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PAN AMERICAN
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TECHNICAL REPORT FOR THE SHAHUINDO MINE, CAJABAMBA, PERU

In accordance with the requirements of National Instrument 43-101 "Standards of Disclosure for Mineral Projects" of the Canadian Securities Administrators

Effective date: November 30, 2022

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1 SUMMARY

1.1 Introduction

This Technical Report has been prepared by Pan American Silver Corp. (Pan American or PAS), in compliance with the disclosure requirements of National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101), to disclose relevant information about the Shahuindo property (Property or Shahuindo). The report is an update to and replaces the "Technical Report on the Shahuindo Property, Cajabamba, Peru", with an effective date of January 1, 2016 (the 2016 Technical Report), prepared by Tahoe Resources Inc. (Tahoe). On February 22, 2019, Pan American completed a transaction to acquire all the outstanding shares of Tahoe. The main purpose of this Technical Report is to give an update on the Property resulting from additional Mineral Resource and Mineral Reserve delineation drilling, disclose updated Mineral Resource and Mineral Reserve estimates, and to report operating results.

The effective date of this Technical Report is November 30, 2022. The effective date of the Mineral Resource and Mineral Reserve estimates is June 30, 2022, which includes *in situ* Mineral Resources and Mineral Reserves which were depleted for mining at that time and the stockpiles which were also inventoried as at June 30, 2022.

Pan American is a silver mining and exploration company listed on the Toronto (TSX:PAAS) and NASDAQ (NASDAQ:PAAS) stock exchanges. It has a diversified portfolio of mining and exploration assets located throughout the Americas, which include 10 operating mines.

1.2 Property description and ownership

The Property within which the Shahuindo mine is located in the district of Cachachi, province of Cajabamba, department and region of Cajamarca, Peru. It is situated approximately 59 kilometres (km) southeast of the town of Cajamarca and 14 km west of the town of Cajabamba. The Property can be accessed from Cajabamba via a combination of asphalt, gravel, and dirt roads. Access can be gained all year round.

Shahuindo comprises one mineral right, ACUMULACION SHAHUINDO, 100% controlled by Pan American's wholly-owned subsidiary, Shahuindo SAC, and has an approximate area of 7,338.91 hectares (ha). The mining right has no expiry date so long as taxes are paid annually. Shahuindo SAC has acquired 612 surface rights within the Property covering a total area of about 3,144.68 ha. Some of these surface rights were used to relocate local land owners into new areas.

There is a State royalty payment structure pertaining to mining operations and a contribution to El Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN) which is Peru's State Energy and Mines Investment Regulator.

Climate in the area is typical of the Sierra region. It is cold and dry during the dry season and humid during the rainy season. Rainfall typically occurs between October and April (wet season), with occasional sporadic showers in the other months. The average annual rainfall is about 1,000 millimetres (mm) with an extreme wet year having a rainfall of 1,550 mm and an extreme dry year receiving 449 mm. The dry season months are May through September.

The Property is located on the west side of the Condebamba River valley. The topography varies from rolling hillsides to steep ravines. Elevation across the Property area varies from 2,400 metres (m) to 3,000 m above sea level (masl).

Peru is an area with high seismic and tectonic activity with earthquakes being more intense near the coastal regions and decreasing gradually towards the mountains and jungle regions. According to the seismic zoning map of Peru's National Building Regulations, Shahuindo is located in Zone 3 which corresponds to moderately high seismic activity.

All the support infrastructure is in place to support the oxide gold mining and extraction activities at Shahuindo.

1.3 History

Modern exploration activities have been conducted on the Property since 1945 by Compania Minera Algamarca S.A. (Minera Algamarca) (1945-1989), Alta Tecnología e Inversión Minera y Metalúrgica S.A. (Atimmsa, 1990), Asarco LLC (Asarco, 1994-1996), Southern Peru Copper Corporation (Southern Peru, 1997-1998) and Sulliden Gold Corporation (Sulliden, 2002-2012). Rio Alto Mining Ltd. (Rio Alto) carried out an extensive surface drilling program of 419 core and RC holes, the majority of which to decrease the nominal drill spacing in the Shahuindo deposit to approximately 25 m x 25 m and expand the Mineral Resource.

From 2014 to 2019, Tahoe completed 283 core and reverse circulation (RC) holes, as resource infill and extension of main mineralized zone and exploration on outlying exploration targets. Tahoe also drilled 13 hydrogeologic holes. The first gold production was in December 2015.

1.4 Geology and mineralization

The Property is located on the eastern flank of the Andean Western Cordillera in northern Peru, approximately 35 km north-northwest of Pan American’s La Arena mine. The area is underlain by folded and faulted Mesozoic West Peruvian Basin sediments. The regional stratigraphy comprises folded siliciclastic and carbonate sediments related to the Upper Jurassic Chicama Formation to the Lower to Middle Cretaceous Goyllarisquizga Group.

The principal zone of mineralization in the Shahuindo district occurs in a belt between two large-amplitude regional-scale folds, the Algamarca anticline and the San Jose Anticline. The Algamarca anticline is upright and symmetrical with amplitude of at least 400 m, whereas the San Jose fold is an asymmetric, overturned, northeast-vergent fold with a shallowly dipping axial surface and amplitude of at least 300 m. Important structural elements include fold limbs and fold axial surfaces, fold-related fractures, faults and related extension fractures, breccia dikes and irregular bodies, and igneous intrusive contacts.

Mineralization at Shahuindo has been identified over a corridor approximately 3.7 km southeast to northwest and 0.5 km southwest to northeast. Oxidation of mineralization extends to a depth of 150 m below surface. Sulfide mineralization has been identified by surface drilling to 700 m depth.

The mineralization is best described as an intermediate-sulfidation epithermal system, though high-sulfidation mineralization occurs at depth and in the core of hydrothermal breccias. The high-sulfidation mineralization was pervasively overprinted by intermediate-sulfidation mineralization (pyrite, galena, sphalerite, Ag sulfosalts), which occurs at shallow levels and in “feeder structures”. Mineralization occurs on fracture surfaces, in breccia matrix, and as disseminations within the sediment packages.

In the oxide facies, which is interpreted to be the result of weathering processes, gold and silver are associated with the presence of jarosite and hematite. In the sulfide facies, gold is typically extremely fine-grained and the mineral species has not been identified. Fine-grained pyrite forms a close association with gold mineralization and occurs as disseminations, veinlets, and semi-massive replacement bodies.

Both structure and lithology control the location, shape, and orientation of the mineralization. The mineralization is hosted within the siliciclastic sandstone-dominant Farrat Formation and the underlying sedimentary Carhuaz formation. These sedimentary rocks have been intruded by at least three felsic stocks which tend to be located along faults and cores of anticlinal structures. In addition, the metallurgical recovery of gold is affected by lithology with the identification of five primary geometallurgical domains based on the relationship between lithology and grain size and gold recovery. Modelling the distribution and occurrence of lithologic units / geometallurgical domains is critical to mine planning.

Metallurgical recovery of gold from the Shahuindo deposit is affected by lithologic grain size, degree of clay alteration and silicification. There is a high degree of lateral and vertical lithologic variability, particularly in the northern half of the deposit. Modelling the distribution and occurrence of lithologic units / geometallurgical (geomet), domains is critical to mine planning, and ultimately metal recovery and revenue.

1.5 Drilling, sampling, and verification

A total of 1,693 holes drilled by Atimmsa, Asarco, Southern Peru, Sulliden, Tahoe, and Pan American have been used to model and calculate the Mineral Resource estimate at Shahuindo. The cut-off date for drill data inclusion in the June 30, 2022 Mineral Resource model is May 31, 2022. The Mineral Resource model database includes 963 RC and 859 diamond drillholes drilled on the Property by the various owners since 1992 with the metres split 133,164 m RC and 154,963 m diamond drilling for a total of 288,127 m.

The majority of the RC and core drillholes are located within the current Mineral Resource footprint with the majority of the drilling in the oxide domain on a nominal 25 m x 25 m spacing. The database also includes twelve diamond core holes that were drilled for geotechnical purposes and subsequently sampled for analyses.

For RC drilling cuttings were sampled on 1.5 m intervals at the rig and 30% of the cuttings of each individual sample were bagged and sent to the laboratory for analyses. The remaining 70% of the sample cuttings were bagged and kept as rejects. Two reference chip trays, one with a complete sample and the other with a sieved sample (one millimetre mesh), were collected for geologic logging and archiving.

For diamond core drilling HQ, NQ, and PQ core was placed into plastic boxes with wooden blocks to denote each drill run. Boxes contain either three metres of HQ core, four metres of NQ core, or two metres of PQ core. Core boxes were securely sealed and delivered once a day, by truck, to core-logging facilities at the on-site core logging facility.

Drill collar northing and easting coordinates are located in relation to the UTM WGS84 coordinate grid. In 2009 Horizon South America S.A.C (Horizon) completed an aerial survey of the Property and created a two metre contour map. Pan American continues with the survey procedure established in 2010 to survey drillholes.

Downhole survey data are available for 943 core and RC holes, corresponding to approximately 52 percent of the number of drillholes in the database used for the Mineral Resource estimate. Pan American continues with the downhole survey procedure established in 2015 to downhole survey all drillholes using a non-magnetic conventional gryro Reflex survey tool with continuous azimuth and inclination measurements normalized to 5 m intervals. The survey information is downloaded, processed, and validated by the Geology department.

Pan American has continued with a logging procedure originally standardized by Sulliden and refined by Rio Alto in 2015, with lithology, fracture orientation, oxidation, sulfide mineralization types and intensities, and alteration type and intensity as well as sample recovery percentages and Rock Quality Designation (RQD) logged into digital spreadsheet forms. Since 2014 GMAPPER software has been used to record geologic and geotechnical data. All drill core since 2003 has been photographed.

Studies have been carried out on the comparison of RC and diamond drilling data and this has demonstrated there is no appreciable difference between the gold estimates based on the RC only and the RC+DDH datasets. The project database has a total of 168,592 gold assays, 167,397 silver assays, and 149,382 total sulfur analyses. The database also includes a 31-element suite of trace element analyses for most holes drilled since 2007. The database contains 6,570 specific gravity measurements. Samples for measurement have been collected from all significant rock types along the extent of the deposit.

Assaying has been carried out by certified labs over time; Sulliden utilized ALS Minerals (ALS, formerly known as ALS Chemex) in Lima for sample preparation and analysis. The ALS laboratory in Lima is ISO 9001:2008 and ISO 17025:2005 certified, Rio Alto used CERTIMIN, where gold was assayed with a 50-gram fire assay using an atomic adsorption finish, also ISO 9001 certified for geochemical, metallurgical, and environmental sample analyses. Both Tahoe and Pan American used the CERTIMIN laboratory in Lima as the primary assay lab.

Standard reference materials (SRMs) were obtained from ROCKLABS and ACTLABS external labs using a blend of various grade materials from the Shahuindo deposit. The drilling programs over the period from July 2016 to May 2022 by both Tahoe Resources and Pan American utilized SRMs, blanks, and field duplicates.. The Quality Assurance and Quality Control (QA/QC) samples were inserted into drill sample sequences and submitted for analysis to the CERTIMIN laboratory in Lima, Peru. Insertion rates were within industry norms and control charts were used to monitor the analytical performance and corrective action was taken as required. During the period from July 2016 to May 2022, a total of 41,496 drillhole samples were submitted for laboratory analysis. A total of 5,530 control samples were inserted with drillhole samples comprising samples taken from both RC and DDH drillholes. The Pan American program was an extension of the previous programs and the data is fit for purpose.

Drill core and RC sampling procedures, sample analyses, QA/QC procedures and sample security employed at Shahuindo are of sufficient quality for use in the estimation of Mineral Resources.

Data verification is undertaken by the Qualified Persons (QPs) who visit the Property regularly and undertake reviews of the processes and practices in their respective discipline. In addition, the basis for the Mineral Resource estimate undergoes rigorous checks on site and at a corporate level.

1.6 Metallurgical testwork

The mineral processing and metallurgical testing include cyanidation, column leach tests, agglomeration testing and flotation testing programs conducted on composite samples from Shahuindo by various companies starting in 1996. These companies include Asarco, Minera Algamarca, Sulliden, Rio Alto, Tahoe, and Pan American, with test work conducted at Dawson Metallurgical Laboratories (Dawson), Kappes, Cassiday & Associates (KCA), Heap Leach Consultants (HLC), SGS Laboratories (SGS), Tahoe’s La Arena laboratory and onsite by Shahuindo SAC.

Cyanidation tests including column leach tests and pilot test heaps on ROM material indicate excellent gold recoveries at both run-of-mine (ROM) and coarse crush sizes with low to moderate reagent requirement, but low silver recoveries. Shahuindo has been in operation since 2015 primarily as a ROM heap leach operation with a life-of-mine (LOM) realized gold recovery of 79% in pad 1, 75% in pad 2A and 65% in pad 2B/C and projected final recoveries approaching 80%.

Compacted permeability and agglomeration tests indicate permeability issues with some of the ore types. These permeability issues can be largely managed by blending.

Table 1.1 presents the field gold and silver recoveries based on the available test work results for ROM and reagents additions based on operational consumptions.

Table 1.1 Metallurgical test results and processing parameters

Parameter	ROM
% Au recovery	80%
% Ag recovery	10%
NaCN consumption	0.4 kg/t
Lime	3.6 kg/t

1.7 Mineral Resources

Pan American updates Mineral Resources on an annual basis following reviews of metal price trends, operational performance and costs experienced in the previous year, and forecasts of production and costs over the LOM. Infill and near-mine drilling is conducted as required throughout the year. The drillhole data cut-off date for the commencement of the current geological interpretation was May 31, 2022, and the effective date of the Mineral Resource estimate is June 30, 2022.

The Mineral Resource estimate was prepared by Pan American staff under the supervision of, and reviewed by Christopher Emerson, FAusIMM, Vice President, Business Development and Geology of Pan American, who is a QP. They have been estimated in accordance with the CIM Estimation of Mineral Resources and Mineral Reserves, Best Practice Guidelines (2019), and reported according to the CIM Definition Standards (2014).

The following elements were estimated using ordinary kriging (OK): gold in grams per tonne (g/t), silver in g/t, copper in g/t, and sulfur in %. The Au grade shell was modeled in one domain at a 0.1 g/t Au threshold. The estimation was defined with 3 passes with incremental search radii restricted by outliers, number of minimum and maximum composites, the minimum and maximum number of drillholes and number of composites per drillholes so that the grade interpolation respects the local and global informing of composites.

The Mineral Resource estimate has been classified as Measured, Indicated, and Inferred based on the confidence of the input data, geological interpretation, and grade estimation parameters.

With the ROM ore, a blending strategy is required to maintain the permeability of the heap leach pads. The argillaceous rock types are referred to as fines as they tend to break finer with blasting and handling whereas the more silicious rock types do not break down as readily and are referred to as coarse material. As the finer material has lower permeability in the heap leach pads, Shahuindo SAC blends the fines with coarse material. The additional value of the coarse material for blending contributes to different cut-off grades by material type. For the purposes of Mineral Resource and Mineral Reserve estimates, this has been simplified to three material types:

1. ROM 1 is coarse material that is used to blend with fine material.
2. FIRO is fine material that would not have sufficient permeability to be sent to the ROM pad on its own and requires blending with ROM 1.
3. ROM 2 is material that has sufficient permeability but is either not suitable or required for blending.

Table 14.1 tabulates a summary of the total Mineral Resources for the Property at June 30, 2022. This total includes contributions from the open pit, classified as oxide, which has potential for open pit extraction. Mineral Resources estimates at the end of June 2022 are based on ROM ore (ROM 1) Au cut-off grade = 0.032 g/t, fine ore in ROM (FIRO) Au cut-off grade = 0.207 g/t, Direct ore from ROM (ROM 2) Au cut-off grade = 0.159 g/t and metal prices: Au = $1,700/oz, Ag = $22/oz also listed in the footnotes.

Table 1.2 Summary of Mineral Resources at June 30, 2022

Classification	Tonnes	Grade		Contained metal	
	Mt	Au g/t	Ag g/t	Au koz	Ag koz
Measured	8.3	0.29	5	77	1,279
Indicated	13.2	0.23	4	98	1,800
Measured + Indicated	**21.6**	**0.25**	**4**	**175**	**3,079**
Inferred (Oxide)	**14.6**	**0.41**	**8**	**194**	**3,724**

Notes:
- CIM Definition Standards (2014) were used for reporting the Mineral Resources.
- Mineral Resources exclude those resources converted to Mineral Reserves.
- Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
- Mineral Resource estimates were prepared under the supervision of, or were reviewed by Christopher Emerson, FAusIMM, Vice President, Business Development and Geology of Pan American who is the QP.
- Mineral Resources have been estimated using heap leaching metal recovery and cost parameters.
- Mineral Resources at June 30, 2022 are based in ROM 1 Au Cut-off grade = 0.032 g/t, FIRO Au cut-off grade = 0.207 g/t, ROM 2 Au cut-off grade = 0.159 g/t.
- Metal prices used are gold at $1,700/oz and silver at $22/oz.
- Mineral Resources were constrained within a Whittle shell to conform with reasonable prospects for eventual economic extraction (RPEEE).
- The drillhole database was closed at May 31, 2022.
- Totals may not compute exactly due to rounding.

Metallurgical testing results on samples of sulphide mineralization that became available after June 30, 2022 has led to the conclusion that the previously reported sulphide Inferred resource does not meet the criteria for reasonable prospects for eventual economic extraction at this time. As such, the deeper sulphide mineralization is not included in the estimated Mineral Resources at the Property.

There are no known environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the potential development of the Mineral Resources. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

1.8 Mineral Reserves

Pan American updates Mineral Reserves on an annual basis following reviews of metal price trends, operational performance and costs experienced in the previous year, and forecasts of production and costs over the life of the mine. The Mineral Reserve is based on Measured and Indicated Mineral Resources estimated as at June 30, 2022. The effective date of the Mineral Reserve estimate is June 30, 2022.

Mineral Reserve estimates are based on assumptions that include mining, metallurgical, infrastructure, permitting, taxation, and economic parameters. Increasing costs and taxation and lower metal prices will have a negative impact on the quantity of estimated Mineral Reserves. There are no other known factors that may have a material impact on the estimate of Mineral Reserves.

The Shahuindo Mineral Reserve estimate is summarized in Table 1.3.

Table 1.3 Summary of Mineral Reserve at June 30 2022

Classification	Tonnes Mt	Au grade g/t	Ag grade g/t	Au koz	Ag koz
Proven	56.0	0.52	8.4	944	15,044
Probable	45.3	0.41	6.1	604	8,847
Proven & Probable	**101.3**	**0.48**	**7.3**	**1,548**	**23,891**
Stockpiles	2.85	0.30	3.1	28	281
Total Reserves	**104.2**	**0.47**	**7.2**	**1,575**	**24,171**

Notes:

- Mineral Reserves are not included in Measured and Indicated Mineral Resources.
- Figures in the tables may not compute exactly due to rounding.
- The Mineral Reserves at end June 2021 are based on a cut-off grade of ROM 1 Au cut-off grade = 0.04 g/t, FIRO Au cut-off grade = 0.26 g/t, ROM 2 Au cut-off grade = 0.18 g/t
- Cut-off values are based on a gold price of $1,500/oz, silver price of $19/oz.
- Metallurgical recoveries are based on feed grade and metallurgical algorithms. No adjustment of the model was necessary to account for dilution.
- Mineral Reserves are reported on a 100% ownership basis; Pan American owns 100% of Shahuindo SAC.

The estimated metallurgical performance was sourced from test work and engineering first principles. Proven and Probable reserves do not include a dilution factor or mining losses. Mineral Resources within the mine plan classified as Inferred were considered to have no economic value and have been classified as waste in the mining schedule.

1.9 Mining method and mine production schedule

Shahuindo consists of an open pit mine and heap leach processing facility that is currently in production and has been operating since November 2015. The open pit is being mined in a sequence of phased cutbacks. The mining method utilizes conventional drill and blast, loading of ore and waste is by diesel powered 90 t excavators into 42 t and 46 t heavy duty highway rigid frame dump trucks. This type of truck is common in this style of operation in Peru. The ore and waste are hauled to the leach pad or waste dumps correspondingly.

Mining is based on an owner operator model, with operations managed and controlled by Pan American utilizing Pan American employees. Mining is carried out on two 12-hour shifts, operating 7 days a week.

The mine design utilizes 8 m benches which are suitable for the size of equipment employed and align with those used since 2016.

The Mineral Reserve estimate discussed in Section 15 gives a mine life of 10 years through to 2032 at an initial production rate of 6 million tonnes (Mt) for the second half of 2022 and 13.1 million tonnes per annum (Mtpa) in average for period 2023 – 2027, 9.4 Mtpa in average for period 2028 – 2030 and 6.6 Mtpa in average for last two years of mine production.

1.10 Processing

Shahuindo is an open pit heap leach operation which has been developed in multiple phases since beginning operations in 2015. The current operation uses truck stacking of ROM ore onto a multiple-lift, single use leach pad at an average rate of 36,000 tonnes per day (tpd) in 8 m and 6 m lifts. Pebble lime (CaO) is added to the ore at the leach pads for pH control before the stacked ore is leached with a dilute sodium cyanide solution. Pregnant leach solution is discharged from the heap flows by gravity to a pregnant solution pond and is pumped to a carbon-in-column (CIC) adsorption circuit where the gold and silver is loaded onto active carbon. Loaded carbon from the CIC circuit is periodically transferred to the recovery plant where the carbon is acid washed and stripped in four and ten tonne batches. Gold and silver are recovered by electrowinning with the resulting electrowinning sludge dried and smelted onsite to produce the final doré product.

The processing design parameters are shown in Table 1.4.

Table 1.4 Processing design parameters

Parameter	
Dry tonnes of ore / day	36,000
Design flow rates	1,850 m^3/hr
Lift height	6 m
Material size	ROM
NaCN consumption	0.4 kg/tonne of ore
Lime addition	3.6 kg/tonne of ore
Au recovery	80%
Ag recovery	10%

1.11 Infrastructure

Shahuindo is a mature operating mine and site infrastructure including site roads are fully developed to support the existing mine production of 13 Mtpa.

The infrastructure and services to support Shahuindo include the following major components:

- Site access road.
- Power supply including back-up power and distribution.
- Water supply for process water, potable water, and fire water.
- Sewage system and solid waste disposal.
- Property buildings including truck shop, explosive magazines, warehouse, maintenance / process warehouse, fuel station, and offices.
- Camps for construction and operations including dining facilities.
- Miscellaneous site services such as security, first aid clinic and communications.

1.12 Mine closure

A closure cost estimate for Shahuindo was prepared in 2021 according to Pan American's standard methodology, which employs the State of Nevada approved Standardized Reclamation Cost Estimator (SRCE) model. This estimate includes consideration of all surface disturbance and reclamation liability at the site and is updated on an annual basis. Shahuindo SRCE model includes demolition of all site infrastructure, re-grading of waste rock facilities, rinsing and covering leach pads, and complete re-vegetation of the site. The current SRCE model estimates the undiscounted value of reclamation costs or environmental liability for the Property to be approximately $56.0 million.

1.12.1 Operating costs

For ROM heap leach ore, the cost of processing is estimated to average $2.87 per tonne plus $2.67 per tonne for General and Administration (G&A) including Lima support (the average leach pad construction cost of $1.46 per tonne is added to the processing costs for the purposes of Mineral Reserve estimation).

Open pit mining costs are referenced to bench 2,860 and estimated at $1.80 per tonne for ore and $2.01 per tonne for waste with incremental mining costs added depending on the vertical and horizontal distances from this reference bench.

1.12.2 Capital costs

Pan American estimates that sustaining capital expenditures in 2022 will be $54.8 million, primarily for the Choloque waste dump construction, water treatment plant, surface water management, truckshop, new warehouse, infill drilling, camp kitchen expansion and the construction of heap leach pad capacity. The mine haul truck fleet that is scheduled to be replaced in 2022 will be leased. Future sustaining capital costs will be dependent on requirements and Mineral Reserve growth if any. The cost of constructing heap leach pad capacity is estimated to average $1.46 per tonne over the remainder of the Mineral Reserves.

1.12.3 Financial analysis

An economic analysis has been excluded from this Technical Report as Shahuindo is currently in production and this Technical Report does not include a material expansion of current production.

1.13 Exploration status

Numerous oxide and sulfide exploration targets that have considerable potential to increase the Mineral Resource and Mineral Reserve base at Shahuindo have been identified through surface mapping, rock-chip and soil sampling surveys, geophysical surveys and drilling conducted by previous owners of Shahuindo and by drilling conducted by Tahoe subsequent to its merger with Rio Alto in April 2015.

Drilling around the periphery of the currently designed pit limits in the second half of 2015 successfully identified mineralization outside of the northeast and southwest margins of the Phase 2 pit shell that will be incorporated into future mine plans. Likewise, condemnation drilling in the planned waste dump area identified shallow mineralization that represents an extension to the known resource; a portion of which will be mined and delivered to the leach pad or stockpile prior to construction of the waste dump foundation.

Other drilling in 2015 identified metal grades and mineralogy similar to Shahuindo at the San Lorenzo, Choloque, and La Chilca prospects proximal to the Shahuindo pit. These targets represent near-term opportunities to increase the Mineral Resource base at Shahuindo.

1.14 Conclusions and recommendations

The results of the laboratory testing program indicate very good gold recoveries at both ROM and moderate crush sizes with low to moderate reagent requirements implying amenability to heap leaching. Silver recoveries are generally low. Realized recoveries of gold from the existing heap leach operation are in line with expected recoveries from ongoing metallurgical test work.

Additional test work to further evaluate curing the ROM ore with a high-concentration NaCN solution prior to normal leaching, including a trial on a section of the operating heap leach, is recommended. Preliminary test work results suggest a modest recovery improvement may be realized by implementing this procedure.

