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Ayawilca Polymetallic Project
Department of Pasco, Central Peru
NI 43-101 Technical Report



Prepared for:

Tinka Resources Limited

Prepared by:

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Effective Date:

2 July, 2019

Project Number:

P00165

CERTIFICATE OF QUALIFIED PERSON

I, Edwin Peralta, P.E., am employed as a Senior Mining Engineer with Amec Foster Wheeler E&C Services Inc, part of the Wood Group (Wood), at the company office at 9460 Double R Blvd, Suite 201, Reno, NV 89521.

This certificate applies to the technical report entitled “Ayawilca Polymetallic Project, Department of Pasco, Central Peru, NI 43-101 Technical Report”, that has an effective date of 2 July 2019 (the “technical report”).

I am registered as a Professional Engineer in the State of Nevada (# 023216) and am a Registered Member of the Society for Mining, Metallurgy and Exploration (RM SME, #04033387). I graduated with a B.S. degree from the Colorado School of Mines in 1995, and with an M.S. degree from the same university in 2000. I have practiced my profession for 23 years.

I have experience in Mineral Reserve estimation, mine planning and design for open pit and underground mining operations, and scoping, prefeasibility and feasibility studies.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I visited the Ayawilca Project site from December 4–5, 2018

I am responsible for Sections 1.1, 1.2, 1.13, 1.15, 1.16, 1.18 to 1.24; Sections 2.1 to 2.6; Section 3; Section 15; Section 16; Section 18; Section 20; Sections 21.1, 21.2.1 to 21.2.5, 21.2.7 to 21.2.11, 21.3.1 to 21.3.2, 21.3.4, 21.3.6 to 21.3.12, 21.4; Section 22; Section 24; Sections 25.1, 25.7, 25.9, 25.10, 25.12 to 25.16; Sections 26.1, 26.2.3, 26.2.6 to 26.2.9, 26.3; and Section 27 of the technical report.

I am independent of Tinka Resources Limited. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Ayawilca Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 15 August, 2019

“Signed”

Edwin Peralta, P.E.

CERTIFICATE OF QUALIFIED PERSON

I, William Colquhoun, FSAIMM, am employed as a Principal Metallurgical Consultant with Amec Foster Wheeler (Perú) S.A., a Wood company (Wood), with an address at Calle Las Begonias 441, Piso 8 San Isidro, Lima 27, Perú.

This certificate applies to the technical report entitled “Ayawilca Polymetallic Project, Department of Pasco, Central Peru, NI 43-101 Technical Report”, that has an effective date of 2 July 2019 (the “technical report”).

I am a Fellow of the South African Institute of Metallurgy and a registered Professional Engineer of the Engineering Council of South Africa. I graduated from Strathclyde University with a Bachelor of Science Degree in Chemical and Process Engineering in 1982.

I have practiced my profession for 32 years. I have been directly involved in mining and polymetallic, (including zinc) processing operations, metallurgical consulting and engineering studies in Africa, Europe, Australia, Far East and North and South America including Peru.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I have not visited the Ayawilca Project site.

I am responsible for Sections 1.1, 1.2, 1.14, 1.17, 1.18, 1.19., 1.22, 1.24; Sections 2.1 to 2.3, 2.5 to 2.6; Sections 3.1, 3.2, 3.5; Section 17; Section 18.9.2; Section 19; Sections 21.1, 21.2.1 to 21.2.4, 21.2.6, 21.2.11, 21.3.1, 21.3.3 to 21.3.5, 21.3.12, 21.4; Section 24; Sections 25.1, 25.8, 25.11 to 25.13, 25.15; Sections 26.1, 26.2.5, 26.2.8, 26.2.9, 26.3.2, 26.3.3; and Section 27 of the technical report.

I am independent of Tinka Resources Limited. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Ayawilca Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 15 August, 2019

“Signed”

William Colquhoun, FSAIMM.



CERTIFICATE OF QUALIFIED PERSON

I, Dorota El Rassi, P.Eng., am employed as Senior Geological Engineer with Roscoe Postle Associates Inc. of Suite 501, 55 University Ave Toronto, ON M5J 2H7.

This certificate applies to the technical report entitled “Ayawilca Polymetallic Project, Department of Pasco, Central Peru, NI 43-101 Technical Report”, that has an effective date of 2 July 2019 (the “technical report”).

I graduated from the University of Toronto in 1997 with a B.A.Sc. (Hons.) degree in Geological and Mining Engineering and in 2000 with a M.Sc. degree in Geology.

I am registered as a Professional Geological Engineer in the Province of Ontario (Reg.# 100012348). I have worked as a geologist for a total of 20 years since my graduation. My relevant experience for the purpose of the Technical Report is:

- Review and report on exploration and mining projects for due diligence and regulatory requirements
- Mineral Resource estimates on a variety of commodities including gold, silver, copper, nickel, zinc, PGE, and industrial mineral deposits
- Experienced user of Gemcom, Leapfrog, Phinar’s x10-Geo, and Gslib software.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I visited the Ayawilca Project site on September 19, 2018

I am responsible for Sections 1.1, 1.2, 1.5 to 1.9, 1.11, 1.12, 1.24; Section 2; Sections 3.1 and 3.2; Section 6; Section 7; Section 8; Section 9; Section 10; Section 11; Section 12; Section 14; Sections 25.1, 25.3, 25.4, 25.6; Sections 26.1, 26.2.1, 26.2.2, 26.2.9, 26.3.1, 26.3.3; and Section 27 of the technical report.

I am independent of Tinka Resources Limited as independence is described by Section 1.5 of NI 43–101.

I have previously co-authored the following technical report on the Ayawilca Project:

- El-Rossi, D., and Ross, D., 2019: Technical Report on the Mineral Resource Estimate for the Ayawilca Property, Department of Pasco, Peru: technical report prepared by Roscoe Postle Associates Inc for Tinka Resources Limited, effective date 9 January, 2019.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 15 August, 2019

“Signed”

Dorota El Rassi, P.Eng.

CERTIFICATE OF QUALIFIED PERSON

I, Adam Johnston, FAusIMM (CP) am employed as Chief Metallurgist with Transmin Metallurgical Consultants of La Perricholi 110, San Isidro, Lima, Peru.

This certificate applies to the technical report entitled “Ayawilca Polymetallic Project, Department of Pasco, Central Peru, NI 43-101 Technical Report”, that has an effective date of 2 July 2019 (the “technical report”).

I graduated from Western Australian School of Mines (BEng Minerals) in 1995.

I am a Chartered Professional (CP) in Metallurgy and a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I have worked as a precious and base metal metallurgist since my graduation. My relevant experience for the purpose of the Technical Report is:

- As a metallurgical consultant on numerous base metal mining and exploration projects around the world
- 25 years experience in metallurgical flowsheet development, testwork and engineering, principally in Australia, Canada, and Peru.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I have not visited the Ayawilca Project.

I am responsible for Sections 1.1, 1.2, 1.10; Sections 2.1, 2.3, 2.6; Sections 3.1; Section 13; Sections 25.1, 25.5; Sections 26.1, 26.2.1, 26.2.4; and Section 27 of the technical report.

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I have no previous involvement with the Ayawilca Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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Dated: 15 August, 2019

“Signed”

Adam Johnston, FAusIMM (CP).

CERTIFICATE OF QUALIFIED PERSON

I, Stella Searston, RM SME, am employed as a Principal Geologist Associate with Amec Foster Wheeler E&C Services Inc, part of the Wood Group (Wood), at the company office at 9460 Double R Blvd, Suite 201, Reno, NV 89521.

This certificate applies to the technical report entitled “Ayawilca Polymetallic Project, Department of Pasco, Central Peru, NI 43-101 Technical Report”, that has an effective date of 2 July 2019 (the “technical report”).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM #111778), a Member of the Australian Institute of Geoscientists (MAIG #2406) and a Registered Member of the Society for Mining, Metallurgy and Exploration (RM SME #4168111). I graduated from James Cook University in Australia in 1987 with a Bachelor of Science degree in geology, and from the University of Tasmania in 1999 with a Master of Economic Geology degree.

I have practiced professionally since graduation in 1987. In that time I have been directly involved in generation of, and review of, mineral tenure, surface and other property rights, geological, mineralization, exploration and drilling data, geological models, sampling, sample preparation, assaying and other resource-estimation related analyses, quality assurance-quality control, databases, resource estimates, risk analyses, preliminary economic assessment, pre-feasibility, and feasibility studies, and due diligence studies in Australia, Southern Africa, the Pacific and North and South America.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I have not visited the Ayawilca Project.

I am responsible for Sections 1.1 to 1.4, Sections 2.1 to 2.3, 2.6; Sections 3.1, 3.2; Section 4; Section 5; Section 23; Sections 25.1, 25.2; and Section 27 of the technical report.

I am independent of Tinka Resources Limited. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Ayawilca Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 15 August, 2019

“Signed and stamped”

Stella Searston, RM SME.

IMPORTANT NOTICE

This report was prepared as National Instrument 43-101 Technical Report for Tinka Resources Limited (Tinka) by Amec Foster Wheeler (Peru) S. A., a Wood company (Wood), Roscoe Postle Associates Inc. (RPA), and Transmin Metallurgical Consultants (Transmin), collectively the Report Authors. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved the Report Authors' services, based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by Tinka subject to terms and conditions of its individual contracts with the Report Authors. Except for the purposed legislated under Canadian provincial and territorial securities law, any other uses of this report by any third party is at that party's sole risk.

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1.0 SUMMARY

1.1 Introduction

Tinka Resources Limited (Tinka) requested that Amec Foster Wheeler (Peru) S. A., a Wood company (Wood), Transmin Metallurgical Consultants (Transmin), and Roscoe Postle Associates Inc. (RPA), compile a technical report (the Report) on a preliminary economic assessment (PEA) study for the Ayawilca polymetallic project (the Project), located in central Peru.

The Project is held 100% by Tinka, through its wholly-owned subsidiary, Tinka Resources S.A.C. The name "Tinka" is used interchangeably to refer to the parent and subsidiary companies.

1.2 Terms of Reference

This Report supports the disclosure in Tinka's news release dated 2 July 2019, entitled "Tinka Reports Positive PEA For The Ayawilca Zinc Project".

The term "Project" is used to refer to all of the mineral tenure holdings; the term "project" refers to the PEA study. Unless otherwise noted, all mineralization is discussed using "zone" nomenclature. Zones are generally described by the major commodity, but may be further broken down by geographic location: Ayawilca Zinc Zone (subdivided into West, Central, South, and East Ayawilca Zones and Zone 3), Ayawilca Tin Zone, and Colquipucro Silver Zone.

All measurement units used in this Report are metric unless otherwise noted. Currency is expressed in United States (US) dollars (US\$). The Peruvian currency is the nuevo sol. The Report uses US English.

Mineral Resources and Mineral Reserves are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (November 2003; 2003 CIM Best Practice Guidelines).

1.3 Project Setting

The Ayawilca Project is located 200 km north–northeast of Lima within the Districts of Yanahuanca and San Pedro de Pillao, Province of Daniel Alcides Carrion, in the Department of Pasco, Peru.

The Project is accessible by road, travelling 310 km north from Lima via the Panamerican Highway to Huaral–Chancay–Oyón and then to Yanahuanca. An alternative road access is via the Central Highway 300 km east of Lima by highway to Cerro de Pasco, then a further 65 km north–northwest by paved road to Yanahuanca. The Project area is accessed from Yanahuanca by gravel road, a further 15 km, through the small communities of San Pedro de Pillao and/or San Juan de Yanacocha. The nearest commercial airport is in Huanuco, the capital of the Huanuco Region and the Huanuco Province.

The mean annual temperature for the Project area during daytime is 15°C; however, temperatures vary significantly with altitude and season. There is a rainy season which generally lasts from October to March. Winter typically occurs from May to September. Exploration can be performed year-round. Any future mining activities would also be conducted year-round.

The city of Cerro de Pasco, approximately 40 km from the Project, is the regional capital and an important mining supply centre. Labour in support of exploration activities can be locally sourced. A small 30-person exploration camp is located in the Project area. Two powerlines cross the Project area. There is a steady source of water for exploration activities from streams, springs, and lakes.

The Project is situated in the Andes Mountains of west–central Peru. Elevations range from 3,300 metres above sea level (masl) to a maximum of about 4,459 masl at Cerro San Lorenzo, near the westernmost part of the Project area. At higher elevations, there are grasses and various moss and lichens. Lower elevations are characterized by small or thorny shrubs and minor cacti.

1.4 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The Project consists of 59 contiguous mining concessions covering 16,917 ha. The concessions are currently in good standing. The mining concessions will remain valid if Tinka pays the annual concession tax and, where applicable, any penalty relating to lack of production, or make a minimum annual investment for each concession.

Tinka holds surface rights in the Project area to support exploration activities through agreements concluded with three local communities:

- Community of San Juan de Yanacocha: usufruct agreement registered as a Public Deed on December 20, 2016, covers 316.7 ha, has a term that runs from February 10, 2017, expiring February 10, 2021
- Community of Huarautambo: usufruct agreement, registered as a Public Deed on December 20, 2016, covers 101.9 ha, runs from February 10, 2017, expiring February 10, 2020
- Community of San Pedro de Pillao: easement agreement, was registered as a Public Deed on December 20, 2016, covers 471.08 ha, runs from February 10, 2017, expiring February 10, 2021

The water used in Tinka's exploration programs was from approved water sources and the volumes used were also approved. Tinka holds no water rights in the Project area. Water rights cannot be purchased in Peru, but they are granted by the national water authority for industrial or mining purposes as part of the permitting process for exploration programs.

There are registered environmental liabilities associated with small-scale historical mining and exploration activity in the general Project area. The Ministry of Energy and Mines (MINEM) have one liability, an adit, listed for the Ayawilca Project in the Environmental Mining Liabilities (PAM in the Spanish acronym) registry. This site is within TK-COL1 and TK-COL24 concessions. As required by Peruvian law, Tinka prepared a list of historical mining activity areas in 2018, and provided that list to MINEM. The Tinka survey identified 57 mining-related sites, which included adits, waste rock dumps, prospecting pits, glory holes, underground mine workings, and trenches. These sites are within TK-COL1, TK-COL34, and TK-COL24 concessions. The state-owned company Activos Mineros S.A.C. is charged with remediation on behalf of the government where the entity or individual that generated the environmental liability is not known. Tinka committed in 2013 to remediation of three of the historical waste rock dumps once Tinka has completed its exploration activities.

There is a 1% net smelter return (NSR) royalty payable to Sierra Peru Pty. Ltd. on mining concessions TK COL 1 to TK COL 46. This NSR royalty can be purchased by Tinka at any time for US\$1 million.

1.5 Geology and Mineralization

The Ayawilca Zinc Zone is considered to be an example of a carbonate replacement-deposit (CRD) -style mineralization.

The Project is within the High Andes zone, which consists of an intra-arc trough, a deep basin, a continental shelf, and the Marañón metamorphic complex (the Marañón Complex). The general geology in the Project area consists of sedimentary and metasedimentary stratigraphy ranging from late Proterozoic to Tertiary in age. The oldest documented rocks in the area belong to the Devonian-age Excelsior Group, overlying the Marañón Complex, and consisting of phyllite, schist and meta-sedimentary rocks. Overlying are red-bed terrestrial sediments including sandstone, conglomerate, and intercalated mudstone of the Permian to lower Triassic Mitu Group. Upper Triassic to Lower Jurassic Pucará Group limestone overlies the Mitu Group, and is the predominant host for both zinc and tin mineralization in the Project vicinity. Goyllarisquiza (Goyllar) Group rocks are well-bedded sandstone, siltstone and mudstone units which overlie the carbonate rocks of the Pucará Group.

The entire sequence has been folded and thrust along north to north–northwest-trending Andean faults (east–west compression), with subsequent trans-tensional faults oriented northeast or east–west.

The Ayawilca Zinc and Tin Zones are hosted mostly within a sequence of limestone breccia, limestone, dolomite, calcareous siltstone, arenite and greywacke, of the Pucará Group.

The Ayawilca Zinc Zone is made up of multiple, gently-dipping sulphide lenses, or “mantos”, generally with vertical thicknesses of 10–30 m (locally thicker) within four areas (West, South, Central, and East Ayawilca Zones). The four structural zones span 2.1 km in the northeast–southwest direction and 1.3 km in the north–south direction. Zinc mineralization occurs as massive to semi-massive sulphide replacements of the carbonate rocks and is thought to be controlled by multiple, sub-parallel, east–west-, and northeast–southwest-trending structures, as well as low-angle east-dipping thrust faults. The zinc occurs as various generations of sulphide impregnations (mostly marmatite, a high-iron variety of sphalerite also known as “black-jack”) accompanied by abundant pyrite, pyrrhotite, chlorite, iron carbonate (siderite), and magnetite. Less common sulphides include sphalerite, galena, arsenopyrite, and chalcopyrite.

Tin mineralization in the Ayawilca Tin Zone pre-dates and is cross-cut by the zinc mineralization. Tin is hosted in massive to semi-massive pyrrhotite mantos typically 10–20 m in vertical thickness (up to 50 m) at or near the contact of the Pucará Group carbonate rocks and the underlying Excelsior Group phyllite. Quartz–tin–copper stockwork mineralization also occurs within the phyllite in some areas beneath the pyrrhotite mantos. Tin occurs predominantly as cassiterite, with very minor stannite, in association with pyrrhotite and pyrite, and lesser chalcopyrite, arsenopyrite, and galena.

The Colquipucro Silver Zone is hosted primarily within oxidized Goyllar Group sandstone with mineralization at or close to the surface. The Colquipucro Silver Zone is believed to be the only documented sandstone-hosted disseminated silver occurrence in Peru. Overall, the Colquipucro Silver Zone is about 550 m in the north–south direction by 380 m in the east–west direction and can reach 75 m in thickness. Silver mineralization is hosted in quartz sandstones and occurs with abundant iron oxides (goethite, jarosite) and manganese oxides in fractures and disseminations within the pore spaces of the sandstones.

Tinka has identified a number of areas within the Project that have exploration potential, including the Chaucha, Valley, Yanapizgo, Pucarumi, and Tambillo zones. Several magnetic anomalies remain untested outside of the Ayawilca Zinc and Tin Zones, all of which are considered high-priority exploration targets.

During 2018, high-grade zinc mantos of massive sphalerite were discovered within a repetition of Pucará carbonate rocks underneath a ‘ledge’ of phyllite at the West Ayawilca Zone. The phyllite is interpreted as a narrow wedge of Paleozoic basement that has been thrust onto limestone by a low-angle fault. Additional thrusts and limestone repetitions have been identified elsewhere, opening up the potential for deeper massive sulphide mineralization to be discovered in the vicinity. Late carbonate–sphalerite–galena–proustite veins at the South and West Ayawilca Zones are steeply dipping, show epithermal textures, and are interpreted to be the last mineralization event. This style of vein mineralization has not been modelled as part of the Mineral Resource; however, these veins can have very high silver grades and offer further exploration potential.

1.6 History

Companies that conducted exploration in the Project area prior to Tinka include Compañía Minera Colquipucro S.A., Cerro de Pasco Corporation and Compañía Minera Buenaventura (Buenaventura). These companies completed underground mining for silver, mapping, rock chip sampling, trenching, and limited drilling (only in the Colquipucro area).

In 2005, the claims that were held by Buenaventura lapsed, and Tinka staked new claims. Tinka's work program has included geological mapping, soil, rock chip and underground workings sampling, ground magnetic, induced polarization (IP), resistivity, gravity, magnetic and electromagnetic geophysical surveys, airborne geophysical surveys, core drilling, metallurgical testwork, and Mineral Resource estimation. Significant zinc mineralization was identified in 2012.

1.7 Drilling

Drilling completed in the period 1996–2018 consists of 227 core holes (77,175.3 m). Four of these drill holes (694.3 m) were completed by Buenaventura during the late 1990s; the remaining drill holes were completed by Tinka.

Tinka has used HQ (63.5 mm core diameter) and NQ (47.6 mm) sizes. All drill core from the Tinka drilling programs is stored in a gated and secured facility located on the main road near the city of Huanuco, 80 km to the northeast of the Project.

During the Tinka drill programs, geologists created quick logs, logged rock quality designation (RQD), marked out sample intervals, and assigned sample numbers. All drill core was then photographed wet with a digital camera before splitting. Until 2014, detailed logging of lithology, alteration, oxidization, and structure was completed by the qualified, responsible geologist on paper forms, and the paper copies were scanned and saved as digital images. Since 2015, detailed logging of lithology, alteration, oxidation and structure has been done directly into portable computers using LogChief software and uploaded into the main project dataset directly following quality control. Core recovery is generally good.

Collars were surveyed using a combination of Total Station and differential global positioning system (GPS) instruments. Down hole survey methods include Reflex Maxibore II and non-magnetic gyroscope instruments. The drill hole deviation was not surveyed for the first 35 holes at the Colquipucro Silver Zone and the first 19 holes at

the Ayawilca Zinc and Tin Zones. Given the length of these unsurveyed holes, the equipment used, drill hole spacing, and the minor deviations shown in surveyed holes, RPA does not consider the missing downhole survey data to be an issue.

1.8 Sampling

Most Tinka drill core was sampled using 2 m intervals, but mineralized intervals can be shorter, and sampling was typically conducted based on mineralization and/or geological boundaries.

Tinka has performed 993 density measurements in total. Sample spacing ranged from 10–60 m down hole, but on average was 20–30 m. Samples were taken from a variety of lithological and mineralogical types. Photographs and brief descriptions were taken before sending to SGS Laboratories in Lima (SGS Lima) or ALS Laboratories in Lima (ALS Lima) for density determinations.

All samples from the 2007 Tinka drill program and the initial drill program conducted at Ayawilca in 2011 were prepared and analyzed by C.H. Plenge & Cia. S.A. (Plenge) in Lima, Peru. International Plasma Laboratories (IPL) in Richmond, British Columbia, Canada was used as a check laboratory for the 2007 program.

All samples from the Ayawilca Zinc Zone and Colquipucro Silver Zone from subsequent Tinka drill campaigns were analyzed by SGS Lima until early in 2014. During the 2014 drill program, all Ayawilca Zinc and Tin Zone samples were analyzed by SGS Lima, and all Colquipucro Silver Zone samples were analyzed by Certimin S.A. (Certimin) at their Lima laboratory.

All samples from the Tinka 2015 Ayawilca Zinc and Tin Zone drill program were analyzed by SGS Lima. Samples from the 2017 Ayawilca Zinc and Tin Zone drill program were analyzed by SGS Lima. Some samples were sent to ALS Lima.

Samples from the Tinka 2018 Ayawilca Zinc and Tin Zone drill program were analyzed by SGS Lima. Check assays were performed by the Inspectorate laboratory (Inspectorate) in Lima.

All laboratories used were independent of Tinka. SGS Lima is ISO 9001:2008 and ISO 14001:2004 certified. ALS Lima is an ISO 9001:2008 certified laboratory. Certimin and Inspectorate hold ISO 9001 and ISO 17025 accreditations for selected analytical techniques. At the time of analysis, IPL held ISO 9001 accreditations. The Plenge laboratory is not certified.

Sample preparation during the Tinka programs varied slightly between laboratories, and included pulverizing to 80% passing -200 mesh (Plenge), pulverizing to 95% passing -140 mesh (SGS Lima), pulverizing to 85% passing -200 mesh (Certimin and ALS Lima). Analytical methods have included multi-element inductively coupled plasma (ICP), atomic absorption spectroscopy (AAS) and fire assay.

On average, one standard or one blank was inserted by Tinka, alternately, after every 10 samples. The frequency was subsequently decreased to every 15 samples; however, after the 2017 program, Tinka reverted to inserting one control sample after every 10 samples. Samples were shipped by Tinka personnel directly to the laboratory. Tinka began submitting field duplicates as part of its quality assurance and quality control (QA/QC) program in 2015.

In RPA's opinion:

- The results of the blanks are within acceptable limits, and the data can be used for resource estimation purposes
- The standard grades cover a reasonable range with respect to the overall resource grades
- Field duplicate results are acceptable.

In RPA's opinion, the sample preparation, analysis, and security procedures are adequate for use in the estimation of Mineral Resources.

1.9 Data Verification

The drill collar sites have been re-surveyed and verified several times since drilling began in 2007. Collars from the 2007 and 2011–2012 campaigns were originally surveyed by hand-held GPS, and then by professional surveyors in late 2011 and in 2012 during the topographic survey. Many of the drill holes were re-surveyed again in late 2014. The results were compared and reconciled to the previous coordinates each time a drill hole was re-surveyed.

Check samples from selected pulps from the 2007 drill program were submitted to IPL, and check samples from the 2011–2013 programs were sent to ALS Lima. In 2014, Tinka re-assayed 1,220 pulp samples at Certimin that had originally been assayed at Plenge. Overall, no bias was detected from any of these programs.

Independent sampling by RPA confirms that there is significant silver and tin mineralization in the drill holes sampled. Confirmation of the zinc and copper mineralization in the Ayawilca Zinc Zone was made by RPA observing numerous drill core intervals with significant sphalerite and chalcopyrite.

RPA's review of the resource database included header, survey, lithology, assay, and density tables. The assay and density tables were reviewed for outliers. A visual check on the drill hole GEMS collar elevations and drill hole traces was completed. RPA compared selected assay records for silver, zinc, and lead in the resource database to the digital laboratory certificates of analysis, which were received directly from SGS Lima and Certimin. In 2016, RPA compared tin values from five SGS certificates. In 2017 and 2018, RPA compared values for the six main metals of interest to six assay certificates, three from SGS Lima and three from ALS Lima, with a focus on intervals within the resource wireframes. No discrepancies were found.

1.10 Metallurgical Testwork

1.10.1 Ayawilca Zinc Zone

Zinc flotation development programs were carried out at Plenge Laboratory in Lima, Peru, and at Expert Process Solutions (XPS) Consulting and Testwork Services, Ontario, Canada under the coordination of Adam Johnston or Transmin Metallurgical Consultants. Tests were conducted to determine best conditions for high zinc recovery to a high-quality zinc concentrate.

The programs focused on the South and West Ayawilca Zones, which host approximately 50% of the resource and most of the higher-grade zinc zones that would be mined in the early years. While the resulting composites were higher grade than the average diluted mining grades, it is believed that the samples were representative of the different mineral textures that will be encountered in the Ayawilca Zinc Zone, and were spatially representative of the South and West Ayawilca Zones, and therefore representative with respect to flotation performance.

- The objective of the testwork was to develop a flowsheet using standard flotation for the zinc mineralization at West and South Ayawilca Zones, which was successfully achieved
- Testwork results have demonstrated that recoveries of 92% zinc at a concentrate grade of 50% zinc can be consistently achieved using a standard flotation process.

Two locked cycle tests were carried out on two different styles of mineralization and both tests produced similar zinc concentrates

- Potentially deleterious elements in the zinc concentrates (including silica, manganese, cadmium, mercury, and arsenic) were well below standard smelter penalty levels. A penalty is anticipated for iron content in the concentrate
- Indium in the two locked cycle zinc concentrates (719 ppm and 400 ppm, respectively) is high and potentially payable, subject to smelter and commercial arrangements.

1.10.2 Ayawilca Tin Zone

The Ayawilca Tin Zone is not included in the PEA.

Preliminary metallurgical testwork on the Ayawilca Tin Zone was conducted from 2016 to 2019. Work has included flotation, magnetic and gravity separation, and mineralogical evaluations, including mineral liberation analyses (MLA).

The preliminary testwork and characterization indicates that the tin mineralization is moderately refractory to standard processing techniques. Cassiterite is dense (SG 7.0), so is usually beneficiated with gravity concentration, but the abundance of the associated pyrrhotite (SG 4.6) complicates gravity separation. Cassiterite within the Ayawilca Tin Zone is mostly fine grained, reducing its ability to be recovered by simple gravity separation.

However, it is promising that by using reverse flotation of pyrrhotite, about 70% Sn recovery was concentrated into a stream with >6% Sn grade. That high tin grade justifies further investigation into more intensive treatment routes such as fine grinding, flotation, gravity separation using higher gravitational forces such as a Falcon gravity concentrator, pyrometallurgy and hydrometallurgy to make a commercial tin concentrate.

1.10.3 Colquipucro Silver Zone

The Colquipucro Silver Zone is not included in the PEA.

Preliminary metallurgical testwork on the Colquipucro Silver Zone was conducted from 2015–2018. Work has included leaching testwork with various reagent concentrations and types, and non-selective bulk batch sulphide rougher flotation testing.

Cleaning testwork would be required to determine if a commercial concentrate could be produced. An alternative approach where the concentrate is leached with cyanide to produce silver doré could also be studied.

These results indicate that around 50% recovery could be achieved by heap leaching, or 60–70% of the silver could be recovered by either conventional tank cyanidation leaching, or flotation, at P80 75 µm.

No further leaching testwork was conducted, and there remains ample opportunity to improve performance with further study.

1.11 Mineral Resource Estimation

RPA estimated Mineral Resources for the Ayawilca Zinc and Tin Zones using the drill results available to 9 October, 2018. The Colquipucro Silver Zone Mineral Resource estimate remains current as of the effective date of 25 May, 2016. There has been no drilling at the Colquipucro Silver Zone since 2015.

1.11.1 Ayawilca Zinc Zones

Wireframe models of mineralized zones were used to constrain the block grade interpolation process. A Leapfrog Geo 4.4.0 vein system modelling tool was used to generate interpretation of the mineralization at a nominal cut-off NSR value of US\$50/t for both the Ayawilca Zinc and Tin Zones. A minimum thickness of 3 m was applied, with rare exceptions where a 2 m thickness was used to allow for a better continuity of the modelled domain. Occasionally, lower-grade intersections were included to maintain continuity. At model extremities, the wireframe models were extrapolated up to 50 m beyond the last drill hole section, however, when a thin intersection was at the edge of the wireframe, the domain was extended to only 25 m. RPA built 40 domains in the following main areas: Central, South, West and East Ayawilca Zones.

Assay values located inside the wireframe models were tagged with domain identifiers and exported for statistical analysis. Results were used to help verify the modelling process.

A total of 440 density measurements are located within the wireframe models representing the Ayawilca Zinc Zone and a total of 19 density measurements are located within the Ayawilca Tin Zone. After removing outliers from the low and high ends of the distribution (below 3.0 t/m³ and above 4.2 t/m³), RPA used the average of these measurements for each area.

RPA was able to differentiate the distribution of zinc, indium, and silver between the various areas within the Ayawilca Zinc and Tin Zones. The manto style of zinc mineralization suggests that capping of the zinc values is not necessary as the higher zinc grades are reasonably controlled by the wireframe models. In the Central and East Ayawilca Zones, indium capping was set at 350 ppm, as indium concentration is considerably lower than that in the South and West Ayawilca Zones. There are significantly higher-grade silver assays in the South Ayawilca Zone, which were capped at 175 g/t Ag.

Compositing was done on 2 m intervals using the downhole compositing method. Composites less than 0.5 m, located at the bottom of the mineralized intercept, were removed from the database.

Grades were interpolated by inverse distance weighting to the third power (ID3) with a minimum of four to a maximum of six composites per block estimate for first pass, and a minimum of one to a maximum of five composites per block estimate in the second pass. A maximum of three composites per drill hole was applied during the first pass to inform interpolated blocks by at least two boreholes. The search ellipse varied slightly by domain.

Zinc, indium, silver, and lead were interpolated for the Ayawilca Zinc Zone. Tin, copper, and silver were interpolated for the Ayawilca Tin Zone. The influence of higher-grade composites for some metals within the Ayawilca Tin and Zinc Zones was spatially restricted. For the Ayawilca Tin Zone, the zone of influence for composites greater than 2% Sn was restricted to 50 x 50 x 20 m and for copper composites greater than 0.75% Cu, to 30 x 30 x 15 m. For the Ayawilca Zinc Zone, the zone of influence for lead composites greater than 2% Pb was also restricted to 30 x 30 x 15 m. Hard boundaries were used to limit the use of composites between wireframe boundaries. Soft boundaries were applied between the South A, Central 4, and Central 5 Ayawilca zones as they share outside edges.

RPA validated the block model by visual inspection, volumetric comparison, and statistical comparison of block grades to assay and composite grade. Visual comparison on vertical sections and plan views, and a series of swath plots found good overall correlation between the block grade estimates and supporting composite grades.

The classification criteria used to define the Indicated Mineral Resources included spatial analysis, drill hole spacing, and continuity of the mineralization. The drill hole

spacing within a resource area assigned the Indicated category commonly ranges from 40–70 m. The limits of the Mineral Resource remain open in several directions.

NSR values, zinc-equivalent (ZnEq) and tin-equivalent (SnEq) grades were calculated by RPA for the purposes of geological interpretation and resource reporting. Assumed recoveries are based on historical testwork and RPA experience from other operations. The following formulas were used to calculate the ZnEq and SnEq for reporting purposes:

- $$\text{ZnEq}(\%) = [\text{Zn}(\%) * \text{US}\$15.34 + \text{Pb}(\%) * \text{US}\$4.70 + \text{In}(\text{g/t}) * \text{US}\$0.18 + \text{Ag}(\text{g/t}) * \text{US}\$0.22] / \text{US}\$15.34$$
- $$\text{SnEq}(\%) = [\text{Sn}(\%) * \text{US}\$155.21 + \text{Cu}(\%) * \text{US}\$37.59 + \text{Ag}(\text{g/t}) * \text{US}\$0.22] / \text{US}\$155.21.$$

Note: NSR assumptions include: metal prices of US\$1.15/lb Zn, US\$300/kg In, US\$15/oz Ag, and US\$1.0/lb Pb, US\$9.00/lb Sn, and US\$2.85/lb Cu. Metal recovery assumptions of 90% Zn, 75% In, 60% Ag, 75% Pb, 86% Sn and 75% Cu. The NSR value for each block was calculated using the following NSR factors: US\$15.34 per % Zn, US\$4.70 per % Pb, US\$0.18 per gram In, US\$0.22 per gram Ag, US\$155.21 per % Sn, and US\$37.59 per % Cu.

For the purposes of developing the cut-off grades, a total unit operating cost of US\$55/t milled was estimated, which includes mining, processing, and general and administrative (G&A) expenses. The US\$55/t NSR cut-off value is approximately equivalent to a 3.6% ZnEq cut-off grade within the Ayawilca Zinc Zone and a 0.33% SnEq cut-off grade within the Ayawilca Tin Zone. Note that the NSR inputs used for resource estimate reporting differ slightly from those used in the PEA mine plan.

1.11.2 Colquipucro Silver Zone

Wireframe models of mineralized zones were used to constrain the block model grade interpolation process assuming open pit mining methods. RPA interpreted and constructed wireframe models in Leapfrog Geo, using a nominal cut-off grade of 15 g/t Ag and a minimum core length of 2 m. Wireframes of the high-grade lenses were created at a minimum grade of approximately 60 g/t Ag. RPA built two low-grade halo domains and 11 high-grade lens domains.

Assay values located inside the wireframe models were tagged with domain identifiers and exported for statistical analysis. Results were used to help verify the modelling process.

Tinka performed 90 density measurements from four drill holes. RPA used the average of the measurements, 2.48 t/m³, to convert resource volumes to tonnages. RPA recommends that Tinka obtain additional measurements using the wax-sealed Archimedes method.

Erratic values of >360 g/t Ag were capped in the high-grade lenses, and >120 g/t Ag in the low-grade halo.

Compositing was done on 2 m intervals using the downhole compositing method. Composites less than 0.5 m, located at the bottom of the mineralized intercept, were removed from the database.

Grade interpolation for silver was estimated by ID3 using two passes for the high-grade lenses and three passes for the lower-grade halo domains. The first pass strategy for high-grade lenses required a minimum of two to a maximum of 12 composites, with a maximum of four composites per drill hole. The search ellipse dimensions were 50 x 50 x 10 m for an anisotropy ratio of 1:1:5. Pass two was similar except that the minimum required number of composites was reduced to one, there was no restriction of composites per drill hole, and the search ellipse dimensions were doubled to 100 x 100 x 20 m.

The search strategy for the first pass for low-grade halos required a minimum of two to a maximum of 12 composites, with a maximum of four composites per drill hole. The search ellipse was isotropic with a radius of 50 m. Pass two was similar except that the minimum required number of composites was reduced to one, there was no restriction of composites per drill hole, and the search ellipse radius was doubled to 100 m. A third pass was required to fill a few blocks along the fringes of the wireframe models. The parameters for the third pass were the same as those for the second pass except that a radius of 180 m was used.

RPA validated the block model by visual inspection, volumetric comparison, and scatterplots. Visual comparison on vertical sections and plan views, and a series of swath plots found good overall correlation between the block grade estimates and supporting composite grades.

Two areas of the Colquipucro Silver Zone were classified as Indicated: the central core, where the drill hole spacing is 50 m by 50 m or closer, and an area towards the north end of the Colquipucro Silver Zone, where the drill hole spacing is closer and the

mineralization exhibits good grade continuity. The remaining blocks are classified as Inferred.

RPA prepared a preliminary open pit shell to constrain the block model for resource reporting purposes, using Whittle software.

1.12 Mineral Resource Statement

Mineral Resources at Ayawilca are reported on the basis of a possible underground mining scenario using a base case US\$55/t NSR cut-off value for both the Ayawilca Zinc and Tin Zones. The Mineral Resources within the Ayawilca Tin Zone lie spatially beneath the Ayawilca Zinc Zone and the two zones typically do not overlap. Mineral Resources are reported with an effective date of 26 November, 2018.

Mineral Resources within the Colquipucro Silver Zone are reported within a preliminary pit shell generated in Whittle software at a reporting cut-off grade of 15 g/t Ag. Since there are no new data and the metal price and cost assumptions remain reasonable, the Colquipucro Silver Zone Mineral Resource estimate remains current as of the effective date of May 25, 2016.

The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee, and independent of Tinka.

Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

Estimates are provided in Table 1-1 for the Ayawilca Zinc Zone and in Table 1-2 for the Ayawilca Tin Zone, and in Table 1-3 for the Colquipucro Silver Zone.

Table 1-1: Mineral Resource Estimate, Ayawilca Zinc Zone

Zone and Confidence Classification	Tonnage (Mt)	ZnEq (%)	Zn (%)	Pb (%)	In (g/t)	Ag (g/t)	Contained Zn (Mlb)	Contained Pb (Mlb)	Contained In (t)	Contained Ag (Moz)
<i>Indicated</i>										
West	7.8	7.7	6.5	0.20	72	15	1,126	35	561	3.9
South	3.9	9.1	7.6	0.09	108	16	652	8	422	2.0
Total Indicated	11.7	8.1	6.9	0.16	84	15	1,778	42	983	5.8
<i>Inferred</i>										
West	5.0	7.1	6.4	0.27	34	17	699	30	170	2.8
Central	18.5	5.6	4.6	0.23	62	12	1,884	95	1,153	7.5
East	11.3	5.9	5.0	0.18	56	14	1,238	44	633	5.0
South	10.2	9.6	7.9	0.27	103	30	1,764	61	1,047	9.9
Total Inferred	45.0	6.7	5.6	0.23	67	17	5,585	230	3,003	25.2

Notes:

1. The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 26 November, 2018.
2. Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported above a cut-off NSR value of US\$55 per tonne.
4. The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$1.15/lb Zn, US\$300/kg In, US\$15/oz Ag, and US\$1.00/lb Pb. Metal recovery assumptions were: 90% Zn, 75% In, 60% Ag, and 75% Pb. The NSR value for each block was calculated using the following NSR factors: US\$15.34 per % Zn, US\$4.70 per % Pb, US\$0.18 per gram In, and US\$0.22 per gram Ag.
5. The NSR value was calculated using the following formula: $NSR = Zn(\%) * US\$15.34 + Pb(\%) * US\$4.70 + In(g/t) * US\$0.18 + Ag(g/t) * US\0.22
6. The ZnEq value was calculated using the following formula: $ZnEq = NSR/US\$15.34$
7. Numbers may not add due to rounding.

Table 1-2: Mineral Resource Estimate, Ayawilca Tin Zone

Confidence Classification	Tonnage (Mt)	SnEq (%)	Sn (%)	Cu (%)	Ag (g/t)	Contained Sn (Mlb)	Contained Cu (Mlb)	Contained Ag (Moz)
Inferred	14.5	0.70	0.63	0.21	18	201	67	8.0

Notes:

1. The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 26 November, 2018.
2. Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported above a cut-off NSR value of US\$55 per tonne.
4. The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$9.00/lb Sn, US\$2.85/lb Cu, and US\$15/oz Ag. Metal recovery assumptions were: 86% Sn, 75% Cu, and 60% Ag. The NSR value for each block was calculated using the following NSR factors: US\$155.21 per % Sn, US\$37.59 per % Cu, and US\$0.22 per gram Ag.
5. The NSR value was calculated using the following formula: $US\$NSR = Sn(\%) * US\$155.21 + Cu(\%) * US\$37.59 + Ag(g/t) * US\0.22
6. The SnEq value was calculated using the following formula: $SnEq = NSR/US\$155.21$
7. Numbers may not add due to rounding.

Table 1-3: Mineral Resource Estimate, Colquipucro Silver Zone

Zone and Confidence Classification	Tonnage (Mt)	Ag (g/t)	Contained Ag (Moz)
<i>Indicated</i>			
High Grade Lenses	2.9	112	10.4
Low Grade Halo	4.5	27	3.9
Total Indicated	7.4	60	14.3
<i>Inferred</i>			
High Grade Lenses	2.2	105	7.5
Low Grade Halo	6.2	28	5.7
Total Inferred	8.5	48	13.2

Notes:

1. The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 25 May, 2016.
2. Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported within a preliminary pit-shell and above a reporting cut-off grade of 15 g/t Ag for the Low-Grade Halo and 60 g/t Ag for the High-Grade Lenses.
4. The cut-off grade is based on a silver price of US\$24/oz Ag.
5. Numbers may not add due to rounding.

Factors that may affect the Mineral Resource estimate include: commodity price assumptions; changes in local interpretations of mineralization geometry and continuity of mineralization zones, and impact on mining selectivity; changes to geotechnical, hydrogeological, and metallurgical recovery assumptions; density and domain assignments; changes to assumed mining method which may change block size and orientation assumptions used in the resource model; input factors used to assess reasonable prospects for eventual economic extraction; and assumptions as to social, permitting and environmental conditions.

1.13 Mining Methods

The mine plan is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty

that the PEA based on these Mineral Resources will be realized. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

The Ayawilca Zinc Zone is planned to be mined using underground mining methods. Use of open pit mining method was discarded based on a review completed by RPA in January 2019, which concluded that an open pit scenario would not be economically viable. The PEA does not include any of the other Mineral Resources estimated for the Project.

Three different approaches were used to assess the selection of appropriate underground mining methods: Boshkov and Wright (1973) Classification System, Hartman Selection System and the UBC Mining Method Selection System. Based on these analyses, and taking into consideration other aspects such as safety, the resource continuity geometry and grade distribution, production scale and costs, R&P and P&P methods were selected. Approximately 50% of the Ayawilca Zinc Zone would be mined using conventional R&P, and the remaining 50% using P&P.

The RPA block model is the basis of the PEA mine plan. The mine production schedule assumes a mining and processing rate of 5,000 t/d, based on a trade-off study. A break-even mining NSR cut-off was estimated, a range of scenarios above this break-even NSR cut-off were analyzed, and an NSR cut-off value of US\$65/t was selected for PEA purposes as it produced the most favourable mining scenario. The mining NSR used different assumptions to the NSR assumptions used in resource estimation. Once the cut-off value had been determined, the mine plan was developed to include provision for external dilution, at an average 5% for R&P mining methods and 10% for P&P methods. No internal dilution was included as the assumption is that waste blocks can be mined separately or left in place as pillars, given the block size assumption of 10 m x 10 m x 5 m. The final step was to include mining recovery considerations. Mining recovery is estimated at 80% for both the R&P and P&P methods.

The subset of the Mineral Resource estimate used in the PEA mine plan is provided in Table 1-4.

Table 1-4: Subset of the Mineral Resources for the Ayawilca Zinc Zone Used in the PEA Mine Plan

Confidence Classification	Tonnage (kt)	Zn (%)	Pb (%)	In (g/t)	Ag (g/t)
Indicated	8,403	6.95	0.18	83.9	15.8
Inferred	29,804	5.79	0.27	62.4	19.0

Notes:

1. The subset of the Mineral Resources in Table 1-1 that are used in the PEA mine plan are reported above a cut-off NSR value of US\$65/t. Indium, while quoted in this subset of the Mineral Resources, was not considered a payable metal in the mine plan.
2. The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$1.20/lb Zn, US\$18/oz Ag, and US\$0.95/lb Pb. Metal recovery assumptions were: 92% Zn, 85% Ag, and 85% Pb. NSR value for each block was calculated using the following NSR factors: US\$15.39 per % Zn, US\$12.25 per % Pb, and US\$0.44 per gram Ag. The NSR value was calculated using the following formula: $NSR = Zn(\%) * US\$15.39 + Pb(\%) * US\$12.25 + Ag(g/t) * US\$0.44$.
3. The subset of the Mineral Resources includes allowance for external dilution, but no internal dilution was incorporated. External dilution is anticipated to average 5% for room-and-pillar mining methods, and 10% for post-pillar mining methods. The assumed average mining recovery for the room-and-pillar and post-pillar mining methods is 80%.

The main levels will be spaced at 70 m vertical intervals, with a sub-level at 35 m spacing. Production was assumed to start in the upper levels targeting higher-grade material and zones that could support a sustainable production rate. Because of the shallow dip of the mantos and assuming favorable ground conditions exist, only minimal or no horizontal pillars will be needed in between levels. In addition, no crown pillar to surface was considered due to the depth of the mineralized zone below surface.

Limited geotechnical information is currently available; however, based on the existing geological information and RQD measurements on drill core, it has been assumed that the conditions would be reasonably favorable for the application of underground mining methods that would require minimum ground support.

The hydrogeological information currently available is limited and not conclusive. There is a high probability of acid rock drainage, as the mineralization is primarily in the form of sulphides. A water treatment plant is expected to be required to treat any

tailings storage facility water balance excess and drainage from the mine, before such waters can be discharged to the environment.

A ramp system will be used to access the mine, connecting the mine portals to the underground infrastructure, including the mine production areas. Two access portals, the North 4255 and West 4035, were designed as the main and secondary accesses respectively. Nine ventilation raises (Raises 1 to 9) will also be required. One-way haulage traffic will be implemented along the main haulage routes to alleviate mine traffic and to facilitate road maintenance, minimizing downtime.

The general arrangement of the ventilation system, at a conceptual level, is such that each intake raise supports two separate exhaust raises and each of the exhaust raises draw air from two separate intake raises, so that all the main haulage drifts are ventilated.

Several extended single headings to R&P blocks will be ventilated using fixed forcing fan/duct systems. The estimated average airflow (rounded) is approximately 1,300 m³/s. Although there is a minimum probability of spontaneous combustion due to occurrence of massive reactive sulphides, no special ventilation requirements are recommended at this level of study.

A one-year pre-production period was included in the mine plan. During the pre-production period, initial underground infrastructure such as the main access ramps, access to production locations, ventilation drifts and raises and ancillary infrastructure will be developed to support the planned production rate. Portal construction is included in the pre-production period.

Mined-out stopes will be backfilled as necessary to provide a safe working environment. Fill will include paste and cemented rockfill types.

The underground mobile equipment fleet is classified into seven broad categories: mucking (e.g. LHDs); haulage (e.g. road trains and articulated haul trucks); drilling (e.g. jumbos, production drills and bolting equipment); raise bore and boxhole; utilities and underground support (e.g. flatbeds, boom trucks, fuel and lube trucks, explosive carriers, shotcrete transmixers and sprayers); surface support; and light vehicles (e.g. personnel transports, jeeps, tractors).

Major fixed equipment will include: fans and ventilation equipment; pumping and water handling equipment, power distribution equipment; data and communications equipment; and maintenance equipment (fixed shop furnishing).

The mine equipment requirements were estimated using benchmark data for equipment productivities.

1.14 Recovery Methods

The selection of a conventional coarse lead and standard zinc flotation-based processing circuit for the Ayawilca Zinc Zone and associated flowsheet is based on metallurgical testwork results and Wood's experience with operations treating similar mineralization and of the same scale as proposed for the Ayawilca Zinc Zone.

Metallurgical testwork has shown that the mineralized material is amenable to froth flotation at a primary grind size of P80 106 μm achieving commercial zinc concentrate grades and recoveries. Due to the minor lead content and its coarse nature in the mineralized material, a dedicated lead flotation circuit (rougher/cleaner cells) was omitted. To recover the lead content, a coarse flotation stage comprising two unit/flash cells located at the secondary grinding discharge will be included. Zinc will be recovered in a standard rougher and two-stage cleaner-scavenger flotation circuit. No regrind circuit is included, based on preliminary testwork results.

The processing plant will consist of the following unit operations:

- Primary jaw crushing
- Crushed ore handling
- Semi-autogenous grind (SAG) milling
- Ball mill secondary grinding in a closed circuit with hydrocyclone classification
- Lead flotation unit cells located at the ball mill discharge including rougher/cleaner stages
- Zinc sequential flotation including the following stages (up to three stages): rougher/cleaner/cleaner-scavenger
- Concentrate dewatering (zinc and lead-silver concentrates)
- Flotation tailings thickening and disposal into a tailings storage facility (TSF)
- Tailings backfill plant
- Fresh and reclaim water supply
- Reagent preparation and distribution.

Two types of final concentrates will be produced: a zinc–indium (zinc) concentrate and a lead–silver concentrate. A portion of the tailings will be used as mine backfill material, while the remaining portion will be disposed in a conventional TSF.

Process plant and site infrastructure energy requirements (excluding the underground mine) are expected to average about 40,000 MWh/a over the planned life-of-mine. The average installed power for these facilities will be about 6 MW (excluding the underground mine). Fresh water requirements are estimated to be 41 m³/h. The major reagents are anticipated to be: lime; thionocarbamate as a collector; alcohol/glycol mix frother; copper sulphate activator; and flocculant.

1.15 Infrastructure

The main infrastructure components include mine and process plant supporting infrastructure, site accommodation facilities, TSF, site and internal access roads, power supply and distribution, fresh water supply and distribution, and water treatment plant. No permanent stockpiles will be required, and no permanent waste rock storage facility is envisioned. Waste generated from decline construction and development activities will be temporarily stored adjacent the mine portals, and will be used during the mine life as backfill material.

The project is located in a remote mountainous river valley area and is a greenfields site. Due to site limitations imposed by topography and potential geological hazards, site development earthworks will be a major project consideration.

The current access to site from Yanahuanca would require upgrading to provide sufficient truck maneuvering room, including minimum turning radius and maximum slopes. Due to the difficulties associated with improving the existing site access, a new road is proposed to the site from the town of Chinche. This road would commence in Chinche, using an existing 8 km stretch of road. At km 8, a new 20 km long road will be constructed, which will lead to a mine control gate to be established at the Project boundary. For cost estimation purposes, it was assumed that the mine portal would be about 12 km from the mine control gate, the process plant 11 km, and the accommodations camp 11 km from the mine control gate.

The Port of Callao, in Lima, was selected as the concentrate export facility for PEA purposes for the larger portion of the zinc concentrate and all of the lead–silver concentrate to be shipped to Asia. However, port selection should be reviewed during more detailed studies, as the Port of Callao currently accounts for about 80% of the

Peruvian foreign trade and there is future potential for congestion issues. It is assumed concentrates will be trucked from the process plant to the port.

Tailings will be stored using conventional slurry tailings technology. For PEA purposes, a site northwest of the Ayawilca Zinc Zone was selected. A conceptual distance of 2–3 km between process plant and TSF locations was assumed for use in cost estimating. The selected site would require relocation of sections of two existing power transmission lines; relocation costs were included in the cost estimate. Tailings are anticipated to be pumped from the process plant and delivered to the TSF via pipeline. The TSF will need to accommodate about 19.1 Mt or 11.58 Mm³ of tailings, assuming 50% of the tailings are used in paste backfill. This would equate to a surface area requirement of approximately 67 ha.

Mine water is planned to be recycled as much as possible. Evaporation and seepage losses will be minimized in order to reduce fresh-water requirements and discharge to the environment. Likewise, runoff water from the temporary waste rock piles adjacent the portals and reclaimed water from TSF will be used for plant operations. The water balance assumes that reclaimed water from the TSF will be the main water source for the process plant. Any excess water from the TSF, and mine contact water, would be diverted to a water treatment plant prior to any discharge to the environment. The water management system will include diversion channels to divert non-contact water around the temporary waste rock piles and TSF; and ditches, culverts and drains where applicable. This non-contact water will be discharged to creeks located downstream of the planned operations.

Fresh water will be required to complement make up water for the plant, and the process plant will require around 41 m³/h as make-up water. The PEA assumption is that this can be met from local creeks. The project will require a water license for use of fresh water and may also require an authorization to discharge liquid effluents, if applicable. Water management and water supplies will be important for operations; in particular, agreements must be reached with regulatory authorities and stakeholders on fresh-water usage.

An accommodations camp, with a 500-person capacity was envisaged for PEA purposes. The PEA assumptions are that the general mine and process surface facilities will include a mine truckshop, a plant maintenance workshop, a laboratory, an explosives storage magazine, water ponds, a general warehouse, an administrative

office building, and a core shed. In total approximately 3,100 m² of general buildings have been accounted for in the capital cost estimate.

Two transmission lines cross the project area:

- L-2254, Paragsha 2 – Vizcarra, owned by ISA Colombia (REP)
- L-2264, Paragsha 2 – Conocochoa, owned by Abengoa Transmision Norte (ATN).

These lines are subject to the guaranteed system of transmission (SGT), which is part of Peru's national interconnection power system (SEIN). An approximate 7.5 km section of each line will need to be relocated under PEA assumptions.

Based on benchmarking, the average installed power for the underground mine is expected to be similar to that required by the process plant. The forecast overall project power demand is about 15 MW, consisting of the total site wide power requirements for the process plant, tailings and general infrastructure (6 MW), as well as the underground mine facilities (6 MW) plus an allowance (3 MW).

The PEA assumption is that the project power tie-in point, which will use a π -type sectioning point, will be within the project area and will tap into the existing L-2264 power line. The PEA also assumes that Tinka will be able to obtain an exemption from regulation PR-20 from the Comité de Operaciones del Sistema Interconectado Nacional (COES). Regulation PR-20 states that a new sectioning point has to be more than 50 km from the nearest existing substation. The closest sub-station to the project, Paragsha 2, is 40 km to the south. COES has previously granted exemptions on the basis of technical space limitations or geographical constraints.

1.16 Environmental, Permitting and Social Considerations

1.16.1 Environmental Considerations

Tinka has completed seven environmental studies in support of drill program permitting in the period 2013–2018. Tinka received an Authorization to Initiate Mining Activities (Resolution N° 0170-2017-MEM/DGM) on 10 February, 2017. Five Certificates of Non-Existence of Archaeological Remains (CIRA) have been granted.

The initial semi-detailed environmental impact study (EIAsd) was compiled in 2012, and included baseline information on physical, biological and social conditions, and an archaeological clearance. The EIAsd was approved in July 2013. A modified EIAsd (referred to as a MEIAsd) report was compiled in 2015, and approved in 2016. A

second MEIAsd report has been filed, and is currently undergoing MINEM review. Monitoring was initiated as part of the EIAsd and MEIAsd approvals, is ongoing, and is conducted on a semi-annual basis. The initial EIAsd program collected data on water quality, air quality and environmental noise. The MEIAsd program was expanded to increase the number of monitoring points, and included monitoring of flora, fauna, and soils.

There are wetlands (bofedales) and two high-altitude lakes in the general project area. The proposed infrastructure sites were selected with consideration for bofedales and high-altitude lake proximity. The closest infrastructure is anticipated to be sited about 100 m from a high-altitude lake shore. During more detailed studies, infrastructure sites must be the subject of additional environmental evaluation.

Initial baseline studies have identified a number of flora and fauna species in the general project area that have been listed as either critically endangered, endangered or vulnerable, under Peruvian legislation (S.D. N° 043-2006-AG and S.D. N° 004-2014-MINAGRI) or are listed in the Appendices of the Convention on International Trade in Endangered Species (CITES) or the Red List of the International Union for Conservation of Nature (IUCN). Additional studies will be required to better document species of concern, determine the likelihood of project impact on the species, and to develop appropriate mitigation measures where required.

1.16.2 Closure and Reclamation Planning

The EIA for the project will include a conceptual closure plan to obtain the environmental approval. A detailed Mine Closure Plan must be submitted within one year after EIA approval. Posting of the corresponding financial assurance for closure must also be completed before the start of production and within the first 20 business days of the following year during which the Beneficiation Concession or Start of Activities is approved, as stated by the Regulaciones para el Cierre de Minas or Mine Closure Regulations. The final closure plan must be submitted two years prior to closure of operations.

A provision of US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmark, was included in the capital costs to account for closure costs.

1.16.3 Permitting Considerations

A comprehensive environmental and social impact assessment will be necessary for the project in order to obtain necessary permits for construction, operations, and closure. This assessment will be conducted in compliance with Peruvian regulations.

The PEA has made certain assumptions as to the timelines needed to complete prior consultation, and collect the necessary wet season/dry season baseline data to allow the EIA report to be completed and lodged with the relevant regulatory authorities. There is a risk that these timeline assumptions are optimistic and may need to be refined during the EIA application process.

Once the environmental and social impact assessment is approved by Peruvian authorities, a variety of permits, licenses, and authorizations will be required to proceed with the project construction and operations. The main permitting requirements include:

- Mine Closure Plan approval
- CIRAs
- Water use authorizations and final licence
- Sanitary authorization, approving wastewater treatment system and discharge
- Sanitary authorization for drinking water treatment system
- Registration as a direct consumer of liquid fuels (fixed or mobile facilities)
- Authorization for acquisition and use of explosives (annual)
- Explosive storing authorization (annual)
- User's certificate for controlled chemical substances and products
- Beneficiation concession
- Start of activities (includes exploitation of construction materials and mining exploitation).

The granted CIRAs do not cover all of the infrastructure areas envisaged in this PEA. Major areas that are known to require additional CIRAs include: mine supporting facilities, mine backfill plant, process plant, primary crusher, power lines, electrical substation, access road and TSF. Review of the final project footprint will be required to ensure that all of the planned operational areas have a CIRA.

1.16.4 Social Considerations

There are three active property agreements in place with local communities that support exploration-stage activities.

In support of obtaining the permits to allow exploration activities, Tinka has conducted a number of town-hall meetings with local communities. Tinka also maintains community relations offices in all three communities and the Tinka team endeavours to meet with as many local stakeholders as possible, as often as possible.

The project will affect at least one community included in the list of indigenous communities maintained by the Ministry of Culture, and will be subject to prior consultation requirements and considerations.

Wood conducted a review of potential social and community impacts as part of the PEA, based on available information provided by Tinka. Tinka has completed a social compliance report for 2017–2018, and files monthly reports on safety indicators including social conflicts (2015–2019 and ongoing) to relevant regulatory authorities. The key risks identified included:

- Potential for conflicts over freshwater usage
- Potential impact on existing wetlands and high-altitude lakes
- Proposed infrastructure locations overlap with existing infrastructure such as roads
- Presence of archeological material in areas proposed to host infrastructure
- Ability to obtain land agreements to support project access, development, construction and operations
- Clear understanding of the project area of influence, including communities that may be potentially impacted
- The ability of the project and company to meet community expectations.

1.17 Markets and Contracts

The information summarized in this subsection is derived from Ocean Partners, a third-party concentrate trading and marketing specialist company, who were contracted by Tinka to prepare a market study to support the PEA.

The expected grade of the Ayawilca zinc concentrate is 50% Zn, which is considered a medium-grade zinc concentrate, and typical of concentrates from many zinc deposits

in central Peru. The economic analysis assumes that the smelter pays for 85% of zinc content in the concentrate subject to a minimum deduction of eight units. The Ayawilca zinc concentrate is expected to receive an iron penalty of US\$7.50 per dry metric tonne (dmt) of concentrate at the smelter (based on an expected iron content for the Ayawilca zinc concentrate of 13%, at a standard penalty rate of US\$1.50/% Fe above 8% Fe). No other deleterious elements are present in the Ayawilca zinc concentrate, and no other penalties are expected. Based on current exchange rates, a figure of US\$35 per wet metric tonne (wmt) is regarded as appropriate to cover the inland freight costs of transporting concentrate produced at Ayawilca to the port of Callao or the Cajamarquilla smelter located close to Lima. Using the proposed marketing strategy, an average sea freight cost of around US\$45/wmt is regarded as a reasonable assumption for financial modelling purposes. Port costs are likely to be in the range of US\$15–20/wmt.

A treatment charge base rate for the zinc concentrate of US\$190/dmt was assumed for the PEA. In the portion of the zinc concentrate to be sold to Asian markets, the indium content in the zinc concentrate is not directly payable but provides a treatment charge credit of US\$20/dmt. Indium is not payable in the zinc concentrate sold to the South American market and there is no treatment charge credit. A treatment charge base rate for the lead-silver concentrate of US\$150/dmt was assumed for PEA, with a silver refining charge of US\$1.00/oz Ag.

Details of the expected Ayawilca lead-silver concentrate are not as well constrained as those for the zinc concentrate, due to fewer metallurgical testwork results. The expected grade of the lead-silver concentrate is 50% Pb, while silver is expected to be in the range of 2,320–5,880 g/t in the lead-silver concentrate. The smelter is assumed to pay for 95% of lead content in the concentrate subject to a minimum deduction of three units. For silver in the lead-silver concentrate, the smelter typically pays for 95% subject to a minimum deduction of 50 g/dmt. No penalties are expected on the lead-silver concentrate.

For the purpose of this PEA, the project economics were estimated based on long-term metal prices of US\$1.20/lb for zinc, established by Tinka, and US\$0.95/lb for lead and US\$18.00/oz for silver, based on Wood's long-term cash flow guidelines for first quarter 2019 (Q1-2019), as of 1 January, 2019, derived from Wood's survey of industry-consensus prices. Indium is assumed to not be payable for the purposes of the PEA;

however, the indium content is assumed to provide a credit on the treatment charge for that portion of the zinc concentrate that will be sold in Asia.

Tinka has no current contracts for property development, mining, concentrating, smelting, refining, transportation, handling, sales and hedging, forward sales contracts or arrangements.

1.18 Capital Cost Estimates

The capital cost estimate was prepared by Wood. All costs are exclusive of the Peruvian value-added tax (Impuesto General a las Ventas or IGV). The capital cost estimate for the PEA has an expected accuracy range of $\pm 35\%$. The cost estimate is expressed in Q1-2019 US\$, and uses an exchange rate of 1.00 US\$ = 3.30 PEN.

Capital costs include the direct costs for project execution, as well as the indirect costs associated with design, construction and commissioning. Indirect project capital costs include EPCM, third-party consultants, construction facilities and services, equipment freight, vendor support, first fill and spares (for the first year of operation). Percentage factors based on Wood's experience with similar projects were used to determine indirect project costs, based on the project direct cost. No indirect costs other than the backfill plant were considered within the mining capital cost.

The initial capital cost estimate is provided in Table 1-5 and the sustaining capital cost estimate is included in Table 1-6.

Table 1-5: Initial Capital Cost Estimate Summary

Description	US\$ M
<i>Mine</i>	43.1
Site preparation	0.6
Haul roads	0.9
Pre-production development	16.4
Mining equipment fleet	15.1
UG mine ventilation	1.8
UG mine electrical distribution	1.3
Mine backfill plant	6.6
Mine support infrastructure and services	0.4
<i>Process plant</i>	76.3
Site preparation and surface water management	7.2
Ore reception and crushing	13.8
Zinc concentrator	39.2
Lead-silver concentrator	3.8
Tailings transport and disposal	3.9
Reagents storage and handling	2.5
Process plant support infrastructure and services	6.1
<i>TSF</i>	6.7
Starter dam	6.0
Water management	0.6
<i>On-site infrastructure</i>	34.3
Water treatment and on-site distribution	5.9
Site electrical sub-station and on-site distribution	10.4
Internal access roads	9.2
Camp	7.2
Other general facilities	1.6
<i>Off-site infrastructure</i>	14.7
Fresh water supply	2.5
Power supply	5.5
External access roads	6.6

Description	US\$ M
Total direct costs	175.0
Indirect costs	33.6
Owner's costs	8.7
Contingency	44.5
Total initial capital cost estimate	261.9

Note: Totals may not sum due to rounding.

Table 1-6: Sustaining Capital Cost Estimate Summary

Description	US\$ M
Mine development	38.0
Mining equipment fleet	61.9
Underground ventilation	9.9
TSF expansion	34.9
Total sustaining capital cost estimate	144.6

Note: Totals may not sum due to rounding.

1.19 Operating Cost Estimates

The operating cost estimate has an expected accuracy range of $\pm 35\%$ and is expressed in Q1-2019 US\$.

The estimate includes the underground mining, processing and G&A operating costs. It excludes costs associated with escalation beyond Q1-2019, currency fluctuations, off-site costs, interest charges and taxes. No contingency has been included in the operating costs.

Table 1-7 is a summary of the operating cost estimate.

Table 1-7: Operating Cost Estimate Summary

Description	LOM Cost Estimate (US\$/t mill feed processed)	LOM Cost Estimate (US\$ M)
Mining	36.66	1,400.5
R&P mining	38.06	716.8
P&P mining	35.29	683.7
Processing	6.44	246.1
G&A	5.48	209.4
Total	48.57	1,855.9

Note: Totals may not sum due to rounding.

1.20 Economic Analysis

Certain information and statements contained in this section and in the Report are “forward looking” in nature. Forward-looking statements include, but are not limited to, statements with respect to the economic and study parameters of the project; Mineral Resource estimates; the cost and timing of any development of the project; the proposed mine plan and mining methods; dilution and extraction recoveries; processing method and rates and production rates; projected metallurgical recovery rates; infrastructure requirements; capital, operating and sustaining cost estimates; the projected life of mine and other expected attributes of the project; the net present value (NPV) and internal rate of return (IRR) and payback period of capital; capital; future metal prices; the timing of the environmental assessment process; changes to the project configuration that may be requested as a result of stakeholder or government input to the environmental assessment process; government regulations and permitting timelines; estimates of reclamation obligations; requirements for additional capital; environmental risks; and general business and economic conditions.

All forward-looking statements in this Report are necessarily based on opinions and estimates made as of the date such statements are made and are subject to important risk factors and uncertainties, many of which cannot be controlled or predicted.

Material assumptions regarding forward-looking statements are discussed in this Report, where applicable. In addition to, and subject to, such specific assumptions discussed in more detail elsewhere in this Report, the forward-looking statements in this Report are subject to the following assumptions:

- There being no significant disruptions affecting the development and operation of the project
- The availability of certain consumables and services and the prices for power and other key supplies being approximately consistent with assumptions in the Report
- Labor and materials costs being approximately consistent with assumptions in the Report
- The timelines for prior consultation and wet season/dry season baseline data collection being generally consistent with PEA assumptions
- Permitting and arrangements with stakeholders being consistent with current expectations as outlined in the Report
- All environmental approvals, required permits, licenses and authorizations will be obtained from the relevant governments and other relevant stakeholders
- Certain tax rates, including the allocation of certain tax attributes, being applicable to the project
- The availability of financing for Tinka's planned development activities
- The timelines for exploration and development activities on the project
- Assumptions made in Mineral Resource estimate and the financial analysis based on that estimate, including, but not limited to, geological interpretation, grades, commodity price assumptions, extraction and mining recovery rates, hydrological and hydrogeological assumptions, capital and operating cost estimates, and general marketing, political, business and economic conditions.

The production schedules and financial analysis annualized cash flow table are presented with conceptual years shown. Years shown in these tables are for illustrative purposes only. If additional mining, technical, and engineering studies are conducted, these may alter the project assumptions as discussed in this Report and may result in changes to the calendar timelines presented.

The PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA based on these Mineral Resources will be realized.

The financial analysis of the Ayawilca Zinc Zone was carried out using a discounted cash flow (DCF) methodology. Net annual cash flows were estimated projecting yearly cash inflows (or revenues) and subtracting projected yearly cash outflows (such as capital and operating costs, royalties and taxes). These annual cash flows were discounted back to the date of beginning of capital expenditure at mid-year 2021 (mid-year -2) and totalled in order to determine the NPV of the project at selected discount rates. A discount rate of 8% was used as the base rate for discounting. All monetary amounts are presented in constant Q1-2019 US\$. For discounting purposes, cash flows are assumed to occur at the end of each period. Revenue is recognized at the time of production.

For the purpose of this PEA, it has been assumed that 75 kdm/a of the zinc concentrate will be sold to a local smelter in Peru and the remaining yearly production will be sold free-on-board (FOB) Asia. Lead-silver concentrate production will be sold FOB Asia. The following payability factors have been applied:

- Zinc concentrate:
 - Zinc: pay for 85.0% of the zinc content, subject to a minimum deduction of eight units.
- Lead-silver concentrate:
 - Lead: pay for 95.0% of lead content, subject to a minimum deduction of three units
 - Silver: pay for 95.0% of silver content, subject to a minimum deduction of 50 g/dmt.

The indium content in the zinc concentrate is not directly payable, but provides a credit on the treatment charge for that portion of the zinc concentrate that will be sold in Asia. A concentrate transport loss of 0.2% was assumed for both concentrates. The zinc concentrate is assumed to be subject to a penalty of US\$1.50 per each 1% Fe above 8.0% Fe.

A construction period of 18 months was considered (starting in mid-year 2021) for the overall project implementation. Year 2023 corresponds to the first year of production. Capital costs were applied in the financial model excluding the Peruvian value-added tax (Impuesto General a las Ventas or IGV in the Spanish acronym). A provision of

US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmark, was included to account for closure costs.

For the purpose of this PEA, it has been assumed that the mine will be run by the Owner. Operating costs were applied in the financial model excluding IGV.

The taxation and royalties modeled within the financial analysis are based on the tax rates and taxation schemes that were validated by Ernst & Young Asesores (EY). The following tax considerations have been applied:

- Modified mining royalty (Law N° 29788)
- Special mining tax (Law N° 29789)
- Employee profit sharing of 8% of taxable income after loss carry-forward
- Complementary mining pension fund as 0.5% of taxable income after loss carry-forward and employee profit sharing
- Corporate income tax rate of 29.5%
- Tax loss carried forward to a maximum of four consecutive years after the year of the loss.

Tax depreciation is straight line. The PEA assumes that the 1% NSR royalty payable to Sierra will be bought out.

No salvage value was considered. The preliminary economic analysis is based on 100% equity financing. No escalation or inflation has been applied. All amounts are in real (constant) terms.

The project is anticipated to generate a pre-tax NPV of \$609 M at an 8.0% discount rate, an IRR of 37.2% and a payback period of 2.2 years. The financial analysis results showed an after-tax NPV of US\$363 M at an 8.0% discount rate, an IRR of 27.1% and a payback period of 3.1 years. Table 1-8 presents a summary of the financial analysis results.

Cash costs were consolidated per pound of zinc payable, net of lead and silver credits. A LOM all-in sustaining cash cost (AISC) was also consolidated. These are presented in Table 1-9.

Table 1-8: Summary of Financial Results

Description	Units	Value
Zn payable	klb	3,927,832
Pb payable	klb	165,154
Ag payable	koz	18,114
Zn payable equivalent	klb	4,330,287
<i>After-Tax Valuation Indicators</i>		
Undiscounted cumulative cash flow	US\$ M	1,051.1
NPV @ 8%	US\$ M	363.4
NPV @ 10%	US\$ M	281.4
Payback period (from start of operations)	years	3.1
IRR	%	27.1
Initial capital	US\$ M	261.9
LOM capital	US\$ M	406.5
Closure costs	US\$ M	20.3

Note: base case at NPV8% is bolded.

Table 1-9: Summary of LOM Cash Costs

Cash Cost	LOM (US\$ M)	US\$/Zn lb payable
<i>Cash Costs</i>		
Mining	1,400.5	0.36
Process	246.0	0.06
G&A	209.4	0.05
Concentrates transport, treatment and refining	1,194.1	0.30
Sub-Total	3,050.0	0.78
<i>By-product credits</i>		
Pb and Ag premium	(482.9)	(0.12)
<i>Net Direct Cash Cost (C1)</i>	<i>2,567.1</i>	<i>0.65</i>
Sustaining capital, royalties* and closure	273.7	0.07
AISC	2,840.8	0.72

Note: * includes Modified Mining Royalty and Special Mining Tax.

1.21 Sensitivity Analysis

A sensitivity analysis was performed considering variations in metal prices, feed metal grades, initial capital and operating costs on the after-tax NPV8% and on IRR. The results of this analysis are presented in Figure 1-1 and Figure 1-2.

The project is most sensitive to fluctuations in the zinc price, then to feed grades. It is less sensitive to changes in operating costs, then initial capital costs. It is least sensitive to changes in silver and lead prices.

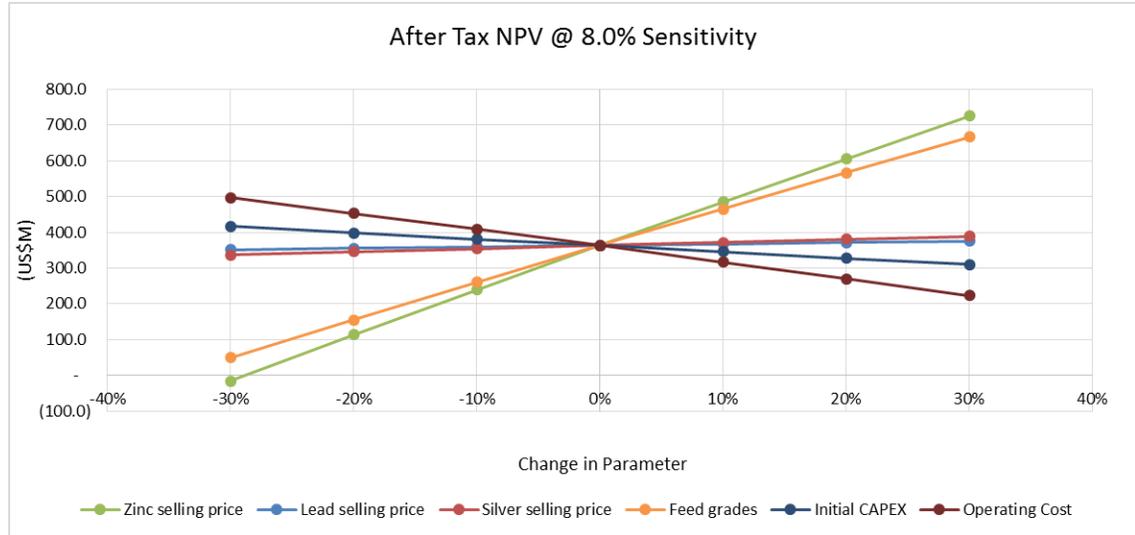
1.22 Risks and Opportunities

A preliminary risk and opportunity assessment was conducted as part of the PEA.

