Rock solid resources.
Proven advice.™

NEXA RESOURCES S.A.

TECHNICAL REPORT ON THE FEASIBILITY STUDY OF THE ARIPUANÃ PROJECT, STATE OF MATO GROSSO, BRAZIL

NI 43-101 Report

Qualified Persons:
Jason J. Cox, P.Eng.
Sean Horan, P.Geo.
Scott Ladd, P.Eng.
Avakash Patel, P.Eng.
Stephan Theben, Dipl. -Ing.

October 15, 2018

Report Control Form

Document Title	Technical Report on the Feasibility Study on the Aripuanã Project, State of Mato Grosso, Brazil		
Client Name & Address	Nexa Resources S.A.		
Document Reference	Project #2894	***Status & Issue No.***	FINAL Version
Issue Date	October 15, 2018		
Lead Author	Jason J. Cox	(Signed)	
Peer Reviewer	Deborah McCombe	(Signed)	
Project Manager Approval	Jason J. Cox	(Signed)	
Project Director Approval	David Smith	(Signed)	

Report Distribution

Name	No. of Copies
Client	
RPA Filing	1 (project box)

Roscoe Postle Associates Inc.
55 University Avenue, Suite 501
Toronto, ON M5J 2H7
Canada
Tel: +1 416 947 0907
Fax: +1 416 947 0395
mining@rpacan.com

TABLE OF CONTENTS

PAGE

1 SUMMARY 1-1
Executive Summary 1-1
Economic Analysis 1-6
Technical Summary 1-12
2 INTRODUCTION 2-1
3 RELIANCE ON OTHER EXPERTS 3-1
4 PROPERTY DESCRIPTION AND LOCATION 4-1
5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY 5-1
6 HISTORY 6-1
7 GEOLOGICAL SETTING AND MINERALIZATION 7-1
Regional Geology 7-1
Local Geology 7-4
Property Geology 7-5
Mineralization 7-7
8 DEPOSIT TYPES 8-1
9 EXPLORATION 9-1
1999-2002 Exploration 9-1
Nexa Exploration 9-2
Exploration Potential 9-4
10 DRILLING 10-1
Previous Drilling 10-1
Recent Drilling 10-2
11 SAMPLE PREPARATION, ANALYSES AND SECURITY 11-1
Sampling Method and Approach 11-1
Density Analysis 11-1
Sample Preparation and Analysis 11-2
Sample Chain of Custody and Core Storage 11-3
Database Management 11-4
Quality Assurance and Control 11-4
12 DATA VERIFICATION 12-1
Data Verification by Nexa 12-1
Data Verification by RPA 12-2
13 MINERAL PROCESSING AND METALLURGICAL TESTING 13-1
Introduction 13-1
Metallurgical Sampling 13-2

Metallurgical Testing ... 13-5
Summary ... 13-36

14 MINERAL RESOURCE ESTIMATE ... 14-1
Comparison with Previous Estimate ... 14-4
Resource Database ... 14-6
Topography ... 14-7
Geological Interpretation ... 14-7
Capping of High Grades ... 14-13
Compositing ... 14-17
Exploratory Data Analysis ... 14-19
Variography ... 14-23
Block Model ... 14-28
Interpolation Strategy ... 14-30
Net Smelter Return Cut-Off Value ... 14-33
Classification ... 14-36
Validation ... 14-40

15 MINERAL RESERVE ESTIMATE ... 15-1

16 MINING METHODS ... 16-1
Mine Design ... 16-1
Mining Method ... 16-6
Underground Mining Fleet ... 16-7
Geotechnical Considerations ... 16-9
Ventilation ... 16-20
Backfill ... 16-27
Production Schedule ... 16-28

17 RECOVERY METHODS ... 17-1
Process Description ... 17-1

18 PROJECT INFRASTRUCTURE ... 18-1
Tailings Storage Facility ... 18-1
Water Collection and Treatment ... 18-6
Power Supply ... 18-7
Water Supply ... 18-8
Site Access ... 18-8

19 MARKET STUDIES AND CONTRACTS ... 19-1
Markets ... 19-1
Contracts ... 19-1

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT ... 20-1
Environmental Overview ... 20-1
Environmental Constraints ... 20-5
Environmental Approval Requirements ... 20-5
Mine Closure Requirements ... 20-9

21 CAPITAL AND OPERATING COSTS ... 21-1

22 ECONOMIC ANALYSIS....22-1
23 ADJACENT PROPERTIES....23-1
24 OTHER RELEVANT DATA AND INFORMATION....24-2
25 INTERPRETATION AND CONCLUSIONS....25-1
26 RECOMMENDATIONS....26-1
27 REFERENCES....27-1
28 DATE AND SIGNATURE PAGE....28-1
29 CERTIFICATE OF QUALIFIED PERSON....29-1

LIST OF TABLES

PAGE

Table 1-1 After-Tax Cash Flow Summary....1-8
Table 1-2 Sensitivity Analyses....1-12
Table 1-3 Mineral Resource Estimate, July 31, 2018....1-16
Table 1-4 Mineral Reserves – July 31, 2018....1-17
Table 1-5 Pre-Production Capital Cost Estimate....1-20
Table 1-6 Operating Cost Estimate....1-21
Table 4-1 Min. Dardanelos Exploration Authorization Permits....4-2
Table 4-2 Royalty Data....4-6
Table 9-1 Anglo American and Karmin Exploration – 1999-2002....9-1
Table 10-1 Drill Hole Database....10-1
Table 11-1 Certified Reference Materials....11-6
Table 12-1 Summary of Re-analysis....12-1
Table 12-2 Summary of RPA Audits of the Resource Database....12-3
Table 13-1 Phase 1 - LCT 2 Results....13-6
Table 13-2 CWi Results....13-8
Table 13-3 SMC Results....13-8
Table 13-4 SPI Results....13-9
Table 13-5 BWi Results....13-10
Table 13-6 Ai Results....13-11
Table 13-7 RWi Results....13-11
Table 13-8 Summary of Key Optimization LCT Results....13-14
Table 13-9 LCT 028 Conditions and Results– Arex Stratabound Master Composite....13-16
Table 13-10 LCT 011 Conditions and Results– Arex Stringer Master Composite....13-17
Table 13-11 LCT 025 Conditions and Results– Arex Stringer Master Composite....13-18
Table 13-12 LCT 030 Conditions and Results– Arex Mix (75% Stratabound, 25% Stringer)....13-19
Table 13-13 LCT 009 Conditions and Results– Ambrex Stratabound Master Composite....13-20
Table 13-14 LCT 029 Conditions and Results– Ambrex Stratabound Master Composite....13-21
Table 13-15 Summary of Settling Tests Using Magnafloc 10 Flocculant (3 g/t)....13-23
Table 13-16 Summary of Filtration Test Work Conducted by ANDRITZ....13-27
Table 13-17 LCT 003F2 Conditions and Results – Link Stringer Composite....13-29

Table 13-18 LCT 004F2 Conditions and Results – Stringer Global Composite 13-30
Table 13-19 LCT 005F2 Conditions and Results – Link Stratabound Composite 13-31
Table 13-20 LCT 006F2 Conditions and Results – Ambrex Stringer Composite 13-32
Table 13-21 LCT 007F2 Conditions and Results – Ambrex Stratabound Composite 13-33
Table 13-22 LCT 008F2 Conditions and Results – Strata Global Composite 13-34
Table 13-23 Pilot Study Samples.. 13-35
Table 14-1 Mineral Resource Statement, July 31, 2018.. 14-2
Table 14-2 Mineral Resources by Type and Area, July 31, 2018 14-3
Table 14-3 Comparison Between Current and December 23, 2016 Estimates................ 14-5
Table 14-4 Grade Capping Levels 14-14
Table 14-5 Uncapped versus Capped Assay Statistics 14-15
Table 14-6 Composite Statistics 14-18
Table 14-7 Wireframe Grouping for Variography and Search Parameters 14-20
Table 14-8 Block Model Setup.. 14-28
Table 14-9 Block Model Attribute Descriptions... 14-29
Table 14-10 Sample Selection Strategy.. 14-30
Table 14-11 NSR Factors 14-34
Table 14-12 Sensitivity to Cut-off Value – Stratabound (Inclusive)............................. 14-35
Table 14-13 Sensitivity to Cut-off Grade – Stringer (Inclusive).................................... 14-35
Table 14-14 Nexa Search Ellipse Ranges for Classification Criteria 14-37
Table 14-15 Comparison Between OK and NN Means (Zn and Cu) – only Measured and Indicated.. 14-40
Table 15-1 Mineral Reserves – July 31, 2018.. 15-1
Table 15-2 Dilution.. 15-2
Table 15-3 Extraction Percentage.. 15-2
Table 15-4 NSR Data 15-3
Table 15-5 NSR Factors... 15-4
Table 16-1 Development Dimensions 16-6
Table 16-2 Main Underground Mining Fleet... 16-8
Table 16-3 Backfill Specification 16-27
Table 16-4 Production Schedule... 16-29
Table 17-1 Comminution – FEL 2 vs. FEL 3 17-5
Table 21-1 Pre-Production Capital Cost Estimate.. 21-2
Table 21-2 Sustaining Capital Cost Estimate.. 21-2
Table 21-3 Operating Cost Estimate.. 21-3
Table 22-1 After-Tax Cash Flow Summary... 22-2
Table 22-2 Sensitivity Analyses 22-6

LIST OF FIGURES

PAGE

Figure 1-1 Sensitivity Analysis 1-11
Figure 4-1 Location Map.. 4-3
Figure 4-2 Property Map.. 4-4
Figure 4-3 Surface Rights Map 4-7
Figure 7-1 Regional Geology.. 7-2
Figure 7-2 Geological Map of the Amazonian Shield 7-3
Figure 7-3 Property Geology... 7-6
Figure 8-1 Target Model 8-2

Figure 10-1 Drill Hole Collar Map 10-4
Figure 12-1 Density Measurements at Ambrex by Rock Unit 12-4
Figure 12-2 Density Measurements at Arex by Rock Unit 12-4
Figure 12-3 2006 – 2018 Results of Blank Samples (Zinc) 12-6
Figure 12-4 2006 – 2018 Time Series of Material ZnPbL1 (Zinc) 12-7
Figure 12-5 2010 – 2015 Time Series of Material APPD0002 (Copper) 12-8
Figure 12-6 2015 – 2017 Time Series of Material APPD0003 (Zinc) 12-9
Figure 12-7 Analysis of Field Duplicate Data (Zinc) 12-10
Figure 12-8 Analysis of Coarse Reject Duplicate Data (Zinc) 12-11
Figure 13-1 Location of 2017 Arex Metallurgical Samples 13-3
Figure 13-2 Location of 2017 Ambrex Metallurgical Samples 13-4
Figure 13-3 Simplified Sequential Flotation Circuit 13-13
Figure 13-4 Variation of Metal Assays in Flotation Products 13-24
Figure 13-5 Variation of Metal Assays in Flotation Products 13-25
Figure 13-6 Yield Stress vs. Solids Percentage 13-26
Figure 13-7 Viscosity vs. Solids Percentage 13-26
Figure 14-1 3D Isometric View of Geological Wireframes 14-10
Figure 14-2 Ambrex Geological Model 14-11
Figure 14-3 Arex Geological Model 14-12
Figure 14-4 Capping Analysis for Body=33 (Ambrex LINK StrataBound) 14-16
Figure 14-5 Cu Capping Analysis for Body=116 (Arex Stringer) 14-17
Figure 14-6 Histograms for Assay (left) and Composite (right) Lengths 14-19
Figure 14-7 Arex Stratabound Contact Analysis 14-21
Figure 14-8 Correlation Matrices for Stratabound and Stringer 14-22
Figure 14-9 Zn and Cu Statistics by Body and Group 14-23
Figure 14-10 Arex Stratabound, Group 21 Zn Directional Variograms 14-24
Figure 14-11 Ambrex and Link Zones Stratabound, Group 3 Zn Directional Correlograms 14-25
Figure 14-12 Arex Stringer, Group 36 Zn Directional Variograms 14-26
Figure 14-13 Relative Nugget Effect Zn and Cu 14-27
Figure 14-14 Variogram Ranges for Zn and Cu 14-27
Figure 14-15 Search Ranges for Zn Stratabound 14-32
Figure 14-16 Search Ranges for Cu Stringer 14-32
Figure 14-17 Global Variograms Used for Classification Criteria 14-38
Figure 14-18 Final Classification Designation 14-39
Figure 14-19 Comparison Between OK and NN Means (Zn Stratabound) 14-41
Figure 14-20 Comparison Between OK and NN Means (Cu Stringer) 14-41
Figure 14-21 Arex Zn Swath Plot – Easting 14-42
Figure 14-22 Arex Cu Swath Plot – Easting 14-42
Figure 14-23 Ambrex Zn Swath Plot – Easting 14-43
Figure 14-24 Ambrex Cu Swath Plot – Easting 14-43
Figure 14-25 Arex Vertical Section Showing Zn Block Versus Composite Grades 14-44
Figure 14-26 Arex Vertical Section Showing Cu Block Versus Composite Grades 14-45
Figure 14-27 Ambrex Link Vertical Section Showing Zn Block Versus Composite Grades 14-46
Figure 14-28 Ambrex Link Vertical Section Showing Cu Block Versus Composite Grades 14-47
Figure 16-1 Aripuana Long Section 16-2
Figure 16-2 Arex Long Section 16-3
Figure 16-3 Link Long Section 16-4
Figure 16-4 Ambrex Long Section 16-5
Figure 16-5 Perspective 3D Solid Geomechanical Schematic 16-11

Figure 16-6 Geomechanical Section 02AR Showing the Existence Of Massive Class III Range of Intense Fracturing 16-13
Figure 16-7 Perspective Solid 3D Geomechanical Schematic 16-15
Figure 16-8 Geomechanical Section 05AB – a Typical Ambrex Section 16-19
Figure 16-9 Ventilation Requirements 16-21
Figure 16-10 Arex Ventilation Schematic Looking NE 16-22
Figure 16-11 Link Ventilation Schematic Looking NE 16-24
Figure 16-12 Ambrex Ventilation Schematic Looking NE 16-26
Figure 17-1 Simplified Process Flow Sheet 17-3
Figure 18-1 General Site Plan and Proposed TMF Sites for Option 10A 18-4
Figure 18-2 TMF Conceptual Design 18-5
Figure 18-3 Engineered Wetlands Concept 18-6
Figure 18-4 Aripuanã Wetland Water Treatment 18-7
Figure 22-1 Sensitivity Analysis 22-5

1 SUMMARY

EXECUTIVE SUMMARY

Roscoe Postle Associates Inc. (RPA) was retained by Nexa Resources SA (Nexa) to prepare an independent Technical Report on the Aripuanã Zinc Project (the Project), located in the state of Mato Grosso, Brazil. The purpose of this report is to audit a Mineral Resource estimate and to disclose the results of a Feasibility Study (FS) on the Project. This Technical Report conforms to NI 43-101 Standards of Disclosure for Mineral Projects. RPA visited the property on June 2 and 5, 2017 and January 30 to February 2, 2017.

The Aripuanã Zinc property is owned by Mineração Dardanelos Ltda. (Dardanelos), a joint venture between Nexa (70%), and Mineração Rio Aripuanã (a subsidiary of Karmin Exploration Inc. (Karmin, 30%)), with Nexa acting as the operator.

To date, the focus of exploration activities on the property has been the Arex, Link, and Ambrex deposits, which contain the current Mineral Resources and Mineral Reserves.

CONCLUSIONS

Work on the Project is of sufficient detail to support a FS. Considering the Project on a stand-alone basis, the undiscounted after-tax cash flow totals US$494 million over the mine life of 13 years, and simple payback occurs 4.6 years from start of production. The after-tax Net Present Value (NPV) at a 9% discount rate is $129 million (based on mid-period discounting), and the Internal Rate of Return (IRR) is 15.8%.

Based on a good track record of upgrading Inferred Resources, there is excellent potential for additional mine life of at least six years.

RPA offers the following conclusions for each area:

GEOLOGY AND MINERAL RESOURCES

- The Aripuanã Zinc deposits are located within the central-southern portion of the Amazonian Craton, in which Paleoproterozoic and Mesoproterozoic lithostratigraphic units of the Rio Negro-Juruena province (1.80 Ga to 1.55 Ga) predominate.

- The Aripuanã Zinc polymetallic deposits are typical Volcanogenic Massive Sulphide (VMS) deposits associated with felsic bimodal volcanism. Three main elongate mineralized zones, Arex, Link, and Ambrex, have been defined in the central portion of the Project. A smaller, deeper zone, Babaçú, lies to the south of Ambrex.

- Two separate material types have been identified – massive sulphide Stratabound Zn-Pb mineralization, and Cu-Au bearing Stringer mineralization found in the footwall of the Stratabound zones.

- The drilling, sampling, sample preparation, analysis, and data verification procedures meet or exceed industry standard, and are appropriate for the estimation of Mineral Resources.

- As prepared by Nexa and adopted by RPA, the exclusive Aripuanã Measured and Indicated Mineral Resources comprise 5.7 million tonnes (Mt) at 2.3% Zn, 0.7% Pb, 0.4% Cu, 0.5 g/t Au, and 20 g/t Ag for 282 million pounds of Zn, 91 million pounds of Pb, 46 million pounds of Cu, 90,000 ounces of Au, and 3.6 million ounces of Ag.

- The Aripuanã Inferred Mineral Resources comprise 23 Mt at 3.8% Zn, 1.5% Pb, 0.5% Cu, 0.9 g/t Au, and 37 g/t Ag for 1.9 billion pounds of Zn, 743 million pounds of Pb, 246 million pounds of Cu, 693,000 ounces of Au, and 28 million ounces of Ag.

- The Mineral Resource estimate is consistent with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves dated May 10, 2014 (CIM (2014) definitions) as incorporated by reference into NI 43-101.

- New drilling since the last Mineral Resource estimate focussed on the Link Zone, and there is a significant increase in resources in that area.

- The Babaçú prospect represents exploration potential beyond the current Mineral Resources. Limited exploration has identified additional mineralized bodies including Massaranduba, Boroca, and Mocoto to the south and Arpa to the north.

MINING AND MINERAL RESERVES

- The deposits support a production rate of 2.3 million tonnes per annum (Mtpa), producing an average of 66,700 tonnes of zinc per year (zinc equivalent of 120,000 tonnes per year, after converting other metals based on net revenue).

- Deposit geometry and geomechanical properties are amenable to bulk longhole mining methods, in primary/secondary or longitudinal retreat sequencing, depending on thickness.

- As prepared by Nexa and adopted by RPA, the Aripuanã Proven and Probable Mineral Reserves comprise 26.2 Mt at grades of 3.7% Zn, 1.4% Pb, 0.2% Cu, 0.3 g/t Au, and 34 g/t Ag, containing 2.1 billion lbs of Zn, 784 million lbs of Pb, 143 million lbs of Cu, 250,000 ounces of Au, and 28.8 million ounces of Ag.

- The Mineral Reserve estimate is consistent with the CIM (2014) definitions as incorporated by reference into NI 43-101.

- Dilution and extraction estimates include:
    - Dilution – planned (captured within stope designs) and additional unplanned dilution applied as factors ranging from 5% to 12%, by mining method.
    - Extraction – initial selection of resources by stope optimization and design, plus additional factors of 90% to 95%, by mining method.

- The stope shapes are based on optimizer output, with some editing and manual redesign. There will be opportunities to reduce planned dilution and increase extraction after infill drilling and before mining.

- Secondary stopes in Ambrex have been deferred until all Primary stopes are complete due to geotechnical concerns, which may be conservative. An earlier start to secondary mining may have a positive impact on the cash flow, due to more efficient usage of capital development.

- Arex, Link, and Ambrex deposits are not directly connected underground, making it difficult to share slow-moving mobile equipment efficiently. Fleet unit numbers are adequate to achieve the proposed mine production with limited sharing.

- There is an opportunity to improve the ventilation circuits and reduce capital development by moving the exhaust raise system further from the centre of the zones.

METALLURGY AND PROCESS

- The results from SGS GEOSOL metallurgical test work form the basis for the current engineering design of the sequential Cu/Pb/Zn flotation circuit.

- Stringer and Stratabound mineralization have been tested separately and in blends of various compositions. Different comminution results and recovery kinetics were observed during bench-scale test work. The decision was made to initially process the two material types separately, on a campaign basis.

- Process performance is projected as:
    - Stratabound Zinc – 89.4% recovery to a 58.4% Zn concentrate. Silver recovery to this concentrate will be 10%.
    - Stratabound Lead – Variable recovery in the range of 80% to 90% with a LOM average of 84.5% to a 58.4% Pb concentrate. Gold and silver recoveries to this concentrate will be 20% and 55%, respectively.
    - Stratabound Copper – 67.5% to a 30.6% Cu concentrate. Gold and silver recoveries to this concentrate will be 50% and 20%, respectively.
    - Stringer Copper – Variable recovery in the range of 85% to 95% with a life of mine (LOM) average of 88.3% recovery to a 31.0% Cu concentrate. Gold and silver recoveries to this concentrate will be 63% and 50%, respectively.

- The LOM economics were developed using relationships between head grade, concentrate grade, and recovery that were established based on the locked cycle tests (LCTs). The concentrate grade divided by the head grade is known as the enrichment ratio (Er), and the variable recoveries above are a function of Er.

- Not all of the LCTs achieved equilibrium. Due to the low correlations between head grade and recovery in the LCTs, it was determed that in some cases the Er ratio would be used in applicable cases for recovery, and pilot plant results were used in other cases. It was determined that the pilot results better reflected recovery for Stratabound zinc, however, in RPA's opinion selected optimized LCTs should be used to determine flotation retention time for design purposes.

- Production throughput was increased by 5% (to 5,250 tpd for Stringer and 6,300 tpd for Stratabound) at a late stage in the FS. There is a risk that this throughput may not be achieved in the comminution circuit at the selected mill sizes. Larger mills will likely be required, involving a modest increase in capital costs. In RPA's opinion, to achieve the increased throughput, the SAG mill should be 7.32 m diameter x 3.66 m effective grinding length (EGL) (24 ft x 12 ft) with a variable frequency drive and an installed motor power of 3,000 kW, and the ball mill should be 4.88 m diameter x 7.32 m EGL (16 ft x 24 ft) with an installed motor power of 3,500 kW. The total installed mill power would increase from 5,600 kW to 6,500 kW. From a spare parts perspective, it is possible to design and fit both mills with 3,500 kW motors, if necessary.

- Processing inefficiencies during transitions between campaigns may offset gains in performance from processing material types separately. The plant configuration will allow full-scale testing of blended feeds during the early years of operation.

- Talc (non-sulphide fines) removal by flotation is sometimes required prior to sequential flotation of Cu, Pb, and Zn, and for this reason, the talc circuit will be continually operated.

- The only notable deleterious element identified was fluorine in the copper concentrate, which may require concentrate blending to ensure marketability.

ENVIRONMENTAL CONSIDERATIONS

- The Environmental Impact Assessment (EIA) is compliant with Brazilian standards and regulation needs for construction of the Project.

- Construction is required to adhere to conditions included in the Preliminary Permit, including execution of Environmental Management Plans.

COSTS AND ECONOMICS

- Pre-production capital costs total US$392 million.

- In RPA's opinion, the capital cost estimate can be classified as Class 3, per American Association of Cost Engineers (AACE) guidelines, which generally corresponds to feasibility studies.

- Contingency comprises 8.3% of direct and indirect capital costs.

- Operating costs average US$34.18 per tonne over the LOM, with higher unit costs at the start and end when full production is not achievable.

- Metal prices are based on consensus annual forecasts from independent banks and financial institutions, converging on long-term prices of US$1.01/lb Zn, US$0.87/lb Pb, US$2.99/lb Cu, US$1,216/oz Au, and US$18.50/oz Ag from 2023 onwards.

- Smelter terms are projected by Nexa based on selling concentrates to China, and are consistent with industry benchmarks.

RECOMMENDATIONS

RPA offers the following recommendations for each area:

GEOLOGY AND MINERAL RESOURCES

- Continue to review minor issues with certain Certified Reference Materials (CRMs) used in analytical quality assurance procedures.
- Increase the wireframe modelling cut-off grade to limit the amount of sub-economic material not related to massive or disseminated sulphides in the stratabound zone in the wireframes.
- Model correlograms for Ambrex and Arex to avoid fitting long second and third variogram model structures when an apparent zonal anisotropy is observed.
- Perform a visual review of the classification of all blocks with a minimum distance to the closest drill hole greater than 25 m, and consider downgrading blocks where appropriate to Inferred.

MINING

- Review and optimize stope shapes after infill drilling and before mining.
- Investigate alternative sequencing for primary/secondary stopes, specifically earlier mining of secondary stopes.
- Review the location of exhaust raises and associated development.
- Implement a rigorous grade control program during operations, to assess impact of material types and effectiveness of blending.

PROCESS

- Test blended material types as mill feed during plant operations.
- Investigate optimum concentrate grade vs. recovery combinations for all concentrates.
- Review the comminution circuit sizing, and update the design as recommended to ensure capacity for both material types.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

- Prior to the construction phase, certain environmental management plans should be developed in further detail:
    - Ecological and human health risk assessments should be further developed, with the aim of identifying and mitigating potential impacts on water quality, air quality, and noise combined with local uses of the areas, which affect the health of local wildlife, feedstock, and/or the local population.

- o Based on the presence of several endangered species in the Project area, plans for the protection of endangered flora and fauna species should be further developed and implemented during all Project phases.

- o Measures to prevent and mitigate effects on water quality from the dry-stack tailings acid rock drainage (ARD)/metal leaching potential need to be further developed and implemented for all phases of the Project, including closure and post-closure.

- Historically, closure of mine sites has the potential to result in significant economic impacts. To avoid these impacts a detailed social management plan should be developed, which includes ongoing consultation, training and planning of workers and local community members, with the aim of mitigating the economic and social effects of mine closure. In Brazil, this plan is required five years before closure.

ECONOMIC ANALYSIS

An after-tax Cash Flow Projection for the Project was generated from the Life of Mine production schedule and capital and operating cost estimates, and this is summarized in Table 1-1. A summary of the key criteria is provided below.

ECONOMIC CRITERIA

REVENUE

- LOM processing of 26 Mt, grading 3.7% Zn, 1.4% Pb, 0.2% Cu, 34 g/t Ag and 0.3 g/t Au
- LOM average metallurgical recovery of 89% Zn, 84% Pb, 75% Cu, 84% Ag and 68% Au
- LOM average metal payable of 85% Zn, 95% Pb, 96% Cu, 83% Ag and 83% Au
- LOM payable metal of 737 kt Zn, 284 kt Pb, 47 kt Cu, 20,000 koz Ag and 139 koz Au
- LOM metal prices based on forward-looking independent long-term forecasts, US$1.01/lb Zn, US$0.87/lb Pb, US$2.99/lb Cu, US$18.50/oz Ag, and US$1,216/oz Au.
- All revenues are received in US$.
- Total gross revenue of US$3,089 million.
- Total offsite treatment, transportation, and refining charges of US$410 million.
- Total royalties of US$126 million.
- Net revenue of US$2,553 million.
- Average unit net revenue of US$84/t processed.
- Revenue is recognized at the time of production.

COSTS

- Pre-production period: 28 months.
- Mine life: 13 years.
- LOM production plan as summarized in Section 16.
- Pre-production capital totals US$392 million.
- Sustaining capital over the LOM totals US$222 million.
- Average operating cost over the mine life is US$34 per tonne processed.
- Costs estimated in BRL at an exchange rate of 3.90

TAXATION AND ROYALTIES

RPA has relied on a Nexa taxation model for calculation of income taxes applicable to the cash flow.

TABLE 1-1 AFTER-TAX CASH FLOW SUMMARY
Nexa Resources S.A. – Aripuanã Zinc Project

Aripuanã Project - FEL3	Cash Flow Summary			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17
	Inputs	UNITS	TOTAL	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
MINING																					
Underground																					
Operating Days	365	days			30	100	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Tonnes mined per day		tonnes / day	5,205.6		2,095	6,113	3,833	5,813	6,511	6,361	6,072	6,250	6,239	6,169	6,081	5,073	4,809	3,429	3,238	-	-
Production		'000 tonnes	26,179	-	63	611	1,399	2,122	2,376	2,322	2,216	2,281	2,277	2,252	2,219	1,852	1,755	1,252	1,182	-	-
Zn Grade		%	3.7%	0.0%	3.6%	3.5%	3.6%	4.0%	4.0%	3.8%	3.8%	3.5%	4.0%	3.5%	3.8%	3.8%	3.6%	2.6%	4.0%	0.0%	0.0%
Pb Grade		%	1.4%	0.0%	1.1%	1.2%	1.3%	1.4%	1.4%	1.4%	1.3%	1.3%	1.4%	1.3%	1.5%	1.3%	1.4%	1.2%	1.6%	0.0%	0.0%
Cu Grade		%	0.2%	0.0%	0.4%	0.6%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%
Ag Grade		oz/t	1.10	-	1.08	1.25	1.16	1.13	1.08	1.19	1.14	1.02	1.17	1.15	1.10	0.92	1.12	0.98	1.04	-	-
Au Grade		oz/t	0.010	-	0.014	0.012	0.009	0.011	0.011	0.010	0.012	0.010	0.009	0.008	0.005	0.011	0.008	0.013	0.006	-	-
Contained Metal in ROM																					
Zn		000 tonnes	973	-	2.2	21.4	50.1	84.3	95.5	88.9	83.3	80.2	90.5	79.5	84.6	69.7	63.3	32.0	47.0	-	-
Pb		000 tonnes	355	-	0.7	7.5	17.9	30.1	34.0	31.4	29.0	29.1	31.6	29.4	32.5	24.3	24.6	14.7	18.6	-	-
Cu		000 tonnes	65	-	0.3	3.5	6.2	7.2	7.2	7.2	6.9	5.9	4.9	5.6	2.3	2.7	2.5	2.3	0.7	-	-
Ag		kozs	28,836	-	67.8	765.9	1,618.9	2,391.1	2,574.3	2,758.3	2,524.4	2,320.0	2,657.2	2,596.1	2,438.1	1,703.5	1,962.4	1,225.0	1,233.2	-	-
Au		kozs	250	-	0.9	7.6	12.8	23.3	26.4	22.3	27.0	22.8	19.4	17.9	11.0	19.9	14.1	16.9	7.4	-	-
PROCESSING																					
Mill Feed		**'000 tonnes**	**25,909**	**-**	**-**	**-**	**1,493**	**1,937**	**2,300**	**2,299**	**2,243**	**2,247**	**2,263**	**2,253**	**2,272**	**2,159**	**2,010**	**1,252**	**1,182**	**-**	**-**
Head grade																					
Zn Grade		%	3.8%				4.4%	4.1%	4.4%	4.3%	3.7%	3.6%	4.0%	3.5%	3.7%	3.3%	3.2%	2.6%	4.0%	0.0%	0.0%
Pb Grade		%	1.4%				1.5%	1.5%	1.5%	1.5%	1.3%	1.3%	1.4%	1.3%	1.4%	1.1%	1.2%	1.2%	1.6%	0.0%	0.0%
Cu Grade		%	0.3%				0.5%	0.3%	0.3%	0.2%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	0.2%	0.2%	0.1%	0.0%	0.0%
Ag Grade		oz/t	1.11				1.43	1.17	1.16	1.27	1.13	1.03	1.18	1.15	1.08	0.84	1.01	0.98	1.04	-	-
Au Grade		oz/t	0.01				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-
Contained Zn		'000 tonnes	973				65.0	79.0	100.1	97.7	83.3	80.2	90.6	79.3	84.5	70.3	63.7	32.0	47.0	-	-
Contained Pb		'000 tonnes	355				23.0	28.2	35.6	34.5	28.9	29.0	31.5	29.4	32.6	24.6	24.7	14.7	18.6	-	-
Contained Cu		'000 tonnes	65				7.6	6.8	5.8	5.0	6.8	5.3	4.9	5.5	3.0	6.3	5.0	2.3	0.7	-	-
Contained Ag		koz	28,836				2,131.5	2,261.2	2,657.1	2,919.3	2,531.4	2,316.1	2,661.8	2,590.5	2,462.2	1,813.3	2,033.7	1,225.0	1,233.2	-	-
Contained Au		koz	250				16.0	20.8	20.7	17.4	23.9	20.4	20.3	20.1	13.5	28.5	23.7	16.9	7.4	-	-
Net Recovery																					
Zn Recovery		%	89.1%				89.2%	89.3%	89.4%	89.4%	89.1%	89.1%	89.2%	89.1%	89.2%	88.3%	88.5%	88.7%	89.4%	0.0%	0.0%
Pb Recovery		%	84.2%				84.8%	84.5%	84.7%	84.5%	83.7%	83.7%	84.1%	83.6%	84.2%	83.3%	84.0%	84.3%	84.7%	0.0%	0.0%
Cu Recovery		%	74.7%				72.2%	70.7%	67.5%	67.6%	75.5%	77.3%	74.5%	75.7%	76.2%	84.6%	81.4%	77.5%	67.7%	0.0%	0.0%
Ag Recovery		%	84.2%				84.3%	84.5%	85.0%	85.0%	83.9%	84.0%	84.4%	84.2%	84.5%	82.1%	83.1%	83.7%	85.0%	0.0%	0.0%
Au Recovery		%	67.6%				68.5%	69.2%	70.0%	70.0%	67.6%	67.3%	68.2%	67.9%	68.2%	65.0%	65.1%	64.8%	69.9%	0.0%	0.0%
Concentrate Production																					
Zn Concentrate		'000 tonnes	1,484				99.2	120.7	153.2	149.6	127.0	122.4	138.4	121.0	129.1	106.3	96.5	48.6	72.0	-	-
Zn		%	58.40%				58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%
Ag		oz/t	1.90				2.11	1.85	1.73	1.95	1.93	1.84	1.89	2.09	1.88	1.56	1.99	2.42	1.71	-	-
Pb Concentrate		'000 tonnes	482				31.5	38.4	48.6	47.0	39.0	39.2	42.7	39.7	44.3	33.0	33.5	20.1	25.4	-	-
Pb		%	62.00%				62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%
Ag		oz/t	32.1				36.5	31.9	30.1	34.1	34.6	31.6	33.7	35.1	30.1	27.7	31.5	32.3	26.7	-	-
Au		oz/t	0.07				0.08	0.10	0.08	0.07	0.08	0.06	0.07	0.07	0.05	0.05	0.04	0.04	0.06	-	-
Cu Concentrate I		'000 tonnes	65				4.5	2.8	-	0.1	7.1	6.7	4.5	5.8	3.4	15.1	10.5	4.6	0.1	-	-
Cu		%	30.98%				31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%
Ag		oz/t	5.16				4.7	5.5	-	5.7	5.4	5.1	5.1	5.1	5.1	5.0	5.4	5.1	11.2	-	-
Au		oz/t	0.84				0.49	0.55	-	0.64	0.73	0.75	0.73	0.65	0.65	0.86	0.99	1.72	1.23	-	-
Cu Concentrate II		'000 tonnes	93				13.4	12.8	12.8	11.0	9.7	6.6	7.4	7.6	4.0	2.3	2.6	1.1	1.5	-	-
Cu		%	30.60%				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%
Ag		oz/t	60.64				31.15	34.95	41.46	52.97	50.74	68.15	70.24	66.30	121.06	145.87	146.86	216.96	161.34	-	-
Au		oz/t	0.88				0.47	0.72	0.81	0.79	0.81	0.94	1.01	0.92	1.25	1.76	1.38	2.01	2.37	-	-
TOTAL Recovered																					
Zn		'000 tonnes	866.7				58.0	70.5	89.5	87.4	74.2	71.5	80.8	70.7	75.4	62.1	56.4	28.4	42.0	-	-
Pb		'000 tonnes	299.1				19.5	23.8	30.2	29.2	24.2	24.3	26.5	24.6	27.5	20.5	20.8	12.4	15.7	-	-
Cu		'000 tonnes	48.6				5.5	4.8	3.9	3.4	5.2	4.1	3.7	4.1	2.3	5.4	4.1	1.8	0.5	-	-
Ag		koz	24,275.3				1,797.0	1,911.1	2,258.6	2,481.1	2,124.5	1,944.8	2,246.5	2,180.9	2,080.7	1,488.2	1,689.1	1,024.9	1,047.8	-	-
Au		koz	168.6				11.0	14.4	14.5	12.2	16.2	13.7	13.8	13.7	9.2	18.5	15.4	10.9	5.1	-	-
REVENUES																					
Metal Prices																					
Zn price		US$/t	$ 2,251				$ 2,545	$ 2,463	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232
Pb price		US$/t	$ 1,944				$ 2,164	$ 2,147	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927
Cu price		US$/t	$ 6,648				$ 7,360	$ 7,329	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594
Ag price		US$/oz	$ 18.49				$ 18.15	$ 18.77	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49
Au price		US$/oz	$ 1,223				$ 1,315	$ 1,318	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216
FX Rate		BRL/USD	$ 3.90				$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90
Payable Metal																					
Zn	85%	'000 tonnes	737				49.3	59.9	76.0	74.3	63.1	60.8	68.7	60.1	64.1	52.8	47.9	24.1	35.7	-	-
Pb	95%	'000 tonnes	284				18.5	22.6	28.6	27.7	23.0	23.1	25.2	23.4	26.1	19.5	19.8	11.8	15.0	-	-
Cu	96%	'000 tonnes	47				5.3	4.6	3.8	3.3	5.0	4.0	3.6	4.0	2.2	5.2	3.9	1.7	0.5	-	-
Ag	83%	kozs	20,032				1,484.5	1,579.0	1,861.5	2,050.6	1,755.7	1,605.6	1,856.3	1,802.0	1,714.9	1,221.2	1,394.6	846.7	859.0	-	-
Au	83%	kozs	139				9.1	12.1	11.9	9.8	13.6	11.3	11.4	11.3	7.1	15.8	13.0	9.3	4.0	-	-
Gross Revenue																					
Zn		US$ '000	1,673,303				125,389	147,546	169,687	165,723	140,711	135,585	153,339	134,023	143,047	117,738	106,932	53,834	79,747		
Pb		US$ '000	557,025				40,119	48,548	55,207	53,385	44,301	44,476	48,505	45,024	50,282	37,499	38,075	22,770	28,834		
Cu		US$ '000	316,718				38,967	33,810	24,933	21,564	32,870	26,068	23,413	26,375	14,537	34,133	25,812	11,141	3,093		
Ag		US$ '000	370,330				26,944	29,646	34,420	37,915	32,463	29,688	34,323	33,319	31,709	22,580	25,785	15,656	15,883		
Au		US$ '000	171,756				12,004	15,881	14,433	11,911	16,556	13,774	13,848	13,731	8,581	19,189	15,755	11,285	4,808		
TOTAL		**US$ '000**	**3,089,132**				**243,422**	**275,432**	**298,680**	**290,499**	**266,901**	**249,592**	**273,428**	**252,471**	**248,156**	**231,139**	**212,360**	**114,685**	**132,366**		
Zn Concentrate																					
Selling Price		US$/t conc	$ 919.99				$ 1,152.18	$ 1,063.29	$ 908.71	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ -	$ -
Concentrate		'000 tonnes	1,484				99.2	120.7	153.2	149.6	127.0	122.4	138.4	121.0	129.1	106.3	96.5	48.6	72.0	-	-
Revenues		**US$ '000**	**$ 1,365,334**				**$ 114,349**	**$ 128,341**	**$ 139,196**	**$ 132,431**	**$ 112,443**	**$ 108,348**	**$ 122,535**	**$ 107,099**	**$ 114,310**	**$ 94,086**	**$ 85,451**	**$ 43,019**	**$ 63,727**	**$ -**	**$ -**
Pb Concentrate																					
Selling Price		US$/t conc	$ 1,604.06				$ 1,792.23	$ 1,748.58	$ 1,572.91	$ 1,627.03	$ 1,642.00	$ 1,572.42	$ 1,615.59	$ 1,638.87	$ 1,526.37	$ 1,488.46	$ 1,546.76	$ 1,561.08	$ 1,481.73	$ -	$ -

	Unit	Total	0	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5
Concentrate	'000 tonnes	482				31.5	38.4	48.6	47.0	39.0	39.2	42.7	39.7	44.3	33.0	33.5	20.1	25.4	-	-
Revenues	**US$ '000**	**$ 773,892**				**$ 56,420**	**$ 67,133**	**$ 76,495**	**$ 76,515**	**$ 64,080**	**$ 61,607**	**$ 69,031**	**$ 65,002**	**$ 67,609**	**$ 49,168**	**$ 51,880**	**$ 31,313**	**$ 37,637**	**$ -**	**$ -**
Cu Concentrate I																				
Selling Price	US$/t conc	$ 2,842.77				$ 2,692.98	$ 2,767.03	$ -	$ 2,603.24	$ 2,704.27	$ 2,713.42	$ 2,697.05	$ 2,613.37	$ 2,603.33	$ 2,832.17	$ 2,980.89	$ 3,771.33	$ 3,341.52	$ -	$ -
Concentrate	'000 tonnes	65				4.5	2.8	-	0.1	7.1	6.7	4.5	5.8	3.4	15.1	10.5	4.6	0.1	-	-
Revenues	**US$ '000**	**$ 185,542**				**$ 12,053**	**$ 7,856**	**$ -**	**$ 172**	**$ 19,292**	**$ 18,228**	**$ 12,216**	**$ 15,288**	**$ 8,900**	**$ 42,694**	**$ 31,353**	**$ 17,281**	**$ 209**	**$ -**	**$ -**
Cu Concentrate II																				
Selling Price	US$/t conc	$ 3,813.41				$ 3,071.25	$ 3,432.19	$ 3,352.34	$ 3,515.64	$ 3,503.00	$ 3,928.99	$ 4,037.56	$ 3,875.47	$ 5,117.06	$ 6,077.52	$ 5,675.68	$ 7,495.40	$ 6,989.83	$ -	$ -
Concentrate	'000 tonnes	93				13.4	12.8	12.8	11.0	9.7	6.6	7.4	7.6	4.0	2.3	2.6	1.1	1.5	-	-
Revenues	**US$ '000**	**$ 354,191**				**$ 41,197**	**$ 43,801**	**$ 42,968**	**$ 38,738**	**$ 33,881**	**$ 25,920**	**$ 30,074**	**$ 29,583**	**$ 20,520**	**$ 13,846**	**$ 14,847**	**$ 8,142**	**$ 10,674**	**$ -**	**$ -**
(=) TOTAL Concentrate Revenues	**US$ '000**	**$ 2,678,959**				**$ 224,020**	**$ 247,131**	**$ 258,660**	**$ 247,856**	**$ 229,697**	**$ 214,102**	**$ 233,856**	**$ 216,972**	**$ 211,340**	**$ 199,795**	**$ 183,531**	**$ 99,755**	**$ 112,246**	**$ -**	**$ -**
Zn Concentrate	%	*51%*				*51%*	*52%*	*54%*	*53%*	*49%*	*51%*	*52%*	*49%*	*54%*	*47%*	*47%*	*43%*	*57%*	*0%*	*0%*
Pb Concentrate	%	*29%*				*25%*	*27%*	*30%*	*31%*	*28%*	*29%*	*30%*	*30%*	*32%*	*25%*	*28%*	*31%*	*34%*	*0%*	*0%*
Cu Concentrate	%	*7%*				*5%*	*3%*	*0%*	*0%*	*8%*	*9%*	*5%*	*7%*	*4%*	*21%*	*17%*	*17%*	*0%*	*0%*	*0%*
(-) Royalties	**US$ '000**	**$ 125,794**				**$ 10,230**	**$ 11,238**	**$ 11,660**	**$ 11,332**	**$ 10,653**	**$ 10,005**	**$ 10,929**	**$ 10,265**	**$ 10,278**	**$ 9,763**	**$ 8,993**	**$ 4,960**	**$ 5,488**	**$ -**	**$ -**
Luiz Almeida	US$ '000	$ 19,061				$ 2,974	$ 3,233	$ 3,131	$ 2,486	$ 2,022	$ 1,579	$ 1,685	$ 1,276	$ 207	$ 310	$ 221	$ -33	$ -30	$ -	$ -
Anglo America	US$ '000	$ 32,352				$ 2,776	$ 3,036	$ 3,101	$ 2,966	$ 2,772	$ 2,573	$ 2,806	$ 2,615	$ 2,520	$ 2,417	$ 2,222	$ 1,216	$ 1,331	$ -	$ -
Garimpeiros	US$ '000	$ 20,802				$ -	$ 27	$ 255	$ 922	$ 1,265	$ 1,570	$ 1,761	$ 2,035	$ 3,324	$ 3,040	$ 2,879	$ 1,782	$ 1,942	$ -	$ -
CFEM	US$ '000	$ 53,579				$ 4,480	$ 4,943	$ 5,173	$ 4,957	$ 4,594	$ 4,282	$ 4,677	$ 4,339	$ 4,227	$ 3,996	$ 3,671	$ 1,995	$ 2,245	$ -	$ -
(=) TOTAL Net Revenues	**US$ '000**	**$ 2,553,165**				**$ 213,790**	**$ 235,892**	**$ 247,000**	**$ 236,524**	**$ 219,044**	**$ 204,097**	**$ 222,927**	**$ 206,706**	**$ 201,062**	**$ 190,032**	**$ 174,537**	**$ 94,795**	**$ 106,757**	**$ -**	**$ -**
NSR	**US$/t ROM**	**$ 84.34**				**$ 125.9**	**$ 106.1**	**$ 91.2**	**$ 87.2**	**$ 83.5**	**$ 77.3**	**$ 83.7**	**$ 78.4**	**$ 74.7**	**$ 75.5**	**$ 74.5**	**$ 65.5**	**$ 75.8**	**$ -**	**$ -**
OPERATING COST																				
Mining (Underground)	US$ '000	$ 305,963				$ 20,757	$ 29,746	$ 24,503	$ 26,696	$ 25,539	$ 25,203	$ 24,453	$ 22,201	$ 26,362	$ 25,090	$ 22,878	$ 18,121	$ 14,413	$ -	$ -
Processing + Tailings	US$ '000	$ 493,152				$ 32,453	$ 39,670	$ 43,252	$ 42,898	$ 41,023	$ 41,277	$ 41,623	$ 41,174	$ 41,885	$ 38,058	$ 36,398	$ 27,238	$ 26,201	$ -	$ -
G&A	US$ '000	$ 86,390				$ 7,497	$ 7,497	$ 7,497	$ 7,022	$ 7,022	$ 7,022	$ 6,760	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 5,648	$ 4,069	$ -	$ -
Total Operating Cost	**US$ '000**	**$ 885,505**				**$ 60,708**	**$ 76,913**	**$ 75,251**	**$ 76,616**	**$ 73,584**	**$ 73,502**	**$ 72,837**	**$ 69,965**	**$ 74,837**	**$ 69,737**	**$ 65,865**	**$ 51,007**	**$ 44,684**	**$ -**	**$ -**
Mining (Underground)	US$ /t proc	$ 11.81				$ 13.9	$ 15.4	$ 10.7	$ 11.6	$ 11.4	$ 11.2	$ 10.8	$ 9.9	$ 11.6	$ 11.6	$ 11.4	$ 14.5	$ 12.2	$ -	$ -
Processing + Tailings	US$ /t proc	$ 19.03				$ 21.7	$ 20.5	$ 18.8	$ 18.7	$ 18.3	$ 18.4	$ 18.4	$ 18.3	$ 18.4	$ 17.6	$ 18.1	$ 21.8	$ 22.2	$ -	$ -
G&A	US$ /t proc	$ 3.33				$ 5.0	$ 3.9	$ 3.3	$ 3.1	$ 3.1	$ 3.1	$ 3.0	$ 2.9	$ 2.9	$ 3.1	$ 3.3	$ 4.5	$ 3.4	$ -	$ -
Total Operating Cost	**US$ /t proc**	**$ 34.18**				**$ 40.7**	**$ 39.7**	**$ 32.7**	**$ 33.3**	**$ 32.8**	**$ 32.7**	**$ 32.2**	**$ 31.1**	**$ 32.9**	**$ 32.3**	**$ 32.8**	**$ 40.8**	**$ 37.8**	**$ -**	**$ -**
Cost/Zn eq.	**US$ /t Zn eq.**	**$ 568.5**				**$ 557.3**	**$ 602.1**	**$ 489.7**	**$ 511.6**	**$ 538.0**	**$ 573.5**	**$ 517.5**	**$ 539.6**	**$ 584.0**	**$ 590.8**	**$ 605.8**	**$ 868.3**	**$ 651.7**	**$ -**	**$ -**
Selling Expenses	**US$ '000**	**$ 368,115**				**$ 25,749**	**$ 30,267**	**$ 37,186**	**$ 35,988**	**$ 31,680**	**$ 30,301**	**$ 33,461**	**$ 30,169**	**$ 31,334**	**$ 27,144**	**$ 24,811**	**$ 12,877**	**$ 17,149**	**$ -**	**$ -**
Zn Concentrate	US$ '000	$ 257,126				$ 17,195	$ 20,912	$ 26,539	$ 25,919	$ 22,007	$ 21,206	$ 23,982	$ 20,961	$ 22,373	$ 18,414	$ 16,724	$ 8,420	$ 12,472	$ -	$ -
Pb Concentrate	US$ '000	$ 83,589				$ 5,454	$ 6,652	$ 8,426	$ 8,148	$ 6,761	$ 6,788	$ 7,403	$ 6,872	$ 7,674	$ 5,723	$ 5,811	$ 3,475	$ 4,401	$ -	$ -
Cu Concentrate	US$ '000	$ 27,400				$ 3,100	$ 2,703	$ 2,221	$ 1,921	$ 2,912	$ 2,307	$ 2,075	$ 2,336	$ 1,287	$ 3,007	$ 2,276	$ 982	$ 275	$ -	$ -
(=) Operating Cash Flow - EBITDA	**US$ '000**	**$ 1,299,546**				**$ 127,334**	**$ 128,712**	**$ 134,562**	**$ 123,921**	**$ 113,779**	**$ 100,295**	**$ 116,629**	**$ 106,572**	**$ 94,892**	**$ 93,151**	**$ 83,862**	**$ 30,911**	**$ 44,925**	**$ -**	**$ -**
EBITDA Margin	%	*49%*		*0%*	*0%*	*57%*	*52%*	*52%*	*50%*	*50%*	*47%*	*50%*	*49%*	*45%*	*47%*	*46%*	*31%*	*40%*	*0%*	*0%*
CAPITAL COST																				
Initial Capital Cost																				
Mining	US$ '000	$ 49,229	$ 492	$ 17,230	$ 24,122	$ 7,384	$ -													
Plant & Infrastructure	US$ '000	$ 192,980	$ 1,930	$ 67,543	$ 94,560	$ 28,947	$ -													
Total Direct Cost	**US$ '000**	**$ 242,209**	**$ 2,422**	**$ 84,773**	**$ 118,682**	**$ 36,331**	**$ -**													
EPCM / Owners / Indirect Cost	US$ '000	$ 119,843	$ 1,198	$ 41,945	$ 58,723	$ 17,976	$ -													
Subtotal Costs	**US$ '000**	**$ 362,051**	**$ 3,621**	**$ 126,718**	**$ 177,405**	**$ 54,308**	**$ -**													
Contingency	US$ '000	$ 30,037	$ 300	$ 10,513	$ 14,718	$ 4,506	$ -													
(=) TOTAL Initial Capital	**US$ '000**	**$ 392,089**	**$ 3,921**	**$ 137,231**	**$ 192,124**	**$ 58,813**	**$ -**													
Operating Capital Cost																				
Mine Development	US$ '000	$ 60,715	$ -	$ -	$ -	$ 17,819	$ 11,721	$ 6,980	$ 6,527	$ 3,015	$ 4,417	$ 3,888	$ 2,624	$ 1,389	$ 1,325	$ 871	$ 137	$ -	$ -	$ -
Sustaining infrastructure	US$ '000	$ 138,420	$ -	$ -	$ -	$ 29,136	$ 10,985	$ 23,416	$ 8,200	$ 4,017	$ 15,815	$ 5,619	$ 14,218	$ 11,247	$ 6,659	$ 4,659	$ 3,119	$ 956	$ 374	$ -
Reclamation and closure	US$ '000	$ 22,693	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,671	$ 2,980	$ 3,103	$ 9,575	$ 3,364
Operational Working Capital	US$ '000	$ -	$ -	$ -	$ -	$ 11,098	$ 1,211	$ 609	$ (535)	$ (958)	$ (819)	$ 1,053	$ (875)	$ (309)	$ (604)	$ (849)	$ (4,292)	$ 785	$ (5,515)	$ -
(=) TOTAL Operating Capital Cost	**US$ '000**	**$ 221,828**	**$ -**	**$ -**	**$ -**	**$ 58,054**	**$ 23,917**	**$ 31,005**	**$ 14,192**	**$ 6,074**	**$ 19,413**	**$ 10,560**	**$ 15,967**	**$ 12,327**	**$ 7,379**	**$ 8,352**	**$ 1,944**	**$ 4,845**	**$ 4,433**	**$ 3,364**
CASH FLOW																				
(+) Revenues	US$ '000	$ 2,678,959	$ -	$ -	$ -	$ 224,020	$ 247,131	$ 258,660	$ 247,856	$ 229,697	$ 214,102	$ 233,856	$ 216,972	$ 211,340	$ 199,795	$ 183,531	$ 99,755	$ 112,246	$ -	$ -
(-) Royalties	US$ '000	$ 125,794	$ -	$ -	$ -	$ 10,230	$ 11,238	$ 11,660	$ 11,332	$ 10,653	$ 10,005	$ 10,929	$ 10,265	$ 10,278	$ 9,763	$ 8,993	$ 4,960	$ 5,488	$ -	$ -
(-) Mining Costs	US$ '000	$ 305,963	$ -	$ -	$ -	$ 20,757	$ 29,746	$ 24,503	$ 26,696	$ 25,539	$ 25,203	$ 24,453	$ 22,201	$ 26,362	$ 25,090	$ 22,878	$ 18,121	$ 14,413	$ -	$ -
(-) Processing Costs	US$ '000	$ 493,152	$ -	$ -	$ -	$ 32,453	$ 39,670	$ 43,252	$ 42,898	$ 41,023	$ 41,277	$ 41,623	$ 41,174	$ 41,885	$ 38,058	$ 36,398	$ 27,238	$ 26,201	$ -	$ -
(-) G&A	US$ '000	$ 86,390	$ -	$ -	$ -	$ 7,497	$ 7,497	$ 7,497	$ 7,022	$ 7,022	$ 7,022	$ 6,760	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 5,648	$ 4,069	$ -	$ -
(-) Selling Expenses	US$ '000	$ 368,115	$ -	$ -	$ -	$ 25,749	$ 30,267	$ 37,186	$ 35,988	$ 31,680	$ 30,301	$ 33,461	$ 30,169	$ 31,334	$ 27,144	$ 24,811	$ 12,877	$ 17,149	$ -	$ -
(=) EBITDA	**US$ '000**	**$ 1,299,546**	**$ -**	**$ -**	**$ -**	**$ 127,334**	**$ 128,712**	**$ 134,562**	**$ 123,921**	**$ 113,779**	**$ 100,295**	**$ 116,629**	**$ 106,572**	**$ 94,892**	**$ 93,151**	**$ 83,862**	**$ 30,911**	**$ 44,925**	**$ -**	**$ -**
(-) Initial Capital (net of taxes)	US$ '000	$ 369,668	$ 3,697	$ 129,384	$ 181,137	$ 55,450	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(-) Sustaining Capital (net of taxes)	US$ '000	$ 173,486	$ -	$ -	$ -	$ 40,908	$ 19,782	$ 26,481	$ 12,830	$ 6,126	$ 17,626	$ 8,282	$ 14,673	$ 11,009	$ 6,955	$ 4,818	$ 2,837	$ 833	$ 325	$ -
(-) Reclamation and Closure	US$ '000	$ 22,693	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,671	$ 2,980	$ 3,103	$ 9,575	$ 3,364
(+-) Operational Working Capital	US$ '000	$ -	$ -	$ -	$ -	$ (11,098)	$ (1,211)	$ (609)	$ 535	$ 958	$ 819	$ (1,053)	$ 875	$ 309	$ 604	$ 849	$ 4,292	$ (785)	$ 5,515	$ -
(=) Pre-Tax Cashflow	**US$ '000**	**$ 733,699**	**$ (3,697)**	**$ (129,384)**	**$ (181,137)**	**$ 19,877**	**$ 107,719**	**$ 107,473**	**$ 111,626**	**$ 108,611**	**$ 83,487**	**$ 107,294**	**$ 92,775**	**$ 84,192**	**$ 86,801**	**$ 76,221**	**$ 29,386**	**$ 40,204**	**$ (4,385)**	**$ (3,364)**
(-) Income Tax	US$ '000	$ 133,951	$ -	$ -	$ -	$ 11,944	$ 11,709	$ 11,908	$ 9,983	$ 8,293	$ 9,390	$ 11,969	$ 10,659	$ 8,853	$ 8,521	$ 24,118	$ 6,604	$ -	$ -	$ -
(-) PIS/COFINS	US$ '000	$ 94,114	$ 143	$ 5,018	$ 7,026	$ 9,898	$ 6,917	$ 8,312	$ 7,167	$ 5,908	$ 7,228	$ 6,258	$ 6,634	$ 6,750	$ 5,736	$ 5,079	$ 3,175	$ 2,864	$ -	$ -
(-) ICMS	US$ '000	$ 99,225	$ 81	$ 2,829	$ 3,961	$ 7,857	$ 7,556	$ 8,559	$ 8,373	$ 7,337	$ 8,091	$ 7,612	$ 7,443	$ 8,148	$ 7,201	$ 6,437	$ 4,039	$ 3,702	$ -	$ -
(+) Tax Recovery	US$ '000	$ 87,823	$ -	$ -	$ -	$ 8,211	$ 9,693	$ 10,880	$ 9,059	$ 7,728	$ 8,256	$ 6,240	$ 6,093	$ 6,786	$ 5,949	$ 5,457	$ 3,472	$ -	$ -	$ -
(=) After-Tax Cashflow	**US$ '000**	**$ 494,231**	**$ (3,921)**	**$ (137,231)**	**$ (192,124)**	**$ (1,610)**	**$ 91,230**	**$ 89,574**	**$ 95,161**	**$ 94,800**	**$ 67,033**	**$ 87,694**	**$ 74,132**	**$ 67,227**	**$ 71,292**	**$ 46,045**	**$ 19,039**	**$ 33,638**	**$ (4,385)**	**$ (3,364)**

PROJECT ECONOMICS			*period*	*0*	*0.5*	*1.5*	*2.5*	*3.5*	*4.5*	*5.5*	*6.5*	*7.5*	*8.5*	*9.5*	*10.5*	*11.5*	*12.5*	*13.5*	*14.5*	*15.5*	*16.5*
Pre-Tax																					
Pre-tax IRR		%	22.3%																		
Pre-tax NPV at 7.0% discounting	7.00%	US$ '000	$333,124	$ (3,697)	$ (125,080)	$ (163,656)	$ 16,784	$ 85,006	$ 79,263	$ 76,940	$ 69,965	$ 50,262	$ 60,369	$ 48,785	$ 41,375	$ 39,867	$ 32,718	$ 11,789	$ 15,073	$ (1,537)	$ (1,102)
Pre-tax NPV at 9% discounting	9.00%	US$ '000	$260,559	$ (3,697)	$ (123,927)	$ (159,172)	$ 16,025	$ 79,671	$ 72,925	$ 69,489	$ 62,030	$ 43,744	$ 51,576	$ 40,914	$ 34,064	$ 32,219	$ 25,957	$ 9,181	$ 11,523	$ (1,153)	$ (812)
Pre-tax NPV at 11.83% discounting	11.00%	US$ '000	$200,178	$ (3,697)	$ (122,806)	$ (154,890)	$ 15,313	$ 74,759	$ 67,196	$ 62,876	$ 55,115	$ 38,168	$ 44,190	$ 34,424	$ 28,144	$ 26,140	$ 20,680	$ 7,183	$ 8,853	$ (870)	$ (601)
After-Tax																					
After-tax IRR		%	15.8%																		
After-Tax NPV at 7.0% discounting	7.00%	US$ '000	$185,023	$ (3,921)	$ (132,666)	$ (173,582)	$ (1,360)	$ 71,994	$ 66,062	$ 65,591	$ 61,068	$ 40,356	$ 49,341	$ 38,982	$ 33,038	$ 32,744	$ 19,765	$ 7,638	$ 12,611	$ (1,537)	$ (1,102)
After-Tax NPV at 9% discounting	9.00%	US$ '000	$129,087	$ (3,921)	$ (131,444)	$ (168,827)	$ (1,298)	$ 67,475	$ 60,780	$ 59,240	$ 54,142	$ 35,123	$ 42,155	$ 32,693	$ 27,200	$ 26,463	$ 15,680	$ 5,948	$ 9,641	$ (1,153)	$ (812)
After-tax NPV at 10.83% discounting	11.00%	US$ '000	$82,625	$ (3,921)	$ (130,254)	$ (164,284)	$ (1,240)	$ 63,315	$ 56,005	$ 53,602	$ 48,107	$ 30,646	$ 36,118	$ 27,507	$ 22,473	$ 21,470	$ 12,492	$ 4,654	$ 7,407	$ (870)	$ (601)

CASH FLOW ANALYSIS

Considering the Project on a stand-alone basis, the undiscounted after-tax cash flow totals US$494 million over the mine life, and simple payback occurs 4.6 years from start of production.

The Net Present Value (NPV) at a 9% discount rate is $129 million, and the Internal Rate of Return (IRR) is 15.8%.

SENSITIVITY ANALYSIS

Project risks can be identified in both economic and non-economic terms. Key economic risks were examined by running cash flow sensitivities:

- Metal price
- Head grade
- Metallurgical recovery
- Operating costs
- Capital costs

IRR sensitivity over the base case has been calculated for a variety of ranges depending on the variable. The sensitivities are shown in Figure 1-1 and Table 1-2.

FIGURE 1-1 SENSITIVITY ANALYSIS

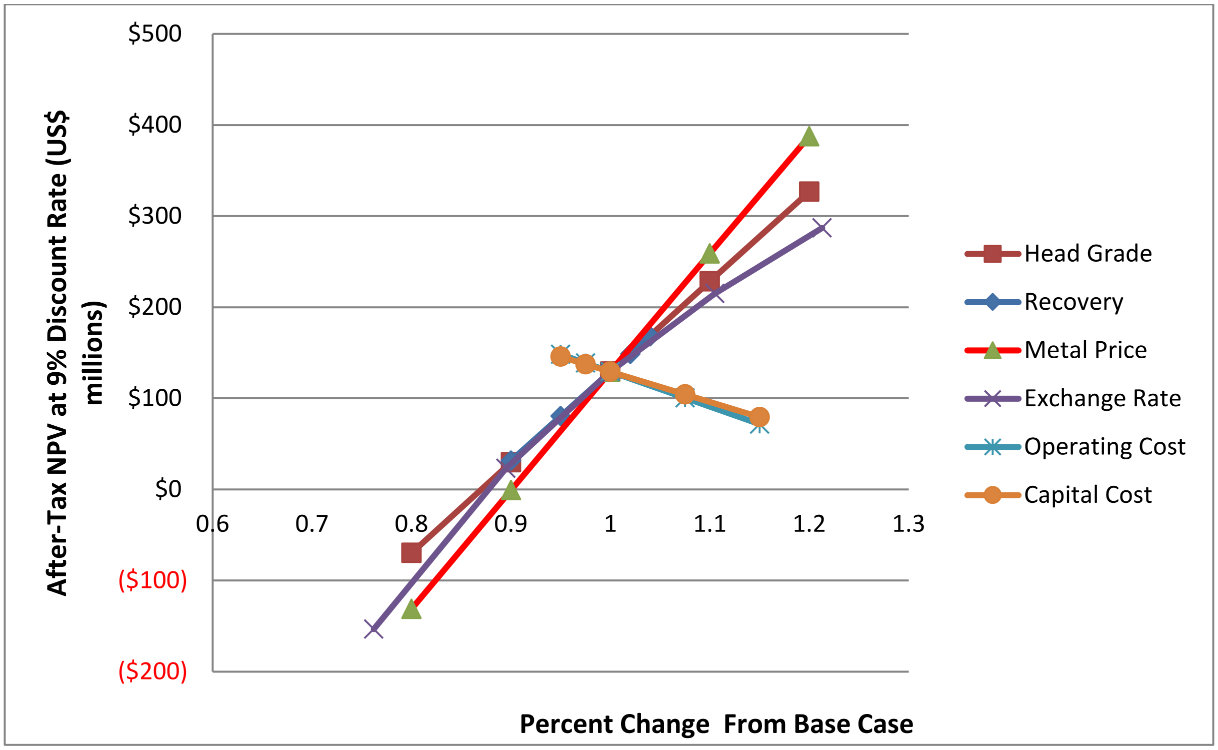


TABLE 1-2 SENSITIVITY ANALYSES
Nexa Resources S.A. – Aripuanã Zinc Project

Description	Units	Low Case	Mid-Low Case	Base Case	Mid-High Case	High Case
Head Grade (Zn)	% Zn	3.0	3.4	3.8	4.1	4.5
Overall Recovery (Zn)	%	80	85	89	91	93
Metal Prices (Zn)	US$ / lb Zn	0.82	0.93	1.03	1.13	1.24
Exchange Rate	BRL/US$	3.00	3.50	3.90	4.30	4.70
Operating Costs	US$/t	32	33	34	37	39
Capital Cost	US$ millions	372	382	392	421	451
Adjustment Factor						
Head Grade (ZnEq)	%	80	90	100	110	120
Overall Recovery	%	90	95	100	102	104
Metal Prices (Zn)	%	80	90	100	110	120
Exchange Rate	%	76	90	100	111	121
Operating Costs	%	95	97.5	100	107.5	115
Capital Cost	%	95	97.5	100	107.5	115
Post-Tax NPV @ 9%						
Head Grade (ZnEq)	US$ millions	(70)	30	129	228	327
Overall Recovery	US$ millions	32	80	129	149	168
Metal Prices (Zn)	US$ millions	(131)	(1)	129	259	388
Exchange Rate	US$ millions	(153)	23	129	215	287
Operating Costs	US$ millions	148	139	129	100	72
Capital Cost	US$ millions	146	137	129	104	79

For head grade, recovery, and metal prices, factors were applied to all metals in the various categories, however, in the table, values for zinc are shown because it provides the most revenue.

The Project is most sensitive to changes in metal prices, and least sensitive to capital costs.

TECHNICAL SUMMARY

PROPERTY DESCRIPTION AND LOCATION

The Project is located in Mato Grosso State, western Brazil, 1,200 km northwest of Brasilia, the capital city. The property is located at approximately 226,000 mE and 8,888,000 mN UTM 21L zone (South American 1969 datum).

LAND TENURE

The property consists of a contiguous block comprising six mining applications, 13 exploration authorizations, and three exploration permit applications covering a total area of 65,887 ha. The permits are owned by Dardanelos, a joint venture between Nexa (70%) and Mineração Rio Aripuanã (a subsidiary of Karmin (30%)), with Nexa acting as the operator.

Karmin is not required to contribute financially to the Project until the completion of a bankable feasibility study, and meanwhile Nexa is fully funding the Project development. One year after the completion of a bankable feasibility study, Karmin is required to contribute on a pro-rata basis towards bringing Aripuanã Zinc into production.

EXISTING INFRASTRUCTURE

The only permanent infrastructure on the Project is a series of exploration drill roads used to access drill sites.

HISTORY

Gold mineralization was discovered in the area during the 1700s by prospectors. Although no formal records exist, the area was likely prospected sporadically over the years.

Anglo American Brasil Ltda (Anglo American) began exploration over the property in 1995. At the time, a small area including Expedito's Pit, now part of the Project, was held by Madison do Brasil (now Thistle Mining Inc.) and optioned to Ambrex Mining Corporation (now Karmin).

Dardanelos was created in 2000 to represent a joint venture, or "contract of association," between Karmin and Anglo American, with the intent of exploring for base and precious metals in areas adjacent to the town of Aripuanã. Anglo American and Karmin held 70% and 28.5% of Dardanelos, respectively, with remaining interest (1.5%) owned by SGV Merchant Bank.

In 2004, the initial agreement between Karmin and Anglo American was amended to allow VM Holding S.A.'s (VMH) participation. VMH subsequently acquired 100% of Anglo American's interest in the Project. In 2007, Karmin purchased SGV Merchant Bank's interests, raising its participation to 30%. In 2016, VMH increased its share holdings in Compañía Minera - Milpo S.A.A. (Milpo), acquiring 80% of its shares. In 2017, VMH rebranded to become Nexa Resources S.A., and listed on the New York and Toronto stock exchanges.

GEOLOGY AND MINERALIZATION

The Aripuanã Zinc deposits are located within the central-southern portion of the Amazonian Craton, in which Paleoproterozoic and Mesoproterozoic lithostratigraphic units of the Rio Negro-Juruena province (1.80 Ga to 1.55 Ga) predominate.

The lithological assemblage strikes northwest-southeast and dips between 35° and near vertical to the northeast.

The Aripuanã Zinc polymetallic deposits are typical VMS deposits associated with felsic bimodal volcanism. Three main elongate mineralized zones, Arex, Link, and Ambrex, have been defined in the central portion of the Aripuanã Project. A smaller, deeper zone, Babaçú, lies to the south of Ambrex. Limited exploration has identified additional mineralized bodies including Massaranduba, Boroca, and Mocoto to the south and Arpa to the north.

The individual mineralized bodies have complex shapes due to intense tectonic activity. Stratabound mineralized bodies tend to follow the local folds, however, local-scale, tight isoclinal folds are frequently observed, usually with axes parallel to major reverse faults, causing rapid variations in the dips.

Massive, stratabound sulphide mineralization as well as vein and stockwork-type discordant mineralization have been described on the property. The stratabound bodies, consisting of disseminated to massive pyrite and pyrrhotite, with well-developed sphalerite and galena mineralization, are commonly associated with the contact between the middle volcanic and the upper sedimentary units. Discordant stringer bodies of pyrrhotite-pyrite-chalcopyrite mineralization are usually located in the underlying volcanic units or intersect the massive sulphide lenses, and have been interpreted as representing feeder zones.

EXPLORATION

Between 2004 and 2007, VMH, a predecessor to Nexa, carried out geological, geochemical, and geophysical surveys over the Project area to allow a more complete interpretation of the regional and local geology and identification of local exploration targets.

Drilling on the property was carried out from 2004 to 2008, in 2012, and from 2014 to present. The purpose of the drill program in 2004 to 2008 was to explore and delineate mineralization on the property, and in 2012, to improve confidence and classification of the Mineral Resources of the Arex and Ambrex deposits. The Link Zone, a zone of mineralization connecting the Arex and Ambrex deposits, and included in the Mineral Resource summary for Ambrex, was discovered in 2014 and delineated in 2015.

As at March 1, 2018, total drilling at the two main deposits, Ambrex, including the Link Zone, and Arex, consists of 621 diamond drill holes totalling 181,832 m. Drilling at the other prospects on the property consists of 77 diamond drill holes totalling 29,244 m.

MINERAL RESOURCES

The Mineral Resource estimate, dated July 31, 2018 was completed by Nexa personnel using Datamine Studio 3, Leapfrog Geo, and Isatis softwares. Wireframes for geology and mineralization were constructed in Leapfrog Geo based on geology sections, assay results, lithological information, and structural data. Assays were capped to various levels based on exploratory data analysis and then composited to one metre lengths. Wireframes were filled with blocks measuring five metres by ten metres by five metres with sub-celling at wireframe boundaries. Blocks were interpolated with grade using Ordinary Kriging (OK) and Inverse Distance Squared (ID^2). Blocks estimates were validated using industry standard validation techniques. Classification of blocks was based on distance based criteria.

The Mineral Resource estimate for the Project as of July 31, 2018 is shown in Table 1-3.

TABLE 1-3 MINERAL RESOURCE ESTIMATE, JULY 31, 2018
Nexa Resources S.A. – Aripuanã Zinc Project

		Grade					Contained Metal				
Stratabound	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	1.1	3.80	1.27	0.16	0.14	30.9	95.7	31.8	3.9	5.2	1.1
Indicated	2.5	3.20	1.00	0.07	0.14	22.1	179.1	55.6	4.1	11.4	1.8
Measured and Indicated	3.7	3.39	1.08	0.10	0.14	24.8	274.8	87.5	8.0	16.6	2.9
Inferred	14.1	6.16	2.36	0.17	0.35	53.8	1,916.9	735.0	51.7	158.3	24.4
Stringer	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	0.7	0.21	0.10	1.12	1.18	12.9	3.0	1.5	16.4	25.1	0.3
Indicated	1.4	0.15	0.06	0.73	1.12	8.9	4.4	1.7	21.9	49.0	0.4
Measured and Indicated	2.0	0.17	0.07	0.86	1.14	10.3	7.5	3.3	38.4	74.1	0.7
Inferred	9.0	0.06	0.04	0.98	1.85	10.6	12.2	8.7	194.8	534.5	3.1
Total	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	1.8	2.48	0.84	0.51	0.52	24.3	98.7	33.4	20.4	30.3	1.4
Indicated	3.9	2.14	0.67	0.30	0.48	17.5	183.6	57.4	26.0	60.4	2.2
Measured and Indicated	5.7	2.25	0.72	0.37	0.49	19.7	282.3	90.8	46.3	90.7	3.6
Inferred	23.1	3.79	1.46	0.48	0.93	37.0	1,929.0	743.7	246.4	692.8	27.5

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources are reported using a US$38/t Net Smelter Return (NSR) block cut-off value.
3. The NSR is calculated based on metal prices of US$1.29 per lb Zn, US$0.99 per lb Pb, US$3.43 per lb Cu, US$1,368 per troy ounce Au, and US$21.37 per troy ounce Ag.
4. Mineral Resources are reported exclusive of Mineral Reserves.
5. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.
6. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

MINERAL RESERVES

The Mineral Reserve estimate for the Project as of July 31, 2018 is shown in Table 1-4.

TABLE 1-4 MINERAL RESERVES – JULY 31, 2018
Nexa Resources S.A. – Aripuanã Zinc Project

Deposit/Category	Tonnes (000 t)	Grade Zn (%)	Pb (%)	Cu (%)	Au (g/t)	Ag (g/t)
Arex						
Proven	4,798	3.0	1.0	0.6	0.4	30.3
Probable	1,015	2.8	0.9	0.6	0.7	22.1
Proven & Probable	5,813	2.9	1.0	0.6	0.5	28.9
Link						
Proven	1,732	4.8	1.8	0.1	0.3	40.0
Probable	6,062	4.0	1.3	0.2	0.3	33.8
Proven & Probable	7,794	4.2	1.4	0.2	0.3	35.2
Ambrex						
Proven	5,272	4.2	1.6	0.1	0.1	38.2
Probable	7,299	3.4	1.4	0.1	0.3	34.7
Proven & Probable	12,571	3.8	1.5	0.1	0.2	36.2
Totals						
Proven	**11,803**	**3.8**	**1.4**	**0.3**	**0.3**	**35.3**
Probable	**14,376**	**3.7**	**1.3**	**0.2**	**0.3**	**33.5**
Proven & Probable	**26,179**	**3.7**	**1.4**	**0.2**	**0.3**	**34.3**

Notes:
1. CIM (2014) definitions were followed for Mineral Reserves.
2. Mineral Reserves are estimated at a cut-off value of NSR = US$ 40.00 / t processed.
3. Mineral Reserves are estimated using an average long-term zinc price of US$1.12 per pound, a long-term lead price of US$0.86 per pound, a long-term copper price of US$2.99 per pound, a long-term silver price of $18.58 per ounce, and a long-term gold price of US$1,187 per ounce and a R$/US$ exchange rate of $3.38.
4. A minimum mining width of 4.0 m was used.
5. Bulk density is 2.70 t/m^3.
6. Numbers may not add due to rounding.

RPA is not aware of any mining, metallurgical, infrastructure, permitting, or other relevant factors that could materially affect the Mineral Reserve estimate.

MINING METHOD

The current Project targets three main elongated mineralized zones, Arex, Link, and Ambrex that have been defined in the central portion of the Aripuanã Project.

The Arex and Ambrex deposits are separate VMS deposits with differing mineralized compositions in stratabound and stringer forms and complex geometric shapes.

The deposit geometry is amenable to a number of underground mechanized mining techniques including and bulk longhole stoping methods. A nominal production target of 6,300 tpd has been used as the basis for the mine production schedule.

Mining will be undertaken using conventional mechanized underground mobile mining equipment via a network of declines, access drifts and ore drives. Access to the Arex, Link, and Ambrex deposits will be from separate portals, which will access the deposits from the most favorable topographic locations.

MINERAL PROCESSING

Based on the metallurgical test program completed to date, the Aripuanã Zinc process flowsheet has been developed by considering conventional technologies for treatment and the recovery of copper, lead, and zinc as separate concentrates. Plant throughput is forecasted to be 2.268 Mtpa of ROM ore from Arex, Link, and Ambrex underground mines. The plant will treat approximately 5,250 tpd (dry basis) of Stringer material and 6,300 tpd (dry basis) of Stratabound material. Key elements of the process flowsheet include primary crushing, semi-autogenous grinding (SAG) followed by ball milling and pebble crushing (SABC) circuit, talc pre-flotation of Stratabound mineralization, sequential flotation of copper, lead, and zinc, and single copper flotation for Stringer mineralization.