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ABBREVIATIONS AND ACRONYMS

Abbreviations & acronyms	Description
$	United States dollar
$/oz	Dollar per ounce
$/t	Dollar per metric tonne
%	Percentage
°	Degree
°C	Degree Celsius
3D	Three-dimensional
AA	Atomic absorption
Ag	Silver
AMC	AMC Mining Consultants (Canada) Ltd., AMC Consultants Pty Ltd
ANA	National Water Authority
ANFO	Ammonium nitrate fuel oil
AR	Argillic
Asarco	Asarco LLC
Atimmsa	Alta Tecnología e Inversión Minera y Metalúrgica S.A.
Au	Gold
Ausenco	Ausenco Vector
Bx	Breccia
CIC	Carbon-in-column
cm	Centimetre
COG	Cut-off grade
DAI	Direct Area of Influence
DAN	Desarrollo Agricola Del Norte
Dawson	Dawson Metallurgical Laboratories
EIA	Environmental Impact Statement
EIAd	Environmental Impact Study Detailed
EIAsd	Environmental Impact Study Semi Detailed
EoR	Engineer of Record
FA	Fire assay
FIRO	Fine ore in ROM
g	Gram
g/t	Grams per tonne
G&A	General and Administration
GSI	Geological strength index
ha	Hectare
HCl	Hydrochloric acid
HLC	Heap Leach Consultants
Horizon	Horizon South America S.A.C
ID^3	Inverse distance cubed
IFC	International Finance Corporation
Int	Intrusive

ITS	Subsequent Technological Improvement Report
KCA	Kappes, Cassiday & Associates
kg	Kilogram
kg/t	Kilogram per tonne
km	Kilometre
koz	Thousand ounces
kt	Thousand tonnes
kV	Kilovolt
kW	Kilowatt
kWh	kilowatt-hour
l/s	Litres per second
LLD	Lower limit of analytical detection
LOM	Life-of-mine
LVA	Locally Varying Anisotropy
m	Metre
m/h	Metres per hour
m/s	Metres per second
m^2	Squared metre
m^3	Cubic metre
m^3/hr	Cubic metre per hour
Ma	Million years / mega annum
masl	Metres above sea level
MDA	Mine Development Associates
MEM	Ministry of Energy and Mines
Metalor	Metalor Technologies S.A.
Minera Algamarca	Compania Minera Algamarca S.A.
mm	Millimetre
MMU	Mobile Manufacturing Unit
MPa	Megapascal
Mt	Million tonnes
Mtpa	Million tonnes per annum
MW	Megawatt
MWH	Montgomery Watson Harza
NI 43-101	National Instrument 43-101
NPV	Net present value
OEFA	Organismo de Evaluacion y Fiscalizacion Ambiental (Environmental Control and Evaluation Organisation)
OK	Ordinary Kriging
OSINERGMIN	El Organismo Supervisor de la Inversión en Energía y Minería
oz	ounce
Pan American or PAS	Pan American Silver Corp.
ppm	Parts per million
Property	Shahuindo Property
QA/QC	Quality Assurance and Quality Control
QP	Qualified Person

RC	Reverse circulation
RMR	Rock mass rating
ROM	Run-of-mine
RPD	Relative paired difference
RPEEE	Reasonable prospects for eventual economic extraction
RQD	Rock Quality Designation
SD	Standard deviation / sandstone
SENACE	National Service for Environmental Certification of Sustainable Investments
SGS	SGS del Peru S.A.C. / Laboratories
Shahuindo	Shahuindo mine
SI	Silicified
SMT	Special Mining Tax
Southern Peru	Southern Peru Copper Corporation
SRCE	Standardized Reclamation Cost Estimator
SRM	Standard reference material
ST	Siltstone
SUNARP	La Superintendencia Nacional de los Registros Públicos
SWAT	Soil and Water Assessment Tool
t	Tonne
t/m^3	Tonnes per cubic meter
Tahoe	Tahoe Resources Inc.
tpd	Tonnes per day
TR	Target Rocks
UCS	Unconfined compressive strength
UTM	Universal Transverse Mercator
V	Volt

2 INTRODUCTION

2.1 General and terms of reference

This Technical Report has been prepared by Pan American, in accordance with the disclosure requirements of NI 43-101, to disclose relevant information about the Property. The report is an update to and replaces the "Technical Report on the Shahuindo Property, Cajabamba, Peru", with an effective date of January 1, 2016, prepared by Tahoe. On February 22, 2019, Pan American completed a transaction to acquire all the outstanding shares of Tahoe. The main purpose of this Technical Report is to give an update on the Property resulting from additional Mineral Resource and Mineral Reserve delineation drilling, disclose updated Mineral Resource and Mineral Reserve estimates, and to report operating results.

The effective date of this Technical Report is November 30, 2022. The effective date of the Mineral Resource and Mineral Reserve estimates is June 30, 2022, which includes the *in situ* Mineral Resources and Mineral Reserves which were depleted for mining at that time and the stockpiles which were also inventoried at June 30, 2022. No new material information has become available between these dates and the signature date given on the certificate of the QPs.

2.2 The Issuer

Pan American is a silver mining and exploration company listed on the Toronto (TSX:PAAS) and NASDAQ (NASDAQ:PAAS) stock exchanges. It has a diversified portfolio of mining and exploration assets located throughout the Americas, which include 10 operating mines.

2.3 Report authors

The persons who prepared this technical report are QPs as defined by NI 43-101 and are not independent of Pan American. The names, details, and responsibilities of each QP are provided in Table 2.1.

Table 2.1 Responsibilities of each Qualified Person

Qualified Persons responsible for the preparation and signing of this Technical Report						
Qualified Person	Position	Employer	Independent of Pan American	Date of last site visit	Professional designation	Sections of report
Martin Wafforn	Senior Vice President, Technical Services and Process Optimization	Pan American Silver Corp.	No	October 25, 2021	P.Eng.	2, 3, 4, 5, 15, 16, 18, 19, 20, 21, 22, 24, and 1.1, 1.8, 1.9, 1.11, 1.12, 1.13, 12.3, 12.4, 25.1, 25.3, 25.4, 26.3
Christopher Emerson	Vice President, Business Development and Geology	Pan American Silver Corp.	No	October 25, 2021	FAusIMM	6, 7, 8, 9, 10, 11, 14, 23, 27, and 1.2, 1.3, 1.4, 1.5, 1.7, 1.14, 1.15, 12.1, 12.2, 26.1
Americo Delgado	Vice President, Mineral Processing, Tailings and Dams	Pan American Silver Corp.	No	September 17-19, 2021	P.Eng.	13, 17, and 1.6, 1.10, 12.5, 25.2, 26.2

Those who have assisted the QPS in the preparation of this Technical Report are listed in Table 2.2.

Table 2.2 Responsibilities of those assisting each Qualified Person

Other experts who have assisted the QPs					
Expert	**Position**	**Employer**	**Independent of Pan American**	**Visited site**	**Sections of report**
Mo Molavi	Director / Principal Mining Engineer	AMC	Yes	No	All
Mort Shannon	General Manager / Principal Geologist	AMC	Yes	No	2 - 12, 14
James Stoddart	Principal Mining Engineer	AMC	Yes	No	15, 16
Carlos Manchego	Senior Manager Mineral Resources	Pan American Silver Corp.	No	Yes	14
Sam Coronado	Mine Geology Director	Pan American Silver Corp.	No	Yes	7 - 12
Brian Brodsky	Director of Geology	Pan American Silver Corp.	No	Yes	6 - 12
Carl Defilippi	Engineering Manager	KCA	Yes	Yes	13, 17
Caleb Cook	Project Engineer/ Project Manager	KCA	Yes	No	13, 17
Mathew Andrews	Vice President Environment	Pan American Silver Corp.	No	Yes	4, 5, 20

Note: AMC refers to AMC Mining Consultants (Canada) Ltd. or AMC Consultants Pty Ltd in the case of James Stoddart.
KCA refers to Kappes, Cassiday & Associates.

2.4 Sources of information

Unless otherwise stated, information, data, and illustrations contained in this Technical Report or used in its preparation have been provided by Pan American for the purpose of this Technical Report. The prior Technical Report for the Property is the 2016 Technical Report. Earlier reports are also referred to where necessary and these are: the 2010 Shahuindo PEA (2010 AMEC Technical Report) authored by AMEC Americas Inc. (AMEC), and the 2012 Shahuindo Technical report authored by Kappes, Cassiday & Associates and Mine Development Associates (2012 KCA / MDA Technical Report).

2.5 Other

Inspections of the Property are carried out regularly by the following QPs.

Mr. Wafforn generally visits the Property two or three times annually as part of his duties with Pan American. While this process was disrupted by COVID-19, his most recent site visits were on October 15, 2019 and October 25, 2021. During these visits, Mr. Wafforn reviewed the operational open pit mine plan, actual mine operation data, consultants' geotechnical reports, mine budget plans, Mineral Reserve to grade control to actual reconciliations, the site layout and logistics for mining and processing, safety protocols and indicators, the environmental layout, and general business performance.

Mr. Emerson most recently visited the Property on October 25, 2021. During the visit Mr. Emerson reviewed the exploration drilling, sampling, and sample security protocols, drill core and the core cutting and storage facilities, bench and surface mapping, cross sections, the operational mine plan, actual mine operation data, grade control protocols, mining leases, site access, surface rights information, and general business performance.

Mr. Delgado makes regular visits to the Property, with his most recent site visits on January 8 - 9, 2020 and September 17 - 19, 2021. During the visits Mr. Delgado reviewed heap leach pad stacking and leaching procedures, permeabilities, geotechnical testing and consultant reports, ore control and sampling, the geometallurgical testing program, metallurgical balance, operational data, water management facilities, metallurgical and analytical lab procedures, and general business performance.

Unless otherwise stated, all units are in metric and currencies are expressed in United States dollars (US$). Project data coordinates are in a local coordinate based on a transformation relative to the Mexico 97 geoid.

This Technical Report has an effective date of November 30, 2022.

3 RELIANCE ON OTHER EXPERTS

The QPs responsible for this Technical Report have relied on the following external legal opinions for input to certain legal matters in sections of this Technical Report for which they do not have specific expertise and have taken appropriate steps, in their professional judgement, to ensure that the work, information, or advice that they have relied upon is sound:

A title opinion prepared by Gallo Barrios Pickmann Abogados for Tahoe Resources Inc. in 2015 (unpublished) titled “Title Opinion on the Shahuindo Mining Concessions”. This title opinion was relied upon in full for its opinion on the status of Shahuindo SAC’s mining concessions in Section 4.2 Mineral Tenure and Title in this Technical Report.

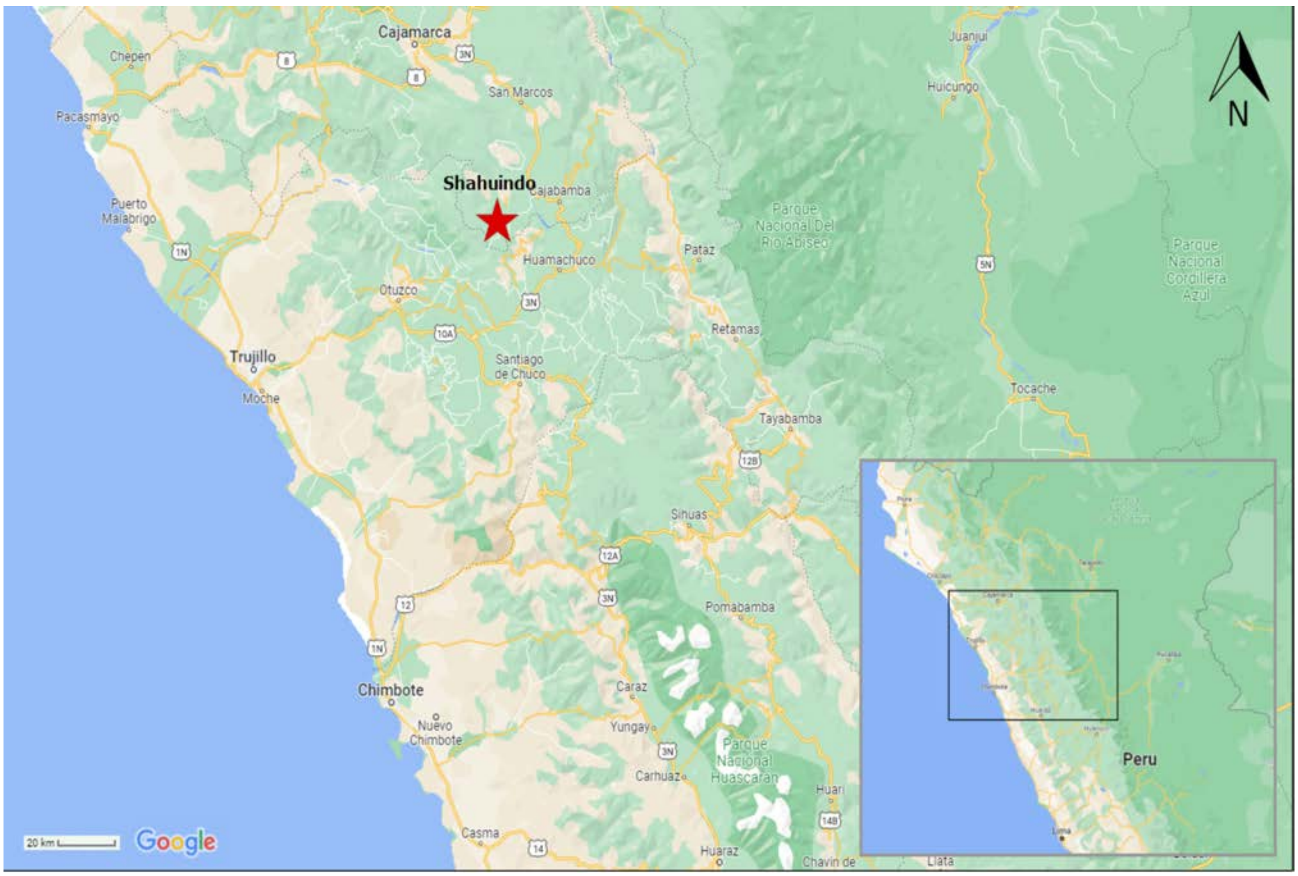
A title opinion prepared by Gallo Barrios Pickmann Abogados for Tahoe Resources Inc. in 2015 (unpublished) titled “Title Opinion on the Shahuindo Surface Lands”. This title opinion was relied upon in full for its opinion regarding surface rights at Shahuindo in Section 4.3 Surface Rights in this Technical Report.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Location

The Property within which Shahuindo is located is in the district of Cachachi, province of Cajabamba, department and region of Cajamarca, Peru. It is situated approximately 59 kilometres (km) southeast of the town of Cajamarca and 14 km west of the town of Cajabamba. The Property is located at latitude 7 degrees 25 minutes south, longitude 78 degrees 25 minutes west or Universal Transverse Mercator (UTM) coordinates 9,158,000-North and 807,000-East, Zone 17S. The location of the Property is shown in Figure 4.1.

Figure 4.1 Property location map



Source: Google (2021).

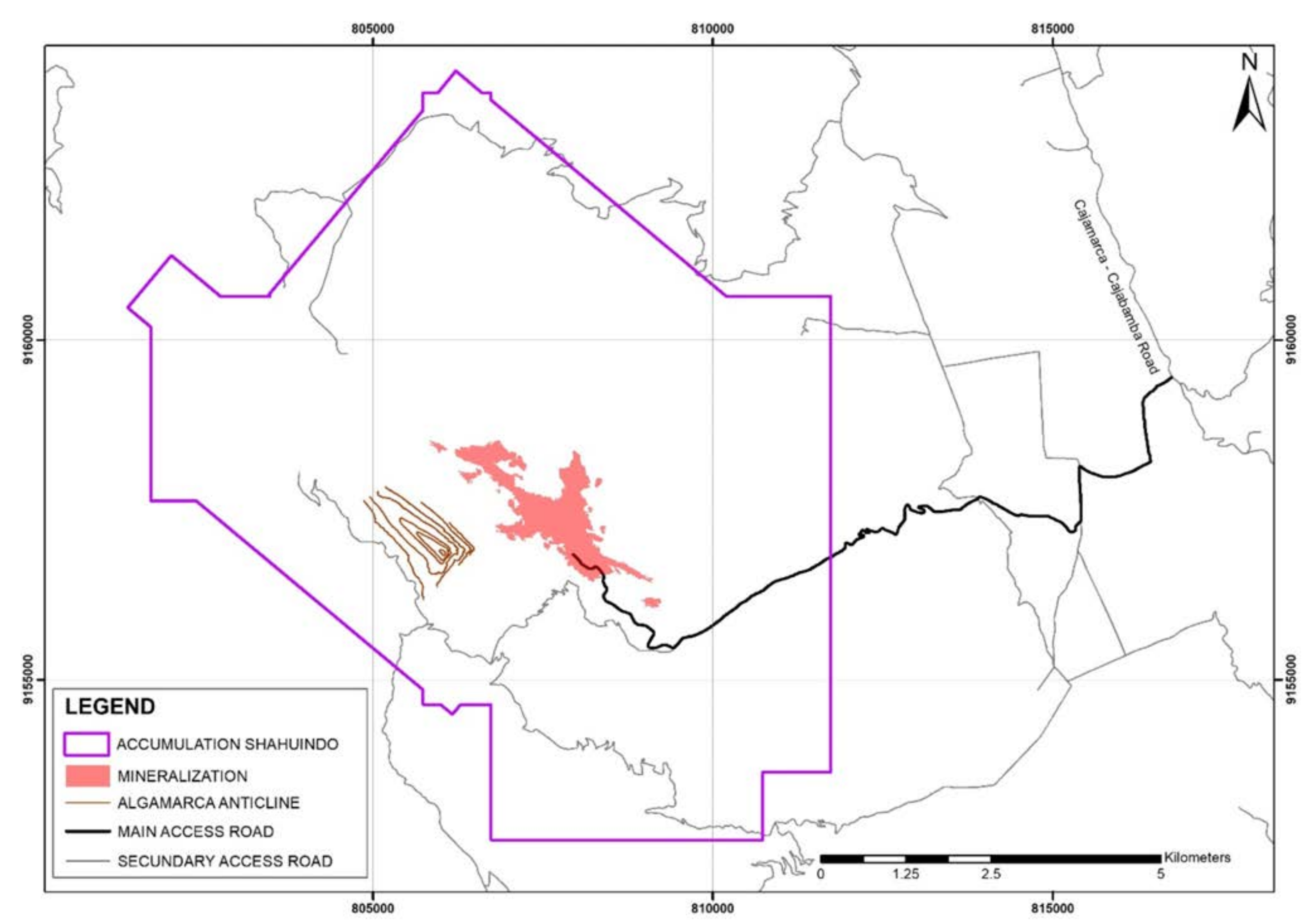
4.2 Mineral tenure and title

Shahuindo comprises one mineral right, ACUMULACION SHAHUINDO, 100% controlled by Pan American's wholly owned subsidiary, Shahuindo SAC, and has an approximate area of 7,338.91 hectares (ha). The mining right has no expiry date so long as taxes are paid annually.

Table 4.1 Mineral title summary

Title name	Application area (ha)	Actual size (ha)	Application method	Date of grant
ACUMULACION SHAHUINDO	7,338.91	7,338.91	Grid and Stake-based	July 2, 1917

Figure 4.2 Mineral claim location map



Source: PAS (2021).

The mining rights and surface rights are registered under the name of Shahuindo SAC in the government title registry office of La Superintendencia Nacional de los Registros Públicos (SUNARP). The mining claims have no expiry date. All concessions are subject to an annual payment of $3 per hectare to the Peruvian government. A Peruvian law firm, Gallo Barrios Pickmann, issued a legal opinion to Tahoe Resources Inc. (Tahoe), in 2015 verifying Pan American's title to the concessions within ACUMULACION SHAHUINDO (Pickmann and Ruiz, 2015). All claims are in good standing as of the effective date of this Technical Report.

4.3 Surface rights

Shahuindo SAC has acquired 612 surface rights within the Property area to date, covering a total area of approximately 3,144.68 ha. Some of these surface rights were used to relocate local land owners into new areas. Shahuindo SAC acquired additional surface rights outside the mining concessions for the same process of relocating land owners. Shahuindo SAC and Desarrollo Agricola Del Norte (DAN) entered into a service agreement for this process; whereas DAN acquired the land outside the mining concessions and will transfer the properties to Shahuindo SAC to be swapped with land inside the concessions. A legal title opinion by Gallo Barrios Pickmann confirms the land ownership by Shahuindo SAC and DAN (Pickmann and Ruiz, 2015). Shahuindo SAC controls sufficient surface lands to accommodate the infrastructure necessary to operate the Property as envisioned in this Technical Report. The water source is currently in the permit process with the governmental authority for use as part of the fresh water supply for Shahuindo.

4.4 Informal mining activity

There is a small group of informal miners within the Property area who are exploiting narrow veins on the west side of the Algamarca anticline. Shahuindo SAC is promoting and participating in a round table discussion with the Algamarca informal miners to update the environmental, social and economic baseline and to work on a sustainable solution to stop all informal mining activity and replace it with other economic alternatives.

Since 2004, Shahuindo SAC has submitted formal reports to the Ministry of Energy and Mines (MEM) regarding the informal mining activities in the mining concessions. The informal mining activities in the Algamarca area are outside the Property area approved in the Environmental Impact Statement for Shahuindo SAC.

4.5 Environmental considerations

4.5.1 Environmental regulations

Mining in Peru is regulated by laws covering mining, environmental impact assessment, and water. The regulations are adminstered by the MEM, the National Service for Environmental Certification of Sustainable Investments (SENACE), and the National Water Authority (ANA) among others. Depending on the level of project development, exploration and mining companies are required to prepare an Environmental Impact Statement (EIA) Category I, Environmental Impact Study Semi Detailed (EIAsd) Category II, Environmental Impact Study Detailed (EIAd) Category III, an Environmental Impact Assessment, a Program for Environmental Management and Adjustment, and a mine closure plan. Mining companies are also subject to regular environmental audits of operations by the Environmental Control and Evaluation Organisation (OEFA).

The environmental and legal framework for Shahuindo is detailed in Section 20.

4.6 Permits

Exploration, construction, and operations conducted to date have been performed under the relevant local and national permits. Pan American does not anticipate delays to the production schedule presented in this Technical Report due to the timing of receipt of necessary permits and licenses.

See section 20.2.1 for more information.

4.7 Royalties, taxes, and fees

4.7.1 Maintenance fees

Pursuant to article 39 of the General Mining Law, titleholders of mining concessions pay an annual Maintenance Fee (Derecho de Vigencia) of $3.00 per hectare. The maintenance fee is due by June 30 and is effective for the following year. Failure to make payments for two consecutive years causes the termination (caducidad) of the mining concession. However, according to article 59 of the General Mining Law, the payment for one year may be delayed with penalty and the mining concessions remain in good standing. The outstanding payment for the past year can be paid on the following June 30 along with the future year. Maintenance fees for concessions held in ACUMULACION SHAHUINDO are current.

4.7.2 Minimum production obligation

Legislative Decree 1010 dated May 9, 2008, and Legislative Decree 1054 dated June 27, 2008, amended several articles of the General Mining Law regarding the Minimum Production Obligation, establishing a new regime for compliance (New MPO Regime).

According to the New MPO Regime, titleholders of metallic mining concessions must reach a minimum level of annual production (Minimum Production) of at least one Tax Unit or “UIT” (S/. 3,850 per hectare) and three UITs within a period of ten years. The ten year period begins on January 1st of the year following granting of the concession.

In the case of mining concessions that were granted on or before October 10, 2008 until the ten year term for reaching Minimum Production established by the New MPO Regime elapses on January 1, 2019, these mining concessions will be subject to the former provisions of the General Mining Law. Failure to comply with the minimum production requirements of the New MPO Regime obligates the concession holder to pay a penalty and may result in the termination of the concessions.

4.7.3 Royalties, OSINERGMIN contribution, and OEFA contribution

4.7.3.1 Royalties

In June 2004, Peru’s Congress authorized a royalty payment structure pertaining to mining operations. Congress further modified the royalty regime under Law No. 29788 which went into effect on October 1, 2011 (Modified Mining Royalty or MMR). The MMR is applied to quarterly operational profit (i.e., operating margin), calculated by dividing the quarterly operating profit by the income generated from the quarterly sales of the mining product. The amount to be paid in royalties is the greater of the quarterly operation profit rate, which ranges from one percent to 12%, or one percent of the revenues generated by quarterly sales. In the case of the small scale mining titleholders, the mining royalty is set to zero. The payment of the mining royalty is considered an expense when determining corporate income tax in Peru.

4.7.3.2 OSINERGMIN contribution

El Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN) is Peru's state energy and mines investment regulator which has the mission to regulate, supervise and oversee national compliance with legal and technical dispositions related to activities in the electricity, hydrocarbon, and mining industry sectors, as well as compliance with legal and technical requirements concerning environmental conservation and protection in the development of these activities. OSINERGMIN is the government agency of record to inspect and audit compliance with safety, job-related health, and mine development matters.

Supreme Decree 128-2013-EF, published on December 19, 2013, established the rate applicable for the OSINERGMIN contribution. This payment is made by all large and medium scale mining titleholders and is calculated on the value of the monthly operating costs, corresponding to the activities directly related to OSINERGMIN minus the Valued Added Tax and the Municipal Promotion Tax. The current OSINERGMIN rate is 0.14%.

4.7.3.3 OEFA contribution

El Organismo de Evaluación y fiscalización Ambiental (OEFA) is the government agency of record that inspects and audits mining projects operations in order to secure compliance with environmental obligations and related commitments.

The Supreme Decree 130-2013-EF, published on December 19, 2013, established the rate applicable for the OEFA Contribution. This payment is made by all large and medium scale mining titleholders and is calculated on the value of the monthly costs corresponding to all activities directly related to OEFA minus the Valued Added Tax and the Municipal Promotion Tax. The OEFA rate is currently set at 0.10% for 2022.

