980 m per month. Core recovery was good with a reported average of about 90%.

Holes are logged in a conventional manner with lithologies and mineralization marked up with a lumber crayon and described, as well as the recording of basic geotechnical observations (rock quality designation, RQD). Particular attention was placed on the degree of magnetism in the core. Logging was performed using a computer and the “Logger” front-end data collector program written for Gemcom®.

## 10.6 Largo Infill Drill Program (Campbell Pit) – 2018

Between April 19th and May 30th, 2018, Largo completed a drilling program with 31 vertical and inclined holes totaling 2,323.10 m at the Campbell Pit.

SGS GEOSEOL started the program with a rig in April 2018. The rig was kept in the area until May 2018, with NQ-sized rods and an average of 1,161.55 m per month. The average recovery reported was about 99%.

At the Campbell Pit, drilling indicated the local change in the thickness and magnetite-pyroxenite modeled bodies. The regional context of mineralized bodies was not changed by this drilling.

From a total of 31 holes drilled, 24 intercepted by mineralization. The Ti-V intervals ranged from 1.34 m to 56.52 m in length with a weighted average of 2.09% $V_2O_5$ and 15.71 % $TiO_2$.

Lithologies, mineralized zones and geotechnical observations (rock quality and RQD) were marked with pencils on the core box, as well as in the standard description worksheet used by the Largo team. All cores were submitted to magnetic susceptibility analysis.

## 10.7 Largo Exploration Drill Program – 2018

During 2018, Largo completed an exploration drilling campaign totaling 38 diamond drill holes: 24 drill holes in NAN totaling 4,223.30 m, and 14 drill holes in Braga-Jacaré totaling 2,218.70 m drilled.

At NAN the 2018 drill program began on May 29th and ended on September 1st, with 24 holes drilled, completing 4,223.3 m. Two Mach Sonda 320 model diamond drills were used. Average monthly drill core production per rig was 703 m. Subsequently, these rigs were mobilized to areas in the southern extension of the Rio Jacaré Intrusion. A total of 14 regional holes (2,218.7 m) confirmed the anomalies, showing the continuity of the metallogenetic potential of mafic-ultramafic intrusion to the south.

The average diameter of the drill rods was NQ and the average recovery in all areas was above 95%. Mineral exploration program was also based on NNE-SSW regional magnetic anomalies associated with the base lithology of the magmatic differentiation of the region.

Lithologies, mineralized zones and geotechnical observations (rock quality and RQD) were marked with pencils on the core box, as well as in the standard description worksheet used by the Largo team. All core was submitted to magnetic susceptibility analysis.

## 10.8 Largo Exploration Drill Program – 2019

In 2019 Largo drilled 129 holes totaling 19,854.75m at 6 deposits. Drilling was distributed as follows; 5 drill holes in Campbell Pit totaling1,924.65m; 20 drill holes in GAN deposit with a total of 3,050.95 m drilled; 47 drilled in NAN holes totaling 5,404.15m and in the Near Mine Targets 57 drill holes totaling 9,475m (NAO, SJO and GAS).

At Campbell Pit in 2019, the campaign began on May 30th, 2019, and ended on November 18th of the same year with a break from July to August. Five drill holes were drilled totaling 1,924.65 m utilizing 2 drill rigs (rigs 274 and 286) working with an average production of 588 meters per month each. The drilling program was to confirm additional mineralization within the west wall portion of Campbell Pit to expand the Mineral Resource sufficiently to confirm its economic potential. The drilling confirmed the mineralized body (magnetite gabbro) in depth and down-dip direction.

The Company drilled 20 holes totaling 3,050.95 m of core at the GAN deposit. The intention of GAN drilling program was to expand the mineralization for SW portion and to confirm the continuity in depth to expand the Mineral Resource sufficiently to confirm its economic potential.

Lithologies, mineralized zones and geotechnical observations (rock quality and RQD) were marked with pencils on the core box, as well as in the standard description worksheet used by the Largo team. All cores were submitted to magnetic susceptibility analysis.

The campaigns have average diameter of the drill rods was NQ and the average recovery in all areas was above 95. The survey was also based on NNE-SSW regional magnetic anomalies associated with the base lithology of the magmatic differentiation of the region.

Also in 2019, a review of the geological description of older drill holes was conducted to obtain further clarification on stratigraphy across the Rio Jacaré Intrusion. More than 18,000 meters of historic drill core were reviewed in relation to the last survey description.

## 10.9 Largo Drill Program – 2020

In 2020 Largo drilled 124 diamond drill holes over areas (Campbell Pit, GAN, NAN and Near Mine Targets. At Campbell Pit Largo completed 4,757.30 m of coring (17 holes), at GAN deposit 6,899.00 m of coring (45 holes) was completed and at NAN 32 holes were drilled totaling 8,187.65 m of core. Thirty drill holes were executed at the São José and Novo Amparo deposits for about 4,923.80 m of core.

At Campbell Pit the 2020 drill program was consisted by 17 holes drilled holes totaling 4,757.75 m and focused on targets to the northwest and southeast in relation to the main ore body with the aim of better defining the geometry of mineralization and increasing the confidence of inferred resources classified in the last Mineral Resource estimate.

Drilling at the GAN consisted by a total of 45 drill holes with 6,899.0 m of core. The program covered all portions of deposit, and the results improved the level of confidence of the interpretation.

The most recent drilling updated the extension of the main GAN body (magnetitite, magnetite-gabbro and magnetite-pyroxenite) to approximately 1.4 km in strike length and to an average vertical depth of 300 m.

At NAN the program consisted of 32 holes for 8,187.65 m of drill core. In total 8 diamond drill rigs were used at the deposit. Drill holes were cased with HQ rods and reduced to NQ rods for normal drilling. On occasion, holes were downsized to BQ rods if drillers encountered downhole issue, but this was rare. The average recovery in all areas was above 97%.

The holes in NAN ore body were arranged further north and east of the main structure line to confirm the ore body at depth, as well as increase confidence in the longitudinal direction of interpretation. The drilling updated the extent of NAN mineralization (magnetitite layer) to approximately 2.4 km strike length to an average vertical depth of 350 m.

Also, in 2020 Largo drilled 15 holes totaling 2,474.95 m of core at ~SJO deposit and at NAO deposit the Company drilled 14 holes totaling 2,260.6 m of core.

Lithologies, mineralized zones and geotechnical observations (rock quality and RQD) were marked with pencils on the core box, as well as in the standard description worksheet used by the Largo team. All cores were submitted to magnetic susceptibility analysis.

## 10.10 Largo Drill Program – 2021 to 2023

Between 2021 and 2023, Largo conducted drilling campaigns at different targets within the Project area. Table 10-2 presents the quantities of the campaigns at Campbell pit (mine), GAN, NAN, SJO, GAS, JAC, and RIOCON, where 283 holes were drilled, including diamond drilling and reverse circulation, totaling 35,832.83 meters of drilling. Figure 10-2 shows the drill holes from the 2021 to 2023 campaigns.

**Table 10-2 – Drill holes of Campbell target, 2021 to 2023**

| Target | Drilling Type | 2021-2023 | |
|---|---|---|---|
| | | Number of Drill holes | Meterage (m) |
| **Campbell Pit** | DD | 66 | 11,406.79 |
| | RC | 141 | 7,739.00 |
| **Gulçari A Norte (GAN)** | DD | 14 | 5,212.05 |
| **Novo Amparo Norte (NAN)** | DD | 4 | 618.66 |
| **São José (SJO)** | DD | 1 | 283.50 |
| **Gulçari A Sul (GAS)** | DD | 19 | 5,125.96 |
| **Jacaré (JAC)** | DD | 28 | 3,943.22 |
| **RIOCON** | DD | 10 | 1,503.65 |
| **Total** | | **283** | **35,832.83** |

Source: GE21, 2024.

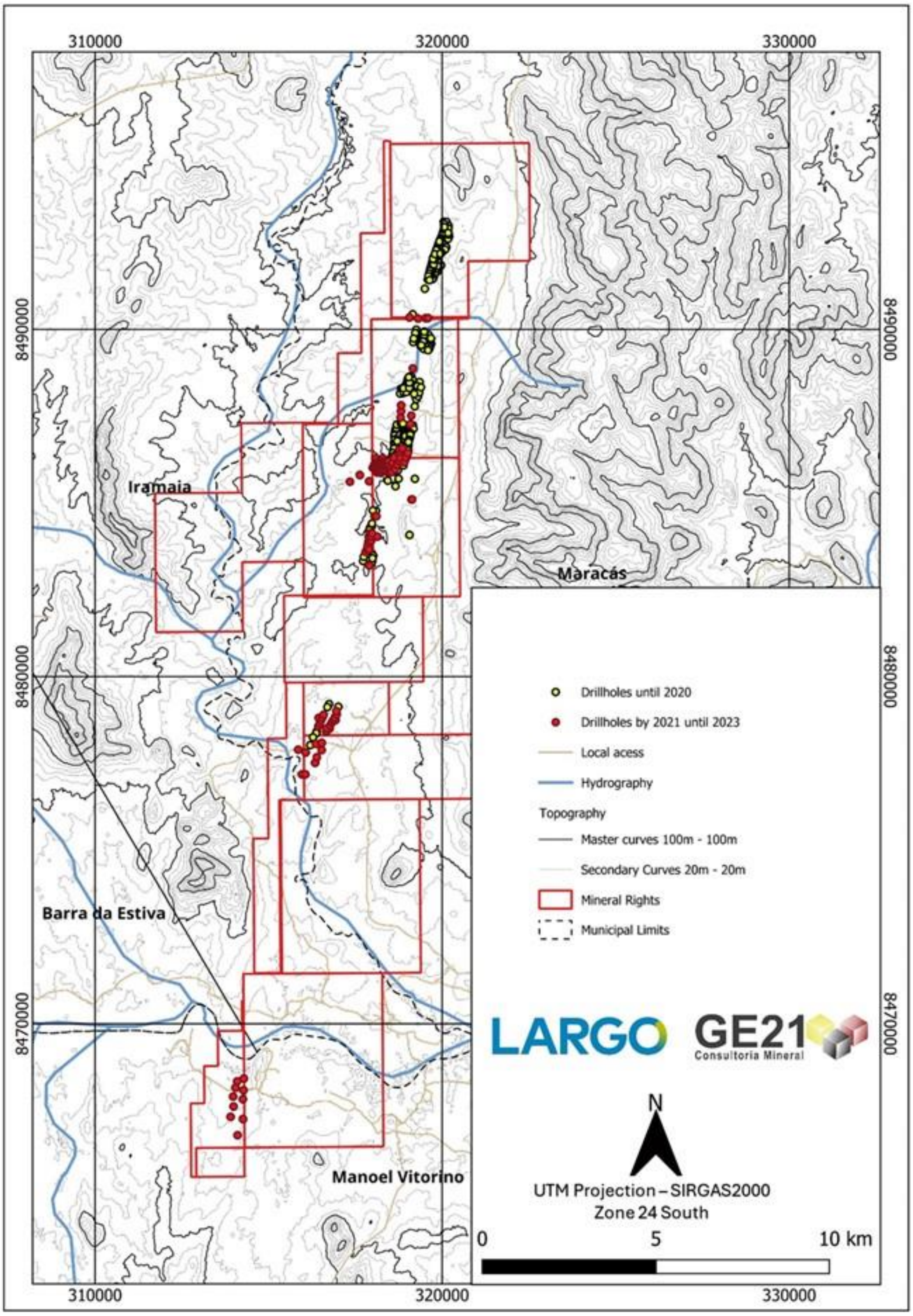



**Figure 10-2 – Drill holes Map 2021 to 2023 Drill holes**

Source: GE21, 2024.

### *10.10.1 Campbell Pit*

A total of 207 holes were drilled at Campbell Pit, of which 66 were diamond drilling (11,406.79 meters) and 141 were reverse circulation drilling (7,739.00 meters).

The 66 diamond drilling holes were executed with an average azimuth of 270° and average inclination of 60°, aiming to represent the mineralized layer that has a dip direction between 90°Az and 110°Az. The 141 reverse circulation drilling holes were executed in the pit area, mostly with an inclination of 90° (vertical), and when oriented, they have an inclination ranging from 55° to 80° in the direction of 270°Az. Table 10-3 presents the collar information for the 207 holes.

**Table 10-3 – Drill holes Campbell target – 2021 to 2023**

| Hole_id | Coord. X | Coord. Y | Elev. Z | Dip | Azimuth | Depth | Year | Type |
|---|---|---|---|---|---|---|---|---|
| **FDGA-130** | 318 247.56 | 8 486 071.53 | 190.02 | 60.00 | 290.98 | 79.90 | 2021 | DD |
| **FDGA-131** | 318 163.00 | 8 486 035.00 | 220.94 | 60.00 | 290.00 | 74.09 | 2021 | DD |
| **FDGA-132** | 318 384.49 | 8 486 115.12 | 189.82 | 70.00 | 290.00 | 85.03 | 2021 | DD |
| **FDGA-133** | 318 378.22 | 8 486 067.44 | 190.28 | 60.00 | 290.00 | 70.26 | 2021 | DD |
| **FDGA-134** | 318 402.42 | 8 485 937.62 | 240.91 | 42.86 | 292.71 | 242.96 | 2021 | DD |
| **FDGA-135** | 318 269.33 | 8 486 020.00 | 199.46 | 37.40 | 289.30 | 134.42 | 2021 | DD |
| **FDGA-136** | 318 328.95 | 8 486 127.46 | 175.78 | 62.97 | 289.31 | 72.69 | 2021 | DD |
| **FDGA-137** | 318 290.86 | 8 486 075.62 | 175.82 | 46.94 | 290.35 | 81.25 | 2021 | DD |
| **FDGA-138** | 318 241.45 | 8 486 129.93 | 189.99 | 54.57 | 290.45 | 80.14 | 2021 | DD |
| **FDGA-139** | 318 338.57 | 8 486 189.27 | 190.49 | 50.90 | 290.34 | 35.49 | 2021 | DD |
| **FDGA-140** | 318 294.46 | 8 486 051.04 | 189.84 | 55.00 | 291.50 | 81.57 | 2021 | DD |
| **FDGA-141** | 318 082.69 | 8 486 133.53 | 270.20 | 52.85 | 285.56 | 40.21 | 2021 | DD |
| **FDGA-142** | 318 047.97 | 8 486 012.95 | 279.60 | 53.67 | 275.78 | 40.04 | 2021 | DD |
| **FDGA-143** | 318 392.20 | 8 486 162.07 | 190.57 | 62.97 | 354.63 | 110.27 | 2021 | DD |
| **FDGA-144** | 318 220.78 | 8 486 000.50 | 210.37 | 63.77 | 289.44 | 45.75 | 2021 | DD |
| **FDGA-145** | 318 180.71 | 8 486 104.41 | 213.28 | 41.36 | 294.80 | 100.85 | 2021 | DD |
| **FDGA-146** | 318 168.07 | 8 486 084.85 | 214.39 | 61.97 | 283.51 | 95.34 | 2021 | DD |
| **FDGA-147** | 318 095.54 | 8 486 153.64 | 269.62 | 55.00 | 290.00 | 80.59 | 2021 | DD |
| **FDGA-148** | 318 346.78 | 8 486 168.66 | 176.62 | 60.44 | 287.19 | 65.61 | 2021 | DD |
| **FDGA-149** | 318 270.58 | 8 485 983.71 | 210.98 | 69.47 | 279.46 | 110.33 | 2021 | DD |
| **FDGA-150** | 318 295.10 | 8 486 155.08 | 180.37 | 54.00 | 290.00 | 65.35 | 2021 | DD |
| **FDGA-151** | 318 301.83 | 8 486 132.54 | 175.62 | 62.00 | 290.00 | 70.90 | 2021 | DD |
| **FDGA-152** | 318 231.70 | 8 486 081.47 | 188.14 | 54.46 | 288.83 | 102.97 | 2021 | DD |
| **FDGA-153** | 318 262.77 | 8 486 131.70 | 184.18 | 54.46 | 284.14 | 105.44 | 2021 | DD |
| **FDGA-154** | 318 328.05 | 8 486 115.59 | 169.35 | 70.00 | 290.00 | 90.58 | 2021 | DD |
| **FDGA-155** | 318 293.99 | 8 486 097.75 | 172.62 | 60.00 | 290.00 | 86.09 | 2021 | DD |
| **FGA-132** | 318 707.56 | 8 486 105.80 | 299.56 | 59.98 | 290.71 | 451.55 | 2021 | DD |
| **FGA-133** | 318 552.68 | 8 485 896.65 | 281.87 | 60.30 | 290.47 | 391.30 | 2021 | DD |
| **FGA-134** | 318 493.22 | 8 485 874.03 | 271.16 | 48.58 | 297.35 | 401.82 | 2021 | DD |
| **FGA-135** | 318 578.74 | 8 486 153.22 | 261.23 | 58.61 | 297.81 | 342.78 | 2021 | DD |
| **FGA-136** | 318 447.41 | 8 486 180.81 | 220.29 | 59.35 | 286.41 | 220.85 | 2021 | DD |
| **FGA-137** | 318 472.00 | 8 486 070.00 | 221.46 | 57.65 | 290.72 | 269.95 | 2021 | DD |
| **FGA-138** | 318 443.32 | 8 486 040.83 | 222.21 | 51.72 | 290.44 | 258.41 | 2021 | DD |
| **GUA-DD-001** | 318 764.73 | 8 486 207.51 | 312.50 | 48.81 | 268.42 | 620.53 | 2022 | DD |
| **GUA-DD-002** | 318 071.60 | 8 486 011.51 | 272.09 | 68.67 | 270.81 | 219.39 | 2022 | DD |
| **GUA-DD-003** | 318 236.89 | 8 485 871.41 | 280.61 | 60.42 | 269.11 | 131.61 | 2022 | DD |
| **GUA-SD-001** | 318 301.12 | 8 486 078.09 | 154.86 | 79.89 | 298.99 | 97.45 | 2022 | DD |

| Hole_id | Coord. X | Coord. Y | Elev. Z | Dip | Azimuth | Depth | Year | Type |
|---|---|---|---|---|---|---|---|---|
| GUA-SD-002 | 318 344.19 | 8 486 101.95 | 153.73 | 79.50 | 279.79 | 87.68 | 2022 | DD |
| GUA-SD-003 | 318 367.60 | 8 486 091.04 | 156.70 | 80.62 | 276.96 | 16.89 | 2022 | DD |
| GUA-SD-004 | 318 129.40 | 8 486 140.41 | 239.62 | 78.44 | 299.13 | 111.45 | 2022 | DD |
| GUA-SD-005 | 318 118.86 | 8 486 103.95 | 243.00 | 81.18 | 289.01 | 48.06 | 2022 | DD |
| GUA-SD-006 | 318 043.86 | 8 486 101.89 | 265.66 | 80.28 | 262.42 | 63.71 | 2022 | DD |
| GUA-SD-007 | 318 103.52 | 8 486 054.64 | 240.23 | 79.87 | 270.64 | 117.99 | 2022 | DD |
| GUA-SD-008 | 318 423.80 | 8 486 188.76 | 200.61 | 44.85 | 275.56 | 173.40 | 2022 | DD |
| GUA-SD-009 | 318 202.50 | 8 486 083.21 | 174.56 | 42.59 | 273.67 | 58.61 | 2022 | DD |
| Gua-SD-010 | 318 331.83 | 8 485 945.03 | 220.77 | 69.12 | 270.24 | 44.48 | 2022 | DD |
| GUA-SD-011 | 318 321.87 | 8 486 087.57 | 149.86 | 80.00 | 270.00 | 49.49 | 2022 | DD |
| GUA-SD-012 | 318 231.66 | 8 486 023.67 | 180.20 | 78.84 | 272.05 | 55.35 | 2022 | DD |
| GUA-SD-013 | 318 109.74 | 8 486 080.83 | 229.40 | 81.09 | 271.04 | 77.07 | 2022 | DD |
| GUA-SD-014 | 318 453.64 | 8 486 189.91 | 201.34 | 44.02 | 274.81 | 201.14 | 2022 | DD |
| GUA-SD-015 | 318 358.93 | 8 486 055.16 | 161.53 | 80.00 | 270.00 | 59.96 | 2022 | DD |
| GUA-SD-016 | 318 192.88 | 8 485 976.35 | 229.43 | 68.45 | 260.44 | 115.91 | 2022 | DD |
| GUA-SD-017 | 318 450.30 | 8 486 181.39 | 201.38 | 67.84 | 266.11 | 234.68 | 2022 | DD |
| GUA-SD-018 | 318 149.54 | 8 486 017.11 | 231.08 | 67.62 | 272.41 | 134.34 | 2022 | DD |
| GUA-SD-019 | 318 241.35 | 8 485 943.41 | 230.16 | 69.10 | 266.83 | 201.11 | 2022 | DD |
| GUA-SD-020 | 318 138.52 | 8 485 931.15 | 279.78 | 58.19 | 268.24 | 200.76 | 2022 | DD |
| GUA-DD-004 | 318 696.53 | 8 486 102.33 | 280.54 | 60.00 | 275.00 | 596.65 | 2023 | DD |
| GUA-DD-005 | 318 523.17 | 8 486 001.09 | 221.70 | 50.00 | 275.00 | 276.80 | 2023 | DD |
| GUA-DD-006 | 318 523.17 | 8 486 001.09 | 221.70 | 69.63 | 280.65 | 299.20 | 2023 | DD |
| GUA-DD-007 | 318 537.32 | 8 485 905.95 | 261.20 | 50.13 | 283.81 | 287.50 | 2023 | DD |
| GUA-DD-008 | 318 647.44 | 8 485 977.88 | 274.98 | 48.88 | 277.94 | 407.10 | 2023 | DD |
| GUA-DD-009 | 318 292.48 | 8 486 295.29 | 259.29 | 56.26 | 158.41 | 339.45 | 2023 | DD |
| GUA-DD-010 | 317 998.27 | 8 486 017.93 | 288.32 | 59.13 | 58.50 | 315.25 | 2023 | DD |
| GUA-DD-011 | 318 073.74 | 8 486 287.65 | 294.46 | 46.43 | 147.78 | 379.90 | 2023 | DD |
| GUA-DD-012 | 318 615.95 | 8 486 315.59 | 290.49 | 51.07 | 222.29 | 410.50 | 2023 | DD |
| GUA-DD-013 | 318 130.81 | 8 485 878.53 | 295.81 | 54.01 | 36.80 | 388.60 | 2023 | DD |
| GUA-RC-001 | 318 274.41 | 8 485 950.39 | 209.68 | 70.00 | 270.00 | 75.00 | 2023 | RC |
| GUA-RC-002 | 318 274.59 | 8 485 927.64 | 219.50 | 70.00 | 270.00 | 100.00 | 2023 | RC |
| GUA-RC-003 | 318 271.10 | 8 485 996.37 | 190.08 | 80.00 | 270.00 | 70.00 | 2023 | RC |
| GUA-RC-004 | 318 439.58 | 8 486 120.60 | 179.58 | 80.00 | 280.00 | 100.00 | 2023 | RC |
| GUA-RC-005 | 318 436.21 | 8 486 145.39 | 180.21 | 80.00 | 283.00 | 100.00 | 2023 | RC |
| GUA-RC-006 | 318 299.30 | 8 486 103.93 | 140.34 | 80.00 | 270.00 | 50.00 | 2023 | RC |
| GUA-RC-007 | 318 241.55 | 8 486 056.71 | 172.11 | 90.00 | 270.00 | 50.00 | 2023 | RC |
| GUA-RC-008 | 318 390.67 | 8 486 180.24 | 179.91 | 90.00 | 270.00 | 100.00 | 2023 | RC |
| GUA-RC-009 | 318 349.18 | 8 486 193.65 | 179.61 | 90.00 | 270.00 | 50.00 | 2023 | RC |
| GUA-RC-010 | 318 380.90 | 8 486 183.34 | 179.26 | 50.00 | 180.00 | 85.00 | 2023 | RC |
| GUA-RC-011 | 318 410.48 | 8 486 161.24 | 178.62 | 90.00 | 270.00 | 90.00 | 2023 | RC |
| GUA-RC-012 | 318 295.92 | 8 486 007.50 | 189.61 | 90.00 | 270.00 | 50.00 | 2023 | RC |
| GUA-RC-013 | 318 142.97 | 8 486 104.59 | 200.57 | 90.00 | 270.00 | 70.00 | 2023 | RC |
| GUA-RC-014 | 318 279.66 | 8 486 083.72 | 141.36 | 90.00 | 270.00 | 50.00 | 2023 | RC |
| GUA-RC-015 | 318 044.98 | 8 486 054.75 | 271.59 | 90.00 | 270.00 | 50.00 | 2023 | RC |

| Hole_id | Coord. X | Coord. Y | Elev. Z | Dip | Azimuth | Depth | Year | Type |
|---|---|---|---|---|---|---|---|---|
| GUA-RC-016 | 318 137.72 | 8 486 075.90 | 200.55 | 90.00 | 270.00 | 70.00 | 2023 | RC |
| GUA-RC-017 | 318 418.92 | 8 486 158.32 | 179.87 | 55.00 | 255.00 | 40.00 | 2023 | RC |
| GUA-RC-018 | 318 158.20 | 8 486 034.46 | 199.32 | 90.00 | - | 70.00 | 2023 | RC |
| GUA-RC-019 | 318 177.00 | 8 486 181.54 | 220.30 | 90.00 | - | 70.00 | 2023 | RC |
| GUA-RC-020 | 318 143.37 | 8 486 142.21 | 220.06 | 90.00 | - | 85.00 | 2023 | RC |
| GUA-RC-021 | 318 335.70 | 8 486 052.76 | 158.95 | 90.00 | - | 50.00 | 2023 | RC |
| GUA-RC-022 | 318 264.83 | 8 486 052.58 | 168.81 | 90.00 | - | 50.00 | 2023 | RC |
| GUA-RC-023 | 318 385.01 | 8 486 164.85 | 169.48 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-024 | 318 379.77 | 8 486 169.05 | 169.20 | 55.00 | 270.00 | 20.00 | 2023 | RC |
| GUA-RC-025 | 318 155.30 | 8 486 011.29 | 221.34 | 90.00 | - | 50.00 | 2023 | RC |
| GUA-RC-026 | 318 109.61 | 8 486 092.13 | 219.75 | 90.00 | - | 75.00 | 2023 | RC |
| GUA-RC-027 | 318 117.66 | 8 486 064.71 | 220.81 | 90.00 | - | 75.00 | 2023 | RC |
| GUA-RC-028 | 318 228.63 | 8 486 096.45 | 174.21 | 90.00 | - | 60.00 | 2023 | RC |
| GUA-RC-029 | 318 429.18 | 8 486 104.23 | 179.38 | 55.00 | 290.00 | 80.00 | 2023 | RC |
| GUA-RC-030 | 318 428.51 | 8 486 105.70 | 179.43 | 55.00 | 270.00 | 80.00 | 2023 | RC |
| GUA-RC-031 | 318 184.86 | 8 486 153.90 | 202.06 | 90.00 | - | 70.00 | 2023 | RC |
| GUA-RC-032 | 318 205.08 | 8 486 171.51 | 201.66 | 90.00 | - | 75.00 | 2023 | RC |
| GUA-RC-033 | 318 162.28 | 8 486 132.95 | 201.52 | 90.00 | - | 75.00 | 2023 | RC |
| GUA-RC-034 | 318 187.57 | 8 486 116.35 | 194.42 | 90.00 | - | 60.00 | 2023 | RC |
| GUA-RC-035 | 318 096.16 | 8 485 994.69 | 270.18 | 90.00 | - | 50.00 | 2023 | RC |
| GUA-RC-036 | 318 207.41 | 8 486 141.79 | 195.70 | 90.00 | - | 40.00 | 2023 | RC |
| GUA-RC-037 | 318 337.58 | 8 486 182.17 | 170.35 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-038 | 318 358.08 | 8 486 181.65 | 171.19 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-039 | 318 260.69 | 8 485 966.19 | 205.23 | 90.00 | - | 45.00 | 2023 | RC |
| GUA-RC-040 | 318 169.76 | 8 486 098.91 | 190.00 | 90.00 | - | 55.00 | 2023 | RC |
| GUA-RC-041 | 318 160.89 | 8 486 083.42 | 196.91 | 90.00 | - | 60.00 | 2023 | RC |
| GUA-RC-042 | 318 159.73 | 8 486 068.71 | 199.15 | 90.00 | - | 70.00 | 2023 | RC |
| GUA-RC-043 | 318 203.31 | 8 486 123.25 | 194.96 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-044 | 318 178.23 | 8 486 113.26 | 194.00 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-045 | 318 207.91 | 8 486 072.61 | 175.25 | 90.00 | - | 31.00 | 2023 | RC |
| GUA-RC-046 | 318 420.68 | 8 486 149.27 | 166.12 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-047 | 318 396.00 | 8 486 165.96 | 162.11 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-048 | 318 383.04 | 8 486 166.66 | 161.04 | 90.00 | - | 20.00 | 2023 | RC |
| GUA-RC-049 | 318 388.86 | 8 486 162.40 | 161.24 | 90.00 | - | 14.00 | 2023 | RC |
| GUA-RC-050 | 318 060.12 | 8 486 030.92 | 271.05 | 90.00 | - | 60.00 | 2023 | RC |
| GUA-RC-051 | 318 421.49 | 8 486 139.48 | 167.93 | 70.00 | 270.00 | 80.00 | 2023 | RC |
| GUA-RC-052 | 318 420.19 | 8 486 122.92 | 169.80 | 70.00 | 270.00 | 80.00 | 2023 | RC |
| GUA-RC-053 | 318 422.54 | 8 486 130.90 | 170.37 | 90.00 | - | 80.00 | 2023 | RC |
| GUA-RC-054 | 318 412.07 | 8 486 088.60 | 171.26 | 60.00 | 270.00 | 45.00 | 2023 | RC |
| GUA-RC-055 | 318 232.46 | 8 486 037.12 | 178.51 | 90.00 | - | 40.00 | 2023 | RC |
| GUA-RC-056 | 318 229.53 | 8 486 082.07 | 174.60 | 90.00 | - | 60.00 | 2023 | RC |
| GUA-RC-057 | 318 253.18 | 8 486 026.79 | 179.55 | 90.00 | - | 45.00 | 2023 | RC |
| GUA-RC-058 | 318 383.97 | 8 486 121.58 | 149.89 | 90.00 | - | 50.00 | 2023 | RC |
| GUA-RC-059 | 318 283.41 | 8 486 026.26 | 177.69 | 90.00 | - | 50.00 | 2023 | RC |

| Hole_id | Coord. X | Coord. Y | Elev. Z | Dip | Azimuth | Depth | Year | Type |
|---|---|---|---|---|---|---|---|---|
| **GUA-RC-060** | 318 305.49 | 8 486 017.26 | 188.87 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-061** | 318 136.05 | 8 486 093.11 | 200.44 | 90.00 | - | 65.00 | 2023 | RC |
| **GUA-RC-062** | 318 257.79 | 8 486 056.95 | 170.10 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-063** | 318 146.12 | 8 486 063.78 | 200.01 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-064** | 318 156.57 | 8 486 047.89 | 200.02 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-065** | 318 153.75 | 8 486 117.42 | 201.07 | 90.00 | - | 65.00 | 2023 | RC |
| **GUA-RC-066** | 318 175.85 | 8 486 016.10 | 200.40 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-067** | 318 123.84 | 8 486 051.16 | 220.47 | 90.00 | - | 75.00 | 2023 | RC |
| **GUA-RC-068** | 318 139.88 | 8 486 028.09 | 220.53 | 90.00 | - | 70.00 | 2023 | RC |
| **GUA-RC-069** | 318 165.59 | 8 485 996.82 | 219.84 | 90.00 | - | 75.00 | 2023 | RC |
| **GUA-RC-070** | 318 062.98 | 8 486 145.99 | 261.65 | 90.00 | - | 70.00 | 2023 | RC |
| **GUA-RC-071** | 318 357.73 | 8 486 033.30 | 171.18 | 90.00 | - | 55.00 | 2023 | RC |
| **GUA-RC-072** | 318 173.80 | 8 486 052.96 | 189.73 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-073** | 318 279.16 | 8 486 192.02 | 199.97 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-074** | 318 167.49 | 8 486 067.33 | 189.88 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-075** | 318 331.24 | 8 486 027.07 | 170.61 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-076** | 318 103.68 | 8 486 172.81 | 259.88 | 90.00 | - | 62.00 | 2023 | RC |
| **GUA-RC-077** | 318 195.94 | 8 486 094.92 | 180.78 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-078** | 318 209.17 | 8 486 102.94 | 180.00 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-079** | 318 127.99 | 8 486 122.86 | 220.28 | 90.00 | - | 70.00 | 2023 | RC |
| **GUA-RC-080** | 318 377.03 | 8 486 094.87 | 155.12 | 90.00 | - | 23.00 | 2023 | RC |
| **GUA-RC-081** | 318 327.52 | 8 486 137.52 | 149.95 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-082** | 318 368.09 | 8 486 146.83 | 150.32 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-083** | 318 317.01 | 8 486 134.39 | 149.80 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-084** | 318 388.69 | 8 486 139.85 | 149.27 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-085** | 318 255.20 | 8 486 148.89 | 179.52 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-086** | 318 239.53 | 8 486 142.93 | 179.74 | 90.00 | - | 55.00 | 2023 | RC |
| **GUA-RC-087** | 318 200.60 | 8 486 034.62 | 180.02 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-088** | 318 251.55 | 8 486 037.01 | 172.89 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-089** | 318 278.60 | 8 486 167.70 | 179.86 | 90.00 | - | 55.00 | 2023 | RC |
| **GUA-RC-090** | 318 193.34 | 8 486 192.03 | 219.66 | 90.00 | - | 64.00 | 2023 | RC |
| **GUA-RC-091** | 318 380.26 | 8 486 112.38 | 153.68 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-092** | 318 351.65 | 8 486 137.28 | 149.84 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-093** | 318 367.11 | 8 486 073.31 | 155.87 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-094** | 318 306.13 | 8 486 048.73 | 162.13 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-095** | 318 354.25 | 8 486 065.70 | 156.35 | 90.00 | - | 65.00 | 2023 | RC |
| **GUA-RC-096** | 318 286.28 | 8 486 110.47 | 149.35 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-097** | 318 296.92 | 8 486 123.09 | 149.78 | 90.00 | - | 34.00 | 2023 | RC |
| **GUA-RC-098** | 318 154.52 | 8 486 156.19 | 219.76 | 90.00 | - | 80.00 | 2023 | RC |
| **GUA-RC-099** | 318 244.51 | 8 486 123.34 | 174.67 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-100** | 318 234.48 | 8 486 116.17 | 174.96 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-101** | 318 238.40 | 8 486 072.89 | 173.47 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-102** | 318 365.14 | 8 486 209.08 | 181.00 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-103** | 318 224.49 | 8 486 054.88 | 172.93 | 90.00 | - | 50.00 | 2023 | RC |

| Hole_id | Coord. X | Coord. Y | Elev. Z | Dip | Azimuth | Depth | Year | Type |
|---|---|---|---|---|---|---|---|---|
| **GUA-RC-104** | 318 272.84 | 8 486 008.01 | 181.22 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-105** | 318 235.89 | 8 486 009.23 | 178.39 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-106** | 318 299.11 | 8 486 200.40 | 180.63 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-107** | 318 320.72 | 8 486 205.64 | 180.67 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-108** | 318 365.08 | 8 486 125.57 | 151.25 | 65.00 | 270.00 | 65.00 | 2023 | RC |
| **GUA-RC-109** | 318 383.72 | 8 486 087.94 | 155.51 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-110** | 318 378.83 | 8 486 025.78 | 170.37 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-111** | 318 274.96 | 8 486 096.19 | 147.45 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-112** | 318 288.40 | 8 486 098.34 | 147.37 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-113** | 318 376.57 | 8 486 057.10 | 161.63 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-114** | 318 336.19 | 8 486 154.53 | 150.01 | 90.00 | - | 40.00 | 2023 | RC |
| **GUA-RC-115** | 318 379.03 | 8 486 151.40 | 147.92 | 90.00 | - | 30.00 | 2023 | RC |
| **GUA-RC-116** | 318 192.06 | 8 486 044.51 | 180.27 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-117** | 318 161.41 | 8 486 073.99 | 180.91 | 90.00 | - | 29.00 | 2023 | RC |
| **GUA-RC-118** | 318 427.67 | 8 486 065.05 | 170.81 | 90.00 | - | 100.00 | 2023 | RC |
| **GUA-RC-119** | 318 250.78 | 8 486 004.65 | 180.36 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-120** | 318 411.28 | 8 486 040.41 | 170.17 | 90.00 | - | 100.00 | 2023 | RC |
| **GUA-RC-121** | 318 177.20 | 8 485 984.36 | 219.49 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-122** | 318 109.94 | 8 486 076.03 | 219.78 | 90.00 | - | 28.00 | 2023 | RC |
| **GUA-RC-123** | 318 131.80 | 8 486 038.74 | 220.60 | 90.00 | - | 70.00 | 2023 | RC |
| **GUA-RC-124** | 318 213.30 | 8 486 025.50 | 179.54 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-125** | 318 049.03 | 8 486 117.95 | 264.50 | 90.00 | - | 70.00 | 2023 | RC |
| **GUA-RC-126** | 318 042.72 | 8 486 078.13 | 267.73 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-127** | 318 216.89 | 8 486 042.14 | 178.26 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-128** | 318 079.06 | 8 486 154.10 | 260.27 | 90.00 | - | 60.00 | 2023 | RC |
| **GUA-RC-129** | 318 116.89 | 8 486 108.94 | 219.44 | 90.00 | - | 90.00 | 2023 | RC |
| **GUA-RC-130** | 318 167.53 | 8 486 169.90 | 219.94 | 90.00 | - | 80.00 | 2023 | RC |
| **GUA-RC-131** | 318 286.30 | 8 486 043.20 | 165.80 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-132** | 318 368.99 | 8 486 102.01 | 144.92 | 90.00 | - | 75.00 | 2023 | RC |
| **GUA-RC-133** | 318 198.07 | 8 485 971.32 | 219.08 | 90.00 | - | 75.00 | 2023 | RC |
| **GUA-RC-134** | 318 214.20 | 8 485 959.00 | 220.10 | 90.00 | - | 75.00 | 2023 | RC |
| **GUA-RC-135** | 318 232.28 | 8 485 966.69 | 203.41 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-136** | 318 187.59 | 8 486 001.51 | 202.05 | 90.00 | - | 50.00 | 2023 | RC |
| **GUA-RC-137** | 318 221.07 | 8 486 147.46 | 180.03 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-138** | 318 199.74 | 8 486 127.22 | 180.13 | 90.00 | - | 45.00 | 2023 | RC |
| **GUA-RC-139** | 318 177.50 | 8 486 111.15 | 180.31 | 90.00 | - | 27.00 | 2023 | RC |
| **GUA-RC-140** | 318 340.50 | 8 486 118.60 | 142.70 | 90.00 | - | 42.00 | 2023 | RC |
| **GUA-RC-141** | 318 295.14 | 8 486 159.88 | 170.65 | 90.00 | - | 70.00 | 2023 | RC |

Source: GE21, 2024.

Table 10-4 presents the intervals from the 2021 to 2023 campaign with grades higher than 2.5% $V_2O_5$.

**Table 10-4 – Intervals with grade over 2.5% $V_2O_5$**

| Hole Id | From | To | Lenght (m) | $V_2O_5$% | $TiO_2$% |
|---|---|---|---|---|---|
| FDGA-104 | 16.00 | 41.40 | 25.40 | 2.78 | 14.62 |
| FDGA-105 | 0.00 | 11.00 | 11.00 | 3.26 | 16.30 |
| FDGA-106 | 0.00 | 10.25 | 10.25 | 3.04 | 15.35 |
| FDGA-107 | 8.20 | 23.37 | 15.17 | 3.33 | 16.14 |
| FDGA-108 | 0.00 | 19.00 | 19.00 | 2.93 | 16.37 |
| FDGA-109 | 7.25 | 17.03 | 9.78 | 2.92 | 14.44 |
| FDGA-109 | 19.15 | 23.00 | 3.85 | 2.60 | 16.22 |
| FDGA-109 | 31.00 | 38.00 | 7.00 | 2.70 | 15.01 |
| FDGA-109 | 48.85 | 53.60 | 4.75 | 2.83 | 14.58 |
| FDGA-110 | 37.35 | 50.15 | 12.80 | 2.76 | 14.04 |
| FDGA-111 | 0.00 | 38.90 | 38.90 | 3.02 | 12.55 |
| FDGA-111 | 40.00 | 49.20 | 9.20 | 2.79 | 12.63 |
| FDGA-115 | 57.20 | 66.80 | 9.60 | 2.82 | 13.01 |
| FDGA-119 | 36.60 | 41.60 | 5.00 | 2.80 | 13.64 |
| FDGA-123 | 250.00 | 254.35 | 4.35 | 2.59 | 13.29 |
| FDGA-128 | 4.00 | 11.45 | 7.45 | 2.78 | 13.60 |
| FDGA-128 | 19.00 | 22.35 | 3.35 | 2.91 | 12.33 |
| FDGA-128 | 22.35 | 55.40 | 33.05 | 2.70 | 10.25 |
| FDGA-129 | 6.00 | 33.53 | 27.53 | 2.68 | 9.24 |
| FDGA-129 | 35.50 | 39.50 | 4.00 | 2.74 | 11.03 |
| FDGA-129 | 39.50 | 51.15 | 11.65 | 2.56 | 11.75 |
| FDGA-129A | 0.00 | 22.17 | 22.17 | 2.89 | 11.28 |
| FGA-43 | 84.00 | 98.00 | 14.00 | 2.94 | 12.84 |
| FGA-43 | 122.00 | 128.00 | 6.00 | 2.87 | 12.43 |
| FGA-57 | 130.00 | 138.10 | 8.10 | 2.60 | 15.67 |
| FGA-58 | 70.00 | 75.40 | 5.40 | 2.84 | 14.36 |
| FGA-58 | 83.00 | 99.00 | 16.00 | 2.84 | 15.60 |
| FGA-58 | 145.00 | 149.00 | 4.00 | 2.58 | 15.72 |
| FGA-59 | 65.00 | 68.00 | 3.00 | 3.04 | 11.24 |
| FGA-59 | 69.00 | 81.87 | 12.87 | 2.93 | 13.95 |
| FGA-59 | 87.17 | 93.00 | 5.83 | 3.23 | 16.02 |
| FGA-61 | 89.00 | 107.00 | 18.00 | 2.65 | 14.84 |
| FGA-64 | 110.00 | 113.25 | 3.25 | 2.56 | 16.47 |
| FGA-67 | 33.00 | 46.00 | 13.00 | 2.68 | 14.21 |
| FGA-68 | 124.00 | 128.00 | 4.00 | 2.75 | 13.26 |
| FGA-69 | 48.00 | 55.00 | 7.00 | 2.70 | 12.28 |
| FGA-69 | 64.00 | 76.00 | 12.00 | 3.10 | 15.19 |
| FGA-69 | 97.00 | 112.00 | 15.00 | 2.81 | 12.65 |
| FGA-70 | 24.17 | 28.00 | 3.83 | 2.55 | 14.69 |
| FGA-71 | 156.02 | 166.20 | 10.18 | 2.80 | 14.99 |
| FGA-73 | 132.50 | 148.40 | 15.90 | 3.14 | 16.05 |
| FGA-77 | 133.50 | 144.50 | 11.00 | 2.88 | 16.36 |
| FGA-79 | 151.00 | 154.00 | 3.00 | 3.07 | 10.23 |
| FGA-79 | 174.00 | 177.00 | 3.00 | 2.63 | 15.74 |
| FGA-89 | 307.00 | 317.00 | 10.00 | 2.71 | 16.25 |
| FDGA-132 | 16.53 | 19.86 | 3.33 | 2.82 | 15.60 |
| GUA-RC-017 | 26.00 | 34.00 | 8.00 | 2.74 | 13.08 |
| GUA-RC-053 | 59.00 | 63.00 | 4.00 | 2.94 | 12.91 |
| GUA-RC-052 | 47.00 | 50.00 | 3.00 | 2.61 | 16.11 |
| GUA-RC-052 | 56.00 | 60.00 | 4.00 | 2.77 | 15.54 |
| GUA-RC-051 | 18.00 | 41.00 | 23.00 | 2.94 | 12.85 |
| GUA-RC-029 | 61.00 | 64.00 | 3.00 | 2.75 | 16.36 |
| GUA-RC-109 | 21.00 | 25.00 | 4.00 | 2.62 | 14.19 |
| GUA-RC-084 | 2.00 | 5.00 | 3.00 | 2.60 | 13.94 |
| GUA-RC-083 | 7.00 | 17.00 | 10.00 | 2.62 | 16.09 |

Source: GE21, 2024.

### *10.10.2 GAN Target*

At the GAN target, 14 diamond drilling holes were executed, totaling 5,212.05 meters in the year 2023. The holes were drilled with azimuths of 270° and 290° and inclinations ranging from 45° to 70°, aiming to represent the mineralized layer which has a dip direction between 90° and 110° and an average inclination of 58°.

Table 10-5 presents the drilling holes executed in the 2023 campaign.

**Table 10-5 – Drill holes of GAN target**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Lenght (m) | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| **GAN-DD-004** | 318853 | 8486577 | 303.86 | 437.55 | 270 | -60 | DD | 2023 |
| **GAN-DD-005** | 318854 | 8486577 | 303.90 | 242.95 | 270 | -45 | DD | 2023 |
| **GAN-DD-006** | 318796 | 8486299 | 310.18 | 464.9 | 270 | -60 | DD | 2023 |
| **GAN-DD-007** | 318771 | 8486387 | 307.21 | 380.9 | 270 | -60 | DD | 2023 |
| **GAN-DD-008** | 318813 | 8487648 | 322.75 | 248.55 | 270 | -45 | DD | 2023 |
| **GAN-DD-009** | 318802 | 8487470 | 321.16 | 409.3 | 270 | -45 | DD | 2023 |
| **GAN-DD-010** | 318815 | 8487648 | 322.84 | 213.15 | 270 | -70 | DD | 2023 |
| **GAN-DD-011** | 318768 | 8486543 | 306.16 | 256.45 | 270 | -60 | DD | 2023 |
| **GAN-DD-012** | 319110 | 8487520 | 328.92 | 515.4 | 270 | -45 | DD | 2023 |

Source: GE21, 2024.

Table 10-6 presents the intervals from this campaign with grades exceeding 0.3% $V_2O_5$. These holes confirm the continuity of mineralization at depth and contribute to the identification of additional Mineral Resources.

**Table 10-6 – Intervals with grade over 0.3% $V_2O_5$**

| Hole Id | From | To | Length (m) | $V_2O_5$% | $TiO_2$% | Year |
|---|---|---|---|---|---|---|
| **GAN-DD-001** | 48.00 | 87.00 | 39.00 | 0.37 | 6.94 | 2023 |
| **GAN-DD-001** | 244.00 | 255.00 | 11.00 | 0.43 | 10.80 | 2023 |
| **GAN-DD-001** | 390.00 | 394.75 | 4.75 | 0.56 | 7.70 | 2023 |
| **GAN-DD-001** | 414.00 | 418.19 | 4.19 | 0.58 | 5.13 | 2023 |
| **GAN-DD-002** | 4.00 | 66.07 | 62.07 | 0.41 | 7.19 | 2023 |
| **GAN-DD-003** | 42.19 | 82.33 | 40.14 | 0.38 | 6.93 | 2023 |
| **GAN-DD-004** | 83.60 | 126.27 | 42.67 | 0.55 | 11.76 | 2023 |
| **GAN-DD-004** | 319.00 | 324.20 | 5.20 | 0.46 | 4.87 | 2023 |
| **GAN-DD-004** | 339.00 | 348.00 | 9.00 | 0.43 | 3.59 | 2023 |
| **GAN-DD-005** | 68.50 | 80.64 | 12.14 | 0.33 | 6.85 | 2023 |
| **GAN-DD-006** | 322.00 | 328.00 | 6.00 | 0.48 | 3.42 | 2023 |
| **GAN-DD-007** | 226.35 | 243.83 | 17.48 | 0.38 | 6.39 | 2023 |
| **GAN-DD-007** | 266.86 | 271.65 | 4.79 | 0.33 | 3.99 | 2023 |
| **GAN-DD-008** | 60.62 | 64.50 | 3.88 | 0.81 | 12.06 | 2023 |
| **GAN-DD-008** | 103.02 | 150.55 | 47.53 | 0.44 | 3.85 | 2023 |
| **GAN-DD-009** | 94.00 | 103.00 | 9.00 | 0.42 | 6.53 | 2023 |
| **GAN-DD-009** | 139.72 | 151.00 | 11.28 | 0.33 | 3.05 | 2023 |
| **GAN-DD-009** | 170.00 | 180.75 | 10.75 | 0.79 | 5.01 | 2023 |
| **GAN-DD-010** | 77.57 | 85.32 | 7.75 | 0.49 | 6.99 | 2023 |
| **GAN-DD-010** | 136.09 | 148.78 | 12.69 | 0.34 | 2.98 | 2023 |
| **GAN-DD-010** | 168.76 | 179.08 | 10.32 | 0.71 | 5.28 | 2023 |
| **GAN-DD-011** | 238.46 | 245.80 | 7.34 | 0.45 | 4.98 | 2023 |
| **GAN-DD-012** | 63.00 | 66.82 | 3.82 | 0.39 | 7.25 | 2023 |
| **GAN-DD-012** | 153.00 | 164.00 | 11.00 | 0.32 | 5.55 | 2023 |
| **GAN-DD-012** | 205.15 | 215.90 | 10.75 | 0.41 | 6.24 | 2023 |
| **GAN-DD-012** | 349.00 | 352.70 | 3.70 | 0.80 | 12.84 | 2023 |
| **GAN-DD-012** | 420.40 | 428.40 | 8.00 | 0.54 | 3.87 | 2023 |
| **GAN-DD-013** | 54.44 | 74.62 | 20.18 | 0.38 | 7.66 | 2023 |
| **GAN-DD-013** | 363.34 | 369.51 | 6.17 | 0.48 | 6.60 | 2023 |
| **GAN-DD-013** | 396.00 | 441.80 | 45.80 | 0.60 | 4.31 | 2023 |
| **GAN-DD-014** | 78.00 | 89.24 | 11.24 | 0.49 | 7.14 | 2023 |
| **GAN-DD-014** | 127.00 | 138.47 | 11.47 | 0.35 | 2.96 | 2023 |

Source: GE21, 2024.

### *10.10.3 NAN Target*

Largo conducted 4 diamond drilling holes at the NAN target, totaling 618.66 meters in the year 2022. The holes were drilled with azimuths ranging from 270.91° to 274.82° and inclinations varying from 43° to 47°, aiming to represent the mineralized layer which has a dip direction between 90° and 100° and an average inclination of 70°.

Table 10-7 presents the collar information for the drilling holes at the NAN target.

**Table 10-7 – Drill holes of NAN target, 2022**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Depth | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| NAN-DD-001 | 8 490 327.81 | 319 518.19 | 338.93 | 173.97 | 274.82 | -43.3 | DD | 2022 |
| NAN-DD-002 | 8 490 330.13 | 319 594.74 | 340.86 | 149.26 | 271.26 | -46.64 | DD | 2022 |
| NAN-DD-003 | 8 490 314.67 | 319 305.33 | 337.50 | 148.63 | 267.18 | -43.17 | DD | 2022 |
| NAN-DD-004 | 8 490 346.60 | 319 058.29 | 336.06 | 146.80 | 270.91 | -45.22 | DD | 2022 |

Source: GE21, 2024.

Table 10-8 presents the intervals from this campaign with grades exceeding 0.3% $V_2O_5$. These holes confirm the continuity of mineralization south of the NAN target and at depth.

**Table 10-8 – Intervals with grade over 0.3% $V_2O_5$ in 2022 drill holes campaign**

| Hole Id | From | To | Length (m) | $TiO_2$% | $V_2O_5$% |
|---|---|---|---|---|---|
| NAN-DD-002 | 2.5 | 3.72 | 1.22 | 7.92 | 0.55 |
| NAN-DD-002 | 66 | 67 | 1.00 | 8.29 | 0.32 |
| NAN-DD-002 | 69 | 70 | 1.00 | 7.10 | 0.31 |
| NAN-DD-002 | 74 | 76 | 2.00 | 7.06 | 0.33 |
| NAN-DD-002 | 86 | 88 | 2.00 | 6.13 | 0.36 |
| NAN-DD-002 | 94 | 95 | 1.00 | 5.25 | 0.32 |
| NAN-DD-003 | 49 | 52 | 3.00 | 5.71 | 0.64 |
| NAN-DD-003 | 76 | 77 | 1.00 | 6.78 | 0.54 |
| NAN-DD-003 | 89 | 90 | 1.00 | 2.79 | 0.33 |

Source: GE21, 2024.

### *10.10.4 SJO Target*

As the SJO target, 1 diamond drilling hole was executed in the year 2022. Table 10-9 presents the collar information for this hole.

**Table 10-9 – Drill hole of NAN target, 2022**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Depth | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| SJO-DD-001 | 319153.03 | 8488880.86 | 330.29 | 283.5 | 275.3 | 43.6 | DD | 2022 |

Source: GE21, 2024.

### *10.10.5 GAS Target*

Nineteen diamond drilling holes were executed at the GAS target, totaling 5,125.96 meters between the years 2021 and 2023.

These holes were drilled with azimuths ranging from 270° to 292.4° and inclinations varying from 43.93° to 75°, aiming to represent the mineralized layers which have a dip direction ranging from 95° to 110° and an average inclination of 60°.

Table 10-10 presents the collar information for the drilling holes at this target.

**Table 10-10 – Drill holes GAS target, 2021 to 2023**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Depth | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| **FEXP-07** | 8485 108.97 | 319 133.87 | 327.75 | 397.40 | 271.10 | -44.76 | DD | 2021 |
| **FEXP-08** | 8485 103.93 | 319 117.09 | 327.13 | 411.96 | 292.40 | -43.93 | DD | 2021 |
| **GAS-DD-001** | 8485 629.74 | 317 894.99 | 294.82 | 151.05 | 266.60 | -45.18 | DD | 2022 |
| **GAS-DD-002** | 8485 615.93 | 317 342.46 | 294.00 | 47.78 | 268.10 | -45.62 | DD | 2022 |
| **GAS-DD-003** | 8485 806.96 | 317 627.06 | 288.18 | 57.22 | 273.94 | -45.19 | DD | 2022 |
| **GAS-DD-004** | 8483 595.80 | 317 793.69 | 293.21 | 158.57 | 295.72 | -45.34 | DD | 2022 |
| **GAS-DD-005** | 8483 677.31 | 317 834.39 | 296.34 | 205.11 | 292.06 | -43.98 | DD | 2022 |
| **GAS-DD-006** | 8484 035.87 | 317 882.89 | 295.60 | 201.94 | 287.54 | -44.47 | DD | 2022 |
| **GAS-DD-007** | 8483 917.51 | 317 881.52 | 294.89 | 255.06 | 290.00 | -45.00 | DD | 2022 |
| **GAS-DD-008** | 8483 770.51 | 317 852.78 | 295.39 | 645.20 | 270.00 | -55.00 | DD | 2023 |
| **GAS-DD-009** | 8483 919.31 | 317 951.77 | 305.45 | 251.97 | 270.00 | -75.00 | DD | 2023 |
| **GAS-DD-010** | 8484 031.47 | 317 952.20 | 299.86 | 301.50 | 270.00 | -75.00 | DD | 2023 |
| **GAS-DD-011** | 8484 134.35 | 317 923.50 | 297.40 | 599.70 | 270.00 | -50.00 | DD | 2023 |
| **GAS-DD-012** | 8483 671.32 | 317 895.59 | 303.84 | 237.20 | 270.00 | -75.00 | DD | 2023 |
| **GAS-DD-013** | 8484 124.52 | 317 980.21 | 300.69 | 311.60 | 270.00 | -75.00 | DD | 2023 |
| **GAS-DD-014** | 8484 619.91 | 318 051.06 | 307.40 | 244.90 | 270.00 | -55.00 | DD | 2023 |
| **GAS-DD-015** | 8484 621.87 | 318 103.54 | 310.33 | 251.15 | 270.00 | -74.00 | DD | 2023 |
| **GAS-DD-016** | 8484 035.35 | 318 133.46 | 304.25 | 146.25 | 270.00 | -45.00 | DD | 2023 |
| **GAS-DD-017** | 8483 200.97 | 317 899.03 | 301.33 | 250.40 | 270.00 | -45.00 | DD | 2023 |

Source: GE21, 2024.

Table 10-11 presents the intervals from these campaigns with grades exceeding 0.3% $V_2O_5$. These holes confirm the continuity of mineralization at depth.

**Table 10-11 – Intervals with grade over 0.3% $V_2O_5$ these drill holes campaigns**

| Hole Id | From | To | Length | $V_2O_5$% | $TiO_2$% |
|---|---|---|---|---|---|
| **FEXP-07** | 315.76 | 318.94 | 3.18 | 0.32 | 3.45 |
| **GAS-DD-004** | 43.00 | 57.00 | 14.00 | 0.49 | 6.52 |
| **GAS-DD-004** | 84.00 | 92.27 | 8.27 | 0.60 | 6.21 |
| **GAS-DD-005** | 64.00 | 78.93 | 14.93 | 0.48 | 7.59 |
| **GAS-DD-005** | 106.00 | 114.00 | 8.00 | 0.58 | 5.92 |
| **GAS-DD-006** | 53.00 | 87.29 | 34.29 | 0.45 | 6.36 |
| **GAS-DD-007** | 76.00 | 107.14 | 31.14 | 0.32 | 4.78 |
| **GAS-DD-008** | 76.59 | 116.06 | 39.47 | 0.34 | 3.91 |
| **GAS-DD-009** | 160.73 | 164.68 | 3.95 | 0.52 | 11.70 |
| **GAS-DD-010** | 142.28 | 177.70 | 35.42 | 0.52 | 6.70 |
| **GAS-DD-011** | 101.00 | 109.10 | 8.10 | 0.56 | 5.91 |
| **GAS-DD-012** | 152.56 | 193.70 | 41.14 | 0.50 | 5.81 |
| **GAS-DD-013** | 154.08 | 188.36 | 34.28 | 0.72 | 8.39 |
| **GAS-DD-014** | 101.22 | 108.24 | 7.02 | 0.76 | 7.04 |
| **GAS-DD-015** | 135.98 | 140.95 | 4.97 | 0.77 | 13.02 |
| **GAS-DD-015** | 157.00 | 168.10 | 11.10 | 0.45 | 4.44 |
| **GAS-DD-016** | 32.00 | 51.67 | 19.67 | 0.31 | 5.46 |
| **GAS-DD-017** | 197.83 | 213.70 | 15.87 | 0.45 | 5.51 |

Source: GE21, 2024.

### *10.10.6 JAC Target*

Twenty-eight diamond drilling holes were executed in the year 2022 at the JAC target, totaling 3,943.22 meters. Most of the holes were drilled with an approximate azimuth of 270° and an average inclination of 46°.

Table 10-12 presents the collar information for the drilling holes at this target.

**Table 10-12 – Drill holes of JAC target, 2022**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Depth | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| **JAC-DD-001** | 315 850.74 | 8 477 899.45 | 244.73 | 153.96 | 111.58 | -44.39 | DD | 2022 |
| **JAC-DD-002** | 316 364.13 | 8 478 065.24 | 258.27 | 220.74 | 292.26 | -44.65 | DD | 2022 |
| **JAC-DD-003** | 315 957.14 | 8 477 189.25 | 241.23 | 154.54 | 272.92 | -45.98 | DD | 2022 |
| **JAC-DD-004** | 316 389.53 | 8 477 682.84 | 255.76 | 135.07 | 271.00 | -43.79 | DD | 2022 |
| **JAC-DD-005** | 316 068.10 | 8 477 817.58 | 245.97 | 158.09 | 271.28 | -44.85 | DD | 2022 |

| Hole Id | Coord. X | Coord. Y | Elev. Z | Depth | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| **JAC-DD-006** | 316 527.69 | 8 478 095.54 | 262.22 | 123.88 | 267.75 | -45.24 | DD | 2022 |
| **JAC-DD-007** | 316 053.98 | 8 477 190.66 | 249.84 | 154.45 | 269.18 | -43.84 | DD | 2022 |
| **JAC-DD-008** | 316 526.76 | 8 477 886.68 | 260.05 | 141.49 | 269.72 | -43.99 | DD | 2022 |
| **JAC-DD-009** | 316 338.38 | 8 477 522.94 | 254.47 | 145.67 | 273.04 | -44.36 | DD | 2022 |
| **JAC-DD-010** | 316 854.75 | 8 478 743.64 | 265.50 | 124.88 | 268.28 | -43.80 | DD | 2022 |
| **JAC-DD-011** | 316 056.68 | 8 477 190.58 | 250.60 | 154.54 | 269.16 | -59.22 | DD | 2022 |
| **JAC-DD-012** | 316 960.22 | 8 478 917.00 | 268.31 | 148.04 | 268.63 | -45.27 | DD | 2022 |
| **JAC-DD-013** | 316 543.32 | 8 478 817.12 | 266.08 | 169.86 | 270.90 | -44.56 | DD | 2022 |
| **JAC-DD-014** | 316 675.64 | 8 478 511.12 | 265.11 | 107.15 | 267.78 | -47.50 | DD | 2022 |
| **JAC-DD-015** | 316 529.79 | 8 478 095.55 | 262.19 | 140.49 | 270.82 | -59.54 | DD | 2022 |
| **JAC-DD-016** | 316 340.55 | 8 477 522.82 | 253.86 | 145.68 | 269.29 | -59.23 | DD | 2022 |
| **JAC-DD-017** | 316 441.49 | 8 478 815.41 | 263.27 | 161.47 | 265.79 | -45.92 | DD | 2022 |
| **JAC-DD-018** | 316 583.75 | 8 478 904.70 | 266.96 | 151.75 | 270.37 | -45.29 | DD | 2022 |
| **JAC-DD-019** | 316 926.39 | 8 478 751.45 | 267.60 | 154.06 | 265.13 | -45.35 | DD | 2022 |
| **JAC-DD-020** | 316 502.03 | 8 478 728.45 | 265.31 | 156.86 | 268.52 | -44.90 | DD | 2022 |
| **JAC-DD-021** | 316 817.75 | 8 478 681.56 | 264.65 | 113.30 | 272.71 | -45.10 | DD | 2022 |
| **JAC-DD-022** | 316 467.34 | 8 478 644.10 | 264.13 | 153.90 | 272.39 | -45.38 | DD | 2022 |
| **JAC-DD-023** | 316 655.74 | 8 478 422.26 | 265.34 | 105.76 | 272.99 | -43.73 | DD | 2022 |
| **JAC-DD-024** | 316 427.23 | 8 478 562.74 | 263.17 | 147.37 | 271.63 | -44.96 | DD | 2022 |
| **JAC-DD-025** | 316 949.36 | 8 479 011.33 | 265.87 | 117.05 | 271.60 | -44.80 | DD | 2022 |
| **JAC-DD-026** | 316 907.70 | 8 478 825.54 | 265.50 | 100.57 | 271.13 | -45.54 | DD | 2022 |
| **JAC-DD-027** | 316 767.01 | 8 478 596.33 | 266.19 | 88.31 | 268.08 | -45.12 | DD | 2022 |
| **JAC-DD-028** | 316 754.07 | 8 478 508.63 | 268.14 | 114.29 | 269.54 | -44.75 | DD | 2022 |

Source: GE21, 2024.

Table 10-13 presents the intervals from this campaign with grades exceeding 0.3% $V_2O_5$. These holes confirm the continuity of the mineralization at the JAC target and at depth.

**Table 10-13 – Intervals with grade over 0.3% $V_2O_5$ in 2022 drill holes campaign**

| Hole Id | From | To | Length | $V_2O_5$% | $TiO_2$% |
|---|---|---|---|---|---|
| **JAC-DD-003** | 59 | 63.26 | 4.26 | 0.49 | 8.8 |
| **JAC-DD-003** | 111 | 120.5 | 9.5 | 0.53 | 5.78 |
| **JAC-DD-004** | 41 | 44 | 3 | 0.34 | 5.82 |
| **JAC-DD-005** | 51 | 56 | 5 | 0.65 | 10.76 |
| **JAC-DD-005** | 103 | 109.24 | 6.24 | 0.54 | 5.47 |
| **JAC-DD-007** | 135 | 138.74 | 3.74 | 0.61 | 10.94 |
| **JAC-DD-008** | 88 | 95 | 7 | 0.35 | 6.43 |
| **JAC-DD-009** | 15 | 18 | 3 | 0.4 | 5.19 |
| **JAC-DD-009** | 48.4 | 51.69 | 3.29 | 0.59 | 10.06 |
| **JAC-DD-010** | 34 | 38 | 4 | 0.39 | 6.24 |
| **JAC-DD-011** | 147 | 152 | 5 | 0.59 | 10.22 |
| **JAC-DD-013** | 50 | 53.2 | 3.2 | 0.57 | 9.81 |
| **JAC-DD-013** | 98 | 134 | 36.0 | 0.45 | 4.82 |
| **JAC-DD-015** | 53 | 61 | 8.0 | 0.32 | 5.12 |
| **JAC-DD-016** | 38 | 41 | 3.0 | 0.4 | 5 |
| **JAC-DD-016** | 71 | 79 | 8.0 | 0.54 | 9.58 |
| **JAC-DD-017** | 29 | 45 | 16 | 0.33 | 3.21 |
| **JAC-DD-018** | 49 | 54 | 5 | 0.49 | 7.64 |
| **JAC-DD-018** | 96 | 102.53 | 6.53 | 0.58 | 5.64 |
| **JAC-DD-018** | 130.6 | 136 | 5.4 | 0.46 | 5.74 |
| **JAC-DD-019** | 98 | 101 | 3 | 0.38 | 6.21 |
| **JAC-DD-020** | 57.59 | 62 | 4.41 | 0.44 | 8.06 |
| **JAC-DD-020** | 137 | 143 | 6 | 0.53 | 5.99 |
| **JAC-DD-022** | 59 | 63 | 4 | 0.57 | 9.99 |
| **JAC-DD-022** | 91 | 95 | 4 | 0.56 | 8.83 |
| **JAC-DD-022** | 139 | 144.97 | 5.97 | 0.64 | 6.65 |
| **JAC-DD-023** | 25 | 28 | 3 | 0.44 | 6.28 |
| **JAC-DD-024** | 45 | 50.09 | 5.09 | 0.71 | 11.09 |
| **JAC-DD-024** | 86.75 | 90 | 3.25 | 0.66 | 10.47 |
| **JAC-DD-024** | 129 | 139.04 | 10.04 | 0.4 | 4.82 |
| **JAC-DD-025** | 35 | 40 | 5 | 0.36 | 5.64 |
| **JAC-DD-026** | 35 | 39 | 4 | 0.36 | 5.55 |
| **JAC-DD-027** | 43 | 48 | 5 | 0.33 | 5.3 |

Source: GE21, 2024.

### 10.10.7 RIOCON Target

Ten diamond drilling holes were executed at the RIOCON target, totaling 1,503.65 meters. The holes in this campaign were drilled with an approximate azimuth of 290° and an average inclination of 45° to represent the mineralized layers, following the regional trend.

Table 10-14 presents the collar information for the drilling holes at the RIOCON target.

**Table 10-14 – Drill holes of RIOCON target**

| Hole Id | Coord. X | Coord. Y | Elev. Z | Lenght | Azimuth | Dip | Type | Year |
|---|---|---|---|---|---|---|---|---|
| **FRC-01** | 314093.5 | 8468348 | 232.94 | 150.3 | 292.6 | -44.35 | DD | 2021 |
| **FRC-02** | 314284.2 | 8468427 | 232.74 | 150.03 | 286.6 | -44.45 | DD | 2021 |
| **FRC-03** | 313977.1 | 8467908 | 243.2 | 150.3 | 287.2 | -43.61 | DD | 2021 |
| **FRC-04** | 313988.9 | 8467624 | 253.82 | 150.73 | 283.3 | -43.00 | DD | 2021 |
| **FRC-05** | 314255 | 8467834 | 242.68 | 149.97 | 289.3 | -43.21 | DD | 2021 |
| **FRC-06** | 314273.7 | 8468093 | 240.85 | 150.31 | 293.1 | -43.09 | DD | 2021 |
| **FRC-07** | 314046.3 | 8468168 | 237.69 | 150.89 | 291.5 | -44.9 | DD | 2021 |
| **FRC-08** | 313903.5 | 8467327 | 253.21 | 150.27 | 292.9 | -44.94 | DD | 2021 |
| **FRC-09** | 314258.5 | 8467264 | 269.62 | 150.51 | 288.7 | -45.56 | DD | 2021 |
| **FRC-10** | 314105.5 | 8466796 | 260.65 | 150.34 | 295.8 | -44.52 | DD | 2021 |

Source: GE21, 2024.

Table 10-15 presents the intervals from this campaign with grades exceeding 0.3% $V_2O_5$. These holes confirm the continuity of the mineralization at the RIOCON target at depth.

**Table 10-15 – Intervals with grade over 0.3% $V_2O_5$ in 2021 drill holes campaign**

| Hole Id | From | To | Length (m) | $V_2O_5$% | $TiO_2$% |
|---|---|---|---|---|---|
| **FRC-02** | 50.94 | 56.86 | 5.92 | 0.40 | 6.54 |
| **FRC-04** | 143.33 | 147.01 | 3.68 | 0.57 | 6.05 |
| **FRC-05** | 62.74 | 70.81 | 8.07 | 0.32 | 4.17 |
| **FRC-05** | 94.57 | 98.97 | 4.40 | 0.49 | 8.00 |
| **FRC-06** | 71.09 | 76.37 | 5.28 | 0.48 | 8.46 |
| **FRC-08** | 127.72 | 131.57 | 3.85 | 0.58 | 4.61 |
| **FRC-10** | 39.11 | 46.86 | 7.75 | 0.30 | 6.01 |
| **FRC-10** | 82.87 | 89.13 | 6.26 | 0.39 | 7.44 |

Source: GE21, 2024.

### 10.10.8 Drill Core Resampling

In 2023, Largo conducted a review of the historical drilling database and re-sampled cores from previous campaigns (historical data).

The database review was conducted concurrently with the implementation of the MX Deposit drilling database management system by Seequent. During this process, existing drilling information was validated through checks with topography, verification of geological descriptions in drill cores, and review of analytical results in laboratory certificates. The validation was performed by Largo and GE21.

During the review of the drilling database, intervals of host lithologies for the mineralization were identified that had either not been sampled or had incomplete chemical information. A more detailed analytical campaign was conducted with the aim of completing the chemical analyses for these intervals in the database. A total of 5097 samples were collected during this campaign.

**Table 10-16 – Number of resampling in Postmortem campaign**

| Target | Number of Samples |
|---|---|
| **NAN** | 473 |
| **SJO** | 1553 |
| **GAN** | 1128 |
| **NAO** | 1943 |

Source: Largo, 2024.

# 11 SAMPLE PREPARATION, ANALYSES AND SECURITY

## 11.1 Sampling Method

### *11.1.1 Previous Operators – Before 2006*

This following subsection has been reproduced in its entirety from the report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project, Brazil** by AkersSolutions in 2009, as fully cited in Section 27, “References”. GE21 has verified the accuracy of the information contained herein and updated as required.

Sampling of mineralization within the Study area by previous operators has been conducted by both diamond-drilling and trench-sampling methods.

The sampling method and approach conducted by CBPM (1981 and 1983) was not known by Largo. However, during Largo’s visit to the core facility, it was observed that the drill core had been carefully sawn in half with all the drill holes at Maracás available for review in the core warehouse. The remaining half showed the core to be very competent. It is believed by Largo, given the competent nature of the rock, together with clearly marked sample intervals, that careful sampling procedures were conducted, and that the sampling method had been conducted in a professional manner. In that period Micon visited the core shed and spent several days reviewing the core. Nothing viewed during the visit would cause Micon to come to a different conclusion. Sampled intervals were easy to identify and the core was in good condition.

Personal communication between R. A. Campbell and Marcos Nunes, then the project geologist for Odebrecht, described the drill-core sampling procedures for 1984 through 1987, as set out below.

“Drill core was split using a diamond blade tile saw. The core pans were cleaned between each split sample. The remaining half of the core sample was returned to the core box. Half the core was then bagged along with its corresponding sample tag and bagged for shipment. Commercial trucking shipped the core samples to GEOSOL’s Laboratory (1983 to 1987), Paulo Abib Engenharia S.A. laboratory (1985 to 1987) both in Belo Horizonte.”

“During the Odebrecht drilling programs samples were crushed, ground completely to pulp passing – 150 mesh and then split at the GEOSOL and Paulo Abib Engenharia S.A.’s preparation facilities in Belo Horizonte, Brazil. The split pulps were then analyzed by XRF method also in GEOSOL and Paulo Abib Engenharia S.A.’s laboratory in Belo Horizonte.”

“The sample core length was 2.0 m in all cases in past sampling programs. The layered nature of the deposit and thicknesses of the mineralized zone from 4 to 100 m justified this interval. The potential mining method of large tonnage open pit was also considered when selecting sample intervals. Smaller intervals would only be taken if there was a particular geological reason to do so.”

"Channel samples were also cut on 2.0 m intervals and usually no greater than this, due to the large amount of material generated. Channel intervals were also governed by topography and geology, so their lengths varied on occasion."

#### *11.1.2 2006 and Early 2007 Re-logging*

At the time of preparation of the Mineral Resource estimate used in this study Largo had drilled no core of its own. It had only re-sampled old drill holes from earlier programs.

In collecting its samples, Largo split all core using a diamond blade tile saw. Half of the core was placed in a numbered plastic sample bag with the sample tag. The remaining half core was returned to the core box. A brick was briefly sawn between each sample cut, to clean the blade and prevent any contamination between samples.

The half core was then sealed in the bags along with its corresponding sample tag. The sample bags were placed into larger "rice" bags, in groups of 15 samples, for shipment. The samples were transported in a company-operated vehicle from the office in Maracás to Salvador, where they were handed over to a commercial transport company for truck delivery to SGS Geosol Laboratórios Ltda. (SGS) in Vespasiano, Minas Gerais State. The core trays with the remaining quarter-core were placed in core racks at the core storage facility / office in Maracás, to be available for future reference.

The sampled core length was 2.0 m in all cases, to duplicate past sampling programs. Largo agreed that the layered nature of the deposit and thicknesses of the mineralized zone from 2 to 100 m justified this interval.

#### *11.1.3 2007 Exploration Drill Program*

This following subsection has been reproduced in its entirety from the report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project, Brazil** by AkersSolutions in 2009, as fully cited in Section 27, "References". GE21 has verified the accuracy of the information contained herein and has updated as required.

Sample boundaries were marked up by the geologists during the logging process. Core was selected for sampling based on magnetite content or nearby strong alteration. Intervals to be sampled were marked in red lumber crayon. The beginning of each sample interval was marked on the edge of the core box with a felt tip marker and with a sample tag, affixed to the box with a staple, at the end of the interval. Overall, about 45% of the core drilled was sampled.

Sampling commenced several meters prior to the beginning of mineralization and proceeded down to the hole, usually at 1-m intervals, until a major lithologic contact. Sampling did not cross these contacts. Sample intervals could be shortened or lengthened depending on these observations. Magnetite and magnetite-pyroxenite were sampled separately, if the magnetite bands were approximately 1 m in size or larger.

Samples were collected by sawing the core in half with a diamond blade tile saw at the logging facility. Once sawn, the half core was placed in a numbered plastic sample bag with the corresponding sample tag. The remaining half core was returned to the core box. A brick was briefly sawn between each sample cut, to clean the blade and prevent any contamination between samples. The sample bags were placed into larger plastic containers, in groups of 15 samples, for shipment. The samples were transported in a company-operated vehicle from the office in Maracás to Jequié where they were handed over to a commercial transport company for truck delivery to SGS in Vespasiano-MG.

Logged and sampled core boxes were stored in a roofed, fenced-in enclosure with a concrete floor and knee wall, within the fenced yard of the farmhouse.

These procedures continued to be used in the 2008, 2011-2012 drilling programs and 2012 infill drilling program.

#### *11.1.4 2018 and 2019 Largo Core Drill Program*

During the geological logging of drill core, the exploration team (geologists) marked the sampling intervals with their corresponding identification in the core box. In general, the sample was selected based on the magnetite content (Kappa Measurement) or based on contacts between guiding mineralization lithologies. Before and after core removal for sampling, all core boxes were photographed. All this data was stored in MS Excel digital files.

After sample intervals were marked, the core was sent to be sawn in half by diamond blades (Figure 11-1). The sampling interval defined was 1m (≈ 3kg), following the same pattern as previous programs. After being cut, an identified half went to the laboratory (batches), and the second part was returned to the core box to be stored in the shed and available for further investigation. The transportation to SGS in Vespasiano-MG was made by road by an outsourced company.

**Figure 11-1 – Largo core cutting facility for the 2018-2019 Exploration Program**

Source: Largo, 2021.

Then the QP visited the core shed and no noncompliance was seen during that visit. The intervals sampled were easy to identify and the core was in good condition.

#### *11.1.5 2020 to 2023 Largo Core Drilling Program*

As holes are being drilled, filled core boxes are delivered by the drilling company directly to the core shed in a location specified by the geologist responsible.

The receipt and registration, and storage of core at the central core facility followed the same acceptable procedures as the previous programs. The box number, final depth, footage markers with depth / feed / recovery of each box are checked. All core boxes are photographed (both whole core and half sawn core) and magnetic susceptibility measurements are made every 25 cm over the length of the entire length of each drill hole.

After geological descriptions are completed, sample intervals are determined by geologists based on geological factors. The sample intervals are marked on the core and on the core box as well with sample tickets stapled to the box.

The drill core is hand sawn by assistants using electrical core cutting saws with diamond blades. The sampling interval is generally 1 m in length (≈ 3 kg). This follows the same procedures as Largo's previous exploration programs.

After sawing, half of the sample was placed in a plastic bag identified with the corresponding sample label. The other half was returned to the core box. A clay brick was sawed briefly between each sample cut to clean the blade and avoid any contamination between samples. The sample bags are collected in batches were placed in larger plastic containers and transported to the SGS in Vespasiano-MG.

The remaining core boxes are stored at the core facility at just south of the mine complex and is available for future reference.

The QP visited the core shed and no noncompliance was seen during that visit. The intervals sampled were easy to identify and the core was in good condition. The core boxes were properly stored at core shed.

### 11.2 Chemical Sample Preparation, Analyses and Security

#### *11.2.1 Pre-2006 Analytical Work*

The majority of this subsection has been reproduced in its entirety from the **A Preliminary Assessment of The Maracás Vanadium Project (2007), Bahia State, Brazil**, by Micon, as fully cited in Section 27, “References”. GE21 has verified the accuracy of the information contained herein and updated as required.

Personal communication between R. A. Campbell and Mr. Marco Nunes also described the sample preparation and analytical protocols in use prior to Largo's involvement in the Project, but after 1983. According to Nunes, CBPM and Odebrecht used GEOSOL and Paulo Abib Engenharia S.A. as their analytical laboratories during the 1981 to 1983 exploration programs and again between 1984 and 1987. Their procedures were summarized as follows.

"A total of 1,675 core samples were prepared at GEOSOL and Paulo Abib Engenharia S.A.'s laboratories in Belo Horizonte, Brazil. These core samples were packaged in batches of 40 samples which included two replicates, one reference standard and one blank, inserted randomly. All samples underwent standard crushing and pulverizing techniques. The entire drill sample was passed through a primary crusher to yield a fine crushed product, with better than 75% of the sample passing 2 mm. When the crushed sample yielded approximately 2 kg the entire sample was pulverized."

"A crushed 2 kg sample was ground using a ring and puck mill pulveriser. The pulveriser uses a chrome steel ring and puck set. All samples were pulverized to over 95% of the ground material passing through a -150-mesh screen. Grinding with chrome steel may impart trace amounts of iron and chromium into the sample."

"Core samples were then analyzed at GEOSOL and Paulo Abib Engenharia S.A.'s laboratories in Belo Horizonte, Brazil. All samples were analyzed for FeO, $Fe_2O_3$, $SiO_2$, $TiO_2$ and $V_2O_5$. Routinely, a sample weight of 0.66 grams was fused with 7.2 g of flux to prepare each bead. However, there were variations to this ratio for some matrices, giving a lower limit for detection of 0.01% and an upper limit of detection of 5.0% for $V_2O_5$. Samples were fused into a glass disc using a Lithium Borate flux much as described for normal fused glass beads. For 'ore grade', materials flux composition and sample/flux ratios were varied to ensure all the sample dissolves and that recrystallization does not occur as the melt is cooled."

#### *11.2.2 Largo Analytical Work (2007, 2008 and 2011-2012)*

The majority of this subsection has been reproduced in its entirety from the Technical Report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project, Brazil** by AkersSolutions, 2012 as fully cited in Section 27, "References". GE21 has verified the accuracy of the information contained herein and updated as required.

All sample preparation and primary analyses of drill core from the 2006/2007 resampling program and the 2007, 2008 and 2011-2012 drilling programs were performed by SGS in Vespasiano-MG, Brazil and Lakefield, Ontario. During 2012 infill drilling program, both SGS in Vespasiano-MG, Brazil, and Intertek in Cotia, Brazil were used for sample preparation and analyses. Originally, the samples were analyzed for FeO, $Fe_2O_3$, $SiO_2$, $TiO_2$ and $V_2O_5$ by the XRF method and for platinum and palladium by a 50 g fire-assay technique at SGS. This was changed to a 20 g fire assay for the 2007 and later drilling programs, because of some initial problems with flux and the amount of magnetite in some of the samples. The XRF method gives a lower limit of detection of 0.01% $V_2O_5$.

SGS claims that their quality assurance system “complies with the requirements of the international standards ISO 9001:2000 and ISO 14001:2004 to chemical analysis and geochem of soils, rocks and ores” (SGS Minerals, 2006). Intertek also claims that their quality assurance system complies with the requirements of the international standards ISO 9001:2008 to chemical analysis and geochemistry of soils, rocks and ores.

Core samples were prepared similarly at both labs using the following protocol:

- weigh, dry and reweigh sample;
- primary crush to -2 mm (70% passing);
- pulverise split fraction to -150 mesh in chrome steel ring mill pulveriser.

The fire-assay procedure employed for platinum and palladium used a 50 g aliquot (later changed to 20 g as described above) with aqua regia digestion, followed by an atomic absorption (AA) spectroscopy finish. Since this was a check sampling program, there were no field duplicates and field blanks inserted by Largo for this resampling program.

Both labs (SGS and Intertek) prepared and analyzed its own laboratory duplicates and inserted its own internal reference standards and blanks. Largo reviewed the quality control data files from both labs, which were verified by the Largo staff member responsible. Also, the Largo staff member made a site visit to each facility to inspect and review the procedure on-site at least one time during the program. There were no abnormalities detected in either the procedures or the results. SGS has ISO/IEC 17025 accreditation for its mineral analytical services.

### *11.2.3 2015 Davis Tube Testwork*

Most of this subsection has been reproduced in its entirety from the Technical Report titled **An Update Mine Plan and Mineral Reserve for Maracás Menchen Project, Bahia State, Brazil**, by Micon (2016), as fully cited in Section 27, “References”. The QP has verified the accuracy of the information contained herein and updated as required.

In June 2015, Largo staff seeking to improve their understanding of vanadium in the mineralization at the Campbell, started a program of Davis Tube (DT) test work to determine the magnetic percentage and the $V_2O_5$ grade and $SiO_2$ grade in the magnetic concentrate.

Davis tube testing is considered by metallurgists to be a simulation of industrial wet magnetic separation. The test is a two-stage process, a pulverising step and the Davis Tube wash. Davis Tube tests use an electromagnet to separate material into magnetic and non-magnetic / paramagnetic fraction. The DT test generates the weight recovery / magnetic iron content, or proportion of the deposit which is magnetite and the “probable” grade of concentrate at a given grind size. The quality of a vanadium-bearing titanomagnetite DT concentrate is process-sensitive depending on the feed size and as well on other parameters like magnetic field strength, current intensity, tube oscillation, tube inclination and wash-water rate during the test work.

The program was completed by September 2015 using the facilities of SGS Geosol and an-instrument purchased by Largo (Figure 11-2 to Figure 11-4). A total of 7,567 pulp-samples were collected from the previous drilling programs. These samples were stored in a secure lock storage area at Largo's exploration camp near the mine site. The samples were collected and packaged into large plastic crates, labeled and strapped down securely, for shipping. A local shipping company picked up the crates and transported them to SGS's facility in Vespasiano suburb in Belo Horizonte. For pulp and coarse reject samples the amount sent was approximately 100 g. The grind size of the stored pulps was, according to historical information, always 95% passing 106 microns. In case any of the pulp samples were not available (lost), coarse reject fractions were chosen. In the event of both missing pulp and reject samples a quarter of the core was sampled at the core facility. This happened exclusively on historical CBPM holes, where most of the pulps and coarse reject fractions are systematically missing.


**Figure 11-2 – Largo's First Davis Tube Device during Implementation on site**

Source: Micon, 2016.

**Figure 11-3 – Two Davis Tube devices at SGS Laboratory**

Source: Micon, 2016.


**Figure 11-4 – Largo Staff During Site Visit at SGS in Vespasiano-MG (August 24th, 2015)**

Source: Micon, 2016.

The sample preparation process was as follows:

- sample all pulps (p) + rejects (r) + core (c);
- received sample weighing (p + r + c);
- drying at 105°C (p + r + c);
- crush to 90% passing 3 mm (c);
- split sample with riffle splitter (c);
- pulverise 250-300 g to 95% passing 106 microns (c);
- pulverising – quality control test (p + r + c);

The following are the specifications and settings used for the Davis tube equipment:

- Feed sample mass: 30 g
- Tube inclination: 45°
- Initial tube oscillation: 30 rpm
- Final tube oscillation: 60 rpm
- Wash-water rate: 540 l/min.
- Magnetic field strength: At the beginning, during the sample feeding procedure in the glass tube, is applied 3,700 Gauss (1.6A) to avoid premature loss of the sample mass. After the entire sample is added the test began applying 1,480 Gauss (0.5A);
- Davis tube washing period: 20 to 30 minutes (dependent on the degree of difficulty for washing the sample).

QA/QC sampling protocol was implemented whereby a pulp duplicate, and one certified standard were inserted into every 40-sample batch.

### *11.2.4 2018-2019 Chemical Assay Preparation, Analyses and Security*

Largo core samples were prepared and analyzed by SGS in an ISO 9000-2001 certified laboratory. The main analysis procedures performed in this laboratory in Belo Horizonte, Minas Gerais were:

- Titration with Potassium Dichromate;
- Fire Assay – ICP;
- LOI: Loss by fire – Calcination of samples at 405 °C / 1000 °C;
- Fusion with lithium tetraborate – X-ray fluorescence;
- Davis Tube;

Pulp samples were also analyzed for $V_2O_5$ using an atomic absorption fire-assay technique. The selected samples were subsequently sent for multiple element analysis by ICP spectrometry as previously described.

### *11.2.5 2020 Chemical Assay Preparation, Analyses and Security*

Largo core samples were prepared and analyzed by ALS in a laboratory that operates under the ISO 17025 quality management system. The physical preparation of the sample was made by ALS with sample registration in the tracking system, drying, crushing of the entire sample up to 70% < 2 mm (-10 #); the crushed samples are quartered using a riffle splitter to obtain a sub sample of approximately 250 g. The sub-sample is pulverized to 85% < 75 microns (-200 #).

The main analysis procedures performed in this laboratory were:

- LOI: Fire of loss – Calcination of samples;
- Fusion with lithium metaborate or tetraborate and Determination by XRF;
- Davis Tube Test.

## 11.3 Density Determination

### *11.3.1 Until 2015*

Most of this subsection has been reproduced in its entirety from the Technical Report titled **Technical Report the Largo Maracás Vanadium Project, 1 Million Tonnes per Year Processing Plant, Brazil by RungePincockMinarco** (2012), as fully cited in Section 27, “References”. The QP has verified the accuracy of the information contained herein and updated as required.

The mass density or density of a material is defined as its mass per unit volume. Mathematically, density (ρ) is defined as mass (m) divided by volume (V). From this equation, mass density must have units of a unit of mass per unit of volume (e.g. $g/cm^3$, $kg/m^3$, etc.).

The Archimedes principle was used to determine the density, further reasoned that if the liquid in this volume were removed and replaced by an object of the same size and shape as this liquid portion, none of the liquid pressure forces acting on its surface would change. Because the object is the same shape and volume as the fluid removed, it would fit exactly into the previous volume without compressing the surrounding fluid. Therefore, Archimedes (287 – 212 B.C) had concluded that the net buoyant for B upward on any object immersed in a fluid is equal to the weight of the fluid displaced.

Up until 2015, all of Largo’s Density samples were analyzed in Federal University of Bahia State, using Archimedes principle. Some of this procedure is illustrated in Figure 11-5. The results are shown in Table 11-1.

**Figure 11-5 – Density Determination by Archimedes Principle (until 2015)**

Source: Pincock, 2012.

**Table 11-1 – Density Summary (until 2015)**

| Target | Lithology | Number of Samples | Density ($g/cm^3$) |
|---|---|---|---|
| NOVO AMPARO (NAO) | Magnetitito | 26 | 4.36 |
| | Magnetita Gabro | 11 | 3.38 |
| | Gabro | 11 | 3.00 |

| Target | Lithology | Number of Samples | Density (g/cm³) |
|---|---|---|---|
| | Anortosito | 3 | 2.88 |
| | Pegmatito | 2 | 2.61 |
| NOVO AMPARO NORTH (NAN) | Magnetitito | 30 | 4.26 |
| | Magnetita Gabro | 11 | 3.33 |
| | Gabro | 11 | 3.06 |
| | Anortosito | 5 | 2.86 |
| | Pegmatito | 3 | 2.6 |
| SÃO JOSE (SJO) | Magnetitito | 19 | 4.3 |
| | Magnetita Gabro | 13 | 3.33 |
| | Gabro | 9 | 3.05 |
| | Anortosito | 3 | 2.84 |
| | Pegmatito | 3 | 2.58 |
| GULÇARI A NORTH (GAN) | Magnetitito | 14 | 4.28 |
| | Magnetita Gabro | 12 | 3.32 |
| | Gabro | 8 | 3.03 |
| | Anortosito | 5 | 2.84 |
| | Pegmatito | 2 | 2.62 |
| GULÇARI B | Magnetitito | 15 | 4.42 |
| | Magnetita Gabro | 14 | 3.35 |
| | Gabro | 3 | 2.90 |
| | Anortosito | 1 | 2.83 |
| | Pegmatito | 2 | 2.63 |

Source: Pincock, 2012.

### *11.3.2 2015 Determination Density*

Most Part of this subsection has been reproduced in its entirety from the report titled **An Update Mine Plan and Mineral Reserve for Maracás Menchen Project (2016), Bahia State, Brazil**, by Micon, as fully cited in Section 27, "References". The QP has verified the accuracy of the information contained herein and updated as required.

In 2015 Largo acquired their own density determination equipment and started making measurements with in-house staff. They used the water immersion method on diamond core sections with a digital density scale (Gehaka DSL 910). Best care and attention were taken by staff as of June 1st, 2015 (Micon, 2016).

A total of 297 core samples were measured to determine the specific gravity of the various ore and waste rock domains and these were added to Campbell's density database. In Micon (2016) report the Largo showed a summary of the Specific Gravity (SG) according to this new series of measurements and the new domain classification is presented in Table 11-2.

**Table 11-2 – Average Specific Gravity for the Campbell deposit, Largo Data 2016**

| Rock Type | Rock Code | Number of Samples | Average SG |
|---|---|---|---|
| Massive and banded magnetite 1 | 10 | 97 | 4.38 |
| Massive and banded magnetite 2 | 11 | 39 | 4.24 |
| Massive and banded magnetite 3 | 12 | 4 | 4.14 |
| Massive and banded magnetite 4 | 13 | 5 | 4.17 |
| Magnetite-pyroxenite 1 | 20 | 116 | 3.52 |
| Magnetite-pyroxenite 2 | 21 | 21 | 3.60 |
| Magnetite-pyroxenite 3 | 22 | 3 | 3.58 |
| Magnetite-pyroxenite 4 | 23 | 3 | 3.46 |
| Pyroxenite | 25 | 98 | 3.23 |
| Magnetite Gabbro | 40 | 13 | 3.37 |
| Gabbro | 45 | 130 | 3.01 |
| Anorthosite | 50 | 16 | 2.78 |
| Pegmatite | 80 | 64 | 2.58 |
| Overburden | 90 | 0* | 1.80* |

Note:
1. According to operating experience during Campbell operation and as in Coffey (2012) for the Satellite.
Source: Micon, 2016.

### 11.3.3 2016 to 2019 Determination Density

In Total, between 2016 and 2019 Largo completed 1555 density determinations in Campbell Pit, GAN and NAN deposits. Table 11-3 summarizes average density obtained in database of this campaign.

**Table 11-3 – Average Specific Gravity from 2016 to 2019, Largo Database**

| | Average (g/cm$^3$) | | |
|---|---|---|---|
| **Rock Type** | **Campbell Pit (906 samples)** | **GAN (330 samples)** | **NAN (319 samples)** |
| **ANO** | 2.77 | 2.83 | 2.81 |
| **GAB** | 3.08 | 3.09 | 3.1 |
| **GCM** | | 3.21 | 3.22 |
| **GPS** | | | |
| **MAG** | 4.39 | 4.2 | 4.32 |
| **MGB** | | 3.51 | 3.5 |
| **MGTGAB** | | 3.26 | 3.28 |
| **MGPYXT** | 3.47 | 3.82 | 3.51 |
| **MPXT** | | 3.62 | 3.62 |
| **PEG** | 2.58 | 2.62 | 2.59 |
| **PYXT** | 3.23 | 3.34 | 3.23 |
| **PXTM** | | 3.36 | 3.36 |

Source: Largo, 2021.

### 11.3.4 2020 Determination Density (by Pycnometer)

In the 2020 campaign, density was determined by specific mass of pulps using a pycnometer, another density method also to validate the previous determinations. This pycnometer was performed at the ALS GLOBAL Laboratory in Vespasiano- MG.

Largo obtained 601 density determinations considering different lithotypes and magmatic cycles for Gulçari A (Campbell Pit) with 143 samples, NAN with 229 samples and GAN with 229 samples. These data were entered in the database duly identified for future use. Table 11-4 summarizes density values by pycnometers determined in 2020.

**Table 11-4 – Average Specific Gravity for deposits, 2020 Pycnometer Data**

| | Average (g/cm$^3$) | | |
|---|---|---|---|
| **Rock Type** | **Campbell Pit (143 samples)** | **GAN (229 samples)** | **NAN (229 samples)** |
| **ANO** | 2.76 | 2.75 | 2.76 |
| **GAB** | 3.02 | 3.00 | 3.04 |
| **GCM** | 3.16 | 3.14 | 3.10 |
| **GPS** | | 2.62 | 2.67 |
| **MAG** | 3.95 | 3.97 | 3.95 |
| **MGB** | 3.52 | 3.42 | 3.30 |
| **MPXT** | 3.67 | 3.48 | 3.61 |
| **MPXT** | 3.78 | | |
| **PEG** | 2.70 | 2.69 | 2.52 |
| **PXT** | 3.27 | 3.13 | 3.15 |
| **PXTM** | 3.22 | 3.28 | 3.32 |

Source: GE21, 2021.

### 11.3.5 2021 to 2023 Campaign

In the 2023 campaign, all density samples were analyzed by Largo, using Archimedes principle. A total of 4,337 samples were analyzed at different targets. Table 11-5 summarizes density values determined in 2023.

**Table 11-5 – Average Specific Gravity for deposits, 2023 Data**

| Lithology | ABR | BRG | GAN | GAS | Campbell Pit | ILG | NAN | NAO | SJO |
|---|---|---|---|---|---|---|---|---|---|
| ***Total of samples*** | ***247*** | ***397*** | ***1456*** | ***303*** | ***831*** | ***282*** | ***275*** | ***249*** | ***297*** |
| **AND** | | 2.90 | 2.74 | 2.85 | 2.75 | | | | 2.68 |
| **ANO** | 2.74 | 2.81 | 2.84 | 2.74 | 2.89 | 2.84 | 2.89 | 2.82 | 2.75 |
| **BRC** | | | | | 2.56 | | | | |
| **DIB** | | | | | | | 2.92 | | |
| **GAB** | 3.11 | 3.04 | 3.08 | 2.99 | 3.02 | 3.09 | 3.09 | 3.06 | 3.02 |
| **GCM** | | | 3.13 | | 3.10 | | 3.18 | 3.10 | 2.98 |
| **GPS** | 2.75 | 2.68 | 2.66 | 2.69 | 2.69 | | 2.66 | 2.64 | |
| **GRT** | 2.66 | 2.68 | 2.59 | 2.61 | 2.65 | 2.82 | | | 2.55 |
| **MAG** | | | 4.27 | 4.06 | 4.10 | | 4.01 | 4.17 | 4.63 |
| **MGB** | | | 3.34 | | 3.45 | | 3.42 | 3.16 | 3.31 |
| **MPXT** | | | 3.47 | | 3.63 | 3.13 | 3.26 | 3.71 | |
| **PEG** | 2.50 | 2.62 | 2.63 | 2.54 | 2.60 | 2.59 | 2.62 | 2.62 | 2.68 |
| **PXT** | | 3.28 | 3.38 | 3.64 | 3.26 | 3.37 | 3.22 | | 3.37 |
| **PXTM** | | | | | 3.46 | | 3.54 | | |
| **QVN** | | | | | | 2.77 | | | |

Source: GE21, 2024.

## 11.4 Largo QA/QC Program

This subsection has been reproduced in its entirety from the Technical Report titled **A Preliminary Assessment of The Maracás Vanadium Project, Municipality of Maracás, Bahia State, Brazil**, by Micon (2007), as fully cited in Section 27, "References". The QP has verified the accuracy of the information contained herein and updated as required.

### *11.4.1 Pre-2006 Program*

It is reported that CBPM and Odebrecht made use of replicate and blank samples along with reference standard materials during their sampling and assaying programs. No detailed results are available for the results of these programs. Therefore, before using the data in a Mineral Resource estimate, Largo decided to conduct a check sampling program on 8% of the mineralized core. That program is described the following.

### *11.4.2 2006 Program*

Largo's drill core re-sampling program was conducted during May 2006 to verify the precision of the $V_2O_5$ grades reported during the 1981 through 1987 drill campaigns. It was also used to provide additional data on the PGM content of the mineralization. A total of 123 quarter core samples from 8 drill holes (7.3% of samples) were analyzed. Check analyses were systematically completed at a second laboratory during the re-sampling program.

The original analyses were done at GEOSOL and Paulo Abib Engenharia S.A. laboratories in Belo Horizonte, Brazil between 1981 and 1987. The 2006 duplicate sample analyses were conducted at SGS Minerals laboratories, both in Belo Horizonte, Brazil and Lakefield, Ontario. Every effort was made to use similar techniques and sample sizes in order to compare results. Check analyses on the 2006 duplicate samples were analyzed by Ultra Trace Analytical Laboratories in Perth, Australia (Ultra Trace). A total of 25 pulp samples (20%) from the resampling program were sent to Ultra Trace for analysis to compare against the duplicate results. Again, every effort was made to use similar techniques.

The duplicate samples sent to SGS were analyzed for the major oxides (FeO, $Fe_2O_3$, $SiO_2$, $TiO_2$ and $V_2O_5$) using borate fusion XRF. The lower detection limit for $V_2O_5$, for this method, was 0.01% while the upper limit was 5%. Elements were reported as oxides. The samples were also analyzed by SGS for platinum and palladium by fire assay with an AA finish on a 50-g sample. Internal quality control procedures included duplicate and blank sample and certified reference material analysis. These data were used to check the analytical reproducibility and precision of the assays.

Ultra Trace's XRF method used a fusion technique, with a high-energy X-ray instrument. The resulting detection limits are reported to often be better than those obtained by pressed methods on older instruments. The lower detection limit for $V_2O_5$ was 0.01% while the Upper limit was 5%. A sample weight of 0.66 g was fused with 7.2 g of flux to prepare each bead. However, there are variations to this ratio for some matrices. Samples were fused into a glass fluxed with lithium borate much as described for normal fused glass beads. For ore grade materials, flux composition and sample / flux ratios are varied to ensure the entire sample dissolves and re-crystallization does not occur as the melt is cooled.

Two comparisons of the results were conducted:

- Original sample results versus SGS duplicate sample (quartered core) results; and
- SGS duplicate sample (quartered core) results versus Ultra Trace check pulp sample results.

In both cases, the agreement was good. Overall, there is little evidence of any systematic or conditional bias. The correlation coefficient between the original samples and the duplicate samples is 0.84 a number considered good for quarter-core field duplicate samples. Any variability in the sample results can be attributed to a number of conditions including differences in sample mass or half core versus quartered core. This is partly confirmed by the comparison of the SGS duplicate samples and the check sample results of the pulps from Ultra Trace where the correlation coefficient is 0.89.

It is therefore concluded that the analytical reproducibility is satisfactory, and that the analytical accuracy is equally acceptable. Consequently, Largo chose to use the original assay data for the geostatistical analysis.

Micon concurs with Largo's decision and concluded that the data were suitable for use in the Mineral Resource estimate. Micon understood that Largo intended to continue sampling the core to get more data on PGM content. It was recommended that, while doing this, Largo continue with the practice of assaying for vanadium pentoxide as well.

#### *11.4.3 Early 2007*

In accordance with the recommendations made in Micon's December 2006 Technical Report (Hennessey, 2006), Largo has continued with a program of resampling of old drill core from the Campbell deposit.

The results, which are graphed on Figure 11-6 below show generally good agreement clustered about the 45° black reference line, except for a clustered group of data (see red ellipse) appearing to fall on a flatter line of about 30° dip. Further investigation revealed that all these data points were from drill hole FGA-41.

Figure 11-7 shows a similar graph with the results of hole FGA-41 removed from the analysis. The red fitted trend line shows agreement is extremely close with y = 0.97x and a correlation coefficient of 0.92. The data are clustered about the black 45° reference line. Micon concludes that something went awry in the analysis of this hole, a calibration or dilution issue with the readings taken in the laboratory.

As a result of this analysis, it was decided that drill hole FGA-41 should be removed from the database and the block model re-interpolated. The resulting Mineral Resource estimate was essentially identical in tonnage to that published in Hennessey (2006) and the $V_2O_5$ grade dropped marginally from 1.37% to 1.35%, a difference of only 1.5%.

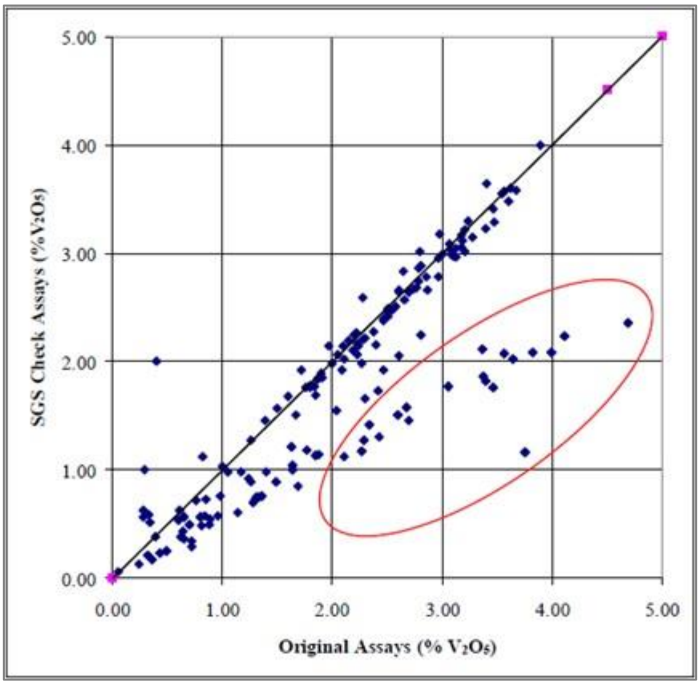



**Figure 11-6 – Gulçari A Core Duplicate Sampling**

Source: Micon, 2007.

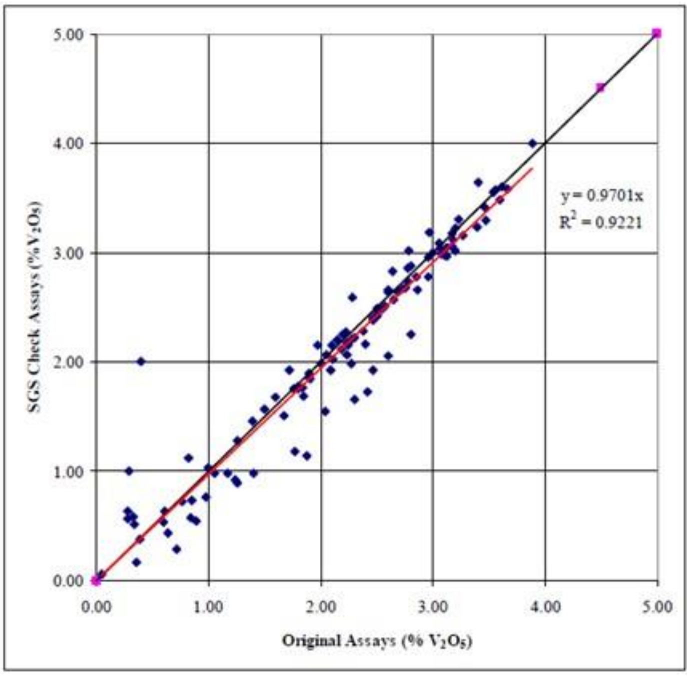



**Figure 11-7 – Campbell Pit Core Duplicate Sampling with Hole FGA-41 Removed**

Source: Micon, 2007.

### *11.4.4 2007 Campaign*

This subsection has been reproduced in its entirety from the report titled **Technical Report of the Feasibility Study for the Maracás Vanadium Project, Brazil**, by AkerSolutions (2012), as fully cited in Section 27, “References”. The QP has verified the accuracy of the information contained herein and updated as required.

Largo’s drill-core sampling program was conducted from April 3rd to October 30th, 2007. A quality assurance / quality control (QA/QC) program was conducted, to verify the precision of the $V_2O_5$, platinum and palladium grades reported during the drill campaign. It was also used to provide additional data on the PGM content of the mineralization.

The QA/QC procedures consisted of the insertion of one of two certified reference standards, two field duplicate samples, and one field blank sample with each batch of samples sent to the laboratory. The laboratory batch size is 40 samples, of which 5 were Largo QA/QC samples. There were also laboratory-inserted blanks and duplicates used by SGS in accordance with its own QA/QC policy.

#### *11.4.4.1 Certified Reference Standards*

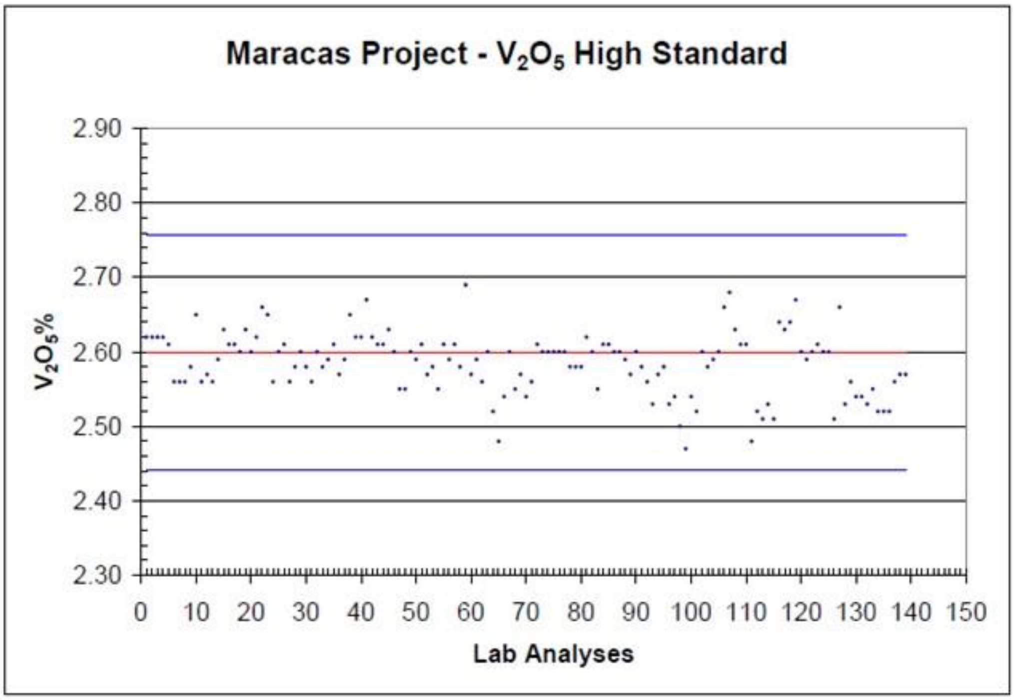
Largo had two certified reference standards made using pulps from an earlier drill program that sampled material from the Campbell Pit deposit. The standards consisted of both a high-grade (magnetitite) and lower-grade (magnetite-pyroxenite) material. The high and low standards were inserted at a rate of approximately one each per batch (40 samples).

These certified reference standards were prepared and packaged by CDN Resource Laboratories of Delta, B.C. Each sample was pulverized in a large rod mill, screened through a 200-mesh screen using an electric sieve and homogenized in a large rotating mixer. Each standard was sealed in plastic to prevent gravity separation and oxidation.

Each of the standards underwent blind round robin assaying for $V_2O_5$ by five laboratories and the data were reviewed and certified by Barry W. Smee, Ph.D., P.Geo. (Smee & Associates Consulting Ltd., see Appendix 2 of Hennessey, 2007). Both standards were also analyzed for PGM and the high-grade magnetitite layers was found to have high enough values to potentially be useful as a precious metal standard. Experience with it has found that while it repeated well as a platinum standard, it did not perform well as a palladium standard.

All the analytical results for the high and low standards were tracked on control charts on a continuous basis from April 3rd to October 30th, 2007. Each of these charts tracks the results of assaying of a single standard over time and plots it against the accepted value (the mean from the round robin assay program) and ±2 standard deviations (SD) from the mean. Staying within the ±2 SD lines is acceptable performance for precision and accuracy at a laboratory.

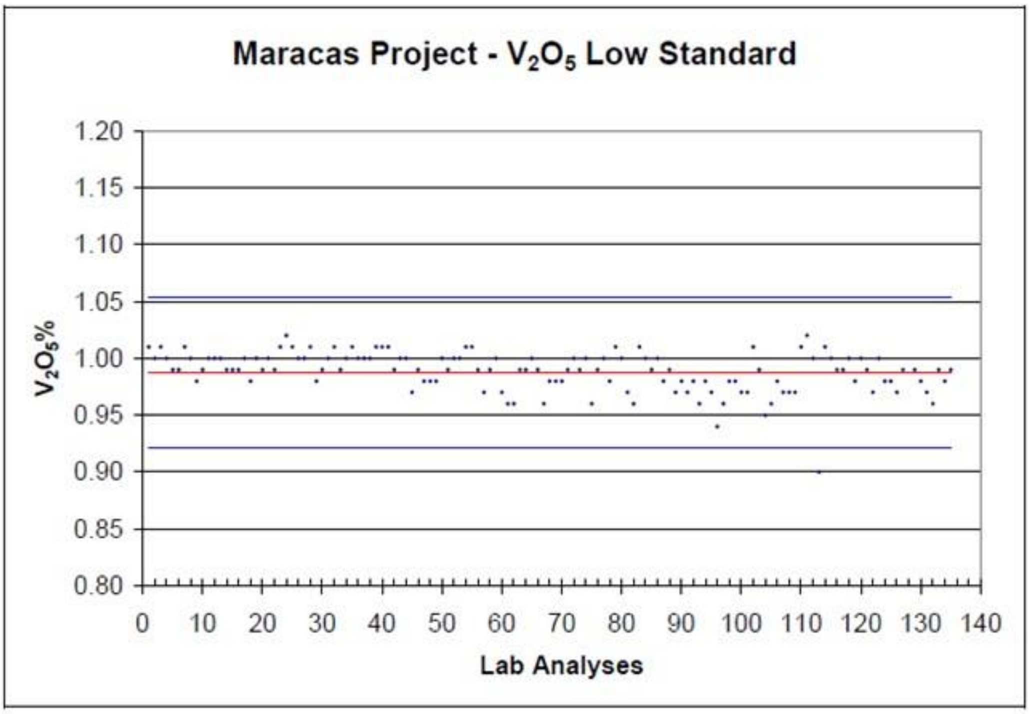
The performance of the in-house $V_2O_5$ standards used by Largo was judged to be acceptable. Figure 11-8 and Figure 11-9 show the $V_2O_5$ analytical results for the high and low standard, as well as the platinum and palladium results for the high standard.




Red line = the accepted value, blue lines = ± 2 SD

**Figure 11-8 – Exploration High Standard $V_2O_5$ Assay Results**

Source: AkerSolutions, 2012.




Red line = the accepted value, blue lines = ± 2 SD

**Figure 11-9 – 2007 Exploration High Standard $V_2O_5$ Assay Results**

Source: AkerSolutions, 2012.

*11.4.4.2 Field Blanks*

Field blanks of a known barren rock were randomly inserted at least once in every 40 samples, usually resulting in one sample per batch. This was done to check for cross contamination at any point in the sample preparation or assaying. Micon has reviewed the analytical results for the field blanks (Figure 11-10) and found them to be acceptable.

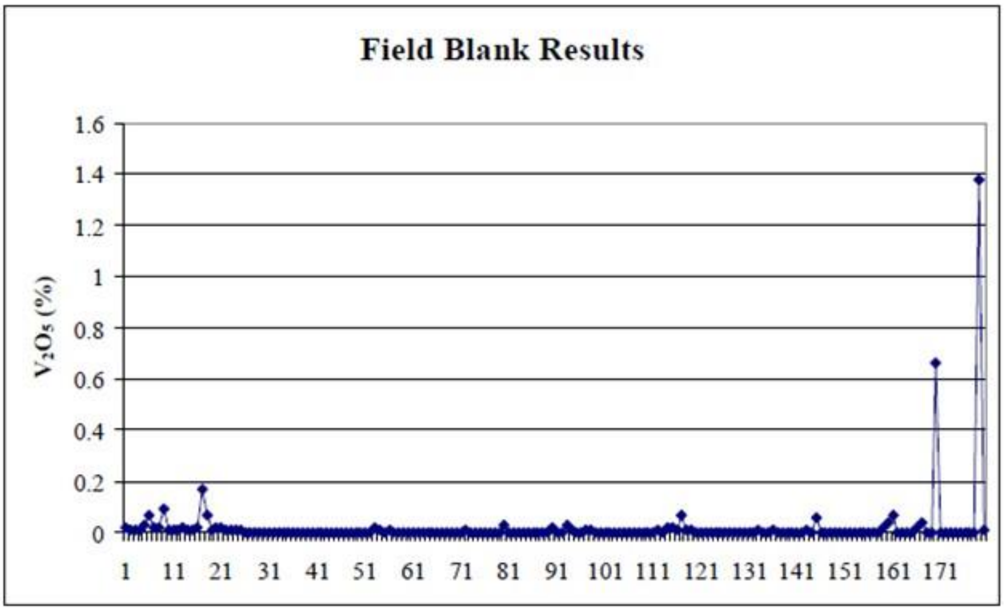



**Figure 11-10 – 2007 Exploration Field Blank Assay Results**

Source: AkerSolutions, 2012.

*11.4.4.3 Duplicates Samples*

Two field duplicate samples were randomly inserted in each batch. These samples are used to determine the precision of the assay laboratory and the degree of nugget effect introduced in sampling. Detailed records were kept at the core shed for all field duplicate sample locations.

SGS also introduced sample duplicates prepared at the laboratory into the stream. These samples are useful in determining the analytical precision of the laboratory.

The results of the field duplicate sampling are presented in Figure 11-11. Micon has reviewed these results and finds them to be acceptable and better behaved than most.

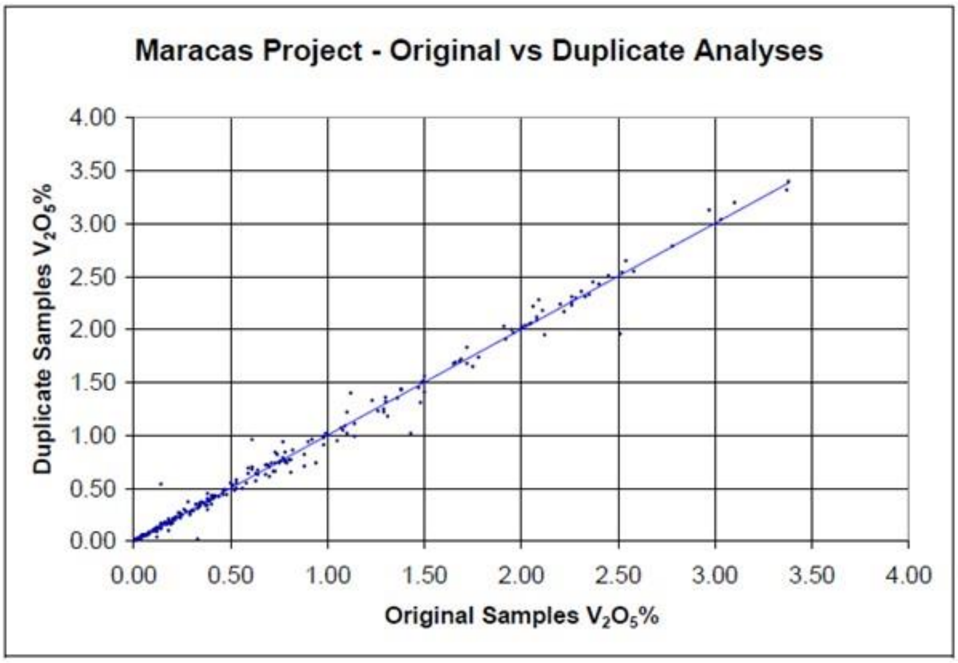



**Figure 11-11 – Maracás Project – Original vs Duplicate Analyses**

Source: AkerSolutions, 2012.

*11.4.4.4 Secondary Laboratory Checks*

Check analyses were systematically completed at a second laboratory during the drill program, to assess the precision and relative bias of the primary laboratory. A total of 500 pulp samples from 40 drill holes (9.1% of samples) were analyzed (Figure 11-12 and Figure 11-13).

The original analyses were done at the SGS laboratory in Belo Horizonte, Brazil. The 2007 duplicate sample analyses were conducted at ALS Chemex laboratory in Vancouver, B.C. Every effort was made to use similar techniques and sample sizes, to compare results. The longest lapse of time between the original assays at SGS and the secondary checks at ALS Chemex was 4 months, and the shortest period was 2 months.

The samples sent to SGS were analyzed for the major oxides (FeO, $Fe_2O_3$, $SiO_2$, $TiO_2$ and $V_2O_5$) using borate fusion XRF. The lower detection limit for $V_2O_5$, for this method, was 0.01%, while the upper limit was 5%. Elements were reported as oxides. The samples were also analyzed by SGS for platinum and palladium by fire assay with an AA finish on a 20-g sample. Internal quality control procedures included duplicate and blank sample and certified reference material analysis. These data were used to check the analytical reproducibility and precision of the assays.

ALS Chemex's XRF method used a fusion technique, with a high-energy X-ray instrument. The lower detection limit for $V_2O_5$ was 0.01%, while the upper limit was 5%. A sample weight of 0.66 g was fused with 7.2 g of flux to prepare each bead. Samples were fused into a glass disc using a lithium borate flux much as described for normal fused glass beads. The samples were also analyzed for platinum and palladium by fire assay with an AA finish on a 20-g sample.

ALS Chemex's XRF method used a fusion technique, with a high-energy X-ray instrument. The lower detection limit for $V_2O_5$ was 0.01%, while the upper limit was 5%. A sample weight of 0.66 g was fused with 7.2 g of flux to prepare each bead. Samples were fused into a glass disc using a lithium borate flux much as described for normal fused glass beads. The samples were also analyzed for platinum and palladium by fire assay with an AA finish on a 20-g sample.

Largo, therefore, concluded that the analytical reproducibility was satisfactory, and that the analytical accuracy is equally acceptable. Consequently, Largo chose to use the original 2007 assay data for the geostatistical analysis. Micon supported the decision.

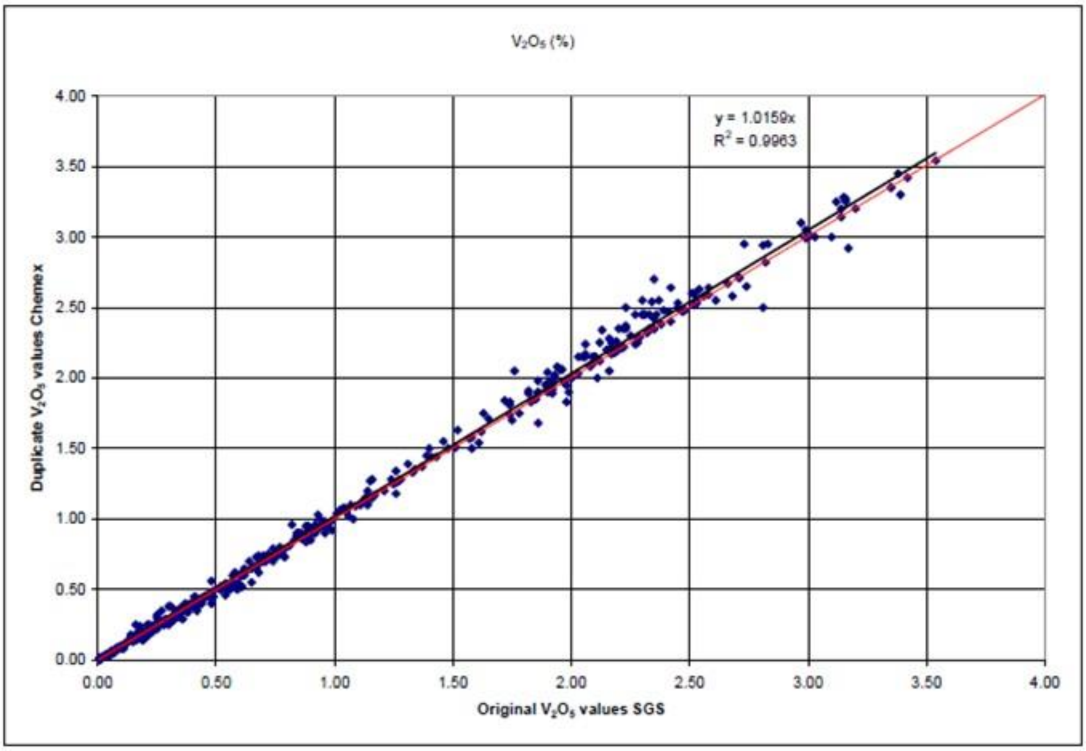



**Figure 11-12 – Secondary Laboratory Check Assays – $V_2O_5$**

Source: AkerSolutions, 2012.

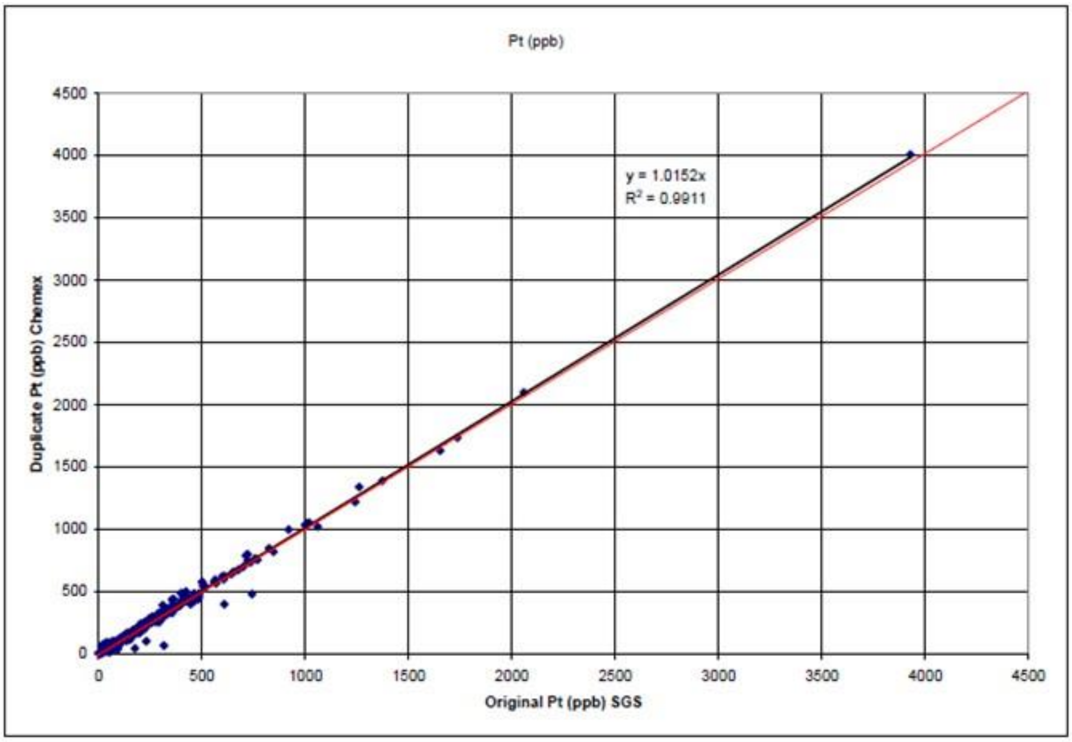



**Figure 11-13 – Secondary Laboratory Check Assays – Pt**

Source: AkerSolutions, 2012.

### *11.4.4.5 AkersSolutions QA/QC Summary (2012)*

The purpose of adding a QC program to any drill program is to verify the accuracy and precision of the laboratory's results and to react immediately to any deviation at the laboratory demonstrated by the standards. Use of the certified reference materials in this case has meant that the laboratory results for the metals can be said to be reasonably accurate and precise.

The SGS pulp duplicates from the 2007 drilling show close agreement and little bias between first and second assay. The correlation coefficients confirm the close agreements between the original and the laboratory duplicates. Largo's field duplicates also showed good reproducibility.

Largo's 180 field blanks routinely returned very low values for all elements with three exceptions. Two samples, LML6272 and VML1682, assayed above background precious metal levels and $V_2O_5$ and one sample, LML6056, showed elevated $V_2O_5$ levels.

The performance of the certified reference standards was good for the high $V_2O_5$, low $V_2O_5$ and platinum determinations with over and under limit palladium assays returned. The high $V_2O_5$ results were stable and consistent and all clustered between the ±2 SD control limits. The results for low $V_2O_5$ standard were good with only one sample that fell outside the ± 2SD control limits. The high $V_2O_5$ standard is not really a precious metal standard. However, the values for platinum were very consistent, except for one sample and within acceptable ±2 SD limits. The palladium results on the other hand were variable showing no consistent drift.

### *11.4.5 RungePincockMinarco Analysis – 2012*

Most of this subsection has been reproduced from the Technical Report titled **Technical Report the Largo Maracás Vanadium Project, 1 million Tonnes per Year Processing Plant, Brazil** by RungePincockMinarco (2012), as fully cited in Section 27, "References". The QP has verified the accuracy of the information contained herein and updated as required.

In 2011-2012 Coffey Mining validated Largo's QA/QC data since 2006. The program was implemented by Largo to complete the survey campaigns analyzed by the companies Intertek and SGS laboratory. The controls defined for the analysis were field white, internal standards (material in certification) and sample duplicates.

The objective of the analysis was to determine the accuracy and accuracy of the values of the retested pairs and to monitor their relative errors.

At the same time as the verification Largo certified two internal standards of high content and lower vanadium content. Table 11-5 and Table 11-6 show the certified standards and statistical results of the certification.

**Table 11-6 – Internal Standard Detection Limits**

| Standard | Mean | Mean + 2SD | Mean -2 SD | Mean + 3 SD | Mean - 3 SD |
|---|---|---|---|---|---|
| $V_2O_5$ High grade | 2.6 | 2.76 | 2.54 | 2.84 | 2.46 |
| $V_2O_5$ Low grade | 0.988 | 1.054 | 0.922 | 1.087 | 0.889d |

Source: RungePincockMinarco, 2012.

**Table 11-7 – Standards and Blank QA/QC Summary Results**

| Reference values | | | | Analyzed Results | | | | Results | |
|---|---|---|---|---|---|---|---|---|---|
| Standard / variable | Origin (%) | Min (%) | Max (%) | Sample N | Min (%) | Max (%) | Mean (%) | % Inside precision limits | % Outside precision limits |
| Site Project | | | | | | | | | |
| Blank / $V_2O_5$ | 0.01 | 0.005 | 0.015 | 199 | 0.001 | 0.18 | 0.008 | 84.422 | 15.578 |
| High Grade / $V_2O_5$ | 2.6 | 2.52 | 2.68 | 187 | 2.38 | 2.53 | 2.45 | 3.21 | 96.76 |
| Low Grade / $V_2O_5$ | 0.988 | 0.955 | 1.021 | 193 | 0.95 | 1.06 | 1.015 | 63.212 | 36.788 |
| XRF_SGS | | | | | | | | | |
| Blank / $V_2O_5$ | 0.01 | 0.01 | 0.01 | 173 | 0.005 | 0.05 | 0.007 | 95.954 | 4.046 |

Source: RungePincockMinarco, 2012.

### *11.4.6 Comparative Data Analysis*

The verification of Coffey (2012) consisted of comparatively analyzing all the controls made available by Largo in addition to analyzing remonstrate values in the core. Table 11-7 shows the quantity of this study.

The pairs of field duplicates showed that 88.78% of the analyses were within the acceptance limit (10%) stipulated. Another observation was that 93.82% of the pairs of pulp duplicates were within the same acceptance limit. On the same condition the Replicate (SGS) with 93.6%, SGS labor vs. Intertek labor interlaboratory check with 96.94% and SGS labor vs ALS labor interlaboratory check with 94.43% showed adequate correlation rates.

Coffey Mining concluded that the patterns showed moderate to high accuracy regarding the interlaboratory check (SGS vs. Intertek) and the other controls were also considered adequate.

**Table 11-8 – QA/QC Program Summary**

| Chemical Element | Sample Type | Number of Samples Analyzed |
|---|---|---|
| $V_2O_5$ | Field Duplicate | 196 |
| | Duplicate (Lab SGS) | 275 |
| | Replicate (Lab SGS) | 296 |
| | Check Lab SGS vs Intertek | 359 |
| | Check Lab SGS vs ALS | 305 |

Source: Coffey, 2012.

#### *11.4.7 2021 and 2023 GE21 QA/QC Analysis*

Since 2009 Largo has implemented a QA/QC program on all drilling programs. This quality control allowed to check precision and accuracy of % $V_2O_5$, % $TiO_2$ and other elements including platinum and palladium contents, reported in the previous Mineral Resource estimative.

The program consisted of routinely inserting certified standards and blanks throughout the laboratory analysis process. The key features of the control samples are described below.

Blank – Until 2018 blank was unmineralized building material acquired at one specific supplier in Maracás city, close to the Project site. From 2018 blank samples were from pegmatites from Gulçari A (Campbell Pit). They are separated in bags of approximately 1 kg and the label is placed regarding the position in the lot. In the control sample the following characteristics are observed:

- Ensure the sample does not have any other source lithology of $V_2O_5$ or $TiO_2$.
- They should be washed with running water to remove dust.

Standard – Internal high and low $V_2O_5$ content standards – In 2018 Largo had Smee and Associates Consulting Ltd. create additional CRM samples for use in the QA/QC program. In later campaigns Largo used also externally certified reference material from SGS. Normally these samples were separated into small bags with 50g of aliquot for each. The Table 11-8 shows Certified Reference Material used in QA/QC internal program of Largo.

**Table 11-9 Main – Certified Reference Material used by Largo**

| Name | Responsible Company |
|---|---|
| Certified Reference Material HCV | SGS-GEOSOL |
| Certified Reference Material LCV | |
| Certificate of Analysis Largo Standard 2018 HG | SMEE & Associates Consulting Ltd |
| Certificate of Analysis Largo Standard 2018 LG | |

Source: GE21, 2024.

Duplicate coarse – Reserves of crushed material from previous campaigns were used as duplicate control samples in the 2020 campaign. Duplicate coarse control was discontinued as of the 2021 campaign.

Pulp Duplicate – Reserves of pulverized material from previous campaigns were used as duplicate control samples in the 2020 campaign. Since the 2021 campaign, duplicates have been made using samples from the same batch as the analysis, considering external recommendations.