Risks were rated according to probability and likely impact, and the assigned a risk rating. A total of 42 risks were identified, of which one was classified as very low, eight as low, 28 as medium and five as high. No risks categorized as "very high" were recognized. No action plans were developed for each risk as it is expected that the outcome of the risk workshop will be used as the basis for the preparation of the overall work plan for the next project stage. Significant risks were identified in the following areas: dewatering assumptions for process plant design, potential for acid mine drainage in the TSF necessitating a liner, water treatment plant assumptions, PR-20 regulation exemption assumption for power supply, Chaquicocha Lake impact on water management assumptions, and water usage needs of local communities.

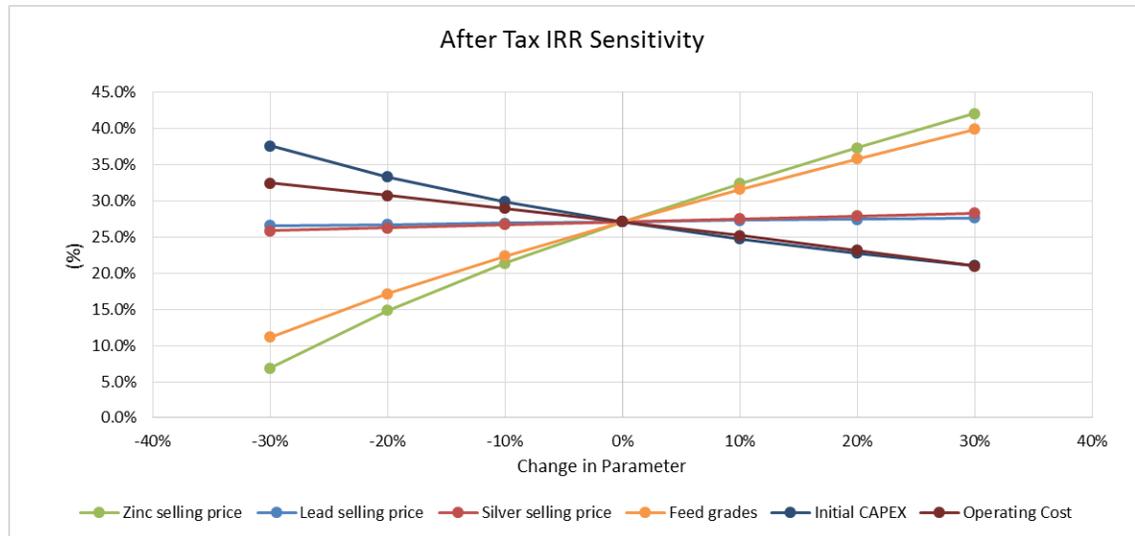
Opportunities were as identified by Wood, and reviewed by Tinka. A total of 15 opportunities were recognized, of which seven were classified as high, six as medium and two as low. No opportunities categorized as "very high" or "very low" were pinpointed. Significant opportunities included: high-grading zinc mill feed material early in the mine plan, Mineral Resource confidence category upgrades/exploration success that may support throughput rate expansion and/or increased feed grade early in the mine plan, treating material from the Ayawilca Tin Zone after the Ayawilca Zinc Zone has been mined out, processing the Colquipucro Silver Zone to produce silver as a new marketable product, and use of cycloned tailings.

Figure 1-1: Sensitivity of After-Tax NPV Discounted at 8.0%



Note: Figure prepared by Wood, 2019.

Figure 1-2: Sensitivity of After-Tax IRR



Note: Figure prepared by Wood, 2019.

1.23 Interpretation and Conclusions

Under the assumptions presented in this Report, and based on the available data, the PEA shows positive economics.

1.24 Recommendations

A two-phase work program is recommended. The first work phase would consist of:

- Exploration and step-out drilling to further investigate high-grade zinc mineralization at the South and West Ayawilca Zones, and potentially support estimation of additional Mineral Resources (10,000 m; program is underway)
- Infill drilling to provide support for Mineral Resource estimate confidence category upgrades (23,000 m)
- Field investigations and data collection to support a pre-feasibility study and to support environmental and permitting requirements
- Engineering studies
- Completion of a pre-feasibility study.

Contingent on positive results from the pre-feasibility study, the second work phase would consist of a feasibility study. The Phase 2 work could include:

- Infill and geotechnical drilling (15,000 m)
- Field investigations and detailed data collection, together with engineering studies
- Adit construction
- Completion of a feasibility study.

Phase 1 is estimated at \$15 M, divided between exploration drilling (\$3 M), infill drilling (US\$7 M) and field investigations and studies to support a pre-feasibility report (\$5 M). The feasibility study is estimated at \$20 M, divided between infill drilling (\$5 M), and field investigations and studies to support the feasibility report (\$15 M).

2.0 INTRODUCTION

2.1 Introduction

Tinka Resources Limited (Tinka) requested that Amec Foster Wheeler (Peru) S. A., a Wood company (Wood), Transmin Metallurgical Consultants (Transmin), and Roscoe Postle Associates Inc. (RPA), compile a technical report (the Report) on a preliminary economic assessment (PEA) study for the Ayawilca polymetallic project (the Project), located in central Peru (Figure 2-1).

2.2 Terms of Reference

This Report supports the disclosure in Tinka's news release dated 2 July, 2019, entitled "Tinka Reports Positive PEA For The Ayawilca Zinc Project".

The term "Project" is used to refer to all of the mineral tenure holdings; the term "project" refers to the PEA study. Unless otherwise noted, all mineralization is discussed using "zone" nomenclature. Zones are generally described by the major commodity, but may be further broken down by geographic location: Ayawilca Zinc Zone (subdivided into West, Central, South, and East Ayawilca Zones and Zone 3), Ayawilca Tin Zone, and Colquipucro Silver Zone.

All measurement units used in this Report are metric unless otherwise noted. Currency is expressed in United States (US) dollars (US\$). The Peruvian currency is the nuevo sol. The Report uses US English.

Mineral Resources and Mineral Reserves are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (November 2003; 2003 CIM Best Practice Guidelines).

Figure 2-1: Project Location Plan



Note: Figure from courtesy Tinka. Star marks the approximate location of the Ayawilca Project. Other projects and refineries/smelters are held by third parties as indicated.

2.3 Qualified Persons

This Report was prepared by the following Qualified Persons (QPs):

- Mr. Edwin Peralta, P.E., Senior Mining Engineer, Wood
- Mr. William Colquhoun, FSAIMM, Principal Metallurgical Consultant, Wood
- Ms. Dorota El Rassi, P.Eng., Associate Senior Geological Engineer, RPA

- Mr. Adam Johnston, FAusIMM CP (Metallurgy), Chief Metallurgist, Transmin
- Ms. Stella Searston, RM SME, Principal Geologist, Wood Associate.

2.4 Site Visits and Scope of Personal Inspection

Mr. Peralta visited the site from 4–5 December, 2018. During this site visit, he: viewed the current access routes to the area from the major cities Lima, and Huanuco; viewed access conditions to site from nearby towns that could potentially provide services to the mine, including Oyón, Yanahuanca, San Pedro de Pillao; inspected the current topography with the purpose of identifying potential sites for major surface infrastructure including mine portals, temporary rock storage facilities and potential borrow material sites; inspected drill core for general mineralization characteristics and geotechnical information; and identified potential water sources.

Ms. El Rassi visited the Project area on 19 September, 2018. She visited the core shacks, examined drill core and outcrops, and held discussions with Tinka geological and technical staff. Ms. El Rassi was able to observe the drilling in progress at Ayawilca and noted that the work was being carried out in a competent fashion, using modern equipment that appeared to be in good repair and appropriate for the job.

2.5 Effective Dates

The Report has a number of effective dates as follows:

- Date of supply of last information on mineral tenure, surface rights and agreements: 27 June, 2019
- Date of supply of most recent information on ongoing drill program: 31 July, 2019
- Mineral Resource estimate, Ayawilca Zinc and Tin Zones: 26 November, 2018
- Mineral Resource estimate, Colquipucro Silver Zone: 25 May, 2016
- Date of PEA financial analysis: 2 July, 2019.

The overall effective date of this Report is the effective date of the financial analysis which is 2 July, 2019.

2.6 Information Sources and References

The Report is primarily based on a preliminary economic assessment prepared for Tinka in June–July 2019, and supporting memoranda and trade-off studies. This

Report is also based in part on internal company reports, maps, published government reports, and public information, as listed in Section 27 of this Report. It is also based on the information cited in Section 3.

Additional information was sought from Tinka employees in their areas of expertise as required.

The following Wood employees visited the site on December 4–5, 2018, and provided input in their areas of expertise to Mr. Peralta and Mr. Colquhoun:

- Mr. Jimmy Trejo, Senior Resource Geologist, visited and inspected drill platforms, reviewed drill core and drill program results and interpretations with Tinka staff, and reviewed logging and sampling protocols. Mr. Trejo also visited a number of potential infrastructure locations with Mr. Ale
- Mr. Jose Ale, Geotechnical Department Manager, E&IS Division, Peru, visited a number of potential locations for the tailings storage facility (TSF) and plant site. During these inspections, Mr. Ale discussed operational considerations with Tinka staff for each of the alternate TSF sites. The site visit also included examination of potential borrow material sources that could potentially provide additional rock fill material. Mr. Ale walked the alternate plant site localities to examine how the main facilities could be accommodated and potential layout options.

Mr. David Ross of RPA visited the site from 11–14 December, 2014 and again from 11–13 January, 2016. He visited the core shacks, examined drill core and outcrops, and held discussions with Tinka geological and technical staff. Ms. El Rassi used inputs from Mr. Ross's site visit when completing data verification.

2.7 Previous Technical Reports

Tinka has previously filed the following technical reports:

- Ross, D., 2015: Technical Report on the Mineral Resource Estimate for the Ayawilca-Colquipucro Property, Department of Pasco, Peru: technical report prepared by Roscoe Postle Associates Inc for Tinka Resources Limited, effective date 25 March, 2015
- Ross, D., 2016: Technical Report on the Mineral Resource Estimate for the Ayawilca-Colquipucro Property, Department of Pasco, Peru: technical report prepared by Roscoe Postle Associates Inc for Tinka Resources Limited, effective date 29 June, 2016

- Ross, D., 2017: Technical Report on the Mineral Resource Estimate for the Ayawilca-Colquipucro Property, Department of Pasco, Peru: technical report prepared by Roscoe Postle Associates Inc for Tinka Resources Limited, effective date 11 December, 2017
- El-Rossi, D., and Ross, D., 2019: Technical Report on the Mineral Resource Estimate for the Ayawilca Property, Department of Pasco, Peru: technical report prepared by Roscoe Postle Associates Inc for Tinka Resources Limited, effective date 9 January, 2019.

3.0 RELIANCE ON OTHER EXPERTS

3.1 Introduction

The QPs have relied upon the following other expert reports, which provided information regarding mineral rights, surface rights, royalties, property agreements, environmental liabilities, market conditions and contracts for this Report as noted below.

3.2 Mineral Tenure, Surface Rights, Royalties and Agreements

The QPs have not reviewed the mineral tenure, surface rights, property ownership, royalties, nor independently verified the legal status of the Project area, underlying property agreements, or permits. The QPs have fully relied upon, and disclaim responsibility for, information derived from experts retained by Tinka through the following document:

- Pickmann, F., and Reyes, A., 2019: Legal Opinion of Ayawilca Project: report prepared by Dentons Gallo Barrios Pickmann for Wood Canada Limited and Tinka Resources, 27 June, 2019, 19 p.

This information is used in Section 4 of the Report. It is also used in support of the Mineral Resource statement in Section 14, and the preliminary economic analysis in Section 22.

3.3 Environmental

The QPs have not independently verified the legal status of the historical environmental liabilities within the Project area. The QPs have fully relied upon, and disclaim responsibility for, information derived from experts retained by Tinka through the following document:

- SNC Lavalin, 2019: Segunda Modificación del Estudio de Impacto Ambiental Semidetallado del Proyecto de Exploración Minera Ayawilca": report prepared by SNC Lavalin for Tinka, 19 February, 2019, 1,599 p.

This information is used in Section 4 of the Report.

3.4 Taxation

The QPs have not independently verified the taxation considerations applied in the financial model. The QPs have fully relied upon, and disclaim responsibility for, information derived from experts retained by Tinka through the following document:

- Ernst & Young Asesores, 2019: Taxation Assumptions for the Ayawilca Project Preliminary Economic Assessment Financial Model: report from Ernst and Young to Wood and Tinka, 25 July, 2019, 3 p.

This information is used in Section 22 of the Report.

3.5 Markets and Contracts

The QPs have not independently verified marketing information on zinc–indium and lead–silver concentrates, or smelter terms information. The QPs have fully relied upon, and disclaim responsibility for, information derived from experts retained by Tinka through the following document:

- Ocean Partners, 2019a: Marketing Assumptions for the Ayawilca Project Preliminary Economic Assessment: report from Ocean Partners to Wood and Tinka, 1 August 2019, 4 p.
- Ocean Partners, 2019b: Updated Zinc Pricing for Use In Ayawilca Project Preliminary Economic Assessment: email from Ocean Partners to Wood and Tinka, 12 August 2019.

This information is used in Section 19 of the Report. It is also used in support of the economic analysis in Section 22.

Concentrate market terms and conditions are a specialized business requiring knowledge of supply and demand of smelter capacity and concentrate types, as well as the terms and conditions of smelters for different quality of concentrate. This requires direct communication with smelters and an extensive database that is outside of the purview of a QP. The QPs consider it reasonable to rely upon Ocean Partners for this information. Ocean Partners offers global trading services to miners, smelters, and refiners in the areas of copper, lead and zinc concentrates. The company has offices or agencies in at least 25 countries. Areas of expertise include:

- Market analysis of concentrate quality
- Identification of “strategic” smelters

- Statistical review of the concentrate market
- Development of a comprehensive marketing strategy
- Obtaining letters of intent from smelters
- Credit risk analysis
- Commercial presentations to banks or other financiers
- Assistance in developing long- and short-term hedging strategies
- Securing long term and spot off-take contracts
- Client visits and assistance in negotiating commercial deals
- Open book custom/toll agency blending.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Introduction

The Ayawilca Project is located 200 km northeast of Lima within the Districts of Yanahuanca and San Pedro de Pillao, Province of Daniel Alcides Carrion, in the Department of Pasco, Peru.

The Project is centred at UTM 332,400 mE by 8,847,600 mN (WGS84 datum, Zone 18S) on national map sheet 21-J.

4.2 Property and Title in Peru

The QPs have not independently verified the following information which is in the public domain and have sourced the data from Elias (2019), Ernst and Young (2017), and KPMG (2016) as well as from official Peruvian Government websites.

4.2.1 Regulatory Oversight

The right to explore, extract, process and/or produce minerals in Peru is primarily regulated by mining laws and regulations enacted by Peruvian Congress and the executive branch of government, under the 1992 Mining Law. The law regulates nine different mining activities: reconnaissance; prospecting; exploration; exploitation (mining); general labor; beneficiation; commercialization; mineral transport; and mineral storage outside a mining facility.

The Ministry of Energy and Mines (MINEM) is the authority that regulates mining activities. MINEM also grants mining concessions to local or foreign individuals or legal entities, through a specialized body called The Institute of Geology, Mining and Metallurgy (Ingemmet).

Other relevant regulatory authorities include the Ministry of Environment (MINAM), the National Environmental Certification Authority (SENACE), and the Supervisory Agency for Investment in Energy and Mining (Osinergmin). The Environmental Evaluation and Oversight Agency (OEFA) monitors environmental compliance.

4.2.2 Mineral Tenure

Mining concessions can be granted separately for metallic and non-metallic minerals. Concessions can range in size from a minimum of 100 ha to a maximum of 1,000 ha.

A granted mining concession will remain valid providing the concession owner:

- Pays annual concession taxes or validity fees (derecho de vigencia), currently US\$3/ha, are paid. Failure to pay the applicable license fees for two consecutive years will result in the cancellation of the mining concession
- Meets minimum expenditure commitments or production levels. The minima are divided into two classes:
 - Achieve “Minimum Annual Production” by the first semester of Year 11 counted from the year after the concession was granted, or pay a penalty for non-production on a sliding scale, as defined by Legislative Decree N° 1320 which became effective on 1 January, 2019. “Minimum Annual Production” is defined as one tax unit (UIT) per hectare per year, which is S/4,200 in 2019 (about US\$1,220)
 - Alternatively, no penalty is payable if a “Minimum Annual Investment” is made of at least 10 times the amount of the penalty.

The penalty structure sets out that if a concession holder cannot reach the minimum annual production on the first semester of the 11th year from the year in which the concessions were granted, the concession holder will be required to pay a penalty equivalent to 2% of the applicable minimum production per year per hectare until the 15th year. If the concession holder cannot reach the minimum annual production on the first semester of the 16th year from the year in which the concessions were granted, the concession holder will be required to pay a penalty equivalent to 5% of the applicable minimum production per year per hectare until the 20th year. If the holder cannot reach the minimum annual production on the first semester of the 20th year from the year in which the concessions were granted, the holder will be required to pay a penalty equivalent to 10% of the applicable minimum production per year per hectare until the 30th year. Finally, if the holder cannot reach the minimum annual production during this period, the mining concessions will be automatically expired.

The new legislation means that title-holders of mining concessions which were granted before December 2008 will be obliged to pay the penalty from 2019 if the title-holder did not reach either the Minimum Annual Production or make the Minimum Annual Investment in 2018.

Mining concessions will lapse automatically if any of the following events take place:

- The annual fee is not paid for two consecutive years.
- The applicable penalty is not paid for two consecutive years.
- The Minimum Annual Production Target is not met within 30 years following the year after the concession was granted.

Beneficiation concessions follow the same rules as for mining concessions. A fee must be paid that reflects the nominal capacity of the processing plant or level of production. Failure to pay such processing fees or fines for two years would result in the loss of the beneficiation concession.

4.2.3 Surface Rights

Mining companies must negotiate agreements with surface landholders or establish easements. Where surface rights are held by communities, such easements must be approved by a qualified majority of at least two thirds of registered community members. In the case of surface lands owned by communities included in the indigenous community database maintained by the Ministry of Culture, it is necessary to go through a prior consultation process before administrative acts, such as the granting of environmental permits, are finalized. For the purchase of surface lands owned by the government, an acquisition process with the Peruvian state must be followed through the Superintendence of National Properties.

Expropriation procedures have been considered for cases in which landowners are reluctant to allow mining companies to have access to a mineral deposit. Once a decision has been made by the Government, the administrative decision can only be judicially appealed by the original landowner as to the amount of compensation to be paid.

4.2.4 Water Rights

Water rights are governed by Law 29338, the Law on Water Resources, and are administered by the National Water Authority (ANA) which is part of the Ministry of Agriculture. There are three types of water rights:

- License: this right is granted in order to use the water for a specific purpose in a specific place. The license is valid until the activity for which it was granted terminates, for example, a beneficiary concession

- Permission: this temporary right is granted during periods of surplus water availability
- Authorization: this right is granted for a specified quantity of water and for a specific purpose. The grant period is two years, which may be extended for an additional year, for example for drilling.

In order to maintain valid water rights valid, the grantee must:

- Make all required payments including water tariffs
- Abide by the conditions of the water right in that water is only used for the purpose granted.

Water rights cannot be transferred or mortgaged. However, in the case of the change of the title holder of a mining concession or the owner of the surface land who is also the beneficiary of a water right, the new title holder or owner can obtain the corresponding water right.

4.2.5 Environmental Considerations

MINAM is the environmental authority, although the administrative authority is the Directorate of Environmental Affairs (DGAAM) of MINEM. The environmental regulations for mineral exploration activities were defined by Supreme Decree No. 020-2008-EM of 2008. New regulations for exploration were defined in 2017 by Supreme Decree No. 042-2017-EM.

An Environmental Technical Report (Ficha Técnica Ambiental or FTA) is a study prepared for approval of exploration activities with non-significative environmental impacts and less than 20 drilling platforms. The environmental authority has 10 working days to make observations.

An Environmental Impact Declaration (Declaración de Impacto Ambiental or DIA) has to be presented for Category I exploration activities which have a maximum of 40 drilling platforms or disturbance of surface areas of up to 10 ha. The environmental authority has 45 working days to make observations.

A semi-detailed Environmental Impact Study (Estudio de Impacto Ambiental Semi-Detallado or EIAsd) is required for Category II exploration programs which have between 40–700 drilling platforms or a surface disturbance of more than 10 ha. The environmental authority has 96 working days to make observations. The total process

including preparation of the study by a registered environmental consulting company can take 6–8 months.

A full detailed Environmental Impact Study (Estudio de Impacto Ambiental Detallado or EIAd) must be presented for mine construction. The preparation and authorization of such a study can take as long as two years.

4.2.6 Permits

In order to start mineral exploration activities, a company is required to comply with the following requirements and obtain a resolution of approval from MINEM, as defined by Supreme Decree No. 020-2012-EM of 6 June 2012:

- Resolution of approval of the Environmental Impact Declaration
- Work program
- A statement from the concession holder indicating that it is owner of the surface land, or if not, that it has authorization from the owners of the surface land to perform exploration activities
- Water License, Permission or Authorization to use water
- Mining concession titles
- A certificate of non-existence of archeological remains (CIRA) whereby the Ministry of Culture certifies that there are no monuments or remains within a project area. However, even with a CIRA, exploration companies can only undertake earth movement under the direct supervision of an onsite archeologist.

4.2.7 Other Considerations

Producing mining companies must submit, and receive approval for, an environmental impact study that includes a social relations plan, certification that there are no archaeological remains in the area, and a draft mine closure plan. Closure plans must be accompanied by payment of a monetary guarantee.

In April 2012, Peru's Government approved the Consulta Previa Law (prior consultation) and its regulations approved by Supreme Decree N° 001-2012-MC. This requires prior consultation with any indigenous communities as determined by the Ministry of Culture, before any infrastructure or projects, in particular mining and energy projects, are developed in their areas.

Mining companies also have to separately obtain water rights from the National Water Authority and surface lands rights from individual landowners.

4.2.8 Taxes

Taxes applicable to the project are outlined in Section 22.

4.2.9 Fraser Institute Survey

The QP has used the Investment Attractiveness Index from the 2018 Fraser Institute Annual Survey of Mining Companies report (the Fraser Institute survey) as a credible source for the assessment of the overall political risk facing an exploration or mining project in Peru.

The QP has relied on the Fraser Institute survey because it is globally regarded as an independent report-card style assessment to governments on how attractive their policies are from the point of view of an exploration manager or mining company, and forms a proxy for the assessment by industry of political risk in Peru from the mining perspective.

The Fraser Institute annual survey is an attempt to assess how mineral endowments and public policy factors such as taxation and regulatory uncertainty affect exploration investment.

Overall, Peru ranked 14 out of 83 jurisdictions in the survey in 2018 on the investment attractiveness index, 37th on the policy perception index, and eighth on the best practices mineral potential index.

4.3 Project Ownership

The Project is held 100% by Tinka, through its wholly-owned subsidiary, Tinka Resources S.A.C. The name "Tinka" is used interchangeably to refer to the parent and subsidiary companies.

4.4 Mineral Tenure

The Project consists of 59 contiguous mineral concessions covering 16,917 ha (Table 4-1; Figure 4-1).

All pre-2016 claims were staked using the PSAD 1956 datum and were subsequently converted to the WGS 1984 coordinate system.

Table 4-1: Mineral Concessions Table

Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
10103501051	TK COL 1	500	378.4020	10.03.06	Yanahuanca and San Pedro de Pillao	Daniel A. Carrion	Pasco	11095515 (Huancayo)	9,517.38 31,407.37	Yes
0103502051	TK COL 2	139.8185	139.8185	01.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095514 (Huancayo)	3,516.65 11,604.94	Yes
1010350305	TK COL 3	71.8975	71.8975	21.02.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095521 (Huancayo)	1,808.33 5,967.49	Yes
1010350405	TK COL 4	5.9914	5.9914	23.02.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095477 (Huancayo)	150.69 497.29	Yes
1010350505	TK COL 5	17.9747	17.9747	17.07.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095522 (Huancayo)	452.09 1,491.90	Yes
1010350605	TK COL 6	74.8932	74.8932	23.02.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095480 (Huancayo)	1,883.68 6,216.14	Yes
010350705	TK COL 7	0.9354	0.9354	11.04.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095523 (Huancayo)	23.53 77.64	Yes
010350805	TK COL 8	0.9973	0.9973	17.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095481 (Huancayo)	25.08 82.78	Yes
010350905	TK COL 9	3.9931	3.9931	23.02.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095482 (Huancayo)	100.43 331.43	Yes
010351005	TK COL 10	0.9343	0.9343	03.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095476 (Huancayo)	23.5 77.55	Yes
010351105	TK COL 11	1.9525	1.9525	10.04.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095485 (Huancayo)	49.09 162.06	Yes

Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
010351205	TK COL 12	20.6575	20.6575	18.04.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095506 (Huancayo)	519.57 1,714.57	Yes
010351305	TK COL 13	0.9895	0.9895	06.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095507 (Huancayo)	24.89 82.13	Yes
010351405	TK COL 14	2.9956	2.9956	16.05.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095509 (Huancayo)	75.34 248.63	Yes
010351505	TK COL 15	23.9654	23.9654	29.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095483 (Huancayo)	602.77 1,989.13	Yes
010351605	TK COL 16	35.9489	35.9489	10.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095484 (Huancayo)	904.17 2,983.76	Yes
010351705	TK COL 17	23.9659	23.9659	10.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095511 (Huancayo)	602.73 1,989.17	Yes
010351805	TK COL 18	5.9916	5.9916	06.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095512 (Huancayo)	150.70 497.30	Yes
010351905	TK COL 19	7.0627	7.0627	03.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095513 (Huancayo)	177.63 586.20	Yes
010352005	TK COL 20	13.4187	13.4187	31.05.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11095488 (Huancayo)	337.50 1,113.75	Yes
010352105	TK COL 21	3.3943	3.3943	29.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096126 (Huancayo)	85.37 281.73	Yes
010352205	TK COL 22	3.6568	3.6568	10.04.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096115 (Huancayo)	91.97 303.51	Yes
010352305	TK COL 23	39.9432	39.9432	13.03.06	Yanahuanca	Daniel A. Carrion	Pasco	11096125 (Huancayo)	1,004.63 3,315.29	Yes

Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
010352405	TK COL 24	11.9829	11.9829	23.02.06	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11096124 (Huancayo)	301.38 994.58	Yes
010352505	TK COL 25	0.7507	0.7507	01.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096113 (Huancayo)	18.88 62.31	Yes
010352605	TK COL 26	1.2949	1.2949	10.05.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096123 (Huancayo)	32.56 107.48	Yes
010352705	TK COL 27	1.4376	1.4376	06.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096121 (Huancayo)	36.15 119.32	Yes
010352805	TK COL 28	1.4662	1.4662	29.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096119 (Huancayo)	36.87 121.69	Yes
010061406	TK COL 29A	548.0939	548.0939	06.05.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096118 (Huancayo)	13,785.39 45,491.79	Yes
010353005	TK COL 30	11.5095	11.5095	10.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096111 (Huancayo)	289.48 955.29	Yes
010353105	TK COL 31	399.0803	399.0803	03.03.06	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11096109 (Huancayo)	10,037.47 33,123.66	Yes
010353205	TK COL 32	61.7518	61.7518	23.02.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096116 (Huancayo)	1,553.15 5,125.40	Yes
010353305	TK COL 33	5.9914	5.9914	01.03.06	San Pedro de Pillao	Daniel A. Carrion	Pasco	11096108 (Huancayo)	150.69 497.29	Yes
010353405	TK COL 34	11.9829	11.9829	15.03.06	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11096114 (Huancayo)	301.38 994.58	Yes

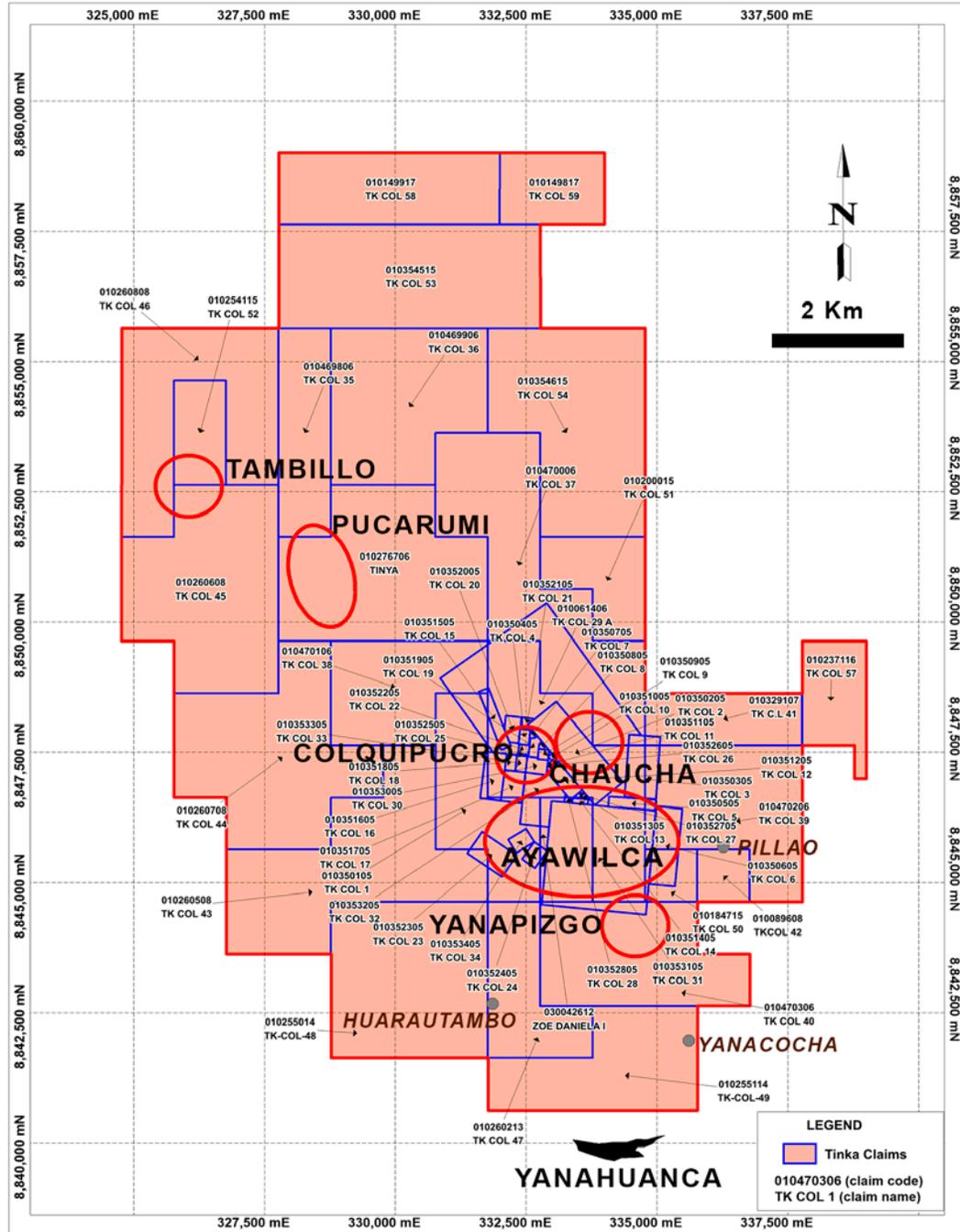
Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
010469806	TK COL 35	400	400	07.03.07	San Miguel de Cauri and San Pedro de Pillao	Lauricocha and Daniel A. Carrion	Huanuco and Pasco	11118739 (Huancayo)	10,060.60 33,200	Yes
010469906	TK COL 36	800	800	05.03.07	San Miguel de Cauri	Lauricocha	Huanuco	11118744 (Huancayo)	20,121.21 66,400	Yes
010470006	TK COL 37	1,000	770.9710	19.04.07	San Miguel de Cauri and San Pedro de Pillao	Lauricocha and Daniel A. Carrion	Huanuco and Pasco	11118738 (Huancayo)	19,391.08 63,990.59	Yes
010470106	TK COL 38	500	446.5340	30.03.07	San Pedro de Pillao	Daniel A. Carrion	Pasco	11118749 (Huancayo)	11,231 37,062.32	Yes
010470206	TK COL 39	700	617.3130	28.05.07	San Pedro de Pillao, Tapuc and Yanahuanca	Daniel A. Carrion	Pasco	11118754 (Huancayo)	15,526.36 51,236.98	Yes
010470306	TK COL 40	700	670.1260	14.03.07	Yanahuanca and San Pedro de Pillao	Daniel A. Carrion	Pasco	11118747 (Huancayo)	16,854.68 55,620.46	Yes
010329107	TK COL 41	300	294.7500	12.12.07	San Pedro de Pillao, Tapuc and Yanahuanca	Daniel A. Carrion	Pasco	11118736 (Huancayo)	7,413.40 24,464.25	Yes
010089608	TK COL 42	1000	1000	30.09.08	San Pedro de Pillao	Daniel A. Carrion	Pasco	11155443 (Huancayo)	2,515.15 8,300	Yes
010260508	TK COL 43	1,000	1,000	30.09.08	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11155446 (Huancayo)	24,954.35 82,349.36	Yes

Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
010260708	TK COL 44	1,000	1,000	23.10.08	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11155442 (Huancayo)	25,151.52 83,000	Yes
010260608	TK COL 45	1,000	1,000	30.09.08	San Miguel de Cauri and San Pedro de Pillao	Lauricocha and Daniel A. Carrion	Huánuco and Pasco	11155445 (Huancayo)	25,151.52 83,000	Yes
010260808	TK COL 46	800	800	30.09.08	San Miguel de Cauri	Lauricocha	Huánuco	11155447 (Huancayo)	20,121.21 66,400	Yes
010276706	Tinya	1,000	1,000	14.09.06	San Miguel de Cauri and San Pedro de Pillao	Lauricocha and Daniel A. Carrion	Huánuco and Pasco	11120829 (Huancayo)	25,151.52 83,000	—
010260213	TK COL 47	400	400	12.02.14	Yanahuanca	Daniel A. Carrion	Pasco	11197133 (Huancayo)	—	—
010255014	TK COL 48	900	900	25.04.17	Yanahuanca	Daniel A. Carrion	Pasco	11244332 (Huancayo)	—	—
010255114	TK COL 49	600	600	26.06.15	Yanahuanca	Daniel A. Carrion	Pasco	11214956 (Huancayo)	—	—
030042612	Zoe Daniela I	200	12.6595	31.03.14	San Pedro de Pillao and Yanahuanca	Daniel A. Carrion	Pasco	11196701 (Huancayo)	—	—
010200015	TK COL 51	300	300	23.07.15	San Pedro de Pillao	Daniel A. Carrion	Pasco	11217508 (Huancayo)	—	—
010254115	TK COL 52	200	200	30.09.15	San Miguel de Cauri	Lauricocha	Huanuco	11219714 (Huancayo)	—	—

Code	Mining Right	Granted Area (ha)	Effective Area (ha)	Grant Date	District	Province	Department	Registry Card	2019 Penalty Amount (US\$/PEN)	Sierra Peru Pty Ltd Royalty
010354515	TK COL 53	1,000	1,000	17.10.16	San Miguel de Cauri	Lauricocha	Huanuco	11235788 (Huancayo)	—	—
010354615	TK COL 54	1,000	1,000.0000	17.10.16	San Miguel de Cauri and San Pedro de Pillao	Lauricocha and Daniel A. Carrion	Huanuco and Pasco	11235790 (Huancayo)	—	—
010149917	TK COL 58	1,000	577.4110	08.09.17	San Miguel de Cauri	Lauricocha	a Huanuco	11253995 (Huancayo)	—	—
010149817	TK COL 59	400	350.9510	17.11.17	San Miguel de Cauri	Lauricocha	Huanuco	11255954 (Huancayo)	—	—
010184715	TK COL 50	100	57.2085	16.02.18	San Pedro de Pillao	Daniel A. Carrion	Pasco	11259087 (Huancayo)	—	—
010237116	TK COL 57	600	322.8520	28.12.17	San Pedro de Pillao and Tapuc	Daniel A. Carrion	Pasco	11259089 (Huancayo)	—	—

Note: Soles to US\$ conversion rate of S/3.3 used.

Figure 4-1: Mineral Tenure Plan



Note: Figure courtesy Tinka, 2019.

4.5 Surface Rights

Tinka holds surface rights in the Project area to support exploration activities through agreements concluded with local communities (refer to Section 4.8).

4.6 Water Rights

Water rights for exploration are granted by the National Water Authority. Water used in Tinka's exploration programs was from approved water sources and the volumes used were also approved. Obtaining water permits is a pre-requisite in Peru prior to any drilling being undertaken.

Tinka does not own any water rights in the Project area. Water rights cannot be purchased in Peru, but they are commonly granted for industrial or mining purposes.

4.7 Royalties and Encumbrances

A 1% net smelter return (NSR) royalty is payable to Sierra Peru Pty Ltd (Sierra) on mining concessions TK COL 1 to TK COL 46 (refer to Table 4-1). The royalty was recorded in the Public Registry by means of a Public Deed dated January 10, 2013, on behalf of Public Notary Dr. Jaime Alejandro Murguía Caveró.

This NSR royalty can be purchased by Tinka at any time for US\$1 million.

4.8 Property Agreements

Tinka has concluded agreements to allow for exploration activities with three communities who hold surface rights in the Ayawilca Project area:

- Community of San Juan de Yanacocha
- Community of Huarautambo
- Community of San Pedro de Pillao.

4.8.1 Community of San Juan de Yanacocha

An usufruct agreement with Community of San Juan de Yanacocha was registered as a Public Deed on December 20, 2016, and has a four-year term that runs from February 10, 2017, the date at which Tinka received an Authorization to Initiate Mining Activities (Resolution N° 0170-2017-MEM/DGM) and expiring February 10, 2021. The agreement covers 316.7 ha.

4.8.2 Community of Huarautambo

An usufruct agreement with Community of Huarautambo was registered as a Public Deed on December 20, 2016, and has a three-year term, that runs from February 10, 2017 (the date of receipt of the Authorization to Initiate Mining Activities), expiring February 10, 2020. The agreement covers 101.9 ha.

4.8.3 Community of San Pedro de Pillao

An easement agreement with the Community of San Pedro de Pillao was registered as a Public Deed on December 20, 2016 and has a four-year term, that runs from February 10, 2017 (the date of receipt of the Authorization to Initiate Mining Activities), expiring February 10, 2021. The agreement covers 471.08 ha.

4.9 Permitting Considerations

Permitting considerations are discussed in Section 20.

4.10 Environmental Considerations

Environmental considerations are discussed in Section 20.

There is an expectation of environmental liabilities associated with historical mining and exploration activity.

The Ministry of Mines and Energy (MINEM) have one liability, an adit, listed in its Environmental Mining Liabilities (PAM in the Spanish acronym) registry for the Ayawilca Project. This site is located within TK-COL1 and TK-COL24 concessions.

As required by local legislation, Tinka prepared a list of historical mining activity areas in 2018, and provided that list to MINEM. The Tinka survey identified 57 artisan-related sites, which included adits, waste rock dumps, prospecting pits, glory holes, underground mine workings, and trenches. These sites are located within the TK-COL1, TK-COL34, and TK-COL24 concessions.

Under Law No. 28271, the responsibility for the remediation of environmental liabilities lies with the person or company that generated the liability. In the case of historical liabilities where entity or person who generated the liability is unknown, the state-owned company Activos Mineros S.A.C. is charged with remediation on behalf of the government.

Tinka committed in 2013 to remediation of three of the historical waste rock dumps once Tinka has completed its exploration activities.

4.11 Social License Considerations

Social licence considerations are discussed in Section 20.

4.12 Comments on Section 4

The legal opinion and additional information provided by Tinka experts supports the following:

- Tinka has a 100% ownership interest
- Mineral concessions are valid and in good standing
- A 1% NSR royalty is payable to Sierra Peru Pty Ltd on mining concessions TK COL 1 to TK COL 46. This NSR royalty can be purchased by Tinka at any time for US\$1 million
- Tinka has agreements in place to allow for exploration activities with three communities who hold surface rights in the Ayawilca Project area; these agreements allow Tinka to continue exploration activities until 2020–2021
- Water used in Tinka’s exploration programs was from approved water sources and the volumes used were also approved. Obtaining water permits is a pre-requisite in Peru prior to any drilling being undertaken. Tinka does not own any water rights in the Project area. Water rights cannot be purchased in Peru, but they are commonly granted for industrial or mining purposes.
- There is an expectation of environmental liabilities associated with historical mining and exploration activity, which in the Project area are mostly assumed by the state. MINEM has assumed responsibility for an existing liability, an adit, within TK-COL1 and TK-COL24 concessions. Tinka has identified 57 historical mining-related sites within the TK-COL1, TK-COL34, and TK-COL24 concessions.

The legal opinion provided indicates that to the extent known, there are no other significant factors and risks that may affect access, title or right or ability to perform work on the Project.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Accessibility

The Project is accessible by road, 310 km north–northeast from Lima via the Panamerican Highway to Huaral–Chancay–Oyón and then to Yanahuanca (refer to locations shown in Figure 2-1). The highway is paved to Oyón. Paving is underway from Oyón to Yanahuanca and the town of Ambo.

Travel by road from Lima to Yanahuanca takes approximately seven hours. An alternative road access is via the Central Highway travelling 300 km east of Lima by highway to Cerro de Pasco, then a further 64 km north–northwest by paved road to Yanahuanca.

The Project area is accessed from Yanahuanca by gravel road, a further 15 km, through the small communities of San Pedro de Pillao and/or San Juan de Yanacocha.

The nearest commercial airport is in Huanuco, the capital of the Huanuco Region and the Huanuco Province, located 80 km northeast of the Project. One daily flight from Lima flies to Huanuco, with a flight duration of approximately 45 minutes. Approximately 30 km south from Huanuco, at the town of Ambo, a junction connects to a gravel road that goes to Yanahuanca, 60 km further southwest. Travel by road from Huanuco to Yanahuanca takes approximately three hours.

5.2 Climate

The mean annual temperature for the Project area during daytime is 15°C; however, temperatures vary significantly with altitude and season. There is a rainy season which generally lasts from October to March, and light snow sometimes falls in the higher elevations. Winter typically occurs from May to September and is generally dry, with clear daytime skies and cool nights.

Exploration can be performed year-round. Any future mining activities would also be conducted year-round.

5.3 Local Resources and Infrastructure

Cerro de Pasco, approximately 40 km from the Project, is the regional capital and an important mining supply centre. Labour in support of exploration activities can be

locally sourced from the communities of San Pedro de Pillao, San Juan de Yanacocha, and the town of Yanahuanca.

Permanent infrastructure on the Project includes a well maintained regional unpaved road, a network of exploration drill roads used to access drill sites, and a small 30-person exploration camp located within the Ayawilca Project area. Two powerlines cross the Project area.

There is a steady source of water for exploration activities from streams, springs, and lakes. Small water courses dry up during the winter months.

Additional discussion on infrastructure considerations is included in Section 18.

5.4 Physiography

The Project is situated in the Andes Mountains of west–central Peru. Elevations range from 3,300 metres above sea level (masl) to a maximum of about 4,459 masl at Cerro San Lorenzo, near the westernmost part of the Project area.

Vegetation is sparse above 3,800 m elevation. At higher elevations, there are grasses and various moss and lichens. Lower elevations are characterized by small or thorny shrubs and minor cacti. Eucalyptus trees are farmed in the valley and lower slopes below 3,800 m elevation.

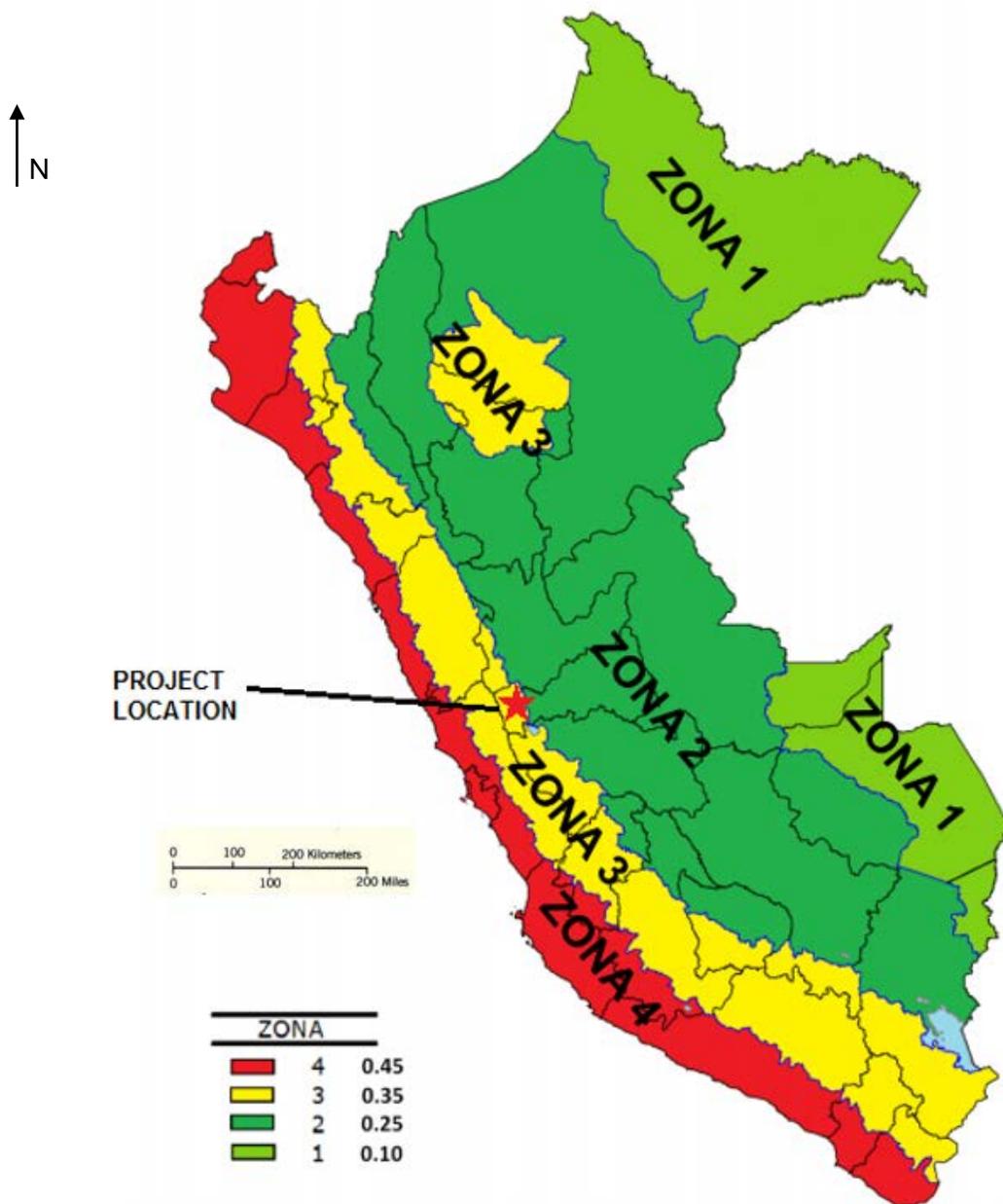
Subsistence agriculture is spread throughout the countryside, and includes potato, corn, and various other ground crops, including alfalfa.

5.5 Seismicity

According to the E.030 Peruvian Technical Regulation for Seismic Design, the Project is located within Seismic Zone 3 (Figure 5-1).

Considering that most of the facilities will be founded directly over bedrock (sedimentary sequences), at this stage of the study, a peak ground acceleration (in rock, with 10% of probability of exceedance in 50 years) of 0.35 *g* can be considered for the purposes of the PEA. In the case of slope stability analysis, a figure of 50% of the peak ground acceleration can be used.

Figure 5-1: Peruvian Seismic Zones



Note: Figure from Resolución Ministerial N°355-2018-VIVIENDA. Zona = seismic zone. Numbers to the right of each seismic zone number represent the peak ground acceleration (g) for each zone.

5.6 Comments on Section 5

The existing local infrastructure, availability of staff, and methods whereby goods could be transported to the Project to support exploration activities are well understood by Tinka, and can support the declaration of Mineral Resources and support evaluation at the PEA stage.

There is sufficient area within the tenure holdings to allow for construction of all mine- and process-related facilities.

Tinka currently has no surface rights holdings in support of mine construction or operations. Tinka holds surface rights in the Project area to support exploration activities through agreements concluded with local communities.

Adjacent mining operations are conducted year-round, and it is expected that any operation conducted by Tinka would also be year-round.

6.0 HISTORY

6.1 Exploration History

The Colquipucro Silver Zone has been the subject of small-scale historical mining, as evidenced by the numerous small adits, an old stone camp, and a stone chimney. Several horizontal cross-cuts, raises, and drifts, as well as a small retort used to dry silver ores, are attributed to 1920–1950s-era activities.

Mining at the Colquipucro Silver Zone from 1950–1954 was performed by Compañía Minera Colquipucro S.A., during which time tunnels were developed into the hillside to explore for silver. The site was optioned to Cerro de Pasco Corporation and to Compañía Minera Buenaventura (Buenaventura) in 1954 and 1960, respectively, and both companies undertook intermittent exploration activities in the area.

Between 1970 and 2005, sporadic exploration activities continued. Buenaventura drilled four holes in the Colquipucro Silver Zone area, mapped and rock chip sampled outcropping gossans, and undertook trenching work. In 2005, the claims lapsed and became available for staking. Sierra recommended the area to Tinka, and Tinka staked new claims over the expired claim areas in 2005.

Tinka's work program, discussed in more detail in Section 9, has included geological mapping, soil, rock chip and underground workings sampling, ground magnetic, induced polarization (IP), resistivity, gravity, magnetic and electromagnetic geophysical surveys, airborne geophysical surveys, core drilling, metallurgical testwork, and Mineral Resource estimation. Tinka discovered significant zinc mineralization in 2012.

6.2 Production

Available historical records reviewed by Tinka list the production from the Colquipucro Silver Zone as:

- 1924: 1,397 kg Ag
- 1930: 10.7 kg Au and 7,705 kg Ag
- 1949: 97 kg Ag.

There is no known modern production from within the Project area.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

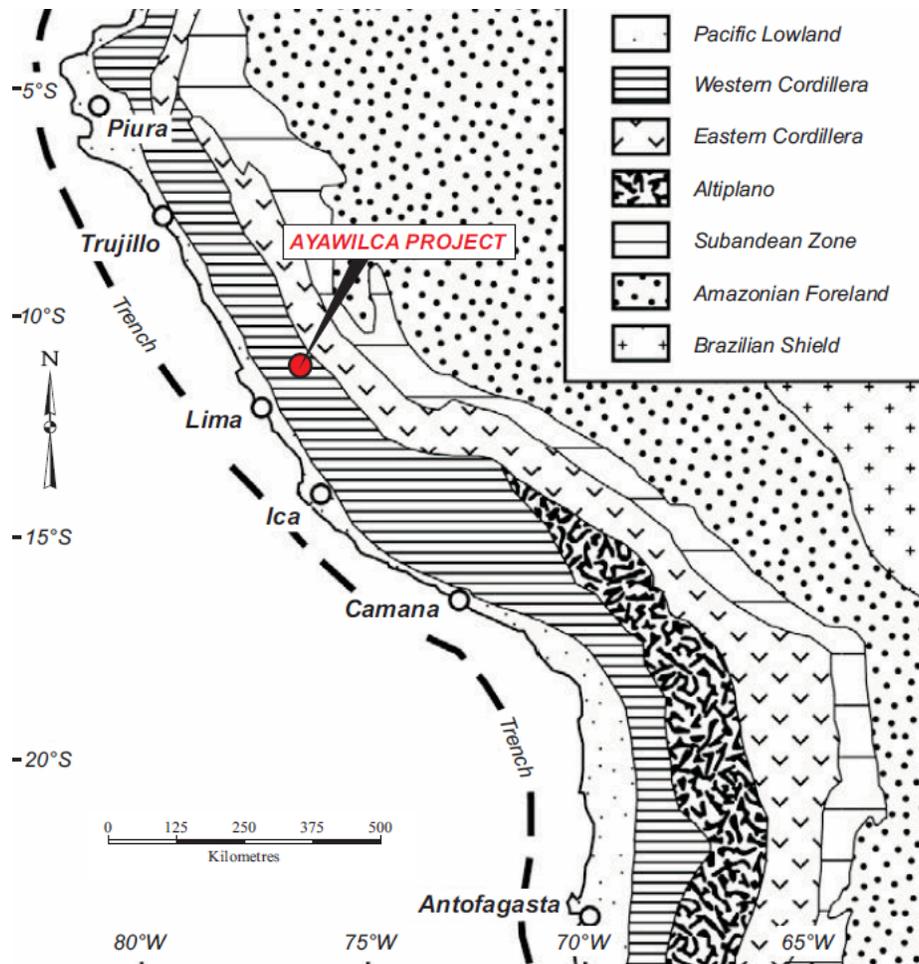
The geology of Peru, from the Peru–Chile Trench in the Pacific to the Brazilian Shield, is defined as three major parallel regions, from west to east: the Andean Forearc, the High Andes, and the Andean Foreland. All three of these regions formed during Mesozoic–Cenozoic evolution of the Central Andes. The Project lies within the High Andes region. A regional morpho-structural map is shown in Figure 7-1.

The High Andes can be divided into three sections, from west to east:

- The Western Cordillera is made up of Mesozoic–Tertiary-age rocks, dominated by the Coastal Batholith which consists of multiple intrusions with ages ranging from Lower Jurassic to Upper Eocene. The belt is about 65 km across by 1,600 km long, running sub-parallel to the Pacific coast, extending into Ecuador and Chile
- The Altiplano is a high, internally-drained plain situated at a mean elevation of almost 4,000 m, slightly below the average altitudes of the Western and Eastern Cordillera. It is 150 km wide and 1,500 km long, extending from northern Argentina to southern Peru
- The Eastern Cordillera forms a 4,000 m high and 150 km wide plateau. During the Cenozoic era, the arc was uplifted, forming the Eastern Cordillera.

Stratigraphically, the High Andes zone consists of, from west to east, an intra-arc trough, a deep basin, a continental shelf (within which the Project is located), and the Marañón metamorphic complex (the Marañón Complex). In general, the formations become progressively older from west to east, spanning from the mid-Tertiary to the Neoproterozoic–Paleozoic.

The Marañón Fold and Thrust Belt (MFTB) was formed during the Eocene in response to east-northeast directed tectonic accretion and subduction. Tight upright folds formed above a shallow detachment horizon towards the west, while more open folds formed above a deeper detachment horizon towards the east. The open fold type has been observed in the Project area. Further east, the style of deformation is different with steeply-dipping reverse faults and open folds affecting the Neoproterozoic crystalline basement of the Eastern Cordillera (Pfiffner, 2013). The MFTB has been mapped within the northern half of Peru over a distance of at least 600 km northwest–southeast by at least 200 km northeast–southwest.

Figure 7-1: Morphostructural Map


Note: Figure from RPA, 2019. Information after Jaillard et al., 2000, Sebrier et al., 1988, and Wipf, 2006.

The mineral deposits of central Peru consist of a variety of base metal deposits in host rocks ranging in age from Permian–Miocene; however, the age of most mineral deposits broadly related to intrusions is 7 Ma to 15 Ma (Miocene). Deposit types include polymetallic carbonate replacement deposits (CRDs), polymetallic veins, zinc–copper skarns, copper–zinc skarns, and porphyry deposits. All of the large zinc-bearing deposits are hosted by Mesozoic carbonate rocks.

The largest zinc-dominant deposit in the region is Cerro de Pasco. The Colquijirca and San Gregorio zinc deposits, located approximately 10 km south of Cerro de Pasco, are also large zinc- and copper-rich CRDs. These deposits are held by third parties.

7.2 Local Geology

The local geology map shows the Project to be underlain by sedimentary and metasedimentary stratigraphy ranging from late Proterozoic to Tertiary in age (Figure 7-2).

The entire sequence has been folded and thrust along north to north–northwest-trending Andean faults (east–west compression), with subsequent trans-tensional faults oriented northeast or east–west.

The oldest documented rocks in the area belong to the Proterozoic Marañón Complex and consist of schist, gneiss, and meta-intrusive rocks. Phyllite outcrops within the Project are part of the Excelsior Group, a Devonian-age unit overlying the Marañón Complex.

The Permian to lower Triassic Mitu Group comprises red-bed terrestrial sediments including sandstone, conglomerate, and intercalated mudstone. Some occurrences of volcanic rocks are found in the upper parts of the Mitu Group elsewhere in the region. The Mitu Group may be over 100 m thick in places; however, thicknesses vary.

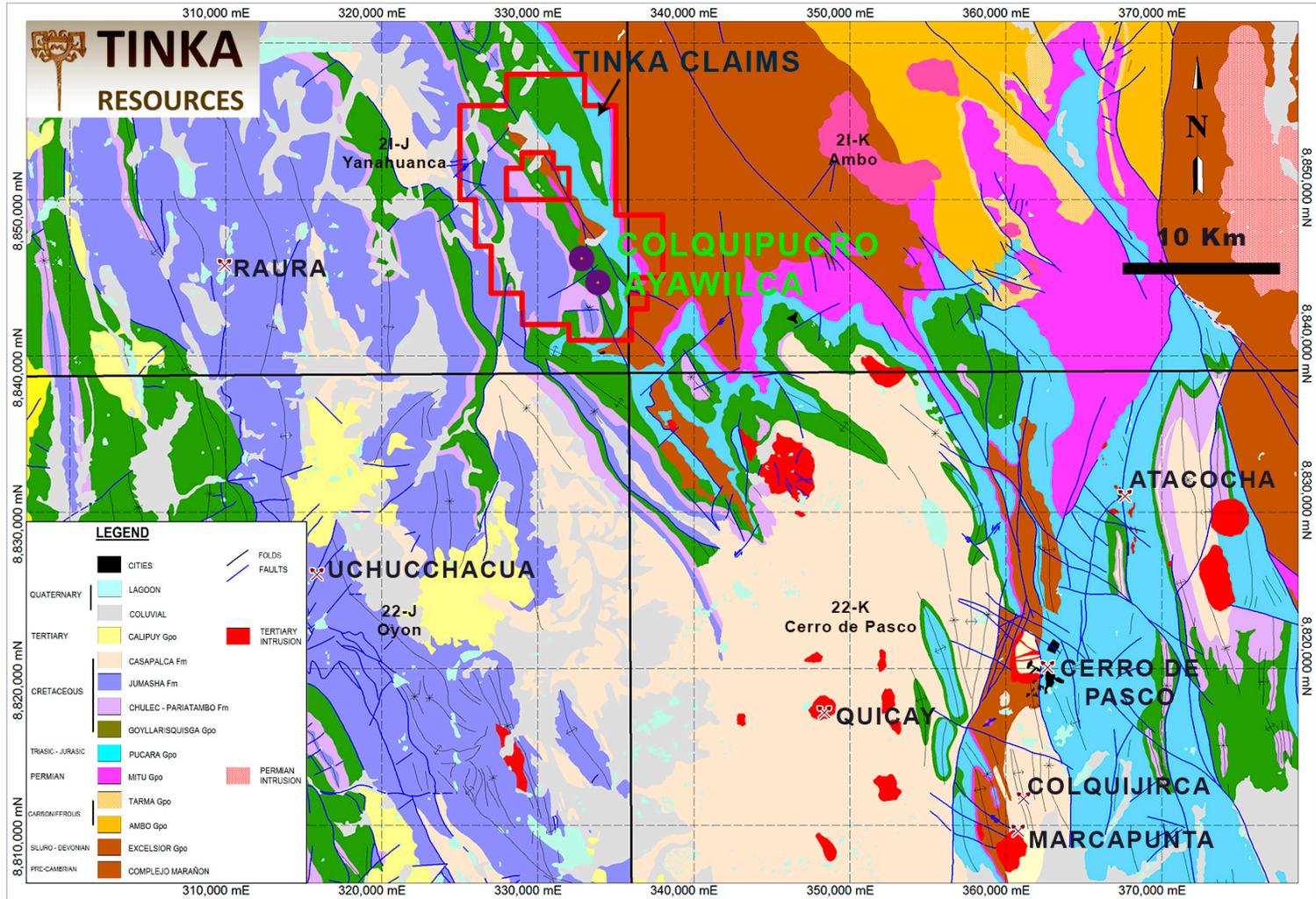
Upper Triassic to lower Jurassic Pucará Group limestone is the predominant host for both zinc and tin mineralization in the Project area, and is an important host of zinc elsewhere in the regional belt.

The Pucará Group limestone is divided regionally into three main units:

- Chambará Formation: dolostone and subordinate limestone
- Aramachay Formation: bituminous shale
- Condorsinga Formation: well-bedded limestone.

The Pucará Group has not been differentiated in the Project area. It is referred to as to as Pucará limestone or carbonate. Studies suggest that the Pucará Group was formed within a north–northwest-trending, elongated post-rift basin complex (Rosas et al., 2007).

Figure 7-2: Local Geology Map



Note: Figure courtesy Tinka, 2019.

The Lower Cretaceous Goyllarisquizga Group (commonly abbreviated to Goyllar sandstones or Goyllar Group) lies disconformably above Pucará Group rocks. The Goyllar Group consists of thick deltaic quartzose sandstones with minor shale, coal, and limestone (Redwood, 2004). The Goyllar Group consists regionally of four formations, from bottom to top the Chimú, Santa, Carhuaz, and Farrat Formations. INGEMMET has classified these rocks as "undifferentiated" in the region; however, the description of the Chimú Formation (white quartz sandstone; dark shale and minor coal beds) best fits the lithologies found on the Project. In general, east of the Colquipucro Fault the Goyllar sandstones are gently dipping to the southeast at less than 10°. West of the Colquipucro Fault the Goyllar sandstones dip gently to the west. Close to the northwest-trending regional faults, folding has typically occurred and the dips of the sandstones and can reach sub-vertical.

Regional mapping emphasizes "fold-and-thrust belt" systems as the prominent structural feature in the region (Cobbing and Sanchez, 1996). The area west of the Project consists of complexly folded and thrust-faulted Cretaceous sedimentary rocks and less deformed early to middle Tertiary calc-alkaline volcanic rocks (Coney, 1971).

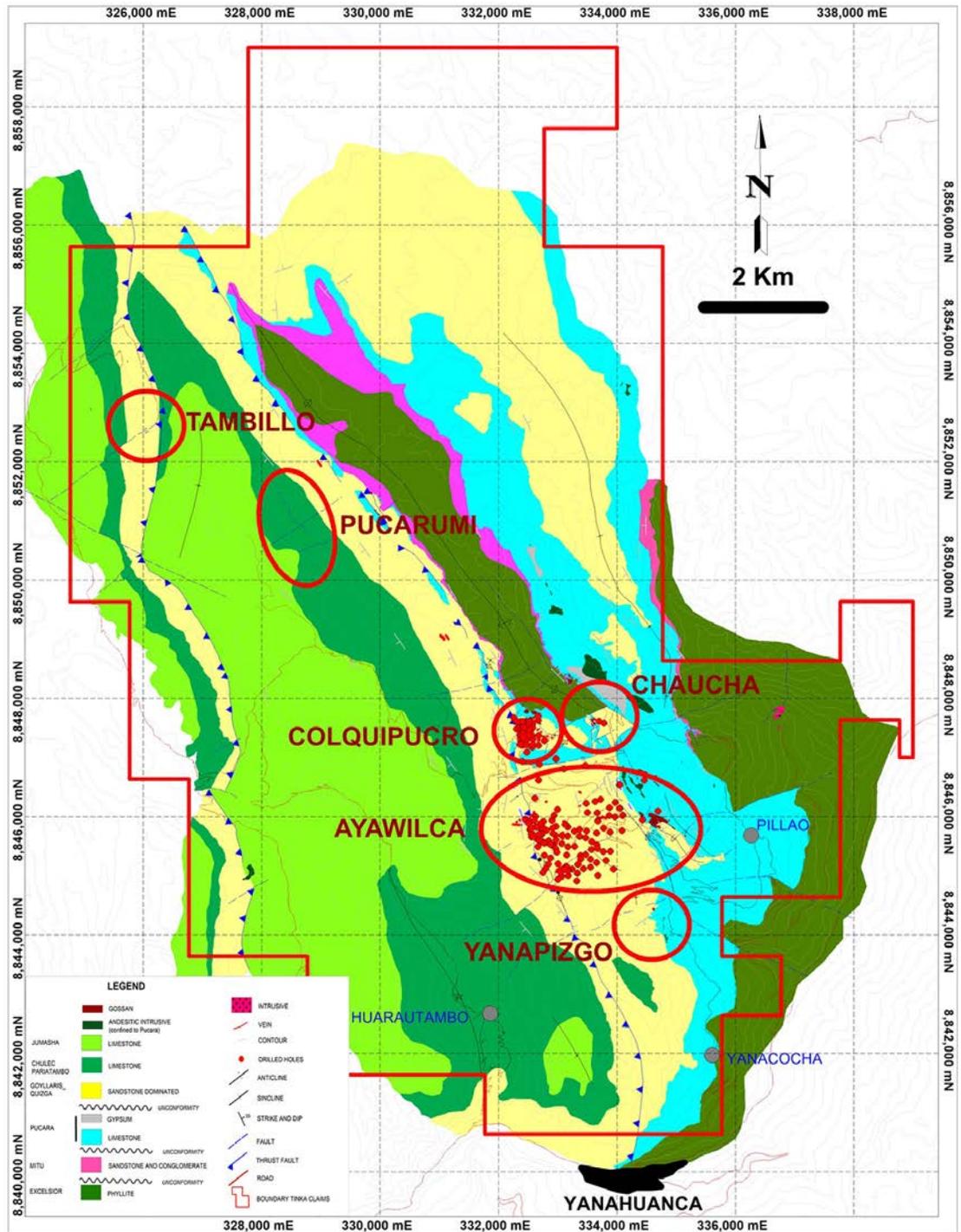
7.3 Project Geology

The Project geology as mapped and interpreted by Tinka is shown in Figure 7-3. Mineral Resources have been estimated at the Ayawilca Zinc and Tin Zones, and the Colquipucro Silver Zone (see additional discussion in Section 14). Prospects include Chaucha, Valley, Yanapizgo, Pucarumi, and Tambillo, and are discussed in Section 9.

7.3.1 Sedimentary Rocks

The oldest rocks mapped within the Project area are phyllite metamorphic (meta-sedimentary) rocks which belong to the Devonian Excelsior Group. The rocks crop out in the north-central and eastern portions of the Project area, and consist of light-coloured quartz-sericite-chlorite phyllite and minor graphitic schist. Foliations strike generally northwest-southeast with gentle to moderate dips to the southwest and northeast. The large phyllite outcrop is interpreted to be the core of an anticline ("basement high") bounded by two sub-parallel north-northwest-trending Andean faults approximately 2 km apart, and cross-cut by numerous northeast-trending trans-tensional faults. The anticline plunges gently to the south, so that the phyllite is observed in drill holes 350 m to 500 m below surface at the Ayawilca Zinc Zone, 2 km south of the outcropping phyllite near the Chaucha area.

Figure 7-3: Project Geology Plan



Note: Figure courtesy Tinka, 2019.

In drill holes in the Ayawilca Zinc and Tin Zones, the top of the Excelsior Group occurs as a tectonic breccia with sub-angular to sub-rounded clasts of quartz and phyllite derived from the Excelsior Group rocks. This surface is interpreted as a major low-angle shear zone which appears to ramp upwards into the overlying Pucará and Goyllar Group rocks at South and West Ayawilca Zones.

Pucará carbonate rocks overlie the Excelsior Group but cannot currently be differentiated by the formal formation names (refer to Section 7.2). The carbonate rocks are often brecciated, with evidence of karstification and dissolution. The carbonate sequence in drill holes is 200–250 m thick, with a tendency to thicken towards the east. The younger limestone beds contain fossil debris (bivalves and crinoids are the most common fossils), becoming more massive and less brecciated towards the base. Thin shale horizons and calcareous sandstone also occur near the base. Greywacke towards the top coincides with a general thickening of the carbonate sequence to the east. White quartz arenite beds are found locally within this carbonate sequence. The base of the Pucará carbonate rocks is truncated by a low angle shear zone at the Ayawilca Zinc and Tin Zones.

Goyllar Group rocks are well-bedded sandstone units which overly the carbonate rocks of the Pucará carbonate rocks. Goyllar Group sandstone occurs as a “cap” above the Ayawilca Zinc and Tin Zones, with an average thickness of 150 m to 200 m. The Goyllar Group is subdivided by Tinka geologists into three distinctive units based on facies types:

- Upper Goyllar: dominated by impure sandstone, siltstone, and mudstone. These rocks outcrop over much of the area of the project. Upper Goyllar rocks appear to have been a poor host to mineralization and alteration, with minor manganese coatings and pyrite observed. Mapping indicates that the Upper Goyllar can be up to 250 m thick, but is typically 50–150 m thick based on drill core intercepts
- Middle Goyllar: A sequence of cross-bedded quartz arenite. These beds are typically massive and host the main silver mineralization at Colquipucro and low-grade disseminated zinc mineralization at Ayawilca. The arenite is well sorted with rounded and interlocking grains suggesting a deltaic environment. The Middle Goyllar is similar to the formally-named Chimú Formation mapped elsewhere in central Peru and is typically 50–100 m thick in the Project area. Quartz arenite and sedimentary breccia similar to those found in the Lower and Middle Goyllar sequences are found underlying the Pucará limestone in a small area in the South

Ayawilca zone. Tinka geologists interpret this deeper occurrence as a repetition of part of the folded Goyllar sandstones caused by a series of ramping low-angle thrusts near the base of the Pucará limestone

- Lower Goyllar: Dominated by interbedded sedimentary breccia, pebble conglomerate, carbonaceous shale and local thin coal seams, grit and medium grained sandstone. On the eastern side of Colquipucro, the Lower Goyllar is made up almost exclusively of quartz pebble conglomerate, while on the western side, coal beds and red shale occurs with the conglomerate, suggesting facies changes during deposition. The Lower Goyllar ranges from 10–80 m thick, with significant local variations. The Lower Goyllar hosts some of the Ayawilca Zinc Zone mineralization as replacement bodies and mantos hosted in conglomerates.

Lying conformably above the Goyllar Group within the wider Project area is a series of carbonate-rich formations of Middle to Upper Cretaceous age. The lowermost of these units is the Chúlec-Pariatambo Formation. It is 100–200 m thick and consists of thinly-bedded fossiliferous limestone with abundant reef fauna. The Jumasha Formation is a thickly-bedded micritic limestone and can be hundreds of metres in thickness. None of these formations were encountered in drill core.

7.3.2 Igneous Rocks

Igneous rocks found within the Project include andesitic dykes and sills that have intruded into the Pucará Group carbonate sequence and crop out in the Zone 3 area, but have not been intersected in drill core. Although these subvolcanic rocks have not been dated, similar types of dykes and sills are found elsewhere in the region and are believed to be of Jurassic age (i.e., pre-Goyllar Group), and therefore predate mineralization. An intrusive porphyry body has been mapped at an area known as “Los Pinos”, approximately 3 km northeast of the East Ayawilca Zone at an elevation of approximately 3,300 m. The Los Pinos porphyry has a granodiorite composition, and in outcrop covers an area of 300 x 200 m. The porphyry exhibits argillic alteration with pyrite veinlets.

No intrusive rocks have been intersected in drill core.

7.3.3 Structure

Two major sub-parallel north–northwest-trending faults cut the Project area. The westernmost of these is the Colquipucro fault, which has ramped Cretaceous rocks on

top of the basement high defined by the outcropping phyllite of the Excelsior Formation. The Colquipucro fault is interpreted to have been reactivated several times with both normal and reverse movement. A sub-parallel fault approximately 2 km to the east is known as the Chaucha fault, and defines the eastern limit of the basement high. East of the Chaucha fault (the Zone 3 area), the Pucará/Goyllar sequence is folded into an overturned syncline. On the eastern limb of this syncline, the Pucará Group is substantially thicker (>500 m in the Zone 3 area).

Several low-angle, east-dipping thrust faults have been recognized in drill core. A major low-angle shear zone defines the boundary between the Pucará carbonate rocks and the Excelsior Formation. At the South and West Ayawilca Zones, several thrust 'ramps' have thickened (or thinned) the Pucará/Goyllar sequence and in places have caused repetitions of the sequence. These thrust faults are believed to have been, in part, conduits for the zinc mineralization.

Northeast-trending faults cross-cut the northwest-oriented fault systems, and generally align with the trend of the Ayawilca Zinc Zone mineralization (i.e. South-Central-East Ayawilca Zones and Zone 3). Northeast-trending faults interpreted from satellite and drone imagery have been identified at the South Ayawilca Zone in particular. Both the northeast faults and the low-angle faults are interpreted to have been important feeders for the mineralization.

The sedimentary sequence is folded on an asymmetrical anticline near the westernmost limit of the basement high block. The axis of this fold is approximately parallel to the trace of the Colquipucro fault, with the western limb displaying steep dips to the west (or possibly steep east dips) while the eastern limb has shallow 5–10° dips to the southeast.

7.3.4 Oxidation

Oxidation by acid waters generated from the breakdown of sulphides has caused deep weathering in the Colquipucro Silver Zone to about 150 m depth. Immediately north of the Colquipucro Silver Zone, for example, are outcrops of the Clinker zone, which is a brown-black ferruginous and manganiferous gossan beneath the sandstone that would have originally been sulphide in the limestone.

At the Ayawilca Zinc Zone, oxidation of sulphides is negligible, and appears to be restricted to just a few metres near the surface.

7.4 Deposit Descriptions

The Ayawilca Zinc and Tin Zones are hosted mostly within a sequence of limestone breccia, limestone, dolomite, calcareous siltstone, arenite and greywacke, of the Pucará Group (Figure 7-4).