4.7.4 Ownership of mining rights

Pursuant to the General Mining Law, mining rights may be forfeited only due to a number of enumerated circumstances provided by law (i.e., non-payment of maintenance fees and / or non-compliance with the Minimum Production Obligation). The right of concession holders to sell mine production freely in world markets is established. Peru is party to agreements with the World Bank Multilateral Investment Guarantee Agency and with the Overseas Private Investment Corporation.

4.7.5 Taxation and foreign exchange controls

A recent modification of the tax law approved by the government of Peru reduced corporate taxes beginning in year 2015. The law progressively decreases the tax from 30% (applied in 2014) to 26% (2019 onward). The new law reduces the rate of corporate income tax and increases the tax rate on dividends as summarized in the following schedule in Table 4.2.

Table 4.2 Corporate income tax

Fiscal years	Corporate income tax	Dividends
2015 – 2016	28%	6.8%
2017 – 2018	27%	8.0%
2019 – forward	26%	9.3%

There are currently no restrictions on the ability of a company operating in Peru to transfer dividends, interest, royalties, or foreign currency in or out of Peru or to convert Peruvian currency into foreign currency.

Congress has approved a Temporary Net Assets Tax, which applies to companies subject to the General Income Tax Regime. Net assets are taxed at a rate of 0.4% on the value exceeding one million Peruvian soles (approximately $345,000). Taxpayers must file a tax return during the first 12 days of April and the amounts paid can be used as a credit against Income Tax. Mining companies which have not started production and those in their first year of operation are exempt from the tax.

Pan American is also subject to a Special Mining Tax (SMT) which is applied to operating income based on a sliding scale with progressive marginal rates ranging from 2% to 8.4%. The SMT has been considered as an income tax for the purposes of this Technical Report.

The Tax Administration Superintendent is the entity empowered under the Peruvian Tax Code to collect federal government taxes. The Tax Administration Superintendent can enforce tax sanctions, which can result in fines, the confiscation of goods and vehicles, and the closing of a taxpayer’s offices.

4.7.6 Worker participation

Under Peruvian law, every company that generates income and has more than twenty employees on its payroll is obligated to grant a share of its profits to its workers. For mining companies, the percentage of this profit-sharing benefit is eight percent of taxable income. The profit-sharing amount made available to each worker is limited to 18 times the worker’s monthly salary, based upon their salary at the close of the previous tax year.

4.8 Risks that may affect access, title, or the right or ability to perform work

Natural resources exploration, development, production, and processing involves a number of risks, many of which are beyond Pan American's control. Property and business risk factors and discussion on these are included in Pan American's quarterly Management Discussion and Analysis and the Annual Information Forms filed on SEDAR. Such risks include the following:

- Changes in the market price for mineral products.
- Community groups or non-governmental organizations that may initiate or undertake actions that could delay or interrupt Pan American's activities at Shahuindo.
- While Pan American considers the regulatory environment in Peru to be very stable, Pan American's activities are subject to environmental laws and regulations that may change over time.
- Title to Pan American's mineral properties at Shahuindo may be subject to prior unregistered agreements, transfers or claims or defects.
- Changes in taxation legislation or regulations in Peru.

The foregoing notwithstanding, Pan American believes that there are no significant risks to Shahuindo in regard to surface and concession title, the ability to access the Property, the receipt of the remaining permits and licenses, or Pan American's ability to perform the work as described in this Technical Report.

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

5.1 Accessibility

Shahuindo is located in northern Peru approximately 970 km by road north-northwest of Lima. The project site can be accessed from Lima by traveling north on Highway 1 (Pan-American Highway) to Ciudad de Dios, then east on Highway 8 to Cajamarca. The site is approximately 130 km from Cajamarca via asphalt-paved highway (100 km on Highway 3N), and gravel and dirt roads. The turnoff the highway is at Cruce Pomabamba approximately 20 km before Cajabamba. The route from Cajamarca to Shahuindo is shown in Figure 5.1.

Figure 5.1 Route from Cajamarca to Shahuindo

Source: 2016 Technical Report.

There are several seaports available to Pan American for the importation of equipment or consumables. These include the Port of Callao in Lima, Port of Paita (northern Peru) and Port Salaverry at Trujillo. There are daily flights between Lima and Cajamarca on Peruvian national airlines.

5.2 Climate

Climate in the area is typical of the Sierra region. It is cold and dry during the dry season and humid during the rainy season. Rainfall typically occurs between October and April (wet season), with occasional sporadic showers in the other months. The average annual rainfall is about 1,000 millimetres (mm) with an extreme wet year having a rainfall of 1,550 mm and an extreme dry year receiving 449 mm. The dry season months are May through September.

The average daily temperature is 15.7°Celsius (C), reaching 23.1°C during the day and decreasing to 7.5°C in the night. The average minimum temperature is 9.7°C and the average maximum temperature is 22.3°C.

The prevailing wind direction is east-northeast with speeds ranging from 0 to 3.1 metres per second (m/s).

Exploration and mining can be conducted year-round with minimal impacts from the weather, though plastic overliners (raincoats) will be used in future years to limit infiltration of precipitation into the leach pads during the wet season.

5.3 Local resources and infrastructure

Manning requirements for Shahuindo are sourced according to Pan American’s employment policy, with priority given to the local area, then expanding to the surrounding communities, including Cajabamba, whenever possible. More experienced and technical personnel have been recruited from Cajamarca and from throughout Peru. At end of June 2022, Shahuindo employs 669 people by Pan American and 2091 contractors, with a majority of employees from within Cajamarca province.

Shahuindo substation is connected to the national grid at 220 kilovolts (kV), distributed on site at 23 kV and further stepped down to 4160 volts (V), 460 V, 220 V, and 110 V. The substation is located at 9152654N 806437E, 4.9 km from the mine and 6.5 km from the process plant.

The total freshwater consumption for Shahuindo averages 25.5 l/s in the dry season. This water is sourced from deep groundwater wells such as the SH-2003X, SH-2018PW, and SH-2031PW wells which are located between 500 m to the northeast, 1,000 m to the north and 1,700 m to the west of the Chalarina pit. Wells SH-2018PW and SH-2031PW flow by pumping to storage ponds 2006A and 2006B.

The non-fresh water supply for Shahuindo comes from a collection pond (Dorita sump) which collects runoff during rainy season, with a capacity of 108,000 m^3, which is located at the bottom of the pit and is used exclusively for road dust control. The water is treated to meet quality requirements of the Environmental Management Instrument.

There is more detail on power and water requirements and infrastructure in Section 18.

5.4 Physiography

The Property is located on the west side of the Condebamba River valley. The topography varies from rolling hillsides to steep ravines. Elevation across the Property’s area varies from 2,400 m to 3,000 masl.

The Property's area is classified as neo-tropical Peruvian "Yungas" by the World Wildlife Fund and includes sub-zones such as:

- Very humid tropical mountain forest. May be present in isolated inaccessible areas, but original vegetation has currently not been identified. The sub-zone is characterized by secondary successive-stage colonist species that have replaced the original forest.
- Humid tropical mountain forest. Covers 60 percent of the Property. Original vegetation is remnant and confined to ravines and steep hillsides. The majority of the sub-zone has been cleared for cultivation of potatoes, oca, mashua, tarwi, barley, broad beans, and green beans, and for cattle grazing.
- Low, dry, tropical mountain forest. Covers 40 percent of the Property, the majority of which falls within the lower part of the Shahuindo gorges, in the area near the Condebamba River. The areas are typically cultivated using irrigation. Crops include corn, potatoes, broad beans, wheat, green beans, vegetables, and fruits.

Valley inhabitants anecdotally report the presence of deer, foxes, rabbits, vizcachas (rodents), and skunks.

5.5 Seismology

Peru is an area with high seismic and tectonic activity with earthquakes being more intense near the coastal regions and decreasing gradually towards the mountains and jungle regions.

According to the seismic zoning map of Peru's National Building Regulations, Shahuindo is located in Zone 3 which corresponds to moderately high seismic activity.

5.6 Population centers

According to Peru´s National Institute of Statistics and Information (Census 2007), Shahuindo's Direct Area of Influence (DAI) has 3,954 inhabitants, distributed in 14 towns. An analysis of the population structure by age reveals a significant majority of people under 25 years old, which increases the proportion of persons of working age. The distribution by sex shows a slight prevalence of male population.

On average, 80% of households are dedicated to agricultural subsistence activities that are complemented with livestock and mining.

Low wages and lack of opportunity in the countryside are determinants of emigration towards main cities such as Cajamarca, Trujillo, or Lima. Young people move temporarily in search of quality educational services. Conversely, immigration is low, though people from nearby towns do come to the area in search of temporary jobs.

5.7 Local infrastructure and services

All the support infrastructure is in place to support the oxide gold mining and extraction activities at Shahuindo and is discussed in detail in Section 18.

6 HISTORY

Mining in the Property's area has occurred intermittently over the past few centuries, with the first mining activities conducted by the Spanish after their conquest of the Inca Empire in the 1530s. It was not until 1945 that modern mining exploration was conducted in the area.

6.1 Ownership history

Legal rights to the mineral leases of Shahuindo were in dispute between 1996 and 2009. A number of Peruvian, Mexican and Canadian companies have been involved in numerous legal processes that were eventually settled in 2009 with 100% ownership being legally registered to Shahuindo SAC (previously Sulliden Shahuindo SAC). The summary of ownership is shown in Table 6.1.

Table 6.1 Summary of ownership

Period	Operator	Comments
1945 – 1989	Minera Algamarca	
Circa 1990	Atimmsa	
1994 – 1996	Asarco LLC	
1997 – 1998	Southern Peru Copper Corporation	
2002 – 2012	Sulliden Gold Corporation	Operating as Sulliden Shahuindo SAC. See history of legal disputes in text below
2014 – 2015	Rio Alto Mining Ltd	Acquired Sulliden Gold Ltd under subsidiary Shahuindo SAC.
2015 – 2019	Tahoe	Acquired Rio Alto Mining Ltd.
2019	Pan American	Acquisition of Tahoe by Pan American on February 22, 2019

Sulliden Shahuindo SAC entered into a Transfer of Mineral Rights and Properties Contract, named "Contrato de Transferencia de Propiedades Mineras" (Definitive Agreement), with Minera Algamarca and Exploraciones Algamarca S.A covering 26 mineral claims and 41 surface rights, which was formalized by public deed dated November 11, 2002.

Subsequently, the vendors (Minera Algamarca and Exploraciones Algamarca S.A.), controlled by new stockholders and other companies of the same group, challenged the Definitive Agreement and launched a number of judicial proceedings against Sulliden Shahuindo SAC. Sulliden Shahuindo SAC also commenced legal proceedings to confirm their rights under the Definitive Agreement and a number of other judicial proceedings to protect its title to the Property. In 2009, Sulliden Shahuindo SAC prevailed and maintained 100% of the mineral claims and surface rights.

In August 2014, Rio Alto acquired all of the outstanding shares of Sulliden Gold Ltd. and became the owner of Shahuindo mineral claims and surface rights under their Peruvian subsidiary, Shahuindo SAC.

In April 2015, Tahoe completed an acquisition of Rio Alto, acquiring control of Shahuindo SAC and Shahuindo mineral claims and surface rights.

Pan American acquired Tahoe on February 22, 2019, and thus now owns Shahuindo SAC which remains the operating company for Shahuindo.

6.2 Exploration history

6.2.1 Summary and early years

Exploration and mining activities have been conducted on the Shahuindo leases since 1945. These exploration activities are summarized in Table 6.2.

Table 6.2 Summary of prior exploration activities on the Property

Period	Operator	Activities
1945 – 1989	Minera Algamarca	Exploration leading to the discovery and operation of an underground Cu-Ag-(Au) mine consisting of 5 adits at Algamarca. Limited small-scale mining (Au) in the Shahuindo and San José communities. No public records of exploration activities.
Circa 1990	Atimmsa	Geologic mapping, 11 reverse circulation and 6 diamond drillholes. Assays and drill logs available for the reverse circulation program.
1994 – 1996	Asarco LLC	Detailed and regional mapping, soil, and rock geochemical sampling, 31 reverse circulation and 58 diamond drillholes, initial metallurgical testing. Drill exploration data available.
1997 – 1998	Southern Peru Copper Corporation	Limited surface sampling, 18 diamond drillholes, 80 reverse circulation holes, initial economic evaluation of the Property. Drill exploration data available.
2002 – 2012	Sulliden Gold Corporation	Large surface drilling campaign totaling 642 holes; both diamond core and RC. Majority of the deposit within the 2012 resource outline drilled to a nominal 50 m x 50 m spacing.
2014 – 2015	Rio Alto Mining Ltd.	Extensive surface drilling program of 419 core and RC holes, the majority of which to decrease the nominal drill spacing in the Shahuindo deposit to approximately 25 m x 25 m and expand the Mineral Resource.
2015 – 2019	Tahoe	283 core and RC holes, as resource infill and extension of main mineralized zone and exploration on outlying exploration targets. Also, drilled 13 hydrogeologic holes. Published NI 43-101 report. Production of first gold December 2015.

Minera Algamarca and Exploraciones Algamarca S.A. commenced exploitation of the Algamarca mine in the 1940s and continued mining and exploration work on the Property until 1989. Algamarca's exploration activities during the 1980s led to the discovery of mineralization and mining of the San José and Shahuindo mines. Most of the Cu-Ag-(Au) vein deposits exploited by Algamarca were on the southwestern limb of the Algamarca anticline, but several small veins and breccia zones on the northeast limb of the Algamarca anticline were also explored and mined by Algamarca (the San José and Shahuindo small-scale gold mines).

From about 1990 to 1998, three companies explored the Shahuindo area – Alta Tecnología e Inversión Minera y Metalúrgica S.A. (Atimmsa), Asarco LLC (Asarco), and Southern Peru Copper Corporation (Southern Peru). Atimmsa, Asarco, and Southern Peru completed geological mapping; soil, outcrop, and rock chip sampling; and RC and core drilling. Work by Asarco and Southern Peru led to the identification of four major low-grade gold-silver zones at Shahuindo – San José, Porphyry, South Contact, and East Zone. Southern Peru stopped work on the Property in 1998 when its parent company, Asarco, merged with Grupo Mexico (Saucier and Poulin, 2004) and the Property reverted to Algamarca in 1999 (Wright et al., 2010b).

6.2.2 Sulliden

Sulliden acquired the Property and commenced exploration activity in 2002. Sulliden's exploration activities are summarized in Table 6.3.

Table 6.3 Summary of Sulliden exploration activities

Year	Description of activities
2002	Preliminary geophysical surveys (magnetometer and induced polarization), re-survey of previous drill collars
2003	27 diamond drillholes. Geologic mapping and trenching, soil survey, surface rock sampling, geophysical surveys (magnetometer and induced polarization), preliminary metallurgical testing, re-survey of previous drill collars
2004	56 diamond drillholes. Geological mapping, soil survey, trenching, surface rock sampling, adit sampling, magnetometer survey
2007	14 diamond drillholes on targets outside of the main mineralized area. Re-establishment of grid, magnetometer surveys, soil sampling
2009	12 diamond drillholes and 25 reverse circulation holes. Acquisition of digital 2 m topography, location of previous hole collars, trenching, drill-hole re-sampling program, soil sampling (mobile metal ion survey), metallurgical test work, preliminary economic assessment
2010	79 diamond drillholes, 82 reverse circulation holes. Mapping, rock sampling, soil sampling, geophysical surveys (magnetometer, induced polarization, down-hole IP), metallurgical test work, geotechnical evaluation
2011	162 exploration diamond drillholes and 145 reverse circulation holes. Geotechnical drilling and evaluation. Mapping, rock sampling, soil sampling. Mineral Resource estimation.
2012	13 exploration diamond drillholes (not included in the 2012 Mineral Resource estimate). Geotechnical drilling and evaluation. Mapping, rock sampling, soil sampling. Geophysical surveys (magnetometer, induced polarization, down-hole IP)

6.2.3 Rio Alto

From their acquisition of Sulliden in August 2014 to their merger with Tahoe in April 2015, Rio Alto completed 351 RC drillholes and 68 diamond drill core holes totaling 56,298 m in and around the Shahuindo deposit. Most of these holes were drilled as infill holes to pre-existing drillholes, with some ‘step-out’ drilling to expand the Mineral Resource. Rio Alto also drilled several holes for metallurgical, geotechnical, and hydrological investigation. Rio Alto drilling effectively decreased the nominal drill spacing in the Shahuindo deposit to approximately 25 m x 25 m and expanded the Mineral Resource.

6.2.4 Tahoe

From the merger of Rio Alto in April 2015 to their acquisition by Pan American in 2019 Tahoe completed a total of 27 RC drillholes and 256 diamond drill core holes totaling 51,439 m. Tahoe drilling concentrated on further infill resource definition drilling and exploration drilling on extensions of the known Mineral Resource.

6.3 Historical estimates

A number of historical Mineral Resource and Mineral Reserve estimates have been prepared for the Property including historical resource estimates that predate the implementation of NI 43-101. The latest Mineral Resource and Mineral Reserve estimates prior to this Technical Report were prepared pursuant to the 2016 Technical Report. None of these historical estimates have been quoted in this Technical Report as they are not relevant to the current operation of the Property.

6.4 Historical production

The following information regarding historical production from the Shahuindo district is reported verbatim from Sulliden’s 2012 Technical Report on the Shahuindo Heap Leach Project (Defilippi et al, 2012).

"The Algamarca mine, located on the southwest side of the Algamarca anticline, produced approximately 1.5 million tonnes grading 2.0% Cu, 680 g/t Ag, and "some gold" over a period of 45 years; the underground operations closed in 1989 (Saucier and Poulin, 2004; Wright et al., 2010a, 2010b). Compania Minera Algamarca SAC was the operator.

On the northeast limits of the Algamarca anticline, Algamarca mined 8,000 tonnes of gold-silver ore from three adits in the Cuerpo San José area in 1988 (Saucier and Poulin, 2004; Saucier and Buchanan, 2005; Wright et al., 2010a, citing Fletcher, 1997). Algamarca also exploited narrow gold-silver veins producing 12,000 tonnes at the Shahuindo mine from 1987 to 1989 (Saucier and Poulin, 2004; Saucier and Buchanan, 2005; Wright et al., 2010a, citing Fletcher, 1997). AMEC's Technical Reports (Wright et al., 2010a, 2010b, citing Montoya et al., 1995) also reference production from underground stopes and a small open pit totaling 70,000 tonnes at an unknown grade from San José and Shahuindo in the 1980s or 1990s. Although this appears to be the same mining described in the Met-Chem reports (Saucier and Poulin, 2004; Saucier and Buchanan, 2005), difference in tonnages cannot be accounted for."

Tahoe attained production, with first gold poured in December 2015. In the period from start up of production in 2016 to early 2019, when Pan American acquired Tahoe, the production was 232 Koz gold. Gold production from 2016 to June 2022 was 719.7 Koz gold.

Small scale underground mining is currently being undertaken by informal miners in the Algamarca anticline area, about 1,000 m west of the open pit operations.

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional geology

The Property is located on the eastern flank of the Andean Western Cordillera in northern Peru, approximately 35 km north-northwest of Pan American's La Arena mine. The area is underlain by folded and faulted Mesozoic West Peruvian Basin sediments.

The regional stratigraphy comprises folded siliciclastic and carbonate sediments related to the Upper Jurassic Chicama Formation to the Lower to Middle Cretaceous Goyllarisquizga Group. The regional stratigraphical column is summarized in Table 7.1; a plan map and example cross section of the regional geology are illustrated in Figure 7.1 and Figure 7.2, respectively.

Table 7.1 Shahuindo regional stratigraphic column

Era	System	Series	Group	Formation	Gold mineralization
Cenozoic	Quaternary	Recent		Alluvial, Fluvial	
		Pleistocene		Glacial,	
				Lacustrine	
	Neogene		Calipuy		AC
	Paleogene				
Mesozoic	Cretaceous	Upper	Goyllarisquizga	Yumagual	
				Pariatambo	
				Chulec	
				Inca	
		Lower		Farrat	SHA
				Carhuaz	SHA
				Santa	
				Chimu	AC, ET, LA, LV, SR
				Oyón	
	Jurassic	Upper		Chicama	

Note: Gold mineralization abbreviations: AC: Lagunas Norte, ET: El Toro, LA: La Arena, LV: La Virgen, SHA: Shahuindo, SR: Santa Rosa.
Source: After Reyes R. L, 1980 and Navarro et. al., 2010.

From oldest to youngest, the regional stratigraphy is described as follows:

Paleozoic (and Precambrian): Basement rocks to the east of the Property along the River Marañon and the Eastern Cordillera. They are not exposed at Shahuindo or in the immediately surrounding area.

Mesozoic: The oldest outcropping rocks in the region belong to the Upper Jurassic Chicama Formation and consist of soft, laminated marine black shales with thin sandstone intercalations.

The Goyllarisquisga Group constitutes predominately siliclastic rocks of the Chimu Formation (principal host rock for gold mineralization at Lagunas Norte, El Toro, La Arena, La Virgin and Santa Rosa deposits and the Algamarca vein system) and the Santa, Carhuaz and Farrat Formations. The Carhuaz and Farrat formations are the hosts for gold and silver mineralization at Shahuindo.

Overlying the Goyllarisquisga Group are shallow marine carbonates of the Inca, Chulec, Pariatambo formations and Yumagual Formations. The Mesozoic sediments were folded and faulted during the late Cretaceous Andean Orogeny.

Cenozoic: The Calipuy Group volcanics unconformably overly the folded and faulted Mesozoic strata south-west of the Property. The Calipuy volcanics are sub-aerial units of interbedded tuffs, andesitic lavas, and agglomerates of andesitic to dacitic composition. Cenozoic andesite, dacite and quartz–feldspar porphyries intruded the Mesozoic sedimentary sequence at c.a. 16 to 26 Ma. (Bussey and Nelson, 2011). One of these intrusions may be related to the gold and silver mineralization at Shahuindo.

The main structural features of the region consist of a series of generally NW-SE trending folds, reverse faults and over-thrusts as shown in Figure 7.2, that disrupt the Jurassic-Cretaceous sedimentary sequence. Individual folds range up to 80 km length and 5 km in width and display various degrees of deformation. The highly competent Chimu Formation, for example, form structurally complex cores to the regional anticlines.

The region is particularly well-endowed with mines and mineral occurrences varying from low-to-high sulfidation systems and from porphyry through polymetallic to epithermal deposits. Mines operating currently or in the recent past, include the Quiruvilca polymetallic Cu-Zn-Pb-Ag mine and the La Arena, Lagunas Norte, La Virgen, and Santa Rosa high-sulfidation epithermal gold mines.