Since 2018 Largo have implemented QA/QC program with following controls:

- 2018 (Coffey, 2012).
    - Blank – sample intern the chemical analysis for $V_2O_5$ and $TiO_2$. The insertion rate of 1 control sample per 32 samples.
    - Standards – external and internal certified sample. The insertion rate of 1 standard sample per 16 samples.
    - Duplicates – verification of laboratory precision. The insertion rate of 1 standard sample per 16 samples

After 2019 normally in batch of 40 samples, at least 5 were control samples. The Intertek, ALS and SGS laboratory also subjected all Largo samples to its internal quality control procedure (standards and blanks). The QP has not checked the procedures of this control program for each laboratory.

Following main control applied Largo's QA/QC program:

- 2019
    - blank sample;
    - high grade standard;
    - low grade standard.
- 2020
    - blank sample;
    - high grade standard;
    - low grade standard;
    - coarse duplicate;
    - pulp duplicate.
- 2021 to 2023
    - blank sample;
    - high grade standard;
    - low grade standard;
    - pulp duplicate.

#### *11.4.7.1 Blanks*

The Blank control samples were randomly inserted during shipment to the Laboratory throughout the program. This control allowed to check a point in the analysis and preparation process for contamination.

In 2020, a total of 463 samples were inserted in the program with reference value of 0.001% and 0.01% $V_2O_5$. Most of the values obtained in the analysis show the absence of % $V_2O_5$ (below detection limit), that is, a source of possible contamination in the analytical circuit was not found (Figure 11-14).

A total of 714 samples were inserted into 2021 to 2023 campaign. The analysis was conducted for all deposits together (Figure 11-15 to Figure 11-18). A source of contamination in the analytical circuit was not found.

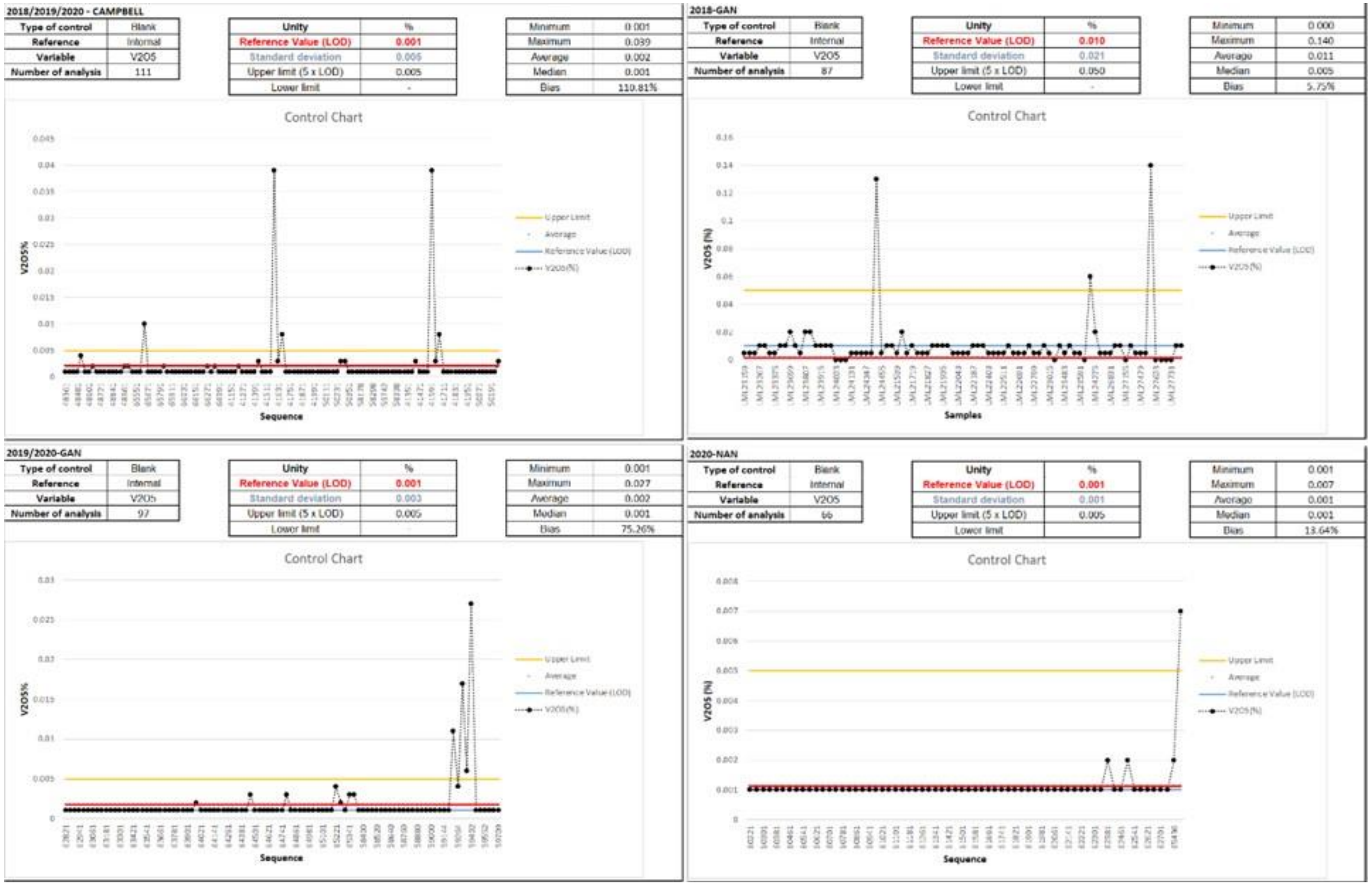



**Figure 11-14 – Blanks Campbell Graphic – 2018 to 2020**

Source: GE21, 2024.

| Reference | BLK BF | Reference Value - Limit of Detection (LOD) | 0.010 | Minimum | 0.000 |
|---|---|---|---|---|---|
| Variable | V2O5 (%) | Standard deviation | 0.031 | Maximum | 0.400 |
| Number of analysis | 177 | Upper limit (5 x LOD) | 0.050 | Average | 0.006 |
| | | | | Median | 0.001 |
| | | | | Bias | -42.26% |

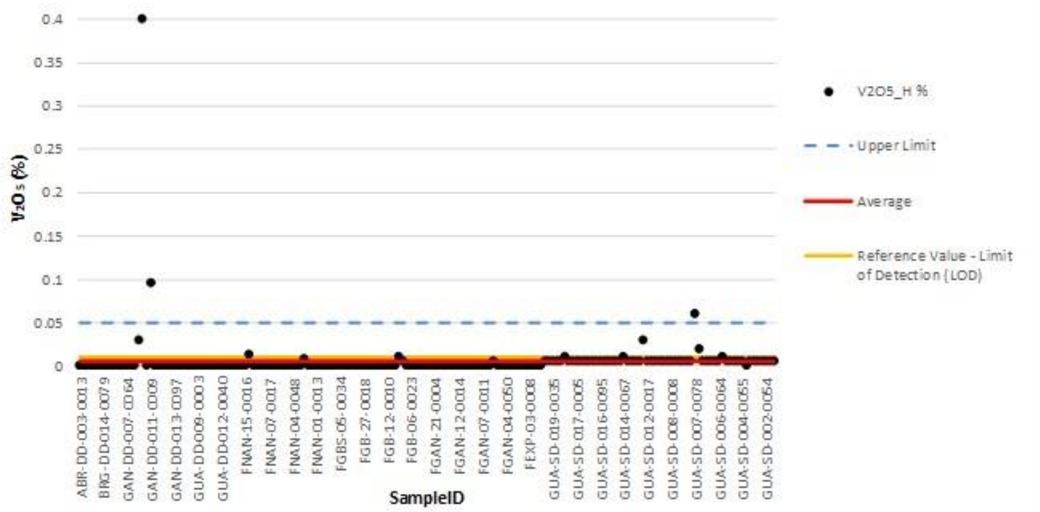



**Figure 11-15 – Blanks Graphics – Laboratory: Largo – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

| Reference | BLK BF | Reference Value - Limit of Detection (LOD) | 0.010 | Minimum | 0.001 |
|---|---|---|---|---|---|
| Variable | TiO2 (%) | Standard deviation | 0.233 | Maximum | 3.101 |
| Number of analysis | 177 | Upper limit (5 x LOD) | 0.050 | Average | 0.033 |
| | | | | Median | 0.005 |
| | | | | Bias | 234.60% |

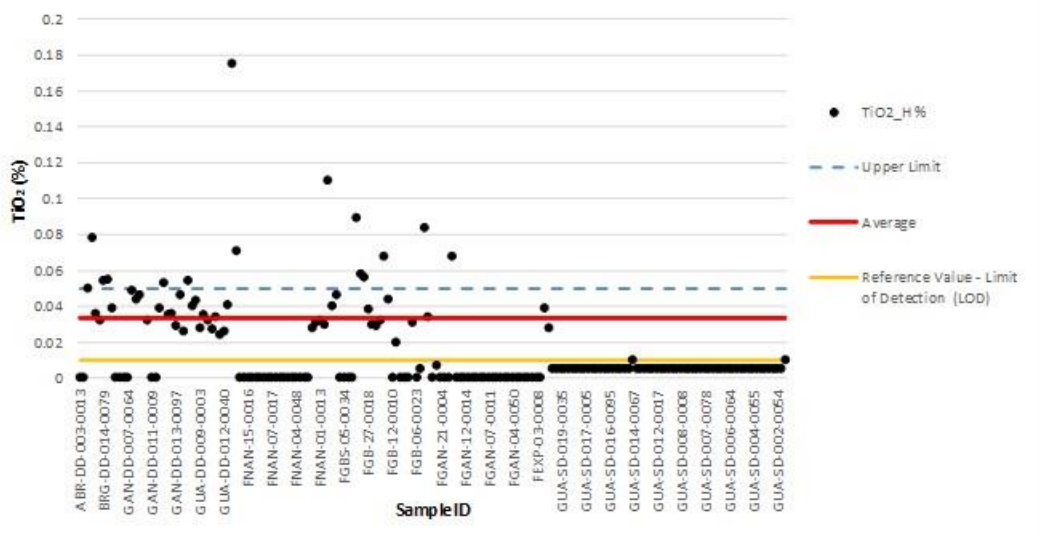



**Figure 11-16 – Blanks Graphics – Laboratory: Largo – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

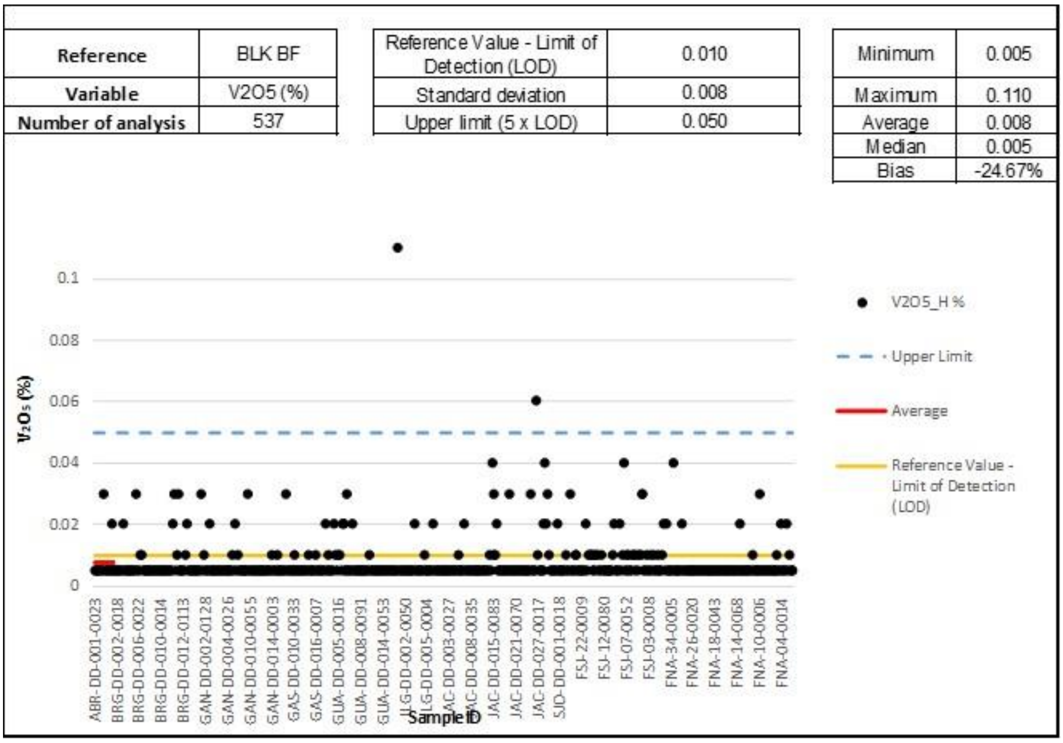



**Figure 11-17 – Blanks Graphics – Laboratory: SGS – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

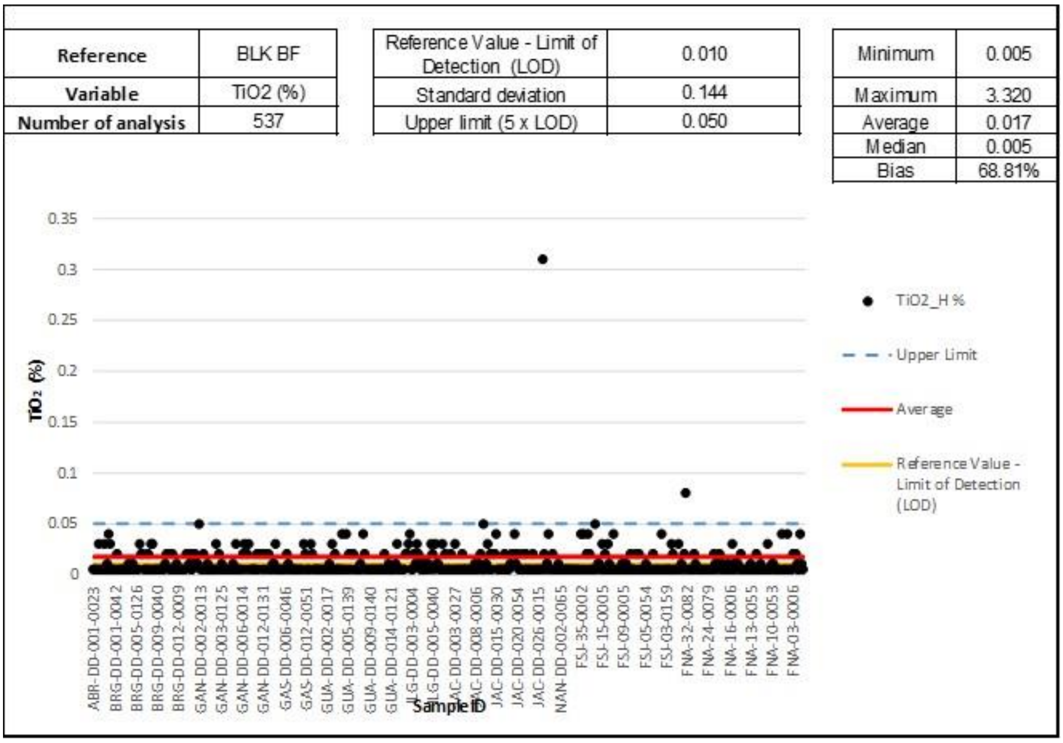



**Figure 11-18 – Blanks Graphics – Laboratory: SGS – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

The QP validated the analytical results of blanks and found them acceptable in 2018, 2019, 2020 and 2021 to 2023 campaign. The analyses of blank prior to 2018 received by the QP did not show values that compromise the data for the estimative of the Mineral Resource.

#### *11.4.7.2 Standard Samples*

Standard samples were also randomly inserted into program batches. These samples were used to determine laboratory accuracy and to measure a possible nugget effect of the samples. Throughout the program, four standards were used, where two had high % $V_2O_5$ values and two, low % $V_2O_5$ values of companies SGS and SMEE & ASSOCIATES CONSULTING LTD.

**ANALYSIS 2020**

- Campbell Pit:

In total survey campaigns, 344 standards have been inserted into the sampling circuit in Campbell since the beginning of the exploration by Largo. The resulting bias in the control charts of high and low value of % $V_2O_5$ was within the acceptable limits stipulated for this type of deposit (bias ±10%) of average $V_2O_5$. Figure 11-19 shows the comparative graphs of this control measure.

The major difference (4.37%) is related to data prior to 2018 and to the low value standard of % $V_2O_5$ LCV-GEOSOL-V2015. Possibly related to calibration of the instrument at the beginning of chemical analyses. The inverse situation in relation to calibration occurs in the analyses of the 2018 HG and LG standards of SMEE analyzed in 2020, showing a better adherence to the certified value.

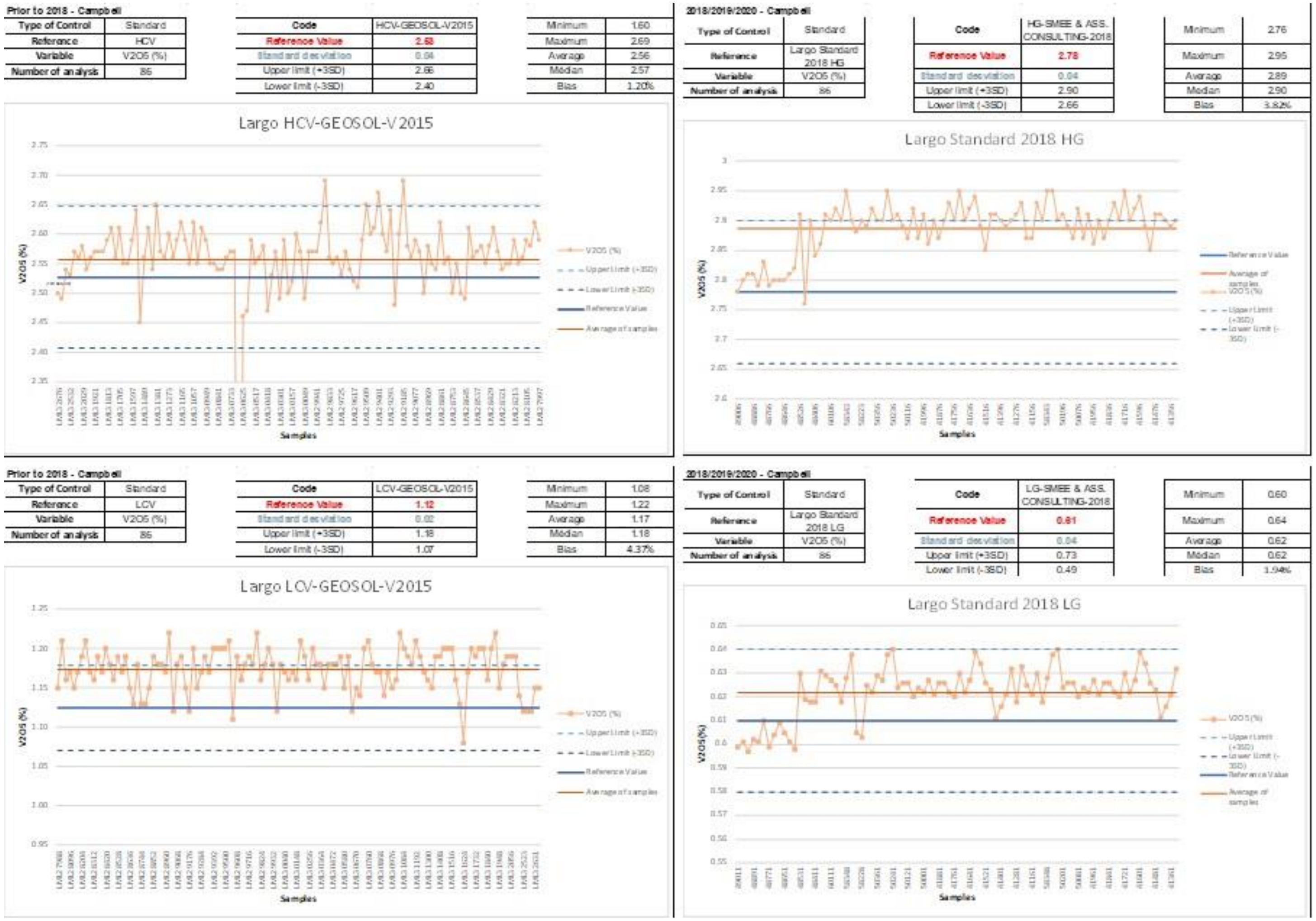



**Figure 11-19 – Campbell Pit Standard Chart**

Source: GE21, 2024.

- GAN

During the drilling campaigns on the GAN deposit, 364 standards were inserted into the sampling circuit. The resulting bias in the high and low value control charts of % $V_2O_5$ stayed also within the acceptable limits stipulated for this control (bias ±10%). Figure 11-20 shows the comparative graphs of this control measure.

The largest difference (-7.26%) observed is related to data prior to 2018 and to the high value standard of % $V_2O_5$ HCV-GEOSOL-V2008 showing accurate but not certified results. Possibly related to instrument calibration. A continuous improvement in time calibration occurs in the analyses of the 2018 HG and LG standards of SMEE analyzed in 2020, showing a better adherence to the reference value.


**Figure 11-20 – Standard GAN Chart**

Source: GE21, 2024.

- NAN

At NAN, 313 standards were inserted into the sampling circuit. The resulting bias in the high and low value control charts of % $V_2O_5$ were also within the acceptable limits stipulated (bias ±10%). Figure 11-21 shows the comparative graphs of this control measure.

The behavior of the same standards used in Campbell and GAN showed a better adherence to the reference value of each certificate. The bias observed is less than 4% showing a good accuracy in general form in relation year of campaign and $V_2O_5$ and $TiO_2$ content.


**Figure 11-21 – NAN Standard Chart**

Source: GE21, 2024.

The QP validated the standard samples and found them acceptable in 2018, 2019, 2020 sampling campaigns (Campbell Pit, GAN and NAN deposits). The analyses of standard samples prior to 2018 received by the QP did not show values that committed the data for the estimative of the Mineral Resource.

**ANALYSIS 2021 to 2023**

A total of 713 control samples were entered from 2021 to 2023. Accuracy analysis was performed for all targets together, for the SGS and internal Largo laboratories (Figure 11-22 to Figure 11-29).

The results were assessed as adequate, presenting a maximum relative bias of 2% in $TiO_2$% analyzes in the SGS laboratory. The QP validated the standard samples and found them acceptable in 2021 to 2023 sampling campaigns.

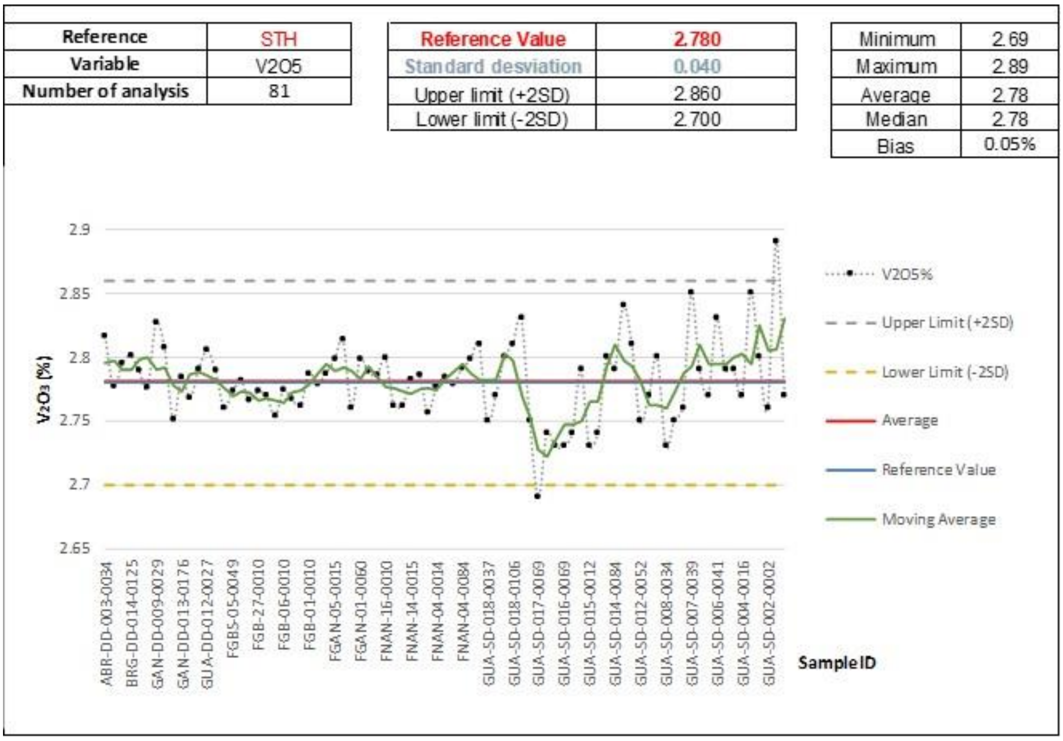



**Figure 11-22 – High Grade Standard Chart – Laboratory: Largo – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

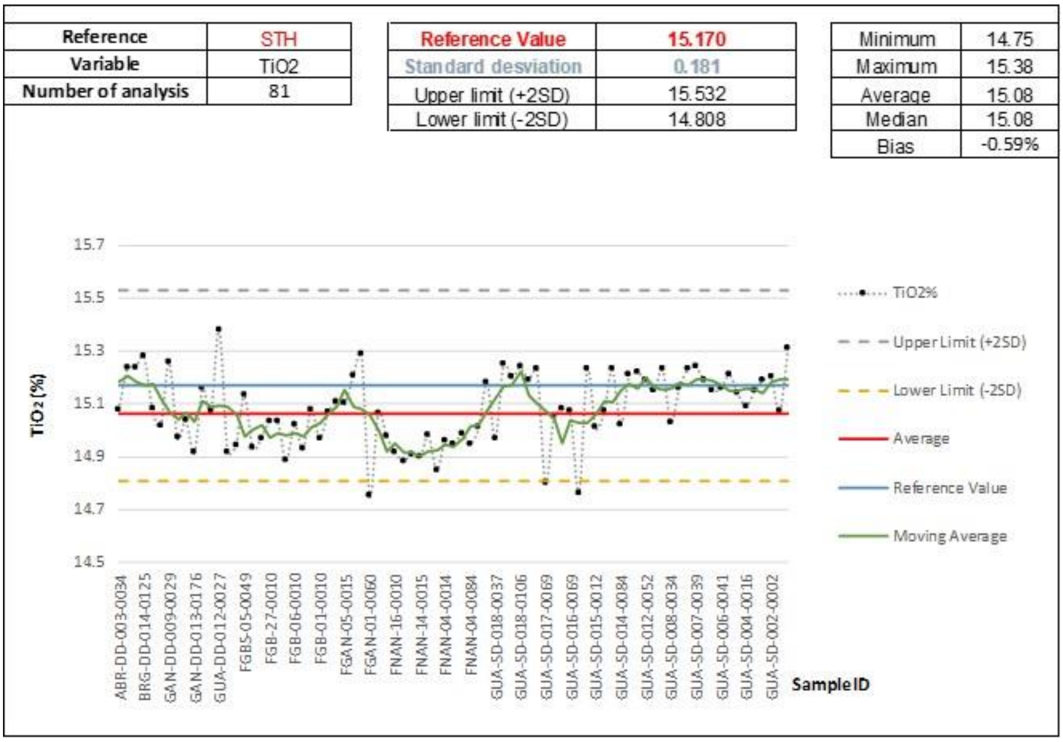



**Figure 11-23 – High Grade Standard Chart – Laboratory: Largo – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

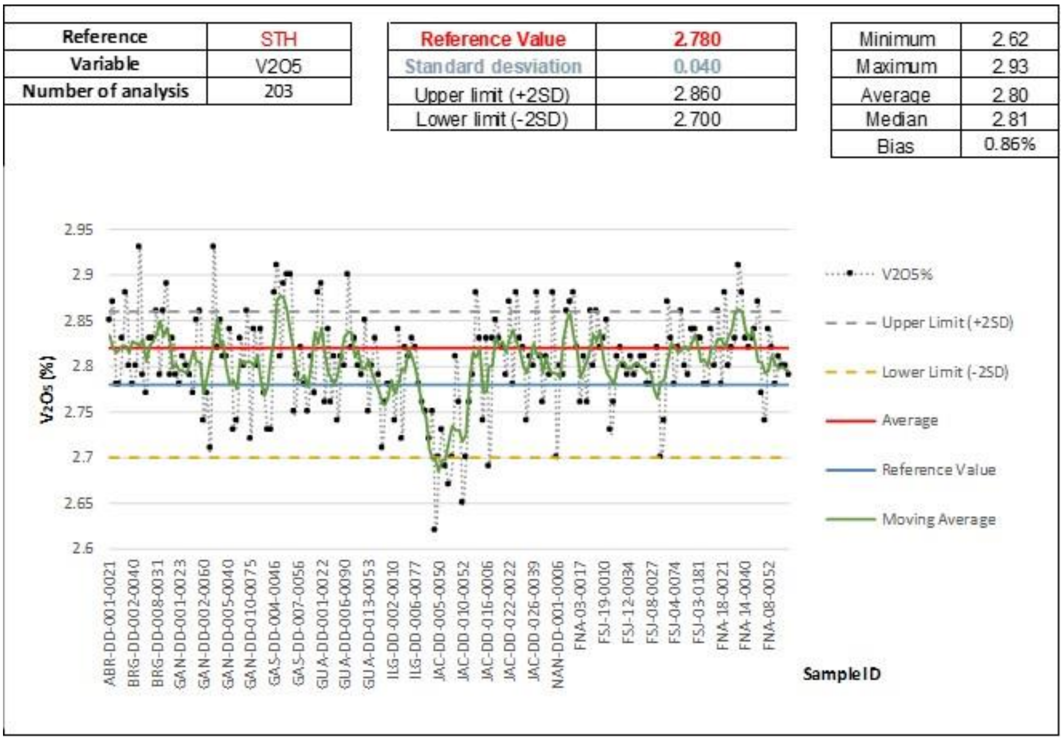



**Figure 11-24 – High Grade Standard Chart – Laboratory: SGS – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

| Reference | STH |
|---|---|
| Variable | TiO2 |
| Number of analysis | 203 |

| Reference Value | 15.170 |
|---|---|
| Standard desviation | 0.180 |
| Upper limit (+2SD) | 15.530 |
| Lower limit (-2SD) | 14.810 |

| Minimum | 14.90 |
|---|---|
| Maximum | 16.20 |
| Average | 15.48 |
| Median | 15.50 |
| Bias | 2.05% |

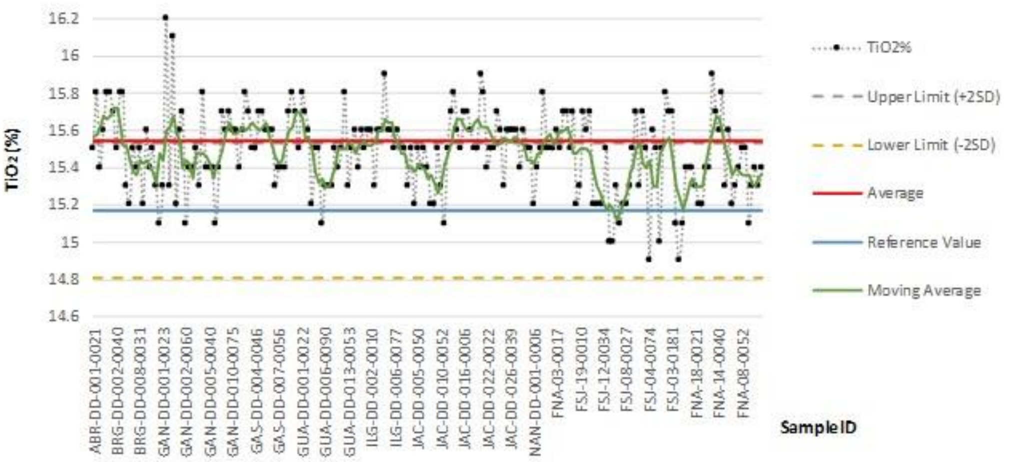



**Figure 11-25 – High Grade Standard Chart – Laboratory: SGS – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

| Reference | STL |
|---|---|
| Variable | V2O5 |
| Number of analysis | 96 |

| Reference Value | 0.610 |
|---|---|
| Standard desviation | 0.010 |
| Upper limit (+2SD) | 0.630 |
| Lower limit (-2SD) | 0.590 |

| Minimum | 0.58 |
|---|---|
| Maximum | 0.64 |
| Average | 0.61 |
| Median | 0.61 |
| Bias | -0.28% |

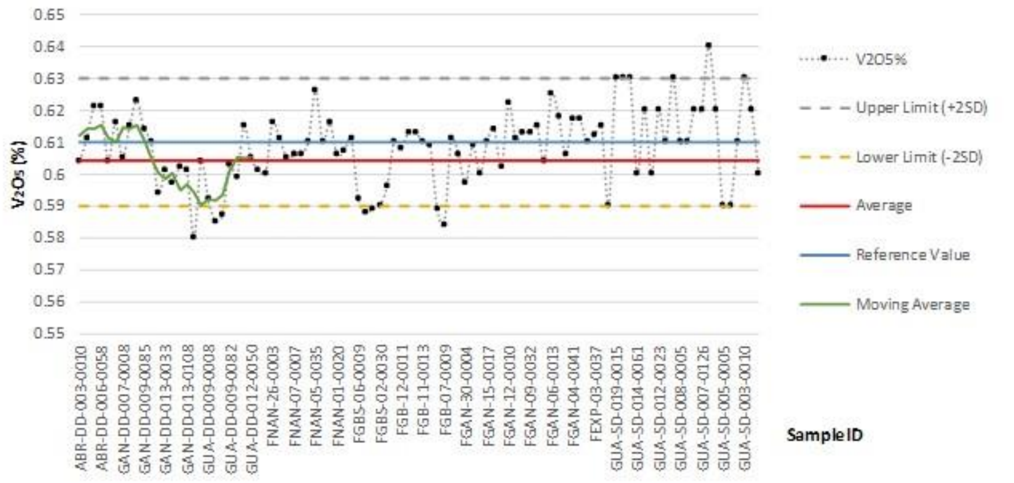



**Figure 11-26 – Low Grade Standard Chart – Laboratory: Largo – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

| Reference | STL |
|---|---|
| Variable | TiO2 |
| Number of analysis | 96 |

| Reference Value | 4.930 |
|---|---|
| Standard desviation | 0.065 |
| Upper limit (+2SD) | 5.060 |
| Lower limit (-2SD) | 4.800 |

| Minimum | 4.51 |
|---|---|
| Maximum | 4.99 |
| Average | 4.90 |
| Median | 4.91 |
| Bias | -0.52% |

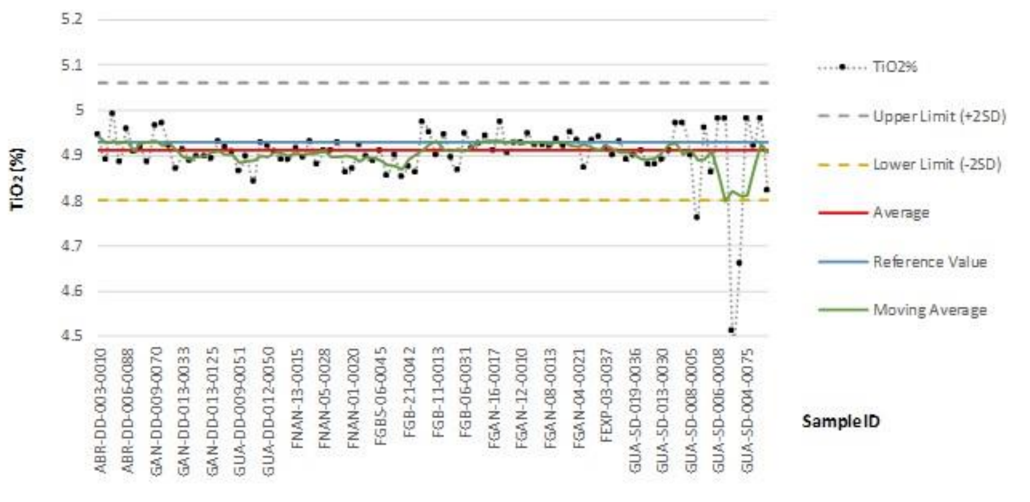



**Figure 11-27 – Low Grade Standard Chart – Laboratory: Largo – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

| Reference | STL |
|---|---|
| Variable | V2O5 |
| Number of analysis | 333 |

| Reference Value | 0.610 |
|---|---|
| Standard desviation | 0.010 |
| Upper limit (+2SD) | 0.630 |
| Lower limit (-2SD) | 0.590 |

| Minimum | 0.53 |
|---|---|
| Maximum | 0.66 |
| Average | 0.61 |
| Median | 0.61 |
| Bias | 0.07% |

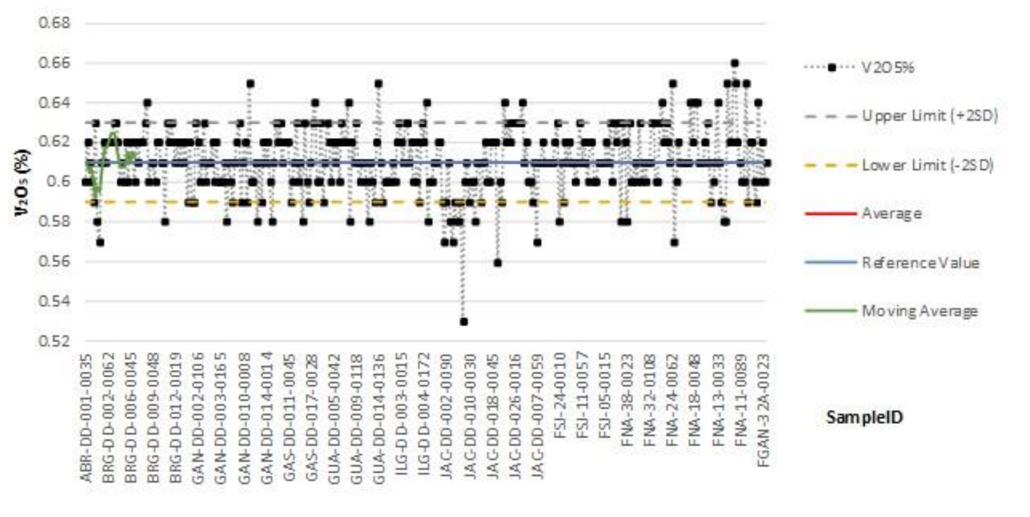



**Figure 11-28 – Low Grade Standard Chart – Laboratory: SGS – $V_2O_5$ – 2021 to 2023**

Source: GE21, 2024.

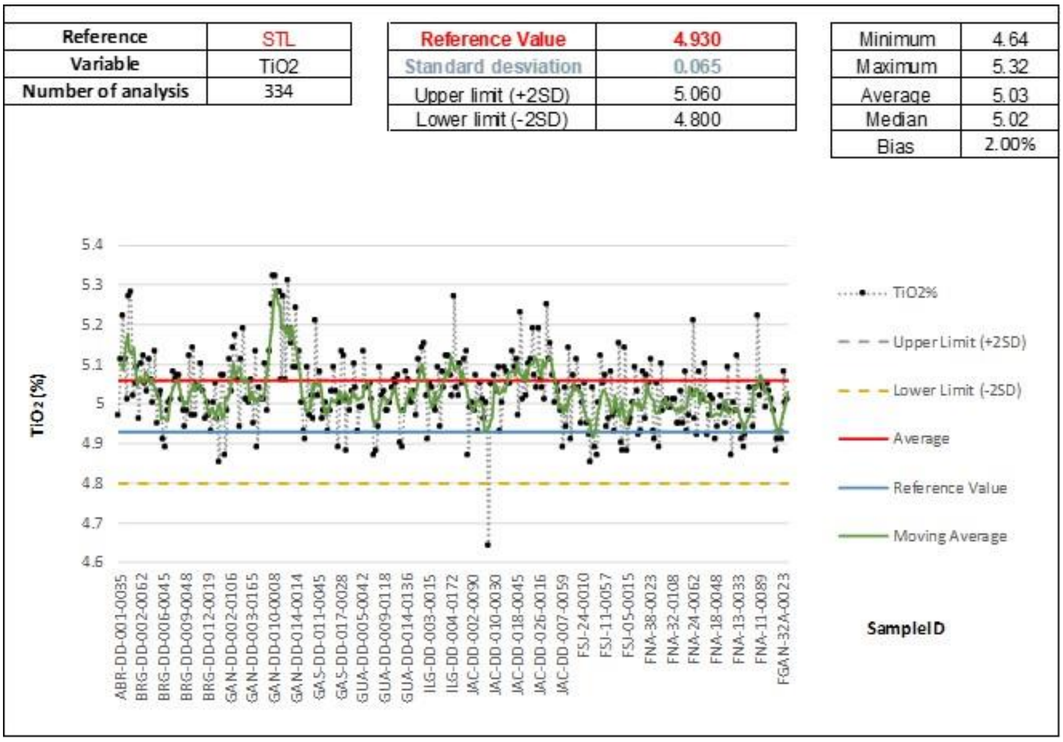



**Figure 11-29 – Low Grade Standard Chart – Laboratory: SGS – $TiO_2$ – 2021 to 2023**

Source: GE21, 2024.

*11.4.7.3 Duplicates*

Duplicate samples are taken from the remaining mass of each sample that was stored in the core shed in 2020 and duplicate samples in the same batch in 2021 to 2023. Its objective is to control the effect of variance in the processes of sample preparation and chemical analysis, with greater focus on the control of quartered crushed material, as well as to evaluate analytical and sampling precision and identify possible sample changes.

**ANALYSIS 2020**

- Campbell

In Campbell's sample flow, considering all existing surveys, 161 coarse samples were inserted. Among which only 7.45% of the total exceeded the 10% limit for this analysis Figure 11-30. The data showed a good correlation between the original samples and their respective duplicates, as well as relating their respective statistical distributions.

| Campbell | |
|---|---|
| Type of control | Duplicate |
| Reference | Global |
| Variable | V2O5(%) |
| Accuracy limit | 10% |
| Number of pairs | 161 |

| | SMP | DUP |
|---|---|---|
| Minimum | 0.0010 | 0.0010 |
| Maximum | 4.00 | 3.46 |
| Average | 1.04 | 1.02 |
| Median | 0.75 | 0.76 |
| Range inside precision limit | 92.55% | |

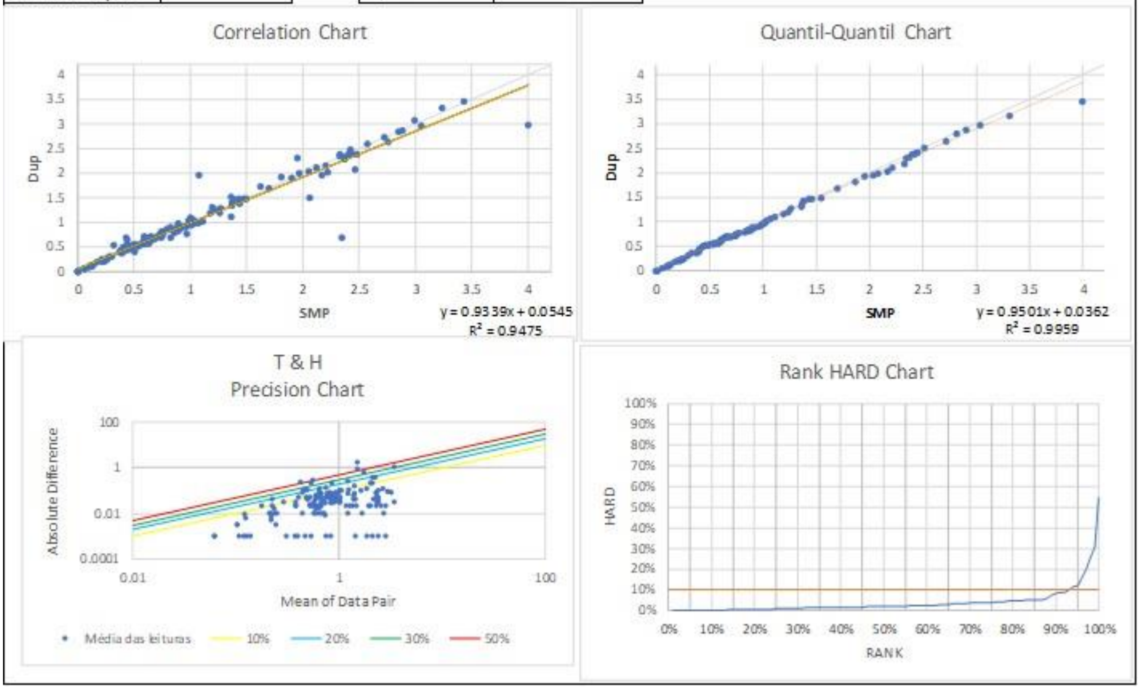
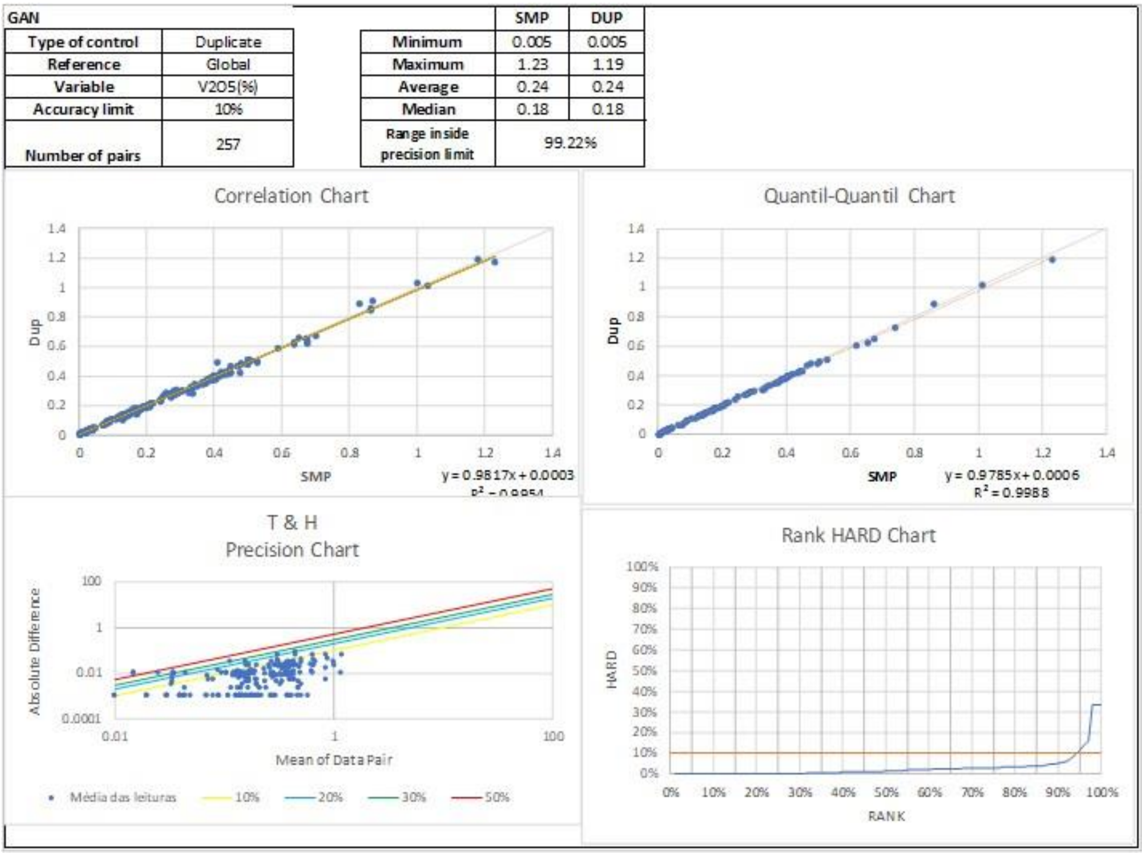



**Figure 11-30 – Duplicates Campbell Chart**

Source: GE21, 2024.

- GAN

In the GAN drill sampling program, 257 coarse samples were inserted. Among which only 0.78% of the total exceeded the 10% limit for this analysis (Figure 11-19). The data showed a high correlation between the original samples and their respective duplicates, as well as relating their respective statistical distributions.



| GAN | |
|---|---|
| Type of control | Duplicate |
| Reference | Global |
| Variable | V2O5(%) |
| Accuracy limit | 10% |
| Number of pairs | 257 |

| | SMP | DUP |
|---|---|---|
| Minimum | 0.005 | 0.005 |
| Maximum | 1.23 | 1.19 |
| Average | 0.24 | 0.24 |
| Median | 0.18 | 0.18 |
| Range inside precision limit | 99.22% | |



**Figure 11-31 – Duplicates GAN Chart NAN**

Source: GE21, 2024.

In the NAN deposit, 174 samples were inserted into the sampling circuit. Among which almost 40% of the total exceeded the 10% limit for this analysis Figure 11-20. However, considering that this analysis is in the samples of low content of % $V_2O_5$, this bias can be explained by inadequate manipulation of samples in laboratory. Nevertheless, the data showed a good correlation between the original samples and their respective duplicates, as well as relating their respective statistical distributions. The difference of 10% between the average of the original samples and their duplicates was considered acceptable by the QP considering the analysis conditions and type of deposit.

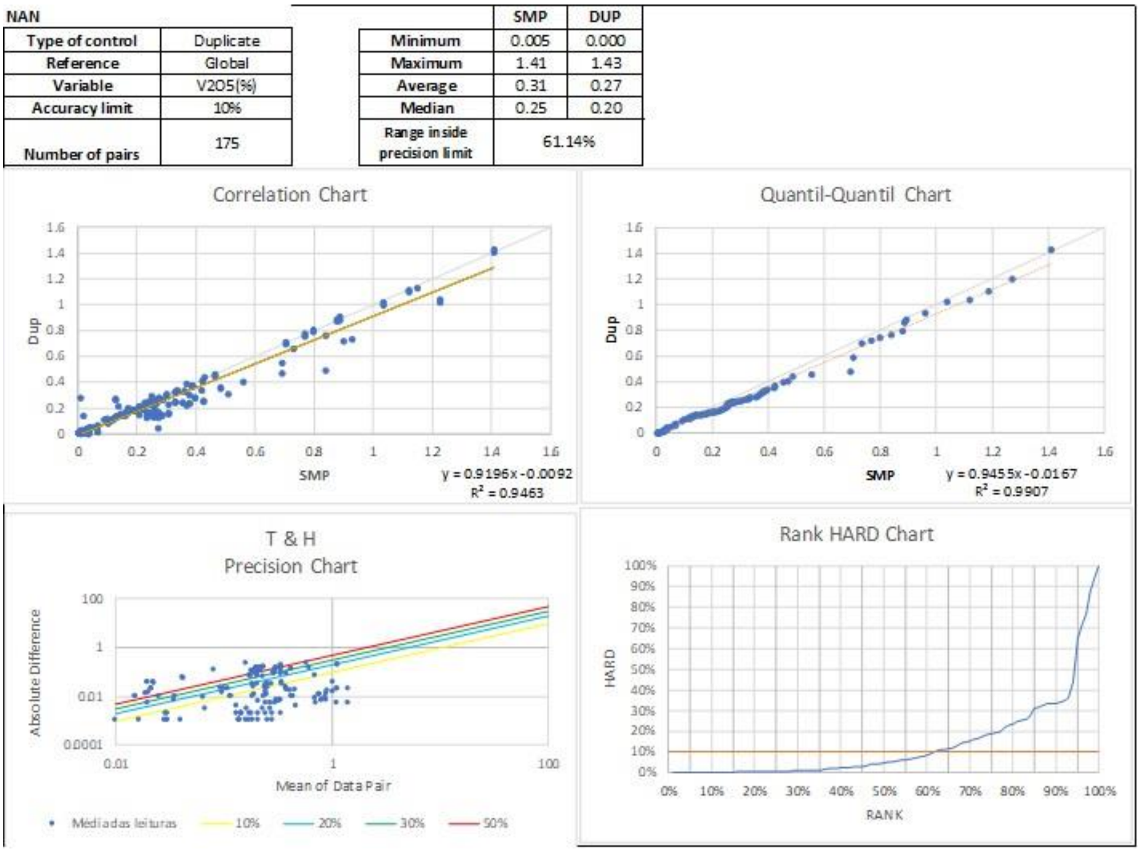



**Figure 11-32 – Duplicates NAN Chart**

Source: GE21, 2024.

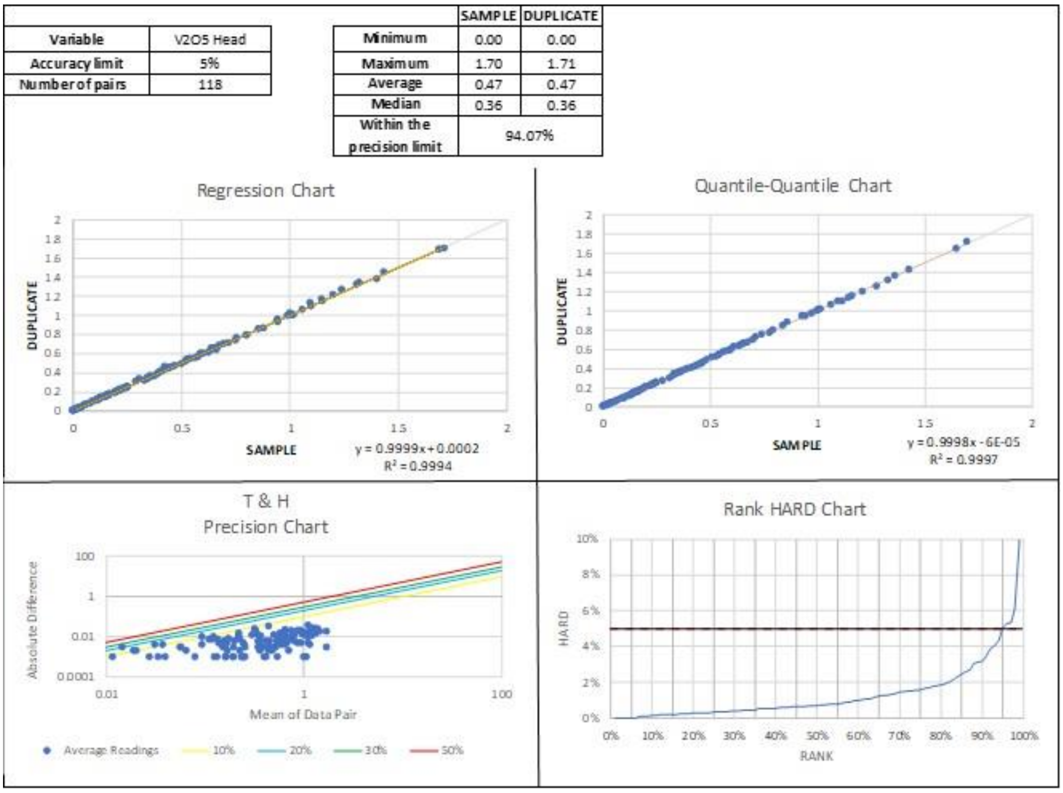
The QP validated the coarse duplicate and found them acceptable in 2018, 2019, 2020 campaign of deposits (Campbell Pit, GAN and NAN deposits). There are not course duplicate samples prior 2018.

**ANALYSIS 2021 TO 2023**

A total of 652 duplicate control samples were inserted into 2021 to 2023 campaign.

Precision analysis was conducted for all deposits, separated by laboratory (Figure 11-33 to Figure 11-36). For pulp duplicates, GE21 adopts HARD accuracy greater than 5% as acceptance limits for more than 90% of samples.

The QP validated the pulp duplicate and found them acceptable in 2021 to 2023 campaign.



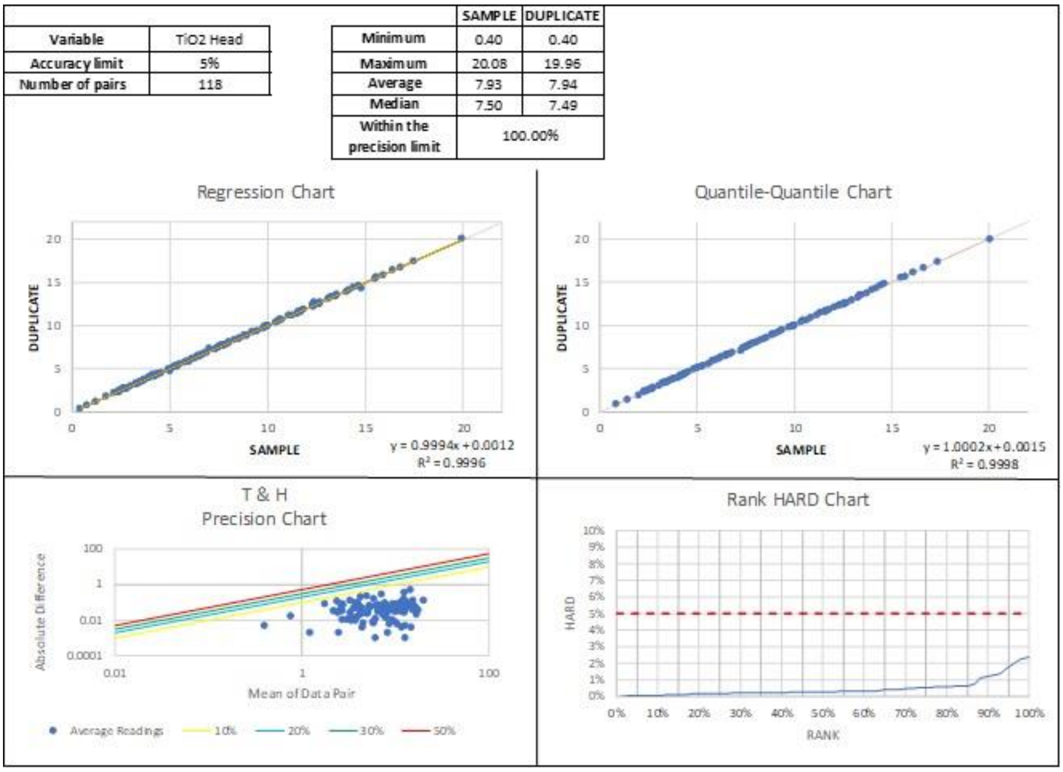
| Variable | V2O5 Head |
|---|---|
| Accuracy limit | 5% |
| Number of pairs | 118 |

| | SAMPLE | DUPLICATE |
|---|---|---|
| Minimum | 0.00 | 0.00 |
| Maximum | 1.70 | 1.71 |
| Average | 0.47 | 0.47 |
| Median | 0.36 | 0.36 |
| Within the precision limit | 94.07% | |



**Figure 11-33 – Duplicates – Laboratory: Largo – $V_2O_5$**

Source: GE21, 2024.



| Variable | TiO2 Head |
|---|---|
| Accuracy limit | 5% |
| Number of pairs | 118 |

| | SAMPLE | DUPLICATE |
|---|---|---|
| Minimum | 0.40 | 0.40 |
| Maximum | 20.08 | 19.96 |
| Average | 7.93 | 7.94 |
| Median | 7.50 | 7.49 |
| Within the precision limit | 100.00% | |



**Figure 11-34 – Duplicates – Laboratory: Largo – $TiO_2$**

Source: GE21, 2024.

| Variable | V2O5 Head |
|---|---|
| Accuracy limit | 5% |
| Number of pairs | 534 |

| | SAMPLE | DUPLICATE |
|---|---|---|
| Minimum | 0.01 | 0.01 |
| Maximum | 2.56 | 2.50 |
| Average | 0.26 | 0.26 |
| Median | 0.16 | 0.16 |
| Within the precision limit | 85.39% | |

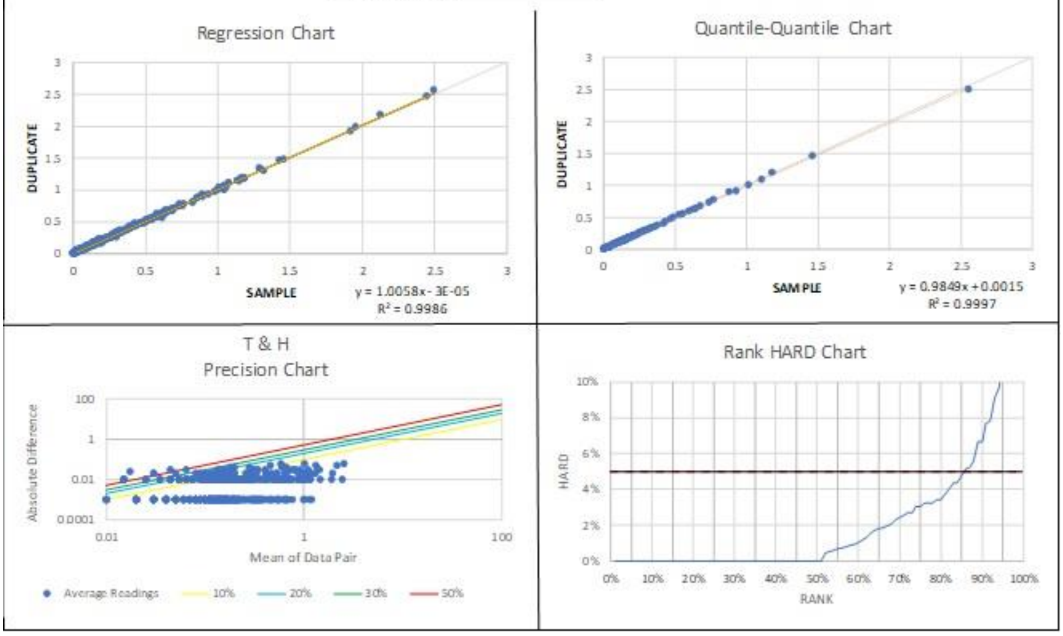



**Figure 11-35 – Duplicates – Laboratory: SGS – $V_2O_5$**

Source: GE21, 2024.

| Variable | TiO2 Head |
|---|---|
| Accuracy limit | 5% |
| Number of pairs | 534 |

| | SAMPLE | DUPLICATE |
|---|---|---|
| Minimum | 0.02 | 0.01 |
| Maximum | 20.40 | 20.50 |
| Average | 4.68 | 4.68 |
| Median | 3.09 | 3.09 |
| Within the precision limit | 97.38% | |

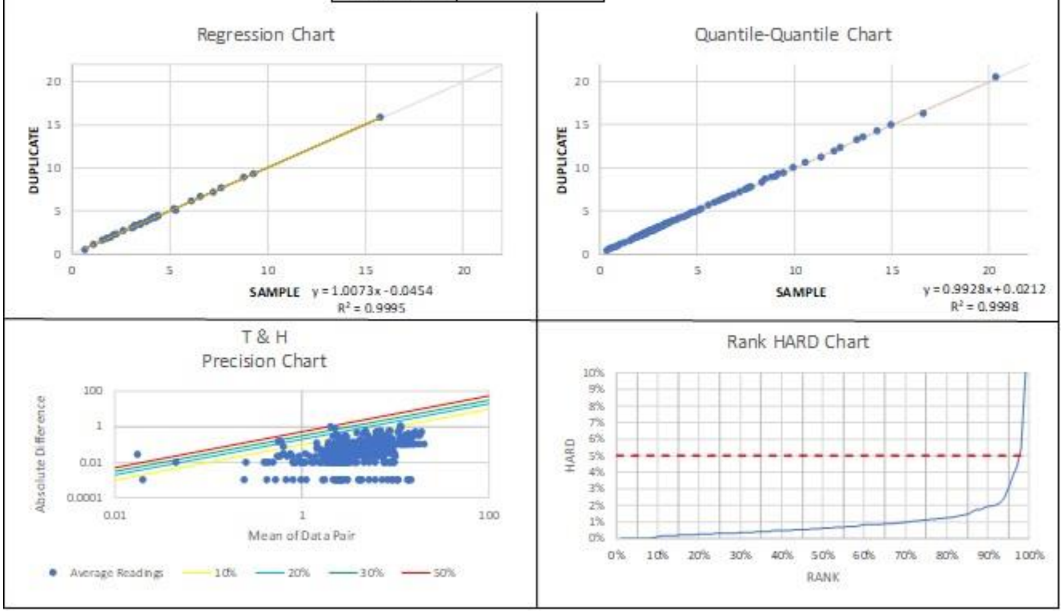



**Figure 11-36 – Duplicates – Laboratory: SGS – $TiO_2$**

Source: GE21, 2024.

*11.4.7.4 2021 and 2023 GE21 Considerations*

The QP makes the following comments based on the 2021 and 2023 QA/QC analysis.

- The values of the standard LCV-GEOSOL-V2015 and Largo Standard 2018 HG for $V_2O_5$% analyzed normally were above the reference value, close to +3SD. This bias does not compromise the sample values but draws attention to the reasons for this change and the measures not to occur in future campaigns.
- In GAN, the high % $V_2O_5$ (GEOSOL and internal Largo) standards showed an improvement in relation to the difference with the reference value from 2019 to 2020.
- The quality of the campaign results from 2021 to 2023 was considered acceptable.

***11.4.8 Qualified Person's Opinion***

In the opinion of the QP, the sampling methods are acceptable, consistent with industry-standard practice, and adequate for Mineral Resource and Mineral Reserve estimation purposes, based on the following:

- The QP has reviewed all historic documents and believes that the observations and conclusions drawn by the authors of the previous reports are valid and are acceptable for use in Mineral Resource and Mineral Reserve Estimation.
- Data are collected following company-approved sampling protocols.
- Sampling has been performed in accordance with industry-standard practices.
- Sample intervals of approximately 1 m for core drilling, broken at lithological and mineralization changes in the core, are typical of sample intervals used for VTM-style mineralization and are consistent with proven results from Campbell Pit production.
- Sampling is representative of the true thicknesses of mineralization. Not all drill core is sampled; sampling depends on location in the stratigraphic sequence and logging of visible magnetite mineralization and non-mineralised intervals based on geological units.
- The specific gravity determination procedure is consistent with industry-standard procedures. There are sufficient specific gravity determinations to support the specific gravity values used in tonnage estimates.
- Preparation and analytical procedures are in line with industry-standard methods for VTM-style mineralization and are suitable for the deposit type.
- The QA/QC program, comprising a blank, CRM, and duplicate samples, meets QA/QC submission rates and industry-accepted standards.
- Sample security has relied upon the fact that the samples were always attended or locked in the on-site sample preparation facility. The chain-of-custody procedure consists of filling out sample submittal forms that are sent to the laboratory with sample shipments to ensure that all samples are received by the laboratory.
- Current sample-storage procedures and storage areas are consistent with industry standards.

- SGS Geosol Laboratories Ltda., ALS Laboratories, both located in Vespasiano, MG, and Intertek, located in Cotia, SP, are fully independent of Largo Inc. These laboratories are renowned for their certifications that ensure excellence in chemical and geotechnical analysis services. SGS Geosol holds ISO 9001, which guarantees the standardization of quality management processes, and ISO 17025, which certifies its technical competence to perform tests and calibrations. Additionally, it is certified to ISO 14001, demonstrating a commitment to responsible environmental practices. Similarly, ALS Laboratories is recognized for its certifications, including ISO 9001, which ensures the quality of its processes, and ISO 17025, which guarantees the accuracy and reliability of its results. ALS also holds ISO 14001 certification, highlighting its commitment to sustainability and good environmental practices. Intertek is likewise accredited with ISO 9001 and ISO 17025, emphasizing its dedication to high-quality service delivery and technical competence in various testing and inspection services, including those related to environmental and safety standards.

# 12 DATA VERIFICATION

## 12.1 Site Visit

The QPs have conducted periodic field visits to the Largo Operations since 2017 to personally inspect the site infrastructure, the procedures used in data collection to Mineral Resource and Reserve estimation, and the results obtained from activities conducted by the Largo team.

The most recent visits conducted by the QP team are listed below:

- The Mining Engineer Porfírio Rodriguez and Geologist Fábio Xavier visited the site from February 6 to 10, 2023.
- Mr. Xavier and Mining Engineer Guilherme Gomides visited the site on January 23 and 24, 2024.
- Mr. Rodriguez and Mining Engineer Paulo Bergmann visited the site on March 13 and 14, 2024.

They were accompanied by the Largo team responsible for providing the information necessary to develop this Report. Below are descriptions of some items observed during the site visit.

## 12.2 Topographic Survey

The Project uses the UTM Projection – Zone 24 South and Datum SIRGAS2000 as a cartographic reference.

Largo used a millimeter precision GPS with RTK for the final drill hole collar location. The topography of the open pit is updated via Drone with a frequency of 3 times per week. The topography covers the entire open pit.

## 12.3 Drilling

There are operational procedures for all drilling phases. A geologist conducts geological and geotechnical descriptions. The magnetic susceptibility is measured each 25 cm along the core downhole and data are stored in a excel database for each drill hole. Prior of geological description geologist used portable magnetometer to help define the contacts of the magnetic lithologies.

A total of 15 holes were checked in the field. The location and the main information observed are consistent with the official database.

Logging and sampling are captured on handwritten drill logs and transferred digitally to a main database.

### 12.3.1 Drilling Database

In 2023, Largo conducted a review of the historical drilling database and re-sampled cores from previous campaigns (historical data).

The database review was conducted concurrently with the implementation of the MX Deposit drilling database management system by Seequent. During this process, existing drilling information was validated through checks with topography, verification of geological descriptions in drill cores, and review of analytical results in laboratory certificates. The validation was performed by Largo and GE21.

During the review of the drilling database, intervals of host lithologies for the mineralization were identified that had either not been sampled or had incomplete chemical information. An analytical Postmortem campaign was conducted with the aim of completing the chemical analyses for these intervals in the database. A total of 5,097 samples were collected during this campaign.

### 12.3.2 Core Shed

Core Shed is located into central office and shows good conditions to store the core samples. Largo informed to the QP that will build new core shed more adequate in future. Figure 12-1 shows the infrastructure of the core shed.

**Figure 12-1 – Core shed infrastructure**

Source: GE21, 2024.

The core shed is clean and well organized. There are rooms to support geologists (computer, printer, etc.) and appropriate places for the description, sampling, and core split activities. There is space to store core boxes and lab reject samples.

#### *12.3.3 QA/QC*

Largo has a QA/QC program that has been modified throughout the drilling campaigns. Currently, the QA/QC is governed by a standard procedure detailed in Section 11.

#### *12.3.4 Density*

Density was calculated using a Jolly balance by the Largo team (pre-2020) and using a pycnometer in an external laboratory (2020). Since 2023, the Jolly balance is the standard procedure.

Density tests were not conducted in weathered rock by the geology team.

#### *12.3.5 Internal Laboratory*

The Largo internal laboratory is used to analyze samples from the mine operation (grade control) and plant. The samples from exploration drilling are analyzed in a certified external laboratory (SGS-Geosol or ALS Geochemistry).

The internal laboratory is in the process of ISO 9001 certification (scheduling external visit to auditing) and has internal system for managing operational procedures.

The procedures for traceability of samples in the laboratory and reported analyzes are in the process of automation.

The Largo laboratory participates in the material certification (CRM) process through a CSIRO program. The laboratory has quality control, within industry standards, based on control tools such as the insertion of Blank control samples, Duplicates and Standards, as well as a check in a certified external laboratory.

#### *12.3.6 Ilmenite Concentration and Pigment Plant*

A site visit was held on March 11$^{th}$, 2024, to the Campbell Pit in Maracás, BA and, in the sequence, in the pilot plant situated in Salvador, capital of the state.

The purpose of the visit, attended by the QPs Porfírio Cabaleiro, FAIG, and Paulo Bergmann, FAusIMM, was to collect information regarding the ilmenite concentration and proposed Pigment Plant and inspect installations and check procedures. Conversations with the Largo's team has clarified some aspects of the Project.

The Ilmenite Plant was working properly, achieving good performance and high-quality concentrate, based on good engineering practices (Figure 12-2).

**Figure 12-2 – Ilmenite Concentration Plant – Flotation**

Source: GE21, 2024.

The concentrate of ilmenite is sent to a pilot plant constructed in a Center of Technology – CIMATED – for developing of technology for pigment production, led by Largo's team and consultants. The pilot plant is producing a high-quality pigment, comparable to the better producers in Brazil. The process is still proprietary and will be detailed as soon as patented (Figure 12-3 and Figure 12-4).


**Figure 12-3 – Pilot plant installation, for pigment product in CIMATEC, Salvador**

Source: GE21, 2024.


**Figure 12-4 – Pilot plant products by step for pigment production**

Source: GE21, 2024.

## 12.4 Qualified Person's Opinion

The exploration QP has reviewed the historical documents regarding the pre-2015 exploration history and believes that the procedures and database are suitable for use in the Mineral Resource Estimate.

After consolidating and understanding all the received data, including data acquisition procedures, analytical results (chemical results and geophysical survey points), and their corresponding quality control programs, the technical reviewer considers that the data is appropriate for the Mineral Resource estimate.

The engineering QPs have had full access to the mining and concentration plan in Maracás and to the Pigment Pilot Plant in Camaçari. They have found the data related to the mining operation and concentration plant operation to be reliable and appropriate for declaring Mineral Reserves for vanadium and ilmenite. The visit to the Pilot Plant in Camaçari was important to clarify the pigment process and ensure that Largo is capable and possesses the necessary technological knowledge to produce commercial $TiO_2$ pigment. There were no limitations to the checks conducted by the QPs.

# 13 MINERAL PROCESSING AND METALLURGICAL TESTING

## 13.1 Introduction

The vanadium recovery plant for the ore extracted from Campbell Pit located in Maracás (BA) was based on extensive process development tests conducted between 1986 and 2010. A detailed description of the plant is provided in the GE21 report titled **Maracás Menchen Project, Bahia, Brazil**, prepared in May 2017 and issued in October of the same year. This Independent Technical Report, prepared by GE21 Ltd on behalf of Largo Resources Ltd, includes an updated mine plan, Mineral Reserve, and preliminary economic assessment of the inferred Mineral Resources. The report is filed on SEDAR.

## 13.2 Process Technical and Economical References

In the GE21 2017 report, data and information from the following reports were examined:

- Lurgi, **Feasibility Study, Maracás Vanadium Project, prepared for Pedreiras Valeria Ltda., Salvador/Bahia, Brazi**l, May 1986.
- Rautaruukki Oy Tutkimuskeskus Research Centre, **Laboratory Research of the Suitability of the Otankäki Process for Extracting Vanadium from Maracás Ore**, December 1989.
- Engenharia e Consultoria Mineral S.A., **Projeto Vanádio de Maracás Projecto Conceitual e Estimativa de Investimento, Produção: 4,500 t/a de $V_2O_5$**, September 1990.
- IMS Processing plant, **Vanádio de Maracás Ltda., Vanadium Pentoxide Production Plant**, 1990.
- SGS Minerals Services, **The Beneficiation Characteristics of Samples from the Vanádio de Maracás Deposit**, November 2007.
- SGS Minerals Services, **Recovery of Vanadium from the Maracás Ore Deposit**, April 2008.
- SGS Minerals Services, **The Solid-Liquid Separation of the Maracás Ore Deposit**, July 2008.
- Vendors' budgetary quotes.
- Largo Resources Ltd (Les Ford), **Pilot Plant Testing of Maracás Magnetite Ore**, October 2010.
- Ausenco Minerals and Metals, **Conceptual design of alternatives for non-magnetic tailings deposition**, September 2010.

The primary focus of the 2017 GE21 Technical Report was to conduct a preliminary feasibility study to produce vanadium concentrate from the Gulçari A deposit, now referred to as the Campbell Pit.

The main objective of this Report is to update the Mineral Resources and Reserves of the Campbell Pit, considering the positive impact of the ilmenite concentrate production through the utilization of tailings from the vanadium concentrate production plant, and to update the mine plan accordingly. Additionally, of significant importance to this Report was the evaluation of the GAN, NAN, SJO and NAO deposits for vanadium and titanium recovery, utilizing the existing or potential new plant infrastructure, as necessary.

The following process test reports for vanadium and titanium recovery were assessed:

- Recuperação de Titânio do Minério do Campbell Pit – Novembro 2020 – Gerência Técnica – Largo Resources – Mineração Menchen da Vanádio Maracás (Titanium Recovery from Campbell Pit Ore – November 2020 – Technical Management – Largo Resources – Menchen Mining by Vanádio Maracás).
- Recuperação Metalúrgica do Depósito Gulçari A Norte – Janeiro 2021 – Gerência Técnica – Largo Resources – Mineração Menchen da Vanádio Maracás (Metallurgical Recovery of the Gulçari A Norte Deposit – January 2021 – Technical Management – Largo Resources – Menchen Mining of Vanádio Maracás).
- Recuperação Metalúrgica do Minério de Novo Amparo Norte – Agosto 2020 – Gerência de Processos Largo Resources – Mineração Menchen da Vanádio Maracás (Metallurgical Recovery of Novo Amparo Norte Ore – August 2020 – Largo Resources Process Management – Menchen Mining of Vanádio Maracás).

## 13.3 Metallurgical Recovery of Vanadium and Titanium from Ore at Campbell Pit

The tests were conducted on lithologies MAG01, MAG02 and MP01, currently mined in Campbell Pit, located in the municipality of Maracás, Bahia. This test work revealed that the titanium present in the deposit is associated with ilmenite, enabling a recovery of approximately 75% from the wet non-magnetitic concentrate (through desliming and flotation recoveries), with an overall recovery from the mined material of about 51%. The tests were performed at the SGS Geosol laboratory in Belo Horizonte, Brazil, and Largo laboratories on the mine site during the period from March to October 2020. Table 13-1 below summarizes the expected recoveries per separation process.

**Table 13-1 – Summary of Results – $TiO_2$ Recovery per unit operation – Campbell Pit**

| Area / Process | Recovery of $TiO_2$ (%) | | |
|---|---|---|---|
| | Top Zone* | Bottom Zone** | Average |
| Crushing / Dry Magnetic Concentration | 97.9 | 98.0 | 98.0 |
| Grinding / Wet Magnetic Concentration | 69.2 | 69.2 | 69.2 |
| Desliming | 95.3 | 91.3 | 93.2 |
| Flotation | 80.4 | 81.3 | 80.9 |
| Global | 51.9 | 50.3 | 51.1 |

Note:
1. Top Zone* (or Upper Zone) refers to elevation above 120 m, while Bottom Zone** (or Lower Zone) refers to elevations below 120 m in the deposit.

Source: Largo, 2021.

### 13.3.1 Sample Characterization – Campbell Pit

Sample material was derived from drill core and was split into two sections, one for testing purposes and the remaining sample was kept for reference. The samples were then separated for metallurgical testing by lithology and zone forming six large samples, A2, A4, A6, A7, A8 and A9. Table 13-2 indicates what each sample represents.

**Table 13-2 – Lithologies of Samples – Campbell Pit**

| Sample | Description | |
|---|---|---|
| | Lithology | Zone |
| **A2** | MAG01 | Bottom |
| **A4** | MAG02 | Bottom |
| **A6** | MP01 | Bottom |
| **A7** | MAG01 | Top |
| **A8** | MAG02 | Top |
| **A9** | MP01 | Top |

Source: Largo, 2024.

The chemical characterization of the samples was conducted using X-ray fluorescence with the use of borate fused beads. The percentage of magnetics was determined using a Davis Tube with a field strength of 1,500 Gauss, and the loss on ignition in a muffle furnace. The results of these analyses are detailed in Table 13-3 below.

**Table 13-3 – Chemical Analysis of Samples – Campbell Pit**

| Sample | Grade (%) | | | | | | | | Magnetic (%) | LOI (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | | |
| **A2** | 2.03 | 10.20 | 2.54 | 65.50 | 1.94 | 5.38 | 13.50 | 0.01 | 59.4 | -1.96 |
| **A4** | 1.69 | 15.80 | 3.25 | 59.30 | 4.33 | 4.79 | 11.40 | 0.01 | 50.4 | -2.02 |
| **A6** | 1.11 | 26.60 | 4.88 | 46.00 | 7.32 | 6.07 | 7.99 | 0.01 | 31.7 | -1.17 |
| **A7** | 2.05 | 9.82 | 2.50 | 66.60 | 1.83 | 5.28 | 13.60 | 0.01 | 59.7 | -2.24 |
| **A8** | 1.53 | 19.20 | 2.84 | 56.30 | 5.01 | 6.35 | 10.60 | 0.01 | 46.8 | -1.77 |
| **A9** | 0.91 | 33.00 | 4.16 | 39.00 | 9.50 | 8.52 | 5.83 | 0.01 | 25.9 | -0.91 |

Source: Largo, 2024.

### 13.3.2 Dry Magnetic Separation – Campbell Pit

Dry Magnetic Separation tests were conducted on sample A6 and A9 using a 1,500 Gauss drum magnetic separator, operating at 33 rpm and fed at a rate of 1.4 kg/min. For each concentration test, the mass, contents, and percentage of magnetic feed, concentrate (magnetic fraction), and tailings (non-magnetic fraction) were measured. Dry concentration tests were not conducted for the other samples as their magnetic concentration exceeds 40%, meeting the current requirements of the wet magnetic concentration process at the VMSA plant. The contents were analyzed using X-ray fluorescence with the use of borate fused beads, and the percentage magnetics wase measured using a Davis Tube with a field strength intensity of 1,500 Gauss. Table 13-4 presents a summary of the results of Dry Magnetic Separation.

**Table 13-4 – Summary of Results – Dry Magnetic Separation – Campbell Pit**

| Sample | % Magnetic | | | Magnetic Recovery (%) | Mass Recovery (%) | Enrichment |
|---|---|---|---|---|---|---|
| | Feed | Concentrate | Tailings | | | |
| A6 | 31.7 | 35.6 | 1.2 | 99.6 | 89.0 | 1.10 |
| A9 | 25.9 | 28.9 | 4.7 | 97.8 | 90.0 | 1.10 |
| Sample | $TiO_2$ (%) | | | Recovery $TiO_2$ (%) | Mass Recovery (%) | Enrichment |
| | Feed | Concentrate | Tailings | | | |
| A6 | 8.04 | 8.59 | 4.04 | 93.9 | 89.0 | 1.07 |
| A9 | 5.76 | 6.17 | 2.02 | 96.5 | 90.0 | 1.07 |

Source: Largo, 2024.

Based on the results in Table 13-4, a titanium recovery of 93.9% for sample A6 and 96.5% for sample A9 was estimated. With these results and the proportions of each ore body in the Gulçari A deposit, the titanium recovery for the upper and lower zones of the deposit can be estimated, as shown in Table 13-5 below.

**Table 13-5 – Top and Bottom Zones – Dry Magnetic Separation Recoveries – Campbell Pit**

| Sample | $TiO_2$ (%) | | | Recovery (%) | | Proportion (%) | |
|---|---|---|---|---|---|---|---|
| | Feed | Concentrate | Tailings | $TiO_2$ | Mass | In Deposit | In Blend C |
| A7 (Top Zone) | 5.28 | 5.28 | - | 100.0 | 100.0 | 12.3 | 31.0 |
| A8 (Top Zone) | 6.35 | 6.35 | - | 100.0 | 100.0 | 3.8 | 10.0 |
| A9 (Top Zone) | 5.76 | 6.17 | 2.02 | 96.5 | 90.0 | 25.6 | 59.0 |
| Total (Top Zone) | 5.70 | 5.90 | 2.02 | 97.9 | 94.0 | 41.7 | 100.0 |
| Sample | Feed | Concentrate | Tailings | $TiO_2$ | Mass | In Deposit | In Blend B |
| A2 (Bottom Zone) | 13.50 | 13.50 | - | 100.0 | 100.0 | 15.8 | 38.0 |
| A4 (Bottom Zone) | 11.40 | 11.40 | - | 100.0 | 100.0 | 6.7 | 17.0 |
| A6 (Bottom Zone) | 8.04 | 8.59 | 4.04 | 93.9 | 89.0 | 21.7 | 45.0 |
| Total (Bottom Zone) | 10.50 | 10.93 | 4.04 | 98.0 | 94.1 | 44.2 | 100.0 |

Source: Largo, 2024.

### *13.3.3 Wet Magnetic Separation – Campbell Pit*

Largo's production process incorporates a grinding circuit, which is responsible for liberating magnetite minerals. This circuit is integrated with wet magnetic separation in open circuit low-field magnetic separators, featuring one rougher step and two cleaner steps. The same concentration method was employed on a laboratory scale to evaluate the behavior of two samples composed of blends.

For the wet magnetic concentration tests, samples A2, A4, A7, and A8 were utilized, along with the concentrates of the dry magnetic separation tests of the A6 and A9 lithologies, designated as PCA6 and PCA9. To prepare for the wet magnetic concentration tests, two samples were created by blending samples from the upper zone (A7, A8, and PCA9) and the samples from the lower zone (A2, A4, and PCA6), proportionally to the composition found in the Gulçari A deposit. Table 13-6 displays the proportions used for the blends in the lower and upper zones, referred to as blends B and C, respectively.

Table 13-6 presents the chemical analysis of both blends.

**Table 13-6 – Proportions – Blend B and C – Campbell Pit**

| Sample | A2 | A4 | PCA6 | Blend B |
|---|---|---|---|---|
| % in Deposit (%) | 16.0 | 7.0 | 19.3 | 42.0 |
| % in Blend B (%) | 38.0 | 17.0 | 45.0 | 100.0 |
| **Sample** | **A7** | **A8** | **PCA9** | **Blend C** |
| % in Deposit (%) | 12.0 | 4.0 | 23.0 | 39.0 |
| % in Blend C (%) | 31.0 | 10.0 | 59.0 | 100.0 |

Source: Largo, 2024.

**Table 13-7 – Chemical Analysis – Blend B and C – Campbell Pit**

| Sample | Grade (%) | | | | | | | | Magnetic (%) | LOI (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | | |
| **Blend B** | 1,63 | 17,7 | 3,56 | 57,5 | 4,61 | 5,36 | 11,0 | 0,01 | 48,7 | -1,79 |
| **Blend C** | 1,47 | 21,9 | 3,11 | 52,6 | 5,78 | 6,38 | 9,35 | 0,01 | 41,6 | 1,58 |

Source: Largo, 2024.

Blend B and Blend C samples (Table 13-8) were utilized to conduct the wet magnetic concentration tests employing a 1,500 Gauss drum magnetic separator. The material was combined with water, creating a pulp with 30% solids by weight, which was then introduced into the magnetic separator.

**Table 13-8 – Summary of Results – Wet Magnetic Separation – Blend B and C – Campbell Pit**

| Sample | Magnetic (%) | | | Recovery (%) | |
|---|---|---|---|---|---|
| | Feed | Concentrate | Tailings | Magnetic | Mass |
| **Blend B** | 48.7 | 97.7 | - | 96.7 | 48.2 |
| **Blend C** | 41.6 | 95.8 | 0.8 | 98.9 | 44.0 |
| **Sample** | **$TiO_2$ (%)** | | | **Recovery (%)** | |
| | **Feed** | **Concentrate (Magnetic)** | **Tailings (non-magnetic)** | **$TiO_2$** | **Mass** |
| **Blend B** | 11.00 | 6.83 | 14.30 | 69.2 | 52.8 |
| **Blend C** | 9.60 | 6.68 | 11.80 | 69.2 | 56.0 |

Source: Largo, 2024.

### *13.3.4 Flotation – Campbell Pit*

After conducting the wet magnetic concentration tests with blends B and C as described earlier in this Report, two samples of non-magnetic tailings were generated. These samples were respectively designated as RNM B and RNM C. All samples underwent chemical characterization using X-ray fluorescence analysis with Panalytical's XRF Magix Fast equipment, employing borate fused beads. Table 13-9 displays the results of the chemical analysis of samples RNM B and RNM C.

**Table 13-9 – Chemical Analysis – Wet Non-Magnetic Blend B and C – Campbell Pit**

| Sample | Grade (%) | | | | | | | | LOI (%) |
|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | |
| **RNM B** | 0.22 | 32.80 | 5.27 | 27.80 | 8.61 | 9.59 | 14.30 | 0.01 | -0.08 |
| **RNM C** | 0.18 | 37.50 | 4.44 | 25.10 | 10.20 | 11.30 | 11.80 | 0.01 | 0.21 |

Source: Largo, 2024.

The flotation tests with the two samples were conducted at the SGS GEOSOL laboratory in Brazil, utilizing Flotinor 10068 reagents (a Clariant industrial mixture containing carboxylic acids) as a collector, DP-OMC-1178 (a non-ionic polymer by BASF) as a co-collector, and fluosilicic acid (H2SiF6) for pH regulation to 4. All tests were exclusively performed on the fraction retained in 10 µm of samples RNM B and RNM C.

Desliming at 10 µm was conducted using a hydrocyclone. The product underflow and the slurry (overflow) of each sample were analyzed using Panalytical's XRF Magix Fast equipment with the use of borate fused beads. Table 13-10 presents the results obtained in the desliming of non-magnetic (RNM B and RNM C) samples from blends B and C.

**Table 13-10 – Desliming Results – Wet Non-Magnetic Blend B and C – Campbell Pit**

| Sample | Flux | $TiO_2$ (%) | Recovery $TiO_2$ (%) | Mass Recovery (%) |
|---|---|---|---|---|
| RNM B | Feed | 14.30 | 93.0 | 91.3 |
| | Underflow | 14.60 | | |
| | Overflow | 11.40 | | |
| RNM C | Feed | 11.70 | 95.3 | 93.8 |
| | Underflow | 11.90 | | |
| | Overflow | 8.90 | | |

Source: Largo, 2024.

In the flotation process, a Denver D12 bench flotation machine equipped with 2.5 l tanks, 2 l/min air flow, and 1,000 rpm rotation was utilized. All generated products were analyzed using Panalytical's XRF Magix Fast equipment with the use of borate fused beads.

For all tests, a 10-minute attrition step at 50% solids was applied, followed by a 2-minute preconditioning with fluorosilicic acid and the reagent DP-OMC-1178, which was uniquely added during this step. The Flotinor 10068 collector, however, was dosed in a staged manner, with the addition divided equally between each of the conditioning steps preceding the froth collections. For example, a test with a dosage of 200 g/t of collector in 4 conditioning stages had the addition of 50 g/t in each stage.

Table 13-11 presents the titanium content and recoveries obtained in the flotation for each collection stage. The results are cumulative, meaning that the grade and recovery indicated in the table for the second collection represent the mass of the first collection plus the second collection, and so forth.

**Table 13-11 – Flotation Results – Blend B and C – Campbell Pit**

| Sample | Test | Reagent Concentration (g/t) | | Collect | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|---|---|
| | | Flotinor 10068 | DP-OMC-1178 | | | |
| RNM B | 2A | 200 | 400 | 1 | 42.40 | 66.3 |
| | | | | 2 | 41.10 | 76.1 |
| | | | | 3 | 40.10 | 80.4 |
| | 2B | 200 | 400 | 1 | 41.80 | 67.5 |
| | | | | 2 | 40.60 | 77.6 |
| | | | | 3 | 39.50 | 82.3 |
| RNM C | 7A | 200 | 400 | 1 | 41.40 | 60.8 |
| | | | | 2 | 40.00 | 74.5 |
| | | | | 3 | 38.60 | 80.3 |
| | 7B | 200 | 400 | 1 | 38.60 | 60.4 |
| | | | | 2 | 36.70 | 76.0 |
| | | | | 3 | 35.20 | 83.0 |
| | 8A | 200 | 200 | 1 | 41.20 | 61.5 |
| | | | | 2 | 39.80 | 79.6 |
| | | | | 3 | 38.70 | 83.1 |
| | 8B | 200 | 200 | 1 | 43.40 | 59.4 |
| | | | | 2 | 41.80 | 78.5 |
| | | | | 3 | 40.90 | 81.6 |
| RNM B | Average - Collect 3 | | | 3 | 39.80 | 81.3 |
| RNM C | Average - Collect 3 | | | 3 | 39.80 | 80.4 |

Source: Largo, 2024.

The average of the results from the third collection suggests that the flotation step can achieve a titanium dioxide ($TiO_2$) recovery of over 80%, generating a concentrate with approximately 40% $TiO_2$.

### *13.3.5 Global Recovery of Titanium – Pit Campbell*

Global recovery of titanium is calculated by multiplying all sequential recoveries of the proposed process route, including dry crushing / magnetic separation recovery, wet grinding / magnetic separation recovery, desliming recovery, and flotation recovery. The formula for global recovery is:

$$R_{Global} = R_{crushing} \times R_{grinding} \times R_{Desliming} \times R_{Flotation}$$

Table 13-12 provides a summary of titanium recoveries obtained in the dry magnetic concentration, wet magnetic concentration, desliming, and flotation steps.

**Table 13-12 – Summary of Results – Global Recovery of $TiO_2$ – Campbell Pit**

| Area / Process | Recovery (%) | | |
|---|---|---|---|
| | Top Zone | Bottom Zone | Average |
| Crushing / Dry Magnetic Concentration | 97.9 | 98.0 | 98.0 |
| Grinding / Wet Magnetic Concentration | 69.2 | 69.2 | 69.2 |
| Desliming | 95.3 | 91.3 | 93.2 |
| Flotation | 80.4 | 81.3 | 80.9 |
| Global | 51.9 | 50.3 | 51.1 |

Source: Largo, 2024.

Based on the provided information, it is indeed possible to recover 51% of the titanium present in the Gulçari A deposit. This recovery would result in the production of an ilmenite concentrate containing 42% $TiO_2$, which meets the minimum requirement for its most probable application, pigment manufacturing.

## 13.4 Metallurgical Recovery of Vanadium and Titanium of Ore from Gulçari A Norte (GAN)

The metallurgical recovery test program for the Gulçari A Norte (GAN) deposit was conducted by MinPro Solutions, the Technological Characterization Laboratory at USP (Universidade de São Paulo), and at the VMSA laboratory from June to November 2020. The tests involved GAN samples 1 through 8, representing the Magnetite, Magnetite-Pyroxenite, and Magnetite-Gabbro lithologies of the Gulçari A Norte deposit.

The tests revealed that the vanadium present in this deposit is associated with magnetite and can be recovered using the same beneficiation process currently employed at the Maracás Menchen Mine. Additionally, the tests indicated that the titanium present in this deposit is associated with ilmenite and can be recovered using flotation. The summarized results are presented in Table 13-13 and Table 13-14 below.

**Table 13-13 – Summary of $V_2O_5$ Recoveries – Gulçari A Norte (GAN)**

| Area / Process | Recovery per Sample $V_2O_5$ (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Crushing / Dry Magnetic Concentration | 95.2 | 97.4 | 97.3 | 97.2 | 100.0 | 100.0 | 98.7 | 96. 9 |
| Grinding / Wet Magnetic Concentration | 99.8 | 99.9 | 99.9 | 99.9 | 98.2 | 99.9 | 99.9 | 99.9 |
| Calcination | 85.0 | 86.8 | 83.8 | 82.5 | - | 84.7 | 67.3 | 73.6 |
| Leaching | 96.8 | 96.8 | 96.8 | 96.8 | - | 96.8 | 96.8 | 96.8 |
| Chemical Plant / Purification and Precipitation | 96.8 | 96.8 | 96.8 | 96.8 | - | 96.8 | 96.8 | 96.8 |
| Global | 75.7 | 79.1 | 76.3 | 75.1 | - | 79.3 | 62.2 | 66.8 |

Source: Largo, 2024.

**Table 13-14 – Summary of $TiO_2$ Recoveries – Gulçari A Norte (GAN)**

| Area / Process | Recovery per Sample $TiO_2$ (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Crushing / Dry Magnetic Concentration | 59.7 | 62.2 | 50.9 | 68.5 | 100.0 | 100.0 | 63.2 | 65.0 |
| Grinding / Wet Magnetic Concentration | 77.5 | 76.0 | 79.8 | 83.1 | 94.7 | 75.8 | 78.0 | 79.5 |
| Desliming | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 |
| Flotation | 88.6 | 94.1 | 92.5 | 82.2 | 83.5 | 98.3 | 96.1 | 89.7 |
| Global | 31.8 | 34.5 | 29.1 | 36.3 | 61.3 | 57.7 | 36.7 | 35.9 |

Source: Largo, 2024.

It should be noted that no vanadium recovery tests were conducted for sample GAN 5 due to its vanadium content being less than 0.10%.

### *13.4.1 Sample Characterization – Gulçari A Norte (GAN)*

Table 13-15 presents the chemical analysis of the lithologies of the samples used for the tests.

**Table 13-15 – Chemical Analysis of Lithologies (GAN)**

| Sample | | Chemical Analysis (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Magnetic Fraction | $V_2O_5$ | $TiO_2$ | Fe | $SiO_2$ | $Al_2O_3$ | P | $Cr_2O_3$ |
| Magnetite Layer C5 | A | 14.0 | 0.94 | 8.10 | 32.70 | 26.30 | 8.83 | 0.03 | <0.10 |
| | B | 13.0 | 0.93 | 8.10 | 32.70 | 26.30 | 8.74 | 0.02 | <0.10 |
| Magnetite Layer C6 | A | 16.0 | 0.64 | 5.30 | 23.60 | 35.20 | 11.80 | 0.02 | <0.10 |
| | B | 17.0 | 0.65 | 5.30 | 23.80 | 35.30 | 11.80 | 0.02 | <0.10 |
| Magnetite Layer C8 | A | 51.0 | 0.69 | 15.20 | 45.20 | 11.90 | 5.64 | 0.03 | <0.10 |
| | B | 51.0 | 0.69 | 15.20 | 45.00 | 11.80 | 5.57 | 0.03 | <0.10 |
| Magnetite-Pyroxenite C4 | A | 26.0 | 1.13 | 7.20 | 31.70 | 26.40 | 8.55 | 0.01 | <0.10 |
| | B | 27.0 | 1.14 | 7.20 | 31.70 | 26.50 | 8.57 | 0.01 | <0.10 |
| Magnetite-Pyroxenite C5 | A | 18.0 | 0.58 | 7.80 | 32.10 | 26.50 | 8.30 | 0.02 | <0.10 |
| | B | 23.0 | 0.58 | 7.80 | 32.20 | 26.70 | 8.37 | 0.02 | <0.10 |
| Magnetite-Pyroxenite C7 | A | 9.0 | 0.02 | 6.20 | 30.00 | 33.90 | 7.35 | 0.21 | <0.10 |
| | B | 11.0 | 0.02 | 6.30 | 29.90 | 34.00 | 7.43 | 0.21 | <0.10 |
| Magnetite-Gabbro C4 | A | 22.0 | 0.98 | 6.80 | 27.80 | 29.30 | 12.50 | 0.02 | <0.10 |
| | B | 24.0 | 0.99 | 6.80 | 27.70 | 29.00 | 12.50 | 0.02 | <0.10 |
| Magnetite-Gabbro C5 | A | 37.0 | 1.02 | 12.20 | 40.20 | 17.20 | 7.34 | 0.03 | <0.10 |
| | B | 37.0 | 1.02 | 12.10 | 40.00 | 17.20 | 7.31 | 0.03 | <0.10 |
| Magnetite-Gabbro C6 | A | 27.0 | 0.67 | 10.50 | 35.80 | 22.80 | 8.55 | 0.04 | <0.10 |
| | B | 28.0 | 0.67 | 10.60 | 35.80 | 22.90 | 8.63 | 0.04 | <0.10 |
| Magnetite-Gabbro C8 | A | 21.0 | 0.32 | 9.70 | 29.60 | 28.20 | 11.10 | 0.03 | <0.10 |
| | B | 22.0 | 0.32 | 9.70 | 29.90 | 28.10 | 10.90 | 0.03 | <0.10 |
| Magnetite-Gabbro C9 | A | 19.0 | 0.40 | 7.70 | 27.00 | 30.90 | 11.40 | 0.02 | <0.10 |
| | B | 20.0 | 0.41 | 7.70 | 27.10 | 30.80 | 11.50 | 0.02 | <0.10 |

Source: Largo, 2024.

To conduct the processing and metallurgy tests, the samples were blended to create eight different samples, designated as GAN 1, GAN 2, GAN 3, GAN 4, GAN 5, GAN 6, GAN 7, and GAN 8. The results of the metallurgical tests for each sample are presented in Table 13-16 to Table 13-20.

**Table 13-16 – Chemical Analysis of Samples (GAN)**

| Sample | Grade (%) | | | | | | Magnetic (%) | LOI (%) |
|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $TiO_2$ | Fe | $SiO_2$ | $Al_2O_3$ | P | | |
| **GAN 1** | 1.07 | 6.96 | 29.30 | 27.80 | 10.70 | 0.01 | 24.2 | - |
| **GAN 2** | 1.00 | 11.50 | 38.50 | 18.60 | 7.46 | 0.02 | 32.8 | - |
| **GAN 3** | 0.67 | 10.50 | 35.10 | 23.00 | 8.70 | 0.04 | 27.2 | 0.40 |
| **GAN 4** | 0.64 | 5.94 | 25.50 | 32.70 | 10.90 | 0.01 | 17.2 | 0.78 |
| **GAN 5** | <0.10 | 6.21 | 29.10 | 33.40 | 7.48 | 0.20 | 9.8 | 0.79 |
| **GAN 6** | 0.68 | 15.20 | 44.30 | 11.90 | 5.65 | 0.02 | 51.6 | - |
| **GAN 7** | 0.32 | 9.67 | 29.30 | 27.30 | 10.80 | 0.03 | 21.1 | - |
| **GAN 8** | 0.40 | 7.66 | 26.30 | 30.50 | 11.50 | 0.02 | 19.1 | 0.25 |

Source: Largo, 2024.

The Mineralogical characterization was conducted using scanning electron microscopy and X-ray diffractometry.

**Table 13-17 – Mineralogical Distribution of Samples (GAN) (-150+20 µm)**

| Mineral | Proportion of the Main Minerals of Each Sample (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GAN1 | GAN2 | GAN3 | GAN4 | GAN5 | GAN6 | GAN7 | GAN8 |
| Amphibole-FeAlCa | 41.0 | 29.0 | 32.0 | 46.0 | 35.0 | 19.0 | 35.0 | 40.0 |
| Magnetite | 26.0 | 37.0 | 31.0 | 20.0 | 11.0 | 46.0 | 22.0 | 20.0 |
| Ilmenite | 14.0 | 21.0 | 21.0 | 12.0 | 14.0 | 27.0 | 18.0 | 15.0 |
| Feldspar | 8.7 | 4.8 | 9.0 | 14.0 | 6.2 | 1.3 | 14.0 | 16.0 |
| Amphibole-FeMg | 2.8 | 1.0 | 0.7 | 0.9 | 4.7 | 2.6 | 1.6 | 0.9 |
| Garnet | 3.1 | 0.4 | 0.3 | 1.7 | 0.1 | 0.1 | 1.9 | 2.5 |
| Phyllosilicates | 2.9 | 3.9 | 1.4 | 1.8 | 5.0 | 2.6 | 3.0 | 2.6 |
| Quartz | 0.6 | 0.5 | 0.9 | 2.8 | 3.8 | 0.2 | 1.6 | 1.5 |
| Amphibole-Fe | 0.1 | 0.6 | 2.3 | 0.6 | 16.0 | 0.4 | 1.4 | 0.3 |
| Titanite | 0.3 | 1.0 | 0.2 | 0.3 | 0.1 | 0.1 | 0.3 | 0.5 |
| Goethite | 0.1 | 0.4 | 1.1 | 0.1 | 0.4 | 0.4 | 0.2 | 0.2 |
| Pyrite | 0.2 | 0.6 | 0.2 | 0.4 | 2.4 | 0.3 | 0.3 | 0.3 |
| Apatite | 0.1 | 0.1 | 0.2 | 0.1 | 1.1 | 0.1 | 0.1 | 0.1 |

Source: Largo, 2024.

**Table 13-18 – Vanadium Distribution by Mineral (GAN) (-150+20 µm)**

| Mineral | Distribution of Vanadium by Mineral for Each Sample (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GAN 1 | GAN 2 | GAN 3 | GAN 4 | GAN 5 | GAN 6 | GAN 7 | GAN 8 |
| Magnetite | 81.0 | 93.0 | 89.0 | 71.0 | 93.0 | 98.0 | 93.0 | 96.0 |
| Amphibole-FeAlCa | 16.0 | 4.0 | 10.0 | 28.0 | <1.0 | 1.0 | 5.0 | 1.0 |
| Garnet | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 2.0 | 2.0 |
| Phyllosilicates | 1.0 | 2.0 | 0.0 | 1.0 | 4.0 | 1.0 | 1.0 | 1.0 |
| Goethite | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 |

Source: Largo, 2024.

**Table 13-19 – Titanium Distribution by Mineral (GAN) (-150+20 µm)**

| Mineral | Distribution of Titanium by Mineral for Each Sample (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GAN 1 | GAN 2 | GAN 3 | GAN 4 | GAN 5 | GAN 6 | GAN 7 | GAN 8 |
| Magnetite | 2.0 | 7.0 | 3.0 | 1.0 | 2.0 | 11.0 | 5.0 | 1.0 |
| Ilmenite | 93.0 | 90.0 | 95.0 | 91.0 | 92.0 | 89.0 | 93.0 | 97.0 |
| Amphibole-FeAlCa | 4.0 | 1.0 | 2.0 | 6.0 | 4.0 | 0.0 | 1.0 | 1.0 |
| Phyllosilicates | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 |
| Titanite | 1.0 | 3.0 | 0.0 | 1.0 | 0.0 | 0.0 | 1.0 | 2.0 |

Source: Largo, 2024.

**Table 13-20 – Liberation – Magnetite and Ilmenite (GAN)**

| Size (µm) | Magnetite Liberation per Size Distribution (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | GAN1 | GAN2 | GAN3 | GAN4 | GAN5 | GAN6 | GAN7 | GAN8 |
| -150 + 20 (Total) | 88.0 | 87.0 | 86.0 | 87.0 | 85.0 | 86.0 | 85.0 | 90.0 |
| -150 +106 | 76.0 | 72.0 | 75.0 | 76.0 | 75.0 | 73.0 | 73.0 | 82.0 |
| -106 +74 | 85.0 | 84.0 | 82.0 | 82.0 | 80.0 | 82.0 | 81.0 | 87.0 |
| -74 +37 | 90.0 | 90.0 | 90.0 | 90.0 | 89.0 | 88.0 | 88.0 | 92.0 |
| -37 +20 | 96.0 | 96.0 | 97.0 | 97.0 | 96.0 | 97.0 | 96.0 | 97.0 |
| **Size (µm)** | **Ilmenite Liberation per Size Distribution (%)** | | | | | | | |
| | **GAN1** | **GAN2** | **GAN3** | **GAN4** | **GAN5** | **GAN6** | **GAN7** | **GAN8** |
| -150 + 20 (Total) | 81.0 | 85.0 | 87.0 | 82.0 | 79.0 | 87.0 | 87.0 | 83.0 |
| -150 +106 | 66.0 | 76.0 | 79.0 | 66.0 | 62.0 | 79.0 | 78.0 | 69.0 |
| -106 +74 | 77.0 | 83.0 | 84.0 | 78.0 | 73.0 | 85.0 | 84.0 | 79.0 |
| -74 +37 | 85.0 | 88.0 | 89.0 | 86.0 | 85.0 | 89.0 | 88.0 | 86.0 |
| -37 +20 | 94.0 | 95.0 | 96.0 | 94.0 | 95.0 | 95.0 | 96.0 | 96.0 |
| **Association** | **Magnetite Liberation per Sample (%)** | | | | | | | |
| | **GAN1** | **GAN2** | **GAN3** | **GAN4** | **GAN5** | **GAN6** | **GAN7** | **GAN8** |
| Free | 88.0 | 87.0 | 86.0 | 87.0 | 85.0 | 86.0 | 85.0 | 90.0 |
| Mixed in binary | 11.0 | 12.0 | 13.0 | 12.0 | 13.0 | 14.0 | 14.0 | 8.9 |
| Mixed in ternary | 1.2 | 1.0 | 0.8 | 1.4 | 2.4 | 0.9 | 0.8 | 1.2 |
| **Association** | **Ilmenite Liberation per Sample (%)** | | | | | | | |
| | **GAN1** | **GAN2** | **GAN3** | **GAN4** | **GAN5** | **GAN6** | **GAN7** | **GAN8** |
| Free | 81.0 | 85.0 | 87.0 | 82.0 | 79.0 | 87.0 | 87.0 | 83.0 |
| Mixed in binary | 16.0 | 13.0 | 12.0 | 16.0 | 18.0 | 12.0 | 12.0 | 14.0 |
| Mixed in ternary | 2.3 | 1.4 | 1.2 | 2.1 | 3.2 | 1.1 | 1.3 | 2.6 |

Source: Largo, 2024.

### *13.4.2 Dry Magnetic Separation Results – Gulçari A Norte (GAN)*

Dry magnetic concentration tests were conducted for samples GAN 1, 2, 3, 4, 7, and 8 from the Gulçari A Norte (GAN) deposit. Sample GAN 5 was not subjected to dry separation due to the absence of significant vanadium content in the C7 zone, from which this sample originated; thus, pre-concentration testing was deemed unnecessary. Sample GAN 6, having more than 50% magnetism, meets the current requirements of the wet magnetic concentration process at the VMSA plant, hence dry magnetic concentration was not required for this sample.

The tests were performed using a 1,500 Gauss drum magnetic separator. For each concentration test, the mass, contents, and percentage of magnetic feed (samples GAN 1, 2, 3, 4, 7, and 8), concentrate (magnetic fraction), and tailings (non-magnetic fraction) were measured. The contents were analyzed using X-ray fluorescence with the use of borate fused beads, and the percentage of magnetics was measured using a Davis tube with an intensity of 1,500 Gauss. The results are detailed in Table 13-21.

**Table 13-21 – Dry Magnetic Separation Results – Low Intensity**

| Sample | Magnetic (%) | | | Magnetic Recovery (%) | Mass Recovery (%) | Enrichment |
|---|---|---|---|---|---|---|
| | Feed | Concentrate (magnetic) | Tailings (non-magnetic) | | | |
| GAN 1 | 22.4 | 39.53 | 2.02 | 95.9 | 54.4 | 1.76 |
| GAN 2 | 32.1 | 46.50 | 1.27 | 98.7 | 68.2 | 1.45 |
| GAN 3 | 28.0 | 49.12 | 2.15 | 96.5 | 55.0 | 1.76 |
| GAN 4 | 20.9 | 34.66 | 1.19 | 97.7 | 58.9 | 1.66 |
| GAN 7 | 21.1 | 38.10 | 0.68 | 98.5 | 54.5 | 1.81 |
| GAN 8 | 16.3 | 25.62 | 1.24 | 97.1 | 61.8 | 1.57 |
| Sample | $V_2O_5$ (%) | | | Recovery $V_2O_5$ (%) | Mass Recovery (%) | Enrichment |
| | Feed | Magnetic | Non-magnetic | | | |
| GAN 1 | 0.71 | 1.35 | 0.07 | 95.2 | 49.8 | 1.91 |
| GAN 2 | 0.56 | 1.15 | 0.03 | 97.4 | 47.1 | 2.07 |
| GAN 3 | 0.59 | 0.98 | 0.04 | 97.3 | 58.8 | 1.65 |
| GAN 4 | 0.43 | 0.77 | 0.03 | 97.2 | 54.1 | 1.80 |
| GAN 7 | 0.26 | 0.49 | 0.01 | 98.7 | 53.0 | 1.86 |
| GAN 8 | 0.24 | 0.40 | 0.02 | 96.9 | 57.7 | 1.68 |
| Sample | $TiO_2$ (%) | | | Recovery $TiO_2$ (%) | Mass Recovery (%) | Enrichment |
| | Feed | Concentrate | Tailings | | | |
| GAN 1 | 6.92 | 7.55 | 6.16 | 59.7 | 54.7 | 1.09 |
| GAN 2 | 11.39 | 10.40 | 13.50 | 62.2 | 68.1 | 0.91 |
| GAN 3 | 10.59 | 9.84 | 11.50 | 50.9 | 54.8 | 0.93 |
| GAN 4 | 5.94 | 6.90 | 4.56 | 68.5 | 59.0 | 1.16 |
| GAN 7 | 9.55 | 11.10 | 7.70 | 63.2 | 54.4 | 1.16 |
| GAN 8 | 7.52 | 7.86 | 6.96 | 65.0 | 62.2 | 1.05 |

Source: Largo, 2024.

In addition, the dry magnetic separation products underwent physical characterization, and the Wi (Bond Work Index) and the specific mass of the products were evaluated, as shown in Table 13-22 below.

**Table 13-22 – Dry Magnetic Product – Wi and Specific Weight**

| Sample | Wi (kWh/t) | Specific Weight (g/cm³) | |
|---|---|---|---|
| | Concentrate | Concentrate | Tailings |
| GAN 1 | 14.1 | 3.92 | 3.45 |
| GAN 2 | 13.7 | 3.72 | 3.33 |
| GAN 3 | 13.3 | 4.12 | 3.49 |
| GAN 4 | 14.0 | 4.23 | 3.58 |
| GAN 5 | 14.3 | 3.51 | - |
| GAN 6 | 13.9 | 4.71 | - |
| GAN 7 | 14.8 | 3.98 | 3.35 |
| GAN 8 | 12.7 | 3.64 | 3.35 |

Source: Largo, 2024.

### *13.4.3 Wet Magnetic Separation – Gulçari A Norte (GAN)*

As previously mentioned in this Report, VMSA's production process includes a grinding circuit responsible for the liberation of magnetite minerals, integrated with wet magnetic separation in open circuit low-field magnetic separators, featuring one roughing step and two cleaning steps. This same concentration method was employed on a laboratory scale to assess the behavior of the six dry magnetic separation concentrate samples generated from GAN samples 1, 2, 3, 4, 7, and 8, as well as for the original GAN 5 and 6 samples, which did not undergo dry concentration. The dry magnetic separation concentrates were renamed and labeled with the PCGAN code, replacing the GAN label. For example, the pre-concentrate from the GAN 1 sample will be labeled as PCGAN 1.

Before conducting the wet tests, the eight samples underwent chemical characterization using X-ray fluorescence, as detailed in Table 13-23 below.

**Table 13-23 – Chemical Analysis – Wet Magnetic Separation Feed**

| Sample | Grade (%) | | | | | | | | | | | Magnetic (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$* | $SiO_2$ | $Al_2O_3$ | Fe | CaO | MgO | $TiO_2$ | P | $Na_2O$ | $K_2O$ | Mn | |
| **PCGAN 1** | 1.35 | 20.24 | 8.23 | 38.55 | 4.20 | 2.64 | 7.71 | 0.01 | 0.80 | 0.39 | 0.14 | 39.5 |
| **PCGAN 2** | 1.15 | 14.06 | 5.87 | 45.87 | 2.15 | 1.33 | 10.27 | 0.03 | 0.40 | 0.47 | 0.15 | 46.5 |
| **PCGAN 3** | 0.98 | 15.52 | 6.11 | 44.79 | 2.16 | 1.04 | 10.14 | 0.03 | 0.59 | 0.33 | 0.15 | 49.1 |
| **PCGAN 4** | 0.77 | 27.00 | 9.20 | 32.17 | 5.46 | 2.68 | 7.05 | 0.04 | 1.27 | 0.48 | 0.16 | 34.7 |
| **GAN 5** | 0.02 | 34.02 | 7.32 | 30.01 | 3.67 | 2.31 | 6.43 | 0.20 | 1.09 | 1.14 | 0.28 | 9.8 |
| **GAN 6** | 0.67 | 11.71 | 5.50 | 44.88 | 1.55 | 1.83 | 15.51 | 0.03 | 0.26 | 0.29 | 0.19 | 51.6 |
| **PCGAN 7** | 0.49 | 18.63 | 7.77 | 39.71 | 2.99 | 1.45 | 11.62 | 0.03 | 0.90 | 0.44 | 0.16 | 38.1 |
| **PCGAN 8** | 0.40 | 26.69 | 10.53 | 31.00 | 4.96 | 2.30 | 8.66 | 0.02 | 1.53 | 0.45 | 0.14 | 25.6 |

Note: *$V_2O_5$ effective (considers only the vanadium contained in the magnetite).
Source: Largo, 2024.

To conduct the wet tests, the eight samples were ground to ensure that the wet magnetic separation feed contained 90% of the mass passing through 106 µm, a size deemed optimal for the liberation of magnetite. The concentration tests were conducted in three stages: rougher, cleaner, and recleaner, all with a magnetic field intensity of 1,500 Gauss. The feed for each magnetic separation stage consisted of 30% solids by weight. The non-magnetic tailings from all three stages were combined to form a single final non-magnetic tailing product. The summarized results of the wet magnetic separation are presented in Table 13-24 below.

**Table 13-24 – Summary of Results – Wet Magnetic Separation**

| Sample | Magnetic (%) | | | Recovery (%) | |
|---|---|---|---|---|---|
| | Feed | Concentrate | Tailings | Magnetic | Mass |
| **PCGAN 1** | 39.50 | 95.14 | 0.16 | 99.8 | 43.1 |
| **PCGAN 2** | 46.50 | 95.35 | 0.13 | 99.9 | 52.1 |
| **PCGAN 3** | 49.10 | 95.33 | 0.03 | 99.9 | 49.1 |
| **PCGAN 4** | 34.70 | 95.51 | 0.07 | 99.9 | 30.1 |
| **GAN 5** | 9.80 | 90.02 | 0.20 | 98.2 | 11.0 |
| **GAN 6** | 51.60 | 94.13 | 0.03 | 99.9 | 48.9 |
| **PCGAN 7** | 38.10 | 93.18 | 0.03 | 99.9 | 41.5 |
| **PCGAN 8** | 25.60 | 93.89 | 0.03 | 99.9 | 28.9 |
| **Sample** | **$V_2O_5$ effective (%)** | | | **Recovery (%)** | |
| | **Feed** | **Concentrate** | **Tailings** | **$V_2O_5$** | **Mass** |
| **PCGAN 1** | 1.35 | 3.27 | 0.006 | 99.8 | 43.1 |
| **PCGAN 2** | 1.15 | 2.32 | 0.003 | 99.9 | 52.1 |
| **PCGAN 3** | 0.98 | 1.98 | 0.001 | 99.9 | 49.1 |
| **PCGAN 4** | 0.77 | 2.34 | 0.002 | 99.9 | 30.1 |
| **GAN 5** | 0.02 | 0.13 | 0.000 | 98.2 | 11.0 |
| **GAN 6** | 0.67 | 1.33 | 0.000 | 99.9 | 48.9 |
| **PCGAN 7** | 0.49 | 1.17 | 0.000 | 99.9 | 41.5 |
| **PCGAN 8** | 0.40 | 1.49 | 0.001 | 99.9 | 28.9 |
| **Sample** | **$TiO_2$ (%)** | | | **Recovery (%)** | |
| | **Feed** | **Concentrate** | **Tailings** | **$TiO_2$** | **Mass** |
| **PCGAN 1** | 7.71 | 4.03 | 10.50 | 22.5 | 43.1 |
| **PCGAN 2** | 10.27 | 4.73 | 16.30 | 24.0 | 52.1 |
| **PCGAN 3** | 10.14 | 4.17 | 15.90 | 20.2 | 49.1 |
| **PCGAN 4** | 7.05 | 3.96 | 8.38 | 16.9 | 30.1 |
| **GAN 5** | 6.43 | 3.07 | 6.85 | 5.3 | 11.0 |
| **GAN 6** | 15.51 | 7.67 | 23.00 | 24.2 | 48.9 |
| **PCGAN 7** | 11.62 | 6.15 | 15.50 | 22.0 | 41.5 |
| **PCGAN 8** | 8.66 | 6.13 | 9.68 | 20.5 | 28.9 |

Source: Largo, 2024.

### 13.4.4 *Calcination – Gulçari A Norte (GAN)*

The calcination tests were conducted at the VMSA laboratory using concentrates produced in the wet magnetic separations outlined in this Report. Each sample underwent characterization through X-ray fluorescence and a Davis tube before being subjected to calcination assays.

In each test, a sample of concentrate was blended with sodium carbonate ($Na_2CO_3$) at a ratio of 100 g of concentrate to 7 g of sodium carbonate. The mixture was then evenly spread in a metallic crucible to form a thin layer. Each crucible containing the material was placed in a muffle oven heated to 1,150 °C for 6 hours. At intervals of 55 minutes, the sample was removed, homogenized, and returned to the muffle oven. The homogenization process aimed to ensure uniform calcination throughout the material and to enhance contact between the concentrate and sodium carbonate, simulating the rotation of an industrial furnace to facilitate this contact. Following calcination, the resulting mixture, now referred to as calcined material, was cooled and subjected to a disaggregation step to eliminate any grain agglomeration that might interfere with subsequent processes.

Table 13-25 presents the results of the chemical analysis of the concentrate samples, referred to as MGAN, obtained from the calcination feed.

**Table 13-25 – Chemical Analysis – Calcination Feed**

| Sample | Grade (%) | | | | | | | | | | | Magnetic (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | Fe | CaO | MgO | $TiO_2$ | P | $Na_2O$ | $K_2O$ | Mn | |
| **MGAN 1** | 3.25 | 2.98 | 2.19 | 62.80 | 0.66 | 0.45 | 4.03 | 0.01 | <0.10 | <0.10 | 0.05 | 95.1 |
| **MGAN 2** | 2.29 | 2.43 | 1.98 | 63.50 | 0.36 | 0.21 | 4.73 | 0.02 | <0.10 | <0.10 | 0.04 | 95.4 |
| **MGAN 3** | 1.98 | 2.15 | 1.66 | 64.70 | 0.29 | 0.15 | 4.17 | 0.01 | <0.10 | <0.10 | 0.03 | 95.3 |
| **MGAN 4** | 2.32 | 3.35 | 2.02 | 62.70 | 0.91 | 0.38 | 3.96 | 0.07 | <0.10 | <0.10 | 0.06 | 95.5 |
| **MGAN 5** | 0.12 | 6.76 | 1.72 | 60.80 | 0.65 | 0.50 | 3.07 | 0.02 | <0.10 | 0.25 | 0.08 | 90.0 |
| **MGAN 6** | 1.32 | 2.00 | 2.63 | 61.80 | 0.23 | 0.43 | 7.67 | 0.01 | <0.10 | <0.10 | 0.06 | 94.1 |
| **MGAN 7** | 1.18 | 2.48 | 2.24 | 62.80 | 0.37 | 0.27 | 6.15 | 0.01 | <0.10 | <0.10 | 0.05 | 93.2 |
| **MGAN 8** | 1.18 | 2.50 | 2.22 | 62.30 | 0.37 | 0.27 | 6.13 | 0.01 | <0.10 | <0.10 | 0.04 | 93.9 |

Source: Largo, 2024.

After disaggregation, the sample was homogenized and divided to conduct leaching tests using 50 g of each sample. For this leaching test, each sample was mixed with 1-liter of water at 70 °C in a 2-liter beaker, forming a pulp that was stirred for 1 hour using a mechanical stirrer. The mixture was then heated on an electric plate to maintain the pulp temperature at 70 °C. After stirring, the pulp was filtered, and the resulting mass was re-suspended in 900 ml of water at 70 °C, forming a new pulp that was stirred for another 15 minutes. Following this step, the pulp was filtered again, and the cake formed was washed with 500 ml of water at room temperature. The filtered solids, referred to as the washed sample, were dried and analyzed by X-ray fluorescence.

The purpose of this test was to assess the extent to which vanadium present in each sample could be leached into water. This evaluation indicates the potential recovery achievable through calcination. The calculation for calcination recovery is follows:

$$\boldsymbol{Rec = \frac{V2O5\ initial - (V2O5\ residual * 0,95)}{V2O5\ initial} * 100}$$

Where:

- Initial $V_2O_5$: Vanadium pentoxide in the calcined sample, determined by the initial chemical analysis right after calcination.
- Residual $V_2O_5$: Vanadium pentoxide of the calcined sample after leaching, filtering, and washing the cake, determined by chemical analysis of the cake.
- Factor 0.95: Represents an estimated 5% reduction in the initial mass of calcined concentrate due to dissolution (leaching).

Two calcination tests were conducted with each sample from the Gulçari A Norte deposit. Table 13-26 summarizes the results of each test.

**Table 13-26 – Calcination Results**

| Sample | Test | $V_2O_5$ (%) | | Recovery (%) | |
|---|---|---|---|---|---|
| | | Calcined Sample | Washed Sample | Per Test | Average |
| GAN 1 | A | 2.78 | 0.40 | 86.3 | 85.0 |
| | B | 2.63 | 0.46 | 83.6 | |
| GAN 2 | A | 1.98 | 0.32 | 84.8 | 86.8 |
| | B | 1.98 | 0.24 | 88.7 | |
| GAN 3 | A | 1.79 | 0.42 | 78.0 | 83.8 |
| | B | 1.79 | 0.20 | 89.5 | |
| GAN 4 | A | 2.21 | 0.36 | 84.6 | 82.5 |
| | B | 1.85 | 0.38 | 80.4 | |
| GAN 6 | A | 0.97 | 0.20 | 80.7 | 84.7 |
| | B | 1.22 | 0.15 | 88.7 | |
| GAN 7 | A | 0.90 | 0.29 | 69.3 | 67.3 |
| | B | 1.01 | 0.37 | 65.3 | |
| GAN 8 | A | 1.34 | 0.80 | 43.5 | 35.0 |
| | B | 1.22 | 0.94 | 26.4 | |

Source: Largo, 2024.

Additionally, preliminary wet magnetic separation tests were conducted with the MGAN 8 sample to reduce the $SiO_2$ content, resulting in a magnetite concentrate with less than 1.5% $SiO_2$.

### *13.4.5 Leaching and Chemical Treatment – Gulçari A Norte (GAN)*

Given that material obtained in the laboratory after calcination has a chemical composition very similar to that of the calcined product currently produced at the Maracás Menchen Mine plant, it is reasonable to assume that subsequent leaching and chemical treatment processes will behave similarly regarding the samples represented by GAN 1 to GAN 8 (except GAN 5, which was not tested).

Based on this assumption, the recovery results achieved in 2019 can be utilized in the calculation of overall vanadium recovery, as presented in Table 13-27 below.

**Table 13-27 – Leaching and Chemical Treatment**

| Process | Recovery $V_2O_5$ (effective) (%) |
|---|---|
| Leaching | 96.8% |
| Chemical Treatment | 96.8% |

Source: Largo, 2024.

### 13.4.6 Global Recovery of Vanadium – Gulçari A Norte (GAN)

Global vanadium recovery is determined by multiplying all sequential recoveries of the current process route, including dry crushing / magnetic separation recovery, wet grinding / magnetic separation recovery, Calcination recovery, Leach recovery, and Chemical Plant recovery, according to the equation provided below. Table 13-28 presents the $V_2O_5$ recovery test results.

$$R_{Global} = R_{Crushing} * R_{Grinding} * R_{Calcination} * R_{Leaching} * R_{Chemical\ Treatment}$$

**Table 13-28 – Summary – $V_2O_5$ Recoveries**

| Samples | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Grade of Concentrate (%$V_2O_5$) | | 3.3 | 2.3 | 2.0 | 2.3 | 0.1 | 1.3 | 1.2 | 1.5 |
| Recovery by Area / Process (%) | Crushing / Dry Magnetic Concentration | 95.2 | 97.4 | 97.3 | 97.2 | 100.0 | 100.0 | 98.7 | 96.9 |
| | Grinding / Wet Magnetic Concentration | 99.8 | 99.9 | 99.9 | 99.9 | 98.2 | 99.9 | 99.9 | 99.9 |
| | Calcination | 85.0 | 86.8 | 83.8 | 82.5 | - | 84.7 | 67.3 | 73.6 |
| | Leaching | 96.8 | 96.8 | 96.8 | 96.8 | - | 96.8 | 96.8 | 96.8 |
| | Chemical Plant / Purification and Precipitation | 96.8 | 96.8 | 96.8 | 96.8 | - | 96.8 | 96.8 | 96.8 |
| | Global | 75.7 | 79.1 | 76.3 | 75.1 | - | 79.3 | 62.2 | 66.8 |

Source: Largo, 2024.

### 13.4.7 Recovery of Titanium – Gulçari A Norte (GAN)

Titanium recovery studies in the Gulçari A Norte deposit, as outlined in this Report, were based on the premise that this metal is a by-product of the $V_2O_5$ production process. The $TiO_2$ recoveries obtained in the dry and wet magnetic concentration steps are a consequence of the necessity to recover $V_2O_5$, with no specific optimization undertaken to enhance $TiO_2$ recovery.

Previous studies indicate that titanium in the Gulçari A deposit is associated with ilmenite. These studies suggest that flotation utilizing a carboxylic acid-based collector (Flotinor 10068) and non-ionic co-collector (DP-OMC-1178) can selectively recover ilmenite from the wet waste of the magnetic separation process. Therefore, it was decided to apply the parameters indicated in these studies to conduct flotation tests with the Gulçari A Norte deposit, which shares a similar geological formation with the Gulçari A deposit.

Eight samples of non-magnetic tailings were generated after the wet magnetic concentration tests described earlier in this Report. These samples were respectively labeled RGAN 1 to RGAN 8. All samples underwent chemical characterization using X-ray fluorescence and borate fused beads. Table 13-29 presents the results of the chemical analysis of the flotation feed samples.

**Table 13-29 – Chemical Analysis – Desliming Feed**

| Sample | (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | Fe | CaO | MgO | $TiO_2$ | P | $Na_2O$ | $K_2O$ | Mn |
| **RGAN 1** | 0.32 | 33.30 | 12.80 | 20.20 | 6.87 | 4.29 | 10.50 | 0.015 | 1.44 | 0.62 | 0.21 |
| **RGAN 2** | 0.22 | 26.70 | 10.10 | 26.70 | 4.10 | 2.54 | 16.30 | 0.042 | 0.85 | 0.87 | 0.26 |
| **RGAN 3** | 0.14 | 28.40 | 10.40 | 25.60 | 3.97 | 1.89 | 15.90 | 0.049 | 1.22 | 0.60 | 0.26 |
| **RGAN 4** | 0.24 | 37.20 | 12.30 | 19.00 | 7.42 | 3.67 | 8.38 | 0.022 | 1.74 | 0.65 | 0.21 |
| **RGAN 5** | <0.10 | 37.40 | 8.01 | 26.20 | 4.04 | 2.53 | 6.85 | 0.225 | 1.13 | 1.21 | 0.31 |
| **RGAN 6** | <0.10 | 21.00 | 8.24 | 28.70 | 2.82 | 3.17 | 23.00 | 0.043 | 0.41 | 0.50 | 0.31 |
| **RGAN 7** | <0.10 | 30.10 | 11.70 | 23.30 | 4.85 | 2.28 | 15.50 | 0.042 | 1.45 | 0.65 | 0.23 |
| **RGAN 8** | 0.14 | 36.50 | 13.90 | 18.30 | 6.82 | 3.13 | 9.68 | 0.029 | 2.11 | 0.60 | 0.18 |

Source: Largo, 2024.

The flotation tests were conducted using Flotinor 10068 reagents (a Clariant industrial mixture containing carboxylic acids) as the collector, DP-OMC-1178 (a BASF non-ionic polymer) as the co-collector, and fluosilicic acid (H2SiF6) to regulate the pH to 4. These tests were exclusively conduct on the fraction retained in 20 µm of samples RGAN 1 to RGAN 8.

Desliming at 20 µm was achieved using a vibrating sieve in wet operation. Both the oversize product and the undersize slurry from each sample underwent analysis by X-ray fluorescence with the use of borate fused beads. Table 13-30 presents the results obtained from these analyses.

**Table 13-30 – Chemical Analysis – Desliming**

| Sample | $TiO_2$ (%) | | | Recovery $TiO_2$ (%) | Mass Recovery (%) |
|---|---|---|---|---|---|
| | Feed | Oversize | Undersize | | |
| **RGAN 1** | 10.30 | 10.50 | 10.00 | 61.0 | 59.8 |
| **RGAN 2** | 16.93 | 17.50 | 16.20 | 58.2 | 56.3 |
| **RGAN 3** | 15.62 | 17.50 | 13.30 | 62.0 | 55.3 |
| **RGAN 4** | 8.41 | 8.81 | 7.64 | 69.0 | 65.9 |
| **RGAN 5** | 6.67 | 6.92 | 6.09 | 73.0 | 70.4 |
| **RGAN 6** | 22.97 | 23.40 | 22.10 | 68.3 | 67.0 |
| **RGAN 7** | 15.10 | 15.10 | 15.10 | 68.3 | 68.3 |
| **RGAN 8** | 9.69 | 10.30 | 8.27 | 74.4 | 70.0 |

Source: Largo, 2024.

For flotation, a Denver D12 bench flotation machine equipped with 2.5 l tanks and rotating at 1,000 rpm was utilized. All products generated underwent analysis using X-ray fluorescence with the use of borate fused beads.

In all tests, a 10-minute attrition step at 50% solids by weight was implemented, followed by a 2-minute pre-conditioning with fluosilicic acid and the reagent DP-OMC-1178, added uniquely during this step. The Flotinor 10068 collector, however, was dosed in a staged manner, with the addition equally divided between each of the conditionings that preceding the froth collections. For example, a test with a dosage of 200 g/t of collector in 4 conditioning stages had the addition of 50 g/t in each stage.