INFRASTRUCTURE

The planned infrastructure at the Project includes:

- Three underground mines, accessed by three portals and three ramps
- Dry Stack Tailings storage facility (TSF)
- Engineering wetlands for water collection and treatment
- Power Supply
- Water storage dam
- Access and site road
- Maintenance shops
- Fuel storage

MARKET STUDIES

The principal commodities at the Project are freely traded, at prices and terms that are widely known, so that prospects for sale of any production are virtually assured. RPA reviewed the concentrate terms provided by Nexa and found them to be consistent with current industry norms.

Metal prices are based on long-term consensus forecasts by independent banks and financial institutions. A year-by-year price curve was used to cash flow modelling.

ENVIRONMENTAL, PERMITTING AND SOCIAL CONSIDERATIONS

The environmental licensing process for the Aripuanã Zinc Project started in 2008 following the Terms of Reference (ToR) issued by Mato Grosso environmental agency (SEMA/MT). An initial Environmental Impact Assessment (EIA) was filed in 2014, however, due to changes in the engineering process in 2015 and 2016, a new ToR was requested and an updated EIA was completed in July 2017 by GeoMinAs – Geologia e Mineração e Assessoria ltda. SEMA/MT issued Preliminary Permit # 309707/2018 in 2018, which is valid until March 14, 2021.

The Environmental Installation Permit was requested in July 2018, and is expected to be issued in November 2018. Brazilian environmental regulations require an Installation Permit in order to start construction and earthworks. An Operation Permit is required to operate the plant. Usually, the Operation Permit application is submitted upon receipt of the Installation Permit.

Consultations with indigenous peoples to date regarding Project impacts and mitigation have been under supervision of National Historical and Cultural Heritage Institute (IPHAN) and National Indian Foundation (FUNAI).

A Preliminary Closure Plan has been developed to provide an early opportunity to discuss the closure approach and initial costing. The Closure Plan will be updated as the Project progresses. At the end of mining operations, the main facilities requiring closure will include the underground mine, water management and drainage systems, mine rock storage area, dry-stack tailings, site access roads, buildings, and associated infrastructure.

CAPITAL AND OPERATING COST ESTIMATES

Pre-production capital costs were estimated by Nexa and SNC-Lavalin using a combination of first principles, quotations, and factored estimates. Capital costs are estimated at a +/- 10% confidence level, with a base date of May 2018.

Pre-production capital costs totalling US$392 million are summarized in Table 1-5.

TABLE 1-5 PRE-PRODUCTION CAPITAL COST ESTIMATE
Nexa Resources S.A. – Aripuanã Project

Area	Category	Units	Initial Costs
Mine	Development	US$ millions	30.4
	Mobile Equipment	US$ millions	18.8
Plant & Infrastructure	Site Prep & Earthworks	US$ millions	27.5
	Civil & Roadwork	US$ millions	24.9
	Steelwork	US$ millions	16.4
	Electrical	US$ millions	31.0
	Instrumentation	US$ millions	13.6
	Mechanical Equipment	US$ millions	62.6
	Piping	US$ millions	17.0
Subtotal Direct Costs		**US$ millions**	**242.2**
Indirect Costs	EPCM	US$ millions	20.1
	Temporary Services	US$ millions	22.0
	Owner's Team	US$ millions	14.8
	Other	US$ millions	63.0
Subtotal Indirects		**US$ millions**	**119.8**
Contingency		US$ millions	30.0
Total Capital Cost		**US$ millions**	**392.1**

In RPA's opinion, the estimate can be classified as Class 3, per American Association of Cost Engineers (AACE) guidelines, which generally corresponds to feasibility studies.

Contingency comprises 8.3% of direct and indirect capital costs, which RPA considers to be reasonable for the current stage of the Project.

SUSTAINING CAPITAL

Sustaining capital was estimated by Nexa, with the majority consisting of mine development and mobile equipment. Sustaining capital over the life of mine totals US$199 million.

OPERATING COSTS

Operating costs, averaging US$71 million per year at full production, were estimated for Mining, Processing, and General and Administration (G&A). Operating cost inputs such as labour rates, consumables, and supplies were based on Nexa operating data. A summary of operating costs is shown in Table 1-6.

TABLE 1-6 OPERATING COST ESTIMATE
Nexa Resources S.A. – Aripuanã Project

Parameter	Total LOM (US$ millions)	Average Year (US$ millions / yr)	LOM Unit Cost (US$ / t)
Mining	306	24.6	11.81
Processing	493	39.5	19.03
G&A	86	6.8	3.33
Total	**886**	**70.9**	**34.18**

Manpower over the life of mine averages 700 people.

2 INTRODUCTION

Roscoe Postle Associates Inc. (RPA) was retained by Nexa Resources S.A. (Nexa) to prepare an independent Technical Report on the Aripuanã Zinc Project (the Project), located in the state of Mato Grosso, Brazil. The purpose of this report is to audit a Mineral Resource estimate and to disclose the results of a Feasibility Study (FS) on the Project. This Technical Report conforms to NI 43-101 Standards of Disclosure for Mineral Projects.

Nexa is one of the largest producers of zinc in the world. It has a diversified portfolio of polymetallic mines (zinc, lead, copper, silver, and gold) and also greenfield projects at various stages of development in Brazil and Peru. In Brazil, Nexa owns and operates two underground mines, Vazante (Zn and Pb) and Morro Agudo (Zn and Pb) and two development projects, Aripuanã and Caçapava do Sul. It also operates two zinc smelters in Brazil (Três Marias and Juiz de Fora). Nexa operates the El Porvenir (Zn-Pb-Cu-Ag-Au), Cerro Lindo (Zn-Cu-Pb-Ag), and Atacocha (Zn-Cu-Pb-Au-Ag) underground mines in Peru. The development projects in Peru include Magistral, Shalipayco, Florida Canyon (JV with Solitario), Hilarión, and Pukaqaqa. It also operates one zinc smelter in Peru (Cajamarquilla).

The Aripuanã Zinc property is owned by Mineração Dardanelos Ltda. (Dardanelos), a joint venture between Nexa (70%), and Mineração Rio Aripuanã (a subsidiary of Karmin Exploration Inc. (Karmin, 30%)), with Nexa acting as the operator.

To date, the focus of exploration activities on the property has been the Arex, Link, and Ambrex deposits, which contain current Mineral Resources and Mineral Reserves.

SOURCES OF INFORMATION

Mr. Jason Cox, P.Eng., RPA Principal Mining Engineer, visited the property between June 2 and 5, 2017 to review drill core, discuss project development plans, and review work on the project to date.

Mr. Sean Horan visited the Project site on January 30 to February 3, 2017. During the site visit, Mr. Horan reviewed logging and sampling methods, inspected core from drill holes, and held discussions with Nexa personnel.

Technical documents and reports on the deposit were reviewed and obtained from project personnel while at the site, and on subsequent meetings between RPA personnel and the Nexa Project Team. The principal technical documents related to RPA's review are listed in the Sources of Information. Discussions were held with Nexa's consultants engaged in the FEL3 study, and with the following people from the Nexa Project Team:

- Mr. Marcelo Augusto Castro Lopes Da Costa
- Mr. Alex Jose Mattos Fortunato, Mining Engineer and Aripuanã Zinc Project Manager
- Mr. Marcelo Del Guidice Rocha Santos, Resource and Reserve Committee
- Mr. Julio Souza Santos, Senior Geologist and Aripuanã Zinc Field Manager
- Mr. Jose Antonio Lopes, Resource Manager
- Ms. Talita Cristina De Oliveira Ferreira, Senior Resource Geologist
- Mr. Rafael Moniz Caixeta, Geologist – Mineral Resources
- Mr. Wagner Santos Palheiros, Aripuanã Project Mining Engineer
- Mr. Eduardo Ribeiro De Queiroz, Project Controls and Cost Estimation
- Ms. Lucia Maria Cabral De Goes, Process Engineering Manager
- Mr. Olavo Freitas De Morais, Financial Planning & Analysis
- Gilmara Patrícia Barros Carneiro, Environmental Consultant

This report was prepared by Jason Cox, P. Eng., Sean Horan, P. Geo., Scott Ladd, P.Eng., Avakash Patel, P.Eng., and Stephen Theben, Dipl-Ing. Mr. Cox prepared Sections 19, 21, and 22 to 24 and contributed to Sections 1, 2, 3, 18, 25, and 26. Mr. Horan prepared Sections 4 to 12 and 14 and contributed to Sections 1, 2, 3, 25, and 26. Mr. Ladd prepared Sections 15 and 16, and contributed to Sections 1, 2, 3, 25, and 26. Mr. Patel prepared Sections 13 and 17 and contributed to Sections 1, 2, 3, 18, 25, and 26. Mr. Theben prepared Section 20, and contributed to Sections 1, 2, 3, 25, and 26.

The documentation reviewed, and other sources of information, are listed at the end of this report in Section 27 References.

LIST OF ABBREVIATIONS

Units of measurement used in this report conform to the metric system. All currency in this report is US dollars (US$) unless otherwise noted.

μ	micron	kVA	kilovolt-amperes
μg	microgram	kW	kilowatt
a	annum	kWh	kilowatt-hour
A	ampere	L	litre
bbl	barrels	lb	pound
Btu	British thermal units	L/s	litres per second
°C	degree Celsius	m	metre
C$	Canadian dollars	M	mega (million); molar
cal	calorie	m^2	square metre
cfm	cubic feet per minute	m^3	cubic metre
cm	centimetre	MASL	metres above sea level
cm^2	square centimetre	m^3/h	cubic metres per hour
d	day	mi	mile
dia	diameter	min	minute
dmt	dry metric tonne	μm	micrometre
dwt	dead-weight ton	mm	millimetre
°F	degree Fahrenheit	mph	miles per hour
ft	foot	Mtpa	million tonnes per annum
ft^2	square foot	MVA	megavolt-amperes
ft^3	cubic foot	MW	megawatt
ft/s	foot per second	MWh	megawatt-hour
g	gram	oz	Troy ounce (31.1035g)
G	giga (billion)	oz/st, opt	ounce per short ton
Gal	Imperial gallon	ppb	part per billion
g/L	gram per litre	ppm	part per million
Gpm	Imperial gallons per minute	psia	pound per square inch absolute
g/t	gram per tonne	psig	pound per square inch gauge
gr/ft^3	grain per cubic foot	RL	relative elevation
gr/m^3	grain per cubic metre	s	second
ha	hectare	st	short ton
hp	horsepower	stpa	short ton per year
hr	hour	stpd	short ton per day
Hz	hertz	t	metric tonne
in.	inch	tpa	metric tonne per year
in^2	square inch	tpd	metric tonne per day
J	joule	US$	United States dollar
k	kilo (thousand)	USg	United States gallon
kcal	kilocalorie	USgpm	US gallon per minute
kg	kilogram	V	volt
km	kilometre	W	watt
km^2	square kilometre	wmt	wet metric tonne
km/h	kilometre per hour	wt%	weight percent
kPa	kilopascal	yd^3	cubic yard
		yr	year

3 RELIANCE ON OTHER EXPERTS

This report has been prepared by RPA for Nexa. The information, conclusions, opinions, and estimates contained herein are based on:

- Information available to RPA at the time of preparation of this report,
- Assumptions, conditions, and qualifications as set forth in this report, and
- Data, reports, and other information supplied by Nexa and other third party sources.

For the purpose of this report, RPA has relied on ownership information provided by Nexa. The client has relied on an opinion by Azevedo Sette Advogados dated June 14, 2017 entitled Title Opinion – Projects Aripuanã and Caçapava Do Sul, and this opinion is relied on in Section 4 and the Summary of this report. RPA has not researched property title or mineral rights for the Aripuanã Zinc Project and expresses no opinion as to the ownership status of the property.

RPA has relied on Nexa for guidance on applicable taxes, royalties, and other government levies or interests, applicable to revenue or income from the Aripuanã Zinc Project.

Except for the purposes legislated under provincial securities laws, any use of this report by any third party is at that party's sole risk.

4 PROPERTY DESCRIPTION AND LOCATION

The Project is located in west-central Brazil, in the state of Mato Grosso, approximately 700 km northwest of Cuiabá and approximately 1,200 km northwest of Brasilia. The centre of the property is located at approximately 10°05'00"S Latitude and 59°25'00"W Longitude (Figure 4-1). The approximate Universal Transverse Mercator (UTM) co-ordinates of the centre of the currently defined mineralization are 226,000 mE and 8,888,000 mN, UTM zone 21L (South American 1969 datum), within the Aripuanã 1:250,000 topographic sheet (SC.21-Y-A).

LAND TENURE

The property consists of a contiguous block comprising six mining applications, 13 exploration authorizations, and three exploration permit applications covering a total area of 65,887 ha (Figure 4-2).

Table 4-1 lists all the subject concessions and relevant tenure information including concession names, tenement numbers, areas, titleholders, and expiry dates.

In 2000, a joint venture between Anglo American Brasil Ltda. (Anglo American) and Karmin was formed to explore for base and precious metals in the area adjacent to the town of Aripuanã. Initially, Anglo American and Karmin held interests of 70% and 28.5% in the joint venture, respectively, with the remaining 1.5% held by SGV Merchant Bank (SGV). In 2004, the joint venture agreement was amended to allow Nexa's participation. Nexa subsequently acquired 100% of Anglo American's interest in the Project. In 2007, Karmin purchased SGV's interests, raising its participation to 30%.

The permits are owned by Dardanelos, a joint venture between Nexa (70%) and Mineração Rio Aripuanã (a subsidiary of Karmin (30%)), with Nexa acting as the operator. Arex and Ambrex targets are covered by three mineral rights held by Dardanelos. Those mineral rights are represented by tenements DNPM 866.173/1992, 866.569/1992 and 866.570/1992. Mining concessions were requested in September 2011 and are pending.

Due to partial interference with Indigenous Land 10 km buffer zone, the area of tenements 866727/2015, 866208/2013, and 866230/2017 have been reshaped and are under judicial review.

TABLE 4-1 MIN. DARDANELOS EXPLORATION AUTHORIZATION PERMITS
Nexa Resources S.A. – Aripuanã Zinc Project

Map Ref	Tenement	Area (ha)	Phase	Holder	Status
1	866570/1992	1,000	Mining Application	MDL	MA with request for encompassing with 866173/1992
2	866569/1992	640.72	Mining Application	MDL	MA with request for encompassing with 866173/1992
3	866173/1992	1,000	Mining Application	MDL	MA with request for encompassing with 866173/1992
4	866174/1992	1,000	Mining Application	MDL	MA with request for encompassing with 866173/1992
5	866565/1992	975	Mining Application	MDL	MA with request for encompassing with 866565/1992
6	866386/2003	412.2	Mining Application	MDL	MA with request for encompassing with 866565/1992
7	866292/2015	839.18	Exploration Authorization	MDL	Request for renewal submitted in 06/21/2018
8	866293/2015	930.38	Exploration Authorization	MDL	Request for renewal submitted in 06/21/2018
9	867381/1991	1,000	Exploration Authorization	MDL	Request for prorogation on 12/10/2013
10	866051/2015	978.88	Exploration Authorization	MDL	Request for renewal submitted in 06/21/2018
11	866729/2015	9,186.52	Exploration Authorization	MDL	Request for renewal until 05/20/2019
12	866730/2015	9,445.85	Exploration Authorization	MDL	Request for renewal until 05/20/2019
13	866812/2008	5,462.3	Exploration Authorization	MDL	Request for renewal until 09/30/2019
14	866067/2017	226.73	Exploration Authorization	MDL	Request for renewal until 05/07/2020
15	866148/2017	9,206.95	Exploration Authorization	MDL	Request for renewal until 07/27/2021
16	866229/2017	126.08	Exploration Authorization	MDL	Request for renewal until 07/27/2020
17	866727/2015	4,388.5	Exploration Application	MDL	EA with a priority.
18	866728/2015	6,679.92	Exploration Authorization	MDL	Request for renewal until 06/21/2021
19	866817/2016	4,062.76	Exploration Authorization	MDL	Authozation valid until June, 2021.
20	866941/2015	461.12	Exploration Authorization	MDL	Request for renewal until 06/21/2021
-	866208/2013(*)	415.61	Exploration Application	MDL	EA with a priority. Under judicial review.
-	866230/2017(*)	7,449.11	Exploration Application	MDL	EA with a priority. Under judicial review.

The islands of Trinidade, Martin Vaz, Arquipelago de Fernando de Noronha, Atol das Rocas, and Penedos de Sao Pedro a Sao Paulo are not shown.

Trinidade and Martin Vaz are administered by Espirito Santo; Arquipelago de Fernando de Noronha by Pernambuco.

October 2018

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Location Map

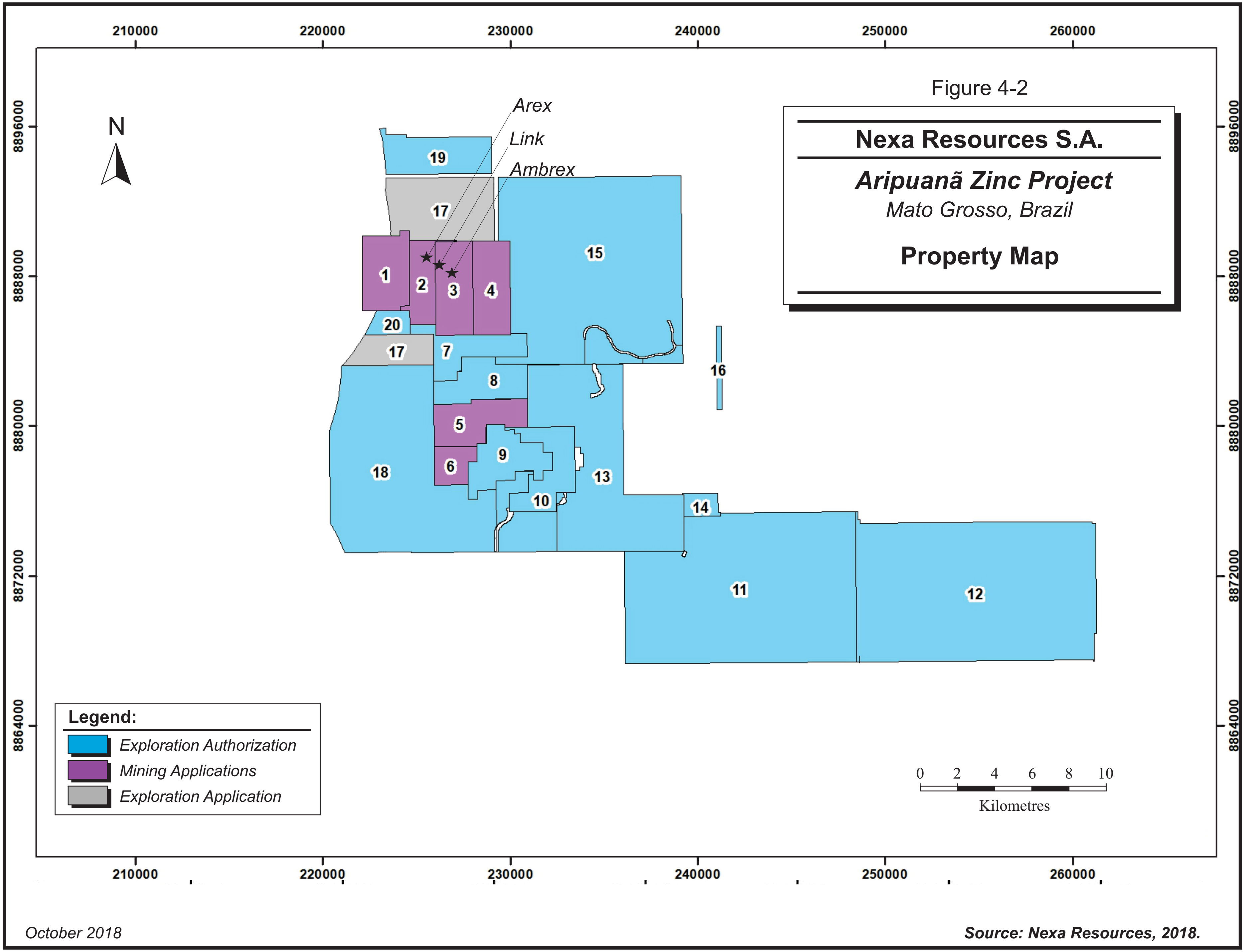


Figure 4-2
Nexa Resources S.A.
Aripuanã Zinc Project
Mato Grosso, Brazil
Property Map
N
Arex
Link
Ambrex
19
17
1
2
3
4
15
20
17
7
8
16
5
9
6
18
13
10
14
11
12
210000
220000
230000
240000
250000
260000
8896000
8888000
8880000
8872000
8864000
Legend:
Exploration Authorization
Mining Applications
Exploration Application
0 2 4 6 8 10
Kilometres
October 2018
Source: Nexa Resources, 2018.
www.rpacan.com

MINERAL RIGHTS

Exploration and exploitation of mineral deposits in Brazil are defined and regulated in the 1967 Mining Code and overseen by the National Mining Agency (ANM), formerly known as National Department of Mineral Production (DNPM). There are two main legal regimes under the Mining Code regulating Exploration and Mining in Brazil: Exploration Permit or Exploration Authorization ("Autorização de Pesquisa", or EP) and Mining Concession ("Concessão de Lavra").

Applications for an EP are made to the ANM and are available to any company incorporated under Brazilian law and maintaining a main office and administration in Brazil. EPs are granted following submission of required documentation by a legally qualified Geologist or Mining Engineer, including an exploration plan and evidence of funds or financing for the investment forecast in the exploration plan. An annual fee per hectare ranging from US$0.35 to US$0.70, is paid by the holder of the EP to the ANM, and reports of exploration work performed must be submitted. During the period where a formal EP application has been submitted by a company for an area, but not yet granted, with the exception of drilling, exploration works are permitted. In this document, these areas are referred to as Exploration Claims.

EPs are valid for a maximum of three years, with a maximum extension equal to the initial period, issued at the discretion of the ANM. The annual fee per hectare increases by 50% during the extension period. After submission of a Final Exploration Report, the EP holder may request a mining concession. Mining concessions are granted by the Brazilian Ministry of Mines and Energy, are renewable annually, and have no set expiry date. The concessions remain in good standing subject to submission of annual production reports and payments of royalties to the federal government.

Areas where the maximum extension of an EP has been reached, and a positive Final Exploration Report and mining concession request have not been submitted by the company, are designated with a status of "Available." Following expiry, the ANM will receive EP applications from the public, including the first owner, for a period of 60 days. If any valid, external EP applications are submitted during this period in addition to the first owner's application, the ANM will review, with consideration of the work completed, and decide to whom it will issue the permit. Before a decision is reached, claim status is set to "In Dispute."

SURFACE RIGHTS

Surface rights can be applied for if the land is not owned by a third party. The owner of an EP is guaranteed, by law, access to perform exploration field work, provided adequate compensation is paid to third party landowners and the owner accepts all environmental liabilities resulting from the exploration work.

Nexa has purchased additional surface rights directly overlying the Arex, Ambrex, and Babaçú deposits since 2012. Surface rights adjacent to the properties and necessary for mine development are currently being negotiated by Nexa. Figure 4-3 displays a map of surface rights currently held by Nexa in relation to the mineral deposits.

ROYALTIES AND OTHER ENCUMBRANCES

Royalties applicable to the Project are detailed in Table 4-2.

TABLE 4-2 ROYALTY DATA
Nexa Resources S.A. – Aripuanã Zinc Project

Receiver of Royalty	Arex	Ambrex	Other Deposits
Garimpeiros Expedito 42.5% Divino 21.25% Joaquim 21.25% Neder 5% Zadir 5% Max 5%		2% Net Smelter Return (NSR) from the start of the first sale of concentrate	
Luiz de Almeida	1.5% of net sales from the first sale of the mineral product		
Anglo American[1]	2% NSR of 70% mining product of Zn, Pb, Cu, Au and Ag from the first of the beginning of the marketing of concentrates or June 13, 2013.		1.5% NSR of 70% of the mining product of Zn, Pb, Cu, Au and Ag

Notes:
1. Anglo American royalty is owned by Nexa only.

PERMITTING

RPA is not aware of any environmental liabilities on the property. Nexa has all required permits to conduct the proposed work on the property. RPA is not aware of any other significant factors and risks that may affect access, title, or the right or ability to perform the proposed work program on the property.

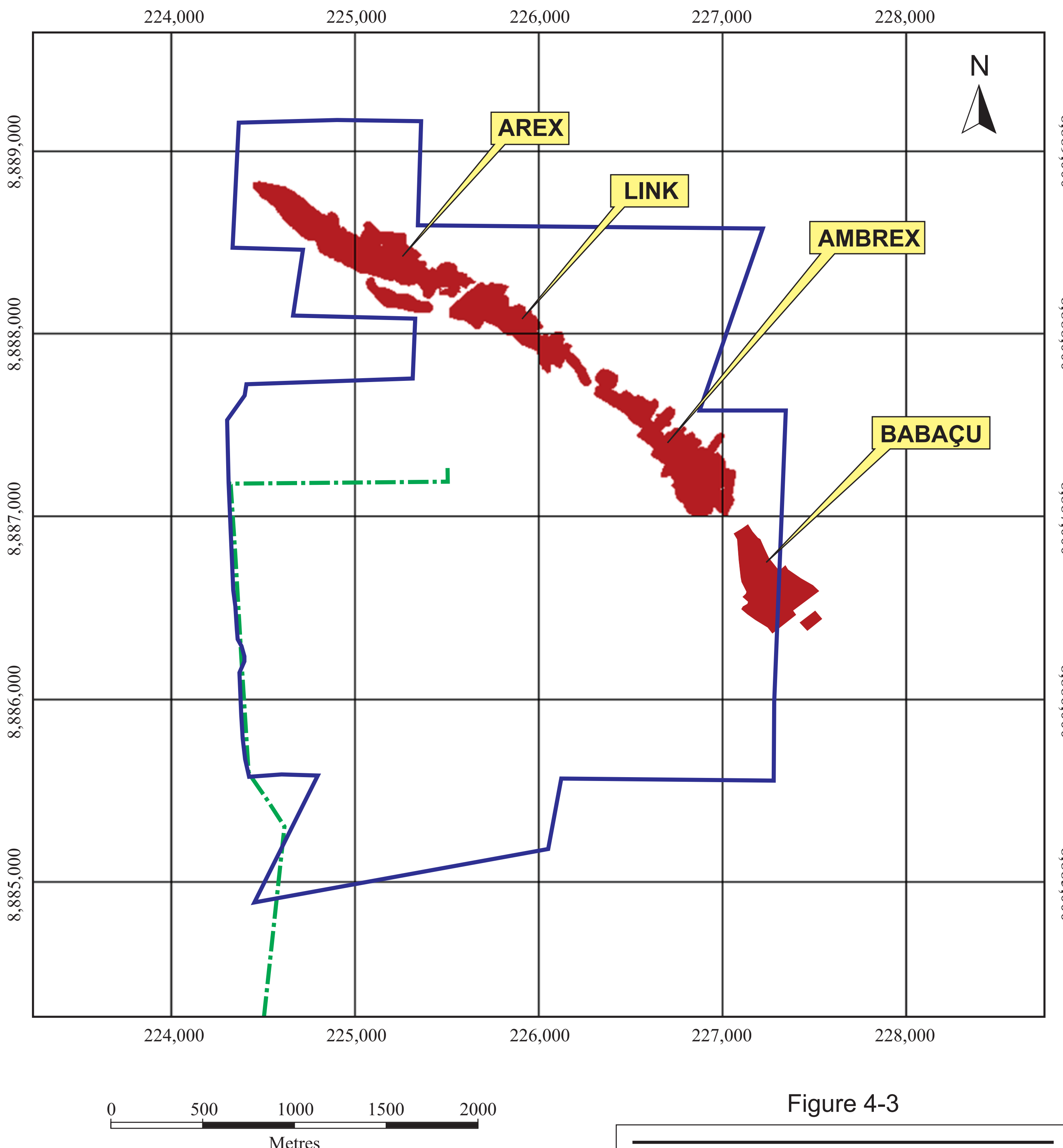


Figure 4-3

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Surface Rights Map

October 2018

Source: Karmin Exploration Inc., 2012.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

ACCESSIBILITY

The Aripuanã Zinc property is located in the northwest corner of the state of Mato Grosso, western Brazil. It can be accessed from the town of Aripuanã by a 25 km unpaved road, which is well maintained in the dry season. Aripuanã can be accessed from the Mato Grosso capital of Cuiabá by a 16 hour drive (935 km) on paved and unpaved roads BR-163/BR364, MT-160, MT-220, MT-170, MT-208, MT-418, and MT-206. The final 250 km between Cuiabá and Aripuanã are on unpaved roads, which are in poor condition and require substantial upgrades to ensure road access to site. Aripuanã is also serviced by an unpaved airstrip suitable for light aircraft. At the time of both site visits, no commercial flights were travelling between Cuiabá and Aripuanã and access to site was accomplished via a three-hour chartered flight.

On the property, temporary roads link drill hole site locations, with the main access gravel road from Aripuanã.

CLIMATE

The climate in the area is hot and humid, with distinct dry (April to September) and wet (October to March) seasons. It is classified as a "Tropical Savanna Climate" in the Koppen Climate Classification due to its high mean temperature and marked wet and dry seasons. The mean annual temperature is 24°C, with monthly average temperatures ranging between 20°C and 30°C. Average annual rainfall is 2,750 mm and annual average evaporation is 1,216 mm.

LOCAL RESOURCES

The economic base in Aripuanã is rooted in the extractive industries, predominantly timber, agriculture, and tourism. Although located in the Amazon district, deforestation has occurred and the area is defined mostly by plantations of rubber and soy beans, as well as artisanal mining operations. No skilled mining workforce exists in the district. Aripuanã has a hospital and related medical facilities as well as primary and secondary schools.

INFRASTRUCTURE

Infrastructure is limited at, and adjacent to, the property. Infrastructure includes a core handling facility located in the town of Aripuanã. Multi-purpose storage sheds are located at the facility and a nursery for drill site and road reclamation is located on site. There are 270 km of unpaved roads on site, which are difficult to traverse during the rainy season (October to March). The gas price is very elevated in the region and there is a very high cost associated with maintenance of the roads.

Services to the property are provided by the town of Aripuanã, which includes accommodation, restaurants, and stores.

The Dardanelos Hydropower dam (261 MW) was completed at Aripuanã in 2011, approximately 20 km from the Project. A thermal power plant next to the Aripuanã airport (Guaçu Power Plant), which uses woodchips and waste as fuel, has a generation capacity of 30 MW.

Numerous rivers occur close to the Project and water supply is not expected to be an issue.

PHYSIOGRAPHY

The Project lies between 250 MASL and 350 MASL, and comprises seven occurrences of mineralization: Arex, Ambrex (including the Link Zone), Babaçú, Massaranduba, Boroca, Arpa, and Mocoto, over a 25 km strike length. The Arex, Ambrex, and Babaçú deposits are visible as three tree covered mounds on a steep ridge surrounded by flat ground. Vegetation is dense on the ridge but has been largely cleared in surrounding areas which are used primarily for agricultural purposes.

6 HISTORY

The following information is summarized from AMEC International (Chile) S.A. (AMEC, 2007).

Gold mineralization was discovered in the area during the 1700s by prospectors and a small fort was constructed to protect the portage at Aripuanã's Cachoeira de Andorinhas (Swallow Falls). No details of the extent of extraction of gold on the property during this time are available. Between 1979 and 1990, artisanal gold miners extracted gold from the Aripuanã area, mostly through gold panning and small excavations. It is thought that at one time up to 2,000 artisanal gold miners were active in the district. One large pit, named Expedito's pit, was excavated during this time and is approximately 200 m deep.

Western Mining Corporation (WMC) held an exploration licence on the property between 1992 and 1994. No details of exploration work completed during this time are available.

Anglo American began exploration over the property in 1995. At the time, a small area including Expedito's Pit, now part of the Project, was held by Madison do Brasil (now Thistle Mining Inc.) and optioned to Ambrex Mining Corporation (now Karmin).

Dardanelos was created in 2000 to represent a joint venture, or "contract of association," between Karmin and Anglo American, with the intent of exploring for base and precious metals in areas adjacent to the town of Aripuanã. Anglo American and Karmin held 70% and 28.5% of Dardanelos, respectively, with remaining interest (1.5%) owned by SGV.

In 2004, the initial agreement between Karmin and Anglo American was amended to allow VM Holding S.A.'s (VMH) participation. VMH subsequently acquired 100% of Anglo American's interest in the Project. In 2007, Karmin purchased SGV's interests, raising its participation to 30%. In 2016, VMH increased its share holdings in Compañía Minera - Milpo S.A.A. (Milpo), acquiring 80% of its shares. In 2017, VMH rebranded to become Nexa Resources S.A., and listed on the New York and Toronto stock exchanges.

Currently, Aripuanã is a jointly held property by Nexa (70%) and Karmin (30%). Karmin is not required to contribute financially to the Project until the completion of a bankable feasibility study. In the meantime, Nexa is fully funding the Project development. Upon completion of a bankable feasibility study, Karmin is required to contribute on a pro-rata basis towards bringing Aripuanã into production.

EXPLORATION AND DEVELOPMENT HISTORY

Excluding drilling, the following exploration activities have been undertaken on the Project:

1. A SPECTREM airborne geophysical survey
2. Geological mapping
3. Ground geophysics
4. LiDAR airborne survey
5. Soil geochemistry

This work was carried out by Anglo American and Karmin between 1999 and 2002. Since 2004, exploration has been conducted by Nexa, and is described in more detail in Section 9, Exploration.

PREVIOUS MINERAL RESOURCE ESTIMATES

Previous Mineral Resource estimates have been completed on the property by AMEC in 2007, by RPA in 2012 for Karmin, and by RPA in 2017 for Karmin, which was updated for Nexa later in 2017. These are superseded by the Mineral Resource estimate presented in Section 14, Mineral Rseource Estimate, of this report.

PAST PRODUCTION

Approximately 350,000 ounces of gold are thought to have been extracted by artisanal miners during the 1979 and 1990 gold rush. There has not been any formal production to date on the property.

7 GEOLOGICAL SETTING AND MINERALIZATION

REGIONAL GEOLOGY

The South American Platform is mainly composed of metamorphic and igneous complexes of Archean/Proterozoic age and makes up the continental interior of South America. The Platform consolidated during Late Proterozoic to Early Paleozoic times in the course of the Brasiliano/Pan-African orogenic cycle during which the amalgamation of different continents and micro continents with closure of several ocean basins led to the formation of the Supercontinent Gondwana. Archean and Proterozoic rocks are exposed in three major shield areas within the framework of Neoproterozoic fold belts (Guiana, Central Brazil, and Atlantic shields). The western continental margin of the South American Plate developed from at least Neoproterozoic to Early Paleozoic times and constitutes a convergent margin, along which eastward subduction of Pacific oceanic plates beneath the South American Plate takes place. Through this process, the Andean Chain, the highest non-collisional mountain range in the world, developed. The eastern margin of the South American Plate forms a more than 10,000 km long divergent margin, which has developed as a result of the separation of the South American Plate and the African Plate since the Mesozoic through the opening of the South Atlantic and the break-up of Gondwana. The northern and southern margins of the South American Plate developed along transform faults in transcurrent tectonic regimes due to the collision of the South American Plate with the Caribbean and the Scotia plates. The South American Plate reveals a long and complex geologic history (Engler, 2009). Figure 7-1 is a simplified geological map of Brazil.

The Project is underlain by Paleoproterozoic and Mesoproterozoic-aged (1.80 Ga to 1.55 Ga) lithologies belonging to the Río Negro-Juruena Province, one of six major geochronological provinces comprising the Amazonian Craton. The Río Negro-Juruena Province occupies a large portion of the western part of the Amazonian Craton (Figure 7-2) and includes volcano-sedimentary sequences, felsic plutonic-gneiss, and granitoids. Rift basins within the province are filled with continental platform molasse and marine sediments of Mesoproterozoic, Paleozoic, and Mesozoic age (Engler, 2009). It is a zone of complex granitization and migmatization. Regional metamorphism, in general, occurred in the upper amphibolite facies (Tassinari et al., 2010).

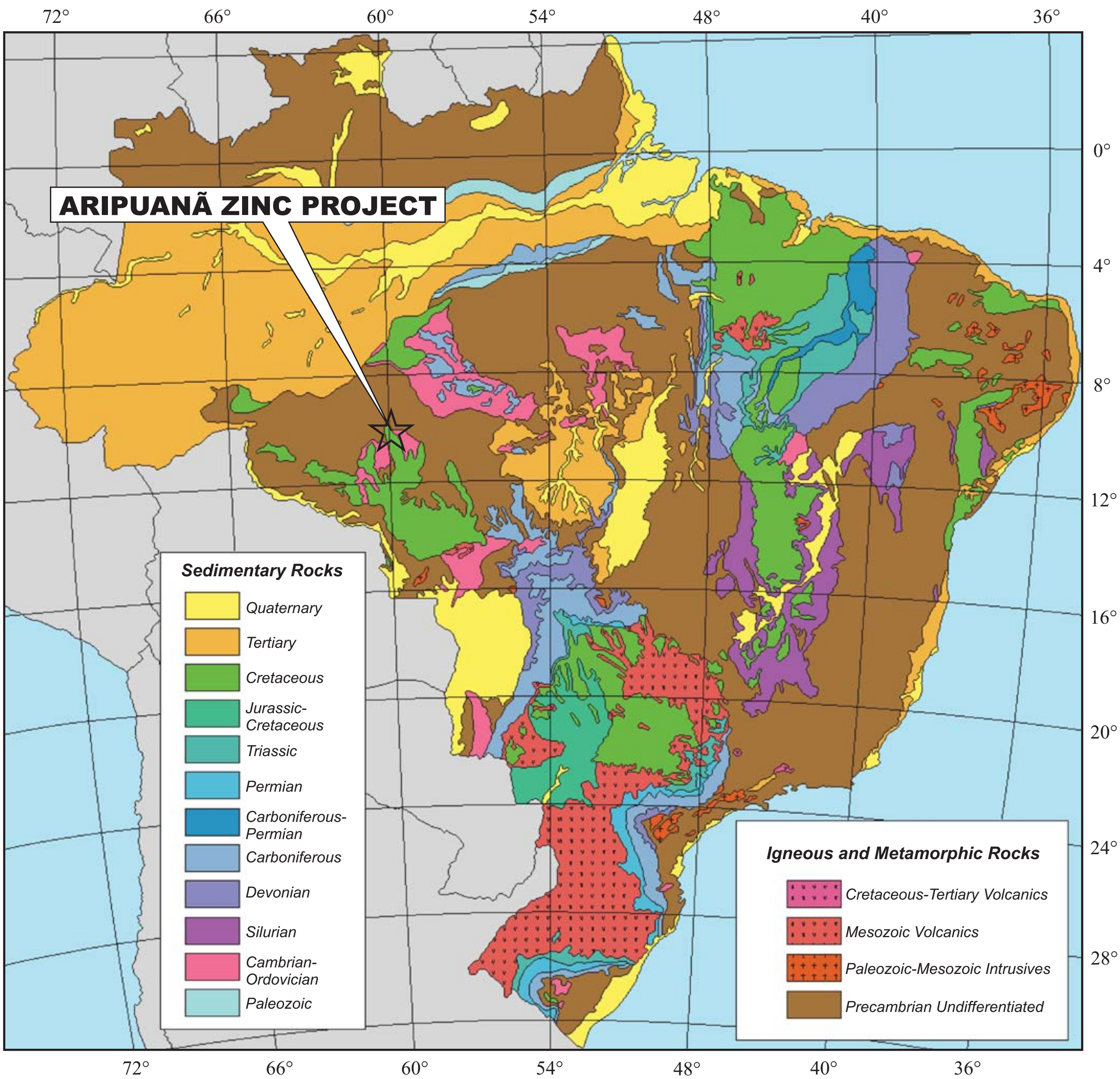


Figure 7-1

Nexa Resources S.A.

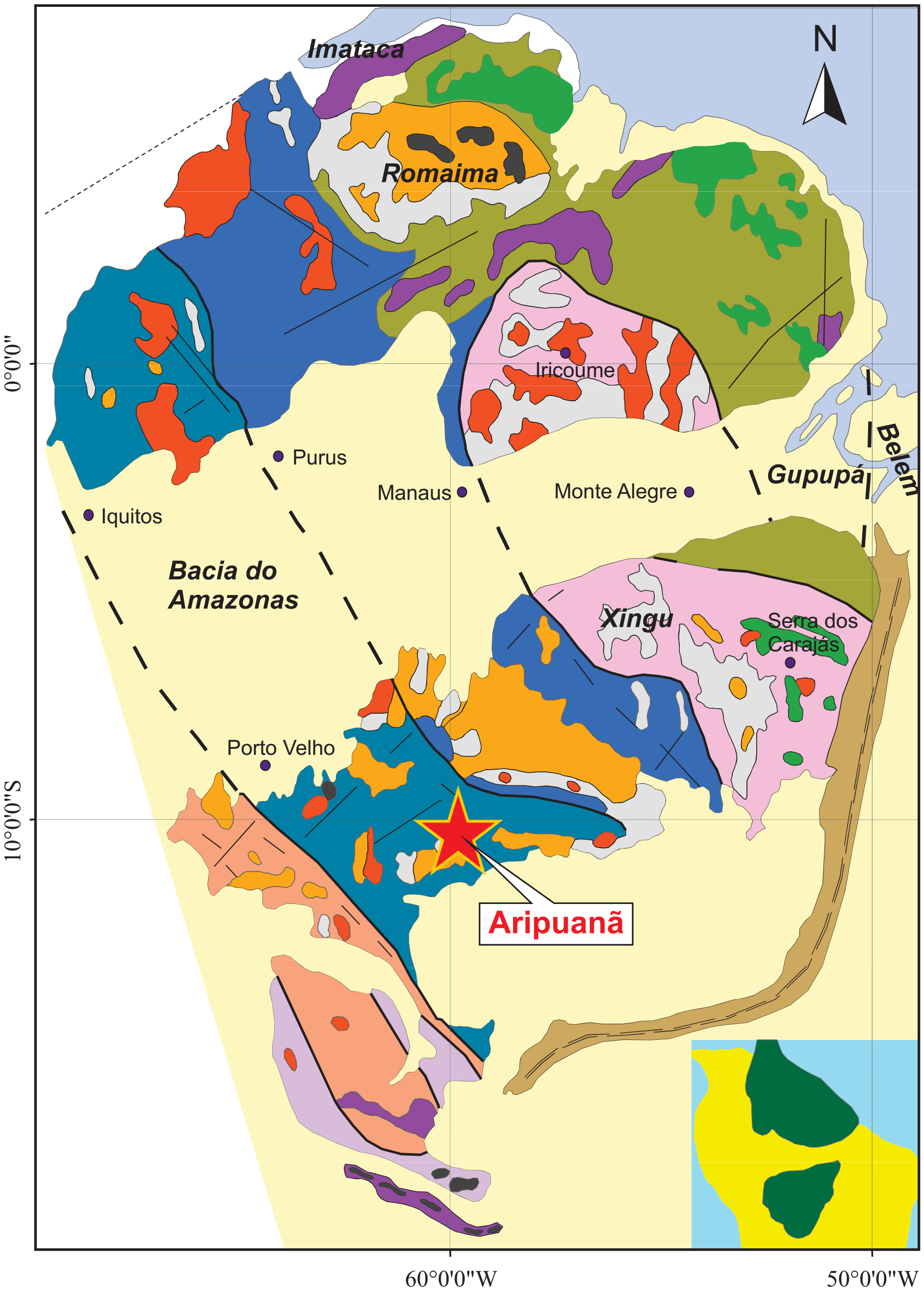
Aripuanã Zinc Project

State of Mato Grosso, Brazil

Regional Geology

October 2018

Source: Votorantim Metais, 2017.



Legend:

Strutures

- Basement Structure
- Neoproterozoic Faults

Geocronological Provinces

- Amazônia Central Province (> 2.5 Ga)
- Maroni-Itacaiúnas Province (2,2 – 1,9 Ga)
- Venturi-Tajapós Province (1,99 – 1,8 Ga)
- Rio Negro-Juruena Province (1,8 – 1,5 Ga)
- Rondoniana-San Ignácio Province (1,55 – 1,3 Ga)
- Sunsás Province (1,25 – 1,0 Ga)

Geological Units

- Phanerozoic Cover
- Granitoid
- Precambrian Sedimentary Cover
- Intermediate Acid Volcanic
- Mafic Volcanics
- Greenstone Belt
- Granulitic Complex
- Neoproterozoic Period

0 200 400 600 800 1000
Kilometres

Figure 7-2

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Geological Map of the Amazonian Shield

October 2018

Source: Karmin Exploration Inc., 2012.

LOCAL GEOLOGY

The following is taken from Simon, Marinho and Lacroix (2007).

The Project area is underlain by a meta-volcano-sedimentary sequence known as the Aripuanã Sequence or the Roosevelt Group (RG), which is interpreted as a back-arc setting of the Tapajós arc. The sequence exhibits greenschist facies grade regional metamorphism, and has been intruded by late-stage A-Type Granites. The sequence is associated with a major intracontinental suture, which defines the margin of the Caiabís graben in the south. The Aripuanã Sequence is bounded by granites and gneisses of the Xingu Complex in the north through interrupted tectonic contacts.

The Aripuanã Sequence comprises three major meta-volcano-sedimentary units:

- a basal unit, represented by felsic and intermediate flows with tuffaceous layers
- an intermediate, transitional felsic volcanic unit
- an upper sequence, represented by inter-layered meta-argillites, meta-tuffs and meta-cherts

These units form a broad semicircular shape surrounding the Rio Branco granite. The mineralized zones are located in the northeastern portion of the arc (Figure 7-3). Post-mineralization aged overthrust faults, dipping to the north and northeast, form complex imbricated sheets, which represent the most characteristic structural feature of the area. Typically, these sheets include portions of the volcanic units, and the upper meta-sedimentary unit, although often the contact relationships are obscured by extreme deformation.

The lithological assemblage generally strikes northwest-southeast and dips between 35° and 70° to the northeast. Stratigraphic features have been offset by younger sinistral, east-west wrench faults that are traced by mapping and magnetic interpretation.

PROPERTY GEOLOGY

The following has been summarized from VMH (2016).

Stratigraphy over the property consists of meta-sediments; meta-volcanic and meta-pyroclastic rocks; and hydrothermally altered rocks at the interface between the meta-sediments and meta-volcanics. The meta-sediments comprise meta-mudstones, meta-siltstones, and carbonaceous meta-siltstone, while the meta-volcanics and meta-pyroclastics grade from rhyolite to dacite in composition. The hydrothermal zone occurs as stratabound when related to exhalative rocks or pipe like when related to the feeder zone. The stratabound portion of the hydrothermal zone has three main types of alteration; carbonate, tremolite, and sericitic. The feeder or stringer zone has three types of alteration; sericitic, phyllic (sericite + chlorite), and chloritic (+silicification). On surface, the hydrothermal alteration zone is strongly masked by tropical weathering, usually associated with gossans. Portions of the property have Phanerozoic alluvial cover.

Figure 7-3 shows the property geology.

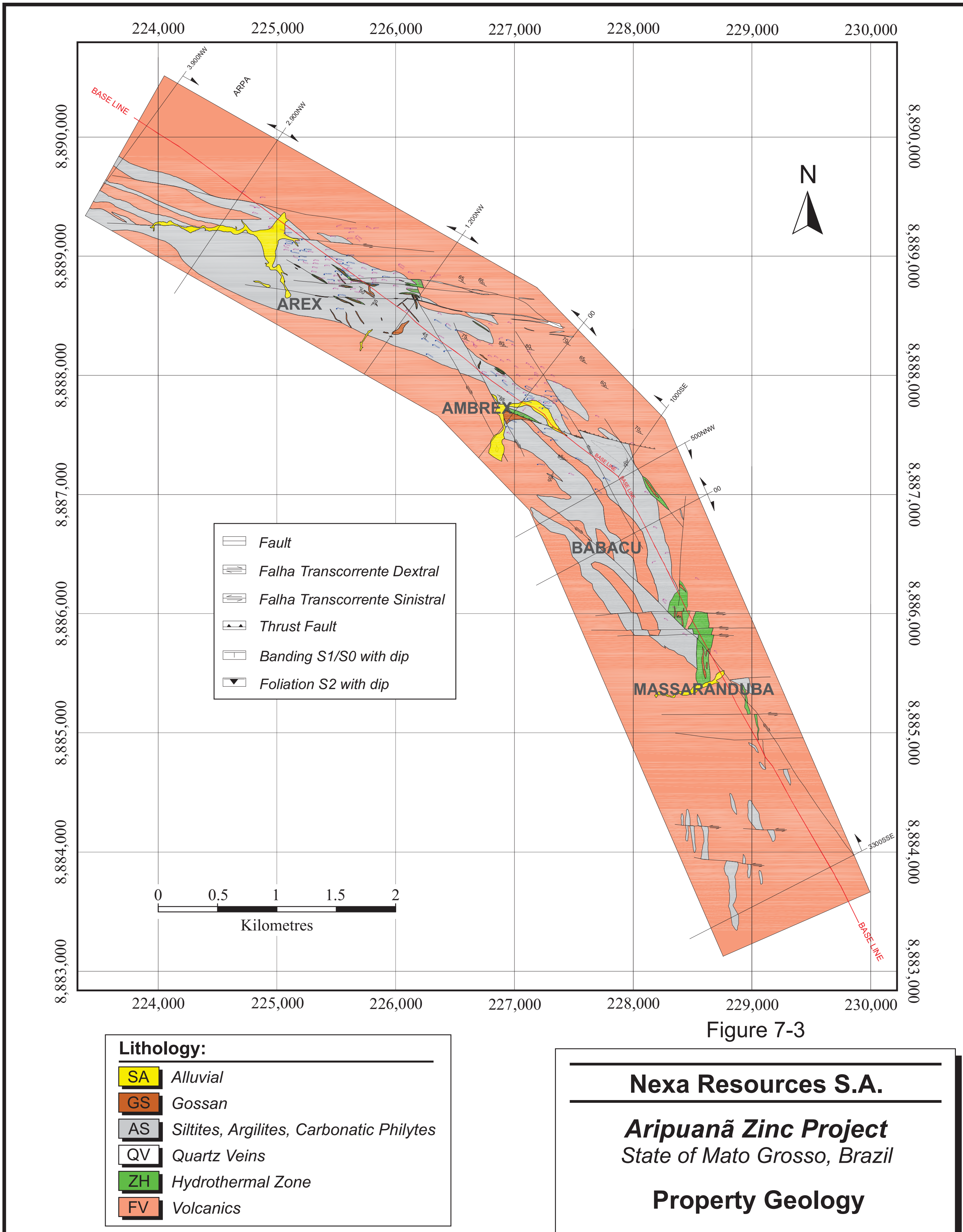


Figure 7-3

Nexa Resources S.A.

Aripuanã Zinc Project
State of Mato Grosso, Brazil

Property Geology

October 2018 ***Source: Amec, 2007 (Edited from Petrus, 2006).***

MINERALIZATION

Three main elongate mineralized zones, Arex, Link, and Ambrex, have been defined in the central portion of the Aripuanã Project. A smaller, deeper zone, Babaçú, lies to the south (stratigraphic footwall) of Ambrex. Limited exploration has identified additional, possible mineralized bodies including Massaranduba, Boroca, and Mocoto to the south and Arpa to the north.

Where outcropping, sulphide mineralization has been oxidized forming gossanous bodies which frequently mark the position of overthrust faults. These gossans are generally small, and contain low levels of gold. They do not appear to be economic at this time.

The individual mineralized bodies have complex shapes due to intense tectonic activity. Stratabound mineralized bodies tend to follow the local folds, however, local-scale, tight isoclinal folds are frequently observed, usually with fold axes that are parallel to major reverse faults, causing rapid variations in the dips. The Ambrex, Arex, Link, and, to a limited extent, Babaçú deposits, represent the best understood zones and are described below.

Hydrothermal alteration is commonly directly adjacent to the Arex, Ambrex, and Babaçú zones, and according to Leite et al. (2005, as cited in AMEC, 2007) presents a zonal and symmetrical standard:

- External zone: Sericite and muscovite in a fine-grained matrix with minor chlorite content. Where present, the low sulphide content is dominated by pyrrhotite.
- Intermediate zone: Transition of sericite to chlorite halo on stringer zones. Tremolite and chlorite alteration with minor carbonatization and silicification.
- Internal zone: Stringer zones are characterized by pervasive chlorite alteration accompanied by quartz veins. Sulphide content is dominated by chalcopyrite and pyrrhotite. Porphyroblastic magnetite and biotite locally substitutes within the sulphide matrix. The stratabound zones are dominated by tremolite, talc and carbonate alteration, accompanied by sphalerite, galena and pyrite, with minor magnetite and fluorite. The stratabound zone may be brecciated.

AREX

Mineralization at the Arex deposit strikes at approximately 110° azimuth, extending over a 1,200 m strike length. Upper portions of the deposit tend to be near-vertical, while lower portions dip at 60° to the northeast. The deposit is characterized by well-defined stringer and stratabound zones. Discrete lenses of stratabound and stringer mineralization, ranging from less than one metre to 15 m thick, interplay within a 100 m to 150 m wide zone, separated by barren, hydrothermally altered rocks. Mineralization comes close to outcropping at surface, and extends to almost 500 m below surface. Discrete lenses may be continuous for up to 300 m down dip. The Arex deformation pattern is made of tight, foliation-parallel folds, and reverse faults which overthrust in the same direction. The deposit presents strong dip variations that are often parallel to foliation and faults. In some areas, this may cause the stratabound and stringer mineralization to be parallel, despite its original perpendicular position.

AMBREX

The Ambrex deposit represents the largest of the known mineralized zones on the Project. The Ambrex deposit is located approximately 1,300 m southeast of Arex. Mineralization strikes at approximately azimuth 125° and has a strike extent of approximately 1,050 m, based on current drilling. The dip varies from near vertical to 70° to the northeast. Mineralization thicknesses typically range between ten metres and 50 m, with a maximum of 150 m. The Ambrex deposit has an upper depth of 60 m below surface, with a lower depth of approximately 700 m. The degree of folding is gentler than at Arex and hosts well marked overthrust faults, which are parallel to metamorphic foliation. The orientation of the stratabound mineralization is generally parallel to the original bedding, while the stringer zone is often approximately perpendicular to the stratabound zone.

LINK ZONE

The Link Zone target, first discovered in 2014, is interpreted to be the westward extension of the Ambrex deposit towards the Arex deposit. It is located southeast of Arex and exhibits shape, mineralization, and alteration features similar to Ambrex. Based on current drilling, the Link Zone has a strike extent of approximately 650 m, and like Ambrex is open ended at depth.

BABAÇÚ

Located southeast of Ambrex, the Babaçú deposit is 600 m long and also dips to the northeast. Similar to Ambrex, the stringer zone is limited in extent and is understood to occur in discrete, thin lenses perpendicular to the stratabound mineralization.

8 DEPOSIT TYPES

The following is summarized from VMH (2012c).

The Aripuanã polymetallic deposits are typical Volcanogenic Massive Sulphide (VMS) deposits associated with felsic bimodal volcanism. Support for this model is based on the geometry of mineralization, host rocks, hydrothermal alteration, and sulphide paragenesis. The VMS deposits have been subsequently deformed and metamorphosed under greenschist facies conditions (Leyte, 2005 and Petrus, 2006, as cited in VMH, 2012c).

Details observed at Aripuanã and consistent with VMS deposits are described below.

1. Host rocks. All mineralized bodies are located on the upper levels of a felsic volcanic unit, in association with finely laminated exhalites, at or close to the contact with an overlying sedimentary unit.
2. Mineralization zonality and predominant textures. Three types of mineralization are found on the property, and are typical of VMS deposits elsewhere:
    - Stringer facies: Cu-Au bearing stringers in the footwall of the stratabound mineralization, containing chalcopyrite and pyrrhotite, with stockwork and breccia textures corresponding to hydrothermal feeder zones
    - Proximal sulphide facies: mixed bodies of stratabound massive and disseminated Zn-Pb mineralization, overlying stringer mineralization
    - Distal sulphide facies: horizons of massive sulphide, stratabound Zn-Pb mineralization, often finely banded, with fine-grained pyrite, pyrrhotite, and sphalerite, sometimes associated with galena, corresponding to depositional areas distant from the feeder zones
3. Geochemical zonality. The Cu/Cu+Zn ratio is higher in the proximity of the Cu-rich feeder zones, and decreases upward from the footwall and towards the distal Zn-rich stratabound mineralization.

Facies associated with the feeder zones are located in the middle of the volcanic unit and are characterized by pyrrhotite and/or chalcopyrite stockworks in a zone of intense chloritic hydrothermal alteration. The sulphide association represents a feeder zone at higher temperature. There is Cu-Au association in these zones. A target model is shown in Figure 8-1.

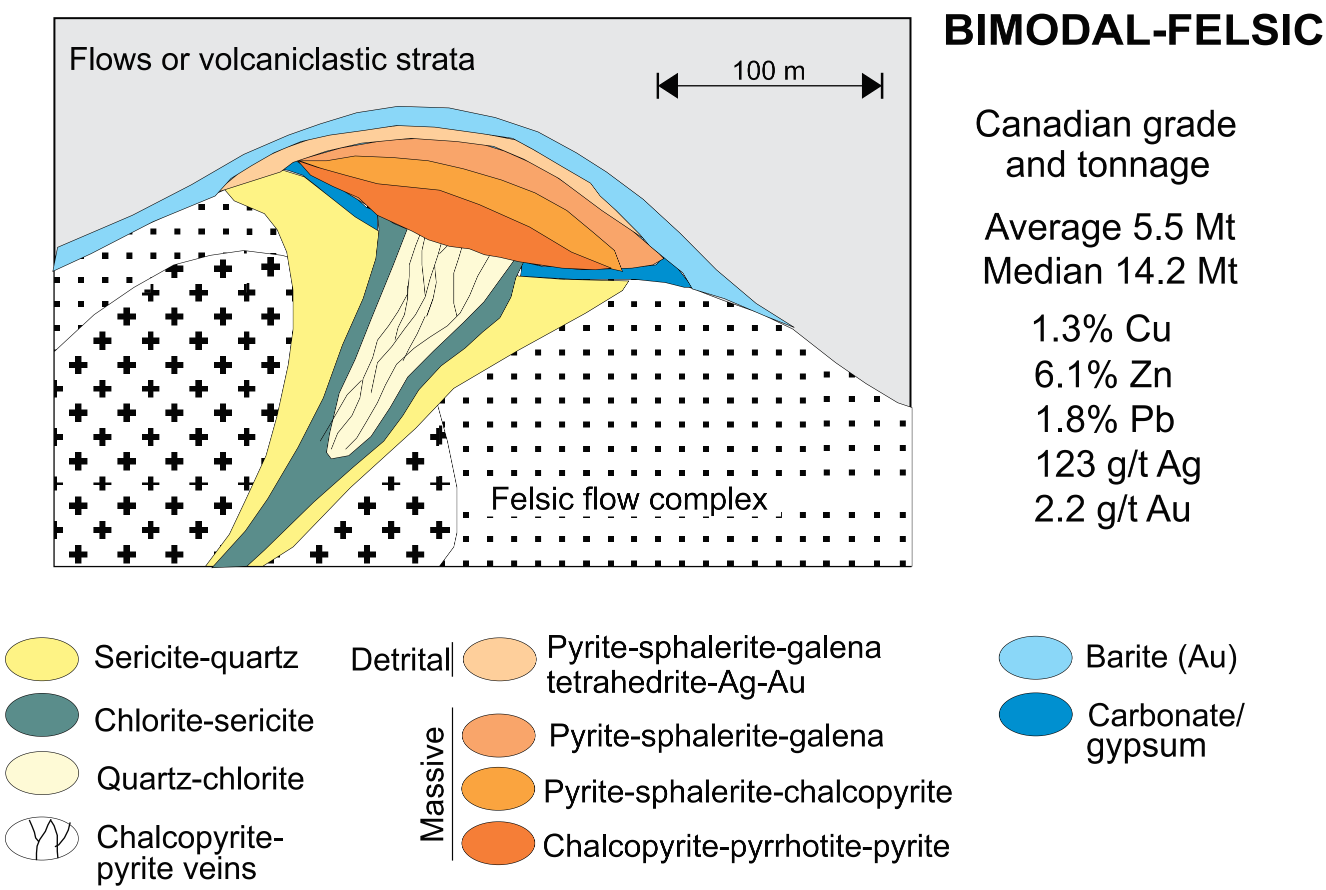


Figure 8-1

Nexa Resources S.A.

Aripuanã Zinc Project
State of Mato Grosso, Brazil

Target Model

October 2018

Source: A.G. Galley et al., 2007.

9 EXPLORATION

1999-2002 EXPLORATION

This section is summarized from VMH (2012a).

Geochemical and geophysical surveys, including a SPECTREM airborne geophysical survey, were conducted by Anglo American and Karmin between 1999 and 2002. The exploration program targeted 13 different areas on the property. Limited details are available on the exact date and operator of the various surveys conducted, however, the following information was recovered in the Anglo American database (Table 9-1).

TABLE 9-1 ANGLO AMERICAN AND KARMIN EXPLORATION – 1999-2002
Nexa Resources S.A. – Aripuanã Zinc Project

Target	Geological Mapping	Geochemistry		Ground Geophysics				
		Stream Sediment	Soil	Gravimetry	Magnetic	IP	VLF	TDEM
Acampamento Velho	x	x	x		x			
Arex	x	x	x	x	x	x	x	
Ambrex	x	x	x		x		x	x
Babaçú	x	x			x			x
Bigode	x	x	x		x		x	
Cafundo	x	x	x		x		x	x
Cone	x	x	x		x			
Joao Paulo	x	x	x		x			
Massaranduba	x	x			x			x
Mocotó-Boróca	x	x	x		x		x	x
Vaca II	x	x	x		x			
Valdir	x	x	x		x			
Vale dos Sonhos	x	x	x					x

Note. IP – Induced Polarization; VLF – Very Low Frequency; TDEM – time-domain electromagnetics

GEOPHYSICS

The airborne SPECTREM geophysical survey is an electromagnetic (EM) method developed by Anglo American. Simultaneous EM, total field magnetic, and radiometric measurements are taken from sensors inside, or towed behind, an aircraft. The survey was conducted in 2001 over 1,800 km^2.

No specific details are available with respect to ground geophysical methods.

GEOCHEMISTRY

No details of sample procedures, quality assurance/quality control (QA/QC), or dates were available. Historically, 760 stream sediment samples and up to 32,000 soil samples with wide distribution over 2,000 km^2 have been collected. Analyses were conducted by Nomos and Mineração Morro Velho (MMV) laboratories.

GEOLOGICAL MAPPING

Geological mapping was completed to varying levels of detail over the thirteen targets listed in Table 9-1 between 1999 and 2002.

NEXA EXPLORATION

In 2004, Nexa, then called VMH, became Project operator and commenced a detailed geological, geochemical, and geophysical exploration program, which included additional drilling described in Section 10, Drilling.

Under contract from Nexa in 2005, Geoambiente Sensoriamento Remoto (Geoambiente) prepared a topographic map based on photogrammetric restitution of two pairs of Ikonos panchromatic images with one metre spatial resolution (173214-0/173214-3 and 173214-1/173214-2), and with ground control on geodesic IBGE stations. Internal control points were surveyed using a differential global positioning system (DGPS). The topographic map has an area 195 km^2 and has 1:10,000 altimetric and 1:5,000 planimetric scales as well as five metre contour lines (plus additional one metre interpolations).

In 2004, Integração Geofísica (Intergeo) compiled and integrated all previous geological, geophysical, and geochemical data to allow a more complete interpretation of the regional and local geology, and the identification of local exploration targets. A digital terrain model was prepared and integrated with airborne gamma-spectrometric (K-Th-U channels), magnetometric, and electromagnetic (time domain EM) survey data, soil geochemical surveys, regional and local geological information, including most of the data previously obtained by Anglo American and Karmin. As a result of this study, five groups of targets were identified in addition to Arex and Ambrex, and additional exploration was recommended.

In 2004, Nexa contracted Petrus Consultoria Geológica Limitada (Petrus) to conduct and/or supervise geological, geochemical, and geophysical exploration at the property. Between 2004 and 2007, additional exploration at the property included relogging of old Anglo American/Karmin core, geological mapping, and geochemical surveys.

A time domain, airborne EM survey was conducted by Fugro Airborne Surveys in 2007. The survey covered approximately 1.8 km^2, divided in four loops of 700 m by 500 m each, with readings on a 100 m by 20 m grid. The survey was flown over 14,290 m using a base frequency of 30 Hz. In addition, 3,860 m were surveyed at three Hz in order to detail the anomalies identified with the 30 Hz survey.

In 2008, exploration efforts consisted of evaluating regional targets. Work included detailed geological mapping and systematic rock, soil, and stream sediment geochemistry. Mobile metal ion (MMI) soil geochemical tests were completed on the Ambrex and Babaçú targets. Core from Arex and Ambrex was re-logged. Exploration drilling at Babaçú and in-fill drilling at Arex and Ambrex took place.

Extensive drilling took place on Arex and Ambrex in 2012, as well as additional metallurgical test work.

In 2013, ground magnetic surveying totalling approximately 138 line-km over the Poraquê, Arpa, Ambrex, Babaçú, Massaranduba, Boroca, and Mocotó targets was completed. Subsequently, a 12 line km ground magnetic survey was completed over the Casagrande target. An extensive program of core re-sampling was completed comprising a total of 11,067 core and pulp analyses from 159 drill holes from Arex, Ambrex, Arpa, and Babaçú. A new structural model was developed based on LiDAR topography in the Arex-Ambrex area and the 1:25,000 scale geological map was updated.

In 2014, ground magnetic surveying totalling approximately 222.8 line km over the Flanco W, Poraquê, Sombra, Mocotó Sul, Jibóia, and Casagrande targets was completed. A total of 991 soil samples were taken over the Somra and Casagrande targets and 25 gold panning samples were taken at the Flanco W, Mocotó Sul, Jobóia, Sombra, and Vaca-Bigode targets.

In 2015, a 1,584.2 line km helicopter-borne, combined magnetic and electromagnetic (VTEM) survey was flown over four areas, namely Arex-Ambrex, Flanco W, Mocotó, and Casagrande

Jibóia. Soil sampling at Flanco W and geological mapping and rock sampling at the Boróca and Mocotó target areas was undertaken. In-fill drilling at Arex and Ambrex was also completed.

EXPLORATION POTENTIAL

BABAÇÚ

Based on a review of 42 drill holes totalling 19,388 m in the Babaçú mineralized body and other exploration work on the property such as airborne and ground geophysical surveys, geological mapping, soil geochemistry, and drill testing of other targets, RPA estimates that the potential tonnage and grade of mineralization at the Babaçú prospect could be three million to six million tonnes grading from 3.0% Zn to 5.0% Zn, 1.0% Pb to 2.5% Pb, 0.2% Cu to 0.5% Cu, 0.15 g/t Au to 0.4 g/t Au, and 10 g/t Ag to 30 g/t Ag. The potential quantity and grade is conceptual in nature as there has been insufficient exploration to define a Mineral Resource, and it is uncertain if further exploration will result in the target being delineated as a Mineral Resource.

The upper and lower values of the above grade ranges are based on the existing drill hole information, with consideration given to the neighbouring bodies, Ambrex and Arex. The estimated tonnage range is based on the dimensions of the Babaçú mineralized body tested by 42 diamond drill holes.

During 2018, Nexa completed an 11,000m drilling program at Babaçu, focused on high grade shoots in the fold hinges. The exploration program still in progress.

10 DRILLING

Drilling on the Aripuanã Zinc property has been conducted in phases by several companies since 1993. Total drilling at the two main deposits, Ambrex, including the Link Zone, and Arex, consists of 572 diamond drill holes totalling 174,604 m. Drilling at the other prospects on the property consists of 77 diamond drill holes totalling 33,273 m.

A drilling summary by deposit up to and including all drilling information available at March 1, 2018, is presented in Table 10-1. A map of drill hole collars is shown in Figure 10-1.

TABLE 10-1 DRILL HOLE DATABASE
Nexa Resources S. A. – Aripuanã Zinc Project

	Historical				Nexa (2004-2018)				Total	
Deposit	**No. DDH**	**Metres**	**No. Perc.**	**Metres**	**No. DDH**	**Metres**	**No. Met.**	**Metres**	**No. Holes**	**Metres**
Arpa					9	5,359			**9**	**5,359**
Arex	76	18,174	19	1,329	222	44,529	21	2,677	**338**	**66,709**
Ambrex (incl. Link Zone)	48	17,408			226	94,493	9	3,222	**283**	**115,123**
Babaçú	7	2,224			35	17,163			**42**	**19,388**
Massaranduba	8	2,184			18	6,343			**26**	**8,527**
Total	**139**	**39,991**	**19**	**1,329**	**510**	**167,887**	**30**	**5,899**	**698**	**215,105**

Notes:
DDH: Diamond drill hole
Perc: Percussion drill hole
Met: Metallurgical drill hole
Drilling totals do not include the current program for Babaçú

PREVIOUS DRILLING

Limited detail on the Anglo American and Karmin drilling campaigns is available. Both reverse circulation (RC) and diamond drilling was performed on site. Results of RC drilling have not been maintained in the current Nexa database. Diamond drill core diameter was HQ (63.5 mm) size. The DDI Reflex Fotobor method was used for downhole survey measurements. Most holes were drilled with azimuths ranging from 180° to 220° and inclinations ranging from -50° to -70°. Drill core boxes are stored on site and are adequately labelled and ordered for efficiently locating and extracting the samples. Original drill reports are not available on site.

RECENT DRILLING

Drilling was conducted by Nexa on the property from 2004 to 2008 and from 2012 to present. The main purpose of the drill program from 2004 to 2008 was to explore and delineate mineralization on the property and from 2012 to present, to improve confidence and support and upgrade the classification of the Mineral Resources at the Arex and Ambrex deposits.

Since the previous Mineral Resource estimate dated December 23, 2016, 66 drill holes totalling 31,061 m have been drilled on the Project. Of these, 64 were directed to the Link zone target, with four intersecting the Arex deposit, but targeting the Link Zone at depth, and two targeted the Ambrex deposit. Total drilling at the two main deposits, Ambrex, including the Link Zone, and Arex, consists of 572 diamond drill holes totalling 174,604 m. Drilling at the other prospects on the property consists of 77 diamond drill holes totalling 33,273 m.

March 1, 2018 is the cut-off date of the Mineral Resource database; all assay results received before this date have been considered in the Mineral Resource estimate.

Drill hole locations are spotted in the field using a hand-held GPS. Small adjustments to the drill hole locations are made where necessary based on topographic relief and non-removable trees. The desired collar position, foresights, and backsights are marked by technicians using a compass. Collar surveying is performed with a differential GPS upon completion of the drill hole and the departing collar azimuth is recorded using a total station. Casings are left in place. Downhole surveying is completed with Deviflex and Maxibor tools by the drilling company at three metre intervals downhole. Duplicate downhole surveys are performed on each hole. From 2014 onwards, Nexa has implemented core orientation for approximately 25% of the drilling using the Reflex ACT core orientation tool.

Drill core is currently placed in plastic boxes and labelled at the rig site prior to transport. Previously, wooden core boxes were used. Drill core is transported by pick-up truck to the Nexa logging facility by the drill company employees, Servitec Sondagem Geologica. Geotechnicians measure drill core runs and note core interval length, core loss, and check core block runs. This information is then cross referenced to the driller’s notes for discrepancies and amended where necessary. Rock Quality Designation (RQD) is measured and a resistance value (R0 to R4) is assigned based on rock hammer tests. No other geotechnical logging is performed on site. The core is photographed both wet and dry prior to mark-up by geologists.

All geological information is manually logged on paper logging sheets, and then hand entered into formatted Microsoft Excel sheets by the logging geologist. Lithology, rock unit, texture, alteration associated with the VMS, and regional alteration are recorded in logging sheets as text fields. The percentage of total sulphides, pyrite, pyrrhotite, chalcopyrite, sphalerite, and galena are recorded. Observations are noted where relevant. Digital logging sheets are imported into the database management program GeoExplo by the database manager. For oriented core, alpha and beta angles are recorded along with structural descriptions. The alpha and beta angles are converted to dip and dip direction using a Microsoft Excel macro.

RPA is of the opinion that the drilling and logging procedures meet industry standards.

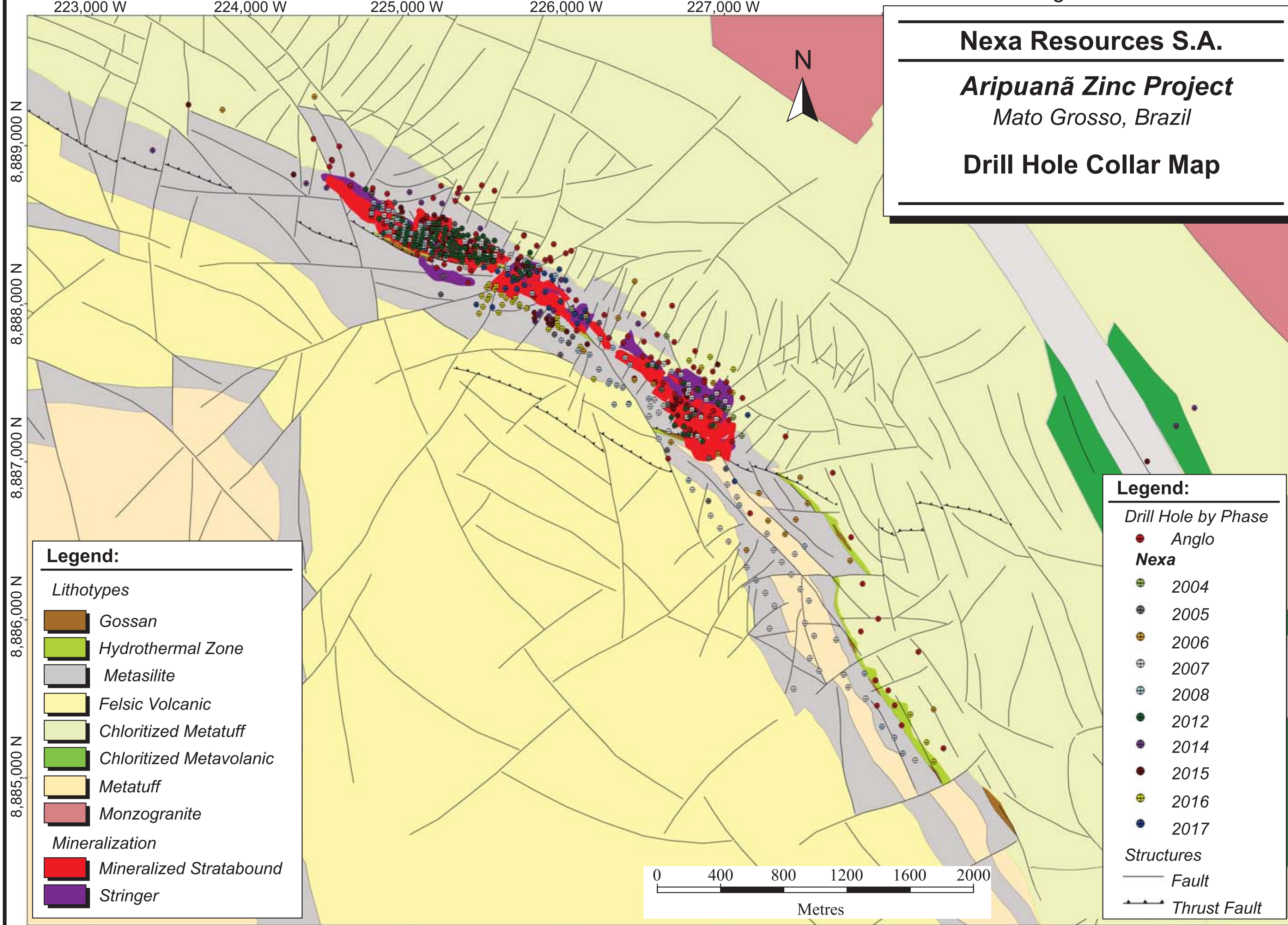
Figure 10-1

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

Drill Hole Collar Map



October 2018

Source: Nexa Resources, 2018.

11 SAMPLE PREPARATION, ANALYSES AND SECURITY

SAMPLING METHOD AND APPROACH

Core is sampled ten metres above and below visible mineralization. Sampling respects geological contacts, and samples vary in length from 0.5 m to 1.5 m depending on core recovery, length of the lithological unit, and mineralization. Geologists mark the core with red and blue lines to indicate where the core is to be sampled and which half is to be assayed. The lines are drawn respecting the geological features such as layering to help minimize sampling bias. Prior to sampling, sample numbers are recorded in the GeoExplo data management system and cross-referenced with the interval depth downhole and the depth recorded in the database. Using felt pens, geologists mark the sample numbers pen on the core boxes and staple a sample tag wrapped in plastic to the box at the start of the sample.

Core is cut into two halves by technicians with a saw; one half of the core is returned to the core box for later reference, while the other half is submitted for sample preparation and analysis. The geologist responsible for logging the drill hole defines the insertion of QA/QC samples including blanks, standards, and duplicates.

Each sample booklet contains four tags for each sample. One sample tag is stapled to the clear plastic sample bag and an additional sample is placed within the bag. One tag is attached to the core box while the remaining tag is left in the booklet for record keeping.

Samples are batched for shipment; individual batches contain up to 250 samples, however, samples from different boreholes do not get combined into the same sample batch.

DENSITY ANALYSIS

Density data are collected from each sample; using the water displacement method. Samples are dried and then weighed using a tared Adventurer Pro scale accurate to 0.1 g. The sample is then added to a polyvinyl chloride (PVC) tube containing a fixed amount of water. The displaced water is collected in a pre-weighed 1,000 mL beaker. The weight and volume of displaced water is recorded by hand and then entered into a spreadsheet. Density values are auto-calculated using both volume and weight of water. The technician compares the values to ensure that they are similar. Any discrepancy results in a repeat of the test. The weighted measurement is used in the final database.