Figure 7.1 Shahuindo regional geology

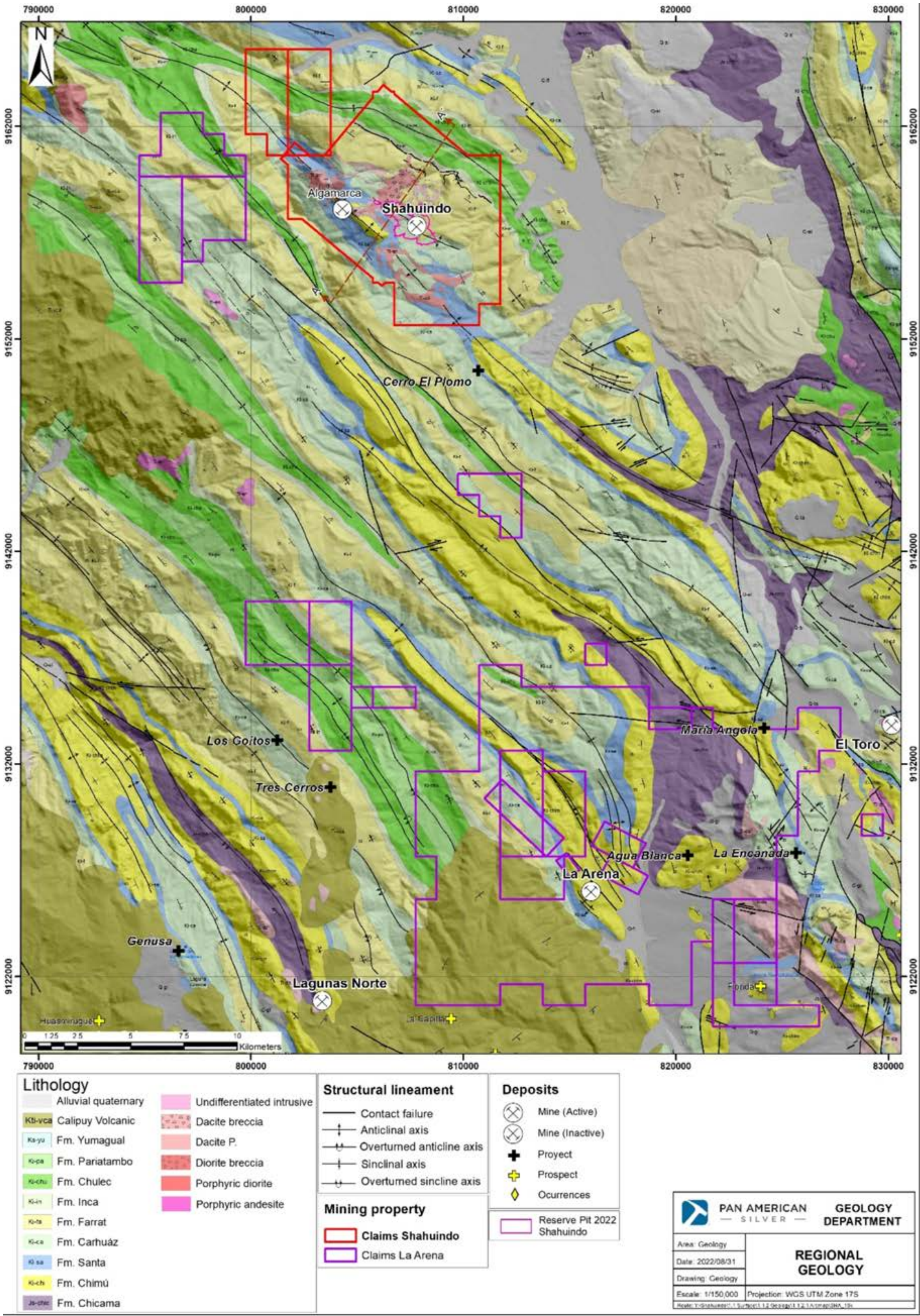
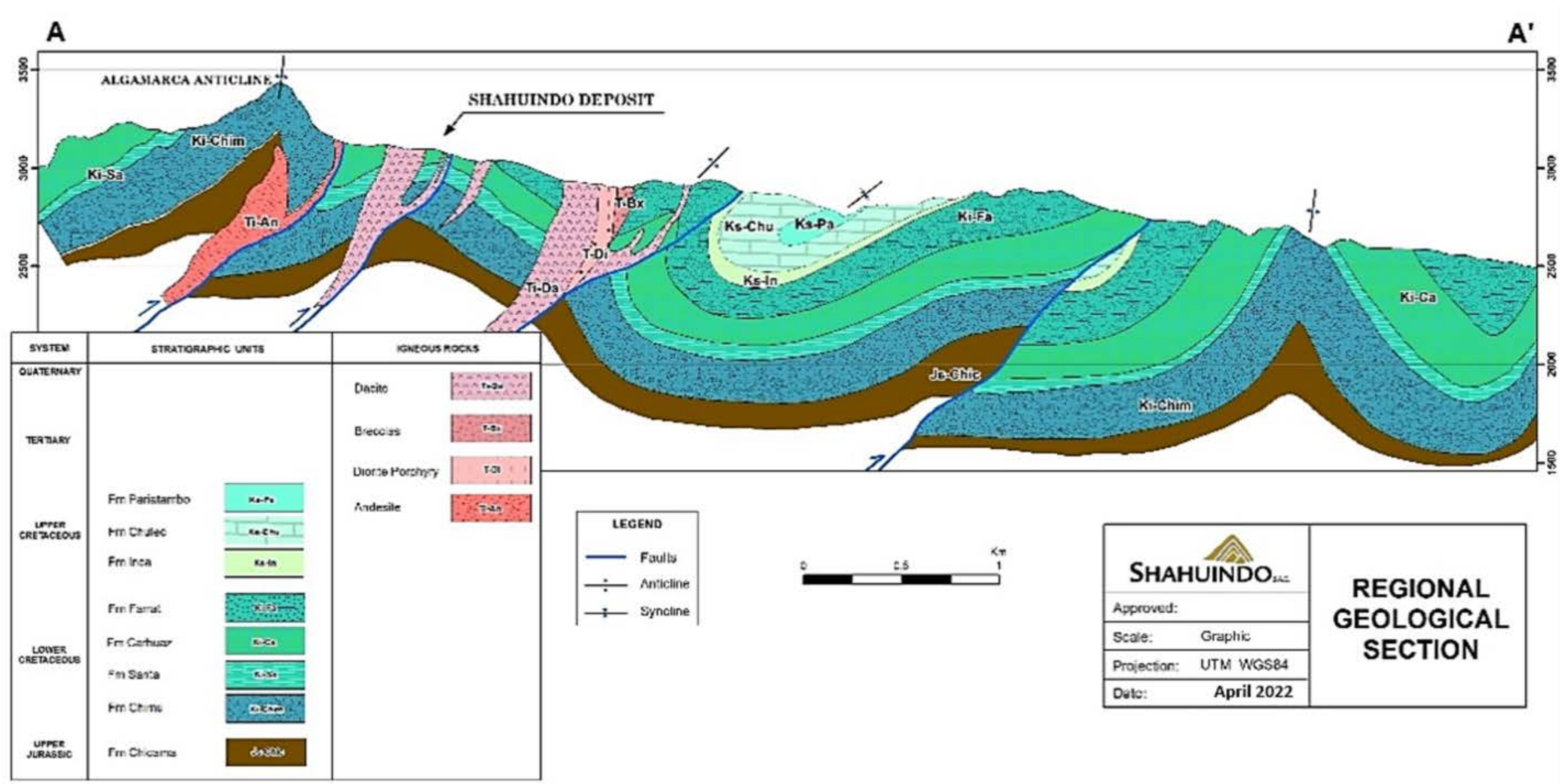


Figure 7.2 Shahuindo regional cross section



Note: Mesozoic sediments are affected by folds and reverse faults. Miocene intrusives were emplaced in the fold axes.

7.2 Property geology

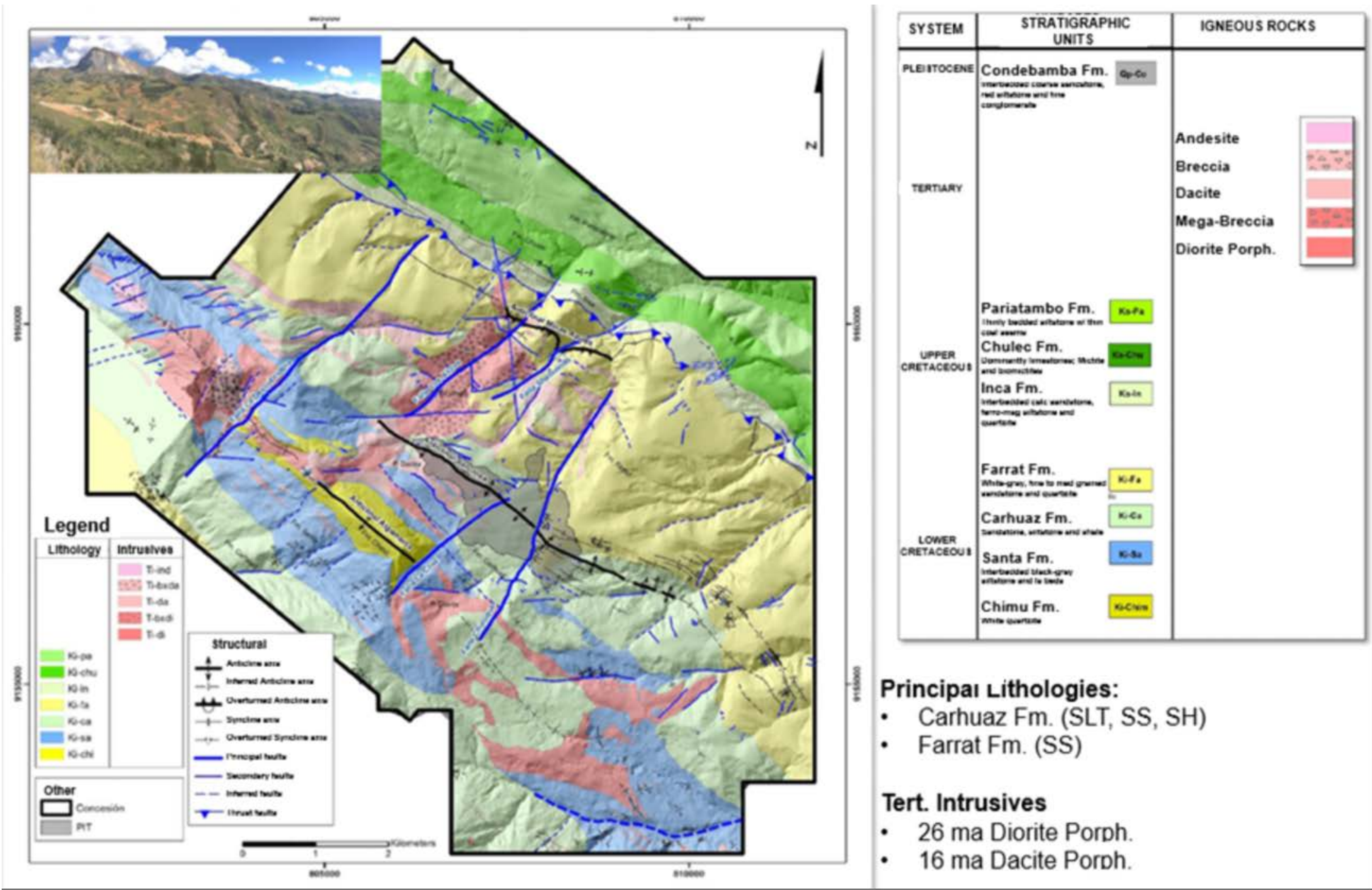
The Property is located within a regional fold and thrust belt of predominantly Mesozoic sedimentary rocks intruded by felsic stocks located along faults and cores of anticlinal structures as shown previously in Figure 7.1 and Figure 7.2. Sedimentary rocks of Lower Cretaceous age consist of a lower, shallow marine-to-deltaic siliciclastic sequence and an upper sequence of finer grained siliciclastic units. District geology is shown in Figure 7.3.

The oldest rocks on the Property are thinly bedded and laminated mudstones with occasional coal seams of the basal Lower Cretaceous Chicama Formation. This formation is only exposed in valleys and in the cores of anticlines.

Overlying the Chicama Formation is the Goyllarisquizga Group, which is comprised from oldest to youngest of the Chimu, Santa, Carhuaz, and Farrat Formations.

White orthoquartzite beds of the Chimu formation form the Algamarca anticline to the southwest of the Shahuindo deposit. The Santa Formation which is exposed on the flanks of the Algamarca anticline consists of mudstone with intercalations of limestone. Overlying the Santa Formation is the Carhuaz Formation, consisting of interbedded sandstone, siltstone, and mudstone, with many sandstones displaying cross bedding and amalgamated wedge-shaped sandstone beds. The Farrat Formation consists of cliff-forming siliciclastic strata dominated by sandstone. The Carhuaz Formation hosts gold and silver mineralization along the core of the Shahuindo deposit while the Farrat Formation hosts mineralization along the northwest, northeast, and southeast flanks, as illustrated in Figure 7.4 and Figure 7.5.

Figure 7.3 Shahuindo district geology



Source: Shahuindo (2021).

Figure 7.4 Shahuindo local geology

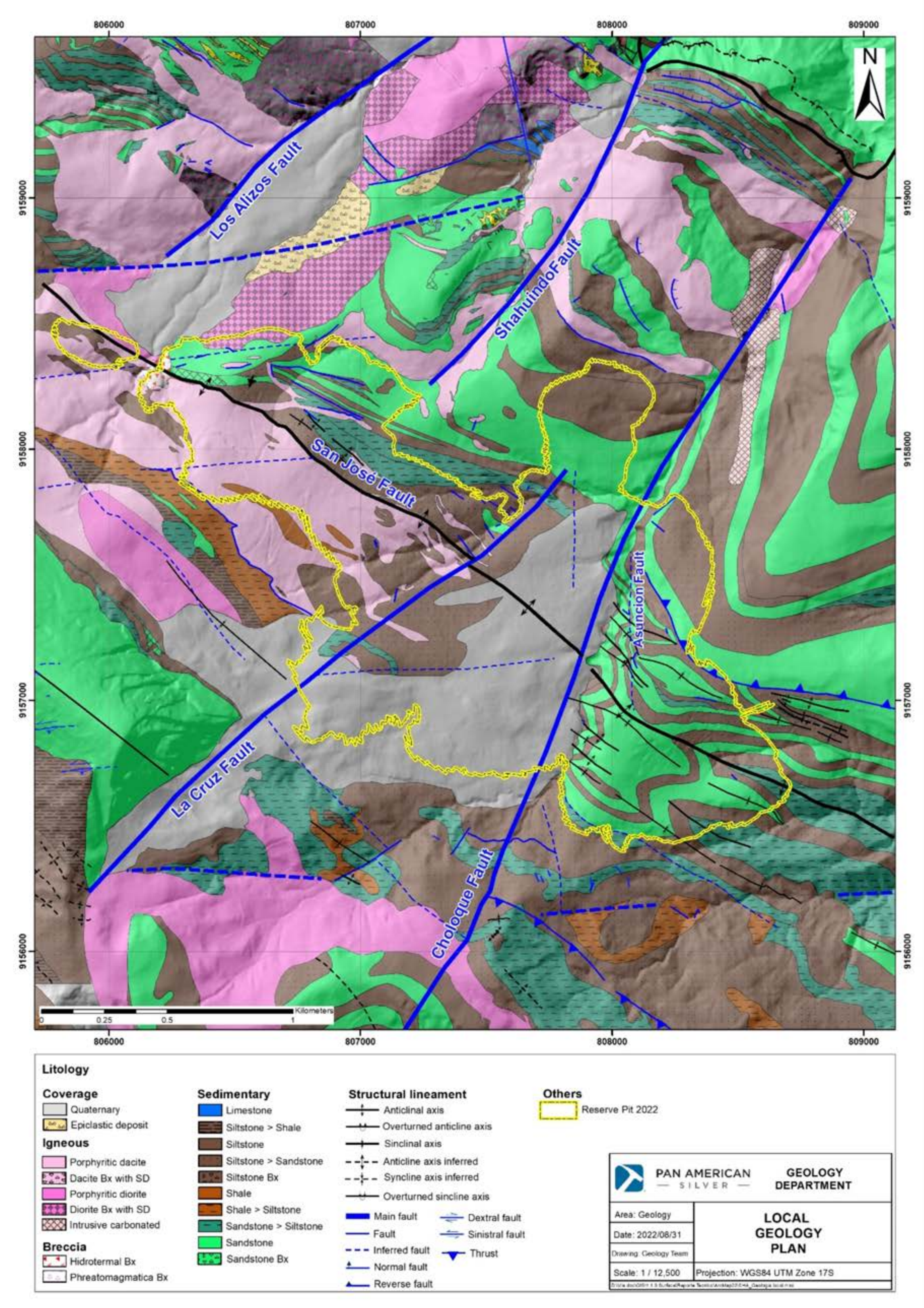
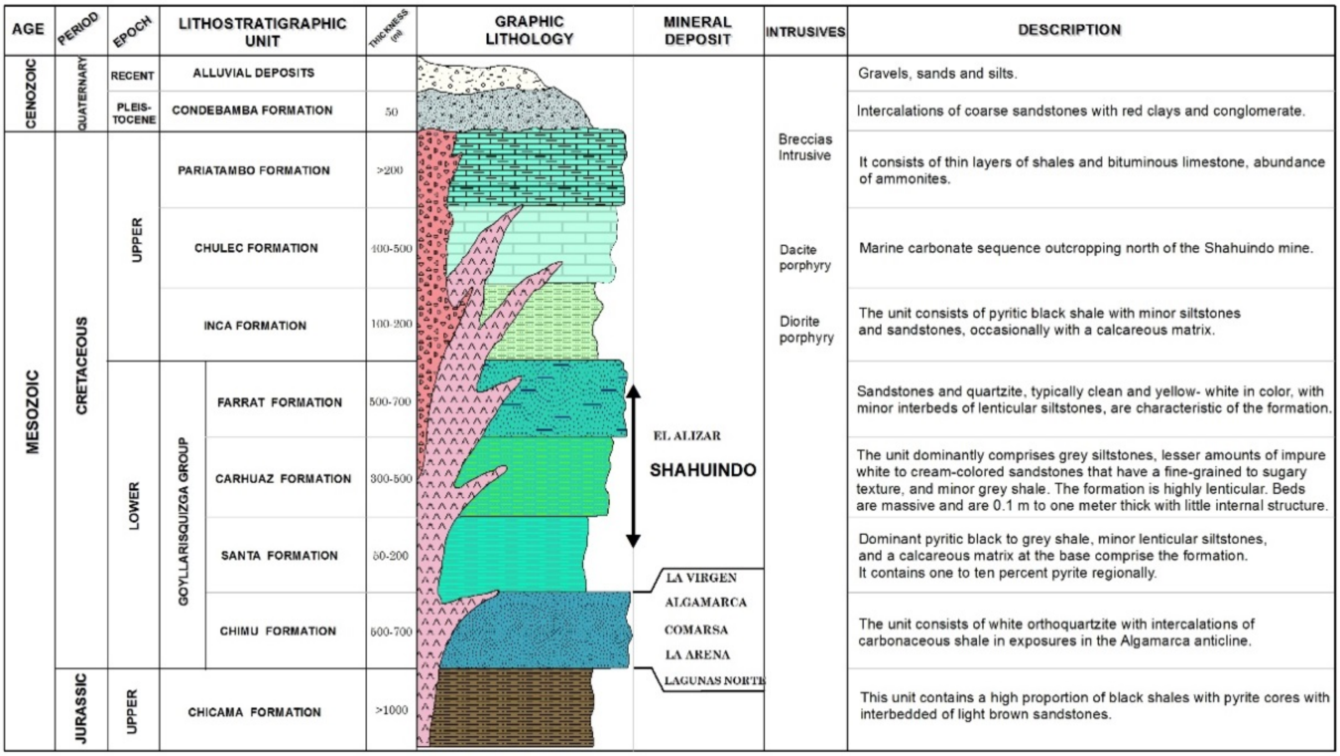


Figure 7.5 Local stratigraphic column for the Carhuaz / Farrat Formations



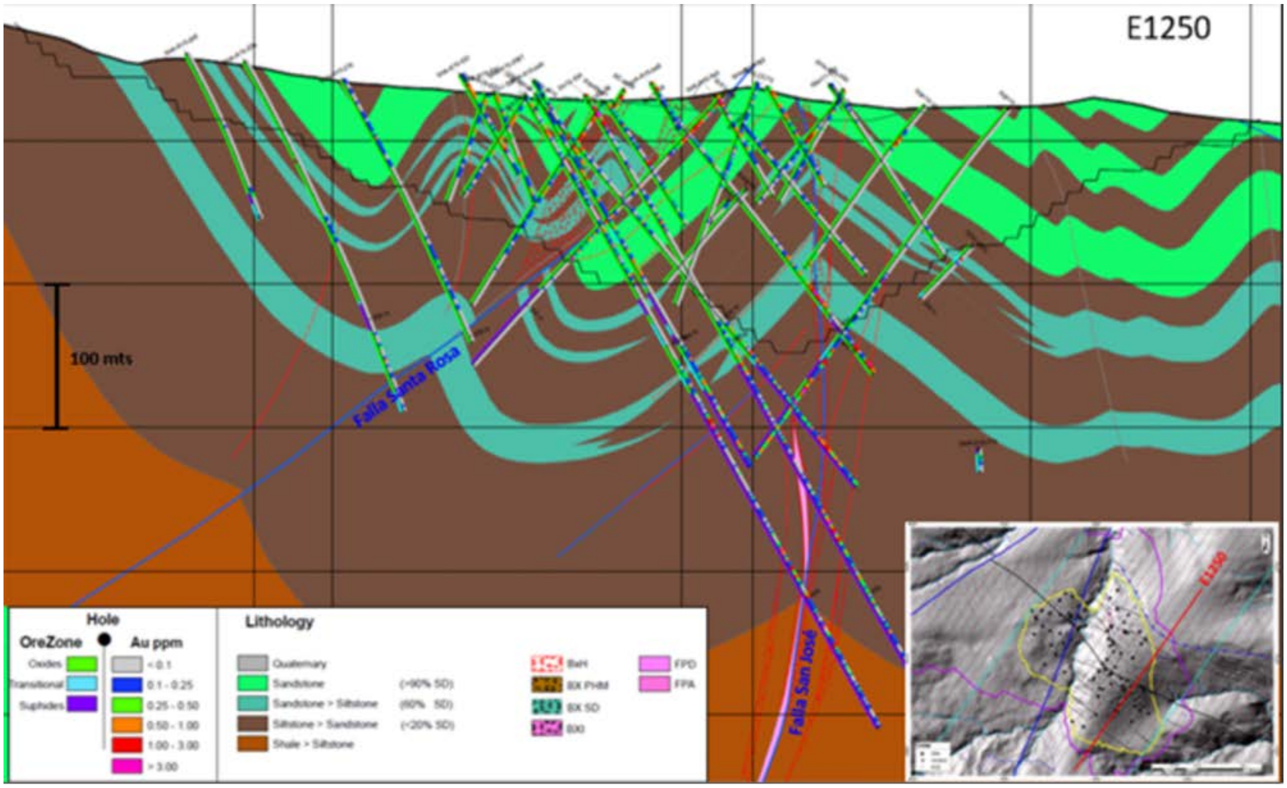
Source: Shahuindo (2021).

Multiple intrusions have intruded the Cretaceous sedimentary sequence at Shahuindo (Figure 7.6 and Figure 7.8). Intrusions include rocks described as andesite, dacite porphyry, and intrusion breccia. Compositions vary from diorite porphyry (known as “andesite” in the district) to dacite porphyry, fine-grained dacite porphyry, quartz diorite porphyry, and foliated quartz diorite porphyry. The three intrusive breccia phases are heterolithic breccia with biotite diorite matrix, heterolithic breccia with fine-grained dacite matrix, and heterolithic megabreccia with foliated quartz-biotite dacite matrix.

Diorite porphyry (andesite) observed in the southeast part of the Property corridor formed as sills in the Goyllarisquizga Group sediments. It is characterized by large (8 mm diameter) biotite phenocrysts, a lack of quartz, and no evidence of hydrothermal alteration. An isotopic age determination is reported to have been made (thought to be zircon U-Pb) on this intrusion that yielded an age of ~26 Ma (Bussey and Nelson, 2011).

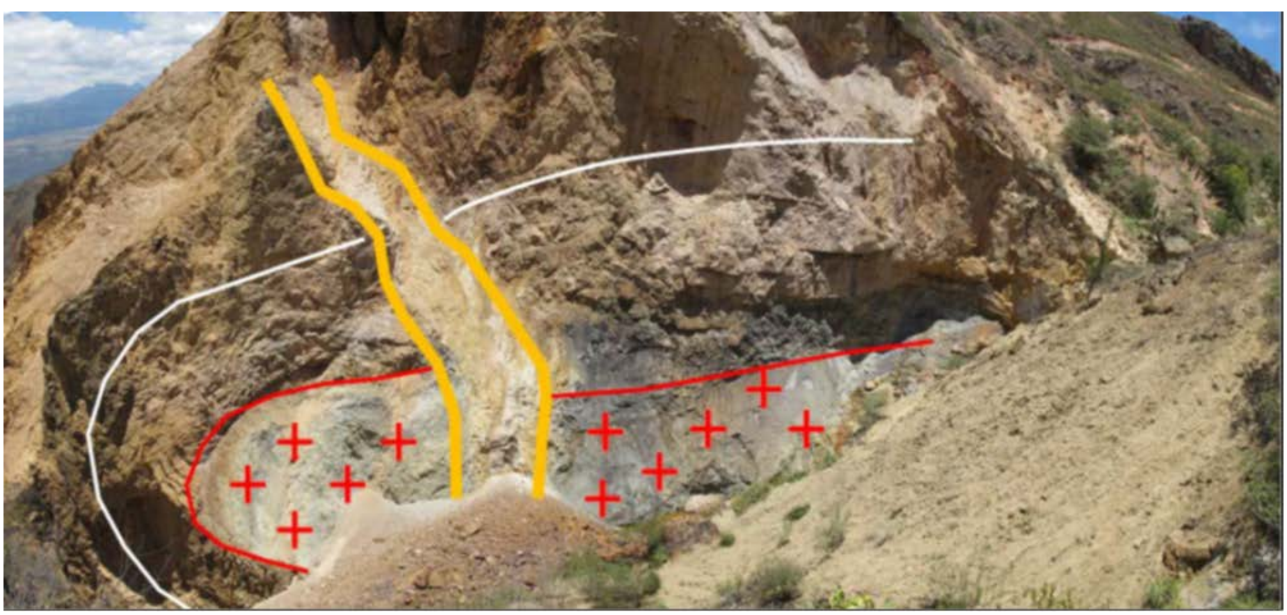
The dacite porphyry is the most widespread intrusive in the district that forms a commonly argillically altered dike-like body with relatively steep discordant contacts in the north part of the main corridor that splays into a series of narrow dikes to the southeast (see Figure 7.6). The dacite porphyry is thought to have been emplaced as sills concordant to Goyllarisquizga Group sediment bedding. An isotopic age determination (zircon U-Pb) of this intrusive yielded an age of ~16 Ma (Bussey and Nelson, 2011).

Figure 7.6 Geological cross section E1250 looking NW



Source: Shahuindo (2021).

Figure 7.7 Intrusive relationships



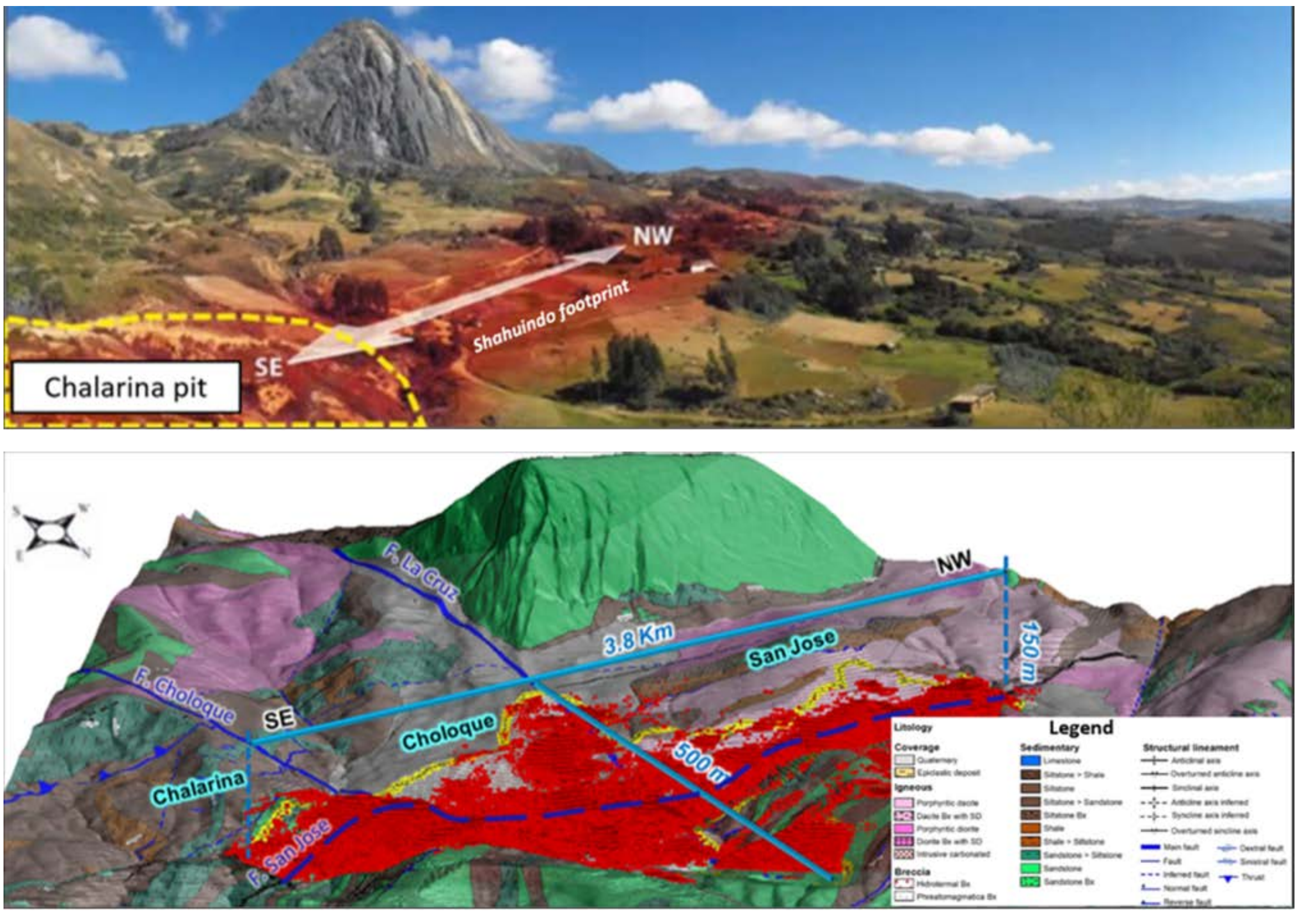
Note: Andesite (red pattern) intruding core of a fold and cut by altered dacite dike (yellow outline) in the northern Property area.
Source: Shahuindo (2021).