Table 13-31 indicates that the titanium contained in GGAN samples 1 to 8, representing the non-magnetic tailings of the wet concentration of the Gulçari A Norte deposit, can be concentrated by flotation. The achieved recoveries varied between tests and zones. Considering the result of the third collection of each test, the average recovery and content for each sample can be assumed as presented in Table 13-32 below.

**Table 13-31 – Flotation Results**

| Sample | Test | Reagent concentration (g/t) | | Collect | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|---|---|
| | | Flotinor 10068 | DP-OMC-1178 | | | |
| **GGAN 1** | **A** | 200 | 400 | 1 | 33.30 | 40.9 |
| | | | | 2 | 28.60 | 71.2 |
| | | | | 3 | 24.00 | 80.4 |
| | **B** | 200 | 400 | 1 | 38.10 | 36.4 |
| | | | | 2 | 36.30 | 53.9 |
| | | | | 3 | 33.90 | 64.1 |
| **GGAN 2** | **A** | 200 | 400 | 1 | 38.30 | 23.2 |
| | | | | 2 | 36.90 | 38.0 |
| | | | | 3 | 35.46 | 45.9 |
| | **B** | 200 | 400 | 1 | 40.80 | 19.4 |

| Sample | Test | Reagent concentration (g/t) | | Collect | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|---|---|
| | | Flotinor 10068 | DP-OMC-1178 | | | |
| | | | | 2 | 39.60 | 30.6 |
| | | | | 3 | 38.10 | 41.7 |
| GGAN 3 | A | 200 | 400 | 1 | 42.10 | 20.7 |
| | | | | 2 | 41.40 | 26.7 |
| | | | | 3 | 41.00 | 30.4 |
| | B | 200 | 400 | 1 | 40.30 | 4.8 |
| | | | | 2 | 39.40 | 8.6 |
| | | | | 3 | 38.50 | 12.5 |
| GGAN 4 | A | 200 | 400 | 1 | 23.00 | 18.6 |
| | | | | 2 | 21.70 | 26.0 |
| | | | | 3 | 20.20 | 32.1 |
| | B | 200 | 400 | 1 | 21.20 | 12.2 |
| | | | | 2 | 20.40 | 18.0 |
| | | | | 3 | 19.00 | 23.3 |
| GGAN 5 | A | 200 | 400 | 1 | 21.80 | 33.6 |
| | | | | 2 | 19.90 | 51.4 |
| | | | | 3 | 18.10 | 58.8 |
| | B | 200 | 400 | 1 | 8.70 | 19.3 |
| | | | | 2 | 8.40 | 28.3 |
| | | | | 3 | 8.10 | 36.0 |
| GGAN 6 | A | 200 | 400 | 1 | 34.10 | 22.6 |
| | | | | 2 | 32.80 | 36.1 |
| | | | | 3 | 32.10 | 42.7 |
| | B | 200 | 400 | 1 | 34.10 | 24.6 |
| | | | | 2 | 32.40 | 42.6 |
| | | | | 3 | 30.20 | 55.5 |
| GGAN 7 | A | 200 | 400 | 1 | 31.80 | 24.7 |
| | | | | 2 | 30.70 | 35.8 |
| | | | | 3 | 30.10 | 45.6 |
| | B | 200 | 400 | 1 | 39.70 | 19.3 |
| | | | | 2 | 38.90 | 38.2 |
| | | | | 3 | 37.50 | 57.2 |
| GGAN 8 | A | 200 | 400 | 1 | 25.00 | 10.5 |
| | | | | 2 | 24.40 | 14.4 |
| | | | | 3 | 24.20 | 18.1 |
| | B | 200 | 400 | 1 | 30.10 | 7.7 |
| | | | | 2 | 29.20 | 11.8 |
| | | | | 3 | 27.90 | 16.6 |

Source: Largo, 2024.

**Table 13-32 – Summary of Results – Collect 3 – Flotation**

| Sample | Collect 3 - Average Results | |
|---|---|---|
| | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
| GGAN 1 | 29.00 | 72.3 |
| GGAN 2 | 36.80 | 43.8 |
| GGAN 3 | 39.80 | 21.5 |
| GGAN 4 | 19.60 | 27.7 |
| GGAN 5 | 13.10 | 47.4 |
| GGAN 6 | 31.20 | 49.1 |
| GGAN 7 | 33.80 | 51.4 |
| GGAN 8 | 26.10 | 17.4 |

Source: Largo, 2024.

To reassess the flotation efficiency for these samples, additional tests were conducted, this time at the VMSA laboratory. Table 13-33 outlines the test conditions and the corresponding results obtained.

**Table 13-33 – Summary of Results – Flotation VMSA Lab**

| Sample | Reagent Concentration (g/t) | | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|
| | Flotinor 10068 | DP-OMC-1178 | | |
| GGAN 1 | 200 | 400 | 46.40 | 88.6 |
| GGAN 2 | 400 | 400 | 44.80 | 94.1 |
| GGAN 3 | 400 | 400 | 43.60 | 92.5 |

| Sample | Reagent Concentration (g/t) | | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|
| | Flotinor 10068 | DP-OMC-1178 | | |
| GGAN 4 | 200 | 400 | 42.10 | 82.2 |
| GGAN 5 | 200 | 400 | 39.40 | 83.5 |
| GGAN 6 | 500 | 500 | 45.60 | 98.3 |
| GGAN 7 | 200 | 400 | 41.60 | 96.1 |
| GGAN 8 | 200 | 400 | 42.50 | 89.7 |

Source: Largo, 2024.

Global recovery is calculated as the product of all sequential recoveries of the proposed process route, including Crushing / Dry Magnetic Separation, Grinding/Wet Magnetic Separation, Desliming, and Flotation recoveries. The formula is expressed as:

$$R_{Global} = R_{Crushing} \times R_{Grinding} \times R_{Desliming} \times R_{Flotation}$$

Table 13-34 to Table 13-36 present the magnetic separation results.

**Table 13-34 – Summary of Results – Dry Magnetic Separation – Titanium Recoveries**

| Sample | $TiO_2$ (%) | | | Recovery $TiO_2$ (%) | Mass Recovery (%) |
|---|---|---|---|---|---|
| | Feed | Concentrate | Tailings | | |
| GAN 1 | 6.92 | 7.55 | 6.16 | 59.7 | 54.7 |
| GAN 2 | 11.39 | 10.40 | 13.50 | 62.2 | 68.1 |
| GAN 3 | 10.59 | 9.84 | 11.50 | 50.9 | 54.8 |
| GAN 4 | 5.94 | 6.90 | 4.56 | 68.5 | 59.0 |
| GAN 5 | 6.43 | 6.43 | - | 100.0 | 100.0 |
| GAN 6 | 15.51 | 15.51 | - | 100.0 | 100.0 |
| GAN 7 | 9.55 | 11.10 | 7.70 | 63.2 | 54.4 |
| GAN 8 | 7.52 | 7.86 | 6.96 | 65.0 | 62.2 |

Source: Largo, 2024.

**Table 13-35 – Summary of Results – Wet Magnetic Separation – Titanium Recoveries**

| Sample | $TiO_2$ (%) | | | Recovery (%) | |
|---|---|---|---|---|---|
| | Feed | Magnetic Concentrate | Tailings Non-magnetic | $TiO_2$ | Mass |
| PCGAN 1 | 7.71 | 4.03 | 10.50 | 77.5 | 56.9 |
| PCGAN 2 | 10.27 | 4.73 | 16.30 | 76.0 | 47.9 |
| PCGAN 3 | 10.14 | 4.17 | 15.90 | 79.8 | 50.9 |
| PCGAN 4 | 7.05 | 3.96 | 8.38 | 83.1 | 69.9 |
| GAN 5 | 6.43 | 3.07 | 6.85 | 94.7 | 89.0 |
| GAN 6 | 15.51 | 7.67 | 23.00 | 75.8 | 51.1 |
| PCGAN 7 | 11.62 | 6.15 | 15.50 | 78.0 | 58.5 |
| PCGAN 8 | 8.66 | 6.13 | 9.68 | 79.5 | 71.1 |

Source: Largo, 2024.

**Table 13-36 – Summary of Results – Titanium Recoveries by Area / Process**

| Sample | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Concentrate $TiO_2$ (%) | | 46.40 | 44.80 | 43.60 | 42.10 | 39.40 | 45.60 | 41.60 | 42.50 |
| Recovery by Area/Process (%) | Crushing / Dry Magnetic Concentration | 59.7 | 62.2 | 50.9 | 68.5 | 100.0 | 100.0 | 63.2 | 65.0 |
| | Grinding / Wet Magnetic Concentration | 77.5 | 76.0 | 79.8 | 83.1 | 94.7 | 75.8 | 78.0 | 79.5 |
| | Desliming | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 | 77.5 |
| | Flotation | 88.6 | 94.1 | 92.5 | 82.2 | 83.5 | 98.3 | 96.1 | 89.7 |
| | Global | 31.8 | 34.5 | 29.1 | 36.3 | 61.3 | 57.7 | 36.7 | 35.9 |

Source: Largo, 2024.

## 13.5 Metallurgical Recovery of Vanadium and Titanium of Ore from Novo Amparo Norte

Metallurgical tests with samples from the Novo Amparo Norte (NAN) deposit were conducted at the laboratories of SGS Geosol in Belo Horizonte, Brazil, and VMSA at the Project site, using samples from the lithologies designated M3, M4 and M5 from March 2019 to June 2020. These tests revealed that vanadium is primarily associated with magnetite, and metallurgical recoveries of this metal can reach up to 77%. Additionally, test results from the HBPC sample indicated that titanium present in the NAN deposit is associated with ilmenite. It was found possible to recover 78% of the titanium present in the waste from the wet magnetic concentration process, resulting in an overall recovery of 58% titanium in the original sample, corresponding to the- run-of-mine (ROM) material. The HBPC sample represents the probable feed of the plant, a blend of M3 and M4 lithologies in the proportion of 43% and 57%, respectively.

These findings suggest that is technically feasible to recover vanadium from the Novo Amparo Norte deposit using the concentration methods already employed in the VMSA plant, such as magnetic concentration and calcination. Moreover, titanium present in the same deposit can be produced as a by-product from wet magnetic concentration tailings, utilizing desliming followed by flotation.

Table 13-37 and Table 13-38 below summarize the expected vanadium and titanium recoveries by each step of the concentration processes.

**Table 13-37 – Summary of $V_2O_5$ Recoveries – Novo Amparo Norte (NAN)**

| Area / Process | Recovery per Sample $V_2O_5$ (%) | | | | Recovery (Reserve) $V_2O_5$ (%) |
|---|---|---|---|---|---|
| | M3 | M4 | M5 | HBPC | |
| Crushing / Dry Magnetic Concentration | 95.0 | 100.0 | 93.0 | 93.8 | 96.0 |
| Grinding / Wet Magnetic Concentration | 97.2 | 97.9 | 95.5 | 95.7 | 97.0 |
| Calcination | 83.0 | 84.0 | 71.9 | 80.6 | 80.0 |
| Leaching | 97.5 | 97.5 | 97.5 | 97.5 | 97.0 |
| Chemical Plant / Purification and Precipitation | 96.7 | 96.7 | 96.7 | 96.7 | 97.0 |
| Global | 72.3 | 77.5 | 60.2 | 68.2 | 70.0 |

Source: Largo, 2024.

**Table 13-38 – Summary of $TiO_2$ Recoveries – Novo Amparo Norte (NAN)**

| Area / Process | Recovery per Sample $TiO_2$ (%) | | | | Recovery (Reserve) $TiO_2$ (%) |
|---|---|---|---|---|---|
| | M3 | M4 | M5 | HBPC | |
| Crushing / Dry Magnetic Concentration | 83.0 | 100.0 | 84.0 | 82.0 | 90.0 |
| Grinding / Wet Magnetic Concentration | 92.0 | 83.0 | 94.0 | 89.0 | 89.0 |
| Desliming | 83.0 | 98.0 | 88.0 | 96.0 | 90.0 |
| Flotation | 89.0 | 83.0 | 45.0 | 81.0 | 74.0 |
| Global | 56.0 | 68.0 | 31.0 | 58.0 | 54.0 |

Source: Largo, 2024.

### *13.5.1 Sample Characterization – Novo Amparo Norte*

Chemical characterization was conducted using X-ray fluorescence with the use of borate fused beads. The result of these analyses is detailed in Table 13-39 below:

**Table 13-39 – Particle Size Distribution and Chemical – Samples M3, M4 and M5**

| SAMPLE M3 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size (µm) | Mass (%) | (%) | | | | | | | | | | | LOI (%) |
| | | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | |
| 212 | 47.80 | 0.51 | 38.60 | 15.60 | 26.70 | 6.83 | 1.82 | 5.06 | 0.03 | 2.81 | 0.88 | 0.19 | -0.25 |
| -62 | 13.30 | 0.62 | 35.40 | 13.30 | 33.10 | 7.02 | 2.31 | 6.16 | 0.05 | 2.13 | 0.69 | 0.22 | -0.55 |
| -44 | 11.40 | 0.60 | 34.80 | 12.70 | 33.40 | 6.99 | 2.37 | 6.26 | 0.05 | 1.95 | 0.62 | 0.22 | -0.68 |
| -16 | 2.53 | 0.63 | 33.90 | 12.20 | 34.40 | 6.88 | 2.27 | 6.64 | 0.08 | 1.83 | 0.58 | 0.23 | -0.62 |
| -15 | 2.94 | 0.59 | 34.80 | 12.60 | 33.30 | 7.18 | 2.40 | 6.29 | 0.07 | 1.92 | 0.59 | 0.24 | -0.53 |
| -22 | 6.40 | 0.61 | 34.40 | 12.50 | 33.70 | 7.23 | 2.38 | 6.37 | 0.08 | 1.85 | 0.57 | 0.24 | -0.45 |
| -15 | 2.58 | 0.69 | 31.10 | 11.30 | 37.30 | 7.03 | 2.31 | 7.52 | 0.09 | 1.53 | 0.49 | 0.24 | -0.74 |
| -38 | 13.00 | 0.52 | 35.10 | 13.50 | 30.30 | 7.40 | 2.36 | 5.64 | 0.07 | 2.06 | 0.64 | 0.22 | 0.29 |
| Global | 100.00 | 0.57 | 36.80 | 14.40 | 30.40 | 7.03 | 2.14 | 5.65 | 0.04 | 2.30 | 0.75 | 0.20 | -0.09 |
| SAMPLE M4 | | | | | | | | | | | | | |
| Size (µm) | Mass (%) | (%) | | | | | | | | | | | LOI (%) |
| | | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | |
| 212 | 22.6 | 1.15 | 13 | 6.29 | 63.8 | 2.06 | 0.97 | 12.7 | 0.03 | 0.61 | 0.36 | 0.27 | -2.2 |
| -62 | 20.5 | 1.08 | 14.4 | 6.6 | 62.4 | 2.41 | 1.1 | 12.9 | 0.06 | 0.64 | 0.36 | 0.28 | -2.38 |
| -44 | 15.6 | 1.03 | 15.9 | 7.1 | 60.6 | 2.77 | 1.28 | 13.2 | 0.04 | 0.71 | 0.38 | 0.3 | -1.88 |
| -16 | 5.11 | 0.92 | 17.4 | 7.67 | 57.3 | 3.09 | 1.42 | 12.3 | 0.05 | 0.73 | 0.42 | 0.29 | -1.94 |
| -15 | 4.32 | 0.95 | 17.6 | 7.77 | 58.4 | 3.21 | 1.44 | 12.8 | 0.05 | 0.74 | 0.39 | 0.31 | -1.95 |
| -22 | 8.47 | 0.91 | 16.7 | 7.43 | 57.6 | 3.11 | 1.38 | 12.7 | 0.06 | 0.65 | 0.31 | 0.31 | -2.01 |
| -15 | 4.63 | 0.95 | 15.5 | 7.04 | 59.8 | 2.99 | 1.3 | 13.5 | 0.06 | 0.55 | 0.25 | 0.32 | -2.03 |
| -38 | 18.8 | 0.71 | 20.4 | 8.68 | 50.7 | 3.48 | 1.76 | 11.8 | 0.08 | 0.8 | 0.4 | 0.26 | -0.54 |
| Global | 100 | 0.95 | 17.6 | 7.65 | 57.4 | 2.91 | 1.45 | 12.1 | 0.04 | 0.73 | 0.43 | 0.27 | -1.58 |
| SAMPLE M5 | | | | | | | | | | | | | |
| Size (µm) | Mass (%) | (%) | | | | | | | | | | | LOI (%) |
| | | $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | |
| 212 | 37 | 0.22 | 29.1 | 12.4 | 40.8 | 4.12 | 0.91 | 10.2 | 0.03 | 2.15 | 0.6 | 0.23 | -0.94 |
| -62 | 14.4 | 0.22 | 28.4 | 11.9 | 41.8 | 4.3 | 1.05 | 10 | 0.07 | 1.94 | 0.52 | 0.25 | -0.95 |
| -44 | 12.83 | 0.21 | 28.4 | 11.9 | 41.3 | 4.49 | 1.17 | 9.49 | 0.05 | 1.81 | 0.49 | 0.26 | 0.39 |
| -16 | 3.25 | 0.21 | 30 | 12.5 | 41.2 | 4.86 | 1.26 | 9.02 | 0.06 | 1.85 | 0.48 | 0.29 | -0.88 |
| -15 | 3.46 | 0.2 | 29.5 | 12.3 | 40.3 | 4.85 | 1.28 | 8.78 | 0.06 | 1.79 | 0.46 | 0.28 | -0.8 |
| -22 | 8.12 | 0.18 | 30.5 | 12.8 | 39.7 | 4.98 | 1.32 | 8.35 | 0.07 | 1.84 | 0.46 | 0.29 | -0.71 |
| -15 | 3.56 | 0.2 | 28.9 | 12.1 | 41.3 | 4.96 | 1.27 | 9.01 | 0.08 | 1.61 | 0.39 | 0.32 | -1.09 |
| -38 | 17.4 | 0.16 | 32.7 | 13.4 | 35.3 | 4.68 | 1.43 | 7.45 | 0.07 | 1.94 | 0.55 | 0.23 | 1.27 |
| Global | 100 | 0.2 | 31.1 | 12.9 | 38.6 | 4.64 | 1.27 | 8.71 | 0.04 | 2.06 | 0.54 | 0.25 | -0.4 |

Source: Largo, 2024.

The mineralogical characterization was exclusively conducted for the HBPC sample, consisting of pre-concentrates (non-magnetic dry) from lithologies M3 and M4. X-ray diffraction and liberation analysis were conducted on the HPPC sample after cyclone desliming, using QEMSCAN, at the SGS LAKEFIELD laboratory in Canada. The results of these analyses are presented in Table 13-40 and Table 13-41.

**Table 13-40 – Mineralogical Analysis – Sample HBPC (M3 and M4)**

| Mineral | Mass (%) |
|---|---|
| Iron Oxides | 32.7 |
| Amphibole | 22.2 |
| Ilmenite | 18.8 |
| Plagioclase | 10.5 |
| Garnet | 7.6 |
| K-feldspar | 1.81 |
| Biotite | 1.43 |
| Chlorite | 1.22 |
| Others | 3.74 |

Source: Largo, 2024.

**Table 13-41 – Liberation Analysis – Sample HBPC (M3 and M4)**

| Mineral | Liberation (%) | | | | |
|---|---|---|---|---|---|
| | Cyclone Underflow | (-150+106) µm | (-106+90) µm | (-90+75) µm | (-75+38) µm |
| Iron Oxides | 87.6 | 89.0 | 90.3 | 85.6 | 85.5 |
| Ilmenite | 87.5 | 83.5 | 87.1 | 88.5 | 91.3 |

Source: Largo, 2024.

Table 13-42 below displays the results of the Bond Work Index (Wi) of the pre-concentrates of samples M3, M4 and HBPC, as well as the Bond Abrasiveness Index (Ai) for samples M3, M4 and M5.

**Table 13-42 – Work Index and Abrasiveness Index**

| Bond Work Index (Wi) – Ball Mill | |
|---|---|
| **Sample** | **Wi (kWh/t)** |
| Pre-concentrate (M3PC) | 17.60 |
| Pre-concentrate (M4PC) | 15.90 |
| HBPC | 16.80 |
| **Bond Abrasiveness Index (Ai)** | |
| **Sample** | **Ai (g)** |
| M3 | 0.032 |
| M4 | 0.018 |
| M5 | 0.025 |

Source: Largo, 2024.

### *13.5.2 Dry Magnetic Separation Tests – Novo Amparo Norte*

The dry magnetic separation tests were conducted in June 2019. To assess the magnetic recovery process and the metallurgical recovery by lithology, the core samples were crushed to particle size of -12.5 mm and subjected to dry magnetic separation tests (Figure 13-1).

For each NAN ore lithology sample, an equipment setup was evaluated to achieve a theoretical mass and metallurgical recovery limited to a maximum 4% loss of magnetics in the tailings.

**Figure 13-1 – Crushed NAN Ore (-12.5mm) and Dry Magnetic Separation Process in Drum Magnetic Separator (Low Intensity)**

Source: Largo, 2024.

Three tests were conducted per sample, the outcomes of which are depicted in Table 13-43 below.

**Table 13-43 – Dry Magnetic Separation by Set Up – Mass Recovery, Magnetic Recovery and Enrichment**

| Sample M3 | | | | | | |
|---|---|---|---|---|---|---|
| **Test** | **Mass Recovery (%)** | **Feed (% Magnetic)** | **Concentrate (% Magnetic)** | **Tailings (% Magnetic)** | **Enrichment** | **Magnetic Recovery (%)** |
| Set up 02 | 46.79 | 12.95 | 19.62 | 5.99 | 1.52 | 70.89 |
| Set up 01 | 64.69 | 12.95 | 17.64 | 4.12 | 1.36 | 88.12 |
| Set up 03 | 76.92 | 12.95 | 15.99 | 1.75 | 1.23 | 94.98 |
| **Sample M4** | | | | | | |
| **Test** | **Mass Recovery (%)** | **Feed (% Magnetic)** | **Concentrate (% Magnetic)** | **Tailings (% Magnetic)** | **Enrichment** | **Magnetic Recovery (%)** |
| Set up 02 | 77.14 | 37.62 | 45.24 | 18.94 | 1.2 | 92.76 |
| Set up 01 | 87.07 | 37.62 | 41.85 | 13.38 | 1.11 | 96.86 |
| Set up 03 | 91.77 | 37.62 | 40.96 | 6.06 | 1.09 | 99.92 |
| **Sample M5** | | | | | | |
| **Test** | **Mass Recovery (%)** | **Feed (% Magnetic)** | **Concentrate (% Magnetic)** | **Tailings (% Magnetic)** | **Enrichment** | **Magnetic Recovery (%)** |
| Set up 02 | 49.85 | 15.4 | 22.82 | 8.36 | 1.48 | 73.87 |
| Set up 01 | 70.49 | 15.4 | 19.12 | 5.88 | 1.24 | 87.52 |
| Set up 03 | 83.53 | 15.4 | 17.83 | 3.65 | 1.16 | 96.71 |

Source: Largo, 2024.

It was determined that the lithology represented by sample M4 already contains sufficient magnetic percentage to proceed to grinding without requiring dry magnetic separation. Table 13-44 presents a summary of the interpretation of the test results with the three lithologies and the potential magnetic and vanadium recoveries achievable in the industrial process.

**Table 13-44 – Dry Magnetic Separation – Summary of Results**

| Sample M3 | | | | | |
|---|---|---|---|---|---|
| **Flux** | **Mass (kg)** | **(%)** | | **Recovery (%)** | |
| | | **Magnetic** | **$V_2O_5$** | **Magnetic** | **$V_2O_5$** |
| Feed | 59.4 | 12.80 | 0.37 | 93.79% | 95.08% |
| Concentrate (Magnetic) | 43.1 | 16.56 | 0.49 | | |
| Non-magnetic | 16.3 | 2.89 | 0.07 | | |
| **Sample M5** | | | | | |
| **Flux** | **Mass (kg)** | **(%)** | | **Recovery (%)** | |
| | | **Magnetic** | **$V_2O_5$** | **Magnetic** | **$V_2O_5$** |
| Feed | 59.8 | 15.77 | 0.14 | 93.44% | 92.96% |
| Concentrate (Magnetic) | 45.7 | 19.28 | 0.17 | | |
| Non-magnetic | 14.1 | 4.38 | 0.04 | | |
| **Sample M4** | | | | | |
| **Flux** | **Mass (kg)** | **(%)** | | **Recovery (%)** | |
| | | **Magnetic** | **$V_2O_5$** | **Magnetic** | **Metallurgical** |
| Feed | - | 36.5 | 0.82 | 100% | 100% |

Source: Largo, 2024.

### *13.5.3 Wet Magnetic Separation Assays – Novo Amparo Norte*

The VMSA process route involves a grinding circuit responsible for liberating magnetite, integrated with wet magnetic separation using low-field magnetic separators in an open circuit comprising a rougher step followed by two cleaner steps.

The recovery of Grinding and Wet Magnetic Separation was calculated based on a pilot test of wet magnetic separation.

A milling curve was determined for each lithology to ensure that the magnetic separation feed size at P90 = 106µm, which is defined as optimal for magnetite liberation, is met. Material ground to this size from the pre-concentrate (M3 and M5) and ore (M4) was used in wet magnetic separation tests.

The wet tests were conducted in a circuit like the current plant's magnetic separation circuit, featuring one rougher step and two cleaner steps. Table 13-45 summarizes the results of the low-intensity wet magnetic separation tests.

**Table 13-45 – Wet Magnetic Separation – Summary of Results**

| Flux | Mass (kg) | (%) | | Recovery (%) | |
|---|---|---|---|---|---|
| **Sample Pre-concentrate (M3)** | | | | | |
| | | Magnetic | $V_2O_5$ | Magnetic | $V_2O_5$ |
| Feed | 30.0 | 18.38 | 0.55 | 99.53% | 99.17% |
| Concentrate (Magnetic) | 5.7 | 96.08 | 2.86 | | |
| Non-magnetic | 24.3 | 0.11 | 0.01 | | |
| **Sample Pre-concentrate (M4)** | | | | | |
| Flux | Mass (kg) | Magnetic | $V_2O_5$ | Magnetic | $V_2O_5$ |
| Feed | 30.0 | 38.31 | 0.83 | 99.84% | 99.87% |
| Concentrate (Magnetic) | 12.1 | 94.63 | 2.05 | | |
| Non-magnetic | 17.9 | 0.10 | 0.002 | | |
| **Sample Pre-concentrate (M5)** | | | | | |
| Flux | Mass (kg) | Magnetic | $V_2O_5$ | Magnetic | $V_2O_5$ |
| Feed | 30.0 | 18.17 | 0.19 | 99.36% | 97.44% |
| Concentrate (Magnetic) | 5.7 | 95.12 | 0.96 | | |
| Non-magnetic | 24.3 | 0.14 | 0.01 | | |
| **Sample Pre-concentrate (HBPC)** | | | | | |
| Flux | Mass (kg) | Magnetic | $V_2O_5$ | Magnetic | $V_2O_5$ |
| Feed | 30 | 27.70 | 0.66 | 99.74% | 99.70% |
| Concentrate (Magnetic) | 8.5 | 97.87 | 2.34 | | |
| Non-magnetic | 21.5 | 0.09 | 0.003 | | |

Source: Largo, 2024.

### *13.5.4 Calcination Tests – Novo Amparo Norte*

In June 2019, calcination tests were conducted at the VMSA laboratory using samples of magnetic concentrate from the Novo Amparo Norte ore (NAN), separated by lithology (M3 concentrate, M4 concentrate and M5 concentrate). The concentrate work performed at the SGS Geosol facility included crushing, dry magnetic separation, milling and wet magnetic separation tests.

The standard procedure defined for the calcination tests in a muffle oven involved the following steps:

1. Mixing a concentrate sample (80 g) with sodium carbonate ($Na_2CO_3$).
2. Placing the mixture in a muffle oven preheated to calcination temperature required for the test (1,050 °C).
3. Heating the sample for 6 hours, with the sample being removed from the muffle oven every 0.5 hours for manual homogenization.
4. Cooling the material after 6 hours of heating and pulverising it briefly to break up agglomerated particles.
5. Homogenizing the material and separating an aliquot for initial chemical analysis (initial $V_2O_5$).
6. Leaching the material at 70 °C for 1 hour, followed by transfer of the leached pulp to a 500 ml volumetric flask for cooling.

7. Filtering the pulp and washing the cake with 1,000 ml of water.
8. Analyzing the cake and determining the residual content of $V_2O_5$.

The recovery of the calcination process in muffle was calculated using the formula:

$$\boldsymbol{Rec} = \frac{\boldsymbol{V2O5\ initial - (V2O5\ residual * 0,95)}}{\boldsymbol{V2O5\ initial}} * \boldsymbol{100}$$

Where:

- $V_2O_5$ initial: Represents the $V_2O_5$ content in the calcined sample, determined by the initial chemical analysis right after calcination.
- $V_2O_5$ residual: Represents the $V_2O_5$ content of the calcined leached after filtering and washing the cake, determined by chemical analysis of the cake.
- The Factor 0.95 represents an estimated 5% reduction in the initial mass of calcined concentrate due to dissolution (leaching).

Table 13-46 to Table 13-48 summarize the results of the calcination tests conducted in a muffle.

**Table 13-46 – Calcination – Summary of Results – NAN – M3**

| Test | NAN - M3 - Metallurgical Recovery | | ScaleUp Factor: Ind / Lab |
|---|---|---|---|
| | Laboratory | Industrial (estimated) | |
| 1 | 79.4 | 84.5 | 1.065 |
| 2 | 82.0 | 86.6 | 1.057 |
| 3 | 80.6 | 85.3 | 1.058 |
| 4 | 78.2 | 82.3 | 1.052 |
| 5 | 81.3 | 84.4 | 1.037 |
| 6 | 79.8 | 81.5 | 1.022 |
| 7 | 77 | 80.4 | 1.044 |
| 8 | 77.9 | 78.8 | 1.012 |
| 9 | 80 | 83.7 | 1.046 |
| 10 | 81 | 83 | 1.025 |
| **Average** | **79.7** | **83** | **1.042** |
| **St. Dv.** | 1.6 | 2.3 | - |

Source: Largo, 2024.

**Table 13-47 – Calcination – Summary of Results – NAN – M4**

| Test | NAN - M4 - Metallurgical Recovery | | ScaleUp Factor: Ind/Lab |
|---|---|---|---|
| | Laboratory | Industrial (estimated) | |
| 1 | 89.9 | 88.6 | 0.986 |
| 2 | 83.8 | 85.1 | 1.015 |
| 3 | 80.9 | 82.8 | 1.024 |
| 4 | 89.8 | 92.2 | 1.027 |
| 5 | 85.4 | 88.8 | 1.041 |
| 6 | 79 | 81.4 | 1.030 |
| 7 | 78 | 78.0 | 1.000 |
| 8 | 77.2 | 80.4 | 1.041 |
| 9 | 78.5 | 78.7 | 1.003 |
| 10 | 83.8 | 84.4 | 1.007 |
| **Average** | **82.6** | **84** | **1.017** |
| **St. Dv.** | 4.7 | 4.7 | - |

Source: Largo, 2024.

**Table 13-48 – Calcination – Summary of Results – NAN – M5**

| Test | NAN - M5 - Metallurgical Recovery | | ScaleUp Factor: Ind / Lab |
|---|---|---|---|
| | Laboratory | Industrial (estimated) | |
| 1 | 75.4 | 75.8 | 1.006 |
| 2 | 70.2 | 73.6 | 1.049 |

| Test | NAN - M5 - Metallurgical Recovery | | ScaleUp Factor: Ind / Lab |
|---|---|---|---|
| | Laboratory | Industrial (estimated) | |
| 3 | 65.9 | 68.3 | 1.036 |
| 4 | 71.1 | 73.1 | 1.027 |
| 5 | 69.5 | 71.5 | 1.029 |
| 6 | 69.1 | 71.9 | 1.040 |
| 7 | 67.8 | 68.7 | 1.015 |
| 8 | 67.6 | 69.7 | 1.032 |
| 9 | 71.6 | 70.8 | 0.989 |
| 10 | 76.2 | 75.8 | 0.995 |
| **Average** | **70.4** | **71.9** | **1.021** |
| **St. Dv.** | 3.3 | 2.7 | - |

Source: Largo, 2024.

Each lithology exhibits different behavior in the calcination process regarding the recoveries obtained. After determining the correlation factors between Process / Laboratory and conducting the calcination tests, the estimated average industrial calcination recovery for the NAN-M3 concentrate was 83.0%, for the NAN-M4 concentrate was 84.0%, and for the concentrate NAN-M5 was 71.9%.

The significantly lower recovery of the NAN-M5 concentrate compared to other lithologies can be attributed to the low $V_2O_5$ content in the M5 concentrate (0.96% effective $V_2O_5$ in the concentrate produced in the wet magnetic separation step) compared to M3 (mean 2.86% effective $V_2O_5$) and M4 (mean 2.05% effective $V_2O_5$).

No calcination test was performed for the HBPC sample. However, the recovery of the calcination step for the HBPC sample can be inferred from the evaluation of the results of the M3 and M4 samples. Considering that the recovery obtained in the laboratory for the M3 lithology was 79.7% and for the M4 it was 82.6%, it can be estimated that the expected recovery in the laboratory for the HBPC sample is 80.6% (43% × 79.7% + 57% × 82.6% = 80.6%).

### *13.5.5 Leaching and Chemical Treatment – Novo Amparo Norte*

After the calcination step, which produces sodium metavanadate in soluble form, the subsequent production of Vanadium Pentoxide ($V_2O_5$) relies heavily on chemical reactions facilitated by the appropriate additions of reagents, temperature controls, and concentration. Additionally, the efficiency of filtering, washing, and handling equipment plays a crucial role in overall process efficiency.

Given these considerations, it is understood that parameters for Leaching Recovery, Silica Removal, Precipitation, and Ammonia Removal should be established through benchmarking and comparison with the current Industrial Plant. Therefore, no additional laboratory tests are necessary for estimating parameters in the leaching area.

For Leaching Recovery: the efficiency and recovery of soluble metavanadate in the leach area primarily depends on the calcination process and hot water dissolution, along with the effectiveness of filtering and washing the leached tailings. Hot water dissolution has already been assessed in the calcination tests mentioned earlier, leaving only estimates of filtering and washing efficiency for soluble vanadium recovery. In this context, historical (benchmarking) and optimized values from the current Industrial Plant are utilized. Thus, for the Leaching stage, a recovery rate of 97.5%, consistent with that of the current Industrial Plant, is considered.

Regarding the Recovery of the Chemical Plant: like the Leaching stage, the recovery of the Chemical Plant, which encompasses Silica Removal, Precipitation, Drying, and Ammonia Removal, is assumed to be 96.7%, mirroring the performance of the current Industrial Plant.

### *13.5.6 Global Recovery of Vanadium – Novo Amparo Norte*

Global recovery refers to the cumulative effectiveness of each step in the processing route. It encompasses dry Crushing / Magnetic Separation recovery, wet Grinding / Magnetic Separation recovery, Calcination recovery, Leaching recovery, and Chemical Plant recovery. This holistic measure of efficiency is calculated by multiplying the individual recovery rates of each step. Table 13-49 provides an overview of the Global Recovery per Sample:

$$R_{Global} = R_{Crushing} * R_{Grinding} * R_{Calcination} * R_{Leaching} * R_{Chemical\ Treatment}$$

**Table 13-49 – Global Recovery per Sample**

| Area / Process | Recoveries per Sample (%) | | | |
|---|---|---|---|---|
| | M3 | M4 | M5 | HBPC |
| Crushing / Dry Magnetic Concentration | 95.08 | 100.00 | 92.96 | 93.80 |
| Grinding / Wet Magnetic Concentration | 97.19 | 97.87 | 95.49 | 95.70 |
| Calcination | 83.00 | 84.00 | 71.90 | 80.60 |
| Leaching | 97.50 | 97.50 | 97.50 | 97.50 |
| Chemical Plant / Purification and Precipitation | 96.70 | 96.70 | 96.70 | 96.70 |
| Global | 72.31 | 77.51 | 60.17 | 68.20 |

Source: Largo, 2024.

Considering the approximate proportions of the lithologies in the resources of the deposit (M3: 33%, M4: 39%, M5: 28%), the recoveries of each stage should be very close to those estimated for the HBPC blending, as shown in Table 13-50 below.

**Table 13-50 – Average Global Recovery – Resources**

| Area / Process | Recoveries (%) | |
|---|---|---|
| | Reserve Average | HBPC |
| Crushing / Dry Magnetic Concentration | 96.41 | 93.80 |
| Grinding / Wet Magnetic Concentration | 96.98 | 95.70 |
| Calcination | 80.28 | 80.60 |
| Leaching | 97.50 | 97.50 |
| Chemical Plant / Purification and Precipitation | 96.70 | 96.70 |
| Global | 70.77 | 68.20 |

Source: Largo, 2024.

### 13.5.7 Metallurgical Recovery of Vanadium and Titanium of Ore from Novo Amparo

The recovery of titanium from ore at the Novo Amparo Norte deposit has been approached under the assumption that titanium is a by-product of the $V_2O_5$ production process. Consequently, the $TiO_2$ recoveries observed in the dry and wet magnetic concentration steps have been considered secondary to the primary goal of $V_2O_5$ recovery. As a result, no specific steps for optimizing $TiO_2$ recovery were explored until the wet magnetic separation stage.

Studies on the Gulçari A deposit, which shares the same geological formation as Novo Amparo Norte, have indicated that titanium, primarily associated with ilmenite, can be selectively recovered using flotation. These studies recommend the use of a carboxylic acid-based collector (Flotinor 10068) and non-ionic co-collector (DP-OMC-1178) for this purpose. Considering these findings, it was decided to conduct flotation tests using the tailings obtained from the wet magnetic concentration tests described in this Report, employing the parameters established in the aforementioned studies.

#### *13.5.7.1 Characterization of Samples for Titanium Recovery – Novo Amparo Norte*

Following the wet magnetic concentration tests conducted with the M3, M4, M5, and HBPC ores as described earlier in this Report, four tailings' samples were generated, named RM3, RM4, RM5, and RHBPC. These samples underwent chemical characterization based on particle size range analysis, utilizing X-ray fluorescence with Panalytical's XRF Magix Fast equipment and borate fused beads.

The results of the chemical analysis of the samples by size range are presented in Table 13-51.

**Table 13-51 – Particle Size Distribution and Chemical Analysis**

| Sample RHBPC. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Size** | **Mass (%)** | **(%)** | | | | | | | | | | **LOI** |
| (mm) | | **$SiO_2$** | **$Al_2O_3$** | **$Fe_2O_3$** | **CaO** | **MgO** | **$TiO_2$** | **$P_2O_5$** | **$Na_2O$** | **$K_2O$** | **MnO** | **$V_2O_5$** |
| +0.075 | 21.10 | 33.70 | 14.00 | 29.80 | 5.94 | 2.28 | 12.80 | 0.02 | 1.99 | 0.91 | 0.32 | 0.21 | -0.76 |
| -0.075 +0.053 | 15.50 | 34.00 | 14.00 | 29.10 | 6.23 | 2.15 | 12.20 | 0.04 | 1.96 | 0.66 | 0.35 | 0.20 | -0.97 |
| -0.053 +0.045 | 9.80 | 34.50 | 14.00 | 29.50 | 6.45 | 2.26 | 12.00 | 0.05 | 1.95 | 0.62 | 0.36 | 0.21 | -0.90 |
| -0.045 +0.038 | 6.00 | 34.60 | 14.00 | 29.00 | 6.52 | 2.27 | 11.20 | 0.05 | 1.93 | 0.60 | 0.35 | 0.21 | -0.75 |
| -0.038 | 47.60 | 33.70 | 13.70 | 28.90 | 6.38 | 2.40 | 11.00 | 0.06 | 1.90 | 0.63 | 0.29 | 0.23 | -0.22 |
| Global | 100.00 | 33.90 | 13.90 | 29.20 | 6.28 | 2.31 | 11.70 | 0.05 | 1.93 | 0.69 | 0.32 | 0.22 | -0.55 |
| **Sample RM3** | | | | | | | | | | | | |
| **Size** | **Mass (%)** | **(%)** | | | | | | | | | | **LOI** |
| **(mm)** | | **$SiO_2$** | **$Al_2O_3$** | **$Fe_2O_3$** | **CaO** | **MgO** | **$TiO_2$** | **$P_2O_5$** | **$Na_2O$** | **$K_2O$** | **MnO** | **$V_2O_5$** |
| +0.075 | 27.60 | 39.90 | 16.50 | 23.30 | 7.25 | 2.14 | 7.70 | 0.03 | 2.56 | 0.97 | 0.24 | 0.22 | -0.21 |
| -0.075 +0.053 | 14.50 | 38.90 | 15.60 | 25.00 | 7.46 | 2.11 | 8.76 | 0.05 | 2.32 | 0.70 | 0.28 | 0.23 | -0.49 |
| -0.053 +0.045 | 7.20 | 38.70 | 15.30 | 25.50 | 7.58 | 2.16 | 8.69 | 0.05 | 2.29 | 0.66 | 0.29 | 0.24 | -0.48 |
| -0.045 +0.038 | 6.10 | 39.40 | 15.80 | 24.80 | 7.75 | 2.28 | 7.83 | 0.06 | 2.38 | 0.70 | 0.26 | 0.24 | -0.27 |
| -0.038 | 44.60 | 38.60 | 15.30 | 24.90 | 7.62 | 2.35 | 7.62 | 0.06 | 2.28 | 0.70 | 0.24 | 0.25 | 0.01 |
| Global | 100.00 | 39.10 | 15.70 | 24.50 | 7.50 | 2.24 | 7.90 | 0.05 | 2.37 | 0.77 | 0.25 | 0.24 | -0.18 |
| **Sample RM4** | | | | | | | | | | | | |
| **Size** | **Mass (%)** | **(%)** | | | | | | | | | | **LOI** |
| (mm) | | **$SiO_2$** | **$Al_2O_3$** | **$Fe_2O_3$** | **CaO** | **MgO** | **$TiO_2$** | **$P_2O_5$** | **$Na_2O$** | **$K_2O$** | **MnO** | **$V_2O_5$** |
| +0.075 | 26.80 | 28.10 | 11.90 | 34.90 | 4.50 | 2.22 | 16.40 | 0.05 | 1.41 | 0.87 | 0.40 | 0.18 | -1.34 |
| -0.075 +0.053 | 13.80 | 27.80 | 11.80 | 35.60 | 4.75 | 2.13 | 16.20 | 0.06 | 1.28 | 0.56 | 0.46 | 0.17 | -1.54 |
| -0.053 +0.045 | 7.90 | 28.30 | 12.00 | 35.20 | 4.98 | 2.23 | 15.40 | 0.06 | 1.29 | 0.56 | 0.45 | 0.18 | -1.36 |
| -0.045 +0.038 | 5.40 | 29.40 | 12.50 | 35.20 | 5.13 | 2.36 | 14.80 | 0.07 | 1.36 | 0.62 | 0.44 | 0.18 | -1.07 |
| -0.038 | 46.10 | 28.30 | 11.80 | 36.00 | 4.88 | 2.45 | 15.50 | 0.07 | 1.27 | 0.59 | 0.36 | 0.22 | -0.23 |
| Global | 100.00 | 28.20 | 11.90 | 35.50 | 4.78 | 2.32 | 15.80 | 0.06 | 1.32 | 0.66 | 0.40 | 0.20 | -0.84 |
| **Sample RM5** | | | | | | | | | | | | |
| **Size** | **Mass (%)** | **(%)** | | | | | | | | | | **LOI** |
| **(mm)** | | **$SiO_2$** | **$Al_2O_3$** | **$Fe_2O_3$** | **CaO** | **MgO** | **$TiO_2$** | **$P_2O_5$** | **$Na_2O$** | **$K_2O$** | **MnO** | **$V_2O_5$** |
| +0.075 | 27.70 | 34.30 | 14.60 | 29.30 | 4.97 | 1.34 | 12.60 | 0.03 | 2.49 | 0.75 | 0.27 | 0.06 | -0.85 |

| Sample RHBPC. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Size** (mm) | **Mass (%)** | **(%)** $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | $V_2O_5$ | **LOI** |
| +0.075 | 21.10 | 33.70 | 14.00 | 29.80 | 5.94 | 2.28 | 12.80 | 0.02 | 1.99 | 0.91 | 0.32 | 0.21 | -0.76 |
| -0.075 +0.053 | 15.50 | 34.00 | 14.00 | 29.10 | 6.23 | 2.15 | 12.20 | 0.04 | 1.96 | 0.66 | 0.35 | 0.20 | -0.97 |
| -0.053 +0.045 | 9.80 | 34.50 | 14.00 | 29.50 | 6.45 | 2.26 | 12.00 | 0.05 | 1.95 | 0.62 | 0.36 | 0.21 | -0.90 |
| -0.045 +0.038 | 6.00 | 34.60 | 14.00 | 29.00 | 6.52 | 2.27 | 11.20 | 0.05 | 1.93 | 0.60 | 0.35 | 0.21 | -0.75 |
| -0.038 | 47.60 | 33.70 | 13.70 | 28.90 | 6.38 | 2.40 | 11.00 | 0.06 | 1.90 | 0.63 | 0.29 | 0.23 | -0.22 |
| Global | 100.00 | 33.90 | 13.90 | 29.20 | 6.28 | 2.31 | 11.70 | 0.05 | 1.93 | 0.69 | 0.32 | 0.22 | -0.55 |
| **Sample RM3** | | | | | | | | | | | | | |
| **Size (mm)** | **Mass (%)** | **(%)** $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | $V_2O_5$ | **LOI** |
| +0.075 | 27.60 | 39.90 | 16.50 | 23.30 | 7.25 | 2.14 | 7.70 | 0.03 | 2.56 | 0.97 | 0.24 | 0.22 | -0.21 |
| -0.075 +0.053 | 14.50 | 38.90 | 15.60 | 25.00 | 7.46 | 2.11 | 8.76 | 0.05 | 2.32 | 0.70 | 0.28 | 0.23 | -0.49 |
| -0.053 +0.045 | 7.20 | 38.70 | 15.30 | 25.50 | 7.58 | 2.16 | 8.69 | 0.05 | 2.29 | 0.66 | 0.29 | 0.24 | -0.48 |
| -0.045 +0.038 | 6.10 | 39.40 | 15.80 | 24.80 | 7.75 | 2.28 | 7.83 | 0.06 | 2.38 | 0.70 | 0.26 | 0.24 | -0.27 |
| -0.038 | 44.60 | 38.60 | 15.30 | 24.90 | 7.62 | 2.35 | 7.62 | 0.06 | 2.28 | 0.70 | 0.24 | 0.25 | 0.01 |
| Global | 100.00 | 39.10 | 15.70 | 24.50 | 7.50 | 2.24 | 7.90 | 0.05 | 2.37 | 0.77 | 0.25 | 0.24 | -0.18 |
| **Sample RM4** | | | | | | | | | | | | | |
| **Size** (mm) | **Mass (%)** | **(%)** $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $TiO_2$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | MnO | $V_2O_5$ | **LOI** |
| +0.075 | 26.80 | 28.10 | 11.90 | 34.90 | 4.50 | 2.22 | 16.40 | 0.05 | 1.41 | 0.87 | 0.40 | 0.18 | -1.34 |
| -0.075 +0.053 | 13.80 | 27.80 | 11.80 | 35.60 | 4.75 | 2.13 | 16.20 | 0.06 | 1.28 | 0.56 | 0.46 | 0.17 | -1.54 |
| -0.053 +0.045 | 7.90 | 28.30 | 12.00 | 35.20 | 4.98 | 2.23 | 15.40 | 0.06 | 1.29 | 0.56 | 0.45 | 0.18 | -1.36 |
| -0.045 +0.038 | 5.40 | 29.40 | 12.50 | 35.20 | 5.13 | 2.36 | 14.80 | 0.07 | 1.36 | 0.62 | 0.44 | 0.18 | -1.07 |
| -0.038 | 46.10 | 28.30 | 11.80 | 36.00 | 4.88 | 2.45 | 15.50 | 0.07 | 1.27 | 0.59 | 0.36 | 0.22 | -0.23 |
| Global | 100.00 | 28.20 | 11.90 | 35.50 | 4.78 | 2.32 | 15.80 | 0.06 | 1.32 | 0.66 | 0.40 | 0.20 | -0.84 |
| **Sample RM5** | | | | | | | | | | | | | |
| -0.075 +0.053 | 13.90 | 32.60 | 14.10 | 31.60 | 5.07 | 1.33 | 13.00 | 0.04 | 2.12 | 0.51 | 0.38 | 0.06 | -1.24 |
| -0.053 +0.045 | 7.60 | 33.70 | 14.40 | 31.30 | 5.31 | 1.43 | 11.90 | 0.05 | 2.12 | 0.50 | 0.36 | 0.07 | -1.03 |
| -0.045 +0.038 | 5.20 | 34.70 | 14.90 | 30.40 | 5.38 | 1.45 | 10.70 | 0.05 | 2.22 | 0.53 | 0.35 | 0.07 | -0.74 |
| -0.038 | 45.60 | 34.10 | 14.20 | 30.00 | 4.85 | 1.55 | 9.90 | 0.06 | 2.08 | 0.58 | 0.25 | 0.07 | 0.55 |
| Global | 100.00 | 33.90 | 14.30 | 30.10 | 4.98 | 1.45 | 11.30 | 0.05 | 2.21 | 0.61 | 0.29 | 0.07 | -0.27 |

Source: Largo, 2024.

The desliming at 10 µm was conducted in a hydrocyclone. The underflow and fines (overflow) of each sample were analyzed using Panalytical's XRF Magix Fast and the use of borate fused beads. Table 13-52 presents the results obtained in the cloning.

**Table 13-52 – Non-magnetic Desliming Results**

| Sample | Flux | $TiO_2$ (%) | $TiO_2$ Recovery (%) | Mass Recovery (%) |
|---|---|---|---|---|
| **M3** | Feed | 7.90 | 83.0 | 77.0 |
| | Underflow | 8.50 | | |
| | Overflow | 5.86 | | |
| **M4** | Feed | 15.80 | 98.0 | 97.0 |
| | Underflow | 15.90 | | |
| | Overflow | 12.60 | | |
| **M5** | Feed | 11.30 | 88.0 | 82.0 |
| | Underflow | 12.20 | | |
| | Overflow | 7.33 | | |
| **HBPC** | Feed | 11.70 | 96.0 | 94.0 |
| | Underflow | 11.90 | | |
| | Overflow | 8.31 | | |

Source: Largo, 2024.

The results depicted in Table 13-52 reveal that cyclone desliming may lead to losses of up to 20% of $TiO_2$, as evidenced in the case of sample M3. However, the anticipated average recovery hovers around 90%, factoring in the proportion of resources attributed to each lithological type (M3: 33%, M4: 39%, M5: 28%). This suggests a loss of approximately 10% of $TiO_2$ on average, a figure closely resembling the titanium content typically found in the slurry currently generated at VMSA for the $V_2O_5$ production process from the Gulçari A deposit.

#### *13.5.7.2 Flotation of Samples for Titanium Recovery – Novo Amparo Norte*

For the flotation process, a Denver D12 bench flotation machine with 2.5-liter tanks, an air flow rate of 2 liters / minute, and a rotation speed of 1,000 rpm was utilized. All resulting products underwent analysis using Panalytical's XRF Magix Fast with borate fused beads.

In each test, a 10-minute attrition step was implemented at 50% solids by weight, followed by a 2-minute pre-conditioning phase with fluosilicic acid and the DP-OMC-1178 reagent, which was added in a single dose during this stage. The Flotinor 10068 collector was introduced in a staged manner, with equal divisions across each of the conditioning steps preceding the froth collections. Hence, for instance, a test with a dosage of 200 g/t of collector across 4 conditioning stages would involve an addition of 50 g/t in each stage. All experiments were conducted solely on the fraction retained in the 10 µm range of the RM3, RM4, RM5, and RHBPC samples. The findings are summarized in the tables below.

Table 13-53 highlights the titanium contents and recoveries obtained during the flotation process for each collection stage. The reported results represent accumulative grades and recoveries, indicating the progressive concentration of titanium across successive collection stages.

**Table 13-53 – Flotation Test Results – Accumulated Grades and Recoveries**

| Sample | Test | Reagent Dosage (g/t) | | Collect | Concentrate $TiO_2$ (%) | $TiO_2$ Recovery (%) |
|---|---|---|---|---|---|---|
| | | Flotinor 10068 | DP-OMC-1178 | | | |
| RHBPC | 1ª | 200 | 400 | 1 | 44.1 | 68.3 |
| | | | | 2 | 43.1 | 80.4 |
| | | | | 3 | 42.3 | 84.4 |
| | 1B | 200 | 400 | 1 | 42.7 | 67.3 |
| | | | | 2 | 40.8 | 81.0 |
| | | | | 3 | 40.0 | 83.8 |
| | 1C | 200 | 400 | 1 | 41.0 | 68.9 |
| | | | | 2 | 39.3 | 81.2 |
| | | | | 3 | 38.3 | 84.6 |
| RM3 | 2ª | 200 | 400 | 1 | 32.3 | 80.6 |
| | | | | 2 | 30.6 | 89.4 |
| | | | | 3 | 29.0 | 91.4 |
| | 2B | 200 | 400 | 1 | 29.4 | 81.2 |
| | | | | 2 | 27.5 | 89.4 |
| | | | | 3 | 26.1 | 91.3 |
| RM4 | 3ª | 200 | 400 | 1 | 48.5 | 37.7 |
| | | | | 2 | 48.3 | 41.3 |
| | 3B | 200 | 400 | 1 | 49.2 | 31.6 |
| | | | | 2 | 48.9 | 36.4 |
| | 9 | 300 | 400 | 1 | 47.7 | 66.1 |
| | | | | 2 | 47.5 | 76.5 |
| | | | | 3 | 47.3 | 78.5 |
| | 10 | 400 | 400 | 1 | 46.5 | 57.3 |
| | | | | 2 | 46.0 | 77.9 |
| | | | | 3 | 45.6 | 82.6 |
| RM5 | 4ª | 200 | 400 | 1 | 47.9 | 13.9 |
| | | | | 2 | 47.9 | 16.3 |
| | 4B | 200 | 400 | 1 | 49.4 | 12.9 |
| | | | | 2 | 49.3 | 14.9 |
| | 11 | 400 | 400 | 1 | 45.1 | 25.0 |
| | | | | 2 | 45.1 | 29.2 |
| | 12 | 500 | 400 | 1 | 43.7 | 36.8 |
| | | | | 2 | 43.4 | 45.4 |
| | 13 | 800 | 800 | 1 | 37.6 | 42.6 |
| | | | | 2 | 36.6 | 60.9 |
| | | | | 3 | 36.0 | 67.6 |

Source: Largo, 2024.

Considering the result of the second collection of each test, the average recovery and grade for each sample is presented in Table 13-54.

**Table 13-54 – Flotation Test Results – Collect 2 – Average Results Summary**

| Sample | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|
| **RM3** | 29.1 | 89.4 |
| **RM4** | 45.6 | 82.6 |
| **RM5** | 43.4 | 45.4 |
| **RHBPC** | 41.1 | 80.9 |

Source: Largo, 2024.

Additionally, a flotation test of the non-magnetic tailings from the M5 lithology, categorized by particle size range, was conducted, revealing low recovery for fines smaller than 38 µm. Table 13-55 presents the obtained results.

**Table 13-55 – Flotation Test Results – By Fraction – Average Results Summary**

| Size (µm) | Test | Collect | Concentrate $TiO_2$ (%) | Recovery $TiO_2$ (%) |
|---|---|---|---|---|
| +53 | 6 | 1 | 46.5 | 86.5 |
| | | 2 | 45.9 | 95.8 |
| -53+38 | 7 | 1 | 35.1 | 89.8 |
| | | 2 | 33.2 | 96.1 |
| | | 3 | 32.4 | 96.4 |
| -38 | 8 | 1 | 45.7 | 6.2 |
| | | 2 | 45.6 | 7.4 |

Source: Largo, 2024.

The global $TiO_2$ recovery (Table 13-56) was estimated based on the recoveries of dry Crushing / Magnetic Separation, Wet Grinding / Magnetic Separation, Desliming, and Flotation, using the formula:

$$R_{Global} = R_{Crushing} \times R_{Grinding} \times R_{Desliming} \times R_{Flotation}$$

**Table 13-56 – $TiO_2$ Recovery by Area, by Sample and Reserve – Average Summary**

| Area / Process | Recovery per Sample $TiO_2$ (%) | | | |
|---|---|---|---|---|
| | M3 | M4 | M5 | HBPC |
| Crushing / Dry Magnetic Concentration | 83.0 | 100.0 | 84.0 | 82.0 |
| Grinding / Wet Magnetic Concentration | 92.0 | 83.0 | 94.0 | 89.0 |
| Desliming | 83.0 | 98.0 | 88.0 | 96.0 |
| Flotation | 89.0 | 83.0 | 45.0 | 81.0 |
| **Global** | **56.0** | **68.0** | **31.0** | **58.0** |
| **Reserve (M3: 33%; M4: 39%, M5: 28%) - Global** | **53.7** | | | |

Source: Largo, 2024.

### *13.5.8 Ilmenite Concentration Plant (Ilmenite Plant)*

The Ilmenite Plant operation commenced in August 2023. The process initiates with the non-magnetic flow generated at the existing wet magnetic separator. There are three principal unit operations in the Ilmenite Plant: desliming, flotation and concentrate dewatering. Desliming aims to remove fines using cyclones because fine material can adversely affect flotation. Ilmenite is concentrated in three flotation stages: rougher, cleaner, and recleaner, using tank-type flotation cells. The rougher stage produces the final tailings from the concentration process. The final concentrate, from the recleaner flotation stage, is pumped to the concentrate thickener. The underflow from the concentrate thickener is pumped to a filtration feed regulation tank in a horizontal vacuum filter. The filter produces the dewatered ilmenite cake, which is stacked to form a pile. From the pile, the concentrate is transported to individual bays for homogenization and subsequent bulk shipment, by trucks, to consumers. Figure 13-2 shows a simplified ilmenite process flowsheet.

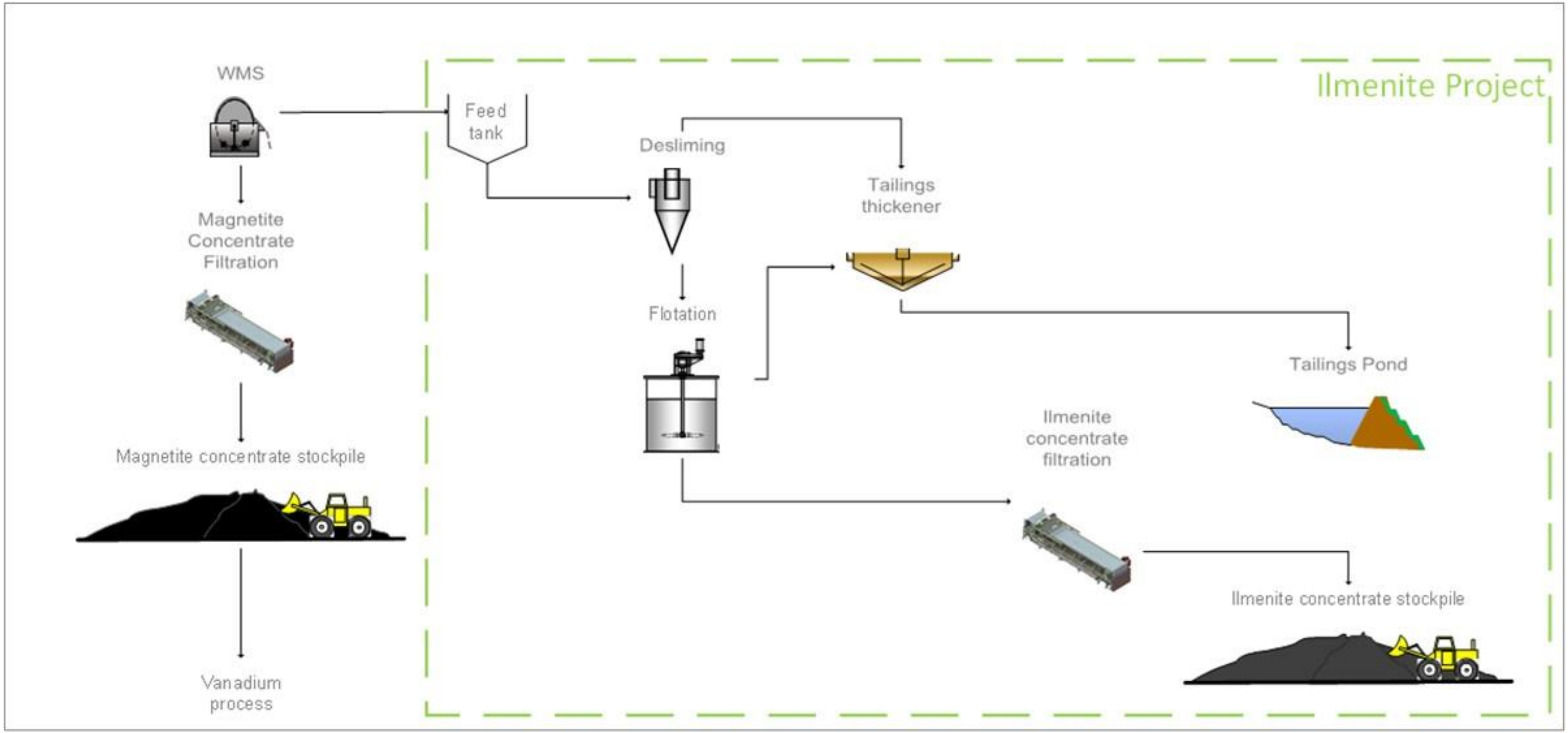



**Figure 13-2 – Ilmenite Process Flowsheet**

Source: Largo, 2024.

During the plant's ramp-up phase, due to several improvements in reagents dosages and the higher efficiency of the industrial equipment compared to lab equipment used for process development, the ilmenite concentrate grate could be increased to 46% $TiO_2$. Table 13-57 shows the results from August 2023 to April 2024.

**Table 13-57 – Ilmenite Production, $TiO_2$ Recovery, and Ilmenite Concentrate Grade**

| Month | Aug/23 | Sept/23 | Oct/23 | Nov/23 | Dec/23 | Jan/24 | Feb/24 | Mar/24 | Apr/24 |
|---|---|---|---|---|---|---|---|---|---|
| Ilmenite Production (t) | 350 | 700 | 814 | 2,546 | 5,610 | 5,100 | 2,000 | 2,463 | 2,374 |
| Flotation Recovery (%) | 55.1 | 52.8 | 36.3 | 41.1 | 42.6 | 56.2 | 58.0 | 44.8 | 43.1 |
| Ilmenite Concentrate Grade (%) | 40.1 | 41.0 | 42.9 | 43.2 | 42.7 | 43.6 | 42,2 | 41.9 | 46.5 |

Source: Largo, 2024.

Although a direct correlation between the samples used in process development and the industrial results is not possible, the results of the plant ramp-up were obtained with ore from the upper zone represented by samples A7, A8, and A9, by Blend C, and by RNM C. Comparing the results of bench flotation from RNM C with industrial results, it's evident that high concentrate grades (46% vs. 41%) are achievable with lower recoveries (53% vs. 80%). As the Ilmenite Plant is in a ramp-up process, improvements in recoveries are expected while maintaining the concentrate grade.

The ilmenite process is monitored by taking samples in all stages, including feeding desliming, cyclones overflow and underflow, flotation feeding, rougher, cleaner, final concentrate, and stockpiles. X-Ray analysis is employed for processes monitoring, while X-ray plus titration analysis methods is used for shipment. The graphic below (Figure 13-3) shows the results of % $TiO_2$ in the final concentrate.

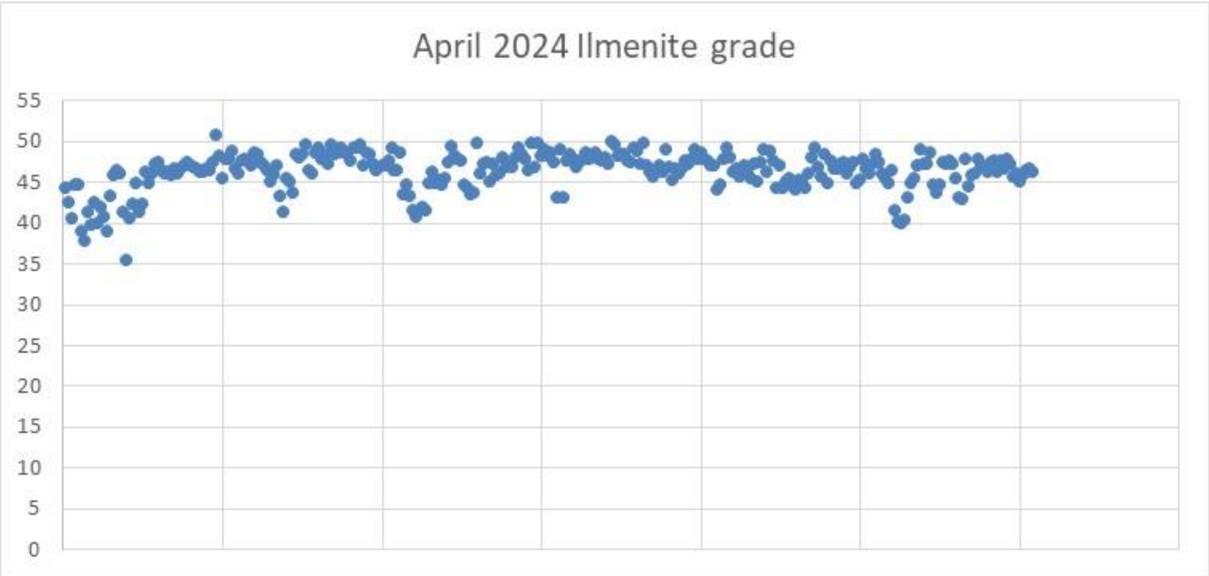



**Figure 13-3 – Graphic: % $TiO_2$ in the Ilmenite Concentrate**

Source: Largo, 2024.

Despite the expected high variation during ramp-up, the graph indicates that it is possible to produce ilmenite concentrate with commercial grade (higher than 44% $TiO_2$) using the Ilmenite Plant and the deposits from Largo. This is corroborated by the fact that, until the issuance of this Report, the Company shipped at least 2 lots of concentrate for exportation.

## 13.6 Pigment Project

### *13.6.1 Pilot Plant Tests for $TiO_2$ Pigment Production from Ilmenite*

Since 2021, Largo has conducted a series of pilot plant tests aimed at producing and optimizing the titanium dioxide ($TiO_2$) pigment production process from ilmenite directly extracted from the Largo Maracás Mine. This Technical Report outlines and summarizes methodologies, tests, and outcomes of this initiative, emphasizing the use of ilmenite from Maracás and the downscaled replication of industrial production processes.

#### *13.6.1.1 Sample Characterization*

The ilmenite used in the pilot plant test follows the characteristics shown in Table 13-58 below:

**Table 13-58 – Characteristics of the Ilmenite Used in the Pilot Plant Test**

| $V_2O_5$ | $SiO_2$ | $Al_2O_3$ | Fe | CaO | MgO | $TiO_2$ | $Cr_2O_3$ | MgO | MnO |
|---|---|---|---|---|---|---|---|---|---|
| 0.26 | 2.25 | 1.01 | 34.63 | 0.24 | 1.00 | 47.75 | 0.05 | 1.00 | 0.85 |

Source: Largo, 2024.

#### *13.6.1.2 Pilot Plant Testing Overview*

The production stages in the pilot plant replicate the phases of industrial pigment production through the sulfate route method, ensuring the applicability of the results in larger-scale operations. All tests have utilized ilmenite extracted from Maracás, reinforcing the integration and potential scalability of this process.

#### *13.6.1.3 Digestion Phase*

To date, the digestion stage in the pilot plant involved 34 batches, consuming a total of 850 kg of ilmenite. Parameters such as temperature, reagent concentration, and residence time have been carefully evaluated and optimized to enhance the reaction's efficacy.

#### *13.6.1.4 Hydrolysis Phase*

During the hydrolysis phase, 15 test batches were processed, resulting in 432 kg of hydrated titanium oxide cake, an intermediate compound essential for pigment production. This stage focused on optimizing parameters like temperature, primary seeding dosage, and residence time, crucial for precipitating high-quality $TiO_2$.

#### 13.6.1.5 Calcination Phase

The pilot plant conducted 144 calcination batches, producing a total of 68 kg of calcined rutile pigment. Out of this total, approximately 54 kg underwent surface treatment and micronization to obtain the final product. This material was externally compared with commercially available products in Brazil, demonstrating similar performance characteristics, thus emphasizing the quality of the pigment produced in the pilot plant.

#### 13.6.1.6 Pilot Plant Process Description

The production process in the pilot plant begins with the grinding of ilmenite to achieve the proper particle size for an efficient acid attack. The ground ilmenite is then reacted with sulfuric acid, using metallic iron to reduce Fe+3 to Fe+2. The resultant liquor undergoes filtration and crystallization to form $FeSO_4.7H_2O$, with the remaining liquor polished through a second filtration before proceeding to hydrolysis. Here, with the addition of primary seeding, hot water, and heating, soluble $TiO_2$ is converted into its insoluble form, called hydrated titanium oxide.

The hydrolyzed liquor is then filtered, and the resulting cake is washed to reduce the iron content and treated with sulfuric acid, aluminum, and rutile seeding agents. The cake undergoes treatment and washing again before calcination, where additives promote rutile crystal formation and influence particle size, crucial for the pigment's characteristics.

After calcination, the pigment is subjected to grinding, surface treatment with oxides, and finally micronization, preparing it for application testing and market distribution.

### 13.6.2 Global Recovery

The global recovery considered for the Project was the standard achieved worldwide for pigment production processes through sulfation. The considered recovery is 85% of $TiO_2$ recovery.

### 13.6.3 Pigment Produced in the Pilot Plant

The pigment produced in the pilot plant was studied by a laboratory specialized in the study and preparation of Latex Paints, verifying properties such as color, brightness, coverage, and applicability according to the requirements of the ABNT NBR 15079 standard.

The pigment produced from an innovative process of titanium recovery from mining waste evidenced performance analogous to market reference titanium dioxide pigments. Within the results obtained from the research of the properties of the new pigment, the following data can be highlighted:

Morphology: the new pigment presented optimized morphological characteristics, verified by images obtained in scanning electron microscopy and laser granulometry tests. The average particle diameter of the new pigment is smaller than the market reference products (FR767 and RKB2), besides presenting granulometric distribution values indicating greater dimensional homogeneity. On the other hand, X-ray diffraction testing confirmed the predominant presence of the rutile crystalline structure of the new pigment, with a similar content to reference pigments.

Chemical Composition: the determination of inorganic elements in the sample of the new pigment demonstrated an evolution in the process of obtaining this pigment, as the presence of chromium and lead was not detected in the sample, as well as a reduction in iron and potassium content. Among the analyzed elements, aluminum and silicon presented the highest contents, a fact correlated with the usual surface treatments of titanium dioxide pigments. When applying the new pigment in latex paints, there was technological demonstration of the maturity of the process of obtaining the new pigment, as the pigment conferred performance like reference materials.

The study conducted with latex paints indicated some differences in specific properties, as highlighted below:

Dry Hiding Power: the data obtained in the dry hiding power test of the paint showed favorable results for the Rutile 001-002/23 pigment. This property resulted in a higher yield of the paint when compared to reference formulations (FR 767 and RKB2). These satisfactory results may be related to the granulometric distribution of the new pigment (particles of smaller diameter and greater homogeneity), which allowed better uniformity and structuring of the particles in the applied paint film.

Weather Resistance: the performance of the accelerated aging test, by exposing latex paint films to UV and xenon radiation, indicated that paints prepared with reference pigments and with the new pigment showed no occurrences of cracks or bubbles, which would denote pronounced polymeric degradation. The latex paint prepared with Rutile 001-002/23 showed low color variation, but with higher values than paints prepared with reference pigments. This data may be indicative of an opportunity for improvement in the surface treatment process of the new titanium dioxide pigment.

### *13.6.4 Conclusion*

Largo's efforts in its pilot plant illustrate a commitment to leveraging its resources for high-value product development. The meticulous optimization of parameters and adaptation of processes within the pilot facility underscores the potential to scale these processes to meet industrial production demands while maintaining environmental and economic sustainability. Further testing and optimizations will continue to refine these processes, aiming to enhance efficiency.

## 13.7 Recommendations

1. Enhance flotation studies and consider conducting pilot-scale tests within the traditional circuit, encompassing rougher, scavenger, and cleaner stages, utilizing column cells.
2. Investigate wet magnetic separation of medium intensity (up to 7,000 Gauss) on a bench scale for the low-intensity wet non-magnetic waste from the current plant, which is rich in titanium, prior to the desliming step in a hydrocyclone. Evaluate the technical and economic feasibility of introducing medium-intensity magnetic separation as a pre-concentration and desliming step before flotation.
3. Assess the recovery of titanium from dry low-intensity non-magnetic tailings, as well as residual vanadium, for each lithology and deposit through bench tests with small samples. Explore the following process developments:
    - Crushing using a vertical shaft crusher (VSI) in a closed circuit with vibrating screen, achieving reduction below approximately 3.0 mm, followed by low (800 Gauss; 1,500 Gauss) and medium intensity wet or dry magnetic separation (up to 7,000 Gauss), in rougher, scavenger, and cleaner stages.
    - Milling in HPGR (High Pressure Grinding Rolls) in a closed circuit with vibrating sieve, achieving reduction below approximately 2.0 mm (or ideally < 2.0 mm), followed by dry or wet magnetic separation in low (800 Gauss: 1,500 Gauss) and medium intensity (up to 7,000 Gauss), in rougher, scavenger, and cleaner stages.
4. Conduct a trade-off study to evaluate the operational expenditure (OPEX) and capital expenditure (CAPEX) associated with crushing in a VSI crusher and grinding in HPGR, as well as compare them with the current plant's crushing and grinding circuit.
5. Perform periodic analyses in an independent certified laboratory to compare and monitor the percentage of $TiO_2$ in ilmenite concentrate for shipments, ensuring the accuracy of the results.

## 13.8 Qualified Person's Opinion

In the opinion of the QP, the metallurgical test work conducted for the Campbell Pit, NAN, SJO, GAN and NAO deposits, concerning both the $V_2O_5$ process and the $TiO_2$ process, is adequate for pre-feasibility and feasibility level process design. The comminution characteristics are well-established at Campbell Pit and have shown consistency across the various testing phases. These characteristics have been evaluated at NAN, SJO, GAN and NAO and found to be similar. Sufficient testing of the ilmenite concentration process for each deposit has been conducted. Metallurgical test work for the proposed Pigment Plant process has also undergone adequate testing to be relied upon for both Mineral Reserve estimates and for initial project design engineering. The samples tested represent the material to be mined and processed according to the mine schedule. The Project's mineralized zones do not contain deleterious elements.

# 14 MINERAL RESOURCE ESTIMATES

## 14.1 Introduction

The QP validated geological models received from Largo and then adjusted these models, when necessary, to produce updated block models and consequent declare the Mineral Resources estimates for Campbell Pit, GAN, SJO, NAO, NAN, GAS, JAC and RIOCON deposits using current topographic and current drilling data. The main factors considered for the Mineral Resource estimate classification were quantity and spatial arrangement of data, interpretation of mineralization controls, type of mineralization and data quality. The Mineral Resource was marked off within the geological and mining right limits.

The deposits identified within the Rio Jacaré Intrusion are similar in nature to the V-Ti-Fe Bushveld Complex (South Africa). The vanadiferous-titanomagnetite mineralization occurs associated stratified gabbro-anorthosite complexes. The Gulçari A (Campbell Pit) deposit has demonstrated high vanadium content and is currently in production for vanadium and ilmenite concentrates. The other deposits exhibit similar geological controls but drilling and metallurgical testing indicating lower concentrations of vanadium and $TiO_2$.

This section presents the main evaluations made to consolidate the Mineral Resources of the Project. The steps for validation were:

- Database analysis.
- Validation of the 3D geological model.
- Analysis of sample support.
- Descriptive statistic of the domains.
- Density.
- Variography.
- Block model validation.
- Interpolation validation.

## 14.2 Database

Most of the mineral research data received and used to define the 3D geological model and Mineral Resource estimate was compiled into Leapfrog Software and classified by deposit to improve file organization, integrity and security. Table 14-1 summarize the databases for the Project.

**Table 14-1 – Drilling Database Summary**

| Target | Nº Drill hole | Drilling (m) | Number of samples | Total Size of samples (m) |
|---|---|---|---|---|
| Gulçari A (Campbell Pit) | 232 | 41,098.88 | 15,884 | 15,356.53 |
| Gulçari A Norte (GAN) | 117 | 20,154.80 | 9,433 | 9,166.97 |
| Novo Amparo Norte (NAN) | 124 | 21,714.26 | 8,711 | 8,405.69 |
| Novo Amparo Oeste (NAO) | 59 | 9,770.05 | 4,260 | 4,156.46 |
| São José (SJO) | 61 | 10,718.85 | 5,159 | 5,072.30 |
| Jacaré (JAC) | 28 | 3,943.22 | 2,079 | 2,078.77 |

| Target | Nº Drill hole | Drilling (m) | Number of samples | Total Size of samples (m) |
|---|---|---|---|---|
| Gulçari A Sul (GAS) | 19 | 5,125.96 | 1,352 | 1,323.42 |
| Rio de Contas (RIOCON) | 10 | 1,503.65 | 284 | 254.11 |
| **Total** | **650** | **114,029.67** | **47,162** | **45,814.25** |

Source: GE21, 2024.

All data from drilling programs were in MS Excel containing grade analysis for $V_2O_5$, $TiO_2$, Fe, $SiO_2$, and Davis Tube Test results.

Such database consists of the following tables:

- Collar – Table with the location, azimuth, inclination and final length of the drill holes.
- Survey – Hole inclination and azimuth information along the drill holes trace.
- Lithology – Geological description of rock types and degree of weathering.
- Assay – Information on the results of multi-element chemical analysis.

Standard validation of this database followed the steps:

- Final Depth – Check for consistency between the final depths listed in the assay and lithological tables and the values listed in the collar table.
- Gaps Overlap – Checking gaps overlap in same hole.
- Collar – Checking of coordinate consistency and final depths – Filling error.

Relevant inconsistency was not found during the database validation process.

## 14.3 Geological Modelling

The mineralized mafic-ultramafic intrusion is within a regional geological context called Rio Jacaré Intrusion, which has a sheet-like structure in the north-south direction, with a length of approximately 70 km, an average width of 1.2 km, and a dip of 70° E.

This igneous body was divided by Brito (2000) into three main zones, namely, Lower Zone, Upper Zone I and Upper Zone II, and between the Lower Zone and the Upper Zone there is a Transition Zone, characterized by the presence of rocks mineralized in iron, titanium and vanadium oxides, organized in layers interspersed with pyrogenic and gabbroic rocks.

Studies conducted by Largo have led to a detailed subdivision of the Upper Zone of the Rio Jacaré intrusion within the Project area into several cyclic units. It is interpreted that cycles C1 to C4 represent the feeder zone of the Rio Jacaré Intrusion. These cycles exhibit limited lateral continuity across the entire length of the deposit and are confined to this feeder zone. In contrast, cycles C5 to C10, which form the upper portions of the deposit, extend laterally over the entire strike length of the Rio Jacaré Intrusion.

The 3D geological models were made available by Largo and were validated by the QP and adjusted when necessary. All typologies are modelled by implicit method using Leapfrog Geo software.

Cycles C5 to C10 were modelled by differentiating each magmatic cycle, while cycles C1 to C4 were modelled together.

Campbell Pit and GAN Deposits were modeled together due to the continuity of mineralization, where C1 to C4 cycles are predominantly in the sector west of Campbell Pit and C5 to C10 cycles are predominantly in the east sector of Campbell Pit and GAN. These last cycles demonstrate continuity and have similar characteristics of North and South Deposits of Rio Jacaré Intrusion.

Results from Davis Tube (%DT) and geological description were used to define the lithology types. Table 14-2 shows the main rock types modelled. Grade shells at 0.3% of $V_2O_5$ and 1% of $TiO_2$ were used to constrain the mineralized zones. The waste typologies such as pegmatite, gabbro, anorthosite, granite and soils also were modelled based on geological description.

**Table 14-2 – Lithology definition by magnetic content**

| Lithology | Magnetics Mass (Tube Davis) |
|---|---|
| Massive and banded Magnetite (MAG) | >35% |
| Magnetite-pyroxenite (MPXT);<br>Magnetite Gabbro (MGB) | 10 - 35% |
| Pyroxenite with Magnetite (PXTM);<br>Gabbro with Magnetite (GCM) | 4 - 10% |
| Pyroxenite (PXT);<br>Gabbro (GAB) | <4% |

Source: GE21, 2024.

The interpretation of small intervals of non-magnetic horizons within the mineralized interval were considered internal dilution.

The modelled geological domains resulted from intersection of magmatic cycles with lithological types.

Figure 14-1 to Figure 14-11 show typical cross-sections of deposits.

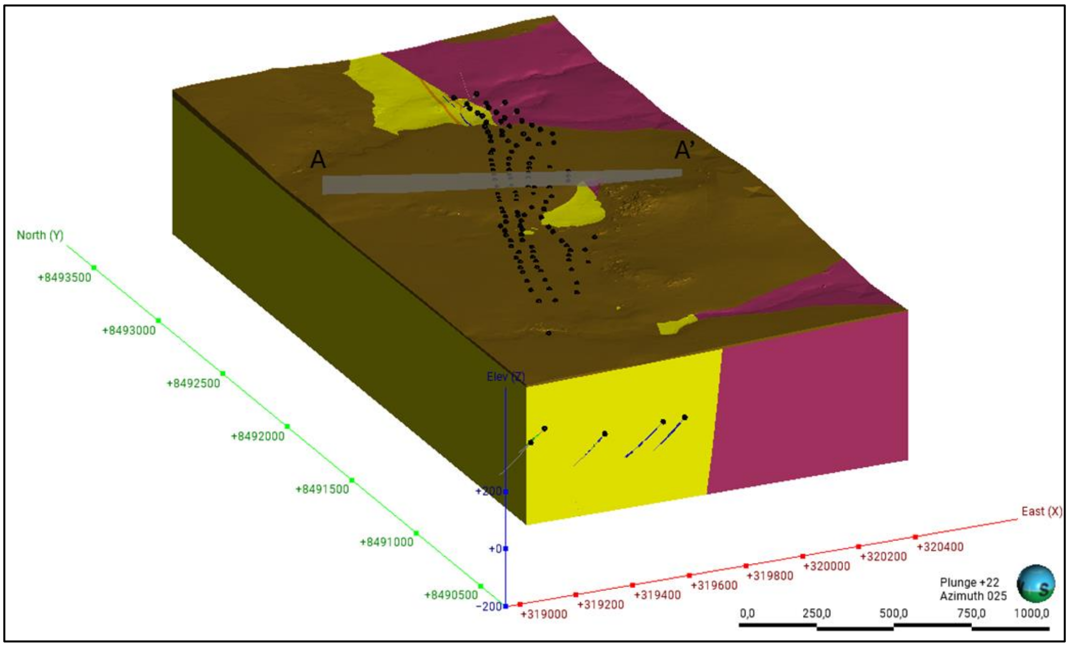



**Figure 14-1 – Geological model 3D – NAN Deposit**

Source: GE21, 2024.

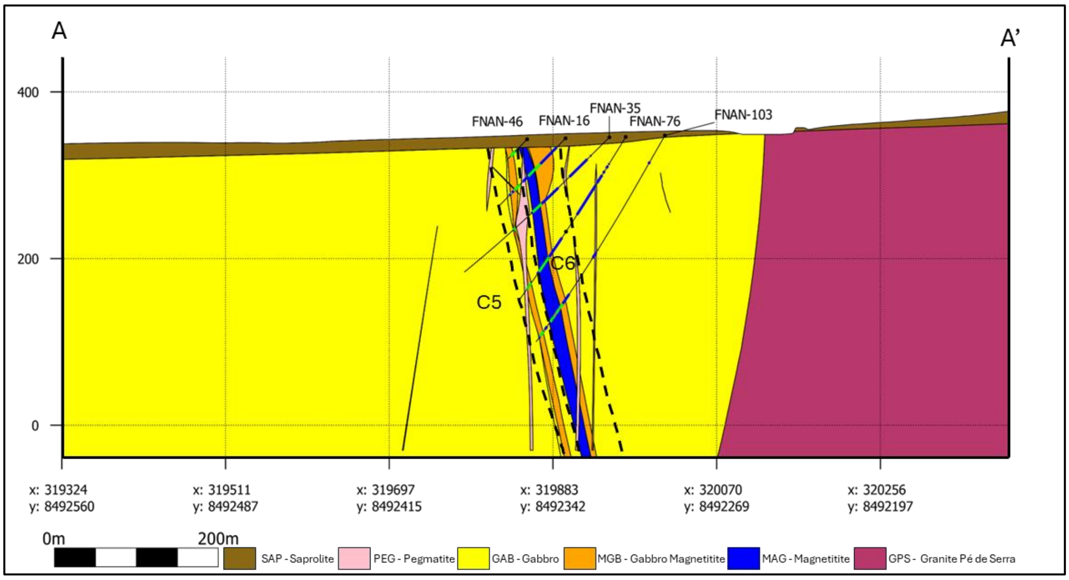



**Figure 14-2 – Typical lithological cross-section with cycle indications– NAN Deposit**

Source: GE21, 2024.

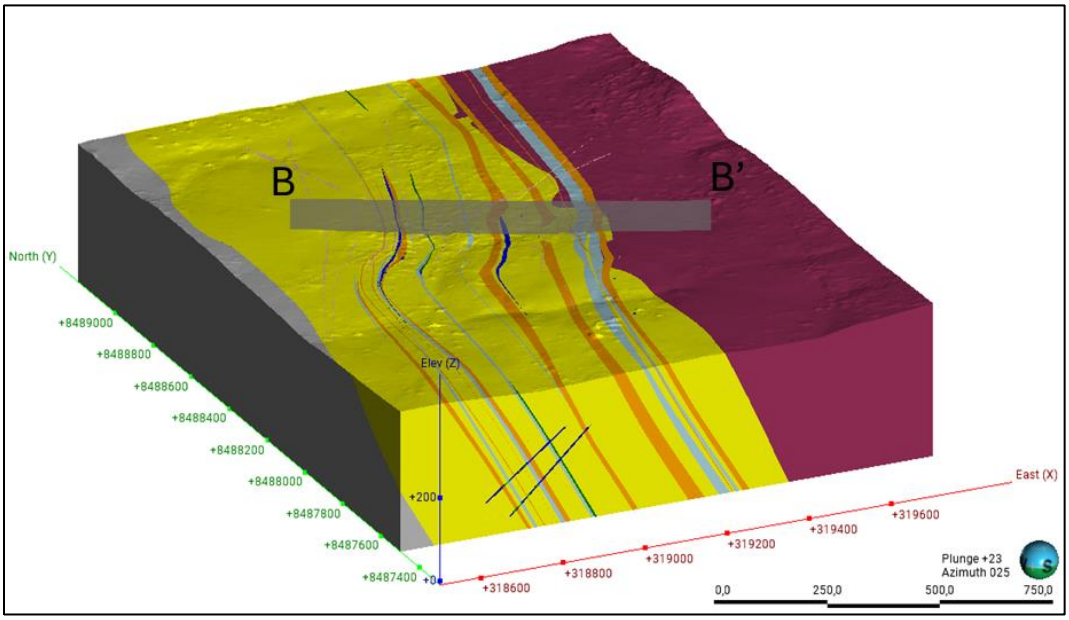



**Figure 14-3 – Geological model 3D –SJO Deposit**

Source: GE21, 2024.

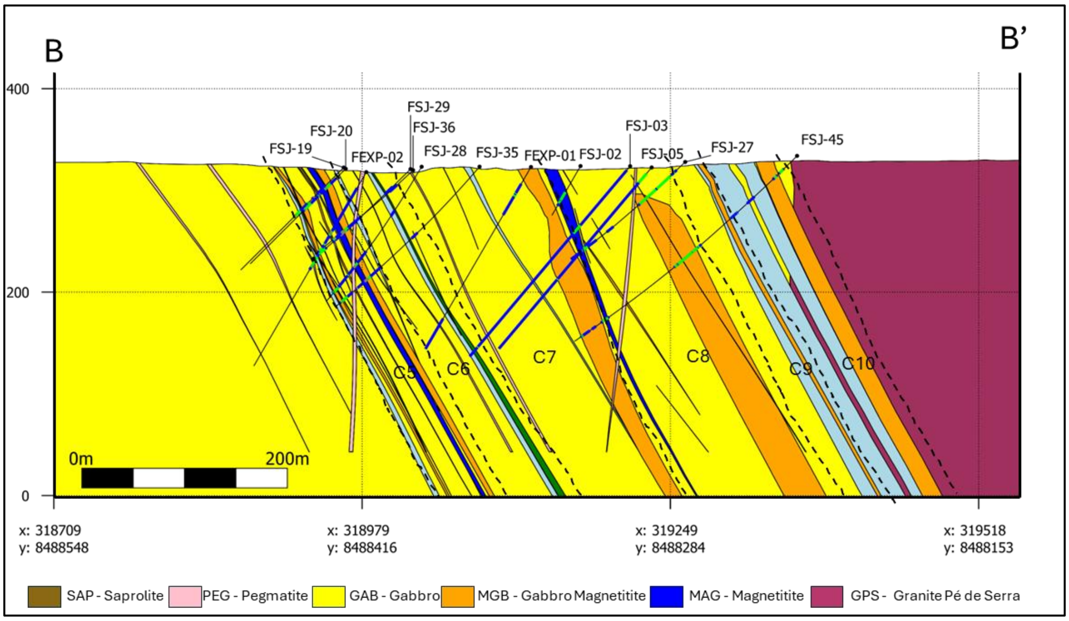



**Figure 14-4 – Typical lithological cross-section with cycle indications – SJO Deposit**

Source GE21, 2024.

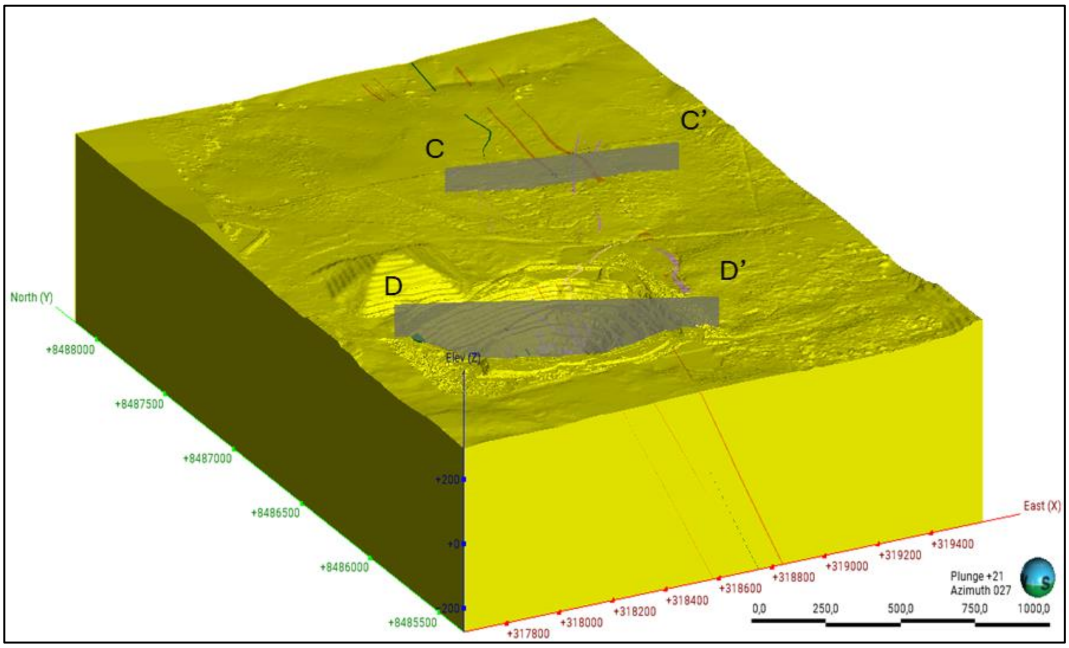



**Figure 14-5 – Geological model 3D – Campbell Pit and GAN Deposit**

Source: GE21, 2024.

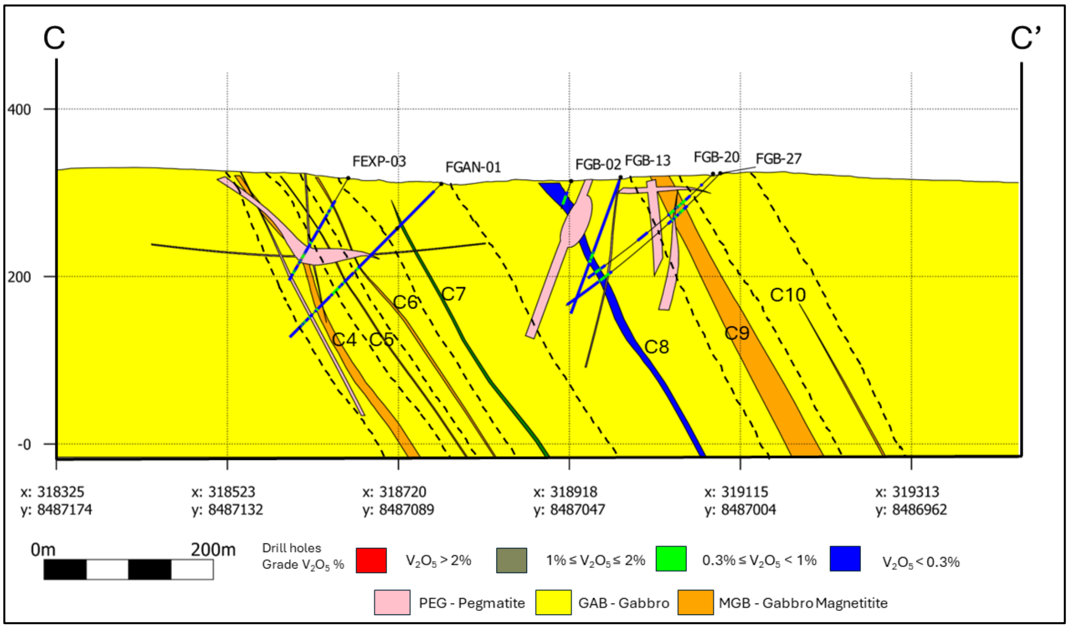



**Figure 14-6 – Typical lithological cross-section with cycle indications – GAN Deposit**

Source: GE21, 2024.

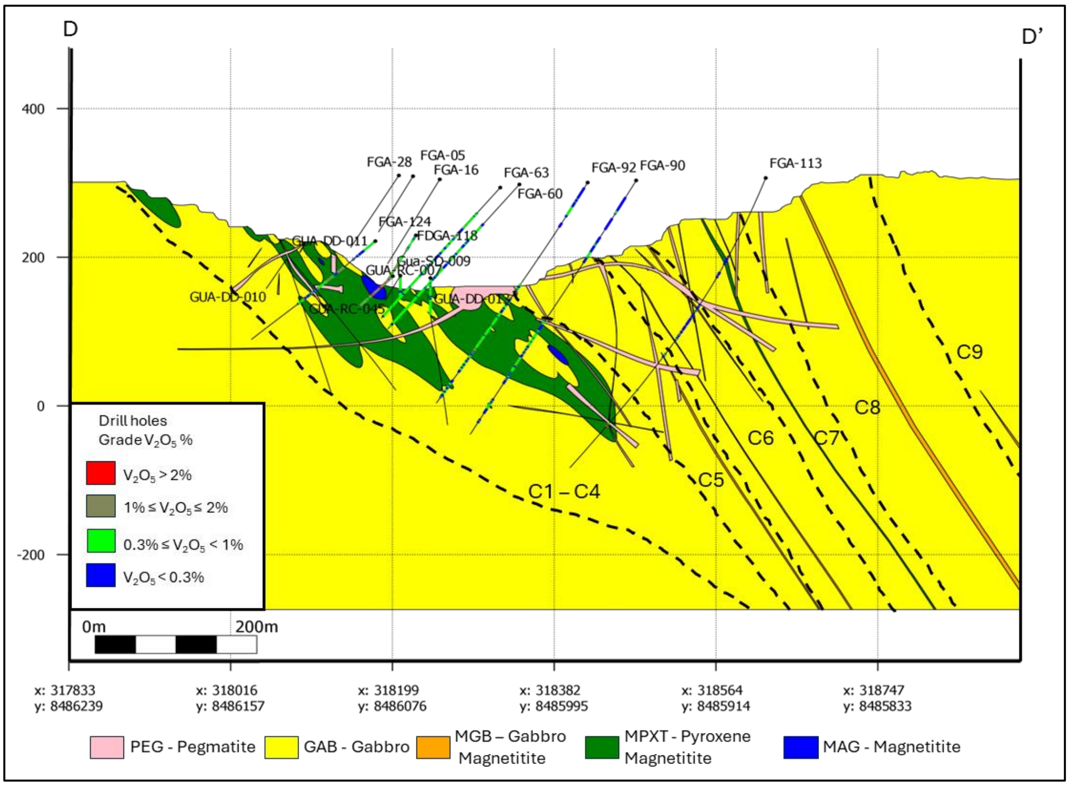



**Figure 14-7 – Typical lithological cross-section with cycle indications – Campbell Pit Deposit**

Source: GE21, 2024.

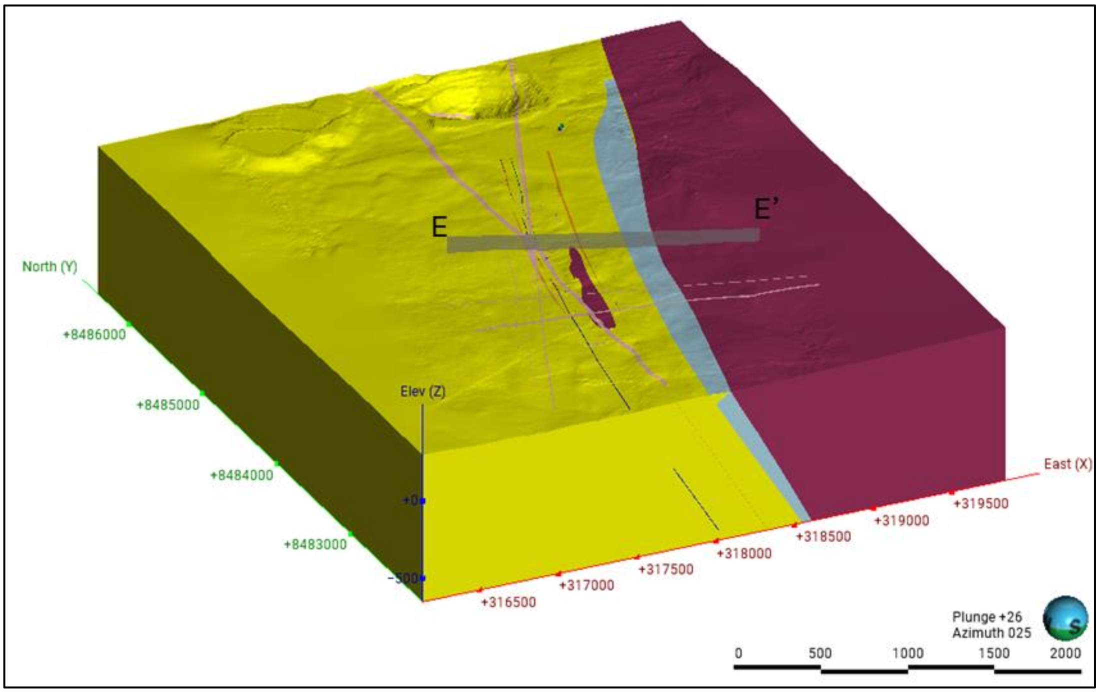



**Figure 14-8 – Geological model 3D – GAS Deposit**

Source: GE21, 2024.

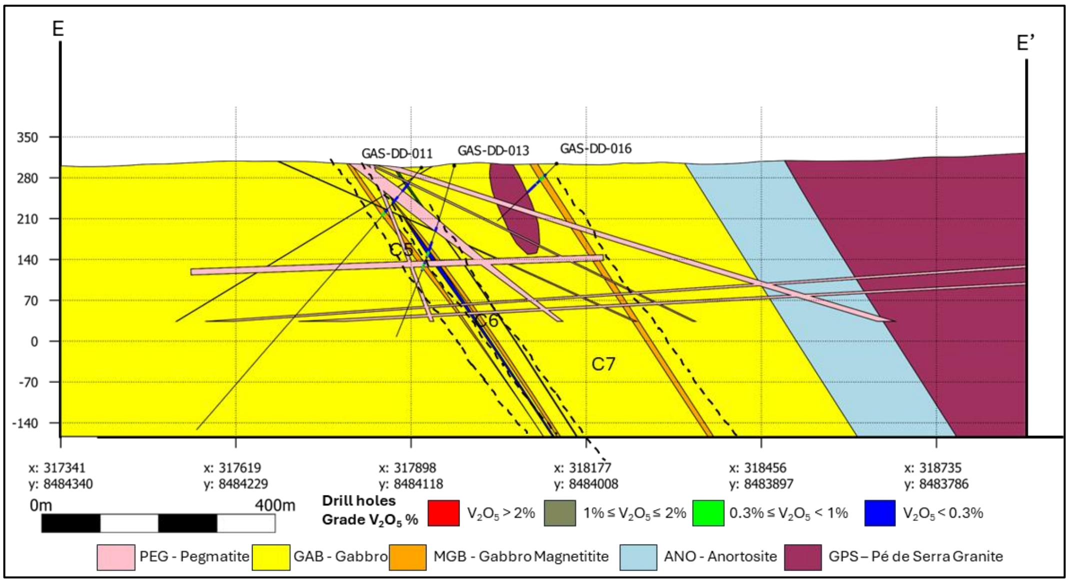



**Figure 14-9 – Typical lithological cross-section with cycle indications – GAS Deposit**

Source: GE21, 2024.

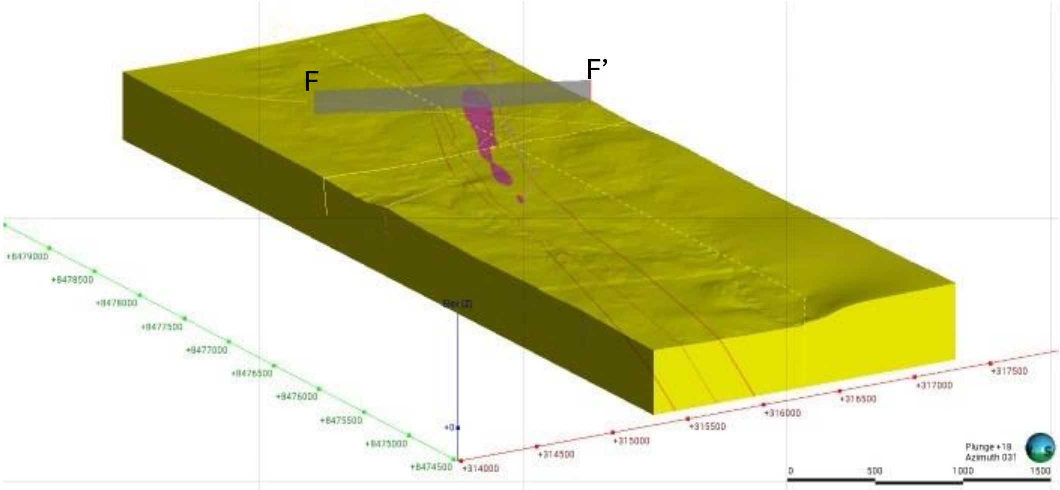



**Figure 14-10 – Geological model 3D – JAC Deposit**

Source: GE21, 2024.

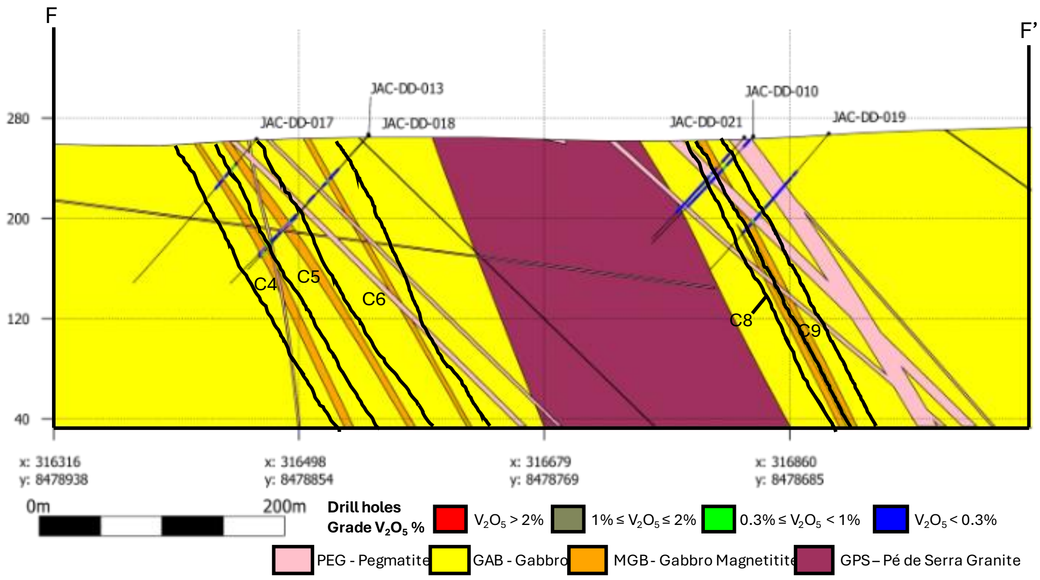



**Figure 14-11 – Typical lithological cross-section with cycle indications – JAC Deposit**

Source: GE21, 2024.

## 14.4 Composite Regularization

The analysis of composite support conducted on the samples indicated the 1-meter modal used in sampling with more than 75% of samples shorter than 1 meter. Considering the dimensions of the mineralized horizons, the QP generated regularized composites of 1 meter for EDA and geostatistical studies. Composites smaller than 0.75 m were not used in the estimate.

## 14.5 Exploratory Data Analysis (EDA)

Exploratory analysis was made over composite data for % $V_2O_5$, %$TiO_2$, %Fe, %$SiO_2$ and %DT in composite. The following is a brief description of attributes analyzed:

- $V_2O_5$ XH – $V_2O_5$ content in head grades.

- $SiO_2$ XH – $SiO_2$ content in head grades.
- Fe XH – Fe content head grades.
- $TiO_2$ XH – $TiO_2$ content in head grades.
- $V_2O_5$ XC – $V_2O_5$ content in the Davis Tube magnetic concentrates.
- $SiO_2$ XC – $SiO_2$ content in the Davis Tube magnetic concentrates.
- Fe XC – Fe content in the Davis Tube magnetic concentrates.
- $TiO_2$ XC – $TiO_2$ content in the Davis Tube magnetic concentrates.
- DT – mass recovery of magnetite in the Davis Tube magnetic concentrates.

Table 14-3 to Table 14-9 show a summary of the statistical analysis conducted for the estimated domain on each target. Figure 14-12 to Figure 14-18 show the boxplot of $V_2O_5$ in the lithologies.

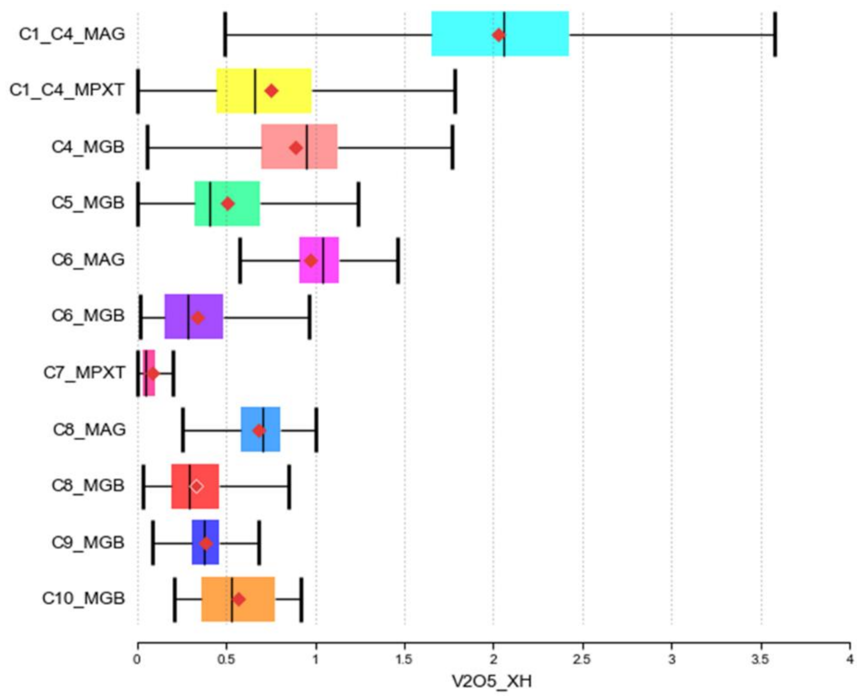



**Figure 14-12 – Campbell Pit and GAN $V_2O_5$ Boxplots**

Source: GE21, 2024.

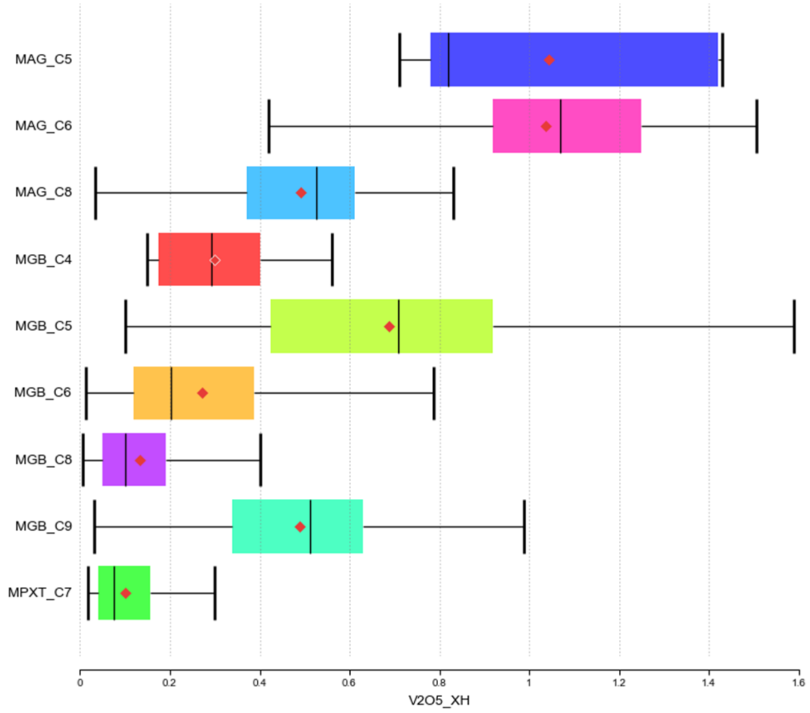



**Figure 14-13 – SJO $V_2O_5$ Boxplots**

Source: GE21, 2024.

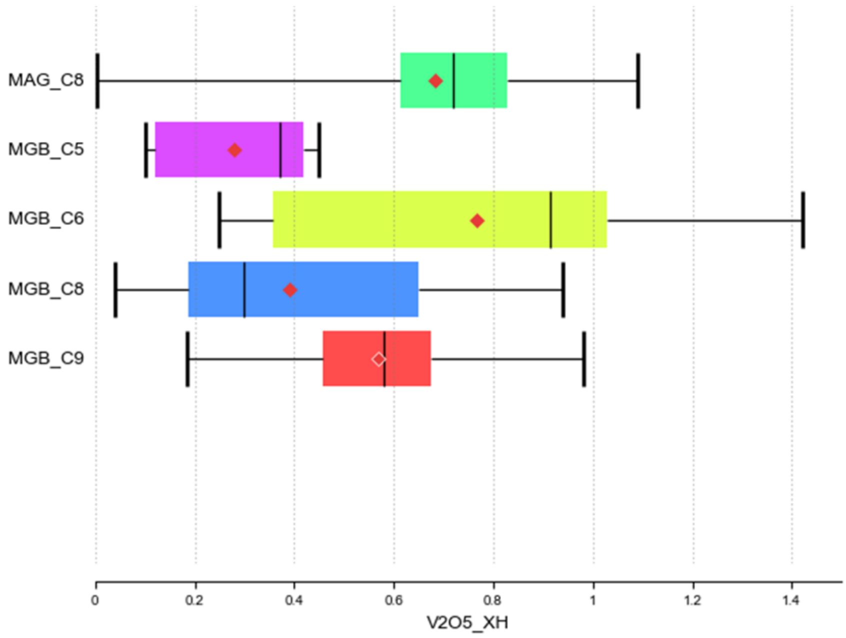



**Figure 14-14 – NAO $V_2O_5$ Boxplots**

Source: GE21, 2024.

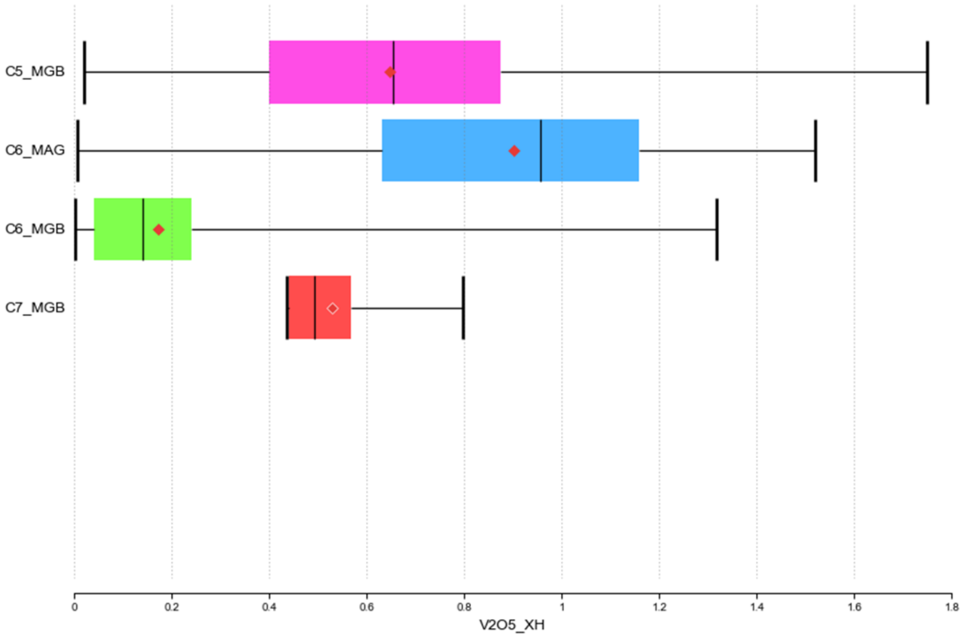



**Figure 14-15 – NAN $V_2O_5$ Boxplots**

Source: GE21, 2024.

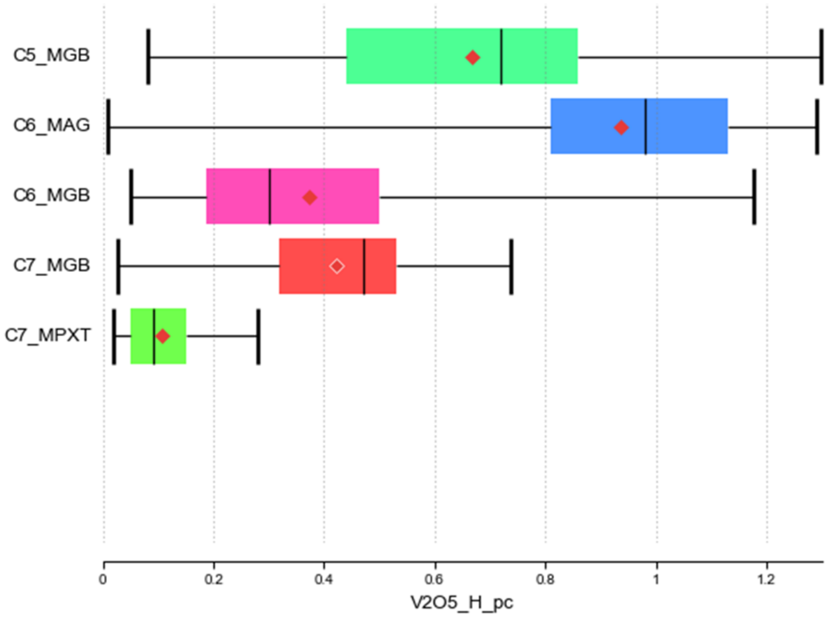



**Figure 14-16 – GAS $V_2O_5$ Boxplots**

Source: GE21, 2024.

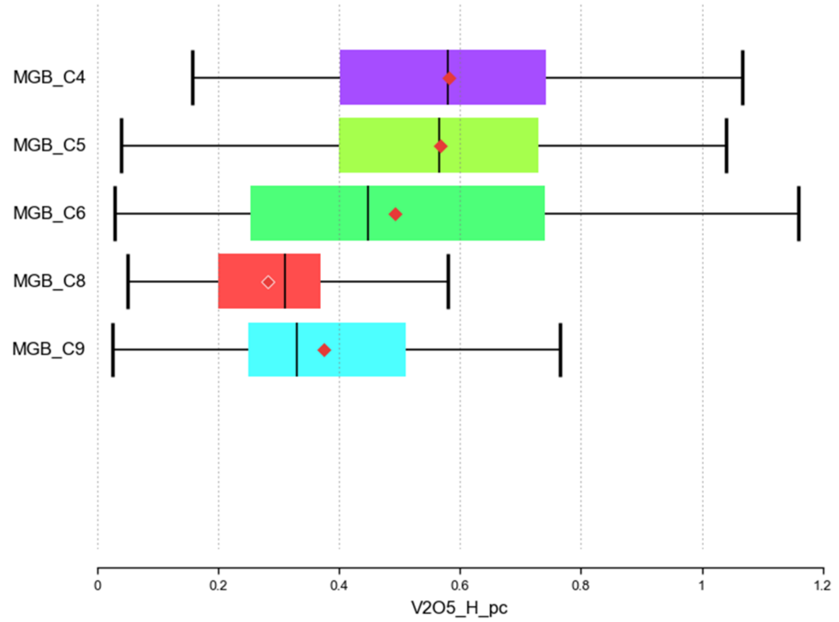



**Figure 14-17 – JAC $V_2O_5$ Boxplots**

Source: GE21, 2024.

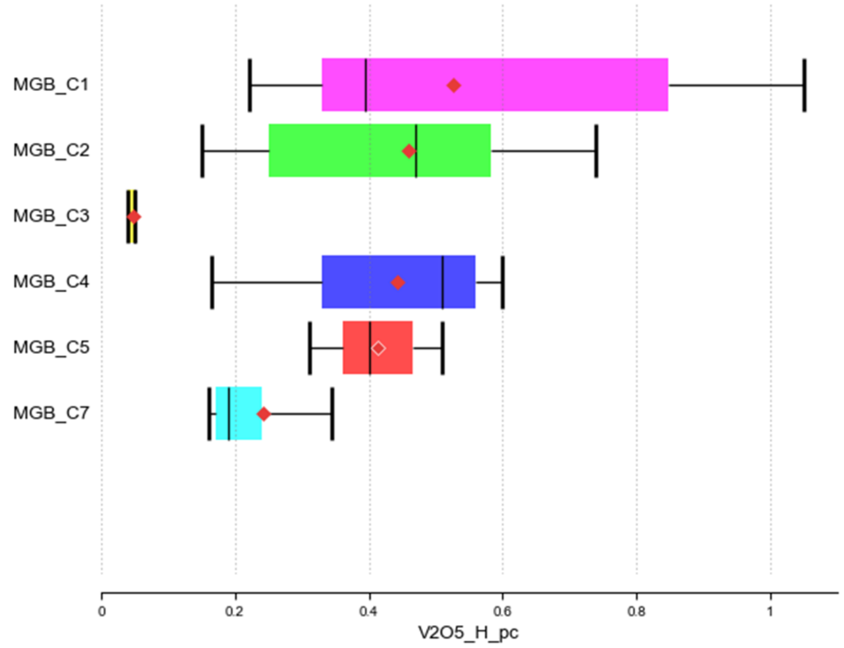



**Figure 14-18 – RIOCON $V_2O_5$ Boxplots**

Source: GE21, 2024.

**Table 14-3 – Campbell Pit and GAN descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| **C1_C4_MAG** | DT | 2 441 | 2 474 | 53.99 | 15 | 0.28 | 224.97 | 0.01 | 56.9 | 90.38 |
| | $TiO_2$_XC | 2 402 | 2 435 | 6.7 | 2.36 | 0.35 | 5.56 | 1.13 | 6.66 | 59.92 |
| | $TiO_2$_XH | 2 176 | 2 207 | 11.87 | 3.3 | 0.28 | 10.9 | 0.04 | 12.27 | 20.31 |
| | $V_2O_5$_XC | 2 401 | 2 434 | 3.51 | 0.57 | 0.16 | 0.32 | 0.19 | 3.39 | 7.9 |
| | $V_2O_5$_XH | 2 176 | 2 207 | 2.05 | 0.64 | 0.31 | 0.41 | 0.05 | 2.09 | 3.93 |
| **C1_C4_MPXT** | DT | 6 354 | 6 438 | 17.9 | 13.33 | 0.74 | 177.62 | 0 | 14.62 | 77.47 |
| | $TiO_2$_XC | 5 623 | 5 691 | 4.44 | 2.01 | 0.45 | 4.04 | 0.58 | 4.39 | 63.27 |
| | $TiO_2$_XH | 5 952 | 6 036 | 5.22 | 2.81 | 0.54 | 7.87 | 0.01 | 4.85 | 17.01 |
| | $V_2O_5$_XC | 5 617 | 5 684 | 3.08 | 0.76 | 0.25 | 0.58 | 0.22 | 3.09 | 11.3 |
| | $V_2O_5$_XH | 5 952 | 6 036 | 0.75 | 0.44 | 0.59 | 0.2 | 0 | 0.66 | 3.68 |

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| C4_MGB | DT | 259 | 267 | 17.78 | 8.44 | 0.47 | 71.25 | 0.09 | 19.15 | 52.31 |
| | $TiO_2$_XC | 238 | 246 | 2.06 | 0.99 | 0.48 | 0.99 | 0.55 | 1.88 | 7.67 |
| | $TiO_2$_XH | 286 | 295 | 6.18 | 1.72 | 0.28 | 2.95 | 0.14 | 6.5 | 11.38 |
| | $V_2O_5$_XC | 230 | 238 | 3.42 | 0.62 | 0.18 | 0.39 | 0.9 | 3.55 | 4.92 |
| | $V_2O_5$_XH | 265 | 273 | 0.89 | 0.31 | 0.35 | 0.1 | 0.02 | 0.95 | 1.79 |
| C5_MGB | DT | 149 | 152 | 18.64 | 9.76 | 0.52 | 95.34 | 0.02 | 16.5 | 43.8 |
| | $TiO_2$_XC | 142 | 144 | 2.29 | 1.61 | 0.71 | 2.61 | 0.4 | 1.87 | 8.87 |
| | $TiO_2$_XH | 263 | 268 | 4.97 | 2.42 | 0.49 | 5.84 | 0.06 | 4.25 | 11.6 |
| | $V_2O_5$_XC | 132 | 133 | 2.33 | 0.77 | 0.33 | 0.59 | 0.37 | 2.54 | 3.61 |
| | $V_2O_5$_XH | 263 | 268 | 0.51 | 0.28 | 0.56 | 0.08 | 0.01 | 0.41 | 1.45 |
| C6_MAG | DT | 161 | 177 | 33.87 | 9.54 | 0.28 | 91.01 | 0.11 | 36.15 | 50.82 |
| | $TiO_2$_XC | 159 | 176 | 3.44 | 1.06 | 0.31 | 1.13 | 1.03 | 3.38 | 7.89 |
| | $TiO_2$_XH | 162 | 179 | 11.79 | 1.9 | 0.16 | 3.6 | 0.05 | 12.2 | 17.32 |
| | $V_2O_5$_XC | 155 | 170 | 2.32 | 0.3 | 0.13 | 0.09 | 1.08 | 2.38 | 3.47 |
| | $V_2O_5$_XH | 162 | 179 | 0.97 | 0.24 | 0.25 | 0.06 | 0 | 1.04 | 1.5 |
| C6_MGB | DT | 197 | 205 | 15.75 | 8.45 | 0.54 | 71.36 | 0.33 | 15.4 | 34 |
| | $TiO_2$_XC | 185 | 193 | 2.08 | 0.98 | 0.47 | 0.97 | 0.66 | 1.9 | 5.12 |
| | $TiO_2$_XH | 205 | 213 | 8.52 | 2.63 | 0.31 | 6.94 | 2.54 | 8.92 | 12.9 |
| | $V_2O_5$_XC | 182 | 191 | 1.36 | 0.56 | 0.41 | 0.31 | 0.23 | 1.32 | 2.53 |
| | $V_2O_5$_XH | 205 | 213 | 0.34 | 0.24 | 0.71 | 0.06 | 0.02 | 0.28 | 1.02 |
| C7_MPXT | DT | 99 | 105 | 16.81 | 6.18 | 0.37 | 38.16 | 0.26 | 17.05 | 30.51 |
| | $TiO_2$_XC | 92 | 98 | 2.66 | 1.21 | 0.45 | 1.46 | 1.2 | 2.26 | 8.6 |
| | $TiO_2$_XH | 102 | 108 | 9.7 | 2.84 | 0.29 | 8.04 | 1.62 | 9.64 | 14.75 |
| | $V_2O_5$_XC | 92 | 98 | 0.39 | 0.41 | 1.06 | 0.17 | 0.11 | 0.24 | 1.87 |
| | $V_2O_5$_XH | 104 | 111 | 0.09 | 0.11 | 1.28 | 0.01 | 0 | 0.05 | 0.55 |
| C8_MAG | DT | 276 | 281 | 40.94 | 11.55 | 0.28 | 133.47 | 1.26 | 42.5 | 60.6 |
| | $TiO_2$_XC | 268 | 273 | 5.17 | 1.3 | 0.25 | 1.69 | 0.61 | 5.33 | 10.99 |
| | $TiO_2$_XH | 313 | 319 | 14.9 | 2.95 | 0.2 | 8.7 | 4.24 | 15.3 | 21.1 |
| | $V_2O_5$_XC | 222 | 225 | 1.58 | 0.3 | 0.19 | 0.09 | 0.73 | 1.62 | 2.65 |
| | $V_2O_5$_XH | 293 | 298 | 0.69 | 0.17 | 0.25 | 0.03 | 0.05 | 0.7 | 1.01 |
| C8_MGB | DT | 184 | 192 | 18.39 | 10.98 | 0.6 | 120.48 | 0.01 | 16.79 | 49.04 |
| | $TiO_2$_XC | 165 | 173 | 2.93 | 1.58 | 0.54 | 2.48 | 0.58 | 2.41 | 8.75 |
| | $TiO_2$_XH | 211 | 220 | 8.93 | 3.51 | 0.39 | 12.29 | 0.78 | 9.01 | 16.56 |
| | $V_2O_5$_XC | 164 | 172 | 1.39 | 0.46 | 0.33 | 0.21 | 0.17 | 1.45 | 2.83 |
| | $V_2O_5$_XH | 211 | 220 | 0.33 | 0.19 | 0.56 | 0.03 | 0.03 | 0.29 | 0.85 |
| C9_MGB | DT | 1 165 | 1 175 | 14.8 | 6.59 | 0.45 | 43.46 | 0 | 14.22 | 36.87 |
| | $TiO_2$_XC | 1 082 | 1 092 | 1.64 | 1 | 0.61 | 0.99 | 0.41 | 1.35 | 8.4 |
| | $TiO_2$_XH | 1 214 | 1 225 | 6.94 | 1.79 | 0.26 | 3.21 | 0.27 | 6.9 | 11.04 |
| | $V_2O_5$_XC | 1 080 | 1 090 | 1.59 | 0.18 | 0.12 | 0.03 | 0.99 | 1.6 | 2.55 |
| | $V_2O_5$_XH | 1 213 | 1 224 | 0.38 | 0.12 | 0.32 | 0.01 | 0.01 | 0.38 | 0.77 |
| C10_MGB | DT | 16 | 17 | 18.56 | 10.5 | 0.57 | 110.26 | 3.92 | 15.23 | 36.9 |
| | $TiO_2$_XC | 15 | 16 | 1.94 | 0.82 | 0.42 | 0.67 | 0.73 | 1.7 | 3.71 |
| | $TiO_2$_XH | 16 | 17 | 6.3 | 2.36 | 0.37 | 5.56 | 2.5 | 6.79 | 9.54 |
| | $V_2O_5$_XC | 15 | 16 | 2.15 | 0.11 | 0.05 | 0.01 | 1.95 | 2.19 | 2.35 |
| | $V_2O_5$_XH | 16 | 17 | 0.56 | 0.23 | 0.41 | 0.05 | 0.21 | 0.53 | 0.92 |

Source: GE21, 2024.

**Table 14-4 – SJO descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| MAG_C5 | DT | 7 | 6.1 | 32.15 | 14.35 | 0.45 | 206.04 | 18.55 | 25.7 | 53.5 |
| | $TiO_2$_XC | 7 | 6.1 | 3.58 | 1.52 | 0.42 | 2.3 | 1.72 | 3.49 | 5.96 |
| | $TiO_2$_XH | 7 | 6.1 | 9.66 | 2.7 | 0.28 | 7.27 | 6.51 | 7.91 | 12.6 |
| | $V_2O_5$_XC | 7 | 6.1 | 2.74 | 0.26 | 0.09 | 0.07 | 2.41 | 2.79 | 3.1 |
| | $V_2O_5$_XH | 7 | 6.1 | 1.04 | 0.34 | 0.32 | 0.11 | 0.71 | 0.82 | 1.43 |
| MAG_C6 | DT | 184 | 190.39 | 36.31 | 11.27 | 0.31 | 126.93 | 0.06 | 38.3 | 60.5 |
| | $TiO_2$_XC | 178 | 184.59 | 3.35 | 0.97 | 0.29 | 0.95 | 1.09 | 3.35 | 7.55 |
| | $TiO_2$_XH | 189 | 195.44 | 11.88 | 2.58 | 0.22 | 6.68 | 0.05 | 12.65 | 14.9 |
| | $V_2O_5$_XC | 178 | 184.59 | 2.36 | 0.43 | 0.18 | 0.19 | 1.11 | 2.37 | 3.49 |
| | $V_2O_5$_XH | 187 | 193.44 | 1.04 | 0.29 | 0.28 | 0.09 | 0.06 | 1.07 | 1.51 |
| MAG_C8 | DT | 65 | 67.1 | 37.68 | 14.14 | 0.38 | 199.87 | 0.1 | 41.28 | 57.94 |
| | $TiO_2$_XC | 60 | 62.1 | 4.9 | 1.31 | 0.27 | 1.71 | 1.17 | 4.95 | 11.17 |
| | $TiO_2$_XH | 65 | 67.1 | 14.17 | 3.56 | 0.25 | 12.65 | 2.49 | 15.31 | 18.9 |
| | $V_2O_5$_XC | 60 | 62.1 | 1.13 | 0.32 | 0.28 | 0.1 | 0.11 | 1.16 | 1.78 |
| | $V_2O_5$_XH | 65 | 67.1 | 0.49 | 0.17 | 0.36 | 0.03 | 0.03 | 0.53 | 0.83 |
| MGB_C4 | DT | 17 | 17.75 | 10.59 | 6.82 | 0.64 | 46.49 | 0.98 | 10.6 | 29.8 |
| | $TiO_2$_XC | 16 | 16.15 | 1.18 | 0.59 | 0.5 | 0.35 | 0.35 | 1.07 | 2.52 |
| | $TiO_2$_XH | 18 | 18.75 | 4.55 | 1.21 | 0.27 | 1.45 | 2.84 | 4.46 | 7.96 |

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$_XC | 16 | 16.15 | 1.51 | 1.06 | 0.71 | 1.13 | 0.56 | 0.87 | 3.34 |
| | $V_2O_5$_XH | 18 | 18.75 | 0.3 | 0.13 | 0.45 | 0.02 | 0.15 | 0.29 | 0.56 |
| MGB_C5 | DT | 220 | 232.63 | 17.11 | 11.6 | 0.68 | 134.57 | 0.05 | 14.8 | 53.6 |
| | $TiO_2$_XC | 196 | 208.53 | 1.98 | 1.06 | 0.54 | 1.12 | 0.57 | 1.69 | 5.5 |
| | $TiO_2$_XH | 239 | 252.23 | 6.87 | 2.59 | 0.38 | 6.69 | 1.93 | 6.48 | 14.74 |
| | $V_2O_5$_XC | 196 | 208.53 | 2.85 | 1.06 | 0.37 | 1.12 | 0.48 | 2.75 | 5.74 |
| | $V_2O_5$_XH | 239 | 252.23 | 0.69 | 0.32 | 0.47 | 0.1 | 0.1 | 0.71 | 1.59 |
| MGB_C6 | DT | 328 | 332.52 | 14.83 | 9.16 | 0.62 | 83.99 | 0.3 | 12.52 | 34.1 |
| | $TiO_2$_XC | 314 | 318.11 | 1.54 | 0.82 | 0.53 | 0.68 | 0.48 | 1.38 | 4.43 |
| | $TiO_2$_XH | 350 | 354.12 | 9.04 | 3.09 | 0.34 | 9.53 | 2.31 | 9.35 | 14.35 |
| | $V_2O_5$_XC | 314 | 318.11 | 1.06 | 0.44 | 0.42 | 0.2 | 0.35 | 0.97 | 2.51 |
| | $V_2O_5$_XH | 350 | 354.12 | 0.27 | 0.21 | 0.79 | 0.05 | 0.01 | 0.2 | 0.98 |
| MGB_C8 | DT | 398 | 403.78 | 7.3 | 7.31 | 1 | 53.4 | 0.05 | 5.53 | 53.9 |
| | $TiO_2$_XC | 287 | 292.33 | 1.56 | 0.88 | 0.56 | 0.77 | 0.39 | 1.24 | 6.32 |
| | $TiO_2$_XH | 423 | 429.23 | 5.01 | 2.29 | 0.46 | 5.24 | 0.99 | 4.72 | 15.73 |
| | $V_2O_5$_XC | 285 | 290.33 | 0.78 | 0.51 | 0.66 | 0.26 | 0.01 | 0.63 | 2.12 |
| | $V_2O_5$_XH | 412 | 418.48 | 0.13 | 0.11 | 0.81 | 0.01 | 0.01 | 0.1 | 0.59 |
| MGB_C9 | DT | 462 | 468.27 | 18.18 | 8.87 | 0.49 | 78.72 | 0.05 | 19.71 | 37.51 |
| | $TiO_2$_XC | 428 | 432.97 | 2.66 | 1.2 | 0.45 | 1.44 | 0.38 | 2.42 | 9.3 |
| | $TiO_2$_XH | 462 | 468.27 | 7.38 | 2.46 | 0.33 | 6.05 | 0.73 | 8.16 | 11.6 |
| | $V_2O_5$_XC | 428 | 432.97 | 1.85 | 0.27 | 0.15 | 0.07 | 0.51 | 1.86 | 2.45 |
| | $V_2O_5$_XH | 462 | 468.27 | 0.49 | 0.19 | 0.39 | 0.04 | 0.03 | 0.51 | 0.99 |
| MPXT_C7 | DT | 64 | 69.34 | 17.25 | 9 | 0.52 | 81.01 | 0.05 | 20.9 | 29.7 |
| | $TiO_2$_XC | 56 | 60.99 | 3.45 | 1.39 | 0.4 | 1.93 | 1.08 | 3.17 | 7.48 |
| | $TiO_2$_XH | 65 | 70.64 | 9.93 | 3.76 | 0.38 | 14.14 | 2.22 | 11.23 | 14.7 |
| | $V_2O_5$_XC | 56 | 60.99 | 0.28 | 0.16 | 0.55 | 0.02 | 0.07 | 0.22 | 0.62 |
| | $V_2O_5$_XH | 65 | 70.64 | 0.1 | 0.08 | 0.76 | 0.01 | 0.02 | 0.08 | 0.3 |

Source: GE21, 2024.