Every tenth sample is also subject to an Archimedes density measurement. The Archimedes density results are kept on site and used as a QA/QC measure. The results of the Archimedes method are typically within 10% of the water displacement method.

SAMPLE PREPARATION AND ANALYSIS

Between 1993 and 1997, Anglo American used Mineração Morro Velho (MMV) and Nomos Laboratories (Nomos). Both laboratories were site-based mine laboratories. The time during which samples were assayed at these facilities predates the definition and implementation of ISO standards 9001 and 17025. RPA was unable to gather additional information regarding independence or performance benchmarks for these laboratories.

Between 2004 and 2007 Nexa (then called VMH) used ACME for sample preparation and analysis. Sample preparation was carried out in Goiania, Brazil, while sample analysis was performed in ACME's Lima facility.

In 2007, the ACME preparation facility was sold to ALS Global; Nexa continued to use the same facility, now under the ALS Global banner for sample preparation and analysis. Sample analysis was performed in Lima, Peru. Both facilities are accredited to International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 9001:2008 and ISO/IEC 17025:2005 (expires 2018), for all relevant procedures.

Both laboratories are independent of Nexa. Sample preparation and analysis has been identical between the two different laboratories and is described below:

Samples were logged into a sample LIMS tracking system, weighed, dried, and crushed to better than 70% passing a two millimetre screen. A split of up to 250 g was taken and pulverized to better than 85% passing a 75 µm screen (ALS code PUL-31). Following preparation, samples were shipped to the respective analytical facility.

The following sample analysis was undertaken at the ACME facilities:

1. **Gold Analysis:** Fire assay (50 g) standard fusion method with an atomic absorption spectrometry (AAS) finish. The lower limit of detection is 0.01 g/t Au.
2. **Multi Element Analysis:** Aqua regia digestion with an AAS finish. Lower limits of detection are 0.001% for lead, zinc, and copper, 1 ppm for silver, and 0.01% for iron.

The following sample analysis is undertaken at the ALS Global facilities in Lima, Peru:

1. **Gold Analysis:** Au-AA24. A 50 g fire assay standard fusion method with an AAS finish. The lower limit of detection is 0.005 ppm Au and the upper limit of detection is 10 ppm Au.
2. **Gold Analysis:** Au-AA26. Gold analyses returned from Au-AA24 with a gold value above 10 ppm are re-assayed using a 50 g fire assay standard fusion method with an AAS finish. Upper limit of detection is 100 ppm.
3. **Multi Element Analysis:** ME-ICP61. 33 multi element suite using four acid digestion and inductively coupled plasma atomic emission spectroscopy (ICP-AES) finish. The upper detection limit for lead, zinc, and copper is 1% and 100 ppm for silver.
4. **Multi Element Analysis:** ME-AA62. Samples that return values above the upper limits in ME-ICP61 are re-assayed using ME-AA62. In ME-AA62, four acid digestion with an AAS finish of a 0.4 g sample is used. Lower limits of detection are 0.001% for lead, zinc, and copper, and 1 ppm for silver.
5. **High Grade Zinc Analysis:** Zn-VOL70. Zinc analyses returned from ME-AA62 with a zinc content over 30% are re-analyzed by dissolving in hydrochloric acid and titrated with EDTA solution with Xylenol orange as an indicator.
6. **High Grade Iron Analysis:** Fe-VOL51. Iron analyses returned from ME-ICP61 with iron content over 50% are re-analyzed by dissolving in hydrochloric acid and titration.

RPA is of the opinion that the sample preparation methods are acceptable for the purposes of a Mineral Resource estimate.

SAMPLE CHAIN OF CUSTODY AND CORE STORAGE

Samples are shipped in rice bags by truck to the ALS Global preparation facility in Goiania, Brazil.

Core is stored at Nexa's onsite core storage facility in Aripuanã, the grounds of which are locked at night and surrounded by a high fence. The storage facility is open at the sides and covered with a corrugated metal roof. A core storage map is maintained by onsite technicians. Pulp and coarse rejects are shipped back to the facility by the laboratory where they are also stored with reference to individual sample locations.

DATABASE MANAGEMENT

Database management is performed by a dedicated onsite geologist under the supervision of the Project Geologist. Data are stored centrally on a Microsoft Cloud server in Fusion, a Datamine database product. Previously, digital logging sheets prepared by the geologist were uploaded to the database management system GeoExplo which has now been superceded by Fusion. Prior to digital logging, original drill logs, structural logs, geotechnical logs, details of chain of custody, site reclamation, and drilling information in paper format are stored on site in a folder, specific to a single drill hole. Folders are clearly labelled and stored in a cabinet in the office, which is locked outside of regular office hours.

Assay Certificates are mailed to the site by ALS Global and emailed to Julio Souza Santos, Project Manager, and Thomas Brenner, both Nexa employees. Certificates are reviewed by Julio Cezar Souza Santos prior to uploading information to Fusion.

Access to the Aripuanã database is by registered Fusion users from Nexa. Nexa maintains several user profiles with different access permissions and privileges defined by the Database administrator. The data are updated automatically daily and weekly. Monthly back-ups are run by Tivit following Nexa protocols.

QUALITY ASSURANCE AND CONTROL

Nexa has implemented an analytical quality control and assurance program to ensure the trustworthiness of exploration data. The program comprises the insertion of certified reference material (CRM's or standards), blanks samples, and different types of duplicate samples into the general sample stream. Table 11-1 lists the types of certified reference materials used by Nexa. From 2004 to 2008, three, commercially sourced, certified reference materials (CRMs), representing low, medium, and high-grade zinc and lead were inserted at a rate of 5%. Copper, silver, and gold CRMs were not used. In 2012, two CRMs sourced from Nexa's sedex mine, Morro Agudo (MA), were used on site. In June 2012, two property-specific CRMs were generated and came into use on site. Standards were inserted in the overall sample stream of drill core at a rate of five standards in 100 samples.

Between 2012 and 2018 Nexa utilized five different standards:

- AP series: four certified standards from the Aripuanã Zinc for Zn, Pb, Cu, and Ag
- MA series: two CRMs sourced from Nexa's sedex mine, Morro Agudo (MA) for Zn only and certified by SGS Geosol
- L1, M1, H1: Low, medium and high grade CRMs for Zn and Pb
- G series: two Geostats CRMs for Au
- GB series: one Intertek CRM for Zn, Pb, Cu and Ag

Standards were inserted in the overall sample stream of drill core at a rate of approximately one standard for every 30 drill core samples.

Prior to 2012, blank material was river sand and sandstone sourced from the property. Subsequent to 2012, only coarsely crushed sandstone was used.

Data collected from quality control samples comprise approximately 10% of all assay data. For each batch of 100 samples, Nexa inserts the following quality control samples: five standards, two blanks, one field duplicate, one pulp duplicate, and one reject duplicate. Blanks are inserted in the sample stream at the end of visible mineralization, standards are randomly inserted within mineralized intervals, and pulp and reject duplicates are randomly inserted in both mineralized and unmineralized intervals. Coarse rejects are requested by Nexa from material before it is shipped back from the laboratory to Nexa's storage facility. Half core field duplicates are taken within mineralization.

A number of check assay programs have been conducted between 2007 and the present including:

- 79 check assays by ACME located in Goiânia, Brazil in 2007
- 99 check assays by Intertek laboratories located in Nova Lima, Brazil in 2014
- 573 check assays sent to CTRS located in Nova Lima of which the results are still pending.

TABLE 11-1 CERTIFIED REFERENCE MATERIALS
Nexa Resources S. A. – Aripuanã Zinc Project

CRM	Count 2004 - 2008	Count since 2009	Zn (%)	SD	Pb (%)	SD	Cu (%)	SD	Ag (g/t)	SD	Au (g/t)	SD
AP0001		510 (Zn, Pb, Cu) 179 (Ag)	4.840	0.230	3.010	0.060	0.470	24.000	96.00	2.00	0.660	0.020
AP0002		517 (Zn, Pb, Cu) 185 (Ag)	9.150	0.310	6.150	0.090	1.444	0.059	207.00	6.00	1.120	0.020
APPD0003		779	2.890	0.080	1.090	0.040	1.220	0.020	43.00	1.00	-	-
APPD0004		775	7.710	0.180	4.040	0.070	0.346	0.007	127.00	3.00	-	-
APPD0005		317	1.509	0.043	0.563	0.012	6.830	0.120	58.10	2.30	-	-
G312-4		392 (Zn, Pb, Cu, Ag) 365 (Au)	-	-	-	-	-	-	-	-	5.300	0.220
G909-1		392 (Zn, Pb, Cu, Ag) 381 (Au)	-	-	-	-	-	-	-	-	1.020	0.060
GBM910-12		170	4.491	0.196	-	-	0.140	-	23.50	1.30	-	-
MA002		50	14.220	0.480	1.613	0.038	-	-	1.53	0.16	-	-
MA004		128	2.910	0.110	0.938	0.044	-	-	1.18	0.22	-	-
ZnPbH1*	83	-	7.690	0.180	4.820	0.145	-	-	-	-	-	-
ZnPbL1*	175	-	0.750	0.010	0.470	0.025	-	-	-	-	-	-
ZnPbM1*	161	-	2.830	0.070	0.990	0.045	-	-	-	-	-	-

Notes:
1. SD = standard deviation

A QA/QC report is prepared monthly by the onsite database manager and reviewed by the Project Geologist. The report is also submitted to the head office for review. Sample batches that include samples identified as having failed performance gates are re-assayed by ALS Global at the request of Nexa. The failed control sample, as well as two shoulder samples from each side, are re-assayed and supersede the failed results in the database.

RPA reviewed the sample preparation, analytical, and security protocols employed by Nexa and is of the opinion that they meet or exceed industry best practices. Based on this assessment, RPA is of the opinion that assay data are sufficiently reliable for Mineral Resource estimation purposes.

12 DATA VERIFICATION

DATA VERIFICATION BY NEXA

VALIDATION OF ANGLO AMERICAN DATA

From 1993 to 1997, assays from 56 FEX series drill holes from the Anglo American drilling campaigns at Arex were completed by MMV and Nomos without the insertion of QA/QC samples into the sample stream. In 1997, for verification purposes, core was quartered over lengths of mineralized core and reanalyzed either at the same laboratory or at a secondary laboratory (MMV, Nomos, ACME, or ALS Chemex). For a similar study conducted on samples from Anglo American's Salobo Project in the Carajás mineral province, state of Pará, Brazil, samples assayed at the Nomos laboratory yielded significantly higher copper grades than MMV, however, results obtained from MMV were comparable to results obtained from ACME.

Based on this information, Nexa (then called VMH) adopted the following strategy for the verification of historical data:

1. Nomos assays were only used if MMV assays were not completed.
2. If re-assays were performed at the same laboratory, the lower grade set of results were used.

A summary of the re-analyses is provided in Table 12-1.

TABLE 12-1 SUMMARY OF RE-ANALYSIS
Nexa Resources S.A. – Aripuanã Zinc Project

Laboratory	Number of Drill Holes
Original Analysis	
Nomos	19
MMV	42
ACME	1
Re-analysis	
Nomos	24
MMV	3
Re-analysis with QA/QC	
ACME	11
ALS Chemex	18

VALIDATION OF NEXA DATA

Nexa utilized GeoExplo and Leapfrog Geo's validation features to validate exploration data and identify database issues including:

- Sample length issues;
- Minimum and maximum assay values beyond normal limits;
- Negative values;
- Detection limit / Zero values;
- Borehole deviations;
- Gaps in assay and logging information;
- Overlaps in assay and logging information;
- Discrepancies between drill hole collar versus topography;
- Inconsistent Datum information;
- Discrepancies between laboratory certificates and database entries.

DATA VERIFICATION BY RPA

SITE VISIT

Pursuant to requirements of NI 43-101, RPA conducted site visits to the Aripuana Project on a number of occasions. Ms. Valerie Wilson, P.Geo., RPA Senior Geologist, visited the Project between October 16 and 19, 2012. During this site visit, RPA verified the geology and assay results from holes FPAR339, FPAR273, and FPAR343 to information in VMH's database. Drill hole contacts agreed with the logging results, and grades of zinc, lead, and copper were observed to correlate to sulphide content. Alteration was noted where present.

Mr. Sean Horan, P.Geo., RPA Principal Geologist, visited the Project site between January 30 to February 3, 2017. During the site visit, Mr. Horan reviewed logging and sampling methods, inspected core from drill holes, and held discussions with Nexa personnel. Subsequent to Mr. Horan's site visit, Mr. Jason Cox, P.Eng., RPA Principal Mining Engineer, visited the property between June 2 and 5, 2017. The purpose of Mr. Cox's site visit was to review drill core, discuss project development plans, and review work on the project to date.

DATABASE REVIEW

RPA has reviewed the drill hole database on various occasions. A summary of the data verification steps is given in Table 12-2.

TABLE 12-2 SUMMARY OF RPA AUDITS OF THE RESOURCE DATABASE
Nexa Resources S.A. – Aripuanã Zinc Project

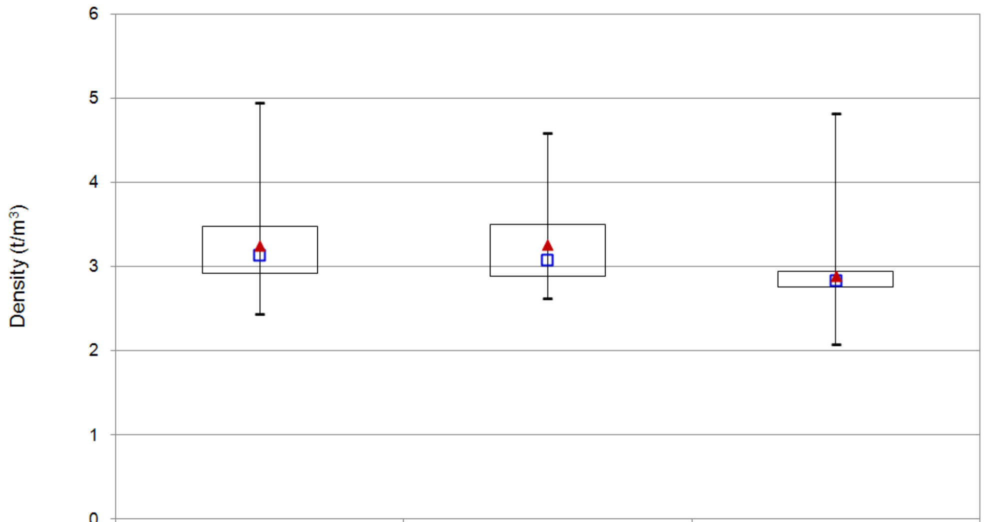
Year	Task	Comments
2012	5% (20 holes) comparison between original logs and digital logs.	Two holes were identified as having errors and were corrected in the database.
	Compared holes FPAR2339, FPAR273 and FPAR343 to assay and litho logs.	Contacts agreed with logging and sulphide content correlated with assays results.
	5% check of assay certificates from ALS.	No major discrepancies found, accidental exclusion of 35% of Ag values due to error in database script.
2015	18% check of assay certificates between 2012 and 2015 from ALS.	No major discrepancies found, Ag scripting issue fixed.
2016	Examined density population for outliers.	Little variance within rock types and density values as expected. Some hydrothermal zone samples report high density values.
	Compared holes BRAPDD0055, BRAPDD0137 and BRAPDD0087 to assay and litho logs.	Contacts agreed with logging and sulphide content correlated with assays results.
2017	>6% check of assay certificates between 2015 and 2016 from ALS.	No major discrepancies found.
2018	Reviewed an error report provided by Nexa and generated by Datamine Studio RM from the database text files	No major discrepancies found.
	Aggregated all assay certificates and compared finalized Cu, Pb, Zn, and Ag values against the database using a routine in Microsoft Excel.	No significant errors found.

RPA is of the opinion that the drill hole database has been maintained to a high standard and is suitable to support Mineral Resource and Mineral Reserve estimation.

DENSITY

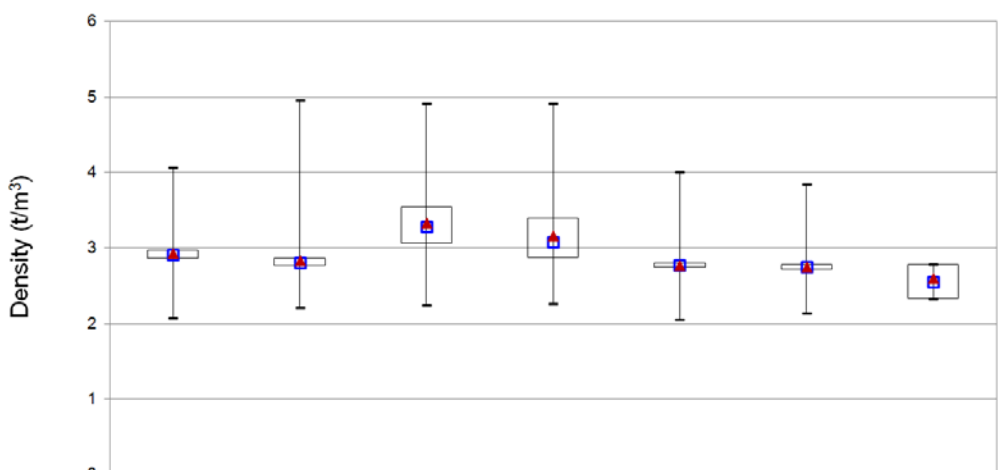
In 2012, RPA compared measured density values by rock unit at Arex and Ambrex. Density values less than two t/m^3 (excluding oxide material) and greater than five t/m^3 were considered outliers based on cumulative distributions and removed from the database. Basic statistics of density data are displayed in Figure 12-1 (Arex) and Figure 12-2 (Ambrex). Samples designated as stratabound mineralization by logging geologists were found to have the highest density both at Arex and Ambrex, followed by stringer mineralization. Little variance exists in any of the other rock units, however, some mineralized hydrothermal zone samples yielded high density values.

FIGURE 12-1 DENSITY MEASUREMENTS AT AMBREX BY ROCK UNIT



	Stratabound	Stringer	Other
Q1	2.92	2.88	2.75
Min	2.43	2.62	2.07
Median	3.13	3.08	2.83
Mean	3.25	3.26	2.88
Max	4.95	4.58	4.82
Q3	3.47	3.50	2.93
NSamples	3463	160	6183

FIGURE 12-2 DENSITY MEASUREMENTS AT AREX BY ROCK UNIT



	Hydrothermal Breccia and Marble	Hydrothermal Zone	Stratabound	Stringer	Volcanics	Sedimentary	Oxide
Q1	2.87	2.77	3.06	2.88	2.75	2.71	2.33
Min	2.07	2.21	2.25	2.26	2.05	2.14	2.33
Median	2.92	2.80	3.28	3.08	2.77	2.75	2.56
Mean	2.94	2.84	3.34	3.17	2.77	2.75	2.61
Max	4.07	4.96	4.91	4.91	4.00	3.85	2.78
Q3	2.97	2.86	3.54	3.39	2.80	2.78	2.78
NSamples	396	4796	1159	1194	3049	539	2

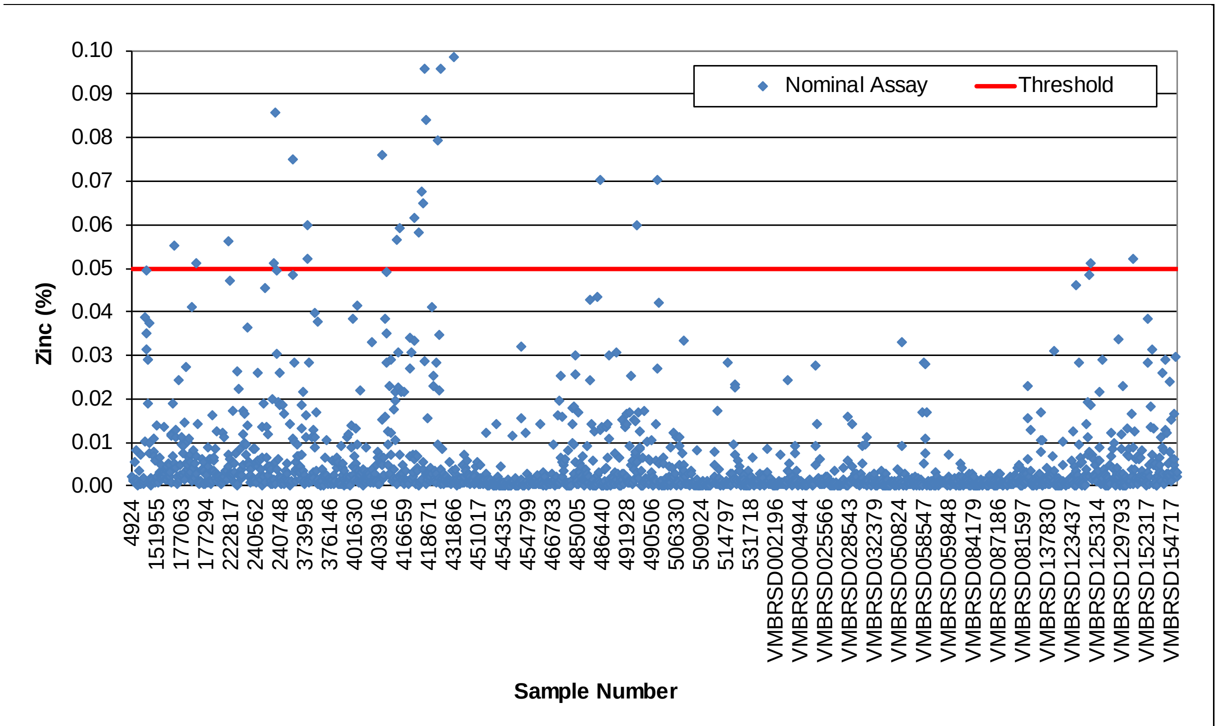
REVIEW OF ANALYTICAL QUALITY CONTROL DATA

RPA reviewed all analytical quality control data from 2004 to 2018; these include the performance data of blank material, certified reference material, as well as those of field, pulp, and coarse reject duplicates. The performance of blank and CRMs was analyzed by charting the data on time series plots. Paired data (field duplicates, pulp duplicates, and coarse reject duplicates) were analyzed using bias charts, quantile-quantile, and relative precision plots.

Normal industry practice for the assessment of the performance of blank samples is to set a failure limit to ten times the detection limit. In the case of the Zn, Pb, and Cu grades of interest, ten times the detection limit is insignificant. While RPA used 20 times the detection limit in the past, Nexa considers five times the practical detection limit of 0.01%, which RPA accepted as equally reasonable in this study.

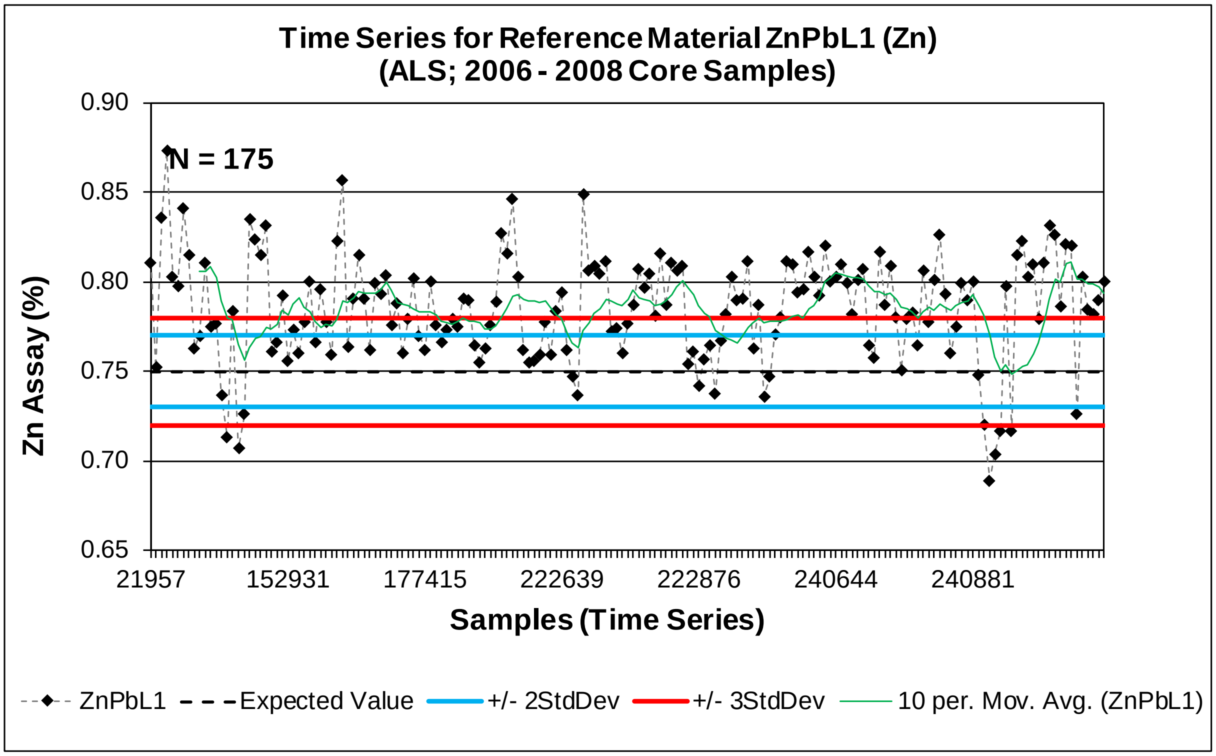
Prior to 2012, blank material was river sand and sandstone sourced from the property. After this date, only sandstone was used, however, Nexa does not distinguish these two materials in their database. The performance of blank samples is generally acceptable, and although Zn analyses yielded 1.8% of all assays above the limit of 0.05% Zn (Figure 12-3), the majority of these failures occurred before 2017. Lead and copper analyses failed in approximately 0.6% and 0.2% of samples, respectively. Based on this analysis, RPA is of the opinion that no systematic contamination of samples occurred during the sample preparation or analysis stages.

FIGURE 12-3 2006 – 2018 RESULTS OF BLANK SAMPLES (ZINC)



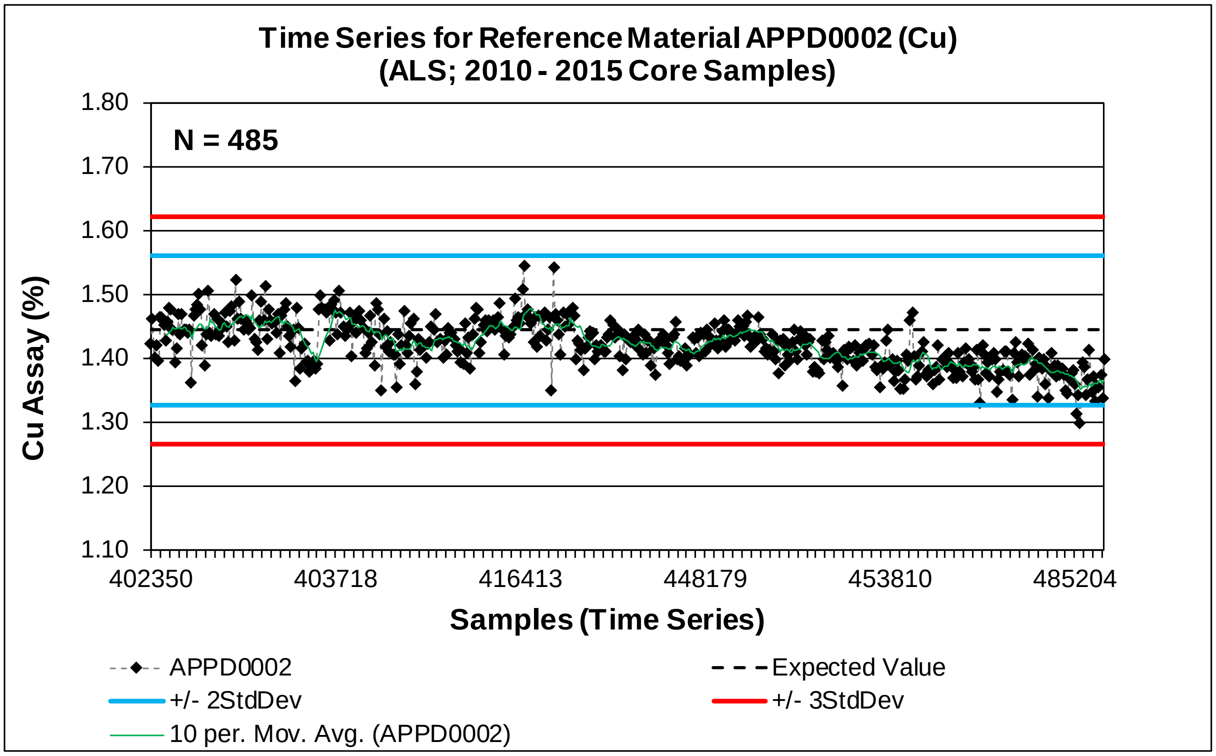
Between 2004 and 2008 Nexa (then called VMH) used a set of three standards with values for lead and zinc. These materials were not commercial or certified and their use was a continuation from Anglo American. Nexa provided RPA with information including "Best Value," standard deviation, and performance gates for these materials. "Best Value" results are typically based on assay results from a single laboratory, and, as a result, only trends, or instrument drift, can be assessed, while a general bias (high or low) and any eventual implications are difficult to assess. Results from materials ZnPbH1 and ZnPbM1 were generally low but typically within three standard deviations of the "Best Value." Lead performed well for material ZnPbL1, however, Zn analyses for the same material were generally high, and approximately 50% of all assays were outside of three standard deviations (Figure 12-4). Due to the low number of samples in the resource database from this time frame, RPA determined that the poor standard performance did not have a meaningful impact on the overall confidence of the mineral resource model supported, in part, by samples collected between 2004 and 2008.

FIGURE 12-4 2006 – 2018 TIME SERIES OF MATERIAL ZNPBL1 (ZINC)



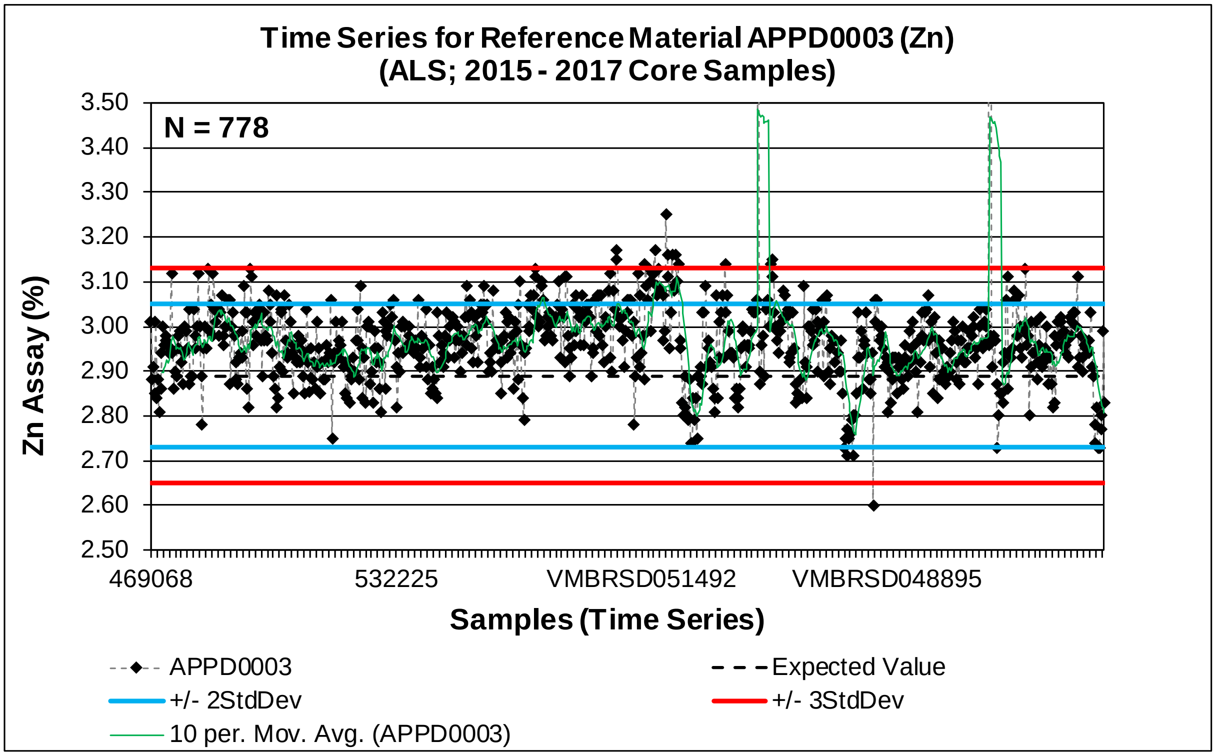
After 2008, Nexa changed to using certified, commercially available materials only. Initially, only CRMs certified for Cu, Pb, and Zn were used. Following a recommendation by RPA in 2012, Nexa added standards for gold in 2015. Between 2010 and 2014 two CRMs were used by Nexa to assess accuracy and precision of Cu, Pb, and Zn analyses. Material APPD001 and APPD002 were sourced from Intertek Group Plc. Both materials are certified for Cu, Pb, and Zn results by ICP-OES. The use of these materials continued into 2015, however, at that time additional CRMs were in use, suggesting that the switch from one set of CRMs to the next did not occur at calendar's year end. A slight positive bias was identified in lead and zinc results of CRM AP0002. Approximately 40% of lead results of AP0002 plotted outside of three standard deviations (3SD). Nine percent of zinc results from CRM AP0001 plotted above 3SD, and consecutive lead samples from AP0001 plotted below 3SD. Over the entire time when both CRM's were in use, a slight trend towards lower assay results can be identified, however, assay results typically stayed within the three standard deviation envelopes (Figure 12-5, graph shown for Cu). In 2012, Nexa added two additional CRMs to the inventory; MA002 and MA004 were provided by SGS Geosol and provided standard values for Cu, Pb, Zn, and Ag for analysis by atomic absorption spectroscopy (AAS). The standards performed well for Pb and Zn; certified Cu values are very low (9.27 g/t and 6.5 g/t for MA-02 and MA-04, respectively). The standards experienced significant scatter well outside of the performance envelope, however, due to the values well below ore-grade material, RPA considers these performance failures as non-material.

FIGURE 12-5 2010 – 2015 TIME SERIES OF MATERIAL APPD0002 (COPPER)



In 2015, Nexa started to use a new set of CRMs. Material APPD0003 and APPD0004 were both sourced from Intertek Group Plc. and provided certified values for Cu, Pb, Zn, and Ag for analysis by inductively coupled plasma – optical emission spectrometry (ICP/OES) and AAS. Copper assays returned values below the expected values for both CRMs, with 8% and 15% of all assays falling below the three standard deviations envelope for materials APPD0003 and APPD0004, respectively. The performance of Pb for APPD0003 is generally acceptable; performance for APPD0004 was low initially but became better with time. Zinc analyses generally performed well for both CRMs (Figure 12-6, APPD0003 shown) with APPD0004 yielding slightly tighter grouped but also slightly biased high results, which nonetheless fell within the three standard deviation envelope. Analysis showed two samples in each CRM with erratic values, likely due to a labelling error. RPA considers the performance of these standards acceptable due to the fact that the main economic elements largely performed well, however, RPA recommends Nexa strengthen its internal QA/QC protocols to ensure fewer failed standards in the future.

FIGURE 12-6 2015 – 2017 TIME SERIES OF MATERIAL APPD0003 (ZINC)



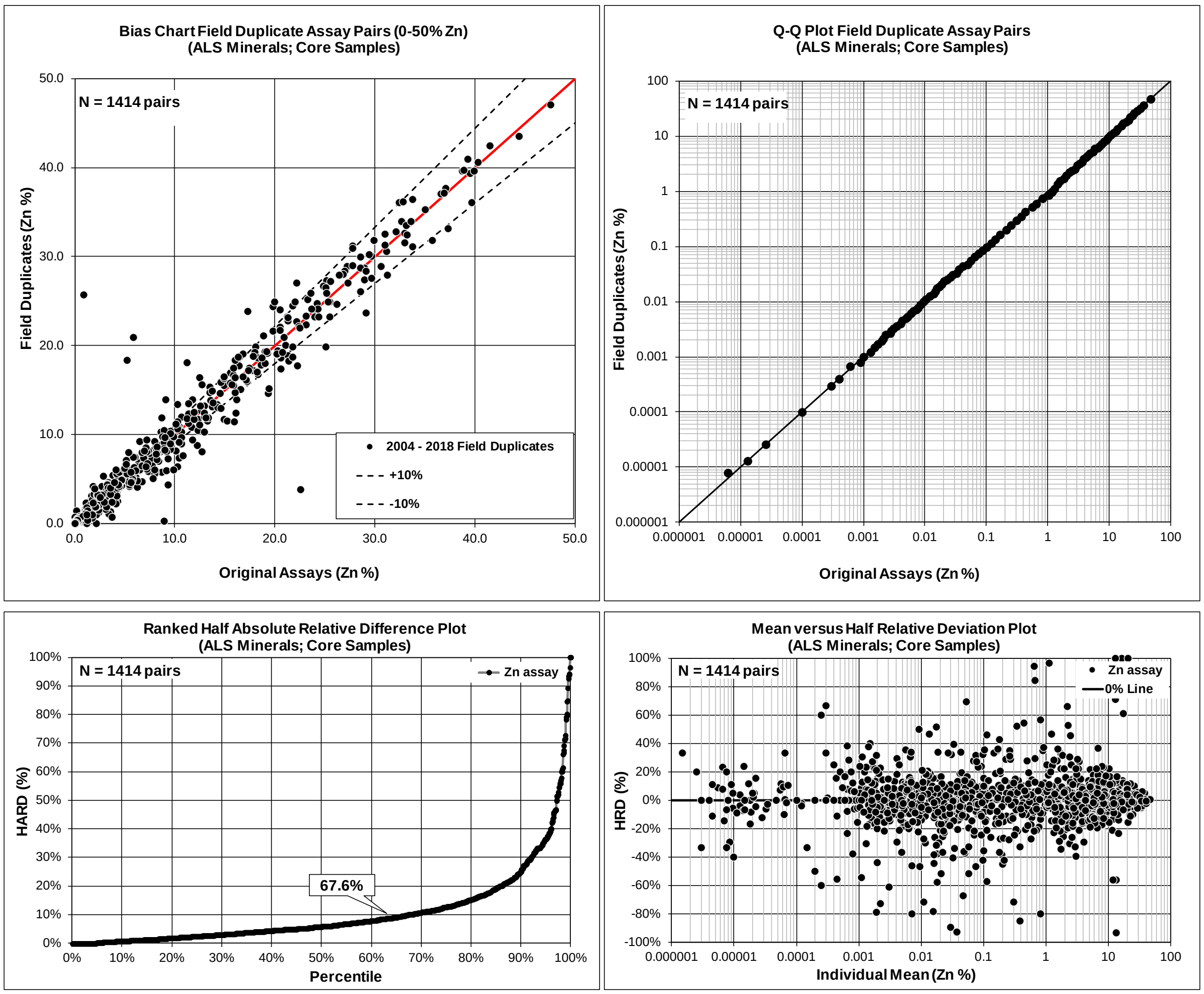
In 2016 and 2017, Nexa introduced CRMs APPD0005 and GMB910-12, respectively. The former CRM is sourced from Intertek Group Plc. and provides certified values for Cu, Pb, Zn, and Ag for analysis by ICP/OES and AAS. Material GBM910-12 is sourced from Geostats Pty. Ltd. and provides certified values, amongst others, for lead and zinc; values for copper are certified, but no standard deviation or confidence interval values are provided.

RPA notes that assays for APPD0005 reported values below the expected value and often below the three standard deviation threshold. Nexa is currently investigating the performance of this standard.

The performance of material GBM910-12 is generally acceptable, however, similar to results obtained from other CRMs, assays are biased low, but typically within a three standard deviation envelope.

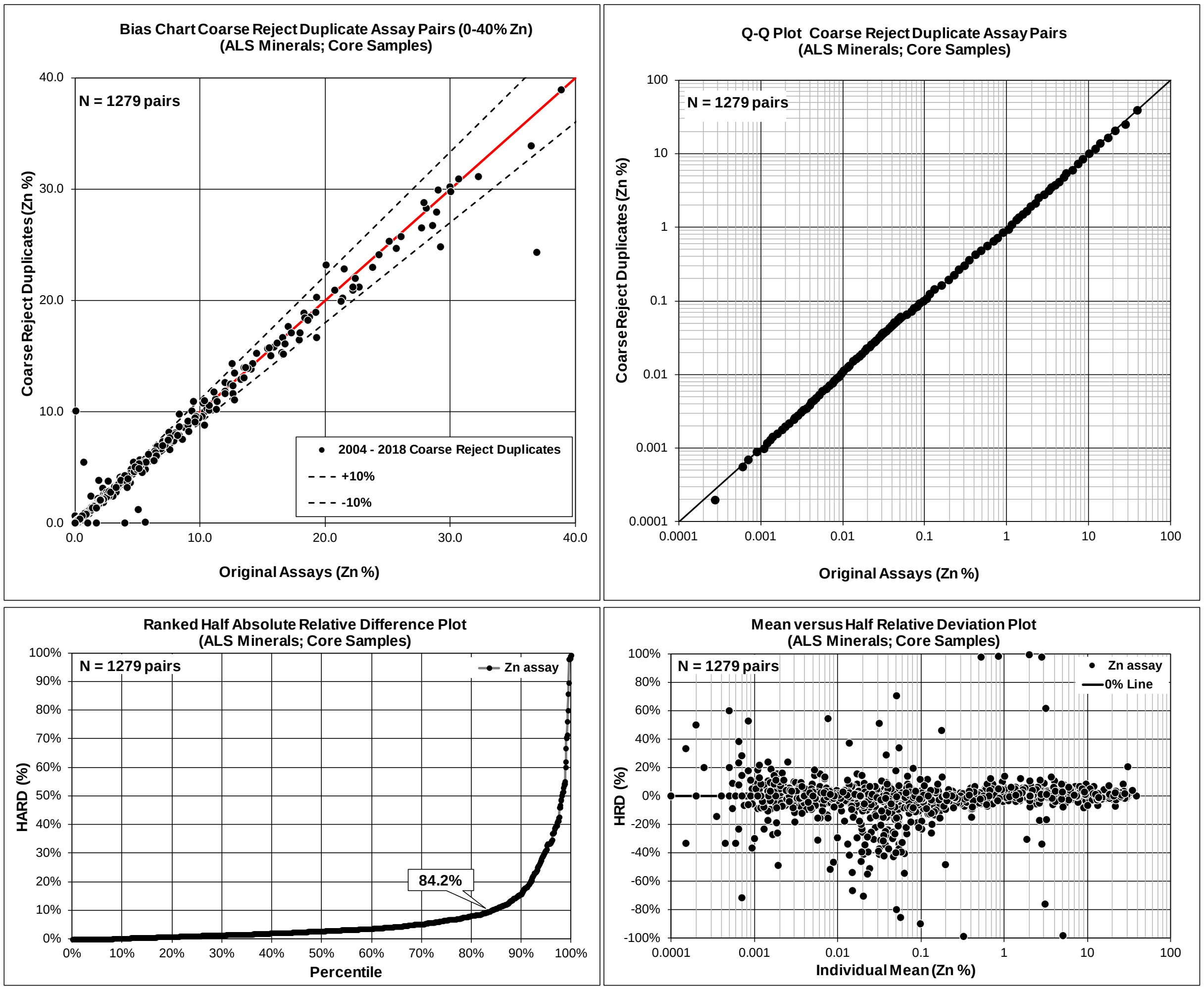
Field duplicate data show no bias but slightly higher than expected variability. Between 55% and 67% of data have a relative difference smaller than 10% (Figure 12-7), which RPA considers to be reasonable.

FIGURE 12-7 ANALYSIS OF FIELD DUPLICATE DATA (ZINC)



Pulp and coarse reject duplicate data show no bias and excellent (Zn and Cu) to good (Pb) correlation between original and duplicate assays (Figure 12-8).

FIGURE 12-8 ANALYSIS OF COARSE REJECT DUPLICATE DATA (ZINC)



Based on the analyses of available analytical quality control data, RPA is of the opinion that exploration data are sufficiently reliable for mineral resource estimation purposes. RPA has identified a number of issues related to the performance of reference material, namely bias (typically low), long-term trends, and the unacceptable performance of CRM APPD0005. RPA recommends stopping the use of CRM APD0005 as the performance issues are clearly related to the CRM itself rather than laboratory performance. A replacement material may have to be selected to cover grade ranges that can be expected at the Aripuanã Project.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

INTRODUCTION

Numerous studies were carried out from 2005 to 2013 for the Aripuanã Zinc Project to identify the best processing option. The evolution of the key studies and the process technologies under consideration were documented (VMH, 2015) and previously reported (RPA, 2017). The optimum processing route was defined through metallurgical test work and it was determined that sequential flotation (Cu-Pb-Zn) presented better economics due to higher recoveries and concentrate grades than bulk flotation into a single concentrate.

Additional test work on drill core from the Aripuanã Zinc Project was conducted by SGS GEOSOL from May 2016 to January 2017 to provide experimental data to support engineering studies. Information on sample validation and additional metallurgical testing has largely been provided by Validaçao das Amostras Selecionadas para Teste Metalurgico (LCASSIS Consultoria em Recursos Minerais (LCASSIS), 2017), the SGS GEOSOL 2017 Report (SGS GEOSOL, 2017), and the Metallurgical Testwork Report (Worley Parsons, 2017a).

Locked cycle test (LCT) work was also conducted in November 2017 by SGS GEOSOL to provide experimental data on the treatment of various types of mineralization, including: Link Stringer, Stringer Global, Link Stratabound, Ambrex Stringer, Ambrex Stratabound, and Strata Global. To the best of RPA's knowledge, this test work program and the results have not been compiled in a final report for review. The final results of the test work were used to define the process route selection.

Pilot studies were undertaken by SGS GEOSOL on Aripuanã mineralization and the results were reported in the 2018 Pilot Study (SGS GEOSOL, 2018).

Metallurgical data obtained from testing were integrated into the FEL3 process design by SNC-Lavalin (SNC-Lavalin, 2018a and 2018b).

METALLURGICAL SAMPLING

Three master composite samples representing the Arex Stratabound, Arex Stringer, and Ambrex Stratabound deposits were prepared from original drill core. These samples were subjected to comminution, flotation, rheology, settling, and filtration bench scale tests, as well as chemical and mineralogical characterization (SGS GEOSOL, 2017).

Shipments of samples for testing included:

- First shipment (May 2016) – 100 kg sample from the Arex body; material was combined to form a composite sample (75% Arex Stratabound, 25% Arex Stringer) for preliminary flotation test work in Phase 1 testing.

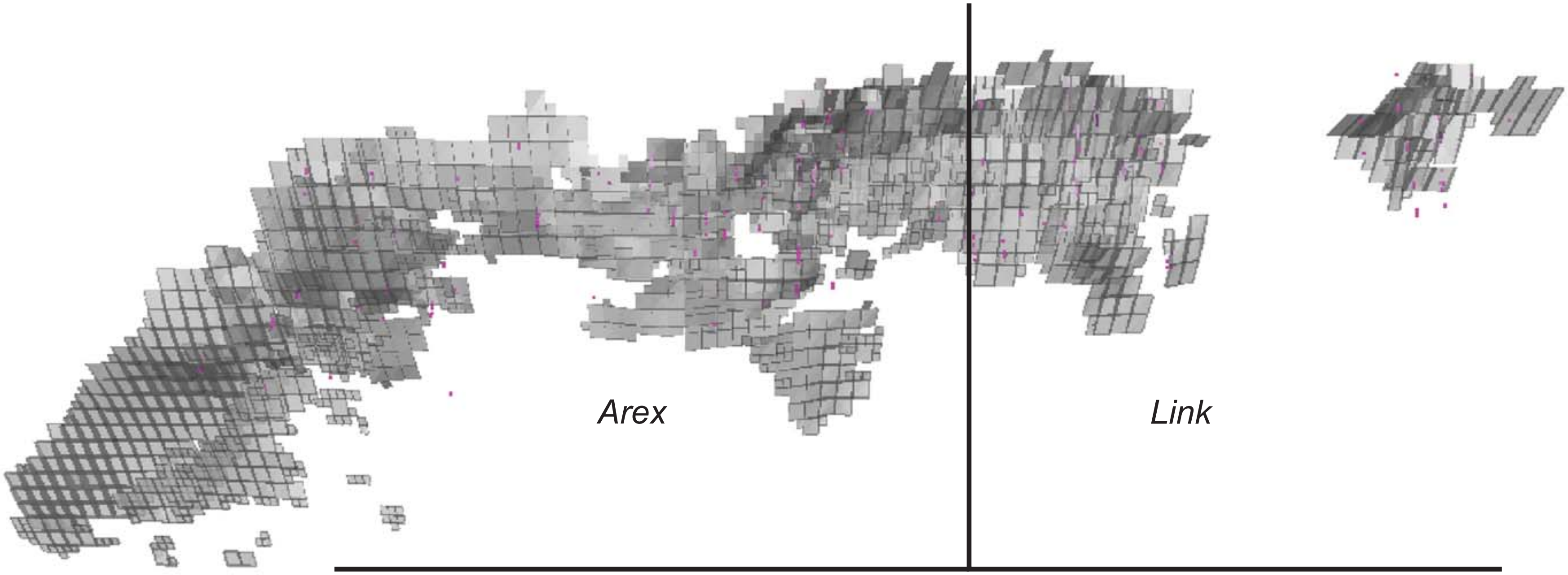
- Second shipment (July 2016) – 550 kg sample; core samples were combined to form three master composites: Arex Stringer, Arex Stratabound, and Ambrex Stratabound, which were used for optimization and definitive flotation tests.

- Variability Samples (July 2016) – 500 kg sample; core samples were combined to form ten Arex Stringer variability samples, ten Arex Stratabound variability samples, and eight Ambrex variability samples.

Detailed sample preparation for comminution was conducted by SGS GEOSOL to generate representative aliquots of material in specific size intervals for different types of tests. The material for comminution testing was sent to SGS Chile, while Bond Ball Mill Grindability testing was conducted at SGS GEOSOL.

Material crushed to 2.0 mm was homogenized and separated into one kilogram sub-samples, which were placed in plastic bags, sealed, and stored in a freezer for flotation test work.

Figures 13-1 and 13-2 illustrate the location of the metallurgical samples selected relative to the Life of Mine (LOM) stopes and the representativeness of sampling in each deposit.



Arex LOM stopes (grey wireframe) and samples selected (pink dots).

Figure 13-1

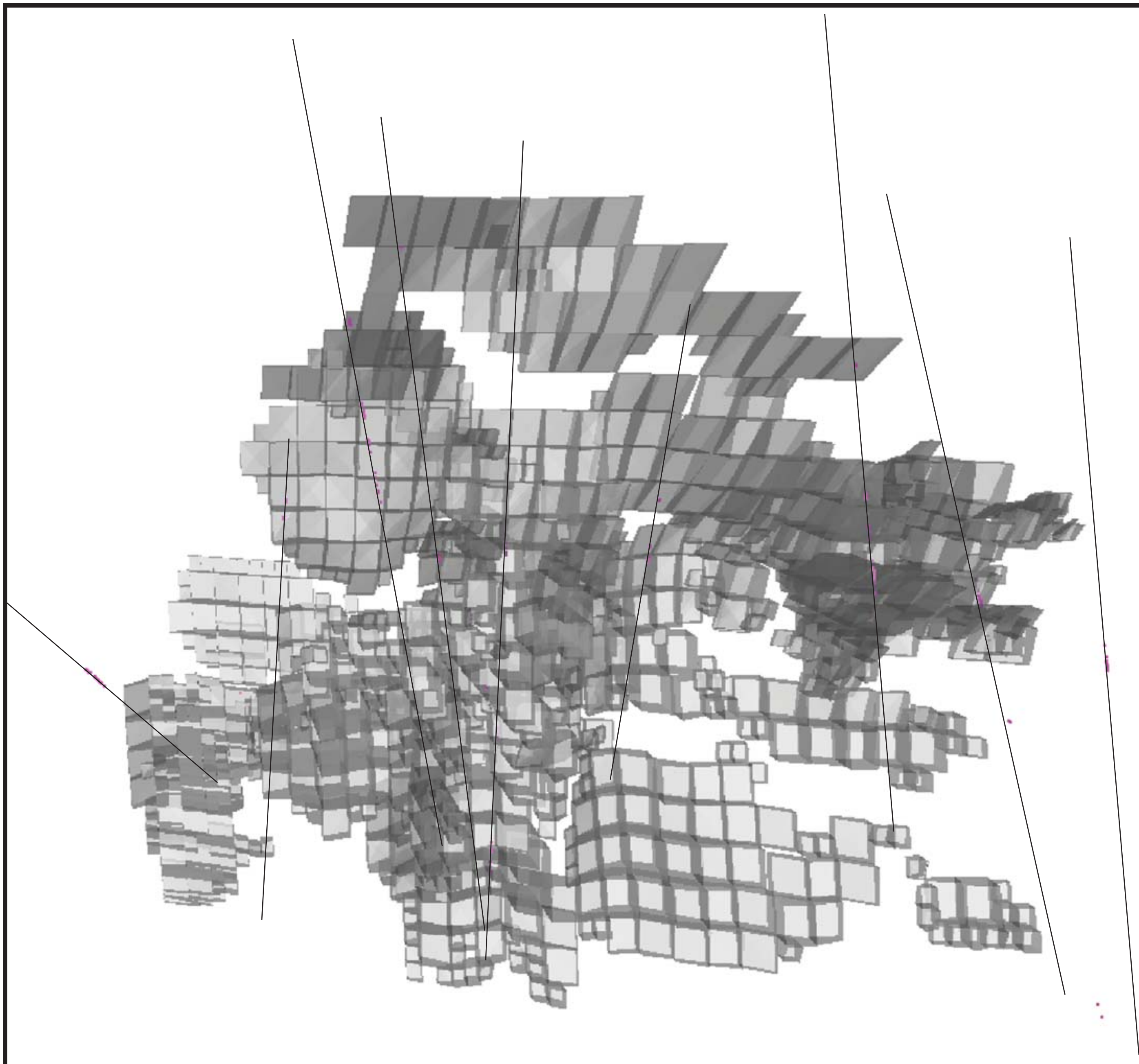
Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Location of 2017 Arex Metallurgical Samples

Source: Votorantim Metais, 2017.



Ambrex LOM stopes (grey wireframe) and samples selected (pink dots).

Figure 13-2

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Location of 2017 Ambrex Metallurgical Samples

October 2018

Source: Votorantim Metais, 2017.

Samples for the 2018 Pilot Study consisted of four samples: Arex and Ambrex Stratabound materials and Arex and Ambrex Stringer materials. These samples were prepared individually and then composites were prepared of Stringer and Stratabound material. RPA was unable to confirm the representativeness of the samples used in the pilot study as the materials were obtained from storage in Aripuanã and the details of the sample source and drill hole location were not provided for review.

METALLURGICAL TESTING

2016 PHASE 1

The 2016 metallurgical test program was carried out in two phases. In Phase 1, a single bulk master composite sample of Arex Stringer and Stratabound mineralization representing both deposits at a ratio of 75% Stratabound to 25% Stringer mineralization was tested. A total of 24 open circuit bench scale flotation tests and two LCTs were conducted using the blended composite sample. The purpose of the testing was to verify the primary grind size (as this has implications for the downstream backfill plant) and to confirm if treating a blended mineralization would result in good metallurgical performance, when compared to treating the materials separately. Information on preliminary flotation test work is presented in detail in Appendix G of the SGS GEOSOL 2017 Report.

Preliminary test results indicated that a sequential flotation circuit with a short talc pre-flotation step followed by talc depression at a coarse primary grind size of P_{80} (80% passing) of 150 µm produced acceptable results (see Table 13-1). The results were as follows:

- Final Cu concentrate: 30.3% Cu, 80.4% recovery.
- Final Pb concentrate: 45.4% Pb, 91.5% recovery (although zinc contamination of the lead concentrate was high).
- Final Zn concentrate: 56.3% Zn, 83.9% recovery

Although parameters were not optimized, circuit conditions were identified for use in the next phase of testing. The overall results from LCT were consistent with previous LCT and the Zn and Pb concentrate quality was higher than previous results. A blended composite of the Arex mineralization resulted in acceptable metallurgical performance in Phase 1 testing.

TABLE 13-1 PHASE 1 - LCT 2 RESULTS

Nexa Resources S.A. – Aripuanã Zinc Project

	Grade (%)						Recovery (%)					
Product	Cu	Fe	MgO	Pb	Zn	S	Cu	Fe	MgO	Pb	Zn	S
Calculated Feed	0.59	15.5	12.1	1.61	3.50	8.40						
Talc Rougher Conc.	0.57	14.9	11.0	1.60	3.80	7.59	9.52	1.43	4.14	1.17	0.70	1.31
Copper Recleaner Conc.	30.3	29.0	0.59	1.50	4.66	33.4	80.43	2.95	0.08	1.39	1.86	6.68
Lead Recleaner Conc.	0.62	12.9	1.88	45.4	11.6	20.8	3.48	2.77	0.55	91.50	9.85	8.84
Zinc Recleaner Conc.	0.20	9.02	0.10	0.44	56.3	35.5	1.99	3.43	0.05	1.57	83.92	26.55
Final Tailings	0.09	15.1	12.2	0.10	0.19	4.91	14.09	90.86	99.32	5.54	4.38	57.93

2016 PHASE 2

In Phase 2 testing, a more comprehensive testing program was undertaken on both blended and individual Arex and Ambrex materials and variability testing was conducted on the different lithologies (SGS GEOSOL, 2017). Test work consisted of comminution, flotation, mineralogy, thickening, filtration, and rheology testing. Bench scale flotation tests were conducted to establish circuit parameters for various mineralization blends, before conducting LCT. A series of LCTs were carried out on each master composite sample and various blends to optimize circuit performance and to evaluate the flowsheet configuration. Information on optimization flotation test work is presented in detail in Appendix H of the SGS GEOSOL 2017 Report. Optimum conditions from development test work were applied to testing various variability samples.

COMMINUTION

A variety of comminution test work was completed, including:

- Crushing Work Index (CWi)
- Semi-Autogenous Grinding (SAG) Mill Comminution (SMC)
- SAG Power Index (SPI)
- Bond Work Index (BWi)
- Bond Abrasion Index (Ai)

Information on comminution test work is presented in detail in Appendix E of the SGS GEOSOL 2017 Report. A brief description of these tests and the results are summarized below.

CWi

The Bond Impact Work Index can be determined from the CWi test and can be used to calculate net power requirements for sizing crushers. Additionally, this index can be used to determine the required open sized settings for jaw crushers and gyratory crushers, or closed sized settings (cone) to achieve a given product size. Table 13-2 summarizes the results of CWi testing. Arex Stringer mineralization is considered to be moderately hard, while Ambrex is classified as soft.

TABLE 13-2 CWI RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample	Maximum Impact Work Index	Minimum Impact Work Index	Average Impact Work Index	Specific gravity
Arex STB	18.47	4.39	9.13	3.31
Arex STR	18.81	4.83	9.32	2.93
Ambrex	10.91	3.87	6.35	3.67

Notes: STB – Stratabound, STR – Stringer

SMC

SMC results are used to determine the drop weight index (DWi), which is a measure of the strength of the rock when broken under impact conditions. The DWi is directly related to the JK rock breakage parameters A and b, which can be used to estimate these parameters. The JKTech Abrasion Test determines the parameter, T_a, which characterizes the resistance of the particles to fracture by abrasion. If the value of T_a is low, then there is a higher resistance to abrasion. The results of SMC testing are summarized in Table 13-3., In RPA's opinion, more SMC testing is necessary to validate comminution sizing.

TABLE 13-3 SMC RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample	DWi (kWh/m^3)	A	b	A x b	SG	T_a
Arex STB	5.83	56.5	0.95	53.7	3.12	0.44
Arex STR	9.42	54.2	0.57	30.9	2.92	0.27
Ambrex	6.86	59.2	0.85	50.3	3.45	0.38

SPI

SPI is a measure of the hardness of an ore from a SAG or autogenous grinding (AG) perspective. The test measures the energy required to perform a standard size reduction. The tests are aimed at determining SAG and ball mill power requirements.

SPI determinations were conducted for all master composite and variability samples (total of 30 samples) and the results are presented in Table 13-4. SGS Chile did not convert SPI minutes into power, therefore SPI values were not used in any comminution simulations. The results did not show a wide variation in hardness within the deposit. Samples were characterized as soft to moderate and the average SPI value for variability samples was 59.6 minutes.

TABLE 13-4 SPI RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample Number	Sample	SPI (minutes)
	Arex Stratabound (STB) Master Composite	47
	Arex Stringer (STR) Master Composite	88
	Ambrex Stratabound (STB) Master Composite	48
1	Arex STB Variability – High Sulphur	44
2	Arex STB Variability – Tremolite	55
3	Arex STB Variability – Pyrrhotite	80
4	Arex STB Variability – High Zinc	68
5	Arex STB Variability – Low Iron	47
6	Arex STB Variability – Low Zinc	52
7	Arex STB Variability – Pyrite	63
8	Arex STB Variability – Talc	39
9	Arex STB Variability – Chlorites	78
10	Arex STB Variability – Carbonates	44
11	Arex STR Variability – Low Iron	66
12	Arex STR Variability –Sulphur	81
13	Arex STR Variability – High Pyrrhotite	71
14	Arex STR Variability – High Gold	79
15	Arex STR Variability – High Pyrite	67
16	Arex STR Variability – High Copper	78
17	Arex STR Variability – Talc	53
18	Arex STR Variability – High Iron	81
19	Arex STR Variability – Low Copper	69
20	Ambrex STB Variability – Low Zinc	46
21	Ambrex STB Variability – Carbonates	40
22	Ambrex STB Variability – Pyrrhotite	62
23	Ambrex STB Variability – Talc	50
24	Ambrex STB Variability – High Zinc	54
25	Ambrex STB Variability – Sulphides	55
26	Ambrex STB Variability – Pyrite	47
27	Ambrex STB Variability – Tremolite	40

BWi

BWi determinations were performed on master composites and all variability samples. A total of 31 BWi determinations were carried out using a closing screen size of 150 µm. Table 13-5 lists the BWi results. No major difference was noted between the master composites and the variability samples. The material is classified as moderate to soft based on the BWi results.

TABLE 13-5 BWI RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample Number	Sample	BWi (kWh/t)
	Arex Stratabound (STB) Master Composite	10.6
	Arex Stringer (STR) Master Composite	12.4
	Arex Mix	12.1
	Ambrex Stratabound (STB) Master Composite	10.8 / 10.3
1	Arex STB Variability – High Sulphur	8.6
2	Arex STB Variability – Tremolite	9.9
3	Arex STB Variability – Pyrrhotite	12.1
4	Arex STB Variability – High Zinc	10.6
5	Arex STB Variability – Low Iron	8.9
6	Arex STB Variability – Low Zinc	11.8
7	Arex STB Variability – Pyrite	10.8
8	Arex STB Variability – Talc	9.9
9	Arex STB Variability – Chlorites	11.2
10	Arex STB Variability – Carbonates	11.8
11	Arex STR Variability – Low Iron	11.9
12	Arex STR Variability –Sulphur	12.4
13	Arex STR Variability – High Pyrrhotite	13.6
14	Arex STR Variability – High Gold	12.7
15	Arex STR Variability – High Pyrite	12.9
16	Arex STR Variability – High Copper	14.2
17	Arex STR Variability – Talc	14.1
18	Arex STR Variability – High Iron	14.6
19	Arex STR Variability – Low Copper	12.9
20	Ambrex STB Variability – Low Zinc	9.5
21	Ambrex STB Variability – Carbonates	9.9
22	Ambrex STB Variability – Pyrrhotite	11.1
23	Ambrex STB Variability – Talc	10.2
24	Ambrex STB Variability – High Zinc	10.3
25	Ambrex STB Variability – Sulphides	10.4
26	Ambrex STB Variability – Pyrite	9.1
27	Ambrex STB Variability – Tremolite	9.6

Ai

Ai can be used to determine steel media and liner wear in crushers, rod mills, and ball mills. The Ai results are summarized in Table 13-6 and the mineralization is moderately abrasive.

TABLE 13-6 AI RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample	Ai
Arex Stratabound Master Composite	0.086
Arex Stringer Master Composite	0.1425
Ambrex Master Composite	0.1448

RWi

RWi can be used to calculate net power requirements of the mill circuit, where the mill operates in closed circuit with a classifier. The RWi results are listed in Table 13-7.

TABLE 13-7 RWI RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

Sample	RWi
Arex Stratabound Master Composite	12.2
Arex Stringer Master Composite	15.4
Ambrex Master Composite	11.2

FLOTATION

Phase 2 flotation testing was conducted using master composite samples of the Arex Stratabound, Arex Stringer, and Ambrex Stratabound mineralization, as well as three Arex blended mineralization with varying ratios of Stratabound to Stringer material (75%:25%, 50%:50%, and 25%:75%). The main objective of this testing phase was to determine the best grade and recovery achievable for each sample under different reagent dosages and flotation times under a sequential flotation scheme (Cu-Pb-Zn). The test program and results were documented in detail by SGS GEOSOL.

A simplified diagram of the sequential flotation process developed is illustrated in Figure 13-3.

The optimization test work determined that the best LCT results in terms of concentrate grades and recoveries achieved were as follows (SGS GEOSOL, 2017):

- Arex Stratabound master composite: LCT 028
- Arex Stringer master composite: LCT 011 and LCT 025 (copper flotation only)
- Arex Mixed (75% Stratabound, 25% Stringer): LCT 030
- Ambrex Stratabound master composite: LCT 029

The results from these tests are summarized in Tables 13-8 to 13-14 and the key findings are as follows:

- Master composites of Arex Stratabound and Ambrex Stratabound mineralization were similar in Zn and Pb feed assays and Zn and Pb flotation recovery, however, the Ambrex sample exhibited low copper concentrate grade and recovery.

- The Arex Stringer master composite sample was high in Cu feed assay and the resulting Cu concentrate was also high in grade and recovery. Zn and Pb concentrate grades and recovery were low, because the feed grades of Zn and Pb were low.

- The Arex Mixed sample (75% Stratabound, 25% Stringer) exhibited the best flotation results:
    - Cu concentrate: 31.3% Cu, 76.9% recovery
    - Pb concentrate: 51.7% Pb, 82.4% recovery
    - Zn concentrate: 52.4% Zn, 83.9% recovery

- Cycles on the majority of LCT were not stabilized, thus an additional campaign of testing is recommended to confirm results. Separate water systems are recommended for the flotation circuits, since many of the LCTs did not achieve equilibrium.

- Flotation columns are preferred and widely accepted in industry for use in the final cleaning stage, however, column flotation testing has not been carried out at the bench scale.

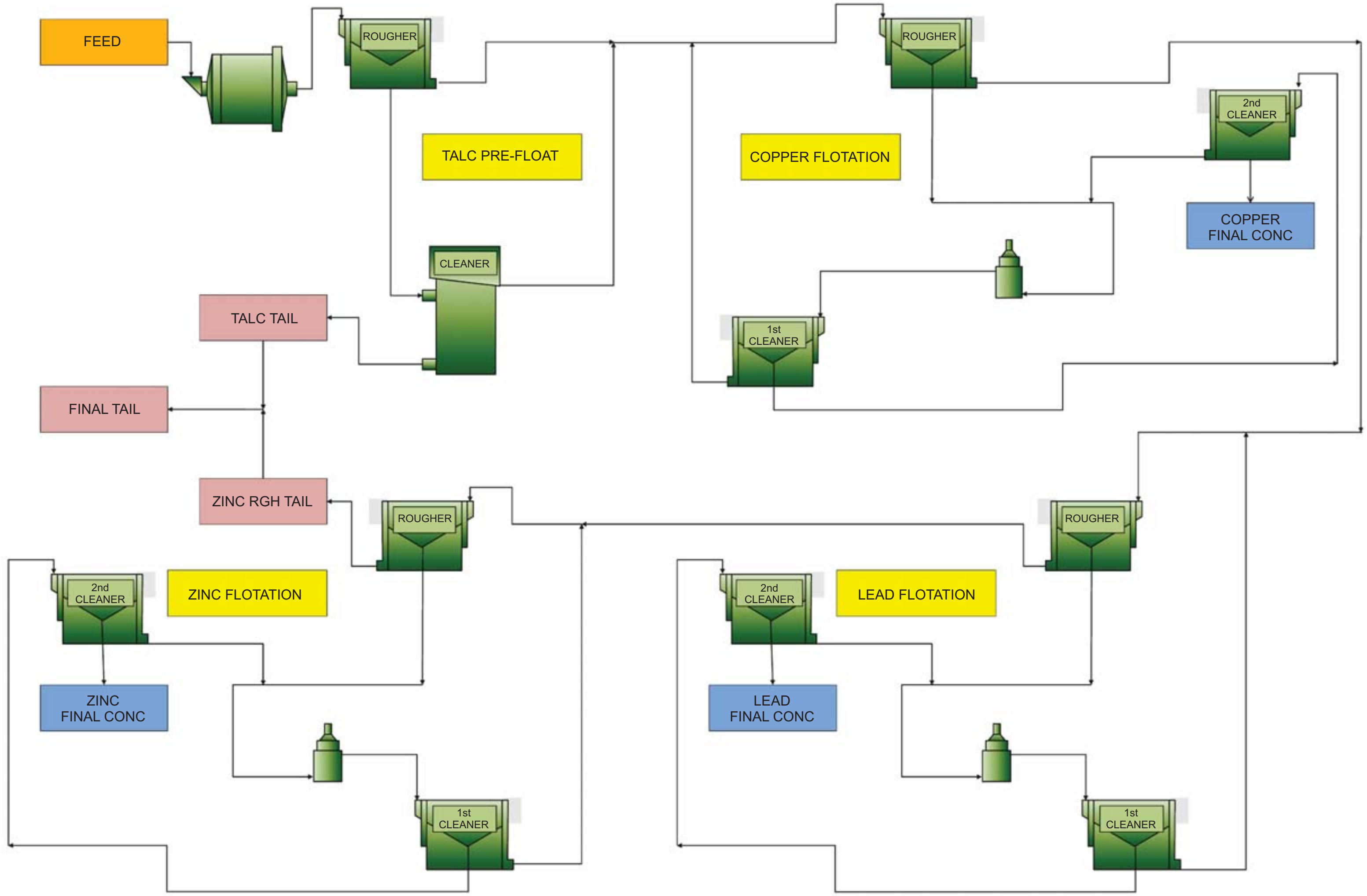


Figure 13-3

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Simplified Sequential Flotation Circuit

October 2018

Source: Votorantim Metais, 2017.