Three intrusive breccia phases are recognized on the Property and include; (1) heterolithic biotite diorite breccia, (2) heterolithic fine-grained dacite breccia, and (3) heterolithic megabreccia. Heterolithic fine-grained dacite breccia occurs as narrow (< 3 m width) dike-like bodies with rounded to subangular clasts (up to 10 centimetres (cm) in diameter) of sandstone, siltstone, dacite porphyry, and rare shale in a matrix of fine-grained lithic clasts and clay with 1 - 3 mm quartz, biotite, and plagioclase crystals.

7.3 Mineralization

Mineralization at Shahuindo has been identified over an area approximately 3.7 km southeast to northwest and 0.5 km southwest to northeast as shown in Figure 7.8. Oxidation of mineralization extends to a depth of 150 m below surface. Sulfide mineralization has been identified by surface drilling to 700 m depth.

Figure 7.8 Mineralized footprint



Source: Shahuindo (2022).

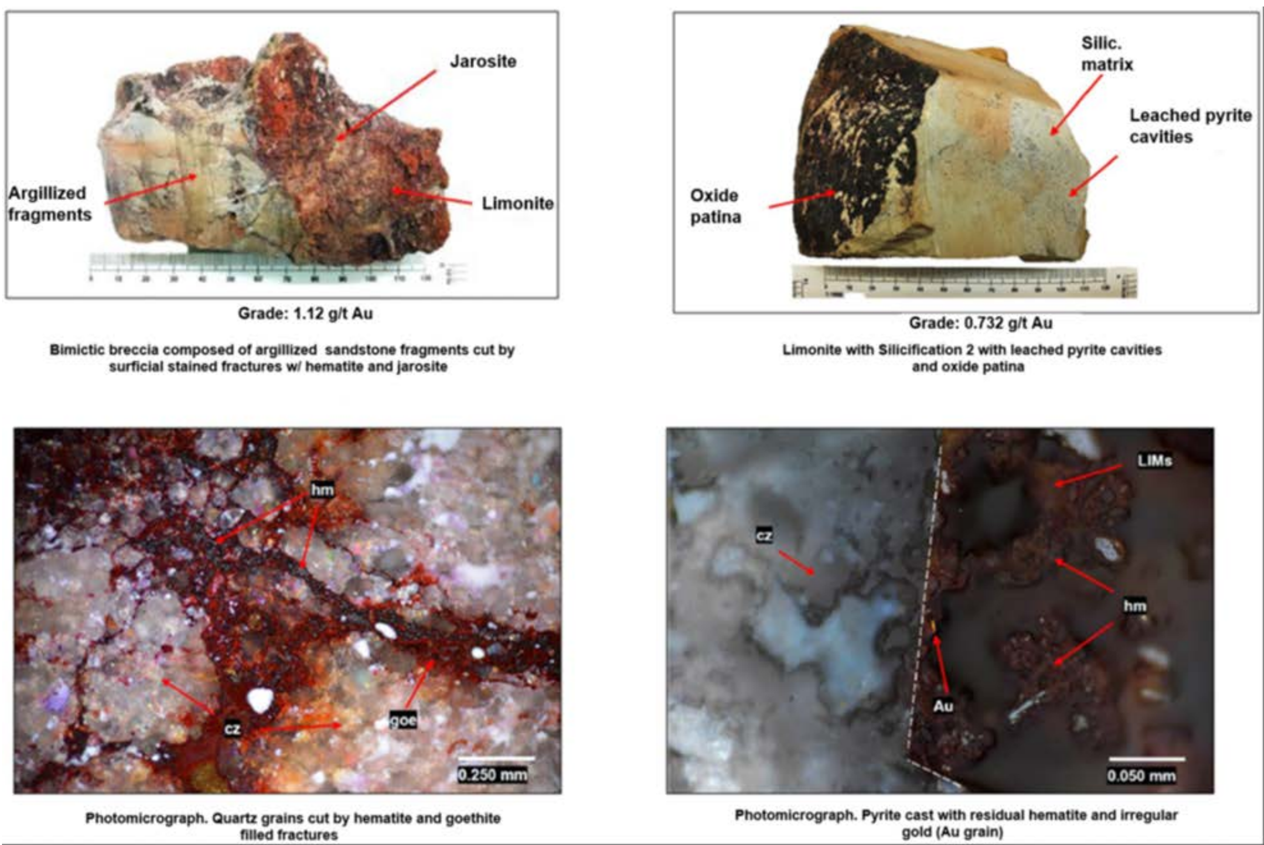
Mineralization at Shahuindo can best be described as an intermediate-sulfidation epithermal system, though high-sulfidation mineralization occurs at depth and in the core of hydrothermal breccias. The high-sulfidation mineralization was pervasively overprinted by intermediate-sulfidation mineralization (pyrite, galena, sphalerite, Ag sulfosalts), which occurs at shallow levels and in “feeder structures”. Mineralization occurs on fracture surfaces, in breccia matrix, and as disseminations within the sediment packages.

The host rocks at Shahuindo are the Carhuaz and Farat sedimentary formations which are folded and locally fault offset, and cut by porphyritic dikes and stocks. Sandstone tends to be a better host to higher grades of gold and silver compared to siltstone. Brecciated structures with polylithic fragments consist of wall rock clasts, locally clasts of residual quartz (the vuggy texture indicating rock dissolution), as well as juvenile clasts of dike rock, the latter evidence of a syn-hydrothermal timing of dike emplacement.

In the oxide facies, which is interpreted to be the result of weathering processes, gold and silver are associated with the presence of jarosite and hematite, see Figure 7.9. In the sulfide facies, gold is typically extremely fine-grained and the mineral species has not been identified. Fine-grained pyrite forms a close association with gold mineralization and occurs as disseminations, veinlets, and semi-massive replacement bodies.

Tetrahedrite, sphalerite, galena, arsenopyrite, stibnite, and covellite have also been reported as minute blebs adhering to zoned pyrite. Although native silver has been identified at San José and in the historic Shahuindo mine, silver is usually found in sulfosalts at Shahuindo.

Figure 7.9 Oxide mineralization



Source: Shahuindo (2021).

7.4. Structural geology

The Shahuindo district occurs along a localized belt of intrusive rocks within the Eocene fold-thrust belt of northern Peru (Montoya et. al., 1995). Geochronological data and field relationships suggest that mineralization commenced around16 Ma (Miocene). Pre-mineralization magmatism at ~26 Ma produced quartz diorite porphyry intrusions (mapped as andesite) and mineralization appears to be associated with dacitic to rhyolitic magmatism, associated brecciation, and probable high-energy diatreme activity.

Mineralization at Shahuindo is controlled along fold-thrust belt structures that may reflect reactivated fold-thrust belt structural elements and / or basement structures, as evidenced by NW-trending Miocene dikes, diatremes, and mineralized breccias parallel the regional strike of fold-thrust structures.

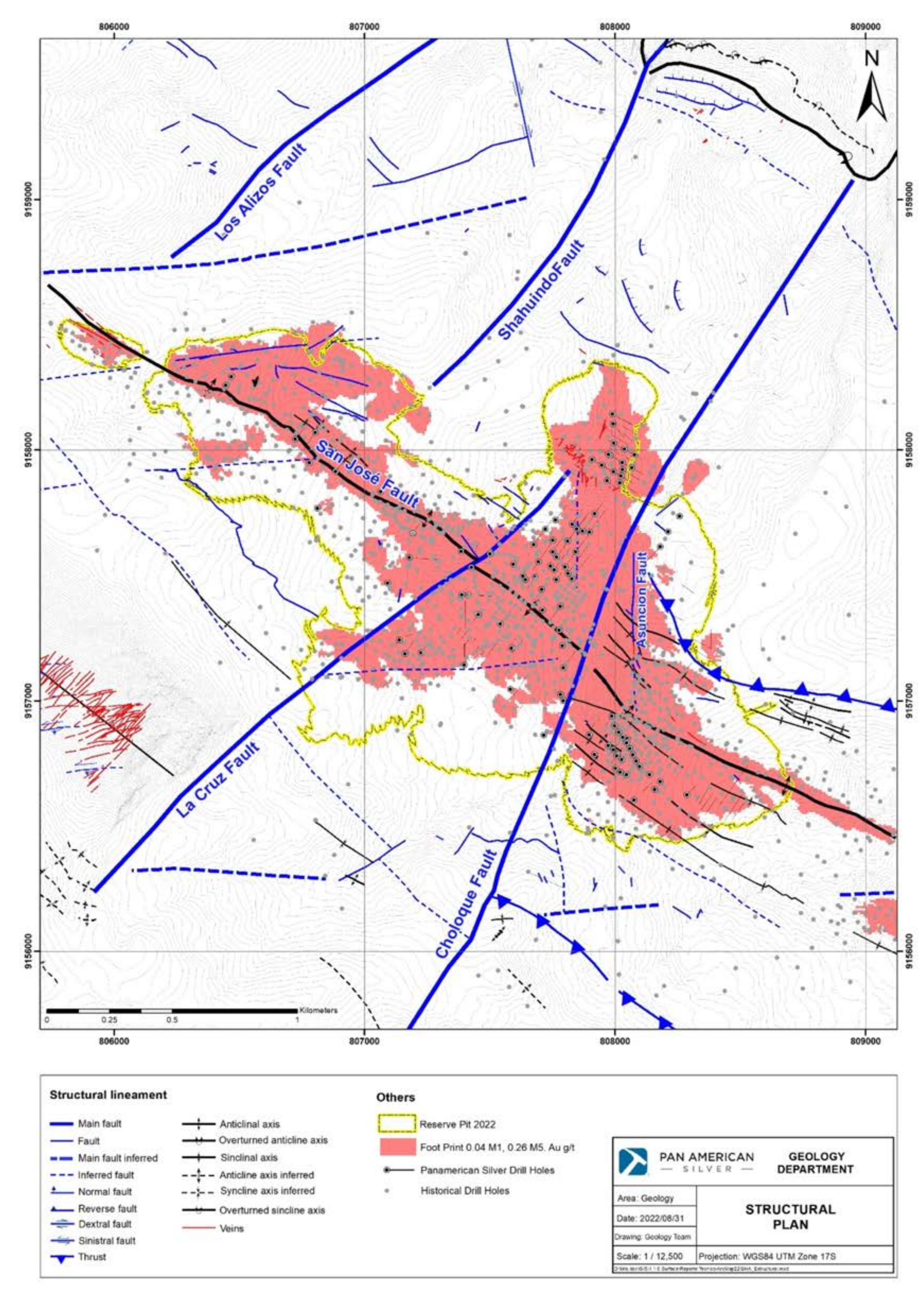
Field evidence indicates that both structure and lithology exert important controls on the location, shape, and orientation of mineralized rock. Important structural elements include fold limbs and fold axial surfaces, fold-related fractures, faults and related extension fractures, breccia dikes and irregular bodies, and igneous intrusive contacts. These structural elements are described below and their geometry and spatial relation to mineralized zones have been used to construct the structural model for the Shahuindo district.

The principal zone of mineralization in the Shahuindo district occurs in a belt between two large-amplitude regional-scale folds, the Algamarca anticline and the San Jose Anticline (Figure 7.10). The Algamarca anticline has amplitude of at least 400 m and is upright and symmetrical. The San Jose fold has an amplitude of at least 300 m and is an asymmetric, overturned, northeast-vergent fold with a low-angle dip (15°-20°) axial surface (i.e., resembling a recumbent style fold).

The Chimú-cored Algamarca anticline is interpreted as a detachment fold based on mapped geometric features of symmetrical, upright and box shape. The fold is believed to have formed as an anticlinal stack of folded strata and folded thrust faults above the postulated sub-horizontal roof thrust below the base of the Algamarca anticline exposure. Old mine workings in the Algamarca mine suggest that the southern limb of the Algamarca anticline continues to at least the 2,690 m elevation.

The strain in fold-thrusts belts is partitioned along strike by transverse tear faults such as the Choloque, La Cruz, and Los Alisos faults noted by Hodder (2010b) and Hodder et al. (2010a). These faults are not well-exposed at surface but are recognized from topographic lineament mapping through kinematics and strong displacement gradients. The faults are thought to be steeply dipping. The La Cruz Fault terminates at the Algamarca anticline to the south and the Pampa de Arena anticline to the north. The Los Alisos Fault, inferred through topographic lineament and alignment of intrusive bodies, shows no displacement nor does it correlate with transverse veins in the Algamarca district. The Los Alisos Fault terminates the northwest margin of the main mineralized corridor on the Property.

Figure 7.10 Combined structure and mineralization map



7.5. Hydrothermal alteration

Mineralization in near surface oxidized and weathered rocks is associated with the presence of iron oxide casts and boxwork after pyrite and other sulfides, limonitic or gossanous coatings, fine-grained euhedral quartz druse as veinlets and vugs in brecciated zones, crystalline white clay or sericite, and alunite, jarosite, or scorodite in veins and veinlets.

Petrographic studies and Terraspec® surveys were conducted by Rio Alto on 50% of the core and chips samples from Shahuindo. This study defined deep occurrences of dickite, pyrophyllite, and alunite along fractures and dikes that may define feeder zones and shallow outflow of an initially reactive fluid. A broad zone of sericite (illite) occurs at shallower depth that may be associated with a white mica-stable mineralizing fluid (Hedenquist, et. al., 2015).

A general southeast to northwest alteration trend is recognized with the following alteration assemblages affecting the sediment sequence: silica-pyrophyllite, silica-paragonite, and illite-muscovite-paragonite. These assemblages indicate increasing temperature and lower pH from southeast to northwest. Decreasing temperature and increasing pH extends from the core of mineralization to the southeast in the southeast part of the deposit.

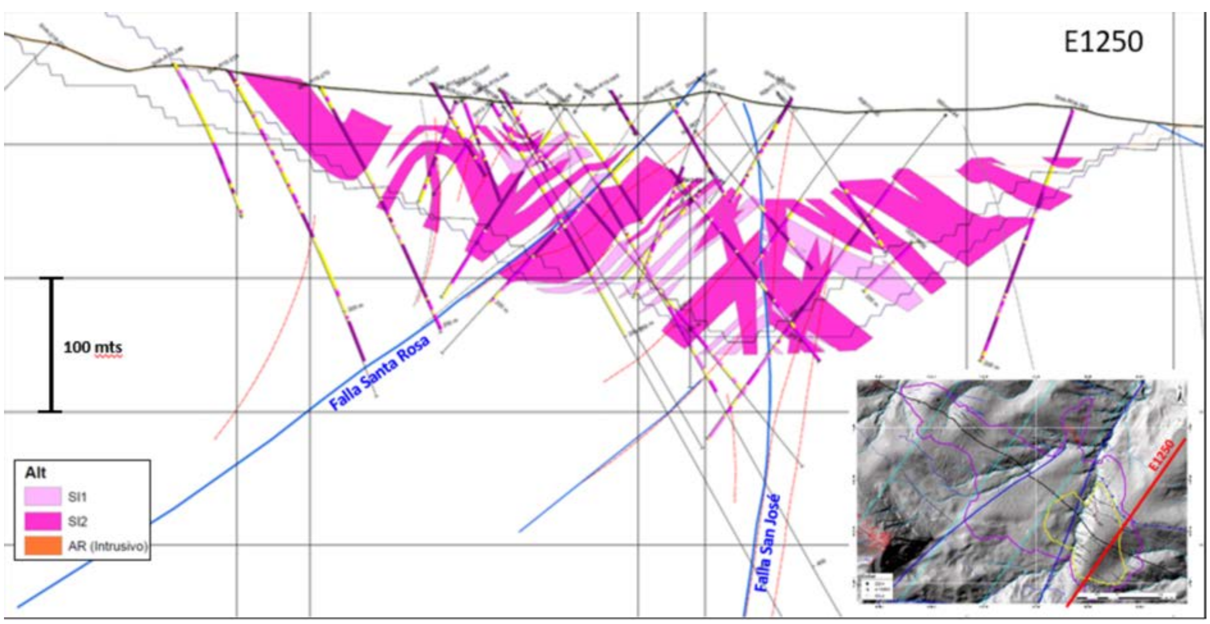
Jarosite forms in acidic environments usually due to oxidation of pyrite-rich rocks in the near surface environment (Figure 7.11) and is a good indicator that pyrite-rich rocks are nearby. At Shahuindo, jarosite occurs in veins and as breccia matrix. Scorodite (iron-arsenic oxide) often forms with jarosite during weathering of rocks rich in arsenic-bearing sulfides or significant pyrite. Scorodite was noted in the eastern area of the Mineral Resource.

Figure 7.12 is a cross sections depicting the distribution of hydrothermal alteration intensities in the Shahuindo deposit.

Figure 7.11 Jarosite in outcrop

Notes:
A - Brown jarosite veins in sandstone (eastern Property).
B - Jarosite and grey-green scorodite (arrows) in breccia matrix exposed in road cut (central Property).
Source: PAS (2021).

Figure 7.12 Cross Section E1250 showing alteration looking NW



Notes to legend: alteration abbreviations are: SI1=Weak silicification, SI2=Mod silicification, SI3=Strong silicification, AR=argillic.
Source: PAS (2021).

7.6. Geometallurgy

Metallurgical recovery of gold from the Shahuindo deposit is affected by lithologic grain size, degree of clay alteration and silicification. There is a high degree of lateral and vertical lithologic variability at Shahuindo, particularly in the northern half of the deposit. Modelling the distribution and occurrence of lithologic units / geometallurgical (geomet), domains is critical to mine planning. In 2020 and 2021 a detailed study involved modeling of geomet domains which consisted of drilling to procure representative material and geomet sample analyses to refine the distribution of lithologic units and create a more comprehensive geomet domain model for planning purposes. Detail for geomet drilling can be found in Section 10.

Modeling of geomet domains began with identification of coarse-grained material such as sandstones, silicified siltstones and silicified material that would be amenable to run-of-mine (ROM) recovery and finer material such as fine-grained siltstones and / or argillized rock that would be considered for blending to optimize overall gold and silver recoveries.

A total of 20 geomet domains were identified from drilling, mine and surface samples based on host lithologic grain size and alteration that could influence recoveries as shown in the following table. Domains are classified as Non-critical (O) if they represent rock / alteration types that are clearly amenable to ROM recovery (generally silicified and / or sandstone units) or are clearly blended material (generally siltstone and / or argillically altered). Critical geomet domains include rock / alteration types that are represent rock / alteration units that would provide uncertain recovery results (i.e., argillized breccia or silicified siltstone). These are shown in Figure 7.13 where the domains key is as follows: SD=sandstone, ST=siltstone, Bx=breccia, Int=intrusive, AR=argillic, SI=silicified and the suffix of 1= wk (weak), 2=mod (moderate), 3=stg (strong) is used.

Table 7.2 Table of geomet domains

Alteration intensity	Lithology			
	SD	ST	BX	INT
AR3	X	X	X	X
AR3	X	X	O	X
AR1	X	O	O	X
SI2	X	O	X	X
SI1	X	O	O	X

Notes: X = Non-critical domain; O = Critical domain.

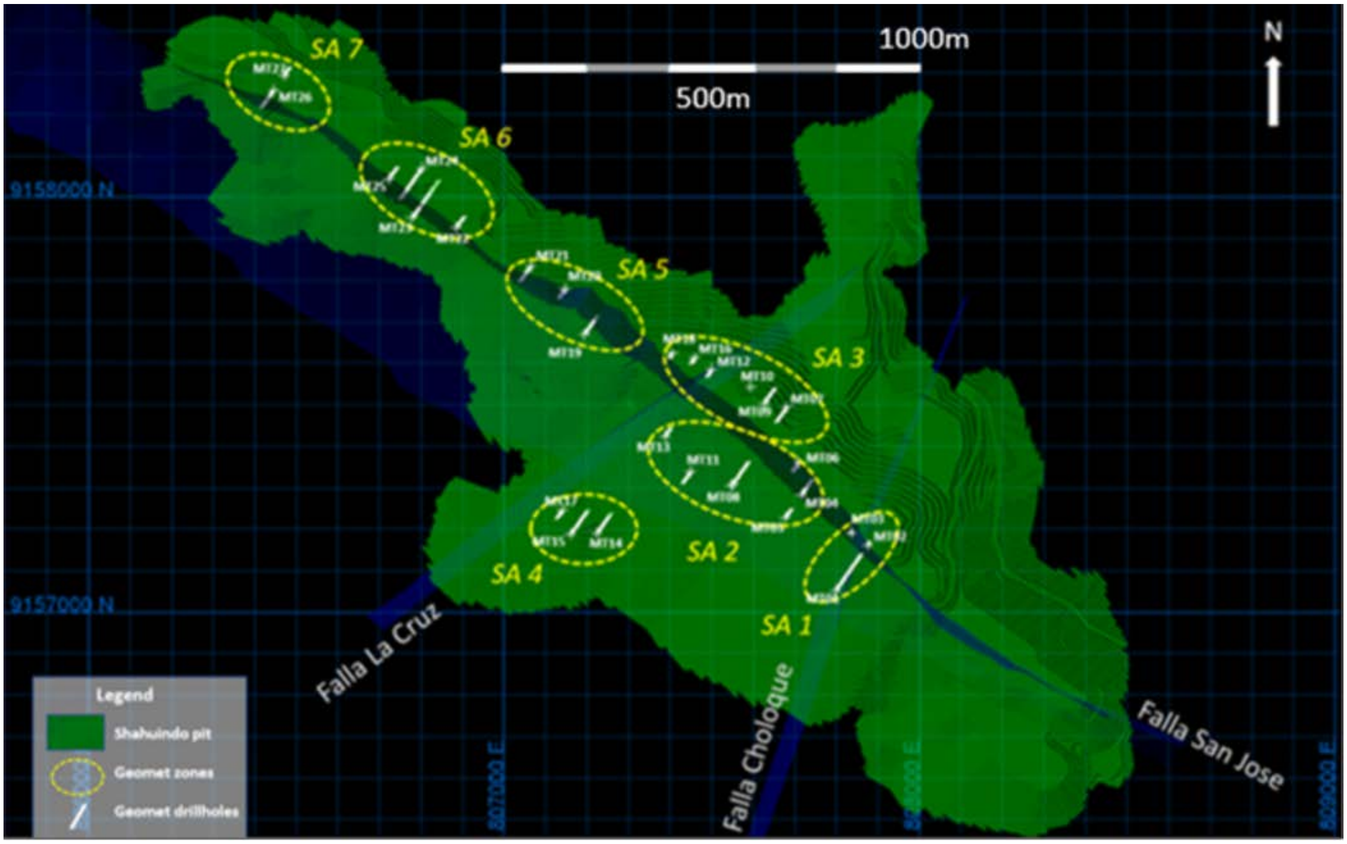
Based on this analysis a total of 14 non-critical and 6 critical domains were defined. The six critical domains are shown in Table 7.3.

Table 7.3 Critical geomet domains

Code	Description
SI1ST	Wk silicified siltstone
SI2ST	Mod-Stg silicified siltstone
AR1ST	Wk argillized siltstone
SI1BX	Wk silicified breccia
AR1BX	Wk argillized breccia
AR2BX	Mod argillized breccia

Based on the distribution of the six critical domains seven geomet sectors were identified throughout the Choloque and San Jose Mineral Resource zones. To provide sample for metallurgical tests a total of 27 geomet drillholes were drilled within these domains. Geomet sectors and drillholes are shown on the following map. A summary of the 2020 - 2021 geomet drilling are included in Section 10.

Figure 7.13 Drillhole locations within geomet domains



Source: PAS (2021).

A total of 38,651 kg of material representing all geomet classes was collected from the geomet drill program. Material for critical geomet domains amounted to 23,598 kg of material and the composition and disposition by rocktype and geomet domain is shown in Table 7.4.