**Table 14-5 – NAO descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| MAG_C8 | DT | 262 | 269.05 | 43.74 | 16.73 | 0.38 | 279.79 | 0.05 | 50.6 | 61.8 |
| | $TiO_2$_XC | 244 | 251.05 | 4.54 | 1.04 | 0.23 | 1.08 | 0.8 | 4.63 | 8.67 |
| | $TiO_2$_XH | 351 | 359.1 | 14.98 | 4.54 | 0.3 | 20.6 | 0.01 | 16.4 | 20.5 |
| | $V_2O_5$_XC | 244 | 251.05 | 1.44 | 0.31 | 0.22 | 0.1 | 0.65 | 1.43 | 3.11 |
| | $V_2O_5$_XH | 351 | 359.1 | 0.68 | 0.22 | 0.33 | 0.05 | 0.01 | 0.72 | 1.09 |
| MGB_C5 | DT | 17 | 17.1 | 8.79 | 4.7 | 0.54 | 22.12 | 0.05 | 7.2 | 19.13 |
| | $TiO_2$_XC | 16 | 16.6 | 1.85 | 3.49 | 1.89 | 12.15 | 0.35 | 0.65 | 12.5 |
| | $TiO_2$_XH | 17 | 17.1 | 3.96 | 1.07 | 0.27 | 1.16 | 2.05 | 3.94 | 6.28 |
| | $V_2O_5$_XC | 16 | 16.6 | 1.63 | 1.13 | 0.7 | 1.28 | 0.44 | 1.31 | 3.28 |
| | $V_2O_5$_XH | 17 | 17.1 | 0.28 | 0.15 | 0.54 | 0.02 | 0.1 | 0.37 | 0.45 |
| MGB_C6 | DT | 10 | 10.05 | 21.27 | 15.18 | 0.71 | 230.31 | 7.3 | 13.73 | 44.2 |
| | $TiO_2$_XC | 8 | 8.05 | 2.05 | 0.91 | 0.44 | 0.83 | 0.84 | 2.01 | 3.46 |
| | $TiO_2$_XH | 10 | 10.05 | 8.17 | 2.97 | 0.36 | 8.8 | 3.4 | 8.63 | 12.7 |
| | $V_2O_5$_XC | 8 | 8.05 | 2.5 | 0.84 | 0.34 | 0.7 | 1.11 | 2.77 | 3.68 |
| | $V_2O_5$_XH | 10 | 10.05 | 0.77 | 0.41 | 0.54 | 0.17 | 0.25 | 0.91 | 1.42 |
| MGB_C8 | DT | 91 | 95.91 | 18.39 | 10.81 | 0.59 | 116.87 | 0.05 | 17.45 | 48.2 |
| | $TiO_2$_XC | 78 | 82.91 | 2.27 | 1.28 | 0.56 | 1.65 | 0.62 | 2.09 | 7.31 |
| | $TiO_2$_XH | 96 | 101.47 | 9.26 | 2.86 | 0.31 | 8.19 | 2.37 | 9.91 | 16.8 |
| | $V_2O_5$_XC | 78 | 82.91 | 1.35 | 0.58 | 0.43 | 0.33 | 0.17 | 1.28 | 2.72 |
| | $V_2O_5$_XH | 96 | 101.47 | 0.39 | 0.25 | 0.63 | 0.06 | 0.04 | 0.3 | 0.94 |
| MGB_C9 | DT | 442 | 453.96 | 22.66 | 6.51 | 0.29 | 42.32 | 0.59 | 23.3 | 38.8 |
| | $TiO_2$_XC | 440 | 451.96 | 2.82 | 1.63 | 0.58 | 2.65 | 0.47 | 2.36 | 13.65 |
| | $TiO_2$_XH | 443 | 454.48 | 8.49 | 1.72 | 0.2 | 2.95 | 2.8 | 8.97 | 11.25 |
| | $V_2O_5$_XC | 440 | 451.96 | 1.86 | 0.18 | 0.09 | 0.03 | 1.35 | 1.87 | 2.49 |
| | $V_2O_5$_XH | 465 | 477.84 | 0.57 | 0.16 | 0.27 | 0.02 | 0.18 | 0.58 | 0.98 |

Source: GE21, 2024.

**Table 14-6 – NAN descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| C6_MAG | DT | 888 | 910.94 | 36.44 | 11.47 | 0.31 | 131.45 | 0.2 | 37.3 | 63.7 |
| | $TiO_2$_XC | 872 | 893.83 | 4.03 | 1.37 | 0.34 | 1.88 | 0.9 | 3.88 | 9.21 |
| | $TiO_2$_XH | 896 | 919.56 | 11.87 | 2.49 | 0.21 | 6.2 | 2.3 | 12.9 | 15.25 |

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$_XC | 871 | 892.83 | 2.06 | 0.52 | 0.25 | 0.27 | 0.55 | 2.16 | 3.38 |
| | $V_2O_5$_XH | 893 | 916.56 | 0.9 | 0.32 | 0.35 | 0.1 | 0.01 | 0.96 | 1.52 |
| **C7_MGb** | DT | 7 | 7.55 | 14.31 | 4.19 | 0.29 | 17.53 | 10.4 | 12.7 | 23.8 |
| | $TiO_2$_XC | 7 | 7.55 | 1.89 | 0.93 | 0.49 | 0.86 | 0.99 | 1.67 | 3.36 |
| | $TiO_2$_XH | 7 | 7.55 | 6.5 | 1.08 | 0.17 | 1.17 | 5.61 | 6.15 | 9.08 |
| | $V_2O_5$_XC | 7 | 7.55 | 2.19 | 0.08 | 0.04 | 0.01 | 2.05 | 2.22 | 2.27 |
| | $V_2O_5$_XH | 7 | 7.55 | 0.53 | 0.12 | 0.22 | 0.01 | 0.44 | 0.49 | 0.8 |
| **C5_MGB** | DT | 1 095 | 1 117.62 | 13.86 | 7.49 | 0.54 | 56.07 | 0.24 | 13.02 | 48.57 |
| | $TiO_2$_XC | 917 | 933.86 | 2.01 | 0.99 | 0.49 | 0.98 | 0.5 | 1.87 | 9.03 |
| | $TiO_2$_XH | 1 101 | 1 123.91 | 6.16 | 1.88 | 0.3 | 3.53 | 0.31 | 6.13 | 19.96 |
| | $V_2O_5$_XC | 917 | 933.86 | 2.94 | 0.75 | 0.25 | 0.56 | 0.1 | 2.87 | 6.53 |
| | $V_2O_5$_XH | 1 101 | 1 123.91 | 0.65 | 0.27 | 0.42 | 0.07 | 0.02 | 0.65 | 1.75 |
| **C6_MGB** | DT | 486 | 506.6 | 18.15 | 7.33 | 0.4 | 53.74 | 0.11 | 17 | 51.03 |
| | $TiO_2$_XC | 468 | 488.29 | 2.33 | 1.09 | 0.47 | 1.19 | 0.43 | 2.14 | 9.05 |
| | $TiO_2$_XH | 874 | 894.69 | 7.6 | 3.54 | 0.46 | 12.5 | 0.16 | 8.55 | 14.5 |
| | $V_2O_5$_XC | 467 | 487.29 | 0.98 | 0.37 | 0.38 | 0.14 | 0.01 | 0.91 | 2.82 |
| | $V_2O_5$_XH | 874 | 894.69 | 0.17 | 0.16 | 0.94 | 0.03 | 0 | 0.14 | 1.32 |

Source: GE21, 2024.

**Table 14-7 – GAS descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| **C5_MGB** | DT | 122 | 126.11 | 12.9 | 5.98 | 0.46 | 35.72 | 0.01 | 12.96 | 34.44 |
| | $TiO_2$_C | 115 | 119.2 | 1.61 | 0.88 | 0.55 | 0.77 | 0.62 | 1.51 | 7.8 |
| | $TiO_2$_H | 122 | 126.11 | 6.27 | 1.6 | 0.26 | 2.56 | 2.65 | 6.24 | 13.63 |
| | $V_2O_5$_C | 115 | 119.2 | 3.18 | 0.77 | 0.24 | 0.59 | 1.15 | 3.23 | 4.94 |
| | $V_2O_5$_H | 122 | 126.11 | 0.67 | 0.24 | 0.37 | 0.06 | 0.08 | 0.72 | 1.3 |
| **C6_MAG** | DT | 44 | 47.45 | 33.51 | 10.83 | 0.32 | 117.23 | 0.3 | 36.18 | 46.5 |
| | $TiO_2$_C | 39 | 42.7 | 3.19 | 0.7 | 0.22 | 0.49 | 1.85 | 3.27 | 4.98 |
| | $TiO_2$_H | 44 | 47.45 | 11.57 | 2.9 | 0.25 | 8.41 | 0.11 | 12.71 | 13.75 |
| | $V_2O_5$_C | 39 | 42.7 | 2.35 | 0.4 | 0.17 | 0.16 | 1.2 | 2.34 | 3.3 |
| | $V_2O_5$_H | 44 | 47.45 | 0.94 | 0.28 | 0.3 | 0.08 | 0.01 | 0.98 | 1.29 |
| **C6_MGB** | DT | 65 | 69.95 | 19.02 | 8.83 | 0.46 | 78.02 | 0.14 | 18.14 | 42.5 |
| | $TiO_2$_C | 57 | 61.67 | 1.91 | 0.73 | 0.38 | 0.54 | 0.9 | 1.73 | 4.11 |
| | $TiO_2$_H | 65 | 69.95 | 10.35 | 2.58 | 0.25 | 6.63 | 1.23 | 10.63 | 13.78 |
| | $V_2O_5$_C | 57 | 61.67 | 1.28 | 0.55 | 0.43 | 0.3 | 0.72 | 1.06 | 3.01 |
| | $V_2O_5$_H | 65 | 69.95 | 0.37 | 0.26 | 0.68 | 0.07 | 0.05 | 0.3 | 1.18 |
| **C7_MGB** | DT | 15 | 15.42 | 15.73 | 6.41 | 0.41 | 41.14 | 5.47 | 16.8 | 23.3 |
| | $TiO_2$_C | 15 | 15.42 | 3.53 | 1.96 | 0.56 | 3.85 | 1.31 | 2.96 | 7.46 |
| | $TiO_2$_H | 15 | 15.42 | 7.06 | 2.06 | 0.29 | 4.26 | 1.42 | 7.53 | 9.64 |
| | $V_2O_5$_C | 15 | 15.42 | 1.56 | 0.5 | 0.32 | 0.25 | 0.09 | 1.66 | 2.18 |
| | $V_2O_5$_H | 15 | 15.42 | 0.42 | 0.17 | 0.41 | 0.03 | 0.03 | 0.47 | 0.74 |
| **C7_MPXT** | DT | 31 | 32.71 | 21.4 | 4.22 | 0.2 | 17.81 | 12.4 | 22 | 29.6 |
| | $TiO_2$_C | 31 | 32.71 | 4 | 1.13 | 0.28 | 1.29 | 1.7 | 3.82 | 6.69 |
| | $TiO_2$_H | 31 | 32.71 | 11.75 | 2.31 | 0.2 | 5.34 | 6.47 | 11.85 | 15.3 |
| | $V_2O_5$_C | 31 | 32.71 | 0.3 | 0.18 | 0.61 | 0.03 | 0.1 | 0.23 | 0.74 |
| | $V_2O_5$_H | 31 | 32.71 | 0.11 | 0.06 | 0.61 | 0 | 0.02 | 0.09 | 0.28 |

Source: GE21, 2024.

**Table 14-8 – JAC descriptive statistic**

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| **MGB_C4** | DT | 60 | 61.81 | 16.54 | 8.46 | 0.51 | 71.53 | 4.3 | 15 | 49.22 |
| | $TiO_2$_C | 60 | 61.81 | 6.37 | 2.84 | 0.45 | 8.06 | 2.21 | 5.86 | 13.9 |
| | $TiO_2$_H | 83 | 84.96 | 5.9 | 1.58 | 0.27 | 2.49 | 2.41 | 5.83 | 11.84 |
| | $V_2O_5$_C | 60 | 61.81 | 2.24 | 0.62 | 0.28 | 0.39 | 0.94 | 2.17 | 3.71 |
| | $V_2O_5$_H | 83 | 84.96 | 0.58 | 0.21 | 0.36 | 0.04 | 0.16 | 0.58 | 1.07 |
| **MGB_C5** | DT | 100 | 103.53 | 19.16 | 8.21 | 0.43 | 67.47 | 2.93 | 17.3 | 37.7 |
| | $TiO_2$_C | 98 | 101.53 | 5.12 | 2.99 | 0.58 | 8.97 | 1.29 | 4.41 | 16.1 |
| | $TiO_2$_H | 101 | 104.53 | 7.68 | 3.03 | 0.4 | 9.2 | 2.48 | 6.45 | 14 |
| | $V_2O_5$_C | 98 | 101.53 | 1.96 | 0.7 | 0.36 | 0.49 | 0.15 | 2.11 | 3.27 |
| | $V_2O_5$_H | 101 | 104.53 | 0.57 | 0.23 | 0.41 | 0.05 | 0.04 | 0.57 | 1.04 |
| **MGB_C6** | DT | 98 | 102.36 | 24.61 | 10.2 | 0.41 | 104.04 | 6.94 | 25.48 | 58.1 |
| | $TiO_2$_C | 97 | 101.36 | 3.64 | 1.47 | 0.41 | 2.17 | 1.3 | 3.43 | 8.44 |
| | $TiO_2$_H | 108 | 112.36 | 10.36 | 2.84 | 0.27 | 8.09 | 3.91 | 11.2 | 15.32 |
| | $V_2O_5$_C | 97 | 101.36 | 1.43 | 0.76 | 0.53 | 0.58 | 0.12 | 1.39 | 2.87 |

| Domain | Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|---|
| | $V_2O_5$_H | 108 | 112.36 | 0.49 | 0.29 | 0.58 | 0.08 | 0.03 | 0.45 | 1.16 |
| **MGB_C8** | DT | 14 | 13.48 | 11.62 | 5.28 | 0.45 | 27.9 | 4.2 | 12 | 23.9 |
| | $TiO_2$_C | 12 | 11.59 | 5.84 | 4.02 | 0.69 | 16.18 | 0.79 | 4.67 | 16.7 |
| | $TiO_2$_H | 14 | 13.48 | 4.36 | 1.65 | 0.38 | 2.73 | 1.75 | 4.87 | 7.29 |
| | $V_2O_5$_C | 12 | 11.59 | 1.12 | 0.62 | 0.55 | 0.39 | 0.12 | 1.35 | 1.86 |
| | $V_2O_5$_H | 14 | 13.48 | 0.28 | 0.17 | 0.61 | 0.03 | 0.05 | 0.31 | 0.58 |
| **MGB_C9** | DT | 105 | 106.28 | 15.98 | 7.83 | 0.49 | 61.25 | 0.04 | 14.9 | 33.4 |
| | $TiO_2$_C | 91 | 92.28 | 7.93 | 5.22 | 0.66 | 27.21 | 0.88 | 6.3 | 19.26 |
| | $TiO_2$_H | 116 | 117.53 | 6.55 | 2.39 | 0.37 | 5.72 | 1.91 | 5.66 | 11.2 |
| | $V_2O_5$_C | 91 | 92.28 | 1.37 | 0.3 | 0.22 | 0.09 | 0.85 | 1.34 | 2.05 |
| | $V_2O_5$_H | 116 | 117.53 | 0.38 | 0.19 | 0.49 | 0.03 | 0.02 | 0.33 | 0.77 |

Source: GE21, 2024.

**Table 14-9 – RIOCON descriptive statistic**

| Variable | Count | Length | Mean | Standard deviation | CV | Variance | Minimum | Median | Maximum |
|---|---|---|---|---|---|---|---|---|---|
| **DT** | 60 | 63.06 | 15.48 | 7.83 | 0.51 | 61.26 | 0.05 | 16 | 34.1 |
| **$TiO_2$_C** | 59 | 61.92 | 3.3 | 4.85 | 1.47 | 23.54 | 0.6 | 1.96 | 25.2 |
| **$TiO_2$_H** | 60 | 63.06 | 7.07 | 2.63 | 0.37 | 6.91 | 2.3 | 6.95 | 13.1 |
| **$V_2O_5$_C** | 59 | 61.92 | 1.7 | 0.77 | 0.45 | 0.59 | 0.19 | 1.75 | 4.72 |
| **$V_2O_5$_H** | 60 | 63.06 | 0.42 | 0.22 | 0.54 | 0.05 | 0.04 | 0.39 | 1.05 |

Source: GE21, 2024.

## 14.6 Variographic Analysis

Variographic analysis was conducted for the MAG, MGB and MPXT domains. The main objectives of this analysis are:

1. To mathematically structure the variability between two points in space to measure the area of influence and the degree and type of variability restricted to a homogeneous field.
2. To establish a spatial distribution model of a regionalized variable to measure estimation precision.

The QP prepared variographic analysis of the composites for each domain separately. In some situations, in domains with a few samples, domains were grouped for create robust variograms. A theoretical variogram was modeled along the hole to evaluate the behavior at the origin of the variogram of each domain. The directional variograms of the %DT, %$V_2O_5$, %Fe, %$SiO_2$, %$TiO_2$ (global content and concentrate) were modelled in each main domain for each deposit.

Table 14-11 shows the adjusted variographic parameters of the treated variables by deposit. Figure 14-19 to Figure 14-22 show examples of variograms adjusted to Campbell Pit and SJO deposits, MAG, MPXT and MGB domains, $V_2O_5$ and $TiO_2$.

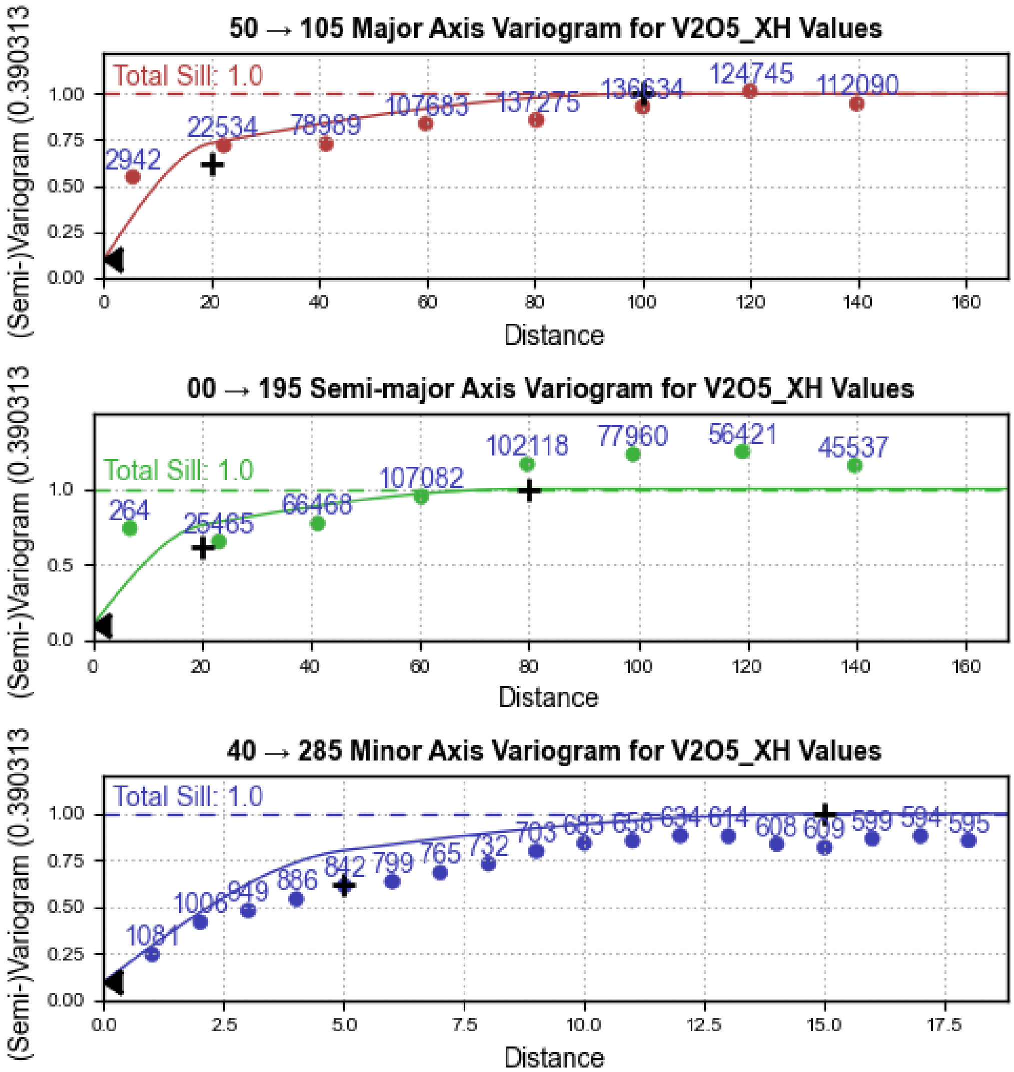



**Figure 14-19 – Variogram adjusted for Campbell Pit West – MAG Domain – Variable $V_2O_5$ -XH**

Source: GE21, 2024.

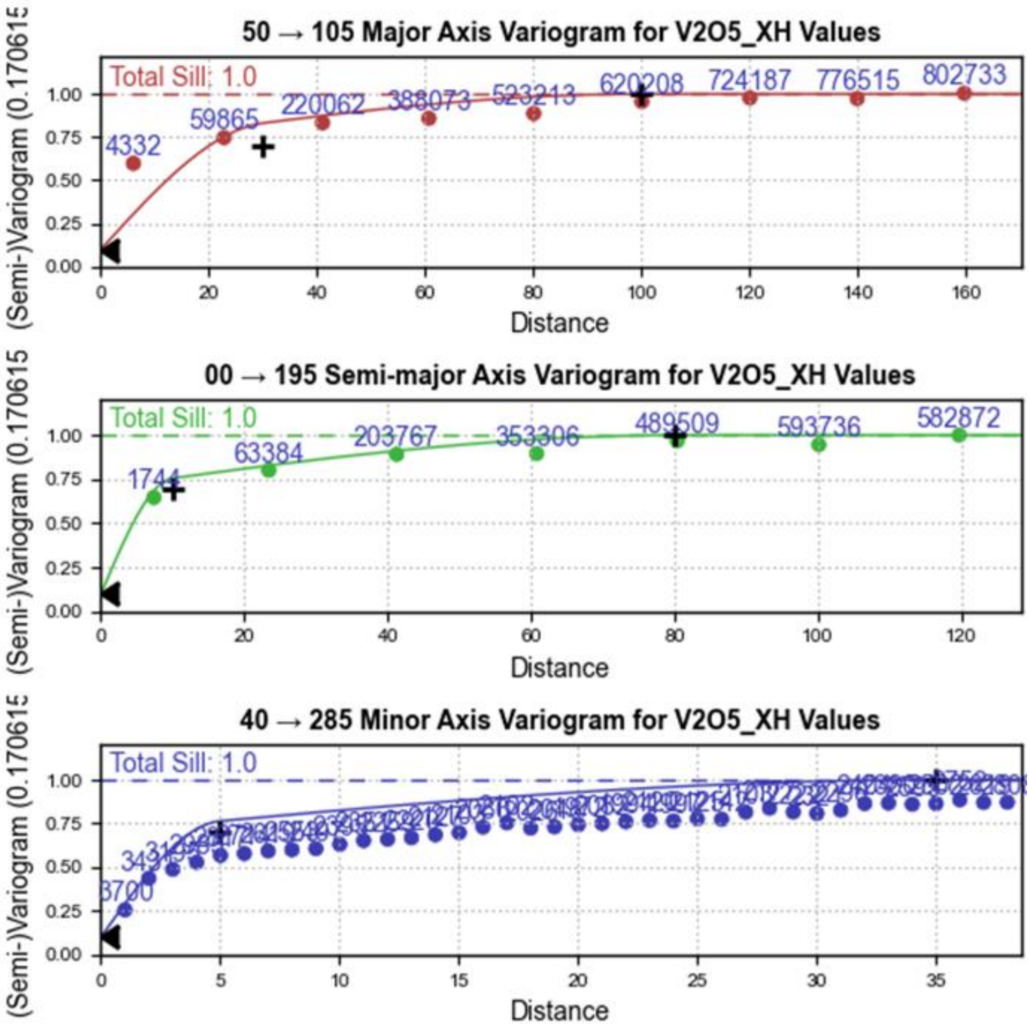



**Figure 14-20 – Variogram adjusted for Campbell Pit – MPXT Domain – Variable $V_2O_5$ -XH**

Source: GE21, 2024.

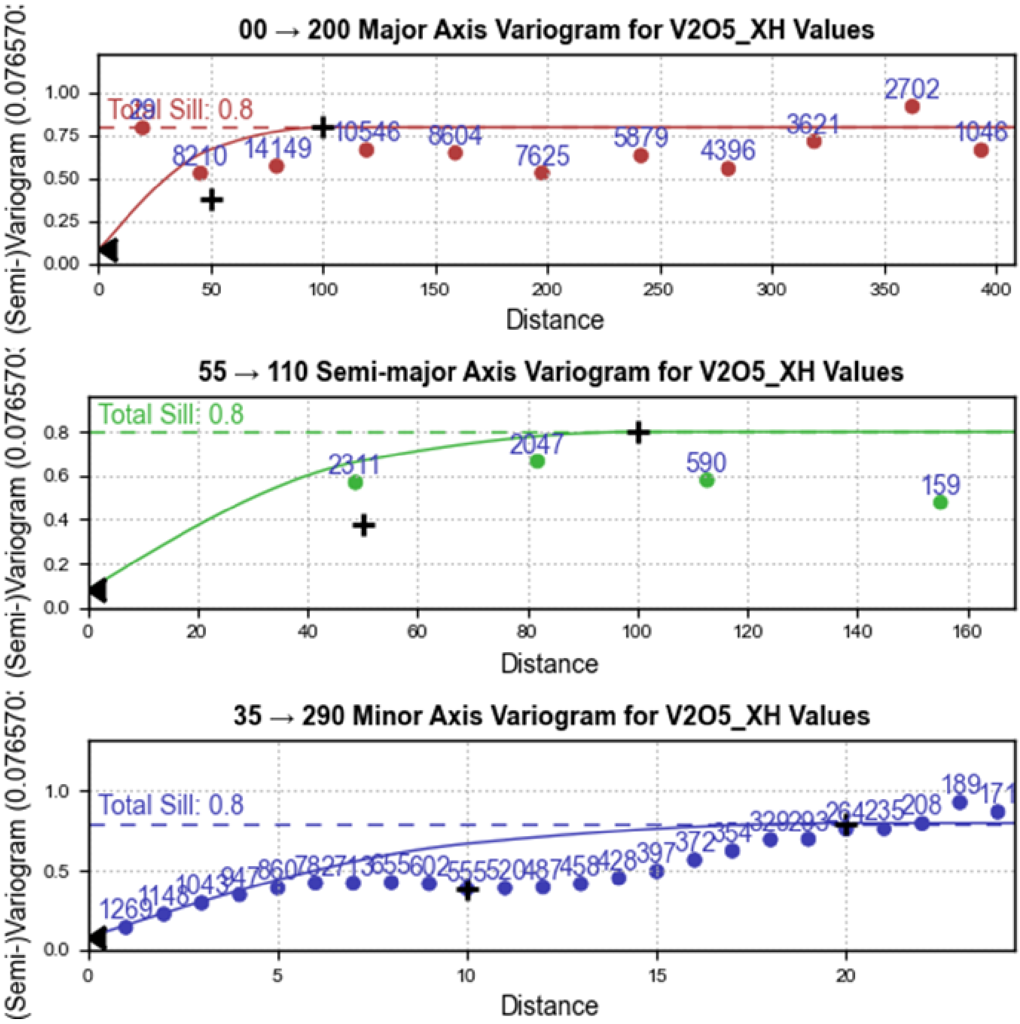



**Figure 14-21 – Variogram adjusted for SJO – MGB Domain – Variable $V_2O_5$ -XH**

Source: GE21, 2024.

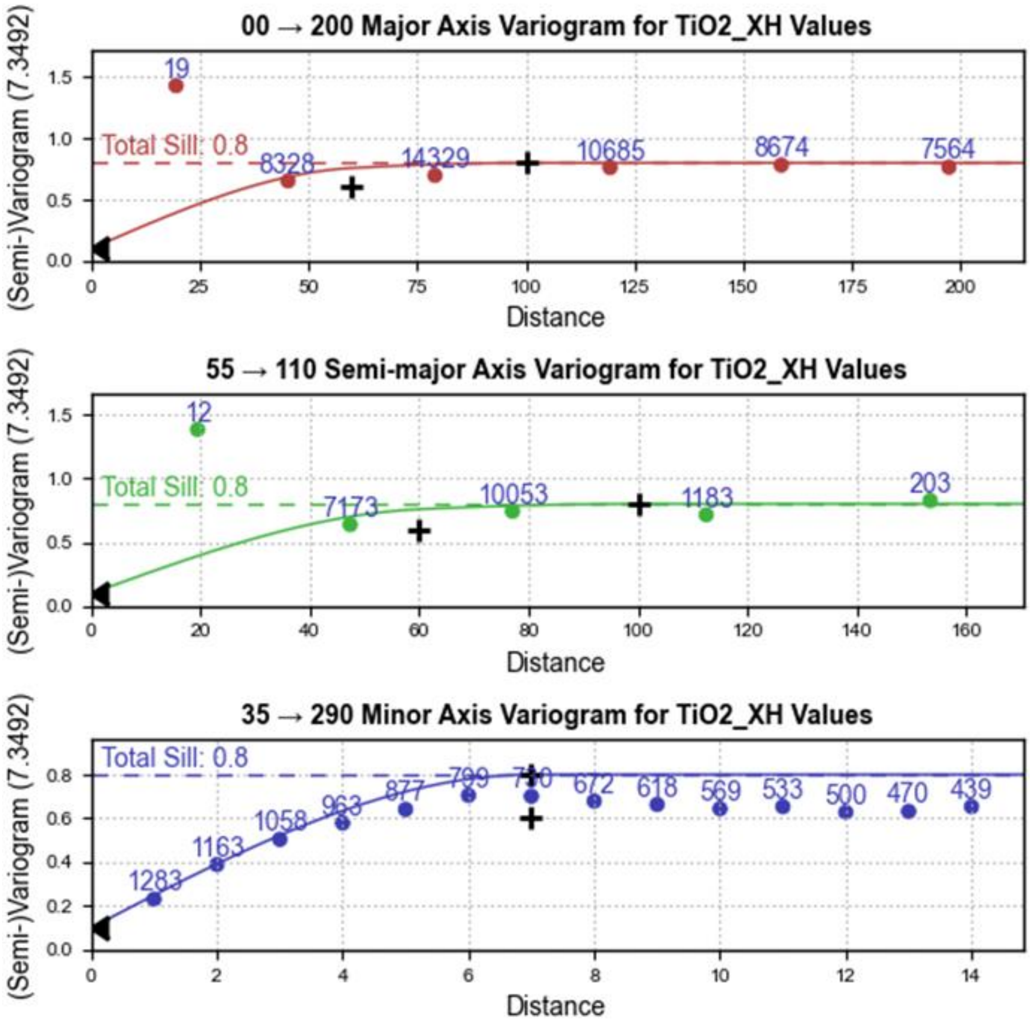



**Figure 14-22 – Variogram adjusted for SJO – MGB Domain – Variable $TiO_2$-XH**

Source: GE21, 2024.

**Table 14-10 – Variographic Parameters**

| Deposit | General | | Direction | | | Nugget | Structure 1 | | | | | Structure 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domain | Variable | Dip | Az | Pitch | | Sill | Structure | Major | Semi-major | Minor | Sill | Structure | Major | Semi-major | Minor |
| CAMPBELL PIT WEST | MAG | DT | 50 | 105 | 90 | 0.15 | 0.5 | Spherical | 25 | 20 | 5 | 0.35 | Spherical | 100 | 60 | 15 |
| | | $V_2O_5$ _XC | 50 | 105 | 90 | 0.05 | 0.57 | Spherical | 15 | 10 | 5 | 0.38 | Spherical | 60 | 40 | 20 |
| | | $V_2O_5$ _XH | 50 | 105 | 90 | 0.1 | 0.52 | Spherical | 20 | 20 | 5 | 0.38 | Spherical | 100 | 80 | 15 |
| | | $TiO_2$ _XC | 50 | 105 | 90 | 0.06 | 0.59 | Spherical | 20 | 20 | 5 | 0.35 | Spherical | 60 | 60 | 10 |
| | | $TiO_2$ _XH | 50 | 105 | 90 | 0.1 | 0.55 | Spherical | 20 | 20 | 5 | 0.35 | Spherical | 60 | 60 | 10 |
| | MPXT | DT | 50 | 105 | 90 | 0.1 | 0.45 | Spherical | 10 | 10 | 5 | 0.45 | Spherical | 70 | 50 | 40 |
| | | $V_2O_5$ _XC | 50 | 105 | 90 | 0.1 | 0.52 | Spherical | 25 | 20 | 5 | 0.38 | Spherical | 100 | 80 | 40 |
| | | $V_2O_5$ _XH | 50 | 105 | 90 | 0.1 | 0.6 | Spherical | 30 | 10 | 5 | 0.3 | Spherical | 100 | 80 | 35 |
| | | $TiO_2$ _XH | 50 | 105 | 90 | 0.1 | 0.52 | Spherical | 25 | 20 | 5 | 0.38 | Spherical | 100 | 80 | 40 |
| | | $TiO_2$ _XC | 50 | 105 | 90 | 0.1 | 0.52 | Spherical | 25 | 20 | 5 | 0.38 | Spherical | 100 | 80 | 40 |
| CAMPBELL PIT EAST + GAN | MAG | DT | 60 | 110 | 0 | 0.15 | 0.5 | Spherical | 20 | 30 | 4 | 0.35 | Spherical | 40 | 60 | 4 |
| | | $V_2O_5$ _XC | 60 | 110 | 0 | 0.05 | 0.3 | Spherical | 20 | 40 | 3 | 0.25 | Spherical | 80 | 100 | 3 |
| | | $V_2O_5$ _XH | 60 | 110 | 0 | 0.08 | 0.27 | Spherical | 40 | 40 | 3 | 0.25 | Spherical | 80 | 100 | 3 |
| | | $TiO_2$ _XC | 60 | 110 | 0 | 0.08 | 0.18 | Spherical | 30 | 30 | 2 | 0.54 | Spherical | 70 | 30 | 5 |
| | | $TiO_2$ _XH | 60 | 110 | 0 | 0.08 | 0.18 | Spherical | 30 | 30 | 2 | 0.54 | Spherical | 30 | 30 | 5 |
| | MGB | DT | 60 | 110 | 0 | 0.15 | 0.67 | Spherical | 70 | 30 | 4 | 0 | Spherical | 70 | 30 | 4 |
| | | $V_2O_5$ _XH | 60 | 110 | 0 | 0.08 | 0.11 | Spherical | 40 | 30 | 2 | 0.16 | Spherical | 100 | 30 | 5 |
| | | $V_2O_5$ _XC | 60 | 110 | 0 | 0.05 | 0.14 | Spherical | 40 | 30 | 2 | 0.16 | Spherical | 100 | 30 | 5 |
| | | $TiO_2$ _XC | 60 | 110 | 0 | 0.08 | 0.18 | Spherical | 25 | 30 | 2 | 0.54 | Spherical | 70 | 30 | 5 |
| | | $TiO_2$ _XH | 60 | 110 | 0 | 0.08 | 0.18 | Spherical | 30 | 30 | 2 | 0.54 | Spherical | 100 | 30 | 5 |
| SJO | MPXT | DT | 55 | 110 | 0 | 0.1 | 0.7 | Spherical | 60 | 60 | 6 | - | - | - | - | - |
| | | $TiO_2$ _XC | 65 | 115 | 0 | 0.02 | 0.38 | Spherical | 81 | 69 | 2.2 | 0.6 | Spherical | 167 | 169 | 3.9 |
| | | $TiO_2$ _XH | 65 | 115 | 0 | 0.17 | 0.37 | Spherical | 152 | 136 | 2.2 | 0.47 | Spherical | 392 | 205 | 3.3 |
| | | $V_2O_5$ _XC | 65 | 115 | 0 | 0.24 | 0.46 | Spherical | 263 | 113 | 1.5 | 0.31 | Spherical | 407 | 407 | 7.5 |
| | | $V_2O_5$ _XH | 60 | 109 | 0 | 0.11 | 0.7 | Spherical | 88 | 85 | 2.8 | 0.2 | Spherical | 200.8 | 180 | 4 |
| | MGB | DT | 55 | 110 | 0 | 0.1 | 0.7 | Spherical | 60 | 60 | 6 | - | - | - | - | - |
| | | $TiO_2$ _XC | 55 | 110 | 0 | 0.1 | 0.5 | Spherical | 60 | 60 | 7 | 0.2 | Spherical | 100 | 100 | 17.5 |
| | | $TiO_2$ _XH | 55 | 110 | 0 | 0.1 | 0.5 | Spherical | 60 | 60 | 7 | 0.2 | Spherical | 100 | 100 | 7 |
| | | $V_2O_5$ _XC | 55 | 110 | 0 | 0.02 | 0.36 | Spherical | 50 | 50 | 10 | 0.42 | Spherical | 100 | 100 | 20 |
| | | $V_2O_5$ _XH | 55 | 110 | 0 | 0.08 | 0.3 | Spherical | 50 | 50 | 10 | 0.42 | Spherical | 100 | 100 | 20 |
| | MAG | DT | 55 | 110 | 0 | 0.15 | 0.35 | Spherical | 60 | 60 | 2.5 | 0.5 | Spherical | 100 | 100 | 5 |
| | | $TiO_2$ _XC | 55 | 110 | 0 | 0.15 | 0.15 | Spherical | 60 | 60 | 3 | 0.5 | Spherical | 100 | 100 | 8 |
| | | $TiO_2$ _XH | 55 | 110 | 0 | 0.1 | 0.38 | Spherical | 60 | 60 | 3 | 0.52 | Spherical | 100 | 100 | 3 |
| | | $V_2O_5$ _XC | 55 | 110 | 0 | 0.02 | 0.53 | Spherical | 50 | 50 | 6 | 0.25 | Spherical | 100 | 100 | 12.5 |
| | | $V_2O_5$ _XH | 55 | 110 | 0 | 0.05 | 0.5 | Spherical | 50 | 50 | 6 | 0.25 | Spherical | 100 | 100 | 6 |
| NÃO | MGB | DT | 75 | 105 | 0 | 0.15 | 0.25 | Spherical | 20 | 20 | 3 | 0.45 | Spherical | 70 | 70 | 10 |
| | | $TiO_2$ _XC | 75 | 105 | 0 | 0.1 | 0.4 | Spherical | 50 | 50 | 7 | 0.5 | Spherical | 100 | 100 | 18 |
| | | $TiO_2$ _XH | 75 | 105 | 0 | 0.2 | 0.3 | Spherical | 50 | 50 | 3 | 0.4 | Spherical | 100 | 100 | 10 |
| | | $V_2O_5$ _XC | 75 | 105 | 0 | 0.05 | 0.35 | Spherical | 50 | 50 | 3 | 0.4 | Spherical | 100 | 100 | 10 |

| Deposit | General | | Direction | | | Nugget | Structure 1 | | | | | Structure 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domain | Variable | Dip | Az | Pitch | | Sill | Structure | Major | Semi-major | Minor | Sill | Structure | Major | Semi-major | Minor |
| | | $V_2O_5$ _XH | 75 | 105 | 0 | 0.15 | 0.25 | Spherical | 50 | 50 | 3 | 0.4 | Spherical | 100 | 100 | 10 |
| NAN | MAG | DT | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 50 | 50 | 4 | 0.3 | Spherical | 100 | 100 | 8 |
| | | $TiO_2$_XC | 75 | 110 | 0 | 0.15 | 0.55 | Spherical | 50 | 50 | 5 | 0.3 | Spherical | 100 | 100 | 10 |
| | | $TiO_2$_XH | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 50 | 50 | 5 | 0.3 | Spherical | 100 | 100 | 10 |
| | | $V_2O_5$ _XC | 75 | 115 | 0 | 0.1 | 0.6 | Spherical | 50 | 50 | 4 | 0.3 | Spherical | 100 | 100 | 8 |
| | | $V_2O_5$ _XH | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 50 | 50 | 4 | 0.3 | Spherical | 100 | 100 | 8 |
| | MGB | DT | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 50 | 50 | 4 | 0.3 | Spherical | 100 | 100 | 6 |
| | | $TiO_2$_XC | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 40 | 40 | 5 | 0.3 | Spherical | 80 | 80 | 5 |
| | | $TiO_2$_XH | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 40 | 40 | 5 | 0.3 | Spherical | 80 | 80 | 5 |
| | | $V_2O_5$ _XC | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 40 | 40 | 4 | 0.3 | Spherical | 80 | 80 | 6 |
| | | $V_2O_5$ _XH | 75 | 110 | 0 | 0.1 | 0.6 | Spherical | 40 | 40 | 4 | 0.3 | Spherical | 80 | 80 | 6 |
| GAS | MGB, MAG, MPXT | DT, $V_20_5$_XH, $V_20_5$_XC, $TiO_2$_XH, $TiO_2$_XC | 58 | 105 | 0 | 0.08 | 0.11 | Spherical | 40 | 30 | 2 | 0.81 | Spherical | 100 | 30 | 5 |
| JAC | MGB | DT | 60 | 110 | 0 | 0.1 | 0.4 | Spherical | 30 | 35 | 4 | 0.5 | Spherical | 85 | 85 | 4 |
| | | $TiO_2$_XC | 60 | 110 | 0 | 0.08 | 0.42 | Spherical | 30 | 35 | 4 | 0.5 | Spherical | 85 | 85 | 4 |
| | | $TiO_2$_XH | 60 | 110 | 0 | 0.08 | 0.42 | Spherical | 30 | 35 | 4 | 0.5 | Spherical | 85 | 85 | 4 |
| | | $V_2O_5$ _XC | 60 | 110 | 0 | 0.05 | 0.45 | Spherical | 30 | 35 | 5 | 0.5 | Spherical | 85 | 85 | 5 |
| | | $V_2O_5$ _XH | 60 | 110 | 0 | 0.08 | 0.42 | Spherical | 30 | 35 | 4 | 0.5 | Spherical | 85 | 85 | 4 |
| RIOCON | MGB | DT, $V_20_5$_XH, $V_20_5$_XC, $TiO_2$_XH, $TiO_2$_XC | 60 | 110 | 0 | 0.1 | 0.5 | Spherical | 30 | 30 | 2 | 0.4 | Spherical | 100 | 100 | 4 |

Source: GE21, 2024.

## 14.7 Block Model

Block models were built for the deposits, as summarized in Table 14-11 to Table 14-18.

In Campbell Pit, C1-C4 cycles were estimated into “Campbell Pit West Block Model”. C5 to C10 cycles from Campbell Pit East and GAN were estimated into “Campbell Pit East and GAN Block Model”.

The dimensions of the blocks were based on the average spacing of the drilling grid and the mining areas. Sub-blocks were used to ensure adherence between modeled surfaces / solids and block models.

**Table 14-11 – Campbell Pit West Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 317640 | 8485320 | -290 |
| **Maximum Coordinates** | 319600 | 8488160 | 410 |
| **Block dimensions** | 5 | 5 | 5 |
| **Sub block dimensions** | 2.5 | 2.5 | 2.5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-12 – Campbell Pit East and GAN Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 317640 | 8485320 | -290 |
| **Maximum Coordinates** | 319600 | 8488160 | 410 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 2.5 | 2.5 | 2.5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-13 – SJO Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 318500 | 8487500 | -20 |
| **Maximum Coordinates** | 319800 | 8489200 | 400 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 5.0 | 5.0 | 5.0 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-14 – NAO Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 318456 | 8488753 | -23 |
| **Maximum Coordinates** | 320256 | 8490773 | 417 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 2.5 | 2.5 | 2.5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-15 – NAN Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 319250 | 8490800 | -190 |
| **Maximum Coordinates** | 320610 | 8493560 | 450 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 2.5 | 2.5 | 2.5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-16 – GAS Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 316140 | 8482020 | -290 |
| **Maximum Coordinates** | 319600 | 8485320 | 410 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 5 | 5 | 5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-17 – JAC Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 315560 | 8476140 | 0 |
| **Maximum Coordinates** | 317260 | 8479600 | 300 |
| **Block dimensions** | 20 | 20 | 20 |
| **Sub block dimensions** | 2.5 | 2.5 | 2.5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

**Table 14-18 – RIOCON Block Model Summary**

| | Y(m) | X(m) | Z(m) |
|---|---|---|---|
| **Minimum Coordinates** | 313400 | 8466270 | -20 |
| **Maximum Coordinates** | 314600 | 8468830 | 300 |
| **Block dimensions** | 40 | 40 | 40 |
| **Sub block dimensions** | 5 | 5 | 5 |
| **Rotation** | 0 | 0 | 0 |

Source: GE21, 2024.

## 14.8 Density

The density values obtained in the campaigns show coherence in the lithologies, as presented in the Section 10. The QP assumed the density average inserted in the lithologies modeled by deposit. Table 14-19 shows the assumed average for each typology in the deposits based on 3D modeling.

**Table 14-19 – Average Specific Gravity assigned in Mineral Resource Estimates**

| Lithology | GAS | JAC | GAN | NAN | NAO | Campbell Pit | RIOCON | SJO |
|---|---|---|---|---|---|---|---|---|
| **ANO** | 2.88 | - | - | - | 2.87 | - | - | 2.82 |
| **COV** | - | - | - | - | 1.8 | - | - | - |
| **COB** | 1.8 | - | - | - | | - | - | - |
| **GAB** | 2.88 | 2.88 | 2.97 | - | 3.01 | 2.97 | 2.88 | 2.99 |
| **GPS** | 2.68 | 2.69 | - | 2.66 | - | - | 2.69 | 2.66 |
| **MAG** | 4.1 | - | 4.42 | 4.15 | 4.24 | 4.42 | | 4.56 |
| **MGB** | 3.86 | 3.45 | 3.2 | 3.33 | 3.29 | 3.2 | 3.45 | 3.22 |
| **MPXT** | 4.03 | - | 3.42 | - | - | 3.42 | 4.03 | 3.54 |
| **PEG** | 2.96 | 2.94 | 2.64 | 2.62 | 2.61 | 2.64 | - | 2.65 |
| **SAP** | - | 1.80 | 1.8 | - | - | 1.8 | 1.80 | - |
| **RSI** | - | - | - | - | 1.8 | - | - | - |
| **EST** | - | - | - | - | - | - | - | 2.82 |
| **AND** | - | - | - | - | - | - | - | 2.68 |

Source: GE21, 2024.

## 14.9 Grade Interpolation

The Ordinary Kriging (OK) estimation method was used to estimate the contents (Head and concentrate) for % $V_2O_5$, %$TiO_2$, %Fe, % $SiO_2$ and %DT obtained for all delimited domain by magmatic cycle.

OK is one of the most widely used geostatistical methods in the sector. In this interpolation, the blocks are estimated based on the regularized intervals (composites). Estimated points are weighted to minimize the variance error in that space, considering the spatial location of the selected composites and the modeled variogram. Variography describes the correlation between regularized samples in relation to the distance and the direction of search.

The estimates were separated for each domain, respecting the composites of each domain. Domains were estimated using the Hard Boundary Concept.

The estimate was made using four steps, varying the neighboring search main radius, named P1, P2, P3, and P4, which was defined based on the range of the variogram modeled for each domain. The parameters used in the estimation are summarized in Table 14-20.

**Table 14-20 – Campbell Pit Kriging Plan**

| Deposit | Radius | Ellipsoid Ranges | | | Nº Samples | | Drill Hole Limit |
|---|---|---|---|---|---|---|---|
| | | Max | Intermediate | Min | Min | Max | Max Samples per hole |
| General Parameters: | | | | | | | |
| Interpolation Method: Kriging; Sector Search Method: Ellipsoid; Ellipsoid Directions: Variable Orientation | | | | | | | |
| Campbell Pit | P1 | 30 | 25 | 4.5 | 5 | 12 | 2 |
| | P2 | 65 | 55 | 10 | 5 | 12 | 2 |
| | P3 | 150 | 120 | 22.5 | 3 | 12 | 2 |
| | P4 | >150 | >120 | >22.5 | 1 | 12 | 2 |
| GAN | P1 | 40 | 40 | 4 | 5 | 12 | 2 |
| | P2 | 65 | 65 | 6.5 | 5 | 12 | 2 |
| | P3 | 150 | 150 | 15 | 3 | 12 | 2 |
| | P4 | >150 | >150 | >15 | 1 | 12 | 2 |
| SJO | P1 | 60 | 60 | 3.5 | 5 | 12 | 2 |
| | P2 | 150 | 150 | 7.5 | 5 | 12 | 2 |
| | P3 | 250 | 250 | 12.5 | 3 | 12 | 2 |
| | P4 | >250 | >250 | >12.5 | 1 | 12 | 2 |
| NAO | P1 | 65 | 65 | 5 | 5 | 12 | 2 |
| | P2 | 150 | 150 | 12 | 5 | 12 | 2 |
| | P3 | 250 | 250 | 20 | 3 | 12 | 2 |
| | P4 | >250 | >250 | >20 | 1 | 12 | 2 |
| NAN | P1 | 65 | 65 | 5 | 5 | 12 | 2 |
| | P2 | 150 | 150 | 12 | 5 | 12 | 2 |
| | P3 | 250 | 250 | 20 | 3 | 12 | 2 |
| | P4 | >250 | >250 | >20 | 1 | 12 | 2 |
| GAS | P1 | 65 | 20 | 3.5 | 5 | 12 | 2 |
| | P2 | 150 | 45 | 7.5 | 5 | 12 | 2 |
| | P3 | 250 | 250 | 75 | 3 | 12 | 2 |
| | P4 | >250 | >250 | >75 | 1 | 12 | 2 |
| JAC | P1 | 55 | 5 | 4 | 5 | 12 | 2 |
| | P2 | 130 | 130 | 10 | 5 | 12 | 2 |
| | P3 | 210 | 210 | 15 | 3 | 12 | 2 |
| | P4 | >210 | >210 | >15 | 1 | 12 | 2 |
| RIOCON | P1 | 65 | 65 | 4 | 5 | 12 | 2 |
| | P2 | 120 | 120 | 8 | 5 | 12 | 2 |
| | P3 | 250 | 250 | 25 | 3 | 12 | 2 |
| | P4 | >250 | >250 | >25 | 1 | 12 | 2 |

Source: GE21, 2024.

## 14.10 Estimate Validation

The QP validated the grade estimate through visual analysis and global and local bias analysis using the nearest neighbor as the comparison estimate.

The analysis of the global bias was conducted on estimated variables by comparing the estimate grade, block by block with the grade estimated by Nearest Neighboring method, which aims to represent the original sample population in deposits.

It is expected that the mean or median of the two populations will remain close, honoring the hypothesis of law of permanence, and evaluating the decrease in variance as a function of increased support. Figure 14-23 to Figure 14-27 show the results of the % $V_2O_5$ analysis of the Measured and Indicated Resources.

Nearest Neighbour

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 150798 |
| Minimum | 0.003 |
| Maximum | 3.506 |
| Average | 0.867 |
| Variance | 0.38 |
| Std Deviation | 0.61 |

Percentile

| | Value |
|---|---|
| 2.5% | 0.05 |
| 5% | 0.096 |
| 25% | 0.393 |
| Median | 0.729 |
| 75% | 1.204 |
| 95% | 2.115 |
| 97.5% | 2.283 |

Ordinary Kriging

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 150798 |
| Minimum | 0.017 |
| Maximum | 2.902 |
| Average | 0.879 |
| Variance | 0.22 |
| Std Deviation | 0.47 |

Percentile

| | Value |
|---|---|
| 2.5% | 0.287 |
| 5% | 0.347 |
| 25% | 0.561 |
| Median | 0.74 |
| 75% | 1.026 |
| 95% | 1.915 |
| 97.5% | 2.065 |

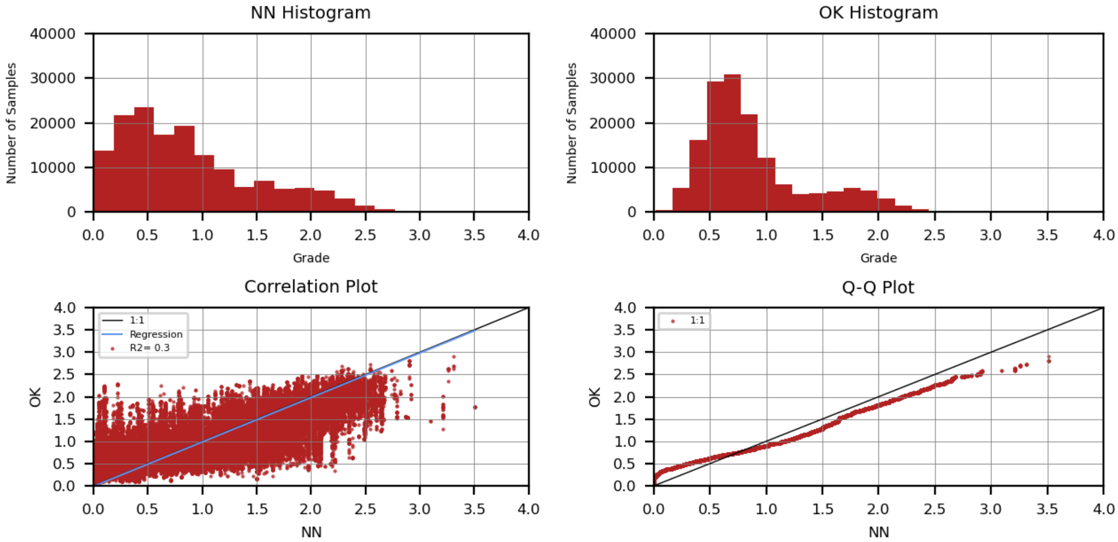



**Figure 14-23 – Campbell Pit West NN Checks Graphs (%$V_2O_5$_XH)**

Source: GE21, 2024.

**Nearest Neighbour**

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 488298 |
| Minimum | 0.001 |
| Maximum | 1.789 |
| Average | 0.465 |
| Variance | 0.09 |
| Std Deviation | 0.31 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.019 |
| 5% | 0.04 |
| 25% | 0.266 |
| Median | 0.397 |
| 75% | 0.609 |
| 95% | 1.09 |
| 97.5% | 1.162 |

**Ordinary Kriging**

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 488298 |
| Minimum | 0.006 |
| Maximum | 1.272 |
| Average | 0.475 |
| Variance | 0.07 |
| Std Deviation | 0.27 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.049 |
| 5% | 0.061 |
| 25% | 0.332 |
| Median | 0.398 |
| 75% | 0.643 |
| 95% | 1.027 |
| 97.5% | 1.098 |

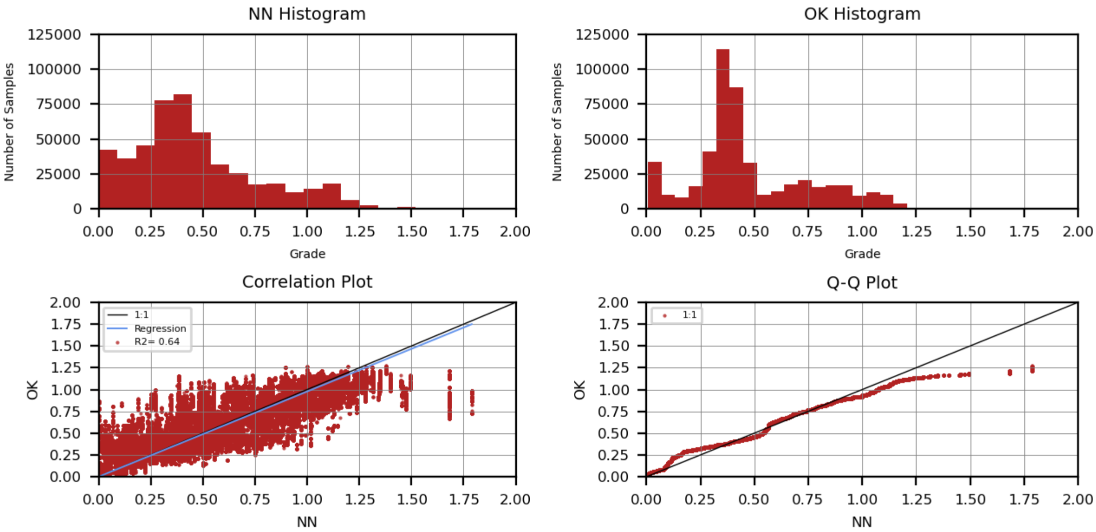



**Figure 14-24 – Campbell Pit East and GAN deposits Checks Graphs (%$V_2O_5$_XH)**

Source: GE21, 2024.

**Nearest Neighbour**

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 40355 |
| Minimum | 0.005 |
| Maximum | 1.59 |
| Average | 0.469 |
| Variance | 0.12 |
| Std Deviation | 0.35 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.03 |
| 5% | 0.036 |
| 25% | 0.161 |
| Median | 0.439 |
| 75% | 0.687 |
| 95% | 1.16 |
| 97.5% | 1.285 |

**Ordinary Kriging**

| Variable | V205_XH |
|---|---|
| Class | Resource |
| N. of Samples | 40355 |
| Minimum | 0.019 |
| Maximum | 1.371 |
| Average | 0.459 |
| Variance | 0.09 |
| Std Deviation | 0.3 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.054 |
| 5% | 0.067 |
| 25% | 0.222 |
| Median | 0.43 |
| 75% | 0.594 |
| 95% | 1.072 |
| 97.5% | 1.165 |

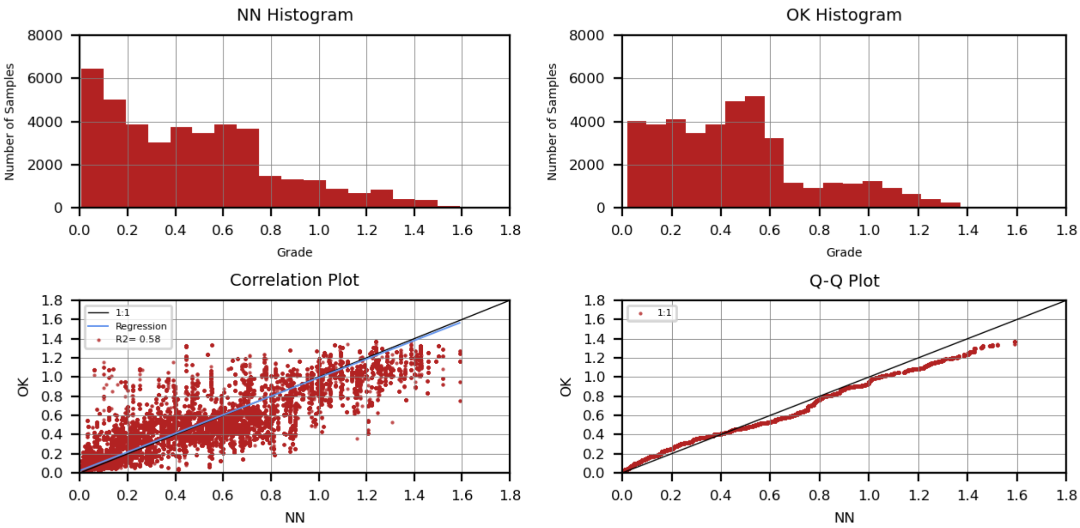



**Figure 14-25 – SJO deposit Checks Graphs (%$V_2O_5$_XH)**

Source: GE21, 2024.

**Nearest Neighbour**

| | |
|---|---|
| Variable | V205_XH |
| Class | Resource |
| N. of Samples | 58398 |
| Minimum | 0.005 |
| Maximum | 1.075 |
| Average | 0.576 |
| Variance | 0.04 |
| Std Deviation | 0.2 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.15 |
| 5% | 0.24 |
| 25% | 0.457 |
| Median | 0.613 |
| 75% | 0.72 |
| 95% | 0.872 |
| 97.5% | 0.94 |

**Ordinary Kriging**

| | |
|---|---|
| Variable | V205_XH |
| Class | Resource |
| N. of Samples | 58398 |
| Minimum | 0.096 |
| Maximum | 0.913 |
| Average | 0.569 |
| Variance | 0.02 |
| Std Deviation | 0.15 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.195 |
| 5% | 0.275 |
| 25% | 0.492 |
| Median | 0.585 |
| 75% | 0.671 |
| 95% | 0.79 |
| 97.5% | 0.816 |

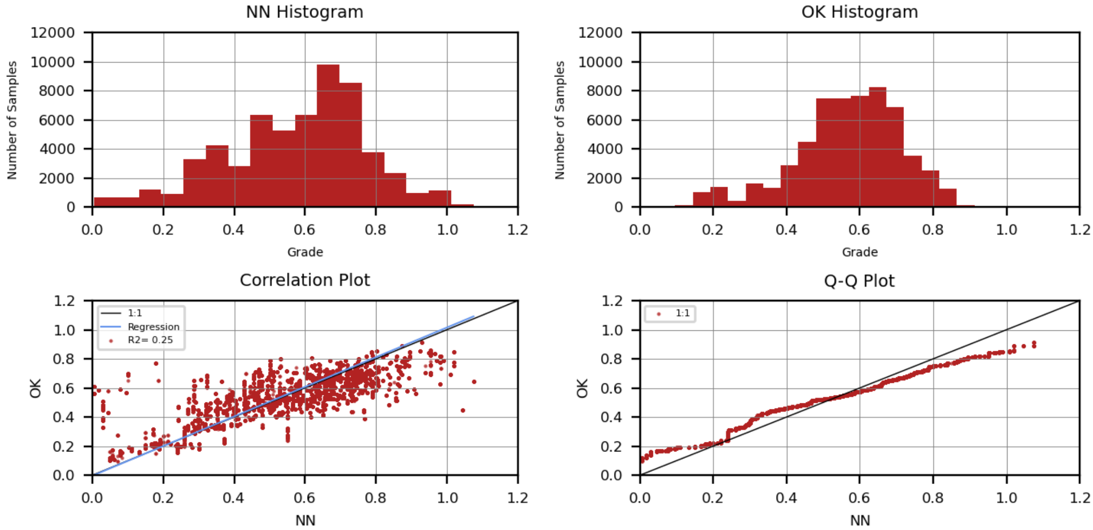



**Figure 14-26 – NAO deposit Checks Graphs (%$V_2O_5$_XH)**

Source: GE21, 2024.

**Nearest Neighbour**

| | |
|---|---|
| Variable | V205_XH |
| Class | Resource |
| N. of Samples | 273436 |
| Minimum | 0.002 |
| Maximum | 1.75 |
| Average | 0.597 |
| Variance | 0.12 |
| Std Deviation | 0.34 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.11 |
| 5% | 0.13 |
| 25% | 0.32 |
| Median | 0.53 |
| 75% | 0.879 |
| 95% | 1.21 |
| 97.5% | 1.27 |

**Ordinary Kriging**

| | |
|---|---|
| Variable | V205_XH |
| Class | Resource |
| N. of Samples | 273436 |
| Minimum | 0.059 |
| Maximum | 1.333 |
| Average | 0.602 |
| Variance | 0.08 |
| Std Deviation | 0.28 |

**Percentile**

| | Value |
|---|---|
| 2.5% | 0.154 |
| 5% | 0.165 |
| 25% | 0.375 |
| Median | 0.625 |
| 75% | 0.8 |
| 95% | 1.054 |
| 97.5% | 1.124 |

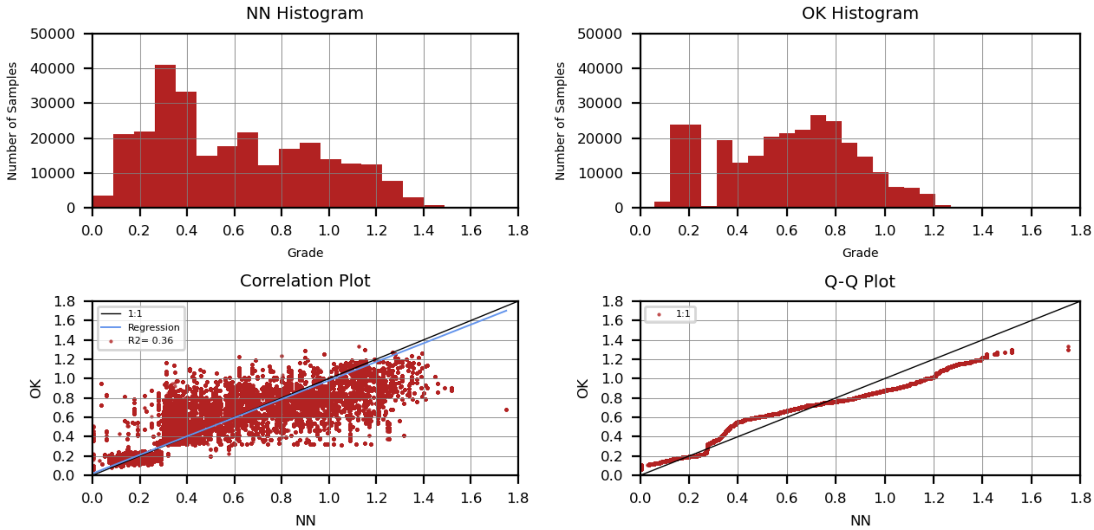



**Figure 14-27 – NAN Checks Graphs (%$V_2O_5$_XH)**

Source: GE21, 2024.

The QP assumes there isn't notable bias on the current estimates, and the smoothing in grades estimates is compatible with the estimate strategies used.

Estimation of local bias was analyzed by the swath-plot technique, which similarly to global analysis, verifies the permanence of the mean by deposit zones. The validation results are shown in Figure 14-28 to Figure 14-32.

The QP assumes that the validation did not demonstrate an excessive smoothing of the estimate considering the resulting values.

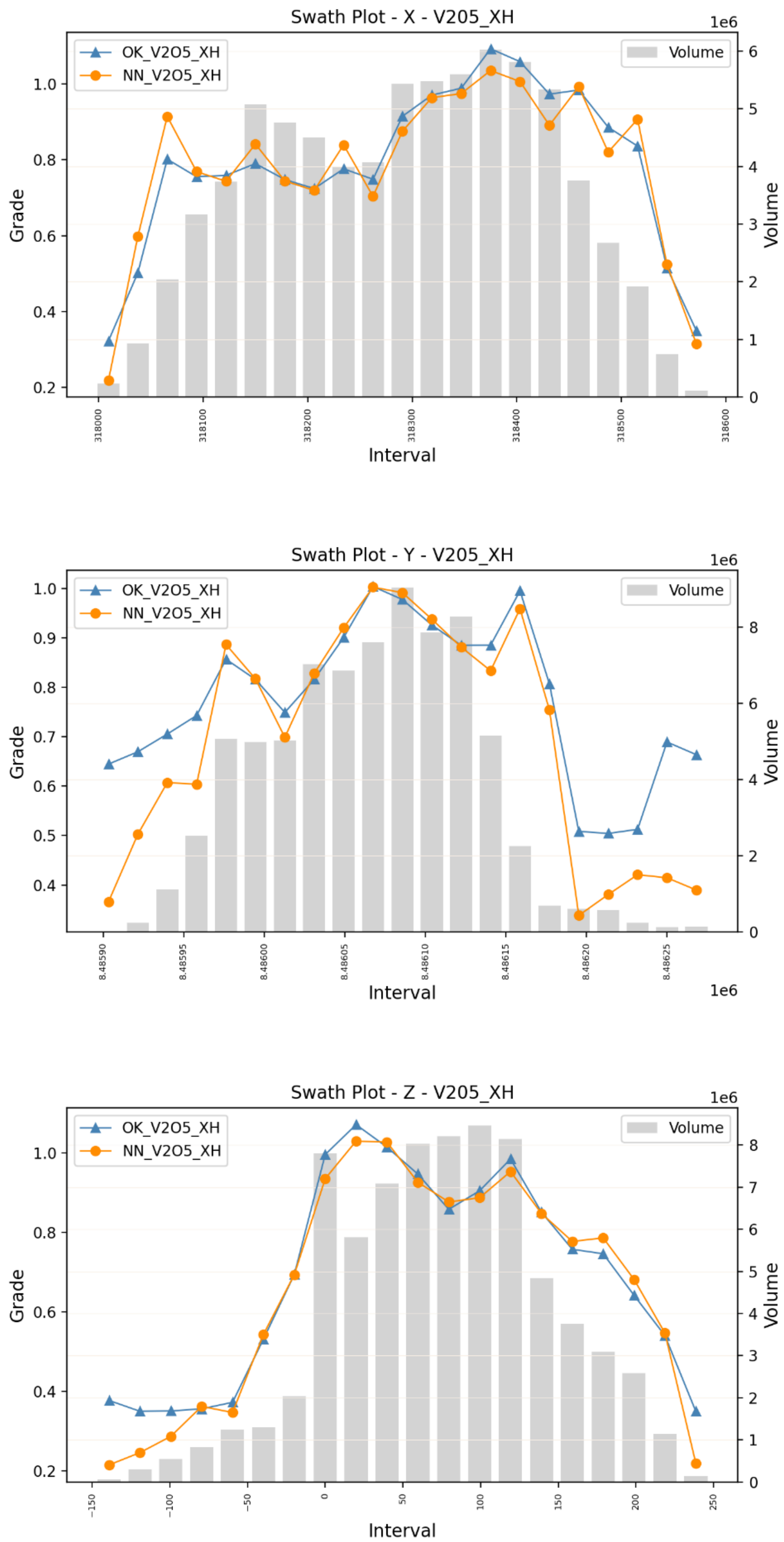



**Figure 14-28 – Campbell Pit West Swath Plots (%$V_2O_5$_XH)**

Source: GE21, 2024.

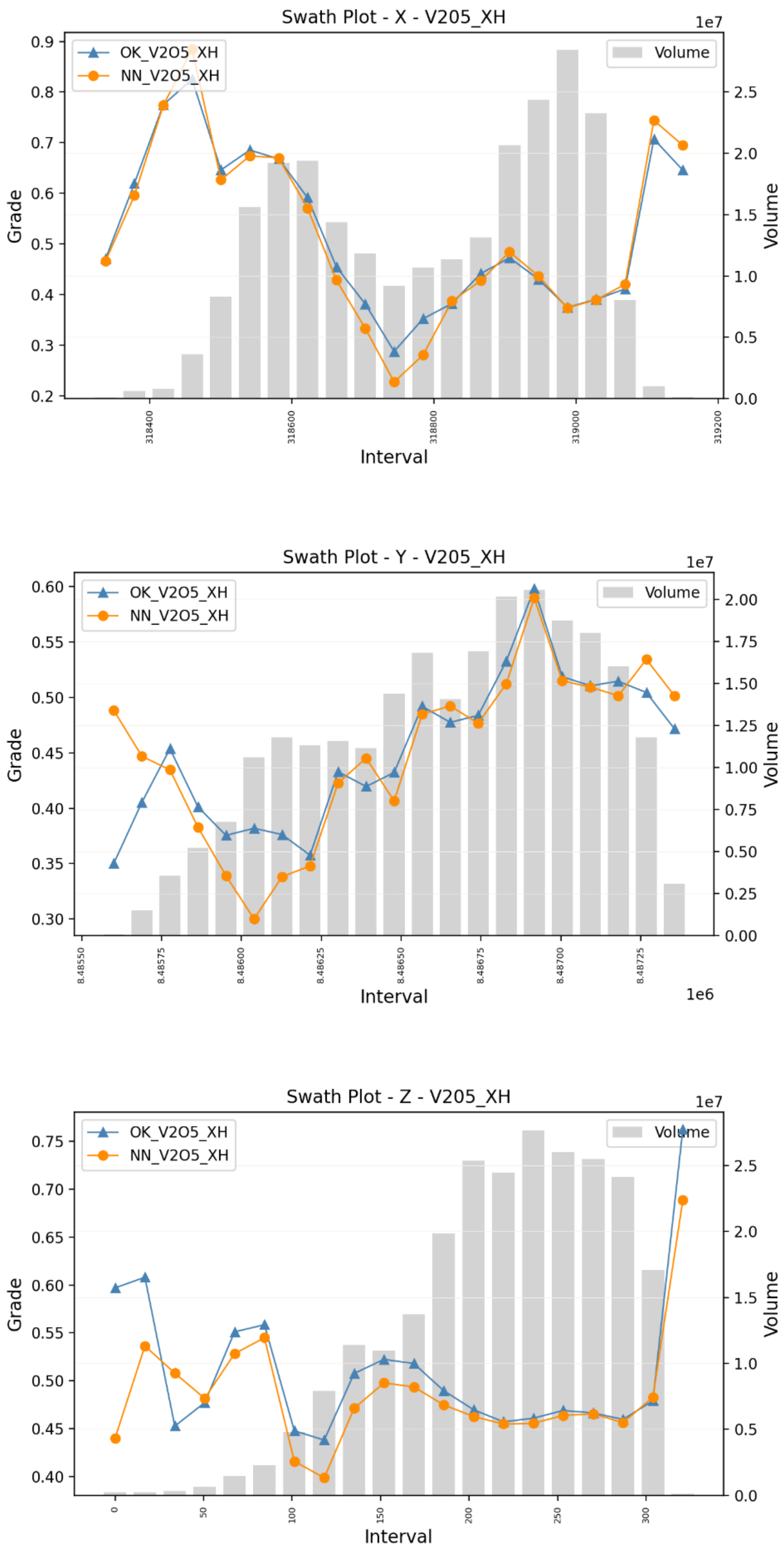



**Figure 14-29 – Campbell Pit East and GAN Swath Plots (%$V_2O_5$_XH)**

Source: GE21, 2024.

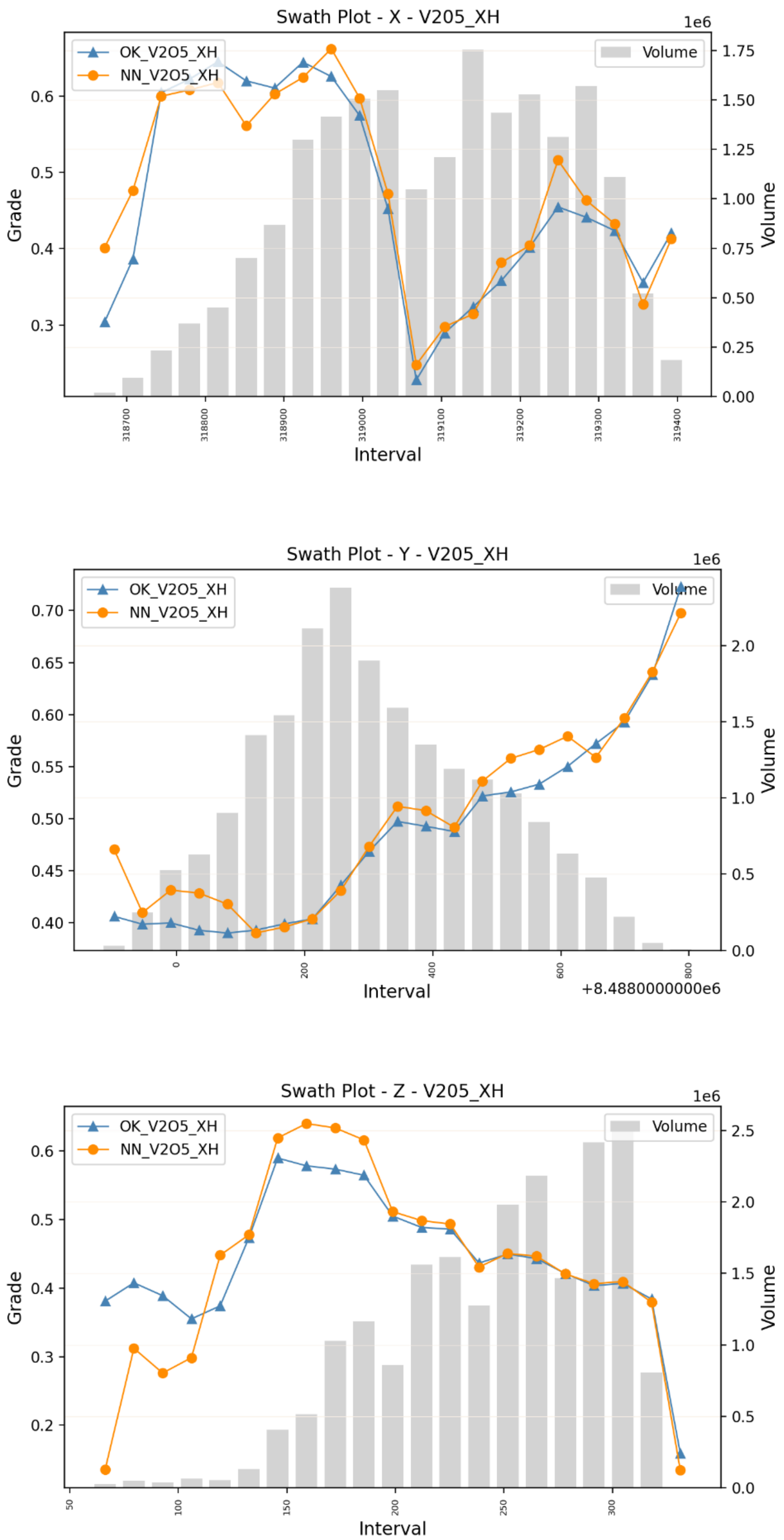



**Figure 14-30 – SJO Swath Plots (%$V_2O_5$_XH)**

Source: GE21, 2024.

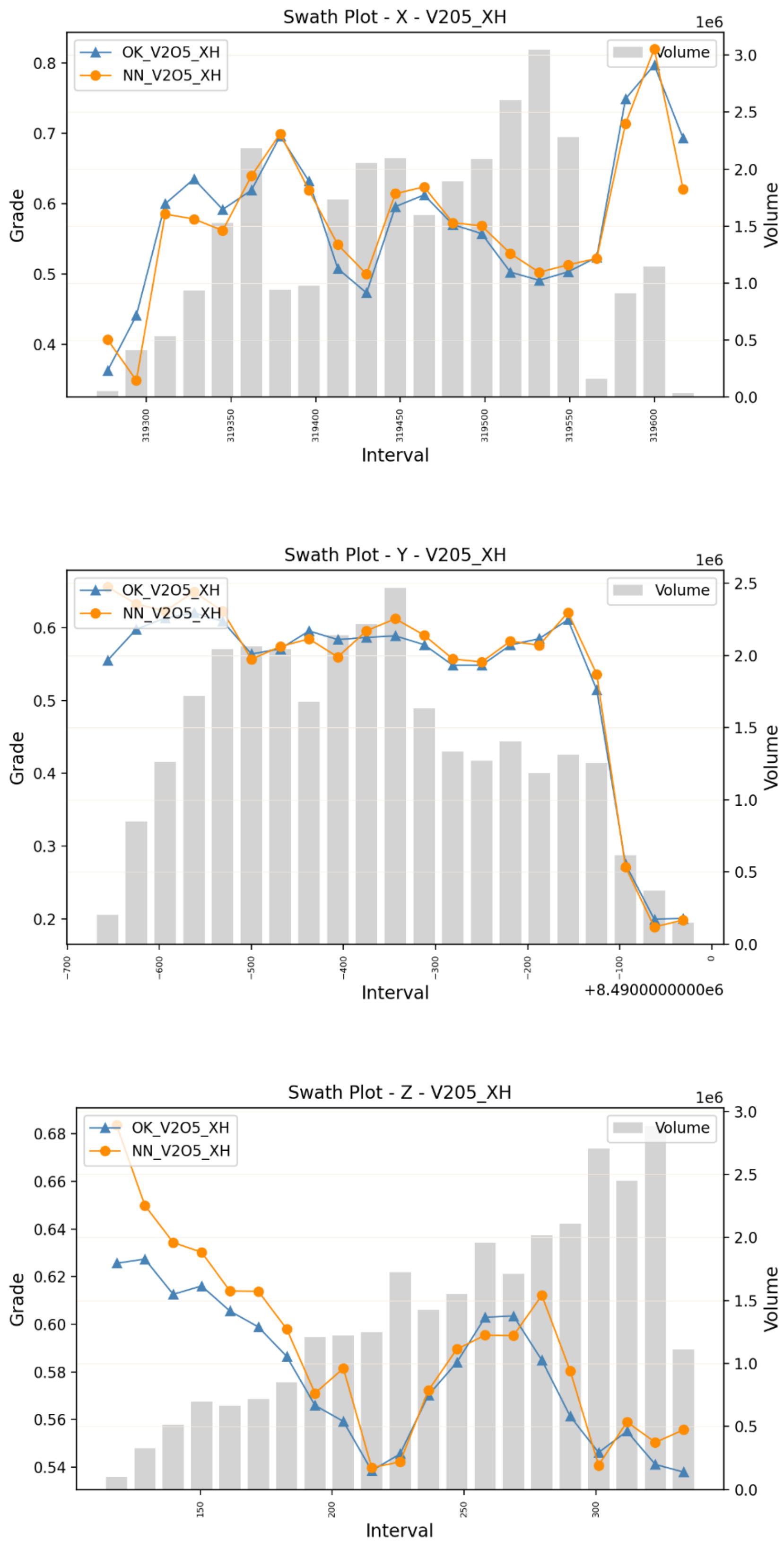
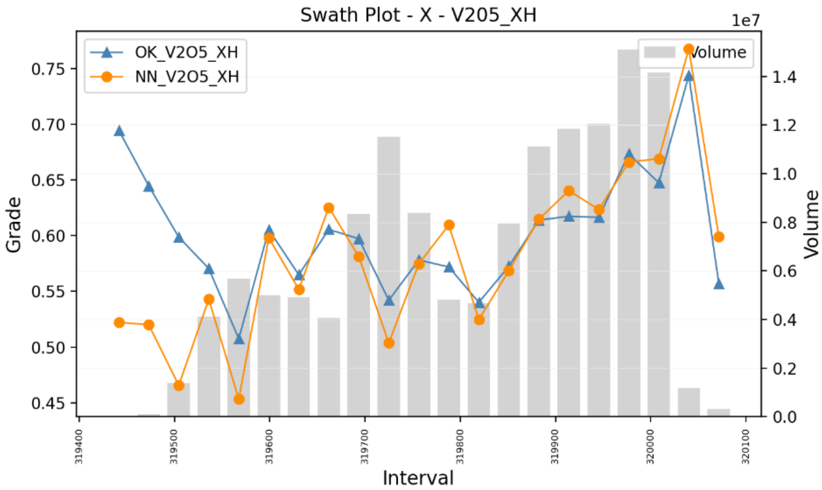
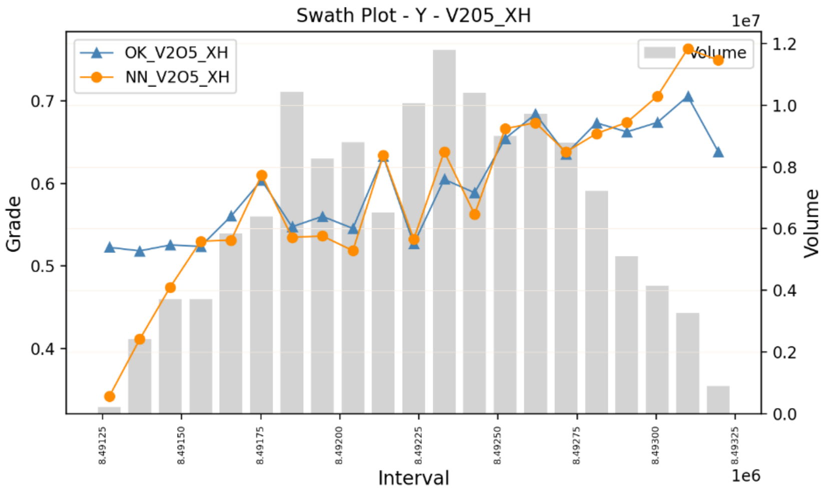



**Figure 14-31 – NAO Swath Plots (%$V_2O_5$_XH)**

Source: GE21, 2024.



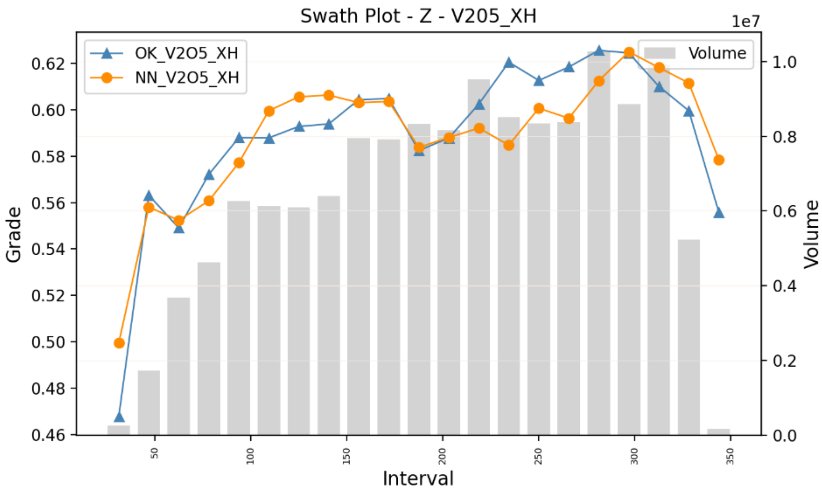




**Figure 14-32 – NAN Swath Plots (%$V_2O_5$_XH)**

Source: GE21, 2024.

## 14.11 Mineral Resource Statement

The QP classified the Mineral Resources based on the QP's internal criteria and in accordance with the CIM definitions. The data collected was evaluated in terms of quality and quantity data.

Mineral Resources are defined by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) as follows:

- A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.
- A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit. Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation. A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve.
- An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation. An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.
- An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated based on limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity. An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that most of the Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

The **CIM Estimation of Mineral Resources & Mineral Reserves Best Practice Guidelines** (2018) require the factors significant to project economics are current, reasonably developed, and based on generally accepted industry practice and experience. The established cut-off grade must realistically reflect the location, deposit scale, continuity, assumed mining method, metallurgical processes, costs, and reasonable long-term metal prices and foreign exchange rates.

For deposits favourable for open-pit mining methods, it is the opinion of the authors of this Report that a Lerchs-Grossman pit of Mineral Resource categories captures the required inputs under CIM best practices and is an efficient means to assess the Reasonable Prospects for Eventual Economic Extraction of mined material. Only the blocks within the conceptual pit envelope were considered as current Mineral Resources. Optimization of the Resource pit was performed in Geovia Whittle software using the parameters presented in Table 14-21.

**Table 14-21 – Main parameters used to define the open pit shells for RPEEE**

| Inputs | Unit | Deposit | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Campbell Pit West | Campbell Pit East + GAN | NAN | SJO | NAO | GAS | RIOCON | JAC |
| **Exchange rate** | **US$/R$** | **5.10** | **5.10** | **5.10** | **5.10** | **5.10** | **5.10** | **5.10** | **5.10** |
| $V_2O_5$ Selling Price | US$/lb $V_2O_5$ | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 |
| $TiO_2$ pigment selling price | US$/t $TiO_2$ | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 |
| Mine recovery | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Dilution | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pit slope angle ranges | Degrees | 37-64 | 40-64 | 40-68 | 40-56 | 40-68 | 40-56 | 40-56 | 40-56 |
| $V_2O_5$ concentrate recovery | % | 78.86 | 70.50 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 |
| $TiO_2$ overall recovery | % | 43.44 | 32.78 | 45.90 | 32.78 | 32.78 | 32.78 | 32.78 | 32.78 |
| Mining cost | US$/t Mined | 2.93 | 2.93 | 2.93 | 2.93 | 2.93 | 2.93 | 2.93 | 2.93 |
| Vanadium processing costs | US$/t ore Feed | 34.6 | 34.6 | 34.6 | 34.6 | 34.6 | 34.6 | 34.6 | 34.6 |
| Ilmenite concentrate costs | US$/t tonne processed | 5.74 | 5.74 | 5.74 | 5.74 | 5.74 | 5.74 | 5.74 | 5.74 |
| $TiO_2$ pigment costs | US$/t concentrate fed | 1 733 | 1 733 | 1 733 | 1 733 | 1 733 | 1 733 | 1 733 | 1 733 |
| SG&A costs | US$/lb $V_2O_5$ | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |

Source: GE21, 2024.

The following are the principal assumptions which were used in the generation of the Mineral Resource Estimate:

- The Mineral Resource cut-off grade is 0.3% of $V_2O_5$ and 1% of $TiO_2$.
- Only MAG, MPXT and MGB domains were considered eligible to classification as Mineral Resource.
- Mineral Resource was restricted to mining rights.

**Table 14-22 – Mineral Resources Estimative for Maracás Project**

| Alvo | Classification | Mass | Head | | Magnetic Concentrate | | | Material Content | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_2O_5$ | $TiO_2$ | DT | $V_2O_5$ | $TiO_2$ | $V_2O_5$ | $TiO_2$ |
| | | Mt | % | | | | | kt | |
| Campbell Pit + GAN | *Measured* | 30.28 | 0.71 | 7.64 | 22.21 | 2.40 | 3.48 | 215.73 | 2,313.22 |
| | *Indicated* | 21.09 | 0.54 | 7.28 | 18.51 | 2.14 | 2.73 | 114.50 | 1,536.38 |
| | ***Measured + Indicated*** | **51.37** | **0.64** | **7.49** | **20.69** | **2.30** | **3.17** | **330.23** | **3,849.60** |
| | *Inferred* | 29.94 | 0.54 | 7.46 | 18.52 | 2.00 | 2.31 | 162.2 | 2,232.6 |
| SJO | *Indicated* | 17.92 | 0.58 | 8.77 | 22.78 | 1.90 | 2.86 | 104.4 | 1,571.6 |
| | ***Measured + Indicated*** | ***17.92*** | ***0.58*** | ***8.77*** | ***22.78*** | ***1.90*** | ***2.86*** | ***104.39*** | ***1,571.57*** |
| | *Inferred* | 15.19 | 0.52 | 7.43 | 19.02 | 1.89 | 2.53 | 78.9 | 1,127.9 |
| NAO | *Indicated* | 7.13 | 0.58 | 10.06 | 27.29 | 1.72 | 3.06 | 41.4 | 717.2 |
| | ***Measured + Indicated*** | ***7.13*** | ***0.58*** | ***10.06*** | ***27.29*** | ***1.72*** | ***3.06*** | ***41.38*** | ***717.16*** |
| | *Inferred* | 4.09 | 0.59 | 8.61 | 23.34 | 1.83 | 3.03 | 24.0 | 351.8 |
| NAN | *Measured* | 19.44 | 0.64 | 9.02 | 22.88 | 2.14 | 2.83 | 123.7 | 1,753.6 |
| | *Indicated* | 8.93 | 0.60 | 9.14 | 21.90 | 2.14 | 2.63 | 53.9 | 815.6 |
| | ***Measured + Indicated*** | ***28.37*** | ***0.63*** | ***9.06*** | ***22.57*** | ***2.14*** | ***2.77*** | ***177.54*** | ***2,569.17*** |
| | *Inferred* | 6.88 | 0.66 | 9.16 | 22.69 | 2.28 | 2.68 | 45.7 | 630.0 |
| GAS | *Inferred* | 11.30 | 0.58 | 8.48 | 18.36 | 2.31 | 2.22 | 66.0 | 958.7 |
| JAC | *Inferred* | 21.16 | 0.47 | 7.78 | 18.57 | 1.74 | 4.65 | 98.9 | 1,645.3 |
| RIOCON | *Inferred* | 13.27 | 0.41 | 7.23 | 16.15 | 1.63 | 3.86 | 55.0 | 959.3 |
| Total | **Measured** | **49.72** | **0.68** | **8.18** | **22.47** | **2.30** | **3.22** | **339.39** | **4,066.84** |
| | **Indicated** | **55.06** | **0.57** | **8.43** | **21.58** | **2.01** | **2.80** | **314.15** | **4,640.66** |
| | ***Measured + Indicated*** | ***104.78*** | ***0.62*** | ***8.31*** | ***22.01*** | ***2.15*** | ***3.00*** | ***653.54*** | ***8,707.50*** |
| | **Inferred** | **101.82** | **0.52** | **7.76** | **18.75** | **1.93** | **3.08** | **530.79** | **7,905.60** |

Notes:
1. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
2. Mineral Resources were estimated by Fábio Xavier, BSc. (Geo), MAIG, a GE21 Associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
3. The Mineral Resource estimates were prepared in accordance with the CIM Standards, and the CIM Guidelines, using geostatistical, economic and mining parameters appropriate to the deposits.
4. Presented Mineral Resources are inclusive of Mineral Reserves. All figures have been rounded to the relative accuracy of the estimates. Summed amounts may not add due to rounding.
5. The Campbell Pit topography survey effective date is January 30th, 2024.
6. The Mineral Resource is reported with an effective date of January 30th, 2024.
7. A cut-off grade of 0.3% $V_2O_5$ head is applied in $V_2O_5$ Mineral Resource.
8. A cut-off grade of 1% $TiO_2$ head, derived from an economic function is associated to $TiO_2$ Mineral Resource.
9. Geometric and economic parameters include:
    - Mine Recovery of 100% and dilution 0%.
    - $V_2O_5$ selling price of $16 per lb.
    - $TiO_2$ pigment selling price of $4,000.00 per tonne.
    - Mining costs of $2.93 per tonne for mineralization and waste.
    - Vanadium processing costs of $34.60 per tonne of ore feed.
    - Ilmenite concentrate costs $5.74 per tonne processed.
    - $TiO_2$ pigment costs of $1,733.00 per tonne of pigment produced.
    - General and Administrative (G&A) costs of $0.27 per lb of $V_2O_5$.
10. Exchange rate: $1.00 = R$5.10.
11. Specific values for each deposit:
    - Campbell Pit + GAN: Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ concentrate recovery of 70.50% to 78.86%. $TiO_2$ overall recovery of 32.78% to 43.44%.
    - NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%.
    - SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.
    - NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.

Source: GE21, 2024.

### *14.11.1 $TiO_2$ Resource in Non-Magnetic Tailings*

Aside from Mineral Resource estimated within the remaining Campbell Pit, three tailings' ponds with material from pre-processed non-magnetic tailings from the vanadium magnetic separation process containing enriched titanium material is available for processing of Ilmenite and further concentration into titanium pigment. Figure 14-33 illustrates the three non-magnetic tailings ponds: BNM-02, BNM-03, and BNM-04.

The methodology applied to Resource classification was based on production reconciliation data.

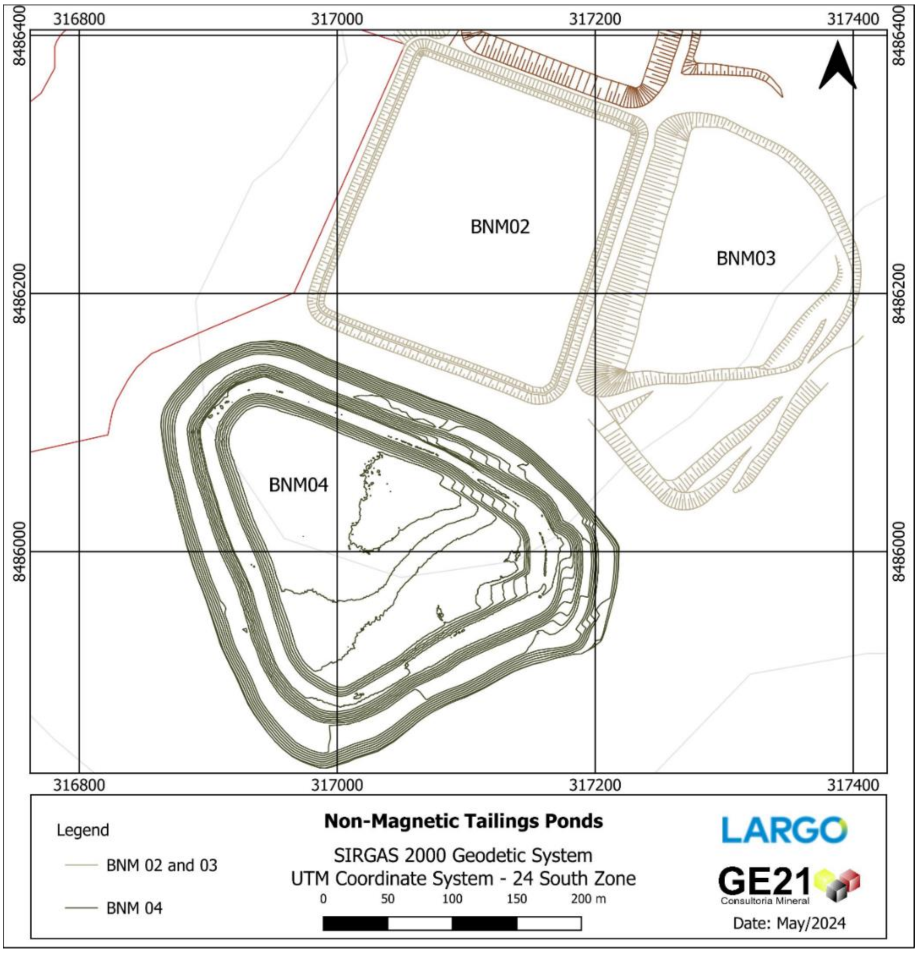



**Figure 14-33 – Non-magnetic Tailings Ponds**

Source: GE21, 2024.

*14.11.1.1 Reconciliation data*

Largo reconciliated mining and production data from 2013 to 2024 of the three ponds containing non-magnetic tailings that were used as basis for estimative and classification of nonmagnetic pond.

Largo conducted a topography surveying over these ponds on April 11th, 2024, and conducted an auger drilling campaign to evaluated grades into the ponds. The augers investigate only the superficial layer of ponds due to operational limitations. Figure 14-34 shows the localization of augers drilling.


**Figure 14-34 – Auger drilling in the Non-magnetic Tailings Ponds**

Source: GE21, 2024.

The QP compared the volume from Largo's reconciliation and the volume derived from the difference between the initial and current topographies of two ponds. The maximum observed relative difference was 5%. The QP estimated the average grade of $TiO_2$ from auger drilling and observed a relative difference of 7% when compared with Largo's reconciliation. The QP considered Largo's reconciliation valid and adopted it as the basis for estimating the $TiO_2$ Mineral Resources in the ponds.

For the measurement of tonnage deposited in ponds, the QP used the reconciliation data from 2013 to 2024 of the three ponds containing non-magnetic tailings as basis for the estimate. The historical data of non-magnetic tailings disposal into ponds are presented as a graph in Figure 14-35.

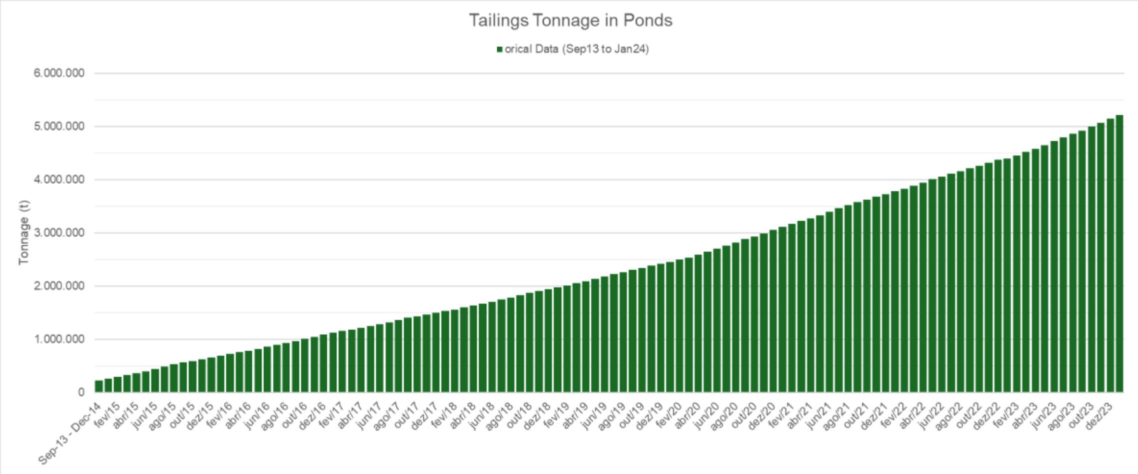



**Figure 14-35 – Monthly tonnage in Ponds**

Source: GE21, 2024.

Production data from September 2013 to December 2014 show a total of 230 kt of tailings material allocated in the ponds. From September 2013 to January 2015, 263 kt was accumulated in BNM-01. From February 2015 to January 2017, 869 kt was accumulated in BNM-02, which received material from BNM-01. From February 2017 to June 2019, 1,052 kt was accumulated in BNM-03. From July 2019 to January 2024, 3,035 kt was accumulated in BNM-04.

As standard procedure, Largo samples and assays the tailings from magnetic separation every eight hours to compound the mensal average. From January 2016 to January 2024, a total of 97 months were analyzed. There is not detailed information before December 2015, therefore the average grade of 11.35% was adopted for this period. Figure 14-36 to Figure 14-38 present the histograms for all samples available from material destinated to the ponds.

**Table 14-23 – Basis statistics tailings – $TiO_2$ %**

| Pond | Number of months | Mean | Standard deviation | Minimum | Q1 | Median | Q3 | Maximum |
|---|---|---|---|---|---|---|---|---|
| **BNM-02** | 13 | 9,829 | 1,007 | 8,620 | 8,810 | 9,710 | 10,770 | 11,330 |
| **BNM-03** | 29 | 11,987 | 1,546 | 9,575 | 10,800 | 12,024 | 13,091 | 15,757 |
| **BNM-04** | 52 | 10,535 | 2,085 | 5,892 | 9,317 | 10,933 | 11,985 | 14,653 |

Source: GE21, 2024.

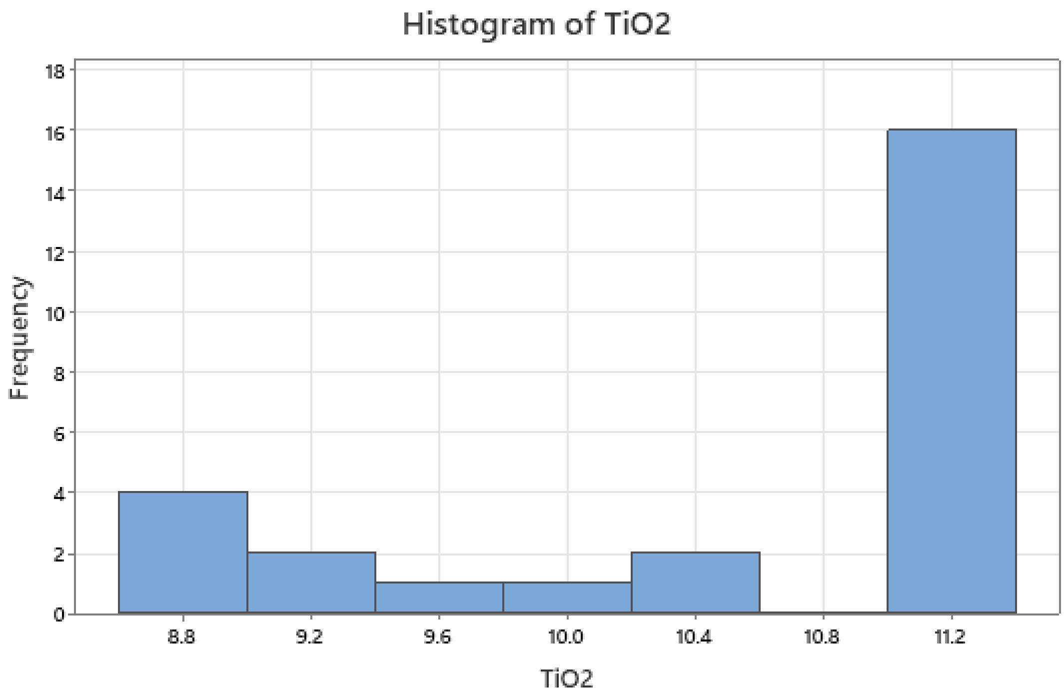



**Figure 14-36 – BNM-02 $TiO_2$ Tailings Histogram**

Source: GE21, 2024.


**Figure 14-37 – BNM-03 $TiO_2$ Tailings Histogram**

Source: GE21, 2024.

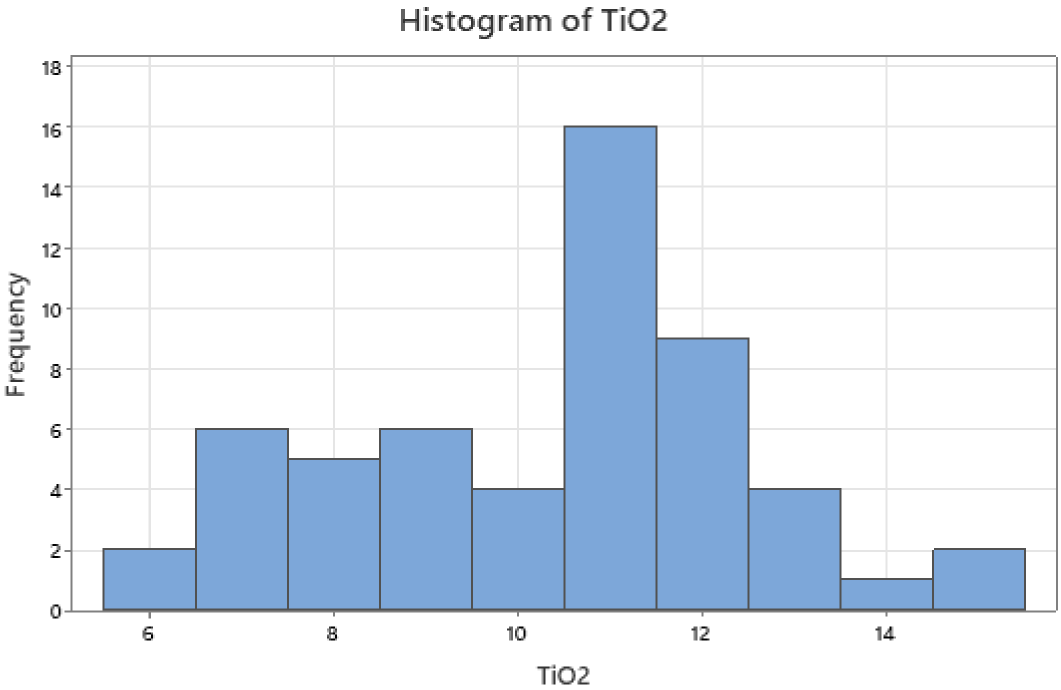



**Figure 14-38 – BNM-04 $TiO_2$ Tailings Histogram**

Source: GE21, 2024.

The grade variation for $TiO_2$ in ponds, monthly, is presented in Figure 14-39.

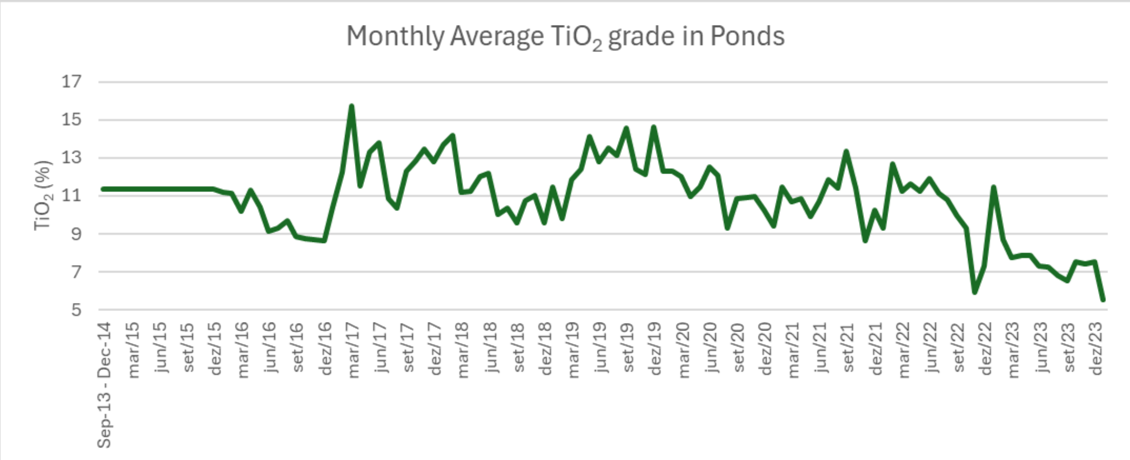



**Figure 14-39 – Monthly Average $TiO_2$ Grade in Ponds**

Source: GE21, 2024.

### *14.11.2 Non-Magnetic Ponds Resource Estimate*

The Non-Magnetic Ponds Resource Estimate utilized the tonnage of material allocated in the ponds as surveyed on January 30th, 2024, along with the average $TiO_2$ grade from all chemical assays reported up to that date. Considering the precision of the measurements and the variability observed in the volume and grade during validation, the Mineral Resource was classified as Indicated.

Table 14-24 shows the accumulated mass of non-magnetic materials from September 2013 to January 2024.

**Table 14-24 – Mineral Resource of $TiO_2$ in Non-Magnetic Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal content (kt) |
|---|---|---|---|---|
| **BNM 02** | Indicated | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Indicated | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Indicated | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Resources** | **Indicated** | **5,218.43** | **10.54** | **550.25** |

Notes:
1. Stock of "Non-Magnetic concentrate" available in the tailing's ponds.
2. Mineral Resource in ponds were estimated based on monthly processing and validated through topographic surveys (primitive data and current data) and reconciliation data.
3. Effective Date: January 30th, 2024.
4. Recovery is 100% and no dilution was applied to these Resources.
Source: GE21, 2024.

No current significant factors or risks were identified by the QP that could materially affect the potential development of the Mineral Resources.

## 14.12 Qualified Person's Opinion

In generating the Mineral Resource Estimate, the QP used various assumptions which are discussed below and throughout this section.

- Measured, Indicated and Inferred Mineral Resources were classified using the 2014 CIM Definition standards, considering the density and quality of the data to delineate the final contours of Resource pits.
- All Mineral Resource tonnages are expressed as "dry" tonnes and are based on density values as presented in the block model.
- With respect to density, it was assumed the general density average of all data according to the geologic model, based on the QP's review of the history of density determination and the realization that the values of each rock type were similar
- With respect to Estimate Validation, it was assumed that there was not a notable bias on the current estimate. This assumption was based on an analysis of the estimation of local bias using the swath-plot technique, as shown in Figures 14.16 to 14.21. Furthermore, the QP assumed that the validation did not demonstrate an excessive smoothing based on the results of the validation.

On the Mineral Resource Statement, assumptions on the forecasted commodity prices are set out in sections 15 and 19 of this Report. Assumptions on the pit slope angles are also discussed in Section 15.

# 15 MINERAL RESERVES ESTIMATES

## 15.1 Summary

Mineral Reserves represent the economically mineable portions of Measured and Indicated Resources, as described in Section 14. GE21 estimated Mineral Reserves for the Campbell Pit, GAN, NAN, SJO, and NAO deposits with an effective date of January 30th, 2024, in accordance with CIM guidelines.

To convert Resources into Reserves, considerations were made for metallurgical recoveries of products, mining dilution and ore loss factors, mining costs, processing costs, SG&A, logistics, and forecasts of vanadium and titanium products prices.

The ultimate pit design was guided by optimization work completed by GE21 using GEOVIA Whittle 4.7 software. The ultimate pit design and mining plan presented in this Report are based on the Proven and Probable Reserves outlined in this section. The mine schedule for all deposits is detailed in Section 16. A summary of Mineral Reserves for Campbell Pit, GAN, NAN, SJO and NAO is provided in Table 15-1.

In addition to Mineral Reserves from the ultimate pit, three historic tailing ponds containing titanium-enriched material from pre-processed, non-magnetic flows of the magnetic separation operation were estimated separately as Probable Reserves, as show in Table 15-2. Details on $TiO_2$ Mineral Reserves from ponds are provided in subsection 15.4 and Section 16.

**Table 15-1 – Maracás Menchen Project – Mineral Reserves Estimate (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | %Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\%V_2O_5$ | $\%TiO_2$ | Mag (Mt) | $\%V_2O_5$ | $\%TiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ in Non-Magnetic Concentrate (kt) |
| **Campbell Pit I** | | | | | | | | | |
| Proven | 16.16 | 22.42 | 0.86 | 6.35 | 3.62 | 3.15 | 5.05 | 114.23 | 842,94 |
| Probable | 5.47 | 18.75 | 0.76 | 5.60 | 1.03 | 3.23 | 4.60 | 33.14 | 259.09 |
| **Total Campbell Pit Reserve** | **21.63** | **21.49** | **0.83** | **6.16** | **4.65** | **3.17** | **4.95** | **147.37** | **1,102.03** |
| **GAN II** | | | | | | | | | |
| Proven | 12.96 | 18.44 | 0.45 | 7.66 | 2.39 | 1.80 | 2.93 | 43.94 | 922.31 |
| Probable | 11.34 | 16.88 | 0.42 | 7.16 | 1.91 | 1.79 | 2.53 | 34.23 | 763.94 |
| **Total GAN Reserve** | **24.29** | **17.71** | **0.44** | **7.42** | **4.30** | **1.79** | **2.75** | **77.17** | **1,685.25** |
| **NAN III** | | | | | | | | | |
| Proven | 19.55 | 21.02 | 0.58 | 8.25 | 4.11 | 2.05 | 3.33 | 84.22 | 1,474.91 |
| Probable | 6.40 | 21.14 | 0.56 | 8.63 | 1.35 | 1.98 | 3.04 | 27.84 | 511.05 |
| **Total NAN Reserve** | **25.95** | **21.05** | **0.58** | **8.34** | **5.46** | **2.03** | **3.26** | **111.06** | **1,985.96** |
| SJO IV | | | | | | | | | |
| Proven | - | - | - | - | - | - | - | - | - |
| Probable | 22.41 | 18.12 | 0.44 | 7.48 | 4.06 | 1.76 | 2.99 | 71.32 | 1,555.47 |
| **Total SJO Reserve** | **22.41** | **18.12** | **0.44** | **7.48** | **4.06** | **1.76** | **2.99** | **71.32** | **1,555.47** |
| NAO V | | | | | | | | | |
| Proven | - | - | - | - | - | - | - | - | - |
| Probable | 6.74 | 24.98 | 0.53 | 9.17 | 1.68 | 1.69 | 3.33 | 28.39 | 562.27 |
| **Total NAO Reserve** | **6.74** | **24.98** | **0.53** | **9.17** | **1.68** | **1.69** | **3.33** | **28.39** | **562.27** |
| **Total Maracás Menchen Mine Proven and Probable Reserves** | | | | | | | | | |

| Category | Tonnage (Mt) | %Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $\%V_2O_5$ | $\%TiO_2$ | Mag (Mt) | $\%V_2O_5$ | $\%TiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ in Non-Magnetic Concentrate (kt) |
| Proven | 48.67 | 20.80 | 0.64 | 7.46 | 10.12 | 2.38 | 3.85 | 241.39 | 3,240.16 |
| Probable | 52.36 | 19.17 | 0.50 | 7.57 | 10.03 | 1.93 | 3.13 | 193.92 | 3,650.82 |
| **Total** | **101.03** | **19.95** | **0.56** | **7.52** | **20.15** | **2.16** | **3.49** | **435.31** | **6,890.99** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a “Qualified Person” as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. The Campbell Pit topography survey effective date is January 30th, 2024.
5. Mineral Reserves are reported with an effective date of January 30th, 2024.
6. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
7. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from the non-magnetic portion.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
9. Geometric and economic parameters include:
   - Mine Recovery of 97% and dilution 10%.
   - $V_2O_5$ selling price (standard purity >98%) of $8.50/lb, with an additional premium of $1.00/lb for high purity (>99.5%) product.
   - $TiO_2$ pigment selling price (purity >94%) of $3,528.00 per tonne.
   - Mining costs of $2.93 per tonne for mineralization and waste.
   - Vanadium processing costs of $34.60 per tonne of ore feed.
   - Ilmenite concentrate costs $5.74 per tonne processed.
   - $TiO_2$ pigment costs of $1,733.00 per tonne of pigment produced.
10. General and Administrative (G&A) costs of $0.27 per lb of $V_2O_5$.
11. Exchange rate: $1.00 = R$5.10.
12. Specific values for each Deposit:
    I. Campbell Pit: Pit slope angles ranging from 37.5° to 64°.$V_2O_5$ concentrate recovery of 78.86%. $TiO_2$ overall recovery of 43.44%. Strip Ratio 3.25 (tonnes per tonne).
    II. GAN: Pit slope angles ranging from 40° to 64. $V_2O_5$ concentrate recovery of 70.50%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.17 (tonnes per tonne).
    III. NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%. Strip Ratio 5.75 (tonnes per tonne).
    IV. SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 4.23 (tonnes per tonne).
    V. NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.98 (tonnes per tonne).

Source: GE21, 2024.

**Table 15-2 – Maracás Menchen Project – Non-Magnetic Reserves in Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal Content (kt) |
|---|---|---|---|---|
| **BNM 02** | Probable | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Probable | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Probable | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Reserves** | **Probable** | **5,218.43** | **10.54** | **550.25** |

Notes:
1. Stock of “Non-Magnetic concentrate” available in the tailing’s ponds.
2. Mineral Reserve in ponds were estimated based on monthly processing and validated through topographic surveys (primitive data and survey conducted on January 30th, 2024) and reconciliation data.
3. Effective Date: January 30th, 2024.
4. Recovery is 100% and no dilution was applied to these Reserves.

Source: GE21, 2024.

## 15.2 Pit Optimization

Geometry for optimal pits was executed through the generation of an optimal sequence of pushbacks, which correspond to increments in the pit’s geometry resulting from the repeated use of the three-dimensional Lerchs-Grossman algorithm for different values of blocks obtained by varying the product price using revenue factors.

This sequence of pit expansions, or pushbacks, is the basis of open pit mine planning when using Whittle software, which projects the evolution of the pit's geometry over time. The sequence of optimal pits was obtained by varying the revenue factor from 10% to 200% concerning the product's selling price. To determine the pit's evolution over time, a feed rate plant annual scale of 3.8 Mt/year of ROM was adopted. The modifying factors for all mines are 10% dilution and a 97% mining recovery, estimated from historical operation data.

The project of an Ilmenite Plant at the Maracás Menchen Mine site, with a capacity to produce 96 ktpy of ilmenite concentrate from the Campbell Pit non-magnetic concentrate, was concluded in 2023, and initial production of ilmenite concentrate started in August 2023.

The proposed Pigment Plant with a capacity of 100 kt of $TiO_2$ per year, would be implemented in 2029 at Camaçari, Bahia, Brazil. The engineering project would be executed in 2025 with construction beginning in 2026. The ramp-up would start in 2029 with 30 kt, increasing to 60 kt in 2030, and would be completed in 2031 when the plant would be set to operate at full capacity.

The project to expand the Ilmenite Plant aims to increase capacity from 196 ktpy to 265 ktpy to meet the demand of Largo's proposed Pigment Plant. The engineering project will be executed in 2024 with construction starting in 2025. The ramp-up expectation is that by 2031, the plant will operate at full capacity.

The Campbell Pit will be exhausted in 2032, and the NAN deposit will be put in operation. After NAN is exhausted, the SJO deposit will be put in operation. The construction of roads and access to NAN will start in 2029, and in 2030 and 2031, NAN and Campbell Pit will operate together. For the NAN operation, a contracted mobile crushing unit will be installed near the NAN Pit. The construction of roads and access to access to SJO will start in 2037. NAN and SJO will be in operating together in 2038. The construction of roads and access to NAO will start in 2045. SJO and NAO will be in operating together in 2044. NAO and GAN will be operating together in 2048. GAN will be exhausted in 2054.

Subsections 15.2.1 to 15.2.4 present the optimization parameters applied and optimal pit results from GEOVIA Whittle 4.7 software for Campbell Pit and GAN, NAN, SJO and NAO, respectively.

### *15.2.1 Campbell Pit and GAN Deposit*

The pit optimization parameters for Campbell Pit and GAN Deposit are presented in Table 15-3. The optimization results, shown pit-by-pit, are illustrated in Figure 15-1. Table 15-4 presents the selected pit highlighted for clarity.

**Table 15-3 – Pit Optimization Parameters for Campbell Pit and GAN Deposit**

| Inputs | Unit | Value |
|---|---|---|
| Exchange Rate | US$/R$ | 5.1 |
| $V_2O_5$ Selling Price (Standard) ($V_2O_5$>98% purity) | US$/lb $V_2O_5$ | 8.5 |
| $V_2O_5$ Selling Price (HP) ($V_2O_5$>99.5% purity) | US$/lb $V_2O_5$ | 9.5 |
| $TiO_2$ Pigment Selling Price ($TiO_2$>94% purity) | US$/t | 3,528.0 |
| Mining Recovery | % | 97 |
| Dilution | % | 10 |
| Pit slope angles (Campbell Pit) | Degrees | 37.5 to 64 |
| Pit slope angles (GAN) | Degrees | 40 to 64 |

| Inputs | Unit | Value |
|---|---|---|
| $V_2O_5$ concentrate recovery (Campbell Pit) | % | 78.86 |
| $V_2O_5$ concentrate recovery (GAN) | % | 70.50 |
| $V_2O_5$ grade cut-off | % | Defined in GEOVIA Whittle$^{TM}$ |
| $TiO_2$ overall recovery (Campbell Pit) | % | 43.44 |
| $TiO_2$ overall recovery (GAN) | % | 32.78 |
| $TiO_2$ grade cut-off | % | N/A |
| Mining Cost | US$/t Mined | 2.93 |
| Vanadium processing costs | US$/t ore feed | 34.6 |
| Ilmenite concentrate @45% $TiO_2$ cost | US$/t processed | 5.74 |
| $TiO_2$ pigment cost | US$/t pigment produced | 1,733.0 |
| SG&A costs | US$/lb $V_2O_5$ | 0.27 |

Source: GE21, 2024.

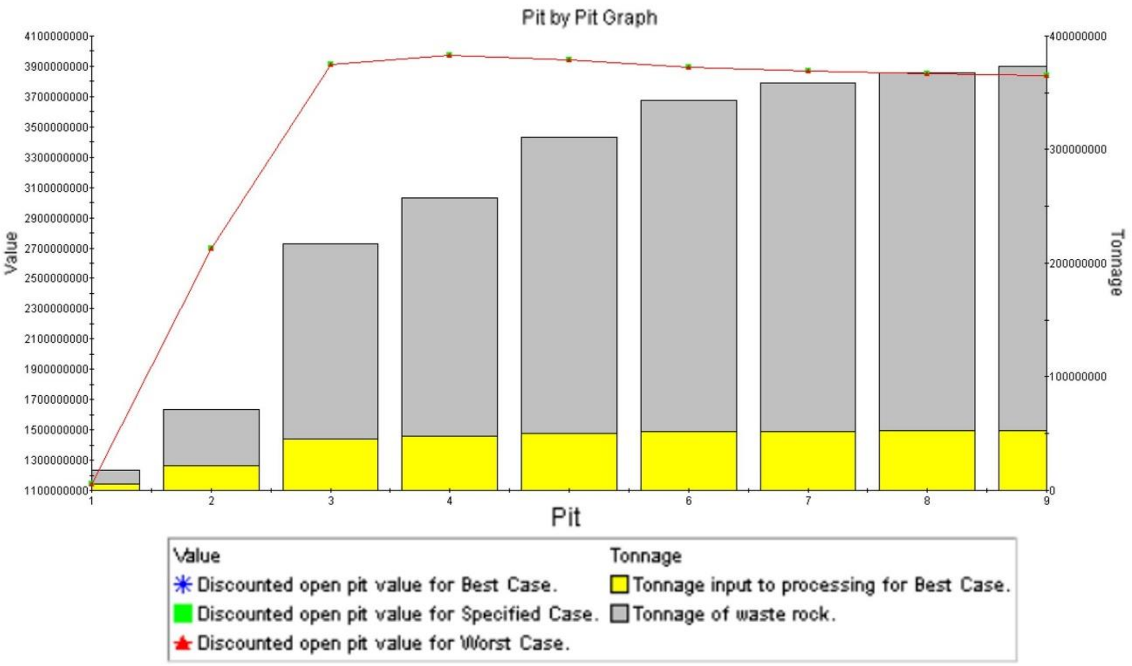



**Figure 15-1 – Campbell Pit and GAN – Pit Optimization Results Graph**

Source: GE21, 2024.

**Table 15-4 – Nested Pits Results for Campbell Pit and GAN**

| Pit | Revenue Factor | Ore (Mt) | Waste (Mt) | Strip Ratio | Conc $V_2O_5$ (%) | Conc $TiO_2$ (%) | Magnetic (%) |
|---|---|---|---|---|---|---|---|
| 1 | 0.4 | 4.22 | 13.84 | 3.28 | 3.12 | 9.41 | 39.67 |
| 2 | 0.6 | 19.42 | 52.25 | 2.69 | 2.75 | 7.22 | 25.25 |
| **3** | **0.8** | **44.93** | **172.09** | **3.83** | **2.20** | **6.90** | **19.87** |
| 4 | 1 | 48.11 | 209.28 | 4.35 | 2.18 | 6.84 | 19.48 |
| 5 | 1.2 | 50.63 | 259.73 | 5.13 | 2.14 | 6.82 | 19.17 |
| 6 | 1.4 | 51.81 | 291.71 | 5.63 | 2.12 | 6.82 | 19.01 |
| 7 | 1.6 | 52.24 | 306.12 | 5.86 | 2.11 | 6.81 | 18.95 |
| 8 | 1.8 | 52.44 | 315.68 | 6.02 | 2.11 | 6.80 | 18.92 |
| 9 | 2 | 52.52 | 320.91 | 6.11 | 2.11 | 6.80 | 18.92 |

Source: GE21, 2024.

### *15.2.2 NAN Deposit*

The pit optimization parameters for NAN are presented in Table 15-5. The optimization results pit-by-pit graph is presented in Figure 15-2. Table 15-6 presents the selected pit highlighted.

**Table 15-5 – Pit Optimization Parameters for NAN**

| Inputs | Unit | Value |
|---|---|---|
| Exchange Rate | US$/R$ | 5.1 |
| $V_2O_5$ Selling Price (Standard) ($V_2O_5$>98% purity) | US$/lb $V_2O_5$ | 8.5 |

| Inputs | Unit | Value |
|---|---|---|
| $V_2O_5$ Selling Price (HP) ($V_2O_5$>99.5% purity) | US$/lb $V_2O_5$ | 9.5 |
| $TiO_2$ Pigment Selling Price ($TiO_2$>94% purity) | US$/t | 3,528.0 |
| Mining Recovery | % | 97 |
| Dilution | % | 10 |
| Pit slope angles ranging | Degrees | 40-68 |
| $V_2O_5$ concentrate recovery | % | 70.0 |
| $V_2O_5$ grade cut-off | % | Defined in GEOVIA Whittle™ |
| $TiO_2$ overall recovery | % | 45.9 |
| $TiO_2$ grade cut-off | % | N/A |
| Mining Cost | US$/t Mined | 2.93 |
| Vanadium processing costs | US$/t ore feed | 34.6 |
| Ilmenite concentrate @45% $TiO_2$ cost | US$/t processed | 5.74 |
| $TiO_2$ pigment cost | US$/t pigment produced | 1,733.0 |
| SG&A costs | US$/lb $V_2O_5$ | 0.27 |

Source: GE21, 2024.

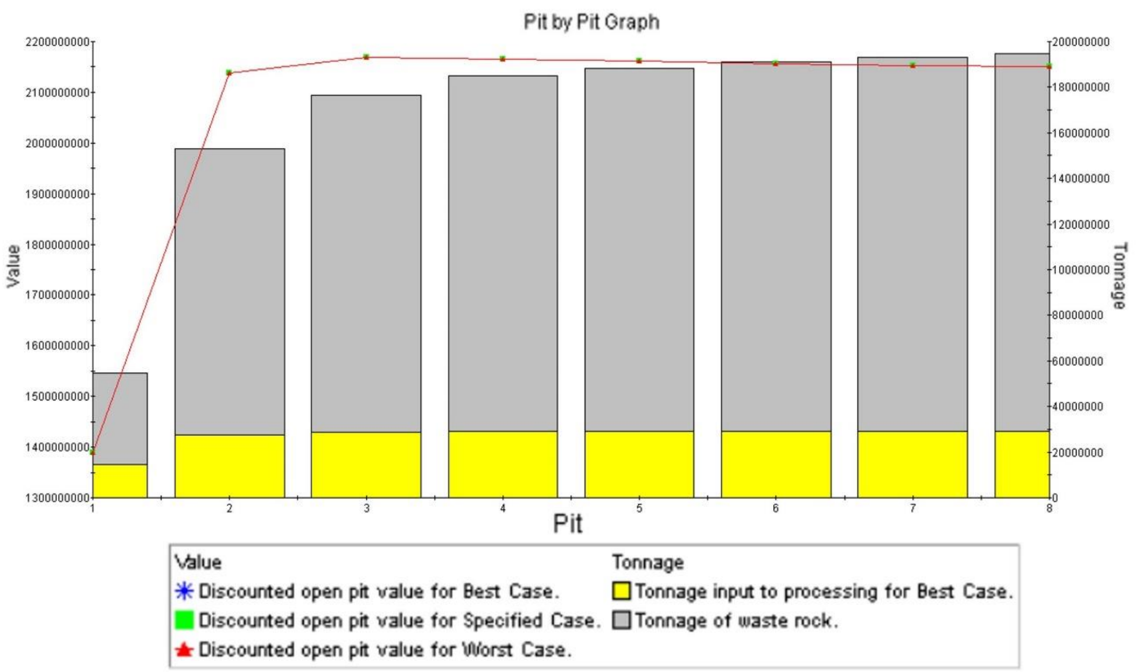



**Figure 15-2 – NAN – Pit Optimization Results Graph**

Source: GE21, 2024.