7.4.1 Ayawilca Zinc Zone

The Ayawilca Zinc Zone is made up of multiple, gently-dipping sulphide lenses, or mantos, generally with vertical thicknesses of 10–30 m (locally thicker) within four areas (consisting of the West, South, Central, and East Ayawilca Zones, respectively).

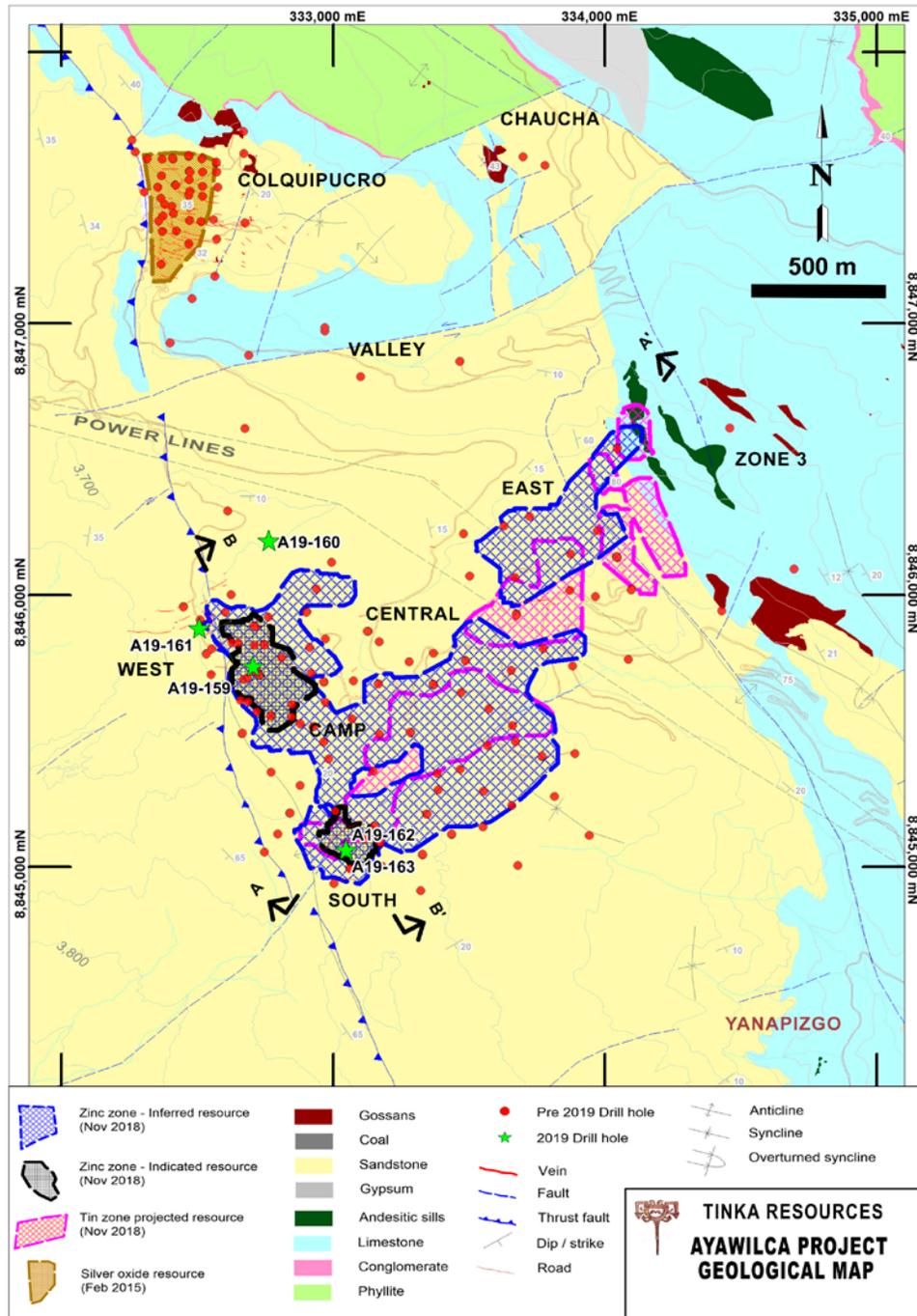
Figure 7-5 is a cross section looking northwest that shows the South, Central and East Ayawilca Zones mineralization. Figure 7-6 looks the same direction, and shows the West and South Ayawilca Zones. The West and South Ayawilca Zones are believed to have the form of “chimneys” up to 200 m thick, consisting of several flat-dipping mantos each up to 70 m thick (refer to discussion in Section 14).

The four structural zones span 2.1 km in the northeast–southwest direction and 1.3 km in the north–south direction. Each zone has been modelled separately. The West Ayawilca Zone is approximately 640 m long in the north–south direction and 300–450 m in the east–west direction. The South Ayawilca Zone is about 550 m long in the northeast–southwest direction and 250 m in the northwest–southeast direction.

Multiple mantos were intersected in the Central and East Ayawilca Zones, but only those showing sufficient continuity between drill sections have been modelled as part of the Mineral Resource estimate.

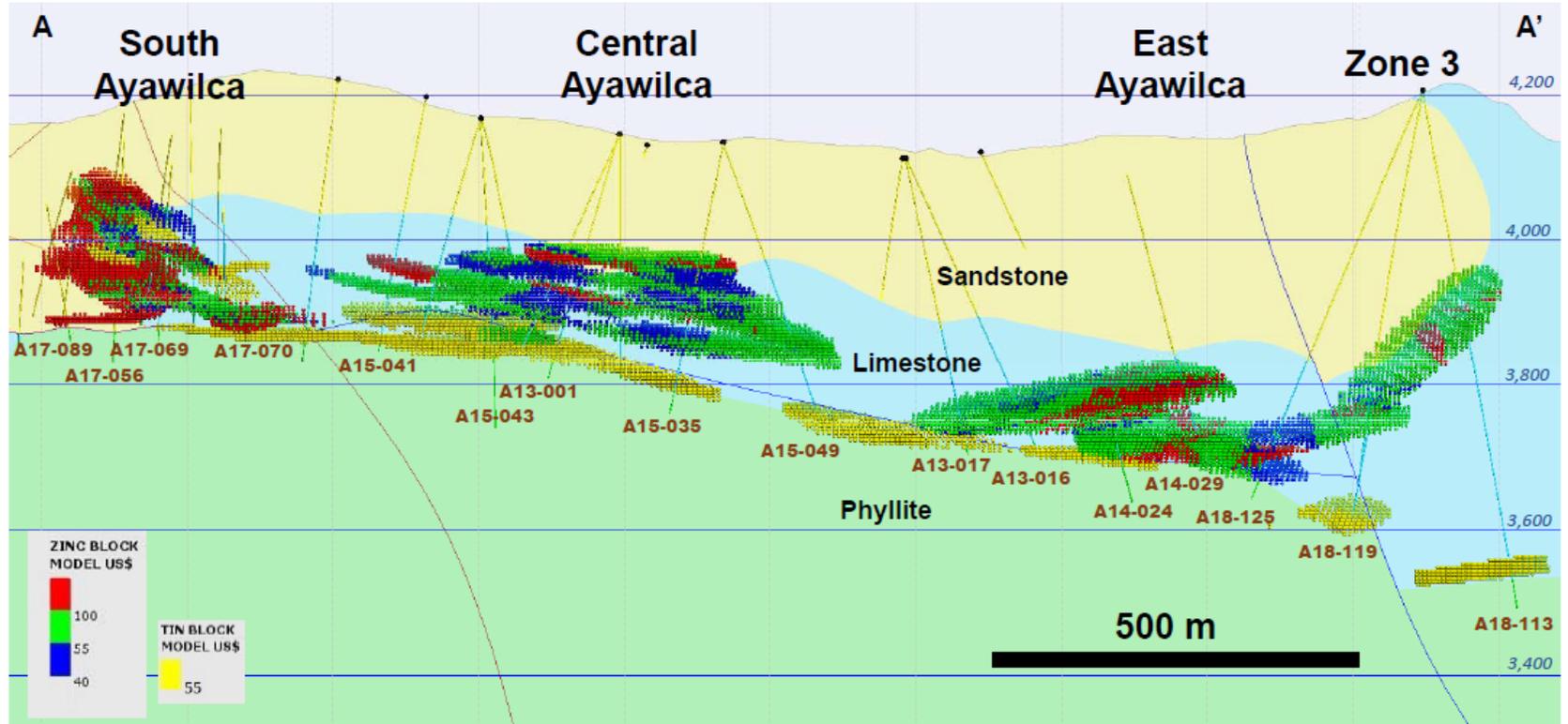
Zinc mineralization occurs as massive to semi-massive sulphide replacements predominantly of the carbonate rocks and to a lesser extent of Lower Goyllar clastic rocks, and is thought to be controlled by multiple, sub-parallel, east–west-, and northeast–southwest-trending structures, as well as low-angle thrust faults. The mineralized zones are interpreted to be generally gently dipping, replacing favourable sedimentary units. The zinc occurs as various generations of sulphide impregnations (mostly marmatite, a high-iron variety of sphalerite also known as “black jack”) accompanied by abundant pyrite, pyrrhotite, chlorite, iron carbonate (siderite), and magnetite. Minor sulphides include low-iron sphalerite, galena, chalcopyrite, and arsenopyrite. Multi-element geochemistry indicates that indium is correlated with the marmatite zinc mineralization.

Figure 7-4: Local Geology Plan



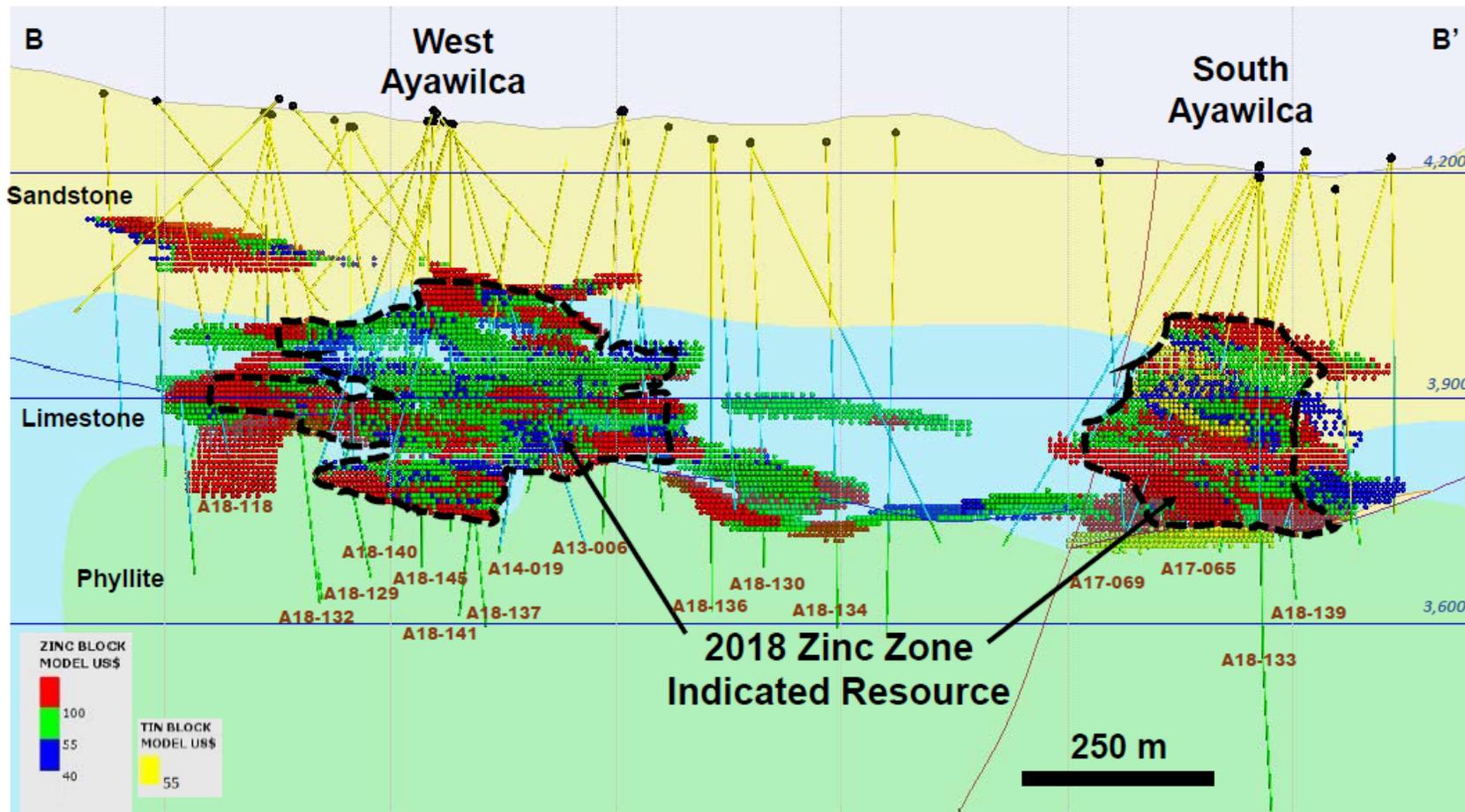
Note: Figure courtesy Tinka, 2019. Note drill holes A19-162 and A19-163 were drilled from the same drill pad. A-A' and B-B' show the locations of Figure 7-5 and Figure 7-6 respectively.

Figure 7-5: Ayawilca Zinc and Tin Zones (South, Central, East and Zone 3)



Note: Figure courtesy Tinka, 2019. Figure looks northwest. Section location is shown on Figure 7-4.

Figure 7-6: Ayawilca Zinc and Tin Zones (West and South Ayawilca Zones)



Note: Figure courtesy Tinka, 2019. Figure looks northwest. Section location is shown on Figure 7-4.

Narrow, high-grade marmatite–sphalerite–galena veins and mantos cut through the Goyllar sandstone, and occasionally have broken through to the surface (e.g., at the West and South Ayawilca Zones). Veins are typically 0.2–1.0 m in width. The veins are not included in Mineral Resource estimation.

During 2018, high-grade zinc mantos of massive sphalerite were discovered within repetitions of Pucará carbonate rocks underneath a ‘ledge’ of phyllite at the West Ayawilca Zone. The phyllite is interpreted as a narrow wedge of Paleozoic basement that has been thrust onto limestone by a low-angle fault. Additional thrusts and limestone repetitions are likely elsewhere, opening up the potential for deeper massive sulphide mineralization to be discovered.

Carbonate–sphalerite–galena–proustite veins occur in outcrop at the South and West Ayawilca Zones and have been intersected in several drill holes. The carbonate-rich veins and replacements are interpreted to be steeply dipping and are interpreted to be the last mineralization event. This style of mineralization is not as yet volumetrically significant and has not been modelled as part of the Mineral Resource; however, these veins can have very high silver grades and offer further exploration potential.

Zinc mineralization is generally associated with argillic alteration within the carbonate host rocks. Disseminated clots of white clays (dickite and/or kaolinite) are common within and near the mineralization, and late-stage siderite veinlets cross-cut the sulphides. Dickite, illite, and pyrophyllite are widespread and were identified using short-wave infra-red spectrometry. Higher-temperature clays, such as pyrophyllite, were most common in the Central Ayawilca Zone area, suggesting a possible thermal aureole centred on this zone.

Strong, pervasive chlorite alteration typically occurs immediately peripheral to the zinc mineralization areas. Massive pyrite is also believed to form as a halo to the zinc mineralization, and is intersected in holes around the fringes of the West and South Ayawilca Zones, and Zone 3, with minimal associated zinc mineralization. Further outward and upward, manganese oxide is common, and believed to form a wider alteration halo.

There is a strong correlation between known zinc mineralization and an underlying magnetic anomaly (consisting of several anomalies) which has approximate dimensions of 3.0 km by 0.8 km oriented northeast–southwest (see Section 9). The magnetic anomaly continues to the northeast of the known mineralization into Zone 3.

The source of the magnetic anomalies is both magnetite (which pre-dates sulphide mineralization and, together with chlorite, forms a halo to the sulphides) and pyrrhotite (which is mostly associated with the tin-copper mineralization). Several magnetic anomalies remain untested outside of the Ayawilca Zinc and Tin Zones, all of which are considered high priority exploration targets.

7.4.2 Ayawilca Tin Zone

Tin mineralization was discovered at Ayawilca in 2014, when a review of multi-element drill data identified anomalously high tin values, and resulted in re-assay of pulps for tin. The tin mineralization pre-dates and is cross-cut by the zinc mineralization described in Section 7.4.1. The tin mineralization, which occurs with chalcopyrite, is hosted in massive to semi-massive pyrrhotite mantos typically 10–20 m in vertical thickness (up to 50 m) typically at or near the contact of the Pucará Group carbonate rocks and the Excelsior Formation phyllite. The pyrrhotite is strongly magnetic, and is believed to be the main source of the large magnetic anomaly.

Mineral liberation analysis (MLA) and quantitative evaluation of materials by scanning electron microscopy (QEMSCAN) mineralogical studies of 11 drill core samples show that tin occurs predominantly as cassiterite, with very minor stannite. The P50 (percentage passing 50% range) for the cassiterite was 20–50 µm, indicating much of the cassiterite is fine grained. Common sulphides occurring with tin are pyrrhotite with lesser chalcopyrite, pyrite, arsenopyrite, and galena. Cassiterite veins are locally observed to cut the massive pyrrhotite lenses.

Massive pyrrhotite hosts most of the tin (\pm copper) mineralization following replacement of limestone beds; however, pyrrhotite veins also cut the underlying phyllite near the contact with the limestone. Drill hole A15-039 cut a network of tin-copper-bearing millimetre to centimetre scale veinlets over a vertical thickness of approximately 40 m that may represent part of a feeder system to the pyrrhotite lenses. The thickest vein measures 10 cm and contains chalcopyrite and arsenopyrite. No conclusive deep-seated feeder fault system for the tin mineralization has been found to date.

At Zone 3, tin is hosted in massive pyrite bodies interpreted to be replacing earlier pyrrhotite mineralization.

7.4.3 Colquipucro Silver Zone

The Colquipucro Silver Zone is hosted primarily within oxidized Goyllar sandstones, with mineralization at or close to the surface. Colquipucro is the only documented sandstone-hosted disseminated silver occurrence in Peru. Historical mining for lead and silver focused on a series of en-echelon east–west-trending, steeply north-dipping faults and veins which hosted high silver grades. The mined structures ranged from 1–3 m thick. In 2006, mapping and sampling by Tinka of an old exploration adit showed that there was lower grade silver mineralization between the veins.

The Colquipucro Silver Zone has been modelled to include 10 north-dipping high-grade zones, a gently-dipping basal zone, and a low-grade halo that encompasses all high-grade zones. Overall, the mineralization extends for about 550 m in the north–south direction by 380 m in the east–west direction by 75 m thick. Figure 7-7 is a cross-section through the zone.

The silver mineralization is hosted in quartz sandstones and occurs with abundant iron oxides (goethite, jarosite) and manganese oxides in fractures and disseminations within the pore spaces of the sandstones. Sulphide minerals are rare, though galena is observed occasionally. The fracture-controlled mineralization is epigenetic and cross-cuts the primary bedding. Mineralized fractures are highly limonitic, locally manganiferous, and can also contain friable gouge and sand. Fracture spacing ranges from a few to many tens of centimetres.

7.5 Prospects/Exploration Targets

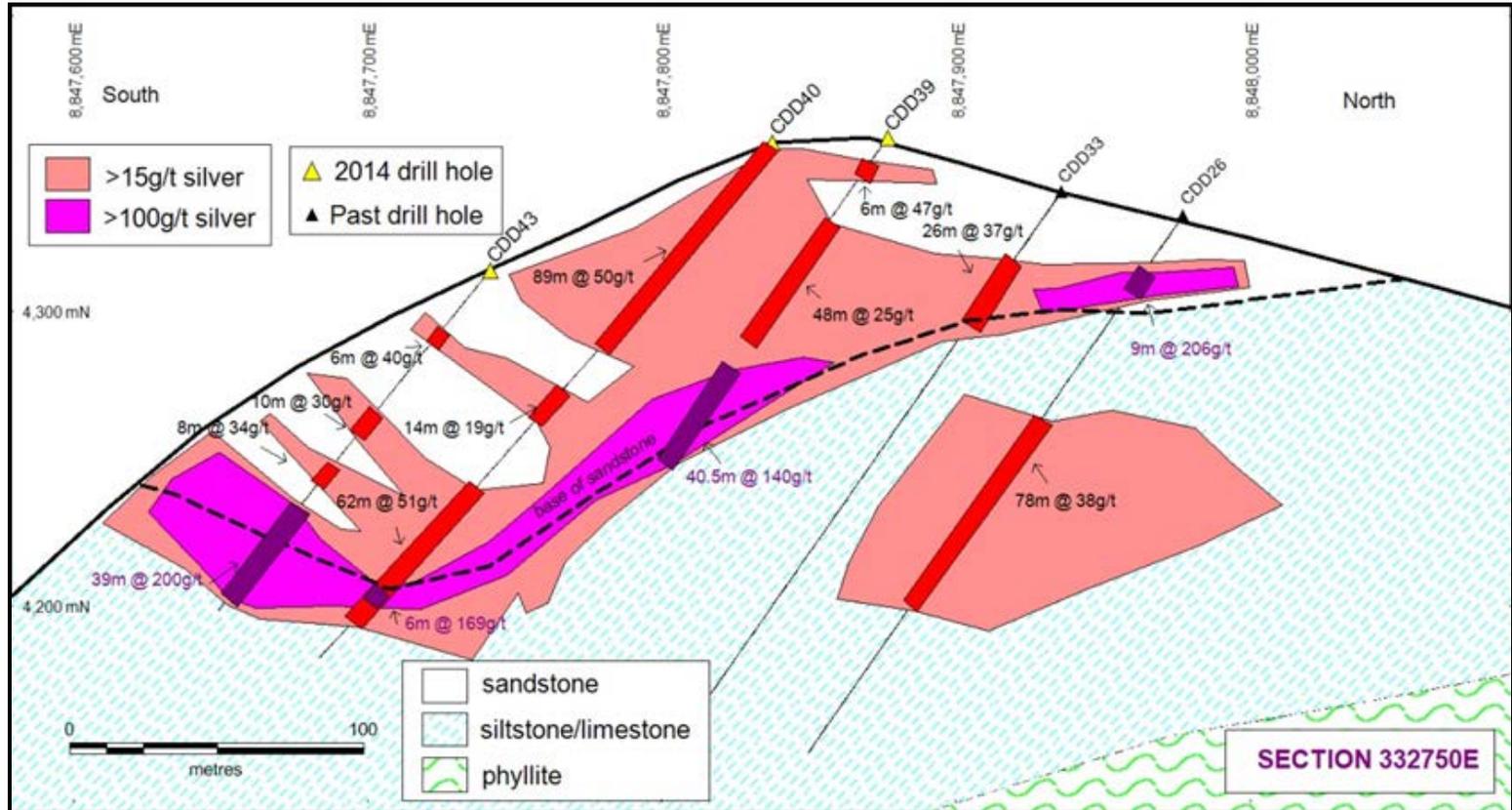
Exploration targets and prospects are discussed in Section 9.

7.6 Comments on Section 7

In the opinion of the QP:

- The understanding of the Ayawilca Zinc and Tin Zone, and Colquipucro Silver Zone settings, lithologies, and geological, structural, and alteration controls on mineralization is sufficient to support estimation of Mineral Resources
- The geological knowledge of the Project area is acceptable to reliably inform mine planning.

Figure 7-7: Colquipucro Silver Zone Drill Section, 332650 E



Note: Figure courtesy Tinka, 2016.

8.0 DEPOSIT TYPES

8.1 Overview

The regional setting, geometry, and zinc mineralogy indicates that the Ayawilca Zinc Zone is an example of a carbonate replacement deposit or CRD, of which there are several other type examples in central Peru (e.g., Cerro de Pasco, Morococha, Colquijirca, and San Gregorio).

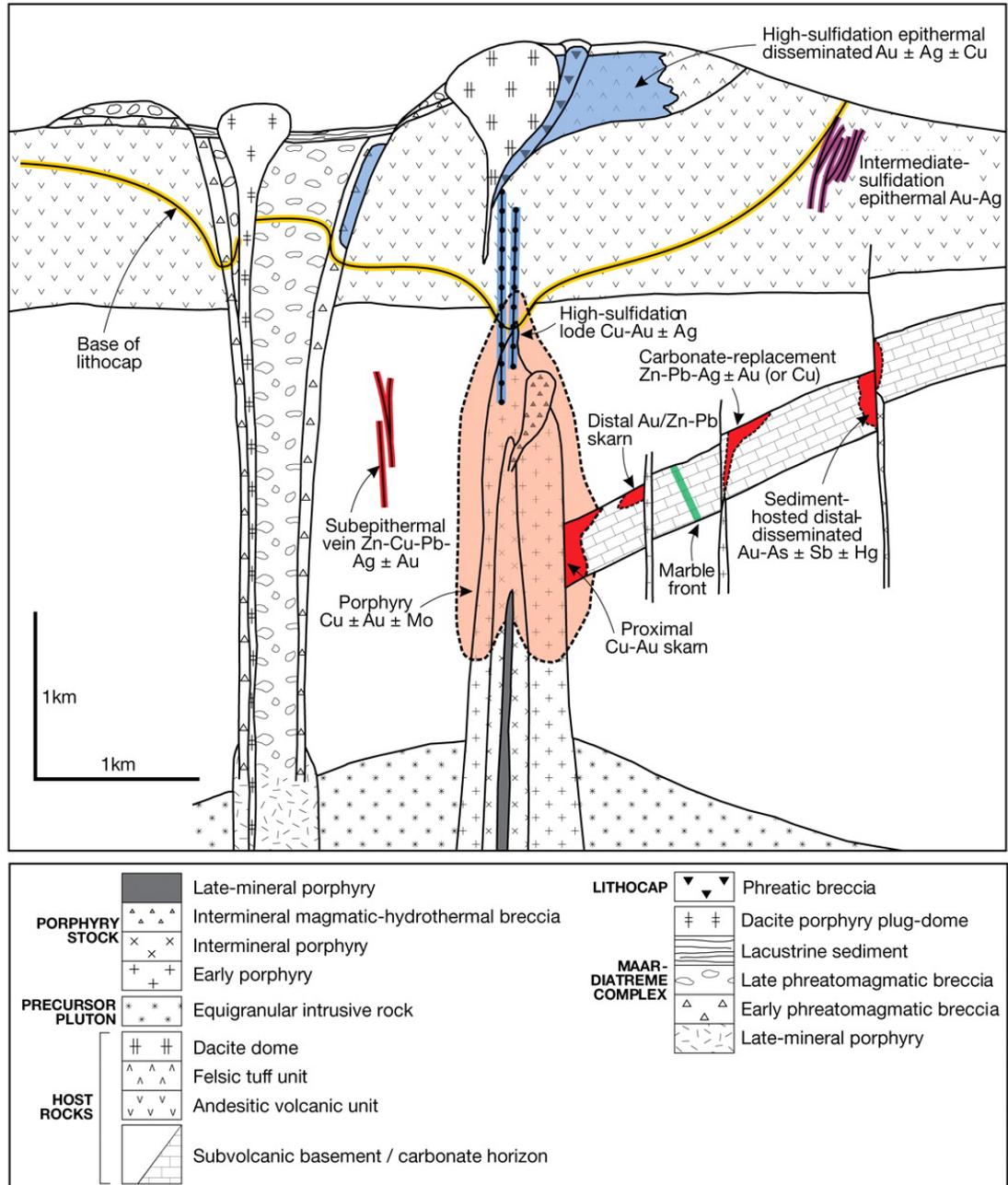
CRDs typically develop when hydrothermal fluids replace carbonate rocks proximal to an intrusive body, although in some cases the causative intrusive body may not be observed or identified conclusively. CRDs are considered more distal from the source than porphyry and skarn deposits, but closer to the source than intermediate (or low) sulphidation epithermal precious metals deposits (Figure 8-1).

The Ayawilca Zinc Zone differs from most other CRDs in central Peru in that it has early tin–copper mineralization associated with pyrrhotite at the Ayawilca Tin Zone. Early pyrrhotite tin–copper mineralization was reported at the Cerro de Pasco deposit although apparently it was not so well developed.

The Colquipucro Silver Zone is believed to be the only documented sandstone-hosted oxide silver occurrence in Peru. Silver is hosted in fractures, faults, and veins with abundant iron oxides (goethite, jarosite) in fractures and disseminations within the pore spaces of the sandstones. The Colquipucro Silver Zone is tentatively classified as a now oxidized disseminated, intermediate sulphidation epithermal deposit (refer to deposit style setting in Figure 8-1). Limited work has been done on the alteration styles of the mineralized rocks at the Colquipucro Silver Zone, so the genetic mineralization model remains as a working hypothesis.

8.2 Comments on Section 8

Exploration programs that use a CRD model are considered to be particularly applicable to the Project area. Intermediate-sulphidation epithermal models could also be employed in the area.

Figure 8-1: Deposit Model Cartoon


Note: Figure from Sillitoe, 2010.

9.0 EXPLORATION

9.1 Grids and Surveys

In late 2011, Tinka contracted PRW Ingenieria y Construccion (PRW) to complete a topographic survey of Colquipucro over an area of 800 m east–west by 800 m north–south.

Early in 2013, Tinka commissioned PRW to undertake a detailed topographic survey of the Ayawilca area contiguous with the survey completed on Colquipucro. The surveying was done using a combination of theodolite, electronic measuring devices, and global positioning system (GPS) instruments. The survey had a nominal 5 m contour accuracy, and covered an area of 2.0 km north–south by 2.5 km east–west. Eleven monuments were established and surveyed for ground control in the eastern part of the target area.

In 2018, Tinka engaged Andesdrones of Lima, Peru to conduct a drone-based topographic survey. The area covered was 5.5 km north–south by 7 km east–west, totalling 2,560 ha, and the survey produced detailed topographic maps with 1 m contours and high-resolution imagery.

9.2 Geological Mapping

Initial geological mapping by Tinka at 1:25,000 scale was carried out in 2005 and early 2006, followed by more detailed mapping at 1:5,000 scale in late 2006. This early mapping identified high-grade vein mineralization in the Goyllar sandstone above the Ayawilca Zinc Zone. Additional geological mapping in 2009 examined key structural features to better understand the geological framework and controls of the mineralization. During 2015, Tinka geologists updated the geological map using the modified stratigraphy obtained from careful relogging of all previous drill holes at Ayawilca. In 2017, detailed mapping was extended north to the Pucarumi area.

Underground mapping of the Colquipucro 3,870 m level exploration adit was conducted at 1:500 scale.

9.3 Geochemical Sampling

Tinka has collected 1,311 rock samples, six stream sediment samples and 3,914 soil samples on sampling grids located between the Colquipucro Silver Zone and Ayawilca Zinc Zone and over the Tambillo and Pucarumi exploration targets.

The Ayawilca–Colquipucro soil grid lines are typically spaced 200 m apart, and oriented north–south. Additional lines spaced 100 m apart were sampled over the Ayawilca Zinc Zone and over areas with significant anomalies. The grid covers an area up to 4.6 km in an east–west direction and up to 7.1 km in a north–south direction. Significant anomalous zinc results were returned over the Ayawilca Zinc Zone, east and south of the Ayawilca Zinc Zone, and north and east of the Colquipucro Silver Zone.

9.4 Geophysics

Airborne magnetic, and induced polarization, gravity, electromagnetic and magnetic ground surveys have been completed, and are summarized in Table 9-1.

An example of the magnetic signature in the Project area is provided in Figure 9-1, with the distribution of the mineralization identified at the Ayawilca Zinc and Tin Zones and Colquipucro Silver Zone highlighted.

9.5 Pits and Trenches

The 3,870 m level adit was sampled by Tinka in 2006, and five surface trenches totalling 1.7 km in length were excavated and sampled at the Colquipucro Silver Zone. At Zone 3, in the eastern end of the Ayawilca Zinc Zone, 10 historical trenches were excavated and sampled. Results from the trenching and underground sampling were used for exploration purposes and drill hole targeting.

9.6 Exploration Potential

Tinka have identified a number of areas that have exploration potential.

9.6.1 Chaucha

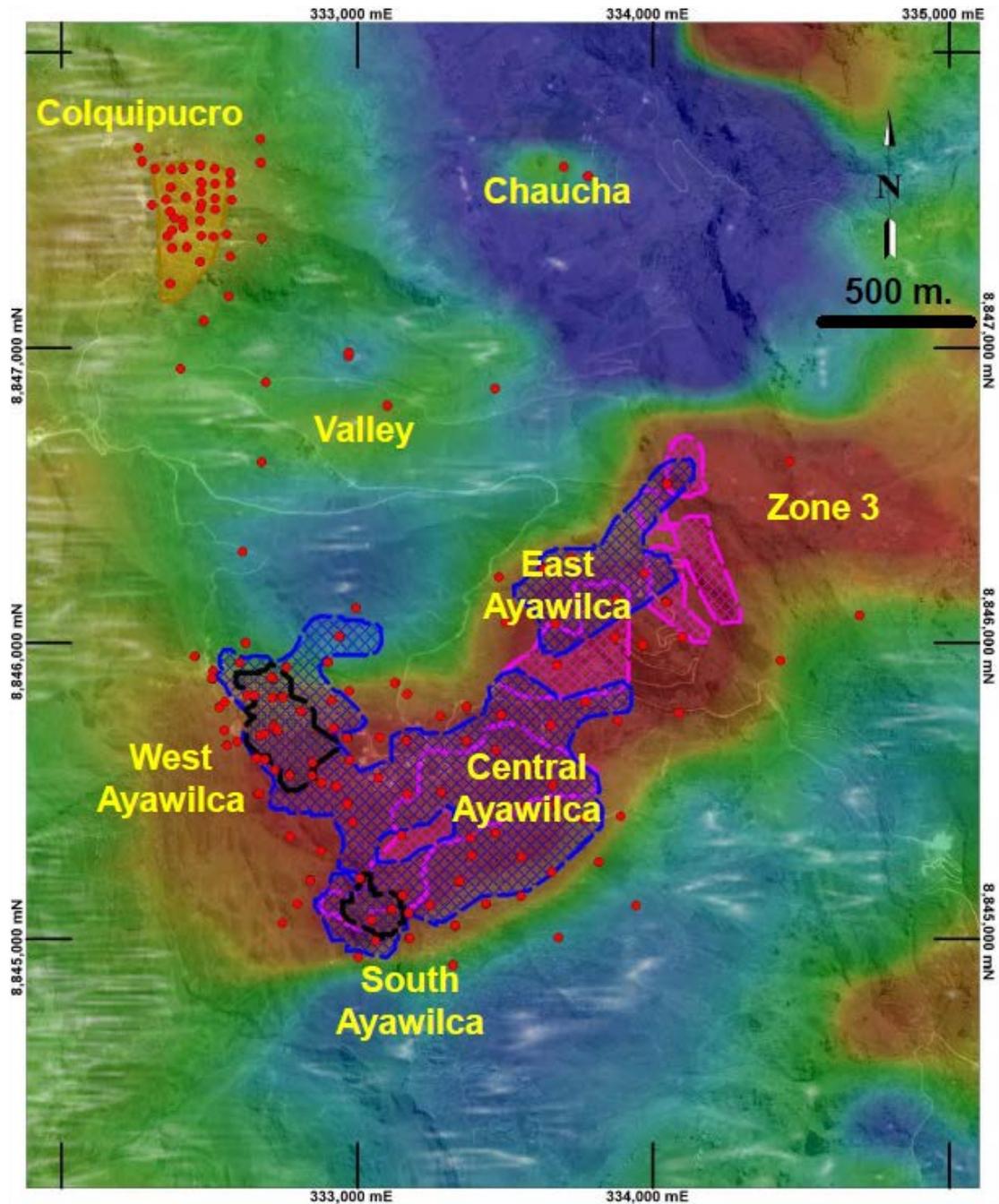
The Chaucha area is located 1 km east of the Colquipucro Silver Zone (refer to Figure 9-1), above the village of Huachuacocho. Two drill holes were completed during 2017, targeting a discrete magnetic anomaly approximately 200 m in diameter beneath an outcrop of brecciated, manganese-altered Goyllar sandstone.

Table 9-1: Geophysical Surveys

Date	Service Provider	Survey Type	Survey Basis	Note
2016	New Sense Geophysics S.A.C., Lima, Peru	Helicopter-based airborne magnetic survey	Helicopter-based airborne magnetic survey; 1,255 km of north-south survey lines and east-west tie lines, spaced every 200 m, at an altitude of 70 m above surface	Identified a strong northeasterly-trending magnetic anomaly roughly coincident with the Ayawilca Zinc and Tin Zones; the anomaly extends northeast into the Zone 3 area (eastern end of Ayawilca Zinc Zone) and southwest beyond the known limits of the South Ayawilca Zone. Other anomalies identified include the Pucarumi, Chaucha, Yanapizgo, and Valley targets.
2006	Fugro Geophysics Pty Ltd, Lima, Peru (Fugro)	IP survey	8 line km in Ayawilca Zinc Zone area, consisting of 10 lines of pole-dipole surveys.	Highlighted a complex fault pattern extending eastward from the Ayawilca Zinc Zone surface showings. Identified a shallow IP feature in the northwest part of the grid and a deep, larger feature in the central part
2010	Fugro	IP survey	Extended 2006 Ayawilca Zinc Zone area data, with 8 pole-dipole lines for 14.1 line km; used ten 25 m receiver dipoles with a single pole transmitter	
2012	Fugro	IP survey	12 lines in Ayawilca Zinc Zone area for a total of 15.5 line-km; used 50 m receiver dipoles	
2013	Fugro	IP survey	Additional 9.3 km at Ayawilca Zinc Zone area.	
2013	Fugro	IP survey	15.85 line km along 14 lines oriented northeast-southwest at the Chaucha zone, 1 km northeast of Colquipucro Silver Zone	Targeted to test for conductive bodies northeast of the Chaucha fault; no priority targets returned.
2015	Fender Geophysics, Sydney, Australia	IP survey	25 line km of IP in the Ayawilca-Colquipucro area, 120 m electrode spacings	Several IP anomalies were identified, the largest and strongest of which was located to the east and northeast of the Colquipucro Silver Zone
2012	Fugro	Ground magnetic survey	34.4 line-km	Three large magnetic features were identified over a distance of 1.5 km northeast-southwest. Drilling in this area

Date	Service Provider	Survey Type	Survey Basis	Note
				has identified magnetic pyrrhotite and lesser magnetite admixed with pyrite, sphalerite, and minor galena, arsenopyrite, and chalcopyrite
2014	Quantec Geoscience (Peru) S.A.C., Lima, Peru	Ground magnetic survey	245 line km within an area 4 km east–west by 7 km north–south at a 100 m line spacing	Data were merged with the Fugro magnetic data. Identified four ovoid, east–west trending anomalies that align along a northeast–southwest orientation in the centre of the survey area.
2016	VDG del Peru S.A.C. Lima, Peru (VDG)	Ground magnetic survey	25.8 line km completed over 14 east–west survey lines and one north–south tie line	Strong magnetic response identified under the mineralized sandstone outcrops on the central part of the survey area
2014	VDG	Gravity survey	Square grid with stations spaced 200 m apart; tightened to 100 m spacing in the area of the Ayawilca Zinc Zone. A total of 513 station readings collected within 4 km east–west by 4 km north–south area	Outlined five gravity anomalies, interpreted to be caused by the presence of denser material, possibly associated with massive pyrrhotite bodies. Anomalies partly coincide with magnetic and chargeability anomalies, covering an area approximately 2.5 km northeast–southwest by 1.5 km northwest–southeast
2015	VDG	Gravity survey	Expanded 2014 survey with 584 additional stations, using a square grid with stations spaced 200 m apart	Identified additional significant gravity anomalies coincident with the phyllite basement to the north, and two elongated gravity highs on the very southernmost limit of the Project area, under Goyllar sandstone. Although denser material is interpreted to lie under the Goyllar sandstone, this anomaly remains untested and poorly understood.
2016	FDG	Time domain electro-magnetic survey	Six 1 km long east–west lines, totalling 6 line-km. A Crone PEM 2 kW transmitter and a Crone PEM digital receiver were used, with a 500 m x 500 m stationary transmitter loop	Identified a weak shallow conductor possibly related to the near-surface sulphide veins. No conclusive response was obtained from the West Ayawilca Zone.

Figure 9-1: Heliborne Magnetics Map



Note: Figure courtesy Tinka, 2019. TMI, reverse colour imagery. Red circle = drill hole. Blue outline is outline of Indicated and Inferred Mineral Resources in the Ayawilca Zinc Zone; black outline is outline of Indicated Mineral Resources in the Ayawilca Zinc Zone, magenta outline is the outline of the Ayawilca Tin Zone projected to surface, and tan outline is outline of the Mineral Resource estimate for the Colquipucro Silver Zone projected to surface.

Drill hole A17-086 intersected 92 m of massive hematite \pm magnetite \pm pyrite, hosted in brecciated limestone. Hematite is replaced by magnetite. These iron oxides are later cut by massive pyrite, with no other significant sulphides present. The zone is interpreted to be shaped as a near vertical breccia pipe of unknown dimensions. No significant zinc mineralization was encountered in this zone, however, the presence of significant massive iron oxides (hematite with magnetite) is intriguing, and is a new style of mineralization at the Project.

Large outcrops of gypsum are located east of the Chaucha River. These outcrops occur over approximately one kilometre of strike, and are up to 100 m in thickness. The gypsum is interpreted to be part of an evaporate sequence within the Pucará Group which has been remobilized along the Chaucha Fault.

9.6.2 Valley

The Valley area is located between the Ayawilca Zinc Zone and the Colquipucro Silver Zone, approximately 700 m north of the West Ayawilca Zone resource boundary (refer to location in Figure 9-1). The Valley target is defined by a broad magnetic anomaly approximately 800 m by 150 m orientated northeast–southwest. Five holes have been drilled by Tinka. Zinc mineralization occurs with semi-massive sulphides consisting of sphalerite and pyrite, with minor galena and magnetite.

9.6.3 Yanapizgo

The Yanapizgo area is located 2 km south of the Ayawilca Zinc Zone (refer to Figure 7-3), where Pucará limestone is exposed at the base of a 300 m cliff. A series of millimetre-scale sphalerite–galena vertical veinlets are Pucará limestone near the contact with Goyllar sandstone. At the contact, the veinlets are sub-horizontal, parallel to stratigraphy, while a smaller number of veinlets cut through the sandstone. Several very small adits of unknown age have worked the zinc–lead–silver veinlets. Preliminary surface mapping has discovered sulphide mineralization over a north–south strike length of approximately 500 m.

A magnetic anomaly with approximate dimensions of 400 m by 150 m, elongated east–west, is located approximately 300 m north of the mineralized outcrops at Yanapizgo. The source of the anomaly is unknown; however, the magnetic anomaly is an obvious drill target given the association between magnetics and zinc mineralization at the Ayawilca Zinc Zone.

9.6.4 Pucarumi

The Pucarumi zone, located 8 km northwest of the Ayawilca Zinc Zone resource (refer to Figure 7-3), was identified in late 2016 by regional prospecting and follow-up of magnetic anomalies identified in an airborne survey carried out in 2016. Goyllar sandstones, and Cretaceous-age Chúlec-Pariatambo, and Jumasha Formation limestones outcrop in this area. Mineralization occurs as zinc oxides in both manganese and iron gossan bodies along northeast-southwest structures and as disseminated zinc oxide hosted in the matrix of a chert-rich intraformational limestone breccia hosted by Chúlec-Pariatambo limestone. Two mineralized host breccias have been identified to date, each measuring approximately 2 m in thickness and traceable over a strike length of as much as 1 km. The source of the magnetic anomaly, which occurs approximately 700 m to the northeast of the mineralized outcrops, remains unexplained.

9.6.5 Tambillo

The Tambillo zone, located 10 km northwest of the Ayawilca Zinc Zone (refer to Figure 7-3), was identified by regional prospecting and was mapped in detail in 2016. It is located near the northwestern corner of the Project, in an area covered with Goyllar sandstone and Chúlec-Pariatambo Formation limestone. Mineralization is dominated by massive pyrite flooding of a medium-grained quartz arenite of the Goyllar Group. The pyrite was mined in the past 20 years, leaving an old pit and the foundations of an abandoned camp. Soil sampling and a ground magnetic survey were carried out over the area in 2016, with no significant anomalies detected.

9.7 Comments on Section 9

In the QP's opinion:

- The exploration programs completed to date are appropriate to the known mineralization styles
- Geophysical data interpretations suggest the potential for additional porphyry-skarn and carbonate replacement deposit targets, and these target areas warrant investigation.

10.0 DRILLING

10.1 Introduction

Drilling completed in the period 1996–2018 consists of 227 core holes (77,175.3 m). Drill holes are tabulated in Table 10-1, and drill hole collars are shown in Figure 10-1.

10.2 Drill Methods

Core drilling has used HQ (63.5 mm core diameter) and NQ (47.6 mm) sizes.

The drill hole deviation was not surveyed for the first 35 holes at the Colquipucro Silver Zone and the first 19 holes at the Ayawilca Zinc Zone. Given the length of these unsurveyed holes, the equipment used, drill hole spacing, and the minor deviations shown in surveyed holes, RPA does not consider the missing downhole survey data to be an issue.

A Tinka geologist was present at the drill rig to end each drill hole. Once the hole was completed, casings were pulled, and the location was identified with a cement monument. Drill sites were rehabilitated.

All drill core from the Tinka drilling programs is stored in a gated and secured facility located on the main road near the city of Huanuco.

10.3 Logging Procedures

There is no information available as to the logging methods used by Buenaventura.

Drill core was transported by Tinka personnel once daily to a core handling facility located within the Project area. Technicians checked the depth markers and box numbers, reconstructed the core, and calculated core recoveries.

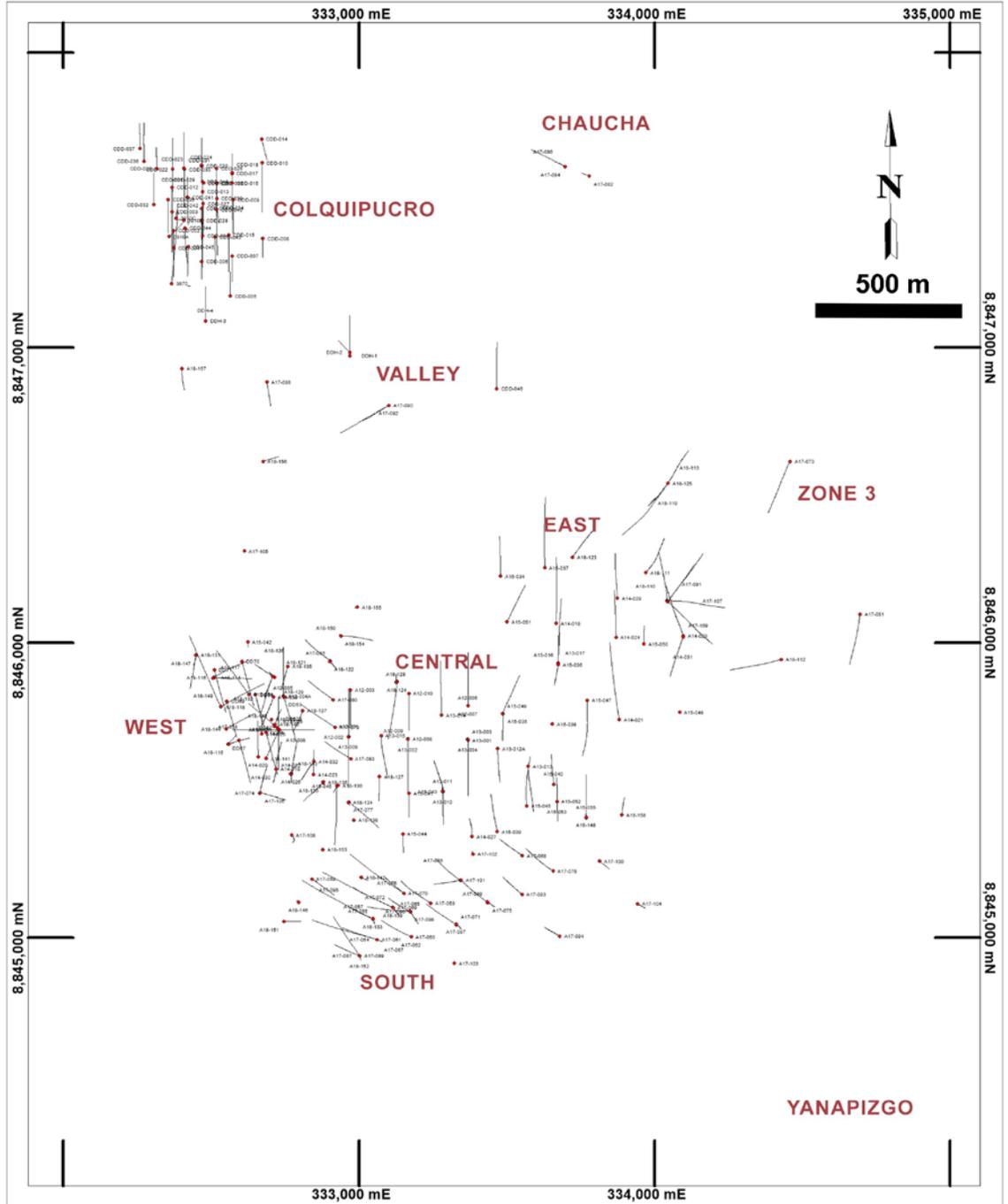
Geologists created quick logs, logged rock quality designation (RQD), marked out sample intervals, and assigned sample numbers. All drill core was then photographed wet with a digital camera before splitting.

Detailed logging of lithology, alteration, oxidization, and structure was completed by the qualified, responsible geologist on paper forms, and the paper copies were scanned and saved as digital images.

Table 10-1: Drill Summary Table

Drill Hole IDs	No. Holes	Length (m)	Campaign	Company	Driller	Rig Type
<i>Colquipucro Silver Zone</i>						
DDH-1 to DDH-4	4	694.3	1996	Buenaventura	Esondi	Not known
CDD1 to CDD15	15	2,670.3	2007	Tinka	Esondi	Not known
CDD16 to CDD25	10	1,603.7	2011-2012	Tinka	Iguana Drilling	Hydracore Portable rig
CDD26 to CDD35	10	2,151.3	2013	Tinka	Consortio SC	LY – Model LF-70; LY – Model 44; Atlas Copco Model CS-3000; Sandvik Model 7-10
CDD36 to CDD46	11	1,882.9	2014	Tinka	Consortio SC	
Sub-total	50	9,002.5				
<i>Ayawilca Zinc and Tin Zones</i>						
DD52 to DD71	8	1,822.1	2011	Tinka	Iguana Drilling	Hydracore Portable rig
A12-01 to A12-10 and DD52B	11	3,709.8	2012	Tinka	Consortio SC	LY – Model LF-70; LY – Model 44; Atlas Copco Model CS-3000; Sandvik Model 7-10
A13-01 to A13-17	17	6,268.4	2013	Tinka	Consortio SC	
A14-18 to A14-33	16	6,529.6	2014	Tinka	Consortio SC	
A15-34 to A15-55	22	8,917.5	2015	Tinka	Explomin	Sandvik DE-710
A17-56 to A17-109	54	20,528.3	2017	Tinka	AK Drilling	Sandvik DE-710
A18-110 to A18-158	49	20,397.2	2018	Tinka	AK Drilling	
Sub-total	177	68,172.8				
Total	227	77,175.3				

Figure 10-1: Drill Collar Location Plan



Note: Figure courtesy Tinka, 2019.

Since early 2015, all logging has been done directly into a digital Maxwell LogChief database. Geological logging was uploaded directly into Leapfrog software for modelling.

All drill core since 2015 has been oriented.

10.4 Recovery

There is no information available as to the core recoveries from the Buenaventura drill program.

Core recovery during the Tinka programs has generally been good, allowing for representative samples to be taken and accurate analyses to be performed. There are intervals of low recovery, commonly associated with faulting. The length, location, and relationship with the mineralization was checked with respect to the resource modelling.

10.5 Collar Surveys

There is no information available as to the collar survey methodology from the Buenaventura drill program.

Collars were surveyed in 2011 and 2013 by PRW, in 2015 by Lima based surveying company Proyectistas Tecnicos del Peru S.A.C., and in 2017 and 2018 by Lima-based PeruLand S.A.C. and Servtop S.A.C. using a combination of Total Station and differential global positioning system (GPS) instruments.

10.6 Downhole Surveys

There is no information available as to the down hole survey methodology from the Buenaventura drill program.

Down hole survey methods used by Tinka are summarized in Table 10-2.

10.7 Sample Length/True Thickness

The current drill hole spacing at the Colquipucro Silver Zone is nominally 50 m by 50 m, but can be tighter in the core of the zone. Most drill holes were drilled towards the south, and angled between -50° and -60°.

Table 10-2: Down Hole Surveys

Year	Note
2007, 2010, 2011, 2012, 2013	Compass and inclinometer at collar, no downhole surveys
2014	Reflex Maxibore II; reading every 1.5 m.
2015, 2017, 2018	Core oriented, surveys using non-magnetic gyroscope. Readings at approximate 5 m intervals.

Drill sections at the Central Ayawilca Zone are approximately 70 m apart and oriented north–south. Drill holes are commonly angled steeply to either the north or south (between 60° and 85°).

At the South Ayawilca Zone, drill sections are spaced approximately 70 m apart and oriented northwest–southeast, with drill holes generally angled steeply to the northwest and occasionally to the southeast (between 55° and 85°).

The West Ayawilca Zone drill spacing is variable, as drill holes have been oriented in several directions since discovery in 2011. Typically, drill holes here are spaced less than 80 m apart.

Most of the mineralization included in the resource model occurs as gently-dipping mantos and stacked mantos. As drilling has been consistently done using high-angle drill holes, true thicknesses are generally at least 85% of the drill intercept. Late-stage mineralization can occur as high-angle veins where true thicknesses will be significantly lower than the core intercept. However, this style of mineralization has not been included in the resource estimates.

10.8 Drilling Completed Since Database Close-out Date

Tinka commenced a drill program in 2019 that had two major targets. The first target is structural repetitions of high-grade zinc mineralization in limestones in the West and South Ayawilca Zone areas at depth under the known mineralization. Drill holes completed testing this target will also serve the dual purpose of infill drill holes. The second drill target will be testing for mineralization extensions in areas where the mineralization has not yet been closed off.

As of 31 July, 2019, five drill holes had been completed (refer to locations shown in Figure 7-4), and a sixth was underway. Provisional geological and geotechnical information available for the completed drill holes indicates that the lithologies and

mineralization styles encountered are similar to those logged from existing drill holes. Only partial assay results are available; from these limited data the mineralization encountered appears to be of similar tenor to that reported in existing drill holes.

10.9 Comments on Section 10

RPA has not identified any drilling, sampling, or core recovery issues that could materially affect the accuracy or reliability of the core samples.

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 Trench Sampling

Trench sampling at Colquipucro used a motorized diamond saw to cut a 10 cm wide channel to a nominal depth and width of 5 cm. A hammer and chisel were used to extract the sample. Samples were taken by hammer and chisel only where the rock surface was irregular and not accessible to the saw.

These data were not used to estimate Mineral Resources.

11.1.2 Adit Sampling

Sampling of the historical 3,870 m level adit in the Colquipucro Silver Zone was done on a systematic basis along the walls between the drifts that accessed and exploited the high-grade fault/vein structures. Initial sampling was carried out at 5 m spacing; however, upon the receipt of highly-anomalous silver values over significant widths, the adit was resampled at nominal 2 m intervals.

These data were not used to estimate Mineral Resources.

11.1.3 Core Sampling

There is no information on the sampling protocol used by Buenaventura.

Sample intervals and numbers were assigned at site by Tinka geologists. Most drill core was sampled using constant 2 m intervals. Drill core was split using a diamond saw at Tinka's core facility located in Huanuco. To avoid sampling bias, the left side of the sawn core was bagged, and the right side was returned to the box for storage. Samples were tracked using three-part ticket booklets. One tag was stapled into the core box at the start of the appropriate sample interval, one tag was placed into the sample bag, and the final tag was retained in the sample booklet for future reference. For each sample, the date, drill hole number, property name, and sample interval depths were noted in the sample booklet.

11.2 Density Determinations

Tinka has performed 993 density measurements in total. Sample spacing ranged from 10–60 m down hole, but on average was 20–30 m. Samples were taken from a variety

of lithological and mineralogical types. Each sample was sawn core and from 10–20 cm long. Photographs and brief descriptions were taken before sending to SGS Laboratories in Lima (SGS Lima) or ALS Laboratories in Lima (ALS Lima) for density determinations. Samples were coated in paraffin wax to preserve the porosity.

A total of 440 density measurements are located within the wireframe models representing the Ayawilca Zinc Zone and a total of 19 density measurements are located within the Ayawilca Tin Zone. Results of the analysis are provided in Section 14.

A total of 90 samples were selected at the Colquipucro Silver Zone. Sample spacing averaged 10–15 m. Most samples were from the Goyllar sandstone. The samples were also documented, as described above. SGS Lima measured the density using the weight in air and weight in water method. Samples were coated in paraffin wax to preserve the porosity.

11.3 Analytical and Test Laboratories

Drill samples from the Buenaventura drilling were assayed at Bondar Clegg in Lima, which was subsequently acquired by ALS Global. Accreditations at the time the work was performed are not known. Bondar Clegg was independent of Buenaventura.

All samples from the 2007 drill program and the initial drill program conducted at Ayawilca in 2011 were prepared and analyzed by C.H. Plenge & Cia. S.A. (Plenge) in Lima, Peru. International Plasma Laboratories (IPL) in Richmond, British Columbia, Canada was used as a check laboratory for the 2007 program.

All samples from both the Ayawilca Zinc and Colquipucro Silver Zones from subsequent drill campaigns were analyzed by SGS Lima until early in 2014. During the 2014 drill program, all Ayawilca Zinc Zone samples were analyzed by SGS Lima, and all Colquipucro Silver Zone samples were analyzed by Certimin S.A. (Certimin) at their Lima laboratory.

All samples from the 2015 Ayawilca Zinc Zone drill program were analyzed by SGS Lima. Samples from the 2017 Ayawilca Zinc Zone drill program were analyzed by SGS Lima. Some samples were sent to ALS Lima. Check assays were performed by the Inspectorate laboratory (Inspectorate) in Lima.

Samples from the 2018 Ayawilca Zinc Zone drill program were analyzed by SGS Lima. Check assays were performed by Inspectorate.

All laboratories used were independent of Tinka. SGS Lima is ISO 9001:2008 and ISO 14001:2004 certified. ALS Lima is an ISO 9001:2008 certified laboratory. Certimin and Inspectorate hold ISO 9001 and ISO 17025 accreditations for selected analytical techniques. At the time of analysis, IPL held ISO 9001 accreditations. The Plenge laboratory is not certified.

11.4 Sample Preparation and Analysis

Samples sent to Plenge were prepared using method S-P-2007, which involved drying in oven at 80°C followed by jaw crushing and roll crushing. The crushers were cleaned with compressed air between samples and with barren calcite after every 10 samples. A 250 g split, using a Jones splitter, was pulverized to 80% passing -200 mesh using a ring and puck pulveriser.

Samples sent to SGS Lima were prepared using method PRP93, which involved drying in oven at 100°C followed by jaw crushing. The sample was crushed to 90% passing -10 mesh size. The crusher was cleaned with compressed air between samples. A 250 g split, using a Jones splitter, was pulverized to 95% passing -140 mesh using a ring and puck pulveriser.

Samples sent to Certimin were prepared using method G0634, which involved drying in oven at 100°C followed by jaw crushing and roll crushing to 90% passing -10 mesh (2 mm). The crushers were cleaned with compressed air between samples. A 250 g split, using a Jones splitter, was pulverized to 85% passing -200 mesh (75 µm using a ring and puck pulveriser).

Samples sent to ALS Lima were prepared using method PREP31, which involved drying in oven at 100°C followed by jaw crushing. The sample was crushed to 70% passing -10 mesh size. The crusher was cleaned with compressed air between samples. A 250 g split, using a Jones splitter, was pulverized to 85% passing -200 mesh using a ring and puck pulveriser.

Sample analysis methods by drill hole are summarized in Table 11-1 and Table 11-2.

In general, silver was determined by inductively coupled plasma (ICP) following a four-acid digest. Over-limit thresholds varied by laboratory. The over-limit method for high-grade silver was a standard fire assay (FA) followed by an atomic absorption spectroscopy (AAS) finish, or at Plenge, a FA followed by a gravimetric finish.

Table 11-1: Colquipucro Silver Zone Analytical Methods

Drill Hole IDs	No. Holes	No. Assays	Analytical Method	Over-Limit (g/t Ag)	Over-Limit Method	Laboratory
DDH-1 to DDH-4*	4	156	ICP	200	AAS	Bondar Clegg
CDD1 to CDD15	15	1,333	AAS	1,000	FA-Gravity	Plenge
CDD16 to CDD35	20	1,774	ICP (ICP40B)	100	AAS	SGS
CDD36 to CDD45**	10	765	ICP (G0153)	25	AAS	Certimin
CDD46	1	107	ICP (ICM40B)	10	AAS	SGS
TOTAL	50	4,135				

Notes: * drilled by Buenaventura; ** over-limit 1,000 ppm Ag (AAS), re-analysis by fire assay-gravity. ICP = inductively-coupled plasma; ICP or ICP40B = optical ICP; ICM40B = 32-element multi-acid digest ICP; FA= fire assay.

Table 11-2: Ayawilca Zinc and Tin Zone Analytical Methods

Drill Hole IDs	No. Holes	No. Assays	Analytical Method	Over-Limit (% Zn)	Over-Limit Method	Laboratory
DD52 to DD71	8	908	ICP	1	AAS	Plenge
DD52B	1	158	ICP (ICP40B)	1	AAS	SGS
A12-01 to A12-10	10	1,289	ICP (ICP40B)	1	AAS	SGS
A13-01 to A14-18	18	2,689	ICP (ICP40B)	1	AAS	SGS
A14-19 to A14-25	7	1,210	ICP (ICP40B)	1	AAS	SGS
A14-26 to a14-33	8	1,320	ICP (ICM40B)	1	AAS	SGS
A15-34 to A15-55	22	3,428	ICP (ICM40B)	1	AAS	SGS
A17-56 to A17-70	15	1,982	ICP (ICM40B)	1	AAS	ALS
A17-71 to A17-109	39	5,883	ICP (ICM40B)	1	AAS	SGS
A18-110 to A18-158	49	8,424	ICP (ICM40B)	1	AAS	SGS
TOTAL	177	27,291				

Notes: Number of drill holes may not match with drill hole IDs. AAS = atomic absorption; ICP = inductively-coupled plasma; ICP or ICP40B = optical ICP; ICM40B = 32-element multi-acid digest ICP; FA= fire assay. Number of assays includes QA/QC samples.

Zinc was also analyzed by AAS with ICP atomic emission spectroscopy (ICP-AES) following a multi-acid digestion. Over-limit zinc, silver, and lead were analyzed using AAS.

Indium was analyzed by mass spectrometry with ICP (ICP-MS) using multi-acid digestion. Over-limit indium was analyzed using AAS.

Tin was analyzed by ICP-AES following a multi-acid digestion. Certain samples reporting values over 100 ppm Sn were sent for re-assay for tin by fusion with sodium peroxide and AAS finish (SGS Lima) or by pressed powder technique analyzed using XRF (ALS Lima).

11.5 Quality Assurance and Quality Control

On average, one standard or one blank was inserted, alternately, after every 10 samples. The frequency was subsequently decreased to every 15 samples, however, since the 2017 program, Tinka reverted to inserting one control sample after every 10 samples. Samples were shipped by Tinka personnel directly to the laboratory. Tinka began submitting field duplicates as part of its quality assurance and quality control (QA/QC) program in 2015.

Table 11-3 shows the number of QC samples submitted to ALS Lima, Certimin, and SGS Lima, and the resulting QA/QC evaluation results.

11.5.1 Blanks

The Tinka QA/QC protocol called for blanks to be inserted in the sample stream at a rate of approximately one in 20 samples. The blanks were inserted into the sample stream prior to shipment to the laboratory. Certified blanks were obtained from CDN Resources Laboratories Ltd., British Columbia, Canada (CDN). In addition, a "sterile" barren rock was inserted alternately with the certified blank starting with the 2014 drill program. The barren rock is not certified. Four failures for silver, 16 failures for zinc, and no failures for tin were recorded.

Blanks in 2017 were purposely submitted after high-grade zinc mineralization. ALS Lima informed Tinka that it cleaned equipment after each sample with air, but not always with sterile quartz. Given the high grades intersected in 2017, this may have resulted in the higher zinc values. Tinka reports that it has re-assayed the failed batches and the new data appear acceptable.

Table 11-3: QA/QC Summary

Metal	Blanks		Standards		Field Duplicates	
	No.	Failure No. or %	No.	Values outside 3SD or %	No.	Failure No. or %
Zn	743	19 or 2.56%	1,961	26 or 1.33%	308	2 or 0.65%
In	452	1 or 0.22%	1,012	43 or 4.25%	308	4 or 1.30%
Pb	743	1 or 0.13%	1,750	35 or 2.00%	308	2 or 0.65%
Ag	743	8 or 1.08%	1,961	5 or 0.25%	308	9 or 2.92%
Sn	743	9 or 1.21%	72	0%	308	3 or 0.97%
Cu	743	1 or 0.13%	1,769	12 or 0.68%	308	2 or 0.65%

The impact of these failures is considered to be of no consequence due to the low grades reported. In RPA's opinion, the results of the blanks are within acceptable limits, and the data can be used for resource estimation purposes.

11.5.2 Standards

Tinka inserts standards at a rate of approximately one in a batch of 10 samples. RPA is of the opinion that the CRM insertion rate exceeds industry standards.

Tinka purchased standards from CDN and Ore Research & Exploration Pty Ltd (OREAS) and has also generated three of its own standards (TK-STD-01 to -03).

OREAS-36 was a zinc standard that proved to have a higher rate of failure outside of the normal deviations. Usage of OREAS-36 was discontinued during 2018, once independent testing confirmed that precision for this particular standard was an issue.

In RPA's opinion, the standard grades cover a reasonable range with respect to the overall resource grades.

Specific pass/fail criteria are determined from the standard deviations provided for each standard. The conventional approach for setting standard acceptance limits is to use the mean assay \pm two standard deviations as a warning limit and \pm three standard deviations as a failure limit. Results falling outside of the \pm three standard deviation failure limits must be investigated to determine the source of the erratic result, either analytical or clerical.

Table 11-4 summarizes the results of the most-used CDN and OREAS standards. The CDN standards include silver and lead. Some of the standards used have indium results (Table 11-5).

11.5.3 Pulp Duplicates

RPA reviewed 1,220 sample pulps from the Colquipucro Silver Zone analyzed at Plenge that Tinka sent to Certimin for referee check assays. The results for silver, after the removal of eight outliers, gave a strong correlation coefficient of 0.989. Results from Certimin average only 1.3% higher than the primary laboratory. Wider differences are seen at grades <60 g/t Ag.

At Ayawilca, 516 sample pulps analyzed at SGS Lima were sent in November 2018 to Inspectorate for check assay. Inspectorate used a four-acid digestion and an ICP mass spectroscopy (MS) suite, with zinc analyzed using an AAS where results were over 1%. The results for zinc show a strong correlation. Results from Inspectorate average 1.9% lower than the primary laboratory, and larger variations are not observed in either low- or high-grade samples.

11.5.4 Field Duplicates

Tinka inserts a field duplicate approximately every 20 regular samples. Half core was quartered by Tinka geologists and sent for analysis with the same batch as the original sample, though with a different sample number. A total of 308 field duplicate samples were used during the 2015 to 2018 campaigns. Results were acceptable.

11.6 Databases

During the logging process, lithological, mineralization, structural and alteration codes are entered into a notebook computer using the LogChief software. LogChief ties in to the DataShed database system of Maxwell GeoServices. Updated geological logging integrated on a daily basis into the geological model built using Leapfrog software.

Geotechnical, sampling intervals and QA/QC control sample information are also digitally entered by field geologists during logging.

Collar and down hole survey data are uploaded to the DataShed database system on a daily basis.

Table 11-4: Evaluation of CDN and OREAS Standards

Standard	Note
CDM-ME-08	Silver and zinc sample values are reported within three standard deviations
CDM-ME-14	Silver and zinc sample values are reported within three standard deviations. A slight high bias for silver is observed. Zinc shows an even distribution around the mean.
CDM-ME-17	Silver and zinc sample values are reported within three standard deviations. A slight high bias for silver and a slight low bias for zinc are seen in both the 2016 SGS Lima and 2017 ALS Lima results.
OREAS-140	Tin standard. Results are within three standard deviations.
OREAS-141	Tin standard. Results are within three standard deviations.

Table 11-5: Standard Best Values

Standard	Silver \pm 1SD	Zinc \pm 1SD	Indium \pm 1SD
CDN-ME-14	Ag (ppm) 42.3/ \pm 4.2	Zn (%) 3.100/ \pm 0.280	
CDN-ME-17	Ag (ppm) 38.2/ \pm 3.3	Zn (%) 7.340/ \pm 0.370	
CDN-ME-1211	Ag (ppm) 86.3/ \pm 8.1	Zn (%) 0.243/ \pm 0.024	
CDN-ME-1303	Ag (ppm) 152.0/ \pm 10.0	Zn (%) 0.931/ \pm 0.048	
CDN-ME-1101	Ag (ppm) 68.20/ \pm 4.60	Zn (%) 1.560/ \pm 0.090	
CDN-ME-06	Ag (ppm) 101.0/ \pm 7.1	Zn (%) 0.517/ \pm 0.040	
CDN-ME-08	Ag (ppm) 61.7/ \pm 4.7	Zn (%) 1.920/ \pm 0.080	
TK-STD-01	Ag (ppm) 12.34/ \pm 0.92	Zn (%) 2.61/ \pm 0.040	In (ppm) 7.19/ \pm 0.62
TK-STD-02	Ag (ppm) 9.17/ \pm 0.42	Zn (%) 5.91/ \pm 0.100	In (ppm) 130.50/ \pm 13.54
TK-STD-03	Ag (ppm) 21.22/ \pm 1.48	Zn (%) 11.61/ \pm 0.610	In (ppm) 415.00/ \pm 27.60
TR-11210	Ag (ppm) 259.0/ \pm 13.0	Zn (%) 5.04/ \pm 0.250	
OREAS-36	Ag (ppm) 10.17/ \pm 0.63	Zn (%) 4.23/ \pm 0.060	
OREAS-37	Ag (ppm) 5.19/ \pm 0.63	Zn (%) 6.26/ \pm 0.150	
OREAS-38	Ag (ppm) 5.49/ \pm 0.63	Zn (%) 10.06/ \pm 0.140	
OREAS-130	Ag (ppm) 6.57/ \pm 0.45	Zn (%) 1.710/ \pm 0.030	
OREAS-135	Ag (ppm) 55.70/ \pm 1.92	Zn (%) 2.800/ \pm 0.670	
CDN-ME-1201	Ag (ppm) 37.60/ \pm 3.4	Zn (%) 4.99/ \pm 0.290	
CDN-ME-1202	Ag (ppm) 10.0/ \pm 1.4	Zn (%) 1.88/ \pm 0.120	
CDN-ME-1204	Ag (ppm) 58.0/ \pm 6.0	Zn (%) 2.36/ \pm 0.120	

Standard	Silver ± 1SD	Zinc ± 1SD	Indium ± 1SD
CDN-ME-1402	Ag (ppm) 131.0/±7.0	Zn (%) 15.23/±0.670	
CDN-ME-1804	Ag (ppm) 137.0/±7.0	Zn (%) 9.94/±0.440	
Standard	Tin ± 1SD	Copper ± 1SD	Indium ± 1SD
OREAS-140	Sn (ppm) 1777.0/±42.0	Cu (ppm) 1529.0/±82.0	In (ppm) 10.7/±1.8
OREAS-141	Sn (ppm) 6061.0/±339.0	Cu (ppm) 2453.0/±98.0	In (ppm) 34.0/±5.0
OREAS-142	Sn (%) 1.04/±0.05	Cu (ppm) 1466.0/±65.0	In (ppm) 45/±5.0

Assay results from the laboratory are uploaded directly in batches into the DataShed database system. Error validations are carried out and failures reported immediately. DataShed is used to provide QA/QC reports using the standard certificates, duplicate results, and field blanks. Failed batches are sent for re-analysis. Check samples are sent to third-party laboratories.

Data are synchronized daily with the main server located in Tinka's Lima offices. Tinka has regular digital back-up protocols in place, and a physical hard drive is backed up every month and stored offsite.

11.7 Sample Security

Core boxes are transported by company vehicle from the drill to the camp logging facility, and again by company vehicle to the gated facility located in Huanuco. Samples are split and bagged under direct supervision of a company geologist. Once bagged, and prior to shipping to Lima in a Tinka vehicle, samples were secured in a locked cage located within the gated facility in Huanuco.

11.8 Sample Storage

Drill core is stored in covered storage areas within the fenced and access-controlled property located on the main road just outside the city of Huanuco. The core boxes are labelled, and depth markers have been placed at appropriate intervals.

Pulps and coarse reject materials are stored at Abil Corporación, S.A.C., a logistics operator specializing in sample storage and transport, in Lima.

11.9 Comments on Section 11

In RPA's opinion, the sample preparation, analysis, and security procedures are adequate for use in the estimation of Mineral Resources.

RPA notes that Tinka continues to undertake ongoing QA/QC reviews and follow-up as required.

12.0 DATA VERIFICATION

12.1 Collar and Assay Checks

The drill collar sites have been re-surveyed and verified several times since drilling began in 2007. Collars from the 2007 and 2011-2012 campaigns were originally surveyed by hand-held GPS, and then by professional surveyors in late 2011 and in 2012 during the topographic survey. Many of the drill holes were re-surveyed again in late 2014. The results were compared and reconciled to the previous coordinates each time a drill hole was re-surveyed.

Check samples from selected pulps from the 2007 drill program were submitted to IPL, and check samples from the 2011–2013 programs were sent to ALS Lima. Check samples from the 2017 and 2018 programs were sent to Inspectorate.