TABLE 13-8 SUMMARY OF KEY OPTIMIZATION LCT RESULTS
Nexa Resources S.A. – Aripuanã Zinc Project

	Grade							Distribution							
	Cu %	Pb %	Zn %	Mg %	Fe %	Au ppm	Ag ppm	Wt. %	Cu %	Pb %	Zn %	Mg %	Fe %	Au %	Ag %
LCT 028 – Arex Stratabound Master Composite															
Calculated feed	0.33	1.53	4.51	7.03	12.9	0.20	33.7	100	100	100	100	100	100	100	100
Talc tail	0.04	0.73	2.30	11.6	8.21			17.5	2.11	8.36	8.92	28.9	11.1		
Cu final conc.	26.7	3.63	7.16	0.79	31.7	11.3	1,068	0.86	69.5	2.05	1.37	0.10	2.11	49.7	27.2
Pb final conc.	0.81	60.6	8.39	0.54	5.89	1.53	852	2.01	4.92	79.8	3.74	0.15	0.92	15.6	50.7
Zn final conc.	0.26	0.54	48.6	0.98	9.38	0.24	40.0	7.64	6.01	2.70	82.5	1.06	5.55	9.34	9.06
Rougher tail	0.08	0.15	0.22	6.81	14.4			72.0	17.4	7.08	3.5	69.8	80.3		
LCT 011 – Arex Stringer Master Composite															
Calculated feed	1.02	0.18	0.24	2.62	11.2	0.5	12.5	100	100	100	100	100	100	100	100
Talc tail	Due to the low content of talc in feed, talc flotation was excluded from LCT circuit in this test														
Cu final conc.	25.4	2.68	4.45	0.43	33.1	13.5	253	3.85	95.7	55.8	71.8	0.64	11.4	93.3	77.7
Pb final conc.	1.93	10.7	3.85	1.69	31.7	4.65	210	0.67	1.26	38.6	10.8	0.43	1.89	6.3	11.2
Zn final conc.	0.46	0.20	4.89	3.80	17.5	0.31	12.0	0.48	0.21	0.50	9.5	0.67	0.72	0.29	0.44
Rougher tail	0.03	0.01	0.02	2.71	10.1			95.0	2.79	5.14	7.97	98.3	86.0		
LCT 025 – Arex Stringer Master Composite (copper flotation only)															
Calculated feed	1.02	0.19	0.26	2.34	11.2	0.49	12.5	100	100	100	100	100	100	100	100
Talc tail	Due to the low content of talc in feed, talc flotation was excluded from LCT circuit in this test														
Cu final conc.	26.7	1.84	2.63	0.54	36.2	13.8	252	3.73	98.1	35.4	37.5	0.87	12.1	93	75.1
Pb final conc.	Due to the low content of lead in feed, lead flotation excluded from LCT circuit in this test														
Zn final conc.	Due to the low content of zinc in feed, zinc flotation excluded from LCT circuit in this test														
Rougher tail	0.02	0.13	0.17	2.41	10.2			96.3	1.89	64.6	62.5	99.1	87.9		

	Grade							Distribution							
	Cu %	Pb %	Zn %	Mg %	Fe %	Au ppm	Ag ppm	Wt. %	Cu %	Pb %	Zn %	Mg %	Fe %	Au %	Ag %
LCT 030 – Arex Mixed (75% Stratabound, 25% Stringer)															
Calculated feed	0.45	1.34	3.56	5.90	12.2	0.27	28.4	100	100	100	100	100	100	100	100
Talc tail	0.06	0.64	1.56	11.8	8.28			13.1	1.75	6.22	5.73	26.1	8.88		
Cu final conc.	31.3	1.14	3.45	0.28	35.2	14.4	660	1.10	76.9	0.93	1.06	0.05	3.17	58.4	25.5
Pb final conc.	1.45	51.7	10.4	0.49	12.0	2.8	741	2.14	6.95	82.4	6.26	0.18	2.11	22.0	55.8
Zn final conc.	0.31	0.81	52.4	0.66	9.65	0.3	44.0	5.69	3.95	3.43	83.9	0.63	4.51	6.32	8.81
Rougher tail	0.06	0.12	0.14	5.52	12.7			78.0	10.5	6.97	3.1	73.1	81.3		
LCT 009 – Ambrex Stratabound Master Composite															
Calculated feed	0.08	1.89	4.36	5.38	17.0	0.18	36.7	100	100	100	100	100	100	100	100
Talc tail	0.02	1.06	2.36	11.6	9.65			5.58	1.38	3.13	3.02	12.0	3.17		
Cu final conc.	4.54	3.38	2.49	12.0	10.9	6.76	1,117	1.05	58.9	1.88	0.60	2.34	0.67	38.9	32.0
Pb final conc.	0.18	43.9	6.50	0.65	20.0	0.61	446	3.62	8.05	84.0	5.40	0.43	4.27	12.1	44.0
Zn final conc.	0.13	0.61	53.9	0.13	11.3	0.30	43.0	7.02	11.3	2.26	86.8	0.17	4.67	11.6	8.23
Rougher tail	0.02	0.20	0.22	5.54	17.9			82.7	20.4	8.74	4.2	85.1	87.2		
LCT 029 – Ambrex Stratabound Master Composite															
Calculated feed	0.07	1.64	4.39	5.11	20.5	0.18	36.7	100	100	100	100	100	100	100	100
Talc tail	0.02	1.05	2.51	11.8	11.6			13.1	4.01	8.40	7.50	30.2	7.43		
Cu final conc.	24.6	3.13	8.58	0.52	28.3	57.4	3,328	0.11	40.3	0.20	0.21	0.01	0.15	33.7	9.72
Pb final conc.	0.30	40.8	6.12	0.33	24.6	1.83	466	3.01	13.8	74.9	4.19	0.19	3.61	30.2	38.3
Zn final conc.	0.15	0.90	45.3	0.52	14.5	0.39	52.0	8.21	18.8	4.51	84.7	0.84	5.81	17.6	11.6
Rougher tail	0.02	0.26	0.20	4.65	22.5			75.6	23.1	12.0	3.44	68.8	83.0		

TABLE 13-9 LCT 028 CONDITIONS AND RESULTS– AREX STRATABOUND MASTER COMPOSITE

Nexa Resources S.A. – Aripuanã Zinc Project

AREX STRATABOUND										
LCT 028 - SEQUENTIAL CIRCUIT										
FINAL CONCENTRATE - MASS BALANCED										
GRADE		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER		26,7	3,63	7,16	0,79	29,2	30,3	1,61	11,3	1068
LEAD		0,81	60,7	8,39	0,54	5,9	18,5	1,05	1,53	852
ZINC		0,26	0,54	48,6	0,98	9,4	32,8	2,11	0,24	40
RECOVERY		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER		77,7	1,94	1,37	0,09	2,0	3,5	0,07	49,7	27,2
LEAD		5,51	75,9	3,75	0,15	1,0	5,0	0,10	15,6	50,7
ZINC		6,72	2,57	82,7	1,03	5,8	33,9	0,76	9,34	9,1
TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm³	LIME gpt	pH	TIME min
TALC ROUGHER										
400	0	0	0	0	0	0	12,7	0	6,5	2
TALC CLEANER										
0	200	0	20	0	0	0	12,7	0	7,6	ESG
COPPER ROUGHER										
300	100	300	30	0	0	0	12,7	0	6,5	7
COPPER CLEANER										
50	30	75	10	0	0	0	12,7	275	11,5	1,5
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	7,5	11,5	0:45
LEAD ROUGHER										
150	50	300	0	17,5	0	0	12,7	125	9,52	7
LEAD CLEANER										
75	0	75	0	6	0	0	12,7	120	11	3
LEAD RECLEANER										
0	0	0	0	0	0	0	12,7	10	11	2,5
ZINC ROUGHER										
0	0	0	0	0	600	32,5	12,7	600	11	12
ZINC CLEANER										
0	0	0	0	0	300	7,5	12,7	125	11	4,5
ZINC RECLEANER										
0	0	0	0	0	0	0	12,7	15	11	3

TABLE 13-10 LCT 011 CONDITIONS AND RESULTS– AREX STRINGER MASTER COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

AREX STRINGER										
LCT 011 - SEQUENTIAL CIRCUIT										
FINAL CONCENTRATE - MASS BALANCED										
GRADE		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER		23,0	2,87	4,93	0,43	32,0	34,4	1,41	13,5	253
LEAD		1,93	10,7	4,16	1,69	31,4	30,4	7,32	4,65	210
ZINC		0,46	0,21	4,90	3,80	17,5	8,0	19,30	0,31	12,0
RECOVERY		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER		98,5	66,6	72,1	0,64	10,7	55,3	0,18	93,3	77,7
LEAD		1,40	36,6	10,6	0,43	1,8	8,5	0,16	6,30	11,2
ZINC		0,23	0,50	8,7	0,67	0,7	1,6	0,30	0,29	0,44
TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm^3	LIME gpt	pH	TIME min
TALC ROUGHER										
0	0	0	0	0	0	0	0	0	nat	0
TALC CLEANER										
0	0	0	0	0	0	0	0	0	0	0
COPPER ROUGHER										
400	100	300	35	0	0	0	12,7	0	5,6	6
COPPER CLEANER										
100	30	75	10	0	0	0	12,7	375	11,5	3
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	30	11,5	2
LEAD ROUGHER										
0	50	200	0	10	0	0	12,7	0	8,08	9
LEAD CLEANER										
75	0	50	0	10	0	0	12,7	175	10,99	3
LEAD RECLEANER										
0	0	0	0	0	0	0	12,7	0	11	2
ZINC ROUGHER										
0	0	0	0	0	400	25	12,7	325	11	12
ZINC CLEANER										
0	0	0	0	0	300	10	12,7	100	11	4
ZINC RECLEANER										
0	0	0	0	0	0	0	12,7	10	11	2

TABLE 13-11 LCT 025 CONDITIONS AND RESULTS– AREX STRINGER MASTER COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

AREX STRINGER										
LCT 025 - SEQUENTIAL CIRCUIT										
FINAL CONCENTRATE - MASS BALANCED										
GRADE		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER		25,1	1,80	2,51	0,70	34,9	1,5	29,7	13,8	252
LEAD		LEAD FLOTATION EXCLUDED FROM THE LCT CIRCUIT IN THIS TEST								
ZINC		ZINC FLOTATION EXCLUDED FROM THE LCT CIRCUIT IN THIS TEST								
RECOVERY		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER		98,1	32,9	34,2	0,99	10,8	55,9	99,8	93,0	75,1
LEAD		LEAD FLOTATION EXCLUDED FROM THE LCT CIRCUIT IN THIS TEST								
ZINC		ZINC FLOTATION EXCLUDED FROM THE LCT CIRCUIT IN THIS TEST								
TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm³	LIME gpt	pH	TIME min
TALC ROUGHER										
0	0	0	0	0	0	0	0	0	0	0
TALC CLEANER										
0	0	0	0	0	0	0	0	0	0	0
COPPER ROUGHER										
400	100	300	20	0	0	0	12,7	0	8,3	6
COPPER CLEANER										
200	50	300	6	0	0	0	12,7	300	11,6	3
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,5	2
LEAD ROUGHER										
0	0	0	0	0	0	0	0	0	0	0
LEAD CLEANER										
0	0	0	0	0	0	0	0	0	0	0
LEAD RECLEANER										
0	0	0	0	0	0	0	0	0	0	0
ZINC ROUGHER										
0	0	0	0	0	0	0	0	0	0	0
ZINC CLEANER										
0	0	0	0	0	0	0	0	0	0	0
ZINC RECLEANER										
0	0	0	0	0	0	0	0	0	0	0

TABLE 13-12 LCT 030 CONDITIONS AND RESULTS– AREX MIX (75% STRATABOUND, 25% STRINGER)
Nexa Resources S.A. – Aripuanã Zinc Project

AREX 75% STRATABOUND 25% STRINGER										
LCT 030 - SEQUENTIAL CIRCUIT										
FINAL CONCENTRATE - MASS BALANCED										
GRADE		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER		31,3	1,14	3,45	0,28	31,8	30,9	0,69	14,4	660
LEAD		1,45	60,7	10,4	0,49	12,3	21,9	1,17	2,78	741
ZINC		0,31	0,81	51,4	0,66	9,8	33,6	1,50	0,30	44
RECOVERY		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER		78,6	0,97	1,11	0,05	2,78	5,93	0,03	58,4	25,5
LEAD		6,77	82,4	6,38	0,17	2,05	8,01	0,10	22,0	55,8
ZINC		3,85	3,50	84,0	0,59	4,35	32,8	0,36	6,32	6,80
TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm^{3}	LIME gpt	pH	TIME min
TALC ROUGHER										
400	0	0	0	0	0	0	12,7	0	6,8	2
TALC CLEANER										
0	300	0	10	0	0	0	12,7	0	8	esg
COPPER ROUGHER										
200	50	200	7,5	0	0	0	12,7	0	7,1	5
COPPER CLEANER										
50	30	25	7,5	0	0	0	12,7	0	11,6	1
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,5	0,5
LEAD ROUGHER										
200	50	300	0	22,5	0	0	12,7	0	9,71	9
LEAD CLEANER										
50	30	75	0	10	0	0	12,7	0	11,03	2
LEAD RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,1	45 s
ZINC ROUGHER										
0	50	0	0	0	300	32,5	12,7	0	11,2	12
ZINC CLEANER										
0	0	0	0	0	200	10	12,7	0	11,5	4
ZINC RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,5	2

TABLE 13-13 LCT 009 CONDITIONS AND RESULTS– AMBREX STRATABOUND MASTER COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

AMBREX STRATABOUND										
LCT 009 - SEQUENTIAL CIRCUIT										
FINAL CONCENTRATE - MASS BALANCED										
GRADE		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER		4,54	3,38	2,49	12,0	10,9	8,89	19,2	6,76	1117
LEAD		0,18	44,9	6,60	0,64	19,0	26,7	1,10	0,61	446
ZINC		0,13	0,61	54,0	0,13	11,0	32,7	0,48	0,30	43
RECOVERY		Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER		68,9	1,74	0,56	2,10	0,62	0,67	1,22	35,2	28,9
LEAD		9,35	81,5	5,16	0,40	3,81	7,05	0,25	11,2	40,7
ZINC		12,6	2,11	81,6	0,15	4,18	16,4	0,21	10,5	7,47
TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm^3	LIME gpt	pH	TIME min
TALC ROUGHER										
400	0	0	0	0	0	0	12,7	0	7,4	0,5
TALC CLEANER										
0	200	0	20	0	0	0	12,7	0	8,1	esg
COPPER ROUGHER										
200	50	0	12,5	0	0	0	12,7	0	11,5	9
COPPER CLEANER										
50	30	25	15	0	0	0	12,7	250	11,5	1
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	20	11,5	0,5
LEAD ROUGHER										
200	50	300	0	15	0	0	12,7	5	8,24	9
LEAD CLEANER										
50	0	50	0	10	0	0	12,7	225	11,2	2
LEAD RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,03	1
ZINC ROUGHER										
0	0	0	0	0	300	32,5	12,7	375	11,1	12
ZINC CLEANER										
0	0	0	0	0	200	10	12,7	175	11,6	4
ZINC RECLEANER										
0	0	0	0	0	0	0	12,7	65	11,5	2

TABLE 13-14 LCT 029 CONDITIONS AND RESULTS– AMBREX STRATABOUND MASTER COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA AMBREX STRATABOUND LCT 029 - SEQUENTIAL CIRCUIT									
FINAL CONCENTRATE									
GRADE	Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au ppm	Ag ppm
COPPER	24,6	3,13	8,58	0,52	28,3	31,5	1,12	57,4	3328
LEAD	0,30	40,8	6,12	0,33	24,6	32,1	0,79	1,83	466
ZINC	0,15	0,90	45,3	0,52	14,5	34,5	1,12	0,39	52,0
RECOVERY	Cu %	Pb %	Zn %	Mg %	Fe %	S %	Si %	Au %	Ag %
COPPER	40,3	0,20	0,21	0,01	0,15	0,21	0,01	33,7	9,72
LEAD	13,8	74,9	4,19	0,19	3,61	5,97	0,15	30,2	38,3
ZINC	18,8	4,51	84,7	0,84	5,81	17,5	0,56	17,6	11,6

TEST CONDITIONS										
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	MIBC gpm³	LIME gpt	pH	TIME min
TALC ROUGHER										
400	0	0	0	0	0	0	12,7	0	6,9	2
TALC CLEANER										
0	300	0	10	0	0	0	12,7	0	8	2
COPPER ROUGHER										
200	50	200	7,5	0	0	0	12,7	0	7,1	5
COPPER CLEANER										
50	30	25	7,5	0	0	0	12,7	45	11,6	1
COPPER RECLEANER										
0	0	0	0	0	0	0	12,7	0	11,5	0,5
LEAD ROUGHER										
200	50	300	0	22,5	0	0	12,7	100	9,71	9
LEAD CLEANER										
50	30	75	0	10	0	0	12,7	125	11,03	2
LEAD RECLEANER										
0	0	0	0	0	0	0	12,7	10	11	45 s
ZINC ROUGHER										
0	50	0	0	0	300	32,5	12,7	375	11,2	12
ZINC CLEANER										
0	0	0	0	0	200	10	12,7	225	11,5	4
ZINC RECLEANER										
0	0	0	0	0	0	0	12,7	50	11,5	2

The metallurgical recoveries referenced by SNC-Lavalin in the process design criteria (PDC) for the FS appear to be consistent with those calculated based on test work:

- Copper recovery (Stringer) = 86.9%
- Copper recovery (Stratabound) = 67.5%
- Lead recovery (Stratabound) = 85.9%
- Zinc recovery (Stratabound) = 89.4%

The LOM economics were developed using relationships between head grade, concentrate grade, and recovery that were established based on the LCTs. The relationship between concentrate grade divided by the head grade is known as the enrichment ratio (Er), which is a function of the mass pull to the concentrate. In general, the recovery is stated as a relationship to head grade.

Not all of the LCTs achieved equilibrium. Due to the low correlations between head grade and recovery in the LCTs, it was determed that the Er ratio would be used where applicable for recovery, and pilot plant results would be used in other cases. Nexa determined that the pilot results better reflected recovery for Stratabound zinc, however, RPA is of the opinion that selected optimized LCTs should be used to determine flotation retention time for design purposes. If concentrates with grades lower than those achieved during test work can be marketed, the metallurgical recoveries used in the cash flow model are:

- Copper recovery (Stringer) = 102.2014 – (0.4471 x Er), based on LCTs and with LOM Er of 34.
- Copper recovery (Stratabound) = 67.5% based on test work.
- Lead recovery (Stratabound) = $exp\left[0.0608 * \ln\left(1 - \frac{E_r}{79.31}\right) + 4.4801\right] + 0.1$, based on LCTs and LOM Er of 29.3
- Zinc recovery (Stratabound) = 89.4% based the pilot test work.

Based on a review of available metallurgical data, elevated levels of fluorine have been found in some of the concentrates. RPA is of the opinion that concentrate blending will result in final concentrates which contain acceptable levels of deleterious elements.

Optimum conditions from development test work were applied to flotation testing of different variability samples. Each variability sample was subjected to Cu, Pb, and Zn flotation via an open cleaner circuit (same configuration used for LCT, except that there was no recirculation of cleaner and recleaner tailings). Talc flotation was only performed on samples from Arex Stratabound or Ambrex Stratabound mineralization.

The results from variability flotation testing are presented in detail in Appendix I of the SGS GEOSOL 2017 Report. Figures 13-4 and 13-5 illustrate the variation of metal assays in the flotation products. There are large variations in metal assay and metal distribution to the talc tail and recleaner concentrates. In the cases where the variation was negative, the results for the variability sample were below the result obtained for the respective master composite with the exception of zinc reported in the zinc recleaner concentrate.

SETTLING, RHEOLOGY, AND FILTRATION

Settling and rheology test work on feed samples from master composites of the Arex and Ambrex individual materials and the Arex Mixed material was conducted at SGS Chile. Details of the test work program are presented in Appendix J of the SGS GEOSOL 2017 Report. The best settling results were obtained using 3 g/t of the BASF Magnafloc 10 flocculant (see Table 13-15). Rheology test work on the products from settling tests was also conducted using a Hake 550 viscometer (Figures 13-6 and 13-7).

TABLE 13-15 SUMMARY OF SETTLING TESTS USING MAGNAFLOC 10 FLOCCULANT (3 G/T)
Nexa Resources S.A. – Aripuanã Zinc Project

Parameter	Arex Stratabound	Arex Stringer	Arex Mixed (75% Stratabound, 25% Stringer)	Ambrex Stratabound
Initial % solids	18	18	18	18
% solids after sedimentation	65	66	66	67
Settling velocity (mm/s)	1.5	2	2	2
Unit area (m^2/tph)	0.7	0.5	0.5	0.6
Yield point no shear (PA)	52	29	42	41
Yield point full shear (PA)	1.7	0.6	2.3	2.3

FIGURE 13-4 VARIATION OF METAL ASSAYS IN FLOTATION PRODUCTS

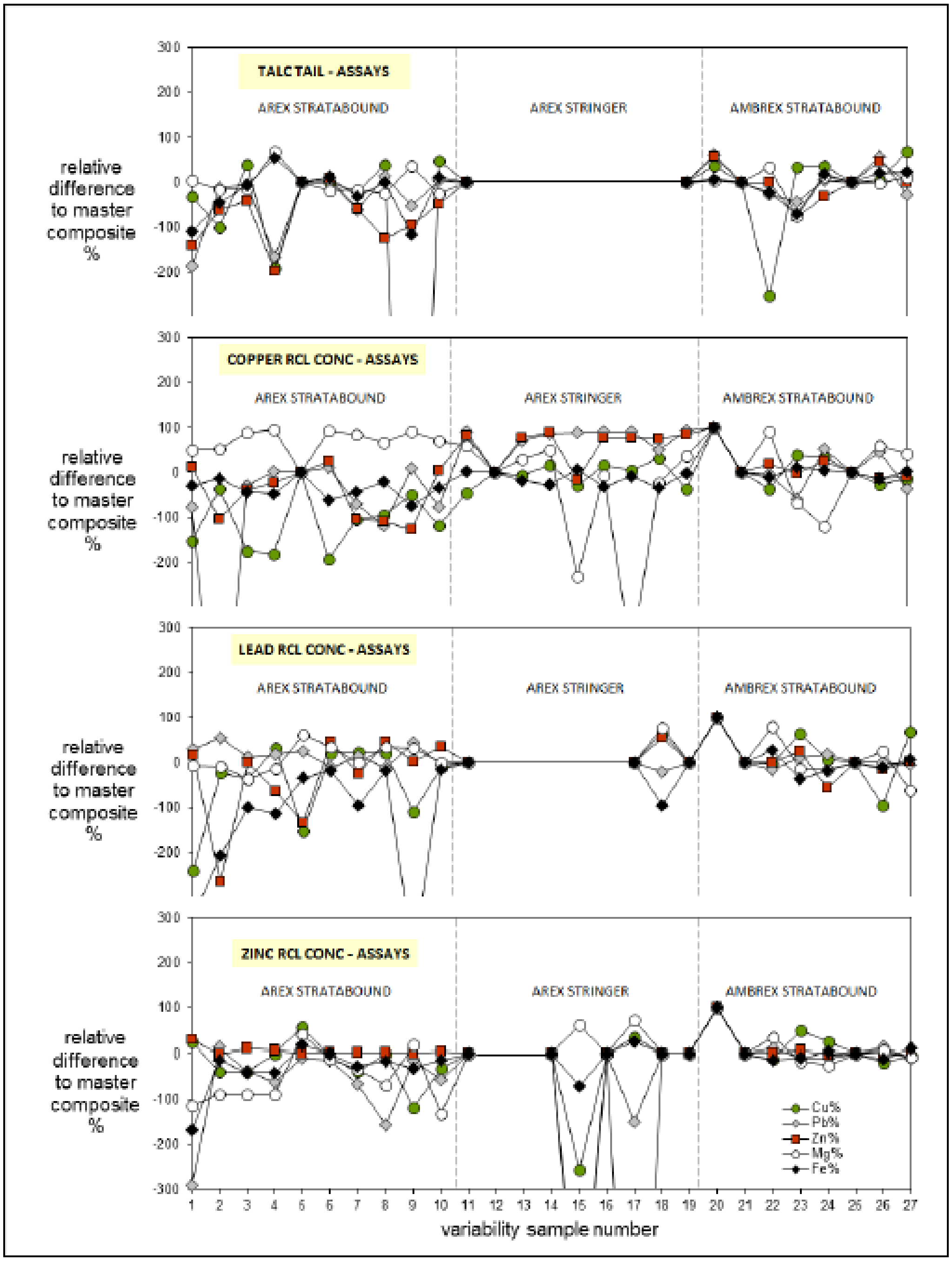


FIGURE 13-5 VARIATION OF METAL ASSAYS IN FLOTATION PRODUCTS

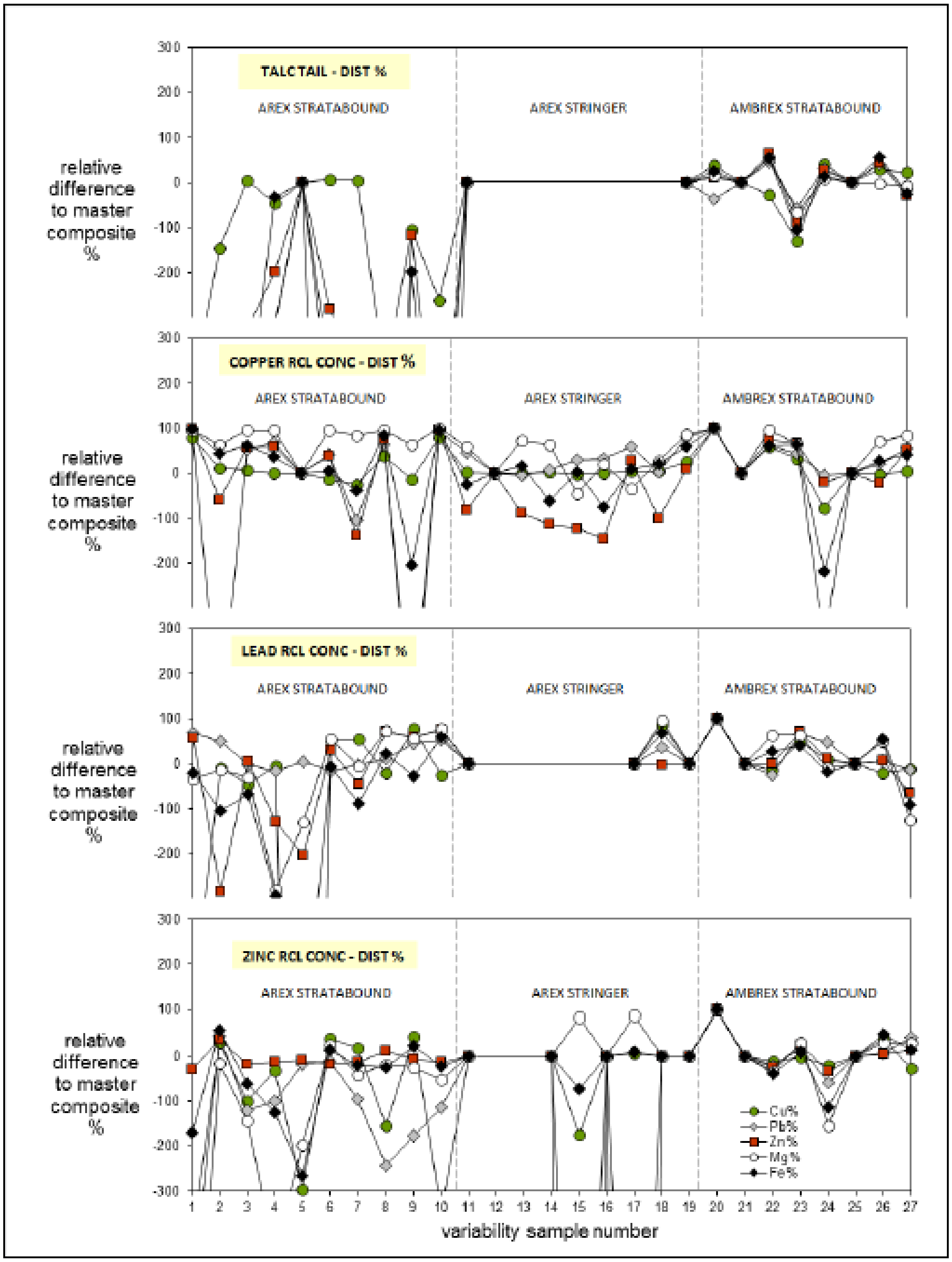


FIGURE 13-6 YIELD STRESS VS. SOLIDS PERCENTAGE

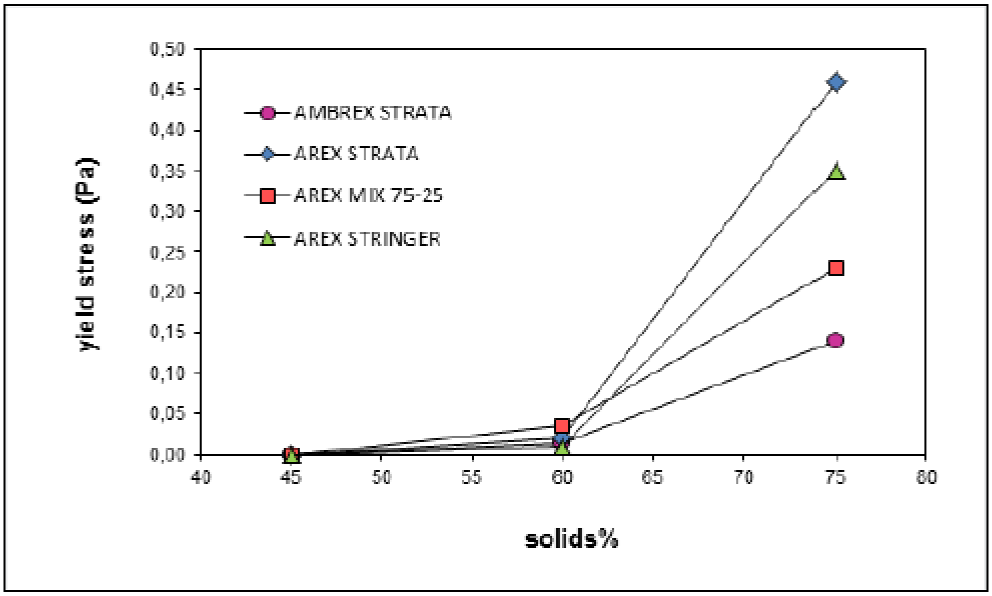
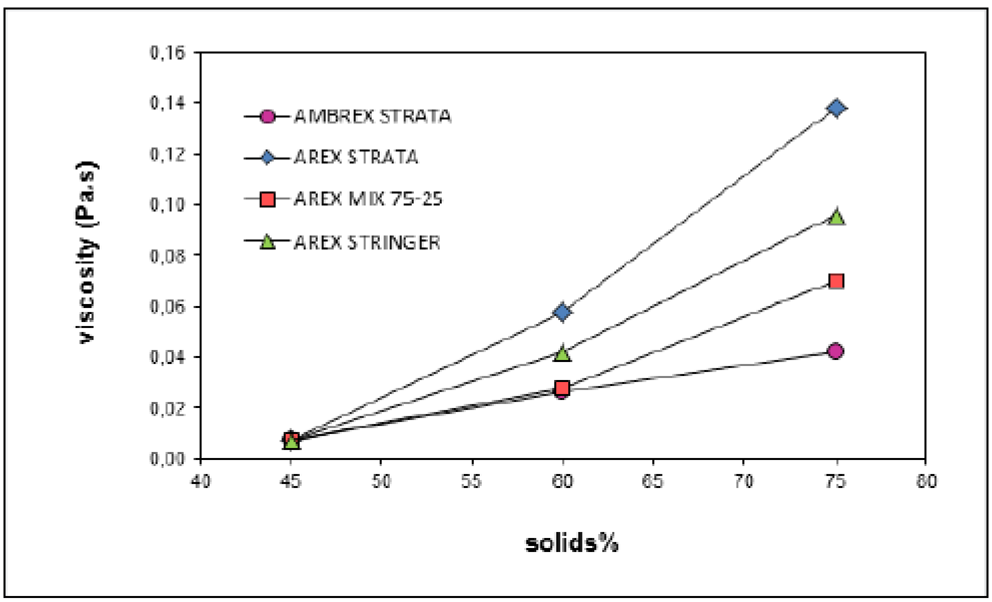


FIGURE 13-7 VISCOSITY VS. SOLIDS PERCENTAGE



Settling test work on flotation tailings from Arex Stratabound, Arex Stringer, and Arex Mixed (75% Stratabound, 25% Stringer) mineralization was conducted by ANDRITZ. Details of the test work program are presented in Appendix K of the SGS GEOSOL 2017 Report. Filtration testing of the Ambrex Stratabound flotation tailings was also performed. The best settling results were obtained using the BASF Magnafloc 10 flocculant, resulting in 60% to 75% solids in the products. A summary of the filtration test work is presented in Table 13-16.

TABLE 13-16 SUMMARY OF FILTRATION TEST WORK CONDUCTED BY ANDRITZ
Nexa Resources S.A. – Aripuanã Zinc Project

Operating Parameter	Arex Stratabound	Arex Stringer	Arex Mixed (75% Stratabound, 25% Stringer)	Ambrex Stratabound
Filtration throughput – dry basis (tph)	211	211	211	211
Production days per year	365	365	365	365
Equipment availability (%)	90	90	90	90
Pulp density (t/m^3)	1.71	1.65	1.66	1.63
Feed solids content (%)	61	61	63	63
Cake thickness (mm)	40	40	40	40
Cake moisture (%)	7	9	9	7
Cake solids content (%)	93	91	91	93
Approximate filtration rate ($kg/h{\cdot}m^{2}$)	104	94	92	94
Recommended filter press model	Overhead	Overhead	Overhead	Overhead
Recommended number of units	2	2	2	2
Recommended frame	2000/180	2000/180	2000/180	2000/180
Recommended filter fabric	Andritz 211k	Andritz 211k	Andritz 211k	Andritz 211k
Feed pressure (bar)	6	6	6	6
Chamber pressure (bar)	8	8	8	8
Chamber size (mm)	2000x2000	2000x2000	2000x2000	2000x2000
Number of chambers per unit	146 to 152	162 to 168	166 to 168	162 to 168

SNC-Lavalin relied on the FEL 2 data for estimation and sizing of equipment in the following areas:

- Concentrate filtration and thickening
- Filtration and thickening reject talc
- Thickening and filtration of final flotation tails

PHASE 2 (FEL 3)

LCT test work was also conducted in November 2017 to provide experimental data on the treatment of various types of mineralization, including: Link Stringer, Stringer Global, Link Stratabound, Ambrex Stringer, Ambrex Stratabound, and Stratabound Global. The results were evaluated based on Stratabound and Stringer material. To the best of RPA's knowledge, this test work program and the results have not been compiled in a final report for review, however, the data for test LCT 004F2 (Stringer Global) have been considered in the FEL 3 process design for copper flotation (SNC-Lavalin, 2018a).

The results from this series of LCT are summarized in Tables 13-17 to 13-22.

TABLE 13-17 LCT 003F2 CONDITIONS AND RESULTS – LINK STRINGER COMPOSITE

Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA LCT 003 EXP LINK STRINGER								
FINAL CONCENTRATE								
GRADE		Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER		24,1	0,25	0,72	0,35	38,3	36,9	195
RECOVERY		Cu %	Pb %	Zn %	MgO %	Fe %	Au %	Ag %
COPPER		96,8	24,2	47,86	0,15	8,46	84,1	73,6
TEST CONDITIONS								
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
-	-	-	-	-	-	-	-	-
TALC CLEANER								
-	-	-	-	-	-	-	-	-
COPPER ROUGHER								
150	100	0	15	0	0	0	7,4	4,0
COPPER CLEANER								
150	25	50	7,5	0	0	0	10,5	1,5
COPPER RECLEANER								
0	0	0	0	0	0	0	10,5	0:45
LEAD ROUGHER								
-	-	-	-	-	-	-	-	-
LEAD CLEANER								
-	-	-	-	-	-	-	-	-
LEAD RECLEANER								
-	-	-	-	-	-	-	-	-
ZINC ROUGHER								
-	-	-	-	-	-	-	-	-
ZINC CLEANER								
-	-	-	-	-	-	-	-	-
ZINC RECLEANER								
-	-	-	-	-	-	-	-	-

TABLE 13-18 LCT 004F2 CONDITIONS AND RESULTS – STRINGER GLOBAL COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA
LCT 4 EXP
STRINGER GLOBAL PP

FINAL CONCENTRATE

GRADE	Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER	33,9	0,32	1,01	0,34	35,3	20,10	243
RECOVERY	Cu %	Pb %	Zn %	MgO %	Fe %	Au %	Ag %
COPPER	90,3	8,10	7,95	0,18	6,96	62,9	50,4

TEST CONDITIONS

SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
-	-	-	-	-	-	-	-	-
TALC CLEANER								
-	-	-	-	-	-	-	-	-
COPPER ROUGHER								
150	150	200	12,5	0	0	0	7	3,0
COPPER CLEANER								
150	100	150	5	0	0	0	10,5	2,0
COPPER RECLEANER								
0	0	0	0	0	0	0	11	1,0
LEAD ROUGHER								
-	-	-	-	-	-	-	-	-
LEAD CLEANER								
-	-	-	-	-	-	-	-	-
LEAD RECLEANER								
-	-	-	-	-	-	--	-	-
ZINC ROUGHER								
-	-	-	-	-	-	-	-	-
ZINC CLEANER								
-	-	-	-	-	-	-	-	-
ZINC RECLEANER								
-	-	-	-	-	-	-	-	-

TABLE 13-19 LCT 005F2 CONDITIONS AND RESULTS – LINK STRATABOUND COMPOSITE

Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA LCT 005 EXP LINK STRATABOUND							
FINAL CONCENTRATE							
GRADE	Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER	26,9	2,97	7,2	1,71	26,8	59,7	2791
LEAD	0,12	61,1	12,5	0,17	5,64	1,56	601
ZINC	0,15	0,97	55,3	0,27	9,80	0,39	45,0
RECOVERY	Cu %	Pb %	Zn %	MgO %	Fe %	Au %	Ag %
COPPER	67,2	0,27	0,24	0,06	0,87	51,2	16,8
LEAD	4,95	90,3	6,76	0,10	3,03	22,1	59,7
ZINC	18,59	4,31	89,9	0,46	15,84	16,6	13,4

TEST CONDITIONS								
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
400	0	0	0	0	0	0	6,4	2
TALC CLEANER								
0	200	0	10	0	0	0	7,6	3
COPPER ROUGHER								
300	75	200	15	0	0	0	6,4	6
COPPER CLEANER								
100	25	200	7,5	0	0	0	10,5	1,5
COPPER RECLEANER								
0	0	0	0	0	0	0	11	45 S
LEAD ROUGHER								
250	40	400	0	30	0	0	8,07	6
LEAD CLEANER								
75	0	200	0	6	0	0	8	3
LEAD RECLEANER								
0	0	0	0	0	0	0	9	1,5
ZINC ROUGHER								
0	0	0	0	0	600	30	11	8,5
ZINC CLEANER								
0	0	0	0	0	0	0	11	4,5
ZINC RECLEANER								
0	0	0	0	0	0	0	11	3

TABLE 13-20 LCT 006F2 CONDITIONS AND RESULTS – AMBREX STRINGER COMPOSITE

Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA LCT 006 EXP AMBREX STRINGER							
FINAL CONCENTRATE							
GRADE	Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER	34,4	0,38	1,2	0,16	34,4	32,82	271,22
LEAD	0,01	0,01	0,01	0,1	0,01	0,00	0,00
ZINC	0,01	0,01	0,0	0,10	0,01	0,00	0,00
RECOVERY	Cu %	Pb %	Zn %	MgO %	Fe %	Au %	Ag %
COPPER	90,1	4,2	4,28	0,07	4,53	38,7	45,1
LEAD	0,00	0,0	0,00	0,00	0,00	0,0	0
ZINC	0,00	0,00	0,0	0,00	0,00	0,0	0

TEST CONDITIONS								
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
-	-	-	-	-	-	-	-	-
TALC CLEANER								
-	-	-	-	-	-	-	-	-
COPPER ROUGHER								
150	100	0	12,5	0	0	0	7,1	3,5
COPPER CLEANER								
250	100	150	3,5	0	0	0	10,5	1,5
COPPER RECLEANER								
0	0	0	0	0	0	0	11	1
LEAD ROUGHER								
-	-	-	-	-	-	-	-	-
LEAD CLEANER								
-	-	-	-	-	-	-	-	-
LEAD RECLEANER								
-	-	-	-	-	-	-	-	-
ZINC ROUGHER								
-	-	-	-	-	-	-	-	-
ZINC CLEANER								
-	-	-	-	-	-	-	-	-
ZINC RECLEANER								
-	-	-	-	-	-	-	-	-

TABLE 13-21 LCT 007F2 CONDITIONS AND RESULTS – AMBREX STRATABOUND COMPOSITE
Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA LCT 007 EXP AMBREX STRATABOUND								
FINAL CONCENTRATE								
GRADE		Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER		26,3	1,90	5,06	0,94	27,1	89,59	0,00
LEAD		0,56	53,4	8,01	0,53	12,9	1,30	783,38
ZINC		0,26	1,60	53,1	0,22	11,3	0,37	66,22
RECOVERY		Cu %	Pb %	Zn %	MgO %	Fe %	Au %	Ag %
COPPER		20,6	0,1	0,08	0,01	0,11	24,2	0,0
LEAD		16,41	77,5	4,56	0,15	1,94	13,124	49,2
ZINC		21,22	6,47	84,1	0,17	4,73	10,405	11,6
TEST CONDITIONS								
SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
400	0	0	0	0	0	0	7,78	3,5
TALC CLEANER								
0	200	0	5	0	0	0	7,98	3
COPPER ROUGHER								
300	75	200	15	0	0	0	7	5
COPPER CLEANER								
0	100	25	200	7,5	0	0	10,5	1
COPPER RECLEANER								
0	0	0	0	0	0	0	11	20 s
LEAD ROUGHER								
150	40	300	0	17,5	0	0	9	6
LEAD CLEANER								
75	0	250	0	7,5	0	0	9	1;15
LEAD RECLEANER								
0	0	0	0	0	0	0	9	50 s
ZINC ROUGHER								
0	0	0	0	0	600	30	11	7
ZINC CLEANER								
0	0	0	0	0	200	12,5	11	3,5
ZINC RECLEANER								
0	0	0	0	0	0	0	11	3

TABLE 13-22 LCT 008F2 CONDITIONS AND RESULTS – STRATA GLOBAL COMPOSITE

Nexa Resources S.A. – Aripuanã Zinc Project

VOTORANTIM - ARIPUANA

LCT 008 EXP

STRATA GLOBAL PP

FINAL CONCENTRATE

GRADE	Cu %	Pb %	Zn %	MgO %	Fe %	Au ppm	Ag ppm
COPPER	32,6	1,48	3,91	0,21	31,0	23,7	1809
LEAD	0,55	56,0	8,99	0,47	11,4	1,27	864
ZINC	0,31	1,40	52,3	0,38	10,4	0,45	69
RECOVERY	**Cu %**	**Pb %**	**Zn %**	**MgO %**	**Fe %**	**Au %**	**Ag %**
COPPER	69,2	0,28	0,27	0,01	0,79	25,1	13,5
LEAD	9,26	83,5	4,92	0,12	2,31	10,7	51,2
ZINC	16,18	6,47	88,8	0,31	6,52	11,7	12,7

TEST CONDITIONS

SMBS gpt	CMC gpt	ZnSO4 gpt	A3894 gpt	A3418 gpt	CuSO4 gpt	A208 gpt	pH	TIME min
TALC ROUGHER								
400	0	0	0	0	0	0	8,12	3,5
TALC CLEANER								
0	200	0	5	0	0	0	8,05	3
COPPER ROUGHER								
300	75	200	17,5	0	0	0	6,9	6
COPPER CLEANER								
100	75	200	7,5	0	0	0	1,5	10
COPPER RECLEANER								
0	0	0	0	0	0	0	1	10,5
LEAD ROUGHER								
200	40	200	0	32,5	0	0	9	6
LEAD CLEANER								
75	0	200	0	10	0	0	9	1,5
LEAD RECLEANER								
0	0	0	0	0	0	0	9	50 s
ZINC ROUGHER								
0	0	0	0	0	450	30	11	8,5
ZINC CLEANER								
0	0	0	0	0	250	12,5	11	4,5
ZINC RECLEANER								
0	0	0	0	0	0	0	11	3

PILOT STUDIES

Pilot studies were undertaken by SGS GEOSOL on samples of Arex and Ambrex mineralization to define the conditions and circuits for grinding and flotation of Stringer and Stratabound materials. The objective of the pilot study was to produce chalcopyrite concentrate with a copper content of 27% to 28% and to produce lead and zinc concentrates containing approximately 55% lead and 55% zinc.

Table 13-23 lists the average head grades of the two composite samples tested.

TABLE 13-23 PILOT STUDY SAMPLES
Nexa Resources S.A. – Aripuanã Zinc Project

Sample	Weight (t)	Cu (%)	Pb (%)	Zn (%)	Ag (ppm)	Au (ppm)
Stringer	6.0	0.82	0.11	0.31	13	0.92
Stratabound	7.5	0.17	1.93	5.50	47	0.33

The key findings from pilot scale testing were as follows:

- **Stringer sample**. A final copper concentrate was produced from a circuit consisting of rougher, cleaner, and recleaner flotation, following by cleaner scavenger column flotation. The copper concentrate contained approximately 24.1% Cu and copper recovery was 85.8%, however, high levels of Zn, MgO, and SiO_2 (4.65%, 4.66% and 10.65, respectively) were reported as contaminants. Based on these results, additional metallurgical testing will be needed to improve the quality of the copper concentrate.

- **Stratabound sample**. Talc was rejected and a concentrate was produced containing 27.2% MgO and MgO recovery was 17.8%. Copper flotation consisted of a rougher-scavenger circuit, which produced a rougher concentrate of 3.63% Cu at 69.0% Cu recovery. The levels of Pb, Zn, and MgO were 1.91%, 3.67% and 14.3%, respectively in the rougher concentrate, however, the low copper content in the feed made it difficult to carry out the copper cleaner and recleaning stages. For lead and zinc flotation, rougher and scavenger flotation was carried out in mechanical cells followed by cleaner and recleaner flotation in column cells. A final lead concentrate was produced containing 62.1% Pb and lead recovery was 80.3% and a final zinc concentrate was produced containing 60.8% Zn and zinc recovery was 87.5%.

- The Stratabound sample was more friable than the Stringer sample.

Information from pilot scale comminution and flotation testing were used by SNC-Lavalin in estimation and sizing of process equipment in the FEL 3 study (SNC-Lavalin, 2018a), however due to the low copper content in Stratabound material, data related to Stratabound copper flotation and concentration needs further validation.

SUMMARY

To process Aripuanã Zinc mineralization, separate material types were identified during characterization. Due to different recovery kinetics during bench testing and lower zinc and lead grades, the decision to initially by-pass lead and zinc flotation circuits during the processing of Stringer mineralization was made.

The copper concentrate grades and recoveries for Stringer materials in pilot scale testing were below targets and will require further study. RPA recommends that a review of the metallurgical test program be undertaken with consideration of mineralogical analysis of feed and flotation products in an effort to improve overall copper flotation and concentration, prior to conducting further pilot scale tests on both Stringer and Stratabound materials.

Pilot scale testing of Stratabound mineralization successfully demonstrated that lead and zinc concentrates could be produced above expected metal grades.

For the FEL 3 Study, SNC-Lavalin has referenced supporting SGS GEOSOL data from LCT 004F2 (Stringer Global) and pilot test FT-03 (Stratabound Global) to develop the process design criteria and flowcharts. Historical FEL 2 data has been used for estimation and sizing of equipment for concentrate filtration and thickening, filtration and thickening of reject talc, and thickening and filtration of final flotation tailings. RPA recommends that scale up factors of greater than 2.5 and 5 be used for rougher flotation retention time and cleaner flotation retention time, for each circuit, respectively. Additionally, RPA is of the opinion that a comparision of the FT-03 pilot test and the corresponding LCT should be completed to ensure consistency in the development of the design criteria.

RPA recommends that additional metallurgical testing be conducted to optimize the current process design for treatment of Stringer and Stratabound ores and ensure that any deleterious elements such as fluorine can be blended to allow marketable production.

14 MINERAL RESOURCE ESTIMATE

The Mineral Resource estimate, dated July 31, 2018 was completed by Nexa personnel using Datamine Studio RM, Leapfrog Geo, and Isatis softwares. Wireframes for geology and mineralization were constructed in Leapfrog Geo based on geology sections, assay results, lithological information, and structural data. Assays were capped to various levels based on exploratory data analysis and then composited to one metre lengths. Wireframes were filled with blocks measuring five metres by ten metres by five metres with sub-celling at wireframe boundaries. Blocks were interpolated with grade using Ordinary Kriging (OK) and Inverse Distance Squared (ID^2). Blocks estimates were validated using industry standard validation techniques. Classification of blocks was based on distance based criteria.

RPA has audited and accepted the Nexa Mineral Resource estimate.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

A summary of the Mineral Resources is provided in Table 14-1, with Table 14-2 listing Mineral Resources by area.

TABLE 14-1 MINERAL RESOURCE STATEMENT, JULY 31, 2018

Nexa Resources S.A. – Aripuanã Zinc Project

	Grade						Contained Metal				
Stratabound	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	1.1	3.80	1.27	0.16	0.14	30.9	95.7	31.8	3.9	5.2	1.1
Indicated	2.5	3.20	1.00	0.07	0.14	22.1	179.1	55.6	4.1	11.4	1.8
Measured and Indicated	3.7	3.39	1.08	0.10	0.14	24.8	274.8	87.5	8.0	16.6	2.9
Inferred	14.1	6.16	2.36	0.17	0.35	53.8	1,916.9	735.0	51.7	158.3	24.4
Stringer	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	0.7	0.21	0.10	1.12	1.18	12.9	3.0	1.5	16.4	25.1	0.3
Indicated	1.4	0.15	0.06	0.73	1.12	8.9	4.4	1.7	21.9	49.0	0.4
Measured and Indicated	2.0	0.17	0.07	0.86	1.14	10.3	7.5	3.3	38.4	74.1	0.7
Inferred	9.0	0.06	0.04	0.98	1.85	10.6	12.2	8.7	194.8	534.5	3.1
Total	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	1.8	2.48	0.84	0.51	0.52	24.3	98.7	33.4	20.4	30.3	1.4
Indicated	3.9	2.14	0.67	0.30	0.48	17.5	183.6	57.4	26.0	60.4	2.2
Measured and Indicated	5.7	2.25	0.72	0.37	0.49	19.7	282.3	90.8	46.3	90.7	3.6
Inferred	23.1	3.79	1.46	0.48	0.93	37.0	1,929.0	743.7	246.4	692.8	27.5

Notes:
1. CIM (2014) definitions were followed for Mineral Resources.
2. Mineral Resources are reported using a US$38/t Net Smelter Return (NSR) block cut-off value.
3. The NSR is calculated based on metal prices of US$1.29 per lb Zn, US$0.99 per lb Pb, US$3.43 per lb Cu, US$1,368 per troy ounce Au, and US$21.37 per troy ounce Ag.
4. Mineral Resources are reported exclusive of Mineral Reserves.
5. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.
6. Numbers may not add due to rounding.

TABLE 14-2 MINERAL RESOURCES BY TYPE AND AREA, JULY 31, 2018

Nexa Resources S.A. – Aripuanã Zinc Project

Type			Grade					Contained Metal				
Stratabound	**Arex**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stratabound	Measured	0.7	3.78	1.27	0.20	0.15	29.8	61.3	20.5	3.3	3.5	0.7
Stratabound	Indicated	0.2	4.01	1.31	0.17	0.18	24.8	14.4	4.7	0.6	0.9	0.1
Stratabound	Measured and Indicated	0.9	3.82	1.27	0.19	0.16	28.9	75.6	25.2	3.9	4.5	0.8
Stratabound	Inferred	1.3	5.80	2.08	0.24	0.41	31.0	167.8	60.2	6.8	17.1	1.3
Stratabound	**Ambrex**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stratabound	Measured	0.3	4.00	1.33	0.05	0.11	34.0	22.7	7.5	0.3	0.9	0.3
Stratabound	Indicated	1.4	2.84	0.86	0.05	0.11	19.6	90.0	27.3	1.5	5.2	0.9
Stratabound	Measured and Indicated	1.7	3.01	0.93	0.05	0.11	21.8	112.7	34.9	1.8	6.1	1.2
Stratabound	Inferred	10.1	6.73	2.71	0.06	0.32	61.7	1,502.2	604.7	14.3	105.3	20.1
Stratabound	**Link**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stratabound	Measured	0.1	3.60	1.16	0.11	0.16	30.6	11.7	3.8	0.4	0.7	0.1
Stratabound	Indicated	0.9	3.63	1.15	0.09	0.18	25.5	74.8	23.6	1.9	5.3	0.8
Stratabound	Measured and Indicated	1.1	3.63	1.15	0.10	0.17	26.2	86.5	27.4	2.3	6.0	0.9
Stratabound	Inferred	2.7	4.19	1.19	0.52	0.42	34.9	246.8	70.1	30.5	35.8	3.0
Stringer	**Arex**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stringer	Measured	0.7	0.21	0.10	1.12	1.18	13.0	3.0	1.5	16.4	25.1	0.3
Stringer	Indicated	0.4	0.10	0.05	0.72	1.25	8.5	1.0	0.4	6.8	17.2	0.1
Stringer	Measured and Indicated	1.1	0.17	0.08	0.97	1.21	11.2	4.0	2.0	23.2	42.3	0.4
Stringer	Inferred	1.5	0.04	0.05	0.68	4.11	9.9	1.2	1.6	22.1	195.4	0.5
Stringer	**Ambrex**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stringer	Measured											
Stringer	Indicated	0.3	0.43	0.09	0.75	0.90	9.6	2.8	0.6	4.8	23.4	0.1
Stringer	Measured and Indicated	0.3	0.43	0.09	0.75	0.90	9.6	2.8	0.6	4.8	23.4	0.1
Stringer	Inferred	4.8	0.07	0.05	1.11	1.55	10.6	7.7	5.1	116.3	101.6	1.6
Stringer	**Link**	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Stringer	Measured											
Stringer	Indicated	0.6	0.05	0.05	0.73	1.14	9.0	0.7	0.7	10.3	0.0	0.2
Stringer	Measured and Indicated	0.6	0.05	0.05	0.73	1.14	9.0	0.7	0.7	10.3	0.0	0.2
Stringer	Inferred	2.7	0.05	0.03	0.93	1.15	11.0	3.2	2.0	56.4	0.1	1.0

Notes:

1. CIM (2014) definitions were followed for Mineral Resources.

2. Mineral Resources are reported using a US$38/t Net Smelter Return (NSR) block cut-off value.
3. The NSR is calculated based on metal prices of US$1.29 per lb Zn, US$0.99 per lb Pb, US$3.43 per lb Cu, US$1,368 per troy ounce Au, and US$21.3 per troy ounce Ag.
4. Mineral Resources are reported exclusive of Mineral Reserves.
5. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.
6. Numbers may not add due to rounding.

COMPARISON WITH PREVIOUS ESTIMATE

The previous Mineral Resource estimate, dated December 23, 2016, was presented in a NI 43-101 Technical Report prepared by RPA for Nexa. Differences between the 2016 estimate reviewed by RPA and the current estimate can be attributed to the following:

- Additional drilling and wireframes update in the Ambrex-Link Zone
- Variograms and estimates updated in the Ambrex-Link Zone
- Changes in Net Smelter Return (NSR) calculations and cut-off value. Different operating costs, prices and metallurgical recoveries adopted
- Unsampled intervals substituted by zeroes
- Maximum number of samples per estimate was limited in Ambrex to reduce smoothing during kriging
- Classification criteria defined for Ambrex Stringer

A comparison between the current and December 2016 estimate is provided in Table 14-3.

TABLE 14-3 COMPARISON BETWEEN CURRENT AND DECEMBER 23, 2016 ESTIMATES

Nexa Resources S.A. – Aripuanã Zinc Project

Current Resource Estimate

		Grade					Contained Metal				
Stratabound	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	10.1	5.72	2.12	0.19	0.22	51.0	1,277.1	473.9	41.7	72.4	16.6
Indicated	14.8	5.07	1.79	0.12	0.22	43.8	1,660.1	584.5	38.3	103.3	20.9
Measured and Indicated	25.0	5.33	1.92	0.15	0.22	46.65	2,937.2	1,058.4	80.0	175.7	37.5
Inferred	14.7	6.17	2.35	0.17	0.34	53.7	1,993.3	760.8	53.7	163.5	25.3
Stringer	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	2.2	0.29	0.13	1.60	1.18	17.9	14.0	6.2	76.5	82.8	1.3
Indicated	3.4	0.17	0.07	1.03	1.35	11.4	12.6	5.3	77.5	148.2	1.3
Measured and Indicated	5.6	0.22	0.09	1.25	1.28	13.9	26.6	11.5	154.0	231.0	2.5
Inferred	9.2	0.06	0.04	1.00	1.84	10.8	12.6	9.1	204.8	545.6	3.2
Total	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	12.3	4.76	1.77	0.44	0.39	45.1	1,291.1	480.1	118.2	155.2	17.8
Indicated	18.2	4.15	1.47	0.29	0.43	37.8	1,672.7	589.7	115.8	251.5	22.2
Measured and Indicated	30.5	4.40	1.59	0.35	0.41	40.7	282.4	90.8	46.3	406.7	40.0
Inferred	23.9	3.81	1.46	0.49	0.92	37.2	2,005.9	769.9	258.5	709.1	28.5

December 23, 2016

		Grade					Contained Metal				
Stratabound	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	8.6	5.88	2.16	0.19	0.23	52.7	1,109.0	407.1	36.0	64.2	14.5
Indicated	9.8	5.38	2.03	0.09	0.25	47.8	1,160.8	437.2	18.7	79.5	15.0
Measured and Indicated	18.3	5.61	2.09	0.14	0.24	50.1	2,269.9	844.3	54.7	143.7	29.5
Inferred	13.2	7.20	2.80	0.10	0.38	62.5	2,099.7	815.4	29.4	162.7	26.6
Stringer	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	Ag (Moz)
Measured	2.3	0.28	0.12	1.54	1.18	17.6	14.4	6.3	78.5	87.8	1.3
Indicated	1.2	0.11	0.05	0.97	1.28	11.2	2.7	1.4	24.5	47.5	0.4
Measured and Indicated	3.5	0.22	0.10	1.35	1.21	15.5	17.2	7.7	103.1	135.3	1.7
Inferred	11.4	0.08	0.05	0.78	1.55	9.3	19.3	13.5	197.0	569.7	3.4
Total	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	10.9	4.68	1.72	0.48	0.43	45.18	1,123.5	413.5	114.6	152.0	15.8
Indicated	10.9	4.83	1.82	0.18	0.36	43.97	1,163.6	438.6	43.2	127.0	15.5
Measured and Indicated	21.8	4.76	1.77	0.33	0.40	44.58	2,287.0	852.0	157.8	279.0	31.3
Inferred	24.6	3.90	1.53	0.42	0.93	37.88	2,119.0	829.0	226.4	732.4	30.0

Difference

		Grade					Contained Metal				
Stratabound	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	18%	-3%	-2%	-2%	-6%	-3%	15%	16%	16%	13%	14%
Indicated	51%	-6%	-12%	35%	-13%	-8%	43%	34%	105%	30%	39%
Measured and Indicated	37%	-5%	-8%	7%	-10%	-7%	29%	25%	46%	22%	27%
Inferred	11%	-14%	-16%	65%	-11%	-14%	-5%	-7%	82%	1%	-5%
Stringer	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	-5%	4%	4%	4%	0%	2%	-3%	-2%	-3%	-6%	-5%
Indicated	184%	56%	28%	7%	5%	2%	363%	281%	216%	212%	202%
Measured and Indicated	59%	-3%	-8%	-7%	6%	-10%	55%	48%	49%	71%	45%
Inferred	-19%	-20%	-17%	28%	18%	16%	-35%	-33%	4%	-4%	-6%
Total	**Tonnes**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**AU (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
Measured	13%	2%	3%	-9%	-10%	0%	15%	16%	3%	2%	13%
Indicated	67%	-14%	-19%	61%	19%	-14%	44%	34%	168%	98%	43%
Measured and Indicated	40%	-7%	-10%	6%	4%	-9%	-88%	-89%	-71%	46%	28%
Inferred	-3%	-2%	-4%	17%	-1%	-2%	-5%	-7%	14%	-3%	-5%

RESOURCE DATABASE

The resource database contains drilling information and analytical results up to March 1, 2018. Information received after this date was not used in the Mineral Resource estimate. The database comprises 608 drill holes for a total of 182,631 m of drilling. A total of 124 drill holes were completed by Karmin/Anglo American prior to Nexa's involvement in the Project (pre-2004). The 124 drill holes were internally reviewed and found to be acceptable to support Mineral Resource estimation.

Nexa previously maintained the resource database in GeoExplo software. The data has now been migrated to Fusion and all future estimates will source data for this database. RPA received data from Nexa in comma separated values (.csv) format, as well as Datamine de-surveyed files (.dm). Data were amalgamated and parsed as required and imported by RPA into Datamine Studio RM and Aranz's Leapfrog Geo software version for review.

For the purpose of the Mineral Resource estimate, a total of 56 drill holes were excluded from the database. The drill holes that were excluded either lacked information, were historic RC drilling or were drilled for the purpose of metallurgical testing.

Section 12, Data Verification, describes the resource database verification steps carried out by RPA and Nexa. RPA is of the opinion that the drill hole database is valid and suitable to estimate Mineral Resources for the Project.

Since the previous estimate dated December 23, 2016, 66 drill holes totalling 31,061 m have been drilled on the Project. Of these, 64 were directed to the Link Zone target, with four intersecting Arex deposit, but targeting Link Zone at depth, and two targeted the Ambrex deposit. The result of the drill program extended the Link Zone northward and southward, and the boundary between the Link Zone and Arex deposit was updated to reflect a new understanding of the mineralization styles and controls. The additional six holes drilled in Arex and Ambrex were excluded from the Mineral Resource estimate but provide confirmation that the Nexa interpretation is reasonable.

Unless stated otherwise, all references to the Ambrex Zone include the Link Zone.

TOPOGRAPHY

A LiDAR topographic survey was completed over the Project in 2008. The resulting digital terrain surface (DTM) is available in AutoCAD Drawing Exchange (DXF) and Datamine. The surface has been validated using survey control points and drill hole collars.

GEOLOGICAL INTERPRETATION

Wireframes of the stratabound and stringer mineralization for Arex and Ambrex were constructed considering geology at a cut-off grade of 0.6% Zn in the stratabound zones and 0.5% Cu in the stringer zones in Seequent's Leapfrog Geo software. In support of the mineralization wireframes, a geological model, also created in Leapfrog Geo was prepared by Nexa and included oxidation, alteration, and topography surfaces, in addition to modelled faults. A zone of discontinuous remobilized stratabound mineralization within a fault zone in the upper sector of Ambrex was also modelled and assigned to stratabound mineralization. Samples with both zinc and copper grades above cut-off grades were considered to be stratabound type mineralization. Some drill hole intercepts with grades below cut-off grade were included to maintain geological continuity.

Mineralization at Arex strikes at approximately 110° azimuth, extending over a 1,200 m strike length. Thin lenses of intermingling stratabound and stringer mineralization within two principal limbs dip from ten degrees to 60° to the northeast and are modelled to join in some areas near surface. The main mineralized zone comes close to outcropping at surface. It is characterized by tightly folded, well defined stringer and stratabound zones. Individual lens thicknesses range from less than one metre to 15 m, but are generally from two metres to seven metres. The mineralization zone is approximately 125 m thick overall, and individual lenses are separated by barren, hydrothermally altered rock from one metre to tens of metres thick. The main mineralization is delineated between two dipping faults.

The Ambrex deposit is located approximately 1,300 m southeast of Arex and southeast of Link Zone. Mineralization strikes at approximately 125° and has a strike extent of approximately 1,050 m based on current drilling. Mineralization at Ambrex is dominated by stratabound mineralization, with volumetrically smaller, less well defined stringer zone perpendicular to and to the east of it. Stratabound mineralization above the Gossan Fault Zone dips at approximately 40º to the southeast. At depth, the mineralization is folded and dips from near vertical to 70° to the southwest. Mineralization thicknesses typically range from ten metres to 60 m. Ambrex has an upper depth of 60 m below surface, but generally is 100 m below surface. The deepest mineralization intersection within the Ambrex model is over 700 m below surface and the deposit remains open at depth. The stratabound mineralization is well defined and follows stratigraphy. The stringer mineralization is poorly defined due to poor drilling angles and crosses stratigraphy, following structural features.

The Link Zone is located between and along strike of Ambrex and Arex over a strike length of approximately 850 m. There is small spatial overlap to the northwest with both Arex and Ambrex. The mineralization bears a closer similarity to Ambrex in that the stringer zone occurs at a high angle to the stratabound zone. The stratabound mineralization comes close to surface and extends to a depth of 500 m below surface while the stringer zone mineralization occurs approximately 200 m below surface and extends to a depth of approximately 400 m below surface.

The stratabound mineralization lenses range from one metre to 30 m thick, with an average thickness of approximately nine metres while the stringer zone thickness ranges from one metre to 20 m with an average of approximately five metres true thickness.

Figure 14-1 shows a 3D perspective view of the wireframes and Figures 14-2 and 14-3 show example sections of Ambrex and Arex, respectively.

RPA's review of the mineralized wireframes included comparison with geological sections prepared by on-site geologists, drill hole information, and a NSR value calculated by RPA from drill hole assays. Assumptions used in NSR calculation are described under Net Smelter Return Cut-Off Value in this section.

A geological model has been prepared over the deposit areas, delineating a hydrothermal alteration zone, a series of faults, and weathering profiles. Meta-sedimentary and meta-volcanic rocks have also been distinguished over Ambrex. RPA found mineralization wireframes to be snapped to drill hole assay intervals, and to match well with the geological interpretation. RPA notes that the cut-off value of 0.6% Zn chosen by Nexa is low when compared with the NSR cut-off value and has caused the inclusion of low grade samples. RPA recommends increasing the wireframe modelling cut-off value to exclude sub-economic mineralization not related to massive or disseminated sulphides in the stratabound zone.

A total of 35 and 32 individual wireframes were constructed over Ambrex and Link Zone to represent the stratabound and stringer zones, respectively. Many of the stringer zone wireframes at Ambrex are defined by a limited amount of drill hole information. A total of 18 and 19 individual wireframes were constructed over Arex to represent the stratabound and stringer zones, respectively.

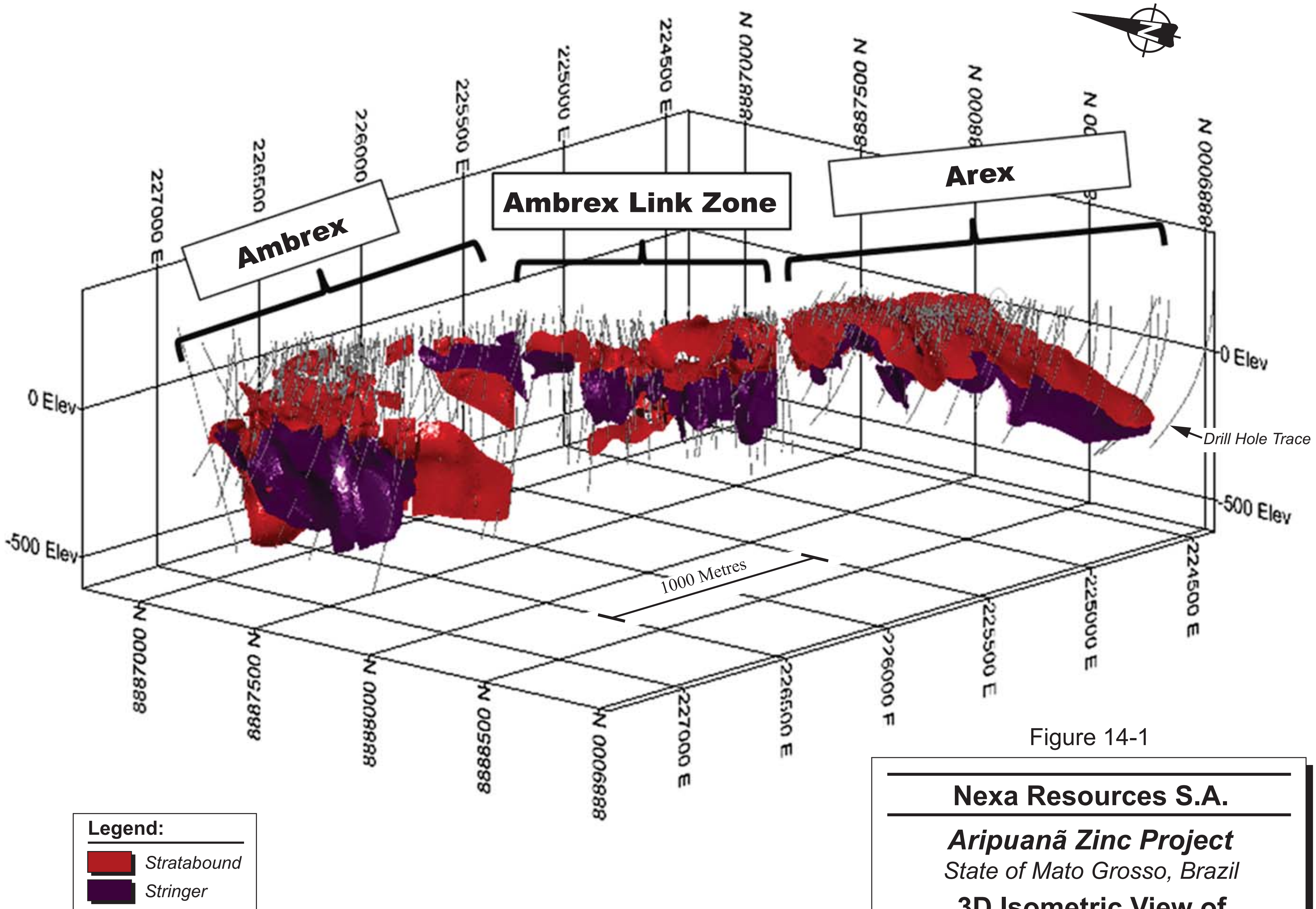


Figure 14-1

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

3D Isometric View of Geological Wireframes

October 2018

Source: *RPA, 2017.*

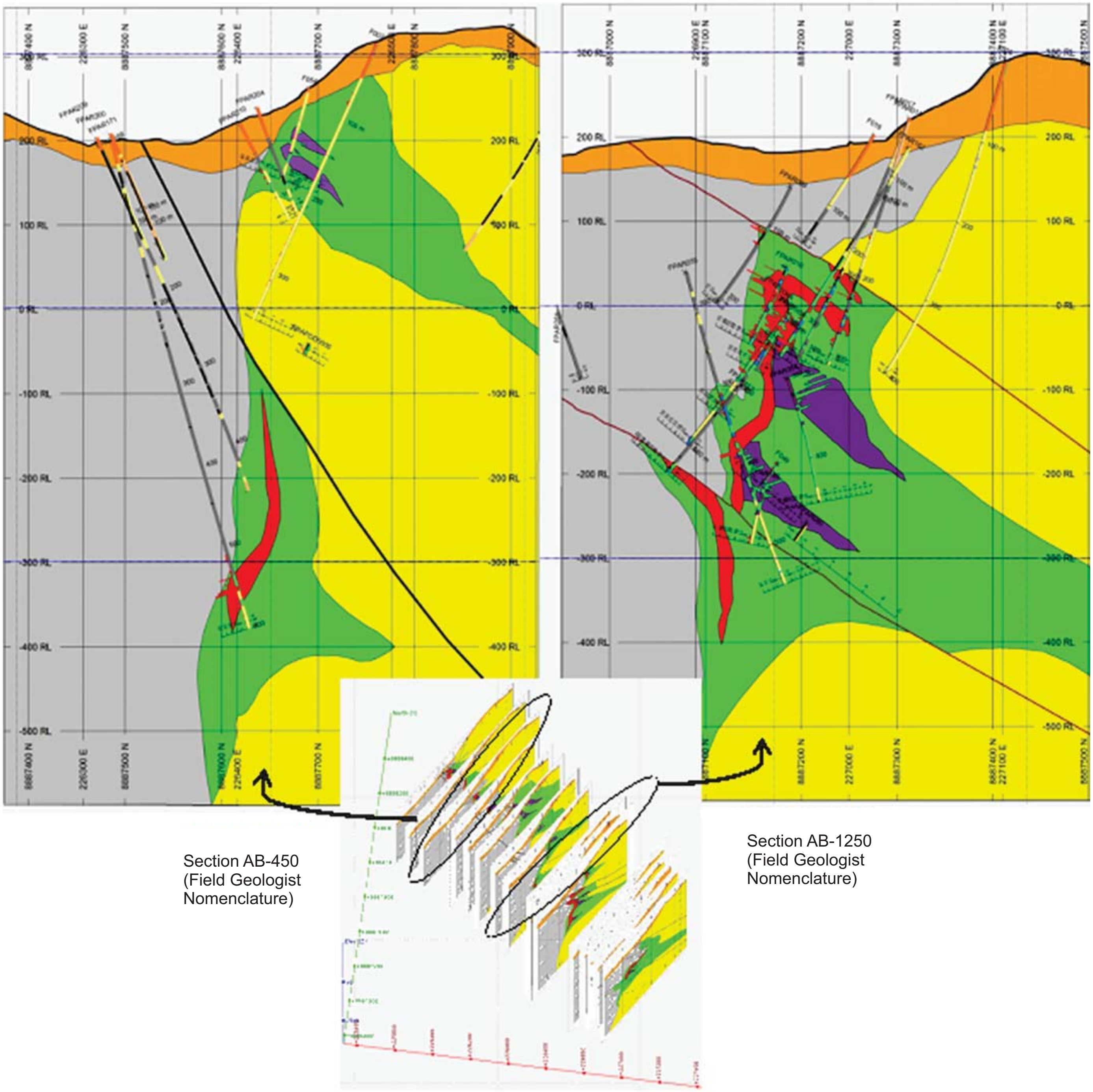


Figure 14-2

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Ambrex Geological Model

October 2018

Source: Votorantim Metais, 2016.

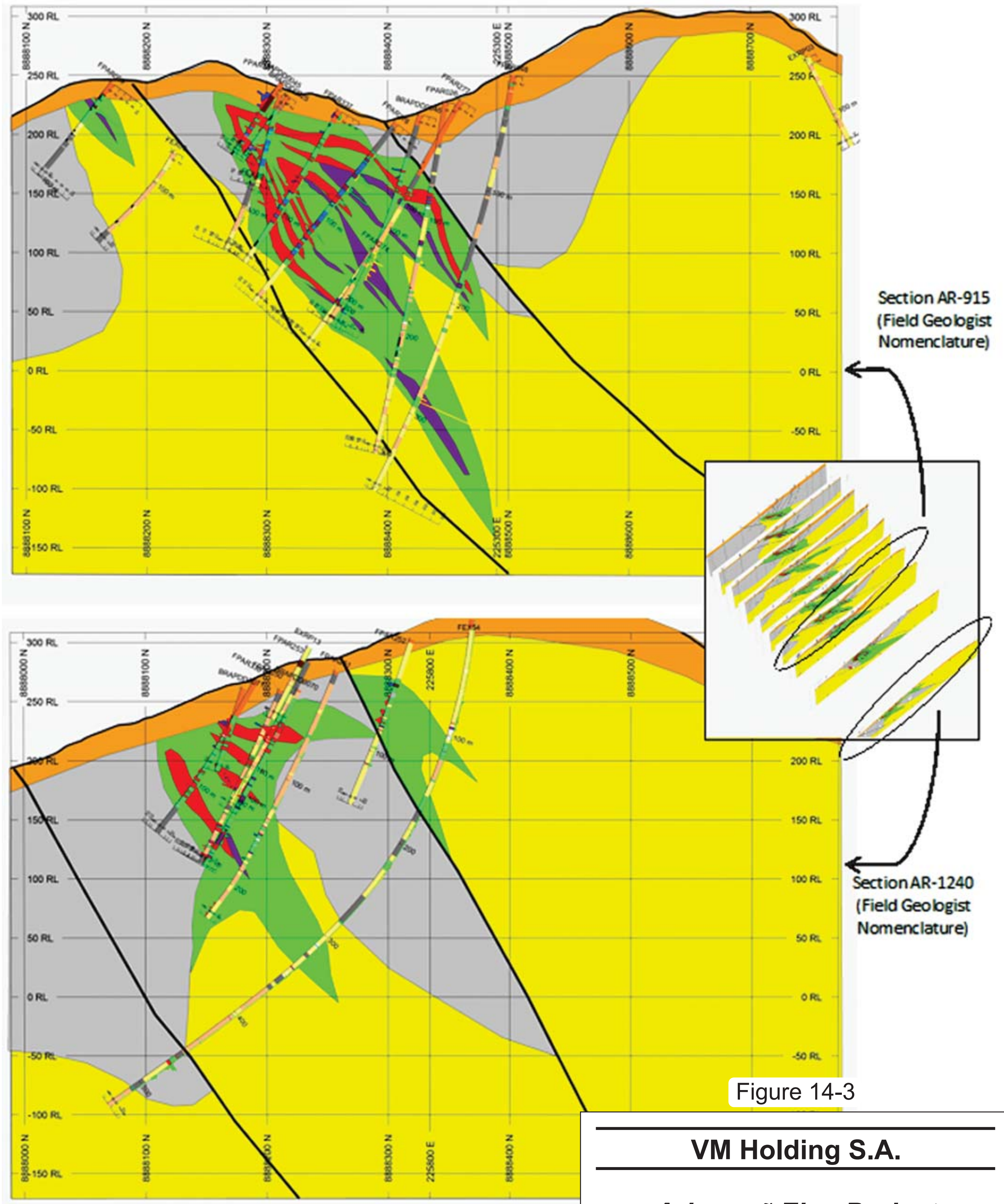


Figure 14-3

VM Holding S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Arex Geological Model

July 2017

Source: Votorantim Metais, 2016.

CAPPING OF HIGH GRADES

Nexa applied high grade capping to Zn, Pb, Cu, Au, and Ag assays to limit the influence of a small amount of extreme values located in the upper tail of the metal distributions. Log probability plots were inspected for each individual wireframe and a capping grade was applied according to inflections on log probability plots (examples given in Figures 14-4 and 14-5). No capping was performed in the hydrothermal zone or for the variables Fe, S, MgO, and density. Raw assays were capped prior to compositing. A summary of capping grades used is provided in Table 14-4 and capped versus uncapped statistics is provided in Table 14-5.

RPA reviewed the capping levels utilized by Nexa and is of the opinion that, in general, the capping grades are reasonable. RPA notes that some of the gold capping values appear high and impart undue influence on the total contained metal.