**Table 15-6 – Nested Pits Results for NAN**

| Pit | Revenue Factor | Ore (Mt) | Waste (Mt) | Strip Ratio | Conc $V_2O_5$ (%) | Conc $TiO_2$ (%) | Magnetic (%) |
|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 11.15 | 43.71 | 3.9 | 1.91 | 9.77 | 27.46 |
| **2** | **0.8** | **27.32** | **125.67** | **4.6** | **1.94** | **8.33** | **20.98** |
| 3 | 1 | 28.85 | 147.72 | 5.1 | 1.95 | 8.25 | 20.64 |
| 4 | 1.2 | 29.14 | 155.88 | 5.4 | 1.95 | 8.25 | 20.61 |
| 5 | 1.4 | 29.22 | 158.95 | 5.4 | 1.94 | 8.25 | 20.59 |
| 6 | 1.6 | 29.27 | 161.87 | 5.5 | 1.94 | 8.25 | 20.58 |
| 7 | 1.8 | 29.30 | 163.80 | 5.6 | 1.94 | 8.25 | 20.57 |
| 8 | 2 | 29.32 | 165.38 | 5.6 | 1.94 | 8.24 | 20.57 |

Source: GE21, 2024.

### *15.2.3 SJO Deposit*

The pit optimization parameters for SJO are presented in Table 15-7. The optimization results pit-by-pit graph is presented in Figure 15-3. Table 15-8 presents the selected pit highlighted.

**Table 15-7 – Pit Optimization Parameters for SJO**

| Inputs | Unit | Value |
|---|---|---|
| Exchange Rate | US$/R$ | 5.1 |
| $V_2O_5$ Selling Price (Standard) ($V_2O_5$>98% purity) | US$/lb $V_2O_5$ | 8.5 |
| $V_2O_5$ Selling Price (HP) ($V_2O_5$>99.5% purity) | US$/lb $V_2O_5$ | 9.5 |
| $TiO_2$ Pigment Selling Price ($TiO_2$>94% purity) | US$/t | 3,528.0 |
| Mining Recovery | % | 97 |
| Dilution | % | 10 |
| Pit slope angles ranging | Degrees | 40-56 |
| $V_2O_5$ concentrate recovery | % | 70.0 |
| $V_2O_5$ grade cut-off | % | Defined in GEOVIA Whittle™ |
| $TiO_2$ overall recovery | % | 32.78 |
| $TiO_2$ grade cut-off | % | N/A |
| Mining Cost | US$/t Mined | 2.93 |
| Vanadium processing costs | US$/t ore feed | 34.6 |
| Ilmenite concentrate @45% $TiO_2$ cost | US$/t processed | 5.74 |
| $TiO_2$ pigment cost | US$/t pigment produced | 1,733.0 |
| SG&A costs | US$/lb $V_2O_5$ | 0.27 |

Source: GE21, 2024.

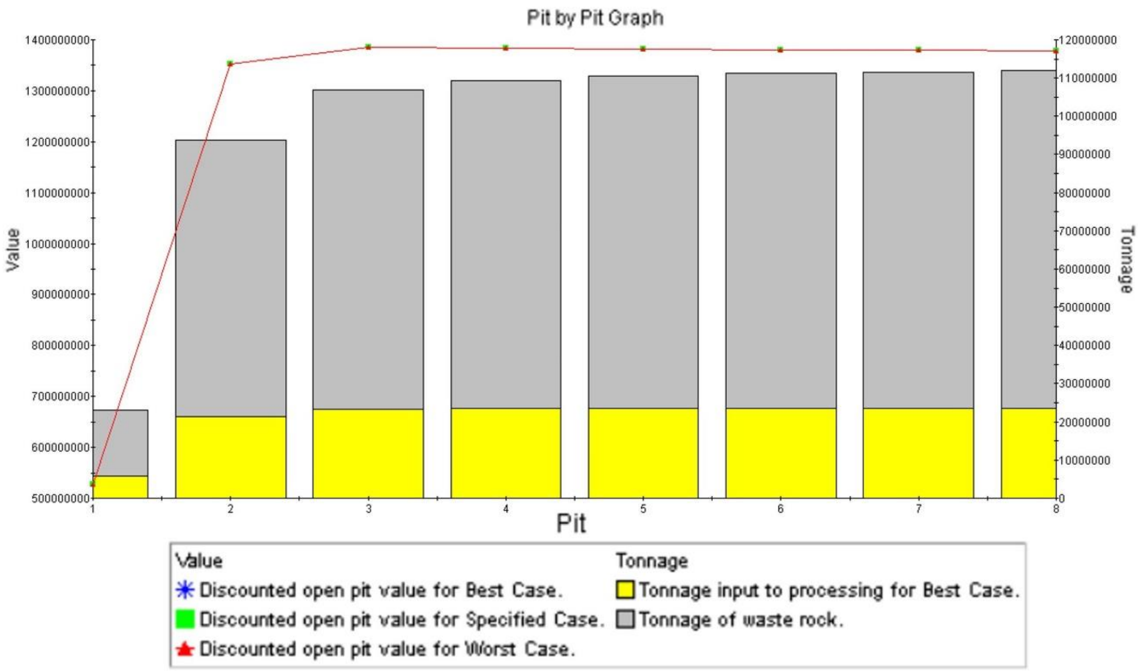



**Figure 15-3 – SJO – Pit Optimization Results Graph**

Source: GE21, 2024.

**Table 15-8 – Nested Pits Results for SJO**

| Pit | Revenue Factor | Ore (Mt) | Waste (Mt) | Strip Ratio | Conc $V_2O_5$ (%) | Conc $TiO_2$ (%) | % Magnetic |
|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 4.30 | 18.87 | 4.39 | 1.80 | 9.71 | 26.48 |
| 2 | 0.8 | 18.89 | 74.80 | 3.96 | 1.60 | 8.10 | 20.34 |
| **3** | **1** | **23.33** | **83.75** | **3.59** | **1.48** | **7.50** | **18.10** |
| 4 | 1.2 | 24.23 | 85.29 | 3.52 | 1.47 | 7.35 | 17.63 |
| 5 | 1.4 | 24.32 | 86.10 | 3.54 | 1.47 | 7.34 | 17.59 |
| 6 | 1.6 | 24.35 | 86.94 | 3.57 | 1.47 | 7.33 | 17.58 |
| 7 | 1.8 | 24.36 | 87.22 | 3.58 | 1.47 | 7.33 | 17.58 |
| 8 | 2 | 24.37 | 87.49 | 3.59 | 1.47 | 7.33 | 17.58 |

Source: GE21, 2024.

### *15.2.4 NAO Deposit*

The pit optimization parameters for NAO are presented in Table 15-9. The optimization results pit-by-pit graph is presented in Figure 15-4. Table 15-10 presents the selected pit highlighted.

**Table 15-9 – Pit Optimization Parameters for NAO**

| Inputs | Unit | Value |
|---|---|---|
| Exchange Rate | US$/R$ | 5.1 |
| $V_2O_5$ Selling Price (Standard) ($V_2O_5$>98% purity) | US$/lb $V_2O_5$ | 8.5 |
| $V_2O_5$ Selling Price (HP) ($V_2O_5$>99.5% purity) | US$/lb $V_2O_5$ | 9.5 |
| $TiO_2$ Pigment Selling Price ($TiO_2$>94% purity) | US$/t | 3,528.0 |
| Mining Recovery | % | 97 |
| Dilution | % | 10 |
| Pit slope angles ranging | Degrees | 40-68 |
| $V_2O_5$ concentrate recovery | % | 70.0 |
| $V_2O_5$ grade cut-off | % | Defined in GEOVIA Whittle™ |
| $TiO_2$ overall recovery | % | 32.78 |
| $TiO_2$ grade cut-off | % | N/A |
| Mining Cost | US$/t Mined | 2.93 |
| Vanadium processing cost | US$/t ore feed | 34.6 |
| Ilmenite concentrate @45% $TiO_2$ cost | US$/t processed | 5.74 |
| $TiO_2$ pigment cost | US$/t pigment produced | 1,733.0 |
| SG&A costs | US$/lb $V_2O_5$ | 0.27 |

Source: GE21, 2024.

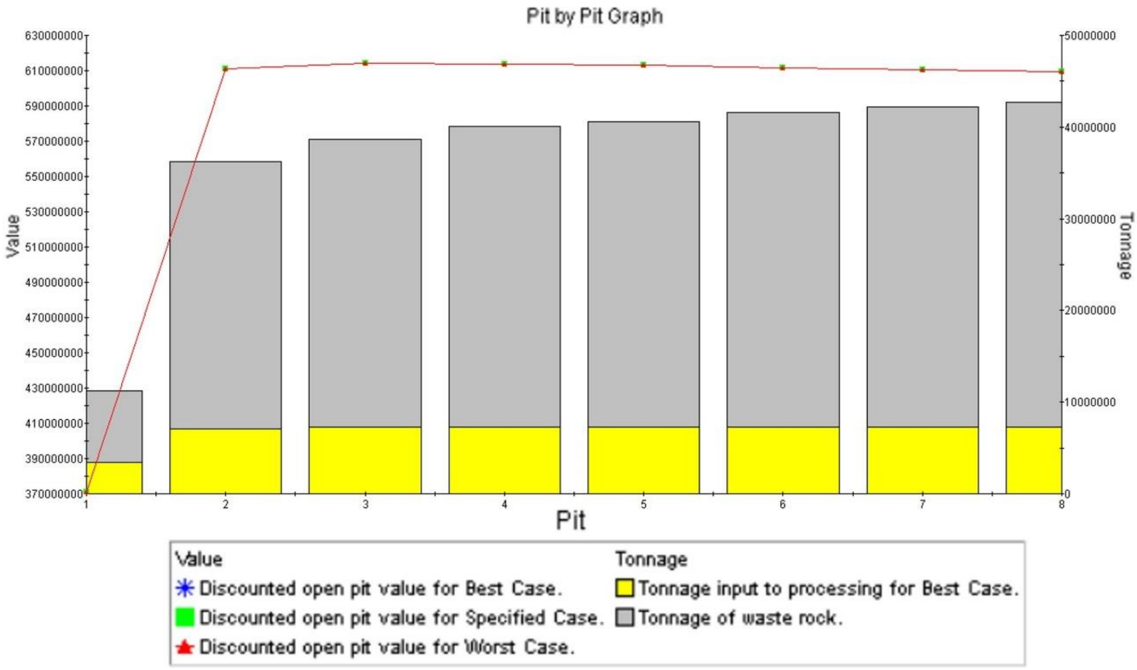



**Figure 15-4 – NAO – Pit Optimization Results Graph**

Source: GE21, 2024.

**Table 15-10 – Nested Pits Results for NAO**

| Pit | Revenue Factor | Ore (Mt) | Waste (Mt) | Strip Ratio | Conc $V_2O_5$ (%) | Conc $TiO_2$ (%) | Magnetic (%) |
|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 3.25 | 7.94 | 2.44 | 1.50 | 10.76 | 29.94 |
| 2 | 0.8 | 7.11 | 29.14 | 4.1 | 1.57 | 9.17 | 24.99 |
| 3 | 1 | 7.24 | 31.44 | 4.34 | 1.56 | 9.15 | 24.88 |
| 4 | 1.2 | 7.29 | 32.79 | 4.5 | 1.56 | 9.14 | 24.86 |
| 5 | 1.4 | 7.30 | 33.27 | 4.56 | 1.56 | 9.14 | 24.86 |
| 6 | 1.6 | 7.32 | 34.25 | 4.68 | 1.56 | 9.14 | 24.84 |
| 7 | 1.8 | 7.32 | 34.87 | 4.76 | 1.56 | 9.14 | 24.84 |
| 8 | 2 | 7.33 | 35.33 | 4.82 | 1.56 | 9.14 | 24.84 |

Source: GE21, 2024.

## 15.3 Ultimate Pit Design

The Ultimate Pit Design consists of projecting, based on an optimal pit, an operational pit that allows for the safe and efficient development of mining operations. The methodology involves establishing an outline of the toes and crests of the benches, safety berms, work sites, and mining site access ramps while adhering to the geometric and geotechnical parameters used.

### *15.3.1 Campbell and GAN Pits*

Table 15-11 presents the geometric parameters adopted to develop the mine design for Campbell Pit and GAN. Figure 15-5 presents the final pits for both deposits. Table 15-12 and Table 15-13 present the Mineral Reserves for the Campbell Pit and the GAN Deposit, respectively.

**Table 15-11 – Mining Design Parameters for Campbell Pit and GAN**

| Description | Units | Value |
|---|---|---|
| Road Ramp Width | m | 15 |
| Ramp Grade | % | 10 |
| Bench Face Angle (detailed in Section 16) | degrees | 55 to 80 |
| Bench Height (10 m weathered and 20 m fresh rock) | m | 10 and 20 |
| Berm Width | m | 6 |
| Minimum Botton Area | $m^2$ | 30 |

Source: Largo, 2024.

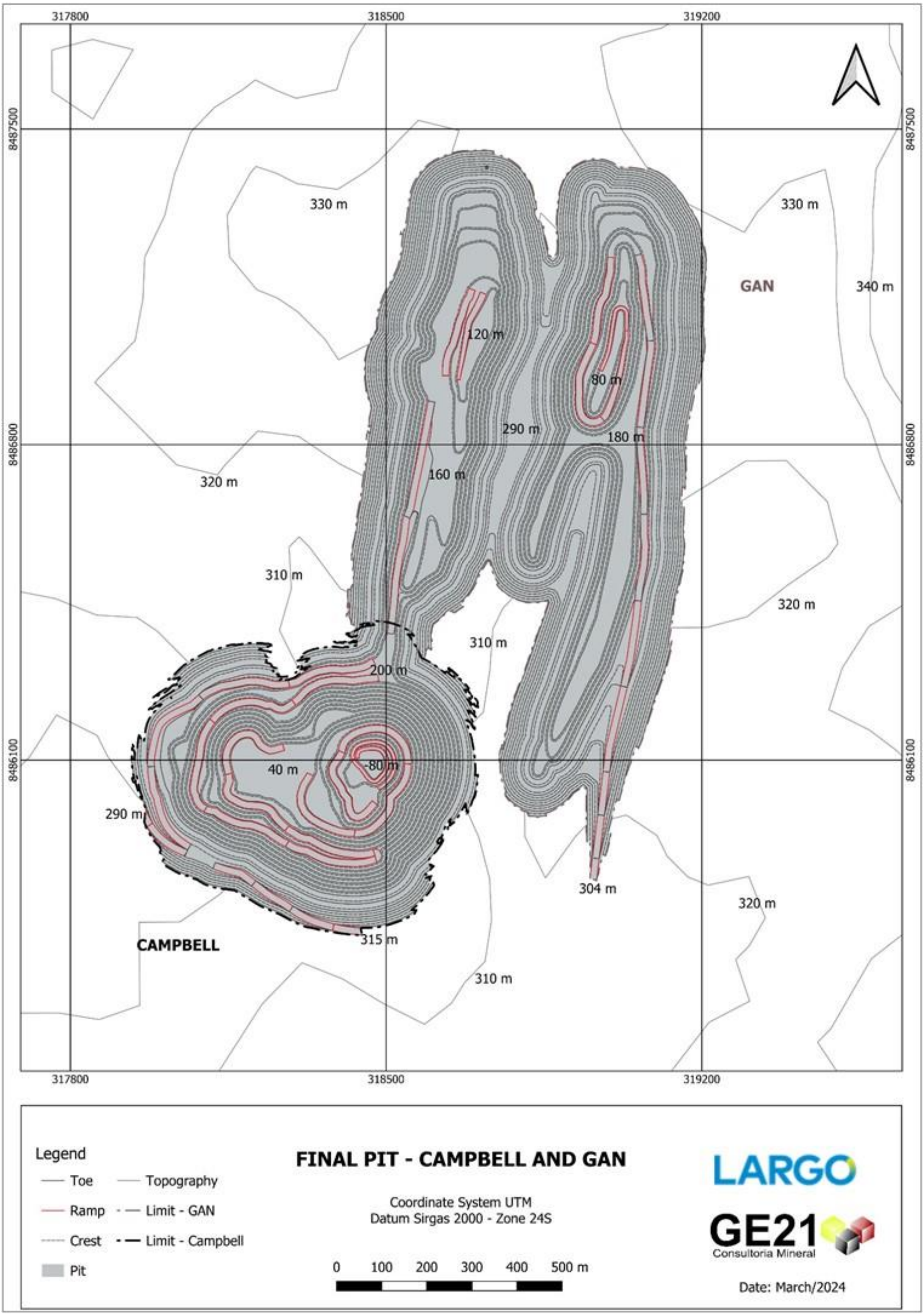



**Figure 15-5 – Campbell Pit and GAN – Final Pit Design**

Source: GE21, 2024.

**Table 15-12 – Maracás Menchen Project – Campbell Pit Reserves (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | % Magnetics | Head | | | | Magnetic Concentrate | | | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | MAG (Mt) | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ Magnetic Tailings (kt) |
| Proven | 16.16 | 22.42 | 0.86 | 6.35 | 25.85 | 27.94 | 3.62 | 3.15 | 5.05 | 62.07 | 2.49 | 114.23 | 842.94 |
| Probable | 5.47 | 18.75 | 0.76 | 5.60 | 23.88 | 30.25 | 1.03 | 3.23 | 4.60 | 62.91 | 2.38 | 33.14 | 259.09 |
| **Total Reserve** | **21.63** | **21.49** | **0.83** | **6.16** | **25.35** | **28.52** | **4.65** | **3.17** | **4.95** | **62.25** | **2.46** | **147.37** | **1,102.03** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (Meng), MAIG, a GE21 associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. The Campbell Pit topography survey effective date is January 30th, 2024.
5. Mineral Reserves were reported with the effective date January 30th, 2024.
6. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
7. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from non-magnetic portion.
8. Exchange rate $ 1.00 = R$ 5.10.
9. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
    - Recovery: 97%.
    - Dilution: 10%.
    - Pit slope angles range from 37.5° to 64°.
    - $V_2O_5$ selling price (standard $V_2O_5$>98% purity) of $8.50/lb, with an additional premium of $1.00/lb for high purity product ($V_2O_5$>99.5%).
    - $TiO_2$ pigment selling price ($TiO_2$ >94% purity) of $3,528.00/tonne.
    - Mining costs of $2.93/tonne for mineralization and waste.
    - Vanadium processing costs of $34.60/tonne ore feed.
    - $V_2O_5$ concentrate recovery of 78.86%.
    - Ilmenite concentrate costs of $5.74/tonne processed.
    - $TiO_2$ pigment costs of $1,733.00/tonne of pigment produced.
    - $TiO_2$ overall recovery of 43.44%.
    - General and Administrative (G&A) costs of $0.27
    - Strip Ratio 3.25 (t/t).

Source: GE21, 2024.

**Table 15-13 – Maracás Menchen Project – GAN Mine Design (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | % Magnetics | Head | | | | Magnetic Concentrate | | | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | MAG (Mt) | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ Magnetic Tailings (kt) |
| Proven | 12.96 | 18.44 | 0.45 | 7.66 | 26.75 | 26.58 | 2.39 | 1.80 | 2.93 | 62.99 | 1.25 | 42.94 | 922.31 |
| Probable | 11.34 | 16.88 | 0.42 | 7.16 | 25.28 | 28.17 | 1.91 | 1.79 | 2.53 | 64.60 | 1.05 | 34.23 | 762.94 |
| **Total Reserve** | **24.29** | **17.71** | **0.44** | **7.42** | **26.06** | **27.32** | **4.30** | **1.79** | **2.75** | **63.70** | **1.16** | **77.17** | **1,685.25** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. Mineral Reserves are reported with the effective date January 30th, 2024.
5. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
6. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from non-magnetic portion.
7. Exchange rate $ 1.00 = R$ 5.10.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
    - Recovery: 97%.
    - Dilution: 10%.
    - Pit slope angles range from 40° to 64°.
    - $V_2O_5$ selling price (standard $V_2O_5$>98% purity) of $8.50/lb, with an additional premium of $1.00/lb for high purity product ($V_2O_5$>99.5%).
    - $TiO_2$ pigment selling price ($TiO_2$ >94% purity) of $3,528.00/tonne.
    - Mining costs of $2.93/tonne for mineralization and waste.
    - Vanadium processing costs of $34.60/tonne ore feed.
    - $V_2O_5$ concentrate recovery of 70.50%.
    - Ilmenite concentrate costs of $5.74/tonne processed.

- $TiO_2$ pigment costs of $1,733.00/tonne of pigment produced.
- $TiO_2$ overall recovery of 32.78%.
- General and Administrative (G&A) costs of $0.27/lb $V_2O_5$.
- Strip Ratio 6.17 (t/t).

Source: GE21, 2024.

### *15.3.2 NAN Pit*

Table 15-14 presents geometric parameters adopted in mine design for the NAN Deposit. Figure 15-6 presents the final pit for the NAN deposit. Table 15-15 presents the final Mineral Reserves for the NAN Deposit.

**Table 15-14 – Mine Design Parameters for NAN**

| Description | Units | Value |
|---|---|---|
| Road Ramp Width | m | 15 |
| Ramp Grade | % | 10 |
| Bench Face Angle | degrees | 59-84 |
| Bench Height | m | 10 |
| Berm Width | m | 6 |
| Minimum Botton Area | m² | 30 |

Source: GE21, 2024.

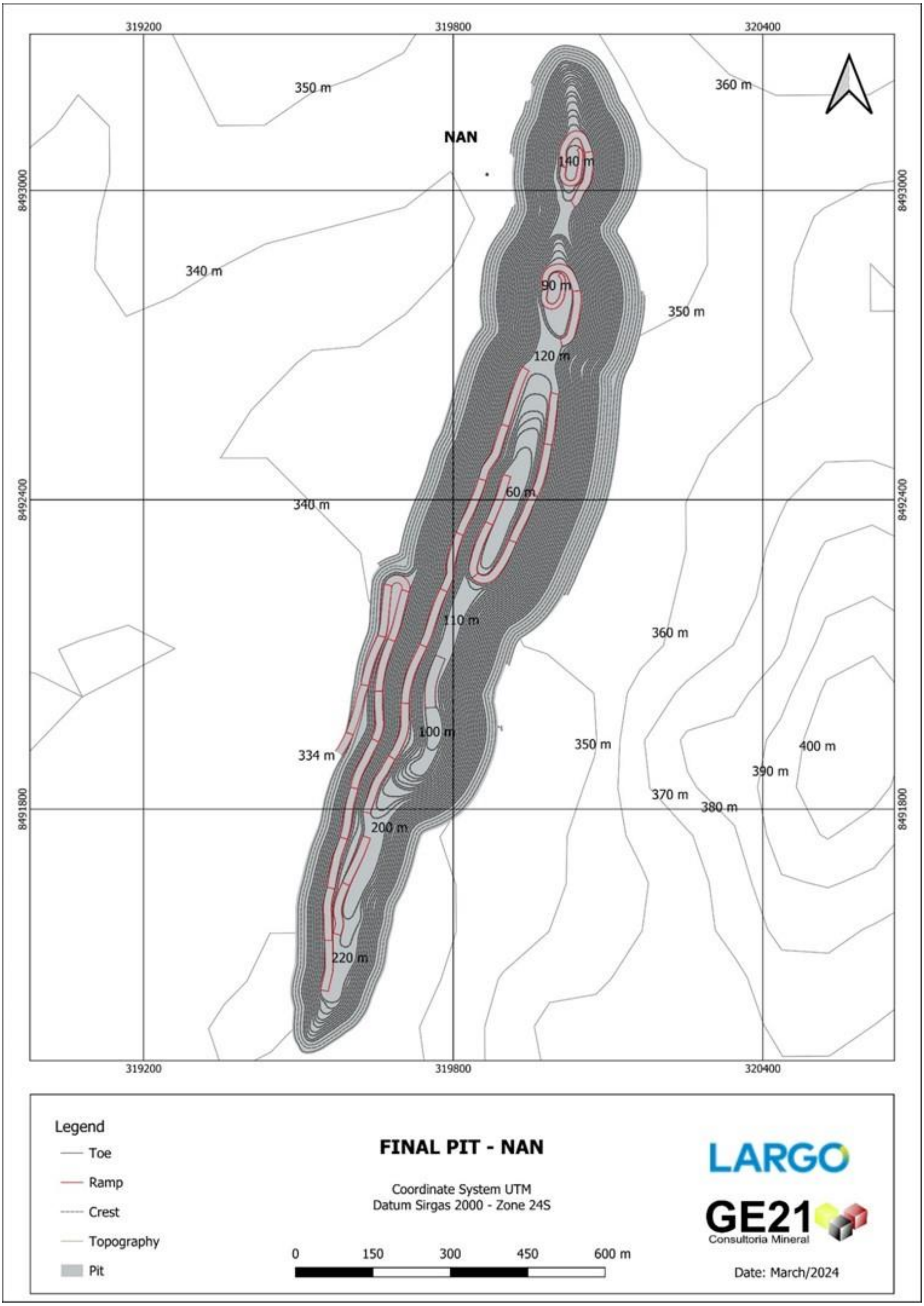



**Figure 15-6 – NAN – Final Pit Design**

Source: GE21, 2024.

**Table 15-15 – Maracás Menchen Project – NAN Reserves (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | % Magnetics | Head | | | | Magnetic Concentrate | | | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | MAG (Mt) | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ Magnetic Tailings (kt) |
| Proven | 19.55 | 21.02 | 0.58 | 8.25 | 27.42 | 24.82 | 4.11 | 2.05 | 3.33 | 62.46 | 3.14 | 84.22 | 1,475.91 |
| Probable | 6.40 | 21.14 | 0.56 | 8.63 | 27.96 | 24.18 | 1.35 | 1.98 | 3.04 | 64.15 | 2.58 | 27.84 | 511.05 |
| **Total Reserve** | **25.95** | **21.05** | **0.58** | **8.34** | **27.55** | **24.66** | **5.46** | **2.03** | **3.26** | **62.88** | **3.00** | **111.06** | **1,986.96** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. Mineral Reserves were reported with the effective date January 30th, 2024.
5. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
6. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from non-magnetic portion.
7. Exchange rate $1.00 = R$5.10.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
   - Recovery: 97%.
   - Dilution: 10%.
   - Pit slope angles range from 40° to 68°.
   - $V_2O_5$ selling price (standard $V_2O_5$>98% purity) of $8.50/lb, with an additional premium of $1.00/lb for high purity product ($V_2O_5$>99.5%).
   - $TiO_2$ pigment selling price ($TiO_2$ >94% purity) of $3,528.00/tonne.
   - Mining costs of $2.93/tonne for mineralization and waste.
   - Vanadium processing costs of $34.60/tonne ore feed.
   - $V_2O_5$ concentrate recovery of 70.00%.
   - Ilmenite concentrate costs of $5.74/tonne processed.
   - $TiO_2$ pigment costs of $1,733.00/tonne of pigment produced.
   - $TiO_2$ overall recovery of 45.90%.
   - General and Administrative (G&A) costs of $0.27/lb $V_2O_5$. Strip Ratio 5.75 (t/t).

Source: GE21, 2024.

### *15.3.3 SJO Pit*

Table 15-16 presents geometric parameters adopted in mine design for the SJO Deposit. Figure 15-7 presents the final pit for the SJO deposit. Table 15-17 presents the final Mineral Reserves for the SJO Deposit.

**Table 15-16 – Mine Design Parameters for SJO**

| Description | Units | Value |
|---|---|---|
| Road Ramp Width | m | 15 |
| Ramp Grade | % | 10 |
| Bench Face Angle | degrees | 59-80 |
| Bench Height | m | 10 |
| Berm Width | m | 6 |
| Minimum Botton Area | m² | 30 |

Source: GE21, 2024.

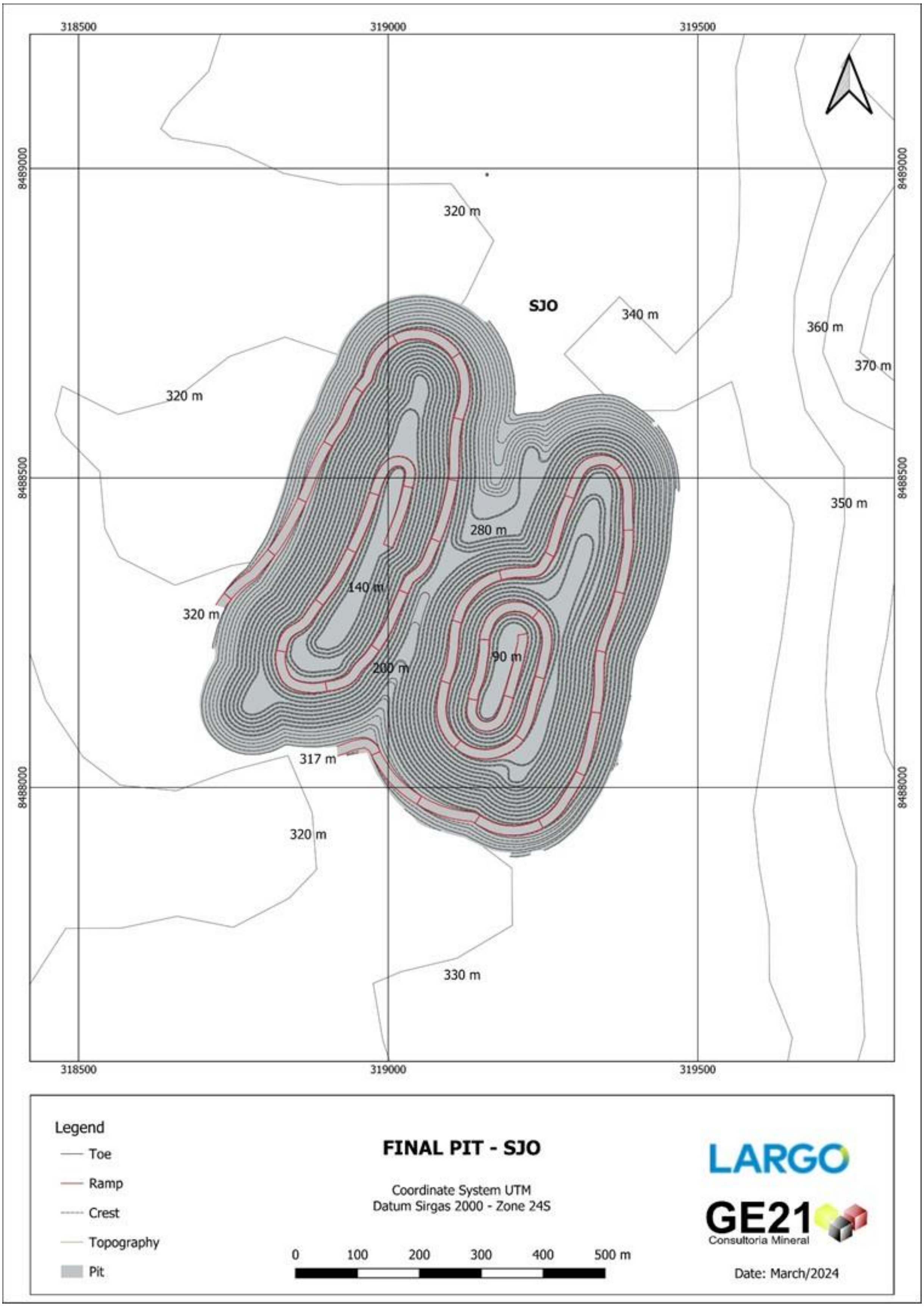



**Figure 15-7 – SJO – Final Pit Design**

Source: GE21, 2024.

**Table 15-17 – Maracás Menchen Project – SJO Reserves (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | % Magnetics | Head | | | | Magnetic Concentrate | | | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | MAG (Mt) | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ Magnetic Tailings (kt) |
| Proven | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Probable | 22.41 | 18.12 | 0.44 | 7.48 | 25.76 | 27.04 | 4.06 | 1.76 | 2.99 | 66.25 | 1.54 | 71.32 | 1,555.47 |
| **Total Reserve** | **22.41** | **18.12** | **0.44** | **7.48** | **25.76** | **27.04** | **4.06** | **1.76** | **2.99** | **66.25** | **1.54** | **71.32** | **1,555.47** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a “Qualified Person” as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. Mineral Reserves were reported with the effective date January 30th, 2024.
5. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
6. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from non-magnetic portion.
7. Exchange rate \$ 1.00 = R\$ 5.10.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
   - Recovery: 97%.
   - Dilution: 10%.
   - Pit slope angles range from 40° to 56°.
   - $V_2O_5$ selling price (standard $V_2O_5$>98% purity) of \$8.50/lb, with an additional premium of \$1.00/lb for high purity product ($V_2O_5$>99.5%).
   - $TiO_2$ pigment selling price ($TiO_2$ >94% purity) of \$3,528.00/tonne.
   - Mining costs of \$2.93/tonne for mineralization and waste.
   - Vanadium processing costs of \$34.60/tonne ore feed.
   - $V_2O_5$ concentrate recovery of 70.00%.
   - Ilmenite concentrate costs of \$5.74/tonne processed.
   - $TiO_2$ pigment costs of \$1,733.00/tonne of pigment produced.
   - $TiO_2$ overall recovery of 32.78%.
   - General and Administrative (G&A) costs of \$0.27/lb $V_2O_5$. Strip Ratio 4.23 (t/t).

Source: GE21, 2024.

### *15.3.4 NAO Pit*

Table 15-18 presents geometric parameters adopted in mine design for the NAO Deposit. Figure 15-8 presents the final pit for the NAO Deposit. Table 15-19 presents the final Mineral Reserves for the NAO Deposit.

**Table 15-18 – Mine Design Parameters for NAO**

| Description | Units | Value |
|---|---|---|
| Road Ramp Width | m | 15 |
| Ramp Grade | % | 10 |
| Bench Face Angle | degrees | 59 - 84 |
| Bench Height | m | 10 |
| Berm Width | m | 6 |
| Minimum Botton Area | $m^2$ | 30 |

Source: GE21, 2024.

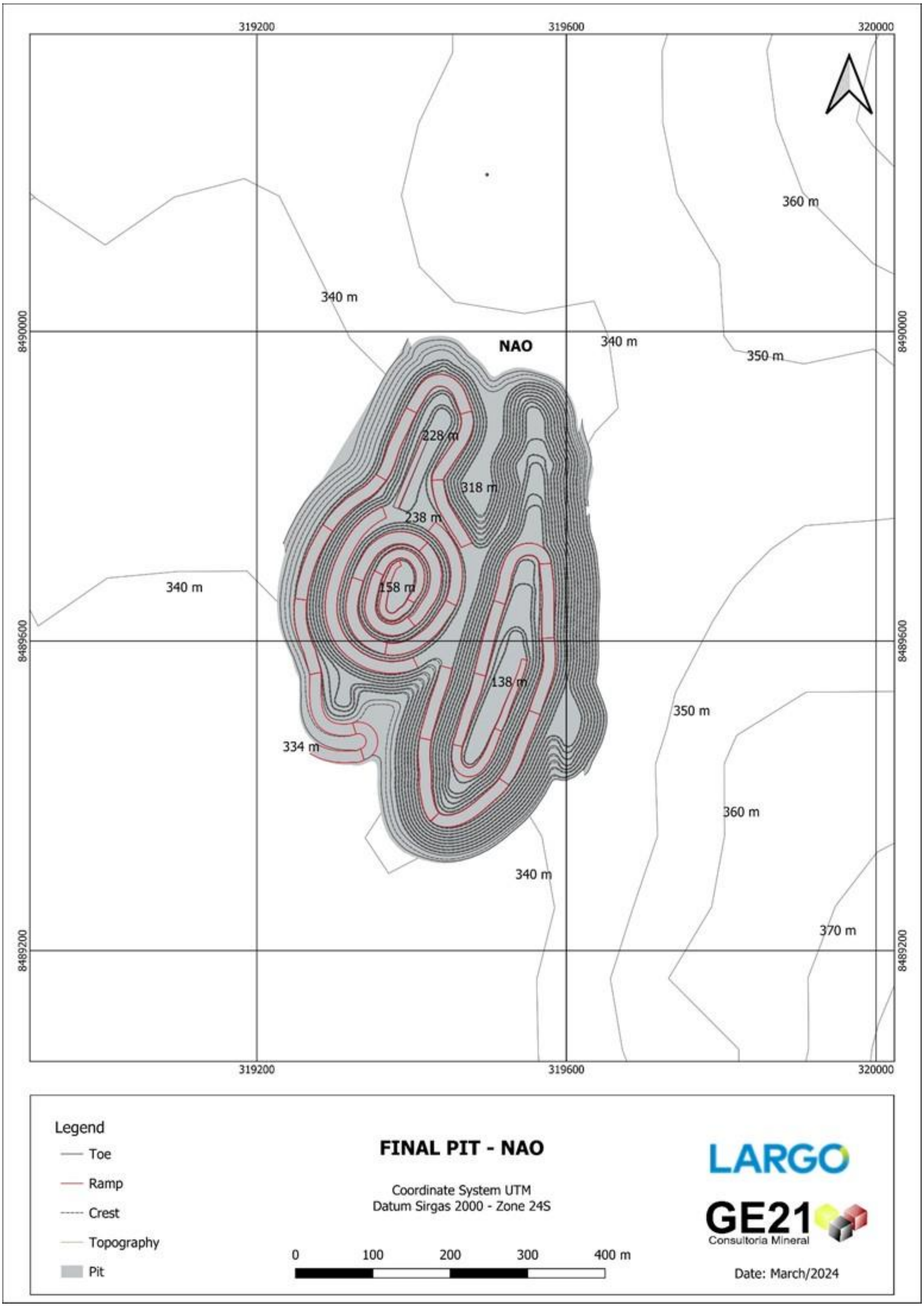



**Figure 15-8 – NAO – Final Pit Design**

Source: GE21, 2024.

**Table 15-19 – Maracás Menchen Project – NAO Reserves (Effective Date – January 30th, 2024)**

| Category | Tonnage (Mt) | % Magnetics | Head | | | | Magnetic Concentrate | | | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | MAG (Mt) | % $V_2O_5$ | % $TiO_2$ | % Fe | % $SiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | $TiO_2$ Magnetic Tailings (kt) |
| Proven | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Probable | 6.74 | 24.98 | 0.53 | 9.17 | 29.41 | 22.56 | 1.68 | 1.69 | 3.33 | 66.62 | 0.94 | 28.39 | 562.27 |
| **Total Reserve** | **6.74** | **24.98** | **0.53** | **9.17** | **29.41** | **22.56** | **1.68** | **1.69** | **3.33** | **66.62** | **0.94** | **28.39** | **562.27** |

Notes:
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. Mineral Reserves were reported with the effective date January 30th, 2024.
5. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
6. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from non-magnetic portion.
7. Exchange rate \$ 1.00 = R\$ 5.10.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
   - Recovery: 97%.
   - Dilution: 10%.
   - Pit slope angles range from 40° to 68°.
   - $V_2O_5$ selling price (standard $V_2O_5$>98% purity) of \$8.50/lb, with an additional premium of \$1.00/lb for high purity product ($V_2O_5$>99.5%).
   - $TiO_2$ pigment selling price ($TiO_2$ >94% purity) of \$3,528.00/tonne.
   - Mining costs of \$2.93/tonne for mineralization and waste.
   - Vanadium processing costs of \$34.60/tonne ore feed.
   - $V_2O_5$ concentrate recovery of 70.00%.
   - Ilmenite concentrate costs of \$5.74/tonne processed.
   - $TiO_2$ pigment costs of \$1,733.00/tonne of pigment produced.
   - $TiO_2$ overall recovery of 32.78%.
   - General and Administrative (G&A) costs of \$0.27/lb $V_2O_5$. Strip Ratio 6.98 (t/t).

Source: GE21, 2024.

## 15.4 $TiO_2$ Reserves in Non-Magnetic Tailings

Aside from Mineral Reserves from the ultimate pit, three tailings ponds contain material from pre-processed non-magnetic tailings of vanadium magnetic separation, which includes enriched titanium material available for processing into ilmenite and further transformation into titanium pigment.

The conversion of non-magnetic tailings material from Indicated Mineral Resources to Probable Reserves was applied to the full extent of the Non-Magnetic Pond Mineral Resources, as the reconciliation data available.

The methodology applied to Reserves classification was based on production reconciliation data and topographic surveying of the ponds.

### *15.4.1 Non-Magnetic Ponds Reserves Estimate*

The Non-Magnetic Ponds Resource Estimate used the tonnage of material allocated in the ponds as surveyed as of January 30th, 2024, along with the average $TiO_2$ grade from all chemical assays reported up to the date. The Indicated Mineral Resource was converted to Probable Mineral Reserve. Forecasted production of tailings was not included in the Reserves assessment. Table 15-20 shows the accumulated mass of non-magnetics from September 2013 to January 2024.

**Table 15-20 – Mineral Reserves of $TiO_2$ in Non-Magnetic Ponds (Effective Date – January 30th, 2024)**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal Content (kt) |
|---|---|---|---|---|
| **BNM 02** | Probable | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Probable | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Probable | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Reserves** | **Probable** | **5,218.43** | **10.54** | **550.25** |

Notes:
1. Stock of "Non-Magnetic concentrate" available in the tailing's ponds.
2. Mineral Reserves in ponds were estimated based on monthly processing and validated through topographic surveys (primitive data and current data) and reconciliation data.
3. Effective Date: January 30th, 2024.
4. Recovery is 100%, and no dilution was applied to these Reserves.

Source: GE21, 2024.

## 15.5 Optimization Risks Assessment

GE21 evaluated potential risks associated with mining and geotechnical activities that could impact the definition of ultimate pits. The appraised risks include:

- Geotechnical studies for NAN, SJO, NAO, and GAN are conservative. Further geotechnical studies are needed to enhance the accuracy of slope angles. Following these analyses, a review of pit optimization should be conducted.
- Production interruptions due to dewatering issues in Campbell Pit can affect production rates and must be mitigated.
- A mining recovery and dilution study should be prepared to enhance the robustness of Mineral Reserves for NAN, SJO, NAO, and GAN. Similarly, the development of a mine reconciliation program is necessary to confirm the Reserve assumptions used.
- Commencement delays for production at NAN, SJO, NAO and GAN are anticipated due to environmental licensing and land acquisition.

Permanent monitoring of the risks must be implemented. Follow-up reports should be prepared and submitted to management departments with consolidated information to facilitate informed decision-making.

## 15.6 Qualified Person's Opinion

Proven and Probable Mineral Reserves were classified using the 2014 CIM Definition Standards. They were estimated based on Measured and Indicated Mineral Resources, with appropriate modifying factors applied to delineate the final operational pit contours at Campbell Pit, NAN, SJO, NAO, and GAN deposits.

In the QP's opinion, the estimate of Mineral Reserves, as well as the parameters and assumptions used, are sufficient for the level of study conducted. No Inferred Resources were converted to Reserves, and that material is considered waste.

All Mineral Reserve tonnages are expressed as "dry" tonnes and are based on density values from the block model. Geotechnical parameters for GAN deposit are derived from Campbell Pit studies. Detailed studies for NAN, SJO, NAO and GAN are required for the next study level.

The Largo Mineral Reserves were prepared with the assumption that the environmental licensing of the satellite deposits will occur within the expected timeframe, thereby avoiding delays in operations. Largo needs to initiate complementary geotechnical and hydrogeological studies for the satellite deposits, especially for NAN, which is scheduled to begin operations in 2029, to confirm the parameters presented in this report.

Grade control is another critical area that Largo must enhance. The current dilution practiced in the Campbell Pit is high at 10%, which negatively impacts the feed grade. If this 10% dilution value is confirmed for the other deposits, it may adversely affect the plant feed due to the low $V_2O_5$ content in these deposits and the overall Mineral Reserves.

In preparing the Mineral Reserve Estimate, the QP used several assumptions regarding the conversion of Mineral Resources to Mineral Reserves, discussed below and throughout this section.

The principal assumptions include:

- Long-term prices for vanadium and titanium, detailed further in Section 19.
- Economic assumptions regarding mining costs, processing costs, SG&A, and logistics provided by the Company based on historical costs.
- The average pit angles used in the Mineral Reserve and Resource Estimate are based on established geotechnical work at Campbell Pit. Similar mineralization and rock type at NAN, SJO, NAO and GAN are discussed further in Section 16.
- GE21 estimated grades of the non-magnetic ponds based on chemical control assays conducted at 8-hour intervals from 2016 to 2024, as presented in Section 15. The distribution of these grades is depicted in the provided histogram. No spatial relationship can be inferred from the deposition of material in the ponds.

# 16 MINING METHODS

The Maracás Menchen Project (Project) comprises five open-pit mining operations employing a contract mining fleet of hydraulic excavators, front-end loaders, and 45-tonne haul trucks. Other equipment has been selected and sized in accordance with the specifications of these trucks and excavators. All mining fleets have chosen and sized for both ore extraction and waste removal purposes.

The waste dump construction method for Campbell Pit follows an ascending approach, incorporating drainage bases and channels to ensure dump stability. Similarly, at the NAN, SJO, NAO, and GAN mines, waste dumps sites will be properly prepared with base drainage and channeling systems to manage water flow, promoting geotechnical stability and preventing erosion of stockpiled materials. Waste rock will be transported by truck and uniformly spread and leveled by a tractor operator. This process involves stacking additional layers above the initial bank while maintaining access ramps for trucks.

## 16.1 Geotechnical Studies

### *16.1.1 Introduction*

The objective of this section is to present the findings of the geotechnical assessment conducted to determine slope angles at the Campbell Pit, situated in Pé de Serra, Maracás, Bahia. As of the date of this Technical Report, geotechnical assessments for other pits are still in progress.

The work involved a bibliographic review of the relevant documents, along with an examination of reports and descriptions of rotary drilling holes provided by Largo. The Geotechnical Study, commissioned by Largo and conducted by Itaaçu Geologia e Engenharia (Maracás Menchen Mine, Pit Zoning, Technical Report, August/2019), relied on the analysis of geological and geotechnical data collected in the field, including a kinematic analysis of mapped structures. Given the robust nature of the rock formations, this type of analysis typically yields optimal results, with simulations using the Limit or Stress Equilibrium Method/Deformation known to produce very high safety factor values.

ISRM/ABGE criteria were applied, and resistance parameters were adopted for this phase based on previous studies conducted for Largo and literature references concerning materials with similar characteristics and behavior, as utilized by consulting and mining firms.

### *16.1.2 Local Conditions*

#### *16.1.2.1 Physical Characteristics*

The pit area is situated in a region characterized by gentle slopes, located between intermittent springs, with negligible water levels and an annual rainfall of approximately 600 mm.

#### *16.1.2.2 Summary of Local Geology*

Detailed information on local geology is provided in Section 7. Below is a summary providing context for the Geotechnical Studies:

- **Stratified Sill of the Jacaré River**:

According to Brito (1983), this formation comprises two zones: the lower gabbro-diorite zone and the upper Stratified Zone.

- **Lower gabbro-diorite zone:**

The lower gabbro-diorite zone comprises rocks from the gabbro-diorite family, characterized as massive, mesocratic, with gray coloration and medium grain size. At the macroscopic level, these rocks are classified as diorites, gabbros, and occasionally as anorthosites.

- **Stratified zone**:

The stratified zone has an average thickness of 600 meters and is divided into four members. It consists of cycles of gabbros, pyroxenites, and magnetitites that alternate upwards. The zone is characterized by layered rocks, predominantly gabbro (80%), with smaller percentages of pyroxenitic rocks, tonalitic rocks, and stratiform magnetite levels.

Covering part of the area are lateritic soils of minimal thickness, altered rocks (W3/4) up to 20±5 meters thick, which extend over an area of approximately 50±10 meters of slightly altered (W2/3) and subsequently sound rock (W1/2).

### *16.1.3 Geotechnical Analysis*

For the development of this study, a survey and analysis of available technical data were conducted, followed by a field visit to identify the primary structural features of the pit. Additionally, drilling holes were described for alignment purposes, and previous descriptions were validated.

The predominant structural feature observed is foliation, with a maximum concentration orientation at 105/56º, leading to planar ruptures in sectors 1 and toppling in sectors 3. Other structural features are localized within the excavated or blasted portions of the pit. Figure 16-1 illustrates the characteristics of the main structures identified during the mapping process.

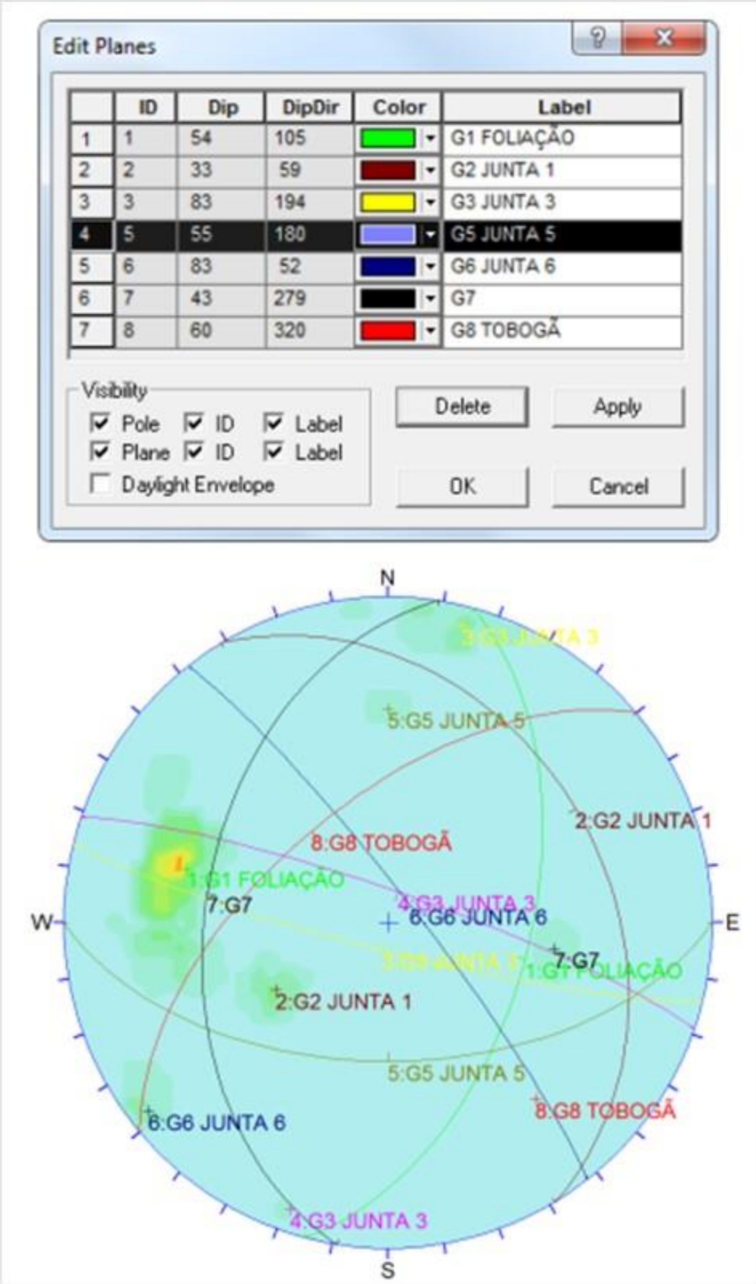



**Figure 16-1 – Stereo system of the main structures in the pit**

Source: Itaaçu, 2019.

### *16.1.3.1 Rock Mass Classification*

The rock mass classification followed the criteria of the Bieniawski Classification (1989), or RMR (Rock Mass Rating), using data collected in the mapping and stored in the attached Table 16-1.

**Table 16-1 – Massif Classes**

| CLASS | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| **RMR** | 100-80 | 80-60 | 60-40 | 40-20 | 20-0 | - |
| **TERM** | Very good | Good | Fair | Poor | Very poor | Cohesive / Saprolite Soil |
| **DESCRIPTIVE** | Very good | Good | Fair | Poor | Very poor | Stiff soil |

Source: Bieniawski Geomechanical Classification, 1989.

There are regular to poor class materials in the upper portions and very good in the lower portions, despite the massif being at low stress conditions at around 60 m in depth. The main rupture mechanism that may occur in the pit is planar rupture along the foliation, mainly in the west portion and toppling in the east portion. In other regions, planar and wedge breaks occur less frequently. From 50 m to 60 m, ruptures occur along the foliation and can be blocked by the friction angle and by interventions with active or passive anchorages. Falling blocks can occur because of fragmentation due to detonations and are also minimized with the use of double-twisted meshes or nets to mitigate the falling of blocks. Circular breaks connecting were not observed.

### *16.1.3.2 Resistance Parameters*

The resistance parameters were obtained from the results of laboratory tests conducted on core samples from drilling. The results are shown in Table 16-2 and Table 16-3.

**Table 16-2 – Test Results of the Gabbro Gazed**

| SAMPLE | SPR | DEPTH (m) | TESTS | λ | Ab (%) | P (%) | d (g/cm³) | V1 (m/s) | σt (MPa) | σc (MPa) | E (GPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **12** | 103 | 20 | A | - | 1.96 | 5.45 | 2.78 | - | - | - | - |
| **11** | 103 | 21 | A | - | 0.38 | 1.09 | 2.89 | - | - | - | - |
| **05** | 103 | 24 | A, B, C | 2.5 | 0.29 | 0.85 | 2.90 | 5,970 | 10 | 163 | 79 |
| **09** | 103 | 34 | B, C | 2.6 | - | - | - | 4,800 | 10 | 67 | 48 |
| **10** | 102 | 38 | C | 2.6 | - | - | - | - | 15 | - | - |
| **03** | 101 | 65 | A, B, C | 2.6 | 0.26 | 0.77 | 2.95 | 5,800 | 15 | 167 | 77 |
| **15** | 101 | 74 | A, B, C | 2.6 | 0.18 | 0.50 | 2.92 | 6,300 | 15 | 156 | 87 |
| **01** | 103 | 78 | B | 2.5 | - | - | - | 6,300 | - | 176 | 99 |

Notes:
A)1 MPa ≈ 10 kgf/cm²
B)1 GPa ≈ $10^4$ kgf/cm²
Source: Itaaçu, 2019.

**Table 16-3 – Results of isotropic pyroxenite-pegmatite-gabbro tests**

| MATERIAL | SAMPLE | SPR | DEPTH (m) | TESTS | λ | Ab (%) | P (%) | d (g/cm³) | V1 (m/s) | σt (MPa) | σc (MPa) | E (GPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1.2) PYROXENITE** | 16 | 101 | 33 | A, B, C | - | 0.32 | 1.05 | 3.32 | - | 5 | - | - |
| | 17 | 101 | 47 | A, B, C | 2.6 | 0.11 | 0.36 | 3.35 | 6, 800 | 19 | 159 | - |
| | 02 | 101 | 61 | A, B | 2.6 | 0.23 | 0.76 | 3.25 | 6, 200 | - | 55 | 136 |
| **(1.3) PEGMATITE** | 08 | 102 | 39 | A, B, C | 2.6 | 0.39 | 0.99 | 2.57 | 4, 900 | 9 | 67 | 48 |
| | 06 | 101 | 44 | A, B | 2.6 | 0.50 | 1.30 | 2.57 | 4, 200 | - | - | - |
| | 04 | 103 | 61 | A, B, C | 2.5 | 0.55 | 1.40 | 2.57 | 4, 900 | 10 | 167 | 77 |
| **(1.4) ISOTROPICGABBER** | 13 | 103 | 53 | A, B, C | 2.6 | 0.18 | 0.51 | 2.90 | 6, 200 | 14 | | |
| | 07 | 103 | 56 | A, B, C | 2.6 | 0.25 | 0.72 | 2.86 | 5, 980 | 15 | 156 | 87 |
| | 14 | 102 | 58 | A, B, C | 2.6 | 0.19 | 0.57 | 2.94 | 6, 400 | 17 | 176 | 99 |

Notes:
A) 1 MPa ≈ 10 kgf/cm²
B) 1 GPa ≈ $10^4$ kgf/cm²
Source: Itaaçu, 2019.

### *16.1.3.3 Hydrogeological Aspects*

The occurrence of a regional water table is not expected in the pit area, only a few well-defined springs with low flow rates that do not affect slope stability and can be adequately managed during mining operations. There is no need for dewatering wells; instead, water can be collected and directed to locations where it can pump out of the pit without disrupting mining operations.

### 16.1.3.4 Pit Sectorization

Campbell pit has an almost circular geometry, with no preferential direction of elongation of the slopes. Sectorization was conduct considering the state of alteration of the materials, the spatial arrangement of the structures, and the expected rupture mechanisms.

Sectors A represent portions of the slope with a degree of alteration greater than or equal to three (W3/4), extending up to 20±5 m in depth, characterized by open fractures and highly altered surfaces. Sectors B are regions of relaxed rock mass with depths of 50± 10 m of rock with little change (W2), but relaxed. Sectors C represent the more stable portions of the rock mass classified as Class I and II (very good and good), in the lower depths.

Table 16-4 and Figure 16-2 detail the characteristics of the sectors and the sectorization of the pit, respectively.

**Table 16-4 – Campbell Pit Sectors**

| Slope | Sector characteristic | Sector azimuths |
|---|---|---|
| **Sector 1A**<br>**Sector 1B**<br>**Sector 1C** | Alteration (W3/4) up to 20±5 m in depth<br>Alteration (W2) 50±10 m deep, relaxed<br>Class I/II (W2/1) | S77E – N15W |
| **Sector 2A**<br>**Sector 2B**<br>**Sector 2C** | Alteration (W3/4) up to 20±5 m in depth<br>Alteration (W2) 50±10 m deep, relaxed<br>Class I/II (W2/1) | N15W – N77W |
| **Sector 3A**<br>**Sector 3B**<br>**Sector 3C** | Alteration (W3/4) up to 20±5 m in depth<br>Alteration (W2) 50±10 m deep, relaxed<br>Class I/II (W2/1) | N77W – S33 W |
| **Sector 4A**<br>**Sector 4B**<br>**Sector 4C** | Alteration (W3/4) up to 20±5 m in depth<br>Alteration (W2) 50±10 m deep, relaxed<br>Class I/II (W2/1) | S33W – S24E |
| **Sector 5A**<br>**Sector 5B**<br>**Sector 5C** | Alteration (W3/4) up to 20±5 m in depth<br>Alteration (W2) 50±10 m deep, relaxed<br>Class I/II (W2/1) | S24E – S77E |

Source: Itaaçu, 2019.

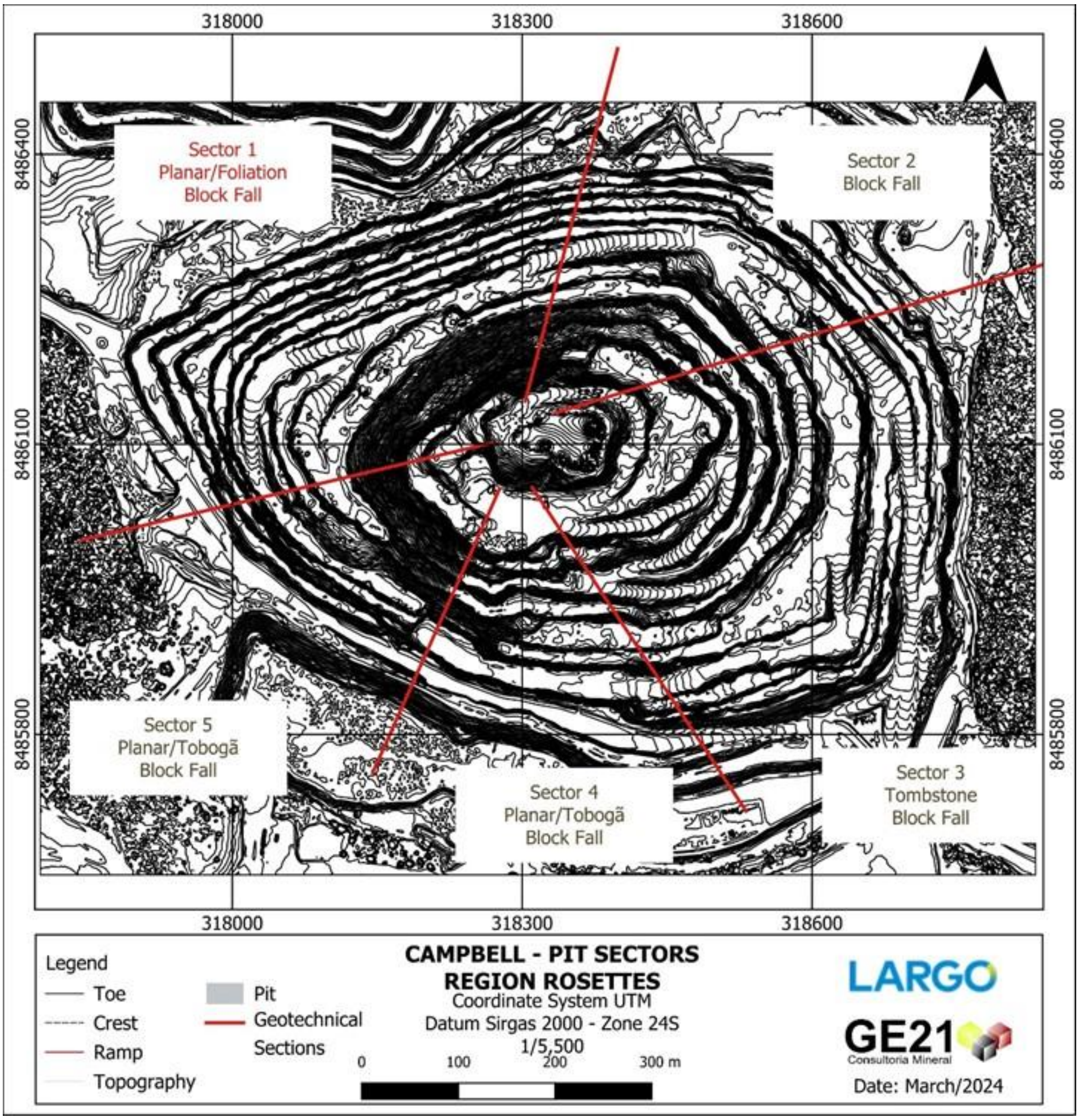



**Figure 16-2 – Campbell Pit Sectors**

Source: Itaaçu, 2019.

### *16.1.4 Disruption Mechanisms*

The primary rupture mechanism in the pit is planar rupture in the most altered materials and in the low-stress condition portion, along the foliation, which is a feature present throughout the pit. The second most important mechanism is blockage, also caused by foliation, but it is a mechanism that can coexist or even be avoided. Other planar ruptures occur in every sector, but their effect is restricted to the bench level, in the altered portions and in the low-stress condition portions. It is observed that in portions below 50±10 m in depth, the mechanism of planar ruptures and toppling practically disappears, with the rock mass becoming more homogeneous and less influenced by foliation.

### 16.1.5 Kinematic Analysis

Kinematic/geometric analysis is essential for understanding the relationship between the structures in a rock mass and the slope to be implemented. The slopes for the sectors were initially designed with a face inclination of 80 degrees to simulate what would happen in the mine and the types of ruptures that would be generated.

Figure 16-3 illustrates the elements and regions with probable instability types for each sector.

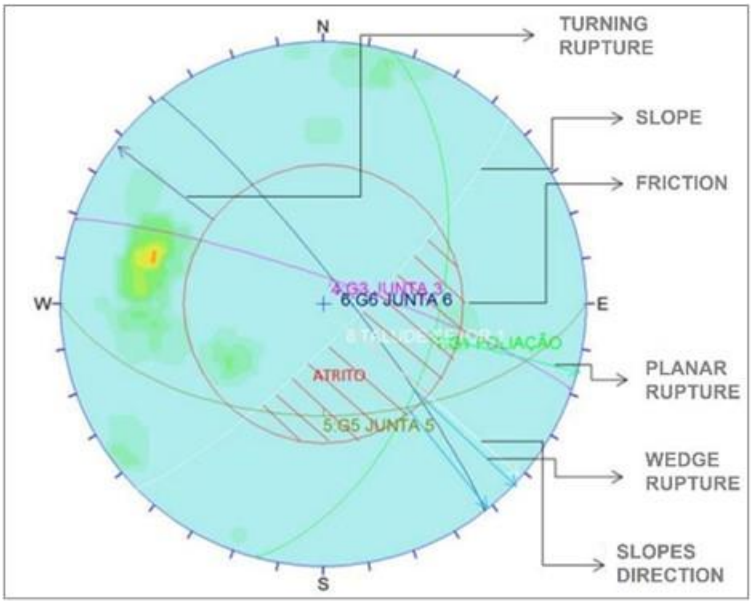



**Figure 16-3 – Key design of elements considered in Kinematic Analysis**

Source: Itaaçu, 2019.

#### *16.1.5.1 Kinematic Analysis of Sectors*

- **Sector A1**

Figure 16-4: representative stereonet of sector A1, indicating a planar rupture along the foliation and two wedge ruptures due to the intersection of joints 5 and 6 with the foliation. The intersection of joint 4 and the foliation generates a wedge, but it is blocked because the intersection line makes an angle greater than 20 degrees with the slope direction.

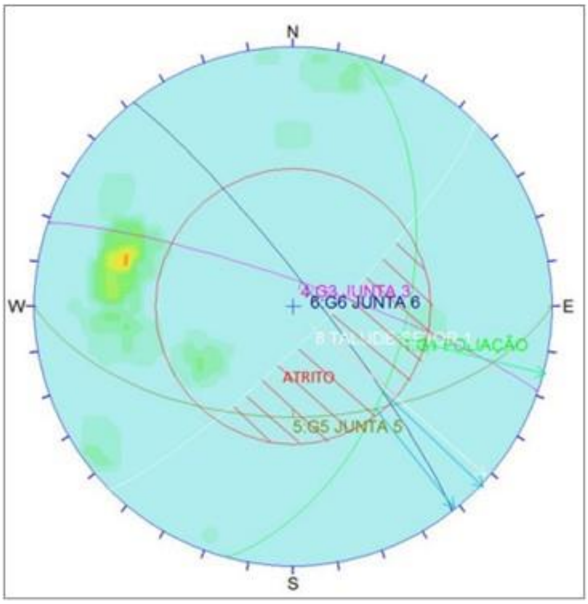



**Figure 16-4 – Pit sector A1 showing wedge ruptures and planar ruptures**

Source: Itaaçu, 2019.

- **Sector A2**

Figure 16-5: in sector A2, ruptures caused by structures are not expected as they are all blocked by the slope's position. Only falling blocks may occur due to a lack of proper clearance.

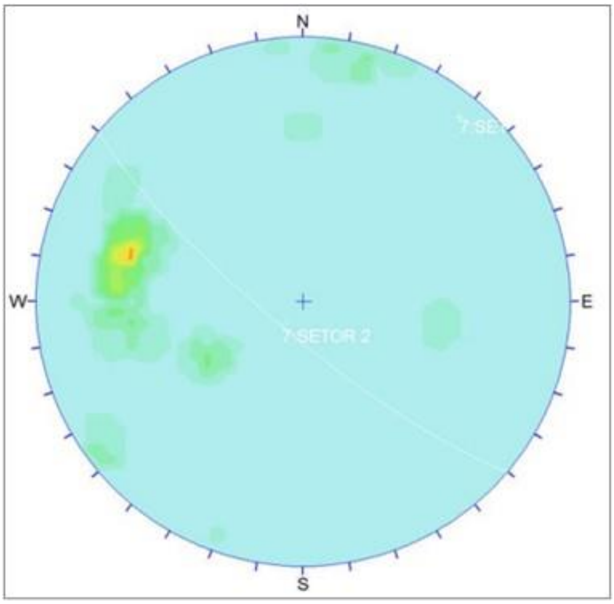



**Figure 16-5 – Pit sector A1 showing wedge ruptures and planar ruptures Source: Itaaçu, 2019**

Source: Itaaçu, 2019.

- **Sector A3**

Figure 16-6: for sector A3, planar ruptures are expected along the Tobogã joint, with tipping in the foliation that dips into the rock mass. Joint 7 is blocked by the friction angle but may eventually slip.

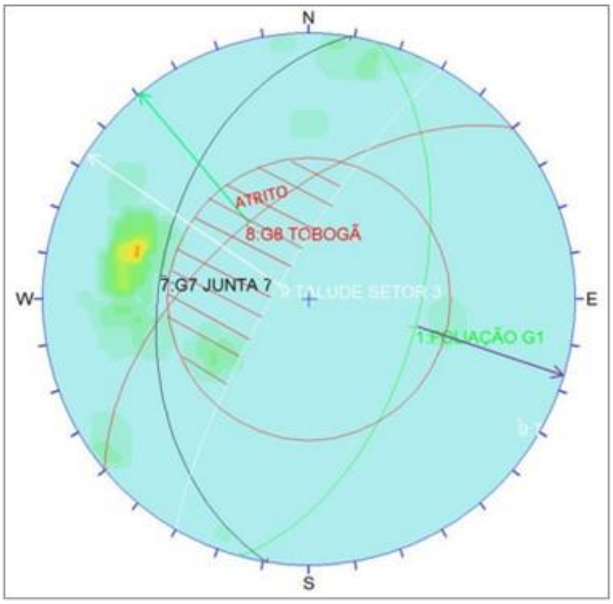



**Figure 16-6 – A3 sector of the pit showing planar and tipping ruptures**

Source: Itaaçu, 2019.

- **Sector A4**

Figure 16-7: in sector A4, planar ruptures are anticipated along joint 8 (Tobogã) and wedge rupture from the intersection of joints 8 and 6, with the intersection line falling into the unstable zone formed by the friction cone and slope direction.

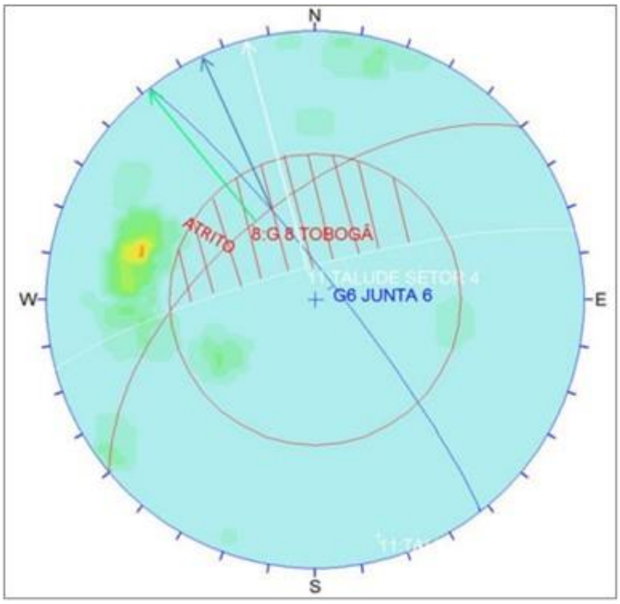



**Figure 16-7 – A4 sector of the pit showing planar and wedge breaks**

Source: Itaaçu, 2019.

- **Sector A5**

Figure 16-8: in sector A5, planar ruptures by joints 4 and 6 are unlikely due to their dip being greater than that of the slope, though there is a 20% chance of occurrence due to surface undulation. Joint 1, with a dip smaller than the friction angle, is blocked but may rupture resistance diminishes over time.

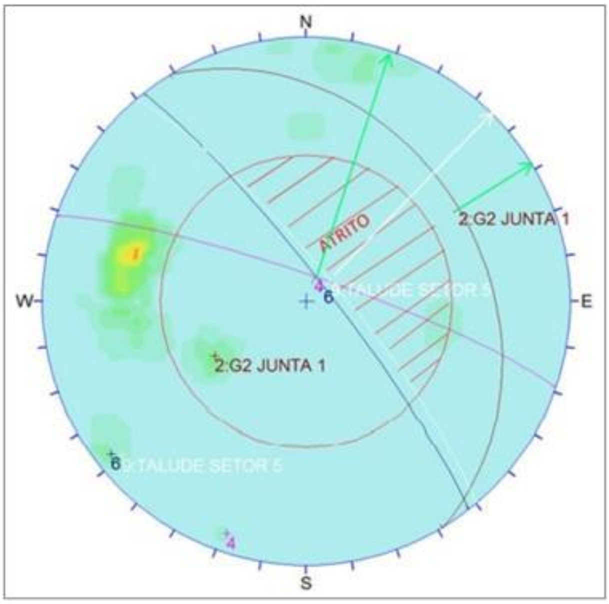



**Figure 16-8 – Sector A5 of the pit showing planar ruptures blocked by friction and a dip greater than that of the slope**

Source: Itaaçu, 2019.

- **Sector B1**

Figure 16-9: sector B1, with an estimated friction angle of 48º may still experience planar ruptures along the foliation and wedge ruptures near the friction cone limit, due to the relaxed portion of the slope.

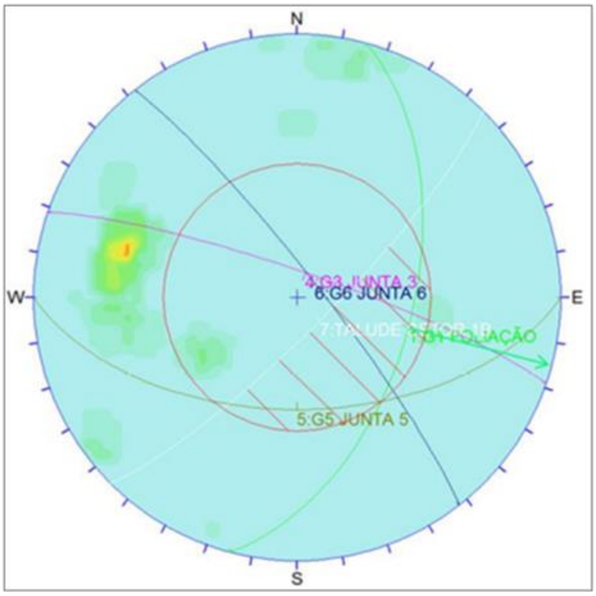



**Figure 16-9 – Sector B1 of the pit showing planar and wedge ruptures near the limit of the friction cone**

Source: Itaaçu, 2019.

- **Sector B2**

Figure 16-10: like sector A2, sector B2 does not expect ruptures from preexisting structures.

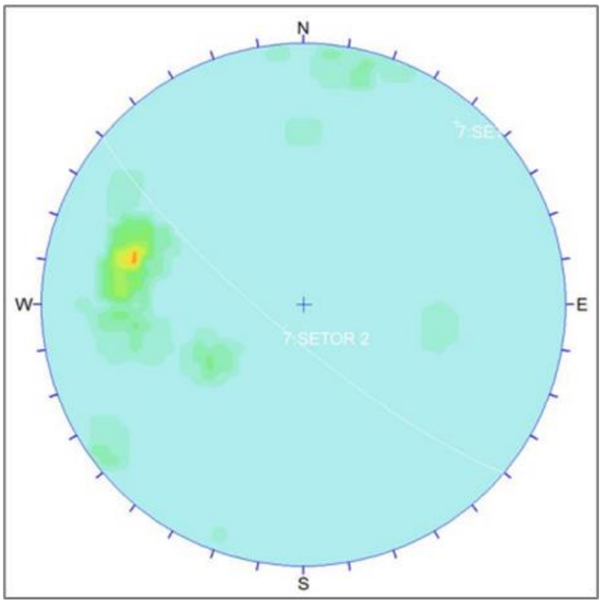



**Figure 16-10 – B2 sector of the pit without ruptures by foundation structures**

Source: Itaaçu, 2019.

- **Sector B3**

Figure 16-11: in sector B3, planar ruptures along the joint 8 and ruptures due to toppling along the foliation may occur.

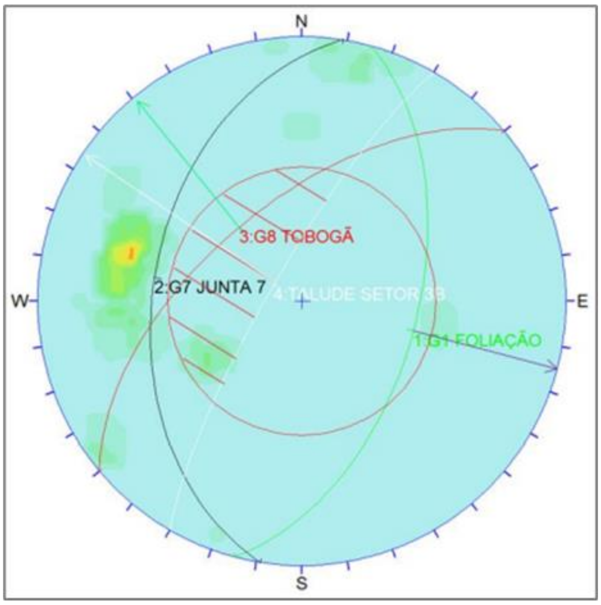



**Figure 16-11 – Sector B3 of the pit, ruptures may occur due to tipping along the foliation and plan along the joint 8 (slide)**

Source: Itaaçu, 2019.

- **Sector B4**

Figure 16-12: sector B4 may experience planar and wedge ruptures through the intersection of joints 6 and 8 and planar ruptures along joint 8 (slide).

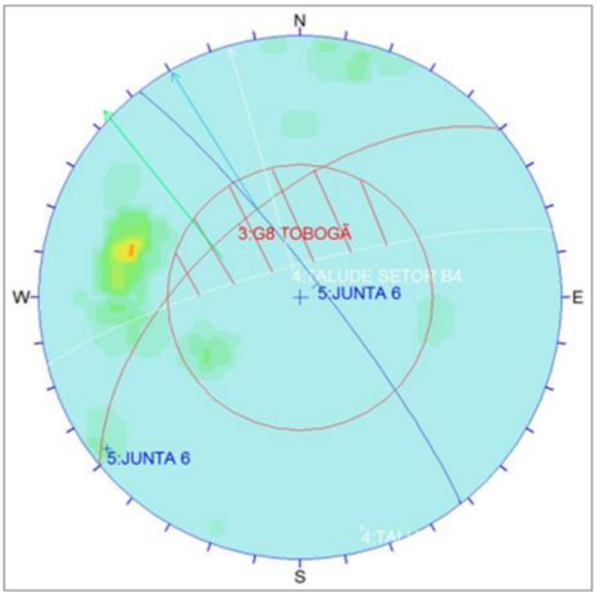



**Figure 16-12 – Sector B4 of the pit, wedge ruptures may occur, planar rupture in joint 8**

Source: Itaaçu, 2019.

- **Sector B5**

Figure 16-13: in sector B5, the intersection of joints 3 and 5 forms wedges but are blocked due to their greater inclination than the slope. The planar rupture potential from joint 2 is blocked by the friction cone, making disruptions theoretically unlikely.

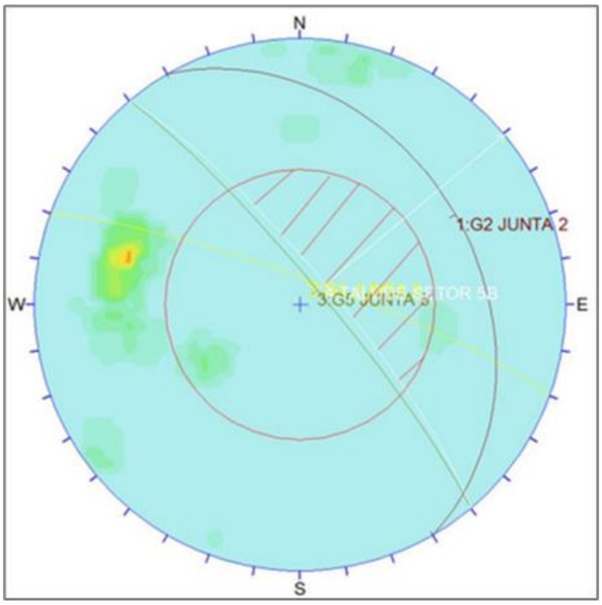



**Figure 16-13 – Sector B5 of the pit indicating that the ruptures were blocked**

Source: Itaaçu, 2019.

- **Sectors C**

No breakages are expected in sectors C, due to closed joint surfaces.

- **Summary**

The kinematic analysis reveals that the primary rupture mechanisms involve planar and wedge ruptures, particularly in the more altered and relaxed portions of the rock mass. These mechanisms are primarily influenced by foliation and joint intersections. The analysis shows that deeper, more intact portions of the rock mass (sectors C) are less likely to experience significant disruptions.

### *16.1.6 Slope Angles for Campbell Pit, NAN, GAN, SJO, and NAO Mines*

Based on the results of the kinematic analysis, adjustments should be made to the slopes currently used in Campbell Pit, particularly in the more altered upper portions and the relaxed lower portions. The stability of the slopes in all sectors are controlled by structural discontinuities rather than the strength of the matrix.

For the NAN, GAN, SJO and NAO mines, geotechnical studies are still in progress. Therefore, the slope angles adopted are derived from Campbell pit assessment. The tables below present the geotechnical angles used (Table 16-5 to Table 16-9).

**Table 16-5 – Geotechnical Angles Adopted in Campbell Pit**

| Sectors | Face Angle (º) | Berm Width (m) | Bench Height (m) | Angle Between Ramps (º) |
|---|---|---|---|---|
| **A1** | 55 | 6 | 10 | 37.5 |
| **A2** | 55 | 6 | 10 | 37.5 |
| **A3** | 60 | 6 | 10 | 40 |
| **A4** | 60 | 6 | 10 | 40 |
| **A5** | 60 | 6 | 10 | 40 |
| **B1** | 55 | 6 | 20 | 45 |
| **B2** | 60 | 6 | 20 | 48.8 |

| Sectors | Face Angle (º) | Berm Width (m) | Bench Height (m) | Angle Between Ramps (º) |
|---|---|---|---|---|
| **B3** | 60 | 6 | 20 | 48.8 |
| **B4** | 60 | 6 | 20 | 48.8 |
| **B5** | 60 | 6 | 20 | 48.8 |
| **C** | 80 | 6 | 20 | 64 |

Source: Itaaçu, 2019.

**Table 16-6 – Geotechnical Angles Adopted in NAN Mine**

| Sectors | Inter Ramp Angle (º) | Maximum Bench Angle (m) | Maximum Bench Height (m) | Minimum Berm Width (m) |
|---|---|---|---|---|
| **CMG-01** | ≤40 | ≤59 | 10 | 6 |
| **CMG-02** | ≤68 | ≤84 | 10 | 3 |
| **CMG-03** | ≤68 | ≤84 | 10 | 3 |

Source: A2GE – Engenharia e Geotecnia, 2024.

**Table 16-7 – Geotechnical Angles Adopted for GAN Mine**

| Sectors | Face Angle (º) | Berm Width (m) | Bench Height (m) | Angle Between Ramps (º) |
|---|---|---|---|---|
| **A** | 60 | 6 | 10 | 40 |
| **B** | 60 | 6 | 20 | 48.8 |
| **C** | 80 | 6 | 20 | 64 |

Source: GE21, 2024.

**Table 16-8 – Geotechnical Angles Adopted in SJO Mine**

| Sectors | Inter Ramp Angle (º) | Maximum Bench Angle (º) | Maximum Bench Height (m) | Minimum Berm Width (m) |
|---|---|---|---|---|
| **CMG-01** | ≤40 | ≤59 | 10 | 6 |
| **CMG-02** | ≤56 | ≤80 | 10 | 5 |
| **CMG-03** | ≤56 | ≤80 | 10 | 5 |

Source: A2GE – Engenharia e Geotecnia, 2024.

**Table 16-9 – Geotechnical Angles Adopted in NAO Mine**

| Sectors | Inter Ramp Angle (º) | Maximum Bench Angle (m) | Maximum Bench Height (m) | Minimum Berm Width (m) |
|---|---|---|---|---|
| **CMG-01** | ≤40 | ≤59 | 10 | 6 |
| **CMG-02** | ≤68 | ≤84 | 10 | 3 |
| **CMG-03** | ≤68 | ≤84 | 10 | 3 |

Source: A2GE – Engenharia e Geotecnia, 2024.

### *16.1.7 QP Opinion*

The GE21 recommendation strongly emphasizes the necessity of conducting geotechnical testing for the NAN, SJO, NAO, and GAN deposits. Below are the studies that need to be developed and/or implemented by Largo:

- **Completion of Geotechnical Studies:** Complete geotechnical studies for the NAN, SJO, NAO, and GAN mines, following the methodologies used for Campbell Pit. This includes drilling-oriented diamond holes on the edges of proposed optimized slopes and conducting in situ geotechnical tests and rock mechanics laboratory tests to confirm or adjust proposed values for required stability.
- **Systematic Surveys:** Conduct systematic surveys of structural features, as these control instabilities.
- **Improvement Devices:** Utilize devices such as passive and active anchors (rods and clamps) and double-twisted anchorage screens to enhance slope performance.
- **Blast Evaluations:** Regularly evaluate blasts to optimize pit walls slopes.
- **Slope Finishing Studies**: Initiate studies on the final finish of slopes, incorporating various production dismantling measures.

These recommendations aim to uphold stability and safety in mining operations by addressing specific conditions and challenges identified in the geotechnical studies.

## 16.2 Mining Schedule

The mining plan for the Project outlines the phased development of pits over time, targeting an annual feed rate of 3.4 million tonnes per annum (Mtpa) of run-of-mine (ROM) material to the plant. The primary focus initially prioritizes vanadium production, guided by the following scheduling assumptions:

### *16.2.1 Mining Assumptions*

- **Production Rate**: The mine will produce 3.4 Mtpa of ROM material. Initial mining will concentrate on the Campbell Pit for the first nine years. Subsequently, the mining sequence will shift to the NAN, SJO, NAO, and GAN pits in sequence.

### *16.2.2 Vanadium and Titanium Production Assumptions*

The Company strategy emphasizes continuing to seek ways for the expansion of vanadium and titanium Reserves through development in the NAN, SJO, NAO, and GAN deposits, along with the potential establishment of a $TiO_2$ Pigment Plant in Camaçari City. Key projects and production capacities are detailed as follows:

- Ilmenite Concentration Plant (Ilmenite Plant): This plant, initially capable of producing 100 ktpy of ilmenite concentrate from the non-magnetic concentrate of the Campbell Pit, was completed in 2023. Initial production commenced in August 2023.
- $TiO_2$ Pigment Plant (Pigment Plant): Proposed for implementation in 2029 in Camaçari, Bahia, Brazil, the Pigment Plant would be designed to produce 100 ktpy of $TiO_2$ pigment. The ramp-up phase would begin in 2029 with 30 ktpy, increase to 60 ktpy in 2030, and would be anticipated to achieve full capacity by 2031.
- Ilmenite Plant Expansion: To support the demand of the proposed Pigment Plant, the Ilmenite Plant will expand its nameplate capacity from 100 ktpy to 265 ktpy. This expansion is expected to ramp-up by 2025 and reach full capacity by 2029.

### *16.2.3 Detailed Timeline*

#### *16.2.3.1 Campbell Pit Development (Years 1-9):*

- Focus on extracting vanadium-rich ore to meet the production target of 2.6 Mtpa.
- Initial production primarily sourced from the Campbell Pit.

#### *16.2.3.2 Subsequent Pits Development (Post-Year 9):*

- Sequential transition of mining activities to the NAN, SJO, NAO, and GAN pits.
- Ensure continuous feed of 3.4 Mtpa to the processing plant.

#### 16.2.3.3 *Ilmenite Concentration and Pigment Production:*

- **2023**: Ilmenite Plant begins production at 100 ktpy.
- **2025**: Ilmenite Plant production increases to 122 ktpy.
- **2026**: Ilmenite Plant production reaches 196 ktpy.
- **2029**: Expansion of the Ilmenite Plant starts ramp-up to 265 ktpy.
- **2029**: Implementation of the proposed Pigment Plant begins, with ramp-up initiated at 30 ktpy.
- **2030**: Pigment Plant increases to 60 ktpy.
- **2031**: Pigment Plant achieves full operational capacity of 100 Ktpy.

#### 16.2.3.4 *Conclusion and Strategic Goals*

The mining schedule for the Project's is designed to seek ways to optimize the extraction of vanadium and titanium Resources, ensuring a consistent production rate while progressively developing multiple pits. The potential strategic expansion of processing facilities aims to meet future production goals, particularly in enhancing titanium dioxide pigment production. Potential ramp-ups and expansions would align with the Company's long-term objectives to maximize Resource utilization and market presence in vanadium and titanium products.

### *16.2.4 Mining Schedule Production*

The mining production schedule for spans 31 years, outlining the sequence and duration of mining activities across multiple pits at the Project. This section provides a comprehensive timeline and transition plan from one pit to another, ensuring continuous production and efficient Resource utilization.

#### 16.2.4.1 *Timeline and Pit Transition Overview*

- **Campbell Pit**:
  - Depletion Year: 2032.
  - Role: Primary source of ROM until 2029.
- **NAN Pit:**
  - Transition Year: 2030 (before Campbell Pit depletion).
  - Role: Becomes the primary pit from 2033 to 2037.
- **SJO Pit**:
  - Transition Year: 2038 (before NAN Pit depletion)
  - Role: Main pit from 2040 to 2043.
- **NAO Pit**:
  - Transition Year: 2045 (after GAN Pit depletion)
  - Role: Primary pit in 2046.

- **GAN Pit**:
  - Transition Year: 2048 (after NAO Pit depletion)
  - Role: Main pit from 2049 to 2054.
- **Mobile Crushing Unit**
  - Deployment: A rented mobile crushing unit will be installed nearby for the NAN, SJO, and NAO pits to facilitate ore processing.
- **Production Schedule Tables and Figures**
  - **Table 16-10**: Contains detailed annual production data for each pit over the 31-year period.
  - **Figure 16-14**: Summarizes the Mining Production Schedule, visually depicting the transition and production volume of each pit.
  - **Figure 16-15**: Shows the Plant Production Schedule, aligning mining activities with plant processing capabilities.

The comprehensive 31-year mining schedule ensures that the Project maintains consistent production rates while strategically transitioning between pits. The use of mobile crushing units for NAN, SJO, and NAO pits facilitates efficient ore processing, supporting the long-term objectives of maximizing Resource utilization and maintaining production stability.

**Table 16-10 – Maracás Menchen Project – Mining Schedule**

| MINEPRODUCTION | | | | | | | | | | | | | PLANTPRODUCTION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Targets | Year | *In Situ* Material | | | Vanadium Product | | Titanium Product | | Waste | S.R. | Total Moved | ROM Stockpile | ROM Plant Feed | Kiln Feed | Vanadium Product | Ilmenite Product | Titanium Pigment Product |
| | | Mass | Head | | Magnetic Concentrate | | Non-Magnetic Concentrate | | | | | Added / removed | | | | | |
| | | (Mt) | % $V_2O_5$ | %$TiO_2$ | %Mag | % $V_2O_5$ | %Non-Mag | %$TiO_2$ | (Mt) | (t/t) | (Mt) | (Mt) | (Mt) | (kt) | (kt) | (kt) | (kt) |
| Campbell | 2024 | 2.2 | 0.77 | 5.62 | 20.12 | 3.08 | 43.79 | 9.08 | 8.8 | 4.1 | 11.0 | 0.04 | 2.1 | 400.7 | 10.5 | 92.6 | - |
| | 2025 | 2.7 | 0.72 | 6.00 | 19.35 | 2.91 | 44.56 | 10.16 | 12.7 | 4.8 | 15.4 | 0.3 | 2.3 | 421.5 | 11.0 | 122.0 | - |
| | 2026 | 2.2 | 0.86 | 6.32 | 23.07 | 3.18 | 40.84 | 11.07 | 13.4 | 6.1 | 15.6 | -0.01 | 2.2 | 473.5 | 12.7 | 196.0 | - |
| | 2027 | 2.2 | 0.81 | 6.40 | 21.95 | 3.03 | 41.96 | 11.34 | 12.4 | 5.5 | 14.6 | -0.4 | 2.6 | 527.6 | 13.3 | 196.0 | - |
| | 2028 | 2.9 | 0.87 | 6.79 | 23.47 | 3.11 | 40.44 | 12.37 | 12.7 | 4.3 | 15.7 | - | 2.9 | 647.3 | 17.0 | 196.0 | - |
| Campbell+NAN | 2029 | 3.2 | 0.84 | 6.21 | 21.71 | 3.15 | 42.20 | 10.84 | 9.2 | 2.9 | 12.4 | - | 3.2 | 646.0 | 17.2 | 265.0 | 30.0 |
| | 2030 | 3.2 | 0.82 | 6.42 | 21.55 | 3.10 | 42.36 | 11.35 | 8.6 | 2.7 | 11.8 | - | 3.2 | 647.5 | 16.9 | 265.0 | 60.0 |
| | 2031 | 2.9 | 0.96 | 6.60 | 23.67 | 3.40 | 40.24 | 11.88 | 8.5 | 2.9 | 11.4 | - | 2.9 | 646.9 | 18.5 | 265.0 | 100.0 |
| | 2032 | 3.7 | 0.56 | 7.47 | 18.87 | 2.21 | 45.04 | 13.56 | 12.2 | 3.3 | 15.9 | - | 3.7 | 647.6 | 12.1 | 265.0 | 100.0 |
| NAN | 2033 | 3.1 | 0.59 | 8.55 | 22.10 | 2.00 | 41.81 | 16.61 | 14.4 | 4.6 | 17.5 | - | 3.1 | 647.4 | 10.9 | 265.0 | 100.0 |
| | 2034 | 3.5 | 0.58 | 7.76 | 19.64 | 2.14 | 44.27 | 14.42 | 17.9 | 5.1 | 21.4 | - | 3.5 | 646.5 | 11.7 | 265.0 | 100.0 |
| | 2035 | 3.8 | 0.59 | 7.31 | 18.13 | 2.29 | 45.78 | 13.23 | 17.1 | 4.5 | 20.9 | - | 3.8 | 647.3 | 12.5 | 265.0 | 100.0 |
| | 2036 | 3.3 | 0.60 | 8.30 | 21.10 | 2.08 | 42.81 | 15.99 | 17.8 | 5.4 | 21.1 | - | 3.3 | 646.3 | 11.4 | 265.0 | 100.0 |
| NAN+SJO | 2037 | 3.1 | 0.57 | 8.91 | 22.66 | 1.90 | 41.25 | 17.76 | 19.9 | 6.5 | 23.0 | - | 3.1 | 647.3 | 10.4 | 265.0 | 100.0 |
| | 2038 | 3.4 | 0.54 | 7.93 | 20.16 | 1.95 | 43.75 | 14.97 | 21.5 | 6.3 | 24.9 | - | 3.4 | 646.7 | 10.6 | 265.0 | 100.0 |
| | 2039 | 3.3 | 0.51 | 8.68 | 20.97 | 1.83 | 42.94 | 16.79 | 21.7 | 6.6 | 25.0 | - | 3.3 | 647.6 | 10.0 | 265.0 | 100.0 |
| SJO | 2040 | 4.8 | 0.40 | 6.01 | 14.50 | 1.82 | 49.41 | 10.22 | 12.7 | 2.7 | 17.4 | - | 4.8 | 644.9 | 9.9 | 265.0 | 100.0 |
| | 2041 | 4.0 | 0.37 | 7.24 | 17.43 | 1.51 | 46.48 | 12.93 | 12.9 | 3.2 | 16.8 | - | 4.0 | 646.7 | 8.2 | 265.0 | 100.0 |
| | 2042 | 3.9 | 0.37 | 7.46 | 17.76 | 1.49 | 46.15 | 13.37 | 15.4 | 3.9 | 19.3 | - | 3.9 | 646.3 | 8.1 | 265.0 | 100.0 |
| | 2043 | 3.3 | 0.45 | 8.47 | 20.73 | 1.63 | 43.18 | 16.08 | 18.5 | 5.6 | 21.9 | - | 3.3 | 643.3 | 8.8 | 265.0 | 100.0 |
| SJO+NAO | 2044 | 3.3 | 0.55 | 8.74 | 21.04 | 1.98 | 42.87 | 17.11 | 18.0 | 5.5 | 21.3 | - | 3.3 | 646.2 | 10.8 | 265.0 | 100.0 |
| | 2045 | 3.0 | 0.61 | 8.98 | 23.00 | 2.06 | 40.91 | 18.17 | 19.1 | 6.4 | 22.1 | - | 3.0 | 645.0 | 11.2 | 265.0 | 100.0 |
| NAO | 2046 | 2.7 | 0.54 | 9.45 | 25.74 | 1.67 | 38.17 | 19.90 | 19.9 | 7.4 | 22.5 | - | 2.7 | 643.2 | 9.0 | 265.0 | 100.0 |
| NAO+GAN | 2047 | 2.9 | 0.51 | 8.82 | 23.92 | 1.68 | 39.99 | 18.20 | 20.9 | 7.3 | 23.8 | - | 2.9 | 643.8 | 9.1 | 265.0 | 100.0 |
| | 2048 | 5.0 | 0.36 | 6.37 | 13.76 | 1.61 | 50.15 | 11.08 | 20.6 | 4.1 | 25.6 | - | 5.0 | 646.2 | 8.8 | 265.0 | 100.0 |
| GAN | 2049 | 5.1 | 0.35 | 6.41 | 13.62 | 1.62 | 50.29 | 11.07 | 24.3 | 4.8 | 29.4 | - | 5.1 | 644.7 | 8.8 | 265.0 | 100.0 |
| | 2050 | 4.3 | 0.38 | 7.17 | 16.12 | 1.68 | 47.79 | 12.67 | 26.2 | 6.1 | 30.4 | - | 4.3 | 642.7 | 9.1 | 265.0 | 100.0 |
| | 2051 | 3.7 | 0.53 | 7.47 | 18.80 | 2.02 | 45.11 | 13.76 | 27.0 | 7.4 | 30.7 | - | 3.7 | 646.8 | 11.0 | 265.0 | 100.0 |
| | 2052 | 3.1 | 0.62 | 8.04 | 22.16 | 2.26 | 41.74 | 15.87 | 27.3 | 8.7 | 30.4 | - | 3.1 | 647.0 | 12.3 | 265.0 | 100.0 |
| | 2053 | 2.8 | 0.52 | 9.67 | 24.86 | 1.71 | 39.04 | 19.97 | 14.7 | 5.3 | 17.5 | - | 2.8 | 642.1 | 9.2 | 265.0 | 100.0 |
| | 2054 | 0.6 | 0.64 | 14.05 | 40.10 | 1.53 | 23.80 | 44.79 | 1.5 | 2.4 | 2.1 | - | 0.6 | 236.5 | 2.3 | 265.0 | 100.0 |
| **Total** | | **101.1** | **0.57** | **7.52** | **19.95** | **2.16** | **43.96** | **13.89** | **507.8** | **5.0** | **608.8** | **-** | **101.1** | **18,853.3** | **343.6** | **7,766.6** | **2,490.0** |

Source: GE21, 2024.

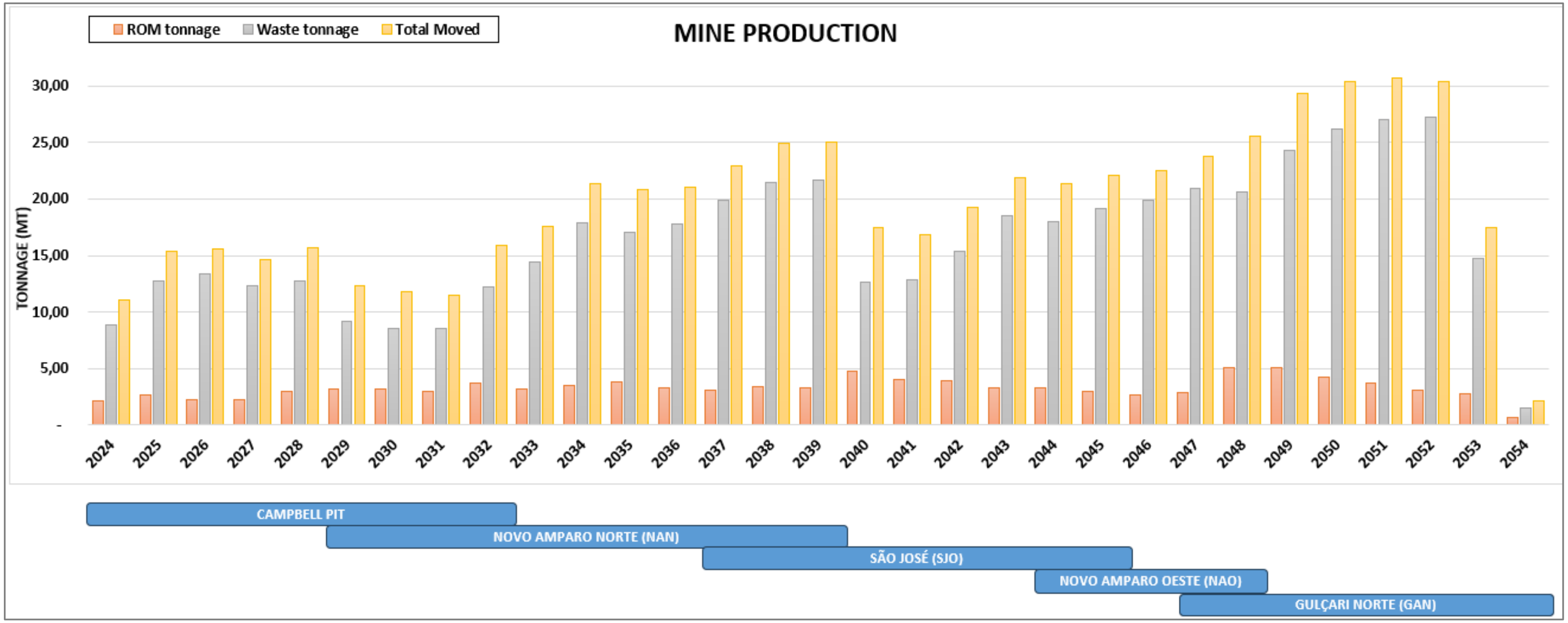



**Figure 16-14 – Maracás Menchen Project – Mining Production Schedule**

Source: GE21, 2024.

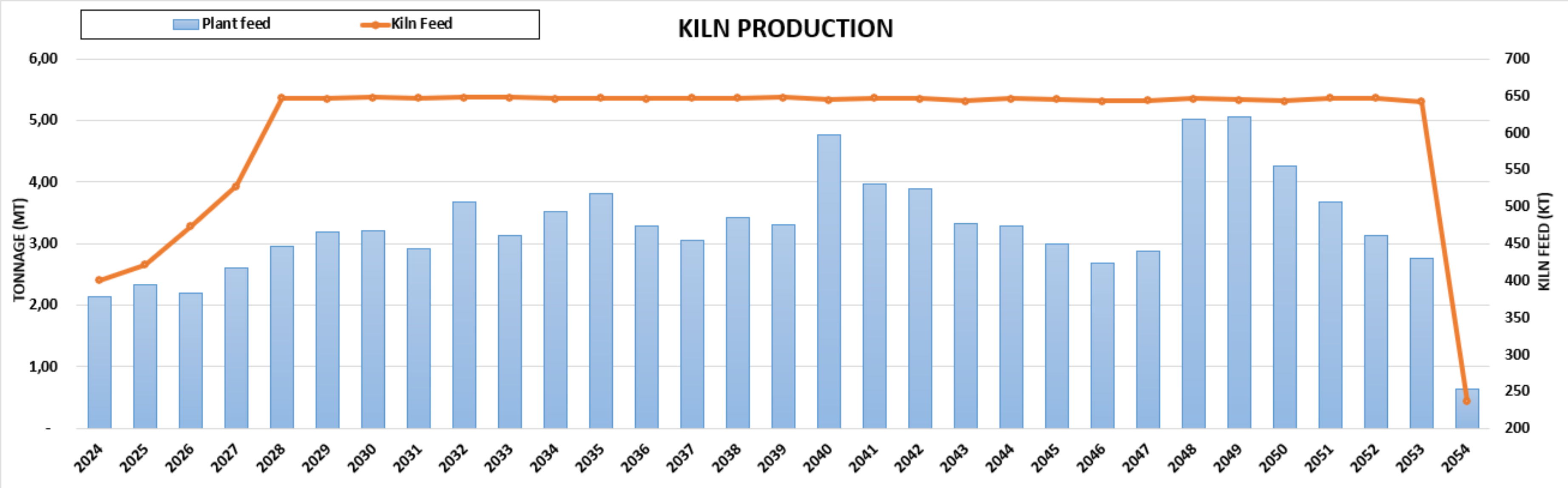



**Figure 16-15 – Maracás Menchen Project – Plant Production Schedule**

Source: GE21, 2024.

### 16.2.5 Mining Schedule Design

The progression of mine life, represented by end-of-period mine plans, is follows:

- Years 01 through 09 for Campbell Pit.
- Years 10 and 16 for NAN Pit.
- Years 18 and 22 for SJO Pit.
- Year 25 for NAO Pit.
- Years 28 and 31 for GAN Pit.

These are illustrated from Figure 16-16 to Figure 16-31 below.

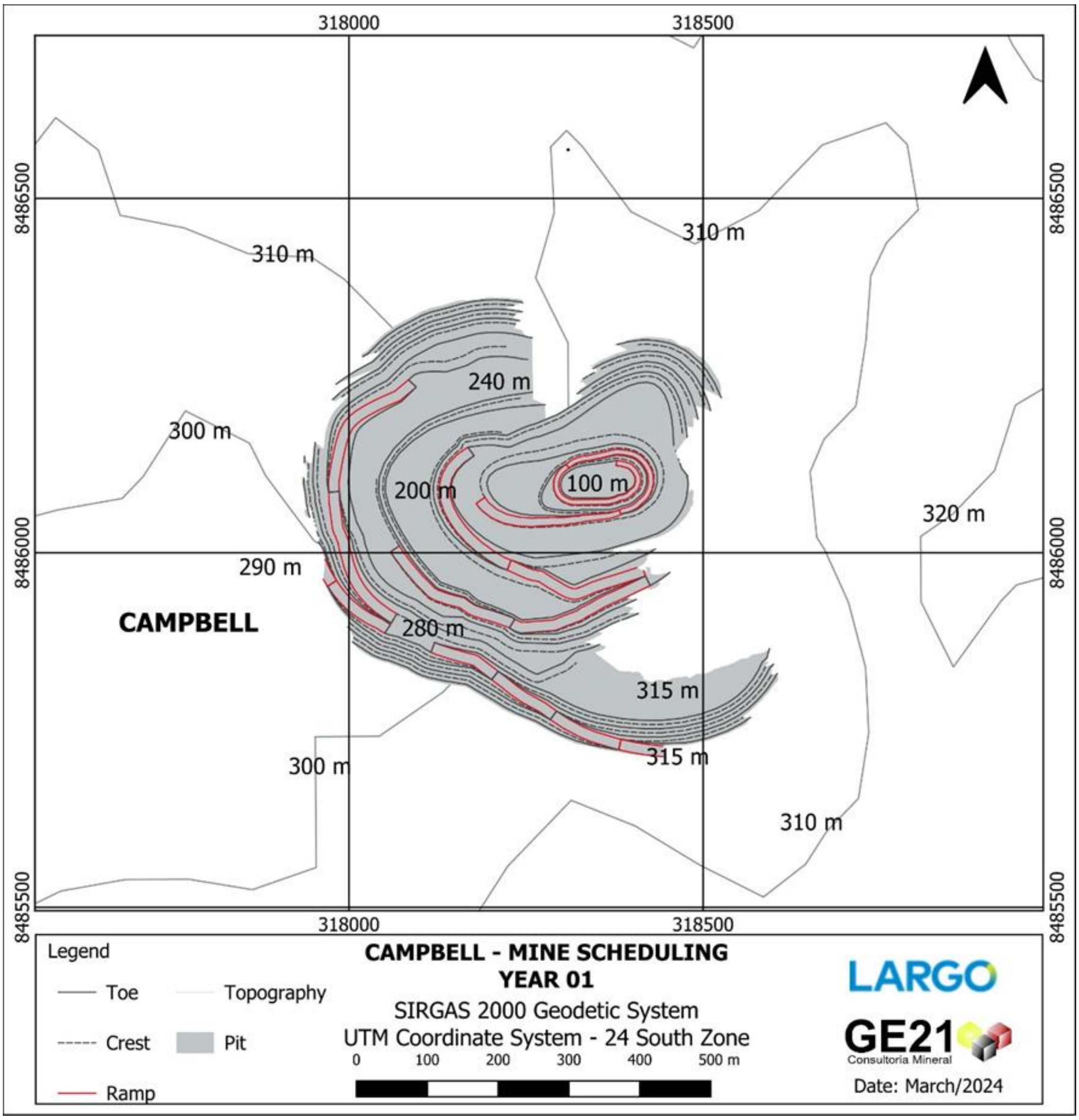



**Figure 16-16 – Campbell Pit – Year 01**

Source: GE21, 2024.

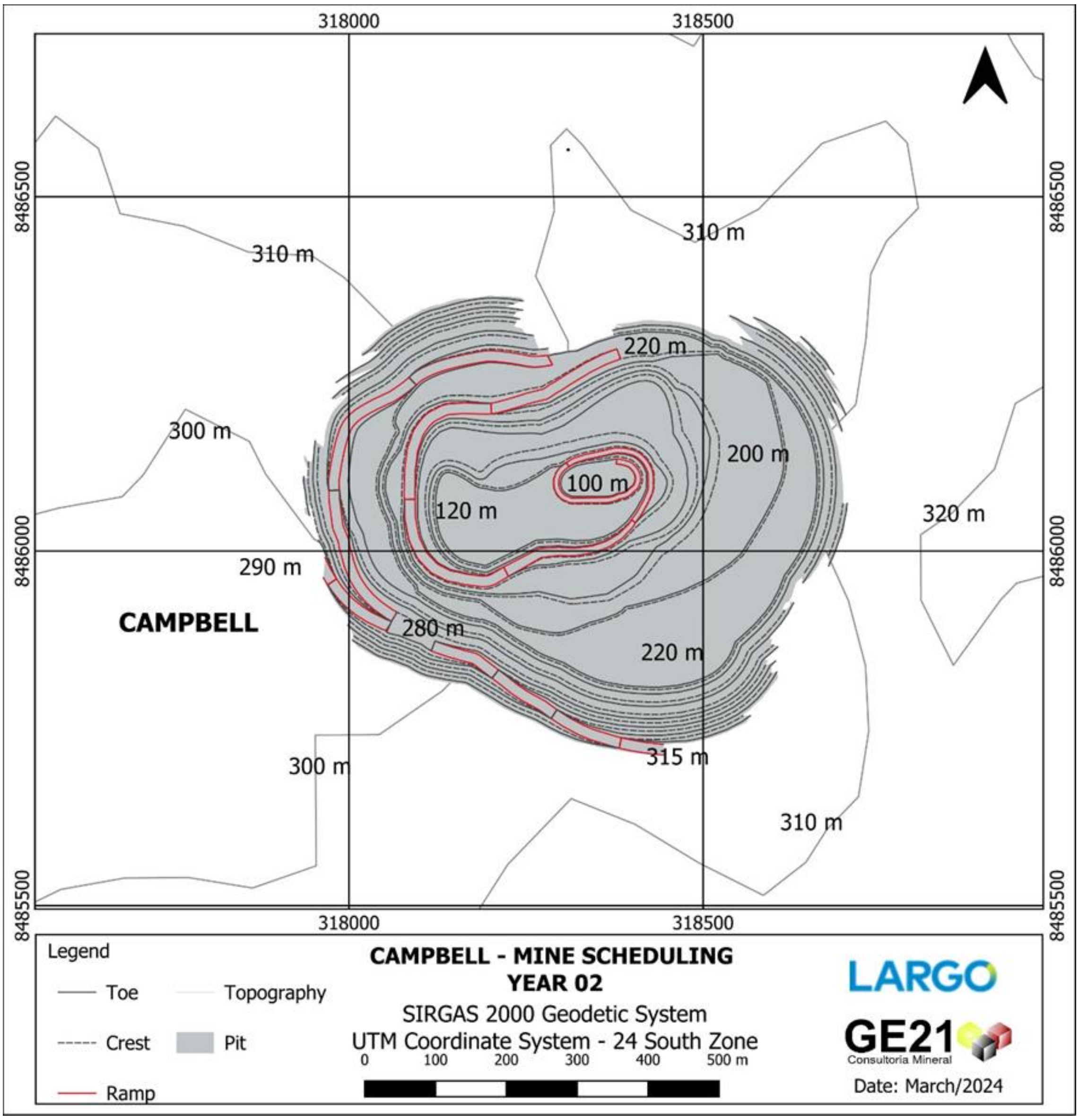



**Figure 16-17 – Campbell Pit – Year 02**

Source: GE21, 2024.

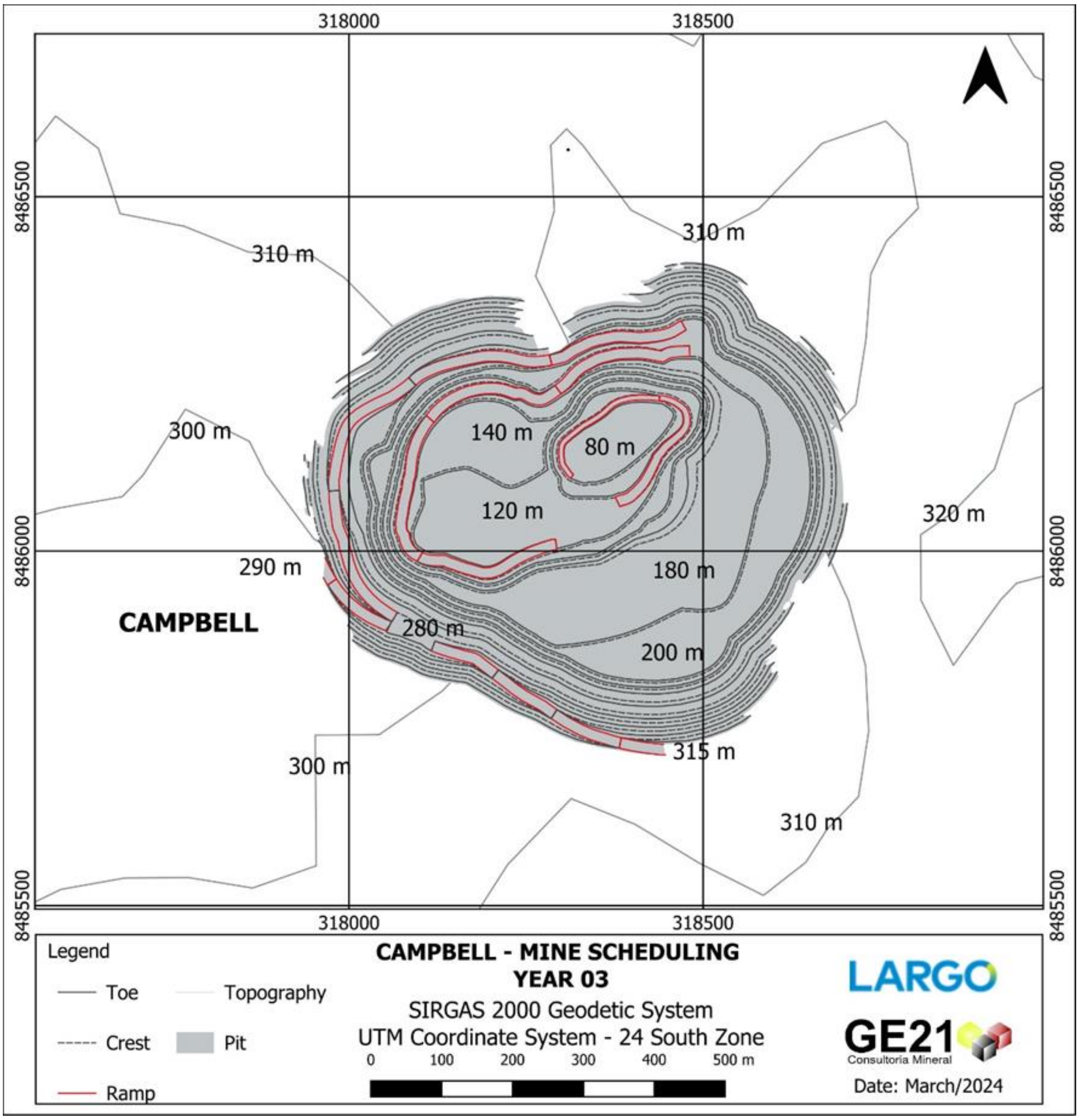



**Figure 16-18 – Campbell Pit – Year 03**

Source: GE21, 2024.

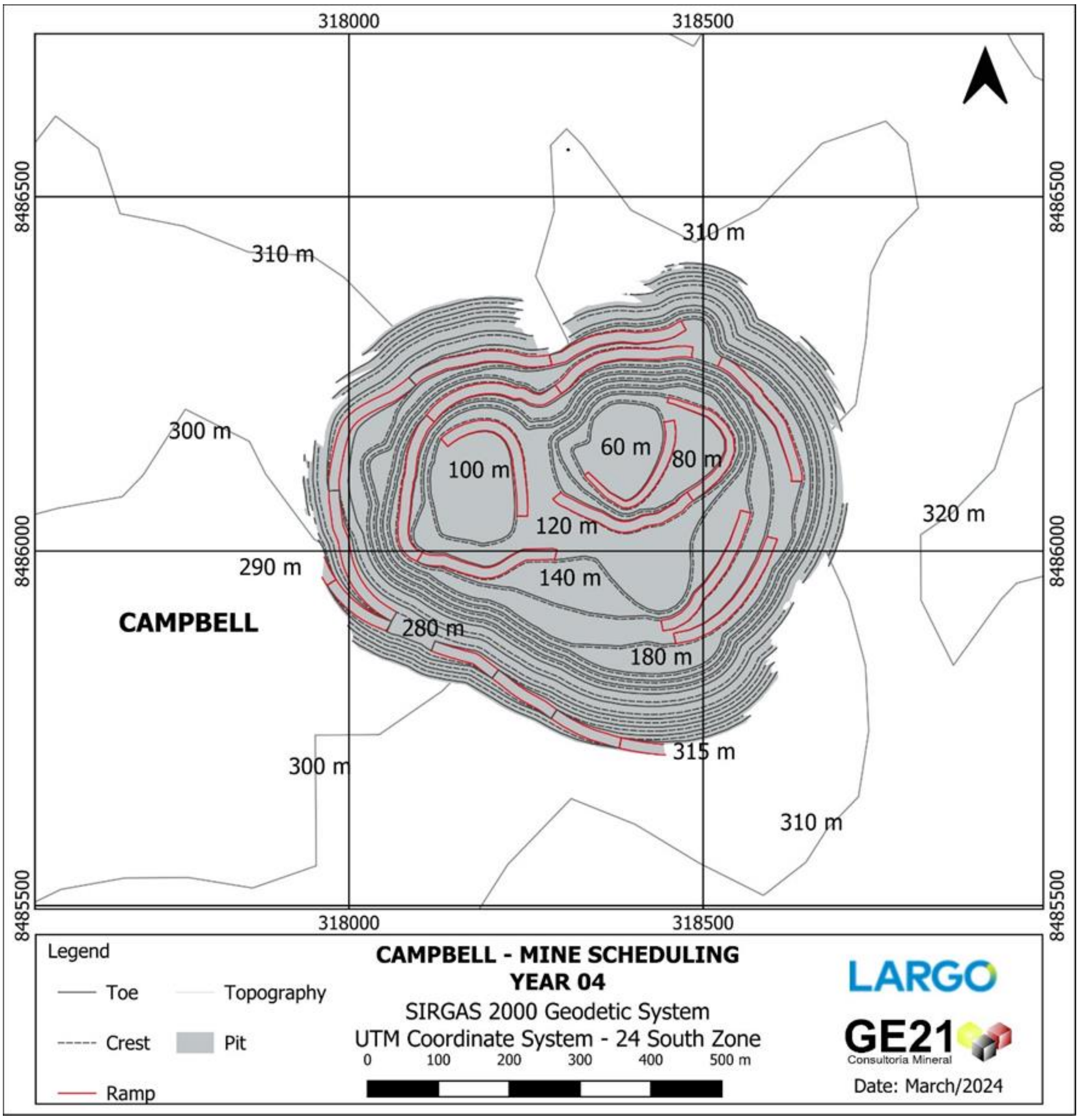



**Figure 16-19 – Campbell Pit – Year 04**

Source: GE21, 2024.

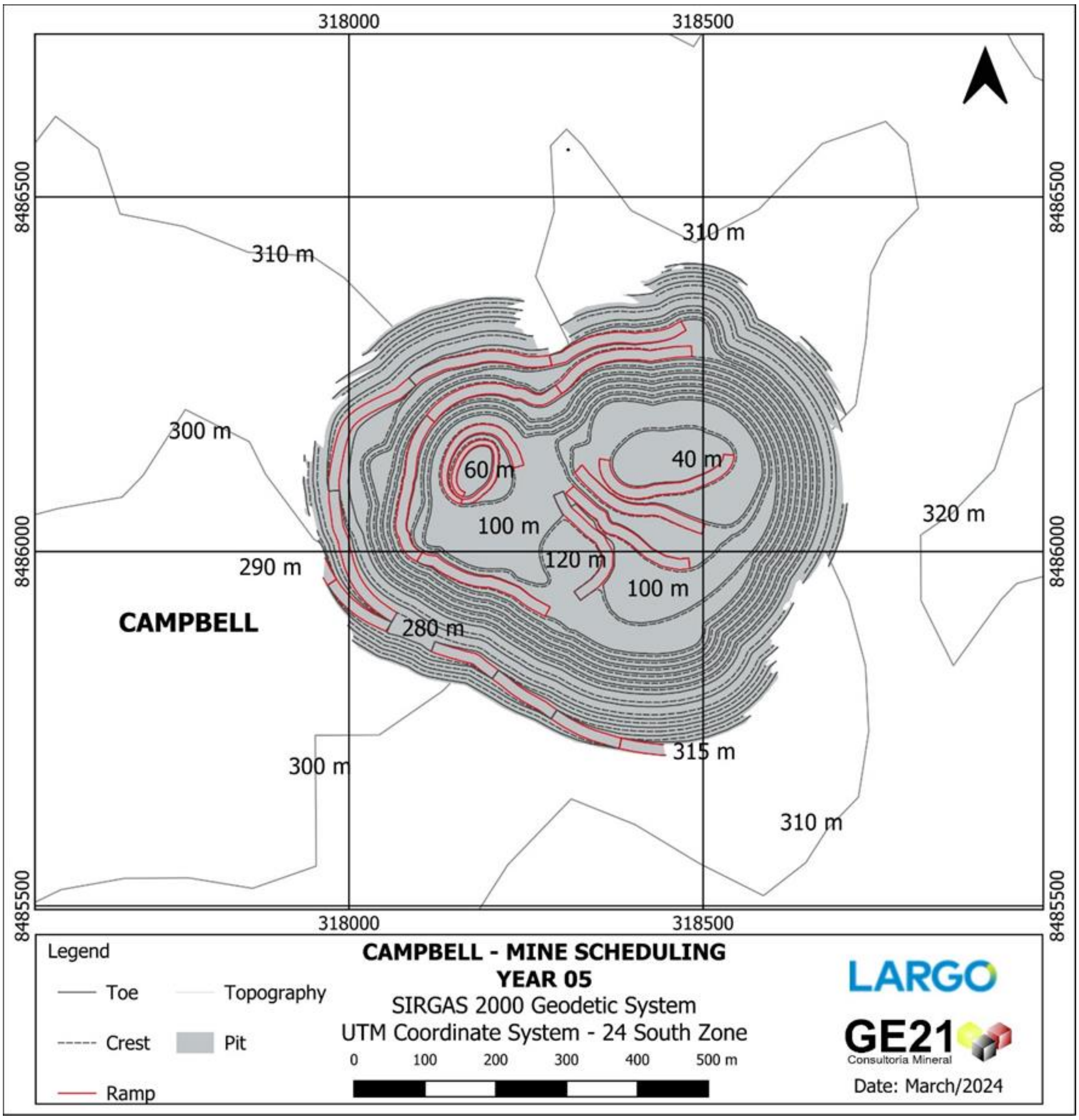



**Figure 16-20 – Campbell Pit – Year 05**

Source: GE21, 2024.

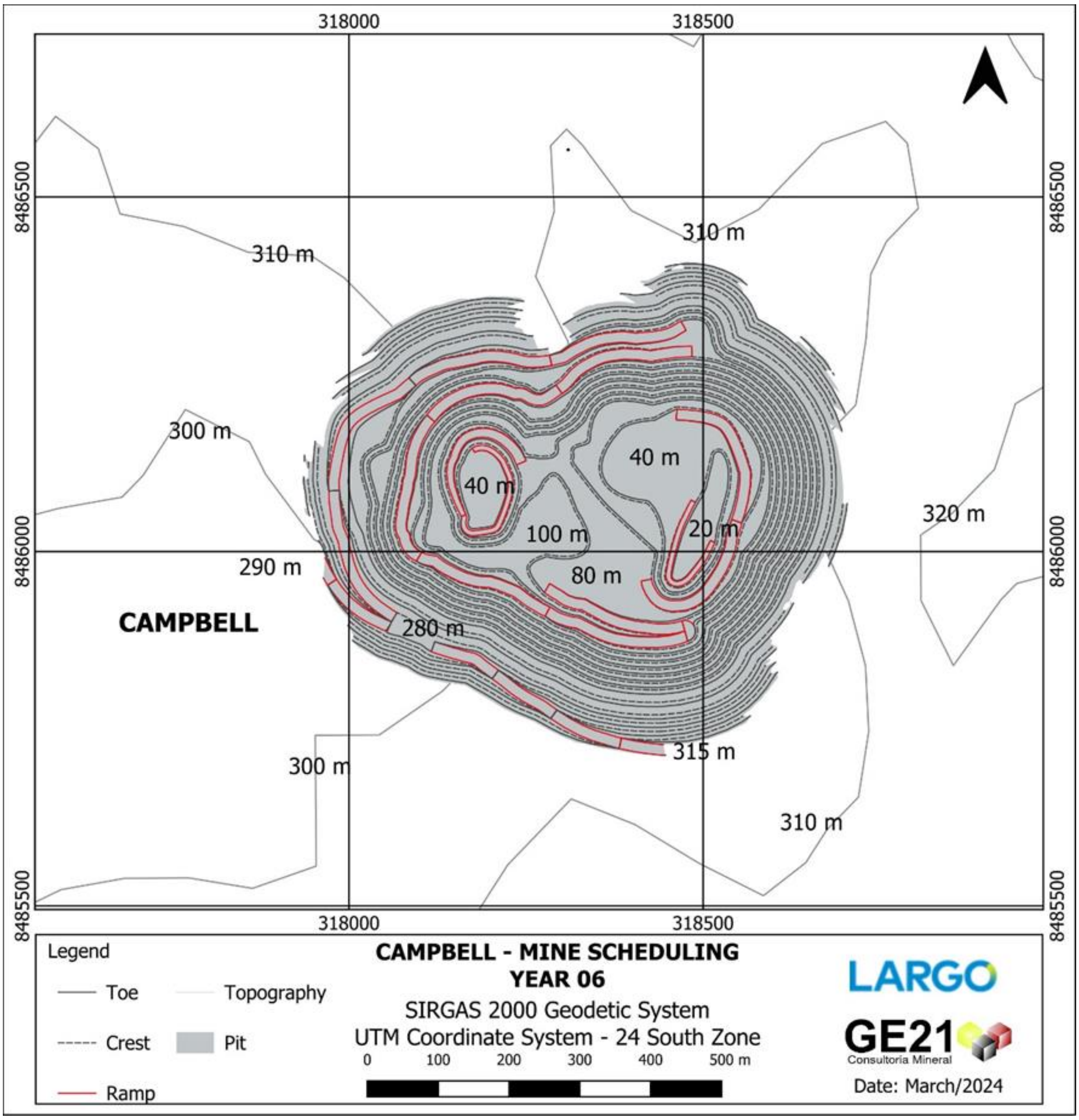



**Figure 16-21 – Campbell Pit – Year 06**

Source: GE21, 2024.

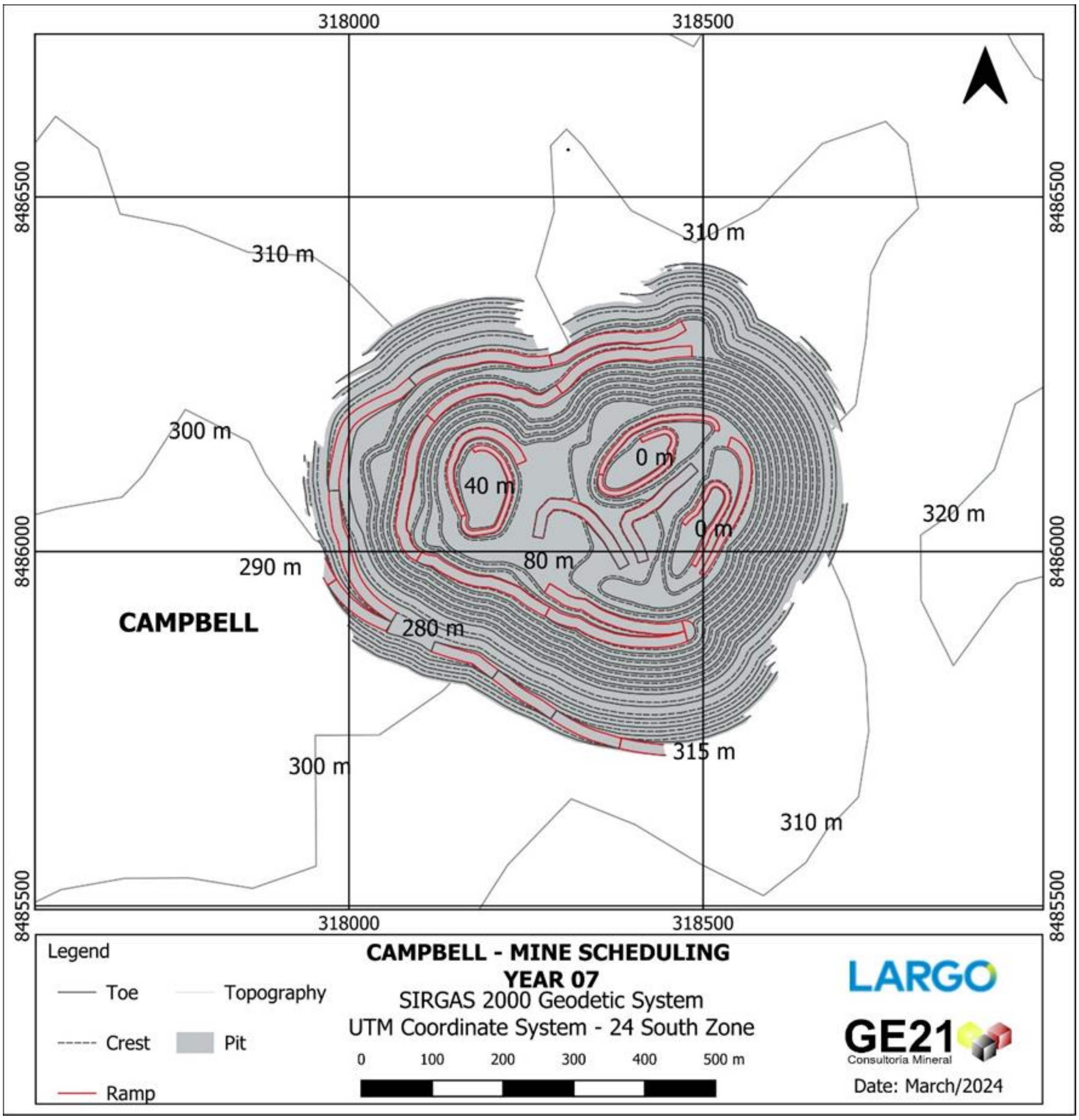



**Figure 16-22 – Campbell Pit – Year 07**

Source: GE21, 2024.