In 2014, Tinka re-assayed 1,220 pulp samples at Certimin that had originally been assayed at Plenge.

Overall, no bias was detected from any of these programs.

12.2 RPA Data Verification

12.2.1 Site Visits

Mr. David Ross, P.Geol., an RPA employee, visited the Project and other related facilities from 11–14 December, 2014 and again from 11–13 January, 2016. Ms. Dorota El Rassi, P.Eng., visited the Project on 19 September, 2018.

Both Mr. Ross and Ms. El Rassi visited the core shacks, examined drill core and outcrops, and held discussions with Tinka geological and technical staff. In 2018, Ms. El Rassi was able to observe the drilling in progress at Ayawilca and noted that the work was being carried out in a competent fashion, using modern equipment that appeared to be in good repair and appropriate for the job.

12.2.2 Witness Sampling

During the 2014–2016 site visits, Mr. Ross selected and marked out a total of six samples of Colquipucro Silver Zone and the Ayawilca Tin Zone for duplicate analysis. The specified intervals were quarter split by Tinka technicians under the supervision of Mr. Ross. The samples were bagged, tagged, and sealed in plastic bags and delivered

to SGS Lima by Mr. Ross. Silver and tin were analyzed by AAS, SGS codes AAS41B and AAS90B respectively.

The independent sampling by RPA confirms that there is significant silver and tin mineralization in the drill holes sampled. Confirmation of the zinc and copper mineralization at the Ayawilca Zinc Zone was made by RPA observing numerous drill core intervals with significant sphalerite and chalcopyrite.

12.2.3 Database Verification

The review of the resource database included header, survey, lithology, assay, and density tables. Database verification was performed using tools provided within the Dassault Systèmes GEOVIA GEMS Version 6.8.2 software package (GEMS).

The assay and density tables were reviewed for outliers. A visual check on the drill hole GEMS collar elevations and drill hole traces was completed. No discrepancies were identified.

RPA compared assay records for silver, zinc, and lead in the resource database to the digital laboratory certificates of analysis, which were received directly from SGS Lima and Certimin. This included 12 certificates with 799 assays from the Ayawilca Zinc Zone, and 14 certificates with 736 assays from the Colquipucro Silver Zone.

In 2016, RPA compared tin values from five SGS certificates.

In 2017 and 2018, RPA compared values for the six main metals of interest to six assay certificates, three from SGS Lima and three from ALS Lima, with a focus on intervals within the resource wireframes. No discrepancies were found.

12.3 Comments on Section 12

The QP has completed a site visit and has reviewed selected database information. The QP concludes that the database is suitable to be used in Mineral Resource estimation, and can be used in mine planning at the PEA level.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

Several phases of metallurgical testwork have been completed at different metallurgical laboratories, all of which are independent of Tinka. Phases 1, 3 and 5 focused on the Ayawilca Zinc Zone mineralization considered in the PEA. The sampling and testwork was supervised by Transmin Metallurgical Consultants of Lima, Peru:

- Phase 1, 2016: SGS Lima completed some scoping flotation tests on two master zinc composites
- Phase 2, 2015–2018: SGS Lima carried out recovery scoping tests on material from the Colquipucro Silver Zone
- Phase 3, 2018: Plenge undertook flotation development
- Phase 4, 2018: Plenge and SGS Lima conducted tin characterization tests
- Phase 5, 2019: Expert Process Solutions Consulting and Testwork Services (XPS), Ontario, Canada completed zinc flotation optimization and also some tin scoping tests.

Phases 3 and 5 of zinc testing are considered the most relevant to this PEA. The results from the Plenge testwork were used for the PEA process plant design, whereas the results from the XPS program were used for projecting the PEA zinc concentrate quality.

The main objectives for the testing were to:

- Develop a recovery process focused on the South and West Ayawilca Zones which are primarily planned to be mined during the first half of the proposed life of mine
- Determine if there are any significant process issues or fatal flaws
- Maximize recovery of zinc to a zinc concentrate
- Maximize recovery of silver and lead to a bulk concentrate
- Maximize payable metal grades of all concentrates
- Minimize penalty element grades in concentrates

- Develop a robust metallurgical flowsheet with low operating and capital cost requirements.

13.2 Ayawilca Zinc Zone Samples

Factors such as grade, lithology, alteration, oxidation, mineralogy, and location were considered in the sample representivity evaluation at the Ayawilca Zinc Zone.

The metallurgical samples were concentrated in the South and West Ayawilca Zones (Figure 13-1). The Central and East Ayawilca Zones were under-represented. These zones are lower grade and would be mined in later years, so are of less importance.

As shown in Figure 13-2, the samples were on average higher grade than the projected mill feed; however, the metallurgical recovery does not appear to be grade dependent, and so it has been assumed that these samples are sufficiently representative for a PEA-level study.

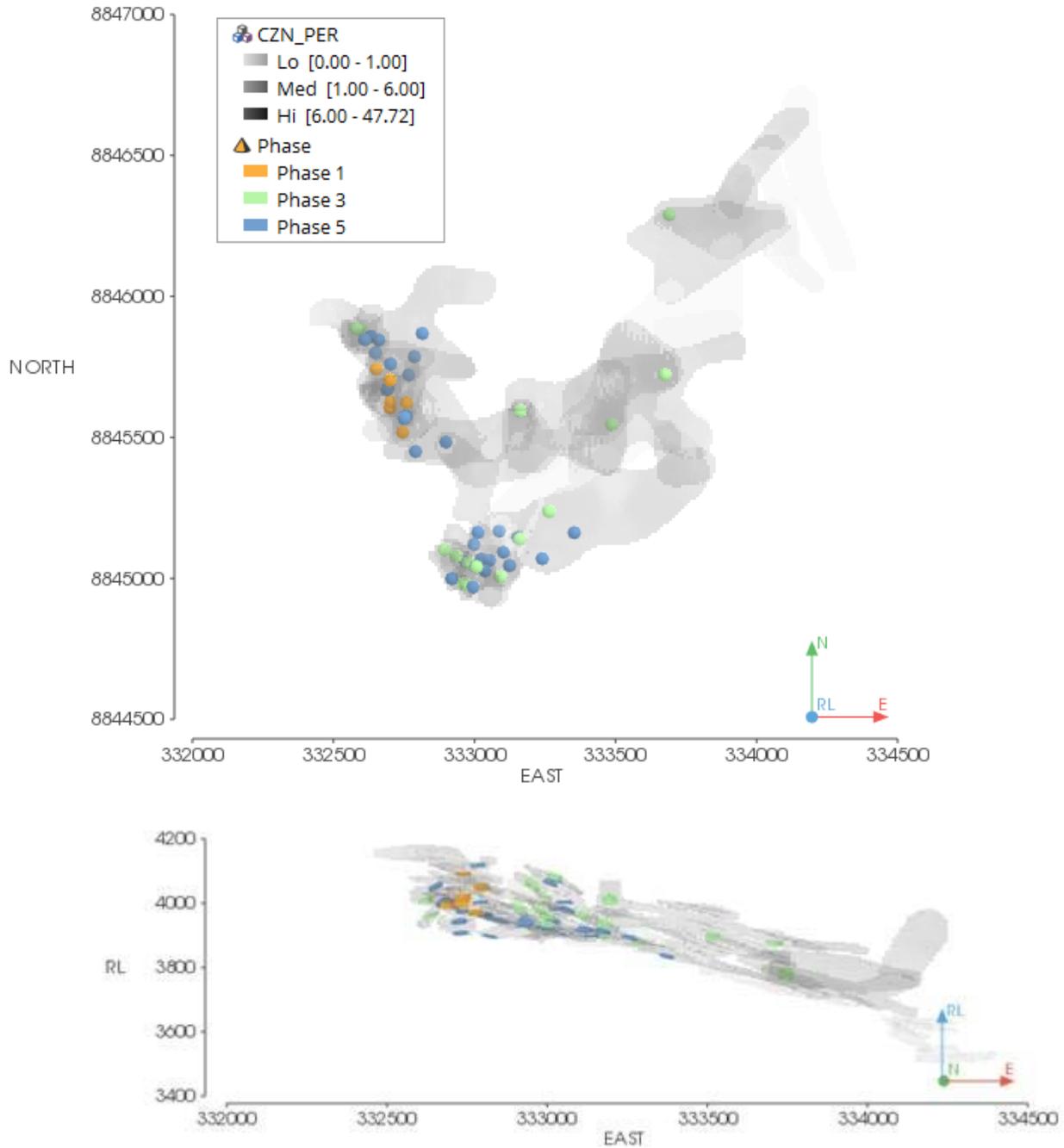
13.2.1 Phase 3, Zinc Development Samples (Plenge)

For Phase 3 of metallurgical development, the quarter-core drill samples listed in Table 13-1 were used. Samples consisted of:

- 17 individual flotation samples (ACFS).
 - South Ayawilca Zone: 11 samples
 - Central Ayawilca Zone: 3 samples
 - West Ayawilca Zone: 2 samples
 - East Ayawilca Zone: 1 sample
- Six individual flotation samples (AAFS)
 - From Phase 1 sampling, located in the West Ayawilca Zone
- Five composites for flotation testing (ACFC)
 - ACFC-01: High-grade zinc with high pyrrhotite content
 - ACFC-02: Low-grade zinc with medium pyrrhotite content
 - ACFC-03: A mix of ACFC-01 and ACFC-02
 - ACFC-04: A composite with high lead/zinc ratio
 - ACFC-05: Medium zinc grade with low pyrrhotite content.

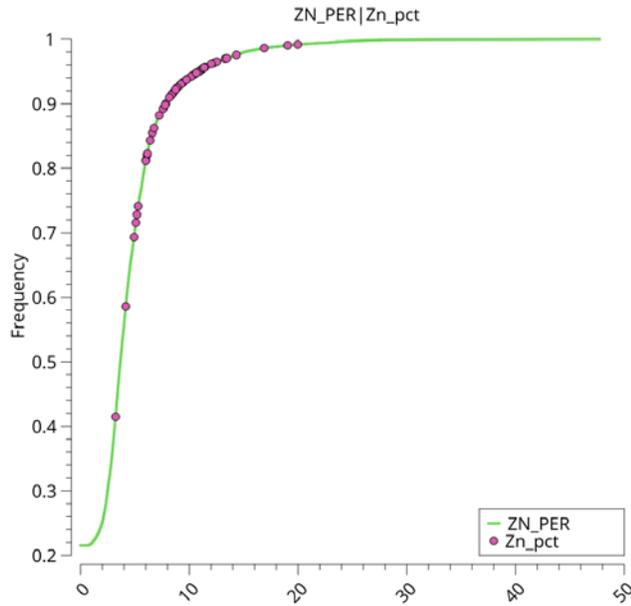
One composite was submitted for comminution testing (ACCC-01); refer to Table 13-2.

Figure 13-1: Location of Metallurgical Samples Tested by Phase



Note: Figure prepared by Transmin, 2019.

Figure 13-2: Distribution of Metallurgical Sample Grades (Dots) Versus the Block Model Zinc Grade Values (Line)



Note: Figure prepared by Transmin, 2019.

Table 13-1: Phase 3 Sample List

Sample ID	Drill Hole ID	Intercept Depth From (m)	Intercept Depth To (m)
AAFS-01	A13-005	164	176
AAFS-02	A13-006	264.65	278
AAFS-03	A14-019	254	268
AAFS-04	A14-022	226	238
AAFS-05	A14-026	288	303.8
AAFS-06	A14-033	270.9	282
ACFS-01	A17-056	124	139
ACFS-02	A17-056	244.1	258
ACFS-03	A17-056	268	281
ACFS-04	A17-057	180.6	195.47
ACFS-05	A17-057	260	272.5

Sample ID	Drill Hole ID	Intercept Depth From (m)	Intercept Depth To (m)
ACFS-06	A17-060	263.5	279.5
ACFS-07	A17-061	181.8	193.6
ACFS-08	A17-061	228	238
ACFS-09	A17-063	300	316.5
ACFS-10	A17-063	339.6	349.9
ACFS-11	A17-066	344	352
ACFS-12	A12-008	198	214.5
ACFS-13	A13-012A	250	266
ACFS-14	A15-038	242	258
ACFS-15	A14-018	388	408
ACFS-16	A18-114	302.9	319.3
ACFS-17	A18-114	354.3	365.8
ACFS-05A	A17-057	260	272.5

Table 13-2: Comminution Composite ACCC-01 Origin

Drill Hole ID	Intercept Depth From (m)	Intercept Depth To (m)
A17-056	174.8	184
A17-069	273.8	280.8
A17-070	350	356.8
A17-071	345	350
A17-096	252.5	258

13.2.2 Phase 5 Zinc Optimization Samples (XPS)

For Phase 5 of metallurgical development, the samples in Table 13-3 were used.

Composites included the following:

- Composite AEC-02 consisted of 11 samples from 11 drill holes at the West and South Ayawilca Zones (91.6 m sampled). AEC-02 had a zinc head grade of 10.8% Zn
- Composite AEC-03 comprised 17 samples from 15 drill holes at the West and South Ayawilca Zones (129.7 m sampled). AEC-03 had a zinc head grade of 10.2% Zn
- Composite AEC-05 consisted of four samples (all used in AEC-03) from four drill holes at the West and South Ayawilca Zones (39.5 m sampled). AEC-05 had a zinc head grade of 6.5% Zn
- Two high pyrrhotite (containing approximately 40% pyrrhotite by volume) composite samples AES 08 and AES 23 were not used in the locked cycle (LCTs) and cleaner tests during this phase of work. High pyrrhotite content was found to inhibit zinc recovery in early flotation tests.

13.3 Ayawilca Zinc Zone Metallurgical Testwork

13.3.1 Overview

Over the course of three phases of zinc flotation testwork (phases 1, 3, and 5), a robust conventional flotation regime was developed for the South and West Ayawilca Zones. Based on visual core inspection, it is assumed that this flowsheet will be suitable for the Central Ayawilca Zone as well.

The marmatite style of sphalerite that predominates in the Ayawilca Zinc Zone determines the quality of the zinc concentrate that can be achieved, but the zinc flotation selectivity and recovery were found to be high using the optimized regime that was developed.

Variability testing confirmed that most of the different zones performed similarly in rougher flotation.

Locked cycle testing achieved a stable performance with over 92% Zn recovery and over 50% Zn concentrate grade, for the samples tested.

Table 13-3: Phase 5 Sample List

Sample ID	Drill Hole ID	Intercept Depth From (m)	Intercept Depth To (m)	Composite ID
AES 01	A17-056	140.15	145.4	AEC-03
AES 02	A17-056A	286.5	294.25	AEC-02
AES 03	A17-061	144	152	AEC-02
AES 04	A17-063	329	338	AEC-02
AES 05	A17-065	310.7	319.45	AEC-02
AES 06	A17-069	284.4	295.1	AEC-02
AES 07	A17-070	321.7	328.6	AEC-03
AES 08	A17-071	330.4	336.4	—
AES 09	A17-075	375.3	379.8	AEC-03
AES 10	A17-089	241	250.2	AEC-02
AES 11	A17-096	343.4	348.7	AEC-03
AES 12	A17-096	269	282	AEC-03, AEC-05
AES 13	A18-133	200	209.5	AEC-03
AES 14	A18-139	311.9	317.9	AEC-03
AES 15	A18-142	236	245.7	AEC-03
AES 16	A17-074	70	78	AEC-02
AES 17	A17-079	304	309.5	AEC-02
AES 18	A17-080	300	306.5	AEC-03
AES 19	A18-118	272.4	281.3	AEC-03
AES 20	A18-118	324	334	AEC-03, AEC-05
AES 21	A18-120	349.4	353.7	AEC-03
AES 22	A18-129	273	281.2	AEC-03
AES 23	A18-130	302	310	—
AES 24	A18-132	260.2	268	AEC-03
AES 25	A18-137	279.3	290.1	AEC-02
AES 26	A18-140	283.6	290.9	AEC-03
AES 27	A18-141	336	345.9	AEC-03, AEC-05
AES 28	A18-141	372.4	378	AEC-02
AES 29	A18-143	151.8	160	AEC-02

Sample ID	Drill Hole ID	Intercept Depth From (m)	Intercept Depth To (m)	Composite ID
AES 30	A18-143	262.3	268.9	AEC-03, AEC-05

13.3.2 Phase 3 Comminution, Plenge (2018)

A single composite was made from ¼ core samples from the South Ayawilca Zone for comminution testing.

A Bond ball mill work index (BBWi) test was completed with a 125 µm reference screen resulting in a P80 close to the 106 µm required. The sample was found to have a BBWi of 10.6 kW-h/t, which is considered to be a moderate hardness for grinding.

13.3.3 Phase 3 Flotation, Plenge (2018)

Composites ACFC-01, ACFC-02 and ACFC-03 were evaluated for the following:

- Development rougher flotation
- Development cleaner flotation
- Locked cycle flotation
- Cleaner flotation optimization.

Individual samples ACFS-01 to ACFS-17 were evaluated for the following:

- Variability rougher flotation.

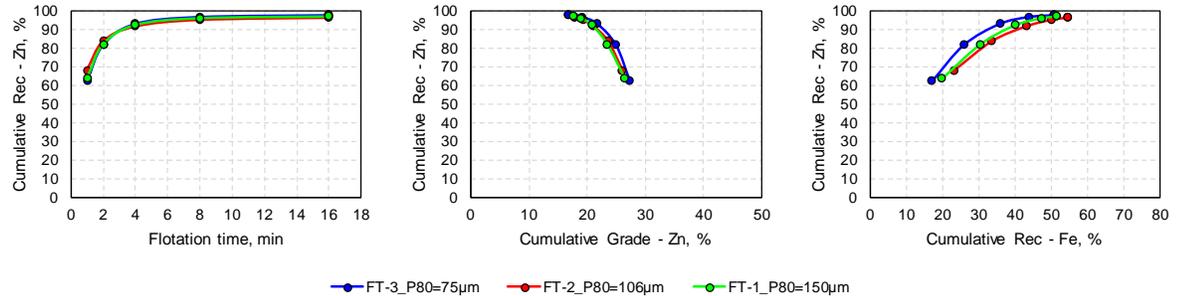
Rougher Grind Selection

Zinc recovery, rougher concentrate grade and iron selectivity are relatively insensitive to the primary grind size (Figure 13-3). A primary grind size of P80 106 µm was selected for subsequent tests.

Collector Dose Selection

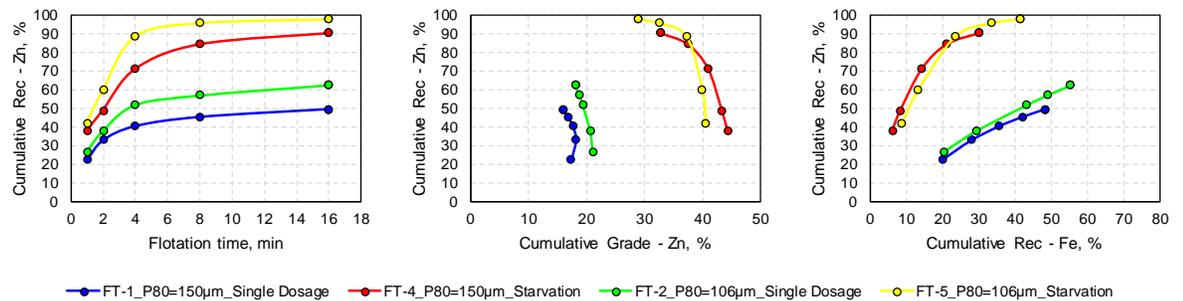
In order to improve zinc recovery and selectivity, tests were conducted adding collector down-the-bank in a starvation regime. This improved performance significantly. Results are presented in Figure 13-4.

Figure 13-3: Flotation Rougher, Effect of Grind Size on Flotation



Note: Figure prepared by Transmin, 2019.

Figure 13-4: Rougher Flotation, Effect of Collector Addition Scheme on Performance



Note: Figure prepared by Transmin, 2019.

Addition of Secondary Collector

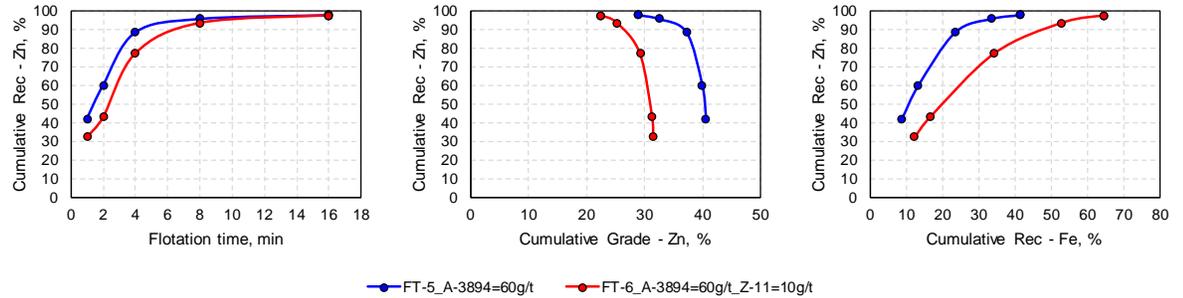
The addition of a secondary collector, SIPX, was evaluated to assess if an improvement of recovery could be achieved. The thionocarbamate reagent alone was able to achieve similar zinc recovery with improved selectivity over iron (Figure 13-5).

Activator Addition

A series of tests varied copper sulfate activator and primary collector addition rates to optimize zinc recovery and selectivity of zinc over iron sulfides.

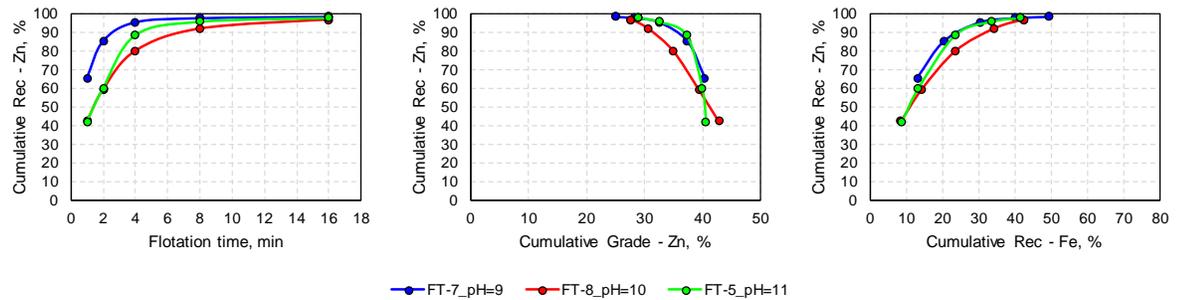
Zinc flotation performance is a function of both activator and collector addition.

Figure 13-5: Effect of SIPX Addition on Flotation Performance



Note: Figure prepared by Transmin, 2019.

Figure 13-6: Effect of pH on Rougher Flotation Performance



Note: Figure prepared by Transmin, 2019.

pH Evaluation

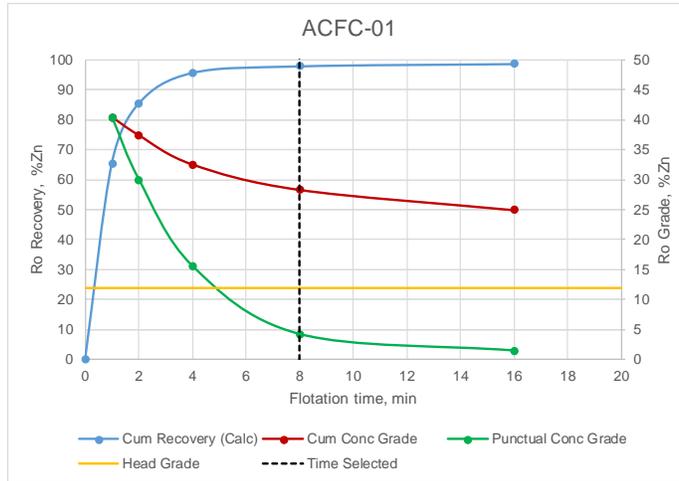
The optimum rougher flotation pH was evaluated at pH 9, 10 and 11, adjusting with lime. There was no material improvement in selectivity over iron or non-sulfide gangue in the rougher at any pH tested, and so pH 9 was selected for subsequent tests.

Rougher Flotation Residence Time

A rougher residence time of eight minutes was selected, however there is potential that this could be reduced to five minutes. Figure 13-7 shows the rougher residence time determination.

Further work on the marginal concentrate value and liberation texture is required.

Figure 13-7: Rougher Flotation Residence Time Determination



Note: Figure prepared by Transmin, 2019.

Regrind Size Determination

No notable improvement in concentrate quality was evident using regrinding from the tests conducted (Figure 13-8). Without regrinding the rougher concentrate (cleaner feed) had a P80 of 50 μm , achieving a similar grade–recovery curve and selectivity to a regrind of P80 of 38 μm .

Effect of Additional Collector In Cleaner

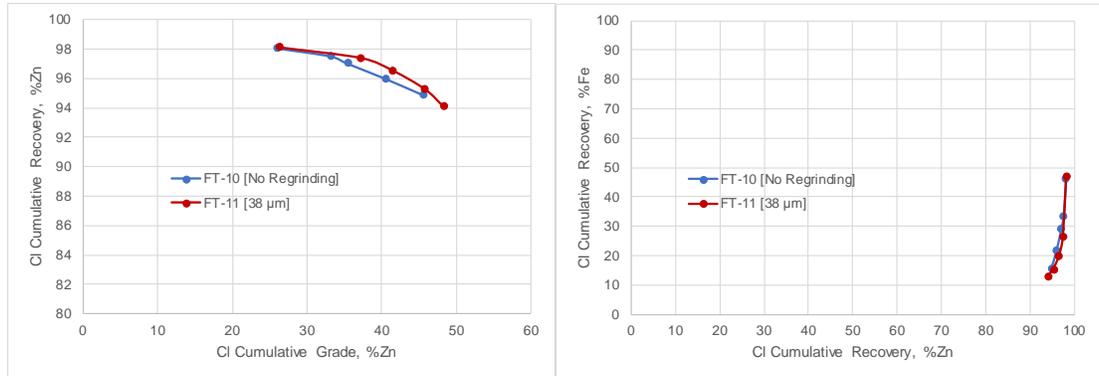
The benefit of adding additional collector (5, 15 g/t A-3894) in cleaning was evaluated, see results in Figure 13-9. Additional cleaner reduced selectivity of zinc over iron but did not improve clear recovery of zinc. Therefore, it was decided not to add any additional collector in the cleaner stage.

Lead–Silver flotation

A single bulk flotation test was conducted on a high-grade lead sample. High lead and silver recovery and flotation kinetics were achieved using a typical reagent regime as shown in Table 13-4. Results of the program are shown in Table 13-5.

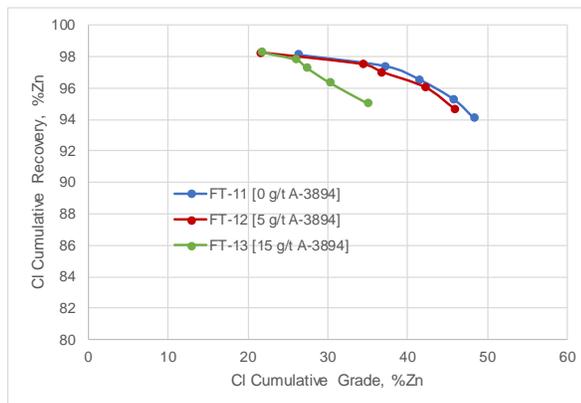
Further work is required to determine if the entrained zinc can be efficiently cleaned from the concentrate, and if these results are also possible for lower-grade lead mineralization.

Figure 13-8: Cleaner Flotation Re grind Size Evaluation



Note: Figure prepared by Transmin, 2019.

Figure 13-9: Cleaner Flotation Collector Addition Evaluation



Note: Figure prepared by Transmin, 2019.

Table 13-4: Pb–Ag Bulk Flotation Test Conditions

Stage	Reagents (g/t)					P80 µm	Solids %	Time min	pH
	CaO	NaCN	ZnSO ₄	A-3418	MIBC				
Grinding	Req	20	200			106			
Bulk Cond.				30	20		30	5	9
Bulk Ro 1-1								1	
Bulk Ro 1-2								1	
Bulk Ro 1-3								2	
Bulk Ro 1-4								4	
Bulk Ro 1-5								8	

Table 13-5: Pb–Ag Bulk Flotation Test Results

Stream	Time min.	Weight %	Assay						Recovery (%)					
			Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Fe (%)	S (%)	Ag	Cu	Pb	Zn	Fe	S
Conc.1	1	5.3	2,777	0.665	34.07	11.02	13.2	20.6	81.2	43.4	81.1	11.5	3.9	10.7
Conc.2	1	2.1	2,124	0.586	26.26	11.75	15.2	20.4	86.3	53.1	86.8	17.1	6.2	14.8
Conc.3	2	2.4	1,647	0.503	20.48	11.76	16.6	19.7	88.9	60.6	90.0	22.7	9.0	19.0
Conc.4	4	3.6	1,236	0.411	15.40	11.03	17.8	18.4	91.1	67.5	92.4	29.1	13.2	24.2
Conc.5	8	4.1	963	0.335	12.02	9.92	18.2	16.6	92.5	71.7	93.9	34.0	17.5	28.4
Ro Bulk Tail		82.5	17	0.03	0.17	4.07	18.1	8.9	7.5	28.3	6.1	66.0	82.5	71.6
Head Calc.		100	182	0.08	2.2	5.1	18.1	10.2	100.0	100.0	100.0	100.0	100.0	100.0
Head assayed		—	173	0.09	2.3	5.2	17.6	10.5	—	—	—	—	—	—

Locked Cycle Testing

After successful open batch test results, locked cycle tests were run on Phase 3 master composites ACFC-01 and ACFC-02. The tests were not stable, and the concentrate quality declined with each cycle.

A comparison between the open and locked cycle results is provided in Table 13-6.

The tests were deficient in several areas, including cleaner reagent regime, poor hydrodynamics due to weak frother and high-grade zinc. However, these tests do highlight the potential benefits of working in an open flotation arrangement, and the importance of considering the effect of recirculating process water on the flotation performance.

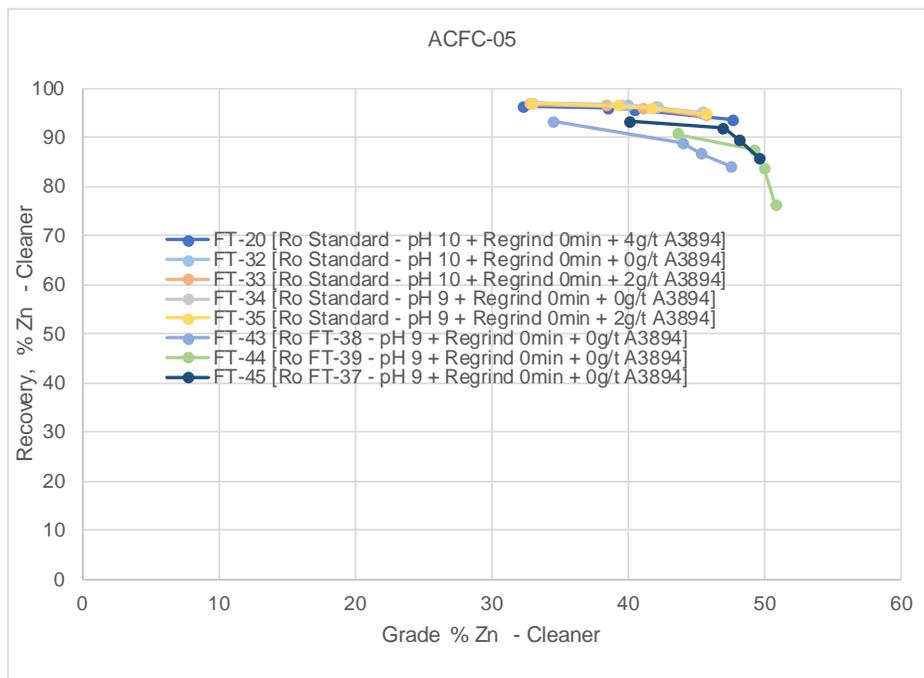
Cleaner Optimization

To improve concentrate quality, a series of cleaner optimization tests were conducted on composites ACFC-01, ACFC-02, and ACFC-05. Figure 13-10 shows the results for ACFC-05.

Table 13-6: Open and Locked Cycle Flotation Test Results Comparison (Plenge)

Composite	Test	Head Calculated				Final Cleaner Conc Grade				Final Cleaner Conc Recovery			
		Cu, %	Zn, %	Fe, %	S, %	Cu, %	Zn, %	Fe, %	S, %	Cu, %	Zn, %	Fe, %	S, %
ACFC-01	LCT	0.07	10.90	26.66	21.83	0.2 ± 0	42.5 ± 1.1	18.1 ± 0.9	35.6 ± 1.5	65.8 ± 3.9	70 ± 14.4	12.7 ± 1.6	30.5 ± 5.7
ACFC-01	OCT	0.07	11.97	26.01	23.58	0.23	46.99	14.87	35.86	73.50	87.71	12.77	33.98
ACFC-02	LCT	0.05	6.47	24.88	15.28	0.2 ± 0	37.5 ± 11.6	23.8 ± 8.3	37.5 ± 5.3	69.9 ± 12.3	93.6 ± 4.3	16 ± 13.1	40.4 ± 24.7
ACFC-02	OCT	0.05	6.72	24.54	32.14	0.3	49.6	14.7	35.7	65.01	90.17	7.31	26.71

Figure 13-10: Cleaner Optimization ACFC-05



Note: Figure prepared by Transmin, 2019.

These tests optimized the following parameters in cleaners:

- Rougher collector addition
- Regrind size
- Conditioning time
- Pulp density
- Activator addition
- Collector addition

- Depressant addition
- Frother type
- Pre-aeration of the feed.

Substantial benefits were achieved for cleaner zinc recovery and zinc concentrate grade, principally due to improved iron selectivity.

Some minor adjustments to the activator and collector additions were made, and consistently good performance was achieved in open batch cleaning tests.

13.3.4 Phase 5 Flotation, XPS (2019)

Samples AES-01 to AES-030 were subjected to quantitative evaluation of minerals by scanning electron microscopy (QEMSCAN) mineralogy at SGS in Canada.

The results of the mineralogy were used to form composites AEC-02, AEC-03 and AEC-05 for flotation development testwork.

The locked cycle flowsheet is included as Figure 13-11.

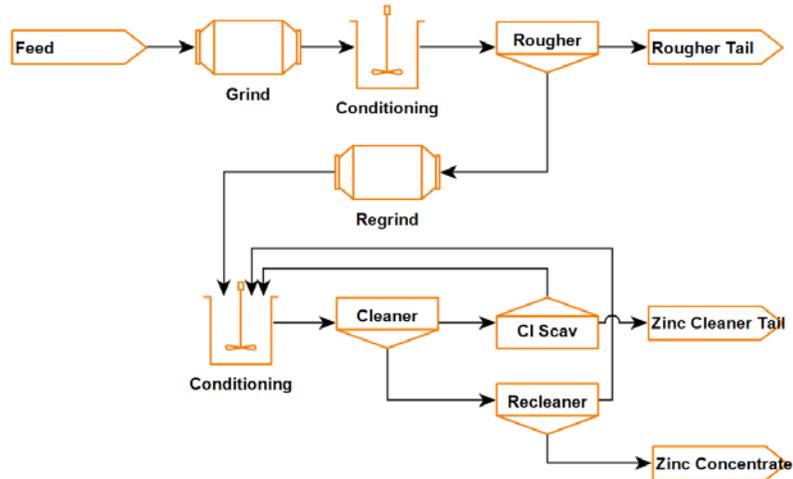
Tests were conducted varying regrind, pH, collector addition and activator addition. Table 13-7 shows the reagent scheme used.

The results confirmed that the scheme from Phase 3 was appropriate, with the addition of a mild regrind to P80 65 μm . Table 13-8 shows the locked cycle flotation test results. Table 13-9 provides detailed results of the tests on samples AEC-02 and AEC-03.

The XPS regime used fresh water for each cycle, so additional work that includes water recirculation is required in future testwork programs.

13.4 Ayawilca Zinc Zone Recovery Estimates

Rougher flotation recovery of zinc has been consistently very high, with fast flotation kinetics. The issue with estimating final zinc recovery has therefore been dependent on the cleaning circuit performance. Most of the cleaning circuit optimization work has been focused on improving final concentrate quality at the cost of final zinc recovery.

Figure 13-11: Locked Cycle Test Flowsheet (XPS)


Note: Figure prepared by Transmin, 2019.

Table 13-7: Locked Cycle Flotation Regime (XPS)

Stage	Reagents (g/t)				P80 µm	Solids %	Time min	pH
	Lime	Copper Sulfate	A3894 Collector	Frother				
Grind	1,500				106	60		
Pre-aeration								
Cond		450				35	3	9
Acond.			20	2.5			2	9
Rougher 1							2	
Cond.			10	2.5			2	9
Rougher 2							2	
Cond.			10				1	9
Rougher 3							3	
Cond.			5				1	9
Rougher 4							5	
Regrind					65		3	
Cond								
Cond		75				15	3	9

Stage	Reagents (g/t)				P80	Solids	Time	pH
	Lime	Copper Sulfate	A3894 Collector	Frother	µm	%	min	
Cond.			10	2.5			1	
Cleaner 01							10	
Cleaner Scv			10				4	
Cleaner 02							10	9

Table 13-8: Locked Cycle Flotation Test Balance Results (XPS)

Composite	Head Grade	Recovery (%)	Grade (%)	
	Zn (%)	Zn	Zn	Fe
AEC-02	10.8	92.5	50.9	13.0
AEC-03	10.2	94.1	50.0	13.8
AEC-05 (open batch test)	6.5	90.7	52.1	12.6

Table 13-9: Detailed Analyses of Locked Cycle Concentrates AEC-02 and AEC-03

Analyte	Unit	Detection Limit	AEC-02	AEC-03	Analyte	Unit	Detection Limit	AEC-02	AEC-03
Al	%	0.01	0.03	0.03	Sr	ppm	3	16	21
As	ppm	5	319	242	Ta	ppm	0.2	<0.2	<0.2
B	ppm	10	<10	<10	Tb	ppm	0.1	<0.1	<0.1
Ba	ppm	3	4	4	Te	ppm	6	<6	<6
Be	ppm	3	<3	<3	Th	ppm	0.1	0.2	0.1
Bi	ppm	2	26	22	Ti	%	0.01	<0.01	<0.01
Ca	%	0.01	0.05	0.05	Tl	ppm	0.1	1.5	2.7
Cd	ppm	2	1800	1650	Tm	ppm	0.1	<0.1	<0.1
Ce	ppm	0.8	0.9	<0.8	U	ppm	0.1	1.1	1.2
Co	ppm	0.2	8.5	11	V	ppm	5	<5	<5
Cr	ppm	30	90	90	W	ppm	0.7	1.1	0.8
Cs	ppm	0.1	1	0.9	Y	ppm	0.1	1	0.9
Cu	ppm	2	2280	1880	Yb	ppm	0.1	<0.1	<0.1

Analyte	Unit	Detection Limit	AEC-02	AEC-03	Analyte	Unit	Detection Limit	AEC-02	AEC-03
Dy	ppm	0.3	<0.3	<0.3	Zn	%	0.01	50.9	50.5
Er	ppm	0.1	<0.1	<0.1	Au	ppb	2	60	21
Eu	ppm	0.1	0.1	<0.1	Pd	ppb	5	<5	<5
Fe	%	0.05	13.1	14	Pt	ppb	5	<5	11
Ga	ppm	0.2	11.7	10.6	Ag	ppm	3	52	51
Gd	ppm	0.1	0.1	0.1	Hg	ppb	5	4,570	4,510
Ge	ppm	0.7	0.9	1.5	C-Total	%	0.01	0.15	0.21
Ho	ppm	0.2	<0.2	<0.2	S-Total	%	0.01	33.9	34.1
Hf	ppm	10	<10	<10	Co ₃ O ₄	%	0.005	<0.005	<0.005
In	ppm	0.2	719	399	CuO	%	0.005	0.303	0.253
K	%	0.1	<0.1	<0.1	NiO	%	0.003	0.008	0.006
La	ppm	0.4	0.5	<0.4	SiO ₂	%	0.01	0.74	0.46
Li	ppm	3	24	24	Al ₂ O ₃	%	0.01	0.08	0.1
Mg	%	0.01	0.16	0.1	Fe ₂ O ₃ (T)	%	0.01	16.94	18.32
Mn	ppm	3	1190	1700	MnO	%	0.001	0.144	0.206
Mo	ppm	1	5	5	MgO	%	0.01	<0.01	<0.01
Nb	ppm	2.4	<2.4	<2.4	CaO	%	0.01	<0.01	<0.01
Nd	ppm	0.4	<0.4	0.4	Na ₂ O	%	0.01	<0.01	<0.01
Ni	ppm	10	20	10	K ₂ O	%	0.01	0.01	0.01
Pb	ppm	0.8	821	4,830	TiO ₂	%	0.01	0.01	0.01
Pr	ppm	0.1	0.1	0.1	P ₂ O ₅	%	0.01	0.01	0.01
Rb	ppm	0.4	0.7	0.4	Cr ₂ O ₃	%	0.01	0.01	0.01
Sb	ppm	2	25	34	V ₂ O ₅	%	0.003	<0.003	<0.003
Se	ppm	0.8	2.6	2.4	Cl	%	0.01	0.03	0.02
Si	%	0.01	0.39	0.26	F	%	0.01	0.02	0.01
Sm	ppm	0.1	0.1	0.2	CO ₃ (calc)	%	0.01	0.25	0.59
Sn	ppm	0.5	378	413	LOI	%		15.26	15.52

The current estimate of 92% Zn recovery has been influenced by the following factors, which if resolved, offer substantial opportunities for higher zinc recovery projections in the future:

- Sample representivity. The samples tested to date are marginally higher-grade Zn than the typical resource mineralization in the Ayawilca Zinc Zone. The Central Ayawilca Zone had poor recoveries in one of the few samples tested
- High-pyrrhotite mineralization was excluded from the tests used for the final PEA projections
- The quality and management of the process water has not been established or tested yet
- Operators that are under pressure to produce a high zinc concentrate from low-zinc sphalerite may tend to sacrifice recovery to ensure product quality.

The zinc recovery and zinc concentrate quality are sensitive to copper sulfate activator addition and collector addition rates, which will make it challenging for the operators to consistently apply an optimized flotation regime.

The projected metal recoveries are included in Table 13-10 and the predicted concentrate grades are summarized in Table 13-11.

The lead and silver recoveries are assumed to be 85%, based on a single rougher batch flotation test in Phase 3, and experience with similar deposits in Cerro de Pasco.

The silver grade in the lead–silver concentrate is calculated using the formula:

- $Ag, g/t = Block_Ag_gpt \times 0.85 / (Block_Pb_%/100 * 0.85 / 0.5)$.

The indium in the zinc concentrate is calculated using the formula:

- $In, g/t = Block_In_gpt \times 0.90 / (Block_Zn_%/100 * 0.90 / 0.48)$.

13.5 Ayawilca Zinc Zone Concentrate Quality

Some samples underwent locked cycle test flotation and final zinc concentrates have been subjected to commercial assays. The concentrate quality range provided in Table 13-12 has been interpreted from these test results.

Table 13-10: Projected Metal Recovery

Recovery	Units	Concentrate	
		Pb-Ag	Zn
Zinc	%	—	92
Lead	%	85	—
Silver	%	85	—
Indium	%	—	92
Iron	%	—	—
Tin	%	—	—

Table 13-11: Projected Concentrate Grades

Conc Grade	Units	Concentrate	
		Pb-Ag	Zn
Zinc	%	4	50
Lead	%	50	
Silver	%	Calculate	Low
Indium	%		Calculate
Iron	%		13
Tin	%		
Moisture	%	10	10

Table 13-12: Projected Concentrate Quality

Element	Unit	Range	Nominal	Element	Unit	Range	Nominal
Al	%	0–0.03	0.03	Pr	ppm	0.1–0.1	0.1
As	ppm	200–400	280	Rb	ppm	0–1	0.55
B	ppm	Low	Low	S	%	30–34	32
Ba	ppm	0–10	4	Sb	ppm	20–40	29.5
Be	ppm	Low	Low	Se	ppm	2–3	2.5
Bi	ppm	20–30	24	Si	%	0.2–0.4	0.32
Ca	%	0–0.1	0.05	Sm	ppm	0.1–0.2	0.15
Cd	ppm	1,000–2,000	1700	Sn	ppm	0–1,000	400

Element	Unit	Range	Nominal	Element	Unit	Range	Nominal
Ce	ppm	0–1	0.9	Sr	ppm	10–30	18.5
Co	ppm	0–20	9.75	Ta	ppm	Low	Low
Cr	ppm	0–100	90	Tb	ppm	Low	Low
Cs	ppm	0–1	0.95	Te	ppm	Low	Low
Cu	ppm	1,000–3,000	2000	Th	ppm	0.1–0.2	0.15
Dy	ppm	Low	Low	Ti	%	Low	Low
Er	ppm	Low	Low	Tl	ppm	1–3	2.1
Eu	ppm	0.1–0.1	0.1	Tm	ppm	Low	Low
Fe	%	11–14	13	U	ppm	1–2	1.15
Ga	ppm	10–20	11.15	V	ppm	Low	Low
Gd	ppm	0.1–0.1	0.1	W	ppm	0–2	0.95
Ge	ppm	0–2	1.2	Y	ppm	0–1	0.95
Ho	ppm	Low	Low	Yb	ppm	Low	Low
Hf	ppm	Low	Low	Zn	%	48–52	50
In	ppm	0–1,000	559	Au	ppb	20–60	40
K	%	Low	Low	Pd	ppb	0–0	Low
La	ppm	0–1	0.5	Pt	ppb	10–20	11
Li	ppm	20–30	24	Ag	ppm	0–100	51.5
Mg	%	0.1–0.2	0.13	Hg	ppb	0–10,000	4,540
Mn	ppm	1,000–2,000	1445	C-Total	%	0.1–0.3	0.18
Mo	ppm	0–10	5	Cl	%	0.02–0.03	0.025
Nb	ppm	Low	Low	F	%	0.01–0.02	0.015
Nd	ppm	0–1	0.4	LOI	%	10–20	15
Ni	ppm	10–20	15	Moisture	%	9–12	10
Pb	ppm	0–1,000	825				

13.6 Ayawilca Zinc Zone Deleterious Elements

While the Ayawilca Zinc Zone contains varying grades of common deleterious elements, such as arsenic, bismuth, antimony and cadmium, the selective flotation reagent regime has resulted in low recovery of these elements to the final concentrate, and so they are not considered to be a high risk for the project. Other deleterious species that can affect zinc concentrate quality such as chlorine, fluorine, organic carbon, talc, mercury, cobalt, nickel, selenium, manganese, and silica are well below the concentrations in the concentrate where they would affect concentrate quality.

Mineralogical samples were examined by QEMSCAN at SGS in Canada. Detailed microprobe work and QEMSCAN analysis was used to identify that the sphalerite is present as high-iron marmatite, a type of sphalerite. It also showed that liberation was good. The theoretical grade–recovery curves indicated that a pure sphalerite concentrate would grade 50–52% Zn.

The iron that is present in the marmatitic sphalerite that predominates in the Ayawilca Zinc Zone will incur a smelter penalty and may affect the number of smelters the concentrate can be sold to with good terms.

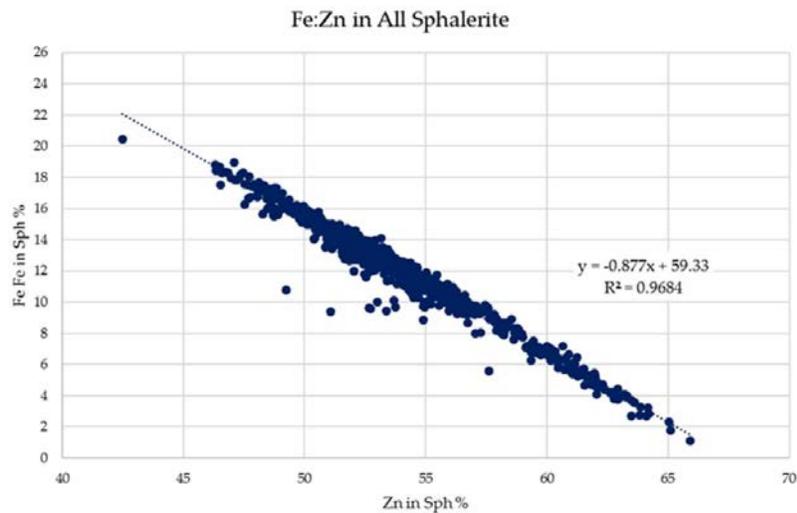
The individual sphalerite crystals in the Ayawilca Zinc Zone are geochemically zoned and have variable amounts of iron within the lattice of the crystal structures. Eighty-eight electron probe micro-analyses (EPMA) were conducted by SGS in 2018 on the sphalerite from four samples, AAFS-01, ACFS-07, ACFS-15 and ACFS-13, to determine its chemistry. EPMA were conducted on sphalerite to determine the major and some trace elements of the minerals, whereas low-grade trace elements below the detection limit of the electron microprobe were determined with a laser ablation ICP-MS. Table 13-13 summarizes EPMA results.

Over 1,000 compositional data points were taken by XPS on the 30 samples flagged for the Phase 5 study. Iron in sphalerite ranges in value from as low as 2% Fe in sphalerite up to 20% Fe in sphalerite, with a mode of 13–14% Fe (Figure 13-12). A mode in the zinc compositions lies between 51–53% Zn.

The presence of the iron dilutes the zinc in the sphalerite. High-iron zinc concentrates will have an upper zinc grade limit dependent on the overall quantity of iron and zinc in the crystal structure of the sphalerite. A zinc concentrate grade between 50–52% Zn is attainable for the mineralization in the Ayawilca Zinc Zone through flotation optimization for the samples tested at over the 92% Zn recovery that is projected.

Table 13-13:EPMA Analysis of Sphalerite Grains (SGS, 2018)

Sample	AAFS-01	ACFS-07	ACFS-15	ACFS-13
No. Analyses	N=22	N=21	N=25	N=20
S	34.20	33.80	34.42	34.19
Mn	0.35	0.11	0.70	0.47
Fe	13.75	13.26	12.18	13.10
Co	0.01	0.01	0.02	0.02
Cu	0.03	0.06	0.03	0.18
Zn	50.99	51.95	52.73	51.49
As	0.00	0.01	0.04	0.25
Ag	0.01	0.01	0.00	0.01
Cd	0.10	0.17	0.13	0.13
In	0.00	0.04	0.00	0.03
Sn	0.00	0.00	0.00	0.00
Sb	0.00	0.00	0.00	0.00
Total	99.44	99.43	100.26	99.86

Figure 13-12:Iron to Zinc Ratio In Sphalerite (XPS, 2019)


Note: Figure prepared by XPS, 2019.

13.7 Ayawilca Zinc Zone Pyrrhotite-Rich Mineralization

Pyrrhotite-rich mineralization is a minor and discrete geometallurgical domain (representing <10% of total mineralization) that will be further studied in future flotation development phases. Very high pyrrhotite concentrations were found during the testwork to inhibit zinc flotation.

Promising improvements, achieved using blending and pre-aeration, should be further developed, together with investigations into controlling process water and grinding chemistry.

13.8 Ayawilca Zinc Zone Metallurgical Variability

Typically, final zinc flotation recovery is related to the rougher flotation recovery. Therefore, to assess the variability of the zinc recovery in the Ayawilca Zinc Zone, a series of 17 variability rougher flotation tests were conducted. Results are included in Table 13-14. It is assumed that the poor performance by three samples can be explained and discounted at this stage:

- Two high-grade samples likely saturated the flotation cell, requiring additional flotation time and reagents for the high zinc head grade
- One mid-grade sample gave very low recovery, despite having coarse and clean mineralization textures. It is assumed that the sample was spoiled due to oxidation during storage.

Copper is generally low grade and the small high-grade copper zones are independent of the zinc mineralization. Copper has a moderate correlation with tin mineralization, which occurs deeper in the Ayawilca Tin Zone. There are no enriched copper sulfide minerals observed that could complicate the flotation chemistry for zinc selectivity. Minor amounts of type II sphalerite were observed, where chalcopyrite is present in tiny inclusions in the sphalerite. Further work is required on high copper to zinc zones to determine if this will be an issue. Potentially this could cause the zinc to float without activation, losing zinc and contaminating the lead-silver concentrate.

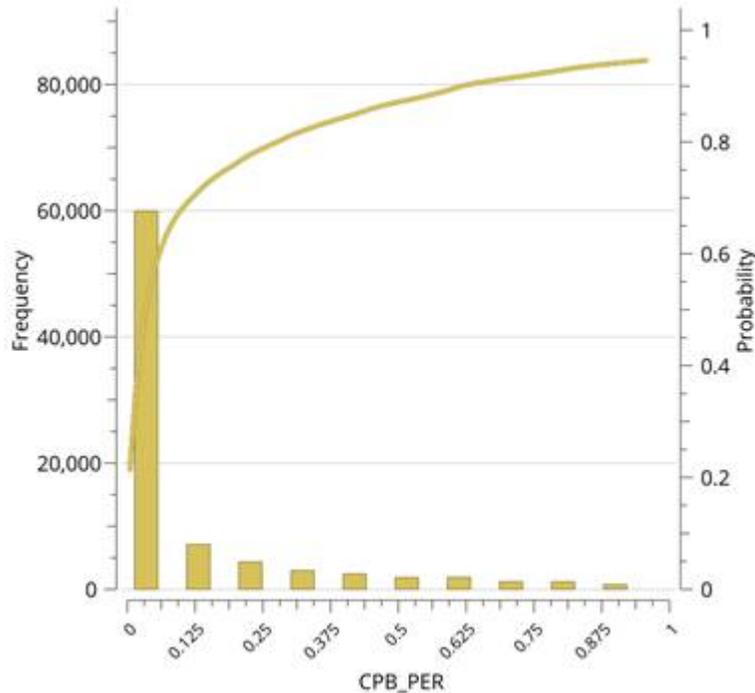
Table 13-14: Zinc Rougher Flotation Variability Tests (Plenge, 2018)

Sample ID	Location Ayawilca Zone	Head Grade (%)				Concentrate Grade (%)				Recovery (%)			
		Cu	Zn	Fe	S	Cu	Zn	Fe	S	Cu	Zn	Fe	S
AAFS-01	West	0.063	6.50	29.5	10.5	0.18	20.3	25.7	23.7	90.2	97.6	27.2	70.6
AAFS-02	West	0.027	9.00	28.9	6.81	0.08	31.0	21.5	21.6	81.4	97.2	21.0	89.6
AAFS-04	West	0.055	10.9	24.6	17.4	0.13	29.2	25.0	34.3	88.4	98.5	37.4	72.4
AAFS-06	West	0.029	10.5	23.1	14.1	0.08	35.3	19.1	29.5	82.7	97.6	24.0	60.5
ACFS-01	South	0.084	12.3	21.5	18.6	0.20	30.9	25.8	34.4	94.2	98.5	47.0	72.6
ACFS-02	South	0.035	7.93	36.1	9.17	0.14	38.3	22.7	25.5	76.8	92.6	12.1	53.4
ACFS-05	South	0.072	16.3	18.9	19.1	0.15	23.4	20.2	27.3	45.1	31.9	23.6	31.6
ACFS-06	South	0.031	6.51	7.83	6.32	0.14	35.9	15.5	27.1	81.7	99.3	35.8	77.2
ACFS-07	South	0.021	7.54	4.80	6.60	0.07	30.7	13.7	24.1	82.3	99.2	69.5	89.0
ACFS-09	South	0.072	11.1	37.2	29.0	0.17	18.1	37.0	35.7	55.9	37.4	22.9	28.3
ACFS-11	South	0.089	7.82	40.4	31.7	0.16	15.8	39.1	40.4	85.8	95.7	45.7	60.3
ACFS-12	Central	0.10	9.44	42.4	31.7	0.18	5.5	48.9	37.2	53.7	18.4	36.5	37.2
ACFS-13	Central	0.064	4.24	25.6	13.7	0.14	10.6	36.0	28.4	83.5	95.3	53.7	79.5
ACFS-14	Central	0.079	3.46	17.2	9.83	0.19	9.0	29.7	23.9	88.7	94.4	62.9	88.6
ACFS-15	East	0.056	7.52	29.2	8.47	0.22	35.9	21.2	27.6	80.1	96.2	14.6	65.7
ACFS-16	West	0.066	8.58	17.4	7.06	0.22	30.0	17.1	22.6	93.5	98.9	27.7	90.4
ACFS-17	West	0.050	14.51	31.5	35.49	0.10	30.3	27.1	41.9	75.2	78.3	32.2	44.3

Lead mineralization is limited and low grade in general, with only about 15% of zinc mineralization having higher than 0.2% Pb content. Figure 13-13 shows the distribution of the block model lead grades in zinc mineralization.

Therefore, the recovery of lead and silver as a separate concentrate will vary in performance, in terms of lead and silver recovery, zinc selectivity and lead-silver concentrate quality. More testwork is required on lead and silver metallurgy. For the PEA, performance has been largely assumed, based on similar deposits in the Cerro de Pasco region.

Figure 13-13: Distribution of Block Model Lead Grades in Zinc Mineralization



Note: Figure prepared by Transmin, 2019.

13.9 Ayawilca Tin Zone

The Ayawilca Tin Zone is not included in the PEA.

Metallurgical development is in the early stages. Pre-concentration of tin by flotation has shown promising results, but an adequate process flowsheet to a final tin concentrate is still to be developed.

13.9.1 Flowsheet Development

Flowsheet development for tin mineralization has been investigated in the following stages, where the phase numbering is based on the overall Ayawilca Project testwork sequence:

- Phase 0 (2016): SGS Mineral Services UK Ltd, Cornwall (SGS UK); flotation, magnetic and gravity separation

- Phase 0 (2016): conducted by ALS Mineralogy Pty Ltd in Brisbane (ALS Brisbane); mineral liberation analysis (MLA) mineralogy
- Phase 4 (2018): conducted by SGS Lakefield Research Limited (SGS Lakefield); advanced mineralogy
- Phase 5 (2019): conducted by XPS, flotation, magnetic and gravity separation.

13.9.2 Sample Locations

Figure 13-14 shows the locations of the drill samples tested with respect to the resource blocks with greater than 0.16% Sn.

13.9.3 Phase 0, SGS UK (2016)

SGS UK conducted scoping testwork on samples from the Ayawilca Tin Zone. The main objective of this work was to scope out the metallurgical conditions to produce a tin concentrate with saleable grades and reasonable recoveries.

SGS UK received 10 drill core intervals, and the samples were crushed and blended to form a composite that assayed 0.81% Sn and 0.12% Cu.

The main minerals present in this composite were pyrrhotite (62.8%), hematite (11.6%), pyrite (10.9%) and quartz (9.2%). The tin was present as cassiterite (1%).

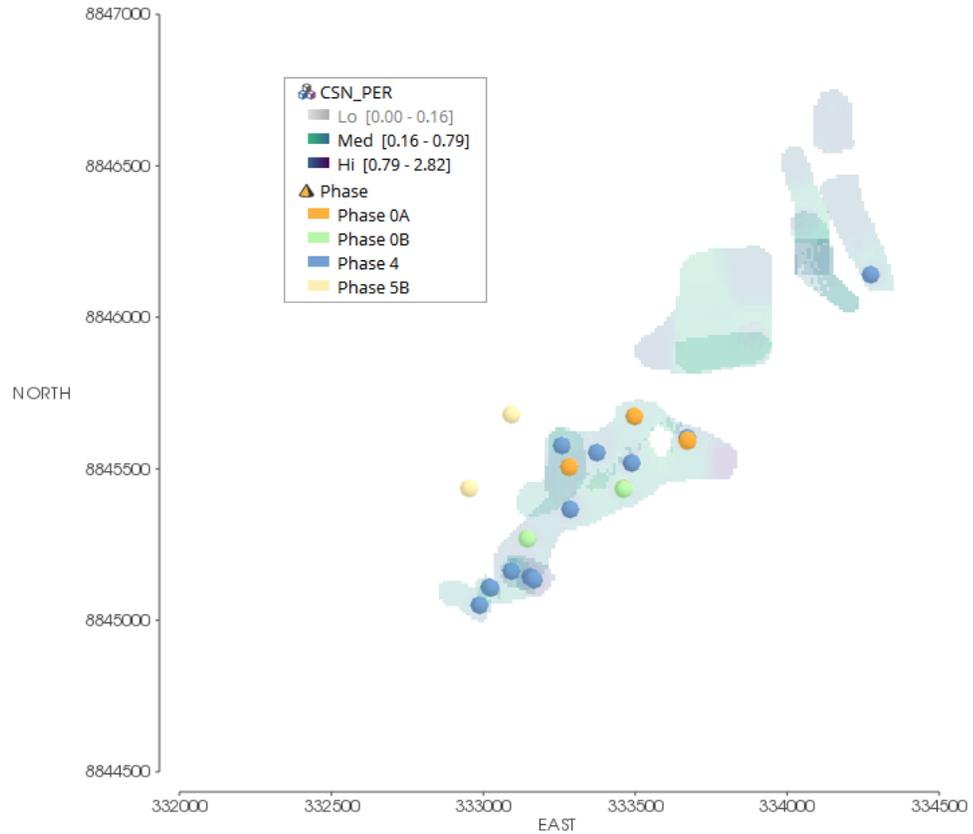
Gravity release analysis of the sized feed material showed that the tin started to liberate at a size around 125 µm. Magnetic separation was able to remove pyrrhotite from the sample; however, significant tin was lost to entrainment.

A bulk sulfide flotation test removed 97% of the sulphur (pyrrhotite) to the rougher concentrate with a loss of 39% Sn. After regrinding this concentrate and using a flotation cleaning stage, 13% of the tin loss was recovered, yielding a 74% Sn recovery to about 25% of the feed mass.

13.9.4 Phase 0, ALS (2016)

ALS Brisbane performed detailed MLA mineralogy was on three drill core assay reject intervals (Table 13-15). The tin in all three samples was predominantly cassiterite (>95%), with minor quantities of stannite. Two of the samples contained 85–90% pyrrhotite, while the third sample was dominated by quartz, pyrite, and siderite gangue.

Figure 13-14: Location of Tin Metallurgical Samples Tested By Phase



Note: Figure prepared by Transmin, 2019.

Table 13-15: MLA Cassiterite Grain Size Analysis Results

Percentile	Grain Size of Cassiterite (µm)		
	Sample A	Sample A	Sample A
P10	7	4	12
P20	14	7	20
P50	56	30	58
P80	121	172	208
P90	194	293	279

Note: percent passing values.

Liberation analysis indicated that 20–60% of the tin was liberated, but the samples characterized were -2 mm, and so these results are pessimistic. Image maps visually indicate that reasonably good liberation of cassiterite could be possible at around P80 76 to 106 μm .

13.9.5 Phase 4, SGS Lakefield (2018)

Twelve composites were formed from drill core assay reject samples. Each composite was assayed, screened and characterized by XRD. Results are provided in Table 13-16.

Eight samples were selected for further study. A sample of each of these composites was ground to P80 300 μm and sent to SGS Lakefield for QEMSCAN mineralogy. The mineral mass distribution calculated for the head samples is shown in Figure 13-15. Figure 13-16 shows a comparison of cumulative cassiterite grain size distribution.

SGS screened each sample at 150 μm . The coarse and fine fraction for each sample was subjected to QEMSCAN mineralogical modal analysis for the determination of mineral assemblage and liberation. The samples consisted of cassiterite in an iron sulphide, quartz, and siderite matrix.

Cassiterite liberation ranged from 25–66%, with an average of 40%. Binary middlings between cassiterite and iron sulphides ranged widely (5–30%), but complex particles were comprised both iron sulphides and quartz.

Cassiterite liberation was only 16% in the coarse +150 μm fraction, and 69% in the finer -150 μm fractions in all samples.

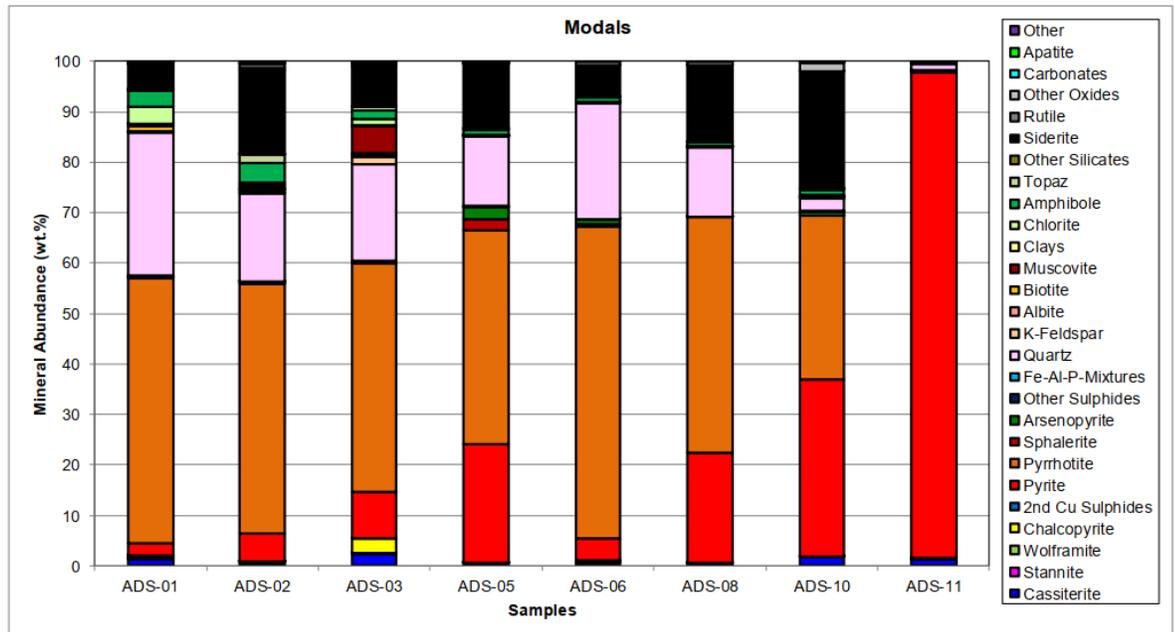
13.9.6 Phase 5, XPS (2019)

XPS tested a single tin composite, AEC-001, as part of the Phase 5 testwork program. The composite was formed from tin drillings from the Ayawilca Tin Zone in the South and Central Ayawilca Zones from intervals with grades from 0.29–3.0% Sn.

Table 13-16:Phase 4 Composite Head Assays

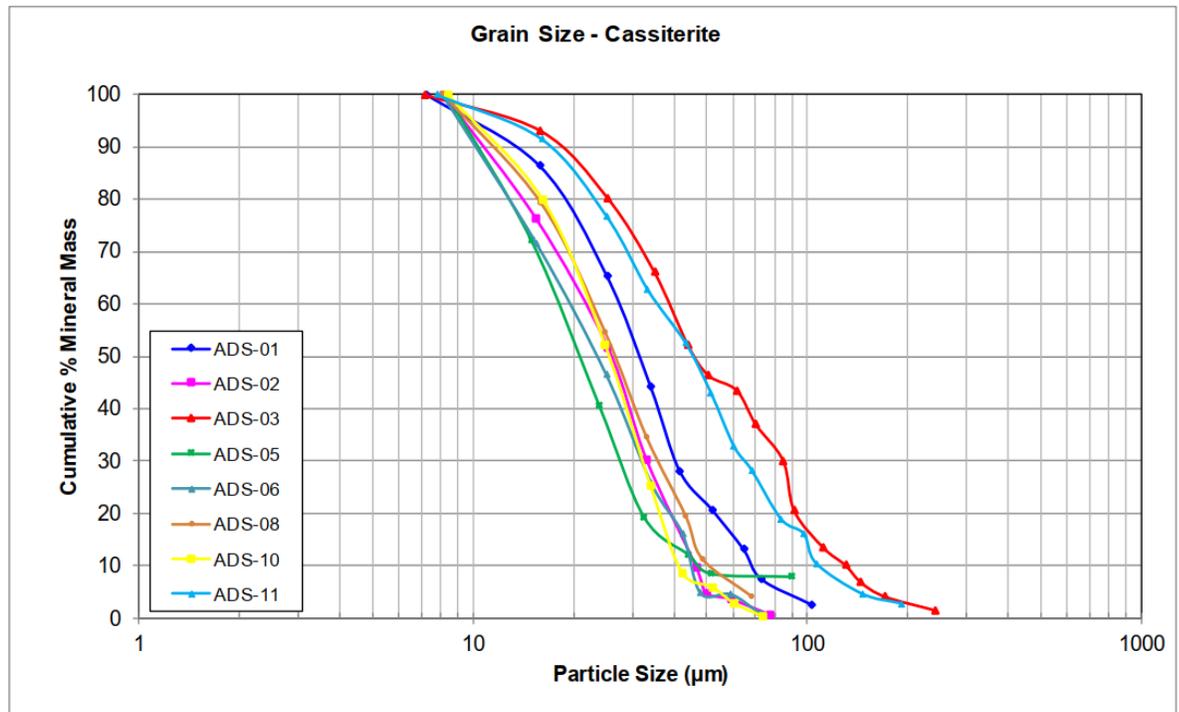
Element and Unit		Assay											
		ADS-01	ADS-02	ADS-03	ADS-04	ADS-05	ADS-06	ADS-07	ADS-08	ADS-09	ADS-10	ADS-11	ADS-12
Ag	g/t	3.6	3.0	30.7	5.4	8.9	13.1	4.2	4.8	22.4	6.0	0.6	5.9
Au	g/t	0.01	0.01	0.01	0.01	0.10	0.01	0.01	0.02	0.04	0.01	0.03	0.03
Cu	%	0.25	0.07	0.82	0.19	0.05	0.17	0.04	0.05	0.22	0.05	0.01	0.05
Pb	%	0.002	0.011	0.003	0.003	0.059	0.021	0.013	0.014	0.011	0.020	0.004	0.020
Zn	%	0.04	0.12	0.03	0.06	0.99	0.22	0.07	0.01	11.28	0.03	0.01	0.05
Fe	%	38.9	40.9	37.4	44.8	44.1	43.6	38.5	48.3	36.4	44.4	46.2	49.9
Sn	%	1.35	0.64	1.92	0.65	0.79	0.76	0.66	1.96	1.08	0.58	1.11	0.57
In	ppm	141	142	157	165	167	160	142	176	499	159	92	176
S _T	%	22.8	23.0	23.9	27.9	31.0	27.0	26.0	33.4	28.5	30.3	53.4	34.0
C _T	%	0.36	1.31	0.59	0.59	1.00	0.86	1.75	1.90	0.63	1.41	0.02	0.88

Figure 13-15:Mineral Mass Distribution Calculated for the Head Samples



Note: Figure from SGS Lakefield, 2018.

Figure 13-16: Comparison of Cumulative Grain Size Distribution for Cassiterite for the Samples



Note: Figure prepared by Transmin, 2019.

Testwork evaluated:

- The flotation of iron sulfides
- The direct flotation of tin
- Iron sulfide flotation followed by tin flotation
- Magnetic separation
- Gravity separation
- Iron sulfide flotation, and gravity concentration of the flotation tails.

The iron sulfide flotation was relatively insensitive to grind sizes between 45–106 µm.

The flotation of iron sulfides was selective against tin flotation, despite the very high mass pull to the concentrate (>70% of the feed). At P80 75 µm, 68.9% of the tin was

concentrated into 18.5% of the mass, upgrading the tin from 1.65% Sn in the feed, to 6.15% Sn in the flotation tailings.

The direct tin flotation was unsuccessful using the fatty acid collector at pH 4.5.

The flotation of tin from the iron sulfide flotation tails was also unsuccessful.

Magnetic separation tests on AEC-001 at grinds of P80 106 and 45 μm were conducted and were considered to be unsuccessful, giving poor recovery and selectivity.

Gravity separation of iron sulfide flotation tails using a Knelson concentrator achieved a 12% Sn recovery to a 56.8% Sn concentrate in open batch testing. Middlings contained a further 22% of the tin in a 7.2% Sn stream, which could potentially be treated to increase final recovery of tin under this regime.

13.9.7 Comments on Ayawilca Tin Zone Testwork

The preliminary testwork and characterization indicates that the tin mineralization is moderately refractory to standard processing techniques. Cassiterite is dense (SG = 7.0), so is usually beneficiated with gravity concentration, but the abundance of the associated pyrrhotite (SG = 4.6) complicates the gravity separation. Cassiterite in the Ayawilca Tin Zone is relatively fine grained (P50 of 30–60 μm), while gravity separation typically works best on coarse-grained particles.

However, it is promising that by using reverse flotation of pyrrhotite, about 70% Sn recovery was concentrated into a stream with over 6% Sn grade. That high grade of tin justifies further investigation into more intensive treatment routes such as fine grinding, flotation, gravity separation using higher gravitational forces such as a Falcon gravity separator, and pyrometallurgy and hydrometallurgy to make a commercial tin concentrate.

13.10 Colquipucro Silver Zone

The Colquipucro Silver Zone is not included in the PEA.

13.10.1 Sample Locations

Composite samples were formed from drill core and subjected to scoping leaching and flotation tests at SGS Lima. Core collar locations shown in Figure 13-17 and Figure 13-18. The composite head assays are provided in Table 13-17. Silver recovery by particle size is shown in Figure 13-19.

13.10.2 Metallurgical Testwork

The first round of leaching testwork in 2015 used a strong (1 g/L NaCN) cyanide leaching solution in bottle rolls tests at different particle sizes. The silver recovery was only around 50% for all composites, until the samples were ground to P80 75 µm, after which the recoveries improved significantly.

An average 80% Ag extraction was achieved at P80 75 µm particle size (Table 13-18). An average of 56% Ag extraction was achieved at P80 6 mm, indicating that tank leaching would achieve about 25% higher silver recovery than heap leaching.

A second round of tests in 2018 on the same composites was carried out using a reduced cyanide concentration (0.2 g/L NaCN) and lead nitrate addition to improve dissolution of silver sulfide minerals. Results are provided in Table 13-19. The silver recovery was reduced slightly to 71% Ag, but the cyanide consumption was reduced significantly from 3.1 kg/t to 0.58 kg/t.

The same composites were subjected to a non-selective bulk batch sulphide rougher flotation test, results of which are included in Table 13-20. All composites produced a reasonably high-grade silver concentrate in the rougher, with recoveries similar to the silver leaching recoveries.