TABLE 14-4 GRADE CAPPING LEVELS
Nexa Resources S.A. – Aripuanã Zinc Project

Ambrex-Excluding-Link

Body	Zn%	Pb%	Cu%	Au_g/t	Ag_g/t
1	-	-	1	1	-
4	40	15	0.2	-	-
5	-	3.5	0.1	-	40
7	10	2.5	-	-	-
8	-	-	0.2	0.9	-
9	10	1.5	-	-	30
10	-	-	0.2	1.5	-
11	-	-	0.5	-	-
12	5	3	-	-	45
20	4	-	-	-	-
21	6	6	0.5	0.7	-
50	-	10	-	-	250
51	30	10	0.2	0.5	-
52	-	-	0.7	2	-
53	15	8	0.2	0.9	130
54	-	-	1.2	2.3	-
55	-	-	0.6	1	290
121	-	-	-	2	-
131	-	-	-	47.5	-
141	-	-	4	-	-
142	-	-	-	3	-
143	-	-	2	10	-
144	-	-	4	-	-
180	-	-	-	2	-
181	-	-	2.5	-	-
184	-	-	7	-	-
191	-	-	1.5	-	-

Arex

Body	Zn%	Pb%	Cu%	Au_g/t	Ag_g/t
62	-	-	-	-	80
63	-	-	0.45	-	-
64	3	-	0.04	-	-
65	-	3	0.1	-	11.5
66	3	0.8	-	-	-
72	-	-	0.25	0.25	-
80	-	-	1.3	-	160
101	1	-	-	4.42	-
104	0.5	-	-	-	-
105	0.8	0.4	-	-	-
106	1.5	-	-	5.5	-
108	0.3	-	3.3	-	-
110	0.2	-	4.3	10	-
112	0.6	-	-	7	-
116	0.025	-	0.85	-	-

Ambrex-Link

Body	Zn%	Pb%	Cu%	Au_g/t	Ag_g/t
30	40	21	11	12.5	-
31	25	-	-	-	160
32	-	5	-	-	105
33	40	18	2.3	4.2	-
34	45	-	-	7	-
36	20	5	-	5	-
39	-	-	-	-	30
40	43	17	-	5.5	-
41	17	-	-	-	-
43	-	-	0.7	2	600
167	0.1	-	-	-	-
168	0.8	2	-	-	-
169	2	2.2	16	18	-
170	0.8	-	10	8.5	-
171	-	-	-	4.5	-
173	-	-	3	8.5	35
174	0.25	-	-	-	-
175	-	-	-	2.5	-
176	-	-	-	-	80
177	-	-	3.5	-	-
178	-	-	-	8	-
179	-	1	-	6	30

TABLE 14-5 UNCAPPED VERSUS CAPPED ASSAY STATISTICS

Nexa Resources S.A. – Aripuanã Zinc Project

						Uncapped					Capped					
Area	Type	Grade	Count	Sampled	Minimum	Maximum	Mean	Stdev	Variance	CV	Maximum	Mean	Stdev	Variance	CV	Metal Loss
Arex	Stratabound	Zn (%)	2,835	2,804	0.0050	48.88	5.20	7.18	51.51	1.38	48.88	5.19	7.18	51.51	1.38	0%
		Pb (%)	2,835	2,804	0.0002	34.40	1.87	3.10	9.62	1.66	34.40	1.87	3.10	9.60	1.66	0%
		Cu (%)	2,835	2,804	0.0001	16.70	0.36	1.15	1.32	3.21	14.03	0.28	0.87	0.76	3.08	-21%
		Au (g/t)	2,835	2,559	0.0025	10.56	0.24	0.62	0.39	2.63	10.56	0.24	0.62	0.38	2.63	0%
		Ag (g/t)	2,835	2,793	0.0100	2,180.00	50.65	106.08	11,253.24	2.09	1,530.00	43.30	79.08	6,253.35	1.83	-15%
	Stringer	Zn (%)	2,273	2,248	0.0001	21.00	0.18	1.00	1.00	5.43	21.00	0.18	0.98	0.95	5.50	-3%
		Pb (%)	2,273	2,248	0.0001	27.50	0.07	0.57	0.32	7.88	27.50	0.07	0.56	0.32	7.98	-1%
		Cu (%)	2,273	2,248	0.0001	20.44	1.33	2.35	5.50	1.76	20.44	1.32	2.33	5.41	1.76	-1%
		Au (g/t)	2,273	2,227	0.0025	138.90	1.43	4.68	21.87	3.28	138.90	1.33	4.18	17.51	3.14	-7%
		Ag (g/t)	2,273	2,214	0.0500	536.00	14.47	30.00	899.98	2.07	536.00	14.47	30.00	899.98	2.07	0%
Ambrex	Stratabound	Zn (%)	10,553	10,505	0.0020	60.90	4.75	6.81	46.35	1.43	46.90	4.72	6.74	45.46	1.43	-1%
		Pb (%)	10,553	10,505	0.0000	42.81	1.73	3.07	9.44	1.78	42.81	1.72	3.04	9.26	1.77	0%
		Cu (%)	10,553	10,505	0.0000	19.24	0.10	0.56	0.32	5.36	11.00	0.10	0.50	0.25	5.01	-4%
		Au (g/t)	10,553	9,276	0.0000	22.70	0.23	0.69	0.48	2.98	12.50	0.22	0.58	0.34	2.60	-4%
		Ag (g/t)	10,553	10,485	0.0100	1,240.00	41.31	80.68	6,509.08	1.95	1,240.00	41.05	79.52	6,323.58	1.94	-1%
	Stringer	Zn (%)	3,732	3,708	0.0001	35.51	0.16	1.18	1.40	7.27	13.41	0.12	0.69	0.48	5.60	-24%
		Pb (%)	3,732	3,708	0.0001	14.00	0.08	0.49	0.24	6.47	8.98	0.07	0.40	0.16	5.72	-9%
		Cu (%)	3,732	3,708	0.0001	52.36	0.65	1.79	3.22	2.76	18.11	0.61	1.16	1.36	1.91	-6%
		Au (g/t)	3,732	3,708	0.0025	96.70	0.91	3.36	11.26	3.67	47.50	0.85	2.49	6.22	2.95	-7%
		Ag (g/t)	3,732	3,709	0.0050	605.00	8.24	18.47	341.05	2.24	605.00	8.09	17.66	311.93	2.18	-2%

FIGURE 14-4 CAPPING ANALYSIS FOR BODY=33 (AMBREX LINK STRATABOUND)

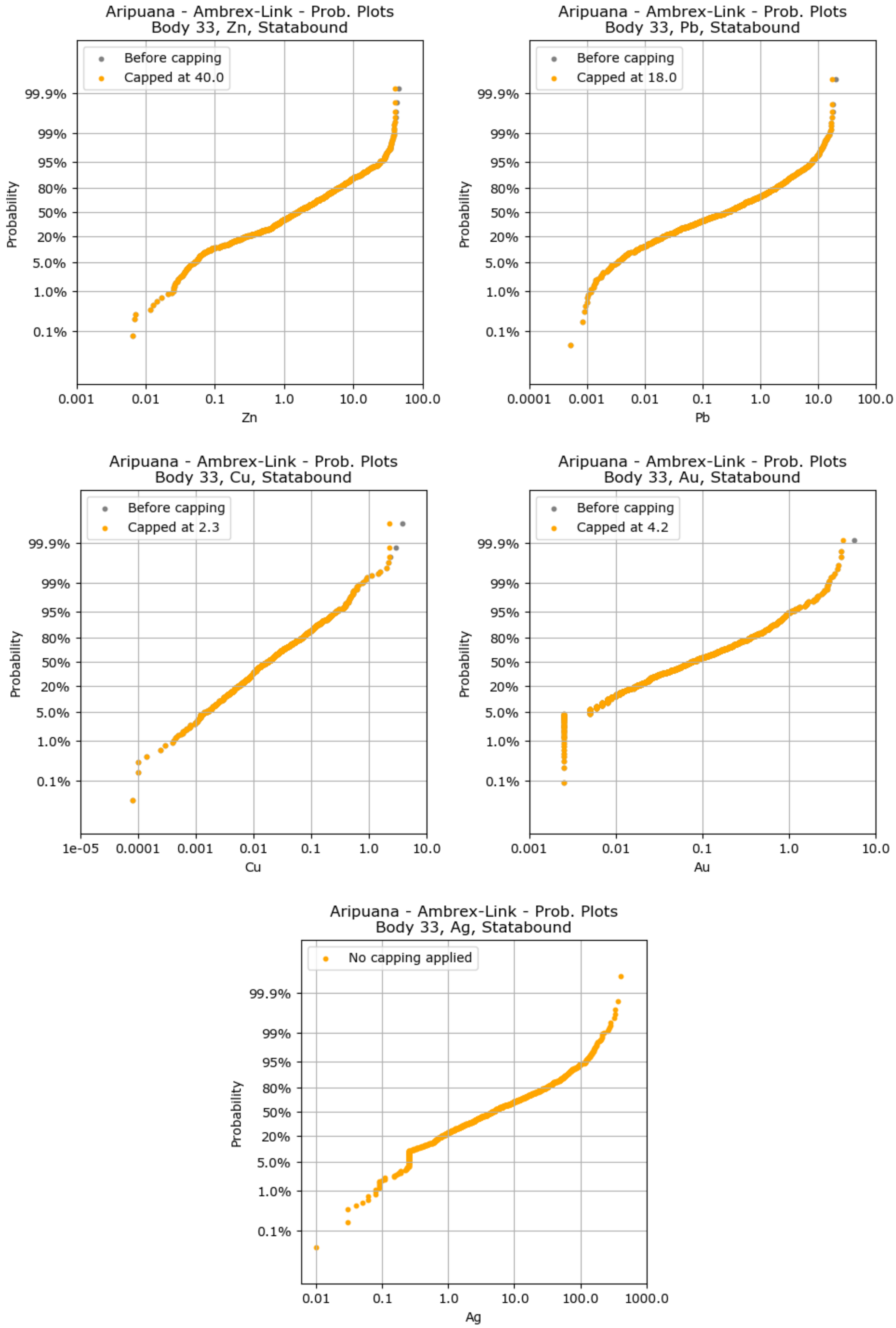
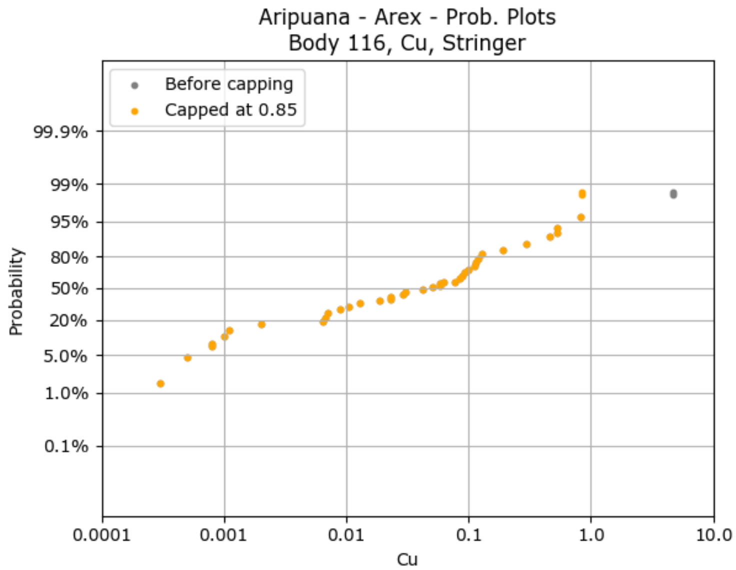


FIGURE 14-5 CU CAPPING ANALYSIS FOR BODY=116 (AREX STRINGER)



COMPOSITING

Nexa composited the capped assays to one metre, which corresponds to the dominant sampling length for the deposit (Figure 14-6). Composites were weighted by length and unsampled core intervals were set to zero. Gold is sampled to a lesser extent than other metals.

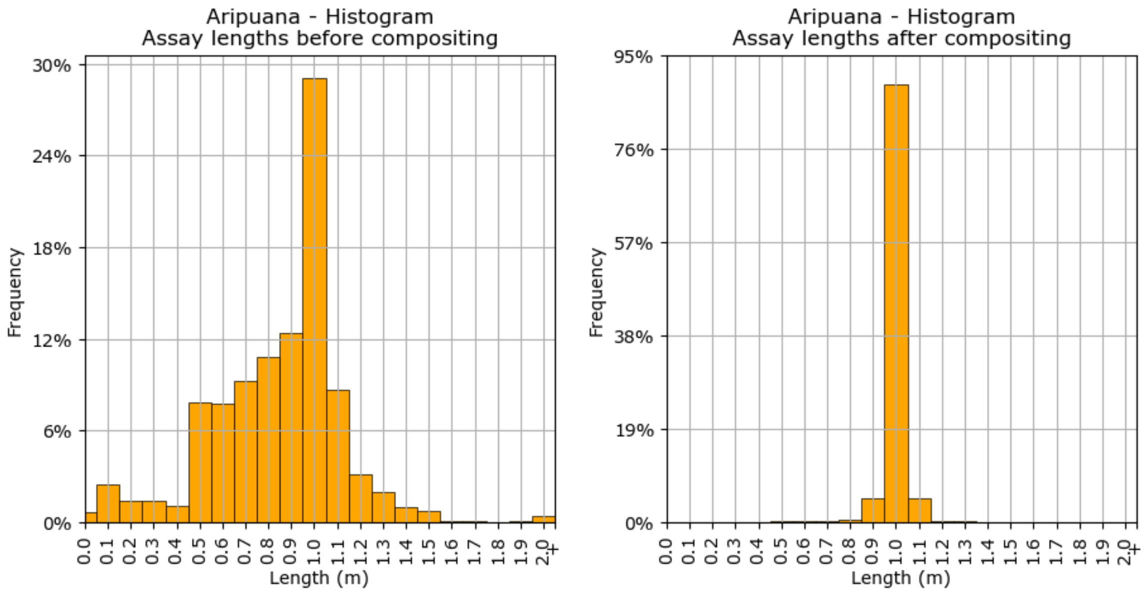
The univariate statistics for the composites is provided in Table 14-6.

TABLE 14-6 COMPOSITE STATISTICS

Nexa Resources S.A. – Aripuanã Zinc Project

Area	Type	Grade	Count	Sampled	Minimum	Uncapped Maximum	Uncapped Mean	Uncapped Stdev	Uncapped Variance	Uncapped CV	Capped Maximum	Capped Mean	Capped Stdev	Capped Variance	Capped CV	Metal Loss
Arex	Stratabound	Zn (%)	2,279	2,251	0.0000	44.42	5.15	6.41	41.07	1.24	44.42	5.15	6.41	41.07	1.25	0%
		Pb (%)	2,279	2,251	0.0000	20.35	1.86	2.75	7.58	1.48	20.35	1.85	2.75	7.56	1.49	0%
		Cu (%)	2,279	2,251	0.0000	16.67	0.35	1.06	1.12	3.00	13.25	0.28	0.82	0.67	2.93	-21%
		Au (g/t)	2,279	2,251	0.0000	8.64	0.21	0.52	0.27	2.47	8.64	0.21	0.52	0.27	2.47	0%
		Ag (g/t)	2,279	2,251	0.0000	1,553.06	50.01	95.41	9,102.70	1.91	808.14	42.75	70.49	4,968.55	1.65	-15%
	Stringer	Zn (%)	1,889	1,873	0.0000	16.73	0.18	0.87	0.75	4.80	16.73	0.17	0.85	0.72	4.85	-3%
		Pb (%)	1,889	1,873	0.0000	11.27	0.07	0.42	0.18	5.96	11.27	0.07	0.42	0.18	6.03	-1%
		Cu (%)	1,889	1,873	0.0000	20.44	1.31	2.17	4.72	1.66	20.44	1.30	2.16	4.65	1.66	-1%
		Au (g/t)	1,889	1,873	0.0000	126.95	1.39	4.17	17.38	3.00	126.95	1.30	3.79	14.37	2.93	-7%
		Ag (g/t)	1,889	1,873	0.0000	373.09	14.04	26.99	728.53	1.92	373.09	14.04	26.99	728.53	1.92	0%
Ambrex	Stratabound	Zn (%)	8,996	8,973	0.0000	46.78	4.71	6.25	39.07	1.33	46.78	4.68	6.19	38.38	1.32	-1%
		Pb (%)	8,996	8,973	0.0000	29.53	1.71	2.78	7.71	1.62	29.53	1.71	2.76	7.59	1.62	0%
		Cu (%)	8,996	8,973	0.0000	18.76	0.10	0.54	0.29	5.18	11.00	0.10	0.48	0.23	4.82	-4%
		Au (g/t)	8,996	8,973	0.0000	17.01	0.20	0.60	0.35	2.96	12.50	0.19	0.51	0.26	2.64	-4%
		Ag (g/t)	8,996	8,973	0.0000	1,035.49	40.94	72.72	5,288.15	1.78	1,035.49	40.68	71.92	5,172.47	1.77	-1%
	Stringer	Zn (%)	3,251	3,246	0.0000	27.27	0.16	1.05	1.10	6.52	11.40	0.12	0.63	0.40	5.19	-24%
		Pb (%)	3,251	3,246	0.0000	10.52	0.08	0.44	0.19	5.79	8.37	0.07	0.36	0.13	5.26	-9%
		Cu (%)	3,251	3,246	0.0000	50.27	0.64	1.64	2.69	2.55	16.00	0.60	1.06	1.12	1.76	-6%
		Au (g/t)	3,251	3,246	0.0000	68.94	0.90	2.76	7.62	3.06	45.27	0.84	2.10	4.43	2.52	-7%
		Ag (g/t)	3,251	3,246	0.0000	514.65	8.13	16.71	279.30	2.05	514.65	7.99	15.97	254.94	2.00	-2%

FIGURE 14-6 HISTOGRAMS FOR ASSAY (LEFT) AND COMPOSITE (RIGHT) LENGTHS



EXPLORATORY DATA ANALYSIS

Nexa performed exploratory statistical analysis including boundary, bivariate and univariate statistical analysis.

Nexa generated contact plots for material inside and outside of the wireframes and concluded that hard boundaries should be used during estimation (e.g., Figure 14-7).

The bivariate analysis results show strong correlations between stratabound Pb-Zn, Pb-Ag and Cu-Au, while for stringer mineralization, good correlations between Cu-Ag and Fe-S exist. In general, stratabound and stringer mineralization Fe and S show strong correlations (Figure 14-8). The results are consistent with the deposit type.

Given the large quantity of individual wireframes, Nexa grouped wireframes based on geological continuity, Zn statistics for stratabound, and Cu statistics for stringer mineralization (Table 14-7 and Figure 14-9). The grouping was applied to variography and the interpolation strategy.

TABLE 14-7 WIREFRAME GROUPING FOR VARIOGRAPHY AND SEARCH PARAMETERS

Nexa Resources S.A. – Aripuanã Zinc Project

Area	Group	Min Type	Body
Ambrex	G1	Stratabound	5, 6, 7, 9, 12
	G2	Stratabound	1, 4, 8, 10, 11
	G3	Stratabound	30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45
	G4	Stratabound	20, 21, 23
	G5	Stratabound	22
	G6	Stratabound	51
	G7	Stratabound	52, 53
	G8	Stratabound	50
	G9	Stratabound	54, 55
	G10	Stringer	166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179
	G11	Stringer	120, 121, 122, 123, 131, 132, 141, 142, 143, 144, 180, 181, 184, 191, 192
Arex	G21	Stratabound	62, 67, 68, 70, 71, 73, 77, 79, 80
	G22	Stratabound	72, 74, 75, 76, 81
	G23	Stratabound	63, 65
	G24	Stratabound	64, 66
	G30	Stringer	150
	G31	Stringer	108, 115, 153
	G32	Stringer	104, 107, 114, 117, 151
	G33	Stringer	105, 106, 152
	G34	Stringer	109, 110, 116
	G35	Stringer	101, 112
	G36	Stringer	160, 161

FIGURE 14-7 AREX STRATABOUND CONTACT ANALYSIS

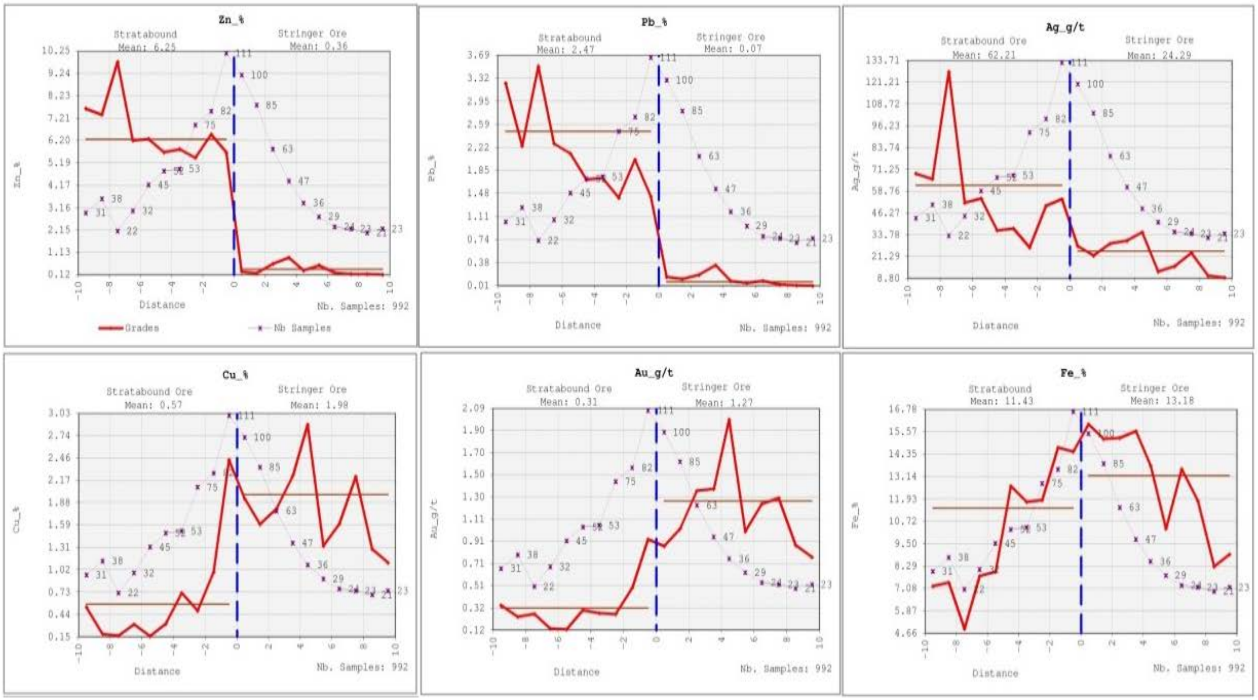


FIGURE 14-8 CORRELATION MATRICES FOR STRATABOUND AND STRINGER

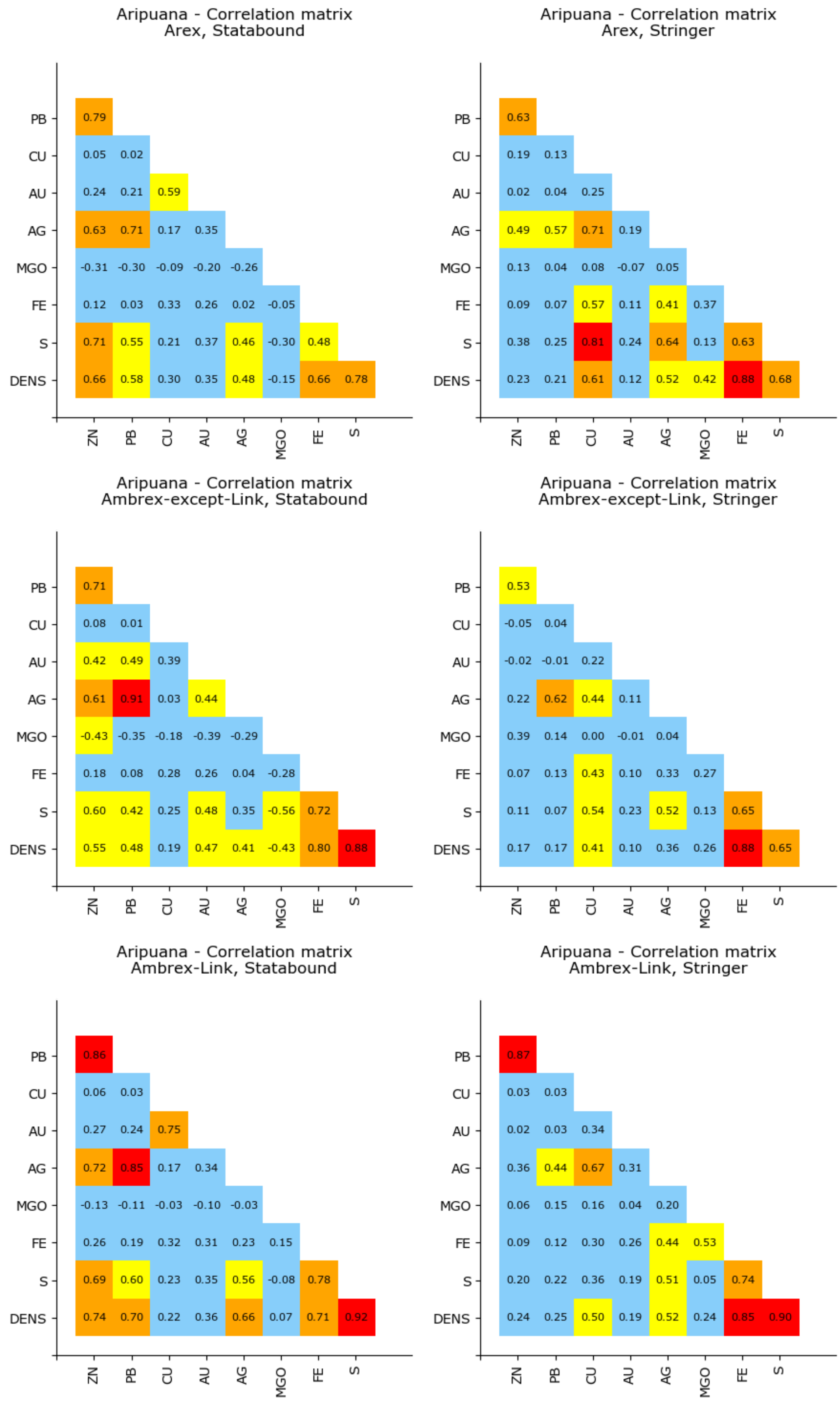
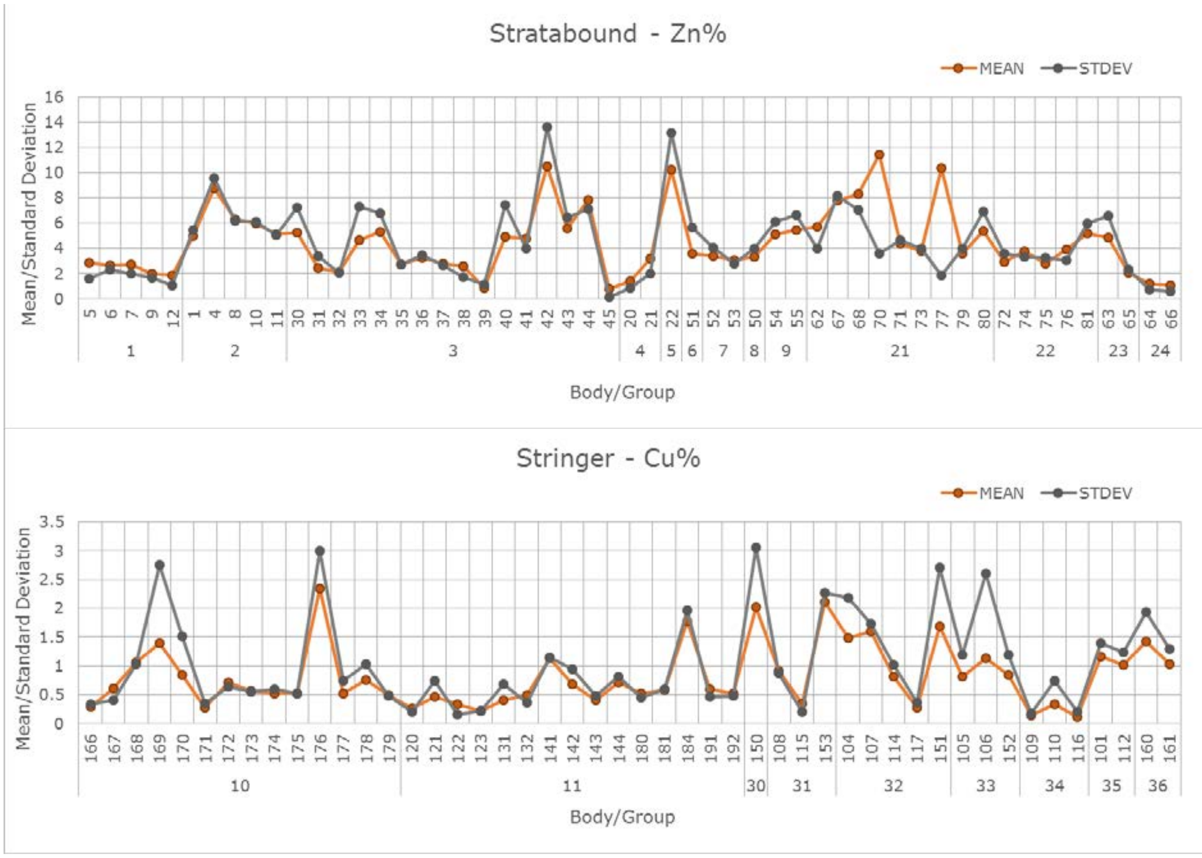


FIGURE 14-9 ZN AND CU STATISTICS BY BODY AND GROUP



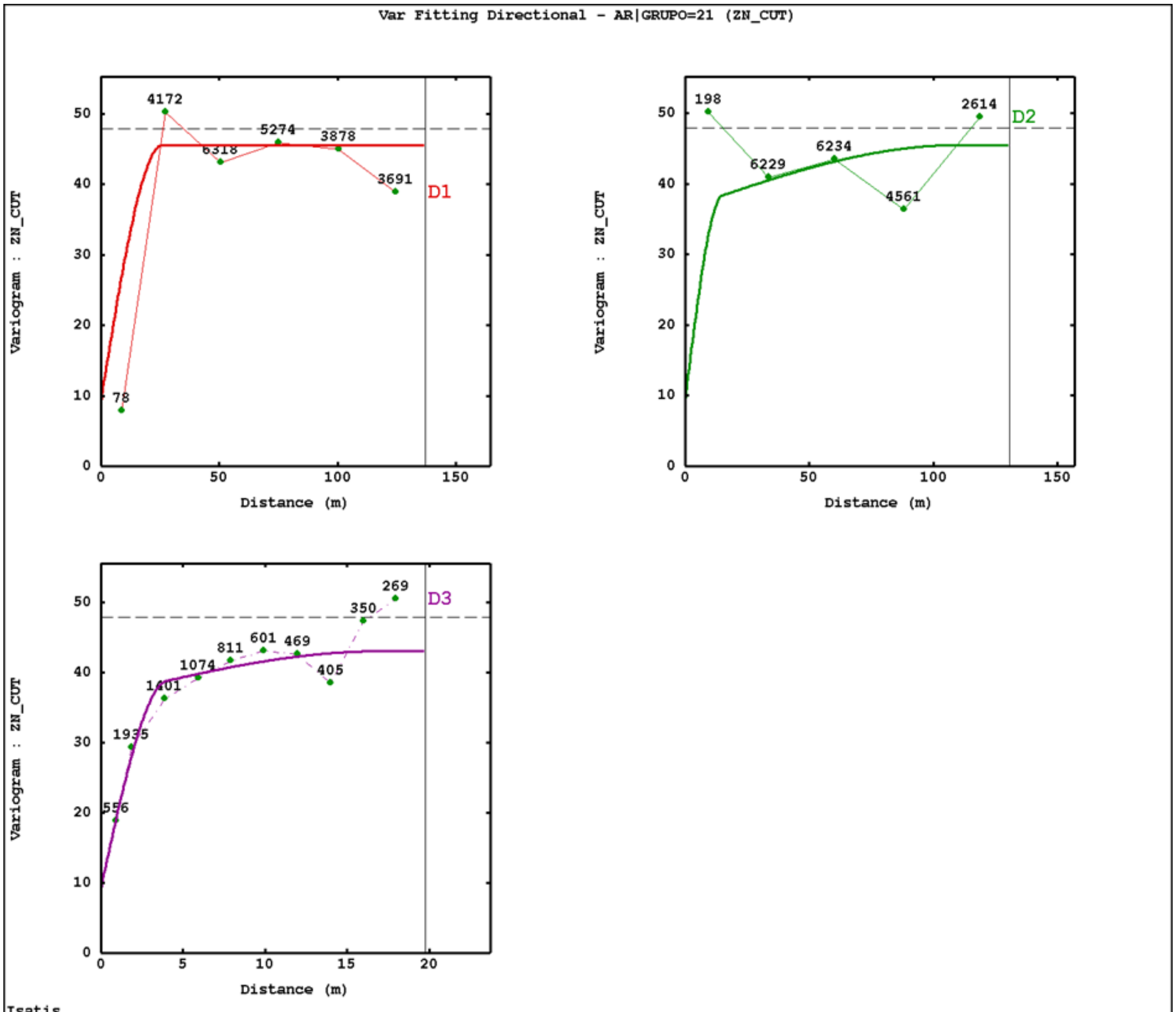
VARIOGRAPHY

In general, experimental traditional variograms were fit by one to three spherical models in three directions for variables Zn, Pb, Cu, Au, Ag, Fe, S, MgO, and density in Isatis. Experimental correlograms were used in the Link Zone. Traditional variograms were not-standardized. Examples of Nexa's variograms are shown in Figures 14-10 to 14-12. The stratabound and stringer relative nugget effects for Zn and copper are shown in Figure 14-13 while the ranges of the variograms are shown in Figures 14-14.

For many of the variograms, the sill was fit to different levels for different directions giving the impression of a zonal anisotropy present in the mineralization. The different sills were accounted for by fitting long tails for the second and third structures for the direction with the lower variance. The variograms were used for OK interpolation and as a guide for selecting search ellipse ranges (range at 80% of the total sill).

In cases where the data did not support directional variograms, omni-directional variograms were modelled.

FIGURE 14-10 AREX STRATABOUND, GROUP 21 ZN DIRECTIONAL VARIOGRAMS




```
Compositas/ap-compdh-ln(GRUPO{GRUPO=21})
- Variable #1 : ZN_CUT
Variogram : in 3 direction(s)
D1   : D1
      Angular tolerance =  22.50
      Lag =  25.000m, Count = 6 lags, Tolerance = 50.00%
      Horizontal Slicing =  25.000m
      Vertical Slicing =  15.000m
D2   : D2
      Angular tolerance =  22.50
      Lag =  30.000m, Count = 5 lags, Tolerance = 50.00%
      Horizontal Slicing =  22.500m
      Vertical Slicing =  22.500m
D3   : D3
      Angular tolerance =  45.00
      Lag =  2.000m, Count = 10 lags, Tolerance = 50.00%
Model : 4 basic structure(s)
Global rotation = Azimuth=N274.00 Dip=45.00 Pitch=12.00 (Geologist Plane)
S1   - Nugget effect, Sill =          9
S2   - Spherical - Range = 4.000m, Sill =        27.5
      Directional Scales = (          26.000m,          15.000m,          4.000m)
S3   - Spherical - Range = 17.000m, Sill =        6.5
      Directional Scales = (          26.000m,         110.000m,         17.000m)
S4   - Spherical - Range = 26.000m, Sill =        2.5
      Directional Scales = (          26.000m,         110.000m,      10000.000m)
```

talitacof
Jan 12 2017 08:21:56
Isatis_FEL3_REV-RPA

FIGURE 14-11 AMBREX AND LINK ZONES STRATABOUND, GROUP 3 ZN DIRECTIONAL CORRELOGRAMS

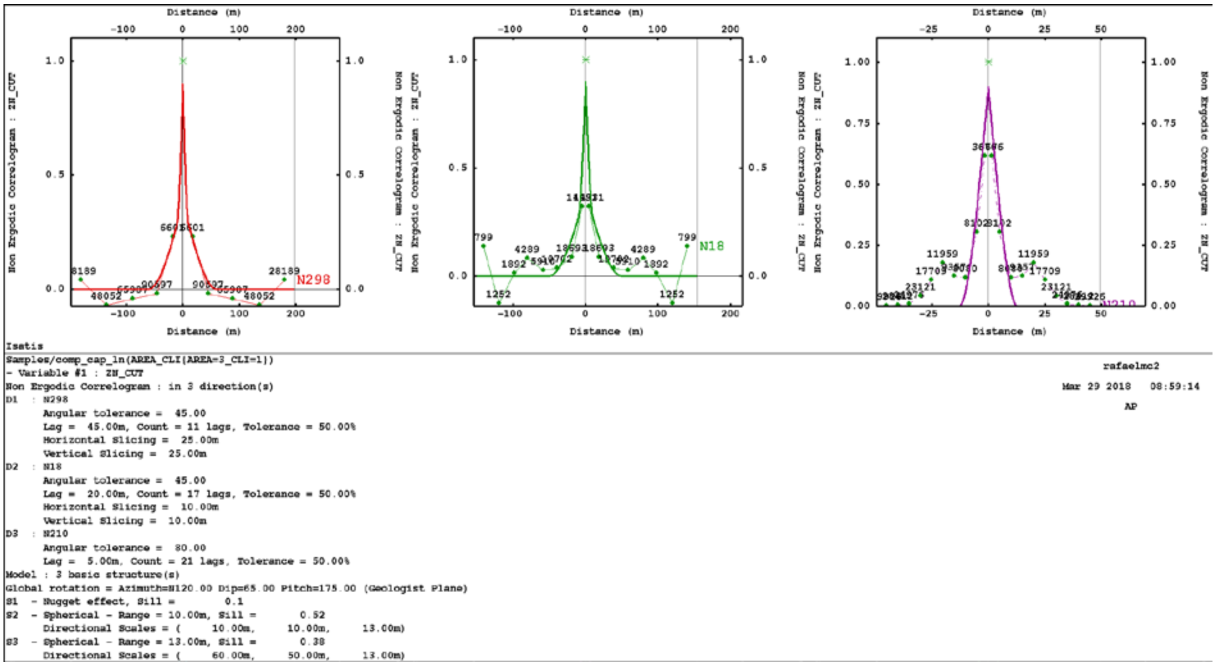
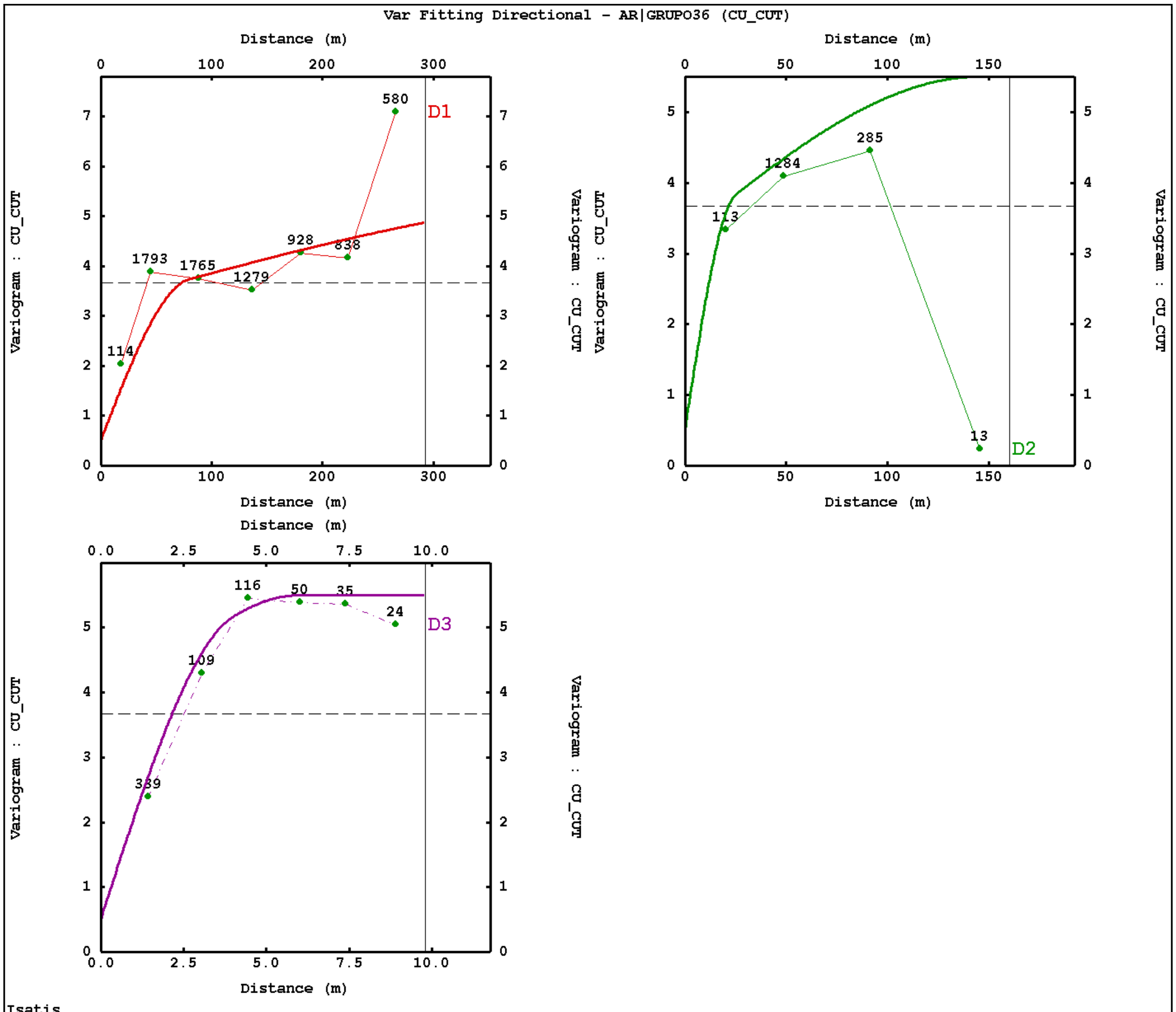


FIGURE 14-12 AREX STRINGER, GROUP 36 ZN DIRECTIONAL VARIOGRAMS




```
Compositas/ap-compdh-1n(GRUPO{GRUPO=36})                          talitacof
- Variable #1 : CU_CUT
Variogram : in 3 direction(s)                                Jan 12 2017   09:49:08
D1  : D1                                                         Isatis_AREX2016
      Angular tolerance =  25.00
      Lag =  45.00m, Count = 7 lags, Tolerance = 50.00%
      Horizontal Slicing =  20.00m
      Vertical Slicing =  15.00m
D2  : D2
      Angular tolerance =  22.50
      Lag =  50.00m, Count = 5 lags, Tolerance = 50.00%
      Horizontal Slicing =  25.00m
      Vertical Slicing =  15.00m
D3  : D3
      Angular tolerance =  45.00
      Lag =  1.50m, Count = 7 lags, Tolerance = 50.00%
Model : 3 basic structure(s)
Global rotation = Azimuth=N290.00 Dip=48.00 Pitch=12.00 (Geologist Plane)
S1  - Nugget effect, Sill =        0.5
S2  - Spherical - Range = 4.00m, Sill =       2.75
      Directional Scales = (     80.00m,      25.00m,       4.00m)
S3  - Spherical - Range = 6.00m, Sill =       2.25
      Directional Scales = (    550.00m,     145.00m,       6.00m)
```

FIGURE 14-13 RELATIVE NUGGET EFFECT ZN AND CU

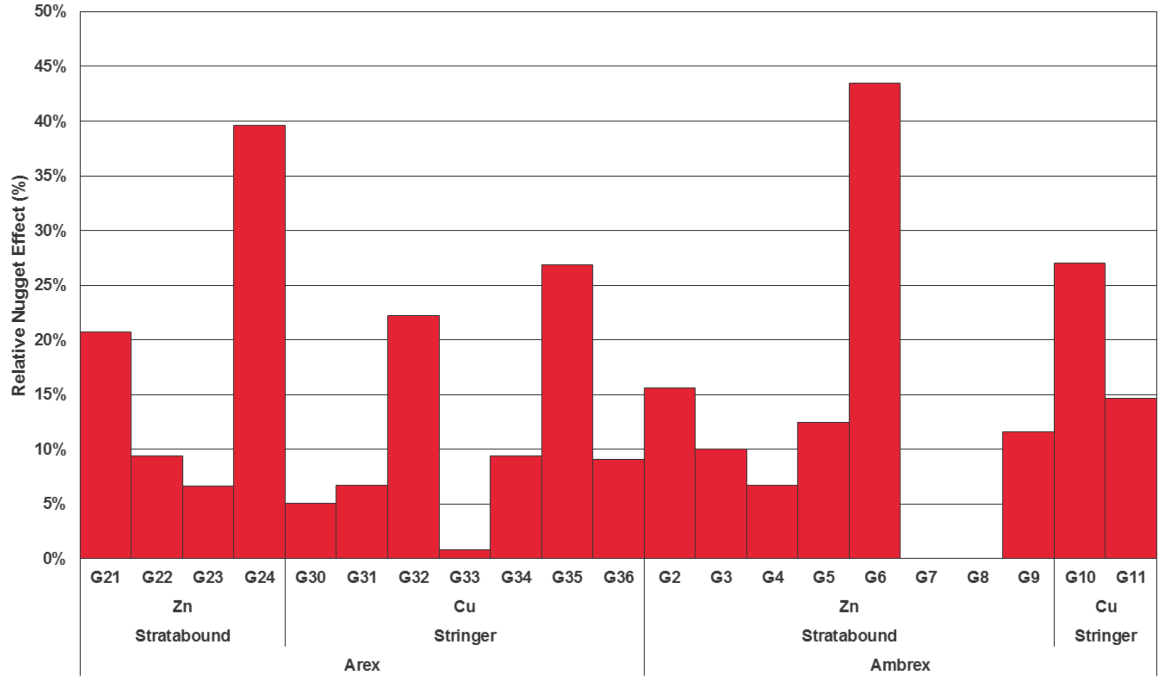
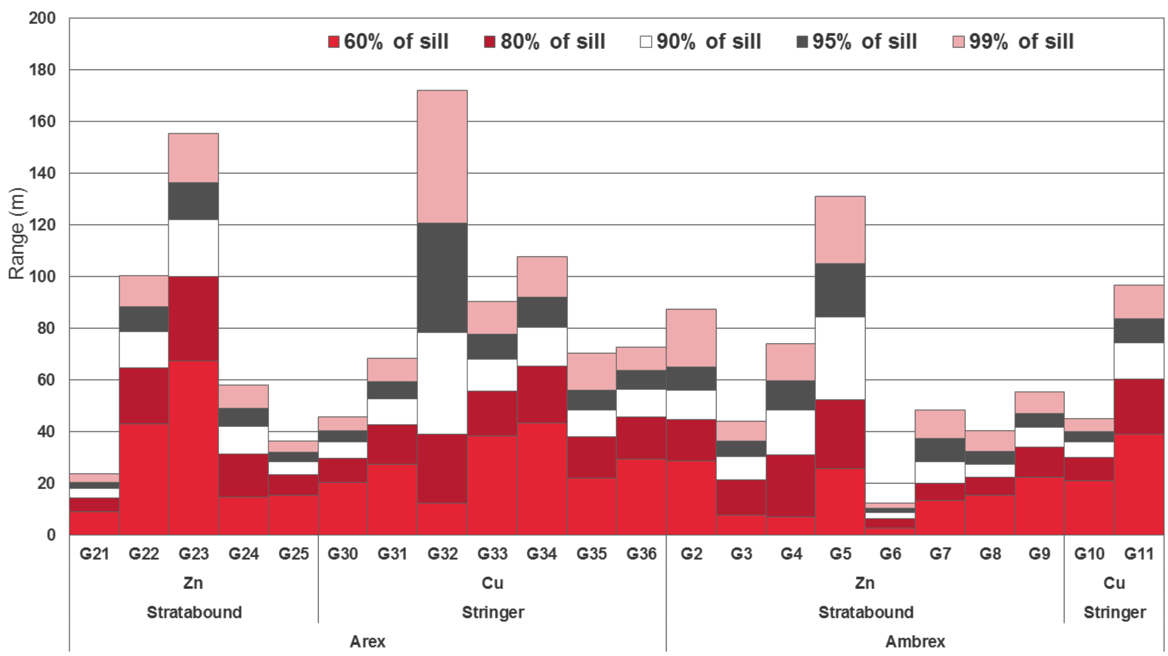


FIGURE 14-14 VARIOGRAM RANGES FOR ZN AND CU



*Note: Ranges shown exclude structures fit to zonal anisotropy

RPA is of the opinion that, in general, the variograms are reasonable. RPA notes that many variograms have been fit with a strong zonal anisotropy in Arex and Ambrex. RPA recommends modelling correlograms to avoid fitting second and third variogram model structures with long ranges.

BLOCK MODEL

Ambrex and Arex wireframes were filled with blocks in Datamine Studio RM. The final block model covers both zones. The block model was sub-celled at wireframe boundaries with parent cells measuring ten metres by five metres by five metres and minimum sub-cell sizes of 1.00 m by 0.25 m by 0.25 m. The block model setup is given in Table 14-8, while a description of the block model attributes is given in Table 14-9.

The block size is appropriate for the drill spacing and proposed mining method and is suitable to support the estimation of Mineral Resources and Mineral Reserves. Comparisons between wireframe and block model volumes are reasonable.

TABLE 14-8 BLOCK MODEL SETUP

Nexa Resources S.A. – Aripuanã Zinc Project

Parameter	X	Y	Z
Origin (m)	224,400	8,886,800	-600
Block Size (m)	10	5	5
Number of Blocks	297	440	210

TABLE 14-9 BLOCK MODEL ATTRIBUTE DESCRIPTIONS

Nexa Resources S.A. – Aripuanã Zinc Project

FIELD	DESCRIPTION		FIELD	DESCRIPTION	
ZN	Estimated Zn(%)		ALT_PRIM	Primary alteration	
PB	Estimated Pb(%)			1	Carbonate
CU	Estimated Cu(%)			2	Chlorite
AU	Estimated Au(g/t)			3	Sericite
AG	Estimated Ag(g/t)			4	Silica
FE	Estimated Fe(%)			5	Talc
MGO	Estimated MgO			6	Tremolite
S	Estimated S			7	Weathered Rock
DENS	Density (t/m³)		ALT_SEC	Secondary alteration	
TON	Tonnes			1	Biotite
CLASS	1	Measured		2	Magnetite
	2	Indicated		3	Absent
	3	Inferred	CLORIT	Chloritization	
	99	Not Classified		1	High
*CLI	1	Stratabound		2	Low
	2	Stringer		3	Residual
	3	Soil	INTENS	Intensity of Alteration	
	4	Hydrothermal Zone		1	High
BODY	Deposit identification			2	Low
	0-59	Ambrex Stratabound	PIRITA	Quantity of Pyrite	
	60-99	Arex Stratabound		1	High
	100-199	Stringer bodies		2	Medium
	1000	Hydrothermal Zone		3	Low
AREA	Target			4	Weathered Rock
	1	Arex		5	Absent
	2	Ambrex	PIRROT	Quantity of Pyrrhotite	
	3	Ambrex-Link			
COLOUR	11	Arex Stratabound		1	High
	17	Arex Stringer		2	Medium
	2-3	Ambrex Stratabound		3	Absent
	47	Ambrex Stringer	SULF	Sulphur	
	5	Link Stratabound		1	Present
	53	Link Stringer		2	Absent

INTERPOLATION STRATEGY

Grades were interpolated into blocks on a parent cell basis using OK. ID^2 was used for groups that did not yield interpretable variograms. Variables Zn, Pb, Cu, Au, Ag, Fe, S, MgO, and density are interpolated and estimates are not density weighted.

Search ellipsoids were oriented based on dynamic anisotropy angles extracted for the mineralization wireframes. The search ranges were determined approximately as follows:

- Pass 1: The range at 80% of the sill (25 m by 25 m by 25 m in the case of ID^2).
- Pass 2: The range of the variogram (50 m by 50 m by 50 m in the case of ID^2).
- Pass 3, 4 and 5: Two, four and ten times the range of the variogram (to interpolate remaining blocks).

The sample selection strategy is given in Table 14-10, while the search ranges for the Zn stratabound and Cu stringer are given in Figures 14-15 and 14-16, respectively.

TABLE 14-10 SAMPLE SELECTION STRATEGY
Nexa Resources S.A. – Aripuanã Zinc Project

Wireframes Group	Search Pass	Min Samples	Max Samples	Max per hole	Min Samples per Octant	Max Samples per Octant	Minimum Octants Used	Method
G1, G2	1	6	16	3	2	4	5	OK
G1, G2	2	6	16	3	2	4	5	OK
G1, G2	3	1	16	10	-	-	-	OK
G1, G2	4	2	16	10	-	-	-	OK
G3	1	3	10	2	1	4	2	OK
G3	2	3	10	2	1	4	2	OK
G3	3	1	10	5	2	4	2	OK
G3	4	1	10	5	2	4	2	OK
G4	1	3	16	5	2	4	4	OK/ID
G4	2	3	16	5	2	4	4	OK/ID
G4	3	2	16	5	2	4	4	OK/ID
G5, G6, G7	1	6	16	3	2	4	5	OK
G5, G6, G7	2	6	16	3	2	4	5	OK
G5, G6, G7	3	3	16	10	-	-	-	OK
G5, G6, G7	4	1	16	10	-	-	-	OK
G8	1	3	16	5	2	4	4	OK
G8	2	3	16	5	2	4	4	OK
G8	3	3	16	5	2	4	4	OK

Wireframes Group	Search Pass	Min Samples	Max Samples	Max per hole	Min Samples per Octant	Max Samples per Octant	Minimum Octants Used	Method
G8	4	3	16	5	2	4	4	OK
G8	5	1	16	5	2	4	4	OK
G9	1	3	16	5	2	4	4	OK
G9	2	3	16	5	2	4	4	OK
G9	3	3	16	5	-	-	-	OK
G9	4	3	16	5	-	-	-	OK
G9	5	1	16	5	-	-	-	OK
G10	1	4	8	8	1	2	2	OK
G10	2	4	8	8	1	2	2	OK
G10	3	4	8	8	1	2	2	OK
G11	1	3	16	8	-	-	-	OK/ID
G11	2	3	16	8	-	-	-	OK/ID
G11	3	3	16	8	-	-	-	OK/ID
G11	4	1	16	8	-	-	-	OK/ID
G11	5	1	16	8	-	-	-	OK/ID
G21, G23, G30, G31, G32, G33, G34, G35, G36	1	4	16	5	1	4	4	OK/ID
G21, G23, G30, G31, G32, G33, G34, G35, G36	2	4	16	5	1	4	4	OK/ID
G21, G23, G30, G31, G32, G33, G34, G35, G36	3	3	16	5	-	-	-	OK/ID
G21, G23, G30, G31, G32, G33, G34, G35, G36	4	2	16	5	-	-	-	OK/ID
G21, G23, G30, G31, G32, G33, G34, G35, G36	5	2	16	5	-	-	-	OK/ID
G22	1	3	16	5	1	4	4	OK
G22	2	3	16	5	1	4	4	OK
G22	3	3	16	5	-	-	-	OK
G22	4	2	16	5	-	-	-	OK
G22	5	2	16	5	-	-	-	OK
G24	1	3	16	5	1	4	3	OK
G24	2	2	16	5	-	-	-	OK
G24	3	2	16	5	-	-	-	OK
G24	4	2	16	5	-	-	-	OK/ID

FIGURE 14-15 SEARCH RANGES FOR ZN STRATABOUND

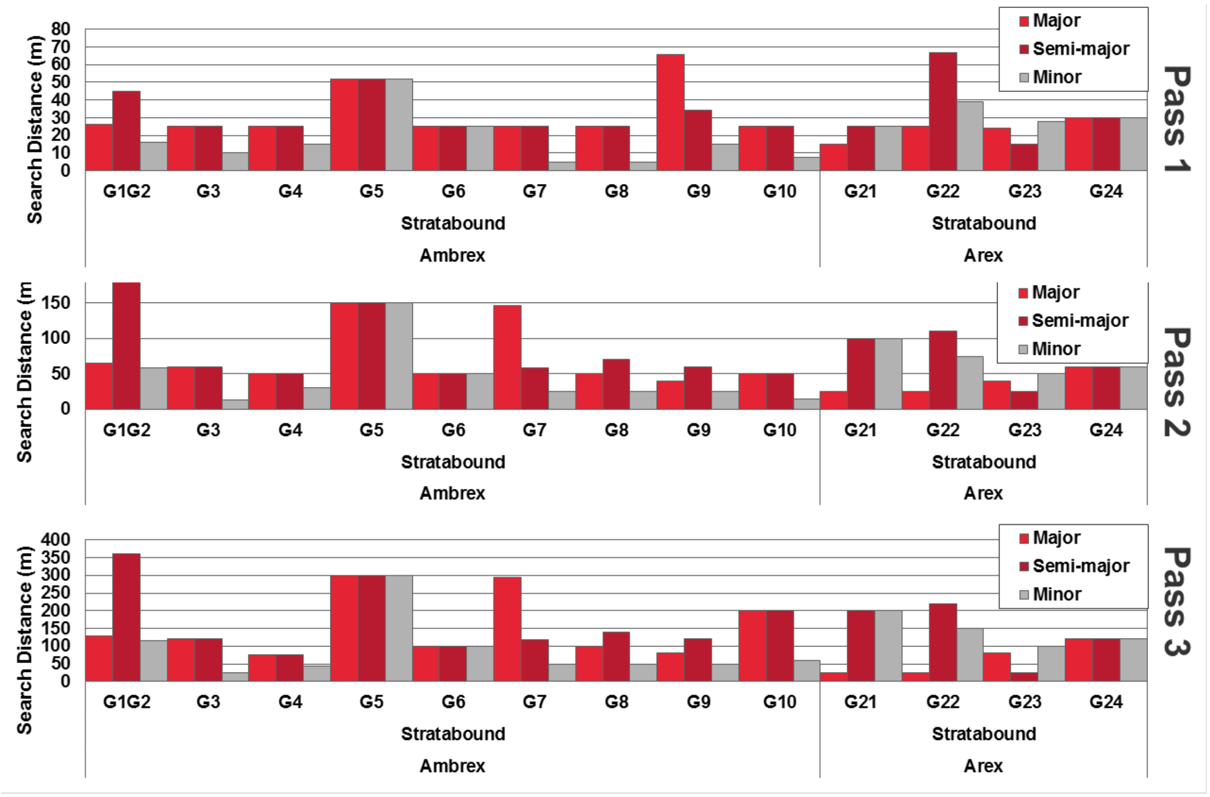
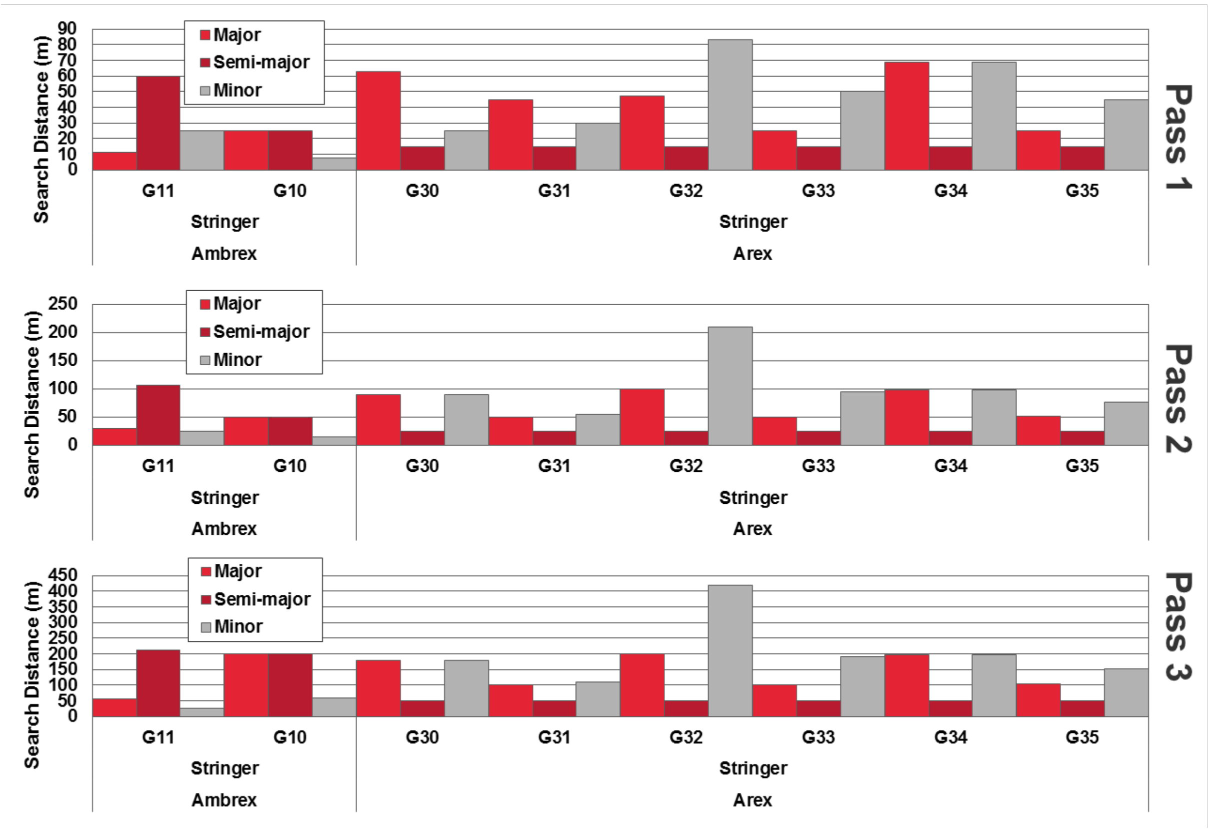


FIGURE 14-16 SEARCH RANGES FOR CU STRINGER



NET SMELTER RETURN CUT-OFF VALUE

An NSR value was assigned to blocks for the purposes of validation of the geological interpretation and resource reporting. NSR is the estimated dollar value per tonne of mineralized material after allowance for metallurgical recovery and consideration of smelter terms, including revenue from payable metals, treatment charges, refining charges, price participation, penalties, smelter losses, transportation, and sales charges.

Input parameters used to develop the NSR calculation have been derived from metallurgical test work on the Aripuanã Zinc property, smelter terms from comparable projects, and information provided by Nexa. These assumptions are dependent on the processing scenario, and will be sensitive to changes in inputs from further metallurgical test work. Key assumptions are listed below.

Metal prices and exchange rate:

- US$1.29 per pound of zinc
- US$0.99 per pound of lead
- US$3.43 per pound of copper
- US$1,368 per ounce of gold
- US$21.37 per ounce of silver
- US$1.00 equals R3.30

Metal prices were selected by Nexa, and are based on consensus, long term forecasts from banks, financial institutions, and other sources.

Metallurgical recoveries are based on preliminary metallurgical testing, and are summarized by zone and deposit:

Stratabound

Copper Concentrate

- 20% Ag recovery to Cu concentrate
- 50% Au recovery to Cu concentrate
- 68% Cu recovery to Cu concentrate grading 31% copper

Lead Concentrate

- 20% Au recovery to Pb concentrate
- 55% Ag recovery to Pb concentrate
- 86% Pb recovery to Pb concentrate grading 58% lead

Zinc Concentrate

- 10% Au recovery to Zn concentrate
- 10% Ag recovery to Zn concentrate
- 89% Zn recovery to Zn concentrate grading 58% zinc

Stringer

Copper Concentrate

- 63% Au recovery to Cu concentrate
- 50% Ag recovery to Cu concentrate
- 90% Cu recovery to Cu concentrate grading 31% copper

Standard smelting and refining charges were applied to the various concentrates. It was assumed that the concentrates would be marketed internationally.

The NSR factors are shown in Table 14-11 which can be used to calculate approximately the NSR for any set of metal grades.

TABLE 14-11 NSR FACTORS
Nexa Resources S.A. – Aripuanã Zinc Project

Metal	Units	All Areas	
		Stratabound	Stringer
Au	US$ per g Au	22.27	23.58
Ag	US$ per g Ag	0.44	0.27
Cu	US$ per % Cu	40.36	53.90
Pb	US$ per % Pb	11.86	-
Zn	US$ per % Zn	15.32	-

For the purposes of developing an NSR cut-off value, a total unit operating cost of US$38.00 per tonne of mineralization milled was estimated, which included mining, processing, and general and administrative expenses.

The sensitivity of the Mineral Resource to NSR cut-off value is shown in Tables 14-12 and 14-13.

TABLE 14-12 SENSITIVITY TO CUT-OFF VALUE – STRATABOUND (INCLUSIVE)
Nexa Resources S.A. – Aripuanã Zinc Project

NSR Cut-off	Tonnes (Mt)	Zn (%)	Pb (%)	Cu (%)	Au (g/t)	Ag (g/t)	Zn (Mlb)	Pb (Mlb)	Cu (Mlb)	Au (koz)	Ag (Moz)
Measured and Indicated											
$20.00	27.23	5.00	1.80	0.14	0.20	43.45	3,002.9	1,080.1	82.8	178.6	38.0
$30.00	26.15	5.16	1.86	0.14	0.21	44.99	2,974.3	1,070.4	79.6	179.9	37.8
$38.00	**24.96**	**5.33**	**1.92**	**0.15**	**0.22**	**46.72**	**2,935.4**	**1,058.8**	**81.7**	**176.6**	**37.5**
$40.00	24.61	5.39	1.94	0.15	0.22	47.26	2,926.2	1,054.6	80.5	174.0	37.4
$50.00	22.76	5.67	2.05	0.16	0.23	50.16	2,847.2	1,028.0	79.8	168.3	36.7
$60.00	20.73	6.01	2.18	0.16	0.24	53.55	2,745.1	997.0	73.1	160.0	35.7
Inferred											
NSR Cut-off	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
$20.00	18.20	5.21	1.98	0.14	0.3	44.6	2,090.1	794.3	56.2	176	26.1
$30.00	16.87	5.54	2.11	0.15	0.32	47.63	2,060.5	784.8	55.8	174	25.8
$38.00	**14.66**	**6.17**	**2.35**	**0.17**	**0.35**	**53.73**	**1,993.8**	**759.4**	**54.9**	**165**	**25.3**
$40.00	14.33	6.28	2.4	0.17	0.35	54.76	1,983.9	758.2	53.7	161	25.2
$50.00	12.50	6.92	2.67	0.19	0.38	61.16	1,906.2	735.5	52.3	153	24.6
$60.00	10.51	7.82	3.04	0.21	0.42	69.49	1,811.4	704.2	48.6	142	23.5

TABLE 14-13 SENSITIVITY TO CUT-OFF GRADE – STRINGER (INCLUSIVE)
Nexa Resources S.A. – Aripuanã Zinc Project

NSR Cut-off	Tonnes (Mt)	Zn (%)	Pb (%)	Cu (%)	Au (g/t)	Ag (g/t)	Zn (Mlb)	Pb (Mlb)	Cu (Mlb)	Au (koz)	Ag (Moz)
Measured and Indicated											
$20.00	7.15	0.20	0.09	1.04	1.11	12.18	32.1	13.7	164.2	256.0	2.8
$30.00	6.34	0.21	0.09	1.15	1.20	13.00	29.4	12.3	160.1	245.2	2.6
$38.00	**5.58**	**0.22**	**0.09**	**1.25**	**1.28**	**13.94**	**26.7**	**11.5**	**154.1**	**230.4**	**2.5**
$40.00	5.38	0.22	0.09	1.28	1.31	14.21	26.2	11.1	152.3	226.3	2.5
$50.00	4.44	0.24	0.11	1.45	1.44	15.74	23.7	10.7	141.7	204.8	2.2
$60.00	3.64	0.26	0.12	1.63	1.56	17.49	21.3	9.2	130.9	183.0	2.0
Inferred											
NSR Cut-off	**Tonnes (Mt)**	**Zn (%)**	**Pb (%)**	**Cu (%)**	**Au (g/t)**	**Ag (g/t)**	**Zn (Mlb)**	**Pb (Mlb)**	**Cu (Mlb)**	**Au (koz)**	**Ag (Moz)**
$20.00	13.65	0.06	0.04	0.77	1.45	8.82	18.1	12.0	231.6	636.1	3.9
$30.00	11.54	0.06	0.04	0.86	1.62	9.51	15.3	10.2	218.8	601.0	3.5
$38.00	**9.26**	**0.06**	**0.04**	**1.00**	**1.84**	**10.83**	**12.2**	**8.2**	**203.8**	**546.9**	**3.2**
$40.00	8.84	0.06	0.05	1.03	1.89	11.07	11.7	9.7	200.6	536.9	3.1
$50.00	7.22	0.06	0.04	1.15	2.15	12.12	9.5	6.4	182.9	498.8	2.8
$60.00	6.01	0.06	0.04	1.27	2.37	12.93	8.0	5.3	168.4	458.2	2.5

CLASSIFICATION

Definitions for resource categories used in this report are consistent with those defined by CIM (2014) and adopted by NI 43-101. In the CIM classification, a Mineral Resource is defined as "a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction." Mineral Resources are classified into Measured, Indicated, and Inferred categories. A Mineral Reserve is defined as the "economically mineable part of a Measured and/or Indicated Mineral Resource" demonstrated by studies at Pre-Feasibility or Feasibility level as appropriate. Mineral Reserves are classified into Proven and Probable categories.

Blocks were classified as Measured, Indicated, and Inferred based on drill hole spacing requirements determined from global variograms for the Arex stratabound, Arex stringer, Ambrex stratabound, and Ambrex Link Zone stratabound domains. Flagging of the blocks by drill hole spacing was done by using a search pass with dimensions as described in Table 14-14 and capturing at least three drill holes.

The first pass involved a numerical classification as described of blocks followed by a post processing of the classification to remove isolated blocks classified as Measured or Indicated. With the exception of small areas in contact with the stratabound zone, the stringer zone at Ambrex was classified as Inferred due to the drill holes intersecting the mineralization at low angles.

The classification criteria for each area are listed in Table 14-14 and the global variograms used as a basis for the classification scheme are shown in Figure 14-17. A longitudinal section showing the final classification is provided in Figure 14-18.

With regard to the classification, RPA notes the following:

- The overall classification is reasonable for the level of study.
- The average drill hole spacing for Measured and Indicated categories is slightly wider than the distances given in Table 14-14 due to the methodology used to flag blocks by distance.
- There are areas in Ambrex where wireframes have been extrapolated to greater distances than the Inferred classification criteria. The majority of this material has been included as Inferred.

With respect to classification RPA recommends the following:

- Performing a visual review of the classification of all blocks with a minimum distance to the closest drill hole greater than 25 m, and consider downgrading blocks where appropriate to Inferred.
- Restricting wireframe extrapolation to distances consistent with the classification criteria.

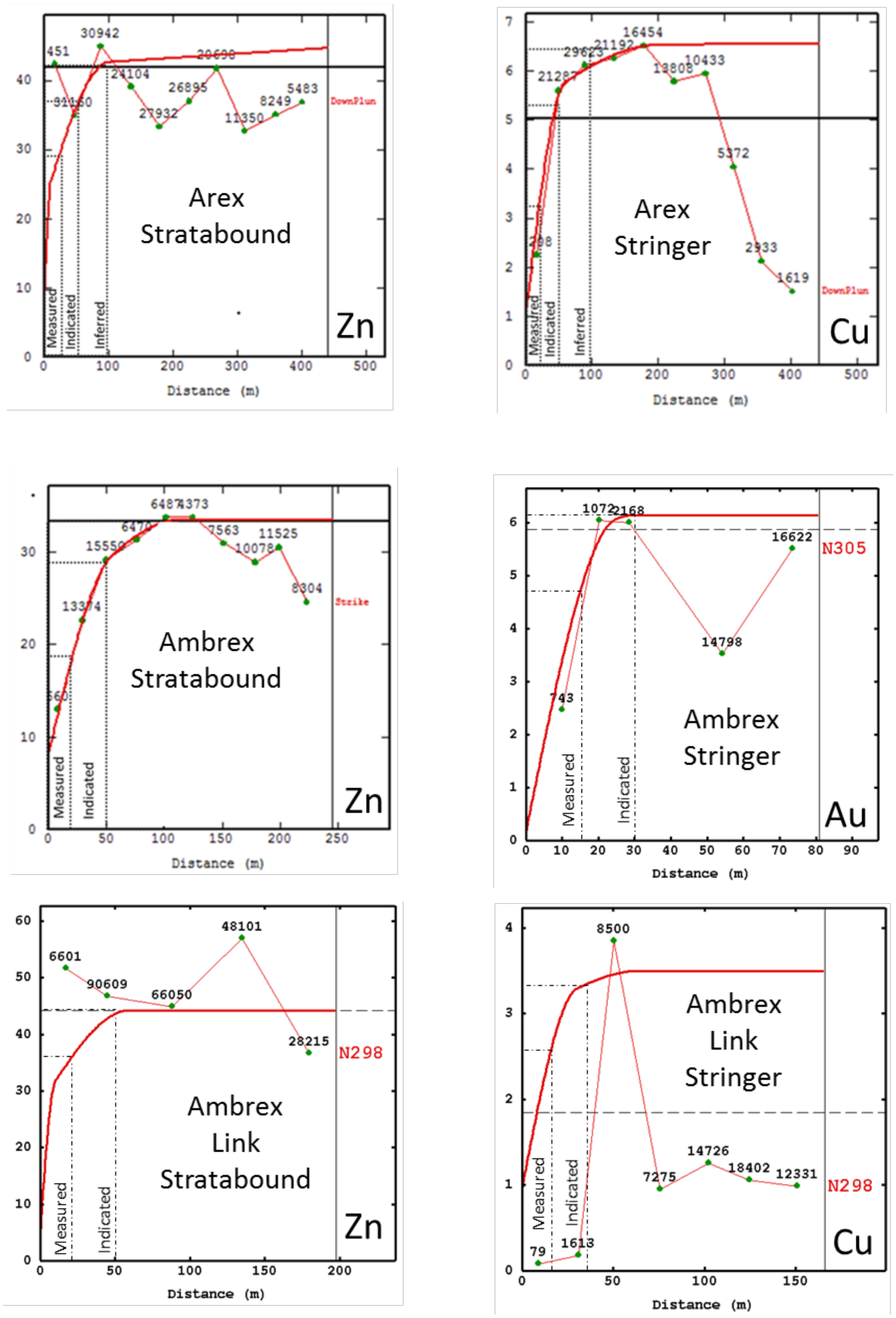
While the overall classification is reasonable, RPA is of the opinion that due to the highly deformed nature of parts of the project, a well defined grade control program, including infill drililing, will be required to ensure appropriate short range mine planning.

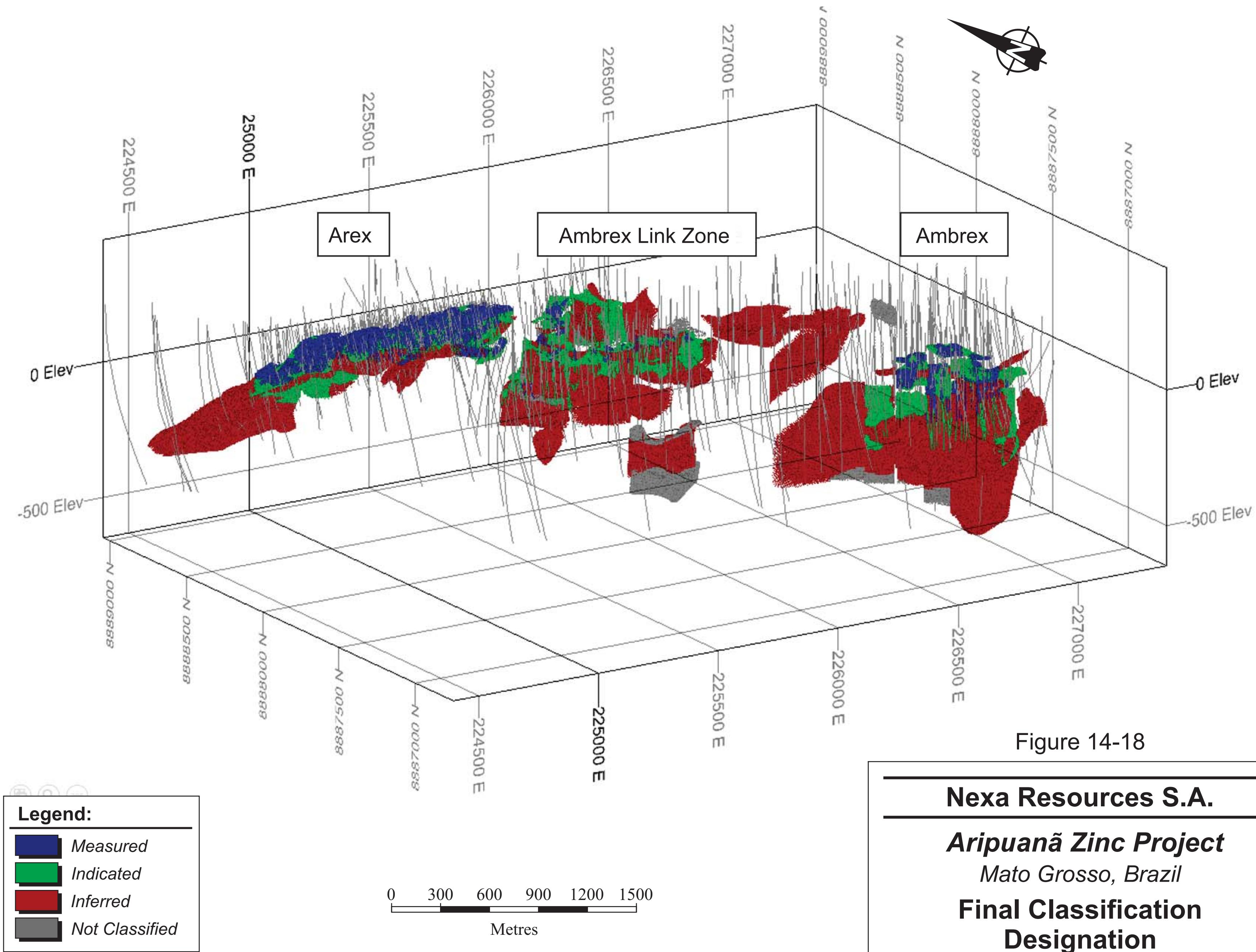
TABLE 14-14 NEXA SEARCH ELLIPSE RANGES FOR CLASSIFICATION CRITERIA
Nexa Resources S.A. – Aripuanã Zinc Project

Area	Type	Measured	Indicated	Inferred
Arex	Stratabound	25 m X 25 m	50 m X 50 m	100 m X 100 m
	Stringer	20 m X 20 m	50 m X 50 m	100 m X 100 m
Ambrex	Stratabound	20 m X 20 m	50 m X 50 m	100 m X 100 m
	Stringer	15 m X 15 m	30 m X 30 m	100 m X 100 m
Ambrex Link Zone	Stratabound	20 m X 20 m	50 m X 50 m	100 m X 100 m
	Stringer	15 m X 15 m	35 m X 35 m	100 m X 100 m
Minimum DDH in ellipse*	All	3	3	-

*Minimum DDH in ellipse refers to the isotropic search ellipsoid used to flag the distances in the blocks

FIGURE 14-17 GLOBAL VARIOGRAMS USED FOR CLASSIFICATION CRITERIA





October 2018

Source: Nexa Resources, 2018.

Figure 14-18

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

Final Classification Designation

VALIDATION

NEXA

A number of validation steps were performed by Nexa including:

- Comparison between OK and NN mean grades (Table 14-15, Figures 14-19 and 14-20)
- Swath plots (Figure 14-21 to 14-24)
- Visual inspection of composites versus block grades (example Figure 14-25 to 14-28)

For many of the variables, areas and mineralization types, there is a better agreement between the NN and OK means, which would suggest that the composite data are clustered. Similar trends are observed on the swath plots. Gold block grades show a large deviation from both the composite and NN mean although the deviation is negative. The Cu composites versus block grades show discrepancies as high as 26% in the stringer zone although the NN grades are within two percent. Mean comparisons on a wireframe by wireframe basis show much larger discrepancies between the means.

RPA is of the opinion the validation performed are typical industry standard validation techniques and in general, the results presented look reasonable.