Table 7.4 Composition of geomet samples

Rocktype	Geomet domain	Interval (m)	Weight (kg)	Weight (%)
SD	SI3SD	175.2	1,946.1	5.1
	SI2SD	162.1	1,774.2	4.6
	SI1SD	13.7	118.2	0.3
ST	SI3ST	15.5	174.7	0.5
	SI2ST	427.2	4,686.4	12.1
	SI1ST	439.8	5,076.7	13.1
	AR2ST	230.3	2,520.8	6.5
	AR1ST	594.5	6807.1	17.6
BX	SI3BX	41.9	538.9	1.4
	SI2BX	204.8	2,252.8	5.8
	SI1BX	231.3	2,519.9	6.5
	AR3BX	26.2	227.3	0.6
	AR2BX	231.7	2,497.2	6.5
	AR1BX	190.3	2,011.0	5.2
INT	SI2INT	4.2	41.1	0.1
	SI1INT	98.1	1,161.4	3.0
	AR2INT	77.6	855.9	2.2
	AR1INT	150.8	1,609.9	4.2
	FRINT	1.7	18.9	0.0
Q	Q	180.1	1,795.0	4.6
Total		**3,496.8**	**38,651.3**	**100.0**

Notes: Grey = Critical domains, SD = sandstone, ST = siltstone, Bx = breccia, Int = intrusive, AR = argillic, SI = silicified, 1 = weak, 2 = moderate, 3 = strong.

8 DEPOSIT TYPES

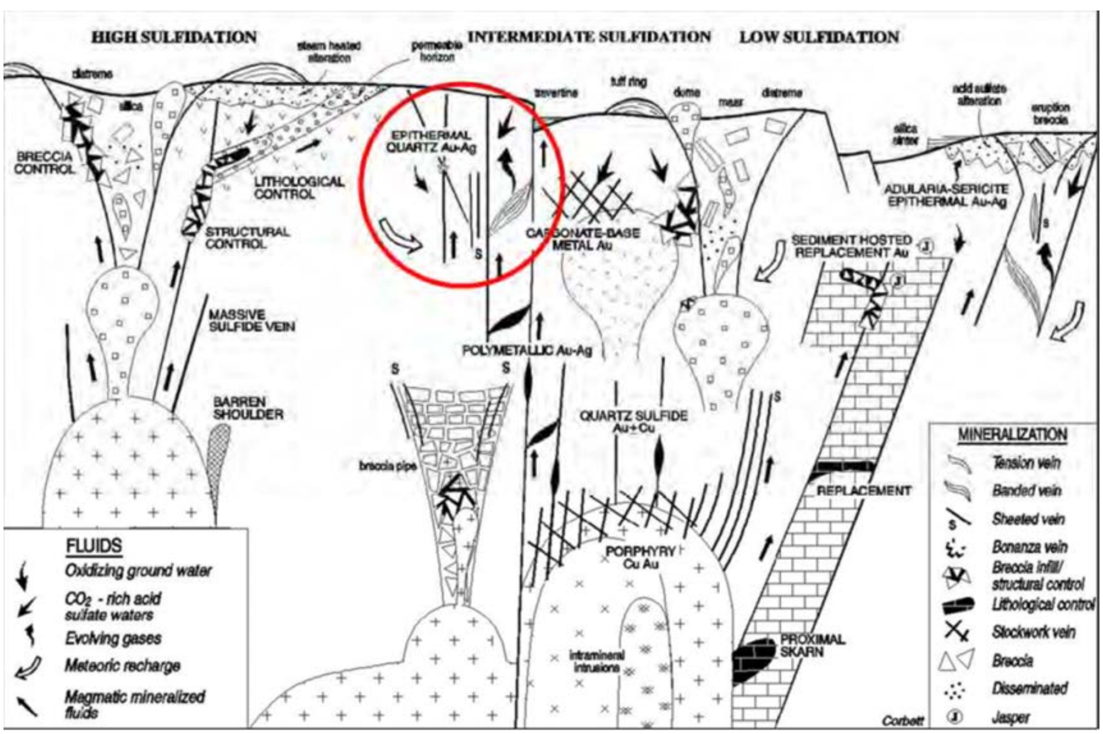
8.1 Deposit types

The Shahuindo deposit formed in a predominantly intermediate-sulfidation epithermal system (Figure 8.1) of probable Miocene age. Distinguishing characteristics of an intermediate-sulfidation environment include mineral assemblages indicating a sulfidation state between those of high and low sulfidation types, relatively high total sulfide content of five to 10 percent in the sulfide environment, presence of silver sulfosalts, and association with andesitic to dacitic volcanics. Magmatic associated fluids are implied. There is no evidence of adularia at Shahuindo, thus ruling out a low-sulfidation environment. There are some observances of enargite at depth, suggesting a mixed intermediate- to high-sulfidation system.

Epithermal deposits form as high-temperature mineralizing fluids rise along structural pathways and deposit quartz and precious and base-metal minerals in open spaces in response to boiling, which is usually coincident to a release of pressure within the hydrothermal system. This quartz and metal deposition, followed by resealing of the system, is repeated over the life of the hydrothermal system resulting in crosscutting and overprinted breccia and vein textures. Typically, the larger and higher grade deposits are associated with long-lived hydrothermal systems marked by complex overlapping veins.

These deposits are strongly structurally controlled. Mineralizing fluids are directed along structural pathways with high-grade “ore shoots” typically concentrated in open dilatant zones. These dilatant zones commonly form where inflections occur vertically and laterally along the deposit. Metal deposition and zoning in epithermal deposits are related to the level of boiling. Typically, precious metals deposit at or near the boiling level while base metals precipitate below. Boiling may occur at different levels as the hydrothermal system evolves producing an overprint of various episodes.

Figure 8.1 Spatial relationship of intermediate sulfidation deposits



Source: After Corbett (2002).

9 EXPLORATION

9.1 Exploration strategy

The exploration strategy at Shahuindo utilizes relatively standard exploration techniques that include detailed surface geologic mapping, surface geochemical sampling, and drill testing, over time. Several targets proximal to the Shahuindo deposit have been identified from geophysical surveys, prior informal mining operations, surface mapping and geochemical sampling which is summarized below.

The most effective exploration tool at Shahuindo has been core and RC drilling, the results of which are discussed in Section 10 of this Technical Report.

Exploration work by Pan American has consisted of follow up on near pit extensions through drilling as well as infilling within the Mineral Resource footprint.

9.2 Geophysical surveys

Val Dór Geofisica Peru conducted magnetic and induced polarization (IP) geophysical surveys between 2002 and 2012 on behalf of the prior owners of Shahuindo. There have been no additional geophysical surveys completed on the concession since.

550-line kilometers of magnetic surveys covered most of the concession suggest a major intrusive body, as indicated by a prominent magnetic high, that extends from the center of the Shahuindo deposit to the northwest project boundary. Another magnetic anomaly may be related to a porphyry body northwest of Shahuindo at the Azules exploration target. Results of the magnetic surveys are illustrated in Figure 9.1.

Over 160 line-kilometers of pole-dipole IP surveys conducted over prospective areas on the Shahuindo concession highlighted anomalies which have subsequently been successfully drill tested since 2002. IP surveys were limited by access with large areas still open to longer term exploration opportunities (Figure 9.2).

Figure 9.1 Shahuindo – Magnetic Survey Results

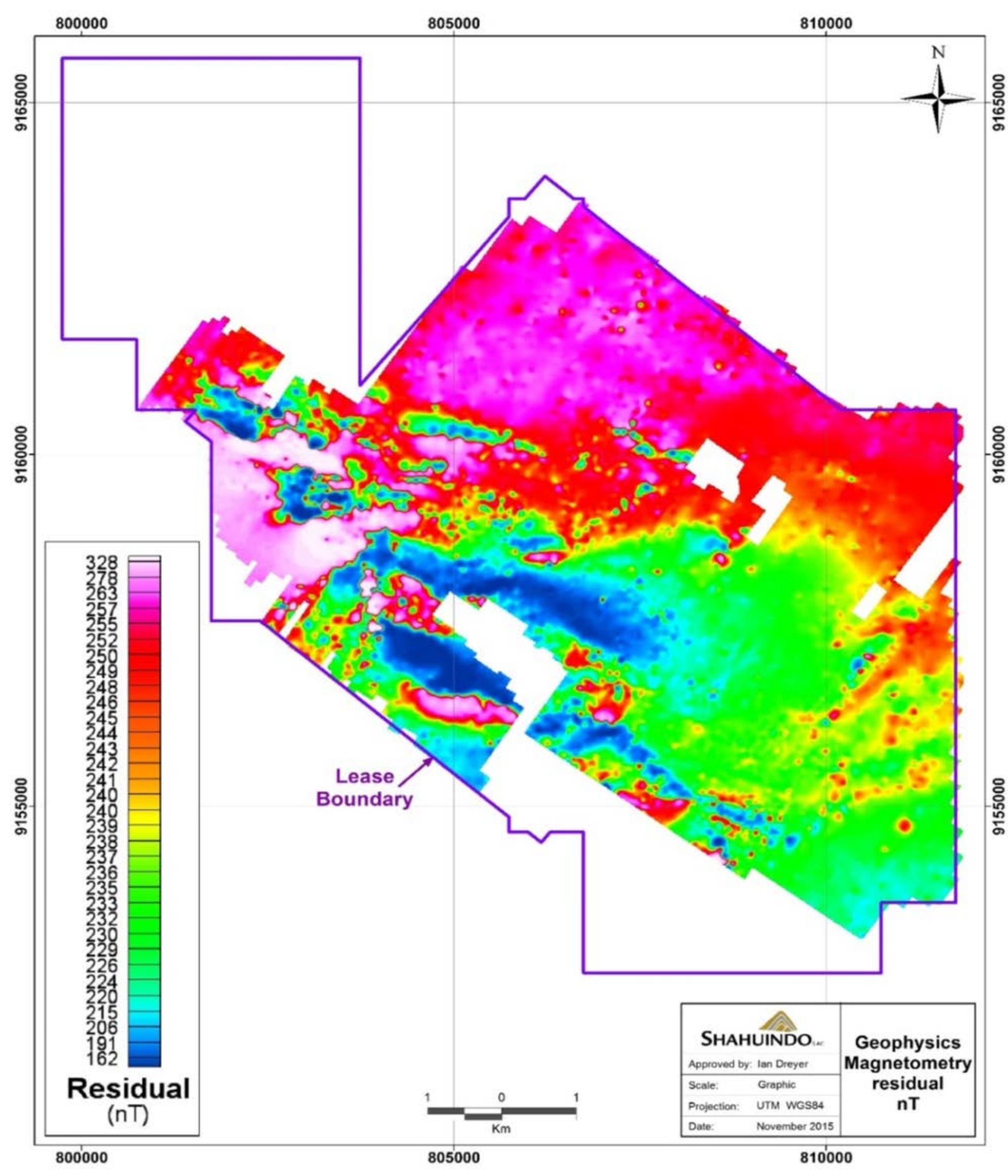
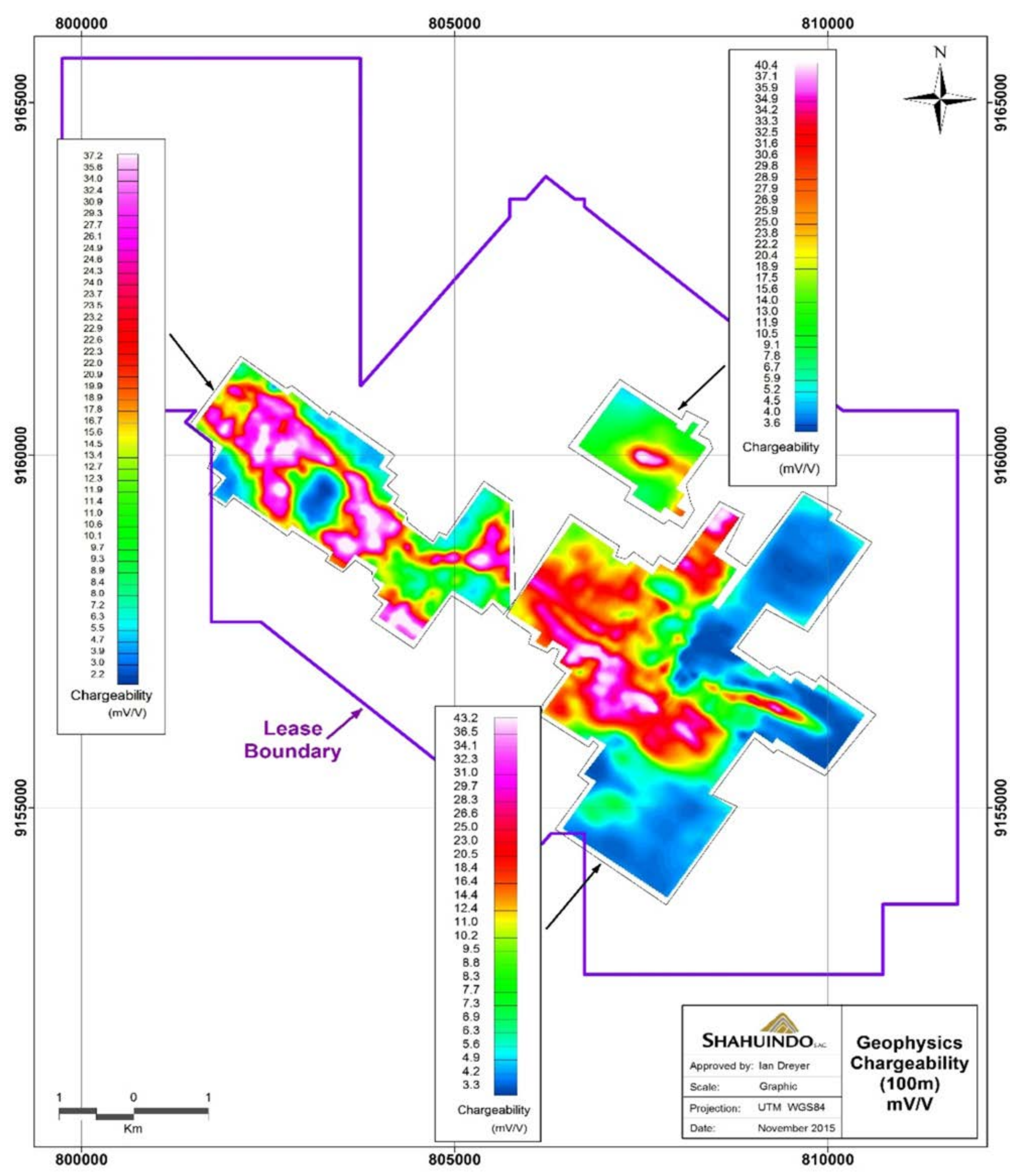


Figure 9.2 Shahuindo – IP Survey Results

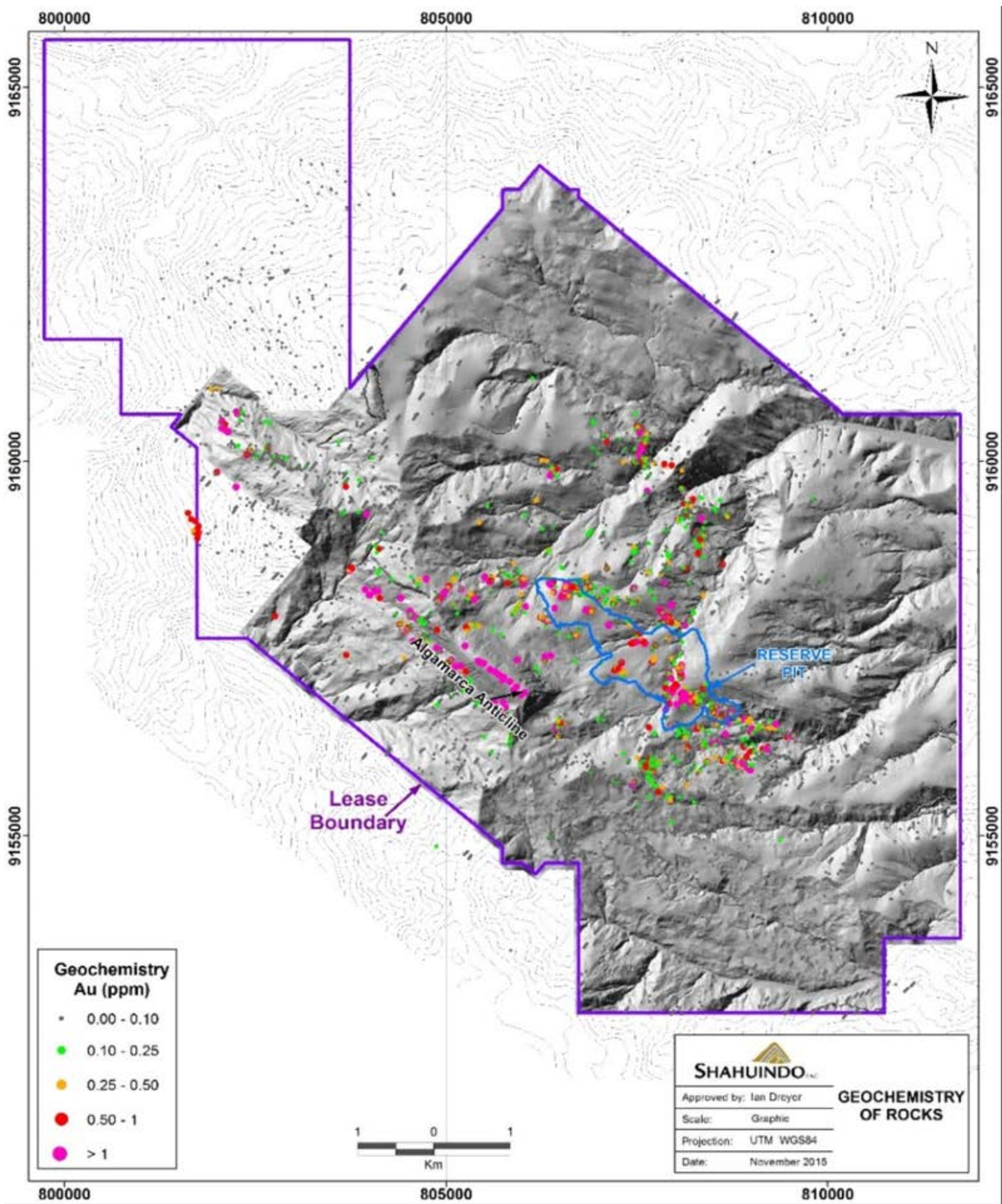


9.3 Geochemistry

Geochemistry is a reliable tool to identify precious and base metal mineralization that can be subsequently tested by drilling as outcrops and subcrops are exposed or lie below shallow cover over the majority on the concession. A large database of soil, channel sample, and rock sampling results has been accumulated since 2002. The Shahuindo district surface sample database contains a total of 15,282 rock samples and 11,680 soil samples. Surface samples consist of trench, grab and rock chip samples. Trench samples are generally excavated to bedrock, or to a maximum depth of 1.8 meters and sampled either horizontally or vertically, consistent with lithologic and structural trends. Sample lengths are variable depending on width of geologic features.

A compilation of rock chip gold geochemistry results is displayed in Figure 9.3.

Figure 9.3 Shahuindo – rock geochemistry



Most of the underground adits from small-scale mining located on the concession were sampled prior to 2012. Where accessible, samples were taken from the adit portal and along the accessible portion of the tunnel. Approximately 140 small adits were sampled.

Detailed soil sampling completed by Sulliden between 2003 and 2012 revealed a series of continuous, parallel gold anomalies in the central and northern areas of the concession and base metal anomalies in the northwest and southeast portions of the concession.

Ongoing geologic mapping and rock chip sampling programs are directed towards identification of mineralized sandstone to be blended with finer grained material to aid recovery of ROM material on the leach pad.

No analytical data from surface rock samples or soil samples were used in the mineral resource estimate.

10 DRILLING

10.1 Introduction

A total of 1,822 holes drilled by Atimmsa, Asarco, Southern Peru, Sulliden, Tahoe, and Pan American have been used to model the Mineral Resource estimate at Shahuindo. The cut-off date for drill data inclusion in the June 30, 2022 Mineral Resource model is May 31, 2022. The Mineral Resource model database includes 963 RC and 859 diamond drillholes drilled on the Property by various owners since 1992. Table 10.1 is a summary of the drilling that has occurred on the Property over time.

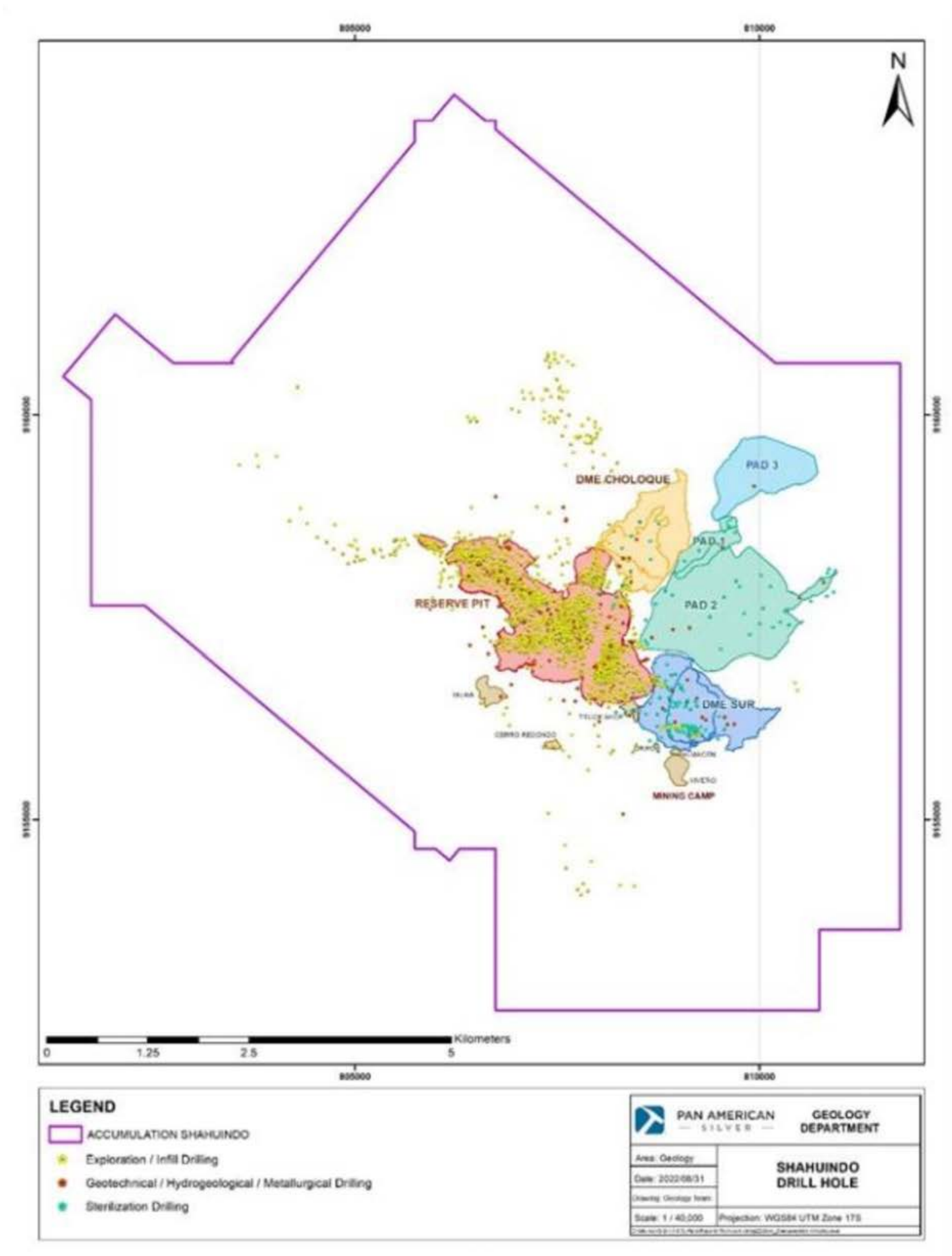
Table 10.1 Shahuindo Summary of drilling included in Resource

Company	Year	Diamond core		Reverse circulation		Total drillholes	Total metres
		Number	Metres	Number	Metres		
Atimmsa	1992	20	2,465.0	-	-	20	2,465.0
Asarco	1994 - 1996	34	5,518.5	40	4,248.0	74	9,766.5
Southern Peru	1997 - 1998	17	1,705.3	79	9,643.0	96	11,348.3
Sulliden	2003 - 2012	437	83,920.0	252	42,884.5	689	126,804.5
Rio Alto	2014 - 2015	68	12,400.9	351	43,898.0	419	56,298.9
Tahoe	2016 - 2018	256	45,767.9	27	5,671.4	283	51,439.3
Pan American	2019 - 2022	27	3,185.1	214	26,819.0	241	30,004.1
Total	**1992 - 2022**	**859**	**154,962.7**	**963**	**133,163.9**	**1,822**	**288,126.6**

The majority of the RC and core drillholes are located within the current Mineral Resource footprint with the majority of the drilling in the oxide domain on a nominal 25 m x 25 m spacing. The database also includes twelve diamond core holes that were drilled for geotechnical purposes and subsequently sampled for analyses. Figure 10.1 is a drillhole location map showing all holes drilled on the Property and there is also a Figure 14.1 which is a plan showing all the drillholes used in the Mineral Resource estimate.

Drillholes in the Mineral Resource area have been collared at azimuths around 35 degrees or 215 degrees to intersect the main structural trend of the deposit at a high angle. In some areas of the resource, and in other exploration targets away from the main mineralized zone, holes are drilled at a variety of azimuths to attempt to intersect local structural features at high angles or due to topographic restrictions on drill site locations.

Figure 10.1 Property drillhole location map



10.2 Drilling methods and equipment

10.2.1 Previous operators

A description of drilling equipment and procedures used by previous operators is summarized in Table 10.2.