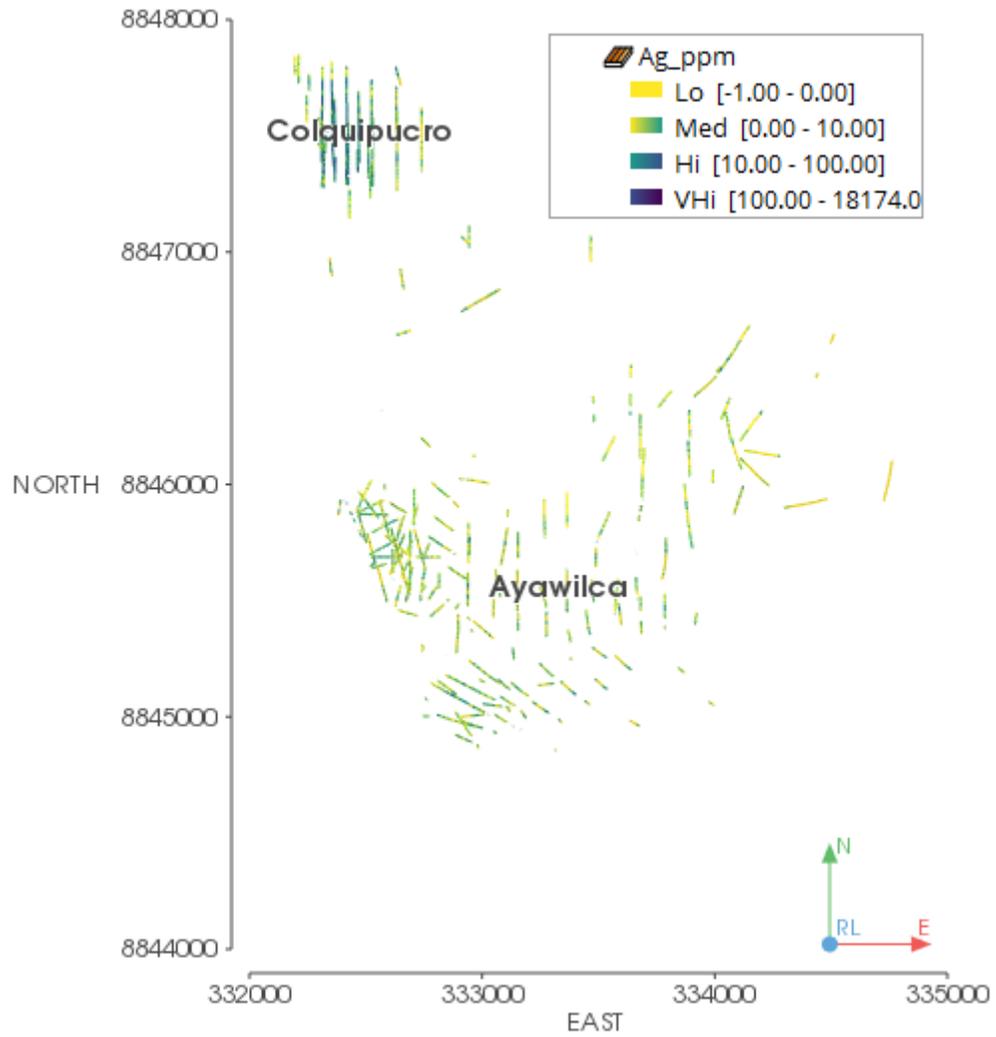
Cleaning testwork would be required to determine if a commercial concentrate could be produced. An alternative approach where the concentrate is leached with cyanide to produce silver doré could also be studied.

13.10.3 Recoveries

These results indicate that around 50% recovery could be achieved by heap leaching, or 60–70% of the silver could be recovered by either conventional tank cyanidation leaching, or flotation, at P80 75 µm.

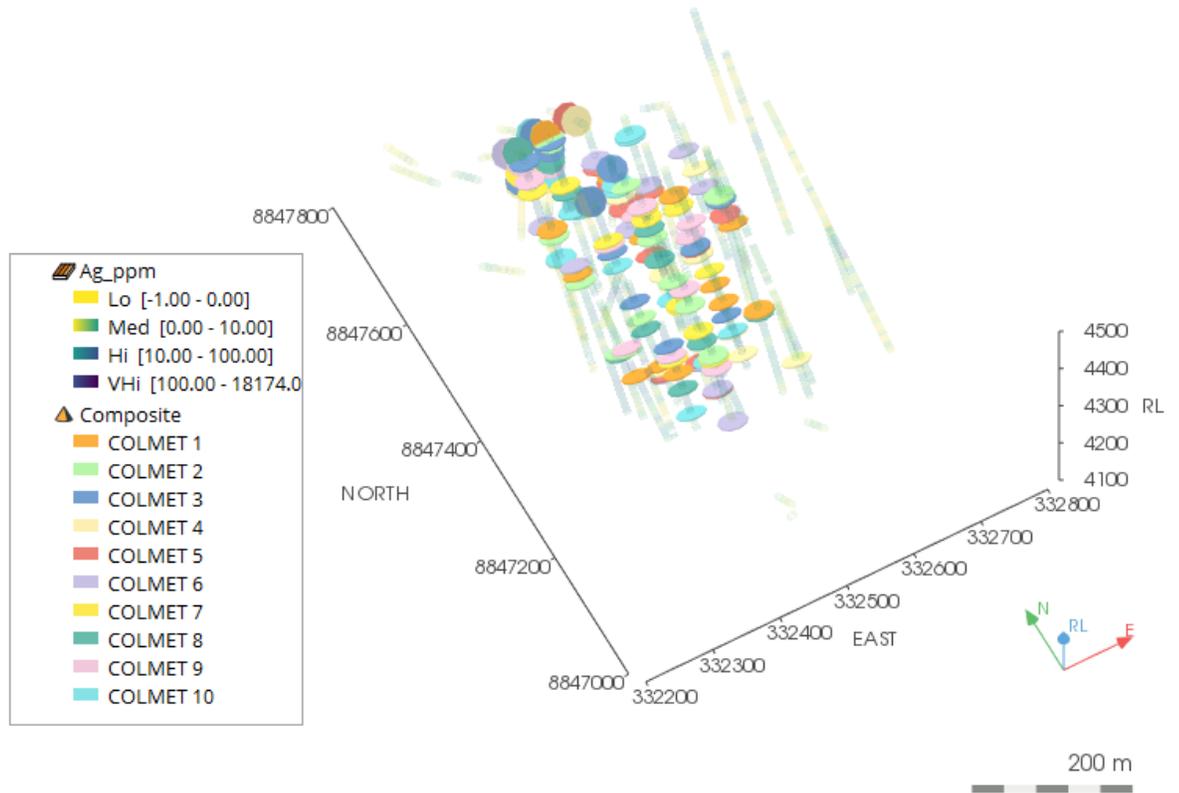
No further leaching testwork was conducted, and there remains ample opportunity to improve performance with further study.

Figure 13-17: Location Plan, Colquipucro Silver Zone Drill Core Used for Composites



Note: Figure prepared by Transmin, 2019.

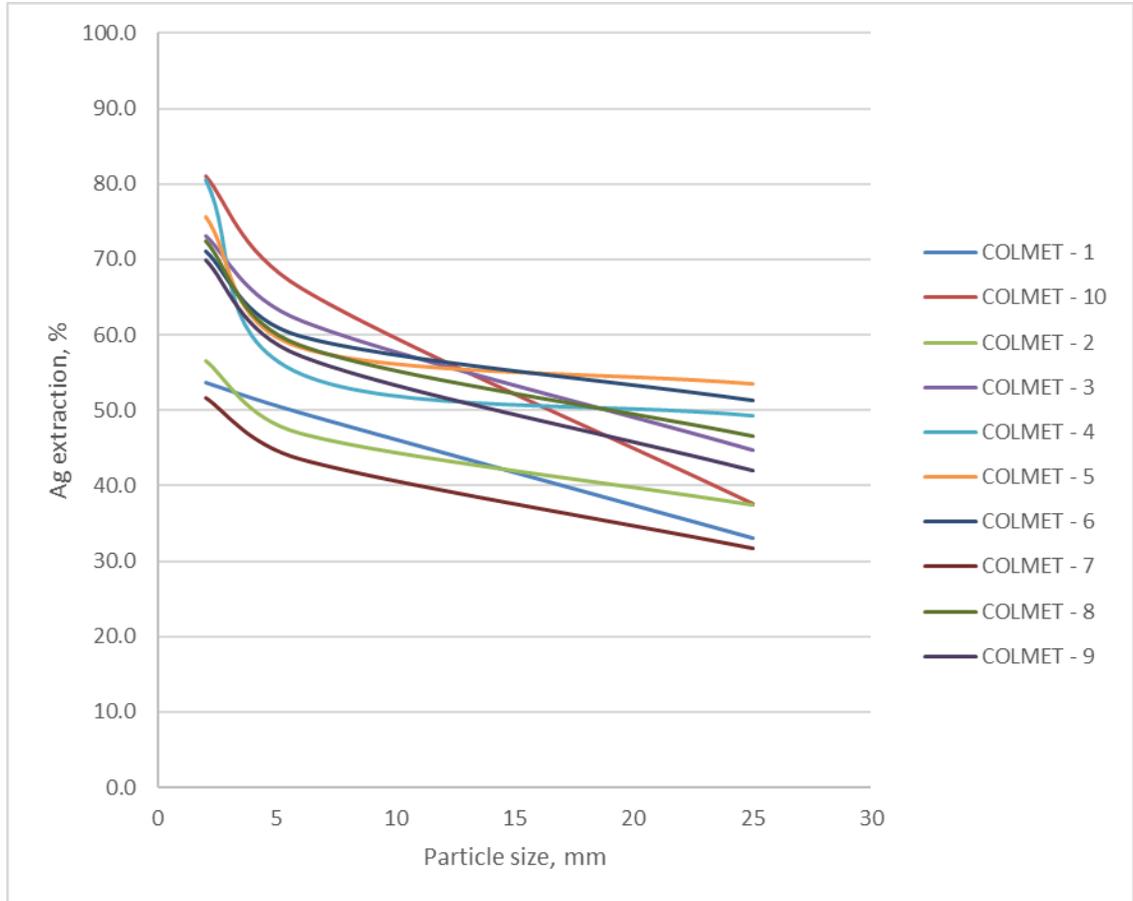
Figure 13-18: Inset Plan, Colquipucro Silver Zone Drill Core Composite Locations



Note: Figure prepared by Transmin, 2019.

Table 13-17:Phase 2 Composite Head Assays

Element	Unit	COLMET 1	COLMET 2	COLMET 3	COLMET 4	COLMET 5	COLMET 6	COLMET 7	COLMET 8	COLMET 9	COLMET 10
Au	g/t	0.009	<0.005	0.006	<0.005	<0.005	0.009	<0.005	<0.005	0.007	<0.005
Ag	g/t	20.72	39.61	89.14	233.09	59.86	135.98	16.28	81.95	224.32	137.43
Al	%	0.24	0.35	0.33	2.18	1.67	3.01	0.29	0.38	0.51	0.52
Ca	%	0.01	<0.01	<0.01	0.18	0.35	0.42	0.01	<0.01	0.03	0.02
Fe	%	2.81	2.13	2.19	8.69	12.48	14.08	2.29	2.36	1.97	3.2
K	%	0.02	0.04	0.03	0.65	0.31	0.28	0.01	0.01	0.08	0.12
Mg	%	<0.01	<0.01	<0.01	0.14	0.5	0.48	<0.01	<0.01	<0.01	0.01
Na	%	<0.01	0.01	0.02	0.12	0.14	0.16	0.01	0.05	0.03	0.04
P	%	0.01	<0.01	<0.01	0.22	0.15	0.26	<0.01	<0.01	<0.01	0.03
S	%	0.27	0.21	0.17	4.39	1.74	1.74	0.13	0.1	0.23	0.9
Ti	%	0.03	0.04	0.03	0.06	0.03	0.04	0.03	0.03	0.03	0.04
Fe	%	3.07	2.36	2.25	9.01	12.93	15.54	2.42	2.47	2.18	3.34
S_Total	%	0.28	0.21	0.17	4.46	1.91	1.89	0.14	0.11	0.23	0.92
Ag	PPM	21.2	36.4	88.6	>100	55.6	>100	15.8	84.2	>100	>100
As	PPM	243	132	280	588	42	103	195	335	742	85
Ba	PPM	20	12	49	131	153	78	10	15	58	47
Be	PPM	<0.5	<0.5	<0.5	<0.5	0.6	0.7	<0.5	<0.5	<0.5	<0.5
Bi	PPM	<5	<5	<5	<5	<5	5	<5	<5	<5	<5
Cd	PPM	1	1	1	6	33	20	2	1	2	<1
Co	PPM	3	2	2	9	10	8	2	2	2	2
Cr	PPM	45	39	34	55	34	35	28	30	33	35
Cu	PPM	13.2	23	34.4	83.3	33.4	59.9	13.8	32.4	65.6	24.1
Ga	PPM	<10	<10	<10	<10	13	16	<10	<10	<10	<10
La	PPM	3.6	2.7	3.7	9.1	5.4	6.7	4	4.4	3.3	3.5
Li	PPM	7	9	10	30	32	57	12	13	11	10
Mn	PPM	2979	2780	657	4757	>10000	>10000	2653	2597	2793	828
Mo	PPM	5	4	3	6	2	2	3	3	3	4
Nb	PPM	3	2	<1	3	8	10	<1	<1	1	<1
Ni	PPM	8	7	6	25	30	23	6	4	6	7
Pb	PPM	1145	780	1098	>10000	1198	2944	848	1240	3033	2249
Sb	PPM	25	21	39	45	26	64	31	27	74	31
Sc	PPM	1.1	1.4	0.8	4	3.4	3.4	0.6	1.5	1	0.7
Sn	PPM	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	PPM	5.7	4.1	4.4	26	31.4	25	4.2	4	6.4	18
Tl	PPM	2	3	2	9	24	32	<2	3	3	5
V	PPM	7	6	6	45	49	59	6	7	8	14
W	PPM	<10	<10	<10	<10	<10	<10	<10	<10	15	<10
Y	PPM	1.2	1.1	1.2	11.1	28.6	13.2	1	1.1	1.2	2.2
Zn	PPM	375.5	493.7	602.5	2052.7	5379.9	5715.5	562.2	367.1	890.7	90
Zr	PPM	8.6	11	11.3	41.3	30.9	29.5	10	14.9	13.1	14.5
Cu	PPM	14	23	33	91	34	59	14	34	72	26

Figure 13-19: Silver Recovery by Particle Size


Note: Figure prepared by Transmin, 2019.

Table 13-18: Scoping Cyanidation Leach Test Results

Composite	Particle size	Leaching time (days)	Consumption (kg/t)		Head Assay (g/t Ag)	Recovery (% Ag)
			NaCN	CaO		
COLMET-1	25 mm	10	2.4	1.4	20.7	33.1
	6 mm	10	2.5	1.5	20.7	49.7
	2 mm	3	1.7	1.9	20.7	53.7
	75 µm	3	2.6	2.1	20.7	74.3
COLMET-2	25 mm	10	3.3	0.8	39.6	37.5
	6 mm	10	3.4	1.2	39.6	47.0
	2 mm	3	1.8	1.5	39.6	56.6
	75 µm	3	2.6	1.6	39.6	78.0
COLMET-3	25 mm	10	2.0	0.8	89.1	44.6
	6 mm	10	2.1	1.4	89.1	61.9
	2 mm	3	1.8	1.3	89.1	73.1
	75 µm	3	2.7	1.7	89.1	84.1
COLMET-4	25 mm	10	9.6	30.9	233.1	49.3
	6 mm	10	9.7	34.2	233.1	54.8
	2 mm	3	5.1	30.9	233.1	80.6
	75 µm	3	5.9	33.8	233.1	88.9
COLMET-5	25 mm	10	4.1	13.3	59.9	53.5
	6 mm	10	4.2	18.4	59.9	58.3
	2 mm	3	3.0	14.2	59.9	75.0
	2 mm	3	3.0	14.3	59.9	76.3
	75 µm	3	4.0	15.1	59.9	82.0
COLMET-6	25 mm	10	5.5	15.3	136.0	51.2
	6 mm	10	6.0	19.4	136.0	59.8
	2 mm	3	3.8	25.2	136.0	71.1
	75 µm	3	4.0	28.6	136.0	75.1
COLMET-7	25 mm	10	2.5	1.0	16.3	31.7
	6 mm	10	3.3	1.1	16.3	43.5
	2 mm	3	1.2	2.0	16.3	51.6

Composite	Particle size	Leaching time (days)	Consumption (kg/t)		Head Assay (g/t Ag)	Recovery (% Ag)
			NaCN	CaO		
	75 µm	3	3.1	2.1	16.3	66.7
COLMET-8	25 mm	10	2.8	1.0	82.0	46.6
	6 mm	10	2.9	1.8	82.0	58.6
	2 mm	3	1.6	2.2	82.0	72.4
	75 µm	3	2.5	2.3	82.0	84.6
COLMET-9	25 mm	10	5.0	1.5	224.3	42.0
	6 mm	10	5.9	1.6	224.3	57.1
	2 mm	3	2.3	1.9	224.3	69.8
	75 µm	3	3.2	2.2	224.3	82.4
COLMET-10	25 mm	10	3.5	3.0	137.4	37.7
	6 mm	10	3.6	3.2	137.4	66.2
	2 mm	3	2.8	3.8	137.4	81.1
	75 µm	3	3.0	4.0	137.4	88.1
	75 µm	3	3.0	3.9	137.4	87.8

Table 13-19: Optimization Cyanidation Leach Test Results

Composite	NaCN (g/L)	Lead Nitrate (g/t)	Consumption (kg/t)		Head Grade (Ag, g/t)		Recovery (Ag, %)
			NaCN	CaO	Assay	Calc	
COLMET 1	0.2	20	0.52	1.28	17.8	18.6	71.7
COLMET 2	0.2	20	0.30	0.74	31.6	33.1	68.4
COLMET 5	0.2	20	0.69	6.47	56.6	52.9	61.6
COLMET 6	0.2	20	0.69	7.96	126.2	114.9	76.0
COLMET 8	0.2	20	0.69	1.89	79.2	80.2	77.4

Table 13-20: Bulk Flotation Test Results

Composite	Head Grade (Ag g/t)		Conc Ro (Ag, g/t)	Recovery Ro (Ag, %)
	Assay	Calc		
COLMET 1	17.8	18.31	418	56.1
COLMET 2	31.6	33.12	888	60.2
COLMET 5	56.6	51.99	480	58.9
COLMET 6	126.2	133.65	1,428	63.4
COLMET 8	79.2	77.83	2,494	68.1

14.0 MINERAL RESOURCE ESTIMATES

14.1 Introduction

RPA estimated Mineral Resources for the Ayawilca Zinc and Tin Zones using the drill results available to 9 October, 2018. The drill database includes 177 drill holes totalling 68,173 m.

The Colquipucro Silver Zone Mineral Resource estimate remains current as of the effective date of 25 May, 2016. There has been no drilling at the Colquipucro Silver Zone since 2015.

14.2 Ayawilca Zinc and Tin Zones

RPA received header, survey, assay, alteration, and geology data from Tinka in Microsoft Excel format. Data was amalgamated and parsed as required, converted to ASCII, and imported into Dassault Systèmes GEOVIA GEMS Version 6.8 (GEMS) for Mineral Resource modelling. Tinka provided an entire Leapfrog project containing latest geological interpretations. RPA used the project to develop a series of 3D resource wireframes for both the Ayawilca Zinc and Tin Zones.

Data verification of the drill hole database included manual verification against hardcopy and original digital sources, a series of digital queries, and a review of Tinka's QA/QC procedures and results. No discrepancies were identified, and RPA is of the opinion that the drill hole database is valid and suitable to estimate Mineral Resources for the Ayawilca Zinc and Tin Zones.

14.2.1 Geological Models

Wireframe models of mineralized zones were used to constrain the block grade interpolation process. A Leapfrog Geo 4.4.0 vein system modelling tool was used to generate interpretation of the mineralization at a nominal cut-off NSR value of US\$50/t for both the Ayawilca Zinc and Tin Zones. A minimum thickness of 3 m was applied, with rare exceptions where a 2 m thickness was used to allow for a better continuity of the modelled domain. Occasionally, lower-grade intersections were included to maintain continuity. At model extremities, the wireframe models were extrapolated up to 50 m beyond the last drill hole section, however, when a thin intersection was at the edge of the wireframe, the domain was extended to only 25 m.

RPA built 40 domains in the following main areas (Figure 14-1): Central, South, West and East Ayawilca Zones, collectively referred to as the Ayawilca Zinc Zone, and the Ayawilca Tin Zone.

The Central Ayawilca Zone is the largest area at Ayawilca. It comprises nine stacked domains, ranging from 160–340 m below surface, one of which has three parts and one is vertical. The Central Ayawilca Zone extends for 1,230 m east–west and 580 m north–south. The thickness of individual domains ranges from 3–27 m and averages 11 m. All domains dip shallowly to the southeast. The Central Area is intersected by 34 drill holes.

The South Ayawilca Zone is currently the highest-grade zinc area and second largest within the Ayawilca Zinc Zone. It consists of five stacked domains ranging from 60–430 m below surface, extending for 1,000 m in the northeast–southwest direction and 300 m in the northwest–southeast direction. The thickness of individual domains ranges from 2–47 m and averages 14 m. All domains dip shallowly to the northeast. The South Ayawilca Zone is intersected by 26 drill holes.

The West Ayawilca Zone is the second-highest grade zinc area within the Ayawilca Zinc Zone. It comprises eight stacked domains ranging from 120–350 m below surface, extending for 630 m east–west and 640 m north–south. The thickness of individual domains ranges from 2–60 m and averages 13 m. All domains dip shallowly to the southeast. The West Ayawilca Zone is intersected by 42 drill holes.

The East Ayawilca Zone consists of four domains ranging from 250–450 m below surface, extending for 520 m east–west and 700 m north–south. The thickness of individual domains ranges from 2–33 m and averages 14.5 m. All domains dip shallowly to the south and southeast. The East Ayawilca Zone is intersected by 10 drill holes.

The main Ayawilca Tin Zone is located beneath the Central and South Ayawilca Zones at the unconformity with the Devonian Excelsior Group. The other smaller domains are interlayered with the South Ayawilca Zone domains. There are eight individual zones ranging from 150–640 m below surface. The main area extends for 1,800 m northeast–southwest and 380 m northwest–southeast, shallowly dipping to the northeast. The thickness of individual domains ranges from 2–46 m and averages 10 m. The Ayawilca Tin Zone is intersected by 35 drill holes.

The rock codes assigned to each wireframe are summarized in Table 14-1.

Figure 14-1: Ayawilca Model Wireframe View

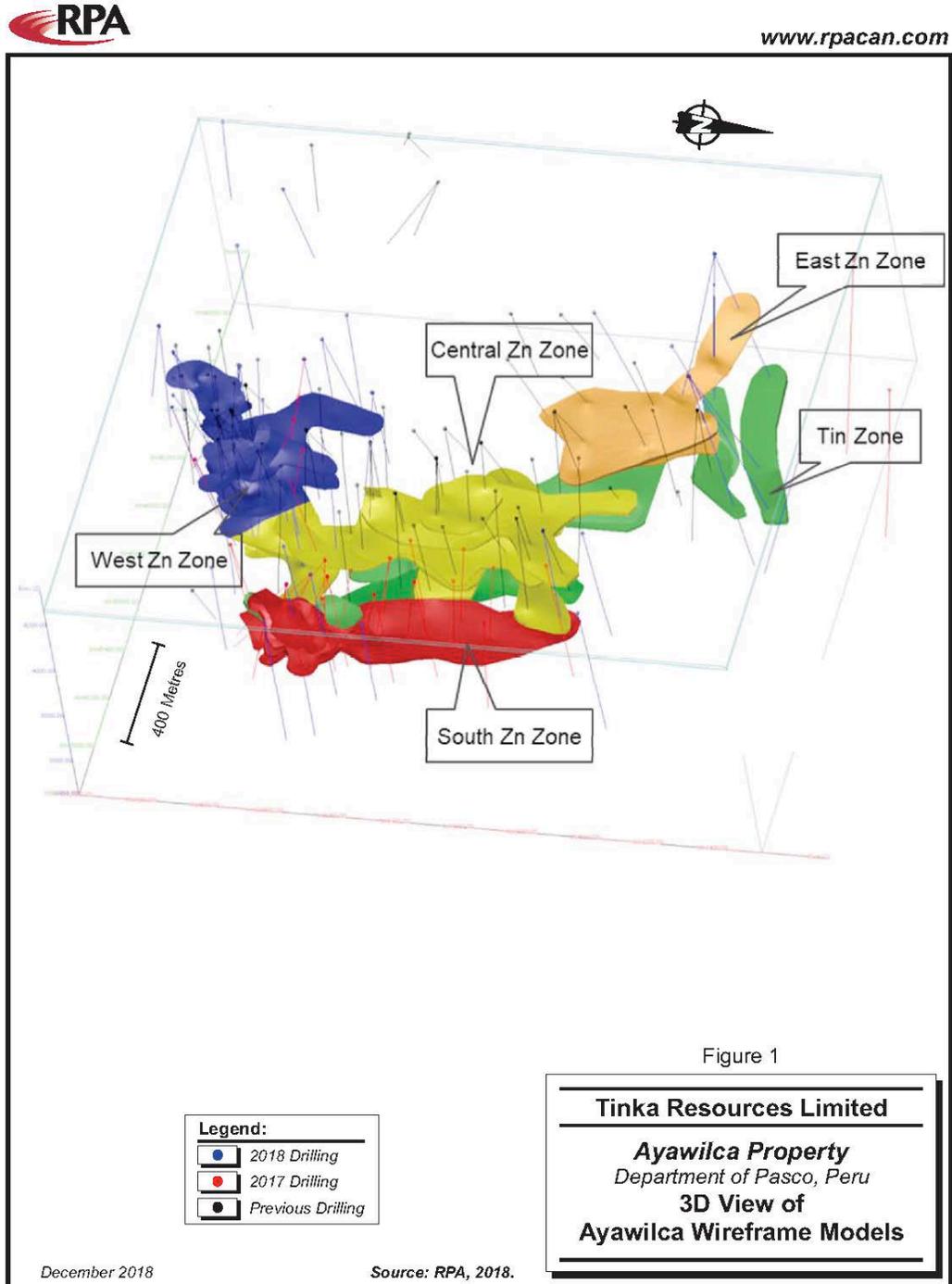


Table 14-1: Rock Codes, Ayawilca Zinc and Tin Zones

West Ayawilca	South Ayawilca	East Ayawilca	Central Ayawilca	Ayawilca Tin
West1(101)	SouthA (401)	East1 (301)	Central1 (201)	Tin1 (1001)
West2 (102)	SouthB (402)	East2 (302)	Central2 (202)	Tin2 (1002)
West3 (103)	SouthC (403)	East3 (303)	Central3 (203)	Tin3 (1003)
West4 (104)	SouthD (404)	East4 (304)	Central4 (204)	Tin4 (1004)
West6 (106)	SouthD1 (406)		Central5 (205)	Tin5 (1005)
West 3A (107)	SouthA2 (405)		Central6 (206)	Tin5A (1010)
West3B (108)			Central8 (208)	Tin6 (1006)
West9 (109)			West3 camp (120)	Tin7 (1007)
			West 5 (105)	Tin8 (1008)
				Tin9A (1019)
				Tin9B (1029)

14.2.2 Exploratory Data Analysis

Assay values located inside the wireframe models were tagged with domain identifiers and exported for statistical analysis. Results were used to help verify the modelling process. Statistics by zone are summarized in Table 14-2.

14.2.3 Density Assignment

A total of 440 density measurements are located within the wireframe models representing the Ayawilca Zinc Zone and a total of 19 density measurements are located within the Ayawilca Tin Zone. After removing outliers from the low and high ends of the distribution (below 3.0 t/m³ and above 4.2 t/m³), RPA used the average of these measurements for each area (Table 14-3).

14.2.4 Grade Capping/Outlier Restrictions

Review of the assay data using histograms and probability plots within the wireframe domains in each zone, and a visual inspection of high-grade values on vertical sections suggest that cutting of erratic values is warranted and appropriate.

Table 14-4 summarizes capping levels for each element and domain and Table 14-5 lists the descriptive statistics of cut resource assay values by zone.

Table 14-2: Assay Data Descriptive Statistics

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
<i>Central Ayawilca Zone</i>						
Count	448	448	448	448	n/a	n/a
Min	0.02	0.00	0	0.10	n/a	n/a
Max	24.60	4.07	626	1,718	n/a	n/a
Mean	4.19	0.28	56	17.32	n/a	n/a
Variance	11.95	0.46	6,858	7,335	n/a	n/a
St Dev	3.46	0.68	89.55	85.64	n/a	n/a
CV	0.82	2.40	1.46	4.94	n/a	n/a
<i>East Ayawilca Zone</i>						
Count	176	176	176	176	n/a	n/a
Min	0.07	0.00	0	0.10	n/a	n/a
Max	22.68	5.74	531	1,806	n/a	n/a
Mean	4.63	0.27	51	36.49	n/a	n/a
Variance	12.70	0.40	8,020	30,820	n/a	n/a
St Dev	3.56	0.63	89.55	175.56	n/a	n/a
CV	0.77	2.33	1.77	4.81	n/a	n/a
<i>West Ayawilca Zone</i>						
Count	947	947	947	947	n/a	n/a
Min	0.02	0.00	0	0.10	n/a	n/a
Max	49.34	12.12	2,000	837.00	n/a	n/a
Mean	5.98	0.29	62.63	20.46	n/a	n/a
Variance	46.23	0.77	22,901	2,096.00	n/a	n/a
St Dev	6.80	0.88	151.3	45.79	n/a	n/a
CV	1.14	3.07	2.42	2.24	n/a	n/a
<i>South Ayawilca Zone</i>						
Count	538	538	538	538	n/a	n/a
Min	0.03	0.00	0	0.74	n/a	n/a
Max	46.28	17.05	2,070	18,174.00	n/a	n/a
Mean	8.15	0.24	142	66.87	n/a	n/a

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
Variance	82.79	0.92	72,840	634,030.00	n/a	n/a
St Dev	9.10	0.96	269.89	796.26	n/a	n/a
CV	1.12	3.92	1.90	11.91	n/a	n/a
<i>Ayawilca Tin Zone</i>						
Count	n/a	n/a	n/a	324	324	324
Min	n/a	n/a	n/a	0.12	0.01	0.00
Max	n/a	n/a	n/a	513.00	9.08	2.07
Mean	n/a	n/a	n/a	14.57	0.76	0.22
Variance	n/a	n/a	n/a	1,079.00	1.14	0.09
St Dev	n/a	n/a	n/a	32.85	1.07	0.29
CV	n/a	n/a	n/a	2.25	1.41	1.37

Note: St Dev = standard of deviation; CV = co-efficient of variation.

Table 14-3: Density Descriptive Statistics

Ayawilca Zone	Count	Minimum (t/m ³)	Maximum (t/m ³)	Mean (t/m ³)	Mean (outliers removed) (t/m ³)	Assigned (t/m ³)
Central	59	2.56	4.35	3.292	3.500	3.5
East	4	3.21	3.72	3.485	3.485	3.5
South	123	2.62	4.60	3.678	3.743	3.7
West	254	2.58	4.46	3.401	3.549	3.5
Tin	19	3.47	4.35	3.931	3.908	3.9

Table 14-4: Capping Levels

Ayawilca Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
Central	No cap	No cap	350	100	n/a	n/a
East	No cap	No cap	350	100	n/a	n/a
South	No cap	No cap	550	175	n/a	n/a
West	No cap	No cap	500	100	n/a	n/a

Ayawilca Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
Tin	n/a	n/a	n/a	100	4	No cap

Table 14-5: Descriptive Capped Assay Statistics

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
<i>Central Ayawilca Zone</i>						
Count	448	448	448	448	n/a	n/a
Min	0.02	0.00	0	0.10	n/a	n/a
Max	24.60	4.07	350	100.00	n/a	n/a
Mean	4.19	0.28	55	12.58	n/a	n/a
Variance	11.95	0.46	5,721	327.6	n/a	n/a
St Dev	3.46	0.68	76	18.1	n/a	n/a
CV	0.82	2.40	1.4	1.44	n/a	n/a
<i>East Ayawilca Zone</i>						
Count	176	176	176	176	n/a	n/a
Min	0.07	0.00	0.0	0.10	n/a	n/a
Max	22.68	5.74	350	100.00	n/a	n/a
Mean	4.63	0.27	47	16.69	n/a	n/a
Variance	12.70	0.40	5,603	547.00	n/a	n/a
St Dev	3.56	0.63	75	23.39	n/a	n/a
CV	0.77	2.33	1.6	1.40	n/a	n/a
<i>West Ayawilca Zone</i>						
Count	947	947	947	947	n/a	n/a
Min	0.02	0.00	0	0.10	n/a	n/a
Max	49.34	12.12	500	100.00	n/a	n/a
Mean	5.98	0.29	56	16.84	n/a	n/a
Variance	46.23	0.77	10,520	519.90	n/a	n/a
St Dev	6.80	0.88	102.6	22.80	n/a	n/a
CV	1.14	3.07	1.84	1.35	n/a	n/a
<i>South Ayawilca Zone</i>						

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
Count	538	538	538	538	n/a	n/a
Min	0.03	0.00	0.01	0.74	n/a	n/a
Max	46.28	17.05	550	175.00	n/a	n/a
Mean	8.15	0.24	113.1	24.08	n/a	n/a
Variance	82.79	0.92	23,998	1,112.00	n/a	n/a
St Dev	9.10	0.96	154.9	33.34	n/a	n/a
CV	1.12	3.92	1.37	1.38	n/a	n/a
<i>Ayawilca Tin Zone</i>						
Count	n/a	n/a	n/a	324	324	324
Min	n/a	n/a	n/a	0.12	0.01	0.00
Max	n/a	n/a	n/a	100.00	4.00	2.07
Mean	n/a	n/a	n/a	13.26	0.71	0.22
Variance	n/a	n/a	n/a	325.30	0.66	0.09
St Dev	n/a	n/a	n/a	18.04	0.81	0.29
CV	n/a	n/a	n/a	1.36	1.14	1.37

Note: St Dev = standard of deviation; CV = co-efficient of variation.

RPA was able to differentiate the distribution of zinc, indium, and silver between the various areas of the Ayawilca Zinc Zone. The manto style of zinc mineralization suggests that capping of the zinc values is not necessary as the higher zinc grades are reasonably controlled by the wireframe models. In the Central and East Ayawilca Zones, indium capping was set at 350 ppm, as indium concentration is considerably lower than that in the South and West Ayawilca Zones. There is a significantly higher silver content in the South Ayawilca Zone, which assay capping at 175 g/t Ag.

14.2.5 Composites

Sample lengths range from 0.5 m to 2.5 m within the resource domain wireframe models with 70% of samples taken at 2 m intervals. Given these distributions, and considering the width of the mineralization, RPA chose to composite to 2 m lengths. Assays within the wireframe domains were composited using the downhole compositing method, which starts at the first mineralized wireframe boundary from the

collar and resets at each new wireframe boundary. Implicit missing intervals within the modeled domains where core was not recovered (marked "void") were ignored during compositing. The complete list of the ignored intervals is presented in Table 14-6. Composites less than 0.5 m, located at the bottom of the mineralized intercept, were removed from the database. Table 14-7 lists descriptive statistics of the composites by zone.

14.2.6 Estimation/Interpolation Methods

Grades were interpolated by inverse distance weighting to the third power (ID3) with a minimum of four to a maximum of six composites per block estimate for first pass, and a minimum of one to a maximum of five composites per block estimate in the second pass. A maximum of three composites per drill hole was applied during the first pass to inform interpolated blocks by at least two boreholes. The search ellipse varied slightly by domain (Table 14-8).

Zinc, indium, silver, and lead were interpolated for the Ayawilca Zinc Zone. Tin, copper, and silver were interpolated for the Ayawilca Tin Zone.

Hard boundaries were used to limit the use of composites between wireframe boundaries. Soft boundaries were applied between the South A, Central 4, and Central 5 Ayawilca Zones as they share outside edges.

Figure 14-2 is a section view of the model and Figure 14-3 and Figure 14-4 show plan views.

The influence of higher-grade composites for some metals within the Ayawilca Zinc and Tin Zones was spatially restricted. For the Ayawilca Tin Zone, the zone of influence for composites greater than 2% Sn was restricted to 50 x 50 x 20 m and for copper composites greater than 0.75% Cu, to 30 x 30 x 15 m. For the Ayawilca Zinc Zone, the zone of influence for lead composites greater than 2% Pb was also restricted to 30 x 30 x 15 m.

The GEMS block model blocks are 10 x 10 x 5 m. A partial block model is used to manage blocks partially filled by mineralized rock types, including blocks along the edges of the zones. A partial model has a parallel block model containing the percentage of mineralized rock types contained within each block.

Table 14-6: List of Implicit Missing Intervals Ignored

Hole ID	From (m)	To (m)	Length (m)	Lithological Unit	Lithological Description in Database
A13-009	326.7	331.1	4.4	Pu	Void, interval with no recovery
A17-061	198.8	201.9	3.1	Pu	No recovery
A17-070	330.2	331.1	0.9	Pu	No recovery
A17-070	332.1	335.5	3.4	Pu	No recovery
A17-071	318.7	321.1	2.4	Pu	No recovery
A17-071	325.4	327.2	1.8	Pu	No recovery
A17-071	357.6	358.6	1.0	Pu	No recovery
A17-075	371.6	373.3	1.7	Pu	No recovery
A18-133	141.5	142	0.5	MGo	Void, interval with no recovery
DD52B	275.6	277.6	2.0	Pu	Void, interval with no recovery

Table 14-7: Composite Descriptive Statistics

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
<i>Central Ayawilca Zone</i>						
Count	380	380	380	380	n/a	n/a
Min	0.11	0.00	0	0.1	n/a	n/a
Max	20.26	3.78	350	100	n/a	n/a
Mean	4.15	0.27	54	12.42	n/a	n/a
Variance	8.57	0.40	4,668	289.9	n/a	n/a
St Dev	2.93	0.64	68	17.02	n/a	n/a
CV	0.71	2.34	1.28	1.37	n/a	n/a
<i>East Ayawilca Zone</i>						
Count	151	151	151	151	n/a	n/a
Min	0.1	0.00	0.03	0.10	n/a	n/a
Max	17.19	3.72	350	100.00	n/a	n/a
Mean	4.45	0.24	45	16.22	n/a	n/a
Variance	7.74	0.24	4,644	486.80	n/a	n/a
St Dev	2.78	0.49	68	22.06	n/a	n/a

Zone	Zn (%)	Pb (%)	In (ppm)	Ag (g/t)	Sn (%)	Cu (%)
CV	0.63	2.08	1.52	1.36	n/a	n/a
<i>West Ayawilca Zone</i>						
Count	841	841	841	841	n/a	n/a
Min	0.04	0.00	0	0.1	n/a	n/a
Max	48.91	7.58	500	100	n/a	n/a
Mean	5.68	0.26	58	15.90	n/a	n/a
Variance	32.73	0.56	10,142	406.3	n/a	n/a
St Dev	5.72	0.75	101	20.16	n/a	n/a
CV	1.01	2.83	1.74	1.27	n/a	n/a
<i>South Ayawilca Zone</i>						
Count	442	442	442	442	n/a	n/a
Min	0.03	0.00	0	0.76	n/a	n/a
Max	40.89	7.22	550	175.00	n/a	n/a
Mean	7.73	0.23	106	23.43	n/a	n/a
Variance	59.50	0.43	18,766	936.80	n/a	n/a
St Dev	7.71	0.66	136.99	30.61	n/a	n/a
CV	1.00	2.84	1.29	1.31	n/a	n/a
<i>Ayawilca Tin Zone</i>						
Count	n/a	n/a	n/a	285	285	285
Min	n/a	n/a	n/a	0.36	0.01	0.00
Max	n/a	n/a	n/a	100.00	4.00	2.07
Mean	n/a	n/a	n/a	13.47	0.66	0.22
Variance	n/a	n/a	n/a	300.20	0.46	0.07
St Dev	n/a	n/a	n/a	17.33	0.68	0.27
CV	n/a	n/a	n/a	1.29	1.02	1.25

Table 14-8: Block Estimate Search Strategy

Name of Search Ellipse in GEMS	Domain (Rock Type)	Z (°)	Y (°)	Z (°)
DIPEAST	West4 (104), West 3A (107), Tin1 (1001), Central1 (201), Tin2 (1002), Tin5A (1010), Tin8 (1008)	00	10	00
DIPEAST2	West2 (102), West3 (103), West3 camp (120), Central2 (202), West 5 (105), Central3 (203), Central4 (204), East4 (304), Central6 (206), Tin3 (1003), Tin4 (1004), Tin5 (1005), Tin6 (1006)	00	15	00
DIPEAST3	SouthB (402), Tin7 (1007), Tin9A (1019),	00	25	00
FLAT	Central5 (205), SouthA2 (405), Tin9B (1029)	00	00	00
DIPSOUTH	West6 (106), West9(109)	00	10	00 ZXZ
DIPSOUT2	West1(101), SouthA (401),	-30	20	15
DIPSOUT3	SouthC(403), SouthD(404), SouthD1 (406)	-30	30	15
DIPSOUT4	East1 (301), East2(302)	-70	15	20
DIPWEST	West3B (108)	-70	55	00 ZXZ
DIPSW	East3 (303)	05	55	00 ZXZ
VERTICAL	Central8(208)	00	00	00

Note: GEMS ZYZ rotation nomenclature is used. Positive rotation around the Y axis is from Z toward X, and around the Z axis is from X toward Y.

Figure 14-2: Drill Section 332725E

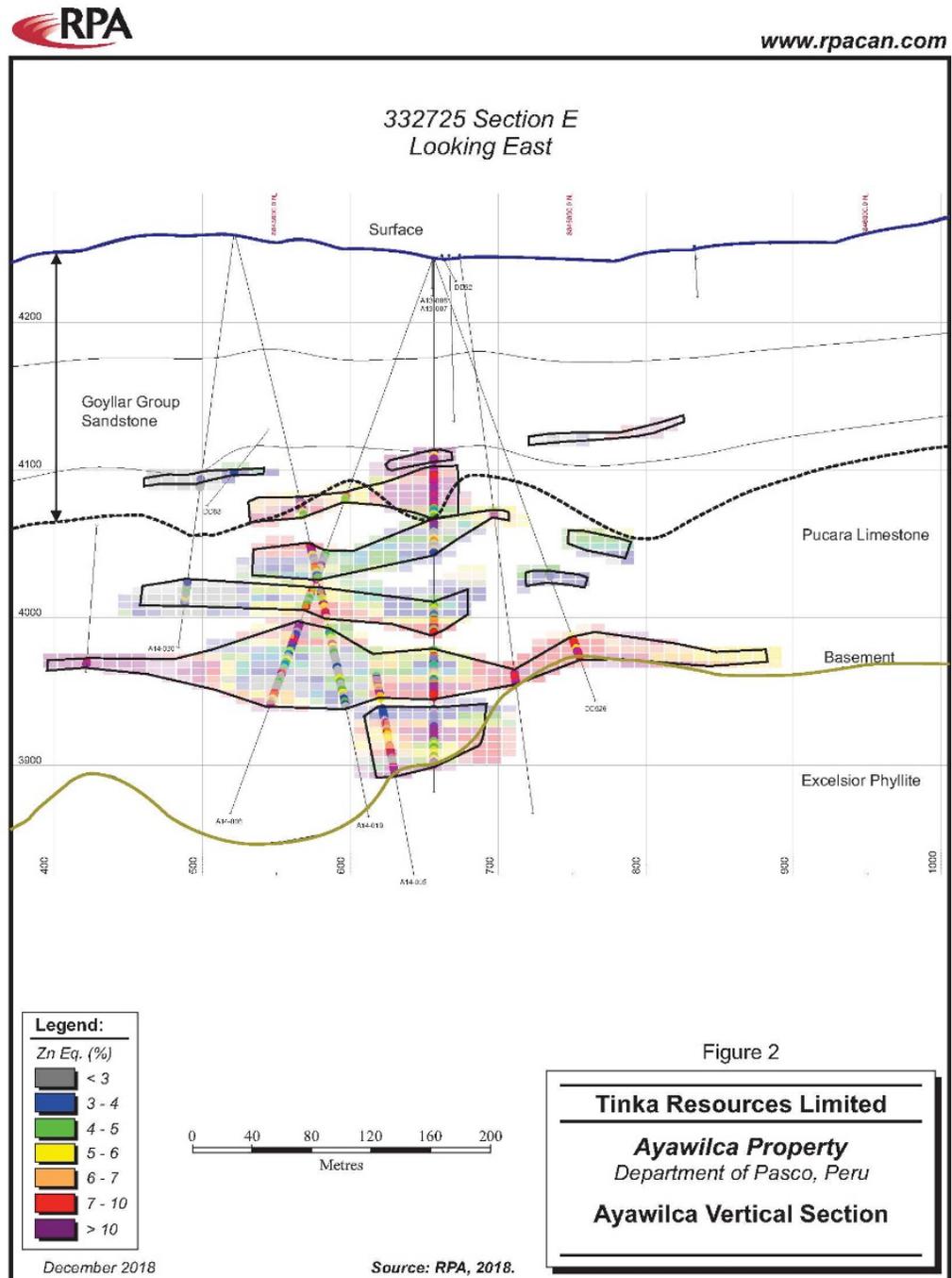


Figure 14-3: Plan View, Ayawilca Zinc Zone

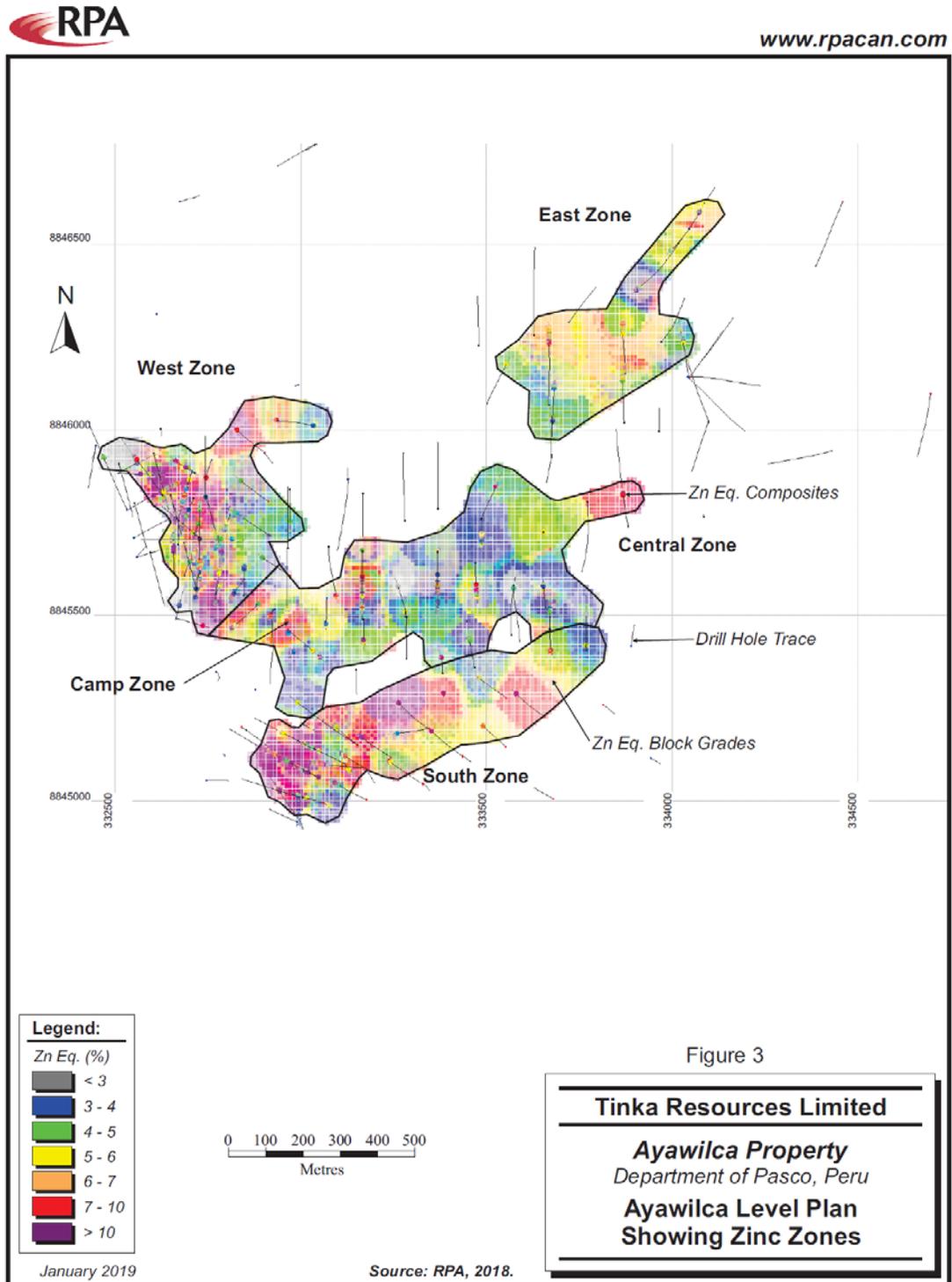
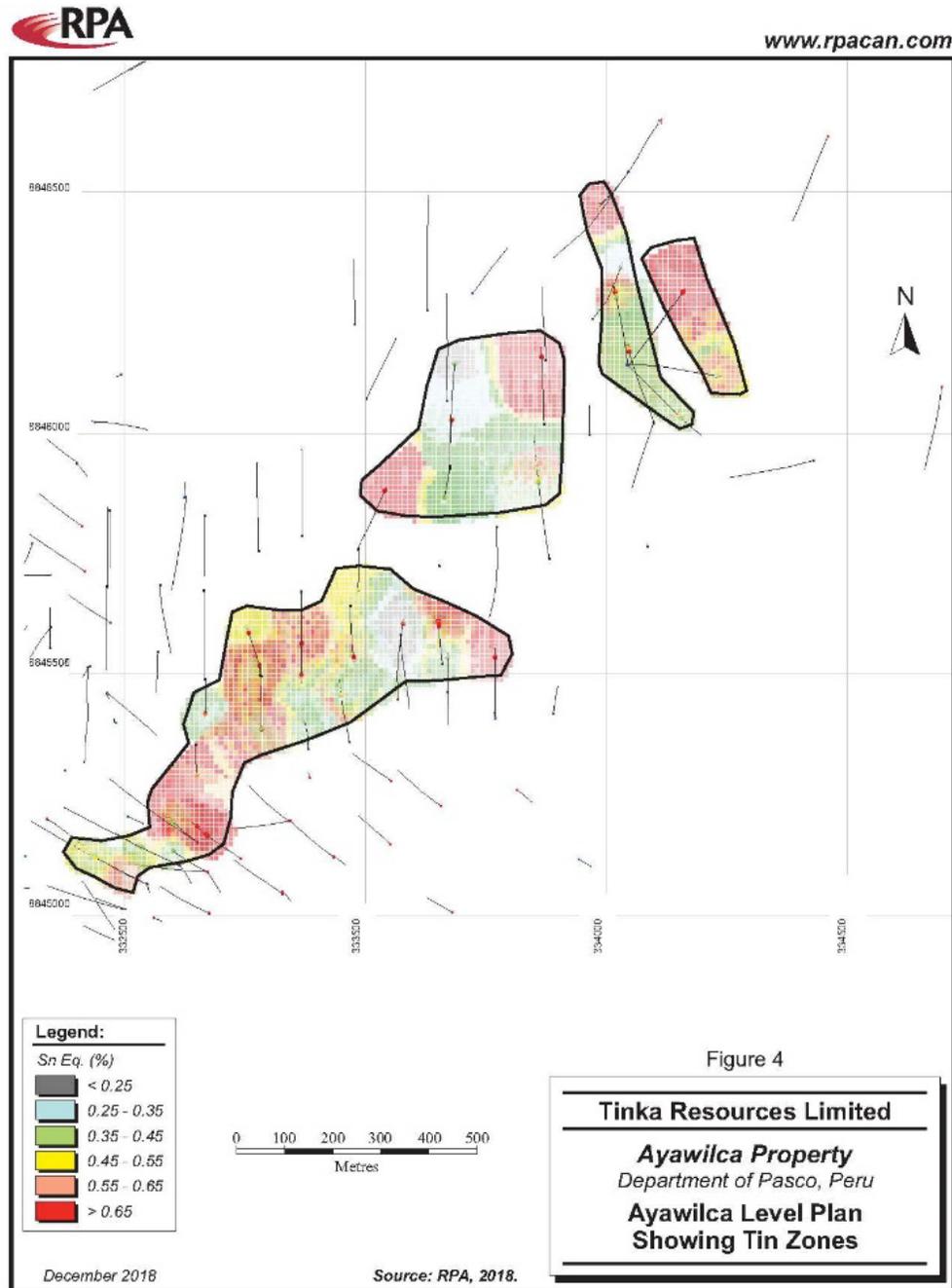


Figure 14-4: Plan View, Aywilca Tin Zone



The block model contains the following information:

- Domain identifiers with rock type
- Estimated grades of zinc, indium, silver, and lead within the zinc-dominated domains, and tin, copper and silver within the tin domains
- NSR, zinc equivalent (ZnEq), and tin equivalent (SnEq) estimates calculated from block grades and related economic and metallurgical assumptions
- The percentage volume of each block within the mineralization wireframe models
- Density values for each domain
- The distance to the closest composite used to interpolate the block grade
- Resource classification codes.

14.2.7 Block Model Validation

RPA validated the block model by visual inspection, volumetric comparison, and statistical comparison of block grades to assay and composite grades. Visual comparison on vertical sections and plan views, and a series of swath plots found good overall correlation between the block grade estimates and supporting composite grades.

Table 14-9 shows a comparison of the block volume estimates.

Statistical analysis comparing estimated block grades versus informing data is shown in histograms in Figure 14-5 and Figure 14-6 for the Ayawilca Zinc Zone and Ayawilca Tin Zone respectively.

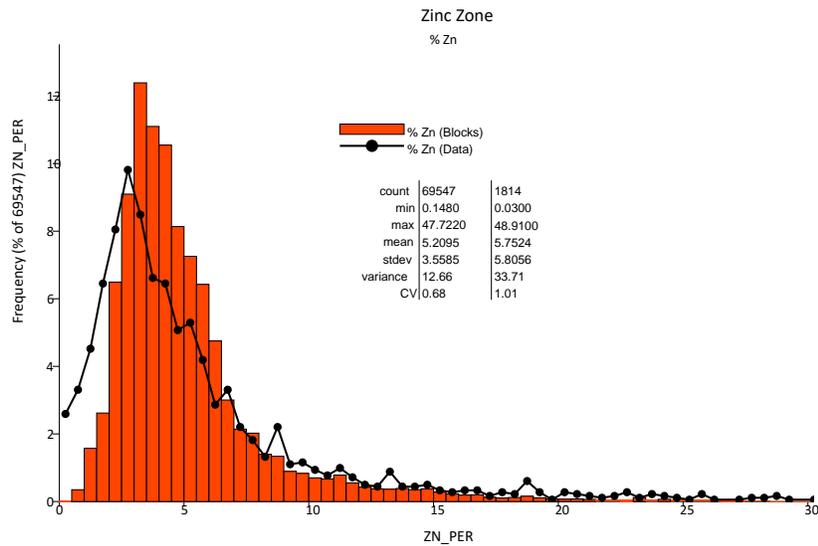
14.2.8 Classification of Mineral Resources

The classification criteria used to define the Indicated Mineral Resources included spatial analysis, drill hole spacing, and continuity of the mineralization. The drill hole spacing within a resource area assigned the Indicated category is commonly ranges from 40 m to 70 m. The limits of the Mineral Resource remain open in several directions.

Table 14-9: Volume Comparison

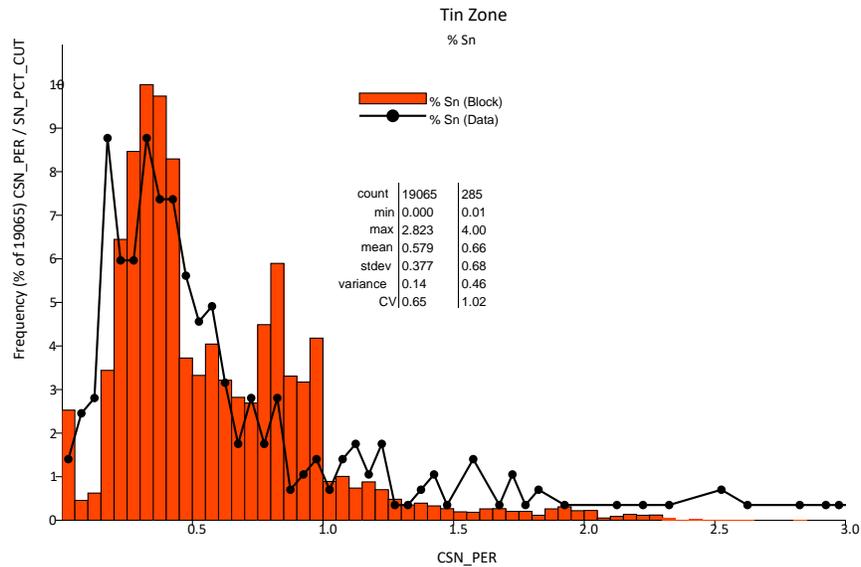
Ayawilca Zone	Block Volume (m ³ x1000)	Wireframe Volume (m ³ x1000)
West	5,362.9	5,362.6
Central	6,559.3	6,560.6
East	3,677.5	3,678.7
South	4,242.6	4,238.9
Tin	5,147.1	5,147.7

Figure 14-5: Estimated Block Grade Histogram, Ayawilca Zinc Zone



Note: Figure prepared by RPA, 2018.

Figure 14-6: Estimated Block Grade Histogram, Ayawilca Tin Zone



Note: Figure prepared by RPA, 2018.

14.2.9 Reasonable Prospects of Eventual Economic Extraction

NSR values, ZnEq and SnEq grades were calculated by RPA for the purposes of geological interpretation and resource reporting. NSR is the estimated value per tonne of mineralized material after allowance for metallurgical recovery and consideration of smelter terms, including payables, treatment charges, refining charges, price participation, penalties, smelter losses, transportation, and sales charges. These assumptions are dependent on the processing scenario, and will be sensitive to changes in inputs from further metallurgical testwork.

Metallurgical recoveries used in the evaluation of reasonable prospects for eventual economic extraction were based on historical testwork and RPA experience from other operations. Metal price assumptions used in consideration of reasonable prospects for eventual economic extraction differ from those used in the mine plan (Section 16), the NSR used to report the subset of Mineral Resources within the PEA mine plan (Section 16) and financial analysis (Section 22).

Key assumptions include:

- Metal prices:
 - US\$1.15/lb Zn
 - US\$300/kg In
 - US\$15/oz Ag
 - US\$1.00/lb Pb
 - US\$9.00/lb Sn
 - US\$2.85/lb Cu
- Recoveries:
 - 90% Zn
 - 75% In
 - 60% Ag
 - 75% Pb
 - 86% Sn
 - 75% Cu.

The NSR factors represent revenue (US\$) per metal unit (per % Zn, for example), and are independent of resource grade. RPA used the following factors to calculate NSR:

- Zn: US\$15.34 per %
- In: US\$0.18 per g/t
- Ag: US\$0.22 per g/t
- Pb: US\$4.70 per %
- Sn: US\$155.21 per %
- Cu: US\$37.59 per %.

The following formulas were used to calculate the ZnEq and SnEq for reporting purposes:

- $$\text{ZnEq}(\%) = \frac{[\text{Zn}(\%)\text{US}\$15.34 + \text{Pb}(\%)\text{US}\$4.7 + \text{In}(\text{g}/\text{t})\text{US}\$0.18 + \text{Ag}(\text{g}/\text{t})\text{US}\$0.22]}{\text{US}\$15.34}$$
- $$\text{SnEq}(\%) = \frac{[\text{Sn}(\%)\text{US}\$155.21 + \text{Cu}(\%)\text{US}\$37.59 + \text{Ag}(\text{g}/\text{t})\text{US}\$0.22]}{\text{US}\$155.21}$$

Note: NSR assumptions include: metal prices of US\$1.15/lb Zn, US\$300/kg In, US\$15/oz Ag, and US\$1.0/lb Pb, US\$9.00/lb Sn, and US\$2.85/lb Cu. Metal recovery assumptions of 90% Zn, 75% In, 60% Ag, 75% Pb, 86% Sn and 75% Cu. The NSR value for each block was calculated using the following NSR factors: US\$15.34 per % Zn, US\$4.70 per % Pb, US\$0.18 per gram In, US\$0.22 per gram Ag, US\$155.21 per % Sn, and US\$37.59 per % Cu.

For the purposes of developing the cut-off grades, a total unit operating cost of US\$55/t milled was estimated, which includes mining, processing, and general and administrative (G&A) expenses. The US\$55/t NSR cut-off value is approximately equivalent to a 3.6% ZnEq cut-off grade within the Ayawilca Zinc Zone and a 0.33% SnEq cut-off grade within the Ayawilca Tin Zone.

Metal prices used for resources were based on consensus, long-term forecasts from banks, financial institutions, and other sources.

14.3 Colquipucro Silver Zone

The Colquipucro Silver Zone resource database includes 8,003 m in 50 drill holes.

RPA received header, survey, assay, alteration, and geology data from Tinka in Microsoft Excel format. Data was amalgamated and parsed as required, converted to ASCII, and imported into Dassault Systèmes GEOVIA GEMS Version 6.7 (GEMS) and ARANZ Leapfrog Geo version 2.1.2 (Leapfrog Geo) for Mineral Resource modelling.

RPA is of the opinion that the drill hole database is valid and suitable to estimate Mineral Resources for the Colquipucro Silver Zone.

14.3.1 Geological Models

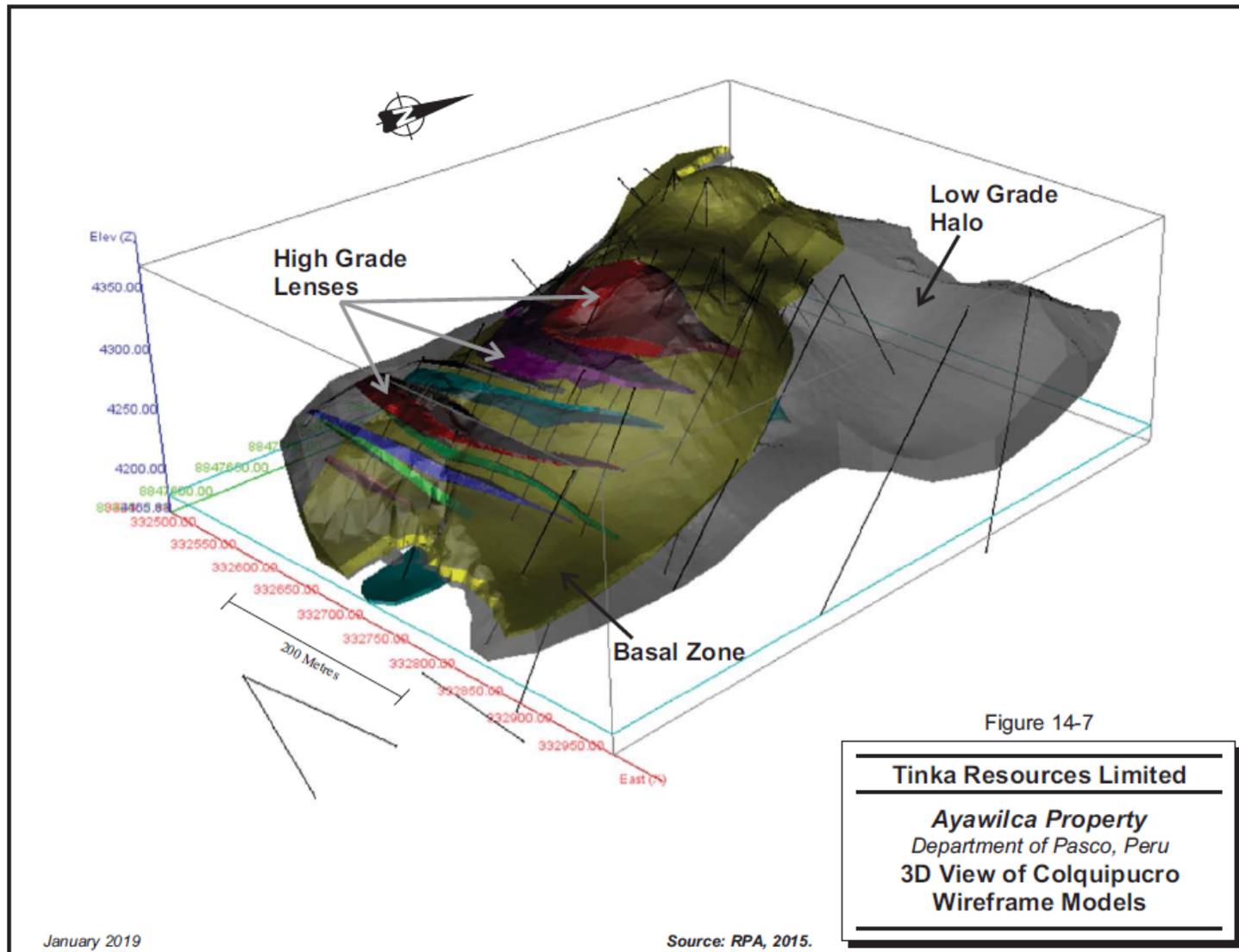
Wireframe models of mineralized zones were used to constrain the block model grade interpolation process. RPA interpreted and constructed wireframe models using a nominal cut-off grade of 15 g/t Ag and a minimum core length of 2 m using Leapfrog Geo. Wireframes of the high-grade lenses were created at a minimum grade of approximately 60 g/t Ag.

RPA built two low-grade halo domains and 11 high-grade lens domains (Figure 14-7). Overall, the zone has dimensions of over 550 m in the north–south direction by 380 m in the east–west direction by 75 m thick.

The mineralization is located on a topographic high and ranges between 4,160–4,360 m elevations. RPA also created wireframe models of the main lithologies including the Goyllar sandstone, the Pucará Formation, colluvium, and the Excelsior Formation. The colluvium domain was grouped with the low-grade halo as it commonly made up of mineralized material. The major domains/lenses include:

- Eight similar, parallel high-grade lenses, named 102 to 109, are located towards the south end of the zone. They dip between 35–45° towards the north. They commonly have dimensions of 200 m along strike by 100 m down dip, and range in thickness between 2–20 m, averaging 6 m. All are hosted entirely in the Goyllar sandstone. Collectively, the eight zones are intersected by 17 drill holes
- Domain 110 is located immediately north of domain 105 and is also hosted in the Goyllar sandstone. It has a shallow dip and measures 150 m along strike by 100 m down dip and averages 30 m thick. Domain 110 is intersected by seven drill holes
- Domain 111 is a flat, thick high-grade domain at the north end of the zone. It measures 160 m north–south by 60 m east–west and averages 40 m thick, and is also hosted in the Goyllar sandstone. Domain 111 is intersected by seven drill holes
- Domain 101 forms a shallow-dipping basal high-grade zone near the bottom of the Goyllar sandstone. It measures 500 m north–south by 300 m east–west and ranges between 2–20 m thick, averaging 7 m thick. Domain 101 is intersected by 39 drill holes
- Domain 50 is a large low-grade halo interpreted to surround the high-grade domains. It measures 550 m in the north–south direction by 380 m in the east–west direction by 75 m thick. Most of its volume is located within the Goyllar sandstone, however, it extends down into the Pucará Formation towards its eastern half. Parts of Domain 50 are not captured by the conceptual open pit shell used to report Mineral Resources
- Domain 51 is a shallow-dipping low-grade domain located entirely within the Pucará carbonate rocks. Parts of Domain 51 are not captured by the conceptual open pit shell used to report Mineral Resources.

Figure 14-7: Colquipucro Silver Zone Model Wireframe View



14.3.2 Exploratory Data Analysis

Assay values located inside the wireframe models were tagged with domain identifiers and exported for statistical analysis. Results were used to help verify the modelling process. Basic statistics by domain are summarized in Table 14-10.

14.3.3 Density Assignment

Tinka performed 90 density measurements from four drill holes. RPA used the average of the measurements, 2.48 t/m³, to convert resource volumes to tonnages. RPA recommends that Tinka obtain additional measurements using the wax-sealed Archimedes method.

14.3.4 Grade Capping/Outlier Restrictions

Review of the assay histograms within the wireframe domains (Figure 14-8 and Figure 14-9) and a visual inspection of high-grade values on vertical sections suggest capping of erratic values >360 g/t Ag in the high-grade lenses, and >120 g/t Ag in the low-grade halo. The coefficient of variation values were reduced to <1 after the cuts were applied. Table 14-11 summarizes the capped data.

14.3.5 Composites

Sample lengths range from 0.6 m to 6.0 m within the wireframe models with more than 90% taken at 2 m. Given these distributions, and considering the width of the mineralization, RPA chose to composite to 2 m lengths. Assays within the wireframe domains were composited starting at the first mineralized wireframe boundary from the collar and resetting at each new wireframe boundary. Composites less than 0.5 m, located at the bottom of the mineralized intercept, were removed from the database. Table 14-12 lists composite descriptive statistics by zone.

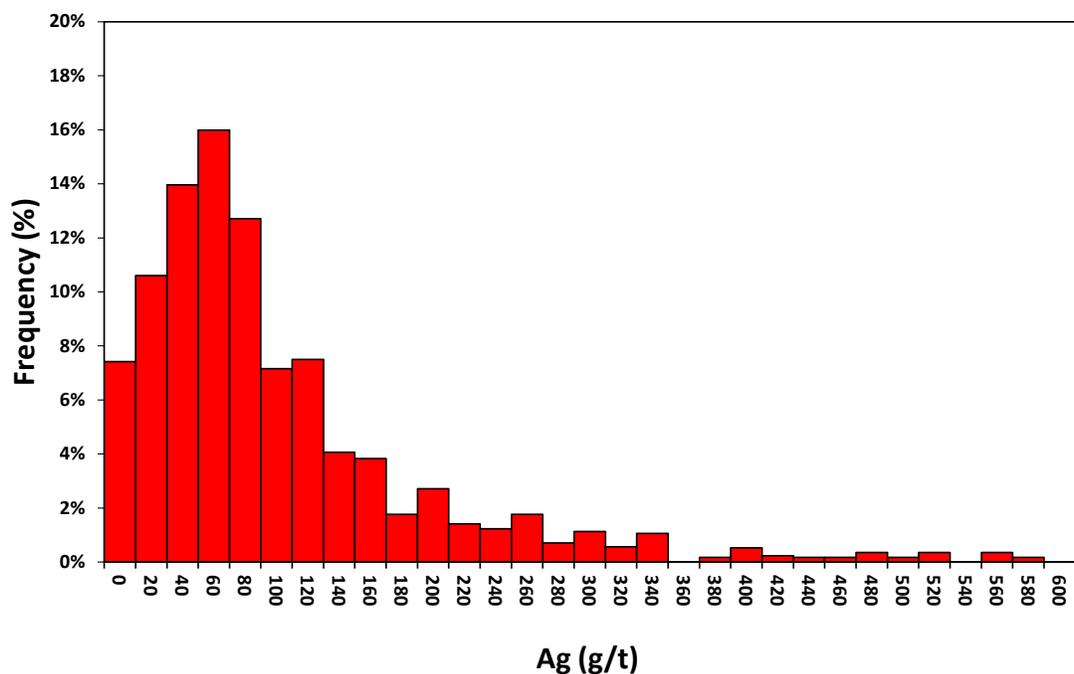
14.3.6 Estimation/Interpolation Methods

Grade interpolation for silver was estimated by ID3 using two passes for the high-grade lenses and three passes for the lower-grade halo domains. Figure 14-10 is a vertical section and Figure 14-11 a level plan through the model.

Table 14-10: Assay Data Descriptive Statistics

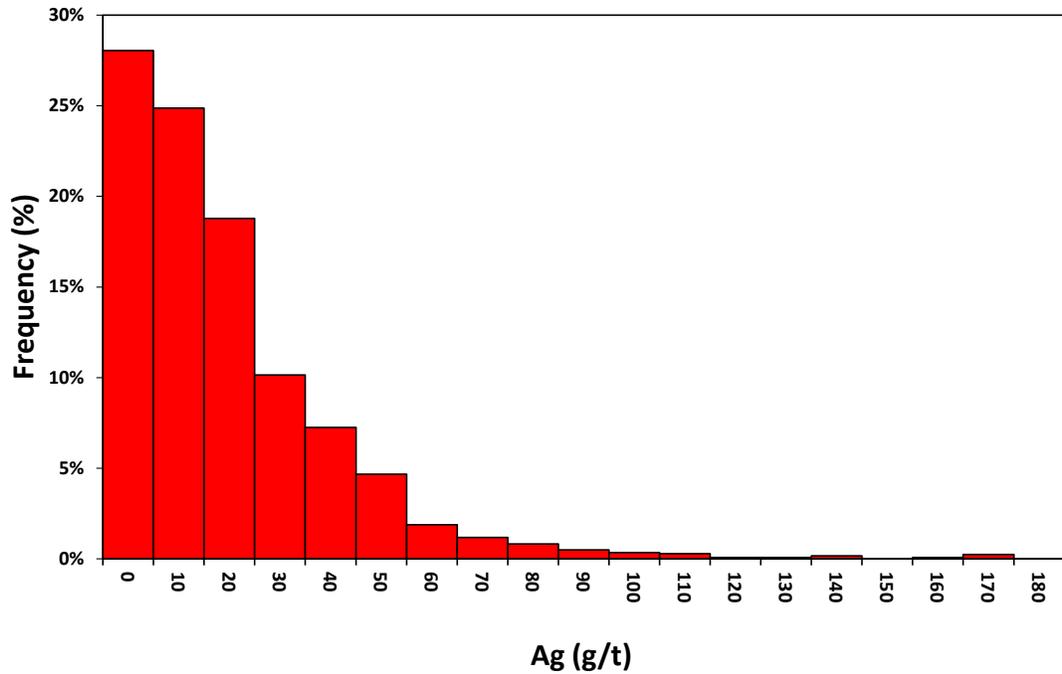
Parameter	High-Grade Lenses	Low Grade Halos
No. of Cases	567	1,448
Minimum (Ag g/t)	0.4	0.1
Maximum (Ag g/t)	1,950	745
Median (Ag g/t)	84	19
Arithmetic Mean (Ag g/t)	124	26
Standard Deviation (Ag g/t)	160	40
Coefficient of Variation	1.3	1.5

Figure 14-8: Assay Histogram, Colquipucro Silver Zone High-Grade Lenses



Note: Figure prepared by RPA, 2018.