TABLE 14-15 COMPARISON BETWEEN OK AND NN MEANS (ZN AND CU) – ONLY MEASURED AND INDICATED
Nexa Resources S.A. – Aripuanã Zinc Project

Area	Arex		Ambrex-Link		Ambrex-except-Link	
Type	Stratabound	Stringer	Stratabound	Stringer	Stratabound	Stringer
Variable	Zn	Cu	Zn	Cu	Zn	Cu
OK mean	5.53	1.26	4.96	0.88	4.58	0.51
NN mean	5.71	1.28	4.83	0.85	4.73	0.46
OK/NN	97%	99%	103%	103%	97%	111%

FIGURE 14-19 COMPARISON BETWEEN OK AND NN MEANS (ZN STRATABOUND)

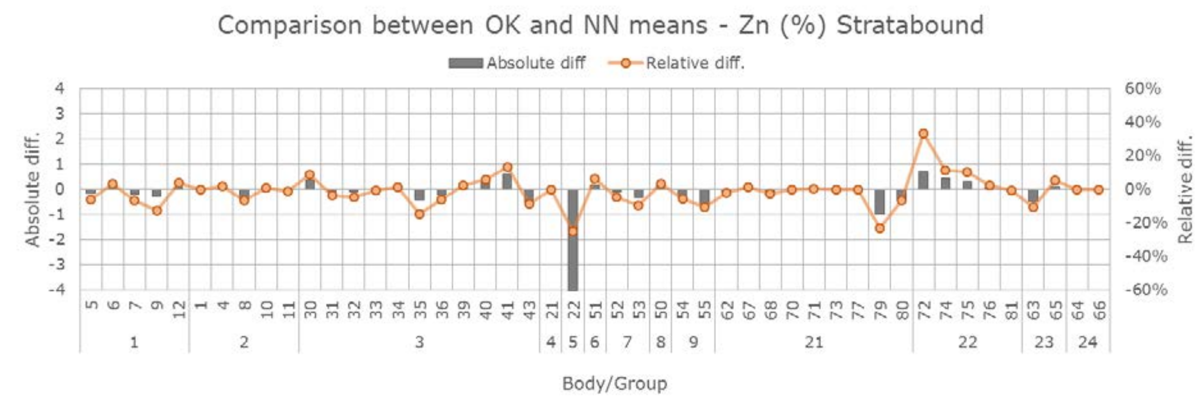


FIGURE 14-20 COMPARISON BETWEEN OK AND NN MEANS (CU STRINGER)

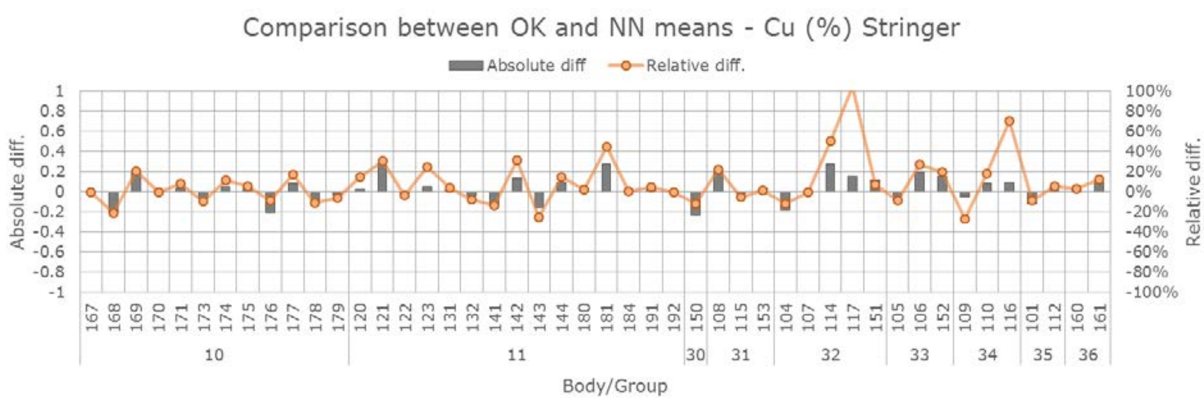


FIGURE 14-21 AREX ZN SWATH PLOT – EASTING

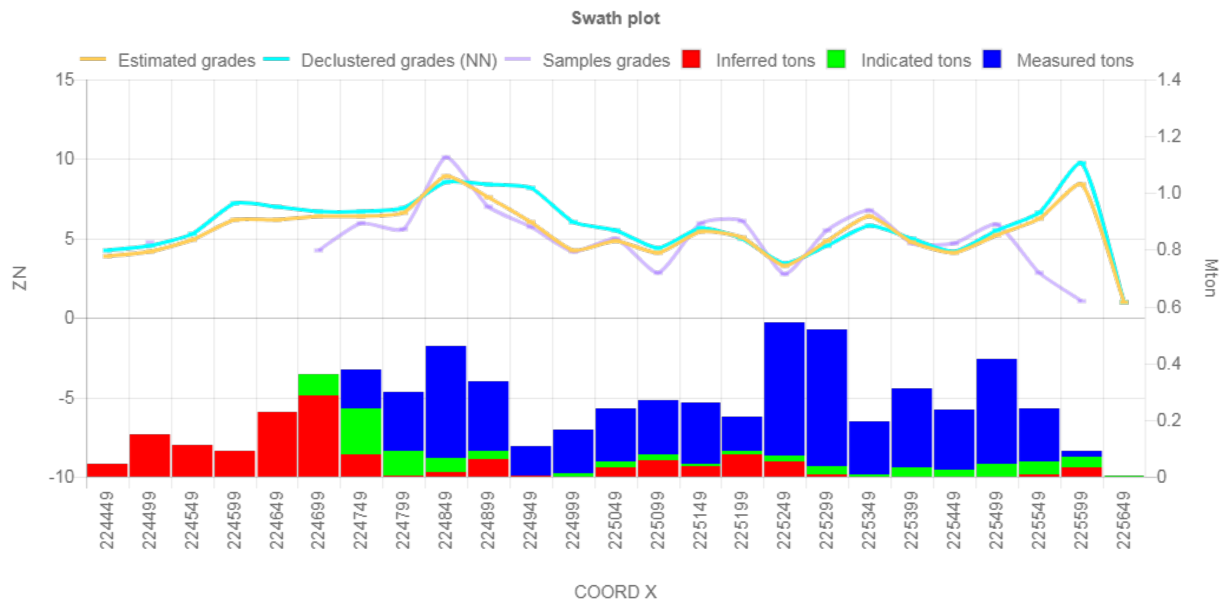


FIGURE 14-22 AREX CU SWATH PLOT – EASTING

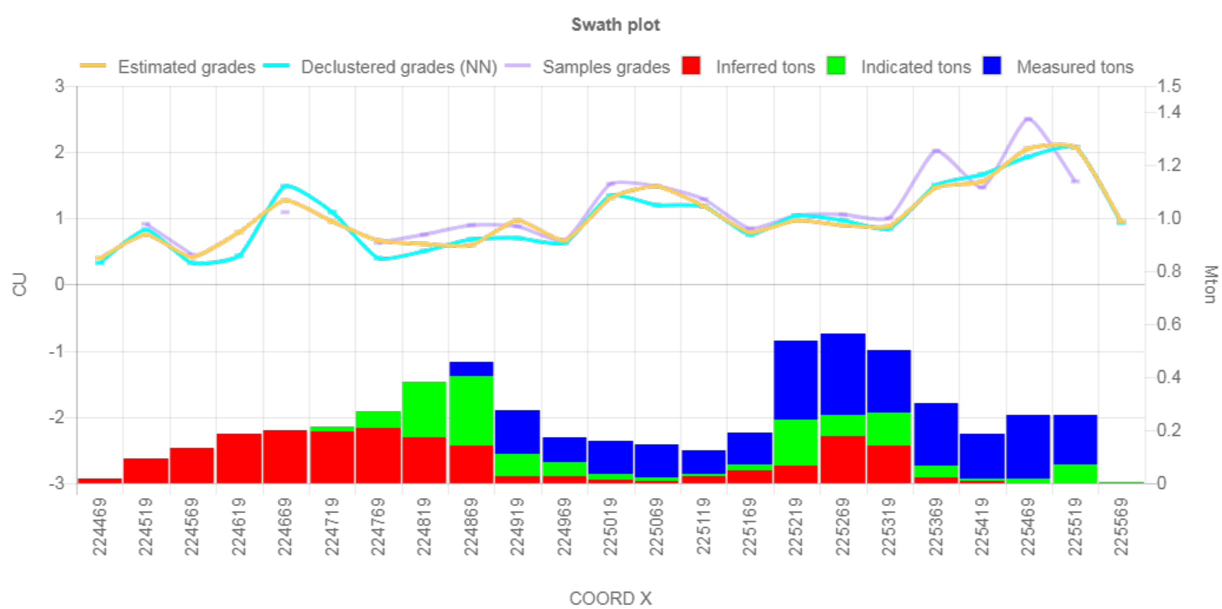


FIGURE 14-23 AMBREX ZN SWATH PLOT – EASTING

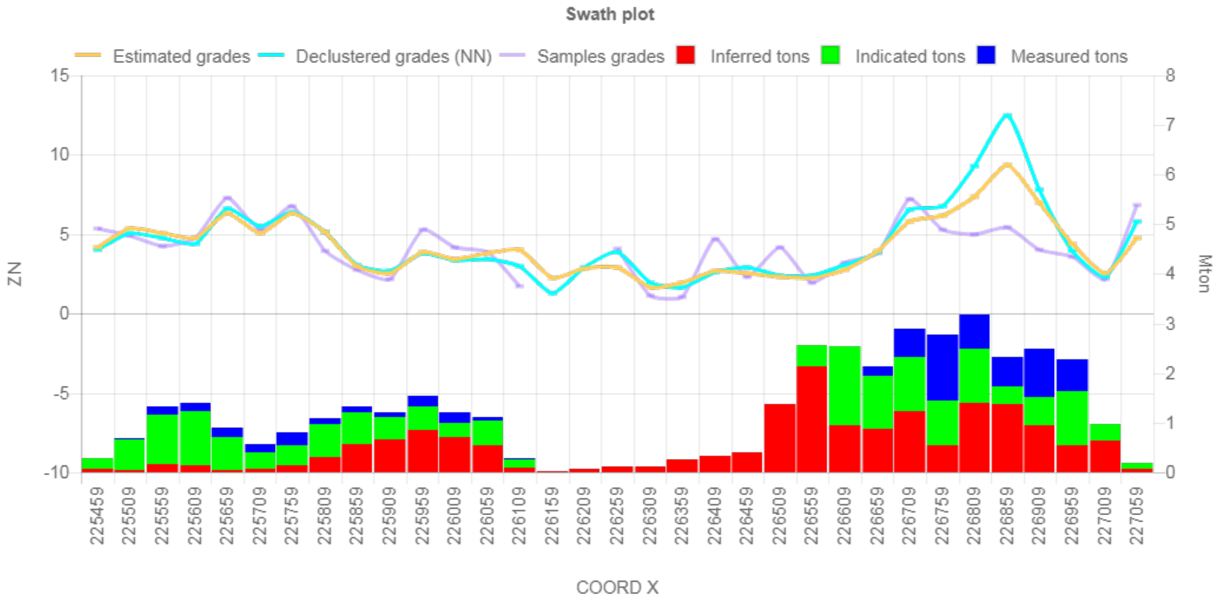
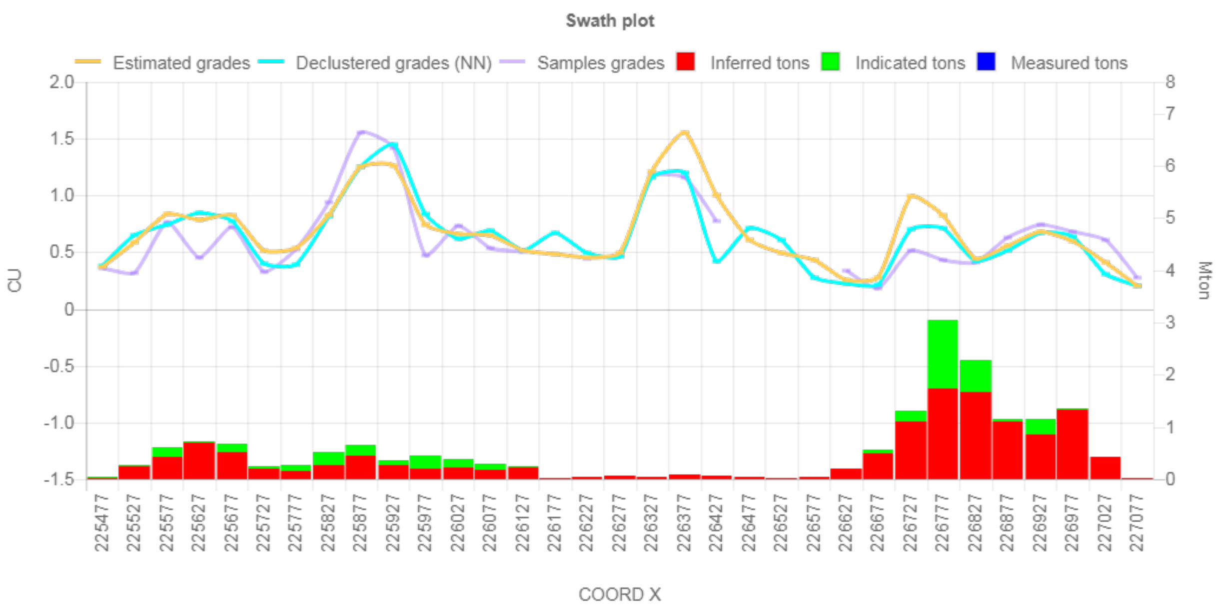


FIGURE 14-24 AMBREX CU SWATH PLOT – EASTING



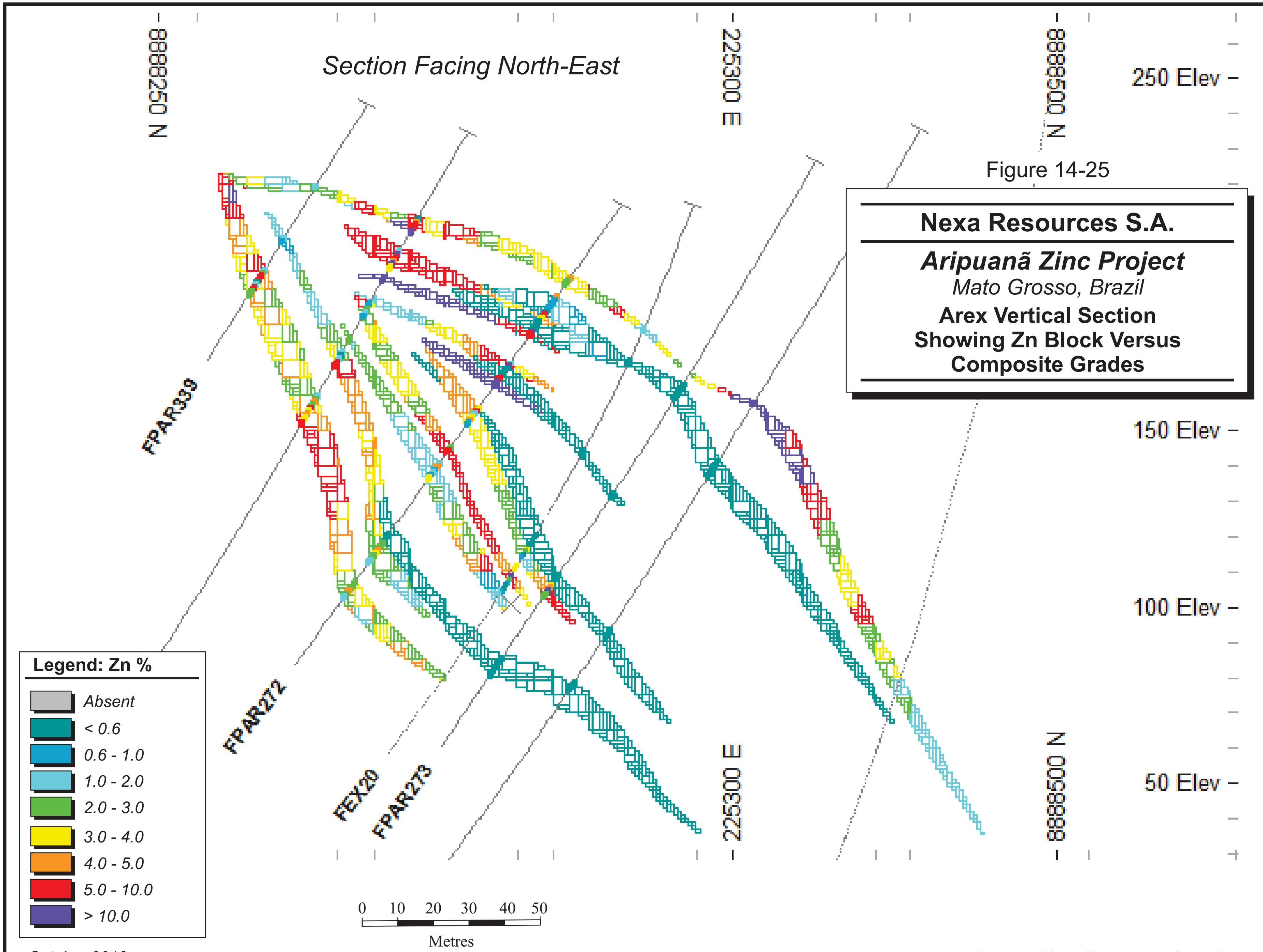


Figure 14-25

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

Arex Vertical Section Showing Zn Block Versus Composite Grades

October 2018

Source: Nexa Resources S.A., 2018.

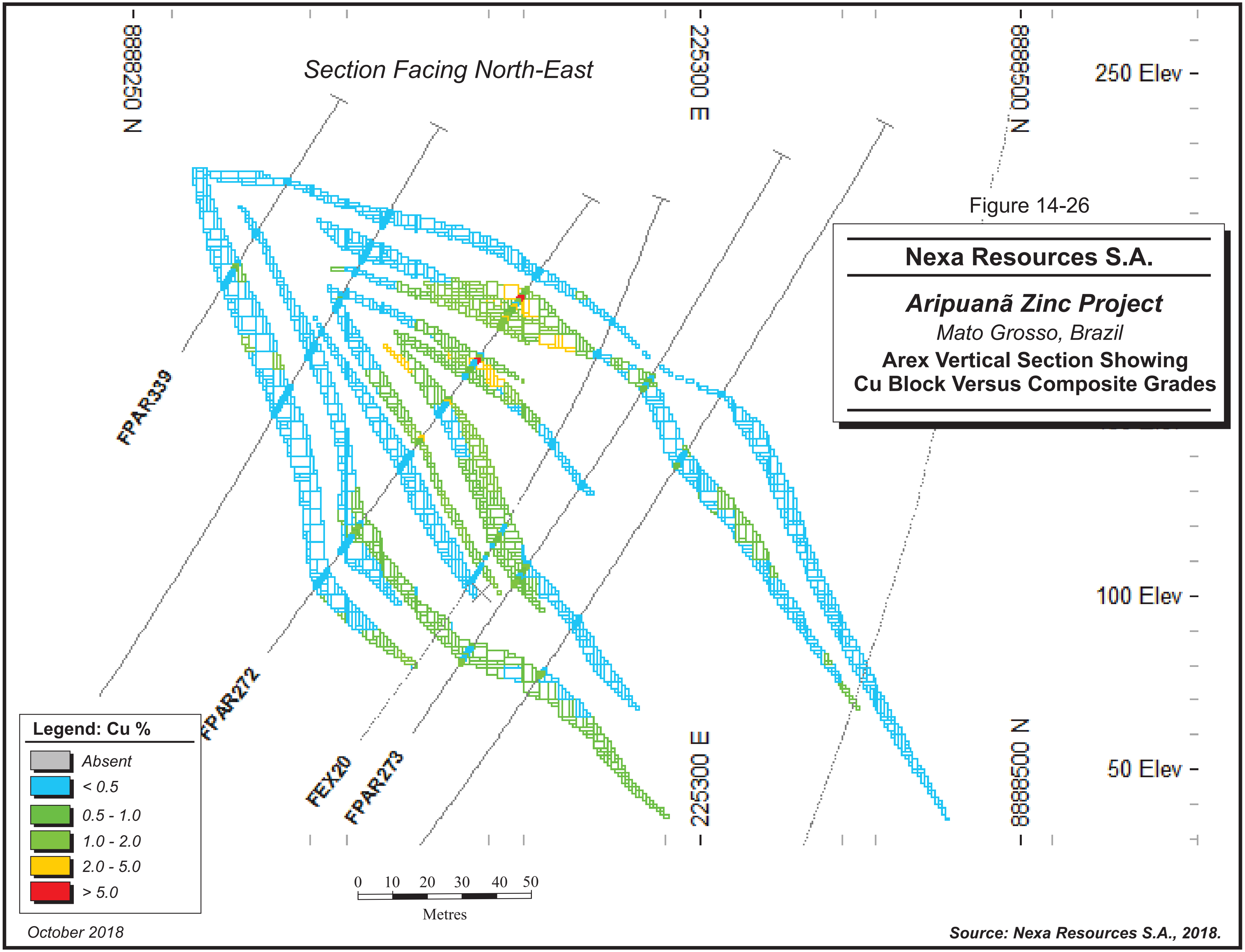


Figure 14-26

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

Arex Vertical Section Showing Cu Block Versus Composite Grades

October 2018

Source: Nexa Resources S.A., 2018.

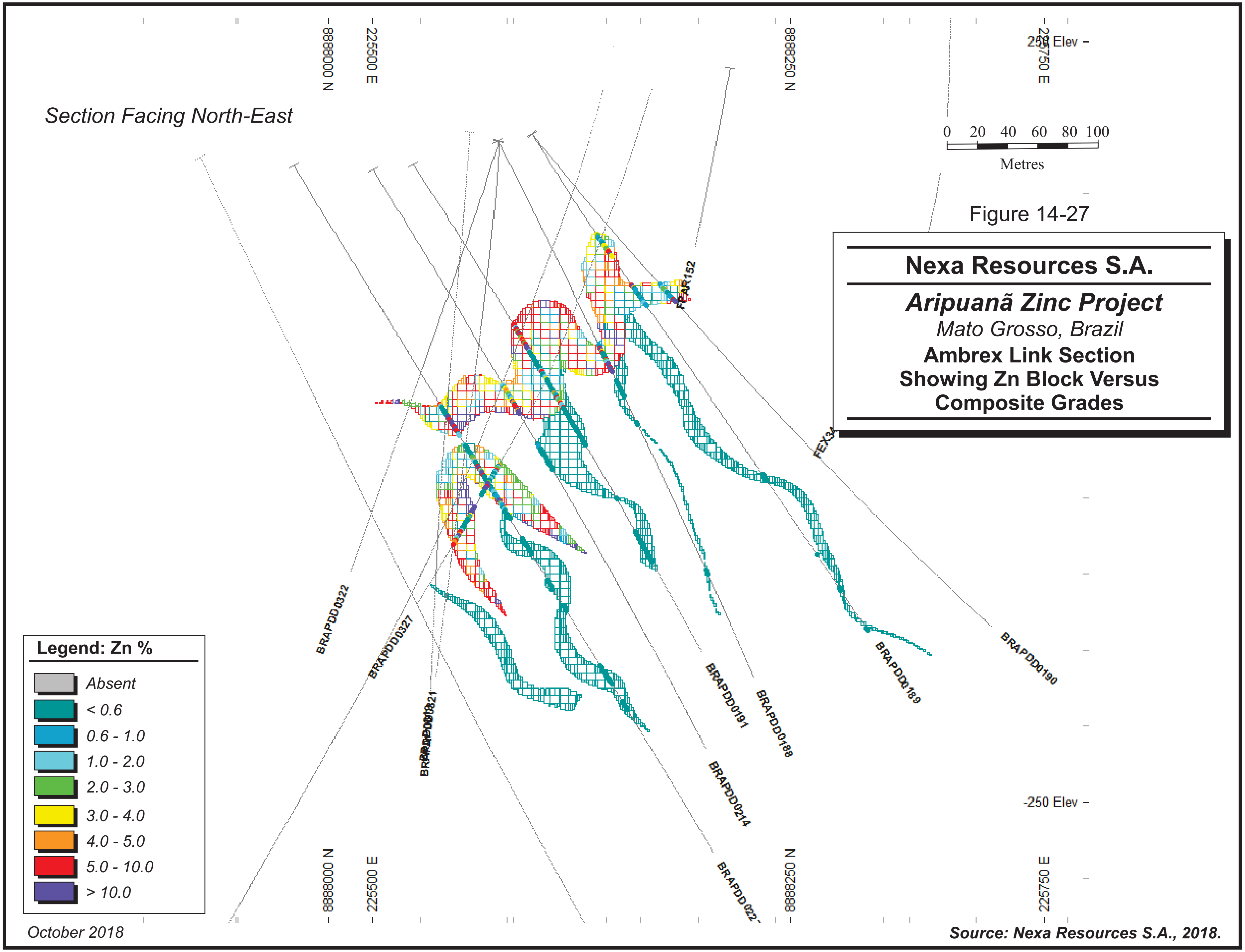


Figure 14-27

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

Ambrex Link Section Showing Zn Block Versus Composite Grades

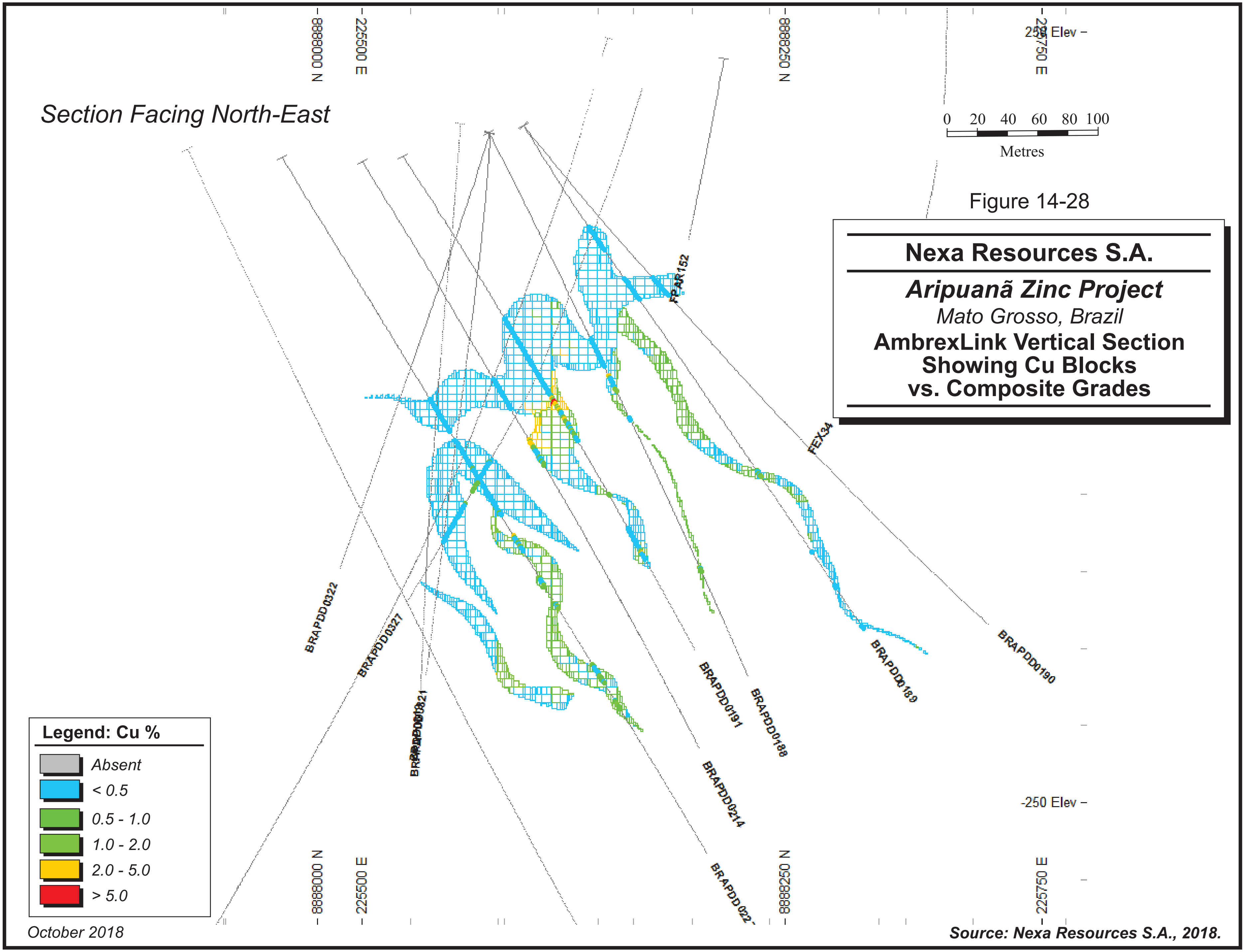


Figure 14-28

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso, Brazil

AmbrexLink Vertical Section Showing Cu Blocks vs. Composite Grades

RPA

With respect to the updated Mineral Resource estimate, RPA noted the following:

- No additional drilling was used in Ambrex and Arex, and some of RPA's previous recommendations were adopted. The changes resulted in minor improvements to both these areas. RPA reviewed the additional six drill holes drilled in the two Areas and noted that in general, mineralization was encountered inside or close to the wireframes.

- The majority of the focus for drilling was in the Link Zone, where there was a significant increase to Mineral Resources since the previous estimate. RPA determined that the area of most uncertainty was associated with the Link Zone geological interpretation. As a subjective test to the uncertainty, RPA remodelled the mineralization wireframes and concluded the that the differences between the resulting estimates following identical interpolation workflows was insignificant.

RPA is of the opinion that the updated Mineral Resource estimate is reasonable and suitable to support the estimation of Mineral Reserves.

15 MINERAL RESERVE ESTIMATE

SUMMARY

The Aripuanã deposit consists of three main orebodies, Arex, Link, and Ambrex. The main commodities being produced are zinc, lead, copper, silver, and gold. The Mineral Reserve estimate for the Project as of July 31, 2018 is shown in Table 15-1.

TABLE 15-1 MINERAL RESERVES – JULY 31, 2018
Nexa Resources S.A. – Aripuanã Zinc Project

Deposit/Category	Tonnes (000 t)	Grade Zn (%)	Pb (%)	Cu (%)	Au (g/t)	Ag (g/t)
Arex						
Proven	4,798	3.0	1.0	0.6	0.4	30.3
Probable	1,015	2.8	0.9	0.6	0.7	22.1
Proven & Probable	5,813	2.9	1.0	0.6	0.5	28.9
Link						
Proven	1,732	4.8	1.8	0.1	0.3	40.0
Probable	6,062	4.0	1.3	0.2	0.3	33.8
Proven & Probable	7,794	4.2	1.4	0.2	0.3	35.2
Ambrex						
Proven	5,272	4.2	1.6	0.1	0.1	38.2
Probable	7,299	3.4	1.4	0.1	0.3	34.7
Proven & Probable	12,571	3.8	1.5	0.1	0.2	36.2
Totals						
Proven	**11,803**	**3.8**	**1.4**	**0.3**	**0.3**	**35.3**
Probable	**14,376**	**3.7**	**1.3**	**0.2**	**0.3**	**33.5**
Proven & Probable	**26,179**	**3.7**	**1.4**	**0.2**	**0.3**	**34.3**

Notes:
1. CIM (2014) definitions were followed for Mineral Reserves.
2. Mineral Reserves are estimated at a cut-off value of NSR = US$ 40.00 / t processed.
3. Mineral Reserves are estimated using an average long-term zinc price of US$1.12 per pound, a long-term lead price of US$0.86 per pound, a long-term copper price of US$2.99 per pound, a long-term silver price of $18.58 per ounce, and a long-term gold price of US$1,187 per ounce and a R$/US$ exchange rate of $3.38.
4. A minimum mining width of 4.0 m was used.
5. Bulk density is 2.70 t/m^3.
6. Numbers may not add due to rounding.

RPA is not aware of any mining, metallurgical, infrastructure, permitting, or other relevant factors that could materially affect the Mineral Reserve estimate.

DILUTION

The dilution that has been applied is related to the selected mining method. The two main mining methods are longitudinal longhole retreat (bench stoping) and transverse longhole mining (vertical retreat mining or VRM) with primary and secondary stope extraction. The dilution is applied on a percentage basis, with no grade applied to the diluting material. The dilution for each method is summarized in Table 15-2.

TABLE 15-2 DILUTION
Nexa Resources S.A. – Aripuanã Zinc Project

Item	Percent Dilution (%)
Development	0
Bench Stope	15
Primary VRM	5
Secondary VRM	12

EXTRACTION

The extraction ratio is related to the mining method and is applied on a percentage basis. The amount of extraction for each method is shown in Table 15-3.

TABLE 15-3 EXTRACTION PERCENTAGE
Nexa Resources S.A. – Aripuanã Zinc Project

Item	Extraction (%)
Development	100
Bench Stope	90
Primary VRM	95
Secondary VRM	90

CUT-OFF VALUE

The NSR cut-off value was determined using the Mineral Reserve metal prices, metal recoveries, transport, treatment, and refining costs, as well as mine operating cost. Metal prices used for Mineral Reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources.

The cut-off value used for the Reserve is based on a NSR value. The NSR formula is:

$$NSR = \frac{Total\ Operating\ Cost}{Tonnes\ Processed}$$

The two main types of mineralization in the deposit are stratabound and stringer. These two types of mineralization are processed separately and, as a result, different parameters are used to calculate their respective NSR value. Cut-off and NSR parameters used to calculate the NSR value are summarized in Table 15-4. The break even NSR cut-off value for the FS is $39.40/tonne processed. For the mine design, an NSR = US$40.00/tonne processed was used.

TABLE 15-4 NSR DATA
Nexa Resources S.A. – Aripuanã Zinc Project

Item	Units	Stratabound	Stringer
Net Metallurgical Recovery			
Zn	%	89.4	0.0
Pb	%	85.9	0.0
Cu	%	67.5	86.9
Au	%	80.0	63.0
Ag	%	85.0	50.0
Cu Concentrate Payable %			
Cu	%	96	
Au	%	90	
Ag	%	90	
Pb Concentrate Payable %			
Pb	%	95	
Au	%	95	
Ag	%	95	
Zn Concentrate Payable %			
Zn	%	85	
Au	%	0	
Ag	%	70	
Charges			
Transport and Treatment			
Zn Concentrate	US$/t conc	$347	
Pb Concentrate	US$/t conc	$338	
Cu Concentrate	US$/t conc	$294	
Refining Cost			
Au in Pb conc	US$/oz	$10.00	
Au in Cu conc	US$/oz	$8.00	
Ag in Pb conc	US$/oz	$1.00	
Ag in Cu conc	US$/oz	$0.50	
Royalty NSR			
Arex Royalties	%	4.9	
Ambrex Royalties	%	5.4	
Net Revenue by Metal			
Zn	%	58	0

Item	Units	Stratabound	Stringer
Pb	%	18	0
Cu	%	3	44
Au	%	5	53
Ag	%	16	3
Operating Costs			
Mining	US$/t proc	$18.96	
Process + Tailings	US$/t proc	$16.94	
G&A	US$/t proc	$3.50	

NSR factors are applied directly to the design based on the Net Revenue by Metal as shown in Table 15-4. The NSR factors are summarized in Table 15-5.

TABLE 15-5 NSR FACTORS
Nexa Resources S.A. – Aripuanã Zinc Project

Item	Units	Stratabound	Stringer
Zn	US$/%	$12.64	$0.00
Pb	US$/%	$9.66	$0.00
Cu	US$/%	$34.24	$44.23
Au	US$/g	$19.31	$20.44
Ag	US$/g	$0.38	$0.23

16 MINING METHODS

Currently, the Project is targeted on mining three main elongate mineralized zones, Arex, Link, and Ambrex, that have been defined in the central portion of the Project.

The Arex and Ambrex deposits are separate VMS deposits with differing mineral compositions in stratabound and stringer forms and complex geometric shapes.

The deposit geometry is amenable to a number of underground mechanized mining techniques including cut-and-fill and bulk stoping methods. A nominal production target of 6,300 tpd has been used as the basis for the mine production schedule.

Mining will be undertaken using conventional mechanized underground mobile mining equipment via a network of declines, access drifts, and ore drives. Access to the Arex, Link, and Ambrex deposits will be from separate portals, which will access the deposits from the most favourable topographic locations.

MINE DESIGN

The mine design has been based around using modern mobile trackless equipment with independent decline accesses into the Arex, Link, and Ambrex deposits.

The three deposits will be accessed from three independent surface cut and cover portals and the ramps are designed at a gradient of 14% to be driven with an arched profile and a cross-sectional area (CSA) of 27 m^2 to accommodate the selected major equipment. The main loading and hauling equipment will be 12.5 t class load haul dump (LHD) combined with 35.5 t class haul trucks.

Main mining sublevels are spaced 75 m apart, with stope sublevels currently placed at 25 m spacing. The top sublevel in each level will leave a five-metre sill pillar. The two mining methods used are longitudinal retreat long hole mining, and transverse VRM with a primary and secondary sequencing. Backfilling of the stopes will be completed using pastefill, cemented rockfill, and rockfill.

Figure 16-1 shows the mine design for the entire Project and Figures 16-2 to 16-4 show the mine design for each separate deposit.

Looking North-East

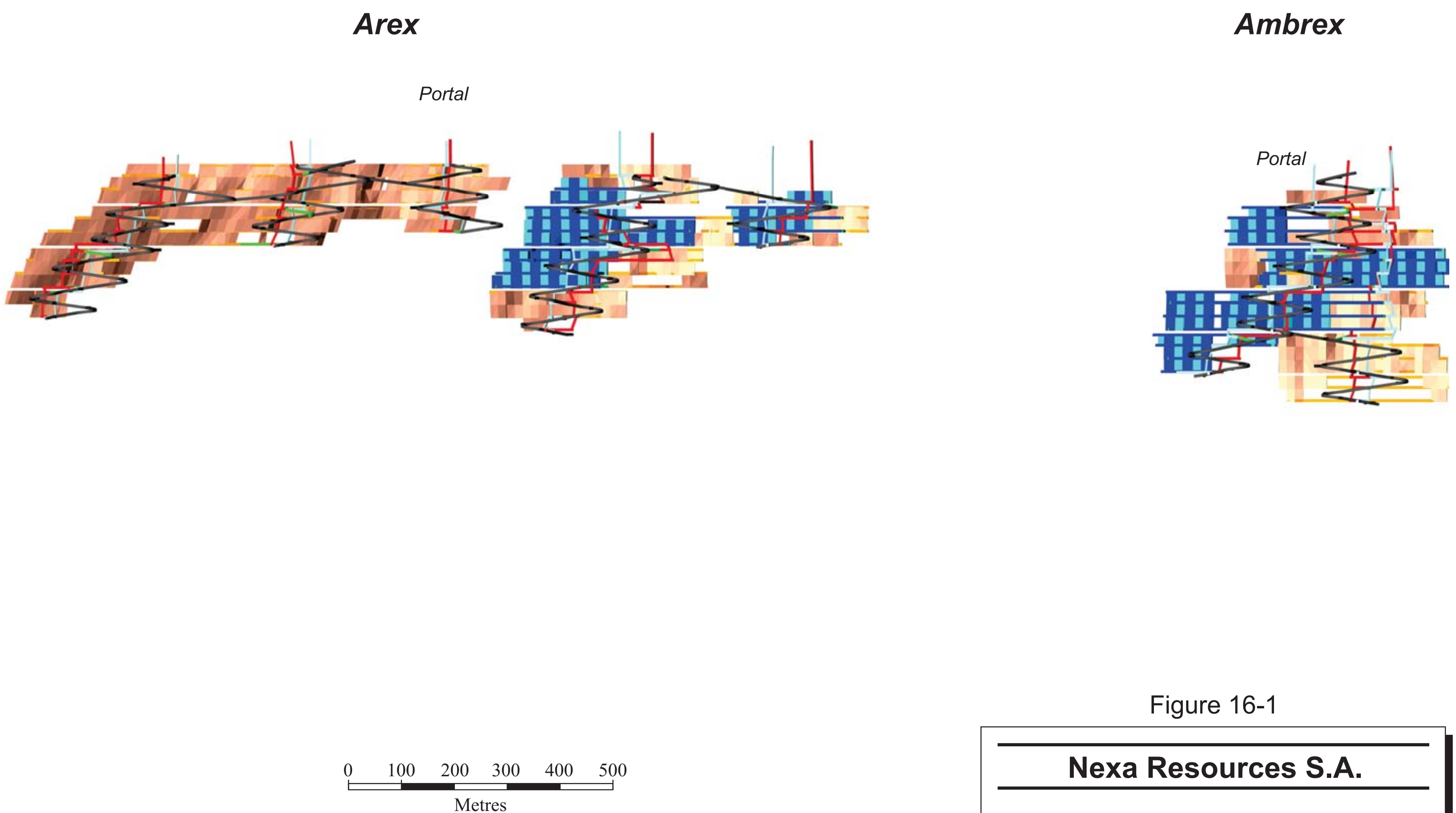


Figure 16-1

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Aripuana Long Section

October 2018

Source: RPA, 2018.

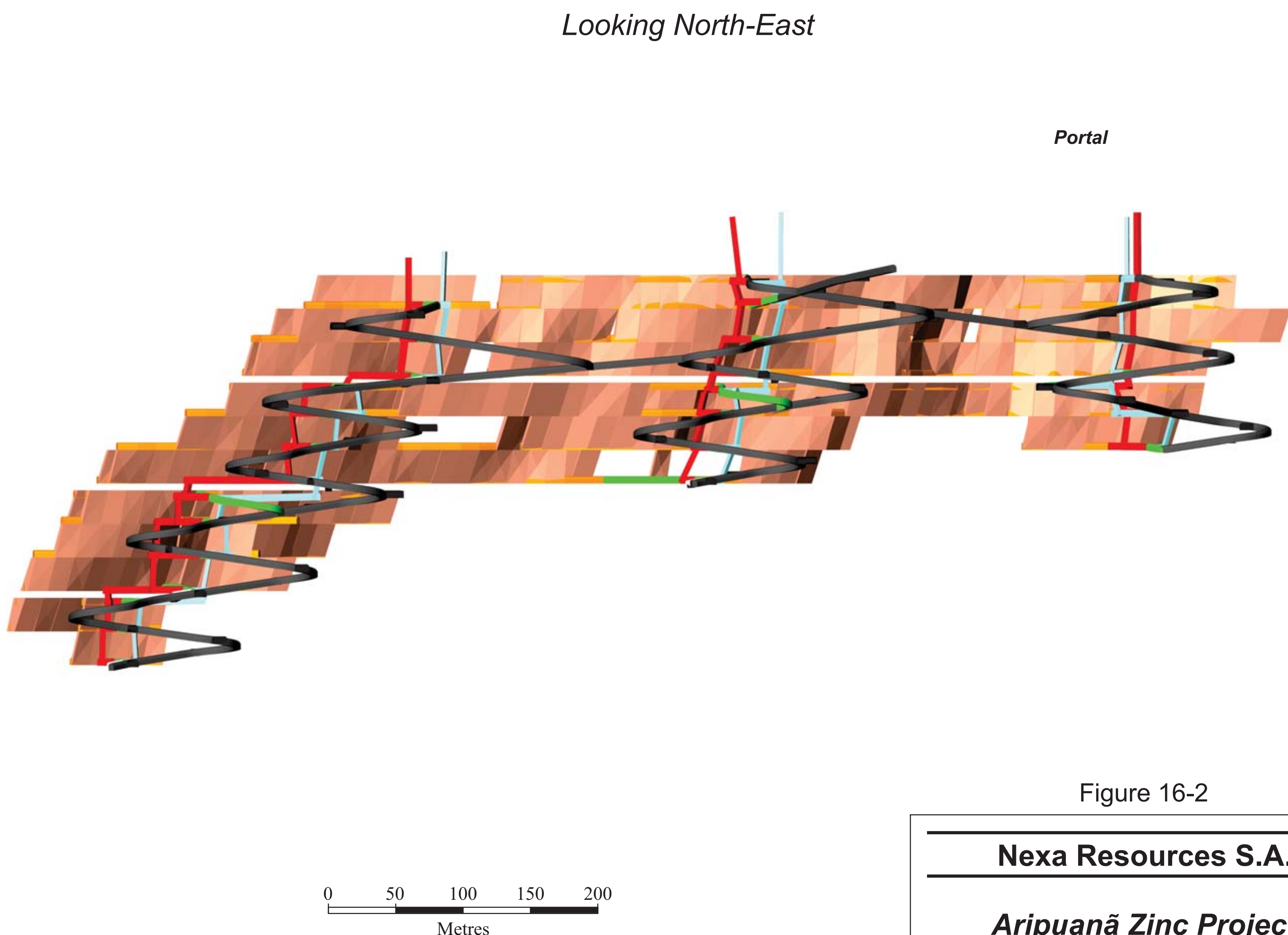


Figure 16-2

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Arex Long Section

October 2018

Source: RPA, 2018.

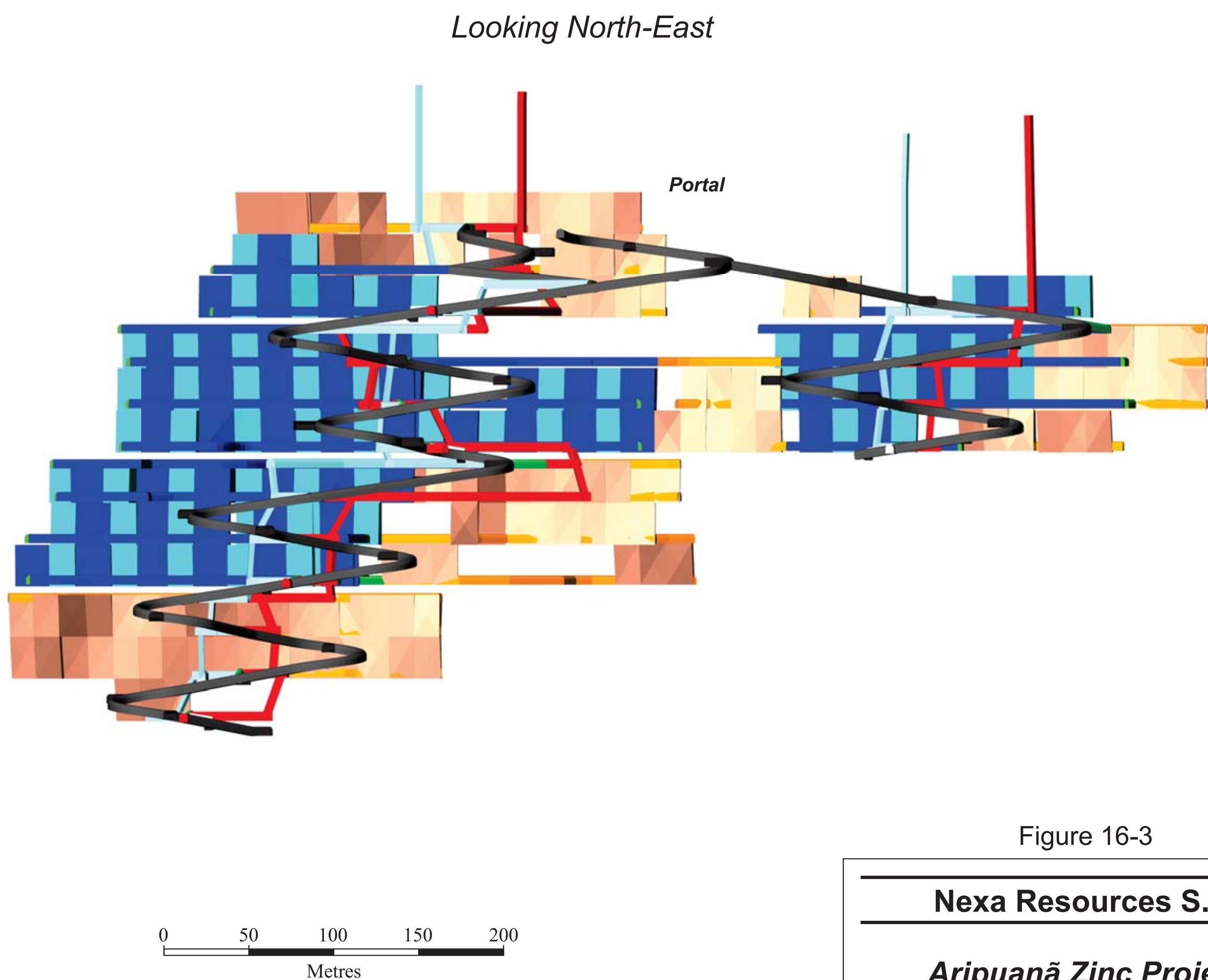


Figure 16-3

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Link Long Section

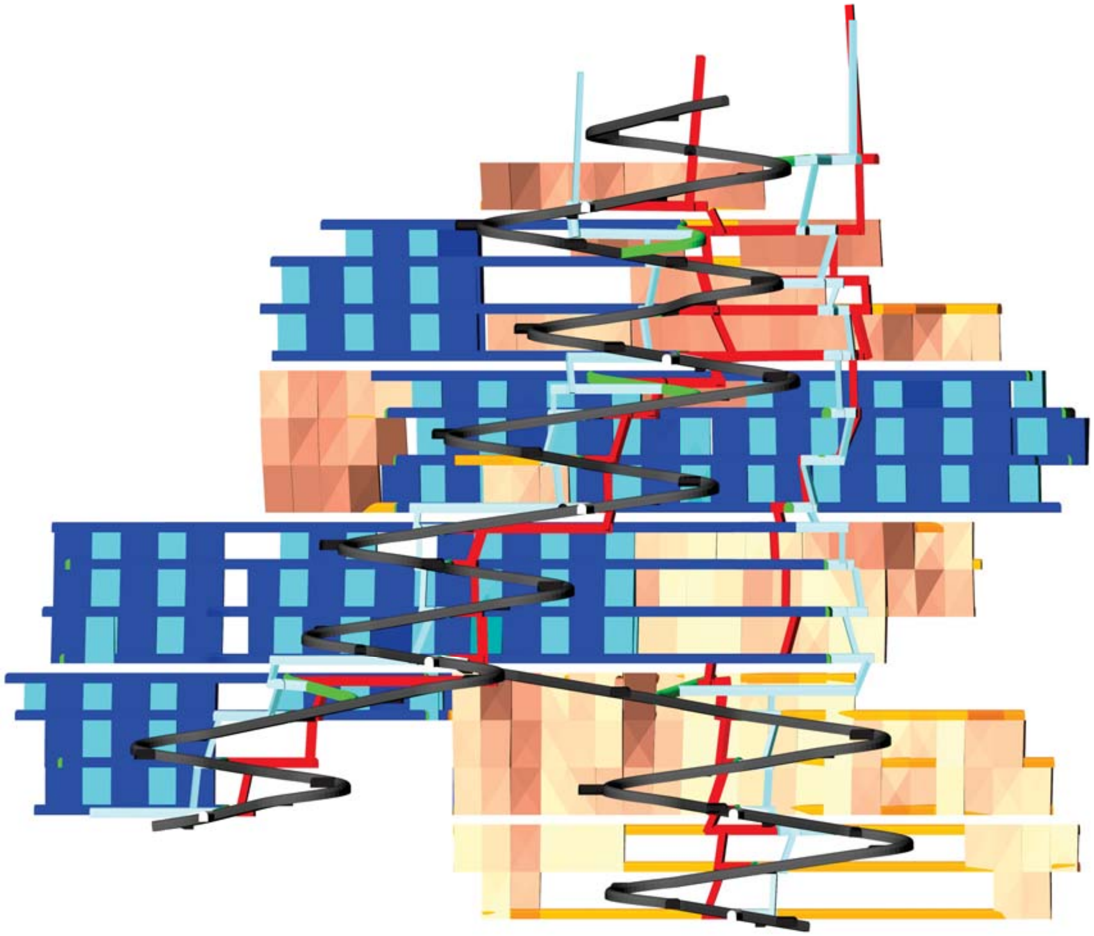
October 2018

Source: RPA, 2018.

RPA

www.rpacan.com

Looking North-East



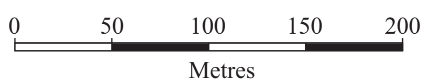


Figure 16-4

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Ambrex Long Section

Source: RPA, 2018.

Material movement in the mine is completed via ramp using haulage trucks. Primary development consists of ramps and raises. Secondary development consists of cross cuts, level access, footwall drives, ore drives, and all infrastructure development (sumps, remucks, etc.).

Table 16-1 shows the development dimensions used in the current mine design.

TABLE 16-1 DEVELOPMENT DIMENSIONS
Nexa Resources S.A. – Aripuanã Zinc Project

Activity	Type	Dimensions (m)
Primary Development	Raisebore Ramps	3.0 Dia 5.0 x 6.0
Secondary Lateral Development	Sublevels Cross Cuts Footwall Drives Ore Drives Sumps, pumps, elec.	5.0 x 5.0

MINING METHOD

A nominal production target of 6,300 tpd (2.2 Mtpa) has been used as the basis for the mine production schedule.

Nexa has undertaken a number of mining method option studies, which have selected a combination of longitudinal longhole retreat stoping (bench stoping) for the narrow zones of the deposits and VRM to mine the thicker zones, for the feasibility mine design and mine plan. To increase the extraction ratio, a primary and secondary stoping sequence will be used in the VRM areas with cemented pastefill used to backfill primary stopes and uncemented rockfill placed in the secondary stopes. Finished longhole retreat stopes will also be backfilled with pastefill, and rockfill as required.

The primary mining method for the Arex deposit is longitudinal retreat mining, with only a small portion of VRM mining. The majority of Link and Ambrex deposits are VRM, and minor areas of longitudinal longhole retreat mining. The tonnage split between VRM and bench stoping is approximately 80:20.

An estimate of the potentially mineable tonnage has been generated based upon the estimated Mineral Resources. The estimate includes both Measured and Indicated Mineral Resources. Deswik Stope Optimizer (DSO) was used to generate stope shapes to a minimum dip of 40°, which results in some flat stopes included in the mine plan. A Minimum Mining Width (MMW) of four metres has been applied.

No hanging wall or footwall dilution was added in the DSO analysis, however, it was accounted for in the mine scheduling.

UNDERGROUND MINING FLEET

The main underground mining fleet is listed below in Table 16-2. The fleet will be mainly sourced from Sandvik AB, Normet Group Oy, and Volvo Group.

TABLE 16-2 MAIN UNDERGROUND MINING FLEET

Nexa Resources S.A. – Aripuanã Zinc Project

Item	Location		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
SCALER	AMBREX	AMBREX - SCALER	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-
NORMET SCAMEC 2000 L	AREX	AREX - SCALER	-	-	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-	-	-
	LINK	LINK - SCALER	-	-	-	-	-	1.0	1.0	1.0	1.0	0.3	0.1	-	-	-	-	-
	TOTAL	TOTAL - SCALER	-	-	-	1.0	1.0	3.0	3.0	3.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	-
ROBOLT	AMBREX	AMBREX - ROBOLT	-	-	-	1.0	1.0	1.0	1.2	1.0	1.2	1.2	1.0	1.0	1.0	1.0	1.0	-
Sandvik DS 311	AREX	AREX - ROBOLT	-	-	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-	-	-
	LINK	LINK - ROBOLT	-	-	-	-	-	1.0	1.0	1.0	1.0	0.3	0.1	-	-	-	-	-
	TOTAL	TOTAL - ROBOLT	-	-	-	1.0	1.0	3.0	3.0	3.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	-
JUMBO	AMBREX	AMBREX - JUMBO	-	-	-	1.0	1.0	1.3	1.8	1.1	2.0	2.0	2.0	2.0	2.0	2.0	0.2	-
Sandvik DD 421	AREX	AREX - JUMBO	-	-	-	-	-	1.1	1.1	1.0	-	-	-	-	-	-	-	-
	LINK	LINK - JUMBO	-	-	-	-	-	1.3	1.3	1.2	1.0	0.3	0.1	-	-	-	-	-
	TOTAL	TOTAL - JUMBO	-	-	-	1.0	1.0	4.0	4.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	-	-
TRUCK 30T	AMBREX	AMBREX - TRUCK 30T	-	-	-	0.1	0.6	2.1	2.9	1.5	3.1	3.1	2.8	1.9	2.5	1.9	0.1	-
Volvo A30G	AREX	AREX - TRUCK 30T	-	-	-	-	-	2.3	1.9	1.2	0.5	0.1	0.0	-	-	-	-	-
	LINK	LINK - TRUCK 30T	-	-	-	-	-	1.2	1.0	0.3	-	-	-	-	-	-	-	-
	TOTAL	TOTAL - TRUCK 30T	-	-	-	1.0	1.0	6.0	6.0	3.0	4.0	4.0	3.0	2.0	3.0	2.0	1.0	-
TRUCK 45T	AMBREX	AMBREX - TRUCK 45T	-	-	-	-	-	0.2	1.3	2.1	3.5	3.5	4.5	8.0	8.2	7.6	5.6	5.0
Sandvik TH 540	AREX	AREX - TRUCK 45T	-	-	0.1	1.3	3.9	4.5	2.1	2.8	3.6	4.2	2.4	0.5	-	-	-	-
	LINK	LINK - TRUCK 45T	-	-	1.1	2.7	2.1	2.6	3.8	1.9	1.3	0.6	1.3	0.2	-	-	-	-
	TOTAL	TOTAL - TRUCK 45T	-	-	2.0	5.0	7.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	8.0	6.0	5.0
LHD Sandvik LH 514	AMBREX	AMBREX - LHD Sandvik LH 514	-	-	-	0.1	1.0	1.0	1.1	1.0	1.1	1.1	1.1	1.0	1.1	1.0	0.1	-
	AREX	AREX - LHD Sandvik LH 514	-	-	-	-	-	1.0	1.0	0.3	-	-	-	-	-	-	-	-
	LINK	LINK - LHD Sandvik LH 514	-	-	-	-	-	1.0	1.0	1.0	1.0	0.1	0.1	-	-	-	-	-
	TOTAL	TOTAL - LHD Sandvik LH 514	-	-	-	1.0	1.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	-	-
LHD Sandvik LH 517	AMBREX	AMBREX - LHD Sandvik LH 517	-	-	-	-	-	0.2	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0	1.0
	AREX	AREX - LHD Sandvik LH 517	-	-	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	0.2	-	-	-	-
	LINK	LINK - LHD Sandvik LH 517	-	-	0.2	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-
	TOTAL	TOTAL - LHD Sandvik LH 517	-	-	1.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	1.0	1.0
FANDRILL	AMBREX	AMBREX - FANDRILL	-	-	-	-	0.1	1.0	1.0	1.1	2.0	2.0	2.1	3.0	3.0	3.0	2.0	2.0
Sandvik DL321	AREX	AREX - FANDRILL	-	0.3	1.0	2.0	2.0	1.2	2.0	1.0	1.0	0.2	1.0	0.1	-	-	-	-
	LINK	LINK - FANDRILL	-	0.3	1.0	1.0	3.0	3.0	2.0	2.0	1.2	2.0	1.0	1.0	-	-	-	-
	TOTAL	TOTAL - FANDRILL	-	-	2.0	3.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0	2.0	2.0
CABOLT	AMBREX	AMBREX - CABOLT	-	-	-	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	-
Sandvik DS421	AREX	AREX - CABOLT	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-	-	-	-
	LINK	LINK - CABOLT	-	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-	-	-
	TOTAL	TOTAL - CABOLT	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-

GEOTECHNICAL CONSIDERATIONS

The available geomechanical data indicates that, in general, good ground conditions are anticipated in the Aripuanã underground. Walm Engineering prepared the geomechanicial information. A summary of their report is as follows.

The geomechanical characterization and classification of rock masses (RMR System Bieniawiski) indicates that the predominant rock mass for the mining region is massive rock of geomechanically very good quality (Class I) to good quality (Class II) composed of resistant to very resistant rocks, which are slightly fractured.

The rock mass of fair quality (Class III) is composed of moderately altered rocks occurring predominantly in shallower depths, and occasionally at depth in the form of thin and noncontinuous lenses within better ground (Class I and II). These small lenses may be associated with the presence of faults and shear zones with predominantly brittle behaviour. No direct relationship was observed between the occurrence of these lenses with the surfaces of the failures indicated in the geological model or indicated in the geological descriptions drill holeholes of the database.

The rock masses of lower quality (Class IV, poor, and V, very poor) and the ground/saprolite layer are located at shallow depths close to the surface and represent the weathering profile on the rock masses of better quality.

The principle stress for the deposit is generally trending east to west, trending on an azimuth of 105°. The principle stress is horizontal and is 1.9 times greater than the vertical stress. The secondary stress is 1.4 times greater than the vertical stress.

To ensure mining is completed in a safe manner, all stope designs in rock mass of Class III or worse were removed from the FS. The majority of these stopes were near surface and are considered crown pillar material.

SEQUENCING

The extraction sequence of the stoping is from the bottom up in both primary and secondary stopes. On each level, the primary stopes are mined upwards from the bottom sublevel.

Mining of the secondary stopes will commence once the mining of all primary stopes is completed. There is potential to optimize the extraction sequence as part of the detailed mine design and scheduling.

In the areas mined by bench stoping, the stopes are mined on retreat and filled after being mined. A cemented paste backfill will be used to fill the stopes after extraction.

AREX AND LINK

RPA notes that the geotechnical reports were prepared before the Link Zone was categorized as a separate zone. The Walm Engineering report “Geomechanical MODEL AND SIZING OF UNDERGROUND EXCAVATION - Aripuana Project BASIC PROJECT TECHNICAL REPORT Geomechanical MODEL - PHASE 1 AREX TARGET” is summarized as follows.

A 3D geomechanical model was developed using Micromine software to present the 3D distribution of the rock mass classes within the Arex target region.

This 3D geomechanical model was prepared by linking vertical geomechanical sections, generating solids and surfaces, using triangulation tools to account for the triangles with maximum volume, equiangular triangles, triangles with minimal surface area or edge of the triangles with proportional length, the choice set for the estimated geomechanical behaviour. Figure 16-5 presents a view of the geomechanical model to the Arex orebody.

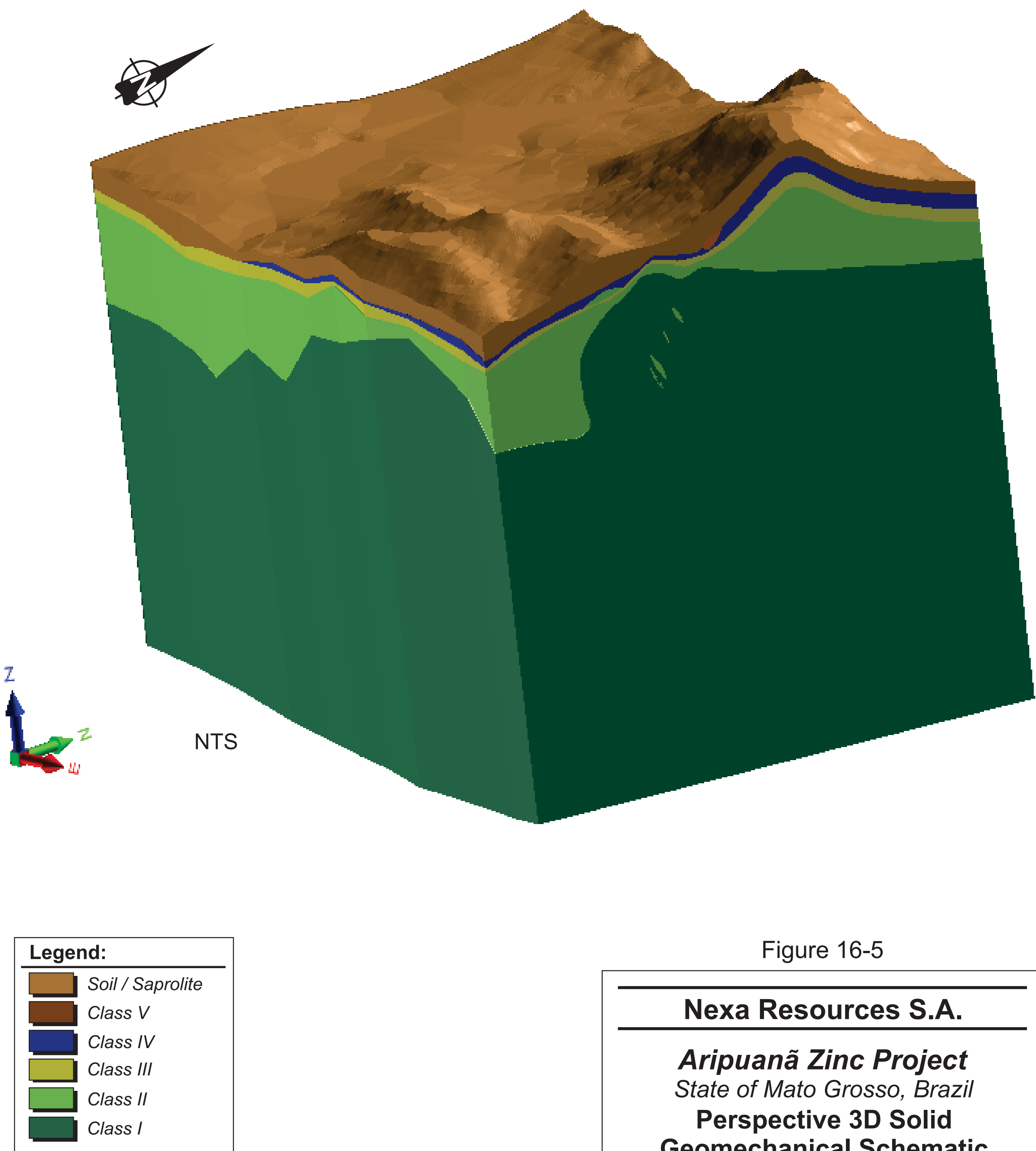


Figure 16-5

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Perspective 3D Solid Geomechanical Schematic

October 2018

Source: RPA, 2018.

The report also shows the interpretation of the predominant groundwater flow in the surface modified layer and the shallow fractured zone. The relatively low electrical conductivity values of springs, less than 50 S/cm, indicates that water does not circulate in long, deep underground routes, which would allow salinization of the aquifer.

The interdigitation units with very different hydraulic behaviour can characterize flows in confined areas, especially at the base of Expedito's Pit, where the mineralized bodies are hydrothermalized and there is a greater textural and compositional heterogeneity of rocks. In the mineralized zone, failures occur that can function as preferential flow pathways. According to Geominas (2009), as cited in Waterway 2013, there are some holes located at the foot of the slopes which are Expedited Sierra artesian (FPAR-holes 160, FPAR-010, FPAR187). This condition may indicate the occurrence of upward flow in the lower portions of the slopes of the Sierra Expedited resulting from the discharge of the confined deep aquifers.

This is an issue of importance to both the stability of underground openings, and for predicting the pumping sizing required for the operation of mines.

It was found locally in the geomechanical reworked sections that the massive presence of narrow tracks with variable length Class III, which refers to the broken mass, can relate to faults (Figure 16-6). Further confirmation is required to determine if the fractures of these bands are sealed or open, or not setting thus high permeability zones. These Class III zones can act as a conduit and draw water down into the mine workings. Stopes that were originally designed in the Class III areas were removed from the FS. Development and infrastructure located within these zone will have additional support installed.

As part of the execution plan, several deep drilling geotechnical holes are planned. These holes will be studied and permeation tests will be conducted, along with acoustic and optical imaging surveys, which can clarify whether these zones refer to aquifers.

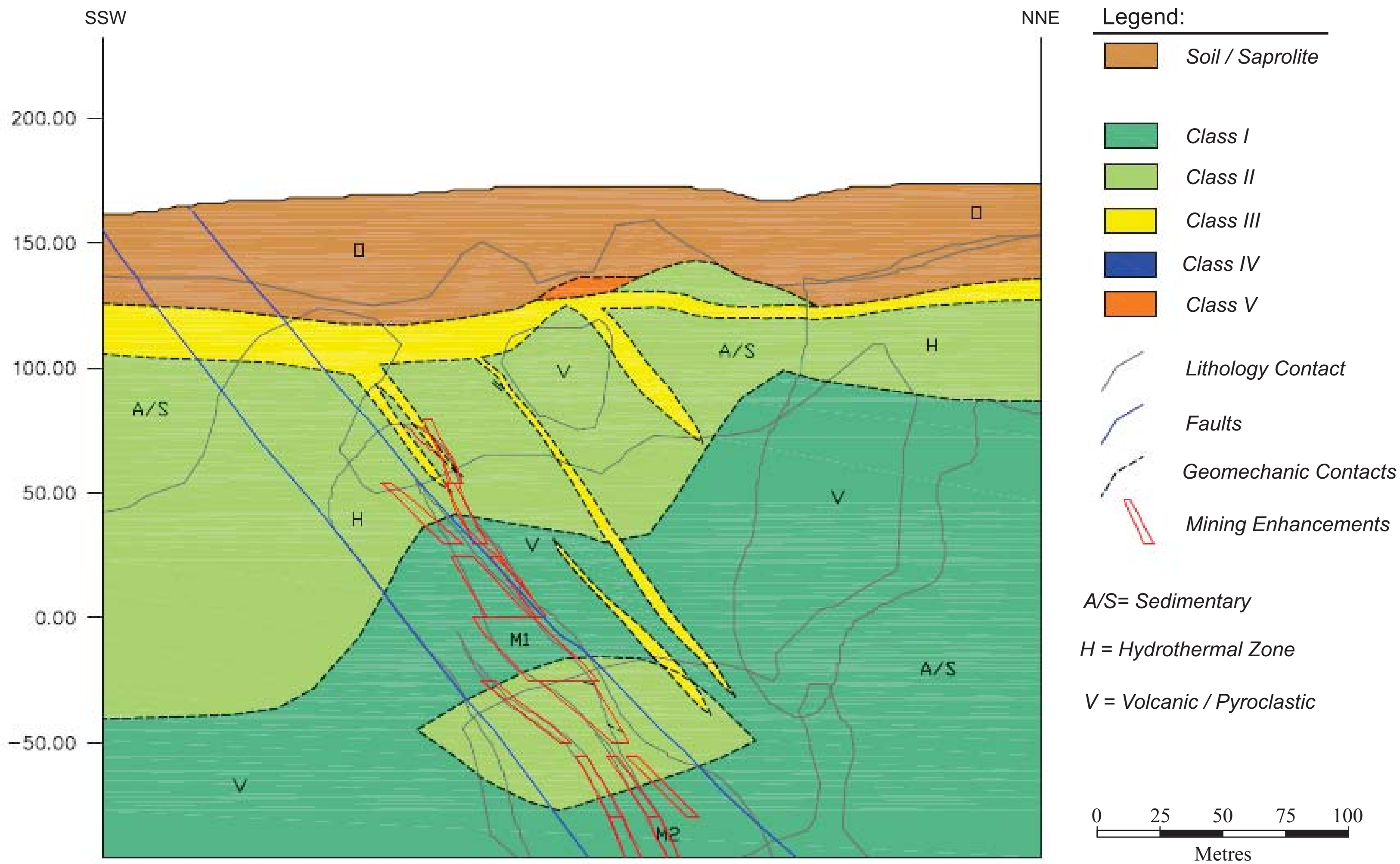


Figure 16-6

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Geomechanical Section 02AR Showing the Existence of Massive Class III Range of Intense Fracturing

October 2018

Source: Nexa Resources S.A., 2018.

AMBREX

Similar to Arex, any stope design located within Class III material was excluded from the FS. The majority of the deposit is within Class I, and Class II material.

The Walm Engineering report “Geomechanical MODEL AND SIZING OF UNDERGROUND EXCAVATION - Aripuana Project BASIC PROJECT TECHNICAL REPORT Geomechanical MODEL - PHASE 3 AMBREX TARGET” is summarized below.

The 3D geomechanical model was developed using Micromine software and presents the 3D distribution of the rock mass classes within the Ambrex region as shown in Figure 16-7.

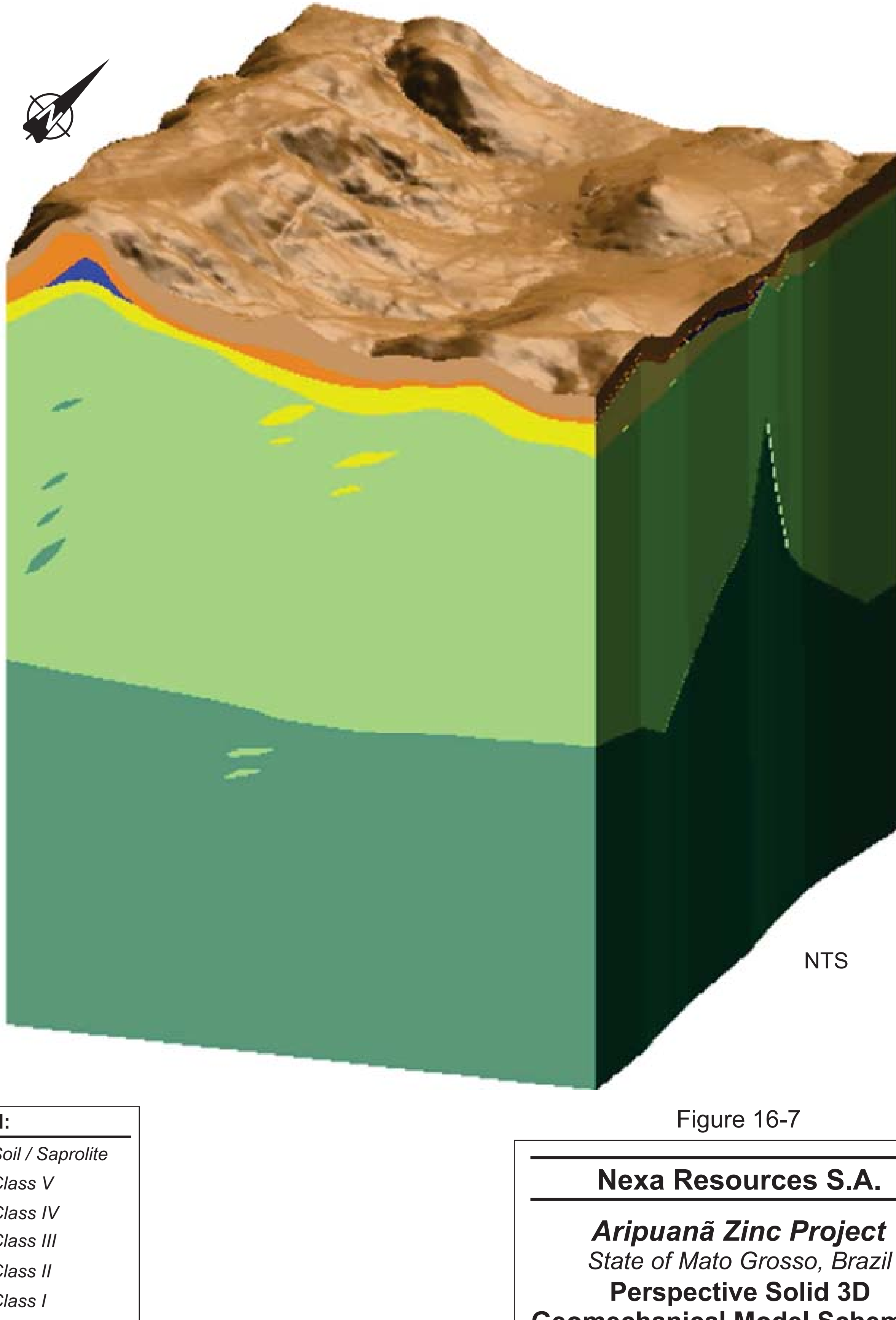


Figure 16-7

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Perspective Solid 3D Geomechanical Model Schematic

October 2018

Source: RPA, 2018.

The rock mass that makes up the Ambrex underground mine consists of the following classes:

Residual soil/saprolite – The top layer which originates from complete decomposition of rock at surface. This layer shows no rock mass behaviour and as a result, is considered to be partly separate from the geomechanical classes defined by Rock Mass Rating (RMR) calculation. This layer covers the entire surface of the studied region and has an average thickness of 30 m, with a tendency to thicken in regions of smooth topography. Partly altered rock is commonly observed within the top layer.

Rock Mass Class V (very poor) - This class consists of highly altered rocks and is considered to be very poor. The solid Class V occurs in the form of continuous layers of varying thickness between 5 m and 40 m. This rock mass is located in the transition soil/saprolite to massive levels of Classes III and IV.

Rock Mass Class IV (poor) - The poor rock mass generally consists of hard rock which exhibits improved resistance or semi-fractured very compact and highly altered types of discontinuities. In general, Class IV occurs in a regular way and usually in thicker layers of approximately 10 m in the central region of the body, or sporadically as isolated and minor lenses. Class IV layers often occur just below Class V.

Additionally, there is a rarely observed occurrence of Class IV lenses at depth in the middle of the Class II rock mass. In this case, the occurrence represents comminuted sections that have been very fragmented, and in some occurences have undergone hydrothermal alteration as the remaining rock occasionally presents powdery or not resistant qualities, or the manifestation of shear zones.

Rock Mass Class III (fair) - The Class III level constitutes as the main transition to bedrock. This class is observed both in shallower depths just below Class IV or V, and at elevated mean depths. As the rock mass gradation changes from weathered rock to solid rock, it is characterized by moderately altered materials with moderate to high resistance and an average degree of fracturing. In this class, rock masses generally have thicknesses ranging from 5 m to 45 m, in the form of continuous layers extending throughout the body, as seen through the interpretation of geomechanical sections.

An important aspect of the massive occurrence of this class also takes place at depth, varying in thicknesses in the form of lenses (approximately 7 m). In these lenses, massives are shown to be very fractured and may present intense veining and a high density of sealed fractures and cracks. These regions may signal the presence and expression of the shear zone with a predominantly brittle behaviour and should be assessed with due care and attention when in proximity to the mining areas and drifts.

During the preparation of the geomechanical model, a significant continuity of these Class III lenses was not observed in depth due to the fact that the model presents only the designed holes when, in reality, these lenses have a certain spacing between them and varying distances of the sections. As a result, the lenses found in isolation have currently been kept within the proposed mining area for the FS, however, there is not sufficient information to represent them or group them into layers or larger lenses. The lenses were noted through both holes described and holes analyzed by photographs and therefore, as summarized in the geomechanical sections, these massive lenses have restricted occurrence, but are common in depth.

Despite the proximity, a direct relationship between the occurrence of these types of massive and surface faults indicated in the geological model has not been verified or assigned to the geological descriptions present in the holes of the database. This indicates that the presence of these structures does not always indicate the presence of poorer quality rock mass with lower geomechanical behaviour.

Rock Mass Class II (good) - Massive good quality rock masses are situated in zones with no surface weathering influence. They are composed of fractured rocks and low resistance, and may or may not be modified with fractures. The top bedrock usually manifests itself between 37 m to 80 m depth, usually below the weathered Class III solid. The thickness of Class II rock masses ranges from 150 m to 600 m.

Rock Mass Class I (very good) – Rock masses that are classified within Class I possess very good geomechanical qualities, are resistant to very resistant, are without alteration, and are relatively unfractured. Class I rock mass is located immediately below the Class II rock mass and occurs below all Class II sections. The depth of the contact between Class I and Class II varies. In the northwest region, this contact often occurs at approximately 200 m below surface, however, the contact reaches the highest elevation in the central region (section

03AB) upon approaching the surface and then gradually decreases to approximately 350 m below surface in the southeast portion of the contact.

Class I also occurs in the form of solid lenses dispersed in the middle of the Class II rock mass. The main difference between Class I and Class II is the degree of fracturing and condition of discontinuities, which are unchanged and are predominantly uncoated in Class I. In this FS, the Class I is primarily represented by a hydrothermal zone, Stringer mineralization, massive and disseminated volcanic rocks, and/or metasedimentary rocks that comprise the footwall.