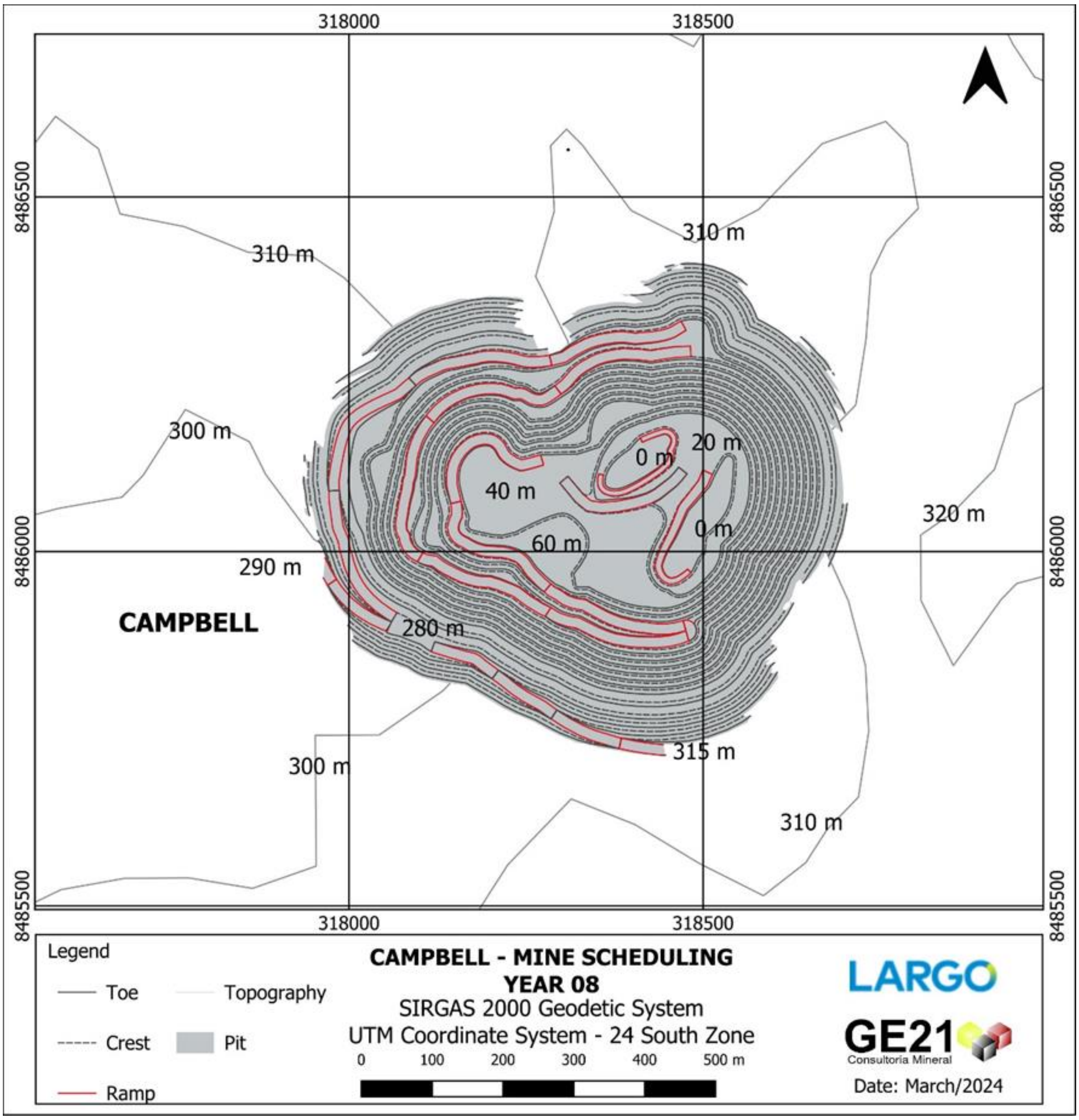



**Figure 16-23 – Campbell Pit – Year 08**

Source: GE21, 2024.

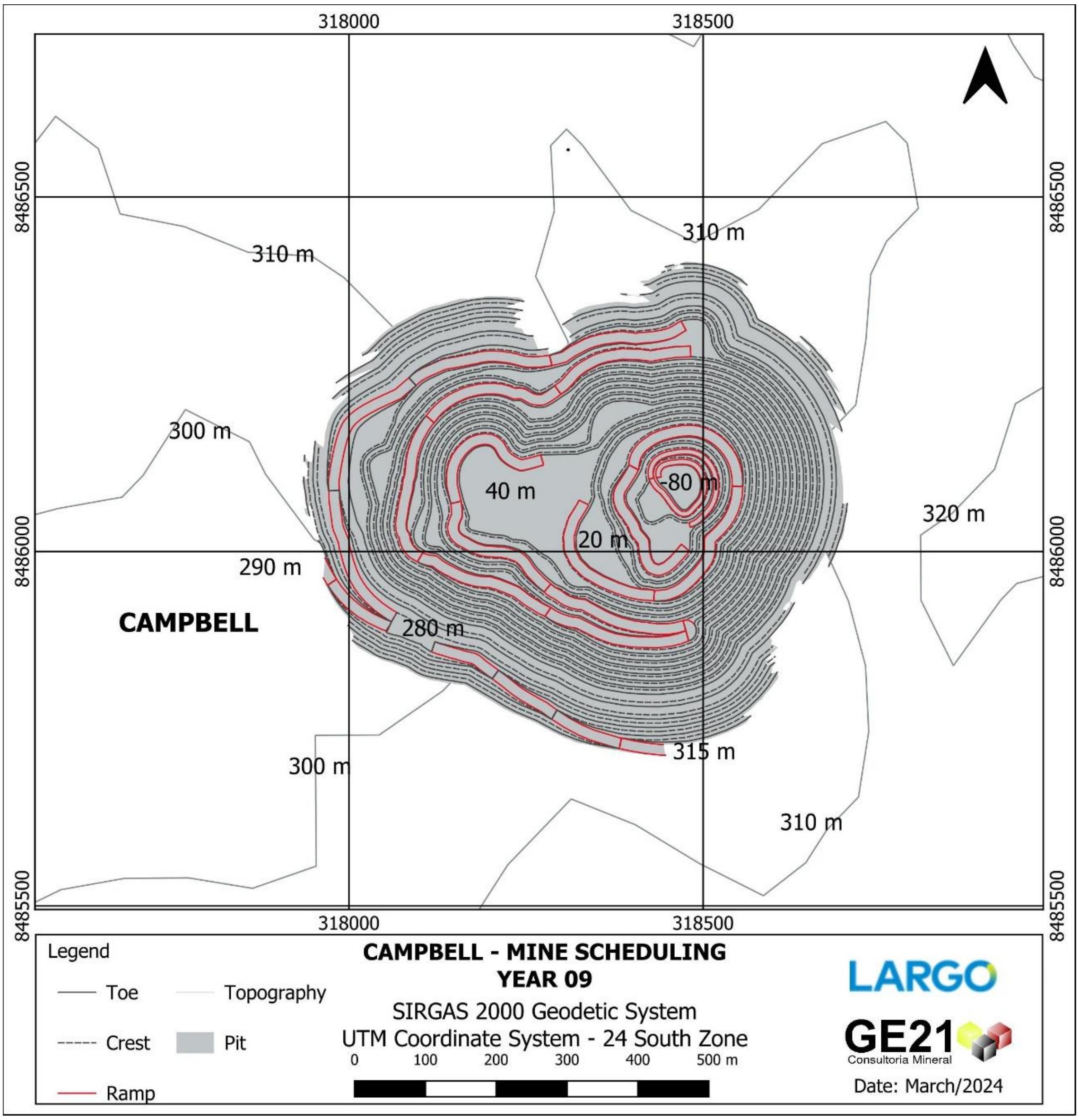



**Figure 16-24 – Campbell Pit – Year 09**

Source: GE21, 2024.

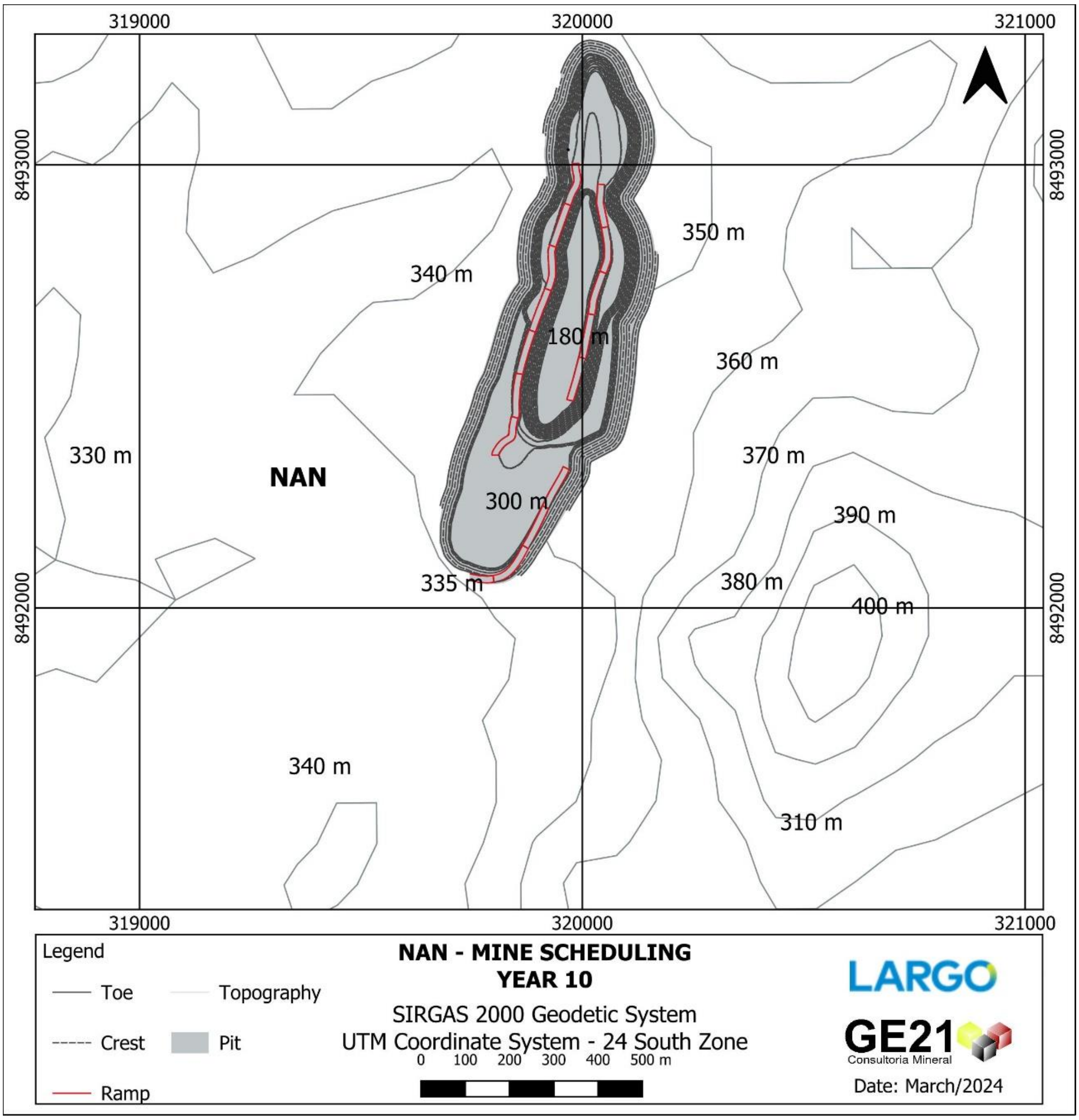



**Figure 16-25 – NAN Mine – Year 10**

Source: GE21, 2024.

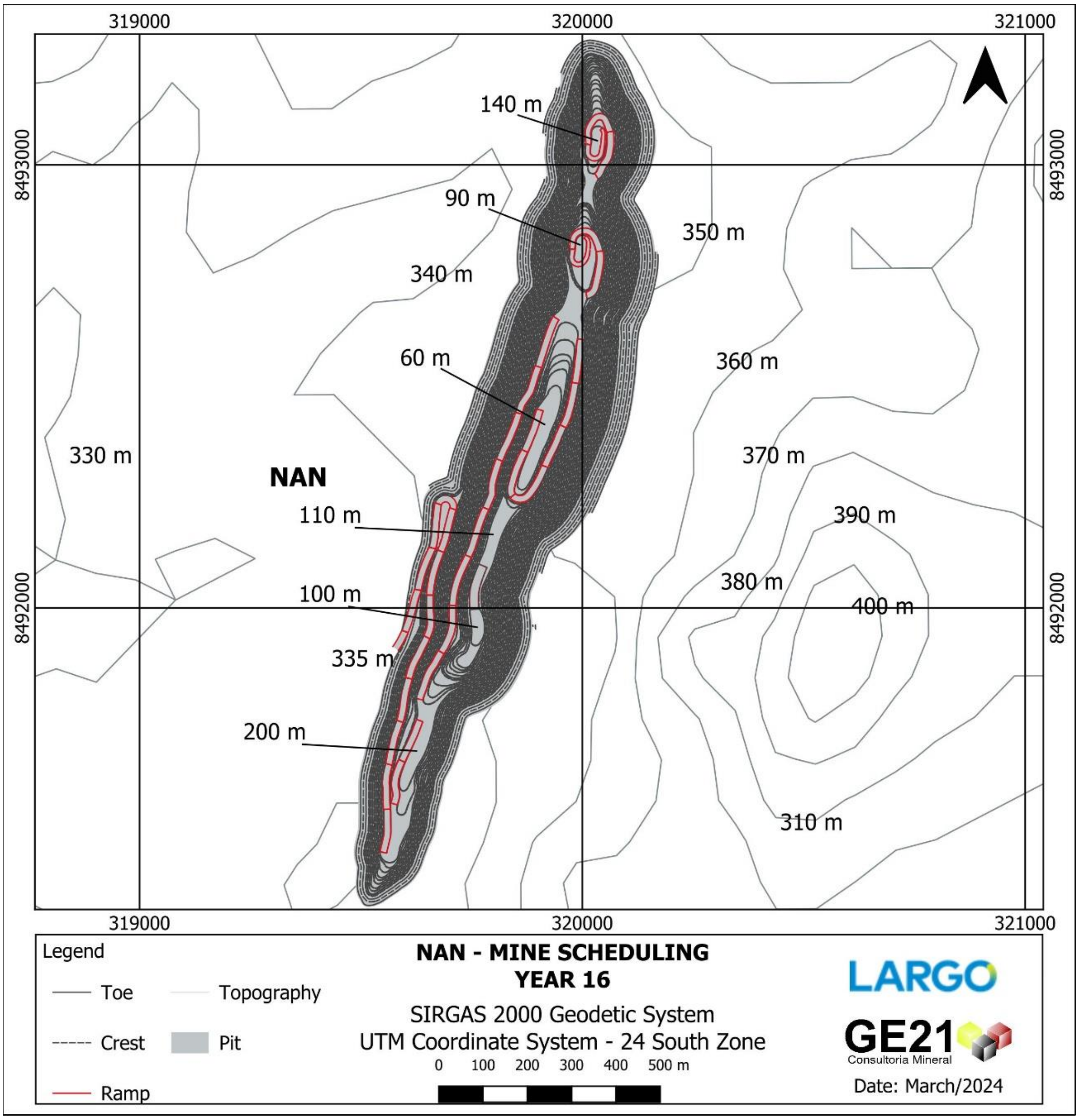



**Figure 16-26 – NAN mine – Year 16 (final pit)**

Source: GE21, 2024.

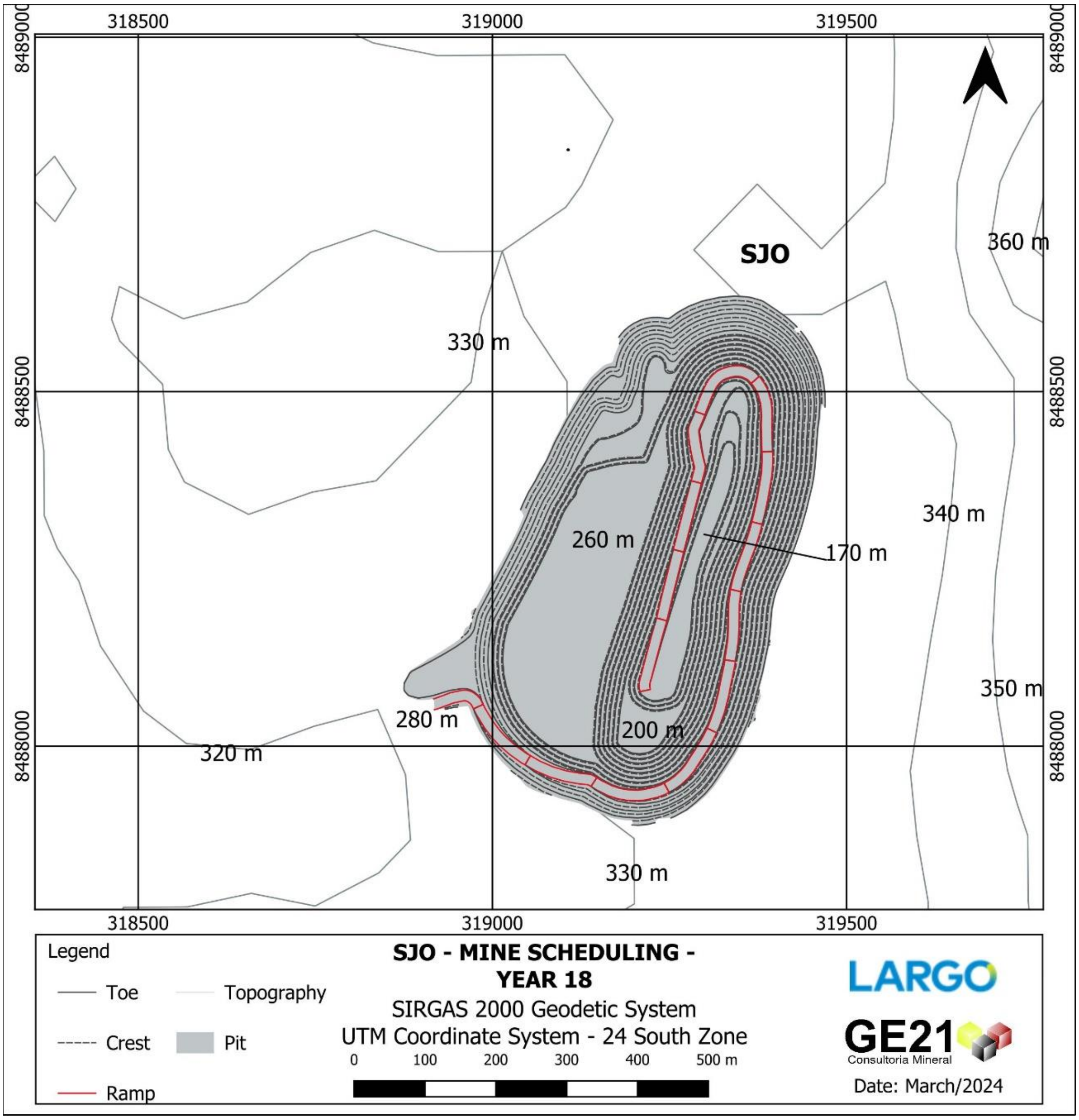



**Figure 16-27 – SJO Mine – Year 18**

Source: GE21, 2024.

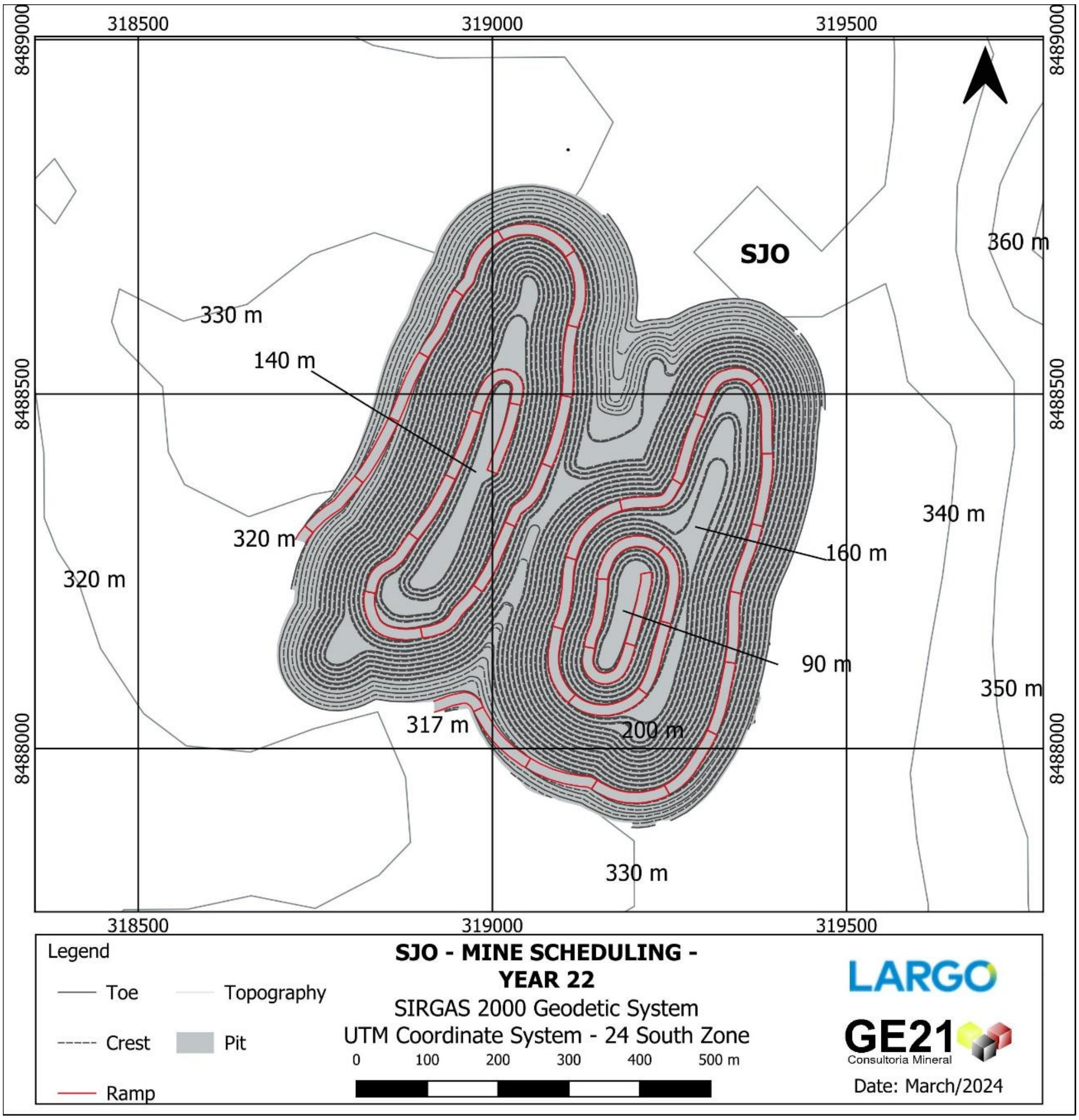



**Figure 16-28 – SJO Mine – Year 22 (final pit)**

Source: GE21, 2024.

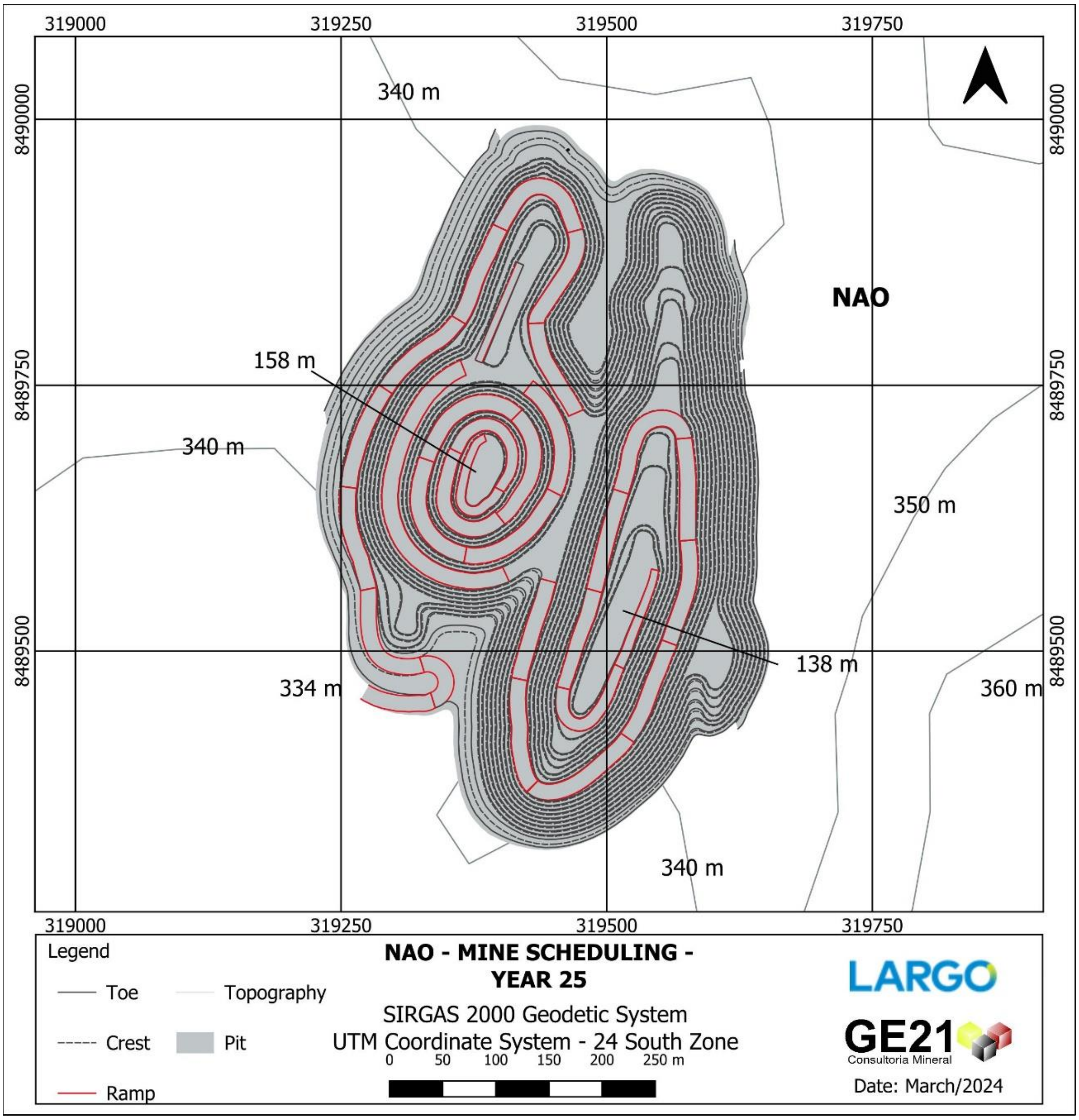



**Figure 16-29 – NAO Mine – Year 25 (Final Pit)**

Source: GE21, 2024.

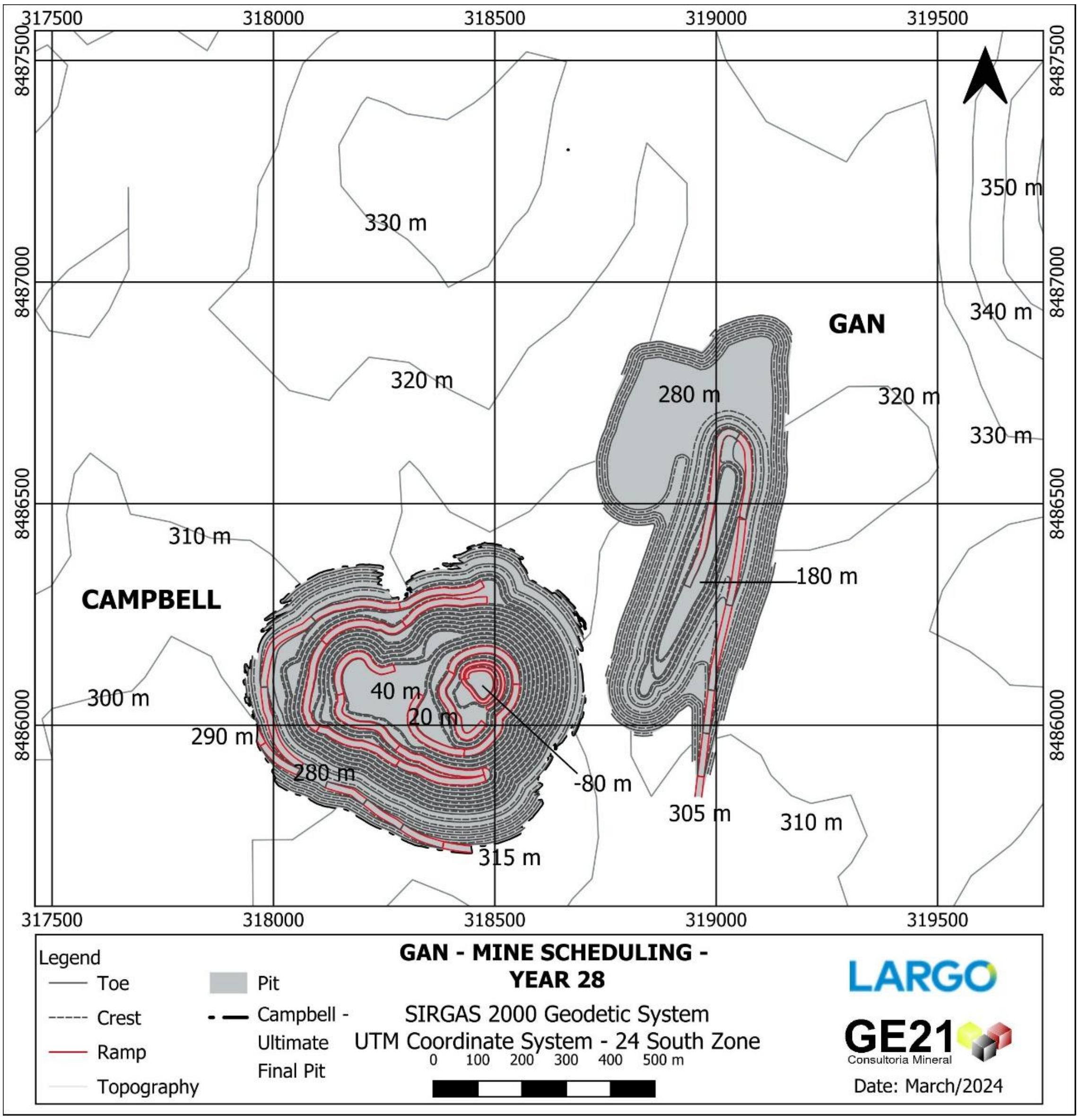



**Figure 16-30 – GAN Mine – Year 28**

Source: GE21, 2024.

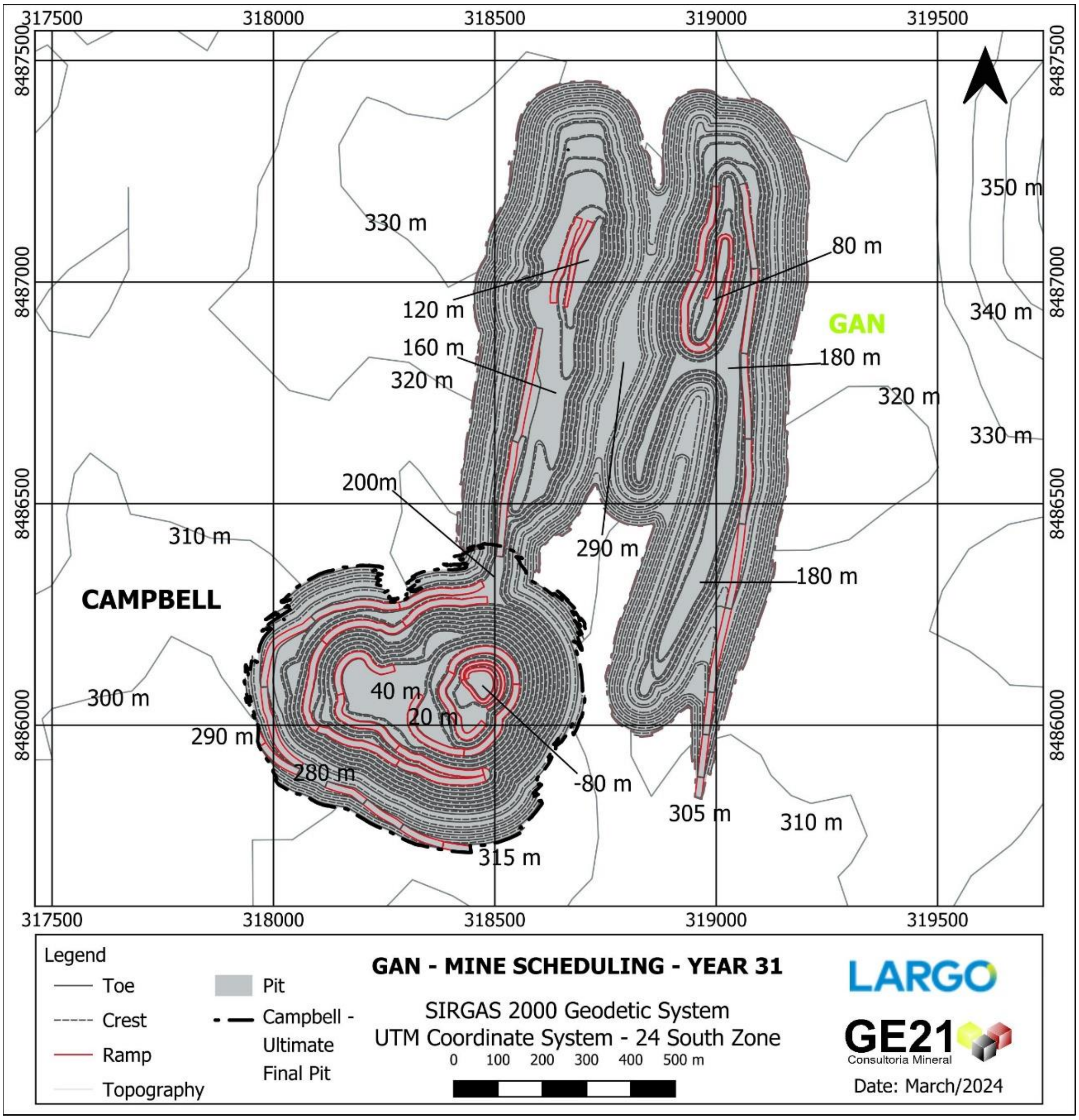



**Figure 16-31 – GAN Mine – Year 31 (Final Pit)**

Source: GE21, 2024.

## 16.3 Waste Disposal

The waste disposal operation utilizes the ascending method, starting during the construction of the heap at the area. Waste rock is transported by truck, then uniformly distributed and leveled by an operator using a tractor. The process is repeated by stacking another bank above the original one, while maintaining a ramp for the trucks to access the area. Final steps for installing the drainage system and revegetation will be conducted on the top benches of the waste dumps.

Table 16-11 and Table 16-12 present the geometric parameters and volumes of each projected waste dump. Figure 16-32 illustrates the Maracás Menchen Waste Dumps, while Figure 16-33 to Figure 16-34 depict waste dumps for each individual mine.

**Table 16-11 – Waste Dumps Design Parameters**

| Parameters | Units | Units |
|---|---|---|
| Slope Angle | ° | 35 |
| Bench Height | m | 10 |
| Berm width | m | 6 |
| Road Ramp width | m | 15 |

Source: Largo, 2024.

**Table 16-12 – Waste Dumps Volume and Areas**

| Waste Dump | Volume ($Mm^3$) | Area (ha) |
|---|---|---|
| **Campbell** | 76.1 | 129.4 |
| **NAN** | 69.7 | 85.8 |
| **SJO** | 47.4 | 66.1 |
| **NAO** | 21.4 | 38.9 |
| **GAN** | 36.4 | 60.4 |

Source: GE21, 2024.

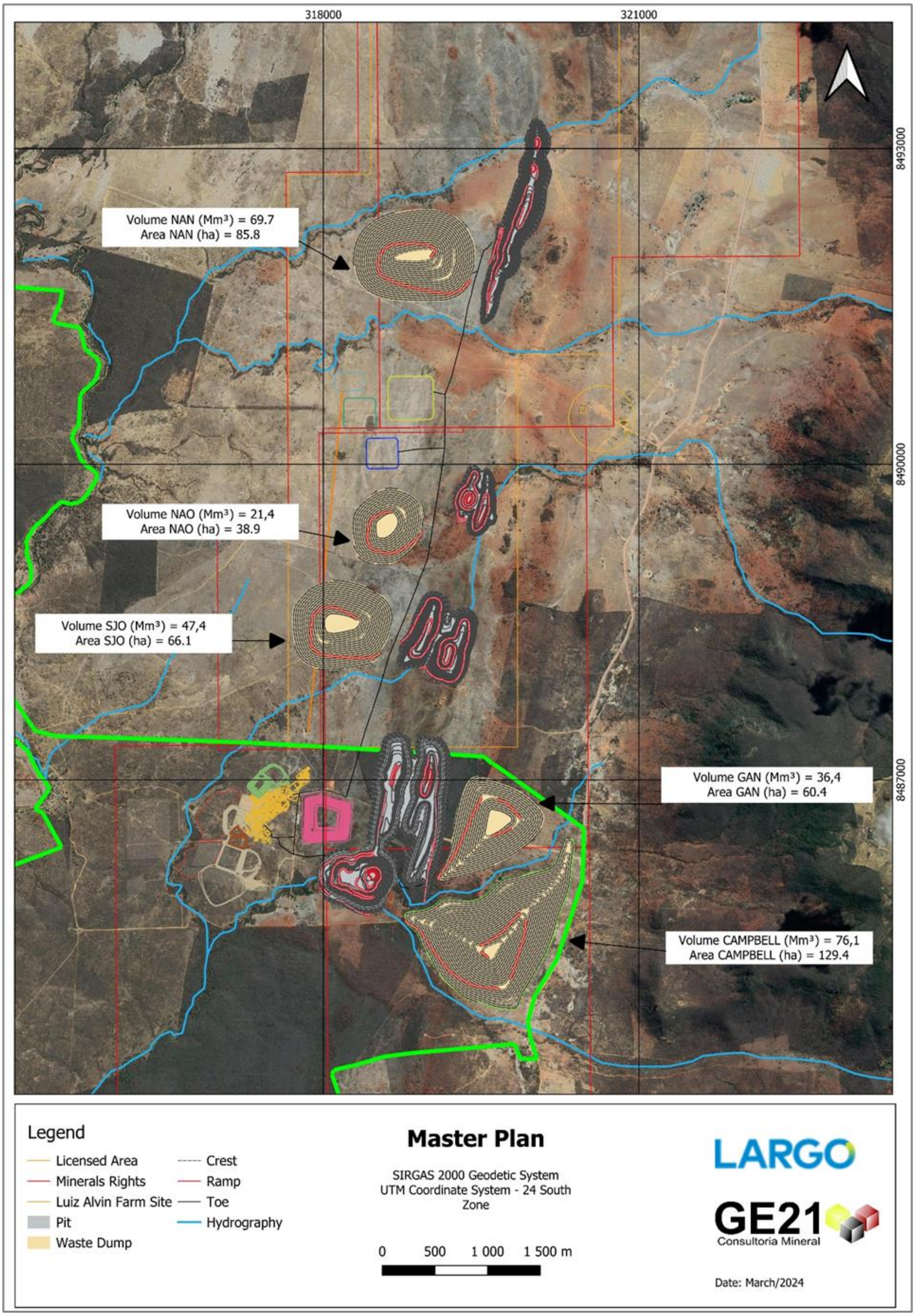



**Figure 16-32 – Maracás Menchen Project – Waste Dumps**

Source: GE21, 2024.

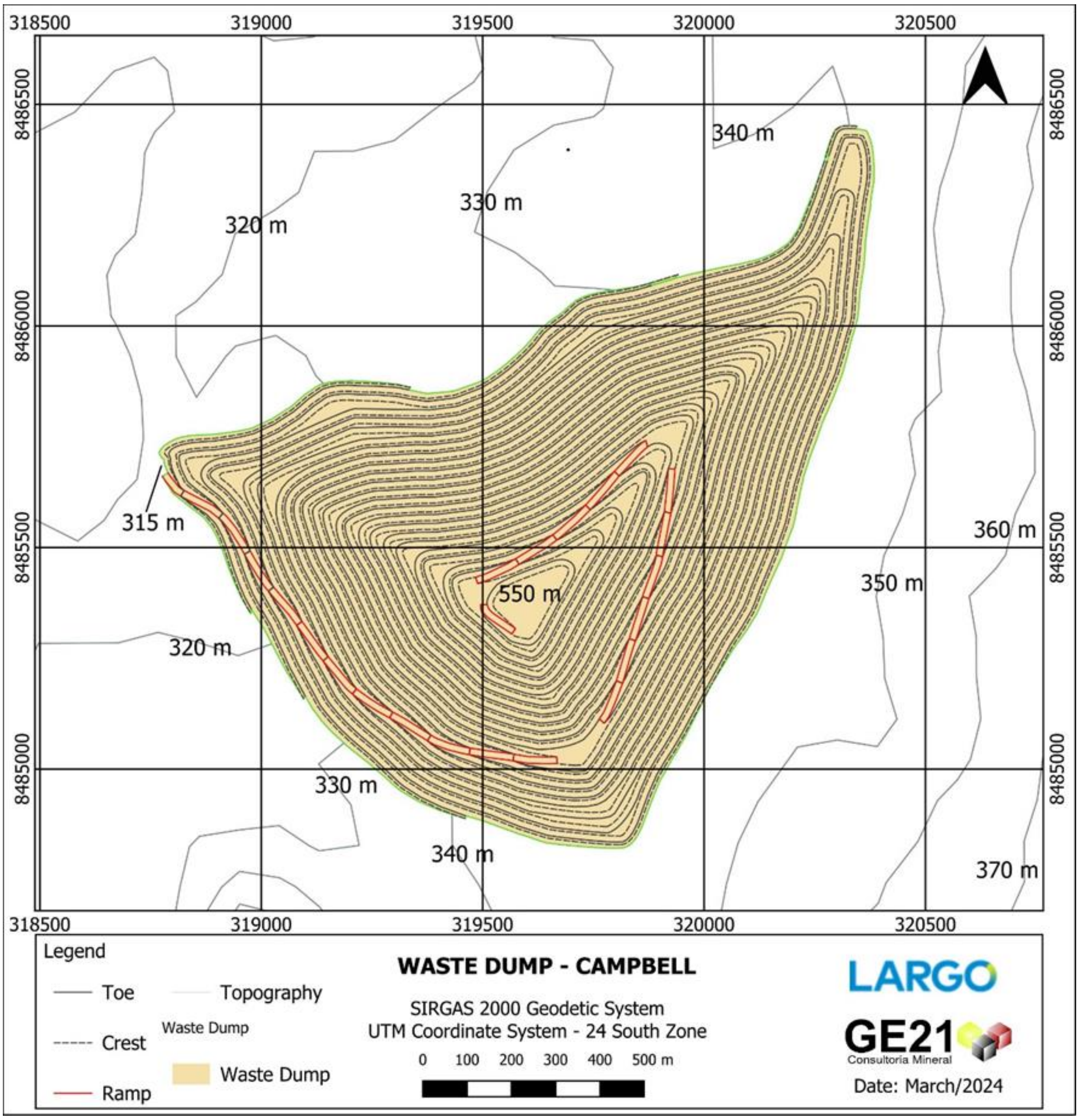



**Figure 16-33 – Campbell Waste Dump**

Source: GE21, 2024.

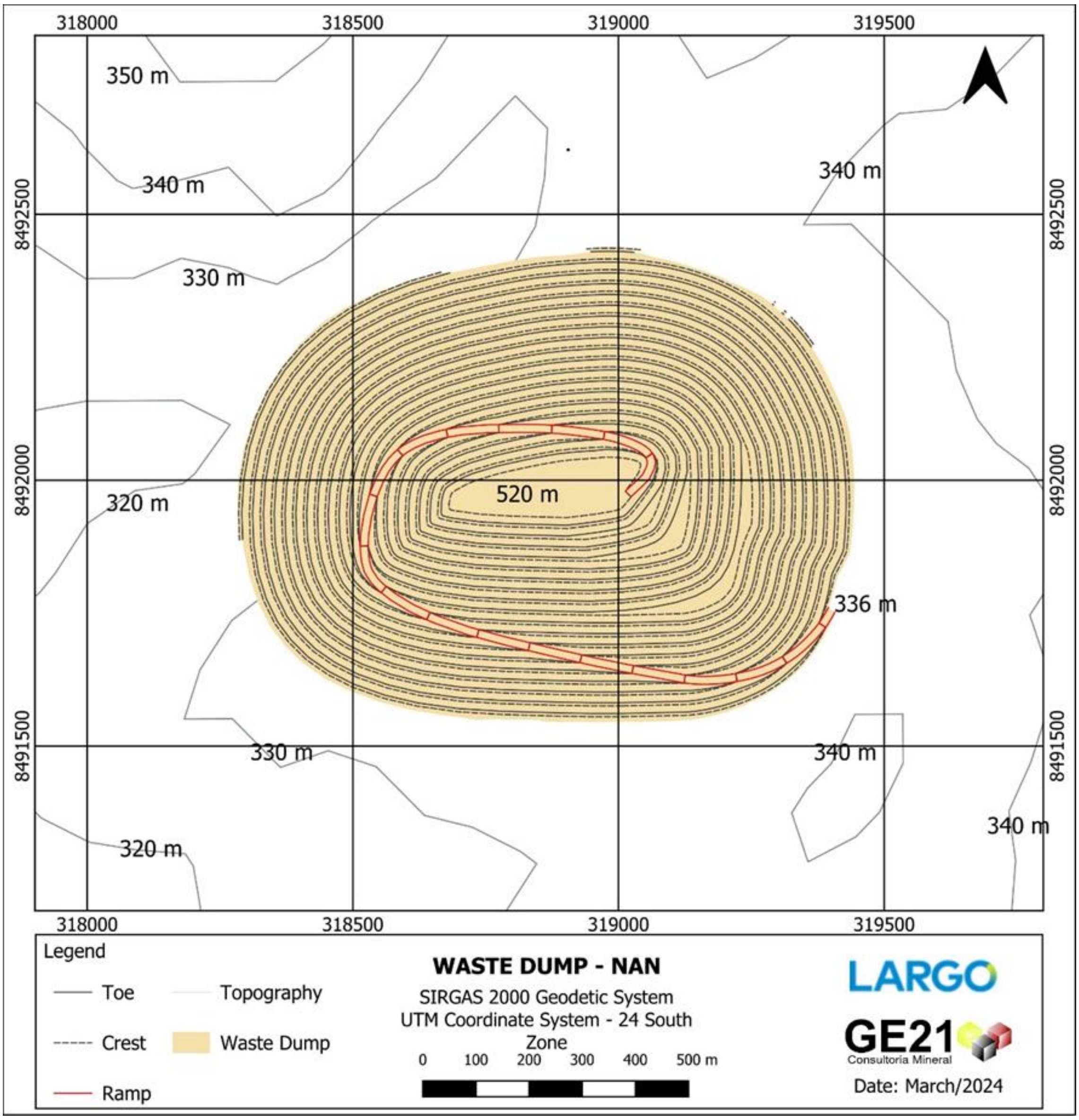



**Figure 16-34 – NAN Waste Dump**

Source: GE21, 2024.

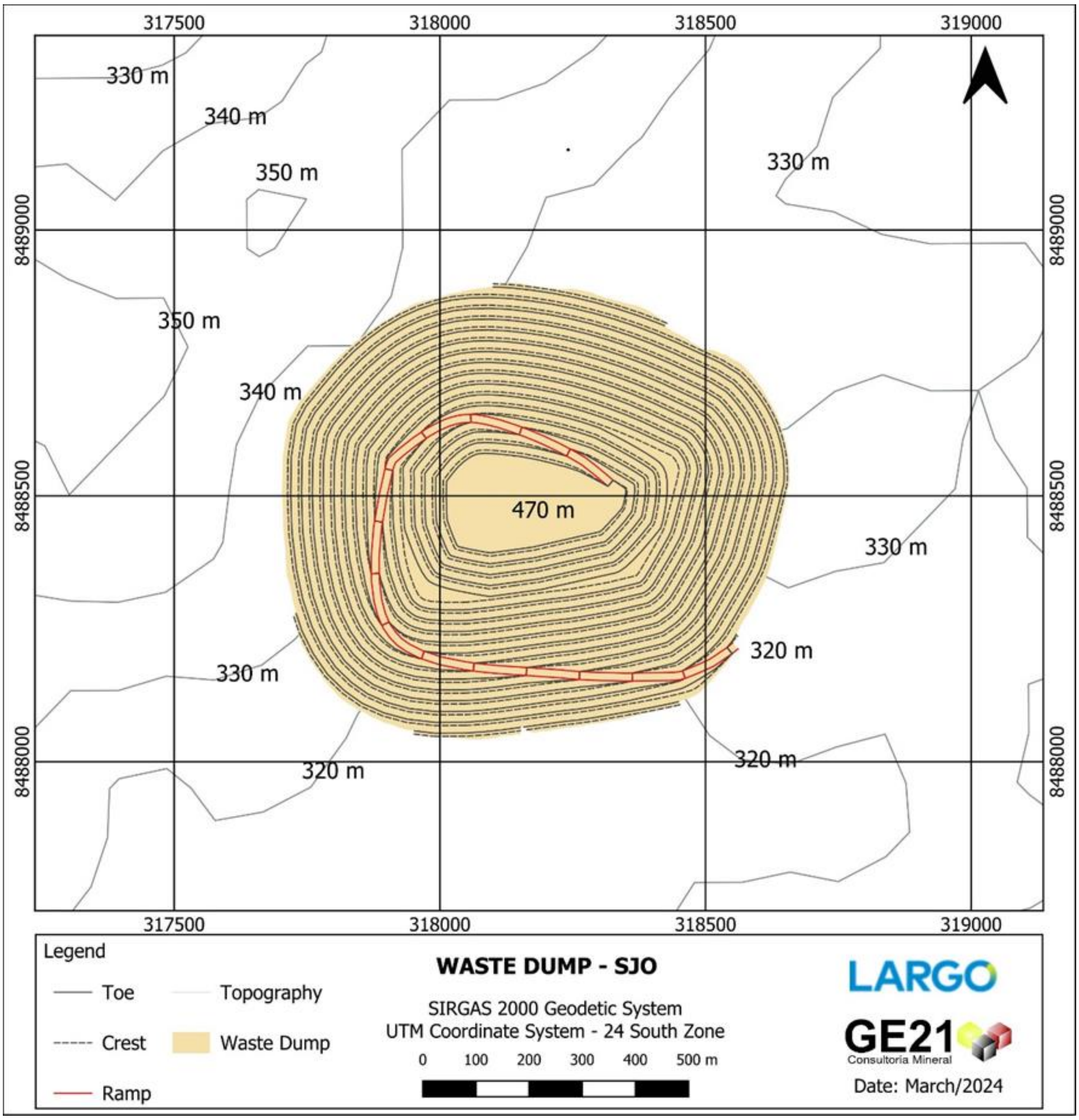



**Figure 16-35 – SJO Waste Dump**

Source: GE21, 2024.

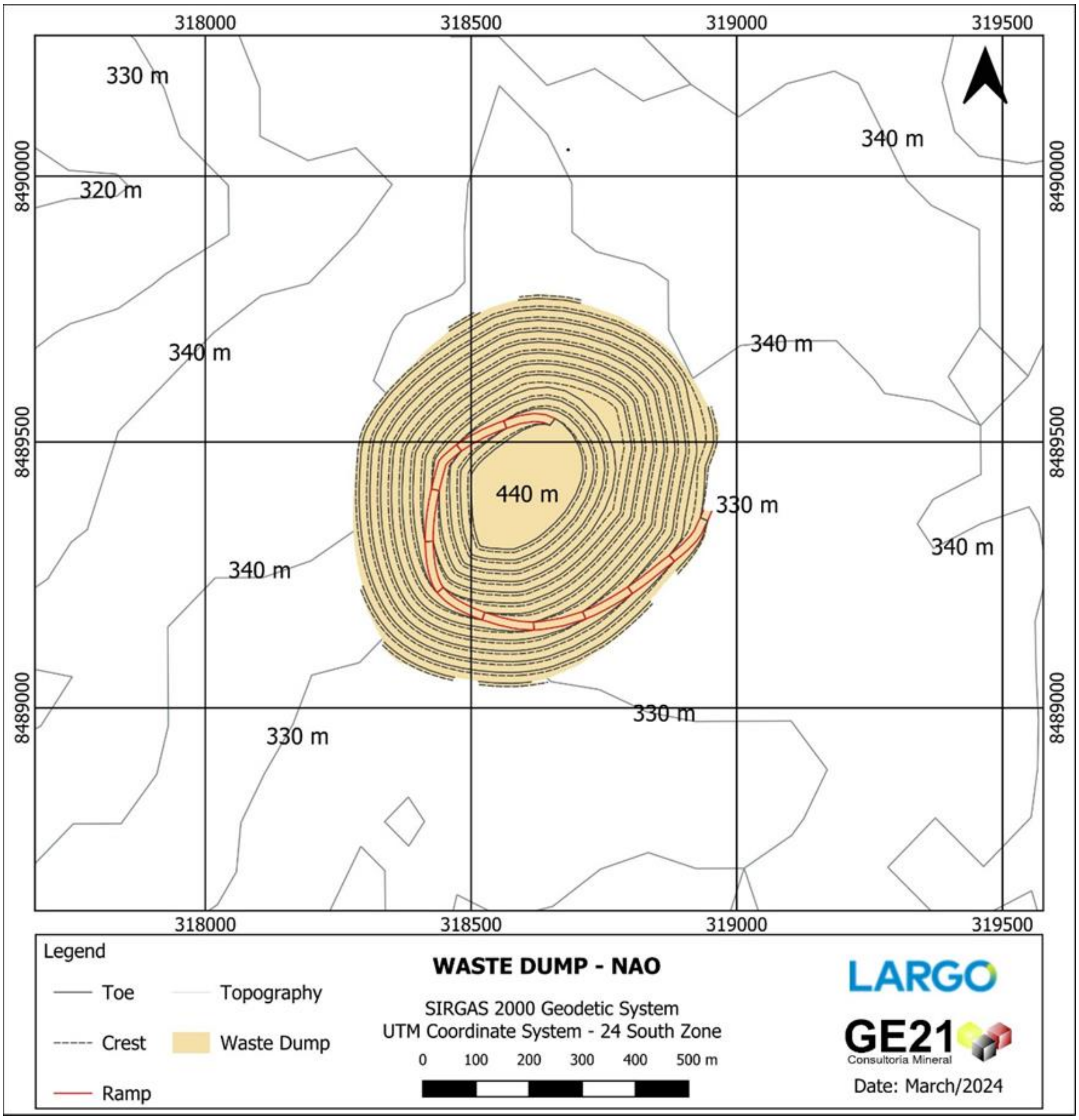



**Figure 16-36 – NAO Waste Dump**

Source: GE21, 2024.

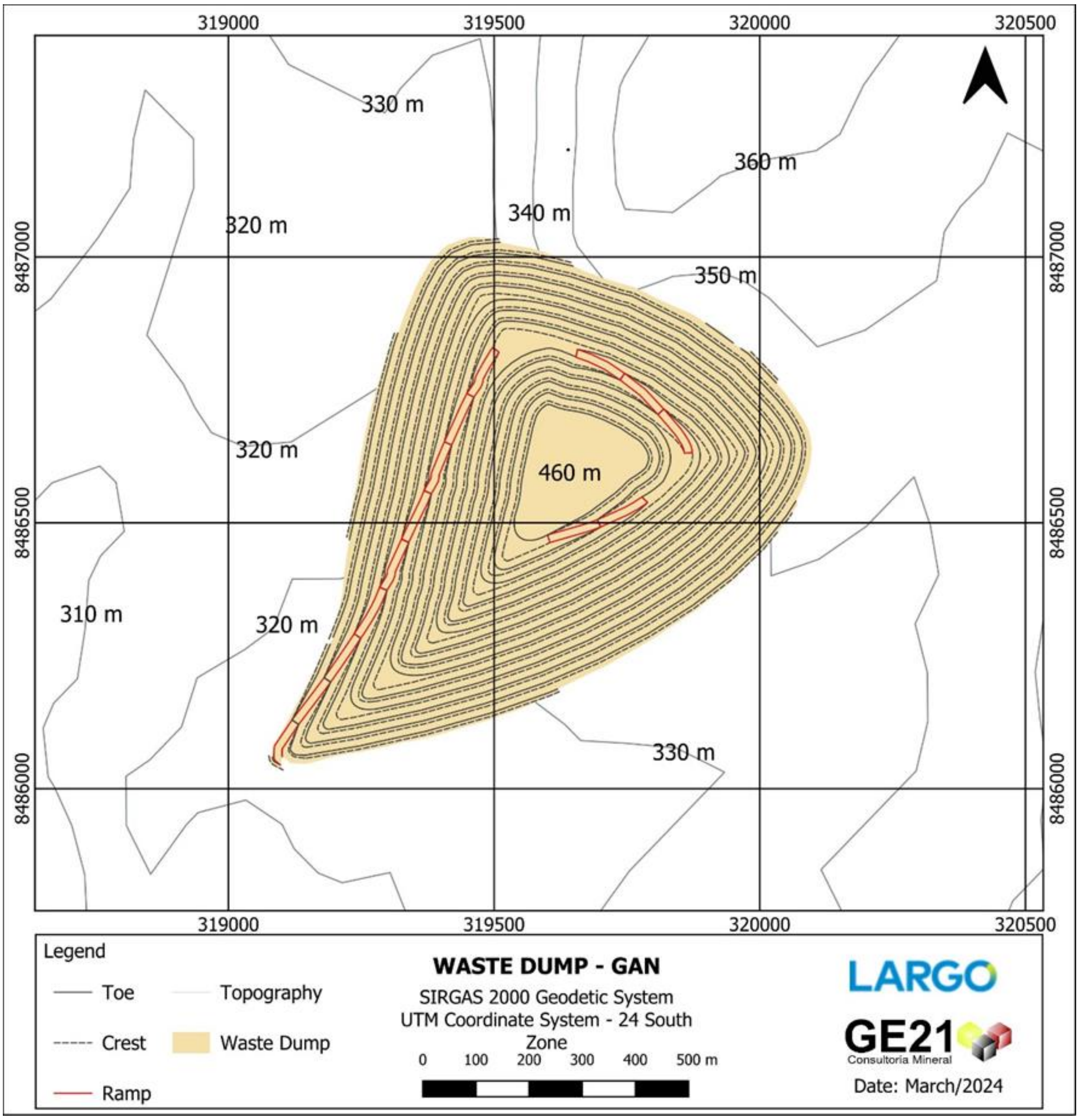



**Figure 16-37 – GAN Waste Dump**

Source: GE21, 2024.

## 16.4 Production Plan

The contracted mining fleet will conduct mine operations at the Project, based on the production plan for ore and waste, along with yearly average haulage distances. Mining activities will primarily encompass the following:

- Drilling and blasting using explosives.
- Excavation, loading and transportation of ore and waste materials.
- Haulage of Run of Mine (ROM) material.
- Haulage of waste material.
- Discharge of ROM material at the crushing circuit.
- Disposal of waste at designated waste dumps.

- Construction and maintenance of all internal accesses to the pits and the waste dumps.
- Maintenance of roads, including floor upkeep, drainage, coating, and signage, throughout the operation areas.
- Implementation and maintenance of the surface drainage systems at access points to mining operations, waste deposits, ore yards, and associated areas.
- Execution of mine infrastructure services, including construction and maintenance of accesses to mining areas, crushers, waste dumps, workshops, offices, mine drainage systems, access signaling, and mine dewatering.
- Loading the primary crusher via wheel loader.
- Establishment and maintenance of operational support facilities (offices, workshops, cafeteria, accommodations, warehouses, changing rooms, restrooms, septic systems, environmental, health, and safety emergency facilities, explosive storage, electrical and hydraulic installations, among others), ensuring compliance with Brazilian environmental standards and labor laws.

Additionally, estimates have been prepared for the infrastructure operations of the mine and the equipment needed to support these activities.

#### *16.4.1 Mining Fleet Sizing*

The decision to size the mining fleet at the Project considering several factors, including the volume of Run-of-Mine (ROM) material, waste to be removal requirements, availability of spare parts, and the diversity of mining contractors in the area. As a result, trucks with load capacities of 40 and 45 tonnes, along with equivalent hydraulic excavators were selected. Ancillary equipment was also chosen to align with the specifications of the trucks and excavators.

Current, Largo operates under a mining fleet contract with Consórcio Maracás – Dinex | EXE Mineral (CM), which includes the following equipment:

- 2 Sany SY980 hydraulic excavators with a 5.5 $m^3$ bucket capacity.
- 3 Sany SY750 hydraulic excavators with a 4.2 $m^3$ bucket capacity.
- 17 Volvo FMX540 8x4 trucks with a 45-tonne capacity.
- 2 Volvo FMX500 8x4 trucks with a 40-tonne capacity.
- 10 Mercedes Benz AROCS 4857 8x4 trucks with a 40-tonne capacity.
- 1 Sandvik Ranger DI550 rotary drill rig with a 4.5/5.0” diameter.
- 4 Sandvik Ranger DP1500I rotary drill rigs with a 4.0/5.5" diameter.
- Additional complementary ancillary equipment.

Detailed specifications of the mining fleet can be found in Table 16-13 below. Figure 16-38 to Figure 16-43 represent the transportation, loading, infrastructure/support, drilling, lubrication/fueling and humidification fleet.

**Table 16-13 – Mining Fleet Contract – Equipment Histogram – CM**

| Type | Manufacturer | Model | Load Capacity | Quantity |
|---|---|---|---|---|
| **Transportation** | | | | |
| Dump Truck 8x4 | Mercedes Benz | AROCS 4851 | 20 m³/ 40 t | 10 |
| Dump Truck 8x4 | Volvo | FMX500 | 22 m³/ 40 t | 2 |
| Dump Truck 8x4 | Volvo | FMX540 | 22 m³/ 45 t | 17 |
| **Loading** | | | | |
| Hydraulic Excavator | Sany | SY750 | 4.2 m³ | 3 |
| Hydraulic Excavator | Sany | SY980 | 5.5 m³ | 2 |
| **Infrastructure/Support** | | | | |
| Hydraulic Excavator | Caterpillar | CAT336 | 2.12 m³ | 1 |
| Track-Type Tractor | Caterpillar | D8t | 48 tonne | 3 |
| Wheel Loader | Caterpillar | 966 | 2.8 m³ | 1 |
| Motor Grader | Caterpillar | 140k | 17 t | 2 |
| Crane Truck | Volvo | VM290 | 10 t | 1 |
| Truck/Trailer | Scania | G440 | 75 t | 1 |
| Hydraulic Excavator | Caterpillar | CAT345 | Breaker | 1 |
| **Drilling** | | | | |
| Hydraulic Drill | Sandvik | DP1500I | 4.0/5.5"Ø | 4 |
| Hydraulic Drill | Sandvik | DI550 | 4.5/5.0"Ø | 1 |
| **Lubrication/Fueling** | | | | |
| Fuel/Lube Truck | Volvo | VM330 | 10,000 l | 1 |
| Fuel/Lube Truck | Volvo | VM330 | 9,000 l | 1 |
| **Humidification** | | | | |
| Water Truck | Volvo | VM330 | 20,000 l | 2 |
| **Total Mining Fleet Contract** | | | | **53** |

Source: Largo, 2024.


**Figure 16-38 – Transportation Fleet Equipment**

Source: Largo, 2024.


**Figure 16-39 – Loading Fleet Equipment**

Source: Largo, 2024.


**Figure 16-40 – Infrastructure/Support Fleet Equipment**

Source: Largo, 2024.

**Figure 16-41 – Drilling Fleet Equipment**

Source: Largo, 2024.


**Figure 16-42 – Lubrication/Fueling Fleet Equipment**

Source: Largo, 2024.

**Figure 16-43 – Humidification Fleet Equipment**

Source: Largo, 2024.

### *16.4.2 Access Roads*

All access roads required for the operations are designed to minimize transport distances between origins and destinations while strictly adhering to technical and safety parameters and standards for transportation equipment. The ramps maintain a maximum grade of 10%, curves have a minimum radius of 30 m, and the width of the bearing track is set at twice the width of the largest vehicle used for single-direction lanes and three times the width of the largest vehicle overall. Additionally, all accesses will feature lateral protection curbs with minimum height equal to half the tire diameter of the largest equipment that travels through the access roads.

The double haul road, considering:

- Travel width:
  - not less than three times the width of the widest haulage vehicle used where dual lane traffic exists; or
  - not less than two times the width the widest haulage vehicle used where only single lane traffic exists, and
- Shoulder barrier or berm:
  - at least three-quarters of the height of the largest tire on any vehicle hauling on road;
  - located and maintained along the edge of the haulage road wherever a drop-off greater than 3 m exists.

The width of the shoulder barrier referred to a haulage road is not included in the width required in the travel width. Clearly marked emergency runaway lanes or retardation barriers shall be provided and maintained at suitable locations and be capable of safely bringing a runaway vehicle to a stope, where the road grade exceeds 5%.

To ensure the safety of operations, protect workers' health, and mitigate environmental impacts, water trucks will operate 24 hours a day, ensuring wetting of all accesses in use. Bulldozers, motor graders, a small hydraulic excavator, water trucks, and a compactor roller will be utilized for the construction and maintenance of the roads.

The road signaling system has been implemented in accordance with Brazilian traffic regulations and specific mining standards. All accesses adhere to Brazilian regulatory standards concerning traffic and mining requirements (Regulation Mining Standards – NRM). Figure 16-44 illustrates the Project access routes for the Campbell Pit, NAN, SJO, NAO and GAN deposits.

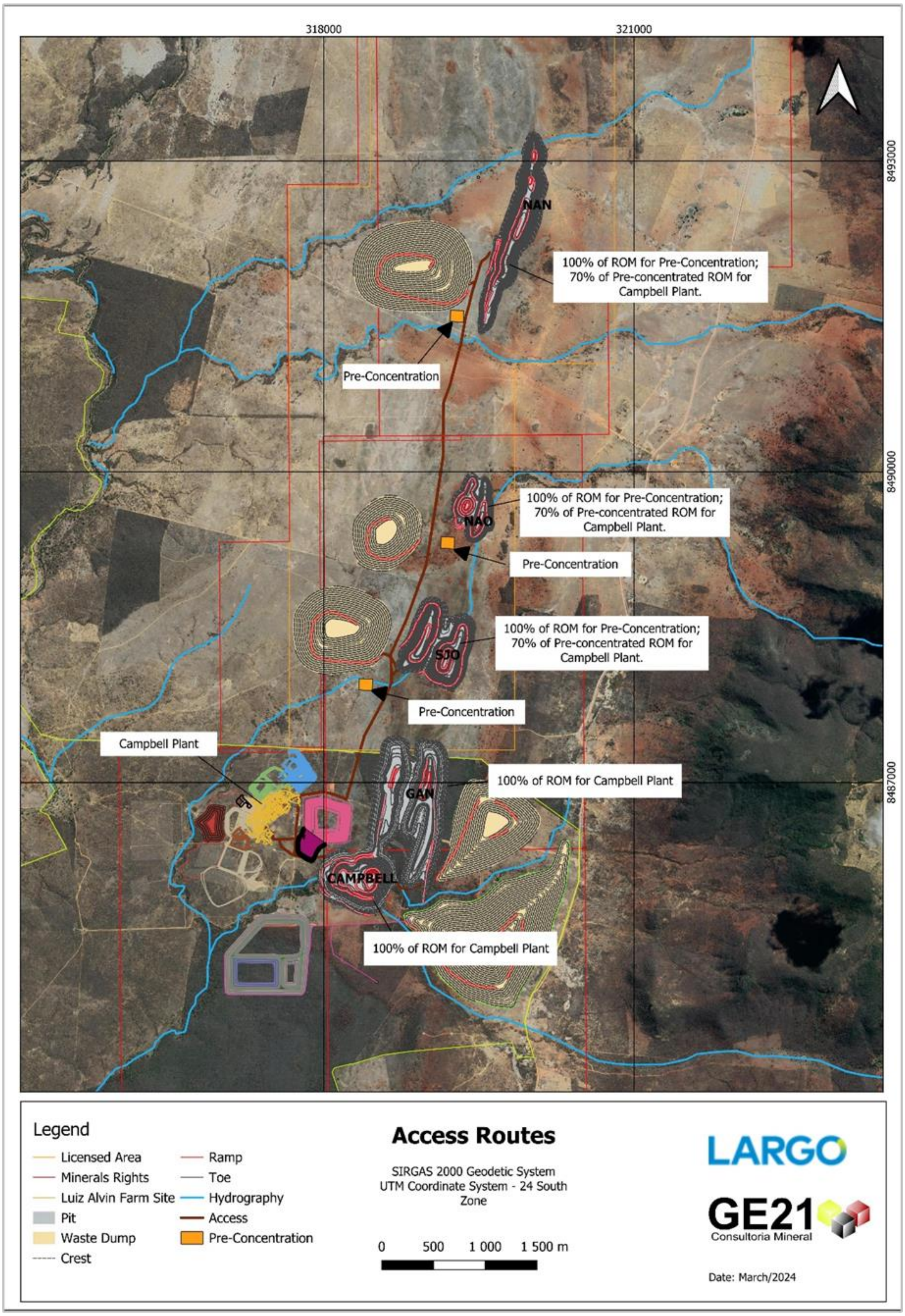



**Figure 16-44 – Project Access Routes for Campbell, NAN, GAN, SJO and NAO deposits**

Source: GE21, 2024.

Figure 16-45 presents the average haulage distance for Campbell Pit, NAN, SJO, NAO, and GAN.

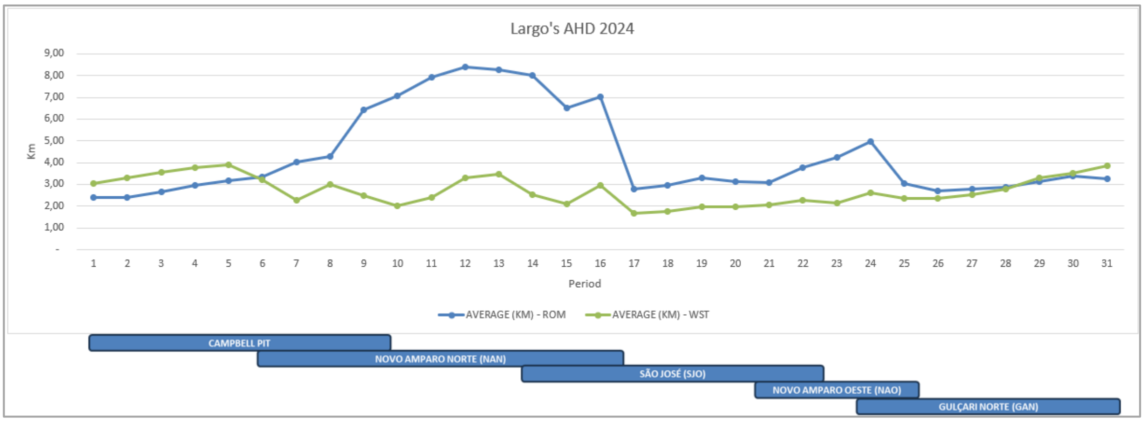



**Figure 16-45 – Average Haulage Distance for Campbell Pit, NAN, SJO, NAO, and GAN Pits**

Source: GE21, 2024.

### *16.4.3 Drilling and Blasting*

The values used for the drilling and blasting plan were derived from the Campbell Pit database. For this analysis, it was assumed that 100% of both ore and waste are hard rocks and necessitate blasting with explosives. To ensure selectivity in mining, ore benches with a height of 5 m and waste benches with a height of 10 m were considered.

For secondary blasting, when required, it will also be conducted using explosives or with a hydraulic hammer integrated with a hydraulic excavator or a bulldozer.

Concerning the storage of explosives in the mine, a specific location for the installation of an Explosive Storage has been designated.

### *16.4.4 Excavation and Loading*

Excavation and the loading of ore and waste rock will be conducted by hydraulic excavators in backhoe configuration. At least two mining fronts will be operated simultaneously to facilitate ore blending. Waste rock removal will also be conduct concurrently at two work fronts to ensure planned ore quality.

Excavators with the backhoe configuration allow excavation by positioning the machine on the upper operating bench while keeping the haulage equipment on the lower operating bench. This model significantly enhances productivity as the truck is positioned approximately 30° from the longitudinal axis of the excavator, reducing turning time during excavation and loading. With the upper positioning of the loading machine, the operator’s field of view increases, thereby enhancing operation safety, productivity, load positioning on the truck, and enabling better selectivity in ore mining. A truck with a payload capacity of 45 metric tonnes has been adopted for this Project for cost-effectiveness, as it widely used in medium-sized mining operations in Brazil, offering economic advantages.

For fleet sizing purposes in drilling, blasting, haulage, and waste disposal, an average moisture content of 6% and a swell factor of 20% with compacting were applied. The mine plan model for Campbell Pit defined a 10% dilution and a 100% mining recovery from the mine reconciliation data. The same dilution and mining recovery assumptions were used for the NAN, SJO, NAO, and GAN deposits.

GE21 has estimated the yearly requirements for the mine fleet to perform the projected mining schedule. Table 16-14 presents equipment specifications, and Table 16-15 presents the quantities of mining equipment. Figure 16-46 represents the Drilling, Loading and Transportation Fleet.

**Table 16-14 – Equipment Specifications**

| Equipment | Reference | Model | Life (hours) |
|---|---|---|---|
| Hydraulic Excavator – 70t (2.8 – 4.5 $m^3$) | Caterpillar | CAT 374 | 30,000 |
| Road Dump Truck 45t – 8x4 | Volvo | FMX540 | 15,000 |
| Drilling Machine | Leopard | Di650i | 25,000 |
| Wheel Loader (3.2 – 7.4 $m^3$) | Caterpillar | CAT 966 | 30,000 |
| Bulldozer CAT D8 | Caterpillar | D8T | 35,000 |
| Bulldozer CAT D6 | Caterpillar | D6T | 35,000 |
| Wheel Dozer CAT 834H | Caterpillar | CAT 834 | 30,000 |
| Grader – Caterpillar | Caterpillar | Cat 140 M | 35,000 |
| Operation Support Truck | Scania | P360 | 15,000 |
| Water Truck – 20,000 l | Volvo | FMX | 18,000 |
| Backhoe Excavator | Caterpillar | CAT432F | 15,000 |
| Hydraulic Excavator – 35 t with Hammer | Komatsu | PC 350 | 30,000 |
| Forklift | Mitsubishi | FD35N3 | 36,000 |
| Blasting & Support Truck | Scania | P360 | 15,000 |
| Fuel & Lube Truck – 8,000 l | Volvo | FMX | 18,000 |
| Maintenance Support Truck – Munck | Mercedes | Axor 3131 | 20,000 |
| Crane – 30 t of capacity | Grove | GMK 3055-9622 | 36,000 |
| Portable Lightning Tower | Patria | LS4 | 7,000 |
| Light Vehicle | Toyota | Hilux | 6,000 |

Source: GE21, 2024.

**Table 16-15 – Mining Equipment Quantitative**

| Mining Fleet | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydraulic Excavator | 4 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 7 | 6 | 6 | 7 | 8 | 8 | 5 | 5 | 6 | 7 | 6 | 7 | 7 | 7 | 8 | 9 | 9 | 9 | 9 | 5 | 1 |
| Haul Truck | 16 | 25 | 27 | 26 | 29 | 25 | 24 | 24 | 29 | 27 | 30 | 32 | 31 | 34 | 39 | 48 | 38 | 33 | 34 | 39 | 34 | 29 | 31 | 34 | 41 | 50 | 55 | 47 | 53 | 32 | 4 |
| Drilling Machine | 6 | 8 | 8 | 7 | 8 | 7 | 7 | 7 | 9 | 9 | 11 | 11 | 10 | 11 | 12 | 12 | 10 | 9 | 10 | 11 | 10 | 11 | 10 | 11 | 13 | 15 | 14 | 14 | 13 | 9 | 2 |
| Wheel Loader | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| Bulldozer CAT D6 T | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 1 |
| Bulldozer CAT D8 T | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 5 | 4 | 4 | 5 | 6 | 6 | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 4 | 1 |
| Grader | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 3 | 1 |
| Operation Support Truck | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Water Truck | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 3 | 1 |
| Backhoe Excavator | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Hydraulic Hammer | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Forklift | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Blasting Support Truck | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Fuel and Lube Truck | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Maintenance Support Truck - Munck | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| Crane | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Portable Lightning Tower | 5 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 6 | 6 | 8 | 8 | 7 | 8 | 9 | 9 | 7 | 7 | 8 | 8 | 7 | 8 | 8 | 8 | 10 | 11 | 11 | 10 | 10 | 6 | 2 |
| Light Vehicle | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **Total** | **61** | **79** | **81** | **79** | **83** | **72** | **71** | **71** | **84** | **82** | **101** | **93** | **89** | **105** | **114** | **123** | **96** | **90** | **94** | **110** | **93** | **102** | **104** | **109** | **124** | **141** | **146** | **137** | **143** | **97** | **40** |

Source: GE21, 2024.

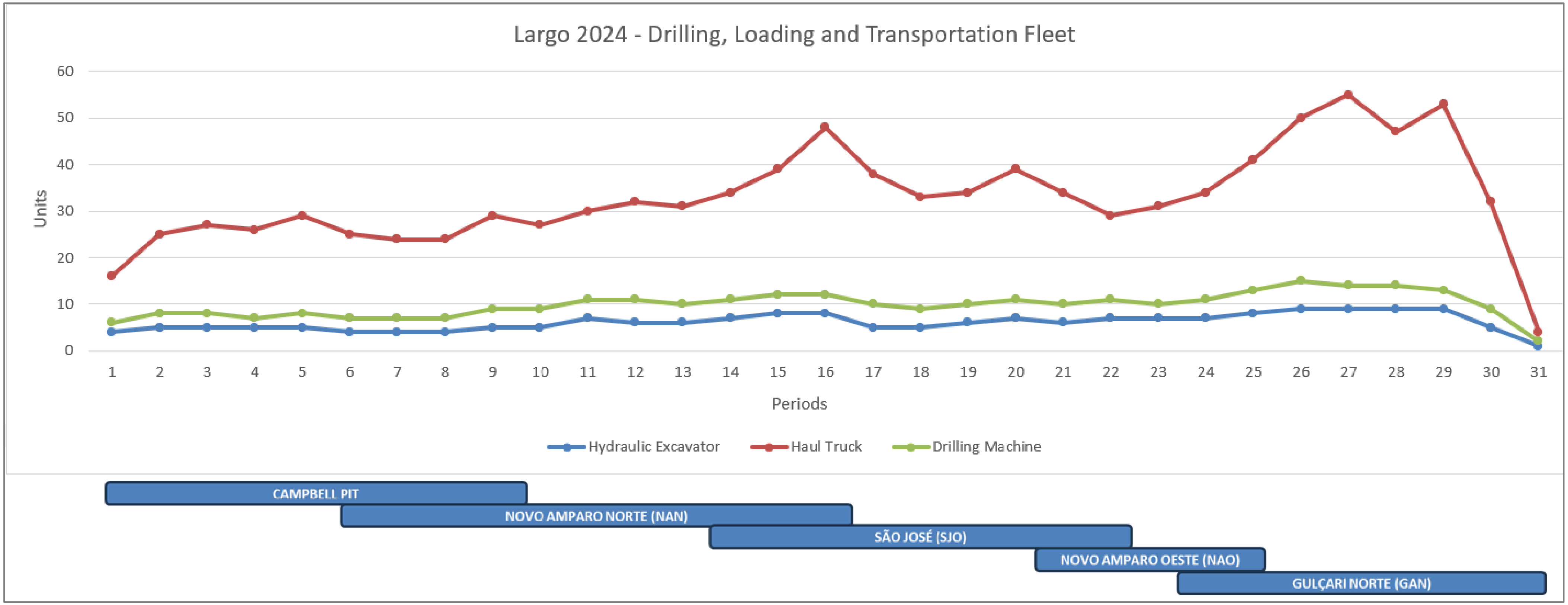



**Figure 16-46 – Drilling, Loading and Transportation Fleet**

Source: GE21, 2024.

## 16.5 Non-Magnetic Tailings Ponds

There are three ponds at the plant location containing titanium-enriched material from previously processed non-magnetic tailings of vanadium magnetic separation. These materials are available for reclaiming and processing for titanium production.

Reclaiming non-magnetic tailings from ponds is not scheduled in the Mining Schedule production and is considered to complement the nominal capacity of the Ilmenite Plant.

An additional generation of 1,275 kt of ilmenite is forecasted until 2054, totaling 2,175 Kt of ilmenite capacity in the ponds. The assumptions for this forecast are:

- **Volume of non-magnetics in Reserves**: Informed by reconciliation data and confirmed by topographic measurement with effective date of January 2024. The average $TiO_2$ grade is 10.54% of the non-magnetic tailings deposited in the ponds, based data since 2013.
- **Forecasted Ilmenite Excess Volume**: Generated from 2024 to 2054, following the average production by each mine.
- **The Plant Production Plan**: The Ilmenite Plant will be fed together with the tailings coming from the Vanadium Plant. The Ilmenite Plant will continue to be fed with the non-magnetic tailings from NAN, SJO, NAO, and GAN mines, where the titanium concentration will be sufficient to secure the proposed Pigment Plant production.

Table 16-16 presents the ilmenite inventory variation estimated from the year 2024 to the year 2054.

**Table 16-16 – Non-Magnetic Tailings and Ilmenite Inventory Variation Plan**

| | | | Ilmenite | | |
|---|---|---|---|---|---|
| Period | Non-Magnetic (kt) | Grade $TiO_2$ (%) | Inventory Variation (kt) | Excess (kt) | Missing (kt) |
| Volume generated between Sep/13 to Jan/24 | 5,218.43 | 10.54 | 900.20 | - | |
| 2024 | | | 1,008.24 | 108.03 | - |
| 2025 | | | 1,131.92 | 123.68 | - |
| 2026 | | | 1,188.21 | 56.29 | - |
| 2027 | | | 1,294.77 | 106.56 | - |
| 2028 | | | 1,306.57 | 11.81 | - |
| 2029 | | | 1,247.84 | - | 58.73 |
| 2030 | | | 1,205.84 | - | 42.00 |
| 2031 | | | 1,145.39 | - | 60.45 |
| 2032 | | | 1,218.53 | 73.14 | - |
| 2033 | | | 1,291.23 | 72.70 | - |
| 2034 | | | 1,370.96 | 79.73 | - |
| 2035 | | | 1,457.98 | 87.02 | - |
| 2036 | | | 1,535.70 | 77.72 | - |
| 2037 | | | 1,614.01 | 78.30 | - |
| 2038 | | | 1,692.12 | 78.11 | - |
| 2039 | | | 1,788.72 | 96.60 | - |
| 2040 | | | 1,884.14 | 95.42 | - |
| 2041 | | | 1,981.30 | 97.16 | - |
| 2042 | | | 2,082.47 | 101.17 | - |
| 2043 | | | 2,171.70 | 89.23 | - |
| 2044 | | | 2,268.54 | 96.84 | - |
| 2045 | | | 2,343.02 | 74.48 | - |
| 2046 | | | 2,396.33 | 53.31 | - |
| 2047 | | | 2,444.48 | 48.15 | - |

| Period | Non-Magnetic (kt) | Grade $TiO_2$ (%) | Ilmenite Inventory Variation (kt) | Ilmenite Excess (kt) | Ilmenite Missing (kt) |
|---|---|---|---|---|---|
| 2048 | | | 2,471.28 | 26.80 | - |
| 2049 | | | 2,483.84 | 12.56 | - |
| 2050 | | | 2,480.35 | - | 3.49 |
| 2051 | | | 2,450.64 | - | 29.71 |
| 2052 | | | 2,400.40 | - | 50.24 |
| 2053 | | | 2,363.99 | - | 36.41 |
| 2054 | | | 2,174.83 | - | 189.16 |

Source: GE21, 2024.

# 17 RECORVERY METHODS

The Maracás vanadium recovery plant commenced operations in 2014 and achieved its nameplate capacity in 2018. Subsequently, in 2019, an expansion project was implemented, increasing the process capacity to 1.9 million tonnes per year (Mt/year) of ROM and the $V_2O_5$ production capacity to 12,000 tonnes per year. The production figures for subsequent years are as follows:

- In 2020, 11,825 t of $V_2O_5$ was produced with an overall recovery rate of 81.5%.
- In 2021, 10,319 t of $V_2O_5$ was produced with an overall recovery rate of 79.7%.
- In 2022, 10,436 t of $V_2O_5$ was produced with an overall recovery rate of 79.1%.
- In 2023, 9,681 t of $V_2O_5$ was produced with an overall recovery rate of 80.0%.

The current process flow sheet comprises three stages of crushing, one stage of dry magnetic separation, two stages of grinding, three stages of wet magnetic separation, ilmenite flotation plant, magnetic concentrate roasting, vanadium leaching, ammonium meta-vanadate (AMV) precipitation, AMV filtration, AMV drying, AMV reaction into $V_2O_5$ or $V_2O_3$, and $V_2O_5$ and $V_2O_3$ screening to generate powder products or fusing $V_2O_5$ into flakes, all three as final products. The $V_2O_3$ plant was commissioned in 2021 and produced $V_2O_3$ powder in a furnace after AMV drying on a route parallel to the $V_2O_5$ circuit. In 2022, 523 t of $V_2O_3$ (equivalent to 607 t of $V_2O_5$) was produced, and 930 t of $V_2O_3$ (equivalent to 1,079 t of $V_2O_5$) was produced in 2023.

The plant for ilmenite concentration from non-magnetic reject was started in 2023, with a capacity to treat 145,000 t of concentrate per year. Since the start-up and commissioning, in 2023 it was produced 10,020 t of concentrate.

Largo is potentially looking to develop the Basic Engineering phase (FEL 3 phase) of the titanium pigment project in 2025. This project would aim to produce titanium pigment in Camaçari city (Bahia state) starting in 2028, with an initial capability to produce 30,000 t/year of $TiO_2$ pigment.

## 17.1 Process Description

A simplified process flow diagram to produce vanadium pentoxide is presented in Figure 17-1, along with a simplified mass balance in the same figure. Additionally, a summary of key process design criteria is provided in Table 17-1.

**Table 17-1 – Summary of Key Process Design Criteria**

| Criterion | Units | 2023 Actual | 2024, 2025 and 2026 Forecast | 2027 onwards |
|---|---|---|---|---|
| Average Ore Processing rate | t/a | 1,685.166 | 2,210.321 | 3,358.252 |
| $V_2O_5$ Production | t/a | 9.627 | 11.196 | 11.047 |
| Average $V_2O_5$ effective grade | % | 0.71 | 0.64 | 0.42 |
| Average plant daily ore throughput | t/d | 4.617 | 6.055 | 9.477 |
| Magnetic Product solids yield | % | 22.06 | 20.96 | 19.89 |
| Average magnetic concentrate $V_2O_5$ grade | % | 3.22 | 3.06 | 2.09 |
| **Total average recovery to $V_2O_5$** | **%** | **80.0** | **78.3** | **79.1** |

Source: Largo, 2024.

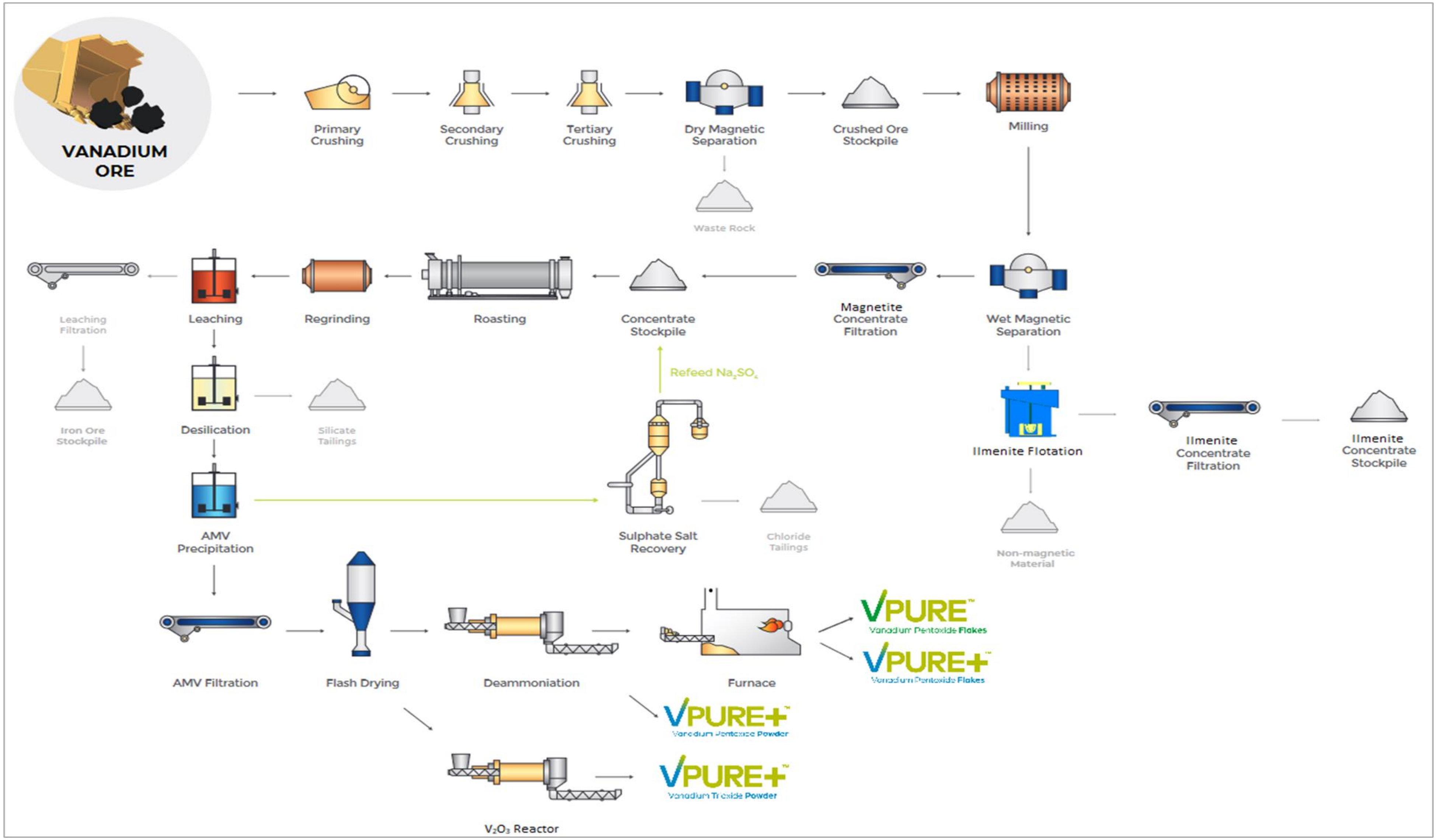



**Figure 17-1 – Conceptual Process Flow Sheet – Vanadium Pentoxide**

Source: Largo, 2024.

## 17.2 Crushing

There are two crushing circuits in the Largo flow sheet. In line 1, the ore is crushed via a three-stage crushing circuit comprised of a primary jaw crusher, two cone crushers and two vibrating sizing screens. In line 2, there is a primary crusher, two cone crushers and one vibrating sizing screen. The fine crushed product is fed to dry-magnetic separator. The magnetic material is disposed in a 4,200-m³-capacity stockpile from which it is withdrawn at a controlled rate to feed the grinding circuit.

## 17.3 Dry Magnetic Separation

The vanadium is contained within the magnetite fraction of the Resource. Magnetite is recovered by using low intensity magnetic separator (LIMS) of 1,500 Gauss. There are two rollers magnetic separator Imbras of 36”x120” with 150t/h of capacity each. The separation is done in the unique step (the separators are in parallel) where the pre magnetic concentrate is blended with the massive ore (magnetite) and sent to the grinding circuit.

## 17.4 Milling

The dry magnetic separation product is sent to the stockpile to feed the grinding circuit. The objective is to feed the mill with a magnetic grade of 42%.

This step of processing uses two ball mills in series. Both mills are similar, with the dimensions of 13x26’ and 2,275 KWh (3,000 HP). The primary mill is fed with dry material and water and operate in a conventional closed circuit with a hydrocyclone battery (primary battery), which has six hydrocyclones Krebs GMax 20 (three operating and three in standby). The secondary mill operates in a undirect closed circuit with the secondary hydrocyclone battery, that means it is fed with the underflow of the secondary hydrocyclone battery, which has ten hydrocyclones Krebs GMax 20 (six operating and four in standby).

The primary mill works with maximum ball size of 80 mm (Magoteaux), and a consumption of 250 g/t, and the secondary mill with maximum ball size of 60 mm (Magoteaux), and a consumption of 200 g/t. The product of this process is a P80 with 106 mµ.

This milled material is fed in the low intensity magnetic separation (LIMS) circuit, with 1 (one) rougher and 2 (two) cleaner stages. There are 5 (five) wet magnetic separators from Inbras Eriez, WD 48x125”.

## 17.5 Magnetite Concentrate Filtering

The final magnetic concentrate is filtered on a Westech filter of 20 $m^2$. The filtered concentrate is collected in a stockpile to be fed in the roasting section of the plant. The non-magnetic concentrate fraction from the beneficiation plant was thickened and pumped to the non-magnetic tailings pond until the last half of last year. After the Phase 1 of expansion, this non-magnetic concentrate now is pumped to the ilmenite flotation plant.

## 17.6 Ilmenite Flotation

The non-magnetic concentrate, generated at the wet magnetic concentrator from milling plant is pumped to a cluster of desliming hydrocyclones, which separates the slimes from the coarse particles. The slime material is sent to the tailing pond and the coarse particles are sent to a flotation circuit with 6 rougher cells, 1 cleaner cell and 1 scavenger cell. The flotation generates an ilmenite concentrate and tailings are pumped to the final tailings pond.

## 17.7 Ilmenite Concentrate Filtering

The final ilmenite concentrate is filtered in a horizontal filter. The filtered concentrate with 10% moisture is collected in a stockpile to be analyzed, conditioned, and shipped in trucks. The ilmenite concentrate can be sold or used in the proposed Largo's Pigment Plant is to potentially be established in Camaçari.

## 17.8 Roasting (Kiln)

The filtered magnetic concentrate, containing approximately 3% $V_2O_5$, is roasted at a high temperature (+1,100 °C) in a rotary kiln (FLSmidth) with diameter of 4.2 m and length of 90 m with rotation rate of 1 rpm. The kiln capacity is 88 t/h. Sodium carbonate ($Na_2CO_3$) is added to the magnetic concentrate at the beginning of the kiln at a rate of approximately 65 kg/t of concentrate. This material is roasted until the temperature mentioned previously (1.100 ºC) where magnetite ($Fe_3O_4$) is oxidized to hematite ($Fe_2O_3$), losing the magnetic characteristic after 6 hours of roasting. The vanadium is extracted from magnetite structure in the sodium vanadate. The consumption of HFO+Diesel at the kiln was reduced over the years due to process improvements and is around 28 kg/t of concentrate.

An off-gas control system with capacity of 13 t/h will collect any dust entrained in the gas from the roaster. To meet local environmental regulations, an electrostatic precipitator is installed to remove such particulates.

The calcined material temperature is reduced in a rotary cooler (FLSmidth) with diameter of 4 m and length of 34 m with rotation rate of 2 rpm achieving 400 °C. The calcined material has sodium vanadate that can be leached in hot water.

## 17.9 Leaching

The calcined material is ground in a ball mill (FLSmidth) to liberate the sodium vanadate contained. The ground calcined material is then leached for one hour and twenty minutes in each of the two agitated tanks installed in series of 120 $m^3$ of capacity.

The leach discharge is sent to thickener (Westech) with 14 m of diameter and then filtered and washed using a vacuum belt filter. The solution containing approximately 110 g/l $V_2O_5$ is pumped to chemical plant for de-silication stage and it is called dirty preg solution.

The solids retained on the filter cloth forms a cake with 10% moisture, 60% Fe, 2.9% $SiO_2$ and 6.8% $TiO_2$ which is stockpiled in a pond at the mine site.

Largo hopes to be able to sell the "cake" from leach stage at some point in the future, notwithstanding that product has a high $TiO_2$ grade and a low Fe grade. It may be possible to blend it with richer magnetite concentrate, which can be found in the region, to create a saleable product.

Desilication is achieved using 398 kg/t of $H_2SO_4$ to reduce the pH from 11 to 8 in three in line agitated tanks, with 111 kg/t of aluminum sulfate and sulfuric acid. Follow the chemical reaction in this process:

$$3Na_2O.2SiO_2 + 2NaOH + Al_2 (SO_4)3 \rightarrow Na_2O.Al_2O_3.6SiO_2 + 3Na_2SO_4 + H_2O$$

After desilication, the solution is pumped to a filter (Andritz, 1200 x 200) with 72 plaques with 16.7 $m^3$/h where the solids are removed and sent to disposal along with the effluent tailings from the evaporator/precipitation. The filtrate, called pregnant leach solution (PLS) or clean pregnant solution (CPL), is pumped to the precipitation stage.

## 17.10 Precipitation

The clean preg solution is pumped (17 $m^3$/h) to a heat exchanger to reduce the temperature lower than 40º. This solution goes to another series of agitated tanks (75 $m^3$), where the vanadium is precipitated as ammonium meta-vanadate (AMV), with the addition of ammonium sulfate after 6 hours of residence.

The reaction is showed below:

$$2NaVO_3 + (NH_4)2SO_4 = 2NH_4VO_3 + Na_2SO_4$$

The precipitate is filtered, washed, and fed to a dryer prior to being calcined to produce $V_2O_5$ powder. The barren solution, which contains sodium and ammonium sulfate salts, is treated to recover ammonium sulfate, which is recycled to precipitation, and sodium sulfate part of which is recycled to the roasting stage.

## 17.11 Evaporation

A crystallization circuit has been designed to recover sodium sulfate salt, ammonium sulfate solution and water from the barren leach liquor.

The barren liquor, which contains ammonium sulfate, sodium sulfate plus small amounts of dissolved AMV and impurities, is first concentrated by evaporation to a predetermined ammonium sulfate concentration.

As this solution approaches a concentration of 250 g/l of $Na_2SO_4$, the salt will start to precipitate. The pulp, with 20% solid, is pumped to a cyclone where the underflow feed a centrifuged. This centrifugal produce salt sulfate solid with 5% moisture. The overflow material (ammonium sulfate) is sent back to precipitation stage and a portion of this slurry is purged to a sealed purged dam as a means of controlling chlorides build up in the circuit.

## 17.12 AMV Drying

Wet AMV (15%) solids are dried in a flash dryer (Drytech) with capacity of 6 t/h of air. The dried AMV is calcined under oxidizing conditions to produce $V_2O_5$ and then melted and cast into flakes for sale.

## 17.13 Ammonia Removal

This process is done in the electric kiln, a Drytech with capacity of 1.5 t/h, at oxidized conditions at temperature of 600ºC.

The exhaust system allows the air pass through the kiln that promote the reaction below:

$$2NH_4VO_3 \rightarrow V_2O_5 + 2NH_3$$

The ammonium divides into N2 and H2, but, because of oxidizing conditions the H2 is converted to H2O before the $V_2O_5$ could be reduced, based on this reaction below:

$$2NH_3 \rightarrow N_2 + 3H_2$$

$$2H_2 + O_2 \rightarrow 2H_2O$$

In the Ammonia Removal reactor, a $V_2O_5$ powder is produced. This powder can be sent to the melting stage (producing $V_2O_5$ fused flakes), or to the screening stage (producing $V_2O_5$ powder).

## 17.14 Melting

The $V_2O_5$ produced at Ammonia Removal reactor is transported to a fusion furnace that melts the $V_2O_5$ powder at 900ºC to produce the final flake product. The fused material is fed in the flocculating table (Drytech) at a capacity of 1.5 t/h.

The flakes are crushed and stored in a silo as a final product. This product is packed in large bags (1 tonne) or drums (250 kg) and shipped.

## 17.15 $V_2O_5$ Screening

The $V_2O_5$ produced at Ammonia Removal reactor is transported to a vibrating screen to remove all the coarse particles. The screen undersize is sent to a package system to be shipped in bags or drums and the oversize returns to the melting stage.

## 17.16 $V_2O_3$ Reactor

After the start-up of $V_2O_3$ plant, the wet AMV from precipitation belt filter is divided into two flows, one is sent to the current flash dryer and other to the $V_2O_3$ reaction plant, which includes a flash dryer and a rotary kiln.

The $V_2O_3$ reaction plant transforms AMV into $V_2O_3$. This process will be done in a kiln with capacity of 942 kg of AMV per hour, at reduced conditions at temperature of 600ºC, which promotes the reaction below:

$$6NH_4VO_3 \rightarrow 3\ V_2O_3 + 9H_2O + 3N_2 + 2H_3$$

Inside the reactor a $V_2O_3$ powder is produced. This powder is packed in large bags (1 tonne) or drums (200 kg) and shipped.

## 17.17 Titanium Pigment Processes

Largo is considering implementing a new process plant in Camaçari industrial complex to produce $TiO_2$ pigment. This process is the well-known $TiO_2$ pigment sulfate process, which uses sulfuric acid to attack the ilmenite in order transforming the oxides into sulfates to solubilize them and produces $TiO_2$ after steps of hydrolysis and calcination. An acid regeneration plant would be implemented to have zero effluent emission of acid solution and reduce sulfuric acid consumption.

The $TiO_2$ production process can be divided into 9 steps: Ore storage; Drying and milling; Digestion and black liquor filtration; $FeSO_4$ crystallization; Hydrolysis; Calcination; Surface treatment; Micronization and Shipment and Acid regeneration. The Figure 17-2 below shows a simplified flow of the pigment production process.

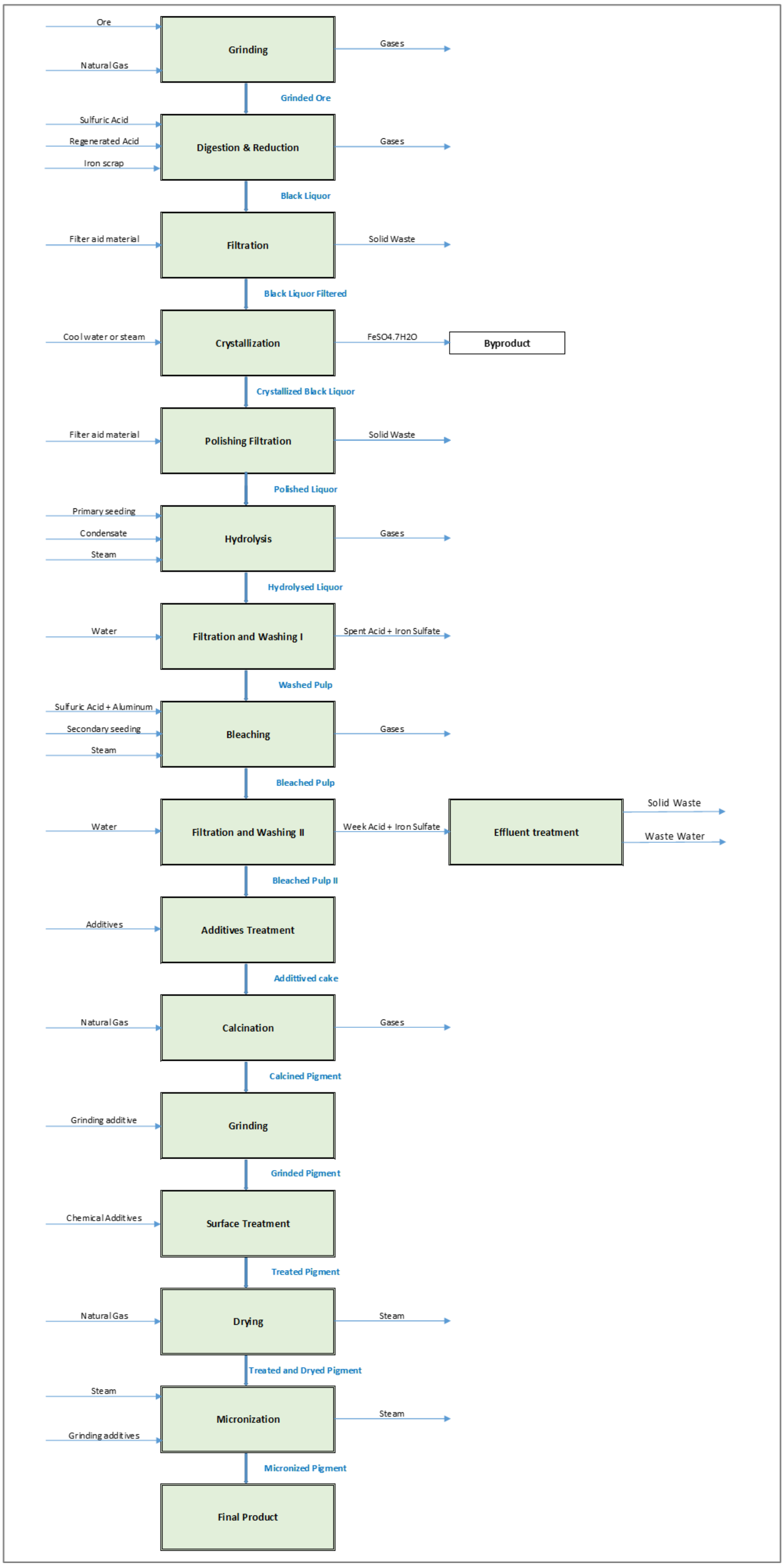



**Figure 17-2 – Simplified Flow of the Pigment Production Process**

Source: GE21, 2024.

#### *17.17.1 Ore Storage*

The proposed Pigment Plant would receive the ilmenite concentrate from Maracás plant and process it in several stages. The ilmenite with more than 45% of $TiO_2$ will be storage in a shed to be fed in the rotary dryer, which will reduce the moisture from 10% to 0%.

#### *17.17.2 Drying and Milling*

The ilmenite will be transported to rotary dryer that will burn natural gas to dry the concentrate and store it in bins. The dried concentrate will be fed a ball or vertical mill, to reduce the particle size distribution. The milled concentrate will be stored in bins.

#### *17.17.3 Digestion and Black Liquor Filtration*

The milled concentrate will be subjected to a digestion step with sulfuric acid. During this reaction, the metal oxides, which are contained in the ore, are transformed to metal sulfates. The resulting solids are mixed with diluted acid to form a slurry, the so-called “black liquor” (Metal-SOx) which is fed to filtration and crystallization. Resulting off-gas is treated before release to atmosphere.

The solids in the raw black liquor, which are unreacted oxides, are separated by filtration and sedimentation. The filtrated black liquor will be pumped into a crystallization system.

#### *17.17.4 $FeSO_4$ Crystallization*

The filtrated black liquor will be pumped into a crystallization system where the containing $FeSO_4$ is removed as copperas ($FeSO_4.7H_2O$) which can be sold or treated to produce iron valuable by-products.

The resulting pure black liquor will feed the hydrolysis unit.

#### *17.17.5 Hydrolysis*

Hydrolysis is the step that aims to orient the crystals towards a given crystallographic form through the addition of a seed. The latter initiates the precipitation of titanium oxide and promotes the efficiency of hydrolysis.

The feed is made by neutralizing titanium sulfate:

$Ti(SO_4)2 + 4\ NaOH \rightarrow TiO_2 + 2\ Na_2SO_4 + 2H_2O$

The feed is introduced into the hydrolyser, then the temperature is increased to about 107 ° C.

$TiOSO_4 + 2H_2O \rightarrow TiO_2 + H_2SO_4$

The titanium oxide that precipitates will have a large specific surface area, so it absorbs water and acid which forms titanium hydroxide. The titanium hydroxide is cooled and filtered. The filtrate, consisting of diluted sulfuric acid, is partially recycled on the attack, in the Digestion area. The titanium hydroxide is filtered and washed to remove unwanted components (e.g. Vanadium (V)).

#### 17.17.6 Calcination

The filtrated titanium hydroxide is sent to the calciner kiln with rutile feeds and rutilization promoter additives. In the calciner, operated at 900-1,000ºC the titanium hydroxide is decomposed in $TiO_2$ rutile and releasing water steam. The resulting off-gas is treated to remove fine particulates ($TiO_2$) and other contaminants before release to atmosphere.

The $TiO_2$ discharged of the calciner is sent to surface treatment area, also called, post treatment unit.

#### 17.17.7 Surface treatment

The base rutile $TiO_2$ from calciner discharge is neutralized, wet milled and fed to the wet surface treatment. In this unit, the pigment surface is improved by precipitation of inorganic hydroxides/oxides on to the pigment surface to reach the desired product quality. The resulting material is washed, filtrated and finally dried.

#### 17.17.8 Micronization and Shipment

Final product is attained by micronization using high-pressure steam. Final pigment product is packed, stored, and sold.

# 18 PROJECT INFRAESTRUCTURE

The infrastructure requirements for the Project are outlined in the following sections and are integrated into the capital cost estimate.

## 18.1 Water Pumping System

Raw water for the Maracás plant is pumped from Rio de Contas, specifically from the lake formed by the Pedra Dam in Porto Alegre village, Maracás, Bahia, Brazil. A 35 km pipeline connects the intake to two concrete tanks, each with a capacity of 1,000 $m^3$, installed on the Maracás site. This volume ensures plant operation for up to 20 hours in case of intake or pipeline failure. The pumping system consists of three pumping stations and two transition stations. Each pumping station includes two pumps – one operational and one standby – to ensure 100% availability. The nominal capacity of the pumping system is 190 $m^3/h$. The average amount of raw water collected in 2023 was 673.2 $m^3$.

## 18.2 Process Water

Water from Rio de Contas is primarily used by the processing plant at the mine. Currently, the plant recovers water from the reclamation circuit and reuses it. The thickeners are sized to accommodate the reclaimed water. A water demineralizing unit and a cooling tower have been installed to treat the water for equipment cooling.

The water from Rio de Contas is stored in two concrete tanks with a total volume of 2,000 $m^3$, providing enough water for 20 hours of plant operation. These tanks also contain a permanent water reserve of 240 $m^3$ for firefighting purposes, complying with Bahia State laws and National Fire Protection Association regulations. The water reserve is sufficient for 2 hours of firefighting.

## 18.3 Water Treatment

Raw water is transferred from the concrete tanks by gravity to the water treatment plant located in the industrial area. The water treatment plant has a nominal capacity of 90 $m^3/h$. The water undergoes clarification, sterilization with sodium hypochlorite, and is stored in a treated water tank with a useful volume of 800 $m^3$.

Treated water is distributed to the following systems:

- 88% for the ore treatment plant.
- 3% for potabilization (human use – not for watering).
- 9% for reverse osmosis and WTP operation.

The ore treatment plant has a steel tank with a designed volume of 360 m³ to store process water, which includes water recovered from thickeners and tailings ponds. Most of the water used in the industrial process is reclaimed from the tailing's ponds to replace inherent process losses (evaporation, moisture retention). If makeup water is required, it will be supplied by a centrifugal pump installed at the treated water tank.

Potable water is storage in a steel tank with a volume of 220 m³, sufficient for 24 hours of consumption.

Half of the treated water tank (400 $m^3$) serves as strategic reserve for firefighting. If additional firefighting is necessary, raw water can be accessed at a rate of 100 $m^3$/h, and the entire reserve of 2,000 $m^3$ of raw water can be utilized, or more if the pipeline is operational.

## 18.4 Sewage Treatment

The site features a compact sewage treatment plant with a nominal capacity of 80 $m^3$/day. The treated effluent is directed to a waterproof reservoir, witch also receives rainwater from the ore treatment plant. All water collected is pumped into the leaching process from the calcined tailings piles, thus reintegrating into the process. In total, 1,544 $m^3$/month are treated.

## 18.5 Fuel and Lubricant Storage and Distribution

Diesel oil is delivered to the unit by tanker trucks and stored in two tanks, each with a capacity of 30,000 liters. Mobile vehicles and convoy trucks are refueled to supply equipment at the mining fronts and auxiliary equipment at the processing plant.

To supply the kiln, fuel oil OCP200 and/or OC2B are stored in a tank with a capacity of 100,000 liters. From there, the fuel is transferred to an auxiliary tank that feeds the kiln.

Lubricants are delivered to the site in drums, stored in a safe area compliant with state regulations, and distributed through convoy trucks and/or distribution lines at maintenance workshops.

## 18.6 Compressed Air

Four screw compressors provide high-pressure air to instruments, the general plant, and tanks. A refrigerant air dryer and filters ensure the instrument air's quality. The compressors are appropriately housed in a compressor building.

### *18.6.1 Air Emissions and Air Quality Monitoring*

The air monitoring system provides crucial information for developing air emissions management strategies. The Project has five air quality monitoring stations installed, operating monthly, 24 hours a day, monitoring SOx, NOx, $NH_3$, V, $V_2O_5$, particulate matter, and PM-10 levels. Alongside these air quality stations, monitoring of SOx, NOx, $NH_3$, V, $V_2O_5$ and particulate matter in the chimneys in operation is conducted to ensure emissions remain within the limits stipulated by current environmental legislation.

## 18.7 Heating

A comprehensive system in place, comprising two fire tube boilers with a capacity of 5,200 kg/h, operating at a gauge pressure of 10 kg/cm² and temperature of 180ºC (producing saturated steam). The burners are fueled by fuel oil, with provision for fuel oil storage tank, day tank, heat exchangers for heating to heat the fuel oil, and all necessary safety devices to ensure reliable operation.

## 18.8 Power Supply

The electrical power requirements for the plant, including the beneficiation, hydrometallurgy, and installed utilities, are approximately 12 MVA. To fulfill this demand, power is supplied at 138 kV, 60 Hz, by an 85 km long transmission line from Coelba's Ibicoara regional Substation. A step-down substation of 13.8 kV is installed at the plant site, with two power transformers of 13.8 kV 15/15 MVA each.

The 13.8 kV power distribution system for the plant is supplied by means of insulated cables or conventional aerial cable system. Substations are designed to meet the requirements of the concentrator, hydrometallurgy plant, crushing and supporting areas. Power required at the water pumping intake at Rio de Contas is supplied by a 13.8 kV substation.

All electrical distribution is achieved via cable trays using armored, interlocked PVC-coated cables. The process and plant site ancillary facilities switchgear and electrical equipment are installed in modular electrical rooms adjacent to, or within, their respective buildings.

The total installed power is 21,308 CV (approximately 12 MVA). After the Ilmenite Plant installation, the installed power will increase to 28,000 CV. Power demands are expected to almost triple by 2033 after the expansion. Table 18-1below shows a summary of these scenarios.

**Table 18-1 – List of Equipment**

| Unit | Equipment | | Power (CV) | | |
|---|---|---|---|---|---|
| | | | Current | With Flotation | After 2033 |
| **Crushing** | **Main equipment** | Primary crusher line 1 | 150 | 150 | 600 |
| | | Primary crusher line 2 | 150 | 150 | 600 |
| | | Secondary crusher line 1 | 350 | 350 | 1,400 |
| | | Secondary crusher line 2 | 300 | 300 | 1,200 |
| | | Tertiary crusher line 1 | 400 | 400 | 1,600 |
| | **Other equipment** | | 778 | 778 | 3,113 |
| | **Crushing total** | | 2,128 | 2,128 | 8,513 |
| **Milling** | **Main equipment** | Primary Mill | 3,200 | 3,200 | 9,600 |
| | | Secondary Mill | 3,200 | 3,200 | 9,600 |
| | | Vaccum pump A | 250 | 250 | 750 |
| | | Vaccum pump B | 300 | 300 | 900 |
| | | Hydrocyclone pump A of line 1 | 400 | 400 | 1,200 |
| | | Hydrocyclone pump A of line 1 | 400 | 400 | 1,200 |
| | | Hydrocyclone pump B of line 2 | 350 | 350 | 1,050 |
| | | Hydrocyclone pump B of line 2 | 350 | 350 | 1,050 |
| | **Other equipment** | | 1,763 | 1,763 | 5,288 |
| | **Milling total** | | 10,213 | 10,213 | 30,638 |
| **Flotation** | **Main equipment** | Pump A of desliming 001 | 0 | 550 | 1,650 |
| | | Pump B of desliming 001 | 0 | 550 | 1,650 |
| | | Pump A of desliming 101 | 0 | 550 | 1,650 |
| | | Pump B of desliming 101 | 0 | 550 | 1,650 |
| | | Pump A of desliming 002 | 0 | 261 | 783 |

| Unit | Equipment | | Power (CV) | | |
|---|---|---|---|---|---|
| | | | Current | With Flotation | After 2033 |
| | | Pump B of desliming 002 | 0 | 261 | 783 |
| | | Pump A of desliming 003 | 0 | 212 | 636 |
| | | Pump B of desliming 003 | 0 | 212 | 636 |
| | **Other equipment** | | 0 | 4,017 | 12,051 |
| | **Flotation total** | | 0 | 7,163 | 21,489 |
| **Roasting** | **Main equipment** | Main Engine 1 | 272 | 272 | 544 |
| | | Main Engine 2 | 272 | 272 | 544 |
| | | Main Engine 3 | 408 | 408 | 816 |
| | | Main Engine 4 | 408 | 408 | 816 |
| | **Other equipment** | | 985 | 985 | 1,970 |
| | **Roasting total** | | 2,344 | 2,344 | 4,689 |
| **Leaching** | **Main equipment** | Vaccum pump of 1° filter | 350 | 350 | 700 |
| | | Vaccum pump of 3° filter | 400 | 400 | 800 |
| | | Regriding mill | 473 | 473 | 945 |
| | **Other equipment** | | 1,159 | 1,159 | 2,318 |
| | **Liaching total** | | 2,382 | 2,382 | 4,763 |
| **Chemical plant** | **Main equipment** | Engine 1 of evaporation MVR | 581 | 581 | 1,161 |
| | | Engine 2 of evaporation MVR | 581 | 581 | 1,161 |
| | | MVR of preevaporation | 178 | 178 | 356 |
| | **Other equipment** | | 2,199 | 2,199 | 4,398 |
| | **Chemical plant total** | | 3,538 | 3,538 | 7,076 |
| **Utilities and laboratory** | | | 703 | 703 | 1,406 |
| **Total plant** | | | **21,308** | **28,471** | **78,575** |

Source: Largo, 2024.

## 18.9 Buildings

The construction and architecture of the Maracás plant buildings considers the climatic characteristics, environmental comfort, ergonomics, durability, standards and codes suitable for a project of this size.

All buildings are constructed with pillars of reinforced concrete, beams, and slabs with concrete block masonry walls with a layer of mortar and paint finishing, ceramic or vinyl flooring and metallic cover. The buildings of Maracás plant are:

- Main entrance
- Administrative building
- Refectory
- Living area and changing room
- Workshops
- Electrical rooms
- Warehouses
- Laboratory and control room

The main entrance, located in east of the plant, is a one-floor masonry building, that contains the nursery, equipped for “first aid”, the entrance gate, the waiting room, and the room for the property security team.

The administrative building is made of masonry and consists of one floor and contains specific areas for Mining Engineering, Geology, Administrative, Industrial Maintenance, Occupational Safety, Environment, Production Process Control and Operational Directorate.

A general layout of the of the plant facility and office buildings, etc. is shown in Figure 18-1.

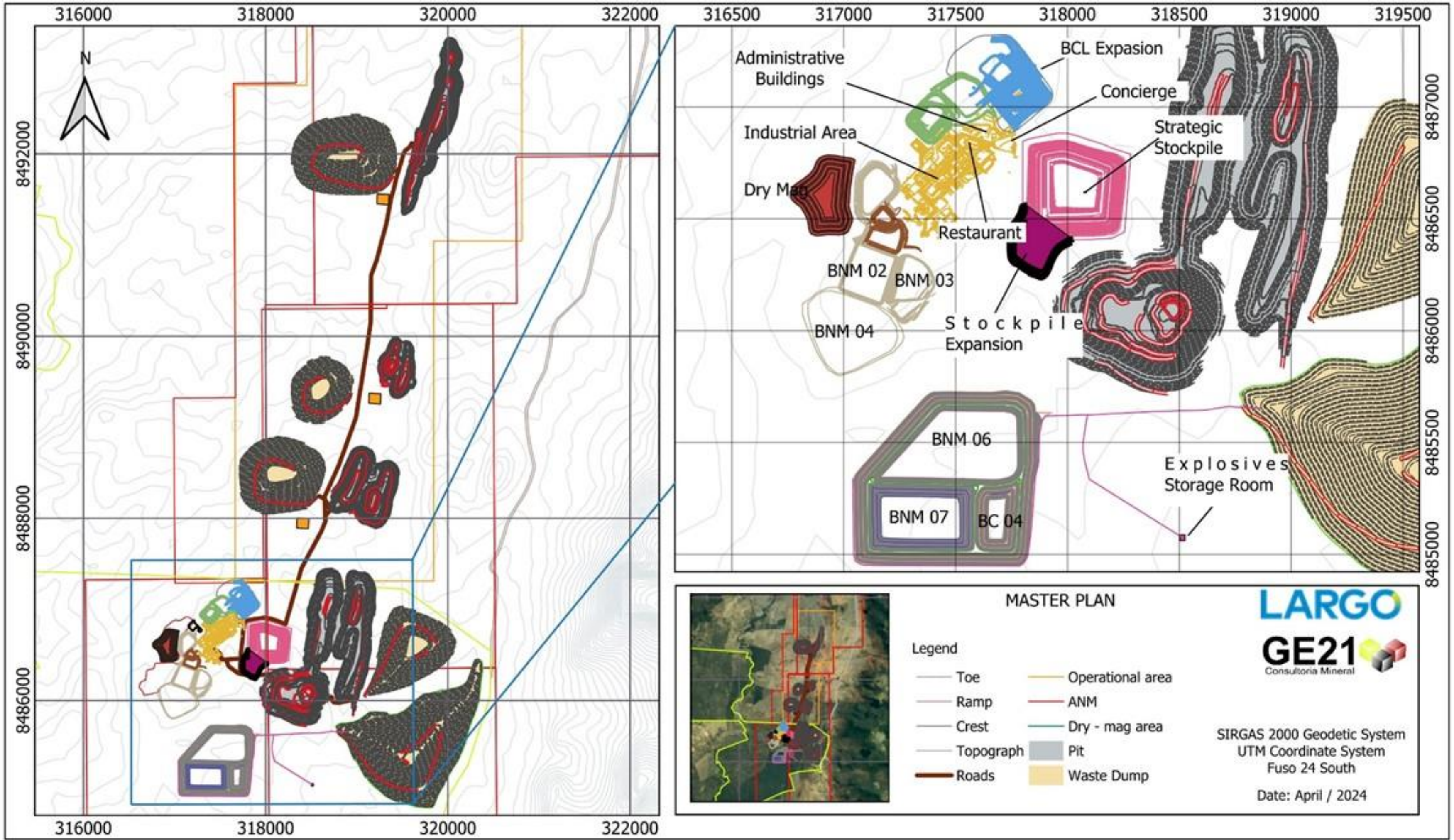



**Figure 18-1 – List of Equipment**

Source: GE21, 2024.

## 18.10 Assay Laboratory

A fully equipped assay laboratory is located at the plant site. The laboratory delivers daily analysis of mining and process samples. The laboratory is a single storey structure located next to the utility area in the plant area.

## 18.11 Miscellaneous Buildings

A main gatehouse is located at the entrance of the plant site. This building is a single-story cinder block structure. A first aid post, equipped for “first response”, is located inside the administration building.

## 18.12 Explosives Magazine

The Project includes one storage warehouse divided into two areas: one for explosives and accessories, and the other for ammonium nitrate emulsion. Both occupy an area of 6,980 m² with the following storage capacities:

- Cartridge Emulsion – 15,000 kg
- Starter Accessories – 60,000 units
- Electronic starters – 25,600 units
- Detonating cord – 75,000 m
- Base Emulsion – 120,000 kg
- Booster (detonator) – 24,000 units

Safe distances, based on R-105 guidelines, dictate that the distance between the explosive’s magazine and the emulsion storage area, as well as between the accessory’s magazine and the emulsion storage area, must be 150 m in both cases. Access to the storage area, for stock management and loading of products used in mine operations, is facilitated by a dedicated access road.

## 18.13 Communications

The Maracás facility is connected to the public communication system through telephone and internet services. Internal communication is conducted by portable and fixed short-frequency radios in all vehicles and equipment. They are also available for plant operators, industrial maintenance, mine operation, occupational safety, property security, environment, and occupational medicine.

A wireless network is in operation for use by the mine dispatcher and onboard fleet management system devices.

## 18.14 Roads

Access to the area, departing from Salvador, capital of Bahia state in Brazil, is via the BR 324 road to Feira de Santana, a distance of 110 km, then by the BR 116 to the junction 20 km after the Municipality of Milagres, a distance of 140 km. From the turn off, a driver follows BA 026 highway to Maracás and past the village of Pé-de-Serra, a distance of 125 km, from this point the driver follows a gravel road for 20.0 km to the mine facility. The total distance is 415 km.

The on-site roads, that provide access for people, vehicles and equipment in the mine's operational area are constructed in accordance the standards established in the NRM, Mining Regulatory Standards, and are included in the mine's internal traffic plan. As for access between industrial and administrative areas, they are paved and signposted in accordance with internal safety regulations.

Some studies have been developed for improvements to the existing public county road, which has a length of about 42 km, between the BA-026 crossing the Project area and the village of Porto Alegre. Largo has been engaged in discussions with the Bahia State transportation agency which is considering paving the existing dirt road in partnership with Largo. Negotiations on this issue have not been concluded. However, the current road is being upgraded with minor improvements needed to ensure timely and efficient transportation of goods, supplies and workers.

## 18.15 Tailings Facility

Three types of tailings are produced and stored in the following facilities:

- Leached Calcine Tailings Dump (potentially saleable as an iron ore by product)
- Chloride Purge Tailings Pond
- Non-Magnetic Tailings Dump (represents a Resource of ilmenite)

The leached calcine tailings are constructed using a “dry stacking” impounding approach and the Chloride Purge and Non-Magnetic facilities are constructed as ponds.

The same tailings management strategies will be used for this production scenario to accommodate required tailings storage for life of the Project, including production from the Campbell Pit and all satellite pits Novo Amparo Norte Mine (NAN) and Gulçari A Norte (GAN).

### *18.15.1 Tailings Disposal Ponds*

The tailings generated by the beneficiation process and the vanadium ore processing plant derive from the following process areas:

- Leached calcine from the processing of kiln discharge.
- Filter cake from the de-silication process.
- Chloride control purge from the evaporation circuit.
- Primary non-magnetic tailings from magnetic separation.

The Leached Calcine Tailings are discharged into the Leached Calcine Tailings Stack. The stack is constructed to meet future needs, the tailings from the leach operation is an iron ore concentrate and the Company is entertaining selling it as a by-product once material impounded is suitable from the environmental perspective. Currently the stacked material is being rinsed with water to recover soluble vanadium back to the processing plant.

The chloride control purge tailings from the evaporation circuit are deposited in the Chloride Purge Tailing Pond together with the cake from the de-silication plant. The original Chloride Purge Tailings Pond is currently full, and a new tailings pond has been constructed and fully licensed and is in operation.

The Non-Magnetic Tailings Ponds (BNM) have been designed to receive the primary non-magnetic tailings originated from the magnetic separation after thickening.

All ponds have similar structures to contain the tailings. These structures are formed by rock-fill structure and sealed by compacted clay and liners on the bottom and side walls. The construction method can be summarized by:

- The deposits have high-width dams, built with waste material from the pit. Due to the availability of space and operational conveniences, these dams constitute a “controlled waste dump”.
- The disposal of the tailings is conducted in waterproof tailings facilities.
- In accordance with Standard NBR 10.157/87, tailings facility must be a minimum distance of 200.0 m from the watercourses, and the bottom must be at least 1.5 m from the maximum level of the water table.
- The construction materials come from mining operations, and all operating procedures follow the same construction technique adopted for deposits already implemented.
- The waterproofing system is specific for each type of tailings stored. the definition of the type of waterproofing material is based on the physical and chemical characteristics of the tailings.
- If any leakage occurs, the leachate is collected in the detection channels and pumped back into the respective deposit, thus preventing any possibility of contamination of the land.
- The release of the tailings to the Non-Magnetic and Chloride tailings deposits is done through hydraulic pumping, with the excess supernatant being returned to the processing plant. the calcined tailings are placed in piles.
- Due to the characteristics of the tailings, the basins are built to be watertight and with no prediction of spillage of deposited liquid material, with the surface defined for a free edge of 1 meter.

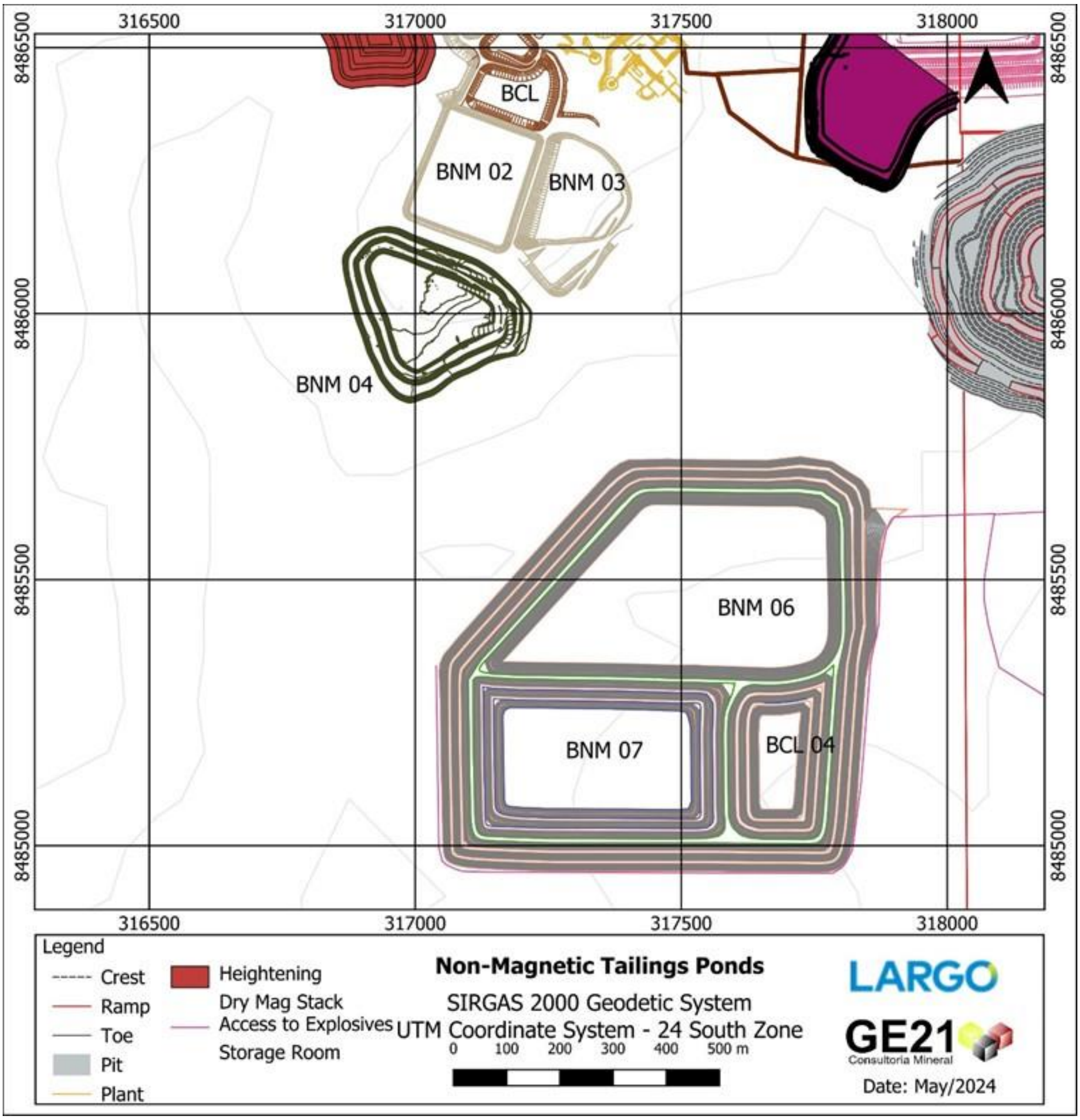



**Figure 18-2 – Non-magnetic Tailing Ponds**

Source: GE21, 2024.

## 18.16 Waste Management

Solid waste generated from the mine, and plant site, including ancillary buildings, is primarily domestic and industrial non-hazardous waste. A comprehensive Waste Management Plan is in place at the mine site. Solid waste includes:

- rejects from construction (scrap wood, metal, concrete, etc.);
- rejects from the mine (empty drums, packing materials, etc.);
- general domestic garbage from the offices and ancillary buildings (paper, refuse, food, etc.).

Construction debris, inert waste and used tires are placed in designated cells and proper disposal procedures of the material is in place. Domestic and industrial solid waste from the mine plant facilities is recycled and re-used in a proper manner, where applicable.