Figure 14-9: Assay Histogram, Colquipucro Silver Zone Low-Grade Halo



Note: Figure prepared by RPA, 2018.

Table 14-11: Descriptive Capped Assay Statistics

Parameter	High Grade Lenses	Low Grade Halos
No. of Cases	567	1,448
Minimum (Ag g/t)	0.4	0.1
Maximum (Ag g/t)	360	120
Median (Ag g/t)	84	19
Arithmetic Mean (Ag g/t)	110	24
Standard Deviation (Ag g/t)	89	22
Coefficient of Variation	0.8	0.9

Table 14-12: Composite Descriptive Statistics

Parameter	High Grade Lenses	Low Grade Halos
No. of Cases	576	1,493
Minimum (Ag g/t)	0.4	0.0
Maximum (Ag g/t)	360	120
Median (Ag g/t)	82	18
Arithmetic Mean (Ag g/t)	109	24
Standard Deviation (Ag g/t)	89	22
Coefficient of Variation	0.8	0.9

Figure 14-10: Colquipucro Silver Zone Vertical Section 332,650E

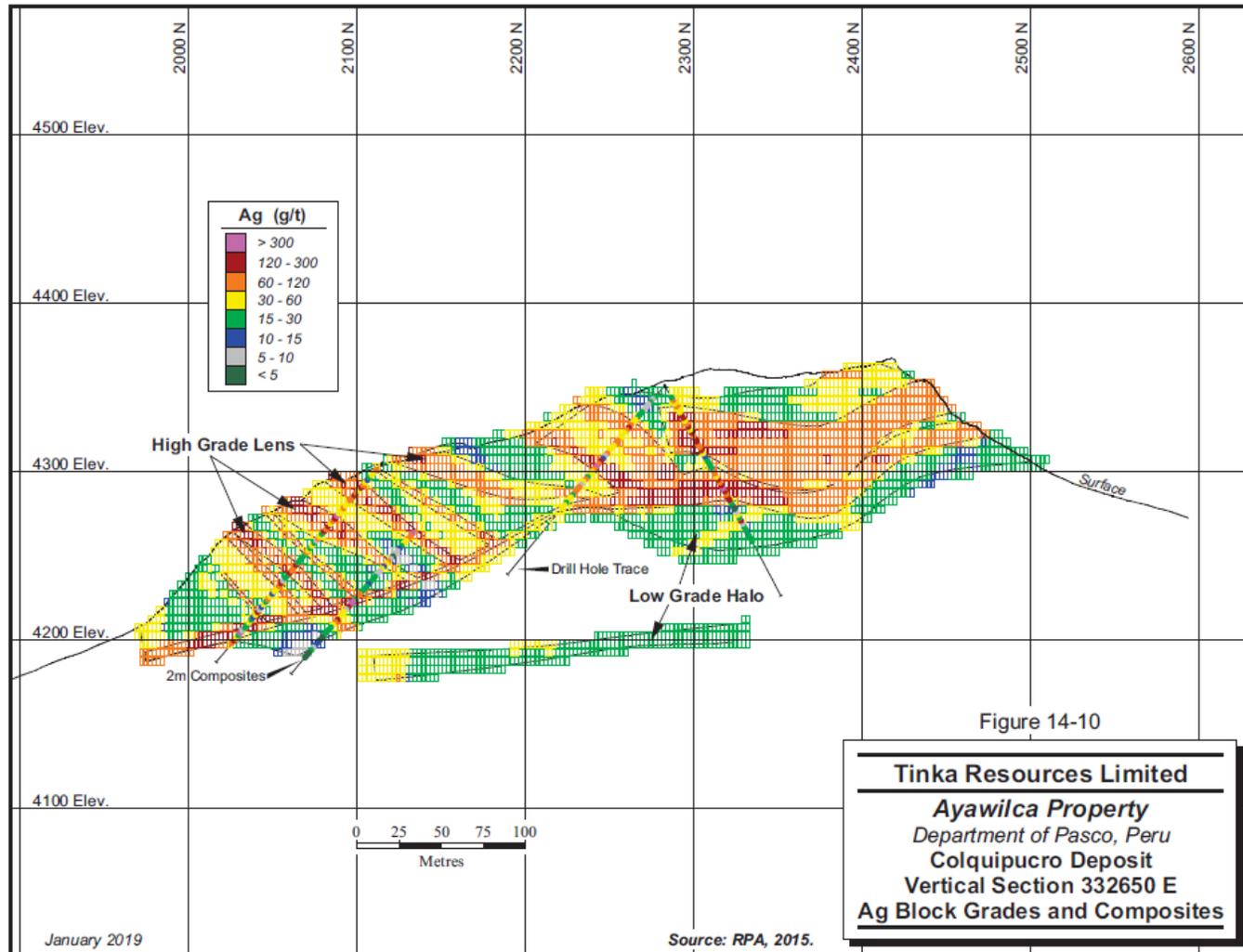
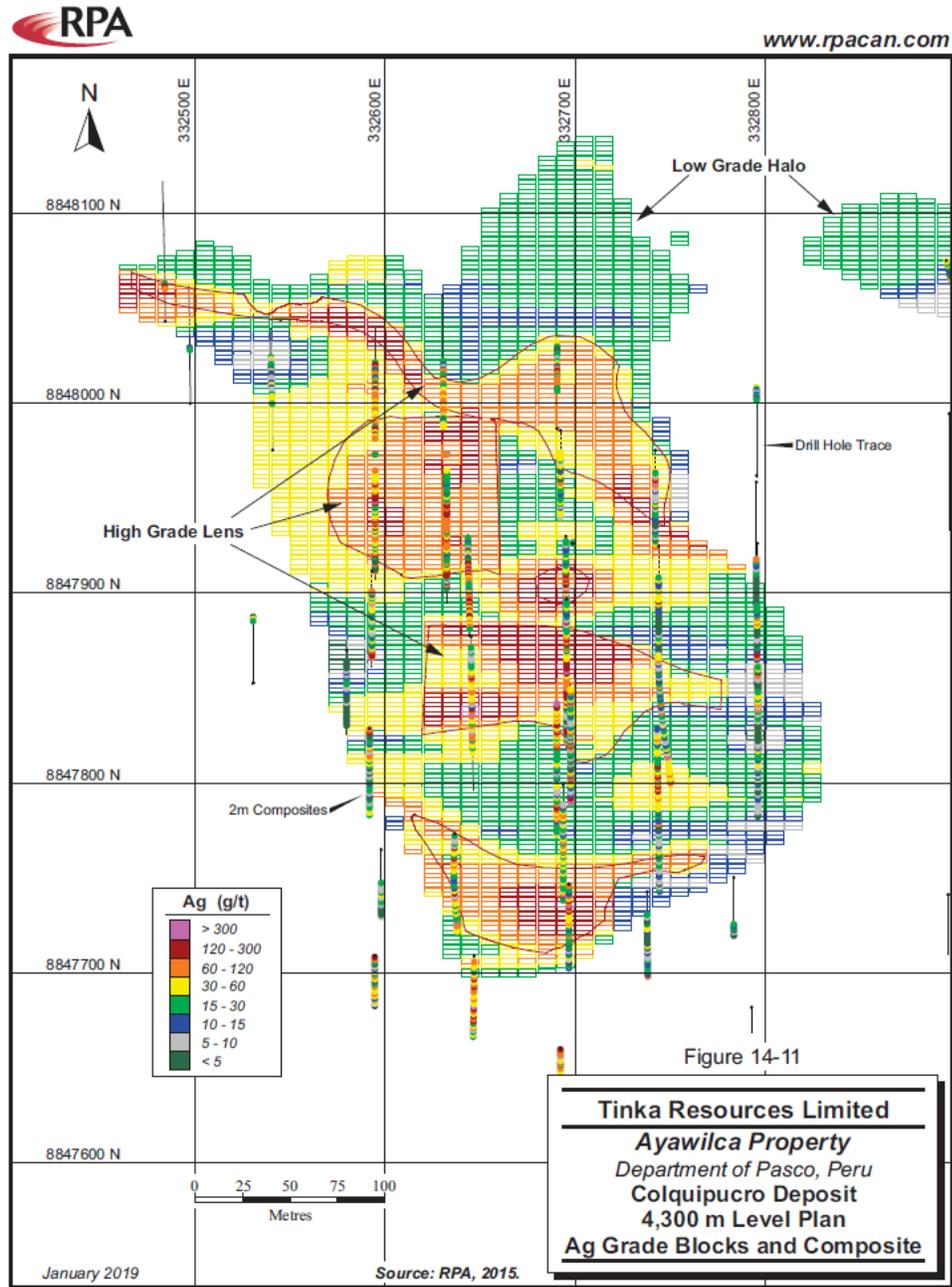


Figure 14-11: Colquipucro Silver Zone 4,300 m Level Plan



The first pass strategy for high grade lenses required a minimum of two to a maximum of 12 composites, with a maximum of four composites per drill hole. The search ellipse dimensions were 50 x 50 x 10 m for an anisotropy ratio of 1:1:5. Search ellipse orientations were aligned in the direction of the wireframe models (Table 14-13). Pass two was similar except that the minimum required number of composites was reduced to one, there was no restriction of composites per drill hole, and the search ellipse dimensions were doubled to 100 x 100 x 20 m.

The search strategy for the first pass for low grade halos required a minimum of two to a maximum of 12 composites, with a maximum of four composites per drill hole. The search ellipse was isotropic with a radius of 50 m. Pass two was similar except that the minimum required number of composites was reduced to one, there was no restriction of composites per drill hole, and the search ellipse radius was doubled to 100 m. A third pass was required to fill a few blocks along the fringes of the wireframe models. The parameters for the third pass were the same as those for the second pass except that a radius of 180 m was used.

The GEMS block model block is 10 x 2.5 x 5 m. A partial block model is used to manage blocks partially filled by mineralized rock types, including blocks along the edges of the zone. A partial model has a parallel block model containing the percentage of mineralized rock types contained within each block. A GEMS block model folder was created for the high-grade lenses and the low-grade halo. The block model contains the following information:

- Domain identifiers with rock type
- Estimated grades of silver inside the wireframe models
- The percentage volume of each block within the mineralization wireframe models
- Resource classification
- Tonnage factors, in t/m³
- The distance to the closest composite used to interpolate the block grade.

Table 14-13:Block Estimate Search Strategy

Domain	Principal Azimuth (°)	Principal Dip (°)	Intermediate Azimuth (°)
101	0	05	60
102	0	-35	5
103	0	-35	-20
104	0	-30	5
105	0	-22.5	15
106	0	-30	-15
107	0	-37.5	-2.5
108	0	-45	7.5
109	0	-50	2.5
110	0	-25	0
111	0	5	0

14.3.7 Block Model Validation

RPA validated the block model by visual inspection, volumetric comparison, and scatterplots. Visual comparison on vertical sections and plan views, and a series of swath plots found good overall correlation between the block grade estimates and supporting composite grades.

The estimated total volume of the wireframe models is 11,957,000 m³, while the volume of the block model at a zero-grade cut-off is 11,956,000 m³. Results are listed by vein in Table 14-14.

14.3.8 Classification of Mineral Resources

Two areas of the Colquipucro Silver Zone were classified as Indicated: the central core, where the drill hole spacing is 50 m by 50 m or closer, and an area towards the north end of the zone, where the drill hole spacing is closer and the mineralization exhibits good grade continuity. Classification was assigned using manually-constructed wireframe solids.

Table 14-14: Volume Comparison, Colquipucro Silver Zone

Zone	Block Volume (m³ x1000)	Wireframe Volume (m³ x1000)
High grade lenses	2,220	2,221
Low grade halo	9,736	9,736
Total	11,956	11,957

14.3.9 Reasonable Prospects of Eventual Economic Extraction

RPA prepared a preliminary open pit shell to constrain the block model for resource reporting purposes. The preliminary pit shell was generated using Whittle software.

It was determined that the metallurgical processes would be heap leaching (HL) and agitation cyanide leaching (mill) for low-grade and high-grade silver mineralization respectively, given the silver grade range within the zone. A value trade-off gave approximately 60 g/t Ag as the mill cut-off grade, or the point at which to switch to HL. The general and administrative (G&A) costs were assumed to be paid by the mill. Iterative optimizations were run varying operating costs according to production rates assumptions in both HL and mill to converge to resource having an HL to mill tonnage ratio in line with the assumptions.

The parameters used in the Whittle pit shell analysis for the resource constraint are listed in Table 14-15.

14.4 Mineral Resource Statement

Mineral Resources for the Ayawilca Zinc and Tin Zones are reported on the basis of a possible underground mining scenario using a base case US\$55/t NSR cut-off value for both the Ayawilca Zinc and Tin Zones. The Mineral Resources within the Ayawilca Tin Zone lie spatially beneath the Ayawilca Zinc Zone and the two zones typically do not overlap. Mineral Resources are reported with an effective date of 26 November, 2018.

Mineral Resources at the Colquipucro Silver Zone are reported within a preliminary pit shell generated in Whittle software at a reporting cut-off grade of 15 g/t Ag. Since there are no new data and the metal price and cost assumptions remain reasonable, the Mineral Resource estimate for the Colquipucro Silver Zone remains current as of the effective date of 25 May, 2016.

Table 14-15: Colquipucro Silver Zone Conceptual Pit Assumptions

Parameter	Value
Pit slope	45°
Process recovery heap leach	50%
Process recovery mill	80%
Silver price	\$24/oz Ag
Mining cost	2.60 \$/t mined
Heap leach cost	3.74 \$/t milled
Milling cost	21.65 \$/t milled
G&A	4.48 \$/t milled

The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee, and independent of Tinka.

Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

Mineral Resource estimates are provided in Table 14-16 for the Ayawilca Zinc Zone, in Table 14-17 for the Ayawilca Tin Zone, and in Table 14-18 for the Colquipucro Silver Zone.

A sensitivity analysis to NSR cut-off was performed, and a range of NSR values for the Ayawilca Zinc Zone are provided in Table 14-19, and in Table 14-20 for the Ayawilca Tin Zone. In both tables, the \$55/t NSR is highlighted. Data in Table 14-16 and Table 14-17 are not additive to the data shown in Table 14-19 and Table 14-20.

Table 14-16: Mineral Resource Estimate, Ayawilca Zinc Zone

Zone and Confidence Classification	Tonnage (Mt)	ZnEq (%)	Zn (%)	Pb (%)	In (g/t)	Ag (g/t)	Contained Zn (Mlb)	Contained Pb (Mlb)	Contained In (t)	Contained Ag (Moz)
<i>Indicated</i>										
West	7.8	7.7	6.5	0.20	72	15	1,126	35	561	3.9
South	3.9	9.1	7.6	0.09	108	16	652	8	422	2.0
Total Indicated	11.7	8.1	6.9	0.16	84	15	1,778	42	983	5.8
<i>Inferred</i>										
West	5.0	7.1	6.4	0.27	34	17	699	30	170	2.8
Central	18.5	5.6	4.6	0.23	62	12	1,884	95	1,153	7.5
East	11.3	5.9	5.0	0.18	56	14	1,238	44	633	5.0
South	10.2	9.6	7.9	0.27	103	30	1,764	61	1,047	9.9
Total Inferred	45.0	6.7	5.6	0.23	67	17	5,585	230	3,003	25.2

Notes:

- The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 26 November, 2018.
- Mineral Resources are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
- Mineral Resources are reported above a cut-off NSR value of US\$55 per tonne.
- The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$1.15/lb Zn, US\$300/kg In, US\$15/oz Ag, and US\$1.00/lb Pb. Metal recovery assumptions were: 90% Zn, 75% In, 60% Ag, and 75% Pb. The NSR value for each block was calculated using the following NSR factors: US\$15.34 per % Zn, US\$4.70 per % Pb, US\$0.18 per gram In, and US\$0.22 per gram Ag.
- The NSR value was calculated using the following formula: $NSR = Zn(\%) * US\$15.34 + Pb(\%) * US\$4.70 + In(g/t) * US\$0.18 + Ag(g/t) * US\0.22
- The ZnEq value was calculated using the following formula: $ZnEq = NSR/US\$15.34$
- Numbers may not add due to rounding.

Table 14-17: Mineral Resource Estimate, Ayawilca Tin Zone

Confidence Classification	Tonnage (Mt)	SnEq (%)	Sn (%)	Cu (%)	Ag (g/t)	Contained Sn (Mlb)	Contained Cu (Mlb)	Contained Ag (Moz)
Inferred	14.5	0.70	0.63	0.21	18	201	67	8.0

Notes:

1. The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 26 November, 2018.
2. Mineral Resource are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported above a cut-off grade of US\$55 per tonne NSR value.
4. The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$9.00/lb Sn, US\$2.85/lb Cu, and US\$15/oz Ag. Metal recovery assumptions were: 86% Sn, 75% Cu, and 60% Ag. The NSR value for each block was calculated using the following NSR factors: US\$155.21 per % Sn, US\$37.59 per % Cu, and US\$0.22 per gram Ag.
5. The NSR value was calculated using the following formula: $US\$NSR = Sn(\%) * US\$155.21 + Cu(\%) * US\$37.59 + Ag(g/t) * US\0.22
6. The SnEq value was calculated using the following formula: $SnEq = NSR/US\$155.21$
7. Numbers may not add due to rounding.

Table 14-18: Mineral Resource Estimate, Colquipucro Silver Zone

Zone and Confidence Classification	Tonnage (Mt)	Ag (g/t)	Contained Ag (Moz)
<i>Indicated</i>			
High Grade Lenses	2.9	112	10.4
Low Grade Halo	4.5	27	3.9
Total Indicated	7.4	60	14.3
<i>Inferred</i>			
High Grade Lenses	2.2	105	7.5
Low Grade Halo	6.2	28	5.7
Total Inferred	8.5	48	13.2

Notes:

1. The Qualified Person for the estimate is Ms. Dorota El Rassi, P.Eng., an RPA employee. Mineral Resources have an effective date of 25 May, 2016.
2. Mineral Resource are reported using the 2014 CIM Definition Standards. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported within a preliminary pit-shell and above a reporting cut-off grade of 15 g/t Ag for the Low-Grade Halo and 60 g/t Ag for the High Grade Lenses.
4. The cut-off grade is based on a silver price of US\$24/oz Ag.
5. Numbers may not add due to rounding.

Table 14-19: Sensitivity Table, Ayawilca Zinc Zone (base case is bolded)

Confidence Classification	NSR Cut-off (US\$/t)	Tonnage (Mt)	ZnEq (%)	Zn (%)	Pb (%)	In (g/t)	Ag (g/t)
Indicated	40	13.6	7.4	6.3	0.16	75	15
	50	12.4	7.9	6.7	0.17	80	15
	55	11.7	8.1	6.9	0.16	84	15
	60	10.8	8.5	7.2	0.16	89	16
	70	9.4	9.2	7.7	0.15	99	16
	80	7.9	10.0	8.4	0.15	111	17
Inferred	40	52.7	6.2	5.2	0.24	60	17
	50	48.1	6.5	5.4	0.24	64	17
	55	45.0	6.7	5.6	0.23	67	17
	60	41.5	7.0	5.8	0.23	70	18
	70	33.9	7.6	6.4	0.22	78	18
	80	26.9	8.3	6.9	0.22	86	20

Note: Footnotes to Table 14-16 also apply to this table. Table 14-16 is not additive to this table.

Table 14-20: Sensitivity Table, Ayawilca Tin Zone (base case is bolded)

NSR Cut-off (US\$/t)	Tonnage (Mt)	SnEq (%)	Sn (%)	Cu (%)	Ag (g/t)
40	17.1	0.65	0.57	0.20	18
50	16.0	0.67	0.60	0.20	18
55	14.5	0.70	0.63	0.21	18
60	12.5	0.76	0.68	0.22	17
70	10.1	0.84	0.76	0.23	18
80	8.3	0.92	0.84	0.25	18

Note: Footnotes to Table 14-19 also apply to this table. Table 14-19 is not additive to this table.

14.5 Factors That May Affect the Mineral Resource Estimates

Factors that may affect the Mineral Resource estimates include:

- Commodity price assumptions

- Changes in local interpretations of mineralization geometry and continuity of mineralization zones, and impact on mining selectivity
- Changes to geotechnical, hydrogeological, and metallurgical recovery assumptions
- Density and domain assignments
- Changes to assumed mining method which may change block size and orientation assumptions used in the resource model
- Input factors used to assess reasonable prospects for eventual economic extraction
- Assumptions as to social, permitting and environmental conditions.

15.0 MINERAL RESERVE ESTIMATES

This section is not relevant to this Report.

16.0 MINING METHODS

The mine plan is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA based on these Mineral Resources will be realized. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

16.1 Overview

The Ayawilca Zinc Zone is planned to be mined using underground mining methods. Use of open pit mining method was discarded based on a review completed by RPA in January 2019, which concluded that an open pit scenario would not be economically viable. The PEA does not include any of the other Mineral Resources estimated for the Project.

Three different approaches were used to assess the selection of appropriate underground mining methods: Boshkov and Wright (1973) Classification System, Hartman Selection System and the UBC Mining Method Selection System. Based on these analyses, and taking into consideration other aspects such as safety, the resource continuity geometry and grade distribution, production scale and costs, a room-and-pillar (R&P) and a variation (post-pillar or P&P) were selected. Approximately 50% of the Ayawilca Zinc Zone would be mined using conventional R&P, and the remaining 50% using P&P.

The RPA block model is the basis of the PEA mine plan. The mine production schedule assumes a mining and processing rate of 5,000 t/d, based on a trade-off study. A break-even mining NSR cut-off was estimated, a range of scenarios above this break-even NSR cut-off were analyzed, and an NSR cut-off value of US\$65/t was selected for PEA purposes as it produced the most favourable mining scenario. The mining NSR used different assumptions to the NSR assumptions used in resource estimation. Once the cut-off value had been determined, the mine plan was developed to include provision for external dilution, at an average 5% for R&P mining methods and 10% for P&P methods. No internal dilution was included as the assumption is that waste blocks can be mined separately or left in place as pillars, given the block size assumption of 10 m x 10 m x 5 m. The final step was to include mining recovery considerations. Mining recovery is estimated at 80% for both the R&P and P&P methods.

The subset of the Mineral Resource estimate used in the PEA mine plan is provided in Table 16-1.

The main levels will be spaced at 70 m vertical intervals, with a sub-level at 35 m spacing (Figure 16-1). Production was assumed to start in the upper levels targeting higher-grade material and zones that could support a sustainable production rate. Because of the shallow dip of the mantos and assuming favorable ground conditions exist, only minimal or no horizontal pillars will be needed in between levels. In addition, no crown pillar was considered due to the depth of the Ayawilca Zinc Zone below surface.

A one-year pre-production period was included in the mine plan. During the pre-production period, initial underground infrastructure such as the main access ramps, access to production locations, ventilation drifts and raises and ancillary infrastructure will be developed to support the planned production rate. Portal construction is included in the pre-production period.

Mined-out stopes will be backfilled as necessary to provide a safe working environment.

16.2 Geotechnical Considerations

Limited geotechnical information is currently available; however, based on the existing geological information and RQD measurements on drill core, it has been assumed that the conditions would be reasonably favorable for the application of underground mining methods that would require minimum ground support.

Using the limited RQD data available, rock mass rating (RMR) estimates were obtained (Table 16-2).

16.3 Hydrogeological Considerations

The hydrogeological information currently available is limited and is not conclusive.

There is a high probability of acid rock drainage, as the mineralization is primarily in the form of sulphides. A water treatment plant is expected to be required to treat any tailings storage facility overflow and drainage from the mine, before such waters can be discharged to the environment.

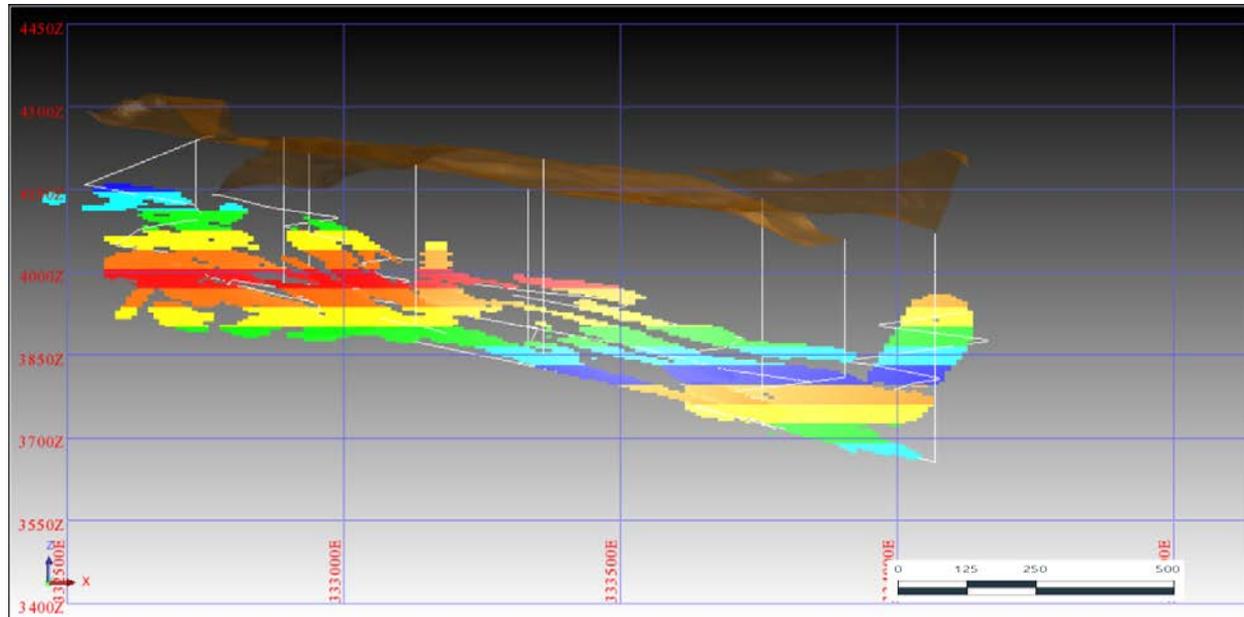
Table 16-1: Subset of Mineral Resources in the Ayawilca Zinc Zone Used in the PEA Mine Plan

Confidence Classification	Tonnage (kt)	Zn (%)	Pb (%)	In (g/t)	Ag (g/t)
Indicated	8,403	6.95	0.18	83.9	15.8
Inferred	29,804	5.79	0.27	62.4	19.0

Notes:

1. The subset of the Mineral Resources in Table 14-16 that are used in the PEA mine plan are reported above a cut-off NSR value of US\$65/t. Indium, while quoted in this subset of the Mineral Resources, was not considered a payable metal in the mine plan.
2. The NSR value was based on estimated metallurgical recoveries, assumed metal prices and smelter terms, which include payable factors, treatment charges, penalties, and refining charges. Metal price assumptions were: US\$1.20/lb Zn, US\$18/oz Ag, and US\$0.95/lb Pb. Metal recovery assumptions were: 92% Zn, 85% Ag, and 85% Pb. NSR value for each block was calculated using the following NSR factors: US\$15.39 per % Zn, US\$12.25 per % Pb, and US\$0.44 per gram Ag. The NSR value was calculated using the following formula: $NSR = Zn(\%) * US\$15.39 + Pb(\%) * US\$12.25 + Ag(g/t) * US\$0.44$.
3. The subset of the Mineral Resources includes allowance for external dilution, but no internal dilution was incorporated. External dilution is anticipated to average 5% for room-and-pillar mining methods, and 10% for post-pillar mining methods. The assumed average mining recovery for the room-and-pillar and post-pillar mining methods is 80%.

Figure 16-1: Proposed Mine Level Layout Plan



Note: Figure prepared by Wood, 2019. Mining level plans are shown at 35 m intervals, colour-coded for level visibility. Figure looks north.

Table 16-2 RMR Estimates

Zone	RMR	Rock Quality
West	35–50	Bad to fair
Central	40–55	Fair to good
East	45–60	Good

16.4 Selection of Throughput Rate

Two conceptual evaluations were performed to select the throughput rate, Taylor's Rule and Tatman's empirical formula for production rate determination. Taylor's Rule was run at four selected NSR block values (\$55, \$58, \$62 and \$65 NSR/t), which suggested a mining rate of 5,000–6,000 t/d. Tatman's empirical formula is based on the geometry of a deposit rather than its size, according to the following formula:

- Production rate (t/a) = rate factor x rate multiplier

where the rate factor equals tonnes/vertical metres and the rate multiplier is an empirical value based on the deposit thickness and risk assumed in the mine design.

Evaluations using 3,000 t/d and 4,000 t/d were found to be sub-economic, so later evaluations focused on 5,000 t/d, 6,000 t/d and 8,000 t/d scenarios. The average production from single headings was estimated in the range of 350–500 t/d, depending on the domain thickness. The minimum average number of headings was estimated assuming 500 t/d per heading, and ranged from 15–24 active headings.

Production rates >5,000 t/d would require longer pre-production periods, higher development capital, and were considered to represent a risk for a deficit of material available for processing. The higher production rates will also have a higher ventilation demand, which will require larger cross-section areas on the main haulage areas to keep air velocity under the limits specified by the regulatory agencies.

As a result of these evaluations, a throughput rate of 5,000 t/d was selected for PEA purposes.

16.5 Mine Cut-off

The estimated NSR cut-off of \$50/t of material processed was determined using data and assumptions provide by both Wood and Tinka. Wood used information compiled from similar projects in the area and from a benchmark database in support of the cut-off determination.

The mine break-even NSR cut-off of \$48.59/t was estimated using an average mining cost for both mining methods, general and administrative (G&A) and preliminary process operating costs. The NSR was then rounded to \$50/t. Figure 16-2 shows the inputs from the various cost areas into the NSR.

The NSR was calculated in the block model using the following equation:

- $NSR = 15.39 * Zn\% + 12.25 * Pb\% + 0.44 * Ag \text{ g/t}$

Where:

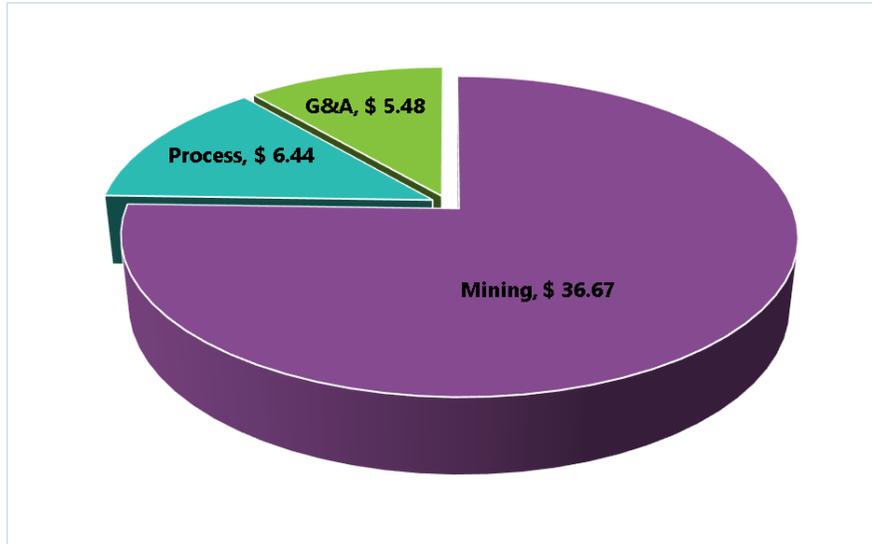
NSR: Estimated mine NSR in \$/t

Zn%: Zinc grade in percent

Pb%: Lead grade in percent

Ag g/t: Silver grade in g/t

Figure 16-2: Inputs to NSR Cut-off



Note: Figure prepared by Wood, 2019.

The NSR per tonne of mill feed material was required to be equal to or exceed the production cost of a tonne of mill feed for the operation to break-even or be potentially economic. A range of scenarios above the \$50/t break-even cut-off were analyzed, and an NSR cut-off of \$65/t was selected. Blocks with an NSR <\$65/t were considered to be waste, blocks with an NSR ≥\$65/t were considered in the mine plan.

16.6 Mining Method Selection

Three different systems were used to determine the most suitable mining method.

16.6.1 Boshkov and Wright (1973) Classification System

This was one of the first qualitative classification systems developed for the selection of mining methods, and evaluated the potential of a combined open pit and underground operation. The assessment is based on general parameters such as the deposit type, dip, and strength of mill feed material and waste to identify the mining methods that have been used under similar conditions.

Based on the Ayawilca Zinc Zone characteristics, the following methods could be applied:

- Open stopes with pillars as required

- R&P.

16.6.2 Hartman Selection System

Hartman (1987) developed a flow diagram type selection process to identify the preferred mining method using the deposit geometry and ground conditions in the mineralized zone. This method focuses on more specific mining methods, and according to Hartman, the approach is qualitative and should be used as a preliminary approach. It also evaluates the potential of a combined open pit and underground operation.

Using the characteristics of the Ayawilca Zinc Zone, the following methods could be applied:

- R&P
- Stope-and-pillar.

16.6.3 UBC Mining Method Selection System

The UBC mining method selection system is based on a modification and simplification of the Nicholas mining methods selection system which identifies feasible mining methods based on a qualitative and quantitative classification. The deposit geometry and grade distribution evaluated first, then the characteristics are reviewed. Finally, the rock strength tests are considered (unconfined compressive strength/principal stress).

Using the UBC mining method selection system, the following methods could be applied:

- Sublevel stoping
- Cut-and-fill stoping
- Open pit
- Sublevel caving
- Shrinkage stoping
- Block caving
- R&P
- Longwall mining
- Top-slicing

- Square-set stoping.

Although this system suggests that open pit mining could be performed, this option was previously discarded for the project based on a review of the potential for an open pit operation completed by RPA in January 2019, which demonstrated that an open pit scenario would not be economically viable.

16.6.4 Conclusions

All three evaluation methods indicated R&P would be suitable. Wood reviewed other aspects such as safety, the continuity and geometry of the mineralized material, grade distribution, production scale and costs, and concluded that R&P and P&P were applicable. The advantages and disadvantages of the methods are summarized in Table 16-3.

It is expected that conventional R&P will be applied in zones with moderate to intermediate thicknesses and variations of this method, such as open stopes with pillars or R&P with benching could be applied in other zones.

Thickness contours of the mineralized domains were plotted at a 15 m threshold, and indicated that approximately 50% of the Ayawilca Zinc Zone could be mined using conventional R&P, and 50% using P&P where the thickness of the mineralized zones is >15 m.

Schematics showing the R&P method is provided in Figure 16-3 and the P&P method in Figure 16-4.

16.7 Design Assumptions and Design Criteria

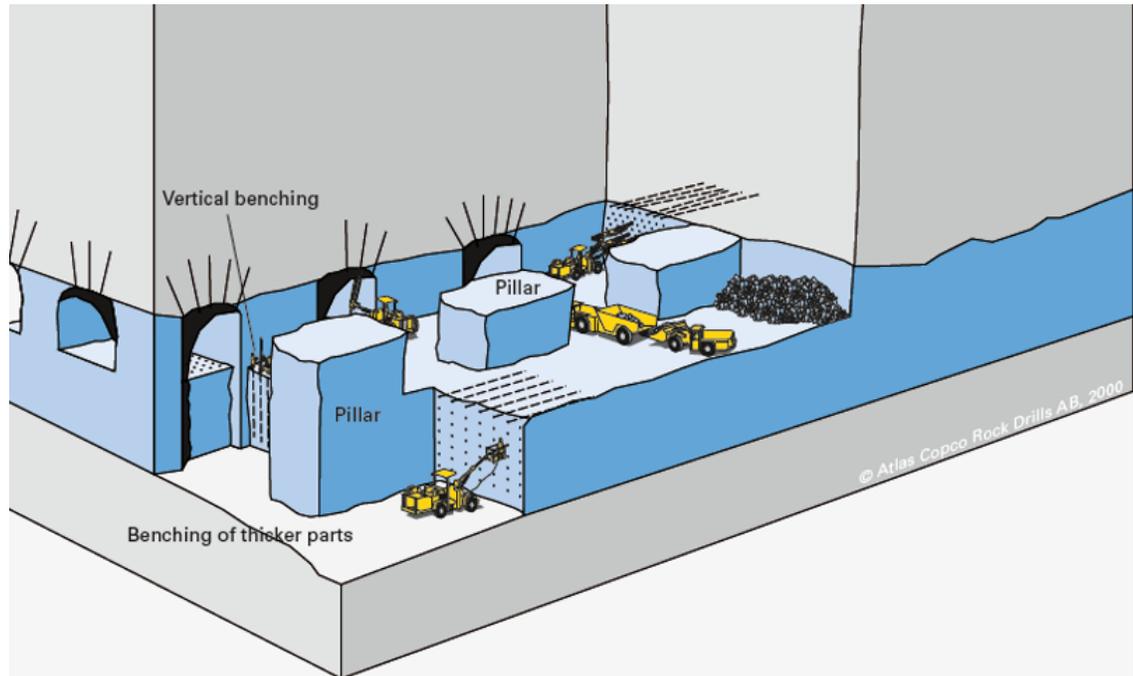
16.7.1 Production Levels

Using the \$65/t mining cut-off as a basis, the mine design assumes 70 m spaced levels, with sub-levels at 35 m intervals. No sill pillar is planned. Figure 16-5 is a 3D view of the layout of the mine showing the main 70 m panel. The selective mining unit (SMU) dimensions were based on the equipment type (Table 16-4).

Table 16-3: Advantages and Disadvantages of Room and Pillar Mining

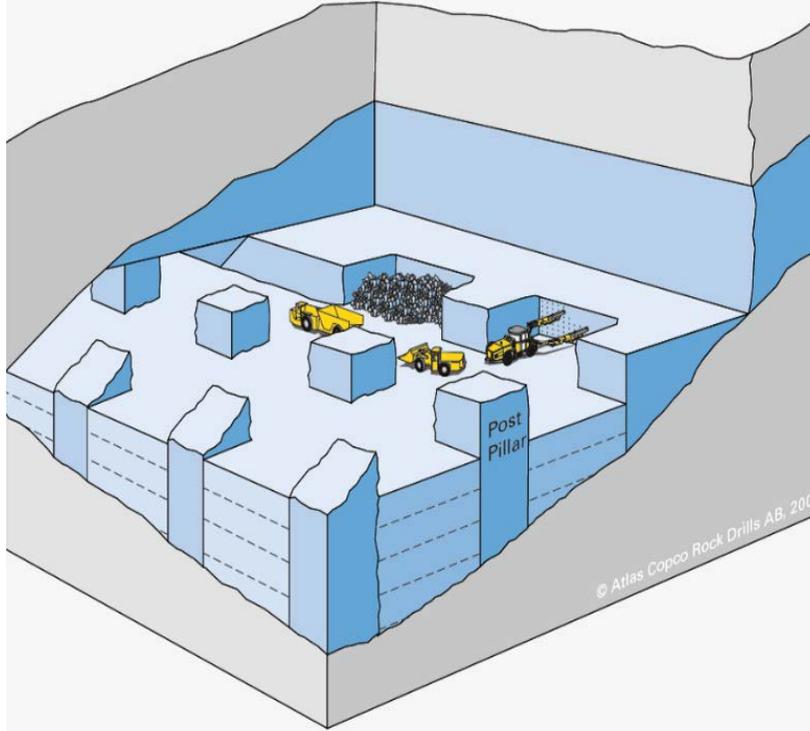
Mining Method	Advantages	Disadvantages
R&P	High productivity Selective mining method Moderate operating cost	Needs rock reinforcement Will leave low-grade material Needs backfill to maximize pillar recovery
P&P	High productivity Low operating cost	Will leave low-grade material Needs backfill to maximize pillar recovery

Figure 16-3: Conventional Room and Pillar Mining



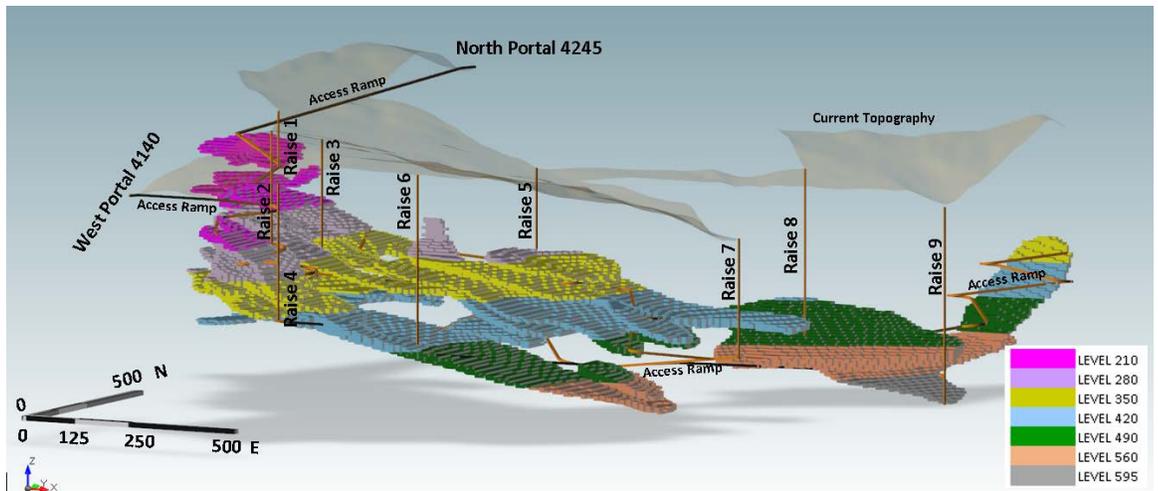
Note: Figure from Atlas Copco, 2000.

Figure 16-4: Post-Pillar Mining



Note: Figure from Atlas Copco, 2000.

Figure 16-5: 3D Proposed Mine Layout



Note: Figure prepared by Wood, 2019.

Table 16-4: SMU Dimensions by Method

Description	R&P	P&P
Length x width	3.8 m x 5.5 m	3.8 m x >5.5 m
Height range	5–15 m	>15 m

16.7.2 Access

A ramp system will be used to access the mine, connecting the mine portal to the underground infrastructure, including the mine production areas. The ramp cross-section was sized based on the ventilation requirements. It was assumed that the ramp will have a maximum gradient of 12% and curves and intersections will be developed at a maximum gradient of 10%.

The location of the main access portals considered the following factors:

- Portal access from access road
- Opportunity to not just mine the higher-grade zones, but to meet a sustained 5,000 t/d production rate
- Proximity to processing and infrastructure facility locations
- Favorable geotechnical conditions for portal infrastructure.

Two access portals, the North 4255 and West 4035, were designed as the main and secondary accesses respectively. Nine ventilation raises (Raises 1 to 9) will also be required. The planned portal and raise locations were included in Figure 16-5.

The North 4255 ramp will intersect the top of the mineralization at elevation 4,146 and the development will continue down to the elevation 4,000 before production starts at this location. A secondary ramp will be developed simultaneously starting at the West 4035 portal. Access to the production locations will be possible by developing drifts and crosscuts branching off from the North 4255 ramp.

The two main ramps will connect at elevation 3,970 and once connected, a one-way-traffic rule will be adopted to address the expected heavy traffic of trucks and other mobile equipment to and from the production locations.

Cross-section dimension assumptions for the primary and secondary access are based on the size of the equipment and the anticipated ventilation requirements (Table 16-5).

Table 16-5: Typical Excavation Cross-Section Dimensions

Access Type	Units	Value
<i>Primary access</i>		
Width	m	5.5
Height	m	5.5
<i>Secondary access</i>		
Width	m	5.0
Height	m	4.5
<i>Main ventilation rise</i>		
Diameter	m	5.0

16.8 Backfill

Approximately 50% of the tailings will be used in paste backfill. It has been estimated that approximately 25 m³ of paste backfill per hour will be required.

Waste rock from mine development will be used for cemented rock fill (CRF) as required to provide additional ground support. Borrow material from a nearby surface pit will be used to complete any rockfill deficiency as required.

16.9 Ventilation

An indicative range of the required ventilation airflow rate was estimated using the following approaches:

- A method developed by John Marks (2012) based on the required mass of air per mass of mineralized material mined
- Benchmark requirements from stoping-type mines sourced from the Wood database
- Benchmark requirements based on the estimated diesel-powered equipment fleet and fixed facilities.

The expected upper limit of 1,604 m³/s and lower limit of 962 m³/s for the Marks' method are based on the specific accuracy range associated with this method, whereas the upper and lower limits associated with the other two methods are based on an

expected accuracy range of $\pm 35\%$. The estimated average airflow rounded to the nearest hundred is approximately $1,300 \text{ m}^3/\text{s}$.

A ventilation schematic is provided in Figure 16-6.

The general arrangement of the ventilation system, at a conceptual level, is such that each intake raise supports two separate exhaust raises and each of the exhaust raises draw air from two separate intake raises, so that all the main haulage drifts are ventilated. Several extended single headings to R&P blocks will be ventilated using fixed forcing fan/duct systems.

Each of the ventilation raises was modeled with a 5 m diameter with to keep the air velocities within a range of 16–20 m/s. The total air-flow capacity of each raise is in the range of $314\text{--}390 \text{ m}^3/\text{s}$, this yields an exhaust capacity of approximately $1,256\text{--}1,560 \text{ m}^3/\text{s}$.

The main decline drift was modeled with a cross-section of $5.5 \times 5.5 \text{ m}$. which at 6 m/s air velocity for a haulage drift, provides an intake capacity of $180 \text{ m}^3/\text{s}$. Air velocities at the main traffic ways are kept at a maximum of 6 m/s. The main ramps, in combination with ventilation raises serving as intakes or exhaust ways, will provide the necessary air ventilation.

The development and commissioning of the main drifts and raises shown in Figure 16-6 would be initiated over a period of approximately 14 years (Table 16-6).

16.10 Mine Infrastructure Facilities

Mine infrastructure facilities will include haul roads, mine truck shop, fuel storage facility, explosives storage magazine, warehouses, dry change room, offices, and backfill plant, water and power distribution, and communications.

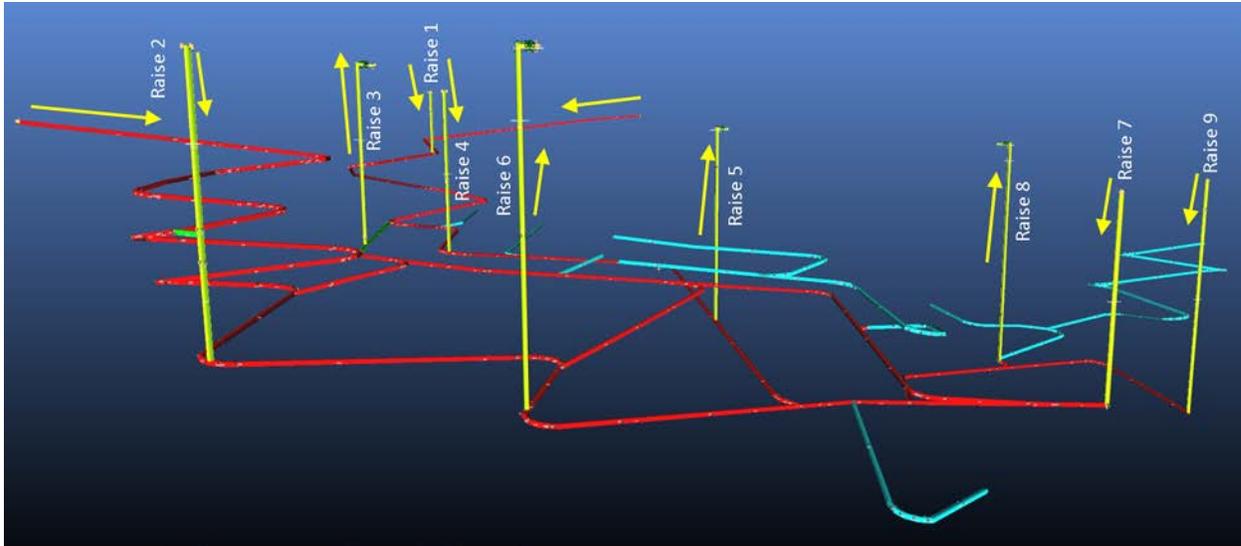
16.11 Development and Production Schedule

16.11.1 Development Schedule

Development and construction of the underground infrastructure will begin a year ahead of production. The main ramps will be developed using conventional drill-and-blast methods. Ventilation raises will be developed using raise bore type machines.

Forecast life-of-mine (LOM) development metre requirements are shown in Table 16-7.

Figure 16-6: General Ventilation System Layout Schematic



Note: Figure prepared by Wood, 2019. The main airways and connecting drifts are shown in red. The drifts that are dead ended to the mining sections are shown in cyan. Vent raises are shown in green. The arrows in yellow indicate the airflow direction in the main intakes and returns.

Table 16-6: Ventilation Intake and Exhaust Raise Schedule

Raise	Application	Project Year
Number 1	Exhaust/Intake	1
Number 2 – Upper	Exhaust/Intake	1
Number 2 – Lower	Exhaust/Intake	4
Number 3	Exhaust/Intake	2
Number 4	Exhaust/Intake	3
Number 5	Exhaust/Intake	6
Number 6	Exhaust/Intake	7
Number 7	Exhaust/Intake	10
Number 8	Exhaust/Intake	11
Number 9	Exhaust/Intake	14

Table 16-7: Development Requirements

Development Type	Unit	Total
Main ramp	m	14,959
Ventilation drifts	m	338
Muck bays	m	1,496
Total horizontal development	m	16,793
Ventilation raise	m	2,720
Stope preparation	m	5,307

16.11.2 Production Schedule

Mine production will start once the two main ramps connect at elevation 3,970. Material will be removed from the production locations using conventional load-haul-dump (LHD) equipment to truck-loading stations and will then transported to the surface to the processing facility. Material from the North and South Ayawilca zones will initially feed the processing plant. The mine production schedule is summarized in Table 16-8.

The process schedule was developed assuming a nine-month ramp-up period. The LOM production rate will be 1.8 Mt/a. The proposed mill feed schedule is provided in Table 16-9.

16.12 Blasting and Explosives

Transportation, permits, management, and storage of explosives will be the responsibility of the Owner. A magazine with a capacity up to 10,000 kg of explosive will be built on-site to temporarily store detonators, boosters, and bulk explosives or ANFO. As the mine development expands deeper, an underground magazine will be built.

16.13 Grade Control

A grade control system will be implemented to ensure that material being fed to the mill is of economic grade. To minimize grade fluctuations a blending strategy will be used, blending mineralized material from different production locations located in different areas or different mantos.

Table 16-8: Forecast Mine Production Schedule

Description	Units	LOM	1	2	3	4	5	6	7	8	9	10	11	12
Mined Material - Indicated	kt	8,403	632	1,046	1,051	832	576	643	520	587	598	476	386	234
Zn Grade	%	6.95	9.29	6.36	6.23	7.68	6.10	6.45	6.61	6.75	6.42	7.28	7.39	7.71
Pb Grade	%	0.18	0.21	0.21	0.25	0.27	0.08	0.12	0.27	0.23	0.13	0.09	0.09	0.08
Ag Grade	g/t	15.8	22.1	18.1	17.9	17.7	12.5	13.2	16.6	16.4	13.6	13.7	12.9	10.7
In Grade	g/t	83.9	110.9	74.2	73.1	73.3	75.7	69.6	78.4	83.4	76.5	90.2	87.0	96.1
Mined Material - Inferred	kt	29,804	1,193	779	774	998	1,249	1,182	1,305	1,243	1,227	1,349	1,439	1,596
Zn Grade	%	5.79	10.29	7.64	5.12	6.48	7.68	6.67	6.63	4.96	5.07	5.42	5.55	5.61
Pb Grade	%	0.27	0.47	0.49	0.54	0.10	0.16	0.34	0.23	0.16	0.40	0.27	0.21	0.18
Ag Grade	g/t	19.0	44.2	33.9	32.5	17.4	18.8	27.6	18.2	11.4	16.8	20.6	17.9	15.2
In Grade	g/t	62.4	111.8	65.5	39.2	81.3	117.8	68.0	88.4	74.5	57.6	46.5	49.3	64.7

Description	Units	13	14	15	16	17	18	19	20	21	22
Mined Material - Indicated	kt	193	151	127	135	92	50	43	31	—	—
Zn Grade	%	8.12	8.31	6.43	6.36	7.88	6.72	5.01	4.88	—	—
Pb Grade	%	0.09	0.08	0.06	0.05	0.03	0.03	0.11	0.12	—	—
Ag Grade	g/t	11.6	11.9	9.6	10.5	14.3	16.5	19.4	19.8	—	—
In Grade	g/t	104.4	116.1	98.3	102.3	152.0	149.5	152.1	154.5	—	—
Mined Material - Inferred	kt	1,632	1,674	1,698	1,695	1,733	1,775	1,782	1,799	1,576	105
Zn Grade	%	5.54	5.77	5.22	5.85	5.57	5.50	5.07	4.49	4.21	4.44
Pb Grade	%	0.20	0.17	0.20	0.21	0.14	0.18	0.28	0.43	0.48	0.21
Ag Grade	g/t	18.4	14.2	12.7	12.7	11.0	15.3	19.5	18.7	25.6	8.2
In Grade	g/t	57.7	53.0	62.4	49.8	52.6	68.7	64.8	43.6	23.3	30.3

Table 16-9: Forecast Mill Feed Schedule

Description	Units	LOM	1	2	3	4	5	6	7	8	9	10	11	12
Feed to Mill - Indicated	kt	8,403	523	985	1,041	863	618	639	537	580	595	494	402	259
Zn Grade	%	6.95	9.29	6.64	6.28	7.43	6.37	6.44	6.58	6.72	6.46	7.14	7.34	7.62
Pb Grade	%	0.18	0.21	0.21	0.25	0.27	0.12	0.12	0.24	0.23	0.14	0.10	0.09	0.08
Ag Grade	g/t	15.8	22.1	18.5	17.9	17.7	13.6	13.3	16.0	16.3	14.0	13.7	13.0	11.2
In Grade	g/t	83.9	110.9	77.6	73.7	73.4	75.2	70.4	77.0	82.5	77.4	88.0	87.2	94.1
Feed to Mill - Inferred	kt	29,804	987	840	784	967	1,207	1,186	1,288	1,250	1,230	1,331	1,423	1,571
Zn Grade	%	5.79	10.29	8.19	5.60	6.37	7.53	6.80	6.65	5.22	5.09	5.37	5.52	5.60
Pb Grade	%	0.27	0.47	0.48	0.53	0.16	0.16	0.31	0.24	0.17	0.37	0.28	0.22	0.18
Ag Grade	g/t	19.0	44.2	36.0	33.0	19.2	18.9	26.3	19.3	12.6	16.2	20.0	18.2	15.6
In Grade	g/t	62.4	111.8	75.1	44.9	76.9	112.9	74.7	86.6	76.3	60.4	48.4	49.2	62.6

Description	Units	13	14	15	16	17	18	19	20	21	22
Feed to Mill - Indicated	kt	203	158	131	134	98	57	45	33	6	0
Zn Grade	%	8.03	8.25	6.75	6.42	7.59	6.94	5.37	4.98	4.98	4.98
Pb Grade	%	0.09	0.08	0.06	0.06	0.04	0.03	0.09	0.12	0.12	0.11
Ag Grade	g/t	11.5	11.8	10.0	10.4	13.5	15.7	18.7	19.6	19.7	15.5
In Grade	g/t	102.4	113.5	101.0	102.1	142.0	147.6	151.3	153.9	153.9	153.7
Feed to Mill - Inferred	kt	1,622	1,667	1,694	1,696	1,727	1,768	1,780	1,797	1,819	171
Zn Grade	%	5.55	5.74	5.30	5.77	5.60	5.52	5.14	4.59	4.27	4.37
Pb Grade	%	0.20	0.17	0.19	0.21	0.15	0.17	0.27	0.41	0.47	0.31
Ag Grade	g/t	18.0	14.8	13.0	12.7	11.2	14.7	18.8	18.8	24.5	14.4
In Grade	g/t	58.4	53.8	61.1	51.4	52.5	66.4	65.1	46.7	27.1	29.1

Regular reconciliation will be required between the estimated mining location grades, the grades indicated from stope/truck sampling and those reported by the processing facility. Mine to plant reconciliation will be essential so that modifications can be made to sampling practice or to the methods or parameters used to estimate grade, tonnage or contained metal, so as to maintain LOM grade and tonnage mill feed rates.

16.14 Mining Equipment

The underground mobile equipment fleet is classified into seven broad categories:

- Mucking (e.g. LHDs)
- Haulage (e.g. road trains and articulated haul trucks)
- Drilling (e.g. jumbos, production drills and bolting equipment)
- Raise bore and boxhole
- Utilities and underground support (e.g. flatbeds, boom trucks, fuel and lube trucks, explosive carriers, shotcrete transmixers and sprayers)
- Surface support
- Light vehicles (e.g. personnel transports, jeeps, tractors).

Major fixed equipment will include: fans and ventilation equipment; pumping and water handling equipment, power distribution equipment; data and communications equipment; and maintenance equipment (fixed shop furnishing).

The mine equipment requirements were estimated using benchmark data for equipment productivities. The projections are provided in Table 16-10 and Table 16-11.

16.15 Comments on Section 16

The Ayawilca Zinc Zone is planned to be mined using underground mining methods. A review completed by RPA in January 2019 demonstrated that open pit mining methods were not likely to be economically viable.

Based on a thickness distribution, approximately 50% of the Ayawilca Zinc Zone will be mined using R&P and the remaining 50% using P&P.

Table 16-10: Forecast Mine and Auxiliary Fleet Requirements

Item	Initial	Sustaining
<i>Main Equipment</i>		
Scoop 4 yd ³	2	2
Scoop 6 yd ³	0	12
Jumbos atlas	3	16
Simba	0	10
Raise borer	1	1
Trucks (30 t)	3	19
<i>Auxiliary Equipment</i>		
Scissor bolter	2	2
Rock breaker	0	4
Scaler	1	1
Front-end-loader	1	1
Shotcrete truck	1	1
Shotcrete pump	1	1
Explosives loader	1	1
Service truck	1	1
Bus	1	1
Pick-up trucks	3	15
Road grader	1	1

Table 16-11: Forecast Service, Support and Ventilation Equipment Requirements

Item	Initial	Sustaining
<i>Service and support equipment</i>		
Water tank	2	2
Portable pumps	5	10
Stationary pumps for sumps	3	6
Air compressor 250 cfm	2	2
Mobile refuge chamber	0	1
Lamp charging station	2	-
Self-rescuers	2	2
Rescue equipment and stretchers	2	2
Surveyors equipment	2	2
Mine geotechnical equipment	1	1
Software and hardware	1	—
Ambulance	1	1
Water tank	2	2
Portable pumps	5	10
<i>Mine Ventilation Equipment</i>		
Ventilation fan 350,000 cfm	1	1
Ventilation fan 200,000 cfm	2	2
Ventilation fan 150,000 cfm	1	1

Note: cfm: cubic feet per minute

R&P offers a slight advantage over P&P mining as it provides more selectivity, whereas P&P has a higher productivity than R&P. Applying both methods, it is estimated that the mine can feed the processing plant at a rate of 5,000 t/d.

With a parent cell size of 10 m x 10 m x 5 m in the resource block model, it was assumed that waste blocks within the resource model would either be left as pillars or that the mineralization could be selectively mined.

Based on the limited information available, favorable ground conditions and favorable hydrogeological considerations were assumed for the mine designs and mine production schedule.

External dilution is at zero grade and it does not add any value to the block, contrarily, blocks located at the edges of the mineralization could become uneconomic at the \$50/t break-even cut-off. To account for this external dilution, a \$65/t value was required for any block to be included in the mine production schedule. There may be some project upside potential if material below this cut-off and above the break-even cut-off can be stockpiled and processed by blending with higher-grade material.

One-way haulage traffic will be implemented along the main haulage routes to alleviate mine traffic and to facilitate road maintenance minimizing downtime.

Mined-out stopes in high-grade areas will be back-filled to maximize mining recovery. Fifty percent of the tailings will be available to use as backfill in combination with waste rock.

Although there is a minimum probability of spontaneous combustion due to occurrence of massive reactive sulphides, no special ventilation requirements were incorporated into the PEA.

The mine production schedule prioritizes development in the high-grade zones where production in early periods is planned. Access to the main production levels are developed mostly in mineralized rock to minimize development in waste rock.

17.0 RECOVERY METHODS

17.1 Process Flow Sheet

The processing flowsheet is based on metallurgical testwork results described in Section 13. Processing of the zinc mineralization will be through a conventional primary crushing, semi-autogenous grinding (SAG), secondary ball mill grinding, coarse lead and standard zinc flotation, concentrate thickening and filtration. The concentrator plant will produce two concentrates: a zinc concentrate which is anticipated to assay 50% Zn based on metallurgical testwork; and a lead–silver concentrate which is anticipated to assay 50% Pb and between 2,750–5,930 g/t Ag. Approximately 50% of the tailings will be mixed with cement and used as structural mine backfill material in the underground operations, while the remainder will be thickened and disposed of in a conventional tailings storage facility (TSF). Process water will be recycled as much as possible to minimize water usage.

Figure 17-1 shows the general process block diagram.

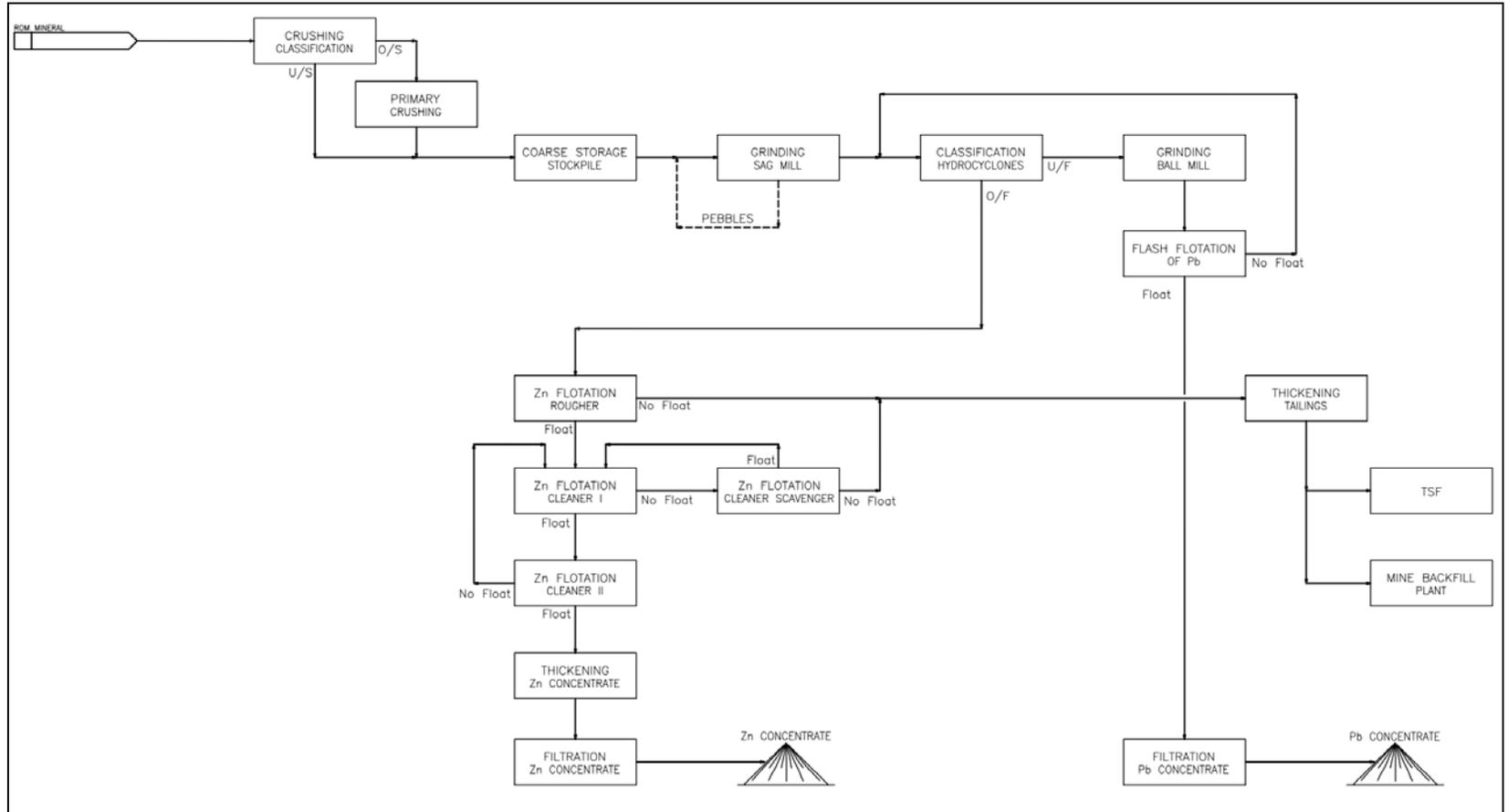
17.2 Plant Design

17.2.1 Process Design Basis

The selection of a conventional coarse lead and standard zinc flotation-based processing circuit for Ayawilca and associated flowsheet is based on metallurgical testwork results (refer to Section 13) and Wood’s experience with operations treating similar mineralization and of the same scale as proposed for Ayawilca.

Metallurgical testwork has shown that the Ayawilca Zinc Zone mineralized material is amenable to froth flotation at a primary grind size of P80 106 μm , achieving commercial zinc concentrate grades and recoveries. Due to the minor lead content and its coarse nature in the mineralized material, a dedicated lead flotation circuit (rougher/cleaner cells) was omitted. To recover the lead content, a coarse flotation stage comprising two unit cells located at the secondary grinding mill discharge will be included. Zinc is recovered in a standard circuit consisting of rougher and two-stage cleaner–scavenger flotation. Based on preliminary testwork results, no regrind circuit was considered necessary.

Figure 17-1: Block Process Diagram



Note: Figure prepared by Wood, 2019. U/S = undersize, O/S = oversize.

Testwork indicated the mill feed will have a medium energy competency for comminution, and a conventional primary crushing, SAG grinding, ball milling circuit was selected for this duty.

17.2.2 Process Design Criteria

A 5,000 t/d throughput rate was selected as the basis for the PEA (refer to Section 16.6).

Key process design criteria used for plant design are summarized in Table 17-1.

The plant design classification falls within the range of “lean” to “standard”, based on a project life of about 20 years, and materials and equipment standards to support normal industry-accepted maintenance times, frequencies and costs. The design will accommodate nominal operation with a small degree of capacity flexibility for upsets and variability, but has no consideration or allowance for any expansion.

17.2.3 Process Description

The processing plant will consist of the following unit operations:

- Primary jaw crushing
- Crushed ore handling
- SAG milling
- Ball mill secondary grinding in a closed circuit with hydrocyclone classification
- Lead flotation unit cells located at the ball mill discharge including rougher/cleaner stages
- Zinc sequential flotation including the following stages (up to three stages): rougher/cleaner/cleaner–scavenger
- Concentrate dewatering (zinc and lead–silver concentrates)
- Flotation tailings thickening and disposal into a TSF
- Tailings backfill plant
- Fresh and reclaim water supply
- Reagent preparation and distribution.

Table 17-1: Process Design Criteria

Parameter	Nominal	Unit	Source
Nominal plant capacity	5,000	t/d	Process calculation
Plant availability	92	%	Recommended by Wood
<i>Mill Feed Characteristics</i>			
Specific gravity	3.6	-	Provided by Tinka
Apparent density (bulk)	2.74	t/m ³	Metallurgical testwork
Moisture	2	% w/w	Assumption
ROM granulometry			
P100	310	mm	Assumption
P80	302	mm	Assumption
Comminution properties			
Crushing work index	11	kW*h/t	Assumption
Ball mill work index	13	kW*h/t	Assumption
Abrasion index	0.12	-	Assumption
<i>Primary Crushing</i>			
Operating hours	16	h/d	Recommended by Wood
Hourly throughput	312	t/h	Process calculation
Product Particle Size (P80)	118	mm	Process calculation
<i>Grinding and Classification</i>			
Operating hours	24	h/d	Recommended by Wood
Hourly throughput	208	t/h	Process calculation
Product particle size (P80)	106	µm	Metallurgical testwork
<i>Lead Flotation</i>			
Rougher:			
Residence time design	0.5	min	Assumption
Cleaner:			
Residence time design	0.5	min	Assumption
<i>Zinc Flotation</i>			
Rougher:			
Flotation time design	20	min	Metallurgical testwork
Cleaner I:			

Parameter	Nominal	Unit	Source
Flotation time design	15	min	Metallurgical testwork
Cleaner II:			
Flotation time design	12.5	min	Metallurgical testwork
Cleaner-scavenger:			
Flotation time design	12.5	min	Metallurgical testwork
<i>Zinc Concentrate</i>			
% Moisture	10	%	Transmin
Zn recovery	92	%	Transmin/metallurgical testwork
Zn grade	50	%	
<i>Lead-Silver Concentrate</i>			
% Moisture	10	%	Transmin
Pb recovery	85	%	Assumption
Pb grade	50	%	
<i>Dewatered Tailings</i>			
Solids content, underflow	55	%	Assumption
TSF: Backfill plant, split	50:50	-	Assumption

Processing of the zinc mineralization considers conventional primary crushing, semi-autogenous grinding (SAG), secondary ball mill grinding, coarse lead and standard zinc flotation, concentrate thickening and filtration. The concentrator plant will produce two concentrates: a zinc-indium (zinc) concentrate and a lead-silver concentrate.

Approximately 50% of the tailings will be mixed with cement and used as structural mine backfill material in the underground operations, while the remainder will be thickened and disposed of in a conventional TSF. A detailed description of each processing stage is provided in the following sub-sections.

17.2.4 Primary Crushing

Run-of-mine (ROM) material will be hauled by dump trucks from the underground mine to the crushing area on surface where the mill feed material will be discharged into a ROM hopper.

The hopper will be installed with a static grizzly and a hydraulic rock breaker to fracture the rocks that exceed the specified passing particle size ($F_{100} = 310$ mm).

An apron feeder will allow the hopper to be discharged, feeding mineralized material to the vibrating grizzly where first coarse classification occurs. The oversize mill feed material will be sent to a primary jaw crusher, while both the crushed and undersize passing material will be transported by conveyor belts to the coarse stockpile. The belt conveyor will be equipped with safety electromagnets to remove metallic objects that could damage the equipment downstream. Figure 17-2 shows the equipment that is planned for the primary crushing area.

17.2.5 Coarse Stockpile and Crushed Ore Handling

The coarse stockpile will have a live tonnage capacity equivalent to 12 hours. From the coarse stockpile, three vibratory feeders (one in stand-by) will reclaim coarse mill feed material to feed into the grinding circuit as shown in Figure 17-3.

The main conveyor belt which feeds the SAG mill will also receive the competent pebbles recirculating from the SAG mill.

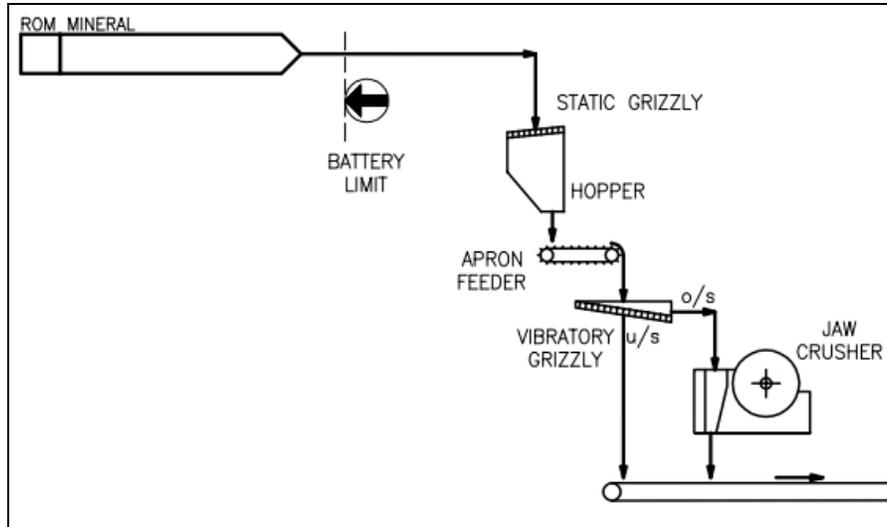
17.2.6 Grinding, Classification, and Lead Flotation Circuit

SAG mill discharge will be screened by a trommel. The trommel oversize will return to the SAG feed conveyor belt, while the trommel undersize will report to a pump box along with the tailings produced by the lead flotation unit cells. At the pump box, a centrifugal pump will feed a hydrocyclone cluster which will classify the material, targeting P_{80} 106 μm suitable for zinc flotation.