Figure 16-8 shows a simplified typical section, featuring the main form of massive occurrence of the classes in the Ambrex region.

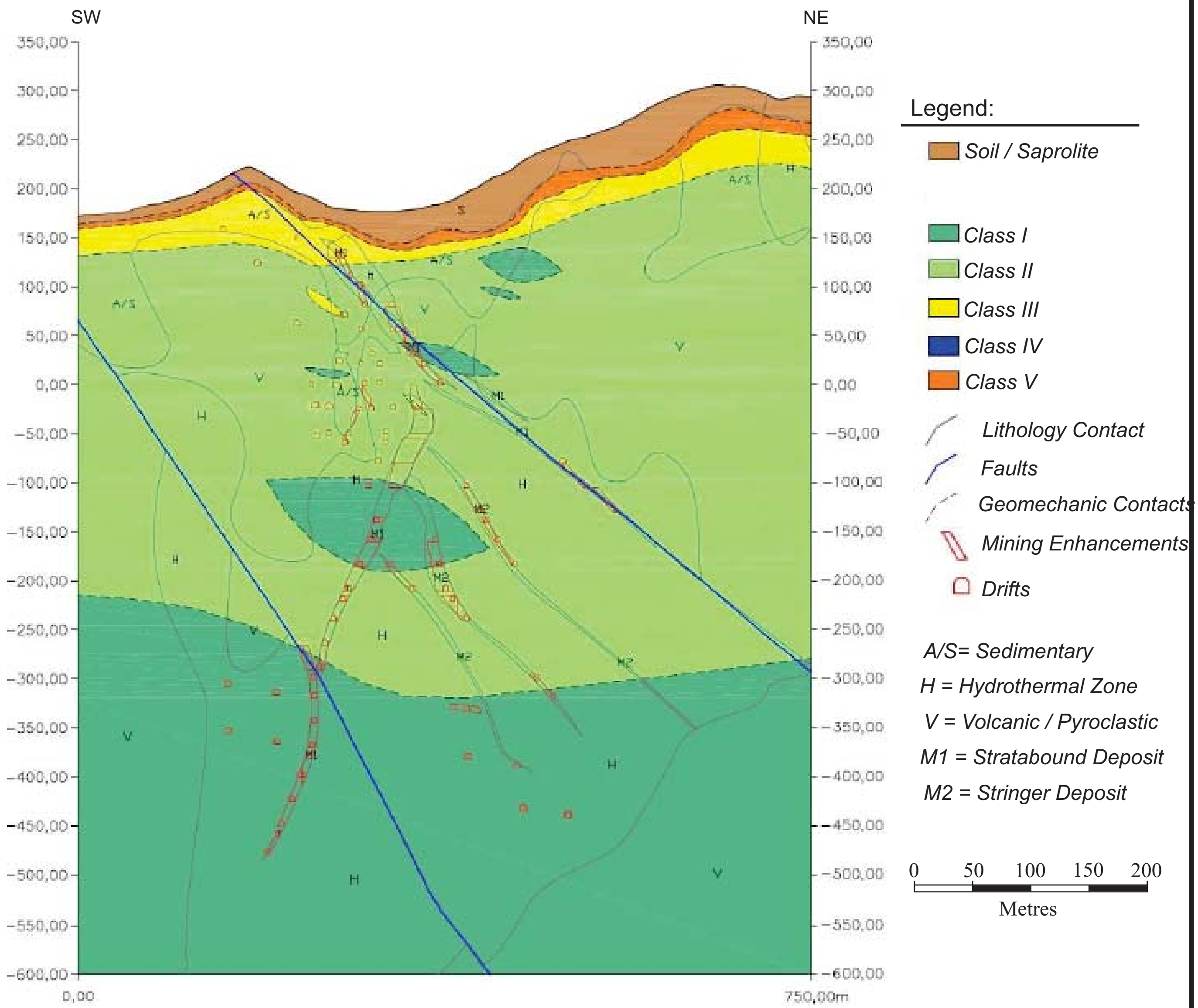


Figure 16-8

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Geomechanical Section 05AB
A Typical Ambrex Section

October 2018

Source: Nexa Resources S.A., 2018.

The geotechnical descriptions of the Ambrex drill core indicate that the majority of the rock types that comprise the rock to be mined by underground methods are classified as very good (Class I) to good (Class II) and represent approximately 33% and 50% of the total material analyzed, respectively. The Class III rock type occurs in approximately 7% of the core descriptions. The remainder is comprised of soil/saprolite, and Classes IV and V, representing the weathering profile of the rocks, and correspond to about 10% of core material.

VENTILATION

The ventilation system for all three orebodies is a pull system which uses a combination of axial and centrifugal fans which can be modified for future growth. The fresh air and exhaust raises are located in the level access in each orebody. As a result, the mining on the levels is ventilated using auxiliary fans and ventilation ducting. Regulators will control the air flow on each level for the fresh air and exhaust access.

The design of the ventilation system complies with the Brazilian mining regulations which require the calculation of fresh air flow based on the following:

- The maximum number of personnel and underground equipment,
- Consumption of explosives used, and
- Monthly tonnages produced.

The three criteria are shown in Figure 16-9.

FIGURE 16-9 VENTILATION REQUIREMENTS

a) Calculation of fresh air flow as a function of the maximum number of people or machines combustion engines with diesel oil Qt = Q1 x Q2 x n1 + n2 (m^3 / min) At where : QT = total flow of fresh air in m3 / min. Q1 = amount of air per person in m3 / min. (In coal mines = 6.0 m3 / min;. In other mines = 2.0 m3 / min.) n1 = number of people in work shift Q 2 = 3.5 m 3 / min./cv (horsepower) of the diesel engines n2 = total number of horsepower diesel engines in operation
b) Calculation of fresh air flow as a function of consumption of explosive QT = 0.5 x [m^3 / min] t At where: QT = total flow of fresh air in m3 / min. A = total amount in kilograms of explosives used for blasting aeration time t = (re) in the front minutes
c) fresh air flow rate calculation according to the disassembled monthly tonnage QT = qx T (m^3 / min) At where: QT = total flow of fresh air in m3 / min. q = air flow in m3 / minute to 1,000 tons per month removed (Up to 180 m3 / min / 1,000 tons per month) T = production in tons per month removed.

The auxiliary fans selected for the Project will provide 37 m^3/s of ventilation up to 165 m using 1.4 m diameter ducting and 1.2 m diameter, 150 hp fans. Fans can be stacked together to allow the ventilation to be projected. In order to provide sufficient air for a truck and LHD, two sets of ducting and fans will be required in the areas which do not have flow through ventilation.

AREX

Arex has a long lateral strike and will be mined by bench stoping. The mine will have three internal ramps exiting through one portal. The mine design has three intake raises and three exhaust raises as shown in Figure 16-10. The total air flow required at peak mining periods is 386 m^3/s.

Looking North-East

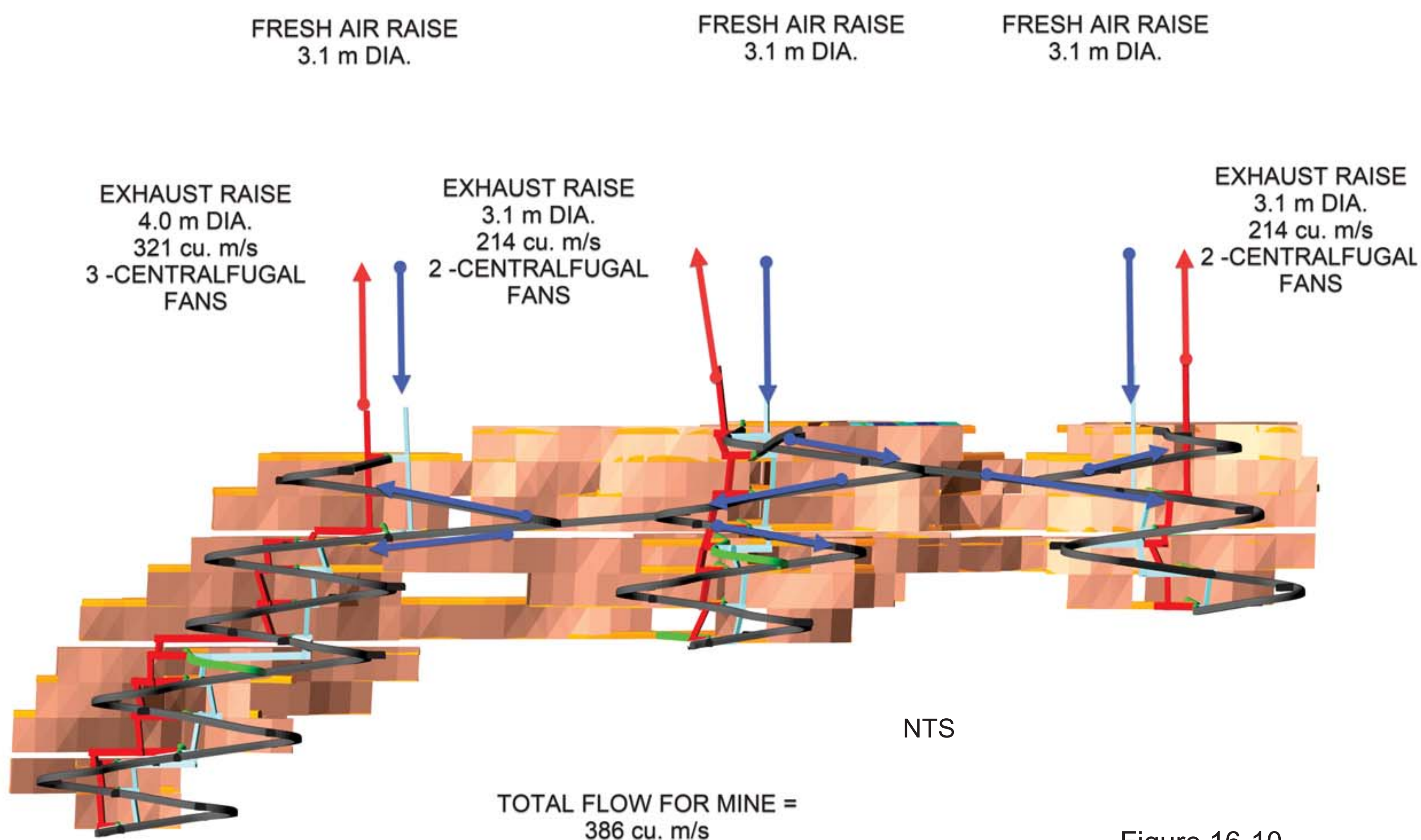


Figure 16-10

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Arex Ventilation Schematic

October 2018

Source: RPA, 2018.

The fresh air raises and exhaust raises are located in the level access drift due to the bench stoping mining method and as a result, the level is ventilated using auxiliary ventilation.

LINK

The Link Zone will predominantly be mined using VRM with some bench stope mining. The mine has two internal ramps exiting through one portal. The mine design has two intake and exhaust raises with axial fans on the exhaust raises as shown in Figure 16-11. The total flow required at peak mining is 394 m^3/s.

Looking North-East

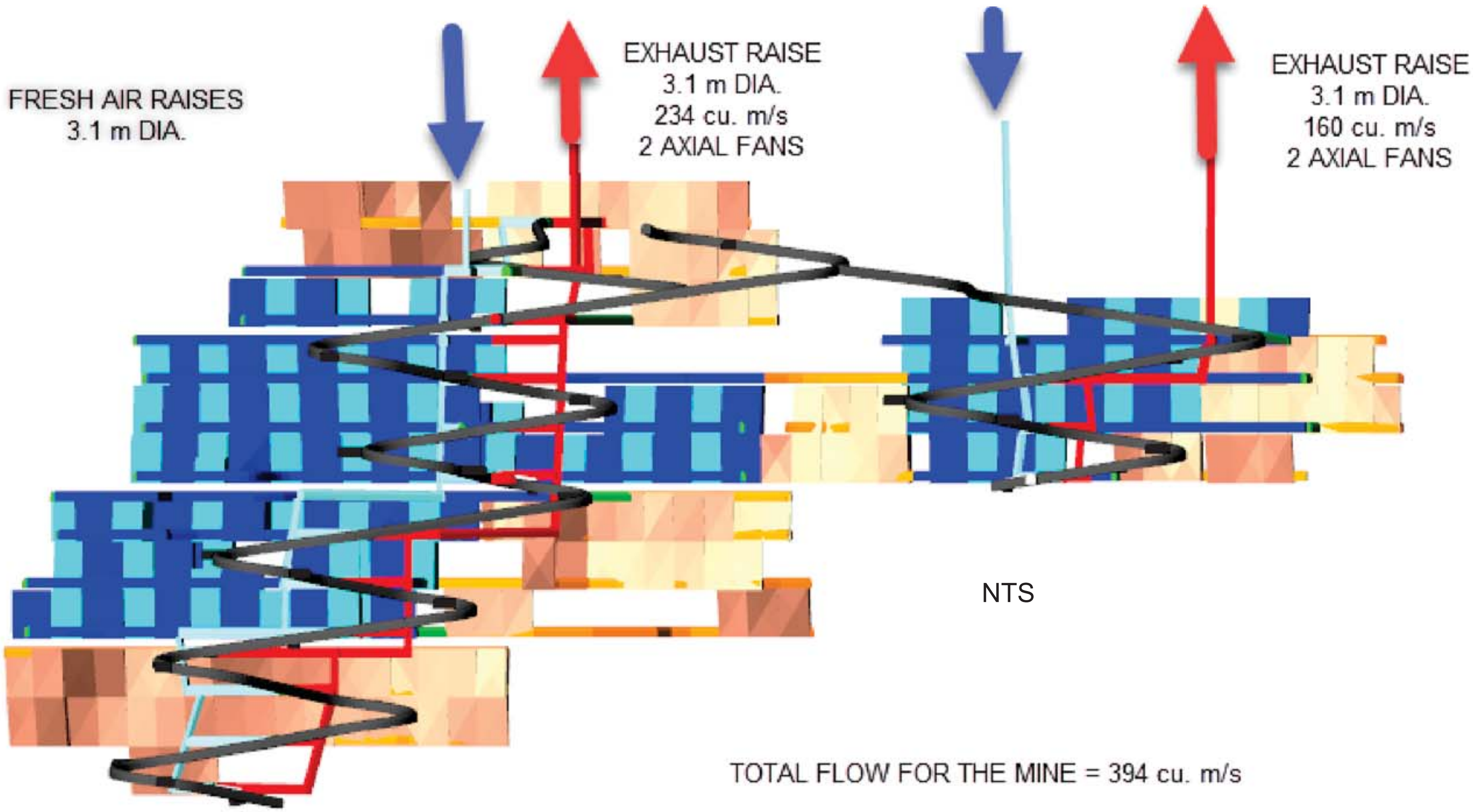


Figure 16-11

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Link Ventilation Schematic

October 2018

Source: RPA, 2018.

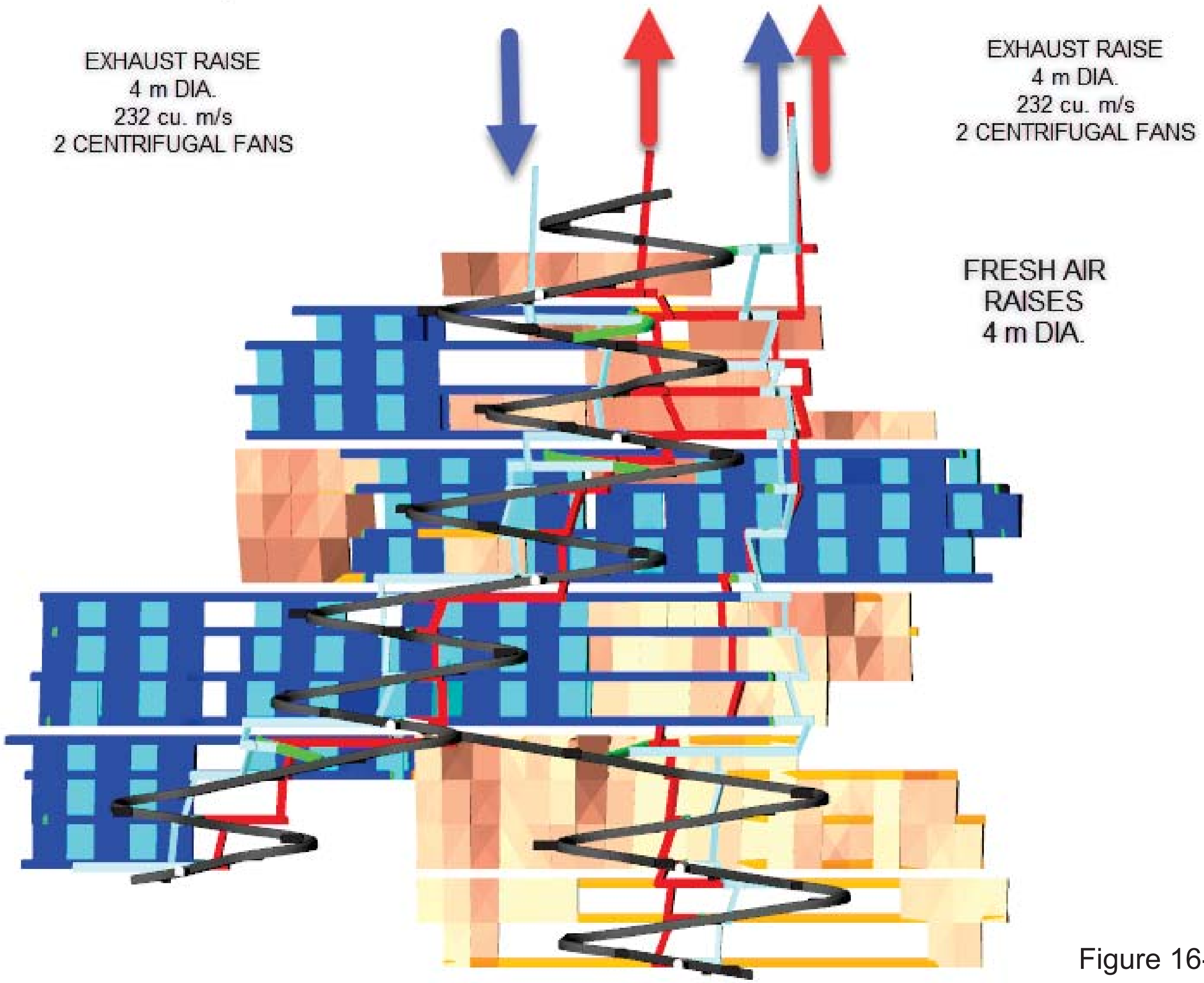
The fresh air raises and exhaust raises are located in the level access drift due to the bench stoping mining method and as a result, the level is ventilated using auxiliary ventilation.

The ventilation design can be improved by moving the exhaust raise underground to the end of the orebody on the west side. This will remove congestion of development near the entrance of the levels and reduce overall development. This relocation would include changing the current intake raise location on the west side to the exhaust raise. The exhaust raise on the west side would be reassigned as the intake raise. This will reduce development by approximately 350 m and allow flow through ventilation on the levels.

On the east side of the orebody, access to the exhaust raise should be made on the level near the raise instead of the level access. This will allow for flow through ventilation.

AMBREX

Ambrex will predominantly be mined through VRM methods with some bench stope mining. The mine has two internal ramps exiting through one portal. The mine design has two intake and exhaust raises with axial fans on the exhaust raises as shown in Figure 16-12. The total flow required at peak mining is 463 m^3/s.



Looking North-East
NTS

Figure 16-12

Nexa Resources S.A.

Aripuanã Zinc Project
State of Mato Grosso, Brazil
Ambrex Ventilation Schematic

October 2018

Source: RPA, 2018.

The fresh air raises and exhaust raises are located in the level access drift due to the bench stoping mining method and as a result, the level is ventilated using auxiliary ventilation.

The ventilation design can be improved by moving the exhaust raise underground to the end of the orebody on the west side. This will remove congestion of development near the entrance of the levels and reduce overall development. This relocation would include changing the current intake raise location on the west side to the exhaust raise. The exhaust raise on the west side would be reassigned as the intake raise. This will reduce development by approximately 350 m and allow flow through ventilation on the levels.

On the east side of the orebody, the intake and exhaust raises are not required until level four. The lateral development above level four can be eliminated. This will reduce development by approximately 200 m and have straight raises reducing resistance.

BACKFILL

The process plant produces tailings quantities of approximately 90% of the plant feed. Tailings can be dry stacked on surface or can be used as backfill for underground voids. It is planned that backfill be placed as consolidated or unconsolidated pastefill with the specfications as outlined in Table 16-3. The strengths achieved by consolidated pastefill meet the geomechanical requirements for Primary and bench stopes.

TABLE 16-3 BACKFILL SPECIFICATION
Nexa Resources S.A. – Aripuanã Zinc Project

Description	Units	Consolidated Pastefill	Unconsolidated Pastefill
Solids	% solid	72%	88%
Water	% solid	24%	12%
Cement	% solid	4%	-
Density	g / cm³	2.4	2.3

In general, waste rock will not be used as backfill and will be hauled to the surface and placed in waste dumps.

PRODUCTION SCHEDULE

The production schedule for the Aripuana Project is summarized in Table 16-4. A nominal target of 6,300 tpd was used in preparing the mining schedule, with feed to the plant consisting of campaigns of Stratabound and Stringer material types, managed via stockpiling.

The deposits support a production rate of 2.3 Mtpa, with average annual metal production of:

- Zinc: 66.7 thousand tonnes;
- Lead: 23.0 thousand tonnes;
- Copper: 3.7 thousand tonnes;
- Silver: 1.87 million ounces (contained in copper and lead concentrates); and
- Gold: 13.0 thousand ounces (contained in copper and lead concentrates).

This average annual production is equivalent to 120,000 tonnes zinc per year, after converting other metals based on net revenue.

TABLE 16-4 PRODUCTION SCHEDULE
Nexa Resources S.A. – Aripuanã Zinc Project

Aripuanã Project - FEL3	Production Schedule Summary			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
	Inputs	UNITS	TOTAL	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
MINING																			
Underground																			
Operating Days	365	days			30	100	365	365	365	365	365	365	365	365	365	365	365	365	365
Tonnes mined per day		tonnes / day	5,205.6		2,095	6,113	3,833	5,813	6,511	6,361	6,072	6,250	6,239	6,169	6,081	5,073	4,809	3,429	3,238
Production		'000 tonnes	26,179	-	63	611	1,399	2,122	2,376	2,322	2,216	2,281	2,277	2,252	2,219	1,852	1,755	1,252	1,182
Zn Grade		%	3.7%	0.0%	3.6%	3.5%	3.6%	4.0%	4.0%	3.8%	3.8%	3.5%	4.0%	3.5%	3.8%	3.8%	3.6%	2.6%	4.0%
Pb Grade		%	1.4%	0.0%	1.1%	1.2%	1.3%	1.4%	1.4%	1.4%	1.3%	1.3%	1.4%	1.3%	1.5%	1.3%	1.4%	1.2%	1.6%
Cu Grade		%	0.2%	0.0%	0.4%	0.6%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%
Ag Grade		oz/t	1.10	-	1.08	1.25	1.16	1.13	1.08	1.19	1.14	1.02	1.17	1.15	1.10	0.92	1.12	0.98	1.04
Au Grade		oz/t	0.010	-	0.014	0.012	0.009	0.011	0.011	0.010	0.012	0.010	0.009	0.008	0.005	0.011	0.008	0.013	0.006
Contained Metal in ROM																			
Zn		000 tonnes	973	-	2.2	21.4	50.1	84.3	95.5	88.9	83.3	80.2	90.5	79.5	84.6	69.7	63.3	32.0	47.0
Pb		000 tonnes	355	-	0.7	7.5	17.9	30.1	34.0	31.4	29.0	29.1	31.6	29.4	32.5	24.3	24.6	14.7	18.6
Cu		000 tonnes	65	-	0.3	3.5	6.2	7.2	7.2	7.2	6.9	5.9	4.9	5.6	2.3	2.7	2.5	2.3	0.7
Ag		kozs	28,836	-	67.8	765.9	1,618.9	2,391.1	2,574.3	2,758.3	2,524.4	2,320.0	2,657.2	2,596.1	2,438.1	1,703.5	1,962.4	1,225.0	1,233.2
Au		kozs	250	-	0.9	7.6	12.8	23.3	26.4	22.3	27.0	22.8	19.4	17.9	11.0	19.9	14.1	16.9	7.4
PROCESSING																			
Mill Feed		**'000 tonnes**	**25,909**	**-**	**-**	**-**	**1,493**	**1,937**	**2,300**	**2,299**	**2,243**	**2,247**	**2,263**	**2,253**	**2,272**	**2,159**	**2,010**	**1,252**	**1,182**
Head grade																			
Zn Grade		%	3.8%				4.4%	4.1%	4.4%	4.3%	3.7%	3.6%	4.0%	3.5%	3.7%	3.3%	3.2%	2.6%	4.0%
Pb Grade		%	1.4%				1.5%	1.5%	1.5%	1.5%	1.3%	1.3%	1.4%	1.3%	1.4%	1.1%	1.2%	1.2%	1.6%
Cu Grade		%	0.3%				0.5%	0.3%	0.3%	0.2%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	0.2%	0.2%	0.1%
Ag Grade		oz/t	1.11				1.43	1.17	1.16	1.27	1.13	1.03	1.18	1.15	1.08	0.84	1.01	0.98	1.04
Au Grade		oz/t	0.01				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Contained Zn		'000 tonnes	973				65.0	79.0	100.1	97.7	83.3	80.2	90.6	79.3	84.5	70.3	63.7	32.0	47.0
Contained Pb		'000 tonnes	355				23.0	28.2	35.6	34.5	28.9	29.0	31.5	29.4	32.6	24.6	24.7	14.7	18.6
Contained Cu		'000 tonnes	65				7.6	6.8	5.8	5.0	6.8	5.3	4.9	5.5	3.0	6.3	5.0	2.3	0.7
Contained Ag		koz	28,836				2,131.5	2,261.2	2,657.1	2,919.3	2,531.4	2,316.1	2,661.8	2,590.5	2,462.2	1,813.3	2,033.7	1,225.0	1,233.2
Contained Au		koz	250				16.0	20.8	20.7	17.4	23.9	20.4	20.3	20.1	13.5	28.5	23.7	16.9	7.4
Net Recovery																			
Zn Recovery		%	89.1%				89.2%	89.3%	89.4%	89.4%	89.1%	89.1%	89.2%	89.1%	89.2%	88.3%	88.5%	88.7%	89.4%
Pb Recovery		%	84.2%				84.8%	84.5%	84.7%	84.5%	83.7%	83.7%	84.1%	83.6%	84.2%	83.3%	84.0%	84.3%	84.7%
Cu Recovery		%	74.7%				72.2%	70.7%	67.5%	67.6%	75.5%	77.3%	74.5%	75.7%	76.2%	84.6%	81.4%	77.5%	67.7%
Ag Recovery		%	84.2%				84.3%	84.5%	85.0%	85.0%	83.9%	84.0%	84.4%	84.2%	84.5%	82.1%	83.1%	83.7%	85.0%
Au Recovery		%	67.6%				68.5%	69.2%	70.0%	70.0%	67.6%	67.3%	68.2%	67.9%	68.2%	65.0%	65.1%	64.8%	69.9%
Concentrate Production																			
Zn Concentrate		'000 tonnes	1,484				99.2	120.7	153.2	149.6	127.0	122.4	138.4	121.0	129.1	106.3	96.5	48.6	72.0
Zn		%	58.40%				58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%
Ag		oz/t	1.90				2.11	1.85	1.73	1.95	1.93	1.84	1.89	2.09	1.88	1.56	1.99	2.42	1.71
Pb Concentrate		'000 tonnes	482				31.5	38.4	48.6	47.0	39.0	39.2	42.7	39.7	44.3	33.0	33.5	20.1	25.4
Pb		%	62.00%				62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%
Ag		oz/t	32.1				36.5	31.9	30.1	34.1	34.6	31.6	33.7	35.1	30.1	27.7	31.5	32.3	26.7
Au		oz/t	0.07				0.08	0.10	0.08	0.07	0.08	0.06	0.07	0.07	0.05	0.05	0.04	0.04	0.06
Cu Concentrate I		'000 tonnes	65				4.5	2.8	-	0.1	7.1	6.7	4.5	5.8	3.4	15.1	10.5	4.6	0.1
Cu		%	30.98%				31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%
Ag		oz/t	5.16				4.7	5.5	-	5.7	5.4	5.1	5.1	5.1	5.1	5.0	5.4	5.1	11.2
Au		oz/t	0.84				0.49	0.55	-	0.64	0.73	0.75	0.73	0.65	0.65	0.86	0.99	1.72	1.23
Cu Concentrate II		'000 tonnes	93				13.4	12.8	12.8	11.0	9.7	6.6	7.4	7.6	4.0	2.3	2.6	1.1	1.5
Cu		%	30.60%				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%
Ag		oz/t	60.64				31.15	34.95	41.46	52.97	50.74	68.15	70.24	66.30	121.06	145.87	146.86	216.96	161.34
Au		oz/t	0.88				0.47	0.72	0.81	0.79	0.81	0.94	1.01	0.92	1.25	1.76	1.38	2.01	2.37
TOTAL Recovered																			
Zn		'000 tonnes	866.7				58.0	70.5	89.5	87.4	74.2	71.5	80.8	70.7	75.4	62.1	56.4	28.4	42.0
Pb		'000 tonnes	299.1				19.5	23.8	30.2	29.2	24.2	24.3	26.5	24.6	27.5	20.5	20.8	12.4	15.7
Cu		'000 tonnes	48.6				5.5	4.8	3.9	3.4	5.2	4.1	3.7	4.1	2.3	5.4	4.1	1.8	0.5
Ag		koz	24,275.3				1,797.0	1,911.1	2,258.6	2,481.1	2,124.5	1,944.8	2,246.5	2,180.9	2,080.7	1,488.2	1,689.1	1,024.9	1,047.8
Au		koz	168.6				11.0	14.4	14.5	12.2	16.2	13.7	13.8	13.7	9.2	18.5	15.4	10.9	5.1

17 RECOVERY METHODS

The description of the processing plant is largely taken from information presented in the Votorantim Metais Technical Report (Votorantim, 2015), the Basis of Design Report (Worley Parsons, 2017b), and the Process Description Report (SNC-Lavalin, 2018b).

PROCESS DESCRIPTION

Based on the metallurgical test program completed to date, the Aripuanã Zinc process flowsheet has been developed by considering conventional technologies for treatment and the recovery of copper, lead, and zinc as separate concentrates. Plant throughput is forecasted to be 2.268 Mtpa of ROM ore from Arex, Link, and Ambrex underground mines. The plant will treat approximately 5,250 tpd (dry basis) of Stringer material and 6,300 tpd (dry basis) of Stratabound material. A simplified process flowsheet is shown in Figure 17-1. Key elements of the process flowsheet include primary crushing, semi-autogenous grinding (SAG) followed by ball milling and pebble crushing (SABC) circuit, talc pre-flotation of Stratabound mineralization, sequential flotation of copper, lead, and zinc, and single copper flotation for Stringer mineralization. A description of the key processing plant unit operations is presented below.

Stratabound material will be campaigned for approximately 11 months of the year and Stringer material for one month of the year. The reason behind this decision by Nexa was improved recovery and throughput based on bench testwork, and the opportunity for maintenance of the lead and zinc circuits during the Stringer runs. RPA recommends that blending tests be carried out during operation to determine whether Stringer material can be introduced concurrently with Stratabound material. Once normal operation has been established with Stringer material during the first campaign, RPA recommends that a trial run including operation of the lead and zinc circuits be completed to see if mass accumulation allows the production of lead and zinc concentrates during Stringer campaigns in operation.

COMMINUTION

Run-of-Mine (ROM) material will be trucked from the underground mine to the ROM stockpile, close to the plant crushing area. Production will be directly discharged into a feed hopper or held temporarily in two stockpiles (approximately 21,000 Mt and 24,000 Mt in size) based on mineralization type and grade and recovered later by wheel loader. Recovery of ROM material from the hopper will be by apron feeder which will discharge to a fixed grizzly scalper with an aperture of 600 mm. The oversize material from the grizzly scalper will feed the jaw crusher.

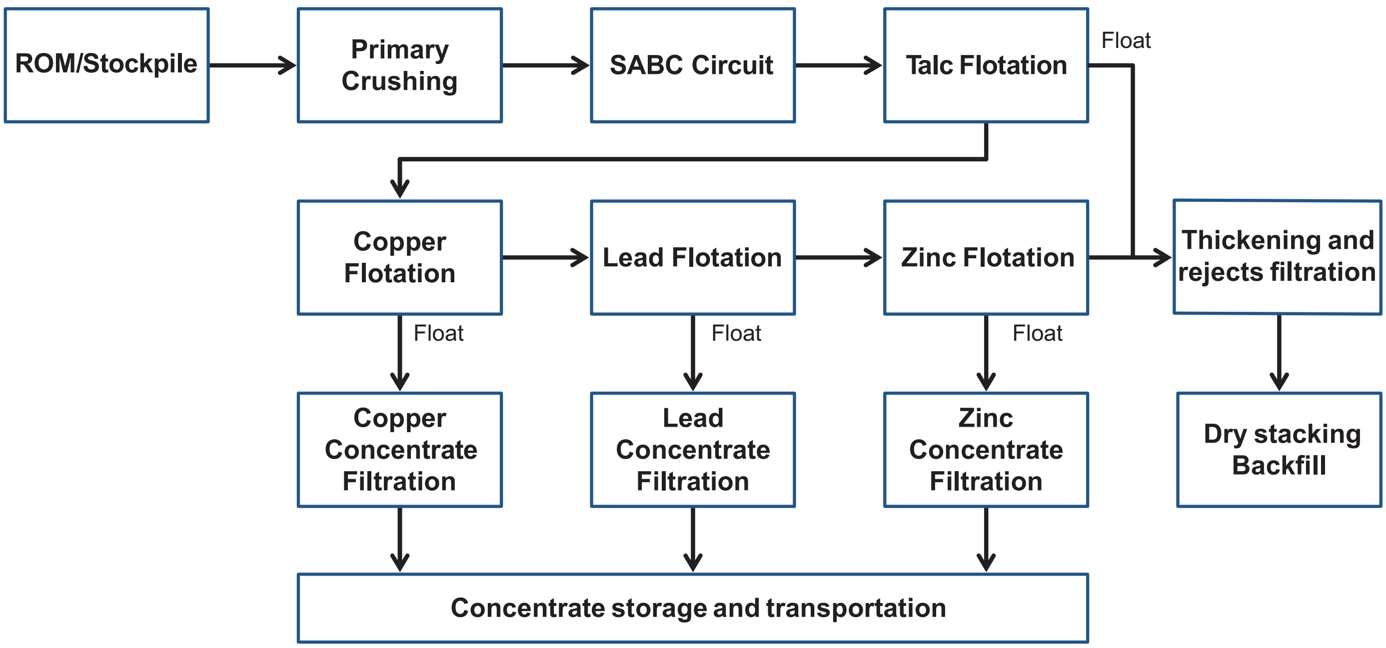


Figure 17-1

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

Simplified Process Flow Sheet

October 2018

Source: SNC-Lavalin, 2018b.

The crushed product, with a particle size of less than 140 mm, will be collected on a conveyor belt together with the fines passing between the feeder plates. There will also be a metal detector and a scrap extractor for removal of any material that could damage the belt or other equipment. The conveyor belt will feed the crushed ROM silo with a capacity of 2,923 tonnes. Apron feeders will remove the crushed product from the silo and deliver the material by conveyor belt to the SAG mill.

A trommel at the SAG mill will separate coarse material for recirculation as SAG mill feed. To maintain the ideal chemistry and slurry density in the SAG circuit, the addition of reclaimed water is controlled. Product from the pebble crusher will also be discharged onto a conveyor belt to feed the SAG mill. The SAG mill product will be transferred to a horizontal vibrating screen.

Undersize screen material from SAG mill discharge will be transferred to a pump box and the slurry will feed a set of hydrocyclones. Hydrocyclone underflow material will return to the ball mill and the hydrocyclone overflow with P_{80} (80% passing size) of 0.150 mm will be transferred to the flotation feed pump box. An online particle size analyzer will be installed to control partition and grinding of the hydrocyclone overflow stream. The ball mill discharge will be screened and the pulp will be combined with the screen undersize from the SAG mill discharge and recirculated as feed to the hydrocyclones.

From FEL 2 at 5,000 tpd, comminution was redesigned for FEL 3 based on campaigning at higher rates, as shown in Table 17-1.

TABLE 17-1 COMMINUTION – FEL 2 VS. FEL 3
Nexa Resources S.A. – Aripuanã Zinc Project

Milling		FEL 2 (5,000 tpd)			FEL 3 (4,5000 tpd Stringer, 6,000 tpd Stratabound		
Unit No.	**Description**	**Dimensions**	**Power Consumption (kW)**	**Note**	**Dimensions**	**Power Consumption (kW)**	**Note**
0230-MO-001	SAG Mill	6.10 m dia, x 2.67 m EGL (20' x 9') (variable frequency drive, VFD)	1,600	With VFD	6.71 m dia, x 3.58 m EGL (22' x 11.75') (VFD)	2,800	With VFD
0230-PE-002A	Horizontal Double-deck Vibrating Screen	2,140 mm x 4,872 mm (7' x 16'); slot size 19.5 mm and 12.7 mm	11		2,400 mm x 4,800 mm; slot size 19.5 mm and 12.7 mm	30	
0230-PE-002B	Horizontal Double-deck Vibrating Screen	2,140 mm x 4,872 mm (7' x 16'); slot size 19.5 mm and 12.7 mm	11	Backup skid-mounted unit	2,400 mm x 4,800 mm; slot size 19.5 mm and 12.7 mm	30	Backup skid-mounted unit
0230-HC-006	Set of Hydrocyclones	508 mm (20") dia.; 4 in operation, 2 backup, 100-140 kPa	-		660 mm (26") dia.; 3 in operation, 2 backup,	-	
0230-MO-007	Ball Mill	4.87 m dia. x 7.32 m EGL (16' x 24')	3,200	With soft starter	4.72 m dia. x 7.47 m Inside Shell (1.5' x 24.5')	2,800	With soft starter

During the late stages of the FEL 3 study, a decision was made to increase throughput by 5% to 5,250 tpd for Stringer material and 6,300 tpd for Stratabound material. To accommodate the increased throughput, RPA is of the opinion that the SAG mill and ball mill will need to have larger sizes than those selected during the FEL 3 design development.

The SAG mill should be 7.32 m diameter x 3.66 m effective grinding length (EGL) (24 ft x 12 ft) with a variable frequency drive and an installed motor power of 3,000 kW, and the ball mill should be 4.88 m diameter x 7.32 m EGL (16 ft x 24 ft) with an installed motor power of 3,500 kW. The total installed mill power would increase from 5,600 kW to 6,500 kW. From a spare parts perspective, it is possible to design and fit both mills with 3,500 kW motors, if necessary.

In RPA's opinion, the additional capital required for resizing mills and motors is negligible in comparison to the overall capital cost and risk associated with undersizing comminution.

Nexa has verified that the extractive side of the plant contained a 20% design factor for throughput. For this reason, the rest of the plant has not been changed from the FEL3 throughput design and it is understood that the design factor for the plant is no longer 20%. Some unit operations and systems may require redesign or modification based on engineering review by Nexa. In RPA's opinion, this poses a very low risk to project economics and can be mitigated during ramp up and operation if necessary.

FLOTATION

Flotation will be conducted sequentially, i.e., the production from the comminution circuit will pass through four independent circuits in sequence. The first flotation circuit is talc/light mineral flotation (e.g., minerals containing magnesium) to remove naturally hydrophobic minerals and to prevent them from contaminating the sulphide concentrates. Due to the high content of light minerals in Stratabound mineralization, these minerals must be removed before sulphide flotation. Stratabound mineralization will be treated via talc flotation, and Stringer only if necessary. Talc removal is not generally required for Stringer mineralization due to its low talc content and any talc present can be depressed by using carboxymethyl cellulose (CMC). The flotation circuits for the recovery of copper, lead, and zinc follow talc flotation. In RPA's opinion, the size and retention time of these circuits require review given the scale up recommendations for rougher and cleaner flotation and the increased throughput as described under Comminution.

Hydrocyclone overflow slurry will directly feed the talc flotation circuit consisting of rougher, cleaner, and scavenger stages. RPA recommends that a flotation feed tank be included in the design between the hydrocyclones and the talc flotation ciruit, and an additional flotation feed tank between the talc circuit and copper circuit to disconnect surging from grinding and talc flotation. Reagents added for talc flotation include methyl isobutyl carbinol (MIBC) as a frother and sodium metabisulphite (SMBS) as a depressor of iron sulphides (pyrite and pyrrhotite). The talc flotation concentrate produced will be pumped to tailings filtration, dewatered, and disposed of. The talc flotation tailings (containing copper, lead, and zinc minerals) will proceed to the copper flotation circuit.

Prior to copper rougher flotation, talc flotation tailings will be conditioned in a tank using the following reagents:

- Stratabound: AERO 3894 or A3894 (dialkyl thionocarbamate collector for copper), zinc sulphate (sphalerite depressor), SMBS (iron sulphide depressor), and CMC (talc depressor)
- Stringer: A3894 (collector), MIBC (frother), and CMC (talc depressor)

Prior to conditioning and cleaner flotation, copper rougher flotation concentrate will be reground to increase sulphide liberation and to promote higher cleaner stage recovery. The product from the copper cleaner flotation circuit is the final copper concentrate. Copper rougher flotation tailings will be pumped to feed the lead flotation circuit (Stratabound) or in the delivered to tailings filtration (Stringer).

The lead flotation circuit is similar to the copper flotation circuit, however, the quantity of flotation cells and the types of reagents used are different. Lead and zinc flotation are only performed for Stratabound mineralization. The reagents used for lead flotation include:

- AEROPHINE 3418A (dialkyl dithiophosphinate collector for lead)
- Zinc sulphate (sphalerite (zinc) depressor)
- SMBS (iron sulphide depressor)
- Lime (pH regulator)
- CMC (talc depressor)
- MIBC (frother)

Prior to lead rougher flotation, the feed slurry is conditioned with the above reagents in a tank. The lead circuit consists of rougher flotation, rougher concentrate regrinding, and cleaner flotation. The product from the lead cleaner flotation circuit is the final lead concentrate. The lead rougher flotation tailings will be pumped to feed the zinc flotation circuit.

The zinc flotation circuit is similar to the copper and lead flotation circuits, however, the quantity of flotation cells and the types of reagents used are different. The reagents used for zinc flotation include:

- AERO 208 or A208 (dialkyl dithiophosphate collector for zinc)
- Copper sulphate (sphalerite (zinc) activator)
- Lime (pH regulator)
- CMC (talc depressor)
- MIBC (frother)

Prior to zinc rougher flotation, the feed slurry is conditioned with the above reagents in a tank. The zinc circuit consists of rougher flotation, rougher concentrate regrinding, and cleaner flotation. The product from the zinc cleaner flotation circuit is the final zinc concentrate. Zinc rougher flotation tailings will be pumped to tailings filtration, dewatered, and disposed of.

THICKENING AND FILTRATION

Thickening and filtration will be performed on flotation concentrates and tailings. Three concentrates (copper, lead, and zinc) will be produced and will require separate thickening and filtration. Tailings generated from flotation will consist of talc concentrate, copper flotation tailings (Stringer), and zinc flotation tailings (Stratabound).

Each concentrate slurry will be pumped to a storage tank feeding two press filters, which will reduce the moisture to approximately 10%. The filtered copper and zinc concentrates will fall by gravity onto belt conveyors that will deliver the material to segregated covered storage areas. The copper and zinc concentrates will be reclaimed by wheel loader for transport by truck. After filtration, the lead concentrates will be bagged in one metric tonne bags. All filtrates will be recovered for use in flotation.

Copper flotation tailings (Stringer) and zinc flotation tailings (Stratabound) will be thickened, combined with talc tailings, and filtered for disposal. Tailings thickener underflow will be filtered to produce a filter cake with approximately 10% moisture that is suitable for dry stacking in two stacks (capacity of 3,525 tonnes each). This stockpiled material can be transported by conveyor or truck, and disposed of in the dry tailings dump. During the rainy season, the tailings will be mixed with cement and pumped as material for mine backfill. The filtrates from the press filter will be pumped to a recovered water pond and reclaimed for return to the process.

BACKFILL

The backfill plant of the Project will serve the Arex and Link mines. To fill the Ambrex mine, a new backfill station will need to be considered. In the rainy season, the underground mines will be filled with backfill paste. Talc concentrate pulp will be combined with flotation tailings and mixed with cement to produce the mine backfill paste.

RECOVERED AND MAKE-UP WATER SYSTEMS

The water system is designed to maximize water recovery and recirculation. Water from tailings thickener overflow and tailings filtration will be pumped to a recovered water pond with a two-day retention capacity. After treatment with hydrogen peroxide, the water is pumped to a 600 m^3 recovered water tank, which will receive make-up water as required.

Water collected from concentrate filtration will be segregated and recirculated for use in the respective flotation circuit.

Make-up water will be collected from a storage pond close to the facilities and will be pumped to a 400 m^3 make-up water tank. This water will be used as make-up for recovered water and for specific uses including feed for the Water Treatment Station (WTS), pump sealing, fire suppression, vacuum pump sealing, reagent preparation, potable water, and feed to various points in the plant circuit.

REAGENT PREPARATION

AERO 3894

This collector is supplied as liquid product at 100% concentration in sealed 200 L drums. The solution from the drums will be transferred to a storage tank and distributed without dilution in copper flotation.

AEROPHINE 3418A AND AERO 208

The collectors will be supplied as liquid products at 100% concentration in sealed 200 L drums and will have identical preparation systems. Solutions will be transferred to dosage tanks, prepared in solubilization tanks to 10% by weight, and transferred to storage tanks. The collector will be pumped and delivered at required dosage rates in several flotation stages for the respective flotation circuits.

SODIUM METABISULPHITE

This reagent will be supplied in one metric tonne bags and delivered to a storage hopper. A screw feeder-doser will transfer the material from the storage hopper to an agitator tank, where SMBS will be dissolved in water to reach a concentration of 5% w/w. The solution will be transferred to a storage tank and pumped at required dosages to copper and lead flotation.

COPPER SULPHATE

Copper sulphate will be supplied in one metric tonne bags and delivered to a storage hopper. A screw feeder-doser will transfer the material from the storage hopper to an agitator tank, where the copper sulphate will be dissolved in water to reach a concentration of 5% w/w. The solution will be transferred to a storage tank and pumped at required dosages to zinc flotation.

ZINC SULPHATE

Zinc sulphate will be supplied in one metric tonne bags and delivered to a storage hopper. A screw feeder-doser will transfer the material from the storage hopper to an agitator tank, where the copper sulphate will be dissolved in water to reach a concentration of 10%. The solution will be transferred to a storage tank and pumped at required dosages to copper and lead flotation.

MIBC

MIBC will be supplied in liquid form at 100% concentration in sealed 200 L drums. The frothing agent will be transferred by pump to respective storage and distribution tanks. The frother will be added in separate lines to various flotation stages. MIBC will be added to maintain froth stability as required in all flotation stages.

CMC

CMC will be supplied in 500 kg bags and delivered to a storage hopper. A screw feeder-doser will transfer the material from the storage hopper to an agitator tank, where the CMC will be dissolved in water to reach a concentration of 2% w/w. The solution will be transferred to a storage tank and pumped at required dosages to copper, lead, and zinc flotation.

HYDRATED LIME

Hydrated lime will be supplied in bulk by truck and pneumatically transported to storage silos. All dust generated during material transfer will be collected by a de-dusting system comprised of exhaust fans and bag filters. Lime will be transferred using a rotating valve coupled with a screw feeder-doser to a covered mixing tank and combined with water to prepare a concentrated slurry containing 5% w/w. Lime slurry will be pumped to various process stages and the reagent will be added at required dosages to control circuit pH.

CEMENT

Cement will be supplied in bulk by truck and pneumatically transferred to storage silos. All dust generated during material transfer will be collected by a de-dusting system comprised of exhaust fans and bag filters. Cement will be transferred using a rotating valve coupled with a screw feeder-doser to a backfill re-slurrying tank and delivered to an agitated slurry mix tank. Cement slurry will be pumped to the mine via a pipeline along the access road from the plant to the mine.

FLOCCULANT (BASF MAGNAFLOC 10)

Flocculant will be supplied as a solid and will be delivered in 25 kg sealed bags and transferred to a storage hopper. Material will be transferred from the storage hopper by screw feeder to an agitated tank and a 0.25% w/w suspension will be prepared. The prepared solution will be pumped to a storage tank and distributed to the thickener.

COMPRESSED AIR SYSTEMS

A dedicated compressed air system will be provided for the press filters for each type of concentrate. One or more compressors, with a stand-by unit, will be available for each filtration system. These compressors will be screw type, air cooled, oil-free, and at a pressure of 7 kg/cm^2.

An exclusive small-size compressor will be installed, without a stand-by unit, to generate dry, oil-free air for the laboratory.

Screw compressors will be installed, with one stand-by unit, to generate dry oil-free air for the beneficiation plant and workshop service and instrumentation air.

Dedicated blowers will be installed, with one stand-by unit, to generate low pressure, oil-free air (approximately 0.4 kg/cm^2) for the flotation stage (tank cells).

DUST SUPPRESSION SYSTEM

The dust suppression system for primary crushing and the homogenization silo will consist of a central unit with pumping and filtration systems, as well as piping and spray nozzles.

DRAINAGE

A drainage system has been devised throughout the operational area, which includes:

- **Process drainage** – restricted to process facility buildings of operational units. The aim is to contain leakage and overflows that may occur during the development of activities and process. The effluent collected returns to the production process itself.

- **Industrial drainage** – restricted to access areas within the industrial unit and entrance gate areas, which may be reached by leakage from piping and its supporting structures, cargo transportation, etc. This drainage must be connected to the emergency drainage and/or effluent treatment station. A water, oil, and grease separation system will be installed in the workshop and in areas with industrial effluents.

- **Pluvial drainage** – aimed at collecting rainwater in areas without risk of contamination, which can be disposed of in the hydrographic network without treatment.

- **Emergency drainage** – aimed at controlling emergency situations related to liquid effluents and industrial drainage and installed in an appropriate location so as to prevent pollution of the local drainage network.

EFFLUENT TREATMENT STATION (ETS)

Compact effluent treatment system (Compact ETS) is a modular system for biological treatment of wastewater (sewage). The water treatment system includes a pretreatment stage with grid, sandbox, grease box, septic tank, and screen or flotation. In case the system is aerobic, there is typically an aeration/digestion chamber. A Compact ETS based on aerobic reactors requires oxygen supply to allow for the development of aerobic organisms (activated sludge) and includes decantation. Water can be disinfected by chlorination, ozonization or UV radiation, and reused or discharged to the environment.

The treatment stages are as follows:

- Effluent intake through an inlet diffuser to avoid turbulence of any material already deposited.

- Decantation and segregation of material in the septic tank.

- Effluent flow out through an outlet prefilter filled with number 3 gravel.

- A passage and inspection box between the septic tank and the biological septo-diffuser filters to facilitate distribution.

- Effluent treatment through anaerobic filtration.

Treated effluent may be discharged, collected and taken to a receiving body, or reused for other industrial purposes.

18 PROJECT INFRASTRUCTURE

The planned infrastructure at the Project includes:

- Three underground mines, accessed by three portals and three ramps
- Dry Stack Tailings storage facility (TSF)
- Power Supply
- Water storage dam
- Access and site road
- Maintenance shops
- Fuel storage

TAILINGS STORAGE FACILITY

The overall waste management strategy for the Aripuanã Zinc Project is largely taken from information presented in a Waste Management Strategy Report (Worley Parsons, 2017c) and the Basis of Design Report (Worley Parsons, 2017b). The current waste management strategy includes the following aspects:

- Surface water management to minimize water entering the tailings area.
- Adoption of dry stack (filtered) tailings disposal on surface and tailings disposal as cemented paste backfill underground.
- Site selection for the Tailings Management Facility (TMF) sites.
- Minimizing the size and space required for the fresh water pond and thus, providing more space for adjacent TMF sites. A portion of the process plant water demand will be supplied from mine dewatering, which will be supplemented by pumping from an aquifer in the vicinity of the mine site.
- Utilization of non-acid forming mine waste rock to provide supplemental perimeter containment of the tailings.

TAILINGS PRODUCTION

Up to 5,000 tpd of tailings solids will be generated at full plant production and approximately 17 million tonnes of tailings will require secure disposal over a period of 13 years. In accordance with a regulatory commitment, a minimum of 50% of the tailings must be disposed of in underground mine workings and plans for tailings disposal as cemented paste backfill has been considered. The remainder of the tailings (approximately 8.5 million tonnes of solids) will be stored on surface in accordance with the filtered dry stack method of disposal. Properly filtered, tailings will be spread and compacted in lifts similar to typical earth embankment construction. Preliminary design and management of the dry stack facilities, or TMF sites, have been considered.

TAILINGS PROPERTIES

The metallurgical properties of the mineralization and the grind size during crushing and the concentration of talc will significantly impact the physical properties of tailings. Talc content is expected to be in the range of 5% to 10% of the tailings by weight.

A laboratory test program has recently been completed by RCS (Rheological Consulting Services) of the University of Melbourne in Victoria, Australia to determine the effect of grind size (P_{80} of 150 µm vs. P_{80} of minus 75 µm) and talc content on rheological and geotechnical properties of the tailings. The test data is currently under review.

TAILINGS MANAGEMENT FACILITY DESIGN

Twelve sites were considered by Nexa for above ground tailings deposition in a trade-off study. The site layout for Option 10A is currently under consideration and is shown in Figure 18-1 and in greater detail in Appendix B of the Waste Management Strategy Report. The process plant site would be centrally located with the Arex deposit to the north, the Ambrex deposit to the east, and four TMF sites to the west and south. The water supply dam is located at the south end of the lease area. Topsoil, excess waste rock, and waste soil will be stockpiled to the southwest of the water supply reservoir.

A preliminary conceptual design of the TMF is shown in Figure 18-2 and the following aspects have been considered:

- Perimeter containment to enhance stability of the TMF using waste rock from the mine.
- Placement and management of potentially saturated tailings in internal cells during the wet season.
- Surface water management at each TMF site.
- Any requirements for a liner and seepage collection system at the base of the tailings deposit.
- The ease of reclaiming and closing the facility and the end of mining.

An acid base accounting (ABA) test program is currently in progress for both the tailings and waste rock and the conceptual design of the TMF sites should be reviewed based on the ABA test results. The next stage of design should also assess slope stability and geotechnical parameters based on current laboratory test results.

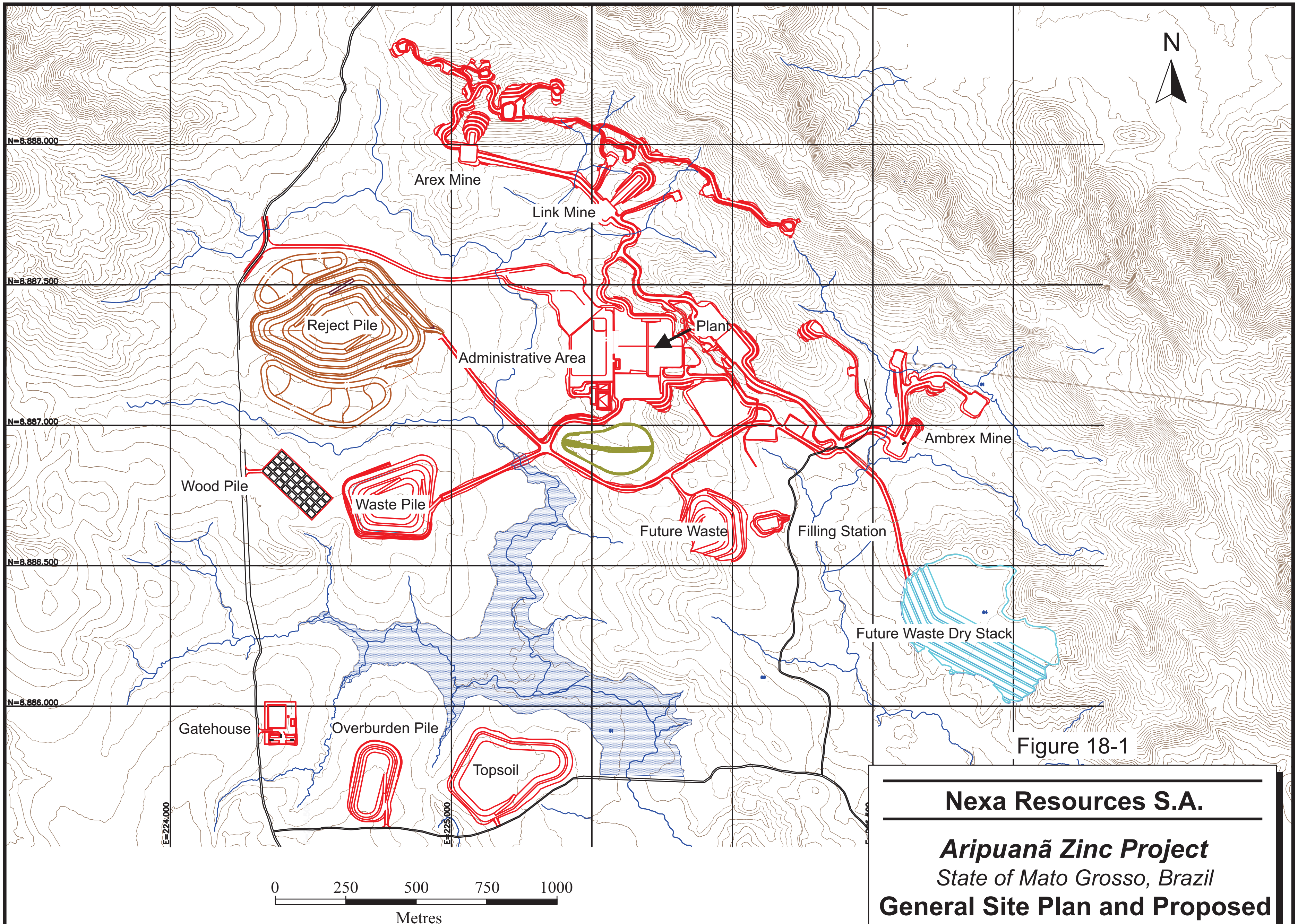


Figure 18-1

Nexa Resources S.A.

Aripuanã Zinc Project

State of Mato Grosso, Brazil

General Site Plan and Proposed TMF Sites for Option 10A

October 2018

Source: Nexa Resources, 2018.

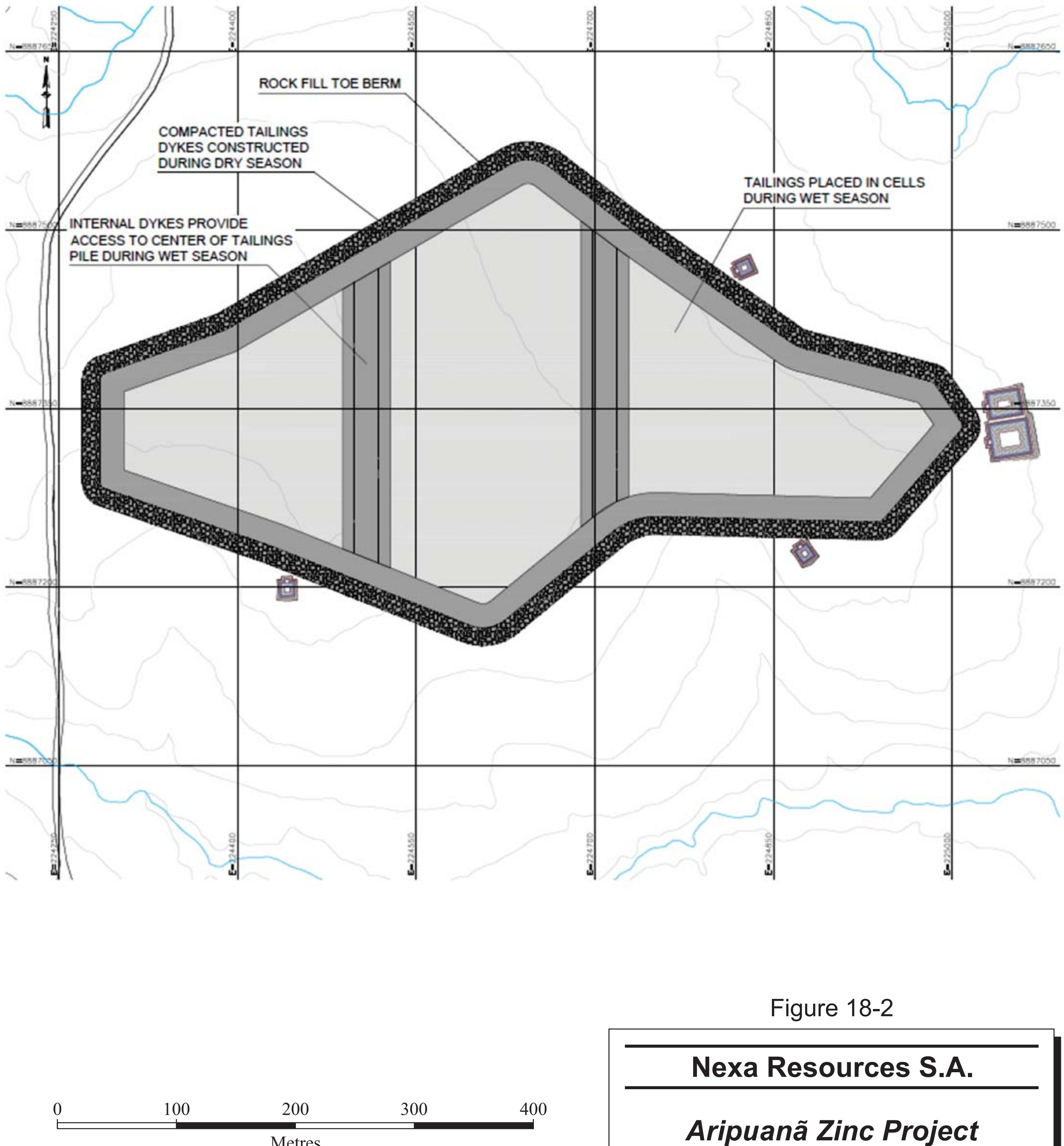


Figure 18-2

Nexa Resources S.A.

Aripuanã Zinc Project

Mato Grosso State, Brazil

TMF Conceptual Design

October 2018

Source: Votorantim Metais, 2017.

WATER COLLECTION AND TREATMENT

Due to the high flow rates and expected low concentrations of dissolved metals, water collection and treatment will be carried out using engineered wetlands. Separate facilities will be developed for process water recovered from the plant and for run-off from stockpiles (ore, waste, and dry stacked tailings) and access roads.

The process water treatment wetland will generate 100% process water recirculation, with zero discharge to the environment.

The stockpile wetland will treat and discharge water in a controlled manner.

The engineered wetlands consist of a solids sedimentation pond, with aerobic and anaerobic passive systems for organic/metals removal and pH adjustment (Figure 18-3).

FIGURE 18-3 ENGINEERED WETLANDS CONCEPT

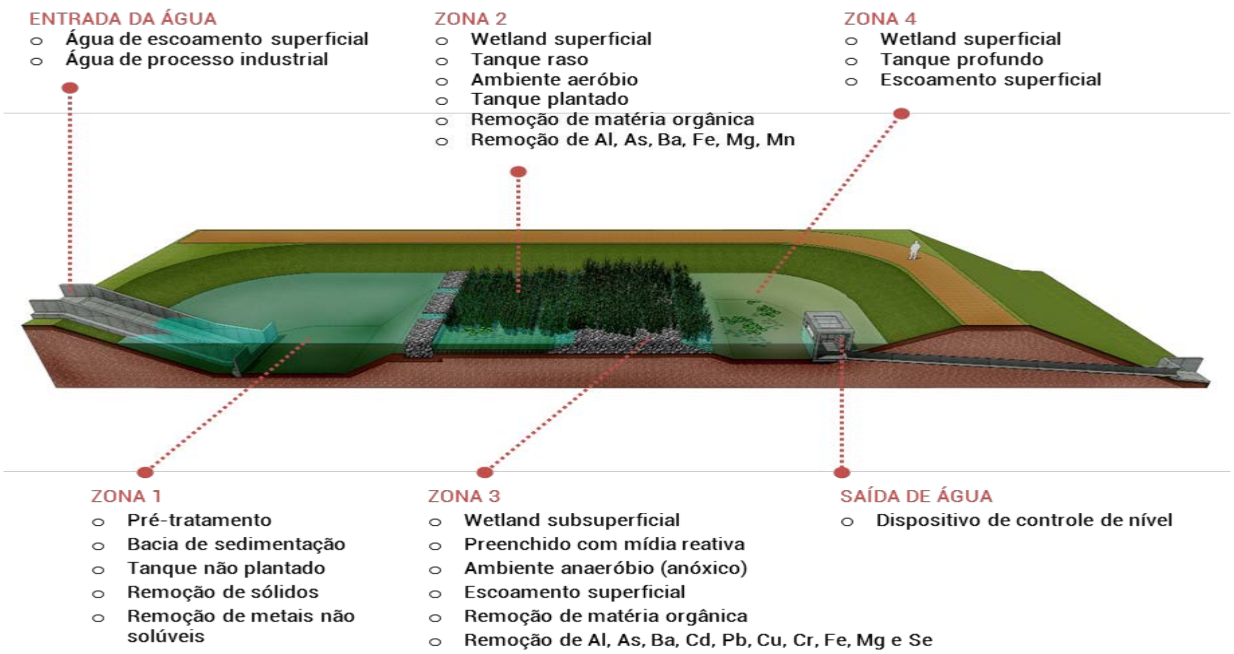
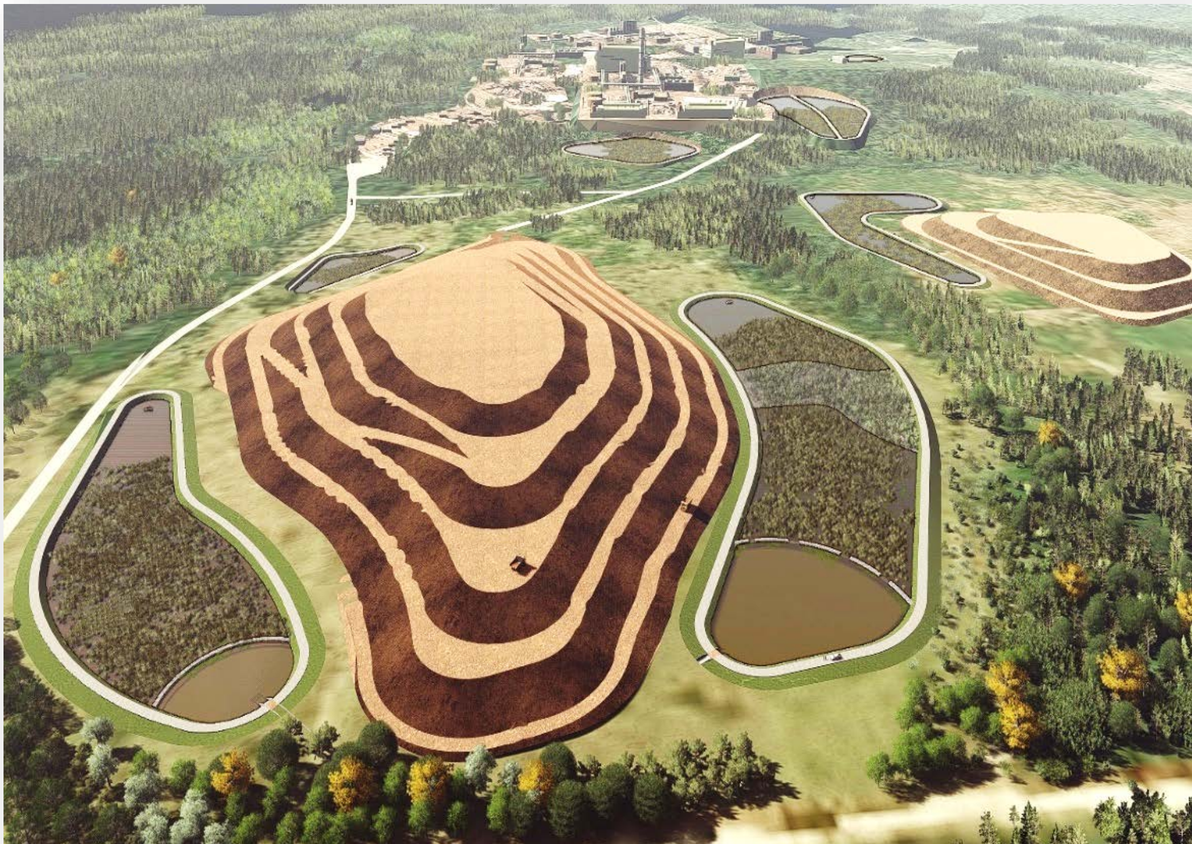


Figure 18-4 shows a general arrangement of the Aripuanã Wetlands, with the drystacked tailings stockpile wetlands in the foreground.

FIGURE 18-4 ARIPUANÃ WETLAND WATER TREATMENT



POWER SUPPLY

Electrical power is proposed to be provided to the Aripuanã Project by the Dardenelos Hydroelectric Plant, connected to the National Energy System, and located near the Project. The Project requires the installation of a 69 kV transmission line and associated infrastructure, such as substations and switchyards, to connect to the Dardenelos transmission system.

RPA understands that the authorization from the Ministry of Mines and Energy for the connection has not yet been obtained, however, it is not expected to be a significant obstacle to advancing the Project.

WATER SUPPLY

The Project water balance requires a top-up of fresh water supply of approximately 150 m^3/h.

Nexa has undertaken a water supply engineering study based on the construction of a water dam and creation of a fresh water lake in a valley adjacent to the Project site (see Figure 18-1).

Nexa has obtained authorization from the regional authority to construct the dam and to draw up to 378 m^3/h of fresh water from the dam to supply the Project.

SITE ACCESS

The Aripuana project is located 25 km from the city of Aripuana (population 17,000) and can be accessed by 935 km of paved roads and land, Cuiaba state capital of Mato Grosso. The city has an airport with a paved runway, which supports small aircraft. Aripuana is connected to the national highway system by dirt roads of average quality. Vegetation to the sides of the access roads is dense, but has been cleared in nearby areas which are mainly used for agriculture.

19 MARKET STUDIES AND CONTRACTS

MARKETS

The principal commodities at the Project are freely traded, at prices and terms that are widely known, so that prospects for sale of any production are virtually assured. RPA reviewed the concentrate terms provided by Nexa and found them to be consistent with current industry norms.

Metal prices are based on long-term consensus forecasts by independent banks and financial institutions. A year-by-year price curve was used for cash flow modelling.

CONTRACTS

No contracts for operations have been negotiated yet.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

The Aripuanã Zinc Project is located approximately 25 km northwest of the municipality of Aripuanã, in the northwestern corner of the Mato Grosso State, Brazil, approximately 1,200 km northwest from Brasília, the federal capital.

The property consists of a contiguous block comprising six mining applications, ten exploration permits (EPs), and seven EPs in applications covering a total area of 66,219 ha. The EPs are owned by Dardanelos, a joint venture between Nexa (70%) and Karmin (30%), with Nexa acting as the operator.

ENVIRONMENTAL OVERVIEW

GEOCHEMISTRY

Geochemical testing carried out to date indicates that some lithologies have the potential to generate acidity due to oxidation of sulphides and low presence of neutralizing components. Other lithologies contain neutralizing minerals, such as dolomite. Therefore, tailings samples have shown no to low acid rock drainage (ARD) potential.

SURFACE WATER

The Project area is located within an area called Depressão Amazonica Meridional (RADAM Brasil 1982) and the Depressão Norte do Mato Grosso (Seplan 1999). This depression includes the drainage network of the Aripuanã River and the Tenente Marques River. The area is hilly with elevations from 129 MASL to 361 MASL and a general northwest-southeast direction.

The Project area, includes two creeks, Arrainha Creek and Maranhão Creek (where the tailings management facility will be located), both of which are tributaries of Guaribal Creek, a tributary of the Aripuanã River, which drains part of the extreme northwest of the state of Mato Grosso and belongs to the Amazon River basin.

Baseline surface water quality data identified that the following metals are present in concentrations above guidelines: aluminum, dissolved iron, manganese, barium, and zinc. These are part of the rock composition in the area and are not linked to mining or other ongoing or historic industrial activities.

Several baseline data collection campaigns identified exceedances of the Ministry of Environment (CONAMA) Resolution No. 357/05 for Class II water bodies, including:

- turbidity;
- dissolved oxygen;
- phosphorus; and
- thermotolerant coliforms and Escherichia coli.

These elevated concentrations are likely linked to human settlements and farming in the area.

CLIMATE AND ATMOSPHERIC ENVIRONMENT

The area does not have a climate station. According to the Köppen-Geiger climate classification, the climate in Aripuanã is monsoon tropical (Am) with temperatures in the coolest months above 18°C, with no pronounced winter season. Annual precipitation is above 2,000 mm, concentrated in the warmer months, and averages below 600 mm in the driest months.

The Aripuanã River basin climate follows the precipitation pattern, with the wet season spanning from November until May. Low flows start in June and end in October. The minimum flows are observed in September and October.

Noise measurements performed in December 2016 in the access roads as well as in Aripuanã showed noise levels above the limit established by NBR 10151/2000.

FLORA

The Project area is covered by natural forest as well as pasture and agricultural lands. The following species observed are considered endangered species:

- *Euterpe edulis* (Juçara Palm Tree);
- *Cordia goeldiana* (*Freijó tree);*
- *Hymenaea curbaril (*Jatobá tree)*;*

- *Aniba rosaeodora* (Pau Rosa Tree)*;*
- *Betholletia excelsea (Nut tree);*
- Virola bicuhyba (Bicuíba tree);
- Manikara cavalcantei (tree sp.); and
- Manikara elata (Maçaranduba tree).

FAUNA

There were 171 birds species identified in the Project area, which can be divided into forest birds and open spaces birds. Four species identified are considered to be endangered species *Harpia harpyja*, *Tinamus tao*, *Hypocnemis ochrgyna*, and *Synallix cherriei.* Due to their status, these species would require mitigation and monitoring commitments by the Project.

Among the terrestrial mammals, there are 81 species identified from a desktop background review and 50 observed during the field survey in the Project area. A total of 10 species are endemic to the Amazon area including *Mazama nemorivaga* (Deer), *Dasyprocta fuliginosa* (rodent) and eight Primates such as *Alouatta puruensis, Ateles chamek, Aotus infulatus, Lagothrixcana, Sapajus apella, Chiropotes albinasus, Cebus unicolor,* and *Mico intemedius*. Although the latter is classified by International Union for Conservation of Nature (IUCN) as less important, its distribution is limited to a small part in the southeast of the state of Amazonas and northwest of the state of Mato Grosso. *Cebus unicolor* is cited in the states of Amazonas, Acre, and Pará, i.e., it has a larger area of distribution.

Eight of the endangered species observed are classified according to the current norms as Portaria MMA 444/2014 and IUCN/2017. The species are: *Lagothrix cana, Ateles chamek, Chiropotes albinasus, Priodontes maximus, Tapirus terrestris, Puma concolor, Tayassu pecari,* and *Lontra longicaudis*.

Among the Bats identified, two are listed as data deficient in Brazil's endangered species list (MMA 444/2014): *Dermanura gnoma* and *Dermanura cinereae*. Bat species are representative of the forest environment.

Among the reptiles and Amphibians observed, the yellow turtle (*Chelonoidis denticulatus)* is considered as vulnerable according to IUCN, however, it was listed as less important according to the study conducted by the Brazilian Chico Mendes Institute for Biodiversity Conservation (ICMBIO) in 2015.

AQUATIC SPECIES

A total of 93 aquatic species were identified during baseline data collection activities, an average of 14 species per creek, with few showing up to 30 species in one creek. In the creeks surveyed, the species are generally of a small size and are distributed homogeneously. The largest fish diversity was observed in the areas where the Guaribal River and Praia Grande Creek discharge into the Aripuanã River.

No macro invertebrates, with potential to transmit water borne diseases were observed in the area. No endangered species were observed among the aquatic organisms (phytoplankton, zooplankton, and microinvertebrates).

LAND AND USE

The area is dedicated to farming of Rubber Trees (*Hevea Brasiliensis*), Nuts (*Bertholletia excelsa*), and Copaíba Oil (*Copaífera landsdorfii*).

There are two conservation areas in the municipality located approximately 100 km to 200 km from the Project: Estação Ecológica Rio Flor do Prado, with an area of 9,000 ha, and Reserva Extrativista Guariba Roosevelt, with an area of 165,000 ha.

Two indigenous villages are located approximately 10 km to 12 km from the Project: Arara do Rio Branco, with an area of approximately 115,000 ha, and Aripuanã, with an area or approximately 750,000 ha. The total population of these two villages is 512, of which 74 live in areas outside of the villages.

COMMUNITY SERVICES AND INFRASTRUCTURE

The municipality of Aripuanã was founded in 1943 and has a total area of 25,107 km² and a population or approximately 20,600. The Project is located approximately 20 km northwest from Aripuanã. The municipality is away from the main economical centres of the state (i.e., Cuiaba, Sinop, and Lucas do Rio Verde). Until 1995, there were gold and diamond artisanal mining activities in the area.

Access to the Project area is through dirt roads. The distance between Aripuanã and Cuiabá is approximately 930 km. Juína is located approximately 200 km from Aripuanã. There is an airport for small airplanes in Aripuanã.