The actions related to the management of solid waste generated in the Project, covering aspects related to the characterization, classification, segregation, handling, packaging, identification, temporary storage, transport, treatment and destination of the waste are:

- Description: The solid waste generated is identified at the generation points, being classified in accordance with ABNT Standard nº 10004:2004:
  - Class I Waste: Hazardous – They are those that are dangerous due to their physical, chemical or contagious infectious properties, which may present risks to public health and the environment.
  - Class II-A Waste: Noninert – They are those that do not fit the classification of Class I or Class II B waste. Class II A – Non-inert waste may have properties such as: biodegradability, combustibility or solubility in water. A residue is classified as Class II A – Non-Inert, when one or more parameters obtained for the Solubilized extract are above the maximum values allowed by Annex G of NBR 10004:2004.
  - Class II-B Waste: Inert – They are those that submitted to the solubilization test, do not have any of its constituents solubilized at concentrations above the drinking water standards, except for appearance, color, hardness, turbidity and flavor, as per annex G of the ABNT NBR 10.004:2004 standard.
- Segregation: the segregation of waste is done at the time of generation, considering its class to preserve its characteristics and enable its eventual reuse or recycling.
- Handling: to carry out the handling of solid waste during the complete management, it is necessary to use the following Personal Protective Equipment – PPEs: uniform (pants and long-sleeved shirt made of denim fabric); gloves; safety glasses; helmet; hearing protection; breath protection; leather boots; and, when necessary, protective clothing. In addition to the use of PPE to carry out activities in the operational area, the issuance of control and prevention documents is required, such as the Work Permit (PT) and Preliminary Task Analysis (APT).
- Packaging and Temporary Storage: hazardous waste (Class I), inert and non-inert (Class II-A and II-B) are temporarily stored in the Waste Treatment Center (CTR) and organized in their respective bays.
- External transport: the collection of segregated waste is done according to its generation, and the collection takes place after identification and packaging by means of a specific vehicle. Waste destined for recyclers or landfill disposal can be sent directly from the generating source to the final destination or temporary storage. All collections of waste from the enterprise's health services are formally registered in a document titled **Collection Report and Cargo Manifest**.

- Environmentally Appropriate Destination / Final Disposal: the choice of destination and/or final disposal of solid waste generated in the Project is based on treatment technologies that consider the least environmental impact, in accordance with the applicable environmental legislation in force.

## 18.17 Future Developments

The strategy for the Maracás plant's future is focused on increasing the amount of vanadium and titanium resources from the Novo Amparo, Gulçari A Norte, São José and Novo Amparo Oeste deposits. Additionally, the development of a Pigment Plant in Camaçari City is being considered. These developments will require specific infrastructure, which will be described in this section.

### *18.17.1 Novo Amparo Norte Mine (NAN)*

Novo Amparo Norte will be mined using open-pit methods and is estimated to occupy an area of 52.6 hectares. The pit is projected to reach a depth of 280 m below surface. Service roads will be established to provide access for personnel, equipment, vehicles, and production flow to the main mine Complex. A main road connecting the NAN mine to the main mine complex will also be constructed, considering the location of the GAN deposit within the overall Project. This road is expected to extend for 6.5 km from the main mine complex and will occupy 36 hectares.

A crushing plant and a dry magnetic separation circuit will be installed near the pit to reduce the mass transported to the milling plant, which will be located at the current Maracás plant site. Only the pre-concentrate will be transported by truck to the milling plant.

The area designated for crushers (primary, secondary, and tertiary), screening (primary and secondary), conveyor belt system (for crushers, sieves, and dry magnetic separator), and dry magnetic separator installation will occupy approximately 17.5 hectares, with the ore pad to feed the crushers covering approximately 8.6 hectares. The pre-concentrated ore pile area will be 8.5 hectares, and the dry sorting tailings pile areas will occupy 30.5 hectares.

Low-grade ore will be stockpiled for later use to feed the plant. The low-grade ore stockpile area will cover 11.0 hectares. Waste from NAN will be stacked in a stockpile area, occupying a total area of 100.0 hectares.

To support the operation, auxiliary infrastructure will be constructed, including buildings with rooms, bathrooms, a small workshop, and a substation to power the crushing system (crushers, sieves, dry magnetic separator), and other facilities mentioned.

### 18.17.2 Gulçari A Norte Mine

Gulçari A Norte (GAN) will be mined using open pit methods and is estimated to occupy an area of 82.2 hectares, reaching a vertical depth of 230.0 m below the surface. Service roads will be established to provide access for personnel, equipment, vehicles, and production flow to the Complex. This road will connect GAN to the current mine complex and will extend for 3.5 km. Due to the proximity of the GAN deposit to the Campbell pit and existing mine infrastructure, ore from GAN will be processed at the existing infrastructure.

### 18.17.3 São José Mine

São José (SJO) will also be mined using open pit methods, covering an estimated area of 46.2 hectares and reaching a vertical depth of 145 m below surface. The road from SJO will connect to the current mine complex (in GAN) and extend for 2.1 kilometers. All material from SJO will be processed at the existing infrastructure in Campbell. The São José deposit will have a pre-concentration plant.

### 18.17.4 Novo Amparo Oeste Mine

Novo Amparo Oeste (NAO) will be mined using open pit methods, covering an estimated area of 21.1 hectares and reaching a vertical depth of 200 m below surface. The road from NAO will connect to the current mine complex (in GAN) and extend for 3.3 kilometers. All material from NAO will be processed at the existing infrastructure in Campbell. The Novo Amparo Oeste deposit will also have a pre-concentration plant.

### 18.17.5 $TiO_2$ Pigment Plant

The proposed $TiO_2$ Pigment Plant (Pigment Plant) would be constructed in the industrial area of Camaçari city, in Bahia state. The Pigment Plant would be expected to produce 100,000 tonnes of $TiO_2$ pigment per year in the final phase. The infrastructure would include a complete pigment production plant with administrative buildings, ilmenite and pigment sheds, warehouses, and utility facilities. Figure 18-3 presents the layout of the proposed Pigment Plant.

**Figure 18-3 – Preliminary 3D Model of Largo's Camaçari Plant**

Source: Largo, 2024.

The Camaçari Industrial Complex was selected as the site for the proposed Pigment Plant due to various logistical, environmental, and synergistic advantages. This location would minimize the environmental impact of plant operations and offer synergies with other operators, such as the availability of ammonia gas at the industrial complex, which is required to produce ammonium sulfate as co-product of the proposed Pigment Plant.

### *18.17.6 Other Future Infrastructure*

To sustain the production process in the mining area, it will be necessary to expand and/or construct new structures, including additional stockpiles, waste piles, and tailing impoundment. These structures are depicted in Figure 18-4 below.

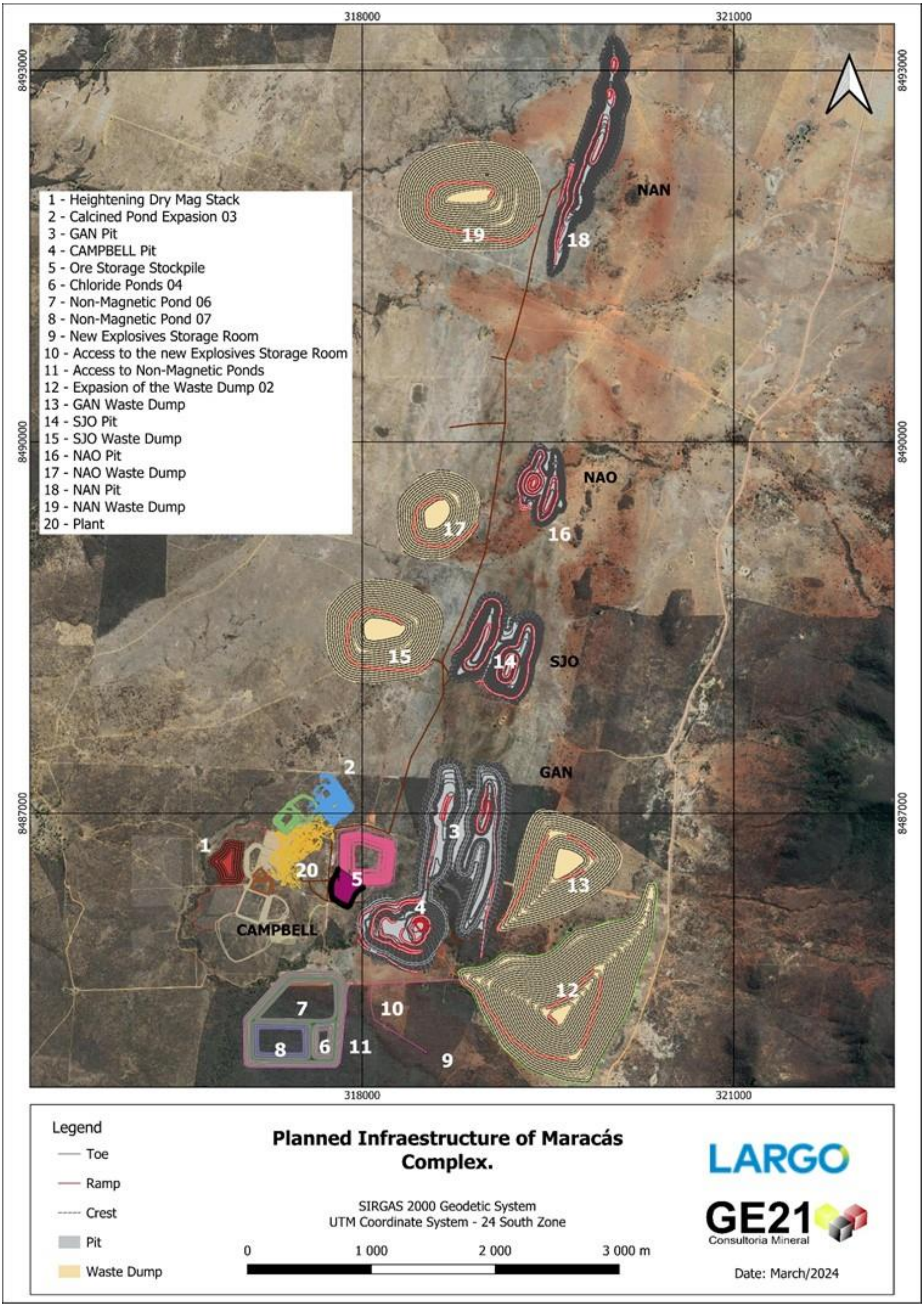



**Figure 18-4 – Planned Infrastructure of Maracás Complex**

Source: GE21, 2024.

# 19 MARKET STUDIES AND CONTRACTS

## 19.1 Information Sources

Largo subscribes to several associations, publications and industry related websites, as listed below:

- Associate Member of Vanitec (www.vanitec.org):

A global organization which encourages and assists technical research and education about vanadium and its world-wide application in the steel, titanium and chemical industries. Vanitec convenes international representatives of companies involved in the mining, processing, manufacturing, research and use of vanadium and vanadium-containing products.

An industry accepted source for metal prices, news, conferences and information for nonferrous metals, rare earths and ferroalloys focused on the Chinese market.

- Project Blue Information Services – Outlook to 2030, 19th ed., published in 2021:

The report includes data and information relating to: Vanadium sources and resources, global production and consumption, supply demand outlook, historical and price forecasts, a review of production by country, uses of vanadium and an overview of the international market.

Project Blue is considered a leader in independent, international metals and minerals research, producing 75 market reports, data books and newsletters designed for the purposes of formulating company strategies, following industry trends, competitor analysis, and gaining a complete overview of a single industry.

## 19.2 Vanadium Market Overview

The vanadium market is characterized by its relative opacity and modest size compared to other commodities. Supply is notably constrained, concentrated primarily in four countries: China, Russia, Brazil, and South Africa. In 2023, the total global production of vanadium reached approximately 127,000 tonnes of pure vanadium, while global consumption was about 118,000 tonnes. This supply-demand dynamic illustrates a relatively balanced market with a slight production surplus for 2023, which continues to persist in 2024.

China dominates the global vanadium market, accounting for around 83,000 tonnes, or approximately 65% of total world production. Russia is also a significant player, contributing an estimated 15-20% of global output. The concentration of production in a few countries poses potential vulnerabilities in the supply chain, especially considering geopolitical and environmental factors.

Vanadium is produced through three primary methods: primary production, secondary production, and co-production. Primary production, which constitutes approximately 17% of global supply, involves extracting vanadium directly from mineral deposits. This method is predominantly used in Brazil, China, and South Africa. In China, the process of primary production involves the exploitation of a unique ore type known as “coalstone” which requires roasting, water leaching, and large quantities of caustic gases. This method has a relatively low recovery rate of around 45% and poses significant environmental challenges.

Secondary production, accounting for approximately 13% of global supply, is derived from recycling spent catalysts, residues from alumina or uranium production, or ash from burning vanadium-bearing coal or petroleum. The United States is the largest producer in this category, with significant contributions from South Korea and other Asian countries.

Co-production remains the most dominant method, contributing to approximately 70% of global vanadium supply. This process involves the recovery of vanadium as a by-product during the production of steel from vanadiferous titanomagnetite (VTM) ore, a type of iron ore. Vanadium in this process is initially separated into slag, which is then further processed to produce vanadium products. Co-production primarily takes place in China and Russia.

Given the concentrated nature of supply and the variety of production methods, the vanadium market remains susceptible to fluctuations driven by both geopolitical events and technological advancements in extraction and recycling processes. The Figure 19-1 below shows the Vanadium production by type from 2013 to 2022.

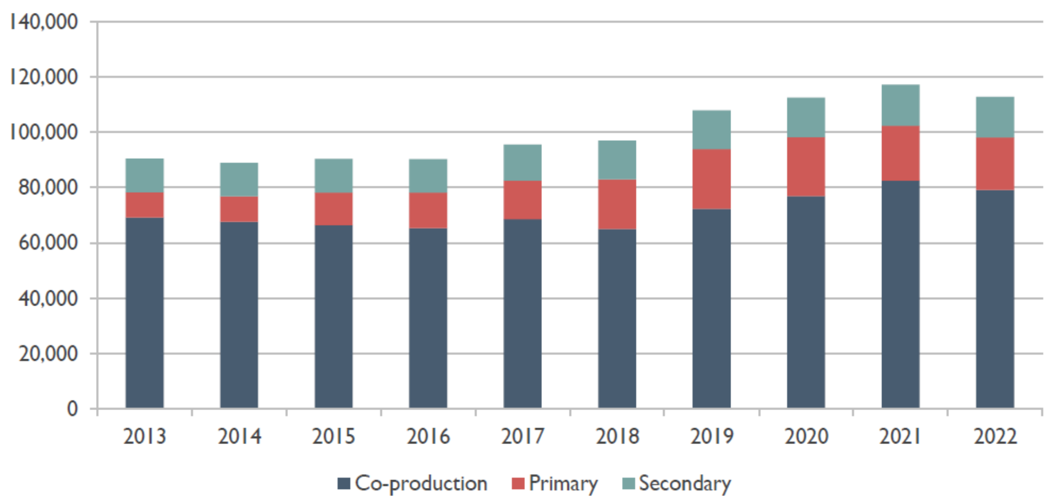



**Figure 19-1 – Vanadium Production by Type**

Source: Project Blue, 2021.

### *19.2.1 Vanadium Demand*

Vanadium demand is primarily driven by four key end-use sectors: steel production (especially rebar), defense and aerospace alloys, chemical catalysts, and vanadium-based energy storage systems. The majority of vanadium produced globally, approximately 83.2% according to Vanitec (Q1, 2024), is consumed in the steel industry. In this sector, vanadium is typically used in the form of ferrovanadium – vanadium and iron alloy – made from standard-grade vanadium (95-96% $V_2O_5$). High-purity vanadium (minimum 99% $V_2O_5$), which has more limited global supply with major producers in Brazil and South Africa, caters to more specialized applications such as aerospace alloys, catalysts, ceramics, dyes, electronics, and batteries.

The steel industry's demand for vanadium is expected to grow further, particularly in light of China's enforcement of mandatory rebar standards requiring higher vanadium content. This is expected to increase vanadium demand by approximately 20% annually (Vanitec). This regulatory shift is significant, given that China is a leading consumer and producer of steel, impacting global vanadium dynamics substantially.

In addition to its traditional uses, vanadium is increasingly critical to the renewable energy sector, specifically in vanadium redox flow batteries (VRFB). These batteries offer energy storage solutions, ideal for supporting the global shift towards renewable energy. The demand for vanadium in VRFBs has experienced a substantial rise over recent years. Global consumption from the energy storage sector surged from approximately 1,800 tonnes in 2020 to around 8,000 tonnes in 2023, marking an increase of nearly 350%. This growth is particularly notable in China, which has rapidly advanced VRFB technology, now holding over 85% of the world's installed VRFB capacity with a cumulative installed capacity reaching 800 MWh as of 2023. Figure 19-2 shows the VRFS Installations and demand for the next years.

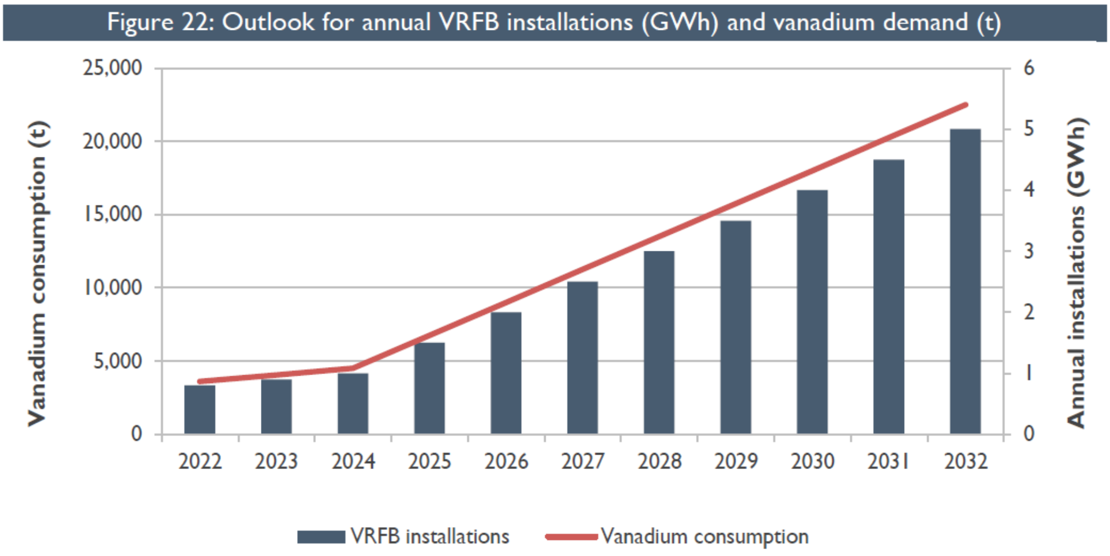



**Figure 19-2 – Outlook for Annual VRFB Installations (GWh) and Vanadium Demand (t)**

Source: Project Blue, 2022.

The strategic importance of vanadium is further underscored by its designation as a critical mineral in several key jurisdictions, including the United States, the European Union, Canada, Australia, Japan, and Korea. This status reflects vanadium's essential role in both aerospace applications – such as the Ti-6Al-4V titanium alloy used for high-strength, high-temperature components in aero-engines and airframes – and in supporting the energy transition through its use in energy storage.

Looking forward, the demand for vanadium is projected to rise significantly. According to the International Monetary Fund (IMF), achieving net-zero emissions by 2050 could necessitate a more than 200% increase in vanadium production. Similarly, the International Energy Agency (IEA) anticipates a 500% surge in vanadium demand by 2050 under a net-zero scenario, driven primarily by its role in energy storage and steel alloying as presented in Figure 19-3. However, with over 80% of global supply concentrated in China, South Africa, and Russia, the vanadium market remains vulnerable to geopolitical and regulatory risks that could constrain supply and elevate prices, as highlighted by the World Bank.

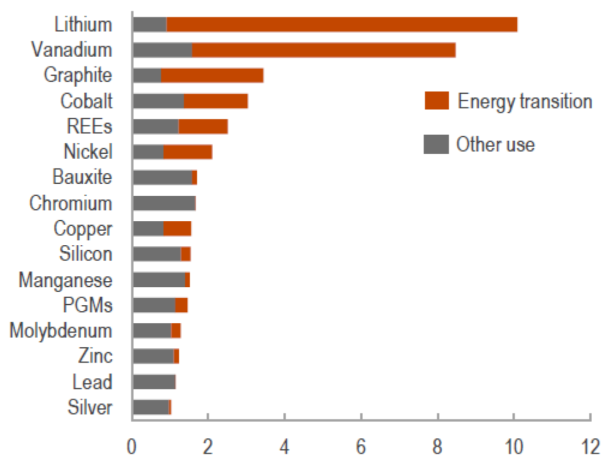



**Figure 19-3 – Demand under Net Zero Emissions Scenario**

Source: International Energy Agency (IEA) World Energy Outlook, 2023; IMF staff calculations.

The current annual production of vanadium, approximately 118,000 metric tonnes, falls short of the projected future demand of 300,000 metric tonnes by 2050 as presented in Figure 19-4 below. This discrepancy underscores the urgent need for investment in new mining projects, which typically require 10-15 years to develop, to meet the burgeoning demand associated with the global energy transition.

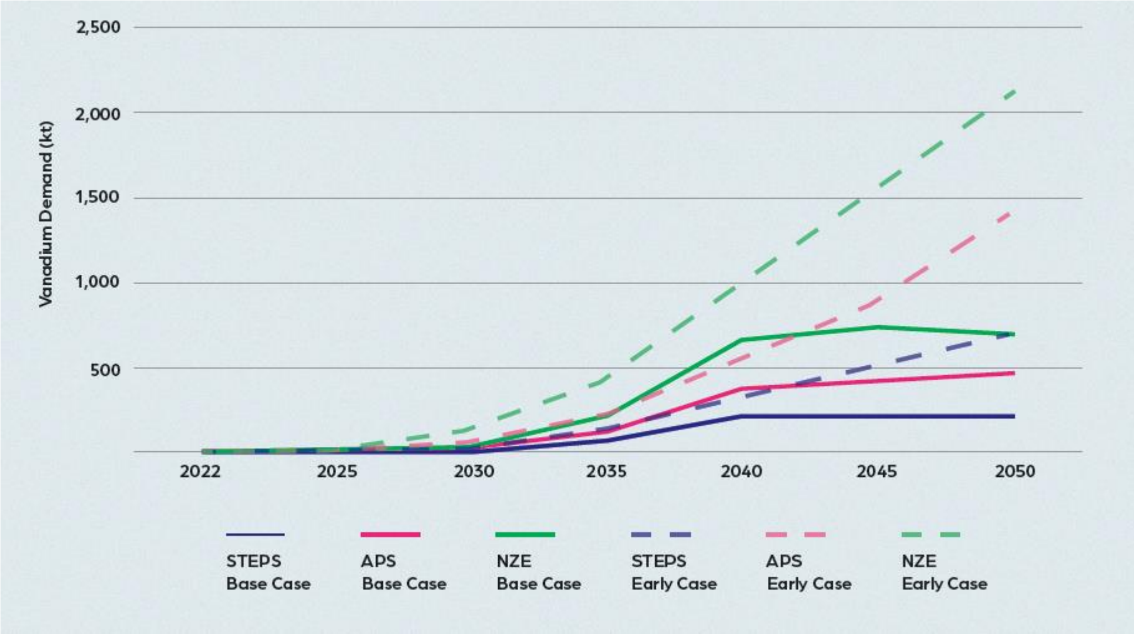



**Figure 19-4 – Projected Demand for Vanadium**

Source: IEA Critical Mineral Data Explorer, 2023.

### *19.2.2 Vanadium Prices*

Ferrovanadium and vanadium pentoxide are the principal commercially traded vanadium products. Neither these nor any other vanadium products are traded by means of an exchange or terminal market such as the London Metal Exchange or COMEX Division of the New York Mercantile Exchange (NYMEX).

Transactions are usually negotiated under 12-month long-term contracts between producers and consumers or trading houses during the fall season. Prices are quoted in terms of US dollars per pound or per kilogram gross weight of contained vanadium pentoxide or vanadium units. The spot market is where smaller consumers who didn't enter a long-term contract source their units. These transactions are recorded by the indexes and affect the pricing of the long-term contracts which are index formula-based. The sharp fluctuations in pricing are mainly driven by spot market over/under supply and traders take advantage of these price curves to maximize profits while producers would prefer a more stable and less volatile market. The large number of units coming out of China in 2023 has caused an oversupplied market in Europe and Asia contributing to the price decline.

The below graph (Figure 19-5) illustrates the trend in ferrovanadium prices over the past 20 years.

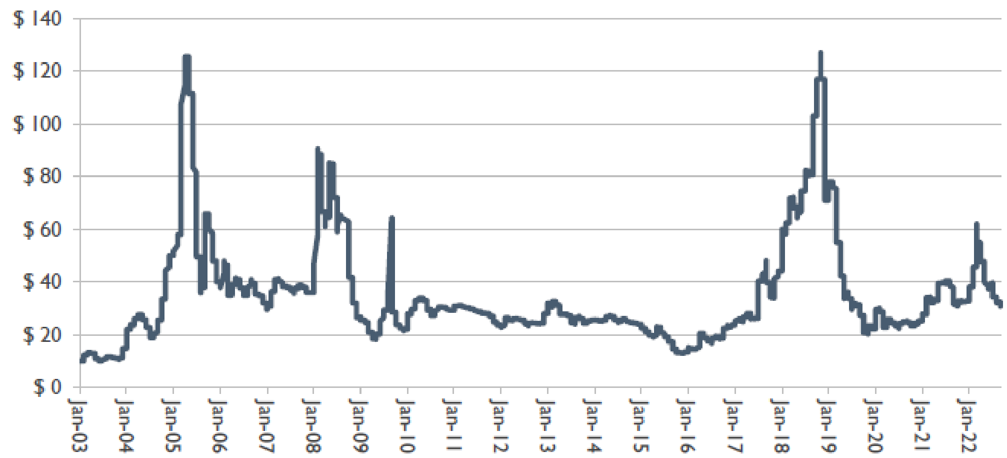



**Figure 19-5 – Ferrovanadium Price Trend – Europe (US$/kg $V_2O_5$)**

Source: Project Blue, 2024.

Over the past 20 years, real prices peaked at US$29.15/lb $V_2O_5$, in 2018, and hit a low of US$2.25 /lb $V_2O_5$, in 2015. In a 2022 report commissioned by Largo, Project Blue predicts that $V_2O_5$ prices will remain elevated in the coming years due to favorable supply and demand dynamics as shown in Figure 19-6 below.

| Table 1: Forecast vanadium pentoxide prices (Europe) (US$/lb) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
| Real | 7.50 | 8.20 | 8.15 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 | 8.09 |
| Nominal | 7.68 | 8.59 | 8.72 | 8.84 | 9.02 | 9.21 | 9.39 | 9.58 | 9.78 | 9.98 |

**Figure 19-6 – Forecast Vanadium Pentoxide Prices (Europe) (US$/lb)**

Source: Project Blue, 2022.

### *19.2.3 Ilmenite Prices*

Ilmenite is a titanium-iron oxide mineral. From a commercial perspective, ilmenite is the main source of titanium dioxide, used in paints, printing inks, fabrics, plastics, paper, sunscreen, food and cosmetics.

Transactions are usually negotiated under 3 to 12-month contracts between producers and consumers or trading houses. Prices are quoted in terms of US dollars per tonne. Stable pricing from the current ilmenite 46% equivalent price in China for 2024 and back calculated to a FOB Brazil equivalent using US$70/mt freight and 13% Chinese. The price used for ilmenite concentrate is US$213.00/t concentrate 46%, data provided by Largo.

### 19.2.4 Titanium Pigment Prices

Titanium dioxide is an inorganic compound with the chemical formula $TiO_2$. It is a white, water-insoluble solid, although mineral forms can appear black. As a pigment, it has a wide range of applications, including paint, sunscreen, and food coloring. It is estimated that titanium dioxide is used in two-thirds of all pigments, and pigments based on the oxide have been valued at $13.2 billion. Blue's projections for the long-term, made in 2021, are still aligned with the current market situation and outlook as presented in the table below (Table 19-1).

**Table 19-1 – Blue's Projection for Long-Term**

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| Chinese Supplies sulfate grades (US$/t pigment) * | 3,332.00 | 3,528.00 | 3,696.00 | 3,696.00 | 3,668.00 | 3,724.00 | 3,836.00 |

Note: Blue's Benchmark prices are calculated from reported import prices CIF Brazil plus import duty at the standard add of 12% rate.
Source: Project Blue, 2021.

## 19.3 Contracts

For the year 2024, Largo committed approximately 80% of its forecasted production under long-term, 12 months or more, agreements with vanadium end users, converters and traders in the steel, aerospace and chemical industries. The balance of material will be sold in the spot market according to availability and demand from time to time. The yearly negotiations for 2025 will be conducted between September and November and are expected to be finalized by mid-December 2024.

## 19.4 Selling Prices Adopted

After analyzing the several sources of vanadium market demand and price forecasts, the QP has assumed the selling prices for economic analysis which are presented in Table 19-2 below.

**Table 19-2 – Consolidated Selling Price**

| Description | Unit | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|
| Average Dollar | **R$/US$** | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 | 5.10 |
| Vanadium - $V_2O_5$ Standard | **US$/lb** | 7.00 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| Vanadium - $V_2O_5$ Premium | **US$/lb** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Vanadium Premium - Sale Price | **US$/lb** | 8.00 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 |
| Vanadium Premium - % of Sales | **%** | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% |
| Ilmenite - Sale Price (No Tax Included) | **US$/t** | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 | 213.00 |
| Ilmenite - Sale Price (Tax Included) | **US$/t** | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 | 222.05 |
| Titanium (Pigment) - Sale Price (No Tax Included) | **US$/t** | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 | 3,332.00 |
| Titanium (Pigment) - Sale Price (Tax Included) | **US$/t** | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 |

Source: GE21, 2024.

# 20 ENVIRONMENTAL STUDIES, PERMITING AND SOCIAL OR COMMUNITY IMPACT

## 20.1 Regulatory Framework Overview

The licensing process in Brazil includes two kinds of licensing processes: the licensing of exploration and mining concessions, as discussed in Section 4, and environmental licensing (also known as social and environmental licensing).

Environmental licenses have been established, implemented, and enforced through various levels of the legal systems, including, constitutional dispositions and federal and state laws. The licensing process is administered through a national system of environmental authorities known as the National Environment System (SISNAMA).

The Brazilian Constitution grants the concurrent legal authority to multiple levels of government to regulate environmental activities (Federal, States and Municipalities), SISNAMA sets out the parameters that allow for the activities at each level to be coordinated by assigning to each entity the capacity to grant environmental licensing, according to the size and characteristics of the licensed activity which provides juridical safety and clarity.

The environmental licenses granted by any entity belonging to the SISNAMA and are structured in three phases, each one requiring different environmental studies and validation routines, as defined by the applicable legal framework (laws, resolutions, administrative acts, etc.).

Environmental permitting in the State of Bahia is the responsibility of the Institute of the Environment and Water Resources (Inema), which regulates, approves and issues environmental permits or licenses.

The permitting process in Bahia considers the nature and size of the projects and activities, the characteristics of the affected ecosystem and the supporting capacity of the area being impacted.

The following types of environmental licenses are necessary for the projects in Bahia:

- Preliminary License (LP): the LP is the most critical license and is granted in the preliminary planning phase of the project or operation, and it approves the location and the conceptual design of the project, attesting to its environmental feasibility and determining the basic requirements and conditions to be observed in the subsequent permitting stages.
- Installation License (LI): the LI is granted so that a project or operation can be installed (or constructed), following the specifications presented in the plans, programs and project specifications proposed by the environmental studies that were approved, including the environmental control measures and other conditions.

- Operational License (LO): the LO is granted for a project to commence its operational phase, after the satisfaction of all the requirements of the previous licenses have been confirmed and the conditions and procedures to be observed during the operation are defined.

Licenses and authorizations are granted based on an analysis of the environmental studies that have been completed. This analysis considers the objectives, criteria and norms for the conservation, preservation, protection and improvement of the environment, the possible cumulative impacts and the planning and land use guidelines of the State. For mining projects that are exceptionally large, as is the case of the Project, the preparation of the Environmental Impact Study (EIA) and Environmental Impact Report (RIMA) must comply with the Reference Term Sheet (TR) issued specifically for the Project.

Environmental licenses have a definite validity or term, which can be renewed or extended, based on the nature of the project and activities. The validity is defined for each license and is stated on the environmental certificate issued; the validity period starts on the day the license is published in the Official Newspaper of the State of Bahia. If the renewal of any license is requested 120 days or more in advance of its expiration date, the validity of that license is automatically extended until Inema issues a formal response, either positive or negative.

For permitting purposes, the classification of mining operations in Bahia is divided in five categories: micro, small, medium, large and exceptionally large. These categories are determined based on three criteria: built area, total investment (capital investment + cash flow, in Brazilian Currency, R$), and number of employees. The project is classified based on the highest ranking of the three criteria. The Project is classified as exceptionally large.

The grant or license for water resources usage in the State of Bahia is governed by the State Decree nº 6,296, from March 21st, 1997; State Law nº 10,431, from December 20th, 2006, substituted by Law nº 12,377 on November 28th, 2011; and Federal Decree nº 24,643, from July 10th, 1934 (*Código de Águas*).

The water grant is obligatory for the lawful and legitimate use of water resources whose purpose is the construction, expansion or alteration of any project that requires surface or groundwater, as well as for any work that alters the water regime, quantity or quality.

The VMSA water grant, as a concession (as is the case of the Largo Project) has a validity of 4 years and is renewable. State water grants are issued by the Inema through specific publications in the Official Gazette of the State of Bahia. The request for water grants in mining involves the execution of hydrologic, hydrogeological and hydrochemical studies. The VMSA received its water grant renewal in February 2021.

In the State of Bahia, Inema is responsible for issuing authorizations for native vegetation suppression, which are necessary to alter the land use for the installation or expansion of mining operations. Authorizations are only issued if the environmental, technical and economic feasibility of the Project has been established and can be renewed only once. The administrative process involving the authorization for vegetal suppression must be conducted by the Inema, based on a specific TR (Reference Term sheet). The documents to be submitted include the Technical Project for Vegetation Suppression (PTSV) and the Forest Inventory, as required by the Secretary of State for the Environment and Water Resources (SEMARH) Norm 29/05, as well as the Degraded Area Recovery Program (PRAD).

The National Environment Council (CONAMA) Norm nº 369/2006, from March 28th, 2006, defines extraordinary cases, in which the competent authority may authorize intervention or vegetal suppression in Permanent Preservation Area (APP), for implementation of projects, plans and activities that result in significant public benefits.

The clause I, letter C, from article 2 of the Norm nº 369/06 explicitly recognizes the public benefits of minerals exploration and extraction granted by the competent authority, except sand, clay, silt and gravel.

The section II, article 7 of the Norm deals specifically with the activities of mineral exploration and extraction to obtain environmental licenses. It is understood, therefore, that once the guidelines and obligations defined by the CONAMA Normative nº 369/2006 are observed, the public benefits of the Project are automatically recognized for environmental permitting purposes and for purposes of obtaining authorization for vegetal suppression and intervention within APPs.

## 20.2 Environmental Permitting Status

The Project (through VMSA) produces vanadium pentoxide and vanadium trioxide ($V_2O_5$ and $V_2O_3$) and has all the necessary licenses to conduct its operations, including those regarding the construction of the Project.

The Operational License for the Campbell Pit operation was published in the Official Gazette on November 8-9, 2014. The renewal process was filed within the legal period established by the environmental agency of the State of Bahia, in May 2020; however, due to the covid-19 pandemic, Inema was unable to visit the Maracás Menchen Mine. Inema is currently in the process of reviewing the information submitted. A formal letter from Inema addressed to Largo confirmed that the LO has been automatically extended until Inema completes its review and inspection process. Meetings have been held (2022 and 2023), recent discussions with Inema's representatives indicate that a field inspection will occur in 2024, and the Company expects that the renewed LO will be issued shortly thereafter.

VMSA applied for the Ilmenite Project environmental license after fulfilling Inema requirements in November 2021. The technical analysis commenced by December 2021 and the license was issued by April 7th, 2022, with validity until April 7th, 2026. The Ilmenite Project is now part of the VMSA project. It is important to highlight that the Ilmenite Project is within the Project's facilities area and no archaeological impact, deforestation, new grant water, road and powerline construction environmental license process was needed. No major constraints were addressed by the Environmental Agency.

VMSA holds the operational license for the entire Campbell reserve, validating the consistency of LVMSA's operations. Projects for exploration and expansion, like GAN, are meticulously planned out. Moreover, ongoing discussions and meetings with environmental agency representatives are underway to facilitate the acquisition of pertinent environmental licenses, aligning with LVMSA's strategic blueprint.

The environmental team collaborates with specialized firms for primary and secondary data collection and monitors physical, biological, and social factors. This collaborative effort actively pursues the acquisition, updating, and structuring of socio-environmental studies to bolster all environmental licensing applications.

Additional environmental licences / processes for the Project's expansions (e.g., non-magnetic waste dam, calcinated dam) will be submitted fulfilling Inema's requirements on time and accordingly with the project's phase / timeline.

As exploration progresses into new areas, such as NAN and São José, the need for and execution of fresh environmental studies and licensing requests will follow suit. To date, no critical issues have surfaced in the socio-environmental studies, nor have they been raised by environmental agency representatives or the community, which could impede or pose significant obstacles to LVMSA's exploration and expansion endeavours.

## 20.3 Environmental Baseline Conditions

The environmental baseline study was conducted as part of the preparation of the EIA. The baseline study was completed by Brandt Meio Ambiente Ltda. in June 2011. The study also included supplemental information related to an Equator Principles Compliance Audit conducted by Mineral Engenharia e Meio Ambiente Ltda. (Mineral) dated December 2011 as requested by parties involved in the financing of the Project: Brazilian finance institutions Itaú BBA, Bradesco and Banco Votorantim Minerals acted as the financing bank's environmental auditor.

### *20.3.1 Climate and Physiography*

The local climate has two distinct seasons, the rainy season (hot and humid) from October to March, and the dry season from April to September. The average daytime temperature in the Project area is 22.3ºC. The months of May to August are the most representative of winter conditions, at which time the average temperature is 18ºC.

Rainfall in the Project area ranges from 480 mm at the Porto Alegre gauge station to 630 mm at the Alagadiço gauge station, both of which are in the local area adjacent to the Project. There is rainfall in different months (regarding driest and wet seasons, and El Niño and La Niña effects), with normal / regular driest period being from May to September, when the monthly precipitation is typically below 20 mm. The Maracás Menchen Mine has seen a rise in rainfall levels in recent years, 2021 (908 mm) and 2022 (928 mm) To manage potential disruptions to production, our operational team has implemented mitigation measures and conducted preventive maintenance during operational downtime. In 2023 this trend was reversed, showing the lowest level of precipitation in the last ten years, 228 mm.

The Project is in the middle branch of the Jacaré river, about 3 km west of the western border of the Maracás plateau, in a region of very flat terrain with maximum relief changes of 25 to 30 m. The altitude in the area averages between 310 m and 340 m and seldom exceeds 400 m. The Jacaré river valley constitutes a long north-south depression with an average width of 10 km and a length of approximately 70 km.

The surrounding terrain is typically ranch / farmland with low trees and shrubs, and relatively flat platforms adjacent to a series of creeks and ponds. The property is bounded to the east by a steep cliff that rises 300 m to the Maracás plateau.

#### *20.3.2 Water Resources*

The Project is in the Rio de Contas watershed, which has an elongated shape with length of 620 km and covers approximately 55,000 km². This area corresponds to 10% of the entire state's territory, making its watershed the largest entirely within Bahia. The main tributaries of Rio de Contas are the Brumado, Antônio, Gongogi, Jequiezinho, Gavião, Sincorá, and Jacaré rivers. The Project is in the municipality of Maracás located in the Jacaré river sub-basin.

The Rio de Contas is a perennial river, although most of its tributaries are intermittent during most part of the year, including the dry season. At the Jequié river flow gauging station, the 26 years average is 25 m³/s, and 99 m³/s at the Ubaitaba station closer to the delta. The main tributaries are the Ourives, Sincorá de Santana, Jacaré and Caldeiras rivers.

The Jacaré river is located 4 km downstream from the Gulçari-A deposit (Campbell Pit) where it receives flow contributions from the João river. The Jacaré river and its tributaries are intermittent watercourses.

**Figure 20-1 – Jacaré River (dry period, October 2023)**

Source: Largo, 2024.

Surface water quality monitoring has been divided into two groups: one group comprising two monitoring stations at the João river (upstream and downstream from the mine site area) and two monitoring stations at the Jacaré river (upstream and downstream from the confluence with the João river), and one group comprising the two monitoring stations located at the Rio de Contas (upstream and downstream from the confluence with the João river). This area is under a water deficit and the surface water bodies are, most of the time, dry.

The monitoring stations have pH values slightly above neutral. The dissolved oxygen (DO) concentrations followed the recommended standards in every monitored point, except during drought period. At most of the monitoring points, most metals were not detected, particularly heavy metals. However, aluminium and iron were detected in every monitoring station, at levels above the legal standard. The elevated aluminium and iron concentrations have been attributed to the geology and soil composition of the region.

The results of the groundwater monitoring campaign conducted by Brandt Meio Ambiente in March 2008 were in compliance with the standards set by the CONAMA regulation 396/2008. The author is not aware of additional studies after 2008.

### *20.3.3 Flora Characterization*

The area of influence of the Project consists of large portions of land covered with natural vegetation and pasture. The natural vegetation is well preserved, but there are areas with secondary vegetation and areas where vegetation was cut down to allow for pasture planting.

Along road BA-026 through Porto Alegre, there are small communities, and the vegetation is deeply modified. Near the Porto Alegre District, there are irrigated plantations, with a complete alteration of the natural landscape and large areas used to grow beans, cassava, watermelons, mangos, and other fruits and vegetables.

The preserved vegetation was classified by Ministry of Environment and Climate Change (MMA – 2006) as Forest Steppe Savannah and Arborous Steppe Savannah. The portions that were subject to human modification and pressure were classified as Forest Steppe Savannah / Agriculture and Arborous Steppe Savannah / Agriculture.

#### *20.3.3.1 Forest Steppe Savannah*

Forest steppe savannah is a subtype of vegetation characterized by moderately densely packed 5 to 20 m tall trees (averaging 5 m) with thick trunks and numerous branches; within the Project area some trees taller than 7 m have been observed. This vegetation pattern corresponds to the arborous caatinga, according to Carvalho and Junior (2005).

The primary defining species of this vegetation are the *Aspidosperma pirifolium, Myracrodruon urundeuva*, *Schinopsis brasiliensis*, *Commiphora leptophloeos*, and *Pseudobombax simplicifolium*, and are usually taller than 10m. The species *Spondias tuberosa*, *Maytenus rigida*, *Capparis yco* and *Jatropha ribifolia* contribute to the overall density of the vegetation, with average heights of up to 5 m. The insolation at the ground level has been estimated at only 5% at some preserved areas during the rainy season, a function of the vegetation density.

This type of vegetation usually occurs in the river sides, even if the rivers are partially or totally dry during most of the year. The deep soils and the higher relative humidity enable the growth of this vegetation type.

#### *20.3.3.2 Arborous Steppe Savannah*

This subtype of vegetation exhibits comparable floristic characteristics as Forest Steppe Savannah; however, the individuals of the Arborous Steppe Savannah are typically shorter, resulting in greater ground level insolation. This subtype corresponds to the Arborous-bushy caatinga, according to Carvalho and Junior (2005).

The shorter individuals in Arborous Steppe Savannah are categorized as bushy-arborous and bushy. The prevailing species differs from Forest Steppe Savannah, with greater frequency of smaller individuals including *Mimosa spp* and *Spondias tuberosa*, *Maytenus rigid*, *Capparis yco* and *Jatropha ribifolia*. These are coincident with *Sideroxylon obtusifolium* and various individuals from the *Malvaceae* family, resulting in a denser herbaceous stratum than in other subtypes. Arborous individuals are still present but are typically more spread out, along with individuals from the *Bromeliaceae* and *Cactaceae* families, reaching 10% to 60% cover in some areas.

This type of vegetation is found in areas further away from the rivers, with more compact soils and low humidity.

#### 20.3.3.3 Recovering Steppe Savannah

Recovering Steppe Savannah is classified by the absence of a variety of species, with individuals more diffusely spaced. Arborous or bushy individuals from the Forest and Arborous Steep Savannah types can occur (2 to 7 m tall). Due to historical exploration activities, their branches are not as numerous or dense as in the past.

The management and soil use activities are the main factors shaping this subtype. Man-made fires occur frequently, designed to “clean” the land for pastures and agriculture; this results in development of a new vegetation cover at a secondary stage of ecological evolution.

#### 20.3.3.4 Human Occupation – Anthropized areas

Anthropized Vegetation is characterized by various types of clean pastures or bushy-arborous vegetation cover, resulting in dirty pastures that, if left without management, can evolve to recover vegetation.

Exotic grass is often introduced to these pastures: *Aristida setifolia* (capim-panasco), *Bracchiaria decumbens* (braquiária) and *Cenchrus ciliaris* (capim-bufel). The annual herb Estilosantes (*Stylosanthes humilis*) and the algodãozinho-de-seda (*Calotropis procera*) can be cited as intrusive / invasive vegetation associated with disturbance of the natural vegetation rather than the management of the pastures.

Pasture management is undertaken for cattle and to a lesser extent for caprines, the latter of which is closely related to the presence of communities. Residents use the land to plant and to raise cattle and goats. Cattle raising activities require larger areas and an alteration of the natural environment with continuous suppression of natural vegetation and replacement exotic grass species. Goat raising, while considered to be as impactful as cattle raising, is less frequent and does not require the continuous removal of natural vegetation.

The revegetation plant used in the area is the *Cactaceae* (palmatória) or Palma (*Opuntia palmadora*, *Cactaceae*), which is consumed as a water source for cattle during the dry season. The poor soil and the lack of regular rainfall limit development of satisfactory agriculture. At Porto Alegre, the original caatinga vegetation was replaced primarily by small plantations, where the population uses the water from the Rio de Contas for irrigation.

#### 20.3.3.5 Forest Inventory

The forest inventory was conducted by Brandt in 2008 and audited by Mineral Engenharia em Meio Ambiente Ltda. (Mineral) in 2011 showed 141 vegetation species, with 111 being identified at the species level (78.7%), 13 at the genus level (9.2%), 10 species remained to confer (cf.) and seven species were not identified. The reasons were due to the absence of reproductive material, available literature, or available herbarium material for comparison. The author is not aware of additional studies after 2008.

The most representative family was *Fabaceae* (20.57%), followed by *Cactaceae* (8.51%), *Malvaceae* and *Euphorbiaceae* (6.4%). These four families represent approximately 41.9% of the observed species. The remaining species are distributed in 39 other families, with a total of 43 botanical families.

The utilization of the region's native species as a source of natural remedies, food and water sources when the dry season becomes too intense is widely known among the residents. The bark and leaves of trees like the pau-ferro (*Caesalpinia ferrea*) and the quixabeira (*Bumelia sartorum*) are used to produce tea against rheumatism and diabetes. The fruit from the icó (*Capparis yco*) and from the umbuzeiro (*Spondias tuberosa*) are part of the diet of the local population, with the latter forming underground tubercles that are used to quench the thirst during harsh dry periods.

Based on the official list of endangered flora, from the Brazilian Institute of Environment and Renewable Natural Resources, IBAMA Norm nº 06/2008, and from the list of International Union for Conservation of Nature (IUCN) the following tables (Table 20-1 and Table 20-2) present the species found and considered vulnerable and rare.

**Table 20-1 – Vulnerable Species**

| Name | Popular Name |
|---|---|
| *Astronium fraxinifolium* | Gonçalo-Alves |
| *Myracroduon urundeuva* | Aroeira do sertão |
| *Pereskia aculeata* | Ora-pro-nóbis |
| *Pilocereus piauhyensis* | Facheiro |
| *Caryocar brasiliensis* | Pequi |
| *Anadenanthera macrocarpa* | Angico |
| *Chloroleucon tortum* | Jurema |
| *Mimosa caesalpinifolia* | Sabiá |
| *Amburana cearensis* | Umburana |
| *Psidium rufum* | Araçá |
| *Manilkara elata* | Maçaranduba |
| *Sideroxylum obtusifolium* | Quixabeira |
| *Schinopsis brasiliensis* | Braúna |

**Table 20-2 – Rare Species**

| Rare Species | | |
|---|---|---|
| **Scientific Name** | **Popular name** | **Family** |
| *Astronium fraxinifolium* | Sete cascas | *Anacardiaceae* |
| *Cnidoscolus pubescens* | Cansanção | *Euphorbiaceae* |
| *Jacaranda cuspidifolia* | Pau de colher | *Bignoniaceae* |
| *Luehea paniculata* | Açoita cavalo | *Malvaceae* |
| *Mimosa tenuiflora* | Buranhém | *Fabaceae* |
| Not identified | Borracha | Not identified |
| Not identified | Pau de curral | Not identified |
| Not identified | Pinheiro Roxo | Not identified |
| *Patagonula bahiensis* | Casca fina | *Fabaceae* |

The species categorized as rare are those with a density smaller than one individual per hectare, according to the methodology proposed by Kageyama and Gandara (1993). These species should also be the targets of environmental management actions for conservation.

### 20.3.4 Fauna Characterization

The fauna characterization was based on a qualitative survey of the various vertebrate groups throughout the Project's area of direct and indirect influence. The survey was conducted in the beginning of 2008 and audited in 2011 by Mineral, through field surveys, interviews with residents and specialized literature.

During the field survey, the entire area of direct influence (ADI) and area of indirect influence (AII) were covered, aiming at identifying wild fauna species present in the region. For the mastofauna survey, direct observations were made through the method of linear transects, walking along existing trails in search of animals or traces such as animal tracks, fur, feces, or dead animals. The animals were identified according to the references Cabrera (1961), Silva (1994) and Emmons (1997).

The same method (linear transects) was used for the avifauna survey, but with the help of binoculars. The AID and AII were searched, along the existing trails, with the purpose of finding individuals, nests, dead animals or vocalizations. The guide for field surveys by Souza (2004) was used, as well as specialized literature (Sic, 1997).

The survey of herpetofauna, reptiles and amphibians were conducted directly at the ponds, water bodies, fallen logs, hollow trees and shadows. The methodology used for identification was recommended by Peters and Orejas Miranda (1971), Marques et al. (2001), Campbell and Lamar (2004), Kwet and Dibernardo (1999).

#### 20.3.4.1 Mammals

The region contains diversified mammal fauna, including species ranging from small mammals (rodents) to large-sized animals. Mammals can occupy a large variety of habitats. There are not a sizeable number of big animals in the region of the Project, but there are numerous small-sized species, such as bats and rodents. Most of the mammals are singular and nocturnal and are seldom observed.

Footprints of a *Puma concolor* (sussuarana), considered to have its largest habitat. the vicinity of the Project, have been observed in the region. In total, 47 species have been identified, belonging to 19 families.

Several mammals have been identified with economic value derived from consumption as food by local residents: armadillos (*Dasypodidae*), preá (*Caviidae*), mocó (*Caviidae*), agoutis (*Dasyproctidae*) and tapetis (*Leporidae*).

According to the Official List of Brazilian Fauna Threatened by Extinction (MMA – Instrução Normativa nº 3 de 27/05/03), the Brazilian three-banded armadillo (*Tolypeutes tricinctus*) is categorized as threatened. The following species are classified as vulnerable: giant anteater (*Myrmecophaga tridactyla*), ocelot (*Leopardus pardalis*), little spotted cat (*Leopardus tigrinus*), and cougar (*Puma concolor*).

### 20.3.4.2 Avifauna

The avifauna was the most representative group during the field survey and is associated with the Project area vegetation and habitat. Birds are considered imperative in any ecosystem, since they combat plagues, contribute with flower pollination, seed spreading, in the control of rodent and venomous animals, collecting and recycling biological wastes and as a bioindicator of environmental conditions.

Limiting the scope of analysis only to the caatinga of the State of Bahia, two studies found approximately 283 and 280 species (Fiúza, 1999; Lima, 2004, respectively). Both studies considered seasonal and year-long species in the Porto Alegre region in the county of Maracás, considered to be within the Project's area of influence. An additional study in 2005 (CBRO, 2005) identified 247 bird species distributed among 51 zoological families.

The Project area contains a large species diversity, estimated at 88.2% of all species found in the State of Bahia. However, due to the good conservation of natural resources and habitat, this diversity is common in the area. Aquatic birds, which use the region's ponds, lakes and rivers for various purposes, contribute significantly to this diversity.

The families with the largest number of individuals (above 4% species / family) were: *Tyrannidae* (20 species), *Emberezidae* (19 species), *Thraupidae* (16 species), *Furnariidae* (15 species), *Thamnophilid* (14 species) and *Trochilidae* (11 species). These six families encompass 38.3% of all species observed.

The consumption of wild avifauna as food and raising as pets are common in many regions of Bahia, including the county of Maracás. This tradition threatens numerous species, including xerimbabos and cinegetic species. The *Tinamidae* family (quails, partridges and tinamous) and the *Columbidae* family (doves and pigeons) are frequently sought as food in the region. The main ornamental birds are the melro (*Icberidae*), galo-de-campina (*Fringillidae*), canário-da-terra (*Fringillidae*), caatinga parakeet (*Psittacidae*), maritaca (*Pittaicidae*), among others.

Based on the Official List of Brazilian Fauna Threatened by Extinction (MMA – Instrução Normativa nº 3 de 27/05/03), none of the species are categorized as threatened.

### 20.3.4.3 Herpetofauna

Though the caatinga reptiles are considered well surveyed (Vanzolini et al., 1980), unexpected findings suggest that little is known about the patterns, which govern their evolution and differentiation (Rodrigues, 2005). This group is evenly distributed throughout the caatinga, with the only absentees being the crocodilians.

The reptile fauna of the region is very rich. During the field survey, the following groups were registered (seen or mentioned during interviews): chelonian, serpents and amphisbaenidae.

The venomous reptile fauna of the region shows ample distribution in every biome, except for the jararaca-da-caatinga (*Bothrops erythromelas*), which is restricted to the caatinga. Species of note include the tropical rattlesnake (*Crotalus durissus*), jararaca (*Bothrops jararaca*), jararacussu (*Bothrops erythromelas*), cobra-patrona (*Bothrops sp*.) and coral snake *(Micrurus sp.*).

Amongst this group, species more susceptible to human activities include the snakes and lizards that live in forested environments, small species and species adapted to the microclimate. These species are usually incapable of enduring the hot temperatures of the open fields; consequently, maintenance of the remaining forested environments is critical for the survival of these communities. A total of 19 species, distributed in 9 families, were registered during the surveys.

The lizards are known as frugivorous reptiles and play a key role in the spreading of seeds.

Twelve species of amphibians were found in the following families: *Bufonidae*, *Leptodactylidae*, *Hylidae* and *Microhylidae* (Quadro B-listanfíbios). These are found in ponds, wells and streams, but larger amphibians have been observed farther away from water resources in drier areas including toads (*Bufo crucifer*) and treefrogs (*Hyla spp*.). In more humid areas, the rãs (*Leptodactylus spp*.) and the black frogs (*Ololygoe spp*.) have been observed.

The red-tailed boa (*Boa constrictor*), rainbow boa (*Epicrates cenchria*), Argentine tegu (*Tupinambis teguixin* and *Tupinambis meriane*) and the tuberculate toad-headed turtle (*Phrynoes tuberculatus* and *Geochelone carbonaria*) are considered the main cinegetic species in the region. However, they do not have the same cinegetic value as the mammals, thus they are only occasionally hunted or captured.

The snakes of epidemiological importance in the region, include tropical rattlesnake (*Crotalus durissus*), jararaca-vermelha (*Bothrops erythromelas*), jararaca (*Bothrops sp*) and the coral snake (*Micrurus sp*). All of them are capable of injuries which, if not properly treated, can lead to death or irreversible damage. Injuries or incidents involving snakes is a common aspect of rural communities where agriculture and pasture are the main labor activities.

### *20.3.5 Aquatic Biota*

Aquatic biota samples were collected along the Rio de Contas to the end of the reservoir, Pedras Dam, including zooplankton, phytoplankton, ichthyoplankton, macrophyte and benthic communities were collected (EIA, 2008).

#### *20.3.5.1 Zooplankton Community*

The qualitative analysis of the samples identified components of the zooplankton community, distributed in the groups *Protozoa*, *Rotifera*, *Crustacea*, *Copepoda*, *Cladocera*, *Crustacea* and *Insecta*.

The samples showed a high concentration of rotifers, cladocerans and copepods, which may be related to anthropogenic eutrophication of the system, due to excess organic matter.

#### *20.3.5.2 Phytoplankton Community*

The qualitative analysis of the samples identified components of the phytoplankton community distributed in the following divisions: *Chlorophyta*, *Cyanophyta*, *Bacillariophyta* and *Euglenophyta*.

The results showed a high concentration of the class *Chlorophyta* inferred to be associated with eutrophication by inputs of inorganic nutrients from agricultural activities for livelihood.

The high concentrations of this class are associated with the hydrodynamic regime change of systems due to damming of rivers, causing deep and abrupt changes in the conditions of phytoplankton communities Bicudo (2005). This is reflective of the transformation of an open system for transportation to a more closed system.

#### *20.3.5.3 Icthyoplankton Community*

Identification of representatives of the *icthyoplankton* community came from observation of Pedras Dam and the collection of eggs and larval fish states EIA (2008). The qualitative analysis identified larvae distributed in the following families: *Erythrinidae*, *Cichlidae* and *Characidae*, *Poeciliidae*, *Engraulidae* and *Ariidae*.

Upstream of the Pedras Dam, the following adult families were identified: *Characidae* (piaba) *Erythrnidae* (betrayed) *Anostomidae* (piau) *Loricariidae* (charitable or catfish), cichlids and *Scianidae* (croaker). Some of the observed species, such as genus *Hoplias sp* (traíra), *Astyanax sp larvae* (piaba), genus *Poecilia sp* (barrigudinho), are abundant in most of the watersheds of the Northeast and Bahia.

One of the representatives of the Family *Cichlidae*, *urolepis Oreochromis* (tilápia), is considered exotic and introduced in Brazil through fishing projects in watersheds. The occurrence of peacock bass (*Cichla sp*) was confirmed by in situ verification of fishing conducted upstream of the Pedras Dam.

Some species, *Aspistor sp* (catfish), are not native to the basins of Bahia and were introduced through fishing projects. Additionally, representatives of the Family *Engraulidae*, *Anchoa spinifer* (sardines) or *Anchoviella vaillanti* (anchovy) have been identified in the rivers of the Northeast and comprise an important food source to coastal communities.

#### *20.3.5.4 Benthic Community*

Representatives belonging to the class *Gastropoda* with a predominance of *Melanoides tuberculatus* (*Grastropoda*; *Thiaridae*) (Muller, 1774) were identified in the Project area. This species is native to East Africa, Southeast Asia, China and Indo-Pacific Islands, and its introduction in Brazil is inferred to be related to trade in ornamental fish and plants (France, 2007). The *Melanoides tuberculatus* occurs in disturbed areas and is usually associated with inputs of organic matter.

#### 20.3.5.5 Aquatic Macrophytes

Aquatic macrophytes are important components of aquatic ecosystems because they contribute to improve the structure and diversity of habitats, interfere with nutrient cycling and participate in the base of food webs (Esteves, 1998).

A hydroelectric dam on the Rio de Contas has created the Pedras Dam lake. According to the sampling program, only 2 species (*Salvinus chara* sp and sp) were identified in this lake. However, according to residents there are other species of aquatic macrophytes that have not been confirmed.

**Figure 20-2 – Pedras Dam reservoir at Porto Alegre**

Source: Largo, 2024.

## 20.4 Social and Economic Baseline

This section presents and discusses the various social and economic (socio-economic) aspects of the Project, including discussion of potential modifications to these aspects throughout the Project lifecycle.

Although the municipality of Maracás is directly benefited / supported by the Project, the indirect benefits extend beyond that county. The changes in the municipality of Maracás will result in new relationships and interactions between the municipality and proximal regional neighbours including, but not limited to economic structure, job opportunities, taxes, income of families and companies, and distribution of work force.

The socio-economic assessment completed for the Environmental Assessment comprised a systematic methodology involving the integration of 25 counties which make up the micro regions that will be impacted by the Project. This assessment emphasizes the Maracás municipality and the area of direct influence of the Project.

The social and economic assessment was based on interviews with residents through March 2008 (primary data) and on secondary data obtained from an audit review report completed by Mineral Engenharia Ambiental Ltda. in 2011.

### *20.4.1 Populations Dynamics*

A study of the evolution of the population of the counties included in the Maracás micro region encompassing the last four decades was undertaken with the purpose of portraying a broad view of the demographic processes experienced by the 25 municipalities. The urban population showed larger growth rates, changing the distribution of the population while maintaining a rural profile in most of the counties.

From 1991 to 2000, the average annual population growth rate of the 27 counties remained positive (1.62%), resulting in a population growth from 509,378 to 532,409. The urban population of all counties grew from 276,868 to 325,905, with Maracás showing the largest annual urban population growth rate (4.75%). Only nine counties (33.3% of the counties) had urban populations, with the remaining 18 counties staying rural.

In the same period, the average annual population growth rate in Maracás was 1.73%. This county, which in 1991 still showed a rural population (44.91% urbanization rate) was considered an urban county by 2000, with 58.44% of its population in cities.

In 2007, the population of Maracás was the third largest of all the counties studied, being smaller than Jequié and Jaguaquara. The average annual population growth rate from 2000 to 2007 was 1.11%. Over the same period the average annual population growth rate of the region's main county, Jequié, fell 0.12%.

### *20.4.2 Employment Structure and Unemployment Rate*

In Brazil, the service sector employs the largest number of economically active people. In Bahia, the relative importance of the different economic sectors is like the national situation: 29.4% of employment in agriculture and grazing; 56.2% in services; and 14.4% in industry. The 27 counties included in the study showed a similar distribution of economic activities: service sector, followed by the agriculture and grazing sector and the industrial sector.

In Maracás county, the largest share of workers is found in the agriculture and grazing sector (45.7%), while the industrial sector provides 11.6% of the county's employment.

In general, the unemployment rate of the Maracás micro region shows a considerable variability (3.92% to 24.94%). Maracás is among the counties with the highest unemployment rates in the region (19.41% in 2000), above the Bahia and Brazilian averages.

In the county of Maracás, the share of the population that is younger than 29 years is 62.56%, which is slightly above the region's average. The portion of the population older than 60 years is smaller than the region's average (8.92% compared to the regional average of 10%). The county is faced with the challenge of providing education, leisure and work opportunities to its young population.

The comparison of the literate population in the micro regional area of influence of the Project from 1991 to 2000 reveals a significant increase in literacy rates. In 1991, the literacy rate of the population between 5 and 9 years was 16.9%. In 2000, this percentage increased to 44.4%. Between 10 and 14 years, 54.8% of the people were literate in 1991 and this rate increased to 91.6% in 2000. The growth in literacy rates was observed in every age demographic in Maracás, even among the oldest people.

### *20.4.3 Economic Aspects*

In 1991, the average monthly income at Maracás was R$ 62.10 (eighth place in the region). From 1991 to 2000, the county showed the smallest income growth rate in the region (18.4%). In 2000, its average per capita income was only R$ 73.50.

The Gini index is a measure of the income concentration and varies from 0 to 1. The closer it is to 1, the worse the income distribution is (income is more concentrated). If the value is closer to 0, the income is more evenly distributed through the population.

In 1991, the best income distribution of all the counties in the micro region was measured in Maracás (0.44). From 1991 to 2000, the income distribution in the counties followed different paths, but income concentration was observed in most of them. In 2000, Maracás still showed one of the best income distributions of the micro region, with 0.5.

The economic activities of the counties of the micro region are highly concentrated in the county of Jequié. Of all the goods produced in the region, Jequié alone is responsible for 45.24%. That means almost half of all the economic activity of the entire region is limited to one county, so, this one county tends to exert a strong attractive force over the others.

The service sector is the main source of income for the counties in the Project's area of influence. However, the economical results of agriculture and grazing activities are also significant. Maracás represents 3.95% of all income generated in the region.

The per capita gross internal product is led by Jequié which remains in front of all other counties with a value of R$ 7,091.48 per year; this value is greater than the state value of R$ 6,582.00. Maracás per capita gross internal product (R$ 2,318.45) is the ninth largest of the micro region. The smallest one of all the 27 counties is Iramaia with R$ 1,785.93.

#### 20.4.3.1 Production Structure on the Maracás County

There was a reduction in the number of businesses that produced dairy cattle milk in Maracás from 1996 to 2006, from 400 milk-producing businesses to 282. Over the same period, cow milk production in the municipality increased by 51% while goat milk production declined 67% and egg production decreased 96% suggesting significant consolidation in cow-milk production.

Seasonal products, particularly sugar cane, beans, and tomato decreased from 1997 to 2006 in Maracás. The only exception was mamona, whose production increased 172%. The area used to grow produce expanded 8.5% over this period.

The total area with permanent crops has been subject to significant changes in the last 10 years. From 1996 to 2006, areas assigned to permanent crops in the county of Maracás shrunk 20%. Coffee production increased from 2000 to 2006, but the 2006 production was smaller than that of 1996. The orange and lemon productions did not change significantly, while passion fruit production fell 89.45% from 1996 to 2000.

### 20.4.4 Land Use and Occupation

The land use and occupation study focused on the communities around the Project site and on the capital of Maracás County. The study examined public services infrastructure, land management and the dependence of residents on natural resources (i.e., water resources) considering this is a semiarid region with established water scarcity concerns.

The goal was to provide an adequate view of the area where the effects of the Project will be greatest. This mapping covered the Project's directly influenced area (DIA), which includes all pits, waste rock / ore piles, tailings ponds, processing units and all other operational and administrative support units.

#### 20.4.4.1 Rural Properties

There are four large rural properties in the DIA, averaging more than 2400 ha where extensive and semi-extensive cattle raising activities are conducted, which requires large pasture areas and small bushes. All landowners of these properties visit them regularly and employ a small number of employees to run the operations. The facilities that exist in the largest properties include barns and warehouses and all show good construction standards including brick walls. Most of these facilities are sized adequately to the property's production.

The construction standard for the houses of the workers is not ideal, but most of them have electric power supply. Water is supplied through rainwater collection and water trucks. There are only a few houses and due to the size of the properties they are far apart from one other.

There are also three smaller properties in the DIA with only one proprietor living onsite and taking care of the land. Secondary activities include household agriculture and traditional cheese production. Temporary employment is common in the region.

Temporary rural workers live in the nearby villages. Most of these villages are along the main road that connects the highway BA-026 (at the community of Pé de Serra) to the village of Porto Alegre.

### *20.4.5 Villages around the Project*

#### *20.4.5.1 Pé de Serra*

Pé de Serra village lies on BA-026 highway in the foothills of the mountains that divide the east-central (upper) and west (bottom) of the municipality of Maracás. The community is characterized by a cluster that was established and developed on the edge of the highway.

Among the communities surrounding the Project, Pé de Serra is the one with the best infrastructure, including power, telephone network, water supply through underground wells, some paved roads and garbage collection. There are inns, small shops and bars. Many homes are vacant waiting for new residents.

There is no sewage collection infrastructure therefore many houses have poor sanitary facilities erected outside the house. Drinking water supply is provided through wells with elevated levels of salts, necessitating the use of desalination plants operated by the city to make the water potable for human consumption. The water supply is at its limit, and the residences are supplied on alternate days to ensure all have access to water.

There is a Family Health Center and a school that offers elementary school grades. Young people are required to move to Maracás to continue their studies.

#### *20.4.5.2 Água Branca*

Água Branca village is in an area adjacent to the municipal road that connects Pé de Serra and Porto Alegre, east-southeast of the Project. Água Branca is the closest vila directly affected by the Project. It is characterized as a cluster of typical rural buildings, with houses located on the edge of the road, amid agricultural lands and pastures.

The community has just over 35 homes of farm workers who subsist from the land work in the large surrounding properties. The houses are typically based off a quite simple pattern, some using adobe-type construction. Most do not have toilets and water supply is provided from wells which require the use of desalination (Section 20.4.5.1). The main source of income is farm work, with some people providing services for the Project under a formal contract.

Public transport is limited to a line connecting the center of Porto Alegre to Maracás, with service running a couple of times during the day. School transport is served by buses and vans provided by the municipality of Maracás.

Among the nine communities visited, Água Branca is the one that has the highest expectations regarding the Project. Specifically, residents are viewing the proposed infrastructure (which was suggested at a public hearing) as extremely positive. The infrastructure includes road improvement and the construction of a potable water treatment plant. The water treatment plant for this community has not yet been implemented due to bureaucratic delays at the state government level.

#### *20.4.5.3 Antonio Caetano*

The village of Antonio Caetano comprises 10 houses located near the Santo Antonio Farm, owned by Mr. Antonio Caetano Neto. This village is located near the Project headquarters along the municipal road that connects Pé de Serra to Porto Alegre.

Households are made up of rural workers who survive from the land in large surrounding properties. It is common to see the cultivation of palm and other crops for subsistence farming, such as beans, corn and watermelon within the properties. The survival of such subsistence crops is threatened by low water availability in the region.

The houses are generally quite simple in pattern, some of adobe-type construction. Most homes do not have toilets and the water supply is inadequate with the use of wells, rainwater collection systems, and water trucks provided by the city.

Public transport is limited to a route connecting the center of Porto Alegre to Maracás, a couple times during the day. School transport is served by buses and vans provided by the municipality of Maracás.

#### *20.4.5.4 Braga*

This village has similar characteristics to the Antonio Caetano. It is located along a neighbouring municipal road that connects Pé de Serra to Porto Alegre, east-southeast of the Project.

#### *20.4.5.5 Caldeirãozinho*

Caldeirãozinho village is located at the margins of the municipal road near the district of Porto Alegre and follows the pattern of occupancy and structure observed in the other villages in the region.

The buildings are simple, with small areas used to grow subsistence crops. They are served by the electric power grid and have a phone network available. Most homes do not have toilets and sewage is held in common pits. The existing trade focuses on Pindobeiras, since the acquisition of products not found in the region are available in Maracás. It has a public school that provides elementary education. The streets are not paved and public transportation is limited to the route connecting Porto Alegre to Maracás.

### *20.4.5.6 Jacaré*

Jacaré village is approximately six kilometres south-southwest from the plant site situated on the banks of the Jacaré river. It borders the municipalities of Maracás and Iramaia and consists of approximately 20 homes of low constructive pattern, some of adobe construction. There is electric power supply to the Village but access to a telephone network is limited. Water supply is limited to individual tanks to capture rainwater or tanker trucks supplied by the City of Maracás.

It is common to have small yards where palm is usually grown for human and animal consumption. There is a school that offers grade 4 elementary education. To continue their education, students go to Porto Alegre.

### *20.4.5.7 Lagoa Comprida*

Lagoa Comprida village is located east-southeast of the Project along a municipal road that connects the neighbouring villages of Pé de Serra and Porto Alegre. The village has a small number of households comprised of rural and agricultural workers who survive from land deals in the large surrounding properties. It is common to cultivate palm and other crops such as beans, corn and watermelon for subsistence. This village has strong relations with the communities of Água Branca and Antonio Caetano based on their proximity.

The houses follow the same regional pattern with most not having toilets, and the water supplied with the use of wells, rainwater collection systems, and water trucks provided by the city.

Public transport is limited to the same line connecting the center of Porto Alegre to Maracás, a few times during the day.

### *20.4.5.8 Pindobeiras*

Pindobeiras is established at the margins of the municipal road, near the district of Porto Alegre. The village of Pindobeiras comprises 30 houses with a population of 122. Five houses are currently vacant. Houses are simple but are served by the electric power grid and telephone network. Most homes do not have toilets.

According to the local leader, since the population does not receive government assistance for the development of agriculture in the settlement, it develops activities in large farms in Maracás. Public transportation is limited to the service connecting Porto Alegre to Maracás.

### *20.4.5.9 Porto Alegre*

Situated close to the Pedras Dam, Porto Alegre is an urban center comprising residential of low to medium quality. Community employment is from fishing and the cultivation of fruits and vegetables at lake banks, including corn, watermelon, and mango. In some areas cattle ranching was identified.

Porto Alegre is the region's most populous village with approximately 250 residences. Residents reported that the increase in the population began with the construction of the railway on the opposite side of the lake.

Infrastructure includes a power grid, public water supply, health services, education and locations for social interaction and leisure. Sanitation is inadequate, with the use of mass pits which have high potential for soil contamination.

The main resource of the Porto Alegre residents is the lake, which provides the water for development of agriculture, fishery and leisure. According to local information, approximately 80 men are engaged in agriculture and fisheries with the most common fish caught being tilapia and piranha. The shrimp fishery is staffed by a group of approximately 25 women.

*20.4.5.10 Quilombola and Indian Communities*

Throughout the Project's DIA (made up of the 27 counties), only the county of Jequié has a Quilombola community that is officially recognized. Quilombola are the descendants of slaves who escaped from slave plantations in Brazil prior to abolition in 1888. The most famous Quilombola was Zumbi and the most famous Quilombo was Palmares.

The people of Maracás consider the communities of Cuscus, Pindobeiras, Caldeirão dos Miranda and Jacaré as being quilombolas, despite not being legally recognized by the Palmares Foundation and National Institute for Colonization and Land Reconstruction (Incra).

There are no Indian communities in the county of Maracás.

The majority of the nine villages within the Project area have less than 24 houses. The exceptions are Pé de Serra and Porto Alegre, which have approximately 220 houses. Most of the houses show humble construction standards, with brick walls and clay. Several houses were built in the 1950's. Many houses have backyards with small plantations and animals for personal consumption. Villages are accessed by a main road and houses are relatively close to one another. The public services are modest with some villages having schools, health clinics and small commercial centers.

All the nine communities have electric power supply. Porto Alegre has some paved streets. Water is obtained from wells, rainwater collected from rooftops and water trucks supplied by the city. In the case of Porto Alegre, the water is drawn from the Rio de Contas, which is dammed 85 km downstream from the community.

Porto Alegre is the village that shows the best sanitary conditions. The main economic activity for many residents of these villages is working with cattle on the farms. In Porto Alegre, there is also commercial irrigated production of fruits and vegetables.

*20.4.5.11 Municipality of Maracás*

Maracás is an urban conglomerate located in the central portion of the county on a plateau at a higher elevation than the surrounding valleys. It is a typical town in the interior of Bahia, with a small population that cultivates the habits and customs of their ancestors. Currently known as the “city of flowers”, Maracás had a population of 20,393 in 2020.

Downtown Maracás has two main avenues, Brasília and João Durval, and has good urban infrastructure with paved streets, a water supply system (the water is withdrawn from the Boca do Mato reservoir, 9 km away), an electric power supply and telephone lines. There is regular waste collection and street sweeping services making the public avenues much more aesthetically pleasing than many villages. However, there is no wastewater collection system, and the domestic sewage is disposed of in pits typically located in the backyard of the houses.

Maracás has legal regulations regarding urbanization, such as those established in the city’s development plan.

The tertiary sector, represented by activities of trade and services, is the main source of municipal income and in 2008 it contributed 65% of Gross Domestic Product (GDP).

The agricultural sector plays a key role in the economy of the city with the agricultural sector accounting for 23% of GDP. Labor absorption accounts for 45.7% of registered jobs in 2008.

The city's economy is not diversified, resulting in low employment. The unemployment rate was 19.41% in 2000, exceeding state and national levels. This generates a high number of people living below the poverty line. In 2003, according to IBGE data, 54.63% of the population of the city was below the poverty line.

Commerce and services are distributed along the main avenues and streets. The local commerce is diversified and in harmony with the size of the city. It includes clothing stores, cellular phone shops, furniture stores, house appliance stores, bookstores, construction supply shops, grocery stores, drugstores, and restaurants. Among the institutional services are a branch of the Banco do Brasil, lotteries, post offices, schools, social centers, health clinic, a Catholic Church and an Evangelical Church.

The educational system is made up of eight public schools, which offer elementary and high school courses. Five of these schools are municipal and three are run by the State. There is a private elementary school and private kindergarten schools. The municipal education system is supplemented by kindergartens available for the children that live downtown and in the surrounding neighbourhoods.

The local college is called Faculdade de Tecnologia e Ciências (FTC), and has on-line graduation courses including business, biology, mathematics, languages as well as some specialization courses.

Water supply is insufficient for the city. For human supply, the municipality makes use of surface waters (rivers and springs) and underground (wells). The county is supplied by a small dam known as Boca do Mato.

Violence and drug use are the most common social issues. According to a representative of the Judiciary, violence involving young people is increasing with narcotics most often cited as a generator. This scenario may reflect different situations, such as lack of perspective and employment opportunities, and poor choice of leisure involvement with people from various places among many others.

### *20.4.6 Historical and Cultural Heritage*

Maracás is a typical city of the Bahia's countryside with a small population that perpetuates the habits and customs of its ancestors. The name of the city comes from Maracás, which is an Indian tool used by the Cariri tribe that lived in the Paraguaçu region.

According to studies by Prof. Carlos Ott, the Portuguese arrived at the Paraguaçu valley doing exploration research of gold and diamonds and found the Indians. Many bloody battles were fought, resulting in the disappearance of the Indians. These Indians are still remembered today in the history of Maracás as being brave and aggressive warriors.

The influence of the gold cycle on the county can be seen today by the city's architecture, showing houses with styles that are typical of that period. The houses are narrow, with high doors and windows, like the ones found in Chapada Diamantina and Ouro Preto.

The Portuguese occupation of the region is evident through the main houses of the farms, in colonial style. One example is the Santa Rita farm, which keeps the big main house with its $18^{th}$ century furniture and chapel.

Since the occupation of the region started in the period in which Brazil was still a colony of Portugal, and during which slavery still existed in Brazil, the presence of black people is very pronounced.

According to Prof. Marina Silva, Maracás was one of the five Brazilian towns that hosted Germans during the Second World War. The German presence in the county is clearly seen by the main church's German gothic style architecture, and by other houses in the same style.

Besides the areas of historical and architectural value, there are some areas that are part of the county's natural heritage and should be protected. For instance, the Jequiriçá river headwaters park was rebuilt by the municipal government, the Eucalyptus Park, the water spring of Jequiriçá river, and mountains of the region.

#### 20.4.6.1 Archaeological Heritage

The report **Programa de Diagnóstico e Prospecção para o Projeto Vanádio de Maracás, Maracás, Bahia** submitted to Inema and Instituto do Patrimônio Histórico e Artístico Nacional (IPHAN) for the Installation Permit, presents the archaeological studies conducted in 2007 by the company Arqueologia Brasil – Projetos, Pesquisas e Planejamento Cultural e Arqueológico Ltda., whose principal office is in Espírito Santo do Pinhal – São Paulo. The archaeological survey was approved by Acervo (Centro de Referência em Patrimônio e Pesquisa), based on Porto Seguro – Bahia. The leader of the technical team was Prof. Dr. Walter Fagundes Morales (archaeologist and sociologist). The other archaeologists of the team were: Luiz Augusto Vivas, Flávia Prado Moi, Daniel Bertrand and Diego Palma Rocha.

The archaeological studies were authorized through the IPHAN Publication nº 162 from July 30th, 2007, which deals with the permission to conduct archaeological survey and analysis for the Project, in the county of Maracás, State of Bahia.

The archaeological survey was concentrated in the areas of the mining rights DNPM 870.134/82 and DNPM 870.135/82, where the mineral targets of the Project are located. In these areas, 20 archaeological sites and 62 occurrences of archaeological materials were identified. Every archaeological site and occurrence are identified by its geographical coordinates and described in the mentioned report with photographs.

This last stage of the archaeological rescue of artifacts includes archaeological heritage education activities. The programs of archaeological recovery and heritage education will be included in the Environmental Control Plan (PCA), which is part of the environmental permitting process for the Project.

### 20.4.7 Living Standards

The human development index (IDH) was created in 1989 to represent the level of development and living standards of a community. The intention of this index is to represent development based on three criteria: life expectancy, education and GDP per capita.

The criterion life expectancy – life expectancy at birth – aims to represent the health condition of a society. In 1991, the Maracás life expectancy index (0.541) was categorized as medium and the county was sixteenth in the micro region. In 2000, the county improved its life expectancy index by 6.7%, reaching 0.577 and achieved the 12th position.

In 1991 the educational indices of the counties in the Project's area of influence were worse than the life expectancy ones. However, from 1991 to 2000, this index increased and overcame the life expectancy values. The Maracás' educational index in 1991 was 0.490 (low). In 2000, this value had increased to 0.714, showing a 59.4% increase and, hence, was classified as medium.

The GDP per capita index is the one that has the smallest contribution to the IDH of the region's counties. In 1991, Maracás had a GDP per capita index of 0.462, placing it in the seventh position out of the 27 counties of the micro region. In the period from 1991 to 2000, the growth of that index in Maracás was only 6.1%, so the county moved down to the fifteenth position, with a GDP per capita index of 0.490.

Out of all the 27 counties located in the Project's area of influence, in 1991, Maracás was in the fourteenth position, with an IDH of 0.498 (low). From 1991 to 2000, the increase in the IDH index of that county was the sixteenth best (22.3%) and its IDH reached 0.609 (medium). As such, the county was in the sixteenth position, losing two positions. The most important of the three criteria, in the case of Maracás, was the education index (0.759).

### *20.4.8 Education*

In 1991, Jequié had the largest average school years of all the counties in the Project's area of influence and had the same value as the State of Bahia (3.3 years). Maracás' average was only 1.5 years and that placed the county in the ninth position among the counties in the micro region. In 2000, Maracás moved to fifth place with a 73.3% increase in its average school years, reaching 2.6 (still low).

Maracás' position with respect to adult illiteracy (older than 25 years) was 14$^{th}$ in 1991 (56.7%). In 2000, Maracás reduced its adult illiteracy rate to 38.6%.

In general, data showed an improvement in the number of Maracás residents that have educational services. However, additional efforts are needed to reach the educational level of the Bahia State (average of 4.5 school years and illiteracy rate of 28.5% in 2000).

At the municipal and state system, Maracás provides education at three levels: kindergarten, elementary and high school. The rural population has free transportation to the schools, provided by the county administration. The population in the villages located near the area of the Project has access to municipal schools.

### *20.4.9 Health*

The hospital beds available in the Project's area of influence are privately owned (52.5% or 741 beds). The public hospital beds total 693 or 47.5%.

Maracás has 64 hospital beds, with 40 being municipal owned and 24 privately owned. This represents a ratio of 1.9 beds for a thousand inhabitants; a value that is smaller than the OMS standard. With respect to hospital beds, Maracás occupies the 13$^{th}$ out of the 27 counties of the micro region.

Maracás has one of the worst (26$^{th}$) healthcare coverage of all the 27 studied counties, with only 67.4% of the population assisted with such programs. Of the 27 counties that make up the micro region, Jequié has the largest number and the greatest variety of medical equipment and is the region's center for medical care. Even so, the medical services are still very precarious.

Maracás has only one piece of X-ray equipment (100-500 mA). Thus, the Maracás population needs to go to another county if a more complex medical examination is necessary.

In 2008, the healthcare system had six public health clinics; four family health units, one healthcare center, one clinic specialized in birth surgery, and one hospital. There is a shortage of doctors for the urban and rural communities. Due to this shortage, the public health clinics in the rural zone operate with nurses and assistants, while doctors are available usually once a month.

From 1999 to 2005, the main cause of death in Maracás was caused by brain / vascular diseases. Heart strokes were the second and diabetes mellitus and transit accidents were third.

### *20.4.10 Housing Conditions and Infrastructure*

In the last census (2000), Maracás had 7,430 families living in private houses (31,678 people) and 7,430 people declared they provided money for their family; 5,288 were spouses; 16,330 were sons and daughters; 152 were parents or mother / father-in-law; 1,035 had another type of relationship, and 220 had no family relationship with the owner of the house.

According to the same census, there were 6,832 houses with adequate sanitary installations in Maracás. Out of these 6,832, 28% had treated water supply, 0.9% wastewater collection, and 76.7% had proper waste disposal.

The data from the last census shows that, though the population of Maracás does not have easy access to basic consumption goods (refrigerators, etc.) or to sanitation services, the housing conditions are not as bad as that seen in many large urban centers, mainly with respect to the number of people per room.

The Maracás' water supply system has 2,914 active water connections, supplying water to 18,533 inhabitants, through a 58 km-long network. The county does not have a sewage collection network, so wastewater is disposed of by individual households.

The public cleaning services are limited to the county's capital and includes tree trimming, street sweeping and waste collection. The waste is disposed of at a simple landfill that started in November 2005.

The city does not have a rainwater drainage system, but the reconstruction of the BA-026 (connects Maracás to Contendas do Sincorá) includes storm water drainage adjacent to the road.

The following roads are used to get to Maracás: BA-026 (Maracás / Contendas do Sincorá), BA-250 (Maracás / Lajedo do Tabocal) and BR-330 (Maracás / Jequié). There is a bus station, where the inter-municipal routes connect to Salvador, Vitoria da Conquista, Iramaia, Jaguaquara, Jequié, Ilhéus and Porto Seguro, and interstate routes from Rio de Janeiro and São Paulo arrive. The county has a landing strip called Luís Eduardo Magalhães.

Maracás also has a community radio station, loud-speaker services, telephone lines, cellular coverage, post offices and four small newspapers. The TV broadcasts are TV-Sudoeste, Aratu, TVE Bahia and Bandeirantes.

There is a municipal market on Saturdays when products from Maracás and Jaguaquara are sold including live animals (i.e., pigs, goats, chicken, ducks), cereals, grains, vegetables and meat. Almost all the products and meat consumed in the county are produced locally. The cereals are brought from other cities in the southeastern region.

#### *20.4.11 Leisure, Tourism and Culture*

The cultural aspects of Maracás are intimately related to the religion of the population. The most important cultural events, both in the rural and urban zones, show traces of popular Catholicism mixed with festivals. The main events of the county are: Ternos de Reis, Festejos Juninos (Trezenas de Santo Antônio and São João), Festa de São Roque, Festa de Nossa Senhora da Graça and Cosme e Damião.

The city has a few public leisure areas, such as the Eucalyptus Park, where environmental institutions are located (ADAB, EBDA, Production Secretary and Flower Project of Maracás). The park is also used for various sports. Besides this park, there is the park of the springs of the Jequiriçá river, where there are ecological tracks, sports courts and municipal squares.

There are also very few leisure areas in the communities surrounding the future Project area. Most of the villages have only small soccer fields. The exception is Porto Alegre that has a sports court built by the municipal government.

#### *20.4.12 Public Safety*

Maracás' public safety is ensured by the 19º Batalhão da Polícia Militar (Military Police) by the 4ª CIA de Polícia Comunitária (Communitarian Police), by Delegacia de Polícia Civil (Civil Police Delegacy) and by the Guarda Municipal de Maracás (County Police).

The Military Police is composed of 14 police officers and 1 vehicle. This structure is enough to ensure the public safety of the county and the services provided include rural surveillance, school surveillance, road blocking at night and drug traffic combat, among others.

The Civil Police has five officers and five public agents, as well as one vehicle. There is no fire department in the municipality.

#### *20.4.13 Property Disputes and Rural Settling*

There are no property or land disputes in the Project's DIA. There is a program for rural settling (Pakhaeta) at the California Farm, village of Pindobeiras. The area available for settling is 2035 ha and is large enough to settle 63 families. The registration process is underway. All the people to be settled will be rural workers in the region.

#### *20.4.14 Water Supply*

The water sources for human consumption include surface water bodies (rivers and springs) and groundwater (wells). The public raw water comes from a small dam called Boca do Mato. The villages of Porto Alegre and Pindobeira obtain their water from the reservoir of the Pedras Dam, Rio de Contas. The other villages get their water from wells and water trucks.

Since it is in the margin of the Pedras Dam, the community of Porto Alegre can use the water from the Rio de Contas for various purposes, including irrigation, leisure and fishing. These multiple water uses do not occur in any other village in the region.

With irrigation and fertile soils, the rural properties of Porto Alegre deliver fruits for export (mango, papaya and cashew) and vegetables for the regional market. Nevertheless, irrigation is not a threat to the supply of water for human consumption, because the lake volume is approximately 1,750 million $m^3$.

Although the fruit production is large at Porto Alegre, fishing is still the most important economic activity in the district of Porto Alegre. Besides fishing, the people also produce freshwater shrimp to be sold in Jequié.

Navigation is done only in the Pedras Dam, but it is restricted to small fishing boats and a special boat that transports goods and people among Porto Alegre, Jequié and Iramaia.

The reservoir is also used for leisure purposes such as carnivals and other events when tents and public shows are set up.

### 20.5 Environmental Impact Assessment, Mitigation and Compensation

This is based on a Technical Report prepared by Mineral Engenharia em Meio Ambiente Ltda., an independent consulting company retained by Largo in 2011 to conduct an Equator Principles Compliance Audit in the Maracás Vanadium Project (Audit Report).

The Audit Report focused on the aspects recognized by Principle 2 – Environmental Assessment, and as advocated, it identified and discussed the impacts and relevant social and environmental risks of the Project, during the phases of installation, operation and decommissioning. Furthermore, it examined the proposed controls, monitoring programs and mitigation measures and appropriate management programs for enforcement of the principles.

### 20.5.1 Physical Environment

#### 20.5.1.1 Erosion and Silting of Water Bodies

The excavation, removal, and storage of soil creates points susceptible to erosion resulting in laminar flow of rainwater, which can generate localized silting. The deforested areas, the excavated slope, openings of access roads, and water catchment systems are all susceptible to low-level erosion. This is due to low annual precipitation and the smooth topography in the DIA. During periods of short, intense rainfall, solids removal and silting of the João river and Jacaré river can occur.

Environmental, Health and Safety Guidelines for Mining establish some protocols and procedures (best management practices) to be considered for the prevention of erosion processes and settling in industrial and mining activities. To decrease the incidence of erosion processes in the area and settling of water bodies, the project has implemented several mitigation measures, including the implementation of the various measures proposed in the PRAD. An example is the erection of protection barriers for the North and South ridges around the Campbell pit to avoid sediment being washed inside the pit.

The access routes will be constructed with drainage channels to drain off rainwater for a containment basin, where the sediments will be cached. The channels are designed for the rainy season (i.e., peak rainfall).

The existing water bodies in the project, specifically the João and Jacaré rivers may have their quality affected by solids and dissolved or suspended substances washed from the installations. Groundwater contamination can occur from the infiltration of water impacted by mine contact water or other sources of surficial contamination. Potential contamination point-sources include:

- waste piles;
- non-magnetic tailings ponds;
- leached calcine tailings dumps;
- chloride purge tailings ponds;
- storm water drainage system;
- effluent from the processing plant;
- oily effluent.

#### 20.5.1.2 Waste Piles

The Project will feature external waste (rock) dumps or piles generated from the mining of various open pits. The waste material originating from the open pits, which will be placed in a waste pile or catchment dyke, is predominantly rock consisting of boulders of varying sizes. The area destined for the Campbell Pit Phase 1 waste pile covers approximately 47 ha and the area destined for the Campbell Pit Phase 2 waste pile covers approximately 119 ha. The waste piles for the satellite pits vary in size ranging from 16 ha to 55 ha.

To assess the potential for leaching of mine rock waste into groundwater or surface water, SGS Laboratories undertook leaching and solubility testing of representative waste materials. This analytical work was undertaken following procedures regulated by the Brazilian Association of Technical Norms-ABNT, according to NBR 10.004/2004.

To assess the potential for acid generating materials (i.e., acid rock draining, or ARD), three types of rocks were submitted for analysis by Associação Brasileira de Agroecologia – Minas Gerais (ABA-M) tests for prediction of acid drainage.

Table 20-3 and Table 20-4 show the results of these analyses and Table 20-5 presents the Neutralization Potential Ratio (NPR) Screening Criteria (after Price et al., 1997) in English.

**Table 20-3 – Test work results – ABA-M – Waste Rock – Campbell**

| Nº | Rock | Sample Reference | PN (1) | PA (2) | PNA (3) | Potential Acid Generation | RPN (4) | Potential Acid Generation |
|---|---|---|---|---|---|---|---|---|
| | | | Em t $CaCO_3$ equiv./ 1,000t rock | | | | | |
| 1 | Gabbro | Top extract – 12 to 60 | 3.0 | <0.01 | 3.0 | Potential | 3.0 | Potential |
| 2 | | Medium extract – 60 to 100 | 2.0 | <0.01 | 2.0 | Potential | 2.0 | Potential |
| 3 | | Lower extract – below 100 | 11.5 | <0.01 | 11.5 | Potential | 11.5 | Potential |
| 4 | Pyroxenite | FGA 61 – LML 7364 | 8.5 | <0.01 | 8.5 | Potential | 8.5 | Potential |
| | | FGA 67 – LML 7369 – Test 1 | 214.0 | <0.01 | 214.0 | Potential | 214.0 | Potential |
| 5 | | FGA 67 – LML 7369 – Test 2 | 224.0 | <0.01 | 224.0 | Potential | 224.0 | Potential |
| 6 | | FGA 68 – LML 7371 | 12.0 | <0.01 | 12.0 | Potential | 12.0 | Potential |
| | | FGA 76 – LML 7375 – Test 1 | 10.5 | <0.01 | 10.5 | Potential | 10.5 | Potential |
| 7 | | FGA 76 – LML 7375 – Test 2 | 11.8 | <0.01 | 11.8 | Potential | 11.8 | Potential |
| 8 | | FGA 79 – LML 7378 | 10.0 | <0.01 | 10.0 | Potential | 10.0 | Potential |
| 9 | | FGA 86 – LML 7387 | 9.7 | <0.01 | 9.7 | Potential | 9.7 | Potential |
| | | FGA 96 – LML 7395/7396 – Test 1 | 13.5 | <0.01 | 13.5 | Potential | 13.5 | Potential |
| 1 | | FGA 96 – LML 7395/7396 – Test 2 | 11.8 | <0.01 | 11.8 | Potential | 11.8 | Potential |
| 1 | | FGA 99 – LML 7398 | 11.0 | 1.2 | 9.7 | Potential | 9.7 | Potential |
| 1 | Pegmatite | LML | 13.0 | <0.01 | 13.0 | Potential | 13.0 | Potential |

| Notes | | Interpretation of ANP Values and RPN | |
|---|---|---|---|
| (1) | PN = Potential neutralizing | PNA < -20 | Probable generation |
| (2) | PA = Potential rock acid | -20 < PNA < +20 | Uncertainty zone – test with RPN or more methods |
| (3) | PNA = Neutralization potential assessed = PN-PA | PNA > +20 | Non-Acid Generating |
| (4) | RPN = Potential ratio of neutralization = PN/PA | | |
| | | RPN < 1.0 | Probably generation of |
| **OBSERVATION: test performed in the laboratory of SGS GEOSOL in Belo Horizonte – MG, in December of 2007 in sample (drill core) collected by the client in the field, Campbell, municipality of Maracás, State of Bahia.** | | 1.0 < RPN < 2.0 | Possible generation of |
| | | 2.0 < RPN < 4.0 | Small generating potential |
| | | RPN > 4.0 | Potential to generate acid |

**Table 20-4 – Test work results – ABA-M – Waste Rock – Campbell**

| Nº | Rock | Sample Reference | Residue Type | Class IIB Not Dangerous – Inert | Class IIA Not Dangerous – Not inert | Class I Dangerous – Corrosive | Class I Dangerous – Reactive | Class I Dangerous – Toxic | Observation |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Gabbro | Top extract – 12 to 60 m | Solid and dry | Yes | No | No | No | No | None |
| 2 | | Medium extract – 60 to 100 m | Solid and dry | No | Yes | No | No | No | Aluminum above the VMP |
| 3 | | Lower extract – below 100 m | Solid and dry | Yes | No | No | No | No | None |
| 4 | Pyroxenite | FGA 61 – LML 7364 | Solid and dry | Yes | No | No | No | No | None |
| 5 | | FGA 67 – LML 7369 | Solid and dry | No | Yes | No | No | No | Arsenic and Aluminum above the VMP |
| 6 | | FGA 68 – LML 7371 | Solid and dry | Yes | No | No | No | No | None |
| 7 | | FGA 76 – LML 7375 | Solid and dry | Yes | No | No | No | No | None |
| 8 | | FGA 79 – LML 7378 | Solid and dry | Yes | No | No | No | No | None |
| 9 | | FGA 86 – LML 7387 | Solid and dry | Yes | No | No | No | No | None |
| 10 | | FGA 96 – LML 7395/7396 | Solid and dry | No | Yes | No | No | No | Aluminum above the VMP |
| 11 | | FGA 99 – LML 7396 | Solid and dry | Yes | No | No | No | No | None |

| Nº | Rock | Sample Reference | Residue Type | Class IIB Not Dangerous Inert | Class IIA Not Dangerous Not inert | Class I Dangerous Corrosive | Class I Dangerous Reactive | Class I Dangerous Toxic | Observation |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Pegmatite | LML 7372/80/84/85/91/94 | Solid and dry | Yes | No | No | No | No | None |

**Table 20-5 – Neutralization Potential Ratio (NPR) Screening Criteria**

| Potential for ARD | Initial NPR Screening Criteria | Comments |
|---|---|---|
| Likely | <1:1 | Likely ARD Generating |
| Possibly | 1:1 – 2:1 | Possible ARD generating if NP is sufficiently reactive or is depleted at a faster rate than sulfides |
| Low | 2:1 – 4:1 | Not potentially ARD generating unless significant preferential exposure of sulfides along fracture planes, or extremely reactive sulfides in combination with insufficiently reactive NP |
| None | >4:1 | No further ARD testing required unless materials are to be used as a source of alkalinity |
| NPR=NP/AP (RPN = PN/PA) | NP = neutralization potential = PN | AP = acid generation potential = PA |

Source: Price et al., 1997.

The analytical results indicate that gabbro, which constitutes the largest component of the waste rock, has a low potential for acid generation (potentially acid generating – PAG). The remaining rock types (pyroxenite and pegmatite) are not considered to be potentially acid generating (i.e., Non-Acid Generating – NAG) with all NPR/RPN values more than 4 (8.5 to 224 for pyroxenite; 9.7 to 13.5 for pegmatite).

*20.5.1.3 Non-Magnetic Tailings Ponds*

The non-magnetic tailings ponds are formed from the deposition of weakly magnetic or non-magnetic minerals obtained from the magnetic separation of titano-magnetite ore after grinding and filtering. This tailing's structure was designed and incorporated into the industrial layout as an alternative solution to conventional tailings deposition in the Jacaré river valley, to protect and preserve an arborous caatinga area near the mine site.

The magnetite rock was subjected to acid drainage prediction tests, solubility testing and leaching of heavy metals, in accordance with the norms of ABNT. The results of such testing are shown in Table 20-6 and Table 20-7 below:

**Table 20-6 – Test work Results – ABA-M – Magnetite Rocks – Campbell**

| Nº | Rock | Sample Reference | PN (1) Em t $CaCO_3$ equiv/1,000 t rock | PA (2) | PNA (3) | Potential Acid Generation | RPN (4) | Potential Acid Generation |
|---|---|---|---|---|---|---|---|---|
| 13 | Magnetite | Top extract – 12 to 60 m | 13.50 | < 0.01 | 13.50 | Potential uncertain | 13.50 | Potential non-existent |
| | | Medium extract – 60 to 100 m – Test 1 | 22.20 | < 0.01 | 22.20 | Potential non-existent | 22.20 | Potential non-existent |
| 14 | | Medium extract – 60 to 100 m – Test 2 | 19.20 | < 0.01 | 19.20 | Potential uncertain | 19.20 | Potential non-existent |
| 15 | | Lower extract – below 100 m | 3.00 | < 0.01 | 3.00 | Potential uncertain | 3.00 | Small potential |

| Notes | | Interpretation of ANP Values and RPN | |
|---|---|---|---|
| (1) | PN = Potential neutralizing | PNA < -20 | Probable generation |
| (2) | PA = Potential rock acid | -20 < PNA < +20 | Uncertainty zone – test with RPN or more methods |
| (3) | PNA = Neutralization potential assessed = PN – PA | PNA > +20 | Rock not producing acid |
| (4) | RPN = Potential ratio of neutralization = PN/PA | | |
| | | RPN < 1.0 | Probably generation of acid |
| **OBSERVATION: Tests performed in the laboratory of SGS GEOSOL in Belo Horizonte – MG, in December of 2007, in samples (drill core) collected by the client in the field Campbell, municipality of Maracás, State of Bahia.** | | 1.0 < RPN < 2.0 | Possible generation of acid |
| | | 2.0 < RPN < 4.0 | Small potential for acid generation |
| | | RPN > 4.0 | Potential non-existent acid generation |

**Table 20-7 – Test work Results – ABA-M – Magnetite Rocks – Campbell**

| Nº | Rock | Sample Reference | Residue Type | Class IIB | Class IIA | Class I | | | Observation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Not Dangerous | | Dangerous | | | |
| | | | | Inert | Not inert | Corrosive | Reactive | Toxic | |
| 13 | Magnetite | Top extract – 12 to 60 m | Solid and dry | Yes | No | No | No | No | None |
| 14 | | Medium extract – 60 to 100 m | Solid and dry | Yes | No | No | No | No | None |
| 15 | | Lower extract – below 100 m | Solid and dry | Yes | No | No | No | No | None |

As shown in Table 20-6 only the magnetite originating from the 100 m level horizon has a (low) potential of acid generation. The upper and middle magnetite has no acidic drainage generation potential.

According to the results presented in Table 20-7, this residue was classified as inert (class IIB) according to ABNT NBR 10.004/2004. Therefore, the risk of leaching and infiltration of dissolved constituents into the soil from the reaction in the stack with rainwater is not anticipated.

According to the design of the tailings facility the first cell will be sealed and monitored as a precaution. The design of the final drainage system for the system will be done after completion of all the “ponds”.

#### *20.5.1.4 Calcine Residue Stack*

The calcine residue tailings consist of synthetic hematite (calcined magnetite) that will contain, regardless of the effectiveness of the leaching and filtering processes, some residues of vanadium and sodium salts soluble in the form of sodium vanadate ($NaVO_3$, $Na_3VO_4$).

This material is stacked in a lined and impermeable structure after filtering and washing. The residue stack was formerly wetted by sprinkling water on top of it, progressively washing for removal of soluble salts. The solution will be collected in tanks and returned by pumping to the metallurgical plant thereby limiting potential infiltration into the subsurface.

The residue remaining on the stack is considered a Class I (dangerous), and the leaching pad is fully waterproof with high density dual layer polyethylene.

This material is not being sold, however Largo continues to explore opportunities to sell this material as iron ore. The Report considered that this material will be stored in appropriate areas (calcined dams).

#### *20.5.1.5 Chloride Salts Residue Pond*

The chloride salt pond contains a solution rich in chlorine, present in the purging of the evaporation system. The effluent flow is in the order of 2.9 $m^3/h$, arranged in a dam type structure (pond) lined with high density polyethylene, dual layer.

#### *20.5.1.6 Storm Water Drainage System*

Each area of the plant has a containment reservoir in which rainwater and washing water from process will be continually collected and recirculated.

#### *20.5.1.7 Waste Oil Effluent*

The maintenance of machinery, vehicles and equipment is a potential source of effluent (impacted discharge water) containing oils and greases and other chemicals. The generation of this effluent or contamination can occur in storage and work areas throughout the project development lifecycle.

To mitigate the possible impacts on the quality of surface and groundwater resources, the Project will implement the following measures:

- Solid material from the tailings ponds as the solution percolates will be systematically and periodically sampled and tested to determine the concentrations of soluble vanadium salts. Upon confirmation of tailings neutralization as class IIB (non-hazardous and inert) based on ABNT NBR 10,004/2004, the stack will be covered with sterile / unreactive rock and soil and vegetated.
- The plant is designed to not generate effluent other than chlorine salt solution, which is sent to a dike designed for evaporation. All other solutions are recycled back in the process.
- An Effluent Treatment System (ETS) has been installed for sanitary effluent treatment and is currently in operation until the end of commissioning and installation phases. The ETS will be decommissioned after this period. The effluent from the ETS is recirculated to the tank and used to wet the calcine leach pad. The effluent from the ETS is assessed under the Effluent Monitoring Program with quarterly analysis of physiochemical parameters including, at a minimum: pH, Biochemical Oxygen Demand (BOD), suspended solids, dissolved solids, total coliforms, color, turbidity, nitrates, nitrites, total nitrogen, total phosphorus, sulfates and sulfides.
- Each plant area has a containment tank where rainwater and washing water is continually collected and recycled back to process water and all impoundment structures and yards (non-magnetic tailings pond, calcine pond, chloride pond, waste, and ore piles), must have containment barriers that prevent the contamination / sedimentation of natural drainage.
- The Plan for Monitoring and Quality Control of Surface Water, Groundwater and Sediment (an Environmental Management Plan) outlines biannual sampling of 14 points for surface water and sediment collecting and 10 wells for monitoring groundwater.

- Mechanical repair areas are equipped with waterproof flooring with collection systems and water/oil separators and are constructed in accordance with legal standards and compatible with the estimated flows to control wastewater and oily effluent. The effluent from oil and water separators is sampled quarterly for pH, BTEX (Benzene, Toluene, Ethylbenzene, and Xylene), TPH (total Petroleum Hydrocarbons) and oils, greases, and lubricants.

*20.5.1.8 Leachate Spill – November 22nd, 2015*

On November 22nd, 2015, a leachate spill occurred outside the waterproofed area of the Leaching Plant. The incident occurred due to a failure of a part of the belt filter tray, which collects the solution containing soluble vanadium mixed with solid calcined material (hematite) resulting from cleaning the belt filter cloth. Because the tray fell, material that is normally pumped to the storage tanks fell on the waterproofed area, under the filter. Due to the elevated volume and high density of the soils, the sump pump on the waterproofed area was swamped (flooded) and had failed. Ultimately, the solution on the waterproofed surface ponded and discharged to the area adjacent to the Leaching Plant. This impacted the drainage used for rainwater and affected the area's naturally dry natural drainage. It is estimated that 20 m of natural drainage was impacted by the spill.

A portable pump was immediately installed to direct additional solutions back to the storage tanks. The total spill volume is estimated at 10 $m^3$ with 60 g of $V_2O_5$ per litre.

To minimize the impacts from the spill, the following measures were immediately implemented:

- Suspension of activities until the tray was changed and the pumping system regularized.
- Solution that remained in ponds near the plant and in the rainwater drainage channel was pumped to the storage tanks located at the Leaching Plant.
- Rainwater was blocked from the drainage channel with a masonry wall to prevent solution from affecting the natural drainage.
- Following the initial response, additional mitigation measures were implemented including:
- Cleaning and removal of the solution pools after the drainage channel as well as in the area's natural drainage.
- The affected area and natural drainage were cleaned with water with the rinsate collected at barriers downstream of the impacted area. The water was then pumped into a water truck for transportation and proper disposal in the calcine basin.

*20.5.1.9 Soil Contamination*

The Solid Waste Management Program presents guidelines for the packaging and disposal of waste generated in the Project. The plan identifies the waste types, volume of generation, packaging and disposal of all waste generated in all the Project phases. It also presents a list of recycling companies that should be intended for recyclable waste.

A landfill project near the industrial area has been recently approved by Inema for disposal of non-toxic wastes. The sludge generated in the Water Treatment Plant (ETA) will be wrapped in a drying bed to separate solid and liquid phases and prepared to be donated to the nearby potteries.

*20.5.1.10 Change in Air Quality*

Fugitive dust from moving vehicles on unpaved access roads and ore and waste stockpiles, particularly in the dry period, generates and mobilizes particulate material. The operation of machinery and equipment will generate dust and atmosphere gases resulting from the combustion of diesel in combustion engines, which can potentially result in a change in air quality in the vicinity of the Project.

In the comminution process (reduction of the ore to small particles or fragments), primary crushing will also generate particulate material. In the calcination stage, kiln emissions will contain $SO_2$, $CO_2$, and $H_2O$. All the sulfur contained in the feed (reagents and fuel) is converted to $SO_2$ and, in smaller proportions, to $SO_3$. The chlorine present is converted into gaseous HCl and released into the furnace.

A scrubbing system will be installed for MVA dust (Ammonium Metavanadate; $NH_4VO_3$) recovery during the MVA drying process.

The ammonia removal system will comprise a scrubbing system to remove any ammonia residue. Sulfuric acid reacts with ammonia to produce ammonium sulfate, which will be pumped into the reagent recovery system.

The future production of ferrovanadium will be by aluminothermic reaction (chemical reduction by aluminium) which does not use an electric furnace. The fumes generated in the process of casting will be extracted by a hood and passed by bag filters for removal of particulates. Dust collected will be re-routed to the furnace.

To verify the emission impacts from pollutants sourced from the Project on air quality in the regions close to it, atmospheric dispersion modelling was undertaken with base case scenarios of FeV and $V_2O_5$ production. The mathematical simulation (analytical model) was re-done in December 2015 by Climate and Environmental Studies System (SECA), an independent consulting company, based in São Paulo. This new set of mathematical simulations were completed with the last generation EPA-AERMOD model, using:

- Two years of weather data collected from the Company's site meteorological station.
- Terrain topography.

- Pollutant emission data generated by the plant's five stacks monitoring system.
- The escape parameters on a grid of the domain area of 2,500 km$^2$ in the municipality of Maracás, State of Bahia.

Table 20-8 and Table 20-9 show the results of atmospheric emissions for the production scenarios, according to Atmospheric Dispersion modelling completed by SECA in 2015.

**Table 20-8 – Maracás Vanadium Plant Atmospheric Emissions**

| Scenery | Sources | Emission Rates (g/s) | | | | |
|---|---|---|---|---|---|---|
| | | NOx | $SO_2$ | MP | V | $NH_3$ |
| Ferro Vanadium FeV | Kiln off gas | 23.1 | 120 | 0.59 | 0.005 | 0 |
| | AMV Flash Dryer | 1.2 | 0.28 | 0.1 | 0.045 | 0 |
| | AMV Reduction Kilns | 0 | 0 | 0.04 | 0.023 | 9.1 |
| | FeV Furnace Baghouse | 0 | 0 | 0.02 | 0.001 | 0 |
| | Quench Scrubber | 0 | 0 | 0.14 | 0.026 | 0 |
| | Screen Dust Collector | 0 | 0 | 0.56 | 0.002 | 0 |
| | Crushing Dust collector | 0 | 0 | 0.83 | 0.002 | 0 |
| Vanadium Pentoxide $V_2O_5$ | Kiln off gas | 23.1 | 120 | 0.59 | 0.005 | 0 |
| | AMV Flash Dryer | 1.2 | 0.28 | 0.1 | 0.045 | 0 |
| | AMV De-ammoniator Kiln | 0 | 0 | 0.07 | 0.029 | 19.7 |
| | Quench Scrubber | 0 | 0 | 0.14 | 0.026 | 0 |
| | Screen Dust Collector | 0 | 0 | 0.56 | 0.002 | 0 |
| | Crushing Dust collector | 0 | 0 | 0.83 | 0.002 | 0 |

The modelling results indicate that independent of the regulated pollutant, there is no violation of air quality standards in the short and long-term of CONAMA resolution nº 3/90 or International Finance Corporation (IFC) standard regulations.

As shown on Table 20-9, the maximum daily average concentration of $SO_2$ was 7.3 µg/m$^3$ for the current short time (24 hrs) scenario. This value represents 2.0% of the daily CONAMA standard for $SO_2$ of 365 µg/m$^3$ and 5.84% of the daily IFC standard of 125 µg/m$^3$. The maximum point is found inside the industrial facility.

**Table 20-9 – Maximum Long-Term Plant Emission Concentrations**

| Pollutant | Maximum Concentrations (µg/m$^3$) – 24 hours | | | | |
|---|---|---|---|---|---|
| | MP10 (24h) | $SO_2$ (24h) | NOx (1h) | Vanadium, V.(24h) | $NH_3$ (24h) |
| Scenario 1 FeV Production | 2.3 | 7.3 | 1.0 | - | - |
| Scenario 2 $V_2O_5$ Production | 2.3 | 7.3 | 1.0 | - | - |
| Primary Standard CONAMA 3/90 | 50 (Year) | 80 (Year) | 100 (Year) | - | - |
| Equator Principles | 35 (Year) | 50 (Year) | 40 (Year) | - | - |

Maximum annual average concentration of $SO_2$ is 0.63 µg/m$^3$ for long-term (one year). This value represents 0.79% for the annual standard of CONAMA 3/90 for $SO_2$, 80 µg/m$^3$, and 0.50% of the annual IFC standard of 125 µg/m$^3$. The maximum point was identified inside the industrial facility.

Maximum hourly average concentration of NOx was 20.5 µg/m$^3$ for the short term (24 hrs) current production scenario. This value is 15.6 times smaller than the default zone of CONAMA 3/90 for the $NO_2$ of 320 µg/m$^3$ and 9.76% times smaller than the default zone of the IFC for the $NO_2$ of 200 µg/m$^3$. Maximum annual average concentration of NOx was 1.0 µg/m$^3$, for both scenarios. This value represents 1% of the annual CONAMA standard of $NO_2$ 100 g/m$^3$ and 2.5% of the annual IFC standard of $NO_2$ 40 µg/m$^3$. The maximum point was identified to the east approximately 5 km distant from the Project.

It will be necessary to develop a new dispersion model for the expansion scenario. The quantities of pollutants (apart from $SO_2$) are expected to increase coincident with an increase in the volume of gas and increasing stack exit velocities. This expected increase will result in different dispersion levels; however, the levels are expected to be within the approved ambient air guidelines. A new dispersion model will be developed to confirm this expectation.

The mine owns and operates an atmospheric emission abatement system consisting of an electrostatic precipitator on the rotary kiln exhaust system and baghouses on different dust generating equipment. The emissions are monitored for the following pollutants on a biannual basis: MP, NOx, SOx, V and $NH_3$.

The Air Quality Monitoring program operates three monitoring stations in the area. The three stations monitor on a monthly basis the following parameters: SOx, NOx, MP, V and $NH_3$.

For combustion gas emissions on mobile sources, the mine uses preventive maintenance and control of emissions from vehicles, equipment and machinery to ensure that operational conditions are per normal standards. The frequency of maintenance of the fleet to control emission of pollutants is set out as per equipment standards.

#### *20.5.1.11 Change in Noise Levels*

The sources of noise in the study area will be linked to the movement of small vehicles, trucks, machinery and equipment used for the opening of access roads, preparation of mine site and infrastructure.

During the operation phase there are activities with intense movement of machinery and equipment that can change the sound pressure level, in the areas of mining and processing. The use of explosives for blasting and the activities conducted in day-to-day life (workshops, offices, cafeterias and other) are also sources of noise.

The community closest to the location of the mine is the village of Água Branca, located about 4 km from the processing plant and mine. Considering the distance of the communities to the installations, the sound levels in these communities will be impacted by moving vehicles, machines and equipment near the villages of Água Branca and Pindobeiras.

A Noise Monitoring Program has been established with points and periodicity defined. To mitigate the impacts of increasing sound levels in the vicinity of the installations, the Project proposes the following mitigating measures:

- The purchase of machinery and equipment with low noise potential.
- Establish routine procedures for motor inspection and preventive maintenance.
- To focus the activities of greater intensity of noise during the day, preferably between 8:00 am and 5:00 pm.
- The Noise Monitoring Program calls for biannual monitoring during operation phases, at the same locations used to determine the baseline data.

In addition to the measures proposed by the Project, the audit report suggested that the noise monitoring points should be reviewed every six months to check for new developments, changed conditions, and impacts in the vicinity of the Project.

### *20.5.2 Biotic Environment*

#### *20.5.2.1 Fauna*

Fauna environmental impacts occur from vegetal suppression, earth-moving, soil exposure, solid waste generation including organic food, atmospheric emissions, fugitive dust and gases, noise, machines and vehicles traffic on the roads, and the changes introduced to ecological corridors through mining activity.

Vegetation suppression may unintentionally cause loss of fauna occupation and land use change. In the areas with the occurrence of amphibians and reptiles, a more intense impact due to suppression of vegetation may have caused reduction of individuals. Removal of vegetation had a more intense impact on birds during the deforestation period, when dispersion of several species of birds in search of refuge, food and safer areas in the surrounding areas occurred.

According to the data, the identified endangered species are not restricted to a single habitat, but instead occupy various habitats and are inferred to have sufficient living area. The endangered fauna, characterized by mammals (cats) are not restricted to the area of the Project and move around easily. Another aspect that can mitigate this impact is that the region offers a good amount of natural environment where fauna can roam.

The presence of extensive vegetal refuges (i.e., areas unmodified or only slightly modified by human activity) can support the mammals in dispersion, with good environmental quality and connectivity, and may encourage the displacement of mammals and birds in search of refuge, food and security.

Similarly, the conservation of the João river valley (former proposed location for the tailings dam) will also mitigate this potential fauna impact by providing shelter, as it is near the area to be suppressed. The herpetofauna will have some of their representatives dispersed to adjacent areas, but it can also experience loss of local populations. Negative ecological interaction amongst displaced species may result in loss of fauna, through food and space competition and potential predation.

Deforestation eliminates habitats where wildlife acquires food and shelter, and where wildlife has places to roam. Preserving areas with pristine vegetation in the surrounding areas of the mine site will reduce this impact and, in accordance with the standard 8 item 6 of IFC, a net loss of biodiversity should be avoided. The requirement is a compensation of losses by creating ecologically comparable areas for the preservation of biodiversity.

According to the potential and realized impacts, and to minimize the loss of wild fauna due to suppression, the project environmental management plan proposes the following plans and programs:

- The Plan for Deforestation Actions. The main objective of this plan is to minimize the loss of local fauna by ensuring that deforestation actions are performed in a progressive manner and oriented in a single direction. This is intended to create opportunity for the spontaneous movement of animals into new areas and provide mechanisms and actions to prevent unauthorized intervention. The plan also supports the presence of professional experts in wildlife management before and during the deforestation actions for the rescue and salvage of fauna.
- The Fauna Rescue and Relocation Plan. The objective of this plan is to rescue and relocate fauna individuals unable to escape through the passages that would be created by the previous Plan. The plan also provides for a Fauna Provisional Rehabilitation Center with infrastructure and equipment required for such activity to facilitate the management of individuals saved in the project.
- Acquisition and legal establishment of a conservation area with 2178 hectares of pristine arboreous caatinga, San Conrado Farm, Municipality of Iramaia; This is well beyond the minimum legal requirement (Law nº 4,771, September 15th, 1965, Código Florestal).

#### *20.5.2.2 Flora*

Vegetation suppression directly and indirectly impacted the flora in the Project Direct Influence Area (DIA). The estimated total vegetation affected by suppression is 150.48 ha, typified by bushy caatinga, bushy/dense caatinga, bushy/arboreal caatinga and dense/arboreal caatinga. The existing biome is at various stages of conservation and diversity.

The potential impact of the Project on the flora is negative based on the studies completed to date. The potential impact will have direct and local coverage because it acts on the directly affected area (DAA) and the direct influence area (DIA), interfering negatively in the dynamics of surrounding populations.

To minimize those potential impacts, it is proposed that ethnobotanical programs be established (through targeted management) to encourage the continuation and multiplication of identified endangered species that have historical-cultural value and are rare. Such a program requires the collection of seeds and seedlings of species (forms of germplasm), for their germination / development in the nursery and the eventual reintroduction to the natural environment. For the success of this program, it is important to identify an appropriate location for the maintenance of seedlings / seedling and training of staff.

### *20.5.3 Environmental Mitigation*

The environmental mitigation plans shown in Table 20-10 and Table 20-11 were proposed as part of the measures to reduce the overall environmental impacts of the Project and were complied with during the different stages of the construction period.

These mitigation measures are intended to facilitate the preservation of the current natural conditions of the site and to reduce the risks that could compromise worker health and safety in a practical, feasible framework.

No conditions were observed by Mineral during their Project audit that would compromise the environment and worker safety. The Project has a very strong commitment to preserve natural resources and to improve the current social conditions at the Maracás micro region.

**Table 20-10 – Mitigation Measures – Operations Phase**

| Subject | Mitigation Measure |
|---|---|
| **Erosion** | Ditching and Silt Catchment |
| | PRAD – Plan of Rehabilitation of Degraded Areas |
| **Land use** | Erosion Control Program |
| **Fauna** | Environmental Training and Awareness Campaign |
| | Environmental Compensation Program – Legal Reserve |
| **Flora** | Erosion Control Program |
| | Environmental Compensation Program – Legal reserve |
| **Surface / underground water** | Discharge Management Program |
| | Water Monitoring Program |
| | Remediation Program |
| **Storm Water Drainage** | Storm Water Natural Drainage Modification Plan |
| | Remediation Plan |
| **Soil** | Erosion Control Program |
| | Soil remediation Plan |
| **Noise** | Noise Monitoring Program |
| | Maintenance Program |
| **Air Quality** | Dust Control |
| | Monitoring Program (MP, NOx, SOx, CO, V, and $NH_3$) |
| | Maintenance Program |
| **Waste Material Disposal** | Waste Management Program |
| **Workers' Safety** | Accident Prevention Plan |
| | Emergency Plan |
| **Fire and Explosion Risk** | Accident Prevention Plan |

## 20.6 Social and Economic Environment

The Vanadium Maracás Project has expended substantial effort characterizing and understanding the socio-economic context of the Project as has been reported in the EIA studies prepared by Integratio, independent consultants responsible for social communication aspects of the Project.

This section summarizes major social and economic impacts arising from various stages of the Project as portrayed in the EIA and Audit report prepared by Mineral Engenharia e Meio Ambiente Ltda.

### *20.6.1 Job and Income Generation*

In accordance with the impact study, the duration of the installation period lasted approximately 22 months. During this period approximately 1,200 jobs were created. The employment generated by the Project is the main benefit to the local population.

During operation, the Project is responsible for generating approximately 430 direct jobs with the majority related to the operation of equipment (crushing, grinding and concentration systems), as well as administrative, managerial and operational positions and approximately 5000 related jobs. For Ilmenite Project, 500 jobs for installation period are expected and 50 direct and 286 related jobs are expected for operational phase.

Wage expenditures are in order of US$ 8,500,000 per year. A sizeable portion is spent in the market of Maracás. The direct spending for goods, services and materials purchased on the local market and additional spending of Maracás County due to increased taxes revenues also provide economic stimulus.

To increase the positive effects on the municipality, management was mandated to give priority to the hiring of local workers and to provide training to people to acquire the necessary skills required for the jobs.

The work force training program is associated with the Environmental Management system, to compensate the population directly affected by the Project, as stated in the performance standard 1 of IFC, “avoid, minimize or offset the negative impacts on workers, communities and the environment.” Training or educating workforce can be an efficient way to benefit the local population with the generation of jobs, since most of the population do not have the skills or education required for the venture.

### *20.6.2 Boosting the Local and Regional Economy*

The municipality has noticed an increase in economic activities which are the result of the creation of new jobs, income generation and increased public revenue.

The distribution of the expenditure pertaining to investment (US$250 million) was as follows: 10% in Maracás, purchase of land, labor, taxes, transport and rents; 30% in the State of Bahia, purchase of cement, supplies, taxes and services; 20% in the State of Minas Gerais, purchase of engineering, services, equipment and steel; 20% in the State of São Paulo, purchase of equipment; and 20% overseas for purchase of equipment from South Africa and China.

To maximize this positive impact, the Company developed a training program for local suppliers with the objective of ensuring that local communities are appropriately included appropriately in the businesses that may potentially affect them.

Largo is focused on strengthening local identity and regional socio-economic development. The Project supports various initiatives related to quality of life, well-being, education, health and cultural appreciation of the communities in which it operates. It also offers professional qualification programs and sustainable projects that allow jobs creation and income for the residents of the city of Maracás.

### 20.6.3 Improvement of Access and Roads

The Company graded and enlarged approximately 42 km of existing dirt road between the villages of Pé de Serra and Porto Alegre during the construction process. This road will be further upgraded and paved through a joint effort with the Bahia State Government. It is proposed that sections of the road be reconstructed, and the entire corridor will be paved with an asphaltic cover, improving the access between villages. It is noted that paving the roads with an asphaltic cover will modify the local hydrological and storm water run-off regimes. The timing of this proposed improvement has not yet been determined due to financial constraints by both the Company and the government of Bahia. A duly protocol has been signed by both parties to that end.

### 20.6.4 Pressure on the Water Supply System

Water supply, water capacity and water availability are heterogeneous and diverse in the municipality. In Maracás and in the district of Porto Alegre, communities that receive most migrants, the currently installed capacity is being subjected to additional demand.

Population increases in the villages of Caldeirãozinho, Pindobeiras, Jacaré, Água Branca and Lagoa Comprida, which rely on water supply through trucks and tanks, necessitate additional water supply. This has resulted in an additional stress to the currently limited supply.

The village of Pé de Serra is supplied by an artesian well with reasonable water availability.

The mine built and commissioned a 25.4 cm diameter, 33 km long water pipeline that brings raw water from Rio de Contas dam to a water treatment plant at the site area for industrial and human use. The system capacity is designed for 250 $m^3$/hr, currently demands only about 100 $m^3$/hr.

As a socio-economic compensation, the Project intends on building a water treatment station in 2018 which will be located near the village of Água Branca that will be handed over to the municipality for water distribution by the municipality.

## 20.7 Geotechnics and Hydrology

Hydrological and geological characterization studies were completed in 2008 by VOGBR and revised in 2011 for Basic Engineering. A summary of these studies is presented in the sections below.

### 20.7.1 Hydrological Studies

The pluviometry and fluviometric data that were incorporated into this assessment were obtained from the Brazilian National Waters Agency (ANA). Stations were selected based on location:

- Pluviometry (rain gauge) Station at Fazenda Alagadiço, ANA code – 01340019.
- Fluviometric Station (flow station using a staff gauge) at Roçados, ANA code – 52265000.

The climatological characterization is derived from average monthly figures from the Ituaçu Station (code – 83,292), obtained from the INMET Publication titled **Normais Climatológicas**, 1992.

#### *20.7.1.1 Climatological Characterization*

The Project area is in the southwestern region of the State of Bahia (Brazil), in the municipality of Maracás. The Maracás climate is classified as Tropical-Monsoon (Am), alternatively called “tropical wet climate” under the Koppen classification (Climatologia do Brasil, Edmon Nimer, 1979). This climate is characterized by hot and semi-arid tropical conditions with 6 dry months. The average annual temperature is 24 °C, with December, January and February being the hottest months, and July and August having the lowest average daily temperatures.

The precipitation regime is characterized by one rainy period during the summer during which the wettest quarter is from November to January and by one dry period in the winter during the quarter ranging from June to August. The average annual rainfall is approximately 600 mm (Figure 20-3) shows the average monthly rainfall for the Project region.

The region’s annual evaporation rate is high, close to 1,600 mm, with approximately 180 hours average monthly sunlight and average relative humidity that varies between 50% to 73%, based on the average monthly data obtained from the Ituaçu weather station.

#### *20.7.1.2 Hydrographical Characterization*

The Project area is contained within the hydrographical basin of the “João” creek, which is a tributary to the right bank of the Jacaré river, which in turn is a tributary to the Rio de Contas. The basin extends over approximately 57.4 k $m^2$ and the length of its main course is 18 km with a 550 m difference of elevation. Water flows are intermittent (Figure 20-3).

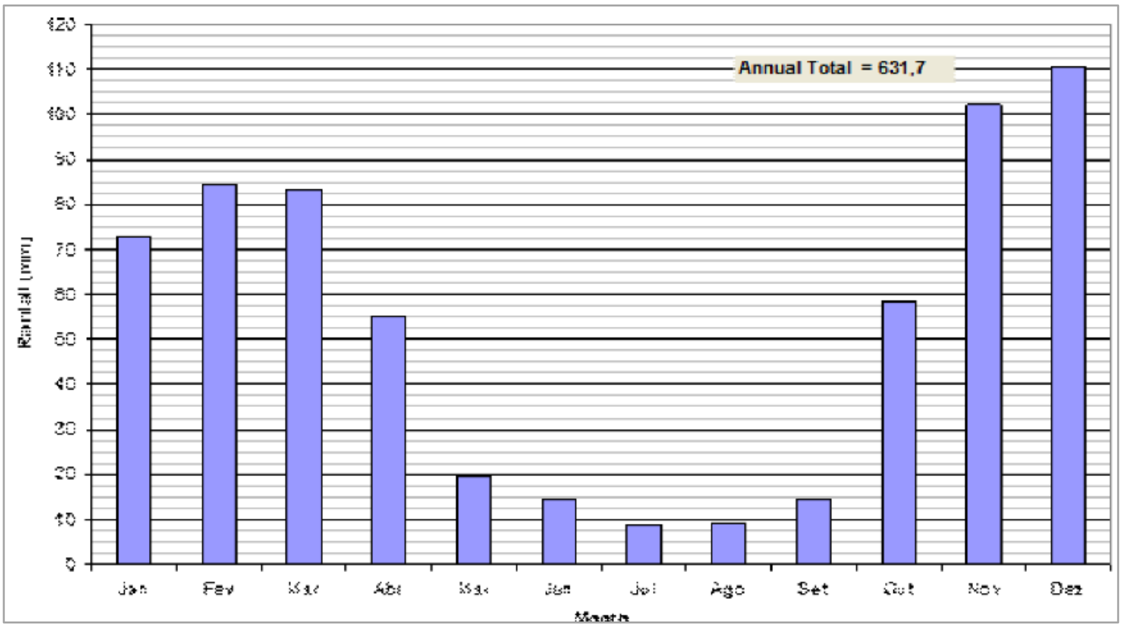



**Figure 20-3 – Average Monthly Rainfall for the pluviometry Station at Fazenda Alagadiço**

Source: ANA code-01340019.

### *20.7.1.3 Intense Rains*

The main characteristics of the intense rains include the total amount of rainfall, the spatial and temporal distribution, and the frequency of occurrence. Intense rainfall data is used in the hydraulic dimensioning of the various project structures (e.g., Probable Maximum Flood; PMF).

The estimated various return periods for rainfall height and intensity ratio (Table 20-11), and for duration and frequency (Figure 20-4), were derived on the basis of statistical treatment of daily rainfall volume figures obtained from the weather station at Fazenda Alagadiço.

**Table 20-11 – Rainfall Rates (mm)**

| Duration | Return Period – TR (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 5 | 10 | 20 | 25 | 50 | 100 | 200 | 500 | 1 | 10 |
| 5min | 5.76 | 7.29 | 8.3 | 9.27 | 9.58 | 10.5 | 11.5 | 12.4 | 13.6 | 14.6 | 17.7 |
| 10min | 10.3 | 13.1 | 14.9 | 16.6 | 17.2 | 18.9 | 20.6 | 22.2 | 24.5 | 26.1 | 31.7 |
| 15min | 14.1 | 17.8 | 20.3 | 22.6 | 23.4 | 25.7 | 28 | 30.3 | 33.3 | 35.6 | 43.1 |
| 20min | 17.2 | 21.7 | 24.7 | 27.6 | 28.6 | 31.4 | 34.2 | 37 | 40.7 | 43.4 | 52.7 |
| 25min | 19.8 | 25.1 | 28.6 | 31.9 | 33 | 36.2 | 39.5 | 42.7 | 46.9 | 50.1 | 60.8 |
| 30min | 22.1 | 28 | 31.9 | 35.6 | 36.8 | 40.4 | 44 | 47.6 | 52.4 | 55.9 | 67.8 |
| 1hr | 31.4 | 39.7 | 45.2 | 50.4 | 52.1 | 57.3 | 62.4 | 67.5 | 74.2 | 79.3 | 96.2 |
| 2hr | 40.4 | 51.1 | 58.2 | 65 | 67.2 | 73.8 | 80.4 | 87 | 95.7 | 102 | 124 |
| 4hr | 48.5 | 61.3 | 69.8 | 78 | 80.6 | 88.6 | 96.5 | 104 | 115 | 123 | 149 |
| 6hr | 52.7 | 66.7 | 76 | 84.8 | 87.7 | 96.3 | 105 | 114 | 125 | 133 | 162 |
| 8hr | 55.6 | 70.3 | 80.1 | 89.4 | 92.4 | 102 | 111 | 120 | 132 | 141 | 171 |
| 10hr | 57.7 | 73 | 83.1 | 92.9 | 95.9 | 105 | 115 | 124 | 137 | 146 | 177 |
| 12hr | 59.4 | 75.2 | 85.6 | 95.6 | 98.8 | 109 | 118 | 128 | 141 | 150 | 182 |
| 14hr | 60.9 | 77 | 87.7 | 97.9 | 101 | 111 | 121 | 131 | 144 | 154 | 187 |
| 24hr | 65.8 | 83.2 | 94.7 | 106 | 109 | 120 | 131 | 142 | 156 | 166 | 202 |

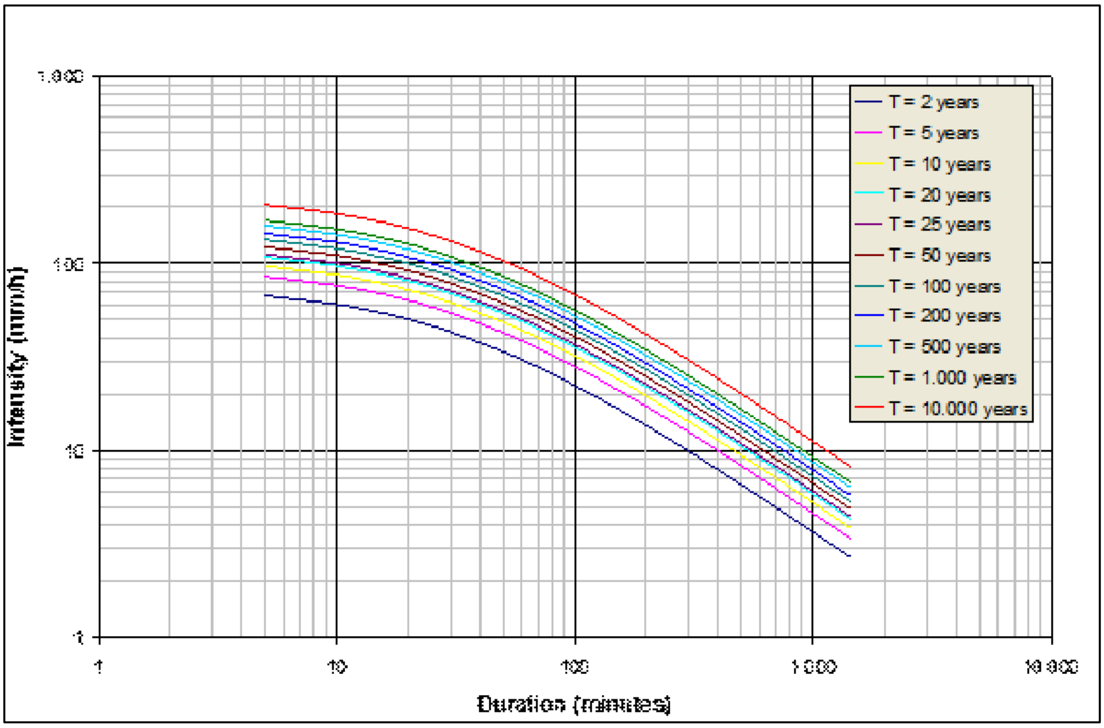



**Figure 20-4 – Intensity, Duration and Frequency Curves**

Source: Largo, 2024.