Table 10.2 Drilling method and equipment

Company	Year	Drillhole type	Drill equipment	Drill contractor	Notes
Atimmsa	1992	RC	Unknown	Unknown	RC drilling compared with Tahoe drilling and considered sufficiently reliable for Mineral Resource work
Asarco	1994-1996	Diamond core (NQ, HQ)	Longyear wireline drill	Geotec SA	
		RC	Unknown	Unknown	Generally dry, good sample recovery
Southern Peru	1997	Diamond core (HQ) and RC	Unknown	Andes Drilling	
	1998	Diamond core (NQ) and RC	Unknown	Podiur	
Sulliden	2003-2004	Diamond core (HQ, NQ)	Skid mounted drill	Forage Orbit S.A.	
	2007	Diamond core (HQ)	Skid mounted drill	MDH Bradley SAC	
	2009-2011	Diamond core (PQ)	Skid and track mounted drills (LF70)	MDH Bradley SAC	
		RC (4.5" to 5.5" hammer)	Foremost Prospector 750 Buggy	AK Drilling International	Frontal hammer for dry samples, conventional hammer for wet samples, tricone in poor ground conditions, 1.5 m sample, reference chip trays
Rio Alto	2014-2015	Diamond core (HQ, NQ) and RC	Unknown	Explomin del Peru	RC (5.25" face sampling hammer), average recovery 95%
Tahoe	2016-2018	Diamond core	Not specified	Not specified	
		RC	Not specified	Not specified	

10.3 Pan American Drilling methods and equipment

Descriptions of drilling equipment and procedures (drilling, collar and downhole surveys, and logging) for Pan American’s 2019 drill program are discussed below.

Pan American’s 2019-2022 drill programs included in the resource model were executed by various contractors (Explomin del Peru, Redrilsa). Drilling during this time period was principally RC (214 RC holes) and a lesser extent diamond core holes (27 in total).. Diamond core was generally HQ and to a lesser degree

NQ size, depending upon ground conditions. Average core recovery was 95%. RC drilling utilized 5¼-inch (133 mm) diameter face sample hammers and achieved an average recovery of 90%.

For RC drilling dry samples were preferred over wet samples, and generally a frontal hammer was used to retrieve dry samples. Conventional hammers were used for wet samples; a tricone was sometimes necessary when ground conditions were very poor. RC cuttings were sampled on 1.5 m intervals. 30% of the cuttings of each individual sample were bagged and sent to the laboratory for analyses. The remaining 70% of the sample cuttings were bagged and kept as rejects. Two reference chip trays, one with a complete sample and the other with a sieved sample (one millimetre mesh), were collected at the same 1.5 m interval and were used for geologic logging.

For diamond core drilling HQ, NQ, and PQ core was placed into plastic boxes with wooden blocks to denote each drill run. Boxes contain either three metres of HQ core, four metres of NQ core, or two metres of PQ core. Core boxes were securely sealed and delivered once a day, by truck, to core-logging facilities at the on-site core logging facility.

10.4 Collar surveys

Drill collar northing and easting coordinates are located in relation to the UTM WGS84 coordinate grid. In 2009 Horizon completed an aerial survey of the Property and create a two-metre contour map. Pan American continues with the survey procedure established in 2010 to survey drillholes.

10.5 Downhole surveys

Downhole survey data are available for 943 core and RC holes, corresponding to approximately 52 percent of the number of drillholes in the database used for the Mineral Resource estimate. Survey data are not available for a number of drillholes completed by prior explorers (Atimmsa, Asarco, Southern Peru, Sulliden and Rio Alto) The unsurveyed drillholes are relatively shallow (average depth of about 125 m), and downhole deviation is considered minor.

Pan American continues with the downhole survey procedure established in 2015 to downhole survey all drillholes using a non-magnetic conventional Reflex Gryro™ survey tool, with continuous azimuth and inclination measurements normalized to 5 m intervals. The survey information is downloaded, processed, and validated by the Geology department.

10.6 Drill logging

Pan American has continued with a logging procedure originally standardized by Sulliden and refined by Rio Alto in 2015.

Sample intervals, alteration, mineralization, and rock type data are logged into digital spreadsheet forms. Since 2014 GMAPPER software has been used to record geologic and geotechnical data. Drill logs record lithology, fracture orientation, oxidation, sulfide mineralization types and intensities, and alteration type and intensity as well as sample recovery percentages and Rock Quality Designation (RQD).

All drill core since 2003 has been photographed.

10.7 Drill database

The database used for the current Mineral Resource estimation was finalized on May 31, 2022, and includes all drill data up through RC hole SHA-R22-559 and core hole SHA-D22-324. The Shahuindo database has a total of 168,592 gold assays, 167,397 silver assays, and 149,382 total sulfur analyses. The database also includes a 31-element suite of trace element analyses for most holes drilled since 2007.

10.8 Sample recovery

In the 2012 KCA / MDA Technical Report prepared on behalf of Sulliden, MDA reported the results of their examination of the relationship between core recoveries to gold grade, particularly evaluating the possible grade loss due to loss of fines in the drilling process. MDA concluded "the data suggests that, if present, this grade loss is limited to a small sample population and would not have a significant impact on the Mineral Resource estimate".

Tahoe did not perform any further study on the relationship between core loss and gold grade since the vast majority of drilling completed for the Mineral Resource model and estimate has been RC holes rather than core holes.

The drilling by Pan American has been predominantly RC drilling and recovery is estimated as 90%.

10.9 Comparison of core and RC drilling

A number of exercises were carried out over the years to examine the relationship of gold values between RC and diamond drilling.

In 2010, AMEC examined the relationship by comparing paired-sample plots for RC and diamond drill sample pairs that were within 5 m and 10 m apart. AMEC reported that there was no statistically significant sampling bias between RC drilling and diamond drilling in the 2010 AMEC Technical Report.

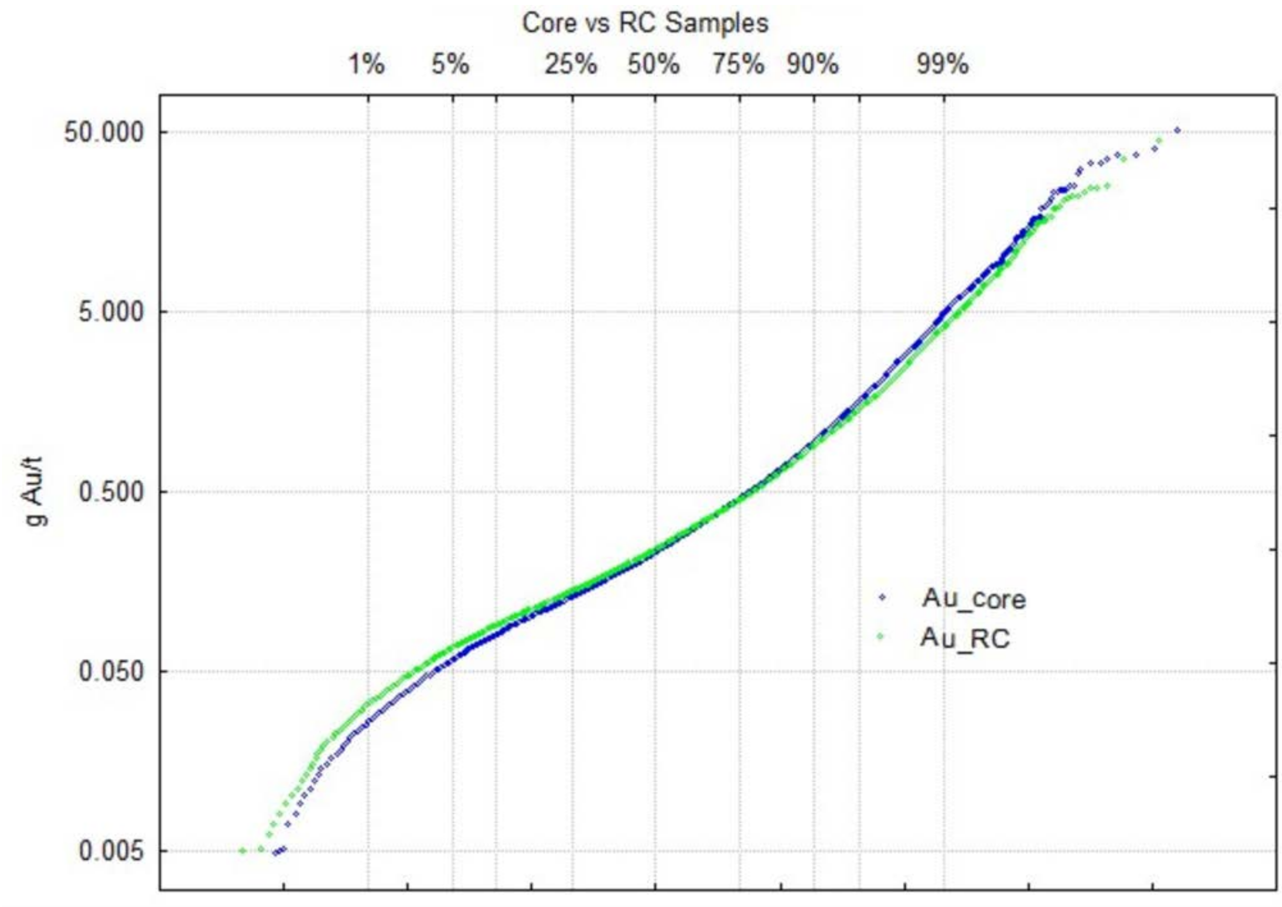
MDA completed an analysis of the gold assay date from RC samples and diamond drill core using the 2012 drill database in the 2012 KCA / MDA Technical Report and came to a similar conclusion as the AMEC study. Both the comparative statistics (Table 10.3) and the quantile-quantile distribution plot (Figure 10.2) of drill data from within the Mineral Resource boundary indicated little to no global difference between the core and RC data. While the average gold values for each drill type are very similar, there was slightly more variation within the core versus the RC data, as indicated by the higher standard deviation and coefficient of variation values.

Table 10.3 Core and RC gold analyses

Drill type	Number samples	Mean	Median	Min	Max	Std Dev	CV
Core	28,521	0.492	0.225	0	59.9	1.241	2.535
RC	19,790	0.46	0.235	0	44.3	1.04	2.261

Source: 2012 KCA / MDA Technical Report.

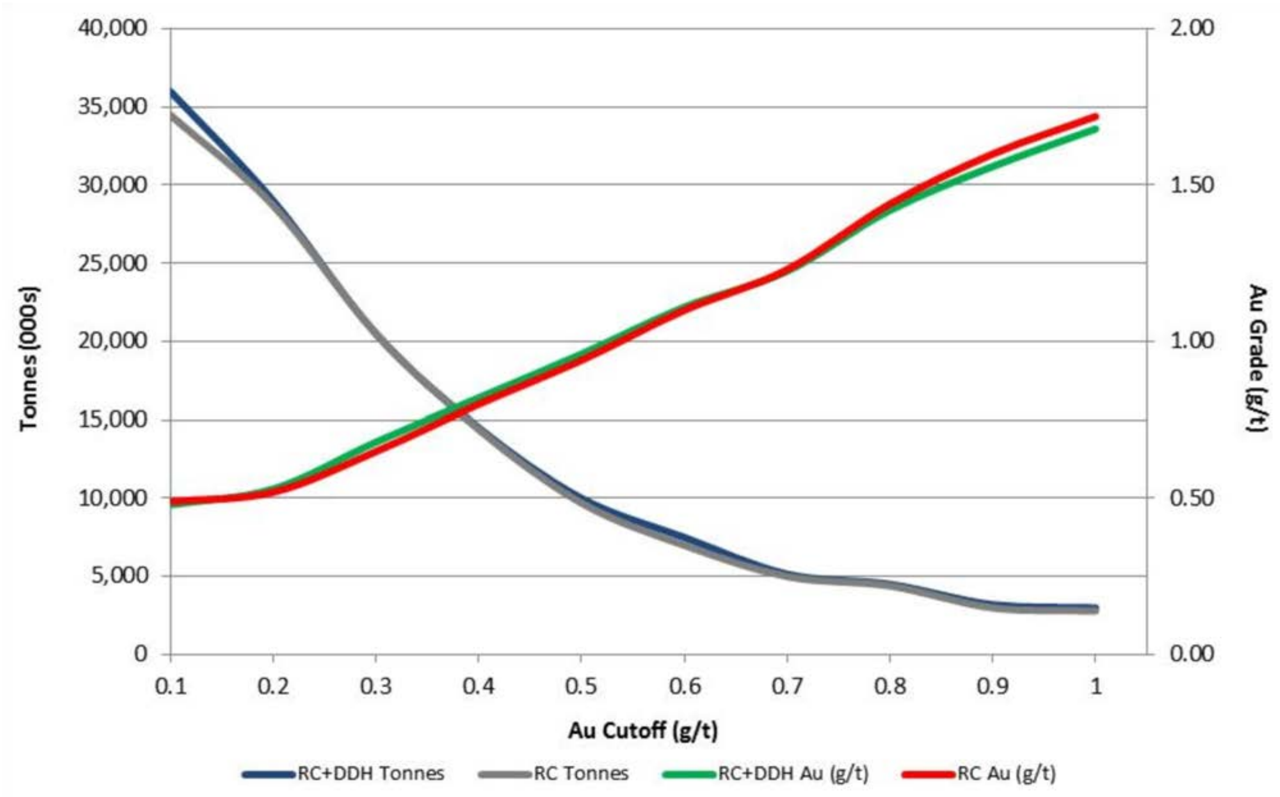
Figure 10.2 Comparative plot of core and RC gold assays



Source: 2016 Technical Report.

To further investigate potential differences between RC sample and core drilling derived data, Tahoe modelled estimates based on RC data only and RC + diamond core data in the area south of the Choloque Fault. The RC drilling in this area is generally 25 m x 25 m spaced and the diamond core is generally 50 m x 50 m spaced. The same geologic model and estimation parameters were used for both estimates with the results constrained within a $1,400/oz Au pit shell. The results shown in Figure 10.3 demonstrate there is no appreciable difference between the gold estimates based on the RC only and the RC + drill core datasets.

Figure 10.3 Comparison of RC to RC + drill core model estimates



Note: Mineral Resource area south of Choloque Fault.
Source: 2016 Technical Report.

10.10 Pan American 2019-2022 drilling

10.10.1 Summary

From Pan American's acquisition of Tahoe Resources in 2019 through the effective date of the 2022 Mineral Resource estimate (June 30, 2022), Pan American continued infill drilling within the current Mineral Resource and pit shell and exploration drilling to test potential Mineral Resource extensions outside of the defined pit, principally testing the deep sulfide targets. In addition, geometallurgical and hydrogeological drilling was carried out to support mine planning. Drilling by Pan American during this period includes 56 core and 217 RC holes totaling 34,832 m, as summarized in Table 10.4.

Table 10.4 Pan American drilling 2019 - 2022 by year

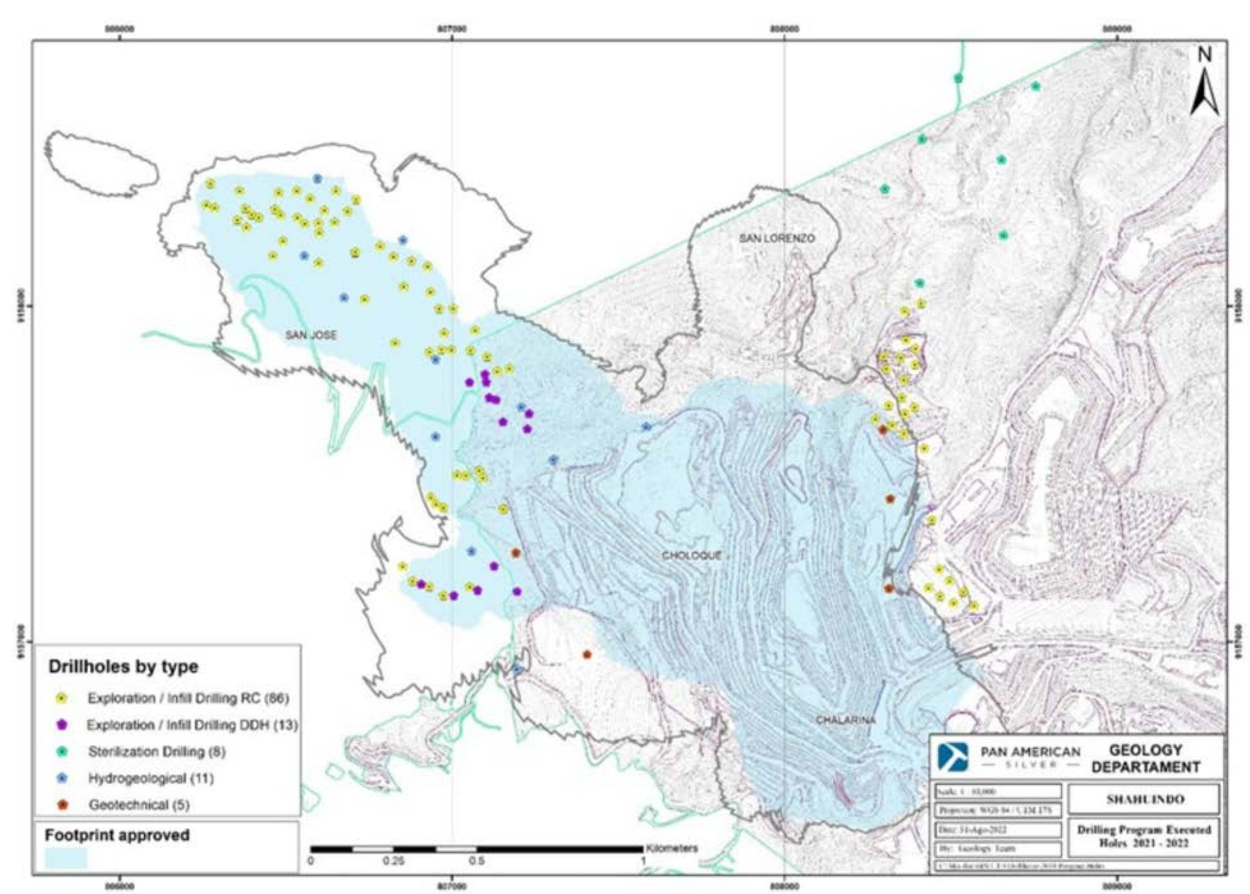
Year	Diamond core		Reverse circulation		Total drillholes	Total metres
	Number	Metres	Number	Metres		
2019	-	-	7	1,437	7	1,437
2020	30	4,905	65	7,999	95	12,904
2021	-	-	40	5,674	40	5,674
2022	26	2,809	105	12,008	131	14,817
Totals	**56**	**7,714**	**217**	**27,118**	**273**	**34,832**

Table 10.5 shown the breakdown of the drilling by purpose during the 2019-2022 period and the location of this drilling is shown in Figure 10.4 by purpose.

Table 10.5 Pan American drilling 2019 - 2022 by purpose

Purpose	Diamond core		Reverse circulation		Total	Total
	Number	Metres	Number	Metres	drillholes	metres
Infill	21	2,188	199	22,943	220	25,131
Exploration (sulfide target)	3	1,405	-	-	3	1,405
Geometallurgical	27	3,500	-	-	27	3,500
Geotechnical	5	621			5	621
Hydrogeological	-	-	18	4,175	18	4,175
Totals	**56**	**7,714**	**217**	**27,118**	**273**	**34,832**

Figure 10.4 Pan American 2019 - 2022 drillhole location map



10.10.2 Infill drilling

A total of 220 holes (21 core and 199 RC holes) for 25,131 m were drilled inside of the current Mineral Resource boundary and pit shell to aid in geologic interpretation and confirm grade estimates and potentially upgrade Mineral Resource in areas of wide-spaced drilling. Infill drilling concentrated in the south Chalarina, Choloque, San Jose, and San Lorenzo zones. No post-Mineral Resource extension drilling was completed during this time period.

10.10.3 Other drilling

Exploration drilling: three diamond drillholes totaling 1,404.9 m were completed in 2020 to test deep sulfide targets below the LOM oxide pit. These holes were designed to test structural intersections or feeder structures controlling higher grade polymetallic mineralization.

Geotechnical drilling: five diamond drillholes totaling 621 m, were completed in and around the proposed pit shell to validate and augment the results from prior geotechnical characterization studies.

Geometallurgical drilling: a total of 27 PQ sized diamond drillholes totaling 3,500 m were completed throughout the LOM pit to support ore characterization studies that were incorporated in pit, process and mine planning studies and design.

Hydrogeological drilling: 18 RC drillholes holes totaling 4,175 m were completed in the Choloque and Chalarina zones to support mine planning studies and design.

11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Historic sampling prep, analyses, and security

Descriptions of sample preparation procedures, analyses, and security for exploration programs prior to Pan American's 2019 drill program are summarized below:

11.1.1 Attimsa (1992)

- No information is available on Attimsa's sample preparation procedures, analyses and security used for their 1992 core drill program.
- Atimmsa used SGS laboratory as the primary laboratory though details for specific sample preparation, analytical methods, or laboratory certification at the time of Atimmsa's drilling program are not available.
- Review of the data on cross section suggests the Atimmsa data to be sufficiently reliable for inclusion in the resource model database.

11.1.2 Asarco (1994-1996)

- All Asarco drill-hole samples were analyzed for gold and silver by one-assay-ton fire assay. In 1994 Asarco used SGS laboratory, in 1995 Asarco used Skyline Laboratories, Inc., SGS, CIMM Peru S.A., and Actlabs, Inc. and SGS was the primary lab again in 1996. SGS, Skyline and Actlabs are currently ISO/IEC 17025 certified, but laboratory certifications are uncertain at the time of Asarco's work.

11.1.3 Southern Peru (1997-1998)

- No information is available regarding sample preparation or analysis for Southern Peru's drilling. Assay certificates from the 1997 and 1998 campaigns show that samples were analyzed by CIMM in Lima for gold and silver plus copper, lead, zinc, molybdenum, arsenic, bismuth, antimony, and mercury (Wright et al., 2010b). Southern Peru also re-assayed five drill holes from Asarco's 1994 drilling at CIMM in Lima.

11.1.4 Sulliden (2003-2012)

- Between 2003 and 2012, Sulliden's samples were submitted to ALS Minerals (ALS, formerly known as ALS Chemex) in Lima for sample preparation and analysis. The ALS laboratory in Lima is ISO 9001:2008 and ISO 17025:2005 certified.
- Samples were received, logged into the laboratory information management system, weighed, dried, and crushed to 70 percent passing plus two millimeters. Crushed samples were separated with a riffle splitter to obtain 250-gram sub samples, which were pulverized to 85 percent passing 75 µm.
- Between 2003 and 2012, gold was assayed with a 50-gram fire assay (FA) with atomic absorption (AA) finish. For samples with greater than 10 grams per tonne (g/t) Au, the fire assay was repeated with a gravimetric finish.
- In 2003 and 2004, silver was assayed from a 5-gram split, digested by aqua regia and read by AA (ALS method AA47); ALS method AA46 was used for values greater than 100 g/t Ag. Between 2007 and 2012, 31 major and trace elements including silver, copper, arsenic, bismuth, and antimony were determined through ICP-AES analysis from a separate split. For samples greater than 100 g/t Ag, a silver assay was carried out from another 5-gram split, digested in aqua regia and read by AA. For samples having greater than 1,000 Ag g/t, silver was assayed by a 50-gram fire assay and a gravimetric finish. Mercury was analyzed with the cold vapor / AA method.
- For 2003 drilling, a total of 2,435 samples were assayed for gold, and pulps for each gold sample above 0.3 g/t Au in mineralized zones were re-assayed for silver. Starting with the 2004 drilling, silver was assayed for all mineralized intersections.

11.1.5 Rio Alto (2014-2015)

- Samples from Rio Alto's 2014-2015 core and RC drill programs were analyzed by CERTIMIN laboratory in Lima. Gold was assayed using a 50-gram fire assay with an atomic absorption finish (CERTIMIN method IC-EF-01). For results greater than 10 g/t Au, the fire assay was repeated using a gravimetric finish (CERTIMIN method IC-EF-10). The procedure for silver analysis used by CERTIMIN is the same as the ALS method used by Sulliden but did not include gravimetric finish for samples greater than 1,000 g/t Ag. The CERTIMIN laboratory is ISO 9001 certified for geochemical, metallurgical, and environmental sample analyses.

11.1.6 Tahoe (2016-2018)

- Tahoe continued to use the CERTIMIN laboratory in Lima as its primary assay lab for all drilling at the Shahuindo project following the same procedures described above for Rio Alto.

The discussion below primarily refers to work carried out by Pan American, however, some of the procedures detailed below have been carried forward from previous operators.

11.2 Pan American sampling prep, analyses, and security

11.2.1 Diamond drill core sampling

Pan American employs the following procedure for diamond drill core sampling; competent core is split lengthwise with a diamond-blade rotary saw; disaggregated core was sampled using a spatula to take half of the sample. Sample lengths are typically 2.0 m but are reduced to break samples at lithologic contacts or changes in oxidation state. Where core was completely disaggregated, sample lengths were changed to coincide with drill runs to minimize mixing between samples of differing core recoveries.

11.2.2 RC chip sampling

Pan American implements the following procedure for RC sampling; standardized sample intervals are of 2.0 m. Different drilling and sampling procedures were used for dry versus wet ground as described below. Over 85% of the meterage completed was drilled dry.

Drilling in dry ground: In most cases, a 5¼-inch frontal recuperation hammer drill was used with pressurized air. In exceptional cases, a conventional 5¼-inch hammer was used based on ground conditions. Samples were reduced using a riffle splitter. The reject (70%) was retained for check-assay sampling. Samples were collected in polyethylene bags and were identified with the corresponding sample number. Each sample was sealed after inserting the laboratory tag number.

Drilling in wet ground: When intersecting ground water, argillaceous material in contact with water, or heavily fractured ground, pressurized air with minimal water was used with a conventional 5¼-inch SD5 hammer. Alternatively, a tricone bit was used where the recovery of cuttings was poor. A gyratory splitter was used to reduce sample size to a 30 / 70 split. Samples were collected with filter bags in truncated buckets in order to avoid spills or contamination.

A double-bagging system was incorporated for samples to be forwarded to the lab. A cloth bag with low filtration capacity was used inside a micro-porous cloth bag with high filtration capacity. If the bags were filled to capacity, both were tied-off separately, tagged, left for filtering, and dried prior to transportation to the primary assay laboratory. The rejects were received in a cloth bag and left for filtering and drying prior to being bagged in a polyethylene bag, tagged, and stored. Where reject samples were too large for a single bag, more than one sample was often obtained. The resulting additional bags filled with the corresponding samples and water from the same drilled interval were filtered and dried before being combined in one polyethylene bag, which was then identified and stored.