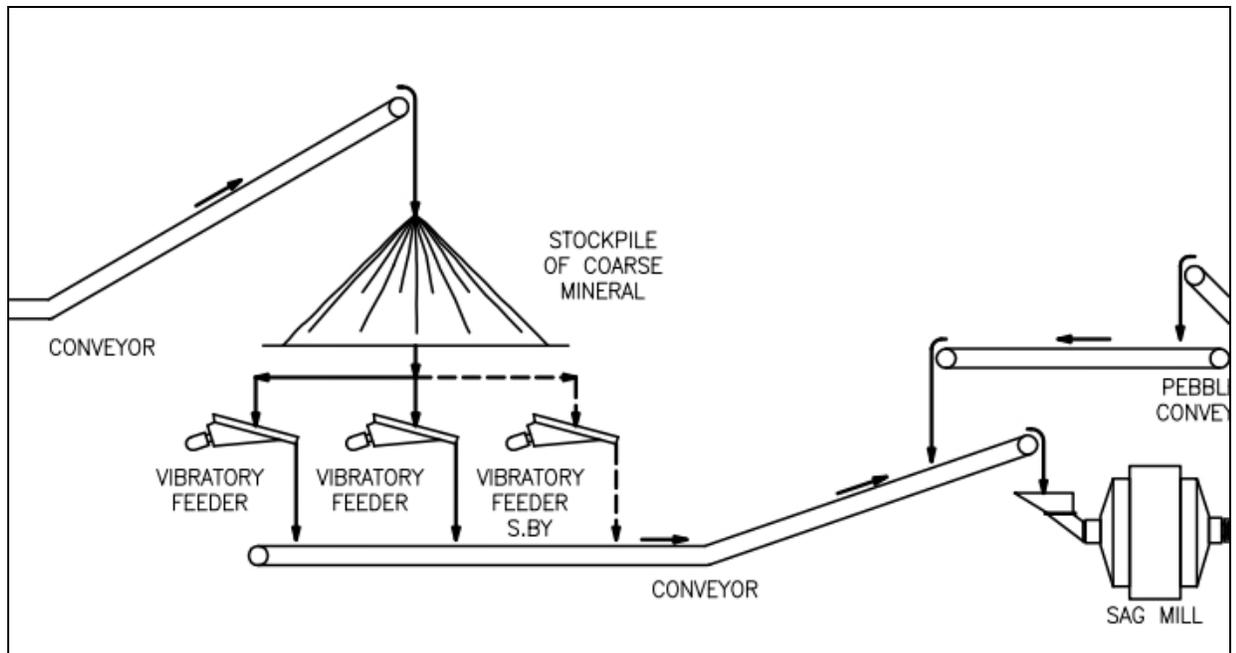
Material at the correct size fraction (hydrocyclone overflow) will be transported by gravity to the zinc rougher conditioning stage prior to being sent to the dedicated zinc flotation circuit. The hydrocyclone underflow will report back to the ball mill as the secondary grinding stage.

The secondary grinding discharge will feed the lead flotation unit cells. This circuit will comprise rougher and cleaner flotation stages. The lead pre-concentrate is sent directly to the lead dewatering stage. A coarse lead-silver concentrate at 85% recovery is planned to be produced by the two lead flotation unit-cells.

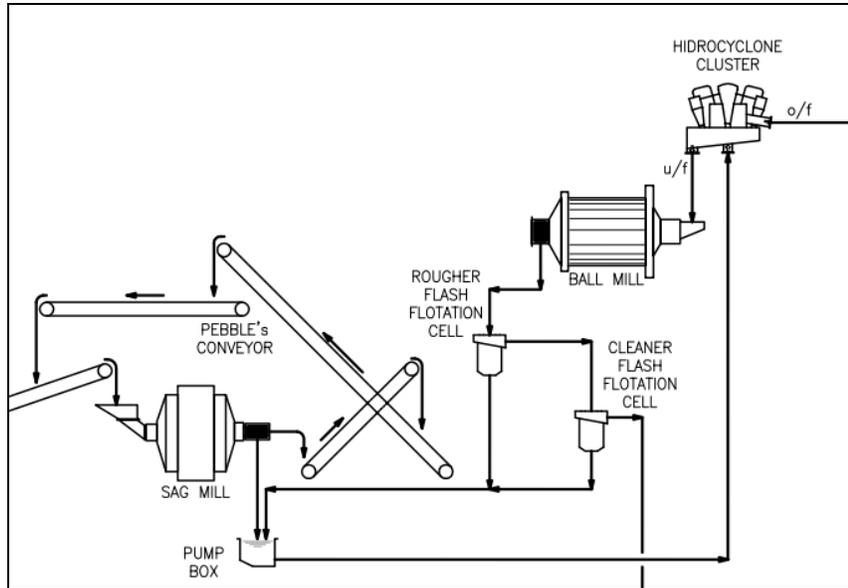
Figure 17-4 shows the flow diagram for SAG grinding, secondary grinding, hydrocyclone classification and the flotation unit cells for lead recovery.

Figure 17-2: Proposed Primary Crushing Circuit


Note: Figure prepared by Wood, 2019. U/s = undersize; o/s = oversize.

Figure 17-3: Proposed Coarse Stockpile and Crushed Mill Feed Handling Circuit


Note: Figure prepared by Wood, 2019.

Figure 17-4: Proposed Grinding, Classification and Lead Flotation Circuit


Note: Figure prepared by Wood, 2019.

17.2.7 Flotation Process

The zinc flotation circuit will consist of rougher, cleaner and cleaner-scavenger stages. Flotation tank cells and Jameson pneumatic cleaner cell units will be used in the zinc flotation circuit to produce a zinc concentrate at 92% recovery.

Jameson-type cells were selected because of the capacity for fine air bubble generation, intense mixing, high bubble loading, and efficient froth washing which promote higher grade concentrates when compared to conventional mechanical cells.

The final concentrate grade is expected to be 50% Zn.

Zinc Flotation

Hydrocyclone overflow from the secondary grinding stage will feed the zinc rougher conditioning tank. Rougher flotation will consist of five 40 m³ flotation tank cells. Rougher concentrate will go directly to the cleaner conditioning tank, while the rougher tailings will become general flotation tailings.

The cleaner I stage will consist of three Jameson cells whose concentrate will report to the cleaner II stage while the cleaner I tailings will be sent to the cleaner–scavenger stage. The cleaner–scavenger stage will include four 10 m³ flotation cells.

The cleaner–scavenger concentrate will return to the cleaner conditioning tank while the tailings will join the rougher tailings to become general flotation tailings.

The cleaner II stage will consist of two Jameson cells. The final concentrate will be pumped to the zinc thickener and the tailings will be returned to the cleaner conditioning tank.

Figure 17-5 shows the proposed zinc flotation circuit.

17.2.8 Concentrate Dewatering

Zinc Concentrate Dewatering

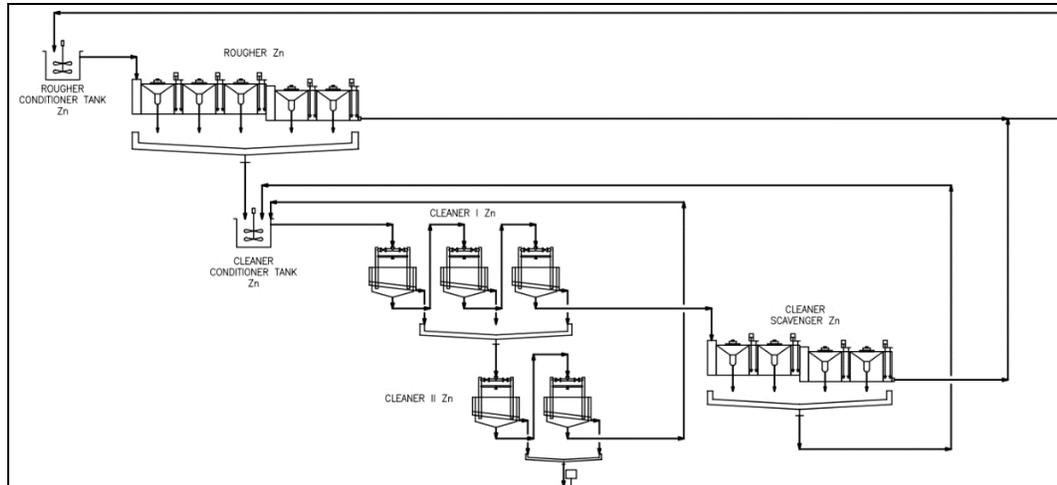
The zinc concentrate high-rate thickener is expected to produce an underflow with 55% solid content. The thickener underflow will be pumped to a press filter to produce a final concentrate cake at 10% moisture. Concentrate cake will be trucked to either a local smelter, or to a port of export for sale. Figure 17-6 shows the thickening and filtering circuit proposed to produce zinc concentrate.

Lead–Silver Concentrate Dewatering

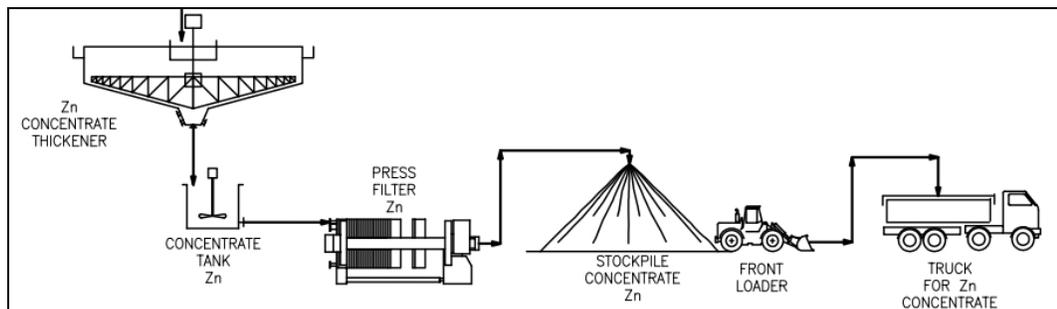
The lead flotation concentrate at 50% solid content from the unit cells flotation circuit will be pumped to a concentrate tank, and then pumped to a vacuum disc filter. Final concentrate cake at 10% moisture will be transported by truck to a port for sale. Figure 17-7 shows the thickening and filtering circuit planned for the production of lead–silver concentrate.

17.2.9 Tailings Dewatering Process and Disposal

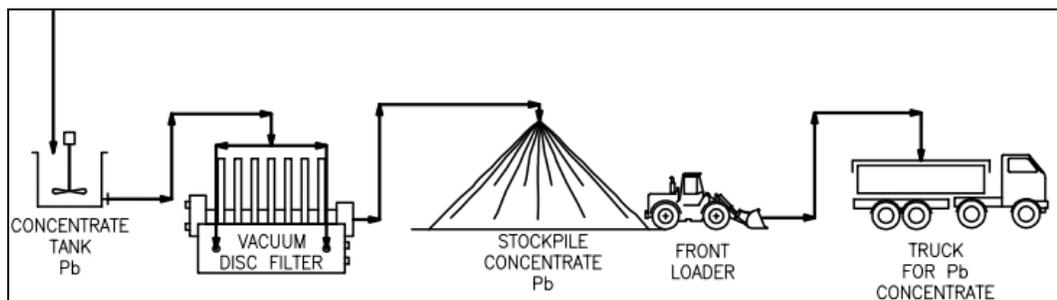
A conventional high rate thickener is proposed for tailings thickening. Tailings will be dewatered to 55% of solid in the underflow. A portion of tailings will be transported by pumps to a TSF, while the remaining portion will be pumped to a backfill plant. The thickener overflow (water) will be returned to the processing plant as process water. Figure 17-8 shows the planned tailings dewatering circuit.

Figure 17-5: Proposed Zinc Flotation Circuit


Note: Figure prepared by Wood, 2019.

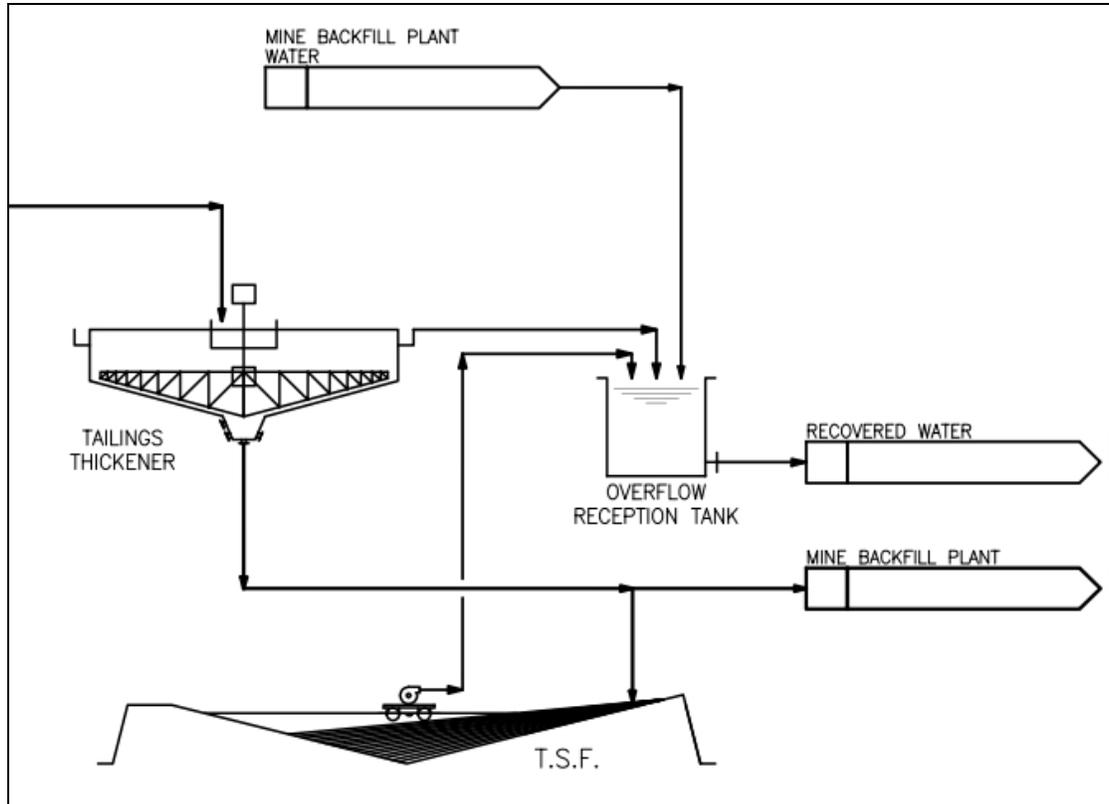
Figure 17-6: Proposed Zinc Concentrate Dewatering Circuit


Note: Figure prepared by Wood, 2019.

Figure 17-7: Proposed Lead-Silver Concentrate Dewatering Circuit


Note: Figure prepared by Wood, 2019.

Figure 17-8: Proposed Tailings Thickening and Disposal Circuit



Note: Figure prepared by Wood, 2019.

17.3 Energy, Water, and Process Materials Requirements

17.3.1 Energy

Process plant and site infrastructure energy requirements (excluding the underground mine) are summarized in Table 17-2, and are expected to average about 40,000 MWh/a over the planned life-of-mine. The average installed power for these facilities will be about 6 MW (excluding the underground mine).

17.3.2 Water

The conceptual water management plan and balance for the project is discussed in Section 18.3. On the basis of this and the projected process water requirements, the

process water balance block flow diagram shown in Figure 17-9 indicates the process plant will require around 41 m³/h as fresh make-up water.

17.3.3 Reagents

Reagent requirement estimates are provided in Table 17-3.

17.4 Comments on Section 17

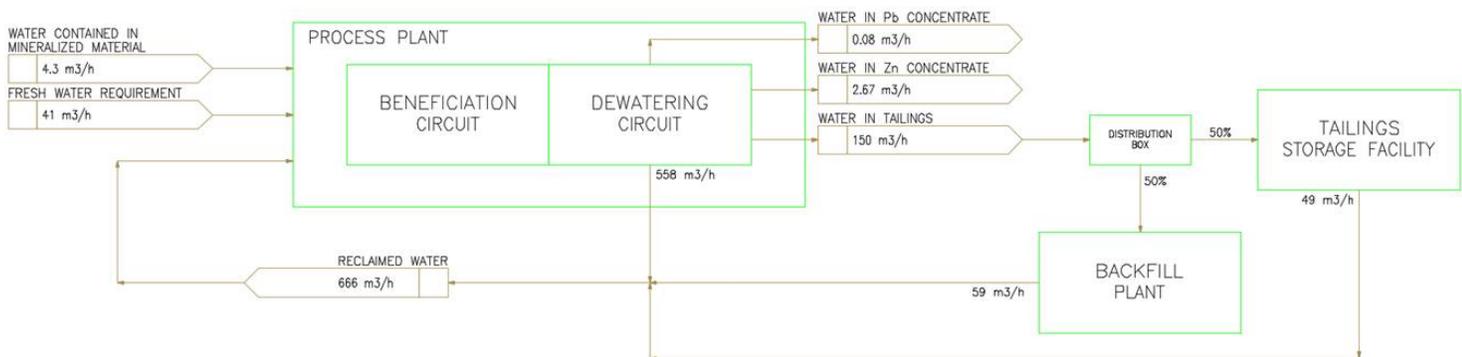
The recovery process will be based on conventional coarse lead and fine zinc flotation recovery methods. Mineralization is expected to respond reasonably to this flowsheet and metallurgical testing of samples from the Ayawilca Zinc Zone indicate that a zinc concentrate grading 50% zinc can be produced with 92% of the zinc recovered to the concentrate. The lead metallurgy has been assumed based on similar operations. The lead–silver concentrate is expected to assay 50% lead and between 2,750–5,930 g/t Ag. Most of the silver is expected to report to the lead–silver concentrate and be payable, while silver is not expected to be payable in the zinc concentrate. The zinc concentrate is expected to be a marketable concentrate with no deleterious elements other than an iron penalty.

No significant variability has been noted in the limited number of metallurgical samples to date; however, a geometallurgical variability program should be conducted in future testing on a broader set of samples including, lower-grade zinc and lead/silver samples, collected across the zones in order to refine the process design criteria and coarse lead flotation circuit assumed in this study. Further definition will also de-risk projected zinc and lead/silver recoveries, process operating costs, and metal production.

Table 17-2: Forecast Energy Consumption

Area	Installed Power (kW)	Power Demand (kW)	Annual Energy Consumption (MWh/a)
<i>Processing Plant</i>	5,900	4,425	38,195
Crushing	258	193	1,129
Coarse ore stockpile and reclaim	144	108	945
Comminution and flotation	5,042	3,781	33,124
Reagents	67	50	438
Tailings thickening	89	67	588
Plant services	300	225	1,972
<i>Site infrastructure</i>	96	72	634
Plant offices	5	3	30
Plant maintenance	26	19	168
Metallurgical and chemical laboratories	66	50	435
Total	5,996	4,497	38,829

Figure 17-9: Block Water Balance Diagram



Note: Figure prepared by Wood, 2019.

Table 17-3: Forecast Reagent Requirements

Reagent	Purpose	Consumption (g/t)	Consumption (t/a)	Basis
Lime	Used to increase and control the slurry pH; will be added at the grinding and rougher conditioning stages.	100	182.5	Assumption
Collector Aero – 3894	Highly selective oil collector; will be added at the grinding and rougher conditioning stages.	25	45.6	Transmin
MIBC	Will be used at a 1:1 ratio with D250 frother to float sphalerite	3.75	6.8	Transmin
D250 frother	Will be used at a 1:1 ratio with MIBC frother to float sphalerite	3.75	6.8	Transmin
Copper sulphate	Will be used for sphalerite activation.	350	638.8	Transmin
Flocculant	An average flocculant dosage was assumed for the tailings dewatering circuit	25	45.6	Assumption

18.0 PROJECT INFRASTRUCTURE

18.1 Introduction

The main project infrastructure components include mine and process plant supporting infrastructure, site accommodation facilities, TSF, external and internal access roads, power supply and distribution, fresh water supply and distribution, and water treatment plant. The infrastructure is likely to be situated within the locations shown in Figure 18-1. As the planned operations will be underground, minimal waste will be generated, hence no permanent waste rock facilities are included in the infrastructure assessments.

The project is located in a remote mountainous river valley area and is a greenfields site. Due to site limitations imposed by topography and potential geological hazards, site development earthworks will be a major project consideration.

18.2 Road and Logistics

18.2.1 Road

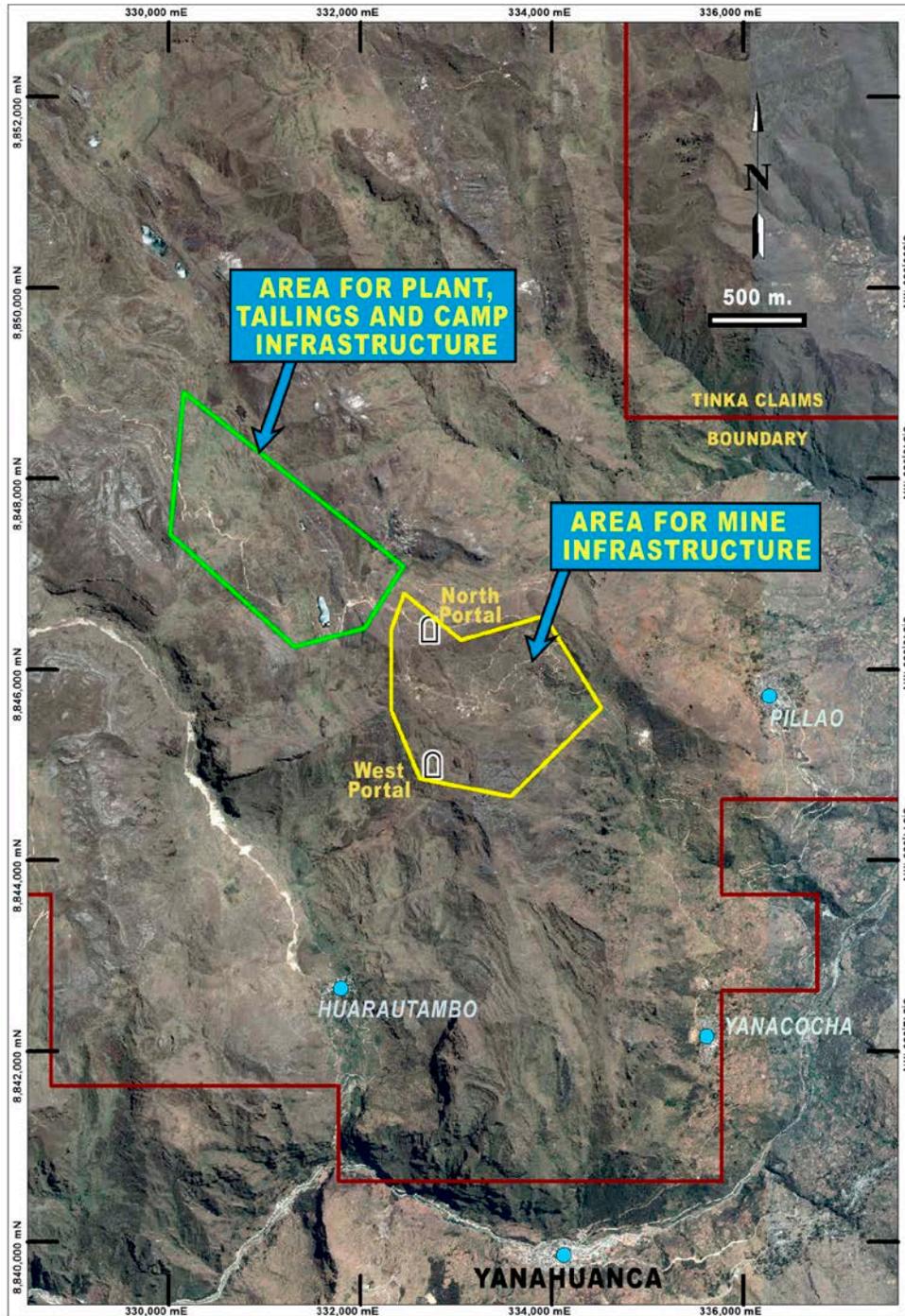
Current Access

Currently, the Ayawilca Zinc Zone is accessible by road, travelling 94 km north of Lima by Panamericana Norte highway (PE-20) to Chancay, then 138 km northeast using the Huaura–Pucallpa road (PE-18) to Oyón, and a last 82 km segment, travelling northeast using the PE-18 road to Yanahuanca. From Yanahuanca to the project site is a further 15 km to the north, via either of the communities of San Pedro de Pillao and/or San Juan de Yanacocha.

Both the PE-20 and PE-18 roads are part of the national road network. The segment of the PE-18 road from Huaura to Oyón is a two-lane road, and is paved. The portion of the PE-18 road from Oyón to Yanahuanca is single lane, and is currently being paved.

The Yanahuanca to site road is single-lane, gravel, and is currently not suitable for trucks.

Figure 18-1: General Infrastructure Area Potential Site Locations



Note: Figure courtesy Tinka, 2019. The image uses a Google Earth backdrop.

Proposed Access Route

The current access to site from Yanahuanca would require upgrading to provide sufficient truck maneuvering room, including minimum turning radius and maximum slopes.

Due to the difficulties associated with improving the existing site access, a new road is proposed to the site from the town of Chinche (Figure 18-2). This road would commence in Chinche, using an existing 8 km stretch of road. At km 8, a new, 20 km-long road will be constructed, which will lead to a mine control gate to be established at the boundary of Tinka's concession holdings.

For cost estimation purposes, it was assumed that the mine portal would be about 12 km from the mine control gate, the process plant 11 km, and the accommodations camp 11 km from the mine control gate.

The road network would be used to transport consumables to the site, and concentrate to either a local smelter or to a port of export.

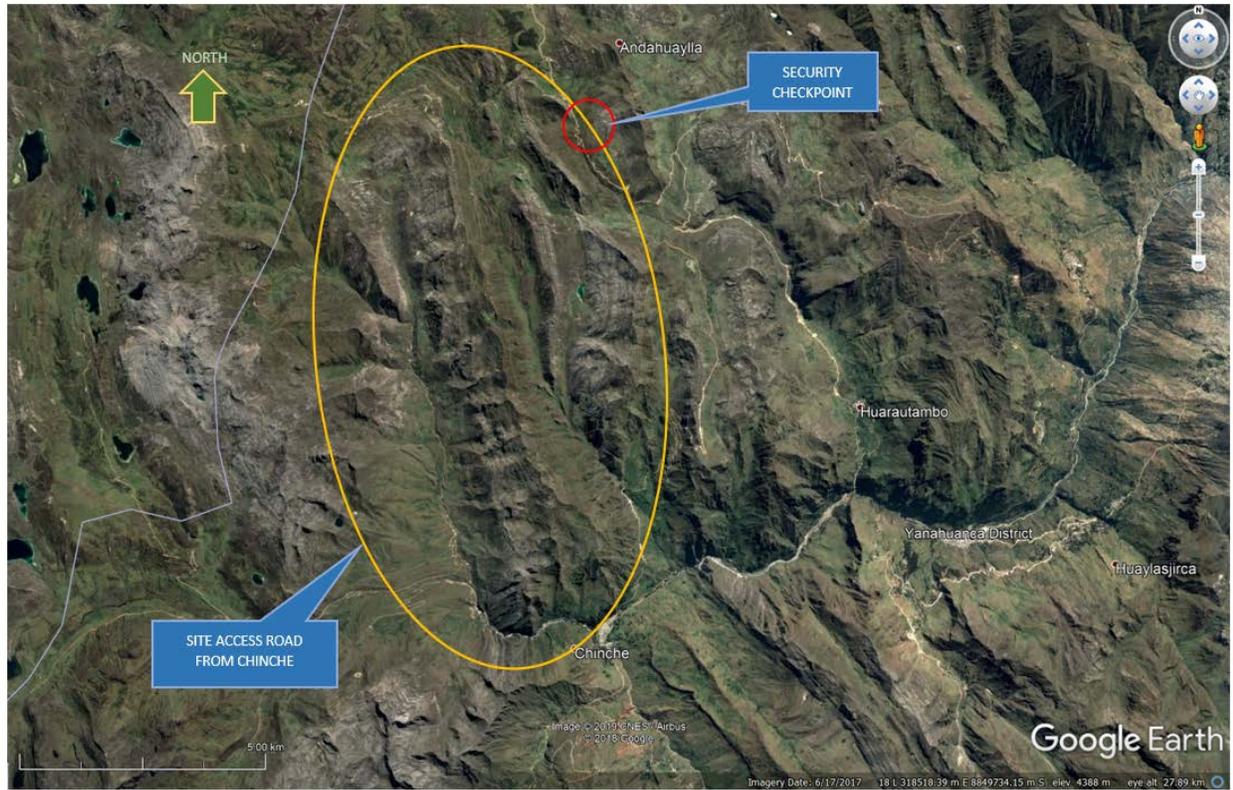
18.2.2 Port

A preliminary analysis of ports that could be used for the project was conducted (Figure 18-3). This indicated that the Port of Callao in Lima was closest to the site (approximately 330 km), and in conjunction with the existing port facilities, resulted in the Port of Callao being selected as the concentrate export facility for PEA purposes for the larger portion of the zinc concentrate and all of the lead–silver concentrate that would be sent to smelters in Asia.

However, port selection should be reviewed during more detailed studies, as the Port of Callao currently accounts for about 80% of the Peruvian foreign trade and there is future potential for congestion issues.

The PEA assumes that concentrate transport for the larger portion of the concentrates that are planned to be exported to markets in Asia will be from the site via the road network linking Chinche, Chancay (rotonda Lachay), Puente Piedra and ending at the Port of Callao, a distance of about 334 km.

Figure 18-2: Planned Access Road Location Map



Note: Figure prepared by Wood, 2019. The image uses a Google Earth backdrop.

Figure 18-3: Port Alternatives Considered in PEA



Note: Figure modified by Wood, 2019, from Encyclopedia Britannica image backdrop. Note the port of Chancay as shown is currently a fishing harbour; however, an industrial port is planned.

18.3 Stockpiles

No permanent stockpiles will be required.

18.4 Waste Storage Facilities

No permanent waste rock storage facilities are planned. Waste generated from decline construction and development activities will be temporarily stored adjacent the mine portals, and will be used during the mine life as backfill material.

18.5 Tailings Storage Facilities

Six different tailings technologies were evaluated during the PEA, and conventional slurry tailings and cycloned tailings were identified as potential project options. The use of conventional slurry tailings technology was selected due to favorable topography, lower construction costs, and lower operational complexity.

Five different TSF locations were reviewed. For PEA purposes, a site northwest of the Ayawilca Zinc Zone was selected. A conceptual distance of 2–3 km between process plant and TSF locations was assumed for use in cost estimating. Tailings should be pumped from the process plant and transported to the TSF via pipeline. The selected site would require relocation of a portion of the two existing power transmission lines; relocation costs were included in the cost estimate.

The PEA plan envisages that 50% of tailings will be used for paste backfill material and the remaining 50% of the tailings will report to the TSF. The TSF will need to accommodate about 19.1 Mt or 11.58 Mm³ of tailings. This would equate to a surface area requirement of approximately 67 ha. The TSF dam wall would reach a maximum height of 47.5 m (at 4,282 masl), with a crest width of 10 m, and would require about 2.6 Mm³ of rockfill. Tailings density was assumed at 1.65 t/m³, and it was assumed that the fill would have a final slope of 2H:1V.

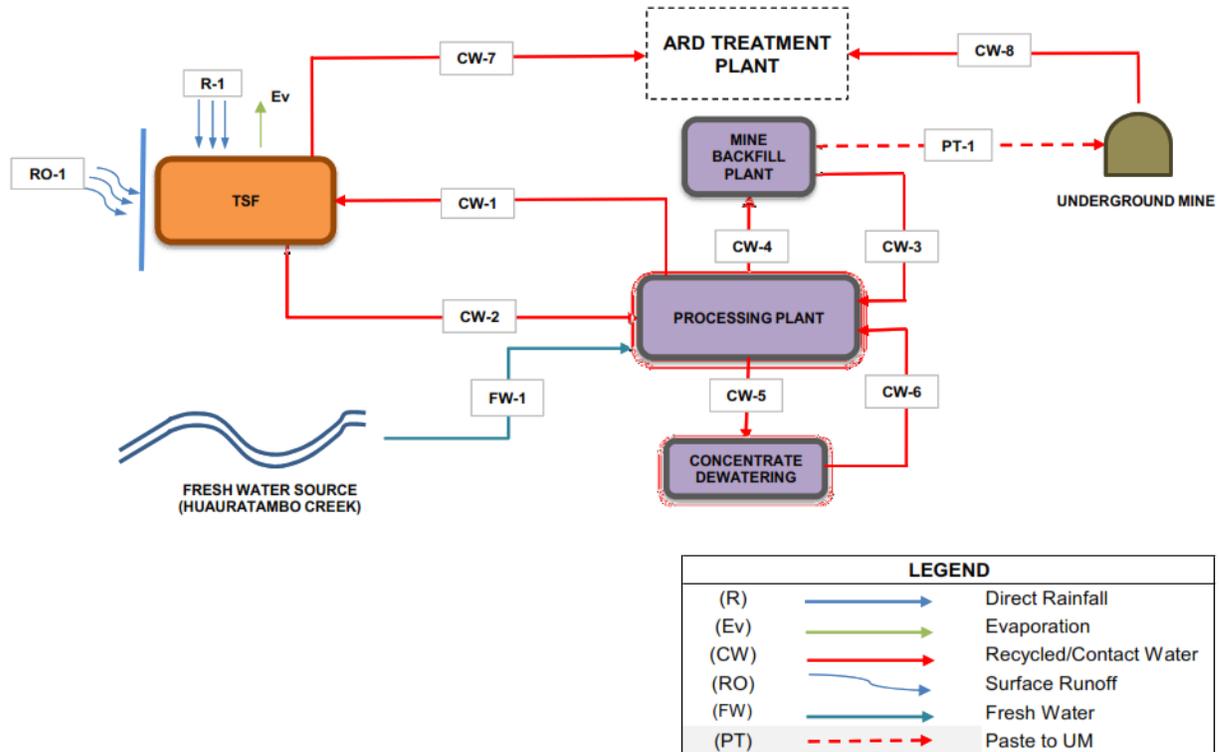
No provision for a TSF liner was made. The depositional plan for the TSF will be developed during future mining studies, and will include provision for management of ponded water within the TSF.

The final site selection will require additional evaluation. As limestones are present in much of the Ayawilca Zinc Zone and adjoining areas, a karstiform features review is recommended. A review should be conducted as to the potential to use cycloned tailings, which should include assessment of whether sufficient sandy materials would be available on or in close proximity to the project site. A material balance will be required as part of that evaluation process.

18.6 Water Management

A water management plan was developed based on a conceptual water balance. A provisional water balance is shown in Figure 18-4. Rainfall and evaporation data were obtained from the Cerro de Pasco meteorological station.

Figure 18-4: Conceptual Water Balance



Note: Figure prepared by Wood, 2019. UM = underground mine.

Mine water is planned to be recycled as much as possible. Evaporation and seepage losses will be minimized in order to reduce fresh-water requirements and discharge to the environment. Likewise, runoff water from the temporary waste rock piles adjacent the portals and reclaimed water from TSF will be used for plant operations.

The water balance assumes that reclaimed water from the TSF will be the main water source for the process plant.

There is a strong likelihood of acid rock drainage (ARD), based on the presence of sulphides in the Ayawilca Zinc Zone. A water treatment plant has been included in the project design. Excess water from the TSF and mine contact water would be diverted to the water treatment plant prior to any discharge to the environment.

The water management system will include diversion channels for non-contact around the temporary waste rock piles and TSF, as well as including ditches in the perimeter of

infrastructure platforms and roads and pipes or culvert concrete boxes for stream crossings. This non-contact water will be discharged to creeks located downstream of the planned operations.

Fresh water will be required to complement make up water for the plant. The project will require a water license for use of fresh water and may also require an authorization to discharge liquid effluents, if applicable.

18.7 Camps and Accommodation

An on-site camp for 500 personnel was assumed for PEA purposes, and will include dormitories, administrative offices, a medical center, laundry area, change house, canteen and kitchen, recreational area, potable water and wastewater treatment plants, and parking.

18.8 Buildings and Built Infrastructure

The PEA assumptions are that the general mine and process surface facilities will include a mine truckshop, a plant maintenance workshop, a laboratory, an explosives storage magazine, water ponds, a general warehouse, an administrative office building, and a core shed. In total approximately 3,100 m² of general buildings have been accounted for in the capital cost estimate.

18.9 Power and Electrical

18.9.1 Existing Transmission Lines

Two transmission lines cross the project area (refer to locations shown in Figure 7-4):

- L-2254, Paragsha 2 – Vizcarra, owned by ISA Colombia (REP)
- L-2264, Paragsha 2 – Conococha, owned by Abengoa Transmision Norte (ATN).

These lines are subject to the guaranteed system of transmission (SGT), which is part of Peru's national interconnection power system (SEIN).

A section of about 7.5 km of each line will need to be relocated under the PEA assumptions.

18.9.2 Project Power Requirements

Based on benchmarking, the average installed power for the underground mine is expected to be similar to that required by the process plant. Therefore, the forecast overall project power demand is about 15 MW, taking into consideration the total site wide power requirements for the process plant, tailings and general infrastructure (6 MW), as well as the underground mine facilities (6 MW) plus an allowance (3 MW). Actual requirements will be determined as part of future more detailed studies.

Four power supply alternatives were assessed. Use of the L-2264 line was selected for PEA purposes as it had no negative impacts on SEIN operation, the line had a greater capacity than other alternatives, and had the lowest implementation costs.

Project power supply assumes the following:

- The project power tie-in point (using a π -type configuration at sectioning point) will be within the project area and will tap into the existing L-2264 power line
- Tinka will be able to obtain an exemption from regulation PR-20 from the Comité de Operaciones del Sistema Interconectado Nacional (COES). PR-20 states that a new sectioning point has to be more than 50 km from the nearest existing substation. The closest sub-station to the project, Paragsha 2, is 40 km to the south. COES have previously granted exemptions on the basis of technical space limitations or geographical constraints.

The power supply scheme will consist of the following:

- Tie-in (at sectioning point)
- New 220 kV sub-station, equipped with a 220/22.9 kV transformer.

In support of more detailed studies, an evaluation of power line rights-of-way requirements should be undertaken.

18.10 Fuel

The PEA assumes that fuel supply will be contracted out and delivered by road transport. Fuel storage tanks and the project gas station are assumed to be located close to the mine services facilities area.

Fuel would be stored in two 12 m³ tanks; this capacity approximately represents the forecast monthly consumption rate.

18.11 Water Supply

The process plant will require around 41 m³/h as make-up water. Potential make-water sources include nearby creeks; if these sources are used, water licences will be required.

The PEA has assumed that water from a nearby creek is available for operations use. Fresh water would be pumped from the creek at a rate of 41 m³/h to a 5,000 m³ capacity storage pond. This design capacity is based on a five-day emergency supply. Water would be pumped as required from the storage pond to the process plant.

18.12 Comments on Section 18

The PEA design assumes conventional infrastructure and conceptual infrastructure locations.

A new project access road from the Chinche community will be constructed, as the current access road would require significant upgrading to support truck traffic.

There is a risk associated with the power supply assumption if the exemption to PR-20 that is used in the PEA design is not forthcoming.

Water management and water supplies will be important to project operations; in particular, agreement must be reached with regulatory authorities and stakeholders as to fresh-water usage.

A water treatment plan will be required for contact water treatment prior to any discharge to the environment.

19.0 MARKET STUDIES AND CONTRACTS

19.1 Market Studies

The information summarized in this subsection is derived from Ocean Partners, a third-party concentrate trading and marketing specialist company, who were contracted by Tinka to prepare a market study to support the PEA (Ocean Partners, 2019a; 2019b).

19.1.1 Zinc Concentrate

Treatment Charges

Zinc prices are currently in the range of US\$1.00–1.20/lb, having reached a 2019 high of US\$1.37/lb in April 2019.

Spot treatment charges (TCs) paid to smelters have recently increased from previous years, indicating a higher availability of zinc concentrates in the market. It is forecast that the spot TCs above US\$275/t seen during May 2019 are close to a peak in the current market. Upward pressure on spot TCs in China is expected to ease in the coming months as smelters are to some extent able to increase production and accumulated stocks in the country are drawn down.

There is believed to be only limited downside potential to TCs over the short and medium term. Any increase in Chinese smelter utilisation will be constrained by environmental factors, restricted credit and subdued end use demand growth. Additionally, output from new zinc projects outside China will eventually ramp up to significant levels.

Overall, the global zinc concentrate market is forecast to be in significant surplus throughout 2020 and 2021, with TCs remaining in the range US\$200–300/t during the period. The global zinc concentrate market is forecast to return to a more balanced condition by 2022 unless new projects are developed.

In a surplus zinc concentrate market, smelters will be more particular about the quality of material they will accept. In these circumstances the acceptability threshold for minor and penalty elements will be lower. Smelters will also pay increased attention to the zinc content of purchased concentrates. Concentrates with a zinc content significantly below 48% will be at increased risk of being rejected. Increased scrutiny of the environmental impact of residue disposal at zinc smelters and the costs

associated with dealing with hazardous waste mean that concentrates with a higher ratio of zinc to residue-forming elements such as silica and iron will be viewed more favourably.

Low TCs over the period 2015–2018 have not incentivized the construction of significant new zinc smelting capacity. Additionally, utilisation rates at existing Chinese smelters are expected to be limited by environmental regulation and restricted credit. It is therefore unlikely that spot TCs will consistently return to the levels below US\$50/t seen over recent years.

Over the long term, an average TC in the region of US\$190/t is regarded as a reasonable figure for financial analysis purposes. This figure includes any price participation that may be applicable.

Concentrate Marketability

The expected grade of the zinc concentrate is 50% Zn, which is considered a medium-grade zinc concentrate, and typical of concentrates from many zinc deposits in central Peru. The preliminary economic analysis in Section 22 assumes that the smelter pays for 85% of zinc content in the concentrate subject to a minimum deduction of eight units.

The expected iron content of the Ayawilca Zinc Zone (~13% Fe) means that the proportion of production that can be sold to smelters in Peru and elsewhere in South America will depend on the iron content of other mines feeding those smelters at that time. Ocean Partners suggested that up to 75,000 dry metric tonnes per year (dmt/a) of concentrate could be sold to smelters in Peru and elsewhere in Latin America.

The Ayawilca zinc concentrate is expected to receive an iron penalty of US\$7.50 per dry metric tonne (dmt) of concentrate at the smelter (at a standard penalty rate of US\$1.50 per 1% Fe above 8% Fe). No other deleterious elements are present in the Ayawilca zinc concentrate, based on current testwork, and no other penalties are expected.

At the proposed production rate, Ocean Partners recommend that Tinka secures at least one long-term contract directly with a smelter, in particular with a smelter in Asia that potentially recovers indium. Spot sales to Chinese smelters could be another preferred option. There is potential for Chinese smelters that recover indium to pay competitive terms.

A portion of the Ayawilca output should also be tendered for free carrier (FCA) delivery from the port of Callao to local trading companies. FCA means that the seller delivers the goods, cleared for export, to the carrier nominated by the buyer at the named place, and the seller pays for carriage to the named place.

The clean nature of the Ayawilca zinc concentrate is likely to make it attractive to those traders that blend concentrates.

Smelters that recover indium may offer more competitive terms for material containing the stated range for Ayawilca zinc concentrates of 320–700 ppm In (averaging 550 ppm In). The exact figure will be dependent on the prevailing indium price. However, a reduction in TCs of around US\$20/t would represent fair value for the Asian smelters only.

Based on current exchange rates, a figure of US\$35 per wet metric tonne (wmt) is regarded as an appropriate figure to cover the inland freight costs of transporting concentrate produced at Ayawilca to the port of Callao or the Cajamarquilla smelter located close to Lima. Based on the proposed marketing strategy an average sea freight cost of around US\$45/wmt is regarded as a reasonable assumption for financial modelling purposes. Port costs are likely to be in the range of US\$15–20/wmt.

19.1.2 Lead–Silver Concentrate

Treatment Charges

Transport and shipping costs are the same as those for the zinc concentrates. No lead smelter is currently operational in Peru, so the concentrates are presumed for this study to be shipped to Asia. Over the long term, an average TC of US\$150/t for the lead–silver concentrate and a silver refining charge (RC) of \$1/oz Ag is regarded as reasonable for budgeting purposes.

Concentrate Marketability

Details of the expected Ayawilca lead–silver concentrate are not as well constrained as those for the zinc concentrate, due to fewer metallurgical testwork results. The expected grade of the lead–silver concentrate is 50% Pb, while silver is expected to be in the range of 2,320–5,880 g/t in the lead–silver concentrate. The smelter is assumed to pay for 95% of lead content in the concentrate subject to a minimum deduction of three units. For silver in the lead–silver concentrate, the smelter typically pays for 95% subject to a minimum deduction of 50 g/dmt.

No penalties are expected on the lead–silver concentrate.

19.2 Commodity Price Projections

Project economics were estimated based on a long-term metal price of US\$1.20/lb for zinc, which was established by Tinka. The long-term metal prices of US\$0.95/lb for lead and US\$ 18.00/oz for silver were based on Wood’s long-term cash flow guidelines for first quarter 2019 (Q1-2019), as of 1 January, 2019, derived from Wood’s survey of industry-consensus prices.

The QP notes that Tinka’s zinc pricing, used in the cashflow analysis, is reasonably aligned with Wood’s internal guidelines, which were US\$1.10/lb for Q1-2019 and at US\$1.15/lb for the second quarter of 2019 (Q2-2019) as of 1 January and 1 April, 2019, respectively.

19.3 Contracts

Tinka has no current contracts for project development, mining, concentrating, smelting, refining, transportation, handling, sales and hedging, forward sales contracts or arrangements.

19.4 Comments on Section 19

Marketable zinc and lead–silver concentrates would be produced from the Ayawilca Zinc Zone.

The zinc concentrate will have zinc as the payable element. Indium in the zinc concentrate is assumed to provide a credit on treatment costs for that portion of the zinc concentrate shipped to Asian markets.

High indium grades in the zinc concentrate represent a potential value-add, although limited value was applied in the PEA for indium. Further technical and marketing studies will be carried out to evaluate how additional value may be derived from indium as part of a future mining operation.

Payable elements in the lead–silver concentrate will be lead and silver.

The zinc concentrate is expected to receive an iron penalty of \$7.50/dmt of concentrate at the smelter. No penalties are expected on the lead–silver concentrate.

The QP has reviewed and analyzed the results of the metallurgical tests for the production of zinc and lead–silver concentrates to support the assumptions in this Technical Report.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Introduction

Tinka has completed seven environmental studies in support of drill program permitting in the period 2013–2018. Tinka received an Authorization to Initiate Mining Activities (Resolution N° 0170-2017-MEM/DGM) on 10 February, 2017.

Five Certificates of Non-Existence of Archaeological Remains (CIRA) have been granted.

20.2 Baseline Studies

The initial EIAsd was compiled in 2012, and included baseline information on physical, biological and social conditions, and an archaeological clearance. The EIAsd was approved in July 2013.

A modified EIAsd (MEIAsd) report was compiled in 2015, and approved in 2016.

A second MEIAsd report has been filed, and is currently under MINEM review.

20.3 Environmental Considerations/Monitoring Programs

20.3.1 Wetlands

Peruvian legislation (Law 28611-2005, General Law of the Environment and Ministerial Resolution N° 092-2014-MEM/DM) identifies wetlands (bofedales) and high-altitude lakes as ecosystems of significance. There are bofedales and two high-altitude lakes, Laguna Chaquicocha (located at 331612.0 E/8846597.5 N) and an unnamed lake (331394.8 E/8847501.9 N) in the project area.

The proposed infrastructure sites were selected with consideration for bofedales and high-altitude lake proximity. The closest infrastructure is anticipated to be sited about 100 m from a high-altitude lake shore. During more detailed studies, infrastructure sites must be the subject of additional environmental evaluation. Peruvian legislation (Ministerial Resolution N° 398-2014-MINAM Guidelines for Environmental Compensation, MINAM 2014) requires implementation of mitigation measures if ecosystems of significance are impacted and can require compensation measures.

20.3.2 Species of Conservation Concern

Initial baseline studies have identified a number of flora and fauna species in the general project area that have been listed as either critically endangered (CR), endangered (EN) or vulnerable (VU), under Peruvian legislation (S.D. N° 043-2006-AG and S.D. N° 004-2014-MINAGRI) or are listed in the Appendices of the Convention on International Trade in Endangered Species (CITES) or the Red List of the International Union for Conservation of Nature (IUCN). Additional studies will be required to better document species of concern, determine the likelihood of project impact on the species, and to develop appropriate mitigation measures where required.

20.3.3 Monitoring Programs

Monitoring was initiated as part of the EIA_{sd} and MEIA_{sd} approvals, is ongoing, and is conducted on a semi-annual basis. The initial EIA_{sd} program collected data on water quality, air quality and environmental noise. The MEIA_{sd} program was expanded to increase the number of monitoring points, and included monitoring of flora, fauna, and soils.

20.4 Closure Plan

The EIA for the project will include a conceptual closure plan to obtain the environmental approval. A detailed Mine Closure Plan must be submitted within one year after EIA approval. Posting of the corresponding financial assurance for closure must also be completed before the start of production and within the first 20 business days of the following year during which the Beneficiation Concession or Start of Activities is approved, as stated by the Regulaciones para el Cierre de Minas or Mine Closure Regulations. The final closure plan must be submitted two years prior to closure of operations.

A provision of US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmark, was included in the capital costs to account for closure costs.

20.5 Permitting

20.5.1 Exploration

Tinka has applied for, and received, environmental permit approvals to conduct all exploration activities to date.

20.5.2 Development

A comprehensive environmental and social impact assessment will be necessary for the project in order to obtain necessary permits for construction, operations, and closure. This assessment will be conducted in compliance with Peruvian regulations, including the following key regulations:

- Ley N° 27446, Ley del Sistema Nacional de Evaluación de Impacto Ambiental
- D.S. N° 019-2009-MINAM, Reglamento de la Ley del Sistema Nacional de Evaluación de Impacto Ambiental
- D.S. N° 040-2014-EM, Reglamento de Protección y Gestión Ambiental para las Actividades de Explotación, Beneficio, Labor General, Transporte y Almacenamiento Minero
- D.S. N° 018-92-EM, Reglamento de Procedimientos Mineros
- D.S. N° 037-2017-EM, Modificación del Reglamento de Procedimientos Mineros
- Ley N° 28090, Ley que regula el Cierre de Minas
- D.S. N° 033-2005-EM, Reglamento para el Cierre de Minas
- D.S. N° 013-2019-EM, Modificación del Reglamento para el Cierre de Minas
- D.S. N° 028-2008-EM, Reglamento de Participación Ciudadana en el Subsector Minero
- R.M. N° 304-2008-MEM/DM, Normas que regulan el Proceso de Participación Ciudadana en el Subsector Minero.

20.5.3 Construction and Operations

Once the environmental and social impact assessment is approved by Peruvian authorities, a variety of permits, licenses, and authorizations will be required to proceed with the project construction and operations. The main permitting requirements include:

- Mine Closure Plan approval
- CIRAs
- Water use authorizations and final licence
- Sanitary authorization, approving wastewater treatment system and discharge

- Sanitary authorization for drinking water treatment system
- Registration as a direct consumer of liquid fuels (fixed or mobile facilities)
- Authorization for acquisition and use of explosives (annual)
- Explosive storing authorization (annual)
- User's certificate for controlled chemical substances and products
- Beneficiation concession
- Start of activities (includes exploitation of construction materials and mining exploitation).

The granted CIRAs do not cover all of the infrastructure areas envisaged in the PEA. Major areas that are known to require additional CIRAs include: mine supporting facilities, mine backfill plant, process plant, primary crusher, power lines, electrical substation, access road and TSF. Review of the final project footprint will be required to ensure that all of the planned operational areas have a CIRA.

20.6 Considerations of Social and Community Impacts

As noted in Section 4.8, there are three active property agreements in place with local communities that support exploration-stage activities.

In support of obtaining the permits to allow exploration activities, Tinka has conducted a number of town-hall meetings with local communities. Tinka also maintains community relations offices in all three communities and the Tinka team endeavours to meet with as many local stakeholders as possible, as often as possible.

As noted in Section 4.2.7, the project will affect at least one community included in the list of indigenous communities maintained by the Ministry of Culture, and will be subject to prior consultation requirements and considerations.

Wood conducted a review of potential social and community impacts as part of the PEA, based on available information provided by Tinka. Tinka has completed a social compliance report for 2017–2018, and files monthly reports on safety indicators including social conflicts (2015–2019 and ongoing) to relevant regulatory authorities. The key risks identified included:

- Potential for conflicts over freshwater usage
- Potential impact on existing wetlands and high-altitude lakes

- Proposed infrastructure locations overlap with existing infrastructure such as roads
- Presence of archeological material in areas proposed to host infrastructure
- Ability to obtain land agreements to support project access, development, construction and operations
- Clear understanding of the project area of influence, including communities that may be potentially impacted, the types of impacts
- The ability of the project and company to meet community expectations.

20.7 Comments on Section 20

Mitigation measures to avoid, reduce, or compensate for potential project effects will need to be developed and supported by comprehensive environmental and social baseline investigations and engineering studies.

The PEA has made certain assumptions as to the timelines needed to complete prior consultation, and collect the necessary wet season/dry season baseline data to allow the EIA report to be completed and lodged with the relevant regulatory authorities. There is a risk that these timeline assumptions are optimistic and may need to be refined during the EIA application process.

21.0 CAPITAL AND OPERATING COSTS

21.1 Introduction

The capital cost estimate was prepared by Wood. All costs are exclusive of the Peruvian value-added tax (Impuesto General a las Ventas or IGV in the Spanish acronym).

21.2 Capital Cost Estimates

21.2.1 Basis of Estimate

The capital cost estimate for the PEA has an expected accuracy range of $\pm 35\%$.

The cost estimate is expressed in Q1-2019 US\$, and uses an exchange rate of 1.00 US\$ = 3.30 PEN.

The estimate includes direct and indirect costs (such as engineering, procurement, construction and start-up of facilities), as well as Owner's costs and contingency associated with mine and process facilities, and on-site and off-site infrastructure.

The following areas are included in the estimate:

- Mine (underground mine development, equipment fleet, backfill plant, and supporting infrastructure and services)
- Process plant (zinc and lead-silver concentrates, conventional 5,000 t/d concentrator flotation plant with supporting plant infrastructure and services)
- TSF
- On-site infrastructure (water treatment and distribution, electrical sub-station and distribution, internal accesses, camp and other general facilities)
- Off-site infrastructure (water and power supply, and new external access).

A small amount of engineering work, being in the range of 1–2% of total engineering for the project, was carried out to support the estimate.

The estimate was based on the following project-specific information:

- Preliminary conceptual mine, process plant and TSF design criteria
- Preliminary conceptual process flowsheet

- Preliminary major mechanical equipment list for process plant and mining equipment fleet
- Preliminary general site layout
- Conceptual electrical supply trade-off study
- Preliminary conceptual mine plan and TSF designs
- Preliminary process plant general mechanical arrangement
- Massive earthworks quantities derived from preliminary sketches (sections).

Factored, end-product units and physical dimensions methods were used to estimate costs based on historical data from similar projects or facilities.

The ratio or factored estimating method was used in estimating the cost of process plant components or areas where the cost of the specialized process equipment made up a significant portion of the total component or area cost. Wood developed costs for process areas for which the costs of the direct labor and bulk materials used to construct the facilities were correlated with the costs (or the design parameters) of the major mechanical equipment.

Using historical data available to Wood from similar projects, the end-product units estimating method was used to relate the end-product units (capacity units) of a plant component to construction costs. This allows an estimate to be prepared relatively quickly, knowing only the end-product unit capacity of the proposed component.

Somewhat similar to the end-products units, the physical dimensions method uses the physical dimensions (length, area, volume, etc.) of the item to be estimated as the driving factor.

Where necessary, historical costs sourced from the Wood data base were scaled using the following 6/10 factoring method:

$$C_b = C_a \left(\frac{S_b}{S_a} \right)^{\text{Power factor}}$$

Where, C_b = the approximate cost (US\$) of equipment having size S_b (cfm, Hp, ft², or other), C_a = is the known cost (US\$) of equipment having corresponding size S_a (same units as S_b), and S_b/S_a is the ratio known as the size factor, which is dimensionless.

A figure of 0.60 was used in general as a power factor for all project components.

The following assumptions were considered:

- All equipment and materials will be new
- The main equipment will be purchased and manufactured in appropriate sizes to be transported by the existing main roads from Lima to the project site
- The execution work will be continuous without interruptions or stoppages
- Concrete will be produced at the construction site
- Contractors will be contracted under unit price contracts
- The project will be executed through an engineering, procurement and construction management (EPCM) contract.

The following are excluded from the capital cost estimate:

- Land acquisition
- Finance costs and interests during construction
- Costs due to fluctuations in exchange rates
- Cost of working capital
- Changes in the design criteria
- Changes in scope or accelerated schedule
- Changes in Peruvian legislation
- Site mitigation (identification and removal of contaminated soils – oil, fuel spilled, heavy metals, pesticides, etc.)
- Other than specified obligations and taxes
- Provisions for force majeure
- Wrap-up insurance
- Reschedule to recover delays due to:
 - Change in scope.
 - Force majeure.
 - Notice to proceed with construction.
 - Labor conflicts.
 - Non-availability of qualified and other labor

- Lack of geotechnical and environmental definitions
- Different soil conditions.

21.2.2 Labour Assumptions

The construction labor and equipment costs were included in the factors that were used in the estimation to account for installation costs or in the unit costs when applied.

21.2.3 Material Costs

All materials required for facilities construction are included in the capital cost estimate. Material costs include freight to the site.

Material costs related to the processing plant such as concrete, structural steel, piping and fittings, and electrical cable were included within the installation factors applied to the mechanical equipment costs.

Material cost related to the processing plant platform, TSF and planned access roads were determined by material-take off quantities from sketches/drawings and installation unit costs. All earthworks quantities were assumed to be neat in place, with no allowance for swell, waste or compaction of materials. Industry-standard allowances for swell and compaction were incorporated into the unit rate.

21.2.4 Contingency

The contingency was established deterministically applying the following percentage factors associated with a PEA level estimate.

- 10% on site preparation, haul roads, underground mine electrical distribution, mine backfill plant and supporting infrastructure direct costs
- 25% on the process plant, TSF, and on-site and off-site infrastructure direct costs, and on the indirect and Owner's costs.

No contingency was considered on the mine development and equipment capital cost.

21.2.5 Mine Capital Costs

This item accounts for the capital costs associated with the underground mine development, mining equipment fleet mine backfill plant, haul roads and support mine infrastructure and services.

The site preparation and haul roads costs were mainly based on massive earthworks quantities estimated from the preliminary general site layout and sketched sections and unit costs sourced from Wood's internal database.

The underground mine development costs were estimated based on the development quantities obtained from a preliminary conceptual mine design and schedule and costs estimated by Wood.

Mine equipment costs were estimated based on a preliminary sizing of the mining equipment fleet and costs based on previous budgetary quotations sourced from Wood's internal database. For estimating purposes, it was assumed that the mine will be run by the Owner.

The underground mine ventilation capital cost was estimated based on a preliminary sizing of the ventilation system composed of drifts, raises and ventilation fans and costs obtained from Wood's internal database.

The underground mine electrical distribution capital cost was estimated based on a conceptual outline of the electrical distribution system to the mine and costs sourced from the Wood's internal database.

The cost associated with the mine backfill (paste) plant were estimated based on a benchmark estimate adjusted using the 6/10 factor method. Mine infrastructure and services costs were estimated based on conceptual sizing and benchmark costs. These costs also account for the cost associated with a rock crusher for the complementary use of CRF.

21.2.6 Process Capital Costs

This item accounts for the capital costs associated with the process plant, including the site preparation in this area and the support process plant infrastructure and services.

The site preparation and surface water management cost accounts for the costs associated with massive earthworks in the process plant area estimated from the preliminary general site layout and sketched sections and unit costs sourced from Wood's internal database.

The process plant and associated infrastructure direct costs were primarily based on the major mechanical equipment list that was prepared as part of the study, and budgetary quotations obtained for equipment at similar projects sourced from Wood's internal database. These were updated and scaled to the required capacity as

necessary. Installation costs were accounted for applying a benchmark factor of 20% on the equipment costs. Civil, structural, architectural, piping, electrical and instrumentation costs were determined based on installed mechanical equipment costs using the benchmark distribution factors presented in Table 21-1. The installed mechanical equipment cost accounts for approximately 40% of the total process plant direct cost.

21.2.7 Infrastructure Capital Costs

Infrastructure areas include:

- TSF dam and water management system
- Acid water treatment plant
- Site electrical sub-station and distribution
- Internal access roads
- On-site camp and other general facilities
- Fresh water supply
- Power supply (including the relocation of a section of the two existing power lines on site)
- External access road.

The TSF costs were estimated based on quantities obtained from a conceptual design and sketches of the TSF and diversion channel and unit costs obtained from Wood's internal database. No liner was considered for the TSF.

As there is a high probability of acidic drainage generation as mineralization by sulphides and sulphates is predominant, and based on conceptual water balance results, it is expected that an acid drainage treatment plant will be required. The cost associated with this plant was estimated based on a benchmark estimate adjusted using the 6/10 factor method.

The cost associated with the site electrical sub-station and on-site distribution was estimated based on a conceptual system design and benchmarked costs for the major components.

The costs associated with the internal access roads were based on massive earthworks quantities estimated from the preliminary general site layout and sketched sections and unit costs sourced from Wood's internal database.

The camp cost accounts for the costs associated with the camp buildings and site preparation in this area. Site preparation costs were based on massive earthworks quantities estimated from the preliminary general site layout and sketched sections and unit costs sourced from Wood's internal database. The building costs were estimated based on a referential personnel headcount and benchmark costs (in US\$/person) sourced from Wood's internal database.

The other general facilities cost accounts for the costs associated with items such as the general office building, and warehouses. These costs were estimated based on a referential sizing of the facility footprints and benchmark costs in US\$/m² from Wood's internal database.

The water supply cost accounts for the costs associated with the freshwater catchment system, storage pond, pipeline and freshwater storage tanks in the project area. These costs were estimated based on a conceptual system design and a combination of unit and benchmark costs for the major components sourced from Wood's internal database.

The power supply cost includes costs associated with the new transmission line from the sectioning point to the existing power line on site (after this is relocated) to the projected on-site electrical sub-station, as well as the costs associated with the relocation of a section (approximately 7.5 km) of each of the existing transmission lines on site. These costs were estimated based on sketched routes and benchmark costs sourced from Wood's internal database.

The cost associated with the external access road was based on massive earthworks quantities estimated from the preliminary general site layout and sketched sections and unit costs sourced from Wood's internal database.

Table 21-1: Process Plant Benchmark Distribution Factors

Cost Item	Distribution Factor	Value (%)
Installed mechanical equipment	% of total process plant direct cost	40.7
Localized earthworks	% of total process plant direct cost	3.3
Concrete works	% of total process plant direct cost	14.3
Structural steel	% of total process plant direct cost	13.1
Piping	% of total process plant direct cost	8.4
Electrical	% of total process plant direct cost	14.3
Instrumentation	% of total process plant direct cost	5.9
Total process plant direct cost		100.0

21.2.8 General and Administrative Capital Costs

Construction labor and equipment costs were included in the factors used in the direct project capital estimation to account for the installation costs or in the unit costs when applied.

Contractor indirect costs include management and supervision of works, accommodation, catering, field offices, mobilization on site, plus consumables, and contractor's profit. These were included in the factors used in the direct capital estimation or in the unit costs when applied.

21.2.9 Owner (Corporate) Capital Costs

Based on Wood's experience with similar projects, the Owner's cost was estimated as the 5% of the total project direct cost. This cost is considered to include pre-operations personnel and training, the Owner's project team during project development and execution, insurance, and permitting.

21.2.10 Sustaining Capital

Wood developed the sustaining capital cost estimate to account for underground mine development, mine equipment and TSF expansion capital costs through the LOM, by

applying the same estimating methodology. The sustaining capital cost estimates are summarized in Table 21-2.

21.2.11 Capital Cost Summary

The initial capital cost estimate is presented in Table 21-3.

Capital costs include the direct costs for project execution, as well as the indirect costs associated with design, construction and commissioning.

Indirect project capital costs include EPCM, third-party consultants, construction facilities and services, equipment freight, vendor support, first fill and spares (for the first year of operation). Percentage factors based on Wood's experience with similar projects were used to determine indirect project costs, based on the project direct cost.

No indirect costs other than the backfill plant were considered within the mining capital cost.

21.3 Operating Cost Estimates

21.3.1 Basis of Estimate

The operating cost estimate has an expected accuracy range of $\pm 35\%$ and is expressed in Q1-2019 US\$.

The estimate includes the underground mining, processing and G&A operating costs. It excludes costs associated with escalation beyond Q1-2019, currency fluctuations, off-site costs, interest charges and taxes. No contingency has been included in the operating costs.

21.3.2 Mine Operating Costs

The mine operating costs were developed by Wood, based on assumptions of R&P and P&P mining methods. Costs were benchmarked from similar projects for the planned 5,000 t/d production rate. All costs assume Owner mining.

The mine operating cost estimate includes the costs associated with stope preparation, drilling, blasting, ground support, backfill, underground loading and hauling and material transport to the primary crusher on surface, as well as support and ancillary equipment operations and maintenance, power, direct labor and mine operations supervision staff.

Table 21-2: Sustaining Capital Cost Estimate Summary

Description	US\$ M
Mine development	38.0
Mining equipment fleet	61.9
Underground ventilation	9.9
TSF expansion	34.9
Total sustaining capital cost estimate	144.6

Table 21-3: Initial Capital Cost Estimate Summary

Description	US\$ M
<i>Mine</i>	<i>43.1</i>
Site preparation	0.6
Haul roads	0.9
Pre-production development	16.4
Mining equipment fleet	15.1
UG mine ventilation	1.8
UG mine electrical distribution	1.3
Mine backfill plant	6.6
Mine support infrastructure and services	0.4
<i>Process plant</i>	<i>76.3</i>
Site preparation and surface water management	7.2
Ore reception and crushing	13.8
Zinc concentrator	39.2
Lead-silver concentrator	3.8
Tailings transport and disposal	3.9
Reagents storage and handling	2.5
Process plant support infrastructure and services	6.1
<i>TSF</i>	<i>6.7</i>
Starter dam	6.0
Water management	0.6
<i>On-site infrastructure</i>	<i>34.3</i>

Water treatment and on-site distribution	5.9
Site electrical sub-station and on-site distribution	10.4
Internal access roads	9.2
Camp	7.2
Other general facilities	1.6
<i>Off-site infrastructure</i>	<i>14.7</i>
Fresh water supply	2.5
Power supply	5.5
External access roads	6.6
Total direct costs	175.0
Indirect costs	33.6
Owner's costs	8.7
Contingency	44.5
Total initial capital cost estimate	261.9

A provision was made in the mine operating cost to account for minor and complementary developments not considered in the conceptual mine design.

Mine staff wages and salaries were included as part of benchmark costs based on similar operations in Peru. A diesel cost of US\$1.30/l was assumed.

The overall average underground mine operating cost was estimated US\$36.66/t of material mined (which equals the mill feed processed), and the total LOM mine operating cost is US\$1,400.5 M, excluding pre-development costs (capitalized mine development costs during the pre-operational period of the process plant).

Table 21-4 presents the underground mine operating cost summary for each of the planned mining methods.

21.3.3 Process Operating Costs

The process operating cost estimate accounts for the operating and maintenance costs associated with the 5,000 t/d process plant operation, supporting services infrastructure, and tailings disposal to the TSF.

Table 21-4: Underground Mine Operating Costs Summary (in US\$/t mined or processed)

Description	R&P Method	P&P Method	Comment
Stope preparation	6.55	7.17	Stope access preparation, utilities, miscellaneous
Drilling and blasting	3.76	3.04	—
Ground support and backfill	8.41	7.95	Rock bolts, wire mesh, shotcrete, cable bolts and backfill as required
Muck haul transport	7.03	6.36	—
Services: power and maintenance	7.46	6.20	Mine services, power, mainly ventilation
Labor	2.80	2.65	—
<i>Sub Total Mine</i>	<i>36.02</i>	<i>33.38</i>	—
Sustaining development	2.05	1.91	Provision for additional development not included in designs; does not include equipment replacement
Total Mining Cost	38.07	35.29	

Operating costs associated with the backfill plant are included in the mine operating cost estimate.

Process plant operating costs were estimated using the following cost categories: power, labour, reagents and consumables, maintenance supplies and services.

In general, the process operating cost estimate is based on the following preliminary documentation: conceptual process flowsheet, conceptual mass balance, mechanical equipment list, list of reagents and consumables, and a referential staffing plan.

21.3.4 Power

Power consumption was estimated based on the power requirements by the major and secondary processing plant equipment (excluding stand-by equipment), and adjusted using benchmark factors to account for auxiliary and minor equipment power demand.

Assumptions included:

- 90% average equipment efficiency
- 75% correction factor

- Crushing circuit operations of 16 h/day
- Other process circuit operations of 24 h/d
- 92% annual availability.

A unit power cost of US\$0.076/kWh was anticipated, based on benchmark costs from similar projects.

21.3.5 Consumables and Reagents

Reagent consumptions were estimated based on the results of previous metallurgical testwork. However, due to the lack of testwork information associated with CaO and flocculant, these reagent usages were estimated based on benchmarks from similar polymetallic processing plants.

Equipment consumables were estimated using Bond empiric correlations for the SAG and ball mill lines and media. These correlations use the abrasion index as the only variable to determine the wear of these in lb/kWh. An assumed abrasion index of 0.12 was applied.

The consumables and reagents costs were sourced from Wood's internal database.

General consumables for the process plant (personnel protective equipment, metallurgical laboratory, chemical laboratories, maintenance, office supplies and others) were estimated using a 12% factor from the total consumable and reagent costs.

21.3.6 Labor

Labour costs were estimated based on a preliminary staffing plan estimate for the operation and maintenance of the process plant based on Wood's experience with similar projects. The estimate accounts for management and headquarters personnel, plant operators and supervisors, as well as laboratory and plant maintenance personnel.

Operating personnel of the plant will work under a rotation system of 12 hours per shift, two shifts per day.

Labor costs were sourced from Wood's internal database. These labor costs include basic salaries as well as bonuses and personnel health insurance costs required by law.

21.3.7 Maintenance Supplies

The overall process plant maintenance cost per year was estimated as the 5% (benchmark factor) of the mechanical equipment direct capital cost and is assumed to account for preventive maintenance, repairs and major equipment maintenance costs for the process plant.

21.3.8 Services

Services costs include the following areas: chemical assays, maintenance services by contractors, personnel mobilization, as well as water and compressed air supply and distribution and other general services.

The chemical assay costs were estimated based on a preliminary testwork program for control of the process plant and unit costs for laboratory tests sourced Wood's internal database.

The maintenance services costs associated with the replacement of mill liners and grinding media were estimated based on benchmark costs for similar process plants.

The costs associated with the personnel mobilization, scheduled maintenance services for plant shutdowns (carried out by contractor companies) and other general services were assumed as the 2% of the total direct capital process plant cost, while the water and compressed air supply and distribution costs were assumed as the 4% of the direct capital cost of these systems.

Table 21-5 is a summary of the estimated annual process plant operating costs.

The estimated LOM process operating cost is US\$246.1 M or an equivalent of US\$6.44/t of mill feed processed.

21.3.9 Infrastructure Operating Costs

General on-site infrastructure operating costs are included in the G&A operating costs.

21.3.10 General and Administrative Operating Costs

The G&A operating cost was estimated at a total LOM of US\$209.4 M or an equivalent of US\$5.48/t of mill feed processed, based on an average benchmark cost of US\$10 M per year from similar operations in Peru.

Table 21-5: Process Plant Operating Cost Estimate Summary

Category	US\$/year	US\$/t	Percentage of Total Estimate
Power	2,951,000	1.62	25
Labor	2,554,500	1.40	22
Reagents and consumables	3,470,900	1.90	29
Maintenance	1,171,100	0.64	10
Services	1,609,200	0.88	14
Total	11,756,700	6.44	100

Note: The overall cost estimate includes costs for laboratory services, transportation and scheduled maintenance of plant equipment (assumed to be carried out by contractors). The services cost estimate includes costs for tailings thickening and disposal in TSF.

21.3.11 Owner (Corporate) Operating Costs

Owner operating costs were included in the G&A estimate.

21.3.12 Operating Cost Summary

Table 21-6 is a summary of the operating cost estimate.

21.4 Comments on Section 21

All costs estimated in this PEA exclude IGV.

Capital cost estimates are expressed in Q1-2019 US\$, considering an exchange rate of 1.00 USD = 3.30 PEN.

No contingency was considered on mine development and equipment capital cost; however, the following factors were applied:

- 10% on site preparation, haul roads, underground mine electrical distribution, mine backfill plant and supporting infrastructure direct costs;
- 25% on the process plant, TSF, and on-site and off-site infrastructure direct costs, and on the indirect and owner's costs.

The estimated Initial capital cost is for the project is US\$261.9 M. Sustaining capital cost accounting for underground mine development, mine equipment and TSF expansion is US\$144.6 M.

Table 21-6: Operating Cost Estimate Summary

Description	LOM Cost Estimate (US\$/t mill feed processed)	LOM Cost Estimate (US\$ M)
Mining	36.66	1,400.5
R&P mining	38.06	716.8
P&P mining	35.29	683.7
Processing	6.44	246.1
G&A	5.48	209.4
Total	48.57	1,855.9

The following items are not included in the operating cost estimate:

- Off-site infrastructure
- Contingency allowance
- Escalation beyond Q1-2019
- Transportation, insurance, and refining costs are included in the financial analysis in Section 22.

22.0 ECONOMIC ANALYSIS

22.1 Cautionary Statements

Certain information and statements contained in this section and in the Report are “forward looking” in nature. Forward-looking statements include, but are not limited to, statements with respect to the economic and study parameters of the project; Mineral Resource estimates; the cost and timing of any development of the project; the proposed mine plan and mining methods; dilution and extraction recoveries; processing method and rates and production rates; projected metallurgical recovery rates; infrastructure requirements; capital, operating and sustaining cost estimates; the projected life of mine and other expected attributes of the project; the net present value (NPV) and internal rate of return (IRR) and payback period of capital; capital; future metal prices; the timing of the environmental assessment process; changes to the project configuration that may be requested as a result of stakeholder or government input to the environmental assessment process; government regulations and permitting timelines; estimates of reclamation obligations; requirements for additional capital; environmental risks; and general business and economic conditions.

All forward-looking statements in this Report are necessarily based on opinions and estimates made as of the date such statements are made and are subject to important risk factors and uncertainties, many of which cannot be controlled or predicted. Material assumptions regarding forward-looking statements are discussed in this Report, where applicable. In addition to, and subject to, such specific assumptions discussed in more detail elsewhere in this Report, the forward-looking statements in this Report are subject to the following assumptions:

- There being no significant disruptions affecting the development and operation of the project
- The availability of certain consumables and services and the prices for power and other key supplies being approximately consistent with assumptions in the Report
- Labor and materials costs being approximately consistent with assumptions in the Report
- The timelines for prior consultation and wet season/dry season baseline data collection being generally consistent with PEA assumptions, and permitting and

arrangements with stakeholders being consistent with current expectations as outlined in the Report

- All environmental approvals, required permits, licenses and authorizations will be obtained from the relevant governments and other relevant stakeholders
- Certain tax rates, including the allocation of certain tax attributes, being applicable to the project
- The availability of financing for Tinka's planned development activities
- The timelines for exploration and development activities on the project
- Assumptions made in Mineral Resource estimate and the financial analysis based on that estimate, including, but not limited to, geological interpretation, grades, commodity price assumptions, extraction and mining recovery rates, geotechnical, hydrological and hydrogeological assumptions, capital and operating cost estimates, and general marketing, political, business and economic conditions.