*20.7.1.4 Design Output Volumes*

The estimated design output volumes were determined to provide input data for use in the hydraulic dimensioning of the structures proposed for the Project.

The design output volumes correspond to 1,000 years return period high water events criteria. Table 20-12 presents the design flow volumes for the proposed hydraulic structures.

**Table 20-12 – Design Flow Volumes for the Hydraulic Structures**

| Structure | Elements | Flow Volume ($m^3/s$) |
|---|---|---|
| Flood Control System | Northern Ridge | 20.6 |
| | Southern Ridge | 202.4 |
| Sediment Catchment | Dyke | - |

*20.7.1.5 Site Water Balance*

The processing plant make-up water requirement during operations is 81.6 $m^3/hr$ where 75.0 $m^3/hr$ is provided from the Rio de Contas and 5.6 $m^3/hr$ is sourced from the water content in the mined ore. The licence provided by the federal water agency, ANA, allows a maximum water taking rate of 300 $m^3/hr$ from the Rio de Contas. The pumping system from the Rio de Contas is sized at 200 $m^3/hr$. There is a circulating water load within the plant with the net make-up being 75 $m^3/hr$.

Figure 20-5 shows a water balance flow chart, involving the structures under consideration and their corresponding flow rates.

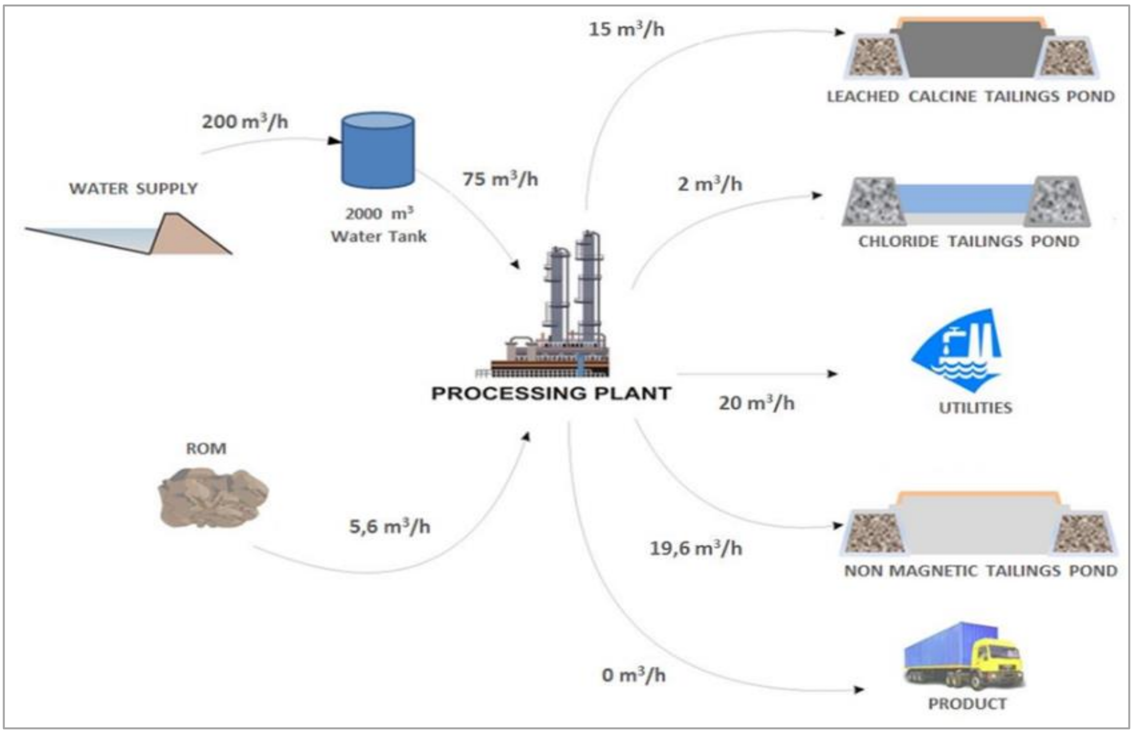



**Figure 20-5 – Flow Chart of the Water Balance for the Project**

Source: Largo, 2024.

Originally, the plan for a conventional slurred tailings system with a tailings pond resulted in a greater demand for water. In response to local stakeholder concerns regarding water supply, this water demand has been reduced with the introduction of ponds and reuse of the water to the plant.

### *20.7.2 Geological / Geotechnical Characterization of the Overall Project Area*

The geological / geotechnical characterization of the Project area is intended to provide input data for engineering design work, namely: the pit, processing plant installations, waste and stockpiles, tailings disposal system and flood control system.

The main activities undertaken to achieve the proposed objectives are as follows:

- Overall geological / geotechnical mapping of the entire installation area.
- Identification, characterization, distribution and use of overburden and outcropping substrate rock materials as cut and fill and foundation material.
- Mapping of areas subject to flooding and waterlogged areas, erosion features, landslides (geohazards) and areas with rock boulders.
- Analysis of field investigations and monitoring, consisting of inspection test pits, geotechnical drilling programs to facilitate in situ viewing of the soil and saprolite stratigraphy.
- Extrapolation and projection of geological / geotechnical vertical sections for the main units within the Project area.

- Characterization of the foundation conditions of the main component units of the Master Plan.

*20.7.2.1 Overall Geological / Geotechnical Characteristics*

The geological / geotechnical mapping for the Project area, in conjunction with the geotechnical investigations, allowed the identification, characterization and mapping of the distribution of the different types of materials throughout the area as illustrated in Table 20-13.

**Table 20-13 – Characterization of Soils and Outcrops in the Project Area**

| Type of Material | Tactile-Visual Classification | Average Thickness (m) |
|---|---|---|
| Alluvium | Yellowish brown, fine to medium-sized sand, with boulders and pebbles of quartz, rare, rounded rock (quartzites, andesites). | 0.2 to 0.5 |
| Red Colluvium | Clayey silt and/or sandy silt matrix, red colored with small amounts of pebbles and granules of quartz or other rock. | 0.5 to 3.0 (max. 8) |
| Brown Colluvium | Brown colored matrix, normally silty, variable quantities of granules and pebbles of weathered rock and/or quartz. | 0.5 to 2.0 |
| Residual Soil / Saprolite | Soils consisting of clayey-silty material with varying amounts of sand and fragments of weathered rock, which may contain foliation structures and veins of quartz. | 1.5 to 3.0 (max. 10) |
| Outcrops | Slightly weathered to very weathered and/or fractured undifferentiated rocks, consisting of granitoids, gabbros, pegmatites, andesites, etc. | Not determined |

**Table 20-14 – Summary of Key Non-Magnetic Tailings Pond 3 Design Aspects**

| Design Aspect | Measurement |
|---|---|
| Maximum height (m) | 20 |
| Length of stack structure (m) | 300 |
| Width of stack structure (m) | 250 |
| Maximum crest elevation (m) | 325 |
| Minimum downstream elevation (m) | 305 |
| Center road width (m) | 10 |
| Height of slopes between berms (m) | 10 |
| Tailings capacity ($m^3$) | 600,000 |
| Maximum area occupied ($m^2$) | 740,000 |

The non-magnetic tailings pond concept consists of a series of ponds formed by rock-fill structures sealed by compacted clayey / saprolitic material as illustrated in Figure 20-6.

The proposed arrangement will be applied to the construction of the various ponds outlined in Table 20-15, which outlines the schedule of pond construction and usage.

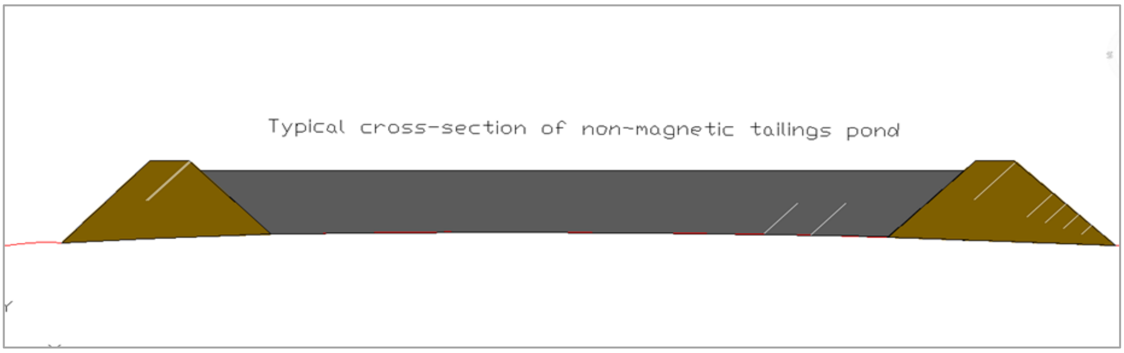



**Figure 20-6 – Typical Cross-Section of the Non-Magnetic Tailings Pond**

Source: Largo, 2024.

**Table 20-15 – Schedule of Non-Magnetic Tailing Pond Construction and Usage**

| Pond | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | |
| 3 | ▓ | ▓ | | | | | | | | | | | | |
| 4 | ░ | ░ | ▓ | ▓ | ▓ | | | | | | | | | |
| 5 | | | ░ | ░ | ░ | ▓ | ▓ | ▓ | ▓ | ▓ | | | | |
| 6 | | | | | | | | ░ | ░ | ░ | ▓ | ▓ | ▓ | ▓ |

**Legend**: ▓ in use for tailing disposal; ░ in construction

In year one the first non-magnetic pond was completed with rejects and a second one was built near and south of the plant and inside the area projected for waste pile. Pond 1 was decommissioned and reused as calcinated tailings I. Pond 2 finished by Feb 2017. Pond 3 operated until 2019. Pond 4 was constructed with rock waste from the mine and started 06/2019 and is expected to operate until April 2024. Ponds 5, 6 and 7 ware projected to build with waste from the mine during the years 2023 and 2028. Environmental license regarding Tailings Pond 6 and 7 was issued by April 2023, shown in Figure 20-7. Pond 6 beginning to be built with rock waste by September 2023 and is expected to start to receive materials by March 2024.

The pond construction sequence consists of stages of vegetation clearing, removal of organic topsoil and other material until the appropriate foundation depths are achieved for rockfill structures.

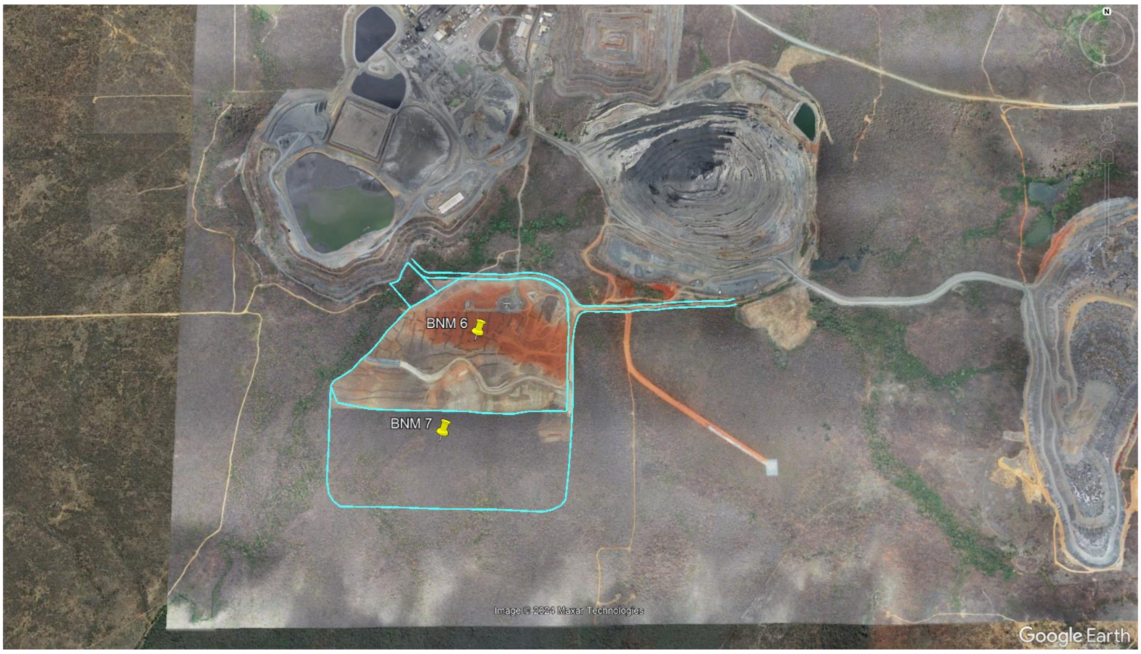



**Figure 20-7 – Layout of Non-Magnetic Tailings Ponds**

Source: Largo, 2024.

### *20.7.2.2 Tailings Disposal Facilities*

The tailings generated by the ore process are of three types: leached calcine from the processing kiln discharge, filter cake from the desilication process and chloride control purge from the evaporation circuit.

The leached calcine tailings are discharged into the Leached Calcine Tailings Stack. The desilication process tailings and the chloride control purge tailings will be deposited in the Chloride Control Purge Tailings Pond. The intended construction location for these ponds is northwest of the open pit, close to the processing plant.

The dikes were built using compacted earth and their base areas are leak-proof using a double-layer geomembrane liner featuring a leak detection system. The construction consists of clearing vegetation from the areas to be occupied by the ponds, removal of organic material, and excavation of material inappropriate for foundations. The perimeter of each pond will be protected by rock-fill channels.

The leached calcine tailings stack was built initially as a first stage to manage the first two years of production. The pond will later be expanded, if required, in a different location, to accommodate Life of Mine (LOM) tailings production for the expanded production scenario.

The initial Chloride Control Purge Pond has been built to accommodate 3 years of tailings production. The pond will later be expanded, if required, in a different location, to accommodate LOM tailings.

Typical sections of the leached calcine stack and chloride control purge ponds are presented on Figure 20-8 and Figure 20-9, respectively.

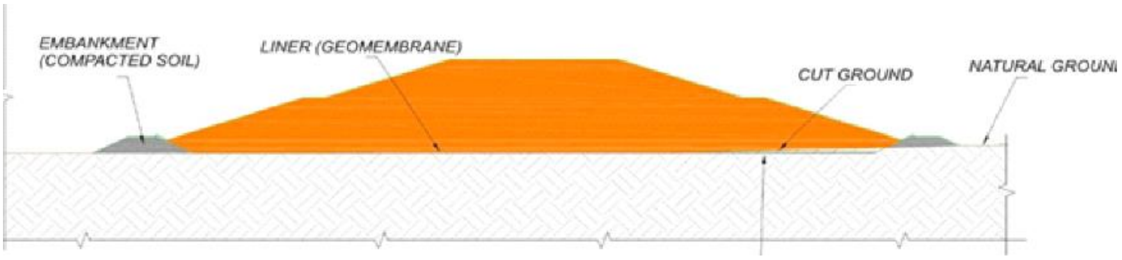



**Figure 20-8 – Typical Cross-Section of the Leached Calcine Tailings Stack**

Source: Largo, 2024.

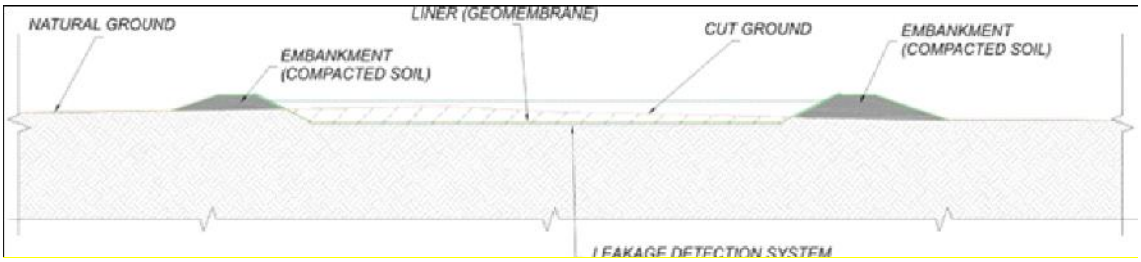



**Figure 20-9 – Typical Cross-Section of the Chloride Control Purge Pond**

Source: Largo, 2024.

The main geometric characteristics of the Leached Calcine Tailings Stack and the Chloride Control Purge Pond are presented in Table 20-16 and Table 20-17, respectively.

**Table 20-16 – Main Geometric Characteristics of the Leached Calcine Tailings Stack**

| Design Aspect | Measurement |
|---|---|
| Maximum dike height (m) | 12 |
| Area occupied ($m^2$) | 120,000 |

| Design Aspect | Measurement |
|---|---|
| Maximum capacity (volumetric; $m^3$) | 2,500,000 |
| Slant of pond slope | 1V:2H |
| Slant of pile slope | 1V:3H |
| Maximum height of the slopes between the berms (m) | 10 |
| Pile berm width (m) | 5 |
| Pond crest width (m) | 7 |

The leached calcine tailings stack is sized according to 10 years of operation at the expanded production rate. The design will be updated to accommodate tailings storage requirements beyond production Year 10.

**Table 20-17 – Main Geometric Characteristics of the Chloride Control Purge Pond**

| Design Aspect | Measurement |
|---|---|
| Maximum height (m) | 5 |
| Area occupied ($m^2$) | 10,000 |
| Maximum capacity (volumetric; $m^3$) | 17,500 |
| Slant of pond slope | 1V:2H |
| Pond crest width (m) | 7 |

The chloride control purge pond is sized according to 10 years of operation at the expanded production rate. The design will be updated to accommodate tailings storage requirements beyond production Year 10.

#### *20.7.2.3 Flood Control System*

The designated area for the Campbell Phase 1 open pit intercepts the João Creek and three direct tributaries. Consequently, installation of a protection system is required to impede the influx of surface water runoff into the pit to allow mining activities to proceed.

For the initial phase, VOGBR proposed that the pit protection system consist of dikes and channels. The selection of this design allows for a good balance between the volume of earth cuts and landfills. However, following ensuing project development it was decided to use a system of protection ridges because of the proximity and the economical usage of waste material from within the open pit. The efficacy of the seepage collection system has not been assessed quantitatively (i.e., theoretical seepage losses versus observed seepage); however, VMSA is currently installing monitoring wells through the walls of the ponds to check and assess any potential bypass seepage. These wells are in addition to monitoring wells installed during construction.

The revised conceptual system was designed with a pair of ridges located around the open pit designated as the Northern Ridge and the Southern Ridge. The intent is to redirect the water downstream from the open pit. The protection ridges form a barrier around the open pit to intercept the watercourses and to raise their water levels above localized topographical elevation variations. The diverted flow then discharges as surface runoff downstream from the open pit.

The design specifics for the Ridges were dictated by the design basis criteria of a 100 m minimum setback distance from the final pit extent. Furthermore, issues relating to the volume of landfill, feasibility of execution and hydraulic workings were also considered in efforts to optimize the adopted system.

The protection ridges have been installed pursuant to the mining activity plan defined for the Campbell Phase 1 pit. The North and South Ridge were completed by the end of Year 2. Vegetation clearing, removal of organic materials, and excavation of appropriate materials for foundation preceded the construction of the ridges. Two levies / ridges are part of the conceptual plan that was developed during the construction period. This conceptual plan indicates the use of an upstream clay-lined “wall” to store storm water during the rainy season and prevent water from entering the pit and retain sediment carried by the runoff water.

Consequently, the water management in the vicinity of the pit is effectively a “closed system”, whereby water pumped from the pit is discharged above the berms and reports back towards the pit or evaporates.

The use of overburden material from the Campbell Phase 1 pit was included in the protection ridge designs. Accordingly, the ridge structures were designed to consist of rock fill, transition material and compacted earth (residual soil / saprolitic material). A summary of the main ridge characteristics is provided in Table 20-18.

**Table 20-18 – Main Characteristics of the Ridges**

| Design Aspect | Ridge Measurement | |
|---|---|---|
| | Northern | Southern |
| Maximum height (m) | 14 | 13 |
| Length of structure (m) | 915 | 875 |
| Maximum crest elevation (m) | 312 | 313 |
| Minimum downstream elevation (m) | 298 | 300 |
| Slant of downstream-side embankment | 1V:1.5H | 1V:1.5H |
| Crest width (m) | 6 | 6 |

NCL do Brasil further advanced the design of the waste pile and ore stockpile based on geometric parameters defined by VOGBR.

The material from the open pit will be placed on the waste pile or the ore stockpile, as varying sizes of boulders. The design criteria geometry for the proposed waste pile can be seen in Section 16.

## 20.8 Current Activities and Plans

The Project construction was concluded in May 2014 and the key ongoing socio-environmental activities consist of community meetings and communication, water, aquatic biota, fauna and flora monitoring, air quality checks and stacks emissions monitoring in 2021 are still in place.

The Action Plan containing the integrated framework of environmental management plan components during operations is in place and an adequate environmental management and structure is active following Environmental Social Health and Safety and Governance – ESG aspects are demanded nowadays.

#### *20.8.1 Project Organization and Sustainability Team*

To fulfill Largo's commitments to complying with the Equator Principals, a Sustainability Team was created in February 2011 and was increased during the years. It consists of the following skills and positions:

- One Sustainability General manager
- One Environment and Management System Coordinator
- One Safety / Health Coordinator responsible for the operation
- One Safety Engineer and four Safety Technicians
- One Agronomist
- One Biologist
- One Senior Communities Analyst

The Sustainability General Manager report directly to the Operational Director. The participation of senior corporate management relating to the environmental aspects of the Project is required for the implementation of the EMPs described in the Actions Plan.

#### *20.8.2 Equator Principles Audit Review*

As mentioned previously, Largo and its subsidiary, Vanádio de Maracás S.A. have committed to comply with best management practices accepted by the International Mining Industry, all Brazilian environmental laws and regulations, and the conditions of all environmental permits issued for the Project.

A finance consortium composed of Itaú-BBA, Bradesco and Banco Votorantim have provided a portion of the finance for the Project in the form of a loan. A requirement for such financial Institutions / IFC Guidelines related to participation in projects such as the Maracás Menchen Project is the performance of a socio-environmental audit by a qualified, independent third party. In discussion with Bank representatives, it was agreed that the audit could be performed by Mineral Engenharia em Meio Ambiente Ltda. (Mineral), a well-known environmental engineering consulting firm, familiar with project permitting in Brazil and having recognized expertise in the performance of environmental audits.

The scope of the audit followed generally accepted auditing principles, reviewing the Ten Equator Principles and respective Performance Standards.

As part of the background review, an evaluation of the permitting and regulatory environment surrounding the Project was completed. This involved a review of the currently issued permits and permits that are pending or in the process of being obtained. During the EIA process, several commitments were made by the Project in the form of preparing and adopting a series of Environmental Management Plans. The content, status and implementation of these plans was reviewed and assessed. The EMP review and the implementation of the environmental management process required for the Project was also assessed with respect to the status of the Project during the audit. This included a review of Largo's monitoring of the Project and the Project's compliance with its permits and internationally accepted best management practices.

### *20.8.3 Socio-Environmental Action Plan and Environmental Management System*

The Action Plan is an outcome of Equator Principle nº 04. It states that an action plan should be drawn up with a description of the actions required for management of any mitigation measures, corrective actions and supplementing measures identified through the Environmental Assessment.

The Action Plan was drawn up by VMSA corporate staff jointly with Mineral, and it incorporates compliance requirements with Brazilian laws and regulations and applicable environmental performance standards and EHS guidelines.

The list of programs is presented below and summarized in Table 20-19.

**Table 20-19 – Action Plan – Environmental Programs**

| Program | Description | Phase |
|---|---|---|
| 1) Environment, Health, and Safety Organization Plan | Plan to manage, apply and supervise the Safety, Health and Environment plans | Construction and Operation |
| 2) Fauna Management Plan | Plan to manage and protect wild fauna | Construction and Operation |
| 3) Forest Management Plan | Plan to manage and protect forests | Construction and Operation |
| 4) Aquatic Biota Management Plan | Plan to manage and protect forests. | Construction and Operation |
| 5) Water Management Plan | Plan to manage industrial and domestic waste waters and their treatment prior to releases to the environment | Construction and Operation |
| 6) Surface Water Management Plan | Plan to manage industrial and domestic waste waters and their treatment prior to releases to the environment | Construction and Operation |
| 7) Waste Management Plan | Plan to manage the solid waste, inert industrial wastes and oily contaminated soils at the Project | Construction and Operation |
| 8) Environmental Monitoring Plan | Plan to monitor specific aspects throughout the life of the mine. Establishment of an "Observer Commission" consisting of local government, ONGs, County leaders, which regularly assess the implementation of the Project | Construction and Operation |
| 9) Plan Rehabilitation of Degraded Areas | Plan to manage the rehabilitation and reclamation activities of the mine site | Construction and Operation |
| 10) Plan of Social Communication | Plan to manage the public and internal communication to assure transparency and democratization of information | Construction and Operation |
| 11) Plan of Hiring Local People | Plan to hire 60% of people from Municipality of Maracás | Construction |
| 12) Plan of Labor Training | Plan to manage the training of skills and competences of local people for project opportunities | Construction and Operation |
| 13) Plan of Guidance of Local Suppliers | Plan to guide local suppliers on project opportunities for new business | Construction |
| 14) Health and Safety Plans | Risk Management Plan – PGR<br>Environmental Risks Prevention Plan – PPRA<br>Health Control Plan – PCMSO | Construction and Operation |

| Program | Description | Phase |
|---|---|---|
| 15) Contingency Plan | Plan to identify and enforce actions in the event of unforeseen events or an “upset” condition and to simulate emergency response | Construction and Operation |
| 16) Closure and Reclamation Plan | Plan to identify the concurrent and ultimate reclamation and closure of the mine area and any off-site impacts or disturbances | Decommissioning |

The Mine Closure and Reclamation Plan calculated for includes expenses, covering mine site, plant, stockpile, tailing dams, waste disposal area, buildings and facilities. Mine closure costs are present in the Section 21 of this report.

The Project must meet the standards required with respect to the legal aspects of the environmental licensing process and the License of Implementation and Operation and Environmental Control Programs and be consistent with the Equator Principles as required by the IFC and the banks (Itaú, Votorantim and Bradesco) financing a portion of the Project.

Integration has been involved with the Project since November 2012 providing guidance and support for the physical, biotic and anthropic / socio-economic characteristics of the Project. The objective of the integration of the three characteristics is to meet the requirements of the PD and the IFC, while observing the conditions and restrictions of all licenses.

The audit company for the PD is Mineral Engineering and Environment (MEE). They have performed audits during the years, e.g., the first being in December 2011, September 2015 and is planned to occur regularly during the Project life. MEE through the course of their audits have identified certain non-conformities (documents PD01, PD02, PD03, PD04, and PD08). These non-conformities are being addressed. Existing response mechanisms are being amended and where no response mechanism exists, new ones are being developed.

The general planning consists of the following:

- Situational Diagnosis including:
  - Analysis of the Social-Environmental Aspects of the Project.
  - Stakeholders Mapping and Analysis:
    - assessment of the requirements and referential of development;
    - performance standards of the IFC;
    - conditions of the environmental control programs;
    - current activities and commitments.
  - Impacts and expectations for the role of the Company by the stakeholders:
    - geographic scope (areas of influence);
    - relevant environmental questions / concerns.
- Operationalization:
  - Action Plan:
    - macro plan;
    - detailing;
    - monitoring of implementation.
  - Evaluation:

  - internal pre-audits;
  - external audit (preparing and monitoring);
  - periodic follow up with financial agents and external audit.
  - Internal Governance:
- Constitution of the Environment Evaluation and Management System (Performance Standard 1 of the IFC):
  - definition of the full monitoring programs for the physical, biotic, and social economic dimensions of the Project.
- Empowerment of the Sustainability Coordinator on the Best Management Practices.
- Implementation of the Social-Environment Internal Committee.
- Addressing and responding to internal demands.
- Definition of the monitoring and evaluation criteria (performance indexes).

* Development of Social Investment and Responsibility Guidelines.
* Design of Projects and Programs for local development and environmental impact mitigation.

During MEE's audit, Performance Standards 1 (PD-1) was adhered to which focuses on the structure of the Environmental Evaluation and Management System. Integratio's priority is for the consolidation of these systems to enable the Company to answer the social, environmental, and economic demands of the Project.

It is important to emphasize the social and environmental investment requirement of the Banco Nacional de Desenvolvimento (BNDES), which is to strengthen the social and economic development of the regions that will receive investments.

The requirement of addressing the social and economic values is a new approach for BNDES which now places an emphasis on sustainable development initiatives to not cause social, economic and environmental impacts to the surrounding regions of the Project.

The Main Equator Principles Framework for VMSA Social Investments are as follows.

* Principle 2: Social and Environmental Assessment:
  - This assessment proposes mitigation and management relevant and appropriate to the nature and scale of the proposed project:
    - social assessment (main impacts from environmental impact study);
    - population expectations;
    - provide employment and income;
    - stimulation of local and regional economy – investment.
* Principle 3: Applicable Social and Environmental Standards:
  - This assessment will refer to the applicable IFC Performance Standards:
    - Performance Standard 1 – Management System and Environmental Assessment: Stakeholders Engagement.

- Principle 5: Consultation and Disclosure:

For projects with significant adverse impacts on affected communities, the process will ensure there is informed consultation and opportunity for participation to address any issues.

The Main IFC approach for VMSA Social Investments is as follows.

- Addressing the Social Dimensions of Private Sector Projects – Good Practice Note (IFC):
  - Traditionally, the "do-no-harm" approach of the World Bank Group's social safeguard policies has made social mitigation plans the primary entry point for distributing benefits to local communities impacted by IFC investments.
  - Unlike mitigation and compensation which have important but limited objectives of protecting affected persons from adverse impacts, sustainable development actions enable the wider population in a project's area of influence to gain access to and take better advantage of the range of opportunities brought about by private sector development.

Regarding Environmental, Social and Governance – ESG aspects, VMSA has initiatives to identify and manage risks related to material ESG issues, i.e., community involvement programs, health and safety management, greenhouse gas emission inventory and report relevant ESG data to shareholders and stakeholders. Additional work and data collection will be done to achieve market and community ESG requirements.

#### *20.8.4 QP Opinion*

What follows is a summary of the socio-environmental analysis developed for the Project to support, from the environmental point of view, the considerations of Qualified Person's Opinion.

The referred opinion was based exclusively on the information provided by Largo, which served as the foundation for the assessments conducted.

In summary, Largo presented documentation highlighting environmental management during its operations, adhering to Environmental, Social, Health and Safety, and Governance (ESG) aspects.

The information presented includes references to the main regulatory acts for environmental licensing and the control of compliance with the conditions of environmental licenses. Additionally, it mentions good environmental management practices and the primary environmental control and monitoring actions, such as solid waste management, air quality monitoring, noise and vibration monitoring, water quality monitoring (including effluents), execution of the environmental educational program, fauna monitoring, and environmental recovery and mine closure measures related to environmental licensing.

The Project is in operation, duly licensed by the competent state body, Inema, whose environmental studies did not present any impediments to the implementation and operation of the Project. Moreover, it complies with international technical standards, such as those of the IFC. The operation of the Project, combined with the environmental control measures provided for in the Environmental Control Plan, guarantees the maintenance of the current environmental license and the respective operation of the Project.

# 21 CAPITAL AND OPERATING COSTS

The capital cost estimate includes all direct and indirect costs, along with the appropriate contingencies necessary for production. All equipment and materials are considered new. The execution strategy is based on an Engineering, Procurement, and Construction Management (EPCM) implementation and a horizontal (discipline-based) construction contract package.

The Company's strategy is focused on continuing to seek ways to increase the amount of vanadium and titanium Resources through NAN, SJO, NAO and GAN deposits, installing a new kiln to increase the capacity to process vanadium ore, expanding the ilmenite flotation plant, and potentially developing the Pigment Plant in Camaçari City.

The CAPEX estimate meets the international AACE classification standard, and each project is in a different class.

The Ilmenite Plant at the Maracás Menchen Mine site has a capacity to produce 196 ktpy of ilmenite concentrate from the Campbell Pit non-magnetic concentrate. Construction of the Ilmenite Plant was concluded in 2023, and initial production of ilmenite concentrate began in August 2023.

The project to install a second kiln to increase the capacity of the vanadium plant involves the installation of a kiln designed for a 20 t/h feed rate, increasing the nameplate capacity of the roasting area from 487.7 ktpy to 648.6 ktpy. The current capital cost estimate has an accuracy level corresponding to an AACE Class 4 estimate, which ranges from -30% to +50% accuracy. An engineering project to improve the CAPEX estimation to Class 3 will be executed in 2025, with construction starting in 2026. Ramp-up will commence in 2027, and by 2028, the plant will operate at its nameplate capacity.

The proposed Pigment Plant, with a nameplate capacity of 100 kt of $TiO_2$ per year, would be implemented in 2029 in Camaçari, Bahia, Brazil. The current capital cost estimate has an accuracy level corresponding to an AACE Class 4 estimate, which ranges from -30% to +50% accuracy. An engineering project to improve the CAPEX estimation to Class 3 would be executed in 2025, with construction beginning in 2026. Ramp-up would start in 2029 and would be completed in 2031, when the plant would operate at its nameplate capacity.

The project to expand the Ilmenite Plant involves increasing the nameplate capacity of Ilmenite Plant from 196 ktpy to 265 ktpy to meet the demand of Largo's proposed Pigment Plant. The current capital cost estimate has an accuracy level corresponding to an AACE Class 4 estimate, which ranges from -30% to +50% accuracy. An engineering project to improve the CAPEX estimation to Class 3 will be executed in 2027, with construction starting in 2028. Ramp-up will commence in 2029, and the plant will operate at its nameplate capacity in the same year.

The Campbell Pit will be depleted by 2032, and the NAN deposit will replace it as Largo's main pit. After NAN, operations will shift to SJO, NAO and GAN respectively as the main pits. For the NAN, SJO and NAO operations, a rented mobile crushing unit will be installed near the respective pits.

The capital cost estimate reflects an approach based on key engineering deliverables that define the scope of the Project. Sustaining capital costs encompass process plant maintenance, infrastructure upkeep, tailings management, and contingency.

The capital cost estimate (CAPEX) was developed under the following assumptions:

- Estimated currency: US dollar (US$).
- Exchange rate: 1.00 = R$ 5.10.

Details of CAPEX related to the expansion steps are provided in sections 21.1 to 21.4.

## 21.1 Mining Costs

Currently, Largo has a mining fleet contract with the Consórcio Maracás – Dinex | EXE Mineral (CM), which operates the Campbell Pit. There is no CAPEX required for the mine fleet. NAN, SJO, NAO and GAN mines will also be operated by the contractor, with no CAPEX needed for the fleet.

Mining CAPEX includes the preparation of 6 km haul road linking NAN to the Campbell beneficiation plant (US$0.9 million).

## 21.2 Processing Plant and Infrastructure

The Ilmenite Plant was constructed at the Maracás Menchen Complex, and investments in the vanadium processing facilities will also be made at the same Complex. The proposed Titanium Plant for pigment production would be in Camaçari, BA. The deployment and expansions will occur as follows:

- Construction of the proposed Pigment Plant (100 ktpy of $TiO_2$ pigment) would start operation in 2028.
- Expansion of Ilmenite Plant to 265 ktpy of ilmenite concentrate starting operation in 2029.
- To prepare plant CAPEX estimates, the following criteria were considered:
- Direct quantities: direct costs were estimated for the main mechanical equipment. Other permanent equipment, materials, and labor associated with the physical construction of the site infrastructure, process plant, and ancillary facilities were factored based on similar projects.

- Quotation Requests: Budget quotes were obtained from pre-approved vendors for all major equipment. These quotes were benchmarked against pricing for similar equipment from databases. Pricing for minor equipment was sourced from a general database. Examples of quoted equipment include:
  - ammonium sulfate drying system;
  - sodium carbonate kiln & cooler system;
  - reactors;
  - agitators;
  - pumps;
  - conveyors;
  - filters;
  - tanks;
  - others.

Contractor's Indirect Costs: Contractor's indirect costs are part of civil works and cover the mobilization and demobilization costs of labor, equipment, and contractor facilities to and from the Project site.

Engineering, Procurement and Construction Management Services (EPCM): EPCM costs, necessary for execution of the Project, include detailed engineering, drafting, project management, and project controls hours. These costs were estimated applying a typical factor over direct cost.

- Owner's Costs: Owner's costs include consultants required for subsequent project phases, such as:
  - risk analysis;
  - project team;
  - diligence and inspection;
  - technology control;
  - project insurance;
  - duties and taxes.

Duties and taxes for the Project are incorporated into the capital costs and were considered at their full amount, without accounting for incentives or taxes reductions. This estimate contains all local, state, and federal taxes, as well as import duties on a line-item basis.

- Exclusions: The capital cost estimate is based on the following exclusions and qualifications:
  - cost of bankable feasibility study, financing, and interest during construction are excluded;
  - sunk costs are excluded.

#### 21.2.1 Ilmenite Concentrate Plant (196 ktpy Concentrate)

The Ilmenite Concentration Plant (Ilmenite Plant) with a capacity to produce 196 ktpy of ilmenite concentrate per annum from the Campbell Pit non-magnetic concentrate was installed in 2023 and has been operating since August 2023. Until the Pigment Plant starts operating, all the ilmenites would be sold in internal and external markets. After 2029, most of the ilmenite concentrate would be directed to the Company's new Pigment Plant, which is planned for construction in Camaçari, Bahia, Brazil. Ilmenite concentrate production is expected to supply all necessary feedstock for the Pigment Plant, with any surplus being sold in the open market.

#### 21.2.2 Second Kiln (2027-2028)

The project to install a second kiln to increase the capacity of the vanadium plant involves installing a kiln designed for 20 t/h feed rate, increasing the nameplate capacity of the roasting area from 487.7 ktpy to 648.6 ktpy. The current capital cost estimate is classified as an AACE Class 4 estimate, which ranges from -30% to +50% accuracy. An engineering project to improve the CAPEX estimation to Class 3 will be executed in 2025, with construction starting in 2026. The ramp-up is scheduled to begin in 2027, and by 2028, the plant will operate at its nameplate capacity.

#### 21.2.3 Titanium Pigment Processing Plant (2025-2030)

The proposed $TiO_2$ Pigment chemical processing plant would be installed in Camaçari, Bahia, Brazil, with a nameplate capacity of 100 ktpy of $TiO_2$ pigment. The Company estimates requiring a total investment of US$480.1 million.

The proposed Pigment Plant with a nameplate capacity of 100 kt of $TiO_2$ per year would be implemented in 2028 at Camaçari, Bahia, Brazil. The current capital cost estimate is classified as an AACE Class 4 estimate, with an accuracy range from -15% to 50%. An engineering project to improve the CAPEX estimation to Class 3 would be executed in 2025, with construction beginning in 2026. Ramp-up would be scheduled to start in 2029 and would be completed in 2031, when the plant would operate at its nameplate capacity.

Table 21-1 shows CAPEX estimation for new $TiO_2$ Pigment with capacity 100 ktpy of concentrate.

**Table 21-1 – Process Plant CAPEX - $TiO_2$ Pigment - 100 ktpy**

| | | M R$ |
|---|---|---|
| **Equipment per Area** | Total | 1,307.1 |
| | Digestion | 118.1 |
| | Filtration and Crystallization | 188.6 |
| | Hydrolysis | 97.6 |
| | Seeding Preparation | 33.5 |
| | Roasting | 156.7 |
| | Treatment of Roasting Discharge | 66.2 |
| | Residue Treatment | 105.8 |
| | Water Treatment | 96.1 |
| | Milling | 116.3 |
| | Pós Milling Treatment | 7.1 |
| | Filtration | 52.5 |
| | Drying | 23.0 |
| | Micronization | 68.1 |

| | | M R$ |
|---|---|---|
| | Packing | 27.4 |
| | Residue Treatment | 28.0 |
| | Chemicals | 37.9 |
| | Utilities | 45.5 |
| | Other Equipment | 38.7 |
| **Other - Assembly, Civil Works, Engineering, Procurement, Construction, 5% Contingency** | | **1,141.1** |
| **Total** | | **2,448.3** |
| **Total M US$** | | **480.1** |

Source: GE21, 2024.

### *21.2.4 Ilmenite Concentration Plant Expansion (2027-2030)*

The Company will perform an expansion of its Ilmenite Plant in Maracás to support its proposed Pigment Plant, increasing the nameplate capacity to a new average production rate of approximately 265 kt of ilmenite concentrate per year. The Company plans to invest US$22 million to support this expansion. Ilmenite production will meet the needs of the Pigment Plant, and any surplus ilmenite is expected to be sold in the open market.

### *21.2.5 Site Preparation for NAN, SJO, NAO and GAN (Roads / Access).*

The Campbell Pit is scheduled to be depleted in 2032, after which the Company plans to commence mining and processing its other deposits. The first deposit to be mined will be NAN starting in 2032.

A rented mobile crushing plant circuit will be installed near the NAN orebody, approximately 6.5 km from the Campbell Pit. The estimated cost of the crushing plant is US$7.99 per tonne of ROM. The rented crushing plant will be configured for dry magnetic separation, and the pre-concentrate will be transported by trucks to the existing milling circuit.

## 21.3 Tailings Ponds

All the tailings generated in Maracás are disposed in ponds structured to receive and contain these residues for several years. These ponds are constructed using waste from mine and geosynthetic material to ensure structural safety. By the end of the mine’s life, a total investment of US$66 million will have been made in these facilities.

## 21.4 Sustaining Capital Cost

The estimated sustaining capital costs from 2024 to 2050 average US$7.5 million per year, which includes provisions for new plants and their expansions.

## 21.5 CAPEX Summary

Table 21-2 provides a summary of the Project's CAPEX, Sustaining CAPEX, and estimates for Mine Closure over the respective years.

LARGO

GE21 Consultoria Mineral

## Table 21-2 – CAPEX summary

| Period | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tailing Ponds | 5.92 | 0.68 | 4.34 | 3.61 | 2.43 | - | - | 4.58 | 3.93 | 2.43 | - | - | 4.56 | 5.04 | 2.43 | - | - | 4.58 | 3.22 | 2.43 | - | - | 4.52 | 5.82 | 2.43 | - | - | 2.18 | 0.53 | 0.49 | - | - | - | - | - | - | - | - |
| Roads / Access to NAN&GAN | - | 0.90 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| $V_2O_5$ Expansion Second Kiln (+20tph) | - | 1.00 | 18.99 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Ilmenite Plant @ Maracás - 265 ktpy | - | - | - | 0.22 | 20.90 | 0.88 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| $TiO_2$ Pigment Plant 100 ktpy | - | 4.80 | 43.21 | 211.24 | 211.24 | 9.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total CAPEX** | **5.92** | **7.24** | **65.30** | **209.01** | **228.52** | **10.21** | **-** | **4.58** | **3.93** | **2.43** | **-** | **-** | **4.56** | **5.04** | **2.43** | **-** | **-** | **4.58** | **3.22** | **2.43** | **-** | **-** | **4.52** | **5.82** | **2.43** | **-** | **-** | **2.18** | **0.53** | **0.49** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| SUSTAINING CAPEX | 13.20 | 5.70 | 8.10 | 8.73 | 8.73 | 9.89 | 11.06 | 13.39 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | 15.72 | - | - | - | - | - | - | - |
| **Total CAPEX+Sustaining CAPEX** | **19.12** | **12.94** | **73.40** | **217.74** | **237.24** | **20.10** | **11.06** | **17.97** | **19.66** | **18.15** | **15.72** | **15.72** | **20.28** | **20.76** | **18.15** | **15.72** | **15.72** | **20.30** | **18.94** | **18.15** | **15.72** | **15.72** | **20.24** | **21.54** | **18.15** | **15.72** | **15.72** | **17.90** | **16.25** | **16.21** | **15.72** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| MINE CLOSURE | 2.78 | 4.09 | 4.39 | 4.20 | 5.53 | 7.24 | 8.52 | 10.88 | 8.90 | 8.38 | 8.57 | 8.78 | 8.49 | 8.25 | 8.29 | 8.14 | 8.03 | 7.61 | 7.59 | 7.78 | 8.24 | 8.35 | 7.82 | 7.84 | 7.72 | 7.76 | 7.84 | 8.30 | 8.61 | 7.88 | 6.39 | 5.62 | 5.62 | 5.62 | 5.62 | 5.62 | 5.62 | 4.72 |

Source: GE21, 2024.

## 21.6 Operating Cost Estimate

The operating costs encompass expenses related to mining, process plants, and general administration (G&A) across various Project phases. All costs are expressed in US dollars. Expenditures and costs were primarily derived or calculated from spreadsheets and information compiled by Largo, reflecting actual costs incurred from 2024 onwards.

### *21.6.1 Mining Cost Contracts*

Largo's unit mining costs are based on the current contract with Consórcio Maracás – Dinex | EXE Mineral (CM). Loading and haulage operations are conducted by Consórcio Maracás using Sany SY750 and SY980 hydraulic excavators with bucket capacities of 4.2 and 5.5 $m^3$, respectively, for ore and waste loading. Transportation is facilitated by Mercedes Benz and Volvo 8x4 trucks, with capacities of 20, 22 and 22 $m^3$. The unit cost is determined based on loading, transportation, and haul distance, detailed in Table 21-3. Table 21-4 presents the average mining costs for project related to Campbell Pit, NAN, SJO, NAO, and GAN mines.

**Table 21-3 – Contract Loading & Haulage Costs**

| Haulage Distance (km) | Cost of Haulage, Load and Spread (US$) | |
|---|---|---|
| | Ore | Waste |
| 0 to 0.50 | 1.60 | 1.48 |
| 0.51 to 1.0 | 1.63 | 1.55 |
| 1.01 to 1.5 | 1.74 | 1.63 |
| 1.51 to 2.0 | 1.77 | 1.67 |
| 2.01 to 2.5 | 1.91 | 1.76 |
| 2.51 to 3.0 | 2.01 | 1.91 |
| 3.01 to 3.5 | 2.14 | 2.01 |
| 3.51 to 4.0 | 2.30 | 2.11 |
| 4.01 to 4.5 | 2.33 | 2.21 |
| 4.51 to 5.0 | 2.43 | 2.35 |
| 5.01 to 5.5 | 2.54 | 2.50 |
| 5.51 to 6.0 | 2.67 | 2.64 |
| 6.01 to 6.5 | 2.82 | 2.78 |
| 6.51 to 7.0 | 2.97 | 2.94 |

Source: Largo, 2024.

**Table 21-4 – Operating Costs - Mining**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| **Mining** | Transportation | **US$/ t moved** | 1.44 |
| | Diesel oil | | 0.34 |
| | Drilling | | 0.45 |
| | Blasting | | 0.35 |
| | Equipment rental | | 0.04 |
| | Labor | | 0.14 |
| | Other | | 0.16 |
| | Topography | | 0.03 |
| **Total Mining Costs** | | **US$/ t moved** | **2.94** |

Source: GE21, 2024.

### *21.6.2 Processing Cost*

The OPEX estimate for the Vanadium Plant and its expansion was estimated based on current plant data. OPEX for the Ilmenite and Titanium Plants was derived from similar operations and quotations. All OPEX estimates are summarized in Table 21-5 to Table 21-7.

**Table 21-5 – Operating Costs - Vanadium Processing**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Vanadium Processing | Reagents and Consumables | US$ / t ore fed | 16.09 |
| | Labor | | 5.16 |
| | Equipment Rental | | 1.71 |
| | Power | | 2.49 |
| | Other | | 0.89 |
| | HSE | | 1.06 |
| | Third-party service providers | | 0.95 |
| | Maintenance Spares and Tools | | 3.82 |
| | Maintenance Third-party service providers | | 1.72 |
| | Maintenance Others | | 0.06 |
| | Maintenance Equipment Rental | | 0.61 |
| **Total Vanadium Processing Costs** | | **US$ / t ore fed** | **34.56** |

Source: Largo, 2024.

**Table 21-6 – Operating Costs - Ilmenite Processing**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Ilmenite Processing | Consumables | US$ / t Ilmenite | 38.39 |
| | Power | US$ | 4.26 |
| | Operations Contracts | US$ | 0.8 |
| | Labor | US$ | 5.86 |
| | Equipment Rental | US$ | 3.61 |
| | Other | US$ | 3.55 |
| **Total Ilmenite Processing Costs** | | **US$ / t Ilmenite** | **56.46** |

Source: GE21, 2024.

**Table 21-7 – Operating Costs - Titanium Pigment Chemical Plant**

| Area | Type of Cost | Unit | Cost |
|---|---|---|---|
| Titanium Pigment Plant | Ilmenite as Raw Material | US$/t $TiO_2$ | 493.00 |
| | Process Cost | | 1,201.00 |
| **Total Pigment Plant - Processing Costs** | | **US$ / t $TiO_2$** | **1,694.00** |

Source: GE21, 2024.

For tailings pond recovery, the cost per tonne of material is estimated at US$1.04/t. This reclaimed material will be processed at the Ilmenite Plant from 2026 to 2032. The estimated processing cost is US$64.38/t of product.

### *21.6.3 General and Administration*

General and Administration (G&A) costs include expenses not accounted for in mining or process costs. These costs encompass management and administration personnel, environmental monitoring, safety and medical services, catering, travel, communications, shared equipment, emergency response, site-wide maintenance, insurance, legal fees, property taxes, and other miscellaneous office expenses.

The annual G&A costs are estimated to be US$6.3 million.

## 21.7 Methodology

An engineering economic model was developed to estimate annual pre- and post-tax cash flows and sensitivities of the Project, using a 7% discount rate. It is important to note that tax estimates involve complex variables that can only be accurately calculated during operations; thus, the after-tax results are approximations. Sensitivity analyses were performed to assess the impact of variations in selling prices, operating costs, and capital costs. The capital and operating cost estimates were specifically developed for this Project and are summarized in Section 21 of this Report. The economic analysis was conducted on a constant dollar basis, without accounting for inflation.

# 22 ECONOMIC ANALYSIS

The economic analyses presented in this section generate forward-looking information. The results depend on inputs that are subject to known and unknown risks, uncertainties, and other factors that may cause actual results to differ materially. Forward-looking Information includes:

- Mineral Resource estimates.
- Assumed prices, commercial discounts, etc.
- Assumed currency exchange rates.
- The proposed mine production plan.
- Projected mining and process recovery rates.
- Assumptions regarding mining dilution and the ability to mine in areas previously exploited using open pit mining methods as envisaged.
- Sustaining costs and proposed operating costs.
- Assumptions as to closure costs and closure requirements.
- Assumptions regarding environmental, permitting, and social risks.
- Changes to costs of production from what is assumed.
- Unrecognized environmental risks.
- Unanticipated reclamation expenses.
- Unexpected variations in quantity of mineralized material, grade or recovery rates.
- Geotechnical or hydrogeological considerations during mining being different from what was assumed.
- Unexpected variations in quantity of mineralized material, grade, or metallurgic recovery and plant recovery efficiency.
- Assumptions regarding geotechnical or hydrogeological conditions during mining.
- Failure of mining methods to operate as anticipated.
- Failure of plant, equipment, or processes to operate as anticipated.
- Assumptions regarding closure costs and requirements.
- Unanticipated reclamation expenses.
- Assumptions regarding the availability of electrical power and the power rates used in the operating cost estimates and financial analysis.
- Ability to maintain the social licence to operate.
- Accidents, labor disputes, and other mining industry risks.
- Changes to interest rates.
- Changes to tax rates.
- Assumption of a commercial discounts in the financial analysis.

## 22.1 Taxes

- Income Tax

A 15% tax rate on pre-tax profit, based on real profit, is applied if the profit is less than R$ 240,000/ year. A rate additional of 10% on pre-tax profit is applied if the profit is greater than R$ 240,000/ year. The Maracás Menchen Mine has been granted a reduction of 75% of this income tax based on a Development Superintendency (Sudene) resolution, the details of which are provided below, resulting in an effective tax rate of 6.25%. This reduction of 75% in the income tax was extended by Brazilian Federal government until 2032/2033.

The Board of Management of Funds and Incentives and Investment Attraction of the Northeast Sudene grants the right to a reduction of 75% of non-refundable Income Tax and Additions, calculated with profit basis of the holding in favor of Largo Vanádio de Maracás S.A., CNPJ 15,191,786 / 0001-49, Based on the Constitutive Report nr. 0553/2023, issued by Sudene in a session held on 12/29/2023.

- Compensation of Tax Losses and Negative – CSLL – Calculation Bases

Compensation tax losses and negative (CSLL) bases determined at the end of each year can be offset, regardless of any period, up to a limit of 30% of the adjusted Net Profit, for the purpose of calculating income tax and social contribution on the net profit.

- Social Contribution on Net Profits

The Social Contribution on Profits is a federal tax charged at 9% of taxable income. For the Maracás Menchen Mine, taxable income is calculated using the actual profits regime.

- VAT

PIS and COFINS taxes are levied on sales and are calculated based on the rates 1.65% and 7.6%.

The state tax called ICMS is levied on sales of products, at a rate of 20.5% when the sale occurs within the same state (Bahia), and 12% when sales are destined for other different states.

In exports, no taxes are levied on revenue.

Currently, national sales represent around 20%, while exports represent 80%.

## 22.2 Royalties

- Financial Compensation by Exploration of Mineral Resources (*Compensação Financeira pela Exploração Mineral*) – CFEM

Financial Compensation for the Exploration of Mineral Resources (CFEM) is the consideration paid to the Government of Brazil for the extraction and economic exploration of Brazilian Mineral Resources.

CFEM focuses on net sales of the raw mineral product, or on the intermediate cost of production when the mineral product is consumed or transformed in an industrial process.

Largo's Maracás Menchen Mine calculates CFEM using both methods above, being 1) for Vanadium products it is calculated from the operating costs incurred in the vanadium products (about 30% of total Mine additional to 7.5% Process OPEX). Since the Maracás Menchen Mine uses the ore in an industrial process, CFEM for vanadium products is calculated with 2% based on the cost of production; and 2) for ilmenite products the CFEM is calculated with 1% based on its Net Sales.

- Companhia Baiana de Pesquisa Mineral – CBPM

CBPM is the Bahia State Geological Survey and was the owner of the mining rights over most of the deposits, only Novo Amparo Norte is the property of VMSA. Pursuant to the terms of the agreement whereby VMSA acquired the mining rights from CBPM, CBPM was granted a 3% royalty over gross sales revenues, less the VAT sales taxes (ICMS and PIS/COFINS).

For the Campbell Pit and Gulçari A Norte (GAN), a royalty of 2% is payable to Ecora Resources PLC and 3% is payable to CBPM. For the Novo Amparo Norte (NAN) no royalty besides CFEM is applied. Table 22-1 presents the detailed royalties and CFEM for vanadium products and ilmenite concentrate.

**Table 22-1 – Royalties and CFEM**

| | Gulçari A – Campbell | | | Gulçari A Norte (NAN) | | | Novo Amparo Norte (NAN) | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **CFEM** | **CBPM** | **Ecora Resources** | **CFEM** | **CBPM** | **Ecora Resources** | **CFEM** | **CBPM** | **Ecora Resources** |
| **Vanadium Products** | 2% of cost of concentrate production | 3% on net revenues (sales revenue – taxes) | 2% on net revenues (sales revenue – taxes – COGS – CFEM – CBPM) | 2% of cost of concentrate production | 3% on net revenues (sales revenue – taxes) | 2% on net revenues (sales revenue – taxes – COGS – CFEM – CBPM) | 2% of cost of concentrate production. | N/A | N/A |
| **Ilmenite Concentrate** | 1% on net revenues (sales revenue – taxes) | 3% on net revenues of Ilmenite Concentrate (sales revenue – taxes) | 2% on net revenues (sales revenue – taxes – – COGS – CFEM – CBPM) | 1% on net revenues (sales revenue – taxes) | 3% on net revenues of Ilmenite Concentrate (sales revenue – taxes) | 2% on net revenues (sales revenue – taxes – COGS – CFEM – CBPM) | 1% on net revenues (sales revenue – taxes) | N/A | N/A |

Source: GE21, 2024.

## 22.3 Depreciation

Depreciation of plant infrastructure and equipment was calculated in a simplified manner, with the investment being depreciated annually over the mine's life at a rate of 10% per year.

## 22.4 Selling, General and Administrative Expenses (SG&A)

For selling, general and administrative expenses (SG&A), the Company considered an amount of $6.3 million per year in the cash flow.

## 22.5 Working Capital

For working capital, the Company considered key assumptions regarding the average time from accounts receivable, accounts payable, inventory of finished goods and raw materials, and tax payable. The table below provides the average time in days:

**Table 22-2 – Financial Cycle Parameters**

| Parameters | Average time (days) |
|---|---|
| Accounts receivable | 50 |
| Inventory of raw materials | 90 |
| Inventory of finish goods | 30 |
| Accounts payable | 45 |
| Tax payable | 45 |

Source: GE21, 2024.

## 22.6 Discounted Cash Flow

The Discounted Cash Flow (DCF) scenario was developed to assess all aspects of the Project, including the new Ilmenite and Pigment Plants and the Vanadium Plant expansion. This assessment is based on economic and financial parameters, combined with mine scheduling, CAPEX and OPEX estimates. Table 22-3 and Table 22-4 present the main economic and financial parameters used in the Project's economic analysis.

**Table 22-3 – Product Selling Prices**

| Price | | | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|
| **Products** | **Un** | | **0** | **1** | **2** | **3** |
| $V_2O_5$ STD with VAT* | US$/lb | **8.45** | 7.00 | 8.50 | 8.50 | 8.50 |
| $V_2O_5$ HP with VAT* | US$/lb | **9.45** | 8.00 | 9.50 | 9.50 | 9.50 |
| Ilmenite with VAT* | US$/t | **222.05** | 222.05 | 222.05 | 222.05 | 222.05 |
| Pigment with VAT* | US$/t | **4,040.05** | 4,040.05 | 4,040.05 | 4,040.05 | 4,040.05 |

*VAT =Value Added Tax
Source: GE21, 2024.

**Table 22-4 – Main Economic Parameters**

| Taxes and Royalties | |
|---|---|
| INCOME TAX | 25% (Sudene Discount of 75% until 2032) |
| CSLL | 9.0% |
| Surface Royalties and CFEM | Based on subsection 22.2 |
| **Financial Parameters** | |
| Discount rate | 7.0% |
| NPV | Beginning of the year |

Source: GE21, 2024.

Table 22-5 and Table 22-6 present the cash flow for the Base Case of the Project.

**Table 22-5 – Base Case Life of Mine Annual Cash Flow – (2024-2042)**

| Cash Flow | | | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vanadium Revenue | M US$ | $ 5,973.16 | $165.34 | $231.10 | $251.11 | $238.20 | $327.03 | $330.79 | $320.95 | $351.05 | $219.01 | $183.98 | $196.61 | $211.04 | $191.83 | $175.21 | $178.46 | $168.02 | $160.85 | $132.99 | $131.46 |
| Ilmenite Concentrate Revenue | M US$ | $ 2,118.96 | $20.55 | $27.28 | $43.52 | $43.52 | $43.52 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 |
| Pigment Revenue | M US$ | $12,884.32 | $ - | $ - | $ - | $ - | $ - | $121.20 | $242.40 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 |
| **Gross Revenue** | **M US$** | **$20,976.44** | **$185.90** | **$258.37** | **$294.63** | **$281.72** | **$370.56** | **$510.84** | **$622.20** | **$813.90** | **$681.86** | **$646.83** | **$659.46** | **$673.89** | **$654.68** | **$638.06** | **$641.31** | **$630.87** | **$623.70** | **$595.84** | **$594.31** |
| Pis | M US$ | $ 219.58 | $ 0.07 | $ 0.09 | $ 0.14 | $ 0.14 | $ 0.14 | $ 2.19 | $ 4.19 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 |
| Cofins | M US$ | $ 1,011.42 | $ 0.31 | $ 0.41 | $ 0.66 | $ 0.66 | $ 0.66 | $10.11 | $19.32 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 |
| ICMS | M US$ | $ 1,596.97 | $ 0.49 | $ 0.65 | $ 1.04 | $ 1.04 | $ 1.04 | $15.96 | $30.50 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 |
| **Net Revenue** | **M US$** | **$18,148.46** | **$185.02** | **$257.21** | **$292.78** | **$279.87** | **$368.71** | **$482.58** | **$568.18** | **$725.55** | **$593.51** | **$558.48** | **$571.11** | **$585.54** | **$566.32** | **$549.71** | **$552.96** | **$542.52** | **$535.35** | **$507.48** | **$505.96** |
| **OPEX Total** | **M US$** | **$10,789.02** | **$118.54** | **$142.59** | **$154.69** | **$148.93** | **$170.38** | **$223.80** | **$273.89** | **$349.23** | **$333.50** | **$326.96** | **$336.46** | **$340.26** | **$336.22** | **$339.41** | **$347.28** | **$351.03** | **$325.24** | **$316.32** | **$321.67** |
| Mine | M US$ | $ 1,681.98 | $29.01 | $42.91 | $43.79 | $40.68 | $43.99 | $37.33 | $36.84 | $35.93 | $47.15 | $47.75 | $54.67 | $55.53 | $55.41 | $62.00 | $69.20 | $75.08 | $50.76 | $47.52 | $53.18 |
| Process | M US$ | $ 8,257.45 | $81.44 | $88.76 | $95.34 | $92.90 | $109.63 | $163.81 | $212.77 | $286.20 | $261.34 | $254.74 | $257.12 | $259.84 | $256.22 | $253.09 | $253.71 | $251.74 | $250.39 | $245.14 | $244.86 |
| Logistc | M US$ | $ 849.59 | $ 8.09 | $10.92 | $15.56 | $15.35 | $16.76 | $22.66 | $24.27 | $27.10 | $25.01 | $24.46 | $24.66 | $24.89 | $24.58 | $24.32 | $24.37 | $24.21 | $24.09 | $23.65 | $23.63 |
| **Gross Profit (M US$)** | **M US$** | **$ 7,359.44** | **$66.48** | **$114.63** | **$138.10** | **$130.94** | **$198.32** | **$258.79** | **$294.29** | **$376.32** | **$260.00** | **$231.52** | **$234.65** | **$245.28** | **$230.11** | **$210.30** | **$205.68** | **$191.49** | **$210.11** | **$191.17** | **$184.29** |
| SG&A | M US$ | $ 239.40 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 |
| CFEM | M US$ | $70.38 | $ 0.91 | $ 1.27 | $ 1.46 | $ 1.39 | $ 1.48 | $ 1.59 | $ 1.65 | $ 1.74 | $ 1.93 | $ 1.93 | $ 2.08 | $ 2.22 | $ 2.21 | $ 2.33 | $ 2.48 | $ 2.59 | $ 2.10 | $ 2.03 | $ 2.14 |
| Royalties CBPM | M US$ | $ 122.99 | $ 5.54 | $ 7.98 | $ 8.94 | $ 8.09 | $11.62 | $11.58 | $10.46 | $11.84 | $ 1.69 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Royalties Anglo | M US$ | $70.77 | $ 3.15 | $ 4.67 | $ 5.19 | $ 4.64 | $ 6.90 | $ 6.78 | $ 6.06 | $ 6.94 | $ 0.42 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Depreciation and Exhaustion | M US$ | $ 1,019.92 | $ - | $ 1.91 | $ 3.22 | $10.68 | $33.06 | $57.39 | $59.43 | $60.54 | $62.33 | $64.30 | $65.87 | $65.53 | $66.04 | $60.60 | $40.30 | $17.54 | $17.08 | $17.79 | $18.02 |
| **EBIT (US$)** | **M US$** | **$ 5,835.99** | **$50.58** | **$92.50** | **$112.99** | **$99.83** | **$138.96** | **$175.14** | **$210.39** | **$288.96** | **$187.33** | **$158.99** | **$160.40** | **$171.24** | **$155.56** | **$141.06** | **$156.60** | **$165.06** | **$184.63** | **$165.05** | **$157.83** |
| IRPJ (US$) | M US$ | $ 875.40 | $ 7.59 | $13.87 | $16.95 | $14.97 | $20.84 | $26.27 | $31.56 | $43.34 | $28.10 | $23.85 | $24.06 | $25.69 | $23.33 | $21.16 | $23.49 | $24.76 | $27.69 | $24.76 | $23.68 |
| IRPJ aditional (US$) | M US$ | $ 583.42 | $ 5.05 | $ 9.24 | $11.29 | $ 9.98 | $13.89 | $17.51 | $21.03 | $28.89 | $18.73 | $15.89 | $16.04 | $17.12 | $15.55 | $14.10 | $15.66 | $16.50 | $18.46 | $16.50 | $15.78 |
| IRPJ (tax incentive) | M US$ | $-254.35 | $ -9.48 | $-17.34 | $-21.18 | $-18.71 | $-26.05 | $-32.84 | $-39.45 | $-54.18 | $-35.12 | | | | | | | | | | |
| CSLL (US$) | M US$ | $ 525.24 | $ 4.55 | $ 8.32 | $10.17 | $ 8.98 | $12.51 | $15.76 | $18.94 | $26.01 | $16.86 | $14.31 | $14.44 | $15.41 | $14.00 | $12.70 | $14.09 | $14.86 | $16.62 | $14.85 | $14.21 |
| **Operational profit (US$)** | **M US$** | **$ 4,106.28** | **$42.87** | **$78.39** | **$95.76** | **$84.61** | **$117.77** | **$148.44** | **$178.31** | **$244.89** | **$158.77** | **$104.94** | **$105.87** | **$113.02** | **$102.68** | **$93.11** | **$103.36** | **$108.94** | **$121.86** | **$108.94** | **$104.17** |
| **(=) EBIT** | **M US$** | **$ 5,835.99** | **$50.58** | **$92.50** | **$112.99** | **$99.83** | **$138.96** | **$175.14** | **$210.39** | **$288.96** | **$187.33** | **$158.99** | **$160.40** | **$171.24** | **$155.56** | **$141.06** | **$156.60** | **$165.06** | **$184.63** | **$165.05** | **$157.83** |
| **Depreciation and Exhaustion** | **M US$** | **$ 1,019.92** | **$ -** | **$ 1.91** | **$ 3.22** | **$10.68** | **$33.06** | **$57.39** | **$59.43** | **$60.54** | **$62.33** | **$64.30** | **$65.87** | **$65.53** | **$66.04** | **$60.60** | **$40.30** | **$17.54** | **$17.08** | **$17.79** | **$18.02** |
| **(=) EBITDA** | **M US$** | **$ 6,855.90** | **$50.58** | **$94.41** | **$116.21** | **$110.51** | **$172.02** | **$232.54** | **$269.82** | **$349.50** | **$249.67** | **$223.29** | **$226.28** | **$236.77** | **$221.60** | **$201.66** | **$196.90** | **$182.60** | **$201.70** | **$182.84** | **$175.85** |
| **Ebtida Margin** | | | **27%** | **37%** | **40%** | **39%** | **47%** | **48%** | **47%** | **48%** | **42%** | **40%** | **40%** | **40%** | **39%** | **37%** | **36%** | **34%** | **38%** | **36%** | **35%** |
| **(-) Capex** | **M US$** | **$ 1,029.50** | **$19.12** | **$13.08** | **$74.64** | **$223.79** | **$243.30** | **$20.37** | **$11.06** | **$17.97** | **$19.66** | **$18.15** | **$15.72** | **$15.72** | **$20.28** | **$20.76** | **$18.15** | **$15.72** | **$15.72** | **$20.30** | **$18.94** |
| **(+) Residual Value** | **M US$** | **$9.58** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** |
| **(+-) Working Capital** | **M US$** | **$ -** | **$35.90** | **$ 8.64** | **$ 4.15** | **$ 1.98** | **$12.91** | **$20.91** | **$18.78** | **$30.37** | **$-13.35** | **$-25.37** | **$ 3.96** | **$ 1.78** | **$ -2.00** | **$ 0.52** | **$ 2.17** | **$ 0.16** | **$ -9.86** | **$ -4.05** | **$ 1.97** |
| **(-) ARO** | **M US$** | **$ 272.23** | **$ 2.78** | **$ 3.86** | **$ 4.39** | **$ 4.20** | **$ 5.53** | **$ 7.24** | **$ 8.52** | **$10.88** | **$ 8.90** | **$ 8.38** | **$ 8.57** | **$ 8.78** | **$ 8.49** | **$ 8.25** | **$ 8.29** | **$ 8.14** | **$ 8.03** | **$ 7.61** | **$ 7.59** |
| **(-) Income Tax** | **M US$** | **$ 1,729.71** | **$ 7.71** | **$14.10** | **$17.23** | **$15.22** | **$21.19** | **$26.71** | **$32.08** | **$44.07** | **$28.57** | **$54.05** | **$54.53** | **$58.22** | **$52.89** | **$47.96** | **$53.24** | **$56.11** | **$62.77** | **$56.11** | **$53.66** |
| **(=) Cash Flow** | **M US$** | **$ 3,834.05** | **$-14.93** | **$54.73** | **$15.80** | **$ -134.68** | **$ -110.90** | **$157.31** | **$199.38** | **$246.21** | **$205.89** | **$168.07** | **$143.50** | **$152.26** | **$141.94** | **$124.18** | **$115.05** | **$102.47** | **$125.04** | **$102.87** | **$93.69** |

Source: GE21, 2024.

Table 22-6 – Base Case Life of Mine Annual Cash Flow (Continuation) (2043-2061)

| Cash Flow | | | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vanadium Revenue | M US$ | $ 5,973.16 | $143.94 | $174.98 | $182.17 | $147.13 | $148.16 | $140.42 | $142.76 | $148.33 | $178.63 | $199.21 | $150.80 | $51.60 | $ - | $ - | $- | $ - | $- | $ - | $ - |
| Ilmenite Concentrate Revenue | M US$ | $ 2,118.96 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $58.84 | $57.56 |
| Pigment Revenue | M US$ | $12,884.32 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $404.01 | $400.57 |
| **Gross Revenue** | **M US$** | **$20,976.44** | **$606.78** | **$637.83** | **$645.02** | **$609.98** | **$611.01** | **$603.27** | **$605.61** | **$611.17** | **$641.48** | **$662.06** | **$613.65** | **$514.45** | **$462.85** | **$462.85** | **$462.85** | **$462.85** | **$462.85** | **$462.85** | **$458.13** |
| Pis | M US$ | $ 219.58 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $ 6.86 | $6.86 | $6.86 | $6.86 | $6.86 | $6.86 | $6.86 | $6.80 |
| Cofins | M US$ | $ 1,011.42 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.60 | $31.32 |
| ICMS | M US$ | $ 1,596.97 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.89 | $49.45 |
| **Net Revenue** | **M US$** | **$18,148.46** | **$518.43** | **$549.47** | **$556.67** | **$521.63** | **$522.66** | **$514.92** | **$517.26** | **$522.82** | **$553.12** | **$573.71** | **$525.30** | **$426.10** | **$374.50** | **$374.50** | **$374.50** | **$374.50** | **$374.50** | **$374.50** | **$370.56** |
| **OPEX Total** | **M US$** | **$10,789.02** | **$333.24** | **$334.23** | **$334.40** | **$331.81** | **$335.04** | **$339.40** | **$350.06** | **$356.78** | **$360.17** | **$366.62** | **$322.37** | **$258.29** | **$215.93** | **$216.03** | **$216.13** | **$216.23** | **$216.33** | **$216.43** | **$213.12** |
| Mine | M US$ | $ 1,681.98 | $62.21 | $56.86 | $55.57 | $60.13 | $63.15 | $69.08 | $79.27 | $84.85 | $82.06 | $84.30 | $49.84 | $ 5.91 | $ - | $ - | $- | $ - | $- | $ - | $ - |
| Process | M US$ | $ 8,257.45 | $247.20 | $253.05 | $254.40 | $247.81 | $248.00 | $246.54 | $246.98 | $248.03 | $253.74 | $257.61 | $248.50 | $229.82 | $194.09 | $194.09 | $194.09 | $194.09 | $194.09 | $194.09 | $192.20 |
| Logistc | M US$ | $ 849.59 | $23.83 | $24.32 | $24.43 | $23.88 | $23.89 | $23.77 | $23.81 | $23.90 | $24.37 | $24.70 | $24.03 | $22.56 | $21.85 | $21.95 | $22.05 | $22.15 | $22.25 | $22.35 | $20.92 |
| **Gross Profit (M US$)** | **M US$** | **$ 7,359.44** | **$185.19** | **$215.24** | **$222.26** | **$189.81** | **$187.62** | **$175.52** | **$167.19** | **$166.05** | **$192.95** | **$207.09** | **$202.92** | **$167.81** | **$158.56** | **$158.46** | **$158.36** | **$158.26** | **$158.16** | **$158.06** | **$157.44** |
| SG&A | M US$ | $ 239.40 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $ 6.30 | $6.30 | $6.30 | $6.30 | $6.30 | $6.30 | $6.30 | $6.30 |
| CFEM | M US$ | $70.38 | $ 2.33 | $ 2.23 | $ 2.21 | $ 2.29 | $ 2.35 | $ 2.46 | $ 2.67 | $ 2.78 | $ 2.74 | $ 2.79 | $ 2.08 | $ 1.16 | $0.97 | $0.97 | $0.97 | $0.97 | $0.97 | $0.97 | $0.95 |
| Royalties CBPM | M US$ | $ 122.99 | $ - | $ - | $ - | $ - | $ 0.38 | $ 5.75 | $ 7.03 | $ 7.04 | $ 7.78 | $ 8.23 | $ 6.81 | $ 2.25 | $ - | $ - | $- | $ - | $- | $ - | $ - |
| Royalties Anglo | M US$ | $70.77 | $ - | $ - | $ - | $ - | $ -0.16 | $ 3.31 | $ 4.13 | $ 4.14 | $ 4.60 | $ 4.89 | $ 4.00 | $ 1.10 | $ - | $ - | $- | $ - | $- | $ - | $ - |
| Depreciation and Exaustion | M US$ | $ 1,019.92 | $17.95 | $17.95 | $17.95 | $17.95 | $17.94 | $18.02 | $18.02 | $18.02 | $18.02 | $17.78 | $17.51 | $17.56 | $17.56 | $15.74 | $13.72 | $11.57 | $9.99 | $8.42 | $6.61 |
| **EBIT (US$)** | **M US$** | **$ 5,835.99** | **$158.62** | **$188.77** | **$195.81** | **$163.28** | **$160.82** | **$139.67** | **$129.05** | **$127.77** | **$153.51** | **$167.09** | **$166.23** | **$139.44** | **$133.73** | **$135.45** | **$137.37** | **$139.43** | **$140.90** | **$142.37** | **$143.58** |
| IRPJ (US$) | M US$ | $ 875.40 | $23.79 | $28.31 | $29.37 | $24.49 | $24.12 | $20.95 | $19.36 | $19.17 | $23.03 | $25.06 | $24.93 | $20.92 | $20.06 | $20.32 | $20.61 | $20.91 | $21.13 | $21.36 | $21.54 |
| IRPJ aditional (US$) | M US$ | $ 583.42 | $15.86 | $18.87 | $19.58 | $16.32 | $16.08 | $13.96 | $12.90 | $12.77 | $15.35 | $16.70 | $16.62 | $13.94 | $13.37 | $13.54 | $13.73 | $13.94 | $14.09 | $14.23 | $14.35 |
| IRPJ (tax incentive) | M US$ | $-254.35 | | | | | | | | | | | | | | | | | | | |
| CSLL (US$) | M US$ | $ 525.24 | $14.28 | $16.99 | $17.62 | $14.70 | $14.47 | $12.57 | $11.61 | $11.50 | $13.82 | $15.04 | $14.96 | $12.55 | $12.04 | $12.19 | $12.36 | $12.55 | $12.68 | $12.81 | $12.92 |
| **Operational profit (US$)** | **M US$** | **$ 4,106.28** | **$104.69** | **$124.59** | **$129.24** | **$107.77** | **$106.14** | **$92.19** | **$85.18** | **$84.33** | **$101.32** | **$110.29** | **$109.71** | **$92.03** | **$88.27** | **$89.40** | **$90.67** | **$92.03** | **$93.00** | **$93.97** | **$94.77** |
| **(=) EBIT** | **M US$** | **$ 5,835.99** | **$158.62** | **$188.77** | **$195.81** | **$163.28** | **$160.82** | **$139.67** | **$129.05** | **$127.77** | **$153.51** | **$167.09** | **$166.23** | **$139.44** | **$133.73** | **$135.45** | **$137.37** | **$139.43** | **$140.90** | **$142.37** | **$143.58** |
| **Depreciation and Exhaustion** | **M US$** | **$ 1,019.92** | **$17.95** | **$17.95** | **$17.95** | **$17.95** | **$17.94** | **$18.02** | **$18.02** | **$18.02** | **$18.02** | **$17.78** | **$17.51** | **$17.56** | **$17.56** | **$15.74** | **$13.72** | **$11.57** | **$9.99** | **$8.42** | **$6.61** |
| **(=) EBITDA** | **M US$** | **$ 6,855.90** | **$176.56** | **$206.71** | **$213.76** | **$181.23** | **$178.76** | **$157.69** | **$147.07** | **$145.79** | **$171.53** | **$184.87** | **$183.74** | **$157.00** | **$151.29** | **$151.19** | **$151.09** | **$150.99** | **$150.89** | **$150.79** | **$150.19** |
| **Ebtida Margin** | | | **34%** | **38%** | **38%** | **35%** | **34%** | **31%** | **28%** | **28%** | **31%** | **32%** | **35%** | **37%** | **40%** | **40%** | **40%** | **40%** | **40%** | **40%** | **41%** |
| **(-) Capex** | **M US$** | **$ 1,029.50** | **$18.15** | **$15.72** | **$15.72** | **$20.24** | **$21.54** | **$18.15** | **$15.72** | **$15.72** | **$17.90** | **$16.25** | **$16.21** | **$15.72** | **$ -** | **$ -** | **$-** | **$ -** | **$-** | **$ -** | **$ -** |
| **(+) Residual Value** | **M US$** | **$9.58** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$-** | **$ -** | **$-** | **$ -** | **$ -** |
| **(+-) Working Capital** | **M US$** | **$ -** | **$ 4.66** | **$ 1.20** | **$ 0.26** | **$ -1.90** | **$ 1.22** | **$ 0.70** | **$ 3.88** | **$ 2.66** | **$ 1.98** | **$ 2.89** | **$-17.71** | **$-26.05** | **$ -8.36** | **$ -0.09** | **$ -0.09** | **$ -0.10** | **$ -0.08** | **$ -0.08** | **$ -0.53** |
| **(-) ARO** | **M US$** | **$ 272.23** | **$ 7.78** | **$ 8.24** | **$ 8.35** | **$ 7.82** | **$ 7.84** | **$ 7.72** | **$ 7.76** | **$ 7.84** | **$ 8.30** | **$ 8.61** | **$ 7.88** | **$ 6.39** | **$5.62** | **$5.62** | **$5.62** | **$5.62** | **$5.62** | **$5.62** | **$5.56** |
| **(-) Income Tax** | **M US$** | **$ 1,729.71** | **$53.92** | **$64.18** | **$66.57** | **$55.51** | **$54.67** | **$47.48** | **$43.87** | **$43.44** | **$52.19** | **$56.81** | **$56.51** | **$47.40** | **$45.46** | **$46.05** | **$46.70** | **$47.40** | **$47.90** | **$48.40** | **$48.81** |
| **(=) Cash Flow** | **M US$** | **$ 3,834.05** | **$92.05** | **$117.38** | **$122.86** | **$99.56** | **$93.49** | **$83.64** | **$75.83** | **$76.13** | **$91.16** | **$100.32** | **$120.85** | **$113.53** | **$108.57** | **$99.61** | **$98.87** | **$98.08** | **$97.45** | **$96.85** | **$96.34** |

Source: GE21, 2024.

**Table 22-7 – Economical Analysis Summary**

| Project Economics | |
|---|---|
| $NPV_{7\%}$ (Pre-tax, After-Tax) | $1.6 billion, $1.1 billion |
| Life of Mine Cash Flow (Pre-Tax, After-Tax) | $5.6 billion, $3.8 billion |

Source: GE21, 2024.

## 22.7 Internal Rate of Return

The Project estimates an NPV (7%) for Largo of US$1.1 billion post-tax and US$1.6 billion pre-tax. The economic study analyzed Largo Inc.'s Investment Plan from 2024 to 2061 as a whole, reflecting its benefits to the Company's strategy. Consequently, the calculated NPV represents the Company's value in its current context, along with the advantages of the projected investments.

This Project is unique and ongoing. Economic parameter indicators, such as the Internal Rate of Return (IRR), were studied to present marginal results associated with this metric. The IRR and the Modified Internal Rate of Return (MIRR) are financial metrics used to evaluate the profitability of investment projects, each with its advantages and limitations. While the IRR seeks to determine the discount rate that makes the net present value (NPV) of cash flows equal to zero, the MIRR adjusts the IRR to consider the reinvestment of intermediate cash flows at a rate different from the Project's IRR. Given the operational stage of the Project, the MIRR is the more appropriate metric for assessing profitability.

Table 22-8 presents the marginal results for the Internal Rate of Return (IRR) related to the entire Project, rather than individual investments or expansions.

**Table 22-8 – Marginal Results for IRR and MIRR**

| | | |
|---|---|---|
| **IRR** | % | N/A |
| **MIRR** | % | 18.5% |

Source: GE21, 2024.

## 22.8 Sensitivity Analysis

A sensitivity analysis was conducted to assess the impact of various economic indicators on the cash flow, focusing on the following attributes:

- Selling Prices.
- CAPEX (Capital Expenditures).
- OPEX (Operational Expenditures).
- Discount Rate.

The after-tax NPV at a 7% discount rate was evaluated by varying the values of Selling Prices, CAPEX, OPEX, and Discount Rate from -20% to +20%. Figure 22-1 presents results of the sensitivity analysis on the cash flow.

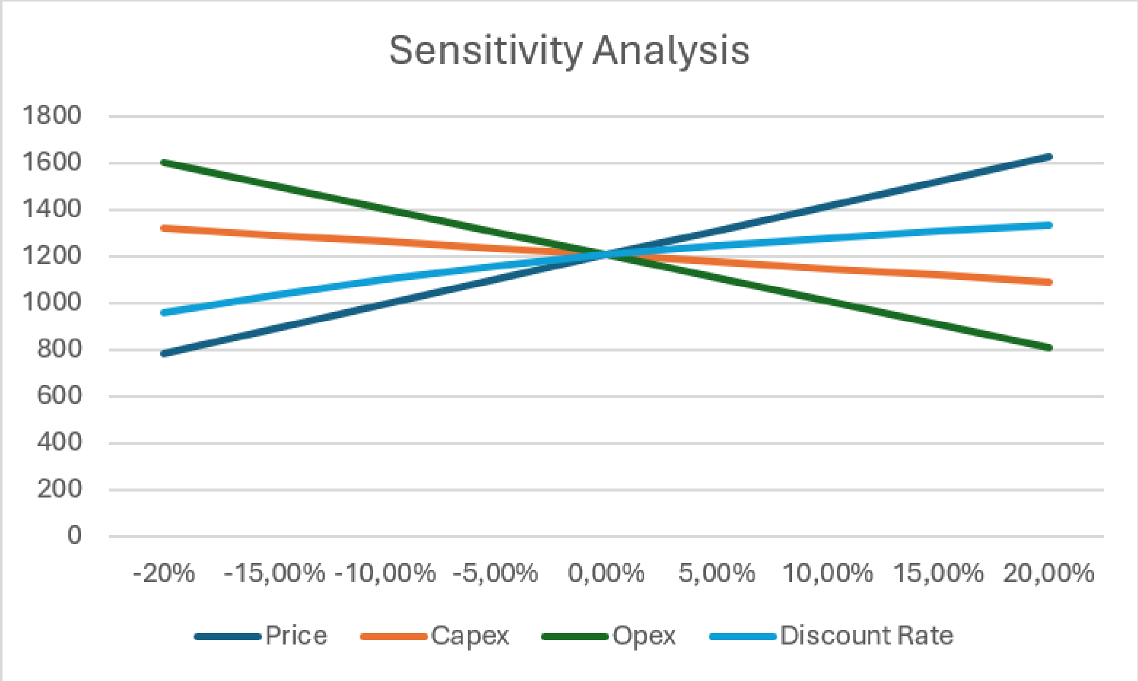



**Figure 22-1 – Sensitivity Analysis**

Source: GE21, 2024.

GE21 concluded, based on the sensitivity analysis, that the Project's profitability is most affected by the selling prices and OPEX, with CAPEX having a lesser impact.

# 23 ADJACENT PROPERTIES

There are no properties immediately adjacent to the Project.

# 24 OTHER RELEVANT DATA AND INFORMATION

The Company has several studies in evaluation or in progress that should improve future results. The main studies include the evaluation of Platinum Group Minerals (PGM), enhancement of magnetite quality, increasing the $TiO_2$ grade of flotation feed, and the implementation of recycling in vanadium production.

## 24.1 Study of Platinum Group Minerals (PGM)

At the end of 2023, Largo plans to resume the study of Platinum Group Minerals (PGM) through tests with auger samples from its Non-Magnetic Basins (BNM) 02 and 03.

In March 2024, Largo announced via a News Release the identification of significant levels of Platinum and Palladium in these samples. Additionally, the Company indicated its intention to review geological information and sampling data from boreholes near the Campbell deposit that yielded PGM results.

### *24.1.1 Non-Magnetic Tailings Pond Auger Drill Hole Highlights*

The non-magnetic tailings material results from the process of separating vanadium-containing materials. This non-magnetic flow consists primarily of silicates (mostly amphiboles and pyroxenes) and ilmenite, which feeds into the flotation plant. The flotation process separates ilmenite from the silicates, generating ilmenite concentrate.

The Non-Magnetic Tailings Pond Auger Drill Hole Highlights returned the following results:

- **BN3TR15:** 3.0 metres grading 0.410g Pt/t and 0.209g Pd/t and 0.07g Au/t totalling 0.687g PGM equivalent (PGM eq.)
- **BN2TR1:** 4.3 metres grading 0.321g Pt/t and 0.118g Pd/t and 0.04g Au/t totalling 0.480g PGM eq.

There are four non-magnetic tailings ponds at the Maracás Menchen Mine. Pond 6 is currently active, while Pond 4 was active during the sampling period, with an estimated tonnage of approximately 3.0 million tonnes (see Table 14-26). Further analysis has also identified gold grades, which are included in the ongoing assesment.

Table 24-1 presents the total results of PGM auger drill program over Ponds 2 and 3.

**Table 24-1 – Auger Drill Program Results (Non-Magnetic Tailings Ponds Two and Three)**

| Hole ID | X Coordinators | Y Coordinates | Z | From | To | Length | Au | Pd | Pt | PGM (Pt+Pd) | PGM eq. (Au+PGM) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (m) | (m) | (m) | g/t | g/t | g/t | g/t | g/t |
| **BNM2TR1** | 317069.00 | 8486353.00 | 326.00 | 0.00 | 4.30 | 4.30 | 0.04 | 0.12 | 0.32 | 0.44 | 0.48 |
| **BNM2TR2** | 317131.00 | 8486325.00 | 327.00 | 0.00 | 1.00 | 1.00 | 0.02 | 0.09 | 0.23 | 0.32 | 0.34 |
| **BNM2TR3** | 317190.00 | 8486300.00 | 327.00 | 0.00 | 2.50 | 2.50 | 0.03 | 0.13 | 0.35 | 0.47 | 0.51 |
| **BNM2TR4** | 317092.00 | 8486311.00 | 327.00 | 0.00 | 3.80 | 3.80 | 0.04 | 0.16 | 0.43 | 0.59 | 0.63 |
| **BNM2TR5** | 317150.00 | 8486284.00 | 327.00 | 0.00 | 1.00 | 1.00 | 0.03 | 0.11 | 0.30 | 0.41 | 0.44 |
| **BNM2TR6** | 317051.00 | 8486295.00 | 327.00 | 0.00 | 0.60 | 0.60 | 0.04 | 0.16 | 0.44 | 0.60 | 0.64 |
| **BNM2TR7** | 317110.00 | 8486269.00 | 327.00 | 0.00 | 1.60 | 1.60 | 0.03 | 0.13 | 0.34 | 0.47 | 0.51 |
| **BNM2TR8** | 317169.00 | 8486243.00 | 327.00 | 0.00 | 1.70 | 1.70 | 0.03 | 0.13 | 0.34 | 0.46 | 0.50 |

| Hole ID | X Coordinators | Y Coordinates | Z | From | To | Length | Au | Pd | Pt | PGM (Pt+Pd) | PGM eq. (Au+PGM) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (m) | (m) | (m) | g/t | g/t | g/t | g/t | g/t |
| **BNM2TR9** | 317070.00 | 8486253.00 | 327.00 | 0.00 | 1.60 | 1.60 | 0.04 | 0.17 | 0.43 | 0.60 | 0.64 |
| **BNM2TR10** | 317130.00 | 8486228.00 | 327.00 | 0.00 | 3.00 | 3.00 | 0.04 | 0.13 | 0.38 | 0.51 | 0.55 |
| **BNM2TR11** | 317031.00 | 8486238.00 | 327.00 | 0.00 | 3.00 | 3.00 | 0.04 | 0.16 | 0.41 | 0.57 | 0.61 |
| **BNM2TR12** | 317090.00 | 8486212.00 | 327.00 | 0.00 | 2.20 | 2.20 | 0.03 | 0.12 | 0.31 | 0.43 | 0.46 |
| **BNM2TR13** | 317154.00 | 8486184.00 | 327.00 | 0.00 | 3.00 | 3.00 | 0.04 | 0.14 | 0.37 | 0.51 | 0.55 |
| **BNM3TR1** | 317309.00 | 8486198.00 | 323.00 | 0.00 | 2.00 | 2.00 | 0.09 | 0.21 | 0.36 | 0.56 | 0.65 |
| **BNM3TR2** | 317309.00 | 8486063.00 | 324.00 | 0.00 | 4.00 | 4.00 | 0.06 | 0.16 | 0.30 | 0.46 | 0.52 |
| **BNM3TR3** | 317309.00 | 8486109.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.06 | 0.15 | 0.32 | 0.47 | 0.53 |
| **BNM3TR4** | 317309.00 | 8486159.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.08 | 0.16 | 0.33 | 0.48 | 0.56 |
| **BNM3TR5** | 317343.00 | 8486178.00 | 323.00 | 0.00 | 3.70 | 3.70 | 0.08 | 0.17 | 0.34 | 0.51 | 0.59 |
| **BNM3TR6** | 317378.00 | 8486156.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.08 | 0.16 | 0.33 | 0.49 | 0.57 |
| **BNM3TR7** | 317276.00 | 8486216.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.08 | 0.20 | 0.38 | 0.58 | 0.66 |
| **BNM3TR8** | 317238.00 | 8486238.00 | 323.00 | 0.00 | 4.00 | 4.00 | 0.06 | 0.21 | 0.36 | 0.57 | 0.63 |
| **BNM3TR9** | 317308.00 | 8486242.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.08 | 0.21 | 0.38 | 0.58 | 0.66 |
| **BNM3TR10** | 317307.00 | 8486292.00 | 323.00 | 0.00 | 3.60 | 3.60 | 0.05 | 0.15 | 0.38 | 0.53 | 0.59 |
| **BNM3TR11** | 317308.00 | 8486345.00 | 323.00 | 0.00 | 3.30 | 3.30 | 0.05 | 0.12 | 0.36 | 0.48 | 0.53 |
| **BNM3TR12** | 317270.00 | 8486175.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.07 | 0.19 | 0.39 | 0.58 | 0.66 |
| **BNM3TR13** | 317348.00 | 8486221.00 | 323.00 | 0.00 | 3.00 | 3.00 | 0.07 | 0.18 | 0.34 | 0.52 | 0.59 |
| **BNM3TR14** | 317398.00 | 8486248.00 | 324.00 | 0.00 | 3.60 | 3.60 | 0.07 | 0.19 | 0.34 | 0.53 | 0.60 |
| **BNM3TR15** | 317222.00 | 8486147.00 | 322.00 | 0.00 | 3.00 | 3.00 | 0.07 | 0.21 | 0.41 | 0.62 | 0.69 |

Source: Largo, 2024.

The Company also performed random sampling around the limit of its ilmenite stockpile, which contains 8,700 tonnes of material as effective date of January 19, 2024. A total of 19 samples were collected and submitted for further analysis, with the results presented in Table 24-2.

**Table 24-2 – Result of 2023 Ilmenite Stockpile Sampling Program**

| Sample ID | $TiO_2$ Ranges | Au | Pd | Pt | Weight Sample | Pd+Pt | Pd + Pt+Au |
|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | g | g/t | g/t |
| **ILM-PC-001-0001** | **>45% $TiO_2$** | 0.09 | 0.2 | 0.51 | 15.76 | 0.71 | 0.8 |
| **ILM-PC-001-0002** | | 0.1 | 0.21 | 0.54 | 15.68 | 0.75 | 0.85 |
| **ILM-PC-001-0003** | | 0.06 | 0.19 | 0.44 | 15.09 | 0.63 | 0.69 |
| **ILM-PC-001-0004** | | 0.09 | 0.27 | 0.63 | 15.31 | 0.9 | 0.99 |
| **ILM-PC-001-0005** | | 0.07 | 0.25 | 0.52 | 15.59 | 0.77 | 0.84 |
| **ILM-PC-001-0006** | | 0.08 | 0.22 | 0.53 | 15.72 | 0.75 | 0.83 |
| **ILM-PC-001-0007** | | 0.06 | 0.25 | 0.55 | 15.71 | 0.8 | 0.86 |
| **ILM-PC-001-0008** | | 0.08 | 0.2 | 0.46 | 15.4 | 0.66 | 0.74 |
| **ILM-PC-001-0009** | | 0.07 | 0.24 | 0.55 | 15.46 | 0.79 | 0.86 |
| **ILM-PC-001-0010** | | 0.09 | 0.2 | 0.56 | 15.16 | 0.76 | 0.85 |
| **ILM-PC-001-0011** | **<45% $TiO_2$** | 0.05 | 0.17 | 0.39 | 15.33 | 0.56 | 0.61 |
| **ILM-PC-001-0012** | | 0.1 | 0.21 | 0.53 | 15.76 | 0.74 | 0.84 |
| **ILM-PC-001-0013** | | 0.07 | 0.21 | 0.47 | 15.25 | 0.68 | 0.75 |
| **ILM-PC-001-0014** | | 0.1 | 0.22 | 0.52 | 15.21 | 0.74 | 0.84 |
| **ILM-PC-001-0015** | | 0.07 | 0.2 | 0.54 | 15.33 | 0.74 | 0.81 |
| **ILM-PC-001-0016** | | 0.07 | 0.2 | 0.48 | 15.22 | 0.68 | 0.75 |
| **ILM-PC-001-0017** | | 0.06 | 0.2 | 0.47 | 15.62 | 0.67 | 0.73 |
| **ILM-PC-001-0018** | | 0.05 | 0.19 | 0.43 | 15.59 | 0.62 | 0.67 |
| **ILM-PC-001-0019** | | 0.05 | 0.2 | 0.47 | 15.7 | 0.67 | 0.72 |
| **ILM-PC-001-0019** | | 0.05 | 0.2 | 0.45 | 15.22 | 0.65 | 0.7 |
| **Minimum** | | 0.05 | 0.17 | 0.39 | 15.46 | 0.56 | 0.61 |
| **Average** | | 0.07 | 0.21 | 0.5 | | 0.71 | 0.79 |
| **Maximum** | | 0.1 | 0.27 | 0.63 | | 0.9 | 0.99 |

Source: Largo, 2024.

### *24.1.2 Past Exploration Work Performed: PGMs at the Maracás Menchen Mine*

Past exploration work was conducted on the Company's Gulçari A Norte (GAN), São José (SJO), Novo Amparo (NAO), and Novo Amparo Norte (NAN) targets, (collectively, the "Northern District") in 2006, 2008, 2011, 2012 and 2014 and 2018. These exploration efforts returned grades of PGMs (Table 24-3 and Table 24-4), however, further studies to explore PGMs was discontinued as the Company focused solely on advancing its vanadium operations.

Highlighted PGMs Results from Past Exploration Work

- FGA23 – 9.0 metres grading 0.860g Pt/t and 0.410g Pd/t
- FGA43 – 9.0 metres grading 0.108g Pt/t and 0.005g Pd/t
- FGA25 – 9.0 metres grading 0.740g Pt/t and 0.110g Pd/t

**Table 24-3 – Past PGM Results of the Campbell Pit (see new release dated April 24th, 2007)**

| Hole - ID | X | Y | Z | Az | Dip | From | To | Length | Pd | Pt | Pt+Pd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | m | m | m | g/t | g/t | g/t |
| FGA10 | 8486183.00 | 318332.00 | 307.01 | 284.00 | 59.00 | 70.50 | 100.00 | 29.50 | 0.06 | 0.44 | 0.50 |
| FGA16 | 8486071.00 | 318251.00 | 304.76 | 284.00 | 60.00 | 121.00 | 131.29 | 10.29 | 0.18 | 0.31 | 0.48 |
| FGA23 | 8486160.00 | 318236.00 | 314.84 | 108.00 | 78.00 | 46.00 | 55.00 | 9.00 | 0.42 | 0.86 | 1.28 |
| FGA25 | 8486165.00 | 318293.00 | 311.13 | 284.00 | 44.00 | 46.00 | 65.00 | 19.00 | 0.11 | 0.74 | 0.85 |
| FGA37 | 8486098.00 | 318319.00 | 302.07 | 292.00 | 50.00 | 98.00 | 108.00 | 10.00 | 0.25 | 0.54 | 0.79 |
| FGA42 | 8486162.00 | 318390.00 | 295.70 | 284.00 | 60.00 | 105.90 | 116.00 | 10.10 | 0.03 | 0.39 | 0.42 |
| FGA43 | 8486108.00 | 318372.00 | 295.71 | 286.00 | 70.00 | 96.00 | 105.00 | 9.00 | 0.05 | 1.08 | 1.13 |
| FGA48 | 8486058.00 | 318300.00 | 298.45 | 293.00 | 50.00 | 47.00 | 79.00 | 32.00 | 0.18 | 0.34 | 0.52 |
| FGA51 | 8486033.00 | 318355.00 | 298.00 | 296.00 | 50.00 | 124.00 | 136.00 | 12.00 | 0.27 | 0.35 | 0.62 |
| FGA54 | 8486113.00 | 318345.00 | 295.93 | 288.00 | 50.00 | 96.00 | 112.00 | 16.00 | 0.21 | 0.26 | 0.47 |

Source: Largo, 2024.

The Company is performing a further review of past drill data with the intention of developing a new database to assess the possibility of the continuity of PGMs in the Northern District.

**Table 24-4 – Past PGM Drill Result Highlights from the Northern District**

| Hole ID | X | Y | Z | Az | Dip | From | To | Length | Pd | Pt | Pt+Pd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | m | m | m | g/t | g/t | g/t |
| FGAN01 | 318772.29 | 8487089.6 | 310.63 | 270 | -45 | 218 | 220 | 2 | 0.57 | 0.58 | 1.15 |
| FGAN12 | 318622.32 | 8486596.5 | 302.83 | 290 | -45 | 106 | 109 | 3 | 0.55 | 0.7 | 1.24 |
| FGAN06 | 318663.09 | 8486495.1 | 300.57 | 290 | -45 | 172 | 175 | 3 | 0.45 | 0.45 | 0.91 |
| FGAN09 | 318565.79 | 8486377.2 | 297.16 | 270 | -45 | 89.3 | 90 | 0.7 | 0.16 | 1.84 | 1.99 |
| FSJ19 | 318989.24 | 8488478.2 | 322.47 | 290 | -45 | 66 | 68 | 1 | 0.78 | 0.34 | 1.12 |
| FSJ20 | 318960.64 | 8488414.9 | 321.27 | 290 | -45 | 56 | 57.4 | 1.4 | 0.89 | 0.58 | 1.48 |
| FSJ21 | 318998.93 | 8488337.3 | 317.74 | 290 | -45 | 114 | 115.2 | 1.2 | 0.97 | 0.49 | 1.46 |
| FNAN02 | 319951.94 | 8492476 | 350.73 | 290 | -45 | 91 | 93 | 2 | 1.46 | 0.53 | 1.99 |
| FNAN12 | 320051.47 | 8492748.1 | 349.85 | 290 | -45 | 133 | 135 | 2 | 1.38 | 0.69 | 2.07 |
| FNAN16 | 319904.35 | 8492353.5 | 349.6 | 290 | -45 | 92.2 | 94.7 | 2.5 | 2.03 | 0.8 | 2.82 |

Source: Largo, 2024.

## 24.2 Magnetite Concentrate Quality

The magnetite concentrate produced by the wet magnetic concentration contain not only magnetite, but small quantities of silica and other minor minerals.

The silica content impacts the plant global recovery. As higher is the silica, lower will be the recovery.

The Company is evaluating improvements in wet magnetic separation that will reduce the content of silica in the concentrate. This improvement consists in install new magnetic concentrators, high frequency screens and demagnetizing coils. The combination of this equipment should provide a better selectivity to the current concentration installed in Maracás plant and increase the global recovery as consequence of the silica reduction in concentrate.

This evaluation and improvements will be done by the end of 2024, and the increase in the recovery should follows it.

## 24.3 Flotation Feed Concentration

The usage of the non-magnetic material produced from 2014 to 2023, that are disposed in the non-magnetic pond, are already in Largos strategy, but the Company is evaluating to use it sooner, in 2024 already.

The material disposed in the ponds have higher content of $TiO_2$ than the ore mined in 2024 and will be mined in the next years, that means the usage of the non-magnetic material from the ponds can improve the ilmenite production in flotation due to the increase of feed rate and due to the elevation of the $TiO_2$ grade in this feed.

This usage will be performed using a repulping system that will pump the material to the flotation plant. It is a simple system that should be operating until the end of 2024, concomitantly with the finalization of Ilmenite Plant ramp-up.

## 24.4 Circular Economy Using Recycling

The Company is evaluating the possibility of use residues from other industries as new sources of vanadium. There are several residues in evaluation, all with high content of vanadium. The main challenge is finding a process route that can be implemented in Maracás plant without impact the production from the current source, the magnetite ore. Despite this challenge, the studies already performed are very promising.

This development could not only increase the vanadium production but is aligned with its strategy to assist in a greener future.

## 24.5 Vanadium for Chemical Industry

The Company is improving its processes in Maracás plant to produce vanadium powder that attend the chemical industry. This market demands a product with very low content of contaminants, and Largo’s plant can produce these materials with improvements there are in progress. This could represent an important increase in Largo’s Market share, in the chemical sector.

## 24.6 Campbell – GAS Connection

The Company is assessing an exploration program to confirm the mineralization between Campbell pit and GAS.

The nineteen diamond drilling holes executed at the GAS target generated 11.3 Mt of Inferred Resources grading 0.58 of $V_2O_5$ and 8.48 of $TiO_2$, head and 2.31 of $V_2O_5$ and 2.22 of $TiO_2$ into concentrate.

The distance between the Campbell Reserves Pit and the GAS Resources Pit is 800 m and can increase the tonnes of ROM near the mining facility.

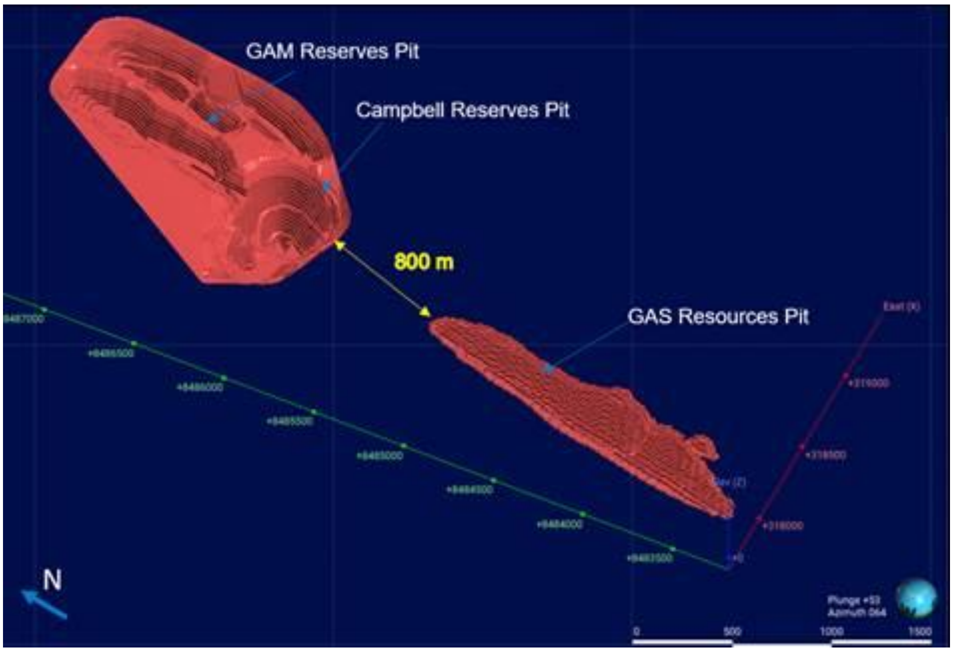



**Figure 24-1 – Location of GAS deposit in relation to the Campbell Pit**

Source: Largo, 2024.

# 25 INTERPRETATION AND CONCLUSIONS

GE21 developed a Mineral Resource for Campbell Pit, GAN, NAO, NAN, SJO, Gulçari A Sul (GAS), Jacaré (JAC) and Rio de Contas (RIOCON) and Mineral Reserve for Campbell Pit, GAN, NAO, NAN and SJO. The QP Fábio Valério Câmara Xavier (MAIG) is responsible for Mineral Resources Estimate, and Guilherme Gomides Ferreira (MAIG) is responsible for Mineral Reserves estimation. The QP Porfirio Cabaleiro Rodriguez (FAIG) supervised the entire report and is responsible for the other sections of this document.

## 25.1 Mineral Exploration and Geology

The procedures of geological description, sampling and preparation of samples for the laboratory and determination of densities were evaluated and considered as acceptable according to the best practices of the industry.

All processes related to the acquisition and organization of the database for the declaration of the Mineral Resources followed appropriate safety standards. The data collection has been standardized within a secure digital environment by resetting the concepts of security and rastreability.

Largo has been executing a mineral research program over the years using the most appropriate techniques given the type of deposit, with, for example, geophysical survey (airborne and terrestrial magnetometry), geochemical surveys, geological mappings, density determinations and studies of the recovery of other minerals ($TiO_2$). Concomitantly with the conclusions of these studies, Largo Inc. increasingly improves their understanding of mineral deposit.

The QP has been following the density studies of the Maracás Menchen Project since 2017 and attesting that the determinations suitable to use in Mineral Resources and Mineral Reserves estimation.

## 25.2 Security and QA/QC

The analysis of quality control, transportation to the laboratory, the conditions of preparation and storage of samples reported in previous reports of former owners and Largo, in addition to the current procedures that have been validated currently, allowed the QP to assume that the data is acceptable for a proposed Mineral Resource estimate.

The same control procedures as the primary and secondary laboratories involved in all drilling programs have so far been recognized as suitable to use in Mineral Resources and Mineral Reserves estimation by the QP in this report.

## 25.3 Geological Model

The Rio Jacaré Intrusion is a mineralized mafic-ultramafic formation with a sheet-like structure running approximately 70 km north-south, an average width of 1.2 km, and a dip of 70° E. Detailed studies by Largo have subdivided the intrusion within the Project area into several cyclic units. Cycles C1 to C4 are interpreted as the feeder zone of the intrusion, showing limited lateral continuity. In contrast, cycles C5 to C10 form the upper portions of the deposit and extend laterally over the entire strike length of the Rio Jacaré Intrusion. Cycles C5 to C10 were modelled by differentiating each magmatic cycle, while cycles C1 to C4 were modelled together.

Results from Davis Tube (%DT) and geological description were used to define the types of lithologies Massive and banded Magnetite (MAG), Magnetite-pyroxenite (MPXT), Magnetite Gabbro (MGB), Pyroxenite with Magnetite (PXTM), Gabbro with Magnetite (GCM), Pyroxenite (PXT) and Gabbro (GAB). Grade shells at 0.3% of $V_2O_5$ and 1% of $TiO_2$ were used to constrain the mineralized zones. The waste typologies such as pegmatite, gabbro, anorthosite, granite and soils also were modelled by implicit method.

The modelled geological domains resulted from intersection of magmatic cycles with lithological types.

The methodology and the result were considered adequate by the QP for the purpose of Mineral Resources Estimative.

## 25.4 Grade Interpolation

The Ordinary Kriging (OK) estimation method was used to estimate the contents (Head and concentrate) for % $V_2O_5$, % $TiO_2$, %Fe, % $SiO_2$ and %DT obtained for all delimited domain by magmatic cycle.

The QP prepared variographic analysis of the composites for each domain separately. In some situations, in domains with a few samples, domains were grouped for create robust variograms. A theoretical variogram was modeled along the hole to evaluate the behavior at the origin of the variogram of each domain. The directional variograms were modelled in each main domain for each deposit.

The estimates were separated for each domain, respecting the composites of each domain, using the Hard Boundary Concept. The estimate was made using four steps, varying the neighboring search main radius, which was defined based on the range of the variogram modeled for each domain.

Interpolation was validated the grade estimate through visual analysis and global and local bias analysis using the nearest neighbor as the comparison estimate and assumes there is not notable bias on the current estimates, and the smoothing in grades estimates is compatible with the estimate strategies used.

The QP recognizes that choice of estimation method as adequate and considered as adequate by the QP for the purpose of Mineral Resources Estimative.

## 25.5 Mineral Resource Estimate

The QP classified the Mineral Resources based on GE21 internal criteria and in accordance with the CIM definitions. The data collected was evaluated in terms of quality and quantity data.

The Mineral Resource cut-off grade is 0.3% of $V_2O_5$ and 1% of $TiO_2$. Only MAG, MPXT and MGB domains were considered eligible to classification as Mineral Resource.

The **CIM Estimation of Mineral Resources & Mineral Reserves Best Practice Guidelines** (2018) emphasize that significant factors affecting project economics must be current, well-developed, and based on accepted industry practices. The cut-off grade should accurately reflect various factors including location, deposit scale, and long-term metal prices. For open-pit mining deposits, the authors recommend using a Lerchs-Grossman pit model to capture necessary inputs and assess economic extraction prospects efficiently. Only blocks within this conceptual pit were considered current Mineral Resources, with optimization performed using Geovia Whittle software based on specified parameters. Table 25-1 summarizes the Mineral Resources of the Project.

**Table 25-1 – Mineral Resource of Maracás Project**

| Target | Classification | Mass | Head | | Magnetic Concentrate | | | Material Content | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_2O_5$ | $TiO_2$ | DT | $V_2O_5$ | $TiO_2$ | $V_2O_5$ | $TiO_2$ |
| | | (Mt) | (%) | | | | | (kt) | |
| Campbell Pit + GAN | Measured | 30.28 | 0.71 | 7.64 | 22.21 | 2.40 | 3.48 | 215.73 | 2,313.22 |
| | Indicated | 21.09 | 0.54 | 7.28 | 18.51 | 2.14 | 2.73 | 114.50 | 1,536.38 |
| | ***Measured + Indicated*** | ***51.37*** | ***0.64*** | ***7.49*** | ***20.69*** | ***2.30*** | ***3.17*** | ***330.23*** | ***3,849.60*** |
| | Inferred | 29.94 | 0.54 | 7.46 | 18.52 | 2.00 | 2.31 | 162.2 | 2,232.6 |
| SJO | Indicated | 17.92 | 0.58 | 8.77 | 22.78 | 1.90 | 2.86 | 104.4 | 1,571.6 |
| | ***Measured + Indicated*** | ***17.92*** | ***0.58*** | ***8.77*** | ***22.78*** | ***1.90*** | ***2.86*** | ***104.39*** | ***1,571.57*** |
| | Inferred | 15.19 | 0.52 | 7.43 | 19.02 | 1.89 | 2.53 | 78.9 | 1 127.9 |
| NAO | Indicated | 7.13 | 0.58 | 10.06 | 27.29 | 1.72 | 3.06 | 41.4 | 717.2 |
| | ***Measured + Indicated*** | ***7.13*** | ***0.58*** | ***10.06*** | ***27.29*** | ***1.72*** | ***3.06*** | ***41.38*** | ***717.16*** |
| | Inferred | 4.09 | 0.59 | 8.61 | 23.34 | 1.83 | 3.03 | 24.0 | 351.8 |
| NAN | Measured | 19.44 | 0.64 | 9.02 | 22.88 | 2.14 | 2.83 | 123.7 | 1,753.6 |
| | Indicated | 8.93 | 0.60 | 9.14 | 21.90 | 2.14 | 2.63 | 53.9 | 815.6 |
| | ***Measured + Indicated*** | ***28.37*** | ***0.63*** | ***9.06*** | ***22.57*** | ***2.14*** | ***2.77*** | ***177.54*** | ***2,569.17*** |
| | Inferred | 6.88 | 0.66 | 9.16 | 22.69 | 2.28 | 2.68 | 45.7 | 630.0 |
| GAS | Inferred | 11.30 | 0.58 | 8.48 | 18.36 | 2.31 | 2.22 | 66.0 | 958.7 |
| JAC | Inferred | 21.16 | 0.47 | 7.78 | 18.57 | 1.74 | 4.65 | 98.9 | 1,645.3 |
| RIOCON | Inferred | 13.27 | 0.41 | 7.23 | 16.15 | 1.63 | 3.86 | 55.0 | 959.3 |
| Total | Measured | 49.72 | 0.68 | 8.18 | 22.47 | 2.30 | 3.22 | 339.39 | 4,066.84 |
| | Indicated | 55.06 | 0.57 | 8.43 | 21.58 | 2.01 | 2.80 | 314.15 | 4,640.66 |
| | ***Measured + Indicated*** | ***104.78*** | ***0.62*** | ***8.31*** | ***22.01*** | ***2.15*** | ***3.00*** | ***653.54*** | ***8,707.50*** |
| | Inferred | 101.82 | 0.52 | 7.76 | 18.75 | 1.93 | 3.08 | 530.79 | 7,905.60 |

**Notes:**

1. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
2. Mineral Resources were estimated by Fábio Xavier, BSc. (Geo), MAIG, a GE21 Associate, who meets the requirements of a "Qualified Person" as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
3. The Mineral Resource estimates were prepared in accordance with the CIM Standards and the CIM Guidelines, using geostatistical, economic, and mining parameters appropriate to the deposits.
4. Presented Mineral Resources are inclusive of Mineral Reserves. All figures have been rounded to the relative accuracy of the estimates. Summed amounts may not add due to rounding.

5. The Campbell Pit topography survey effective date is January 30th, 2024.
6. The Mineral Resource is reported on an effective date of January 30th, 2024.
7. A cut-off grade of 0.3% $V_2O_5$ head is applied in $V_2O_5$ Mineral Resource.
8. A cut-off grade of 1% $TiO_2$ head, derived from an economic function, is associated to $TiO_2$ Mineral Resource.
9. Geometric and economic parameters include:
   - Mine Recovery of 100% and dilution 0%.
   - $V_2O_5$ selling price of $16 per lb.
   - $TiO_2$ pigment selling price of $4,000.00 per tonne.
   - Mining costs of $2.93 per tonne for mineralization and waste.
   - Vanadium processing costs of $34.60 per tonne of ore feed.
   - Ilmenite concentrate costs $5.74 per tonne processed.
   - $TiO_2$ pigment costs of $1,733.00 per tonne of pigment produced.
   - General and Administrative (G&A) costs of $0.27 per lb of $V_2O_5$.
10. Exchange rate: $1.00 = R$5.10.
11. Specific values for each Deposit:
   - Campbell Pit + GAN: Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ concentrate recovery of 70.50% to 78.86%. $TiO_2$ overall recovery of 32.78% to 43.44%.
   - NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%.
   - SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.
   - NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%.

Source: GE21, 2024.

The $TiO_2$ tailings dam was considered as Resource Indicated for the reasons already mentioned above and quantified and qualified with mine reconciliation data and topographic surveys. Table 25-2 summarizes the Mineral Resources of the Project.

**Table 25-2 – Mineral Resource of $TiO_2$ in Non-Magnetic Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal content (kt) |
|---|---|---|---|---|
| **BNM 02** | Indicated | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Indicated | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Indicated | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Resources** | **Indicated** | **5,218.43** | **10.54** | **550.25** |

**Notes:**
1. Stock of “Non-Magnetic concentrate” available in the tailing’s ponds.
2. Mineral Resource in ponds were estimated based on monthly processing and validated through topographic surveys (primitive data and current data) and reconciliation data.
3. Effective Date – January 30th, 2024.
4. Recovery is 100% and no dilution was applied to these Resources.

Source: GE21, 2024.

No current significant factors or risks were identified by the QP that could materially affect the potential development of the Mineral Resources.

## 25.6 Mining

The ultimate pit design and mining plan developed in this report is based on the Proven and Probable Reserves presented here in and the Mineral Reserves summary for deposits are presented on Table 25-2.

Aside from Mineral Reserves from the ultimate pit, three tailings’ ponds bearing titanium enriched material from pre-processed non-magnetic tailings of vanadium magnetic separation are estimated separately as Probable Reserves, as presented on Table 25-3. Details on $TiO_2$ Mineral Reserves from ponds are provided on subsection 15.4.1 and Section 16.

**Table 25-3 – Maracás Menchen Project – Total Mineral Reserves Estimate (Effective Date – January 30th, 2024**

| Category | Tonnage (Mt) | %Magnetics | Head | | Magnetic Concentrate | | | Metal Contained | |
|---|---|---|---|---|---|---|---|---|---|
| | | | % $V_2O_5$ | % $TiO_2$ | Mag (Mt) | % $V_2O_5$ | % $TiO_2$ | $V_2O_5$ in Magnetic Concentrate (kt) | %$V_2O_5$ |
| **Campbell Pit I** | | | | | | | | | |
| **Proven** | 16.16 | 22.42 | 0.86 | 6.35 | 3.62 | 3.15 | 5.05 | 114.23 | 842,94 |
| **Probable** | 5.47 | 18.75 | 0.76 | 5.60 | 1.03 | 3.23 | 4.60 | 33.14 | 259.09 |
| **Total Campbell Pit Reserve** | **21.63** | **21.49** | **0.83** | **6.16** | **4.65** | **3.17** | **4.95** | **147.37** | **1,102.03** |
| **GAN II** | | | | | | | | | |
| **Proven** | 12.96 | 18.44 | 0.45 | 7.66 | 2.39 | 1.80 | 2.93 | 43.94 | 922.31 |
| **Probable** | 11.34 | 16.88 | 0.42 | 7.16 | 1.91 | 1.79 | 2.53 | 34.23 | 763.94 |
| Total GAN Reserve | 24.29 | 17.71 | 0.44 | 7.42 | 4.30 | 1.79 | 2.75 | 77.17 | 1,685.25 |
| **NAN III** | | | | | | | | | |
| Proven | 19.55 | 21.02 | 0.58 | 8.25 | 4.11 | 2.05 | 3.33 | 84.22 | 1,474.91 |
| Probable | 6.40 | 21.14 | 0.56 | 8.63 | 1.35 | 1.98 | 3.04 | 27.84 | 511.05 |
| **Total NAN Reserve** | **25.95** | **21.05** | **0.58** | **8.34** | **5.46** | **2.03** | **3.26** | **111.06** | **1,985.96** |
| **SJO IV** | | | | | | | | | |
| **Proven** | - | - | - | - | - | - | - | - | - |
| **Probable** | 22.41 | 18.12 | 0.44 | 7.48 | 4.06 | 1.76 | 2.99 | 71.32 | 1,555.47 |
| **Total SJO Reserve** | **22.41** | **18.12** | **0.44** | **7.48** | **4.06** | **1.76** | **2.99** | **71.32** | **1,555.47** |
| **NAO V** | | | | | | | | | |
| **Proven** | - | - | - | - | - | - | - | - | - |
| **Probable** | 6.74 | 24.98 | 0.53 | 9.17 | 1.68 | 1.69 | 3.33 | 28.39 | 562.27 |
| **Total NAO Reserve** | **6.74** | **24.98** | **0.53** | **9.17** | **1.68** | **1.69** | **3.33** | **28.39** | **562.27** |
| **Total Maracás Menchen Mine Proven and Probable Reserves** | | | | | | | | | |
| **Proven** | 48.67 | 20.80 | 0.64 | 7.46 | 10.12 | 2.38 | 3.85 | 241.39 | 3,240.16 |
| **Probable** | 52.36 | 19.17 | 0.50 | 7.57 | 10.03 | 1.93 | 3.13 | 193.92 | 3,650.82 |
| **Total** | **101.03** | **19.95** | **0.56** | **7.52** | **20.15** | **2.16** | **3.49** | **435.31** | **6,890.99** |

**Notes:**
1. Mineral Reserves estimates were prepared in accordance with the CIM Standards.
2. Mineral Reserves are the economic portion of the Measured and Indicated Mineral Resources.
3. Mineral Reserves were estimated by Guilherme Gomides Ferreira, BSc. (MEng), MAIG, a GE21 associate, who meets the requirements of a “Qualified Person” as established by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014) (CIM Standards).
4. The Campbell Pit topography survey effective date is January 30th, 2024.
5. The Mineral Reserves are reported with an effective date of January 30th, 2024.
6. The reference point at which the Mineral Reserves are defined is the point where the ore is delivered from the open pit to the crushing plant.
7. Vanadium product comes from magnetic concentrate, while $TiO_2$ product comes from the non-magnetic portion.
8. Mineral Reserves were estimated using the Geovia Whittle 4.3 software and following the geometric and economic parameters:
9. Geometric and economic parameters include:
   - Mine Recovery of 97% and dilution 10%.
   - $V_2O_5$ selling price (standard purity >98%) of $8.50/lb, with an additional premium of $1.00/lb for high purity (>99.5%) product.
   - $TiO_2$ pigment selling price (purity >94%) of $3,528.00 per tonne.
   - Mining costs of $2.93 per tonne for mineralization and waste.
   - Vanadium processing costs of $34.60 per tonne of ore feed.
   - Ilmenite concentrate costs $5.74 per tonne processed.
   - $TiO_2$ pigment costs of $1,733.00 per tonne of pigment produced.
10. General and Administrative (G&A) costs of $0.27 per lb of $V_2O_5$.
11. Exchange rate: $1.00 = R$5.10.
12. Specific values for each Deposit:
    I. Campbell Pit: Pit slope angles ranging from 37.5° to 64°. $V_2O_5$ concentrate recovery of 78.86%. $TiO_2$ overall recovery of 43.44%. Strip Ratio 3.25 (tonnes per tonne).
    II. GAN: Pit slope angles ranging from 40° to 64. $V_2O_5$ concentrate recovery of 70.50%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.17 (tonnes per tonne).
    III. NAN: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 45.90%. Strip Ratio 5.75 (tonnes per tonne).
    IV. SJO: Pit slope angles ranging from 40° to 56°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 4.23 (tonnes per tonne).
    V. NAO: Pit slope angles ranging from 40° to 68°. $V_2O_5$ concentrate recovery of 70.00%. $TiO_2$ overall recovery of 32.78%. Strip Ratio 6.98 (tonnes per tonne).

Source: GE21, 2024.

**Table 25-4 – Maracás Menchen Project – Non-Magnetic Mineral Reserves in Ponds**

| Pond | Classification | Mass (kt) | Grade $TiO_2$ (%) | Metal Content (kt) |
|---|---|---|---|---|
| **BNM 02** | Probable | 1,131.77 | 10.69 | 120.99 |
| **BNM 03** | Probable | 1,051.72 | 11.87 | 124.84 |
| **BNM 04** | Probable | 3,034.94 | 10.03 | 304.42 |
| **Total in Ponds Reserves** | **Probable** | **5,218.43** | **10.54** | **550.25** |

**Notes:**
1. Stock of "Non-Magnetic concentrate" available in the tailing's ponds.
2. Effective Date – January 30th, 2024.
3. Mineral Reserve in ponds were estimated based on monthly processing and validated with topographic surveys (primitive data and current data) and reconciliation data.
4. Recovery is 100% and no dilution was applied to these Reserves.

Source: GE21, 2024.

The mining production schedule spans 31 years, outlining the sequence and duration of mining activities across multiple pits at the Project. The mining plan for the Project outlines the phased development of pits over time, targeting an annual feed rate of 3.4 million tonnes per annum (Mtpa) of run-of-mine (ROM) material to the plant. Initial mining will concentrate on the Campbell Pit for the first nine years. Subsequently, the mining sequence will shift to the NAN, SJO, NAO, and GAN respectively.

## 25.7 Processing

The Company strategy for expansion of Reserves through development in the NAN, SJO, NAO, and GAN deposits, and $TiO_2$ Pigment production. Key projects and expansions and production capacities are detailed as follows:

- Ilmenite Concentration Plant (Ilmenite Plant): This plant, initially capable of producing 100 ktpy of ilmenite concentrate from the non-magnetic concentrate of the Campbell Pit, was completed in 2023. Initial production commenced in August 2023.
- $TiO_2$ Pigment Plant (Pigment Plant): Proposed for implementation in 2029 in Camaçari, Bahia, Brazil, the Pigment Plant is designed to produce 100 ktpy of $TiO_2$ pigment. The ramp-up phase would begin in 2029 with 30 ktpy, increase to 60 ktpy in 2030, and would be anticipated to achieve full capacity by 2031.
- Ilmenite Plant Expansion: To support the demand of the proposed Pigment Plant, the Ilmenite Plant will expand its nameplate capacity from 100 ktpy to 265 ktpy. This expansion is expected to ramp-up by 2025 and reach full capacity by 2029.

## 25.8 Economic Analysis

The economic study analyzed Largo Inc.'s Investment Plan from 2024 to 2061 as a whole and its benefits to the Company's strategy. In this way, the calculated NPV reflects the value of the Company in its current situation, along with the benefits of the projected investments.

The Project is singular (a running project), and economic parameters indicators such as IRR and Payback cannot be calculated or separated for each project phases. GE21 conducted a study aiming to present marginal results associated with the parameters. Table 25-5 presents the economic analysis results.

**Table 25-5 – Economic Analysis Results**

| Item | Value |
|---|---|
| NPV@7% Pre-tax | US$1.6 Billion |
| NPV@7% Post-tax | US$1.1 Billion |
| Marginal IRR | 18.5% |

Source:GE21, 2024.

# 26 RECOMMENDATIONS

GE21's QPs recommend advancing the Project to a Feasibility Study, which should consider the following recommendations:

## 26.1 Mineral Resources

- Complete the process of implementing MX Deposit into the project's routine operation.
- Continue the density tests using the same procedure adopted in the period from 2021 to 2023.
- Continue research activities seeking to better understand the geological context and control mineralization, especially $TiO_2$ mineralization.
- Deepen studies regarding mineralization in PGM to understand the mineralization.
- Continue to expand the total Mineral Resource with:
- Infill drilling campaign to convert indicated to measured Mineral Resources in Campbell Pit to support the mining operation.
- Infill drilling campaign to convert indicated and inferred Mineral Resources in measured and indicated Mineral Resources in NAN, SJO, NAO and GAN deposits to support the Feasibility Study and exploratory survey to increase total Mineral Resources in the continuity of strike.
- Drilling campaign to convert inferred Mineral Resources in measured and indicated Mineral Resources in GAS, JAC and RIOCON deposits to convert to Mineral Reserves.

## 26.2 Mining

- Develop detailed grade control procedures for NAN, SJO, NAO, and GAN deposits before starting mining.
- Improve the grade control program and reconciliation program for Campbell Pit and update the mine recovery and dilution parameters.
- Measure the moisture and blasted swell effect for ore and waste, and review the fleet sizing estimation.
- Conduct a detailed geotechnical analysis for NAN, SJO, NAO, and GAN deposits, including a geotechnical-oriented diamond drilling campaign and logging, with sample collection for tensile, compressive and shear strength tests, and review the pit optimization parameters.
- Perform supplementary geotechnical investigations of planned infrastructure sites, including waste dump areas.
- Implement hydrological and hydrogeological studies for the NAN, SJO, NAO and GAN deposits, and ensure continuous monitoring of the water level for Campbell Pit.
- Develop grade control procedures for deposit and reclaiming of ponds to complement the control of the blend to fed into the Ilmenite Plant.

## 26.3 Metallurgical Testing and Processing

- Enhance flotation studies and consider conducting pilot-scale tests within the traditional circuit, encompassing rougher, scavenger, and cleaner stages, utilizing column cells.
- Investigate wet magnetic separation of medium intensity (up to 7,000 Gauss) on a bench scale for the low-intensity wet non-magnetic waste from the current plant, which is rich in titanium, prior to the desliming step in a hydrocyclone. Evaluate the technical and economic feasibility of introducing medium-intensity magnetic separation as a pre-concentration and desliming step before flotation.
- Assess the recovery of titanium from dry low-intensity non-magnetic tailings, as well as residual vanadium, for each lithology and deposit through bench tests with small samples. Explore the following process developments:
    - Crushing using a vertical shaft crusher (VSI) in a closed circuit with vibrating screen, achieving reduction below approximately 3.0 mm, followed by low (800 Gauss. 1,500 Gauss) and medium intensity wet or dry magnetic separation (up to 7,000 Gauss), in rougher, scavenger, and cleaner stages.
    - Milling in HPGR (High Pressure Grinding Rolls) in a closed circuit with vibrating sieve, achieving reduction below approximately 2.0 mm (or ideally < 2.0 mm), followed by dry or wet magnetic separation in low (800 Gauss: 1,500 Gauss) and medium intensity (up to 7,000 Gauss), in rougher, scavenger, and cleaner stages.
- Conduct a trade-off study to evaluate the operational expenditure (OPEX) and capital expenditure (CAPEX) associated with crushing in a VSI crusher and grinding in HPGR, as well as compare them with the current plant's crushing and grinding circuit.
- Perform periodic analysis in an independent certified laboratory to compare and monitor the percentage of $TiO_2$ in ilmenite concentrate for shipments, ensuring the accuracy of the results.
- Conduct metallurgical tests to develop the process to recover the PGM from the ponds.

## 26.4 Capital and Operating and Costs

- Improve CAPEX and OPEX estimates for non-magnetics ponds, ilmenite, pigment and vanadium expansion plants, presented in Section 21 for the next stage of the Project, the Feasibility Study.

## 26.5 Environment

- Start environmental studies to obtain the environmental license before the planned start date of operations in NAN, SJO, NAO and GAN, thus avoiding production delays.

## 26.6 Estimates Costs

An estimate for the costs of the recommended items is shown below in Table 26-1:

**Table 26-1 – Recommendation Costs**

| Items | Costs (US$x1000) |
|---|---|
| Density test work | 30 |
| Mineral research including geological mapping, soil geochemistry, geophysical survey and drilling | 3,000 |
| Geotechnical Studies for NAN, SJO, NAO, and GAN | 1,600 |
| Campbell Pit bolting | 200 |
| Hydrological and hydrogeological studies | 550 |
| Metallurgical tests | 850 |
| Environmental studies for NAN, SJO, NAO, and GAN | 1,100 |
| Development of a Feasibility Study for NAN, SJO, NAO and GAN | 1,000 |

Source: GE21, 2024.

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