There are 31 health establishments and 21 schools in the municipality of Aripuanã. Approximately 60% of the houses are provided with public water supply while the remaining 40% of the houses have their water supply from wells or springs. A total of 85% of the houses have septic tanks to treat their sewage.

ARCHAEOLOGY

Archaeological studies performed in the Project area in 2015 showed no archaeological remains, however, additional studies will be performed to confirm these findings.

ENVIRONMENTAL CONSTRAINTS

According to a report performed by Worley Parsons (Relatório Técnico – Amostragem de Solos – June 2018 – VM 7MI-0400_RL-0000GEO-1017RO) the former processing area has metal concentrations in soil above the limit established by current environment regulations (Pb 199 mg/kg to 525 mg/kg; As 15.8 mg/kg to 43.5 mg/kg; and Cu 136 mg/kg to 244 mg/kg). No organic compounds were identified onsite. There was no information regarding groundwater quality in the area.

ENVIRONMENTAL APPROVAL REQUIREMENTS

ENVIRONMENTAL ASSESSMENT

The environmental licensing process for the Aripuanã Zinc Project started in 2008 following the Terms of Reference (ToR) (Ofício nº 20084/CM/SUIMIS/2008) issued by Mato Grosso environmental agency (SEMA/MT). For strategic reasons, the process was put on hold and the field activities performed in 2008 were consolidated into a document in the format of a "Diagnosis of an EIA – Environmental Impact Assessment of the Project" (EIA). In 2012, a new ToR was requested (Ofício nº 85522/CM/SUIMIS/2012), and further studies performed resulting in a comprehensive EIA. The EIA was completed in 2012, however, it was not filed with the authorities due to low commodity prices at that time. In 2014, with zinc prices increasing, the EIA was filed. Considering further exploration on the property, production levels were increased in 2015 from 1.2 Mtpa to 1.8 Mtpa. SEMA performed many inspections and the Public Hearing was held on August 26, 2015. During 2015 and 2016, the permitting process was led by SEMA/MT, however, due to changes in the engineering process, the analyses were put on hold until all changes were considered in the EIA documentation. Also, additional biological, noise, and vibration studies were carried out. As a result, a new ToR was requested (Protocolo nº 79893/2017). An EIA and the Environmental Impact Report (RIMA) were completed in July 2017 by GeoMinAs – Geologia e Mineração e Assessoria ltda.

Project impacts described for construction, operations, and closure phases are listed below. These impacts were considered during Project planning. Each potential impact was evaluated considering its magnitude, probability, and duration. Key impacts are summarized below.

- Changes in air quality;
- Changes in noise and vibration;
- Changes in soil structure, sedimentation, and erosion processes;
- Changes in the terrain and landscape;
- Changes in the surface water flow (Arrainha and Maranhão Creeks) and quality;
- Changes in groundwater flow and quality;
- Changes in vegetation (abundance, function, connectivity and quality);
- Changes in wildlife and wildlife habitat;
- Changes in vectors insects populations;
- Changes in fish and fish habitat;
- Changes in labour and economy;
- Changes in community services and infrastructure.

No resettlement will be required to implement the Aripuanã Zinc Project.

PRELIMINARY PERMIT

SEMA/MT issued Preliminary Permit # 309707/2018 which is valid until March 14, 2021. The permit has the following technical requirements which the Project should meet to obtain the Installation Permit:

1. Develop and submit a detailed schedule for labour force during the Project's implementation phase;
2. Prepare and submit workforce housing proposal during the implementation phase;
3. Prepare and submit an Environmental Management Plan for the implementation and operation phases;

4. Implement fixed-location monitoring during the Project's implementation phase;
5. Undertake a traffic survey and identify raw materials routes as well as prepare an emergency plan;
6. Submit the processing plant layout;
7. Complete the process plant effluent control system design and an emergency plan in the case of failure of the effluent system;
8. Submit the water and mass balance for the processing plant;
9. Submit the drainage system control design;
10. Submit details of the waste press filter as well as parameters regarding water recirculation in the process;
11. Prepare a Soild Waste Management Plan (Plano de Gerenciamento de Resíduos Sólidos, or PGRS) including the design or disposal system for temporary and non temporary wastes during the implementation and operation phases, including construction debris;
12. Establish solid waste class II (domestic) volumes generated by the Project that have to be treated and disposed of by Nexa. Coordination with the municipality is recommended;
13. Develop the standardization documentation of the Water and Effluents Management Program and describe the training program;
14. Carry out studies and develop measures to control, remediate, and prevent generation of aqueous solution as a result of oxidation of sulphide ore present in mining waste in the presence of water (DAM). Detail these in the Decommissioning Plan;
15. Develop measures to prevent DAM after Project decommissioning and identify mitigation actions in case DAM occurs after decommissioning;
16. Complete designs of the fuel station, maintenance shops, and car wash and their environmental management systems;
17. Complete the basic design of the backfill structure, including mass and water balance;
18. Develop the backfill flowchart and description;
19. Perform monitoring of springs and tubular wells;
20. Complete the illumination, ventilation, and fire plans;
21. Provide for drainage, disposal or recovery of the mine water;
22. Provide the impact of mining on the local water table;
23. Update the surface water quality program;
24. Complete trace metal analysis in fish tissues;
25. Complete soil analysis for heavy metals, according to CONAMA Resolution 420/2009;
26. Complete the Project's water balance;
27. Complete the basic design for the dam's construction phases;
28. Provide an emergency plan for the dam;
29. Provide the monitoring plan of the dam (including instruments);
30. Complete the basic construction design of the waste pile using raincoats;

31. Submit an emergency plan for the waste pile;
32. Develop the waste pile monitoring plan including instruments and geotechnical analysis;
33. Develop the detailed social programs for the implementation, operation, and decommissioning phases;
34. Complete the potential deforestation area's Forest Inventory (PEF) as well as the destination of the timber including the forest revegetation according to Article 18 of Decree 8188/06;
35. Develop a flora conservation program including an action and monitoring plan as well as the duration, including studies of the structure of the *Lecythidaceae* population, mainly the nut trees (*Bertholletia excelsa*) and endangered species described in the EIA.
36. Present evidence of the discussions of the developed programs with the community;
37. Provide updated data of the consultation processes at National Indian Foundation (FUNAI) and National Historical and Cultural Heritage Institute (IPHAN);
38. Develop a health program for the community directly affected;
39. Submit a technical-photographic report which proves the implementation and performance of the actions proposed in the programs, plans, and projects with the respective professional registration (ART);
40. Develop a program specific to the monitoring of fauna endangered species and migratory, described in Portaria 444/2014 and 445/2014, with responsible ART;
41. Dispose of construction debris in an environmentally adequate manner;
42. Consider the requirements of the municipality highlighted in the Ofício (Technical Letter) # 561/2015 – GP; (Technical Letter) # 030/2015/SEMATIC and Ofício (Technical Letter) # 005/CMSA/2015;
43. Prepare a more comprehensive Action Program together with the Community and Local Public Power, including the impacts on health, security education, etc.;
44. Include the monitoring of trace metals in fish tissues and also the identification of spawning areas and natural breeding grounds in the Aquatic Biota Monitoring Program;
45. Allow 2 ha for each 1 ha degraded in the degraded areas recovery plan (PRAD);
46. Include the protocol in the transmission line environmental permit request;
47. Develop an improvement project for the Aripuanã Project's access road, providing a copy of the permitting process protocol;
48. Provide guidance for safety and environmental control throughout the Project area;
49. Submit a proposal of Permanent Preserved Areas (APP) regarding the compensation intervention in sloped preserved areas.

PERMITS OR APPROVALS TO OBTAIN

The Environmental Installation Permit is expected to be issued in November 2018. Brazilian environmental regulations require an Installation Permit in order to start construction and earthworks. An Operation Permit is required to operate the plant. Usually, the Operation Permit application is submitted upon receipt of the Installation Permit.

CONSULTATION ACTIVITIES

Consultations with indigenous peoples to date regarding Project impacts and mitigation have been under supervision of IPHAN and FUNAI.

The Public Hearing Meeting Minutes available for review did not mention complaints regarding impacts to indigenous people.

The minutes describe the presentation of the Project, the mitigation measures, and a number of public questions. No major complaints were indicated or described in the document.

MINE CLOSURE REQUIREMENTS

A Preliminary Closure Plan has been developed to provide an early opportunity to discuss the closure approach and initial costing. The Closure Plan will be updated as the Project progresses. At the end of mining operations, the main facilities requiring closure will include the underground mine, water management and drainage systems, mine rock storage area, dry-stack tailings, site access roads, buildings, and associated infrastructure. The following list summarizes the main activities associated with closure:

- Infrastructure, equipment, and mining materials will be removed.
- Some facilities (e.g., access roads) may be required for the proper care and maintenance of the site during closure and will be removed/rehabilitated once they are no longer required.
- The underground mine will be flooded.
- The storage/stockpile areas will be stabilized (chemically and physically) and revegetated.

The overall objective of closure is to return the site to a chemically and physically stable state which is self-sustaining and supports the desired future land uses.

The following monitoring programs are required during closure:

- Geotechnical monitoring;
- Air emission and noise control;

- Solid waste management;
- Erosion and dredging process control;
- Degraded areas recovery;
- Rehabilitation area flora and fauna monitoring;
- Social communications;
- Employment termination;
- Performance of the social and environmental closing program.

KEY ISSUES AND RECOMMENDATIONS FOR FUTURE WORK

Based on the information reviewed and the Project knowledge obtained during this review, RPA is of the opinion that the current EIA is compliant with Brazilian standards and regulation needs for the current stage of the Project.

Prior to the construction phase, certain environmental management plans should be developed in further detail:

- Ecological and human health risk assessments should be further developed, with the aim of identifying and mitigating potential impacts on water quality, air quality, and noise combined with local uses of the areas, which affect the health of local wildlife, feedstock, and/or the local population.

- Based on the presence of several endangered species in the Project area, plans for the protection of endangered flora and fauna species should be further developed and implemented during all Project phases.

- Measures to prevent and mitigate effects on water quality from the dry-stack tailings ARD/metal leaching potential need to be further developed and implemented for all phases of the Project, including closure and post-closure.

- Historically, closure of mine sites has the potential to result in significant economic impacts. To avoid these impacts a detailed social management plan should be developed, which includes ongoing consultation, training and planning of workers and local community members, with the aim of mitigating the economic and social effects of mine closure. In Brazil, this plan is required five years before closure.

21 CAPITAL AND OPERATING COSTS

PRE-PRODUCTION CAPITAL

Pre-production capital costs were estimated by Nexa and SNC-Lavalin using a combination of first principles, quotations, and factored estimates. Capital costs are estimated at a +/- 10% confidence level, with a base date of May 2018.

The breakdown of sources for the cost estimate is:

- Quotes for the Project – 65% of direct capital
- Quotes provided by Nexa – 19% of direct capital
- Costs provided by Nexa – 8% of direct capital
- Allowances – 5% of direct capital
- Databases – 3% of direct capital

Costs were estimated in BRL, with 90% of the estimate originating in this currency. 7% of costs originate in US$, and were converted at a rate of 3.35 (BRL/US$). 3% of the costs originate in Euros, and were converted at a rate of 3.90 (BRL/EUR). Upon completion of the FEL3 study in Q3 2018, total capital costs in BRL were converted to US$ for economic evaluation using an exchange rate of 3.90 (BRL/US$).

Pre-production capital costs totalling US$392 million are summarized in Table 21-1.

TABLE 21-1 PRE-PRODUCTION CAPITAL COST ESTIMATE
Nexa Resources S.A. – Aripuanã Project

Area	Category	Units	Initial Costs
Mine	Development	US$ millions	30.4
	Mobile Equipment	US$ millions	18.8
Plant & Infrastructure	Site Prep & Earthworks	US$ millions	27.5
	Civil & Roadwork	US$ millions	24.9
	Steelwork	US$ millions	16.4
	Electrical	US$ millions	31.0
	Instrumentation	US$ millions	13.6
	Mechanical Equipment	US$ millions	62.6
	Piping	US$ millions	17.0
Subtotal Direct Costs		**US$ millions**	**242.2**
Indirect Costs	EPCM	US$ millions	20.1
	Temporary Services	US$ millions	22.0
	Owner's Team	US$ millions	14.8
	Other	US$ millions	63.0
Subtotal Indirects		**US$ millions**	**119.8**
Contingency		US$ millions	30.0
Total Capital Cost		**US$ millions**	**392.1**

In RPA's opinion, the estimate can be classified as Class 3, per American Association of Cost Engineers (AACE) guidelines, which generally corresponds to feasibility studies.

Contingency comprises 8.3% of direct and indirect capital costs, which RPA considers to be reasonable for the current stage of the Project.

SUSTAINING CAPITAL

Sustaining capital was estimated by Nexa, with the majority consisting of mine development and mobile equipment. Sustaining capital is summarized in Table 21-2.

TABLE 21-2 SUSTAINING CAPITAL COST ESTIMATE
Nexa Resources S.A. – Aripuanã Project

Area	Category	Units	Sustaining Costs
Mine	Development	US$ millions	60.7
	Mobile Equipment	US$ millions	75.9
Plant & Infrastructure	Dry Stack Tailings	US$ millions	22.5
	Other	US$ millions	40.0
Total Capital Cost		**US$ millions**	**199.1**

OPERATING COSTS

Operating costs, averaging US$71 million per year at full production, were estimated for Mining, Processing, and General and Administration (G&A). Operating cost inputs such as labour rates, consumables, and supplies were based on Nexa operating data. A summary of operating costs is shown in Table 21-3.

TABLE 21-3 OPERATING COST ESTIMATE
Nexa Resources S.A. – Aripuanã Project

Parameter	Total LOM (US$ millions)	Average Year (US$ millions / yr)	LOM Unit Cost (US$ / t)
Mining	306	24.6	11.81
Processing	493	39.5	19.03
G&A	86	6.8	3.33
Total	**886**	**70.9**	**34.18**

Manpower over the life of mine averages 700 people. Operating costs break down by type as follows:

- Labour – 31%
- Materials – 32%
- Third-Party Services – 15%
- Equipment Operation – 22% (diesel, parts, electricity)

22 ECONOMIC ANALYSIS

An after-tax Cash Flow Projection for the Project was generated from the Life of Mine production schedule and capital and operating cost estimates, and this is summarized in Table 22-1. A summary of the key criteria is provided below.

ECONOMIC CRITERIA

REVENUE

- LOM processing of 26 Mt, grading 3.7% Zn, 1.4% Pb, 0.2% Cu, 34 g/t Ag and 0.3 g/t Au
- LOM average metallurgical recovery of 89% Zn, 84% Pb, 75% Cu, 84% Ag and 68% Au
- LOM average metal payable of 85% Zn, 95% Pb, 96% Cu, 83% Ag and 83% Au
- LOM payable metal of 737 kt Zn, 284 kt Pb, 47 kt Cu, 20,000 koz Ag and 139 koz Au
- LOM metal prices based on forward-looking independent long-term forecasts, US$1.01/lb Zn, US$0.87/lb Pb, US$2.99/lb Cu, US$18.50/oz Ag, and US$1,216/oz Au.
- All revenues are received in US$.
- Total gross revenue of US$3,089 million.
- Total offsite treatment, transportation, and refining charges of US$410 million.
- Total royalties of US$126 million.
- Net revenue of US$2,553 million.
- Average unit net revenue of US$84/t processed.
- Revenue is recognized at the time of production.

COSTS

- Pre-production period: 28 months.
- Mine life: 13 years.
- LOM production plan as summarized in Section 16, Mining Methods.
- Pre-production capital totals US$392 million.
- Sustaining capital over the LOM totals US$222 million.
- Average operating cost over the mine life is US$34 per tonne processed.
- Costs estimated in BRL at an exchange rate of 3.90

TAXATION AND ROYALTIES

RPA has relied on a Nexa taxation model for calculation of income taxes applicable to the cash flow.

TABLE 22-1 AFTER-TAX CASH FLOW SUMMARY
Nexa Resources S.A. – Aripuanã Zinc Project

Aripuanã Project - FEL3	Cash Flow Summary			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17
	Inputs	UNITS	TOTAL	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
MINING																					
Underground																					
Operating Days	365	days			30	100	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Tonnes mined per day		tonnes / day	5,205.6		2,095	6,113	3,833	5,813	6,511	6,361	6,072	6,250	6,239	6,169	6,081	5,073	4,809	3,429	3,238	-	-
Production		'000 tonnes	26,179	-	63	611	1,399	2,122	2,376	2,322	2,216	2,281	2,277	2,252	2,219	1,852	1,755	1,252	1,182	-	-
Zn Grade		%	3.7%	0.0%	3.6%	3.5%	3.6%	4.0%	4.0%	3.8%	3.8%	3.5%	4.0%	3.5%	3.8%	3.8%	3.6%	2.6%	4.0%	0.0%	0.0%
Pb Grade		%	1.4%	0.0%	1.1%	1.2%	1.3%	1.4%	1.4%	1.4%	1.3%	1.3%	1.4%	1.3%	1.5%	1.3%	1.4%	1.2%	1.6%	0.0%	0.0%
Cu Grade		%	0.2%	0.0%	0.4%	0.6%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%
Ag Grade		oz/t	1.10	-	1.08	1.25	1.16	1.13	1.08	1.19	1.14	1.02	1.17	1.15	1.10	0.92	1.12	0.98	1.04	-	-
Au Grade		oz/t	0.010	-	0.014	0.012	0.009	0.011	0.011	0.010	0.012	0.010	0.009	0.008	0.005	0.011	0.008	0.013	0.006	-	-
Contained Metal in ROM																					
Zn		000 tonnes	973	-	2.2	21.4	50.1	84.3	95.5	88.9	83.3	80.2	90.5	79.5	84.6	69.7	63.3	32.0	47.0	-	-
Pb		000 tonnes	355	-	0.7	7.5	17.9	30.1	34.0	31.4	29.0	29.1	31.6	29.4	32.5	24.3	24.6	14.7	18.6	-	-
Cu		000 tonnes	65	-	0.3	3.5	6.2	7.2	7.2	7.2	6.9	5.9	4.9	5.6	2.3	2.7	2.5	2.3	0.7	-	-
Ag		kozs	28,836	-	67.8	765.9	1,618.9	2,391.1	2,574.3	2,758.3	2,524.4	2,320.0	2,657.2	2,596.1	2,438.1	1,703.5	1,962.4	1,225.0	1,233.2	-	-
Au		kozs	250	-	0.9	7.6	12.8	23.3	26.4	22.3	27.0	22.8	19.4	17.9	11.0	19.9	14.1	16.9	7.4	-	-
PROCESSING																					
Mill Feed		**'000 tonnes**	**25,909**	**-**	**-**	**-**	**1,493**	**1,937**	**2,300**	**2,299**	**2,243**	**2,247**	**2,263**	**2,253**	**2,272**	**2,159**	**2,010**	**1,252**	**1,182**	**-**	**-**
Head grade																					
Zn Grade		%	3.8%				4.4%	4.1%	4.4%	4.3%	3.7%	3.6%	4.0%	3.5%	3.7%	3.3%	3.2%	2.6%	4.0%	0.0%	0.0%
Pb Grade		%	1.4%				1.5%	1.5%	1.5%	1.5%	1.3%	1.3%	1.4%	1.3%	1.4%	1.1%	1.2%	1.2%	1.6%	0.0%	0.0%
Cu Grade		%	0.3%				0.5%	0.3%	0.3%	0.2%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	0.2%	0.2%	0.1%	0.0%	0.0%
Ag Grade		oz/t	1.11				1.43	1.17	1.16	1.27	1.13	1.03	1.18	1.15	1.08	0.84	1.01	0.98	1.04	-	-
Au Grade		oz/t	0.01				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-
Contained Zn		'000 tonnes	973				65.0	79.0	100.1	97.7	83.3	80.2	90.6	79.3	84.5	70.3	63.7	32.0	47.0	-	-
Contained Pb		'000 tonnes	355				23.0	28.2	35.6	34.5	28.9	29.0	31.5	29.4	32.6	24.6	24.7	14.7	18.6	-	-
Contained Cu		'000 tonnes	65				7.6	6.8	5.8	5.0	6.8	5.3	4.9	5.5	3.0	6.3	5.0	2.3	0.7	-	-
Contained Ag		koz	28,836				2,131.5	2,261.2	2,657.1	2,919.3	2,531.4	2,316.1	2,661.8	2,590.5	2,462.2	1,813.3	2,033.7	1,225.0	1,233.2	-	-
Contained Au		koz	250				16.0	20.8	20.7	17.4	23.9	20.4	20.3	20.1	13.5	28.5	23.7	16.9	7.4	-	-
Net Recovery																					
Zn Recovery		%	89.1%				89.2%	89.3%	89.4%	89.4%	89.1%	89.1%	89.2%	89.1%	89.2%	88.3%	88.5%	88.7%	89.4%	0.0%	0.0%
Pb Recovery		%	84.2%				84.8%	84.5%	84.7%	84.5%	83.7%	83.7%	84.1%	83.6%	84.2%	83.3%	84.0%	84.3%	84.7%	0.0%	0.0%
Cu Recovery		%	74.7%				72.2%	70.7%	67.5%	67.6%	75.5%	77.3%	74.5%	75.7%	76.2%	84.6%	81.4%	77.5%	67.7%	0.0%	0.0%
Ag Recovery		%	84.2%				84.3%	84.5%	85.0%	85.0%	83.9%	84.0%	84.4%	84.2%	84.5%	82.1%	83.1%	83.7%	85.0%	0.0%	0.0%
Au Recovery		%	67.6%				68.5%	69.2%	70.0%	70.0%	67.6%	67.3%	68.2%	67.9%	68.2%	65.0%	65.1%	64.8%	69.9%	0.0%	0.0%
Concentrate Production																					
Zn Concentrate		'000 tonnes	1,484				99.2	120.7	153.2	149.6	127.0	122.4	138.4	121.0	129.1	106.3	96.5	48.6	72.0	-	-
Zn		%	58.40%				58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%	58.4%
Ag		oz/t	1.90				2.11	1.85	1.73	1.95	1.93	1.84	1.89	2.09	1.88	1.56	1.99	2.42	1.71	-	-
Pb Concentrate		'000 tonnes	482				31.5	38.4	48.6	47.0	39.0	39.2	42.7	39.7	44.3	33.0	33.5	20.1	25.4	-	-
Pb		%	62.00%				62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%
Ag		oz/t	32.1				36.5	31.9	30.1	34.1	34.6	31.6	33.7	35.1	30.1	27.7	31.5	32.3	26.7	-	-
Au		oz/t	0.07				0.08	0.10	0.08	0.07	0.08	0.06	0.07	0.07	0.05	0.05	0.04	0.04	0.06	-	-
Cu Concentrate I		'000 tonnes	65				4.5	2.8	-	0.1	7.1	6.7	4.5	5.8	3.4	15.1	10.5	4.6	0.1	-	-
Cu		%	30.98%				31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%
Ag		oz/t	5.16				4.7	5.5	-	5.7	5.4	5.1	5.1	5.1	5.1	5.0	5.4	5.1	11.2	-	-
Au		oz/t	0.84				0.49	0.55	-	0.64	0.73	0.75	0.73	0.65	0.65	0.86	0.99	1.72	1.23	-	-
Cu Concentrate II		'000 tonnes	93				13.4	12.8	12.8	11.0	9.7	6.6	7.4	7.6	4.0	2.3	2.6	1.1	1.5	-	-
Cu		%	30.60%				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%
Ag		oz/t	60.64				31.15	34.95	41.46	52.97	50.74	68.15	70.24	66.30	121.06	145.87	146.86	216.96	161.34	-	-
Au		oz/t	0.88				0.47	0.72	0.81	0.79	0.81	0.94	1.01	0.92	1.25	1.76	1.38	2.01	2.37	-	-
TOTAL Recovered																					
Zn		'000 tonnes	866.7				58.0	70.5	89.5	87.4	74.2	71.5	80.8	70.7	75.4	62.1	56.4	28.4	42.0	-	-
Pb		'000 tonnes	299.1				19.5	23.8	30.2	29.2	24.2	24.3	26.5	24.6	27.5	20.5	20.8	12.4	15.7	-	-
Cu		'000 tonnes	48.6				5.5	4.8	3.9	3.4	5.2	4.1	3.7	4.1	2.3	5.4	4.1	1.8	0.5	-	-
Ag		koz	24,275.3				1,797.0	1,911.1	2,258.6	2,481.1	2,124.5	1,944.8	2,246.5	2,180.9	2,080.7	1,488.2	1,689.1	1,024.9	1,047.8	-	-
Au		koz	168.6				11.0	14.4	14.5	12.2	16.2	13.7	13.8	13.7	9.2	18.5	15.4	10.9	5.1	-	-
REVENUES																					
Metal Prices																					
Zn price		US$/t	$ 2,251				$ 2,545	$ 2,463	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232	$ 2,232
Pb price		US$/t	$ 1,944				$ 2,164	$ 2,147	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927	$ 1,927
Cu price		US$/t	$ 6,648				$ 7,360	$ 7,329	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594	$ 6,594
Ag price		US$/oz	$ 18.49				$ 18.15	$ 18.77	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49	$ 18.49
Au price		US$/oz	$ 1,223				$ 1,315	$ 1,318	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216	$ 1,216
FX Rate		BRL/USD	$ 3.90				$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90	$ 3.90
Payable Metal																					
Zn	85%	'000 tonnes	737				49.3	59.9	76.0	74.3	63.1	60.8	68.7	60.1	64.1	52.8	47.9	24.1	35.7	-	-
Pb	95%	'000 tonnes	284				18.5	22.6	28.6	27.7	23.0	23.1	25.2	23.4	26.1	19.5	19.8	11.8	15.0	-	-
Cu	96%	'000 tonnes	47				5.3	4.6	3.8	3.3	5.0	4.0	3.6	4.0	2.2	5.2	3.9	1.7	0.5	-	-
Ag	83%	kozs	20,032				1,484.5	1,579.0	1,861.5	2,050.6	1,755.7	1,605.6	1,856.3	1,802.0	1,714.9	1,221.2	1,394.6	846.7	859.0	-	-
Au	83%	kozs	139				9.1	12.1	11.9	9.8	13.6	11.3	11.4	11.3	7.1	15.8	13.0	9.3	4.0	-	-
Gross Revenue																					
Zn		US$ '000	1,673,303				125,389	147,546	169,687	165,723	140,711	135,585	153,339	134,023	143,047	117,738	106,932	53,834	79,747		
Pb		US$ '000	557,025				40,119	48,548	55,207	53,385	44,301	44,476	48,505	45,024	50,282	37,499	38,075	22,770	28,834		
Cu		US$ '000	316,718				38,967	33,810	24,933	21,564	32,870	26,068	23,413	26,375	14,537	34,133	25,812	11,141	3,093		
Ag		US$ '000	370,330				26,944	29,646	34,420	37,915	32,463	29,688	34,323	33,319	31,709	22,580	25,785	15,656	15,883		
Au		US$ '000	171,756				12,004	15,881	14,433	11,911	16,556	13,774	13,848	13,731	8,581	19,189	15,755	11,285	4,808		
TOTAL		**US$ '000**	**3,089,132**				**243,422**	**275,432**	**298,680**	**290,499**	**266,901**	**249,592**	**273,428**	**252,471**	**248,156**	**231,139**	**212,360**	**114,685**	**132,366**		
Zn Concentrate																					
Selling Price		US$/t conc	$ 919.99				$ 1,152.18	$ 1,063.29	$ 908.71	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ 885.23	$ -	$ -
Concentrate		'000 tonnes	1,484				99.2	120.7	153.2	149.6	127.0	122.4	138.4	121.0	129.1	106.3	96.5	48.6	72.0	-	-
Revenues		**US$ '000**	**$ 1,365,334**				**$ 114,349**	**$ 128,341**	**$ 139,196**	**$ 132,431**	**$ 112,443**	**$ 108,348**	**$ 122,535**	**$ 107,099**	**$ 114,310**	**$ 94,086**	**$ 85,451**	**$ 43,019**	**$ 63,727**	**$ -**	**$ -**
Pb Concentrate																					
Selling Price		US$/t conc	$ 1,604.06				$ 1,792.23	$ 1,748.58	$ 1,572.91	$ 1,627.03	$ 1,642.00	$ 1,572.42	$ 1,615.59	$ 1,638.87	$ 1,526.37	$ 1,488.46	$ 1,546.76	$ 1,561.08	$ 1,481.73	$ -	$ -

Concentrate		'000 tonnes	482				31.5	38.4	48.6	47.0	39.0	39.2	42.7	39.7	44.3	33.0	33.5	20.1	25.4	-	-
Revenues		**US$ '000**	**$ 773,892**				**$ 56,420**	**$ 67,133**	**$ 76,495**	**$ 76,515**	**$ 64,080**	**$ 61,607**	**$ 69,031**	**$ 65,002**	**$ 67,609**	**$ 49,168**	**$ 51,880**	**$ 31,313**	**$ 37,637**	**$ -**	**$ -**
Cu Concentrate I																					
Selling Price		US$/t conc	$ 2,842.77				$ 2,692.98	$ 2,767.03	$ -	$ 2,603.24	$ 2,704.27	$ 2,713.42	$ 2,697.05	$ 2,613.37	$ 2,603.33	$ 2,832.17	$ 2,980.89	$ 3,771.33	$ 3,341.52	$ -	$ -
Concentrate		'000 tonnes	65				4.5	2.8	-	0.1	7.1	6.7	4.5	5.8	3.4	15.1	10.5	4.6	0.1	-	-
Revenues		**US$ '000**	**$ 185,542**				**$ 12,053**	**$ 7,856**	**$ -**	**$ 172**	**$ 19,292**	**$ 18,228**	**$ 12,216**	**$ 15,288**	**$ 8,900**	**$ 42,694**	**$ 31,353**	**$ 17,281**	**$ 209**	**$ -**	**$ -**
Cu Concentrate II																					
Selling Price		US$/t conc	$ 3,813.41				$ 3,071.25	$ 3,432.19	$ 3,352.34	$ 3,515.64	$ 3,503.00	$ 3,928.99	$ 4,037.56	$ 3,875.47	$ 5,117.06	$ 6,077.52	$ 5,675.68	$ 7,495.40	$ 6,989.83	$ -	$ -
Concentrate		'000 tonnes	93				13.4	12.8	12.8	11.0	9.7	6.6	7.4	7.6	4.0	2.3	2.6	1.1	1.5	-	-
Revenues		**US$ '000**	**$ 354,191**				**$ 41,197**	**$ 43,801**	**$ 42,968**	**$ 38,738**	**$ 33,881**	**$ 25,920**	**$ 30,074**	**$ 29,583**	**$ 20,520**	**$ 13,846**	**$ 14,847**	**$ 8,142**	**$ 10,674**	**$ -**	**$ -**
(=) TOTAL Concentrate Revenues		**US$ '000**	**$ 2,678,959**				**$ 224,020**	**$ 247,131**	**$ 258,660**	**$ 247,856**	**$ 229,697**	**$ 214,102**	**$ 233,856**	**$ 216,972**	**$ 211,340**	**$ 199,795**	**$ 183,531**	**$ 99,755**	**$ 112,246**	**$ -**	**$ -**
Zn Concentrate		*%*	*51%*				*51%*	*52%*	*54%*	*53%*	*49%*	*51%*	*52%*	*49%*	*54%*	*47%*	*47%*	*43%*	*57%*	*0%*	*0%*
Pb Concentrate		*%*	*29%*				*25%*	*27%*	*30%*	*31%*	*28%*	*29%*	*30%*	*30%*	*32%*	*25%*	*28%*	*31%*	*34%*	*0%*	*0%*
Cu Concentrate		*%*	*7%*				*5%*	*3%*	*0%*	*0%*	*8%*	*9%*	*5%*	*7%*	*4%*	*21%*	*17%*	*17%*	*0%*	*0%*	*0%*
(-) Royalties		**US$ '000**	**$ 125,794**				**$ 10,230**	**$ 11,238**	**$ 11,660**	**$ 11,332**	**$ 10,653**	**$ 10,005**	**$ 10,929**	**$ 10,265**	**$ 10,278**	**$ 9,763**	**$ 8,993**	**$ 4,960**	**$ 5,488**	**$ -**	**$ -**
Luiz Almeida		US$ '000	$ 19,061				$ 2,974	$ 3,233	$ 3,131	$ 2,486	$ 2,022	$ 1,579	$ 1,685	$ 1,276	$ 207	$ 310	$ 221	$ -33	$ -30	$ -	$ -
Anglo America		US$ '000	$ 32,352				$ 2,776	$ 3,036	$ 3,101	$ 2,966	$ 2,772	$ 2,573	$ 2,806	$ 2,615	$ 2,520	$ 2,417	$ 2,222	$ 1,216	$ 1,331	$ -	$ -
Garimpeiros		US$ '000	$ 20,802				$ -	$ 27	$ 255	$ 922	$ 1,265	$ 1,570	$ 1,761	$ 2,035	$ 3,324	$ 3,040	$ 2,879	$ 1,782	$ 1,942	$ -	$ -
CFEM		US$ '000	$ 53,579				$ 4,480	$ 4,943	$ 5,173	$ 4,957	$ 4,594	$ 4,282	$ 4,677	$ 4,339	$ 4,227	$ 3,996	$ 3,671	$ 1,995	$ 2,245	$ -	$ -
(=) TOTAL Net Revenues		**US$ '000**	**$ 2,553,165**				**$ 213,790**	**$ 235,892**	**$ 247,000**	**$ 236,524**	**$ 219,044**	**$ 204,097**	**$ 222,927**	**$ 206,706**	**$ 201,062**	**$ 190,032**	**$ 174,537**	**$ 94,795**	**$ 106,757**	**$ -**	**$ -**
NSR		**US$/t ROM**	**$ 84.34**				**$ 125.9**	**$ 106.1**	**$ 91.2**	**$ 87.2**	**$ 83.5**	**$ 77.3**	**$ 83.7**	**$ 78.4**	**$ 74.7**	**$ 75.5**	**$ 74.5**	**$ 65.5**	**$ 75.8**	**$ -**	**$ -**
OPERATING COST																					
Mining (Underground)		US$ '000	$ 305,963				$ 20,757	$ 29,746	$ 24,503	$ 26,696	$ 25,539	$ 25,203	$ 24,453	$ 22,201	$ 26,362	$ 25,090	$ 22,878	$ 18,121	$ 14,413	$ -	$ -
Processing + Tailings		US$ '000	$ 493,152				$ 32,453	$ 39,670	$ 43,252	$ 42,898	$ 41,023	$ 41,277	$ 41,623	$ 41,174	$ 41,885	$ 38,058	$ 36,398	$ 27,238	$ 26,201	$ -	$ -
G&A		US$ '000	$ 86,390				$ 7,497	$ 7,497	$ 7,497	$ 7,022	$ 7,022	$ 7,022	$ 6,760	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 5,648	$ 4,069	$ -	$ -
Total Operating Cost		**US$ '000**	**$ 885,505**				**$ 60,708**	**$ 76,913**	**$ 75,251**	**$ 76,616**	**$ 73,584**	**$ 73,502**	**$ 72,837**	**$ 69,965**	**$ 74,837**	**$ 69,737**	**$ 65,865**	**$ 51,007**	**$ 44,684**	**$ -**	**$ -**
Mining (Underground)		US$ /t proc	$ 11.81				$ 13.9	$ 15.4	$ 10.7	$ 11.6	$ 11.4	$ 11.2	$ 10.8	$ 9.9	$ 11.6	$ 11.6	$ 11.4	$ 14.5	$ 12.2	$ -	$ -
Processing + Tailings		US$ /t proc	$ 19.03				$ 21.7	$ 20.5	$ 18.8	$ 18.7	$ 18.3	$ 18.4	$ 18.4	$ 18.3	$ 18.4	$ 17.6	$ 18.1	$ 21.8	$ 22.2	$ -	$ -
G&A		US$ /t proc	$ 3.33				$ 5.0	$ 3.9	$ 3.3	$ 3.1	$ 3.1	$ 3.1	$ 3.0	$ 2.9	$ 2.9	$ 3.1	$ 3.3	$ 4.5	$ 3.4	$ -	$ -
Total Operating Cost		**US$ /t proc**	**$ 34.18**				**$ 40.7**	**$ 39.7**	**$ 32.7**	**$ 33.3**	**$ 32.8**	**$ 32.7**	**$ 32.2**	**$ 31.1**	**$ 32.9**	**$ 32.3**	**$ 32.8**	**$ 40.8**	**$ 37.8**	**$ -**	**$ -**
Cost/Zn eq.		**US$ /t Zn eq.**	**$ 568.5**				**$ 557.3**	**$ 602.1**	**$ 489.7**	**$ 511.6**	**$ 538.0**	**$ 573.5**	**$ 517.5**	**$ 539.6**	**$ 584.0**	**$ 590.8**	**$ 605.8**	**$ 868.3**	**$ 651.7**	**$ -**	**$ -**
Selling Expenses		**US$ '000**	**$ 368,115**				**$ 25,749**	**$ 30,267**	**$ 37,186**	**$ 35,988**	**$ 31,680**	**$ 30,301**	**$ 33,461**	**$ 30,169**	**$ 31,334**	**$ 27,144**	**$ 24,811**	**$ 12,877**	**$ 17,149**	**$ -**	**$ -**
Zn Concentrate		US$ '000	$ 257,126				$ 17,195	$ 20,912	$ 26,539	$ 25,919	$ 22,007	$ 21,206	$ 23,982	$ 20,961	$ 22,373	$ 18,414	$ 16,724	$ 8,420	$ 12,472	$ -	$ -
Pb Concentrate		US$ '000	$ 83,589				$ 5,454	$ 6,652	$ 8,426	$ 8,148	$ 6,761	$ 6,788	$ 7,403	$ 6,872	$ 7,674	$ 5,723	$ 5,811	$ 3,475	$ 4,401	$ -	$ -
Cu Concentrate		US$ '000	$ 27,400				$ 3,100	$ 2,703	$ 2,221	$ 1,921	$ 2,912	$ 2,307	$ 2,075	$ 2,336	$ 1,287	$ 3,007	$ 2,276	$ 982	$ 275	$ -	$ -
(=) Operating Cash Flow - EBITDA		**US$ '000**	**$ 1,299,546**				**$ 127,334**	**$ 128,712**	**$ 134,562**	**$ 123,921**	**$ 113,779**	**$ 100,295**	**$ 116,629**	**$ 106,572**	**$ 94,892**	**$ 93,151**	**$ 83,862**	**$ 30,911**	**$ 44,925**	**$ -**	**$ -**
EBITDA Margin		*%*	*49%*		*0%*	*0%*	*57%*	*52%*	*52%*	*50%*	*50%*	*47%*	*50%*	*49%*	*45%*	*47%*	*46%*	*31%*	*40%*	*0%*	*0%*
CAPITAL COST																					
Initial Capital Cost																					
Mining		US$ '000	$ 49,229	$ 492	$ 17,230	$ 24,122	$ 7,384	$ -													
Plant & Infrastructure		US$ '000	$ 192,980	$ 1,930	$ 67,543	$ 94,560	$ 28,947	$ -													
Total Direct Cost		**US$ '000**	**$ 242,209**	**$ 2,422**	**$ 84,773**	**$ 118,682**	**$ 36,331**	**$ -**													
EPCM / Owners / Indirect Cost		US$ '000	$ 119,843	$ 1,198	$ 41,945	$ 58,723	$ 17,976	$ -													
Subtotal Costs		**US$ '000**	**$ 362,051**	**$ 3,621**	**$ 126,718**	**$ 177,405**	**$ 54,308**	**$ -**													
Contingency		US$ '000	$ 30,037	$ 300	$ 10,513	$ 14,718	$ 4,506	$ -													
(=) TOTAL Initial Capital		**US$ '000**	**$ 392,089**	**$ 3,921**	**$ 137,231**	**$ 192,124**	**$ 58,813**	**$ -**													
Operating Capital Cost																					
Mine Development		US$ '000	$ 60,715	$ -	$ -	$ -	$ 17,819	$ 11,721	$ 6,980	$ 6,527	$ 3,015	$ 4,417	$ 3,888	$ 2,624	$ 1,389	$ 1,325	$ 871	$ 137	$ -	$ -	$ -
Sustaining infrastructure		US$ '000	$ 138,420	$ -	$ -	$ -	$ 29,136	$ 10,985	$ 23,416	$ 8,200	$ 4,017	$ 15,815	$ 5,619	$ 14,218	$ 11,247	$ 6,659	$ 4,659	$ 3,119	$ 956	$ 374	$ -
Reclamation and closure		US$ '000	$ 22,693	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,671	$ 2,980	$ 3,103	$ 9,575	$ 3,364
Operational Working Capital		US$ '000	$ -	$ -	$ -	$ -	$ 11,098	$ 1,211	$ 609	$ (535)	$ (958)	$ (819)	$ 1,053	$ (875)	$ (309)	$ (604)	$ (849)	$ (4,292)	$ 785	$ (5,515)	$ -
(=) TOTAL Operating Capital Cost		**US$ '000**	**$ 221,828**	**$ -**	**$ -**	**$ -**	**$ 58,054**	**$ 23,917**	**$ 31,005**	**$ 14,192**	**$ 6,074**	**$ 19,413**	**$ 10,560**	**$ 15,967**	**$ 12,327**	**$ 7,379**	**$ 8,352**	**$ 1,944**	**$ 4,845**	**$ 4,433**	**$ 3,364**
CASH FLOW																					
(+) Revenues		US$ '000	$ 2,678,959	$ -	$ -	$ -	$ 224,020	$ 247,131	$ 258,660	$ 247,856	$ 229,697	$ 214,102	$ 233,856	$ 216,972	$ 211,340	$ 199,795	$ 183,531	$ 99,755	$ 112,246	$ -	$ -
(-) Royalties		US$ '000	$ 125,794	$ -	$ -	$ -	$ 10,230	$ 11,238	$ 11,660	$ 11,332	$ 10,653	$ 10,005	$ 10,929	$ 10,265	$ 10,278	$ 9,763	$ 8,993	$ 4,960	$ 5,488	$ -	$ -
(-) Mining Costs		US$ '000	$ 305,963	$ -	$ -	$ -	$ 20,757	$ 29,746	$ 24,503	$ 26,696	$ 25,539	$ 25,203	$ 24,453	$ 22,201	$ 26,362	$ 25,090	$ 22,878	$ 18,121	$ 14,413	$ -	$ -
(-) Processing Costs		US$ '000	$ 493,152	$ -	$ -	$ -	$ 32,453	$ 39,670	$ 43,252	$ 42,898	$ 41,023	$ 41,277	$ 41,623	$ 41,174	$ 41,885	$ 38,058	$ 36,398	$ 27,238	$ 26,201	$ -	$ -
(-) G&A		US$ '000	$ 86,390	$ -	$ -	$ -	$ 7,497	$ 7,497	$ 7,497	$ 7,022	$ 7,022	$ 7,022	$ 6,760	$ 6,589	$ 6,589	$ 6,589	$ 6,589	$ 5,648	$ 4,069	$ -	$ -
(-) Selling Expenses		US$ '000	$ 368,115	$ -	$ -	$ -	$ 25,749	$ 30,267	$ 37,186	$ 35,988	$ 31,680	$ 30,301	$ 33,461	$ 30,169	$ 31,334	$ 27,144	$ 24,811	$ 12,877	$ 17,149	$ -	$ -
(=) EBITDA		**US$ '000**	**$ 1,299,546**	**$ -**	**$ -**	**$ -**	**$ 127,334**	**$ 128,712**	**$ 134,562**	**$ 123,921**	**$ 113,779**	**$ 100,295**	**$ 116,629**	**$ 106,572**	**$ 94,892**	**$ 93,151**	**$ 83,862**	**$ 30,911**	**$ 44,925**	**$ -**	**$ -**
(-) Initial Capital (net of taxes)		US$ '000	$ 369,668	$ 3,697	$ 129,384	$ 181,137	$ 55,450	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(-) Sustaining Capital (net of taxes)		US$ '000	$ 173,486	$ -	$ -	$ -	$ 40,908	$ 19,782	$ 26,481	$ 12,830	$ 6,126	$ 17,626	$ 8,282	$ 14,673	$ 11,009	$ 6,955	$ 4,818	$ 2,837	$ 833	$ 325	$ -
(-) Reclamation and Closure		US$ '000	$ 22,693	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,671	$ 2,980	$ 3,103	$ 9,575	$ 3,364
(+-) Operational Working Capital		US$ '000	$ -	$ -	$ -	$ -	$ (11,098)	$ (1,211)	$ (609)	$ 535	$ 958	$ 819	$ (1,053)	$ 875	$ 309	$ 604	$ 849	$ 4,292	$ (785)	$ 5,515	$ -
(=) Pre-Tax Cashflow		**US$ '000**	**$ 733,699**	**$ (3,697)**	**$ (129,384)**	**$ (181,137)**	**$ 19,877**	**$ 107,719**	**$ 107,473**	**$ 111,626**	**$ 108,611**	**$ 83,487**	**$ 107,294**	**$ 92,775**	**$ 84,192**	**$ 86,801**	**$ 76,221**	**$ 29,386**	**$ 40,204**	**$ (4,385)**	**$ (3,364)**
(-) Income Tax		US$ '000	$ 133,951	$ -	$ -	$ -	$ 11,944	$ 11,709	$ 11,908	$ 9,983	$ 8,293	$ 9,390	$ 11,969	$ 10,659	$ 8,853	$ 8,521	$ 24,118	$ 6,604	$ -	$ -	$ -
(-) PIS/COFINS		US$ '000	$ 94,114	$ 143	$ 5,018	$ 7,026	$ 9,898	$ 6,917	$ 8,312	$ 7,167	$ 5,908	$ 7,228	$ 6,258	$ 6,634	$ 6,750	$ 5,736	$ 5,079	$ 3,175	$ 2,864	$ -	$ -
(-) ICMS		US$ '000	$ 99,225	$ 81	$ 2,829	$ 3,961	$ 7,857	$ 7,556	$ 8,559	$ 8,373	$ 7,337	$ 8,091	$ 7,612	$ 7,443	$ 8,148	$ 7,201	$ 6,437	$ 4,039	$ 3,702	$ -	$ -
(+) Tax Recovery		US$ '000	$ 87,823	$ -	$ -	$ -	$ 8,211	$ 9,693	$ 10,880	$ 9,059	$ 7,728	$ 8,256	$ 6,240	$ 6,093	$ 6,786	$ 5,949	$ 5,457	$ 3,472	$ -	$ -	$ -
(=) After-Tax Cashflow		**US$ '000**	**$ 494,231**	**$ (3,921)**	**$ (137,231)**	**$ (192,124)**	**$ (1,610)**	**$ 91,230**	**$ 89,574**	**$ 95,161**	**$ 94,800**	**$ 67,033**	**$ 87,694**	**$ 74,132**	**$ 67,227**	**$ 71,292**	**$ 46,045**	**$ 19,039**	**$ 33,638**	**$ (4,385)**	**$ (3,364)**
PROJECT ECONOMICS			*period*	*0*	*0.5*	*1.5*	*2.5*	*3.5*	*4.5*	*5.5*	*6.5*	*7.5*	*8.5*	*9.5*	*10.5*	*11.5*	*12.5*	*13.5*	*14.5*	*15.5*	*16.5*
Pre-Tax																					
Pre-tax IRR		%	22.3%																		
Pre-tax NPV at 7.0% discounting	7.00%	US$ '000	$333,124	$ (3,697)	$ (125,080)	$ (163,656)	$ 16,784	$ 85,006	$ 79,263	$ 76,940	$ 69,965	$ 50,262	$ 60,369	$ 48,785	$ 41,375	$ 39,867	$ 32,718	$ 11,789	$ 15,073	$ (1,537)	$ (1,102)
Pre-tax NPV at 9% discounting	9.00%	US$ '000	$260,559	$ (3,697)	$ (123,927)	$ (159,172)	$ 16,025	$ 79,671	$ 72,925	$ 69,489	$ 62,030	$ 43,744	$ 51,576	$ 40,914	$ 34,064	$ 32,219	$ 25,957	$ 9,181	$ 11,523	$ (1,153)	$ (812)
Pre-tax NPV at 11.83% discounting	11.00%	US$ '000	$200,178	$ (3,697)	$ (122,806)	$ (154,890)	$ 15,313	$ 74,759	$ 67,196	$ 62,876	$ 55,115	$ 38,168	$ 44,190	$ 34,424	$ 28,144	$ 26,140	$ 20,680	$ 7,183	$ 8,853	$ (870)	$ (601)
After-Tax																					
After-tax IRR		%	15.8%																		
After-Tax NPV at 7.0% discounting	7.00%	US$ '000	$185,023	$ (3,921)	$ (132,666)	$ (173,582)	$ (1,360)	$ 71,994	$ 66,062	$ 65,591	$ 61,068	$ 40,356	$ 49,341	$ 38,982	$ 33,038	$ 32,744	$ 19,765	$ 7,638	$ 12,611	$ (1,537)	$ (1,102)
After-Tax NPV at 9% discounting	9.00%	US$ '000	$129,087	$ (3,921)	$ (131,444)	$ (168,827)	$ (1,298)	$ 67,475	$ 60,780	$ 59,240	$ 54,142	$ 35,123	$ 42,155	$ 32,693	$ 27,200	$ 26,463	$ 15,680	$ 5,948	$ 9,641	$ (1,153)	$ (812)
After-tax NPV at 10.83% discounting	11.00%	US$ '000	$82,625	$ (3,921)	$ (130,254)	$ (164,284)	$ (1,240)	$ 63,315	$ 56,005	$ 53,602	$ 48,107	$ 30,646	$ 36,118	$ 27,507	$ 22,473	$ 21,470	$ 12,492	$ 4,654	$ 7,407	$ (870)	$ (601)

CASH FLOW ANALYSIS

Considering the Project on a stand-alone basis, the undiscounted after-tax cash flow totals US$494 million over the mine life, and simple payback occurs 4.6 years from start of production.

The Net Present Value (NPV) at a 9% discount rate is $129 million, and the Internal Rate of Return (IRR) is 15.8%.

SENSITIVITY ANALYSIS

Project risks can be identified in both economic and non-economic terms. Key economic risks were examined by running cash flow sensitivities:

- Metal price
- Head grade
- Metallurgical recovery
- Operating costs
- Capital costs

IRR sensitivity over the base case has been calculated for a variety of ranges depending on the variable. The sensitivities are shown in Figure 22-1 and Table 22-2.

FIGURE 22-1 SENSITIVITY ANALYSIS

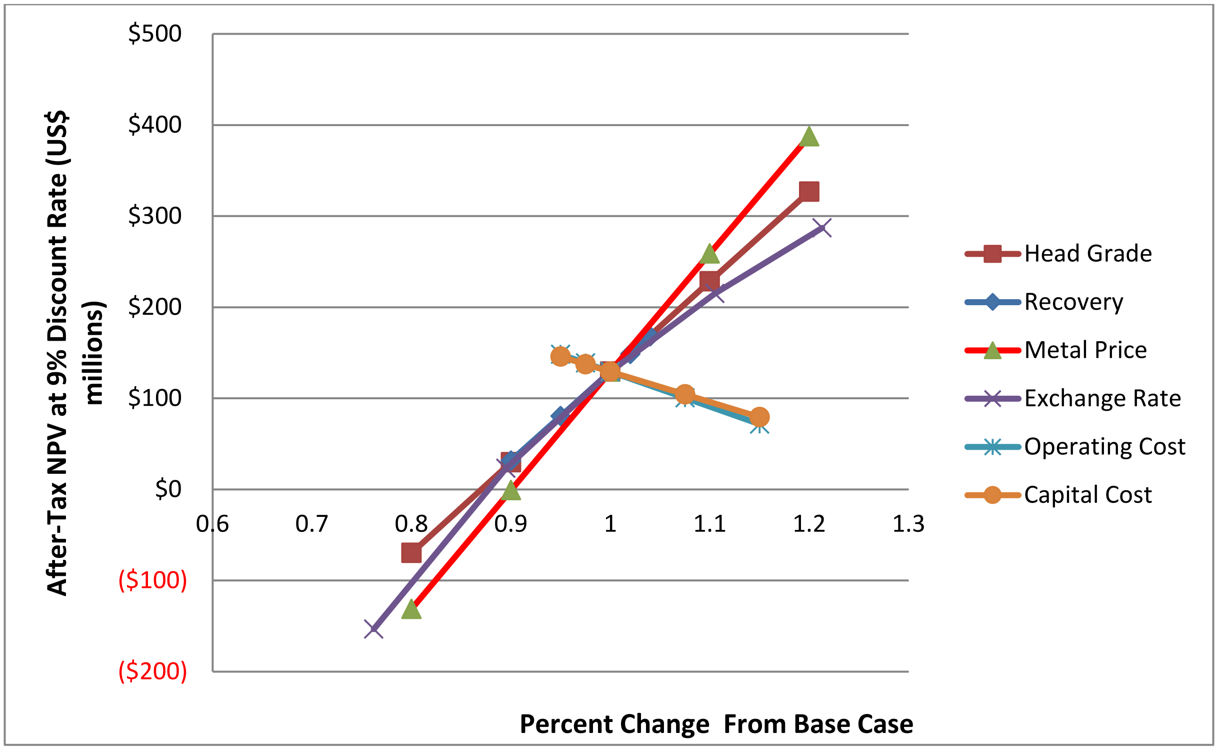


TABLE 22-2 SENSITIVITY ANALYSES
Nexa Resources S.A. – Aripuanã Zinc Project

Description	Units	Low Case	Mid-Low Case	Base Case	Mid-High Case	High Case
Head Grade (Zn)	% Zn	3.0	3.4	3.8	4.1	4.5
Overall Recovery (Zn)	%	80	85	89	91	93
Metal Prices (Zn)	US$ / lb Zn	0.82	0.93	1.03	1.13	1.24
Exchange Rate	BRL/US$	3.00	3.50	3.90	4.30	4.70
Operating Costs	US$/t	32	33	34	37	39
Capital Cost	US$ millions	372	382	392	421	451
Adjustment Factor						
Head Grade (ZnEq)	%	80	90	100	110	120
Overall Recovery	%	90	95	100	102	104
Metal Prices (Zn)	%	80	90	100	110	120
Exchange Rate	%	76	90	100	111	121
Operating Costs	%	95	97.5	100	107.5	115
Capital Cost	%	95	97.5	100	107.5	115
Post-Tax NPV @ 9%						
Head Grade (ZnEq)	US$ millions	(70)	30	129	228	327
Overall Recovery	US$ millions	32	80	129	149	168
Metal Prices (Zn)	US$ millions	(131)	(1)	129	259	388
Exchange Rate	US$ millions	(153)	23	129	215	287
Operating Costs	US$ millions	148	139	129	100	72
Capital Cost	US$ millions	146	137	129	104	79

For head grade, recovery, and metal prices, factors were applied to all metals in the various categories, however, in the table, values for zinc are shown because it provides the most revenue.

The Project is most sensitive to changes in metal prices, and least sensitive to capital costs.

23 ADJACENT PROPERTIES

RPA is not aware of any significant deposits or properties adjacent to the Aripuanã Project.

24 OTHER RELEVANT DATA AND INFORMATION

No additional information or explanation is necessary to make this Technical Report understandable and not misleading.

25 INTERPRETATION AND CONCLUSIONS

Work on the Project is of sufficient detail to support a FS. Considering the Project on a stand-alone basis, the undiscounted after-tax cash flow totals US$494 million over the mine life of 13 years, and simple payback occurs 4.6 years from start of production. The after-tax Net Present Value (NPV) at a 9% discount rate is $129 million (based on mid-period discounting), and the Internal Rate of Return (IRR) is 15.8%.

Potential additional mine life of up to six years is illustrated by significant Inferred Resources and a good track record of conversion to Indicated Resources.

RPA offers the following conclusions for each area:

GEOLOGY AND MINERAL RESOURCES

- The Aripuanã Zinc deposits are located within the central-southern portion of the Amazonian Craton, in which Paleoproterozoic and Mesoproterozoic lithostratigraphic units of the Rio Negro-Juruena province (1.80 Ga to 1.55 Ga) predominate.

- The Aripuanã Zinc polymetallic deposits are typical VMS deposits associated with felsic bimodal volcanism. Three main elongate mineralized zones, Arex, Link, and Ambrex, have been defined in the central portion of the Project. A smaller, deeper zone, Babaçú, lies to the south of Ambrex.

- Two separate material types have been identified – massive sulphide Stratabound Zn-Pb mineralization, and Cu-Au bearing Stringer mineralization found in the footwall of the Stratabound zones.

- The drilling, sampling, sample preparation, analysis, and data verification procedures meet or exceed industry standard, and are appropriate for the estimation of Mineral Resources.

- As prepared by Nexa and adopted by RPA, the exclusive Aripuanã Measured and Indicated Mineral Resources comprise 5.7 Mt at 2.3% Zn, 0.7% Pb, 0.4% Cu, 0.5 g/t Au, and 20 g/t Ag for 282 million pounds of Zn, 91 million pounds of Pb, 46 million pounds of Cu, 90,000 ounces of Au, and 3.6 million ounces of Ag.

- The Aripuanã Inferred Mineral Resources comprise 23 Mt at 3.8% Zn, 1.5% Pb, 0.5% Cu, 0.9 g/t Au, and 37 g/t Ag for 1.9 billion pounds of Zn, 743 million pounds of Pb, 246 million pounds of Cu, 693,000 ounces of Au, and 28 million ounces of Ag.

- The Mineral Resource estimate is consistent with the CIM (2014) definitions as incorporated by reference into NI 43-101.

- New drilling since the last Mineral Resource estimate focussed on the Link Zone, and there is a significant increase in resources in that area.

- The Babaçú prospect represents exploration potential beyond Mineral Resources. Limited exploration has identified additional mineralized bodies including Massaranduba, Boroca, and Mocoto to the south and Arpa to the north.

MINING AND MINERAL RESERVES

- The deposits support a production rate of 2.3 Mtpa, producing an average of 66,700 tonnes of zinc per year (zinc equivalent of 120,000 tonnes per year, after converting other metals based on net revenue).

- Deposit geometry and geomechanical properties are amenable to bulk longhole mining methods, in primary/secondary or longitudinal retreat sequencing, depending on thickness.

- As prepared by Nexa and adopted by RPA, the Aripuanã Proven and Probable Mineral Reserves comprise 26.2 Mt at grades of 3.7% Zn, 1.4% Pb, 0.2% Cu, 0.3 g/t Au, and 34 g/t Ag, containing 2.1 billion lbs of Zn, 784 million lbs of Pb, 143 million lbs of Cu, 250,000 ounces of Au, and 28.8 million ounces of Ag.

- The Mineral Reserve estimate is consistent with the CIM (2014) definitions as incorporated by reference into NI 43-101.

- Dilution and extraction estimates include:
  - Dilution – planned (captured within stope designs) and additional unplanned dilution applied as factors ranging from 5% to 12%, by mining method.
  - Extraction – initial selection of resources by stope optimization and design, plus additional factors of 90% to 95%, by mining method.

- The stope shapes are based on optimizer output, with some editing and manual redesign. There will be opportunities to reduce planned dilution and increase extraction after infill drilling and before mining.

- Secondary stopes in Ambrex have been deferred until all Primary stopes are complete due to geotechnical concerns, which may be conservative. An earlier start to secondary mining may have a positive impact on the cash flow, due to more efficient usage of capital development.

- Arex, Link, and Ambrex deposits are not directly connected underground, making it difficult to share slow-moving mobile equipment efficiently. Fleet unit numbers are adequate to achieve the proposed mine production with limited sharing.

- There is an opportunity to improve the ventilation circuits and reduce capital development by moving the exhaust raise system further from the centre of the zones.

PROCESS

- The results from SGS GEOSOL metallurgical test work form the basis for the current engineering design of the sequential Cu/Pb/Zn flotation circuit.

- Stringer and Stratabound mineralization have been tested separately and in blends of various compositions. Different comminution results and recovery kinetics were observed during bench-scale test work. The decision was made to initially process the two material types separately, on a campaign basis.

- Process performance is projected as:
  - Stratabound Zinc – 89.4% recovery to a 58.4% Zn concentrate. Silver recovery to this concentrate will be 10%.
  - Stratabound Lead – Variable recovery in the range of 80% to 90% with a LOM average of 84.5% to a 58.4% Pb concentrate. Gold and silver recoveries to this concentrate will be 20% and 55%, respectively.
  - Stratabound Copper – 67.5% to a 30.6% Cu concentrate. Gold and silver recoveries to this concentrate will be 50% and 20%, respectively.
  - Stringer Copper – Variable recovery in the range of 85% to 95% with a LOM average of 88.3% recovery to a 31.0% Cu concentrate. Gold and silver recoveries to this concentrate will be 63% and 50%, respectively.

- The LOM economics were developed using relationships between head grade, concentrate grade, and recovery that were established based on the LCTs. The concentrate grade divided by the head grade is known as the Er, and the variable recoveries above are a function of Er.

- Not all of the LCTs achieved equilibrium. Due to the low correlations between head grade and recovery in the LCTs, it was determed that in some cases the Er ratio would be used in applicable cases for recovery, and pilot plant results were used in other cases. It was determined that the pilot results better reflected recovery for Stratabound zinc, however, in RPA's opinion selected optimized LCTs should be used to determine flotation retention time for design purposes.

- Production throughput was increased by 5% (to 5,250 tpd for Stringer and 6,300 tpd for Stratabound) at a late stage in the FS. There is a risk that this throughput may not be achieved in the comminution circuit at the selected mill sizes. Larger mills will likely be required, involving a modest increase in capital costs. In RPA's opinion, to achieve the increased throughput, the SAG mill should be 7.32 m diameter x 3.66 m EGL (24 ft x 12 ft) with a variable frequency drive and an installed motor power of 3,000 kW, and the ball mill should be 4.88 m diameter x 7.32 m EGL (16 ft x 24 ft) with an installed motor power of 3,500 kW. The total installed mill power would increase from 5,600 kW to 6,500 kW. From a spare parts perspective, it is possible to design and fit both mills with 3,500 kW motors, if necessary.

- Processing inefficiencies during transitions between campaigns may offset gains in performance from processing material types separately. The plant configuration will allow full-scale testing of blended feeds during the early years of operation.

- Talc (non-sulphide fines) removal by flotation is sometimes required prior to sequential flotation of Cu, Pb, and Zn, and for this reason, the talc circuit will be continually operated.

- The only notable deleterious element identified was fluorine in the copper concentrate, which may require concentrate blending to ensure marketability.

ENVIRONMENTAL CONSIDERATIONS

- The EIA is compliant with Brazilian standards and regulation needs for construction of the Project.

- Construction is required to adhere to conditions included in the Preliminary Permit, including execution of Environmental Management Plans.

COSTS AND ECONOMICS

- Pre-production capital costs total US$392 million.

- In RPA's opinion, the capital cost estimate can be classified as Class 3, per AACE guidelines, which generally corresponds to feasibility studies.

- Contingency comprises 8.3% of direct and indirect capital costs.

- Operating costs average US$34.18 per tonne over the LOM, with higher unit costs at the start and end when full production is not achievable.

- Metal prices are based on consensus annual forecasts from independent banks and financial institutions, converging on US$1.01/lb Zn, US$0.87/lb Pb, US$2.99/lb Cu, US$1,216/oz Au, and US$18.50/oz Ag from 2023 onwards.

- Smelter terms are projected by Nexa based on selling concentrates to China, and are consistent with industry benchmarks.

26 RECOMMENDATIONS

RPA offers the following recommendations for each area:

GEOLOGY AND MINERAL RESOURCES

- Continue to review minor issues with certain CRMs used in analytical quality assurance procedures.

- Increase the wireframe modelling cut-off grade to limit the amount of sub-economic material not related to massive or disseminated sulphides in the stratabound zone in the wireframes.

- Model correlograms for Ambrex and Arex to avoid fitting long second and third variogram model structures when an apparent zonal anisotropy is observed.

- Perform a visual review of the classification of all blocks with a minimum distance to the closest drill hole greater than 25 m, and consider downgrading blocks where appropriate to Inferred.

MINING

- Review and optimize stope shapes after infill drilling and before mining.

- Investigate alternative sequencing for primary/secondary stopes, specifically earlier mining of secondary stopes.

- Review the location of exhaust raises and associated development.

- Implement a rigorous grade control program during operations, to assess impact of material types and effectiveness of blending.

PROCESS

- Test blended material types as mill feed during plant operations.

- Investigate optimum concentrate grade vs. recovery combinations for all concentrates.

- Review the comminution circuit sizing, to ensure capacity for both material types.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

- Prior to the construction phase, certain environmental management plans should be developed in further detail:
    - Ecological and human health risk assessments should be further developed, with the aim of identifying and mitigating potential impacts on water quality, air quality, and noise combined with local uses of the areas, which affect the health of local wildlife, feedstock, and/or the local population.

- Based on the presence of several endangered species in the Project area, plans for the protection of endangered flora and fauna species should be further developed and implemented during all Project phases.

- Measures to prevent and mitigate effects on water quality from the dry-stack tailings ARD/metal leaching potential need to be further developed and implemented for all phases of the Project, including closure and post-closure.

- Historically, closure of mine sites has the potential to result in significant economic impacts. To avoid these impacts a detailed social management plan should be developed, which includes ongoing consultation, training and planning of workers and local community members, with the aim of mitigating the economic and social effects of mine closure. In Brazil, this plan is required five years before closure.

27 REFERENCES

LCASSIS Consultoria em Recursos Minerais, 2017, Relatório de Validação das Amostras Selecionadas para Teste Metalúrgico, Projecto Aripuanã – MT, prepared for Votorantim Metais (March 2017).

RPA, 2017, Technical Report on the Preliminary Economic Assessment of the Aripuanã Zinc Project, Mato Grosso State, Brazil, prepared for VM Holding S.A. (July 31, 2017).

RPA, 2017, Technical Report on the Aripuanã Zinc Project, Mato Grosso State, Brazil, prepared for Karmin Exploration Inc. (March 1, 2017).

SGS GEOSOL, 2017, Bench Scale Metallurgical Testwork on Drill Core Samples from the Aripuanã Project, Final Report, prepared for Votorantim Metais (February 15, 2017).

SGS GEOSOL, 2018, Estudo Piloto de Flotação com Minério Sulfetado de Aripuanã Final Report, prepared for Nexa Resources (February 2018).

SNC-Lavalin, 2018a, Projeto Aripuanã, FEL 3, Critérios de Projeto, Dados Básicos e Critérios de Projeto Processo, CP-I721515002-0000PCD0001, Rev. 2, prepared for Votorantim Metais (May 11, 2018).

SNC-Lavalin, 2018b, Projeto Aripuanã, FEL 3, Memorial Descritivo Processo, MD-I721515002-0000PCD0001, Rev. 1, prepared for Votorantim Metais (May 15, 2018).

Votorantim Metais Ltda., 2015, Technical Report, FEL 2 Study, Location: Aripuanã, MT, Commodity: Zn, Pb, Cu, Rev. 00, internal report.

Walm, 2017, Geomechanical Model and Sizing of Underground Excavation – Aripuana Project – Level 1 Target Ambrex, prepared for Votorantim Metais, (May 17,2017)

Walm, 2017, Geomechanical Model and Sizing of Underground Excavation – Aripuana Project – Sizing of Underground Excavation – Phase 1 – Target Ambrex, prepared for Votorantim Metais, (June 23,2017)

Walm, 2017, Geomechanical Model and Sizing of Underground Excavation – Aripuana Project - Description of the Survey of News – Phase 3 – Target Ambrex, prepared for Votorantim Metais, (February 4,2018)

Walm, 2017, Geomechanical Model and Sizing of Underground Excavation – Aripuana Project – Phase 3 – Target Ambrex, prepared for Votorantim Metais, (May 25,2018)

Walm, 2017, Geomechanical Model and Sizing of Digging Underground – Aripuana Project – Phase 1 – Target Arex, prepared for Votorantim Metais, (June 26,2017)

Walm, 2017, Geomechanical Model and Sizing of Digging Underground – Aripuana Project – Phase 1 – Target Arex, prepared for Votorantim Metais, (June 26,2017)

Walm, 2017, Geomechanical Model and Sizing of Underground – Aripuana Project – Description of the Survey of News – Phase 3 – Target Arex, prepared for Votorantim Metais, (February 6,2018)

Walm, 2017, Geomechanical Model and Sizing of Underground – Aripuana Project – Geomechanical Model – Level 3 Target Arex, prepared for Votorantim Metais, (March 23,2018)

Walm, 2017, Geomechanical Model and Sizing of Underground – Aripuana Project – Phase 3 – Target Arex, prepared for Votorantim Metais, (May 28,2018)

Worley Parsons, 2017a, Projeto Aripuanã, Fase V1, Metallurgical Testwork, 7MI-0401-RL-0200PCD0804, Rev. 1, prepared for Votorantim Metais (April 26, 2017).

Worley Parsons, 2017b, Projeto Aripuanã, FEL2, Basis of Design, 7MI-0401-RL-0000COR1021R01, Rev. 1, prepared for Votorantim Metais (January 19, 2017).

Worley Parsons, 2017c, Projeto Aripuanã, Fase V1, Waste Management Strategy, Technical Report, 7MI-0401-RL-0300PRO0801, Rev. 5, prepared for Votorantim Metais (May 16, 2017).

28 DATE AND SIGNATURE PAGE

This report titled "Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil" prepared for Nexa Resources SA and dated October 15, 2018 was prepared and signed by the following authors:

(Signed and Sealed) ***"Jason J. Cox"***

Dated at Toronto, ON
October 15, 2018

Jason J. Cox, P.Eng.
Principal Mining Engineer

(Signed and Sealed) ***"Sean Horan"***

Dated at Toronto, ON
October 15, 2018

Sean Horan, P.Geo.
Senior Geologist

(Signed and Sealed) ***"Scott Ladd"***

Dated at Toronto, ON
October 15, 2018

Scott Ladd, P.Eng.
Principal Mining Engineer

(Signed and Sealed) ***"Avakash Patel"***

Dated at Toronto, ON
October 15, 2018

Avakash Patel, P.Eng.
Principal Metallurgist

(Signed and Sealed) ***"Stephan Theben"***

Dated at Toronto, ON
October 15, 2018

Stephan Theben, Dipl.-Ing.
Managing Principal

29 CERTIFICATE OF QUALIFIED PERSON

JASON J. COX

I, Jason J. Cox, P.Eng., as an author of this report entitled “Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil” prepared for Nexa Resources SA and dated October 15, 2018, do hereby certify that:

1. I am a Principal Mining Engineer and Executive Vice President, Mine Engineering, with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of the Queen’s University, Kingston, Ontario, Canada, in 1996 with a Bachelor of Science degree in Mining Engineering.

3. I am registered as a Professional Engineer in the Province of Ontario (Reg. #90487158). I have worked as a Mining Engineer for a total of more than 20 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Review and report as a consultant on many mining operations and projects around the world for due diligence and regulatory requirements
   - Feasibility Study project work on several mining projects, including five North American mines
   - Operational experience as Planning Engineer and Senior Mine Engineer at three North American mines
   - Contract Co-ordinator for underground construction at an American mine

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I visited the Aripuanã Zinc Project on June 2 to 5, 2017.

6. I am responsible for Sections 19, 21, and 22 to 24 and contributed to Sections 1, 2, 3, 18, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I have prepared a previous NI 43-101 Technical Report on the Aripuanã Project for VM Holding S.A. dated July 31, 2017 on the property that is the subject of the Technical Report.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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

Dated this 15th day of October, 2018.

(Signed and Sealed) *"Jason J. Cox"*

Jason J. Cox, P.Eng.

SEAN HORAN

I, Sean Horan, P.Geo., as an author of this report entitled “Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil” prepared for Nexa Resources SA and dated October 15, 2018, do hereby certify that:

1. I am a Senior Geologist with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of Rhodes University, South Africa, in 2003 with a B.Sc. (Hons.) degree in Environmental Studies, and in 2004 with a B.Sc. (Hons.) degree in Geology. I also have a post-graduate certificate in Geostatistics from the University of Alberta, Canada.

3. I am registered as a Professional Geologist in the Province of Ontario (Reg.#2090). I have worked as a geologist for a total of 11 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Geological consulting to the mining and exploration industry in Canada and worldwide, including resource estimation and reporting, due diligence, geostatistical studies, QA/QC, and database management.
   - Geologist responsible for all geological aspects of underground mine development, underground exploration, resource definition drilling planning, and resource estimation at a gold mine in Ontario, Canada.
   - Geologist with an alluvial diamond mining and prospecting company in Angola.
   - Experienced user of AutoCAD, Datamine Studio 3. SQL Database Administration, Visual Basic, Javascript (Datamine Studio 3), Century Systems (Fusion SQL drill hole database tools), Snowden Supervisor, and GSLIB.

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I visited the Aripuanã Zinc Project on January 30 to February 3, 2017.

6. I am responsible for Sections 4 to 12 and 14 and contributed to Sections 1, 2, 3, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I have prepared previous NI 43-101 Technical Reports on the Aripuanã Project for Karmin Exploration Inc. dated March 1, 2017, for Votorantim Metais Ltda. dated May 24, 2017, and for VM Holding S.A. dated July 31, 2017 on the property that is the subject of the Technical Report.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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

Dated this 15th day of October, 2018.

(Signed and Sealed) *"Sean Horan"*

Sean Horan, P.Geo.

SCOTT C. LADD

I, Scott C. Ladd, P.Eng., as an author of this report entitled "Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil" prepared for Nexa Resources SA and dated October 15, 2018, do hereby certify that::

1. I am Principal Mining Engineer with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of the Laurentian University, Sudbury, Ontario in 1998 with a B.Eng. degree in Mining Engineering.

3. I am registered as a Professional Engineer in the Province of British Columbia (Reg. #167289). I have worked as a mining engineer for a total of 20 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Principal Mining Consultant and Regional Manager responsible for Canadian operations with an Australian based mining consulting firm.
   - Preparation of scoping, prefeasibility, and feasibility level studies and reporting for due diligence and regulatory requirements.
   - Principal Mining Engineer with an international diamond corporation, responsible for technical and operational leadership, support, and guidance for all Canadian operating mines and projects.
   - Director, Operations Performance Management and Strategic Mine Planning with a major Canadian mining company.
   - Open Pit Mine Manager/Technical Services Superintendent at a coal mine in Alberta.

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I did not visit the Aripuanã Zinc Project.

6. I am responsible for Sections 15 and 16, and contributed to Sections 1, 2, 3, 18, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

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

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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

Dated this 15th day of October, 2018

(Signed and Sealed) ***"Scott C. Ladd"***

Scott C. Ladd, P.Eng.

AVAKASH PATEL

I, Avakash Patel, P.Eng., as an author of this report entitled "Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil" prepared for Nexa Resources SA and dated October 15, 2018, do hereby certify that::

1. I am Vice President, Metallurgy and Principal Metallurgist with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON, M5J 2H7.

2. I am a graduate of the University of Regina, Saskatchewan in 1996 with a B.A.Sc. in Regional Environmental Systems Engineering (Civil/Chemical).

3. I am registered as a Professional Engineer in the Province of Ontario (Reg. #90513565) and in the Province of British Columbia (Reg. #31860). I have worked as a metallurgical engineer for a total of 21 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Reviews and reports as a metallurgical consultant on numerous mining operations and projects for due diligence and regulatory requirements.
   - Senior positions at numerous base metal and precious metal operations, and consulting companies responsible for general management, project management, and process design.
   - Sr. Corporate Manager – Metallurgy and Mineral Processing with a major Canadian mining company and a junior Canadian mining company.
   - Manager of Engineering/Processing Engineering with two large international Engineering companies responsible for designing, planning, and execution for multiple complex mining projects.

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I did not visit the Aripuanã Zinc Project.

6. I am responsible for Sections 13 and 17 and contributed to Sections 1, 2, 3, 18, 25, 26, and 27 of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

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

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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

Dated this 15th day of October, 2018

(Signed and Sealed) ***"Avakash Patel"***

Avakash Patel, P.Eng.

STEPHAN THEBEN

I, Stephan Theben, Dipl.-Ing., as an author of this report entitled "Technical Report on the Feasibility Study of the Aripuanã Project, State of Mato Grosso, Brazil" prepared for Nexa Resources SA and dated October 15, 2018, do hereby certify that:

1. I am Mining Sector Lead and Managing Principal with SLR Consulting (Canada) Ltd. at 36 King Street East, 4th floor, Toronto, M5C1E5.

2. I am a graduate of RWTH Aachen Technical University in 1997 with a Mining Engineering Degree. I also passed the State Exam for Mining Engineering in 2000.

3. I am registered as a Professional Member with the Society for Mining, Metallurgy and Exploration (Membership # 04231099). I have worked as a mining environmental professional for a total of 20 years since my graduation. My relevant experience for the purpose of the Technical Report is:
   - Responsible for the preparation and success approval of several Environmental Impact Assessment Reports
   - Responsible for environmental aspects of mine permitting for several projects
   - Responsible for the environmental and geotechnical components of several PEA, PFS and FS studies
   - Experience if reviewing and auditing environmental and permitting data for a multitude of projects
   - Work as a government official in Germany and as a technical expert for the European Union in the area of mine permitting

4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

5. I did not visit the Aripuanã Zinc Project.

6. I am responsible for the preparation of Section 20 and contributed to Sections 1, 2, 3, 25, and 26 (environmental aspects) of the Technical Report.

7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.

8. I have prepared a previous NI 43-101 Technical Report on the Aripuanã Project for VM Holding S.A. dated July 31, 2017 on the property that is the subject of the Technical Report.

9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, Section 20 of the Technical Report for which I am responsible contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 15th day of October, 2018.

(Signed and Sealed) ***"Stephan Theben"***

Stephan Theben, Dipl.-Ing.