The production schedules and financial analysis annualized cash flow table are presented with conceptual years shown. Years shown in these tables are for illustrative purposes only. If additional mining, technical, and engineering studies are conducted, these may alter the project assumptions as discussed in this Report and may result in changes to the calendar timelines presented.

The preliminary economic analysis is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA based on these Mineral Resources will be realized.

22.2 Methodology Used

The financial analysis was carried out using a discounted cash flow (DCF) methodology. Net annual cash flows were estimated projecting yearly cash inflows (or revenues) and subtracting projected yearly cash outflows (such as capital and operating costs, royalties and taxes). These annual cash flows were discounted back to the date of beginning of capital expenditure at mid-year 2021 (mid-year -2) and totalled to determine the NPV of the project at selected discount rates. A discount rate of 8% was used as the base discounting rate.

In addition, the IRR, expressed as the discount rate that yields an NPV of zero, and the payback period, expressed as the estimated time from the start of production until all initial capital expenditures have been recovered, were also estimated.

Sensitivities to variations in commodity prices, grades, initial capital costs and operating costs were carried out to identify potential impacts on NPV and IRR.

All monetary amounts are presented in constant Q1-2019 US\$. For discounting purposes, cash flows are assumed to occur at the end of each period. Revenue is recognized at the time of production.

22.3 Financial Model Parameters

22.3.1 Mineral Resource, Mineral Reserve, and Mine Life

The PEA mine plan is based on the subset of Mineral Resources in Table 16-1. Indicated Mineral Resources account for 22% of total mill feed and Inferred Mineral Resources for 78% of total mill feed.

The forecast mine and mill feed schedules were included as Table 16-8 and Table 16-9 respectively.

22.3.2 Metallurgical Recoveries

Metallurgical recoveries and concentrate grades used for the financial analysis are summarized in Table 22-1 and Table 22-2 respectively. A 10% moisture content assumption was used for both the zinc and lead–silver concentrates.

22.3.3 Smelting and Refining Terms

It is estimated that 75 kdmt/year of the zinc concentrate will be sold to a local smelter in Peru and the remaining yearly production will be sold free-on-board (FOB) Asia. Lead–silver concentrate production will be sold FOB Asia.

Table 22-1: Forecast Metallurgical Recoveries

Item	Recovery Rate (%)
<i>Zn concentrate</i>	
Zn recovery	92.0
In recovery	92.0
<i>Pb–Ag concentrate</i>	
Pb recovery	85.0
Ag recovery	85.0

Table 22-2: Forecast Concentrate Grades

Item	Concentrate Grade (%)
<i>Zn concentrate</i>	
Zn grade	50
Fe grade	13
<i>Pb–Ag concentrate</i>	
Pb grade	50

The following payability factors have been applied:

- Zinc concentrate:
 - Zinc: pay for 85.0% of the zinc content, subject to a minimum deduction of eight units.
- Lead–silver concentrate:
 - Lead: pay for 95.0% of lead content, subject to a minimum deduction of three units
 - Silver: pay for 95.0% of silver content, subject to a minimum deduction of 50 g/dmt.

In the portion of the zinc concentrate to be sold to Asian markets, it was assumed that the indium content in the zinc concentrate is not directly payable, but provides a treatment charge credit.

Table 22-3 outlines the concentrate treatment and refining charges applied in the economic assessment. These figures include any price participation that may be applicable.

The zinc concentrate is assumed to be subject to a penalty of US\$1.50 per each 1% Fe above 8.0% Fe.

Table 22-4 presents the concentrate transport costs applied. A concentrate transport loss of 0.2% was assumed for both concentrates.

22.3.4 Metal Prices

The metal prices used are provided in Section 19.2.

22.3.5 Capital Costs

Capital cost assumptions are outlined in Section 21.2. A construction period of 18 months was considered (starting in mid-year 2021) for the overall project implementation. Year 2023 corresponds to the first year of production. Capital costs were applied in the financial model excluding IGTV.

22.3.6 Operating Costs

Operating cost assumptions are outlined in Section 21.3. For the purpose of this PEA, it has been assumed that the mine will be run by the Owner. Operating costs were applied in the financial model excluding IGTV.

22.3.7 Royalties

Royalties are discussed in Section 4.7. The PEA assumes that the 1% NSR royalty payable to Sierra will be bought out and therefore the royalty is not included in the cashflow analysis.

22.3.8 Working Capital

A working capital allocation was included in the cash flow model. The following payment terms were assumed:

- 60 days in accounts receivable, including NSR
- 30 days in accounts payable, including 100% operating costs, special mining tax, modified mining royalty and sustaining capital.

Table 22-3: Concentrate Treatment and Refining Charges

Item	Units	Cost
<i>Zn concentrate</i>		
Portion sold locally		
Treatment charge – base rate	US\$/dmt	190
Credit on TC for indium content	US\$/dmt	—
Treatment charge – net rate	US\$/dmt	190
Portion sold to Asia		
Treatment charge – base rate	US\$/dmt	190
Credit on TC for indium content	US\$/dmt	(20)
Treatment charge – net rate	US\$/dmt	170
<i>Pb\–Ag concentrate</i>		
Treatment charge	US\$/dmt	150
Ag refining charge	US\$/oz	1.00

Table 22-4: Concentrate Transport Costs

Item	Units	Cost
Land transport to local smelter or Callao port	US\$/wmt	35.0
Port charges (Callao)	US\$/wmt	17.5
Ocean freight to Asia	US\$/wmt	45.0

Working capital is assumed to be recovered at project completion. Thus, the sum of all working capital over mine life is zero.

22.3.9 Taxes

The taxation and royalties modeled within the financial analysis are based on the tax rates and taxation schemes that were validated by Ernst & Young Asesores (EY). The following tax considerations have been applied:

- Modified mining royalty (Law N° 29788)
- Special mining tax (Law N° 29789)
- Employee profit sharing of 8% of taxable income after loss carry-forward

- Complementary mining pension fund as 0.5% of taxable income after loss carry-forward and employee profit sharing
- Corporate income tax rate of 29.5%
- Tax loss carried forward to a maximum of four consecutive years after the year of the loss.

Tax depreciation is straight line and was split into the following categories:

- Pre-operational expense (depreciated in the first year of production)
- 1 year (expensed when incurred)
- 5 years (or 20% per year)
- 10 years (or 10% per year)
- 20 years (5% per year).

Table 22-5 presents the capital distribution among the different depreciation categories applied.

The following previous and projected general expenses and explorations costs were included in the amortization balance for tax calculation purposes only:

- Previous exploration costs of US\$17.0 M and projected exploration costs of US\$15.0 M. These are amortized over the LOM
- Previous preoperative general expenses of US\$4.3 M and projected preoperative general expenses of US\$25.0 M. These are amortized in the first production year.

22.3.10 Closure Costs and Salvage Value

A provision of US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmarking, was included to account for closure costs.

No salvage value was considered.

22.3.11 Financing

The preliminary economic analysis is based on 100% equity financing.

Table 22-5: Capital Distribution Among Depreciation Categories

Depreciation Category	Initial Capital (%)	Sustaining Capital (%)	Total LOM Capital (%)
Pre-operational expense	3	—	2
1 year	19	33	24
5 years (20%/year)	20	43	28
10 years (10%/year)	8	—	5
20 years (5%/year)	50	24	41
Total	100	100	100

22.3.12 Inflation

No escalation or inflation has been applied. All amounts are in real (constant) terms.

22.4 Economic Analysis

The project is anticipated to generate a pre-tax NPV of \$609 M at an 8.0% discount rate, an IRR of 37.2% and a payback period of 2.2 years. The financial analysis results showed an after-tax NPV of US\$363 M at an 8.0% discount rate, an IRR of 27.1% and a payback period of 3.1 years. Table 22-6 presents a summary of the financial analysis results.

Cash costs were consolidated per pound of zinc payable, net of lead and silver credits. A LOM all-in sustaining cash cost (AISC) was also consolidated. These are presented in Table 22-7.

Figure 22-1 presents the main cost value drivers at 8% discount rate. Figure 22-2 and Figure 22-3 show the cumulative undiscounted and discounted cash flows forecast for the project. Table 22-8 presents the cash flows summary on an annual basis.

Table 22-6: Summary of Financial Results

Description	Units	Value
Zn payable	klb	3,927,832
Pb payable	klb	165,154
Ag payable	koz	18,114
Zn payable equivalent	klb	4,330,287
<i>After-Tax Valuation Indicators</i>		
Undiscounted cumulative cash flow	US\$ M	1,051.1
NPV @ 8%	US\$ M	363.4
NPV @ 10%	US\$ M	281.4
Payback period (from start of operations)	years	3.1
IRR	%	27.1
Initial capital	US\$ M	261.9
LOM capital	US\$ M	406.5
Closure costs	US\$ M	20.3

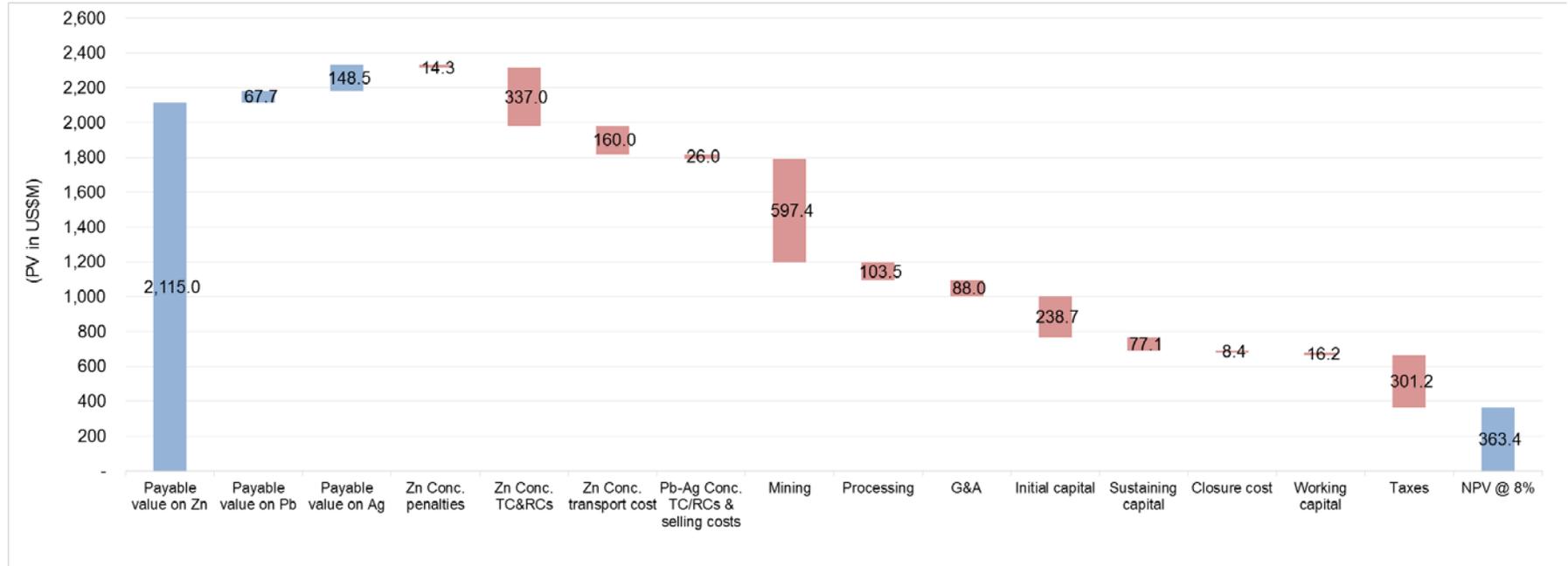
Note: base case at NPV8% is bolded.

Table 22-7: Summary of LOM Cash Costs

Cash Cost	LOM (US\$ M)	US\$/Zn lb payable
<i>Cash Costs</i>		
Mining	1,400.5	0.36
Process	246.0	0.06
G&A	209.4	0.05
Concentrates transport, treatment and refining	1,194.1	0.30
Sub-total	3,050.0	0.78
By-product credits		
Pb and Ag premium	(482.9)	(0.12)
<i>Net Direct Cash Cost (C1)</i>	<i>2,567.1</i>	<i>0.65</i>
Sustaining capital, royalties* and closure	273.7	0.07
AISC	2,840.8	0.72

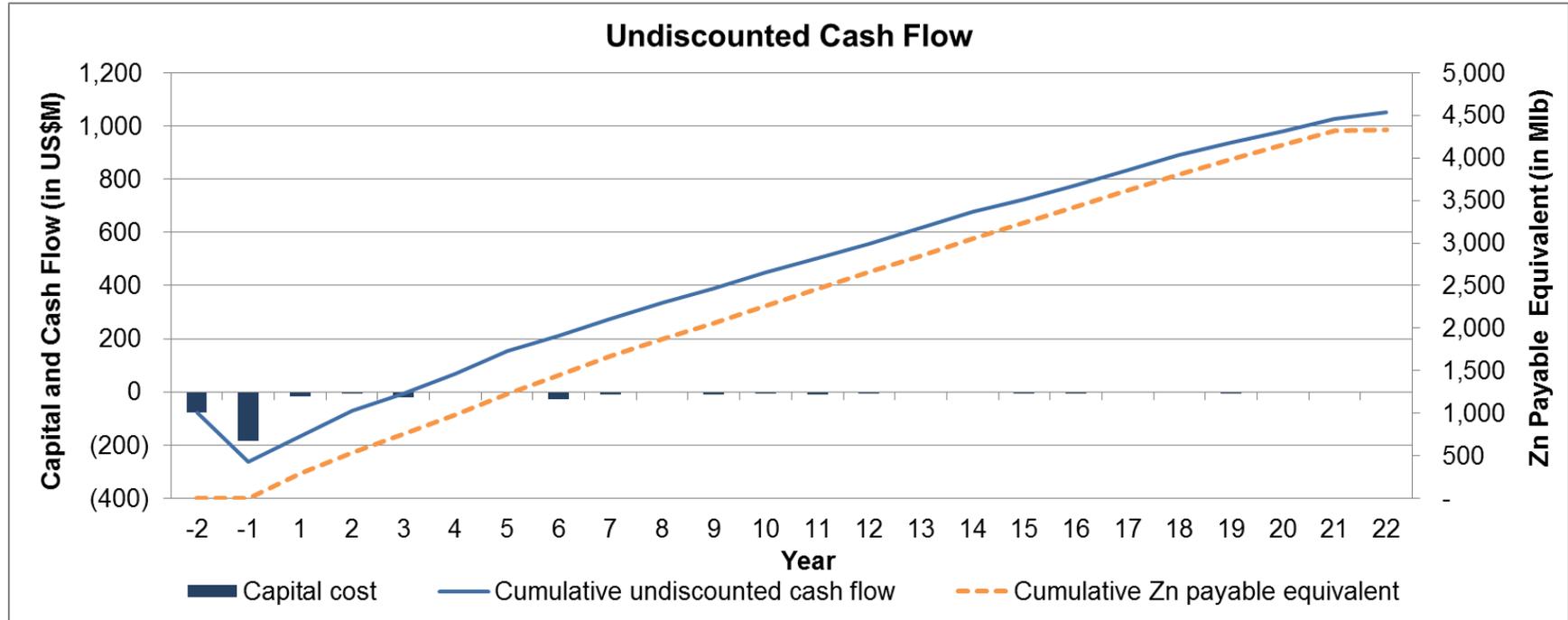
Note: * includes Modified Mining Royalty and Special Mining Tax.

Figure 22-1: Main Cost Value Drivers (Discounted at 8%)



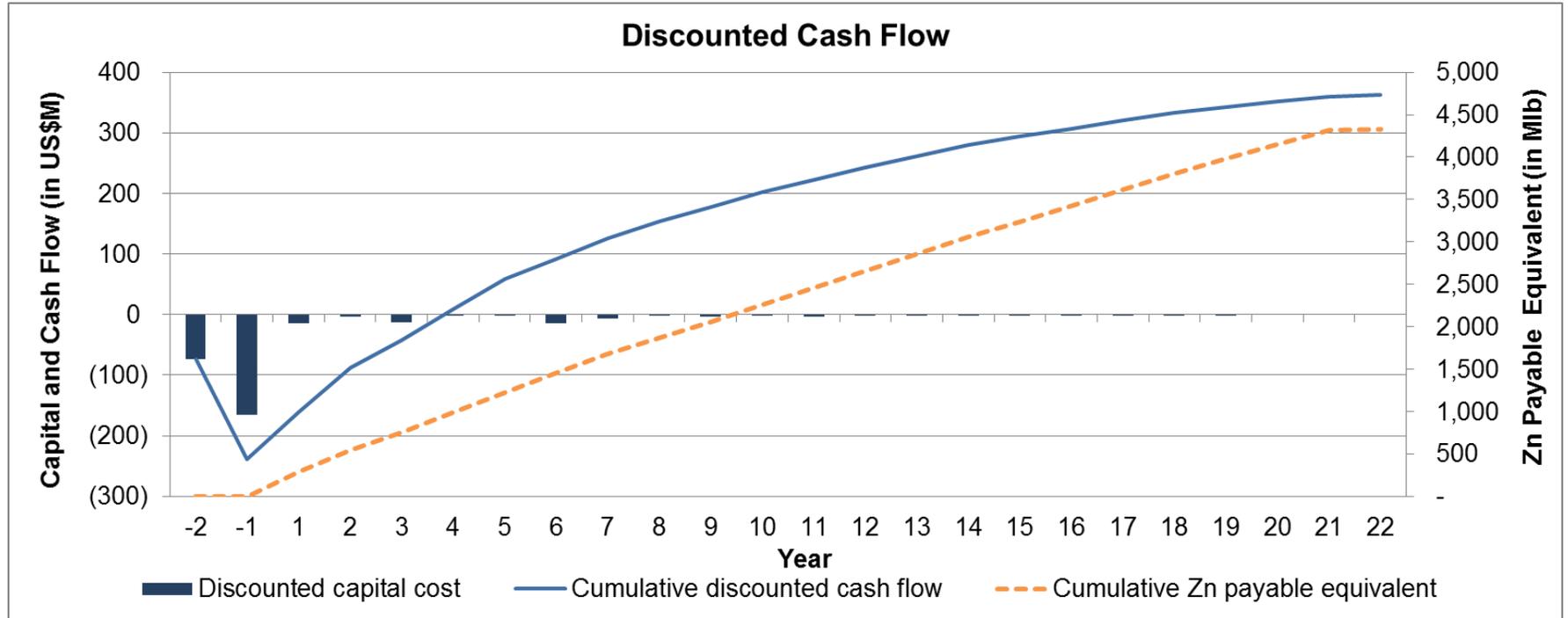
Note: Figure prepared by Wood, 2019.

Figure 22-2: Cumulative Undiscounted Cash Flow



Note: Figure prepared by Wood, 2019.

Figure 22-3: Cumulative Discounted Cash Flow (At 8% Discount Rate)



Note: Figure prepared by Wood, 2019.

Table 22-8: Cash Flow Forecast on an Annual Basis

Description	Units	LOM	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
<i>Production (Feed to Mill)</i>																											
Material Processed	kt	38,206	—	—	1,510	1,825	1,825	1,830	1,825	1,825	1,825	1,830	1,825	1,825	1,825	1,830	1,825	1,825	1,825	1,830	1,825	1,825	1,825	1,830	1,825	1,825	171
Zn Grade	%	6.05	—	—	9.94	7.35	5.99	6.88	7.13	6.67	6.63	5.70	5.54	5.85	5.93	5.89	5.83	5.96	5.40	5.82	5.71	5.56	5.15	4.60	4.27	4.37	
Pb Grade	%	0.25	—	—	0.38	0.34	0.37	0.21	0.14	0.25	0.24	0.19	0.29	0.23	0.19	0.17	0.19	0.17	0.19	0.19	0.14	0.17	0.26	0.40	0.47	0.31	
Ag Grade	g/t	18.3	—	—	36.5	26.5	24.4	18.5	17.1	21.7	18.3	13.8	15.5	18.3	17.1	14.9	17.3	14.5	12.8	12.5	11.3	14.8	18.8	18.8	24.5	14.4	
In Grade	g/t	67.1	—	—	111.5	76.5	61.5	75.2	99.9	73.2	83.7	78.3	66.0	59.2	57.7	67.2	63.4	59.1	64.0	55.2	57.3	69.0	67.2	48.7	27.5	29.3	
<i>Metal Recovery</i>																											
Zn Recovered	Mlb	4,685.4	—	—	304.5	272.0	221.9	255.3	263.9	247.0	245.3	211.4	205.1	216.6	219.5	218.7	215.9	220.7	200.0	216.0	211.2	205.9	190.5	170.6	158.2	15.2	
Pb Recovered	Mlb	176.0	—	—	10.8	11.5	12.6	7.1	5.0	8.4	8.2	6.4	10.0	7.9	6.6	5.8	6.4	5.7	6.3	6.7	4.9	5.7	9.0	13.9	16.1	1.0	
Ag Recovered	koz	19,105	—	—	1,505	1,322	1,215	926	851	1,081	915	691	771	913	851	748	862	723	639	628	566	737	937	939	1,220	67	
In Recovered	t	2,360	—	—	155	128	103	127	168	123	141	132	111	99	97	113	107	99	108	93	96	116	113	82	46	5	
<i>Concentrate Production</i>																											
Zn Concentrate Produced	kdmt	4,251	—	—	276	247	201	232	239	224	223	192	186	197	199	198	196	200	181	196	192	187	173	155	144	14	
Zn Grade	%	50.0%	—	—	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
In Grade	g/dmt	555	—	—	561	520	513	547	701	548	632	687	596	505	486	570	544	495	593	474	502	620	653	530	322	334	
Pb-Ag Concentrate Produced	kdmt	160	—	—	10	10	11	6	4	8	7	6	9	7	6	5	6	5	6	6	4	5	8	13	15	1	
Pb Grade	%	50.0	—	—	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Ag Grade	g/dmt	3,721	—	—	4,789	3,948	3,303	4,455	5,884	4,398	3,814	3,674	2,640	3,951	4,413	4,394	4,642	4,354	3,463	3,224	3,955	4,416	3,570	2,323	2,600	2,331	
<i>Payable Metals</i>																											
Zn Payable	Mlb	3,927.8	—	—	255.2	228.0	186.0	214.0	221.2	207.0	205.7	177.2	172.0	181.6	184.0	183.3	181.0	185.0	167.7	181.1	177.1	172.6	159.7	143.0	132.6	12.7	
Pb Payable	Mlb	165.2	—	—	10.1	10.8	11.8	6.7	4.7	7.9	7.7	6.0	9.4	7.4	6.2	5.5	6.0	5.3	5.9	6.3	4.6	5.4	8.4	13.0	15.1	0.9	
Ag Payable	koz	18,114	—	—	1,427	1,253	1,152	878	807	1,025	867	655	731	865	807	709	817	686	606	595	536	698	889	890	1,157	64	
Metal Value	US\$ 000	5,196,344	—	—	341,568	306,429	255,220	278,975	284,426	274,393	269,750	230,201	228,428	240,576	241,192	237,975	237,543	239,440	217,749	233,976	226,499	224,795	215,610	199,965	194,300	17,334	
Zn Payable Value	US\$ 000	4,713,398	—	—	306,273	273,638	223,234	256,823	265,483	248,436	246,816	212,667	206,347	217,939	220,780	220,019	217,165	222,024	201,205	217,319	212,473	207,129	191,590	171,598	159,142	15,297	
Pb Payable Value	US\$ 000	156,896	—	—	9,606	10,232	11,244	6,351	4,419	7,510	7,327	5,746	8,924	7,059	5,891	5,199	5,672	5,075	5,639	5,947	4,371	5,096	8,022	12,347	14,337	885	
Ag Payable Value	US\$ 000	326,050	—	—	25,690	22,560	20,742	15,801	14,523	18,447	15,607	11,789	13,157	15,578	14,520	12,758	14,706	12,342	10,906	10,710	9,655	12,569	15,997	16,020	20,820	1,152	
TC&RC and Penalties	US\$ 000	(826,695)	—	—	(53,315)	(48,023)	(40,024)	(44,370)	(45,388)	(43,354)	(42,909)	(37,001)	(36,552)	(38,254)	(38,471)	(38,146)	(37,870)	(38,424)	(35,104)	(37,715)	(36,642)	(36,061)	(34,215)	(31,681)	(30,261)	(2,918)	
Zn Concentrate TC	US\$ 000	(752,858)	—	—	(48,356)	(43,363)	(35,652)	(40,791)	(42,116)	(39,507)	(39,260)	(34,035)	(33,068)	(34,841)	(35,276)	(35,160)	(34,723)	(35,466)	(32,281)	(34,747)	(34,005)	(33,188)	(30,810)	(27,751)	(25,846)	(2,616)	
Zn Concentrate Penalties	US\$ 000	(31,815)	—	—	(2,067)	(1,847)	(1,507)	(1,734)	(1,792)	(1,677)	(1,666)	(1,435)	(1,393)	(1,471)	(1,490)	(1,485)	(1,466)	(1,499)	(1,358)	(1,467)	(1,434)	(1,398)	(1,293)	(1,158)	(1,074)	(103)	
Pb-Ag Concentrate TC	US\$ 000	(23,909)	—	—	(1,464)	(1,559)	(1,713)	(968)	(673)	(1,144)	(1,117)	(876)	(1,360)	(1,076)	(898)	(792)	(864)	(773)	(859)	(906)	(666)	(777)	(1,222)	(1,881)	(2,185)	(135)	
Ag Refining	US\$ 000	(18,114)	—	—	(1,427)	(1,253)	(1,152)	(878)	(807)	(1,025)	(867)	(655)	(731)	(865)	(807)	(709)	(817)	(686)	(606)	(595)	(536)	(698)	(889)	(890)	(1,157)	(64)	
Transport Costs	US\$ 000	(367,443)	—	—	(25,772)	(22,653)	(17,840)	(20,582)	(21,215)	(19,891)	(19,712)	(16,202)	(15,935)	(16,862)	(17,010)	(16,860)	(16,633)	(17,042)	(15,070)	(16,678)	(16,031)	(15,589)	(14,394)	(12,917)	(11,920)	(634)	
Zn Concentrate Transport	US\$ 000	(350,141)	—	—	(24,713)	(21,525)	(16,600)	(19,882)	(20,728)	(19,063)	(18,904)	(15,568)	(14,951)	(16,083)	(16,361)	(16,286)	(16,008)	(16,482)	(14,448)	(16,023)	(15,549)	(15,027)	(13,509)	(11,556)	(10,339)	(536)	
Pb-Ag Concentrate Transport	US\$ 000	(17,302)	—	—	(1,059)	(1,128)	(1,240)	(700)	(487)	(828)	(808)	(634)	(984)	(778)	(650)	(573)	(625)	(560)	(622)	(656)	(482)	(562)	(885)	(1,362)	(1,581)	(98)	
Net Smelter Return	US\$ 000	4,002,206	—	—	262,481	235,753	197,355	214,023	217,822	211,149	207,129	176,999	175,942	185,461	185,711	182,970	183,040	183,974	167,575	179,583	173,826	173,145	167,001	155,367	152,119	13,782	
NSR from Zn Concentrate	US\$ 000	3,578,584	—	—	231,136	206,903	169,475	194,417	200,847	188,189	186,986	161,628	156,936	165,543	167,653	167,088	164,968	168,577	153,117	165,083	161,484	157,516	145,978	131,132	121,884	12,042	
NSR from Pb-Ag Concentrate	US\$ 000	423,622	—	—	31,345	28,850	27,880	19,606	16,975	22,960	20,142	15,371	19,006	19,917	18,058	15,882	18,071	15,398	14,457	14,500	12,341	15,629	21,023	24,234	30,235	1,740	
Production Costs	US\$ 000	(1,855,870)	—	—	(85,692)	(88,649)	(88,604)	(89,059)	(89,553)	(89,317)	(88,901)	(88,766)	(88,538)	(88,294)	(88,417)	(89,751)	(89,563)	(89,052)	(87,767)	(87,127)	(86,848)	(87,014)	(88,224)	(89,897)	(80,987)	(5,851)	
Mining	US\$ 000	(1,400,470)	—	—	(67,693)	(66,896)	(66,851)	(67,246)	(67,800)	(67,564)	(67,148)	(66,953)	(66,785)	(66,541)	(66,664)	(67,939)	(67,810)	(67,299)	(66,014)	(65,315)	(65,095)	(65,261)	(66,471)	(68,084)	(59,234)	(3,809)	
Process	US\$ 000	(246,049)	—	—	(9,724)	(11,753)	(11,753)	(11,785)	(11,753)	(11,753)	(11,753)	(11,785)	(11,753)	(11,753)	(11,753)	(11,785)	(11,753)	(11,753)	(11,753)	(11,785)	(11,753)	(11,753)	(11,753)	(11,785)	(11,753)	(1,104)	
G&A	US\$ 000	(209,350)	—	—	(8,274)	(10,000)	(10,000)	(10,027)	(10,000)	(10,000)	(10,000)	(10,027)	(10,000)	(10,000)	(10,000)	(10,027)	(10,000)	(10,000)	(10,000)	(10,027)	(10,000)	(10,000)	(10,000)	(10,027)	(10,000)	(939)	
Royalties	US\$ 000	(108,830)	—	—	(13,075)	(9,591)	(5,903)	(7,314)	(7,584)	(6,805)	(6,408)	(3,926)	(3,855)	(4,477)	(4,395)	(4,058)	(4,060)	(4,128)	(3,365)	(3,903)	(3,646)	(3,602)	(3,185)	(2,622)	(2,785)	(144)	
Modified Mining Royalty	US\$ 000	(56,228)	—	—	(6,954)	(4,993)	(2,964)	(3,731)	(3,877)	(3,446)	(3,229)	(1,932)	(1,919)	(2,184)	(2,137)	(1,998)	(1,997)	(2,010)	(1,826)	(1,963)	(1,899)	(1,887)	(1,814)	(1,683)	(1,640)	(144)	
Special Mining Tax	US\$ 000	(52,602)	—	—	(6,121)	(4,598)	(2,939)	(3,583)	(3,707)	(3,358)	(3,179)	(1,994)	(1,937)	(2,293)	(2,257)	(2,060)	(2,063)	(2,118)	(1,538)	(1,940)	(1,747)	(1,715)	(1,371)	(939)	(1,145)	—	
Net Operating Earnings	US\$ 000	2,037,506	—	—	163,715	137,513	102,849	117,651	120,686	115,027	111,819	84,307	83,548	92,690	92,899	89,160	89,417	90,795	76,443	88,553	83,332						

Description	Units	LOM	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Taxes	US\$ 000	(559,595)	—	—	(17,464)	(38,514)	(26,258)	(31,653)	(32,567)	(33,233)	(32,790)	(23,471)	(23,145)	(25,425)	(28,064)	(26,453)	(26,814)	(28,544)	(23,338)	(27,153)	(25,584)	(25,302)	(22,695)	(18,191)	(22,938)	—	
Employee Profit Share	US\$ 000	(126,233)	—	—	(3,940)	(8,688)	(5,923)	(7,140)	(7,346)	(7,497)	(7,397)	(5,294)	(5,221)	(5,735)	(6,331)	(5,967)	(6,049)	(6,439)	(5,265)	(6,125)	(5,771)	(5,708)	(5,120)	(4,104)	(5,174)	—	
Complementary Pension Fund	US\$ 000	(7,258)	—	—	(227)	(500)	(341)	(411)	(422)	(431)	(425)	(304)	(300)	(330)	(364)	(343)	(348)	(370)	(303)	(352)	(332)	(328)	(294)	(236)	(298)	—	
Income Tax	US\$ 000	(426,104)	—	—	(13,298)	(29,327)	(19,994)	(24,102)	(24,798)	(25,306)	(24,968)	(17,872)	(17,624)	(19,360)	(21,369)	(20,142)	(20,417)	(21,735)	(17,771)	(20,676)	(19,481)	(19,266)	(17,281)	(13,852)	(17,466)	—	
Capital Costs	US\$ 000	(426,777)	(75,953)	(185,936)	(18,657)	(6,381)	(19,698)	(4,180)	(4,637)	(27,220)	(12,292)	(4,070)	(10,002)	(5,500)	(10,878)	(8,048)	(3,309)	(1,251)	(7,801)	(8,008)	(1,251)	(1,243)	(7,690)	(924)	(924)	(924)	
Initial Capital	US\$ 000	(261,889)	(75,953)	(185,936)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Sustaining Capital	US\$ 000	(144,565)	—	—	(17,733)	(5,458)	(18,774)	(3,256)	(3,713)	(26,296)	(11,368)	(3,147)	(9,079)	(4,576)	(9,954)	(7,124)	(2,385)	(328)	(6,878)	(7,084)	(328)	(319)	(6,766)	—	—	—	
Closure Cost	US\$ 000	(20,323)	—	—	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)	(924)
<i>Working Capital</i>																											
Change in Working Capital	US\$ 000	—	—	—	(33,572)	3,341	7,100	(3,862)	(524)	2,870	(633)	4,062	637	(1,904)	404	300	(416)	(359)	3,066	(1,965)	347	121	1,605	1,448	(185)	18,120	
Net Cash Flow																											
Before Tax	US\$ 000	1,610,730	(75,953)	(185,936)	111,485	134,473	90,251	109,609	115,525	90,677	98,894	84,298	74,183	85,286	82,425	81,413	85,692	89,184	71,708	78,580	82,428	81,408	69,507	63,372	67,238	24,983	
After Tax	US\$ 000	1,051,134	(75,953)	(185,936)	94,021	95,958	63,993	77,957	82,958	57,444	66,105	60,828	51,038	59,861	54,362	54,960	58,878	60,641	48,370	51,427	56,844	56,106	46,812	45,180	44,300	24,983	

22.5 Sensitivity Analysis

A sensitivity analysis was performed considering variations in metal prices, feed metal grades, initial capital and operating costs on the after-tax NPV8% and on IRR. The results of this analysis are presented in Figure 22-4 and Figure 22-5.

The project is most sensitive to fluctuations in the zinc price, then to feed grades. It is less sensitive to changes in operating costs, then initial capital costs. It is least sensitive to changes in silver and lead prices.

Table 22-9 presents the project NPV at a range of discount rates from 5% to 15%. The NPV8%, which is the base case, is bolded in the table.

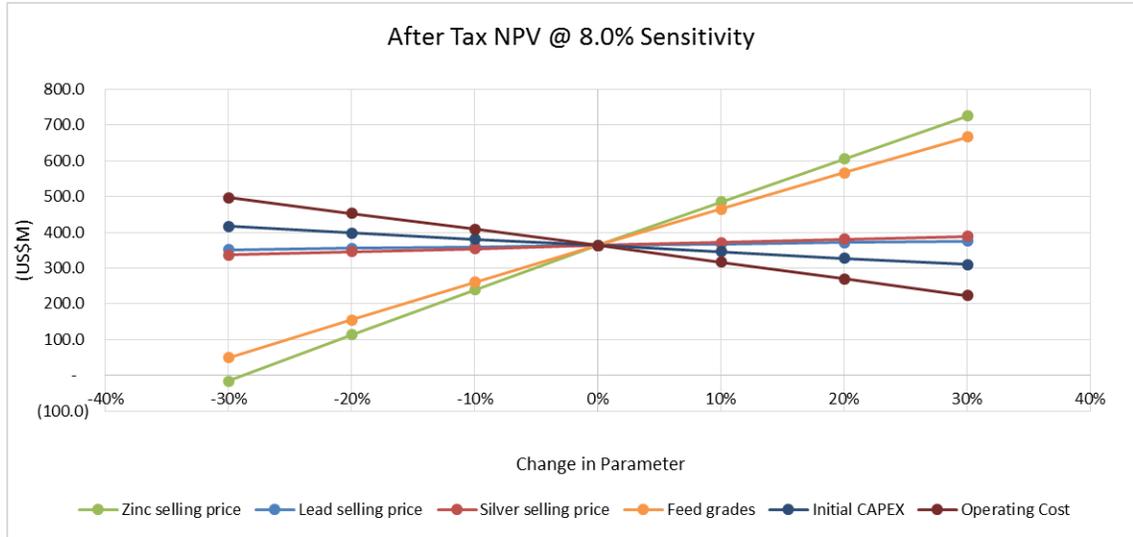
22.6 Comments on Section 22

Under the assumptions in this Report, and based on the available data, the project shows positive economics.

Using an 8% discount rate, the project has an after-tax NPV of US\$363 M, an IRR of 27.1% and a payback period of 3.1 years.

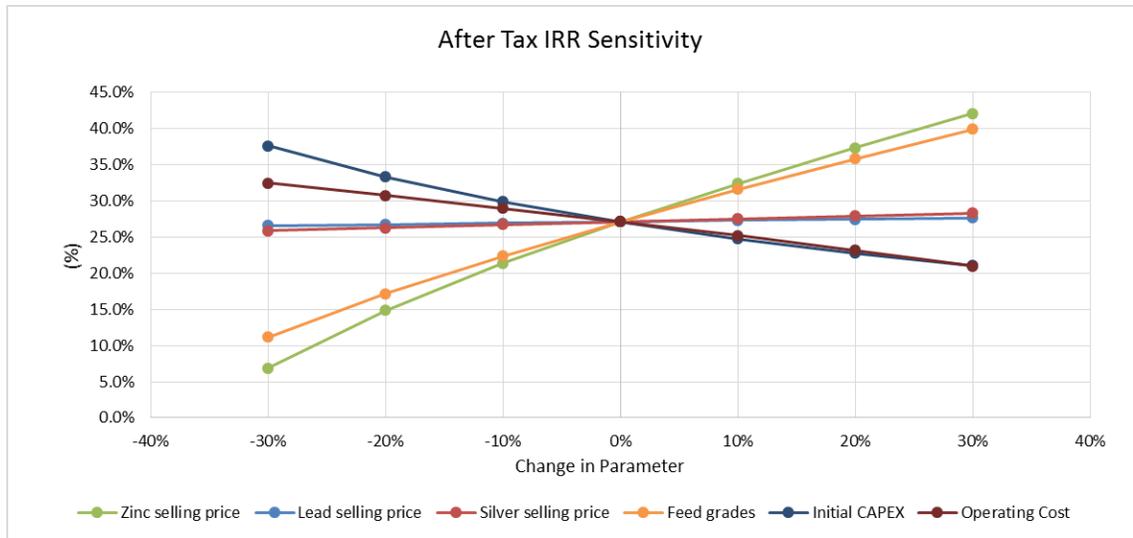
There is upside potential for the project if the zinc prices increase from the assumptions used in the Report, since the sensitivity analysis shows that the project is most sensitive to zinc price changes.

Figure 22-4: Sensitivity of After-Tax NPV Discounted at 8.0%



Note: Figure prepared by Wood, 2019.

Figure 22-5: Sensitivity of After-Tax IRR



Note: Figure prepared by Wood, 2019.

Table 22-9: NPV at Different Discount Rates (base case is bolded)

Discount Rate	After Tax (US\$M)
NPV 5%	535
NPV 7%	413
NPV 8%	363
NPV 10%	281
NPV 12%	217
NPV 15%	145

23.0 ADJACENT PROPERTIES

This section is not relevant to this Report.

24.0 OTHER RELEVANT DATA AND INFORMATION

24.1 Risks and Opportunities

24.1.1 Risks

A high-level risk analysis was undertaken for the project as envisaged in the PEA. Risks were rated according to probability and likely impact, and the assigned a risk rating. No action plans were developed for each risk as it is expected that the outcome of the risk workshop will be used as the basis for the preparation of the overall work plan for the next project stage.

A total of 42 risks were identified, of which one was classified as very low, eight as low, 28 as medium and five as high. No risks categorized as “very high” were recognized. The high- and medium-rated risks only are summarized in Table 24-1. Some risks have been combined in this summary presentation.

24.1.2 Opportunities

Opportunities were as identified by Wood, and reviewed by Tinka. A total of 15 opportunities were recognized, of which seven were classified as high, six as medium and two as low. No opportunities categorized as “very high” or “very low” were pinpointed.

The high- and medium-rated opportunities only are summarized in Table 24-2. Some opportunities have been combined in the table summary presentation.

Table 24-1: PEA Stage Risk Register (Medium and High Risks)

Risk Rating	Risk	Comment
High	Dewatering assumptions for process plant design.	Conservative dewatering assumptions were used in process plant design. Dewatering testwork will be required on representative samples. Variations from design assumptions could lead to variations in capital and operating cost estimates for the concentrate and tailings dewatering circuits.
	Acid mine drainage	The tailings could be a potential ARD generator. No liner system is included in the capital cost estimate. If future testwork results indicate that a liner will be needed, this will result in additional capital costs.
	Water treatment plant assumptions	Although a water treatment plant has been included in the capital cost estimate, higher than planned water treatment requirements could potentially increase capital and operating costs.
	PR-20 regulation exemption assumption	If no exemption can be obtained, and the transmission line tie-in at the sectioning point must be >50 km radius from the nearest sub-station, an additional electrical sub-station and transmission line will be required, which will increase capital costs.
	Chaquicocha Lake	As there are no completed hydrological or hydrogeological studies on the lake, it has been assumed that no water management will be needed. If this assumption is found to be erroneous, additional water management capital and operating costs would be incurred.
Medium	Inferred Mineral Resources	Inclusion of Inferred Mineral Resources. There is a risk that a portion of these resources may not be able to be upgraded to higher confidence categories or eventually to Mineral Reserves.
	Geotechnical and hydrological assumptions	Different geotechnical and hydrogeological conditions than assumed could have either a negative or positive impact on the project cost and schedule. No contingencies were applied due to the uncertainties.
	Sudden combustion event	There is a risk of a potential sudden combustion event within the underground mine caused by the reaction of massive sulphides present in some areas that could potentially harm the operations personnel and stop operations. This would also affect the production schedule and project cash flow assumptions.
	Comminution assumptions	The ball mill work index testwork was carried out on a limited number of samples. Different comminution parameters to those assumed could have either a negative or positive impact on the project cost.
	Presence of marmatite	Areas that have a high proportion of the zinc contained in marmatite could limit obtaining a marketable zinc concentrate grade at times, with a negative impact on the project cash flows
	Zinc metallurgical recovery	The final metallurgical performance may be reduced or improved by further investigations. The factors that present the highest risks to metallurgical performance include sample representivity, water recirculation, pyrrhotite

Risk Rating	Risk	Comment
		mineralization, grinding chemistry and flotation hydrodynamic efficiency.
	Lead–silver metallurgical parameter assumptions	Existing flotation testwork has been conducted only for high-grade material (>2.0% Pb). There is no testwork data on low-grade mineralization (<0.2% Pb) and no laboratory lead–silver flotation tests. Different metallurgical parameters than those assumed could have a negative impact on recoveries and project cash flows
	Metallurgical recoveries	Different metallurgical recoveries than assumed for the payable elements could have either a negative or positive impact on concentrate production and project cash flow forecasts.
	TSF design	Assumed geotechnical parameters have been used. Construction costs included in the capital cost estimate are based on costs from similar projects for earthworks and civil works. Different geotechnical conditions than assumed could have either a negative or positive impact on the project cost and schedule. In addition, due to recent TSF failures worldwide, legislation regarding TSF design may change, and this is likely to be associated with higher capital and operating costs or longer permitting periods.
	Karstiform features in proposed TSF area	It is possible that karstiform features exist within the footprint of the tailings storage facility site selected. This could potentially increase the capital cost due to the need to include a liner system or special treatment for the dam foundation, which is not currently accounted for in the capital cost estimate.
	Fresh water supply assumptions	Hydrogeological and hydrological information currently available is limited and no inventory or water quality monitoring of potential water sources for the project are currently available. Although water storage facilities have been accounted for in the capital cost estimate, long unexpected dry seasons could make water unavailable for the project at times during construction or operations, potentially increasing the costs to obtain the fresh water required. In addition, a poor water quality could lead to permitting issues and higher discharge treatment costs
	New access road	The impact of the construction of the new road to access the project site on the stakeholders or environment has not yet been evaluated and as such could provide impediments to execution. Construction costs included in the capital cost estimate are based on costs from similar projects for earthworks and civil works, as specific geotechnical information is not currently available for the project. Different soil conditions than assumed could have either a negative or positive impact on the project cost and schedule. In addition, adverse weather conditions could potentially damage this road causing delays and additional costs.
	Land acquisition	Delays in the land acquisition process could potentially delay the project schedule and impose higher acquisition costs as the project progresses
	Environmental and social license	There is uncertainty related to the potential impact on communities, water bodies, sensitive species, and archaeological material, and with the time required collect

Risk Rating	Risk	Comment
	assumptions	the necessary wet season/dry season baseline data to allow the EIA report to be completed and lodged with the relevant regulatory authorities that could potentially delay the permitting process, and delay obtaining the social license to operate. There is a risk that the timeline assumptions are optimistic.
	Site access	Interruptions to site access from issues such as adverse weather conditions or stakeholder activity that could result in construction and operational delays
	Governmental factors	Changes in government or legislation that could result in changes to project assumptions, permitting requirements, construction and operational activities, and capital and operating costs.
	Public consultation	Delays in the prior consultation process that could result in permitting delays
	Commercial penalties on concentrates	Unexpected commercial penalties on the concentrates would lead to lower revenues than forecast in the cashflow analysis.

Table 24-2: PEA Stage Opportunities Register (Medium and High Ratings)

Opportunity Rating	Opportunity	Comment
High	High-grading early in mine plan	Prioritize mine development in higher-grade areas. This material could be potentially stockpiled for treatment at plant start-up.
	Throughput expansion	May be supported by future exploration campaigns and site investigations
	Mineral Resource confidence category upgrades/exploration success	Drill and exploration programs may identify additional mineralization in the Ayawilca Zinc and Tin Zone areas that can support Mineral Resource estimates; infill drill programs may support confidence category upgrades
	Ayawilca Zinc Zone	If additional high-grade zinc zones are discovered, this would could have a significant impact on project economics
	Ayawilca Tin Zone	There is potential to mine and process Ayawilca Tin Zone material at the end of the Ayawilca Zinc Zone mine life, potentially reusing much of the zinc plant equipment and infrastructure
	Colquipucro Silver Zone	Incorporate the Colquipucro Silver Zone mineralization to produce silver as a new marketable product
	Use of cyclone tailings	Cycloned tailings would reduce the rockfill volume required for

Opportunity Rating	Opportunity	Comment
		the TSF dam construction and thereby reduce TSF capital costs.
Medium	Zinc recovery	Additional metallurgical testwork may allow an increase in the zinc recovery assumptions, coupled with a zinc recovery versus zinc concentrate grade trade-off
	Ore sorting	Could better discriminate mineralized material from the Ayawilca Zinc and Tin Zones sent to the process plant
	Process technology improvements	Future developments in process technology could result in circuit efficiency gains, and potentially reduce some process steps
	In-country zinc concentrate sales	Potential of selling a greater proportion of the zinc concentrate in-country, thereby reducing shipping and port costs
	Payable indium	Indium may become a payable metal, depending on market conditions

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs note the following interpretations and conclusions within their areas of expertise, based on the review of data available for this Report.

25.2 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The legal opinion and additional information provided by Tinka experts supports the following:

- Tinka has a 100% ownership interest
- Mineral concessions are valid and in good standing
- A 1% NSR royalty is payable to Sierra Peru Pty Ltd on mining concessions TK COL 1 to TK COL 46. This NSR royalty can be purchased by Tinka at any time for US\$1 million
- Tinka has concluded agreements to allow for exploration activities with three communities who hold surface rights in the Ayawilca Project area; these agreements allow Tinka to continue exploration activities until 2020–2021
- Water used in Tinka’s exploration programs was from approved water sources and the volumes used were also approved
- Tinka owns no water rights in the Project area. Water rights cannot be purchased in Peru, but they are commonly granted for industrial or mining purposes.
- There is an expectation of environmental liabilities associated with historical mining and exploration activity. Most historic environmental liabilities lie with the State. MINEM has identified an existing liability, an adit, within the TK-COL1 and TK-COL24. Tinka has identified 57 historical mining-related sites within TK-COL1, TK-COL34, and TK-COL24 concessions. Tinka committed in 2013 to remediation of three of the historical waste rock dumps once Tinka has completed its exploration activities.

To the extent known to Tinka, there are no other significant factors and risks that may affect access, title or right or ability to perform work on the Project.

The existing local infrastructure, availability of staff, and methods whereby goods could be transported to the Project area to support exploration activities are well understood by Tinka, and can support the declaration of Mineral Resources and support evaluation at the PEA stage

Adjacent mining operations are conducted year-round, and it is expected that any operation conducted by Tinka would also be year-round.

25.3 Geology and Mineralization

The Ayawilca Zinc Zone is an example of a CRD, of which there are several other type examples in central Peru (e.g., Cerro de Pasco, Morococha, Colquijirca, and San Gregorio).

The geological understanding of the settings, lithologies, and structural and alteration controls on mineralization is sufficient to support estimation of Mineral Resources.

Thrusts and limestone repetitions have potential for deeper massive sulphide mineralization to be discovered in the Ayawilca Zinc Zone vicinity. Late-stage epithermal veins may have potential for silver mineralization in the Ayawilca Zinc Zone vicinity.

Tinka have identified a number of areas that have exploration potential, including the Chaucha, Valley, Yanapizgo, Pucarumi, and Tambillo zones. Several magnetic anomalies remain untested outside of the Ayawilca Zinc and Tin Zones, all of which are considered high priority exploration targets.

25.4 Exploration, Drilling and Analytical Data Collection in Support of Mineral Resource Estimation

The exploration programs completed by Tinka to date are appropriate for the mineralization styles.

The quantity and quality of the lithological, collar and down-hole survey data collected in the exploration program completed are sufficient to support Mineral Resource estimation. No drilling, sampling, or core recovery issues that could materially affect the accuracy or reliability of the core samples have been identified.

The collected sample data adequately reflect deposit dimensions, true widths of mineralization, and the deposit style.

Sampling is representative of the zinc, lead, indium and silver values, reflecting areas of higher and lower grades.

The independent analytical laboratories used by Tinka are accredited for selected analytical techniques.

Sample preparation has used procedures and protocols that are/were standard in the industry and has been adequate throughout the history of the Project. Sample analysis uses procedures that are standard in the industry.

The QA/QC programs adequately address issues of precision, accuracy and contamination, and indicate that the analytical results are adequately accurate, precise, and contamination free to support Mineral Resource estimation.

The sample preparation, analysis, and security procedures are adequate for use in the estimation of Mineral Resources.

The data verification programs concluded that the data collected from the Project adequately support the geological interpretations and constitute a database of sufficient quality to support the use of the data in Mineral Resource estimation.

25.5 Metallurgical Testwork

25.5.1 Ayawilca Zinc Zone

Testwork results have demonstrated that recoveries of 92% Zn at a concentrate grade of 50% Zn can be consistently achieved using a standard flotation process. Potentially deleterious elements in the zinc concentrates (including silica, manganese, cadmium, mercury, and arsenic) were well below standard smelter penalty levels in the samples tested. A penalty is anticipated for iron content in the concentrate.

25.5.2 Ayawilca Tin Zone

The Ayawilca Tin Zone is not included in the PEA.

The preliminary testwork and characterization indicates that the tin mineralization is moderately refractory to standard processing techniques. Using reverse flotation of pyrrhotite, about 70% Sn recovery was concentrated into a stream with over 6% Sn grade. That high grade of tin justifies further investigation into more intensive treatment routes such as fine grinding, flotation, gravity concentration, pyrometallurgy and hydrometallurgy to make a commercial tin concentrate.

25.5.3 Colquipucro Silver Zone

The Colquipucro Silver Zone is not included in the PEA.

Around 50% recovery could be achieved by heap leaching, or 60–70% of the silver could be recovered by either conventional tank cyanidation leaching, or flotation, at P80 75 µm.

There remains ample opportunity to improve performance with further study

25.6 Mineral Resource Estimates

The Mineral Resource estimate conforms to industry best practices and is reported using the 2014 CIM Definition Standards.

Mineral Resources are reported on the basis of a possible underground mining scenario using a base case US\$55/t NSR cut-off value for both the Ayawilca Zinc and Tin Zones. The Mineral Resources within the Ayawilca Tin Zone lie spatially beneath the Ayawilca Zinc Zone and the two zones typically do not overlap. Mineral Resources are reported with an effective date of 26 November, 2018.

Mineral Resources at the Colquipucro Silver Zone are reported within a preliminary pit shell generated in Whittle software at a reporting cut-off grade of 15 g/t Ag. Since there are no new data and the metal price and cost assumptions remain reasonable, the Mineral Resource estimate for the Colquipucro Silver Zone remains current as of the effective date of 25 May, 2016.

Factors that may affect the Mineral Resource estimates include: commodity price assumptions; changes in local interpretations of mineralization geometry and continuity of mineralization zones, and impact on mining selectivity; changes to geotechnical, hydrogeological, and metallurgical recovery assumptions; density and domain assignments; changes to assumed mining method which may change block size and orientation assumptions used in the resource model; input factors used to assess reasonable prospects for eventual economic extraction; and assumptions as to social, permitting and environmental conditions.

25.7 Mine Plan

The PEA mine plan is based on a subset of the Mineral Resources estimated for the Ayawilca Zinc Zone.

No other Mineral Resource estimates inform the PEA mine plan.

Limited geotechnical information is currently available. It has been assumed that the conditions would be reasonably favorable for the application of underground mining methods that would require minimum ground support.

The hydrogeological information currently available is limited and not conclusive.

Approximately 50% of the Ayawilca Zinc Zone would be mined using conventional R&P, and 50% using P&P. The main levels will be spaced at 70 m vertical intervals, with a sub-level at 35 m spacing. No sill pillar is planned.

A ramp system will be used to access the mine, connecting the mine portal to the underground infrastructure, including the mine production areas.

The general arrangement of the ventilation system, at a conceptual level, is such that each intake raise supports two separate exhaust raises and each of the exhaust raises draw air from two separate intake raises. Several extended single headings to R&P blocks will be ventilated using fixed forcing fan/duct systems.

Mined-out stopes will be backfilled as necessary to provide a safe working environment. Approximately 50% of the tailings will be used in paste backfill. Waste rock from mine development will be used for CRF.

The mine production schedule assumes a mining and processing rate of 5,000 t/d. Blocks with an NSR value \geq \$65/t were considered to be mill feed material; blocks below this NSR value were treated as waste.

The mine plan assumes use of conventional equipment.

A one-year pre-production period was included in the mine plan, and a nine-month process ramp-up. The forecast mine life is 22 years.

To minimize grade fluctuations a blending strategy will be used, blending mineralized material from different production locations located in different areas or different mantos.

Regular reconciliation will be required between the estimated mining location grades, the grades indicated from stope/truck sampling and those reported by the processing facility. Mine to plant reconciliation will be essential so that modifications can be made to sampling practice or to the methods or parameters used to estimate grade, tonnage or contained metal, so as to maintain LOM grade and tonnage mill feed rates.

25.8 Recovery Plan

The processing circuit will comprise the following stages: conventional primary crushing, SAG, secondary ball mill grinding, coarse lead flotation, zinc flotation, and concentrates and tailings dewatering. The proposed equipment is conventional.

Two types of final concentrates will be produced: a zinc–indium (zinc) concentrate and a lead–silver concentrate.

A portion of the tailings will be used as mine backfill material, while the remaining portion will be disposed in a conventional TSF.

Metallurgical testwork has shown that the mineralized material is amenable to froth flotation at P80 100 µm achieving acceptable grades and recoveries. The mill feed material responds better to roughing stages than cleaning flotation stages.

Energy, water and reagent requirements have been estimated.

25.9 Infrastructure

Infrastructure requirements will include mine and process plant supporting infrastructure, site accommodation facilities, TSF, site and internal access roads, power supply and distribution, fresh water supply and distribution, and water treatment plant. No permanent stockpiles will be required, and no permanent waste rock storage facility is envisioned.

Due to site limitations imposed by topography and potential geological hazards, site development earthworks will be a major project consideration.

As there are difficulties associated with improving the existing site access, a new road is proposed to the site from the town of Chinche.

The Port of Callao, in Lima, was selected as the concentrate export facility for PEA purposes for the larger portion of the zinc concentrate and all of the lead–silver concentrate that would be sent to smelters in Asia. However, port selection should be reviewed during more detailed studies, as the Port of Callao currently accounts for about 80% of the Peruvian foreign trade and there is future potential for congestion issues.

For PEA purposes, a TSF site northwest of the Ayawilca Zinc Zone was selected. A conceptual distance of 2–3 km between process plant and TSF locations was assumed for use in cost estimating. The selected site would require relocation of a portion of

the existing power transmission lines; relocation costs were included in the cost estimate. TSF deposition is assumed using conventional slurry techniques. Investigation of the use of cycloned tailings is recommended.

Mine water is planned to be recycled as much as practicable. The water balance assumes that reclaimed water from the TSF will be the main water source for the process plant. The PEA assumption is that the fresh water requirements for operations can be met from local creeks. Water management and water supplies will be important to operations; in particular, agreement must be reached with regulatory authorities and stakeholders as to fresh water usage. Contact water from any TSF overflow, and water exiting the mine, would be diverted to a water treatment plant prior to any discharge to the environment. Water diversion structures for non-contact water will be constructed. This non-contact water will be discharged to creeks located downstream of the planned operations.

A 500-person accommodations camp was assumed. General mine and process surface facilities will include a mine truckshop, a plant maintenance workshop, a laboratory, an explosives storage magazine, water ponds, a general warehouse, an administrative office building, and a core shed.

The project area is crossed by the L-2254 and L-2264 transmission lines. An approximate 7.5 km section of each line will need to be relocated under PEA assumptions. The PEA assumption is that the project power tie-in at the sectioning point will be within the project area and will tap into the existing L-2264 power line. The PEA also assumes that Tinka will be able to obtain an exemption from regulation PR-20 from COES.

The forecast overall project power demand is about 15 MW.

25.10 Environmental, Permitting and Social Considerations

Tinka has completed seven environmental studies in support of drill program permitting in the period 2013–2018, and has five CIRA certificates.

There are bofedales and two high-altitude lakes in the general project area. The closest infrastructure is anticipated to be sited about 100 m from a high-altitude lake shore. During more detailed studies, infrastructure sites must be the subject of additional environmental evaluation. As a result, infrastructure site areas selected in the PEA may not be the sites that are used in more detailed studies.

Initial baseline studies have identified a number of flora and fauna species in the general project area that have been listed as either critically endangered, endangered or vulnerable. Additional studies will be required to better document species of concern, determine the likelihood of project impact on the species, and to develop appropriate mitigation measures where required.

No closure plan has been prepared, as conceptual closure planning is only required when presenting an EIAd. A provision of US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmark, was included in the capital costs to account for closure costs.

A comprehensive environmental and social impact assessment will be necessary for the project in order to obtain necessary permits for construction, operations, and closure. This assessment will be conducted in compliance with Peruvian regulations. Once the environmental and social impact assessment is approved by Peruvian authorities, a variety of permits, licenses, and authorizations will be required to proceed with project construction and operations.

The granted CIRAs do not cover all of the infrastructure areas envisaged in this PEA. Major areas that are known to require additional CIRAs include: mine supporting facilities, mine backfill plant, process plant, primary crusher, power lines, electrical substation, access road and TSF. Review of the final project footprint will be required to ensure that all of the planned operational areas have a CIRA.

The project will affect at least one community included in the list of indigenous communities maintained by the Ministry of Culture, and will be subject to prior consultation requirements and considerations.

Wood conducted a review of potential social and community impacts as part of the PEA, based on available information provided by Tinka. Tinka has completed a social compliance report for 2017–2018, and monthly reports on safety indicators including social conflicts (2015–2019 and ongoing) to relevant regulatory authorities. Key issues identified from Wood's review include:

- Potential for conflicts over freshwater usage
- Potential impact on existing wetlands and high-altitude lakes
- Proposed infrastructure locations overlap with existing infrastructure such as roads
- Presence of archeological material in areas proposed to host infrastructure

- Ability to obtain land agreements to support project access, development, construction and operations
- Clear understanding of the project area of influence, including communities that may be potentially impacted, the types of impacts
- The ability of the project and company to meet community expectations.

Mitigation measures to avoid, reduce, or compensate for potential project effects will need to be developed and supported by comprehensive environmental and social baseline investigations and engineering studies.

The PEA has made certain assumptions as to the timelines needed to complete prior consultation, and collect the necessary wet season/dry season baseline data to allow the EIA report to be completed and lodged with the relevant regulatory authorities. There is a risk that these timeline assumptions are optimistic and may need to be refined during the EIA application process.

25.11 Markets and Contracts

The payable element in the zinc concentrate is expected to be zinc. Payable elements in the lead–silver concentrate will be lead and silver.

The zinc concentrate is expected to be a medium-grade zinc concentrate, and typical of concentrates from many zinc deposits in central Peru. The clean nature of the Ayawilca zinc concentrate should make it attractive to those traders that blend concentrates.

The zinc concentrate is expected to receive an iron penalty of US\$7.50 per dmt of concentrate at the smelter (at a standard penalty rate of US\$1.50 per each 1% Fe above 8% Fe). No other deleterious elements are thought to be present in the zinc concentrate, and no other penalties are expected.

At the proposed production rate, Ocean Partners recommend that Tinka secures at least one long-term contract directly with a smelter, in particular with a smelter in Asia that potentially recovers indium. There is potential for Asian smelters that recover indium to pay competitive terms for material containing the stated indium range for the Ayawilca zinc concentrates.

Details of the expected Ayawilca lead–silver concentrate are not as well constrained as those for the zinc concentrate, due to fewer metallurgical testwork results. The smelter

is assumed to pay for 95% of lead content in the concentrate subject to a minimum deduction of three units. For silver in the lead–silver concentrate, the smelter typically pays for 95% subject to a minimum deduction of 50 g/dmt. No penalties are expected on the lead–silver concentrate.

Project economics were estimated based on long-term metal prices of US\$1.20/lb for zinc, US\$0.95/lb for lead, and US\$18.00/oz for silver.

Tinka has no current contracts for project development, mining, concentrating, smelting, refining, transportation, handling, sales and hedging, forward sales contracts or arrangements.

25.12 Capital Cost Estimates

The capital cost estimate was prepared by Wood. All costs are exclusive of the Peruvian value-added tax (Impuesto General a las Ventas or IGV). The capital cost estimate for the PEA has an expected accuracy range of $\pm 35\%$.

The estimate includes direct and indirect costs (such as engineering, procurement, construction and start-up of facilities), as well as Owner's costs and contingency associated with mine and process facilities, and on-site and off-site infrastructure.

Sustaining capital costs are estimated at \$144.6 M.

Initial capital costs are estimated at \$261.9 M.

25.13 Operating Cost Estimates

The operating cost estimate has an expected accuracy range of $\pm 35\%$ and is expressed in Q1-2019 US\$.

The estimate includes the underground mining, processing and G&A operating costs. It excludes costs associated with escalation beyond Q1-2019, currency fluctuations, off-site costs, interest charges and taxes. No contingency has been included in the operating costs.

The life-of-mine operating cost estimate is \$1,855.9 M. The estimate per tonne of mill feed processed over the LOM is \$48.57/t.

25.14 Economic Analysis

The preliminary economic analysis is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA based on these Mineral Resources will be realized.

The financial analysis uses a DCF methodology and an NPV8% as the base case. All monetary amounts are presented in constant Q1-2019 US\$. The economic preliminary analysis is based on 100% equity financing. No escalation or inflation has been applied. All amounts are in real terms.

Indicated and Inferred Mineral Resources account for 22% and 78% of total mill feed, respectively.

A total of 75 kdmt/year of the zinc concentrate will be sold to a local smelter in Peru and the remaining yearly production will be sold FOB Asia. Lead-silver concentrate production will be sold FOB Asia.

A construction period of 18 months was considered (starting in mid-year 2021) for the overall project implementation. Year 2023 corresponds to the first year of production. Capital costs were applied in the financial model excluding IGV.

The mine will be run by the Owner. Operating costs were applied in the financial model excluding IGV.

The cashflow analysis assumes that 1% NSR royalty payable to Sierra will be bought out, and is therefore not included in the analysis.

Working capital will be recovered at project completion.

Taxation and royalties modeled within the financial analysis are based on the tax rates and taxation schemes that were validated by EY. Previous and projected general expenses and explorations costs were included in the amortization balance for tax calculation purposes only.

A provision of US\$20.3 M, equivalent to the 5% of the total capital cost based on benchmark, was included to account for closure costs. No salvage value was considered.

The project is projected to generate a pre-tax NPV of \$609 M at an 8.0% discount rate, an IRR of 37.2% and a payback period of 2.2 years. The financial analysis results

showed an after-tax NPV of US\$363 M at an 8.0% discount rate, an IRR of 27.1% and a payback period of 3.1 years. AISC are estimated at \$2,840.8 M over the LOM, which equates to \$0.72 per payable zinc pound.

A sensitivity analysis was performed considering variations in commodity prices, grades, initial capital and operating costs on the after-tax NPV8% and on IRR. The project is most sensitive to fluctuations in the zinc price, then to grade. It is less sensitive to changes in operating costs, then initial capital costs. It is least sensitive to changes in silver and lead prices.

25.15 Risks and Opportunities

Risks were rated according to probability and likely impact, and the assigned a risk rating. No action plans were developed for each risk as it is expected that the outcome of the risk workshop will be used as the basis for the preparation of the overall work plan for the next project stage. Significant risks were identified in the following areas: dewatering assumptions for process plant design, potential for acid mine drainage in the TSF necessitating a liner, water treatment plant assumptions, PR-20 regulation exemption assumption in relation to the proposed power supply, and Chaquicocha Lake impact on water management assumptions.

Opportunities were identified by Wood, and reviewed by Tinka. Significant opportunities included: high-grading mill feed material early in the mine plan, Mineral Resource confidence category upgrades/exploration success throughput expansion, treating material from the Ayawilca Tin Zone after the Ayawilca Zinc Zone has been mined out, processing the Colquipucro Silver Zone to produce silver as a new marketable product, and use of cycloned tailings.

25.16 Conclusions

Under the assumptions presented in this Report, and based on the available data, the PEA shows positive economics.

26.0 RECOMMENDATIONS

26.1 Introduction

A two-phase work program is recommended. The first work phase would consist of:

- Exploration and step-out drilling to further investigate high-grade zinc mineralization at the South and West Ayawilca Zones, and potentially support estimation of additional Mineral Resources
- Infill drilling to provide support for Mineral Resource estimate confidence category upgrades
- Field investigations and data collection to support a pre-feasibility study and to support environmental and permitting requirements
- Engineering studies
- Completion of a pre-feasibility study.

Contingent on positive results from the pre-feasibility study, the second work phase would consist of a feasibility study. The Phase 2 work could include:

- Infill and geotechnical drilling
- Adit construction
- Field investigations and detailed data collection, together with engineering studies
- Completion of a feasibility study.

Phase 1 is estimated at \$15 M, divided between exploration drilling (US\$3 M), infill drilling for the pre-feasibility (US\$7 M) and field investigations and studies to support a pre-feasibility report (\$5 M). Phase 2 is estimated at \$20 M, divided between infill drilling (\$5 M), and field investigations and studies to support the feasibility report (\$15 M).

26.2 Phase 1

26.2.1 Exploration and Infill Drill Programs

Exploration and step-out drilling is recommended to further investigate high-grade zinc mineralization at the South and West Ayawilca Zones, and potentially support estimation of additional Mineral Resources. Mineralization currently outlined in the

South and West Ayawilca Zones contain the thickest and highest-grade portions of the Ayawilca Zinc Zone, and portions of the mineralization remain open. A 10,000 m program is proposed, and is currently underway.

For the infill drill program to support a pre-feasibility study, a drill hole spacing study is recommended to determine the optimal drill spacings to support Mineral Resource confidence category classifications. The results should be used to lay out an infill drill program for the Ayawilca Zinc Zone. A 23,000 m program is proposed.

A portion of the drill core from the infill drill program should be used to gather additional density information, and, where required, support additional metallurgical tests. Drilling should also be used to obtain sufficient geotechnical information to support underground mine designs

26.2.2 Mineral Resource Estimate Update

The Mineral Resource estimates should be updated with the results of the current and planned drill programs with the aim of supporting pre-feasibility-level assessments.

26.2.3 Mine Planning

A program of geotechnical drilling is recommended to support mine designs at the pre-feasibility level. These drill holes will be completed as part of the infill drill program described in Section 26.2.1.

A study should be undertaken to review potential alternatives for cut-off grade optimization and higher throughput rates.

26.2.4 Metallurgical Testwork

The zinc mineralization responded well to conventional treatment by milling and flotation.

A comprehensive testwork and development program will be required before completing detailed mining studies. This should include additional sampling (particularly of the lower-grade Central and East Ayawilca Zones under-represented in previous sampling) and testing considering at least the following items:

- Geological modelling of sulphide species, lithological, and mineralogical domains
- Identification and selection of metallurgical variability samples
- Evaluation of treatment alternatives for pyrrhotite-rich zones

- Semi-autogenous grind (SAG) and ball mill grinding design tests, BBWi, abrasion index, JK drop weight and SMC tests
- Grinding variability testwork
- Flotation optimisation testwork
- Flotation variability testwork
- Locked cycle flotation testwork
- Tests on water quality and effect on flotation
- Tests for viability of lead and silver flotation performance
- Concentrate thickening and filtration tests
- Tailings thickening, transport and deposition tests
- Development of geometallurgical model for mine planning

26.2.5 Process Design

Trade-off studies should be conducted to define the preferred process flow sheet and select the process plant facility location.

When the Mineral Resource estimate update is available, a review should be undertaken to determine if there is potential for project expansion if the Ayawilca Tin Zone can be processed following mining of the Ayawilca Zinc Zone. Evaluation of the potential for equipment synergies should be conducted.

26.2.6 Infrastructure

A geotechnical field investigation should be completed to support the project facilities locations and infrastructure design. Once geotechnical data are available, trade-off studies should be conducted to determine optimal infrastructure location sites.

TSF locations and design should be further evaluated. One aspect of such studies will be the potential to use cycloned tailings, which will include assessment of whether sufficient sandy materials would be available on or in close proximity to the project site. A material balance will be required as part of the evaluation process.

A hydrogeological and hydrological study should be completed to understand surface and underground water conditions and behaviours that can support engineering studies, development of a project water balance, and creation of a robust and dynamic

conceptual model that can be used to derive additional numerical and prediction models for use in operational water management. Aspects that will need to be included in the work program include:

- Development of static and kinetic geochemical analyses and hydrogeochemical models to address the potential of acid drainage
- Inventorying water sources in the project area of influence, focusing on the two micro-basins in which the project is located
- Implementation of water monitoring activities to provide baseline data

An evaluation to quantify the number and nature of karstiform features should be undertaken. A seismic hazard study should be conducted.

A route study to determine what will be required for project access is required.

A review is needed to confirm what port facilities may be available, and to determine likely concentrate handling costs at the preferred port option.

Although the PEA assumes power will be sourced via an ATN-owned transmission line, power options should be further researched. Clarification should be sought from COES that Tinka may be able to use a PR-20 regulation exemption.

26.2.7 Environmental, Social and Permitting

Sufficient baseline studies will need to be completed to support a pre-feasibility study. The project EIA document will require baseline studies to have been conducted in both dry and rainy seasons. A review of existing data should be undertaken to ensure that the information collected is suitable to support the EIA process.

Additional information required to support the pre-feasibility study that still remains to be collected will include:

- Completion of archaeological and heritage searches once the infrastructure locations have been selected
- Cross-check of the selected infrastructure sites, and other areas that are planned to be disturbed against protected areas such as lagoons, wetlands, protected flora sites, and registered archaeological sites to ensure selected sites will have the minimal disturbance possible

An assessment of any additional CIRAs that may be required should be undertaken once optimal infrastructure sites have been located.

Stakeholder consultations and community awareness campaigns should be conducted to ensure stakeholders are aware of the project scope and likely impacts. This should be completed before the project moves to the “prior consultation” phase required under Peruvian law as part of the application for the Start of Activities approval.

Tinka should determine surface rights strategies to obtain long-term surface leases with local communities. As soon as practicable, Tinka should enter into negotiations with applicable stakeholders for land usage rights, and conclude signed agreements.

26.2.8 Report

When sufficient data are to hand, a pre-feasibility study document should be completed to support estimation of Mineral Reserves for the project.

26.2.9 Budget Estimate

Exploration Drill Program

Assuming an all-in drilling cost of US\$300/m, about 10,000 m of drilling is contemplated, at an overall cost of US\$3 M. This program is underway.

Infill Drill Program

Assuming an all-in drilling cost of US\$300/m, about 23,000 m of drilling is contemplated, at an overall cost of US\$7 M.

All Other Programs

A cost projection of about US\$5 M is required to complete the other Phase 1 programs. This estimate covers metallurgical testwork, field investigations, geochemical investigations, hydrological, hydrogeological and hydrogeochemical studies, TSF design considerations, engineering studies, report compilation, and permitting, social and general and administrative expenses.

26.3 Phase 2

If the results of the pre-feasibility study indicate positive project economics and a project that Tinka considers warrants further evaluation, a feasibility study should be considered.

26.3.1 Drill Program

Depending on the results of the Phase 1 infill drill program, a further 15,000 m of drilling will likely be required to support feasibility-level evaluations.

26.3.2 Other Programs

Field investigations and work programs to support feasibility-level designs are likely to include metallurgical testwork, geotechnical investigations, potentially commencing pre-development works such as an adit, hydrological, hydrogeological and hydrogeochemical studies, infrastructure design considerations, engineering studies, report compilation, and permitting, social and general and administrative expenses.

26.3.3 Budget Estimate

Infill Drill Program

Assuming an all-in drilling cost of US\$300/m and 15,000 m of drilling, the feasibility infill program will require a budget of about US\$5 M.

All Other Programs

The remaining field and study programs, together with completion of a feasibility study report, are estimated to require about US\$15 M.

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