11.3 Sample storage

Pan American maintains core-storage facilities at the project site and one leased storage warehouse in the city of Cajamarca. All core generated at Shahuindo is stored at either of these facilities.

Archived drill core is stored in wooden and corrugated plastic boxes under cover at the core-storage facilities. Core boxes are in racks and stacked by hole number.

RC and laboratory coarse rejects and pulps are stored at the project site in a secure metal building. Coarse rejects are stored in labelled plastic bags and organized by hole and campaign. Pulps are stored in envelopes in cardboard boxes.

Stored coarse rejects and pulps are in varying condition. Some materials from previous operators were reorganized and transferred to new plastic bags by Sulliden to prolong their useful life and make locating individual samples more convenient. Pan American maintains a drill sample inventory of project materials including certificates, core, coarse rejects, and pulps.

11.4 Sample preparation and analysis

Since 2014 all samples for the Shahuindo drill programs have been analyzed by CERTIMIN laboratory in Lima an independent contract laboratory located in Lima. The CERTIMIN laboratory is ISO 9001 certified for geochemical, metallurgical, and environmental sample analyses.

Gold was assayed using a 50-gram fire assay with an AA finish (CERTIMIN method IC-EF-01). If the result was greater than 10 g/t Au in the initial fire assay, the fire assay was repeated using a gravimetric finish (CERTIMIN method IC-EF-10). Silver was assayed from a 5-gram split, which was digested by aqua regia and read by AA. For samples having greater than 100 Ag g/t, a silver assay was carried out from another 5-gram split, which was digested in aqua regia and read by AA.

An on-site prep and analytical laboratory designed and constructed by Pan American and operated by SGS was commissioned in August 2021. The laboratory is only being used for mine production and grade-control analyses. For all exploration samples, Pan American used the CERTIMIN laboratory in Lima as its primary assay lab until July 2021. SGS Lima lab was used from July 2021 to May 2022.

11.5 Sample security

Project management at Shahuindo has continually maintained oversight of sample security from the Property to laboratory facilities. Since 2014, all samples were shipped directly from the project site to the CERTIMIN laboratory in Lima.

Chain of custody procedures consist of filling out sample submittal forms that are physically handed to the laboratory with sample shipments to ensure that all samples are received by the laboratory.

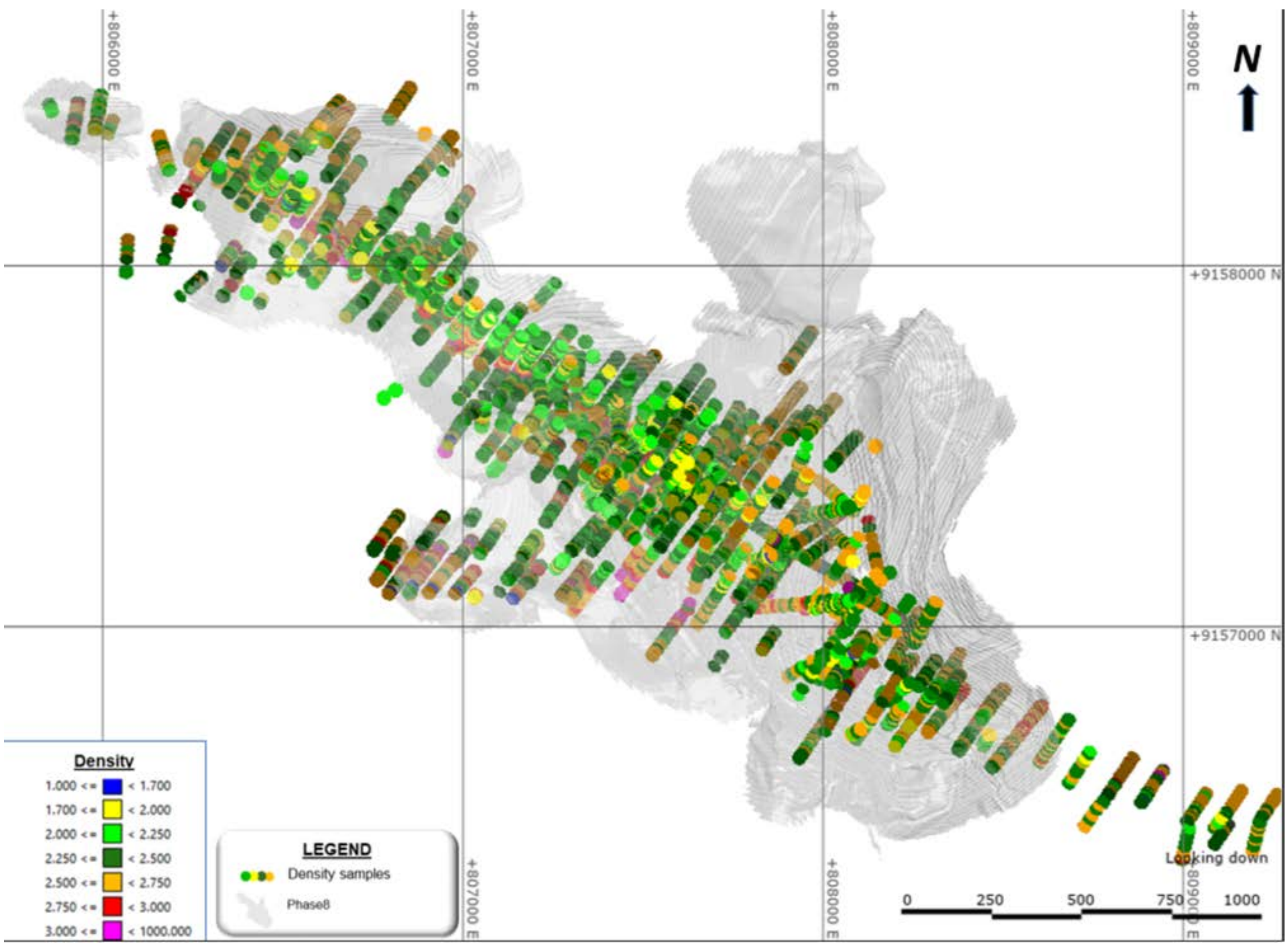
11.6 Bulk density determinations

The database contains 6,570 specific gravity measurements. Samples for measurement have been collected from all significant rock types along the extent of the deposit.

Samples were taken during various drill campaigns from drill core located throughout the deposit. In 2004 and 2005, 87 drill core samples were sent to ALS in Lima for specific gravity determination (Saucier and Poulin, 2004; Saucier and Buchanan, 2005). In 2010, 353 core samples from Sulliden's 2009 and 2010 drill campaigns were sent to KCA in Reno, Nevada for specific gravity measurements. In 2011 and 2012, Sulliden submitted 971 core samples to KCA in Reno and SGS and ACME in Lima, Peru. Drill core specific gravity measurements conducted by KCA, ACME, and SGS used the coated immersion / water displacement method.

From 2019 to 2022 Pan American sent 5,276 drill core samples to CERTIMIN lab in Lima where density measurements were collected using a standard paraffin-coated sample method. The extensive density database now provides accurate density data for specific lithologies, alteration and ore types in the Mineral Resource estimation. A map showing distribution of density measurements is shown in Figure 11.1.

Figure 11.1 Density sample location map



Source: PAS (2021).

11.7 Quality Assurance and Quality Control

Descriptions of Quality Assurance and Quality Control (QA/QC) data and performance for exploration programs prior to Pan American's 2019 drill program are summarized below:

11.7.1 Historic Quality Assurance and Quality Control

11.7.1.1 Attimsa (1992)

- No information is available for Attimsa's QA/QC program for their 1992 core drill program. This is considered to be of minimal risk to the current resource given the small number of samples compared to the considerably larger resource database.

11.7.1.2 Asarco (1994-1996)

- According to Saucier and Poulin (2004), Asarco analyses included internally prepared standards with every batch of drill samples and the standards had highly reproducible gold and silver values. Pan American has no details on the results of these standards. According to Fletcher (1997, cited by Saucier and Poulin, 2004), "[The laboratory] generally has very good precision…in their assays, but their results are typically 5-7% low for gold, and 11-15% low for silver relative to the standards. This discrepancy is probably due to matrix effects in the standards which have carbonate content, versus the routine drill samples which have none."
- A total of 1,835 duplicate samples were prepared and sent to a separate laboratory as a check assay. According to Fletcher (1997, cited by Saucier and Poulin, 2004), in general, the check assays validated the original assay values.
- Pan American has no reason to doubt Fletcher's (1997) analysis and conclusions but cannot confirm the results as no data is available for Asarco's standards or check assays.

11.7.1.3 Southern Peru (1997-1998)

- No information is available for Southern Peru's QA/QC program for their 1997-1998 drill programs. This is considered to be of minimal risk to the current resource given the small number of samples compared to the considerably larger resource database.

11.7.1.4 Sulliden (2003-2012)

- For Sulliden's 2003 drilling, no blanks, duplicates, or standards were included to check the original assay results. However, 200 pulps taken randomly within the mineralized intervals were sent to SGS for re-assay for gold by fire assay with AA finish and gravimetric finish for gold grades over 5 g/t. Silver was assayed by multi-acid digestion with an AA finish. Saucier and Poulin (2004) reported that there was a "good correlation" between the original and check assays.
- No blanks, site duplicates, or standards were submitted as checks of Sulliden's original assays from their 2004 drill program (Saucier and Buchanan, 2005). However, 355 pulps were randomly selected from within mineralized intervals by Sulliden and sent to Actlabs in Lima for gold and silver check assays. Saucier and Buchanan (2005) reported that "a fairly good correlation could be found between the original values and the reanalysis."
- AMEC reported that except for the reject check program in 2003 and 2004, Sulliden did not apply QA/QC procedures until their 2009 drill program (Wright et al., 2010b). In 2009, Sulliden instituted commercially prepared standard reference materials, fine blanks, field duplicates for RC drilling, core duplicates for diamond drilling, and coarse-crush reject and pulp duplicates. The following information is summarized from the 2010 AMEC report (Wright et al., 2010b) for Sulliden's 2009-2010 drilling programs:
  –

- For the first stage of their 2009-2010 core and RC drill programs, Sulliden analyzed 110 RC field duplicates, 38 core duplicates, 99 coarse-crush reject duplicates, and 99 check assays performed at SGS in Lima, in addition to fine blanks and four commercial standards included with sample batches. AMEC concluded that based on analysis of the results of standards and check assays, the accuracy of the gold assays was "excellent," whereas based on analysis of the check assays, the accuracy of silver assays was not as good as the accuracy of the gold assays (Wright et al., 2010b).

- Based on analysis of RC and core field duplicates, AMEC concluded that the sampling precision for gold was acceptable for the resource estimate used for feasibility-level analysis (Wright et al., 2010b). Silver grades were not analyzed for the core and RC field duplicates. Analysis of the gold results of coarse-crush duplicates indicated that sub-sampling precision was better than generally accepted limits. Silver grades of coarse reject duplicates were not assayed.
- No pulp duplicates were analyzed as part of the 2009 Sulliden drill program. Analytical precision is generally established by the analysis of pulp duplicates.
- Analysis of 80 blank samples found only two minor issues above "a practical detection limit" of 0.02 Au g/t. A plot of blank grades versus previous sample grade showed no correlation (Wright et al., 2010b).
- Sulliden completed a comprehensive QA/QC testing program in 2011 and 2012, which included the analysis of commercially prepared standard reference materials, fine blanks, field duplicates for RC drilling, core duplicates for diamond drilling, and coarse-crush reject and pulp duplicates. The laboratory analyses for the standards, fine blanks, RC field duplicates and core duplicates were completed at ALS while the analysis of the pulp duplicates were completed at SGS. A review of standards by MDA suggested that "overall the analyses of standards suggest that Sulliden's gold analyses may be, in aggregate, very slightly conservative" (Defilippi, et. al., 2012). There were 1,843 analyses of blank material, with only two counting as failures at a nominal 0.01 g/t failure line.

11.7.1.5 Rio Alto (2014-2015)

The following QA/QC procedures and results are applicable to the Rio Alto (2014-2015) drilling included in the 2016 Resource estimate. A summary of inserted QA/QC samples is shown in Table 11.1 below:

- Rio Alto completed a large RC and diamond core infill drill program in late 2014 and early 2015. The primary laboratory was changed from ALS to CERTIMIN, Lima lab on the basis of high-quality QA/QC and better turnaround experienced at the La Arena operations.
- Rio Alto inserted blanks, standards, and field duplicates into the sample stream to check the field and lab QA/QC process. Blanks showed no evidence of contamination and field duplicates showed good repeatability despite a low insertion rate. Review of the standards results showed CERTIMIN assays low in the lower silver grade results and, to a lesser extent in the gold results. There appeared to be a consistent low bias at the CERTIMIN laboratory, mainly affecting silver assays.

Table 11.1 Summary of Rio Alto QA/QC program included in Tahoe 2016 Resource Estimate

Type	DDH samples	RC samples	Duplicates	Duplicates (%)	Blanks	Blanks (%)	Standards	Standards (%)
Geotechnical	586		27	4.6%	32	5.5%	31	5.3%
RC		11,631	166	1.4%	600	5.2%	587	5.0%
DDH	373		17	4.6%	18	4.8%	20	5.4%
Total	**959**	**11,631**	**210**	**1.7%**	**650**	**5.2%**	**638**	**5.1%**

Blanks

- Certified fine blanks at an average grade of 0.006 g/t Au and 0.3 ppm Ag were purchased from SGS and inserted into the sample stream approximately every 50 m downhole in RC holes and at or near the end of runs of mineralization in the diamond core holes. No failures were observed with nominal 0.012 g/t Au and 0.6 ppm Ag upper acceptable limits of tolerance; well below a limit that would affect the resource estimate for either element. There was no evidence of additional contamination after higher grades were encountered in the sample prior to the blank.

Field duplicates

- Rio Alto analyzed field duplicate samples from RC data which showed generally good to very good repeatability in most grade ranges for both gold and silver despite a low insertion rate. Outliers were rare and not extreme, particularly given the observed nugget variance in the variography. The repeatability of sampling at lower gold grades close to the anticipated cut-off grade was found to be acceptable. Core field duplicates were not analyzed as there were not a statistically valid number of diamond core samples for analysis (27 core samples).

Standards

- Results for four commercially prepared standards from SGS (Lima) used by Rio Alto were reviewed. The three lower grade standards (ST05, ST06, ST54) show gold results biased slightly lower. All silver results are biased low (Table 11.2), with the lower grade silver standards showing the most bias. These results suggested a calibration error at the CERTIMIN Lima laboratory with follow-up work recommended.

Table 11.2 Summary of Rio Alto standards used in Tahoe 2016 Resource Estimate

Standard	No. of control samples	Certified mean Au (g/t)	Control sample mean Au (g/t)	Bias for Au (%)	Certified mean Ag (g/t)	Control sample mean Ag (g/t)	Bias for Ag (%)
ST05	75	0.485	0.456	-6%	14.8	12.63	-15%
ST06	47	0.530	0.513	-3%	8.4	6.44	-23%
ST54	242	0.794	0.763	-4%	17.7	16.49	-7%
ST50	235	0.871	0.869	0%	23.4	22.51	-4%

11.7.1.6 Tahoe (2016-2018)

- A separate QA/QC analysis was not conducted by Tahoe Resources in 2016-2018. Tahoe drill data was incorporated with Pan American drill data generated during 2016-2022 and incorporated into the Mineral Resource estimate of this report.
- As describe in the 2016 technical report, Tahoe was of the opinion that the sampling methods, security, and analytical procedures used at Shahuindo were adequate for mineral resource estimation. While information was lacking for the Atimmsa and Southern Peru data, it represented only 7.6% of the dataset and was not considered to have a material effect on the resource estimate.
- A continued program of specific gravity measurements was recommended due to the importance of bulk-density in the determination of resource tonnage.
- The 2014-2015 QA/QC program demonstrated no evidence of laboratory contamination from the analysis of the blank samples. The field duplicates displayed good repeatability, particularly around the expected gold cut-off grade to be used while mining. Standards were biased slightly low (gold) to very low (silver). This was unlikely to have any material effect on the resource estimate.
- Tahoe believed the rate of insertion of control samples was acceptable for blanks and standards, although low for RC field duplicates. Tahoe subsequently (2016) increased the insertion rate for RC field duplicates.

The discussion below primarily refers to work carried out by Pan American.

11.7.2 Pan American Quality Assurance and Quality Control

Following the acquisition of Tahoe Resources in 2019, Pan American continued with the same Quality Assurance and Quality Control programs implemented by Tahoe. For both Tahoe and Pan American Standard reference materials (SRMs) were obtained from ROCKLABS and ACTLABS external labs using a blend of various grade materials from the Shahuindo deposit. External checks are made on SRM on a quarterly basis with production samples submitted to SGS by both Tahoe and Pan American.

The drilling programs over the period from July 2016 to May 2022 by both Tahoe Resources and Pan American utilized SRMs, blanks, and field duplicates. The QA/QC samples were inserted into drill sample sequences and submitted for analysis to the CERTIMIN and SGS laboratories in Lima.

During the period from 2016 to May 2022, a total of 41,496 drillhole samples were submitted for laboratory analyses. A total of 5,530 control samples were inserted with drillhole samples, these comprise samples taken from both RC and diamond drillholes. A summary of the QA/QC samples submitted and submission rates are summarized in Table 11.3 and Table 11.4, respectively.

Table 11.3 Summary of QA/QC program 2016 – May 2022

Year	SRMs	Blanks	Field duplicates	Total QA/QC	Total samples
2016	386	475	525	1,386	10,260
2017	448	454	514	1,416	10,562
2018	368	277	350	995	6,396
2019	50	45	44	139	626
2020	80	70	72	222	4,797
2021	271	259	246	776	5,571
2022	205	201	190	596	3,284
Total	**1,808**	**1,781**	**1,941**	**5,530**	**41,496**

Source: PAS (2021).

The compliance or insertion rates for the various streams are shown below based on the total number of samples submitted.

Table 11.4 Summary of QA/QC insertion rates 2016 – May 2022

Year	SRMs	Blanks	Field duplicates	Total
2016	3.8%	4.6%	5.1%	13.5%
2017	4.2%	4.3%	4.9%	13.4%
2018	5.8%	4.3%	5.5%	15.6%
2019	8.0%	7.2%	7.0%	22.2%
2020	1.7%	1.5%	1.5%	4.6%
2021	4.9%	4.6%	4.4%	13.9%
2022	6.2%	6.1%	5.8%	18.1%
Total for period	**4.36%**	**4.3%**	**4.7%**	**13.3%**

Source: PAS (2021).

A submission rate of 4 - 5% (relative to total samples analyzed) for SRMs, blanks, and pulp and coarse duplicates is ideal. The rate of insertion of control samples is considered acceptable. However coarse and pulp duplicates should be considered to be added to the sample stream for future QA/QC campaigns to determine the precision of the laboratory for the sample preparation and assay steps.

11.7.3 Standard reference material

SRMs contain standard, predetermined concentrations of material (silver, lead, zinc, gold, etc.) which are inserted into the sample stream to check the analytical accuracy of the laboratory. SRMs should be monitored on a batch-by-batch basis and remedial action taken immediately if required. For each economic mineral it is recommended the use of at least three SRMs with values:

- At the approximate cut-off grade (COG) of the deposit.
- At the approximate expected grade of the deposit.
- At a higher grade.

Control charts are commonly used to monitor the analytical performance of an individual SRM over time. SRM assay results are plotted in order of analysis along the X-axis. Assay values of the SRM are plotted on the Y-axis. Control lines are also plotted on the chart for the expected value of the SRM, two standard deviations above and below the expected value (defining a warning threshold), and three standard deviations above and below the expected value (defining a fail threshold). Control charts show analytical drift, bias, trends, and irregularities occurring at the laboratory over time.

Three commercial standards, using material from the Shahuindo deposit, were prepared by SGS Lima and used during the 2016 - 2021 drill campaigns. Table 11.5 summarizes the SRM performance.

Table 11.5 Summary of SRM performance for 2016 – May 2022

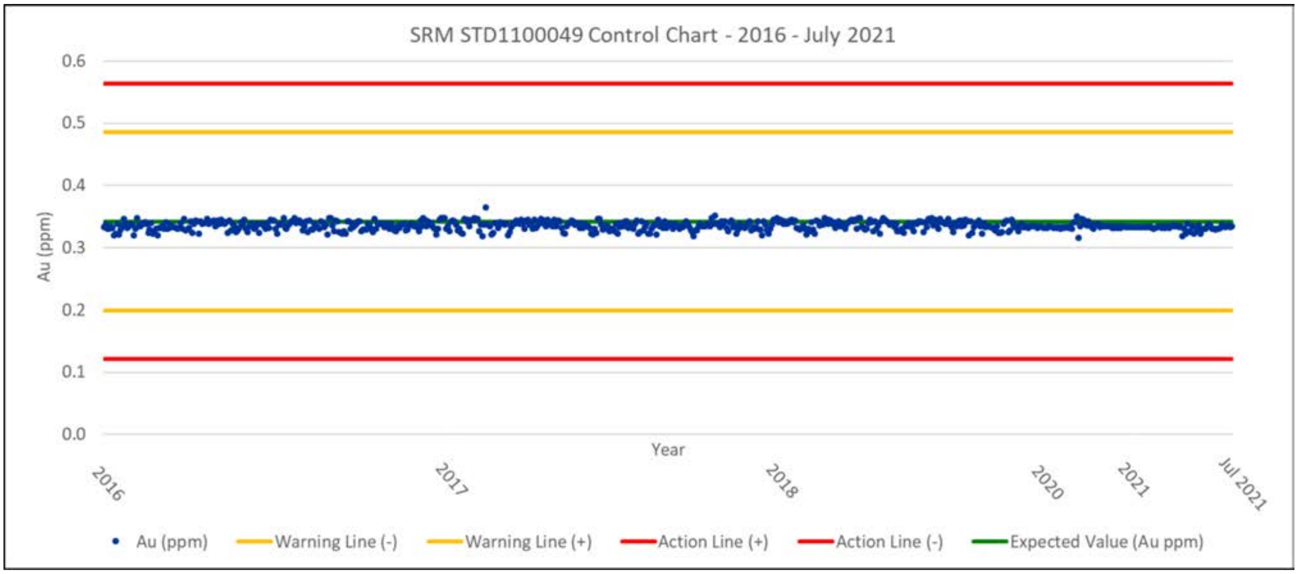
SRM	ST1100049	ST1100005	ST1100050	SHD-01	SHD-02	SHD-03	% Fail (failures ± 3SD)
Expected Value (Au ppm)	0.342	0.485	0.871	0.24	0.646	1.145	
SD	0.073	0.048	0.115	0.024	0.042	0.09	
2016	190	28	168				0
2017	216	42	190				0
2018	154	73	139				0
2019	0	0	0	18	17	15	0
2020	32	19	29				0
2021	99	87	85				0
2022	72	62	71				0

Source: PAS (2021).

The SRM control charts for each SRM for the period from 2016 to May 2022 are shown in Figure 11.2 to Figure 11.7. Separate charts are shown for the CERTIMIN, Lima lab (2016-July 2021) (Figure 11.2 to Figure 11.4) and SGS Lima Lab (July 2021-May 2022) Figure 11.5 to Figure 11.7). The red lines on each chart represent ± 3SD from the expected value.

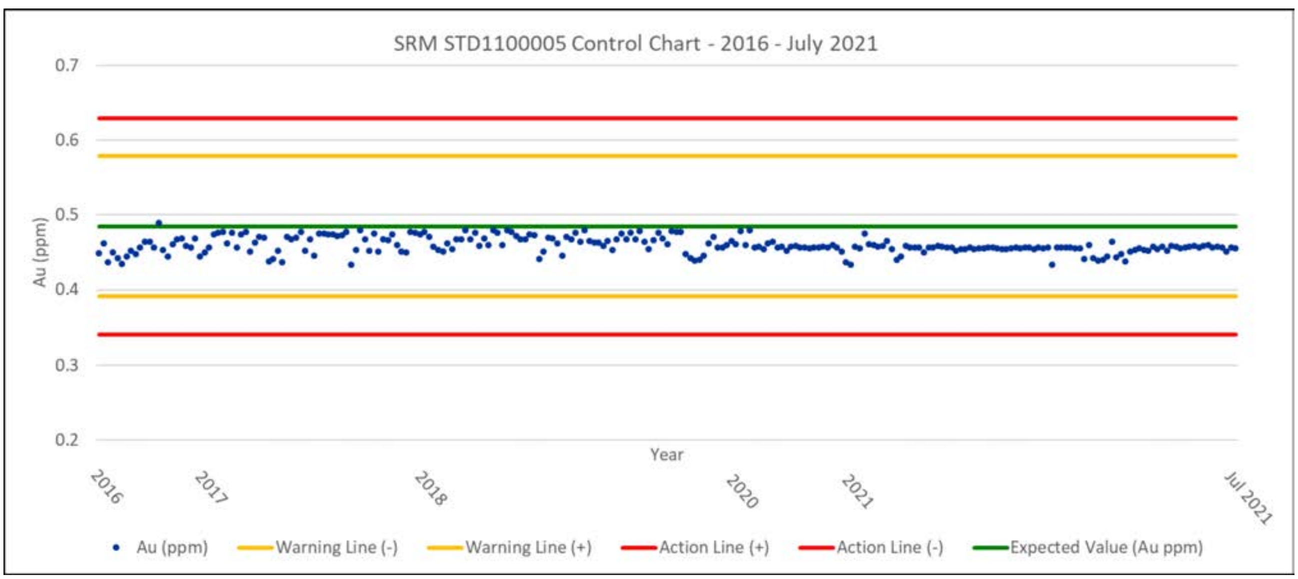
CERTIMIN Lima Laboratory

Figure 11.2 Chart of Au analyses of low-grade Standard ST00049 (CERTIMIN Lab)



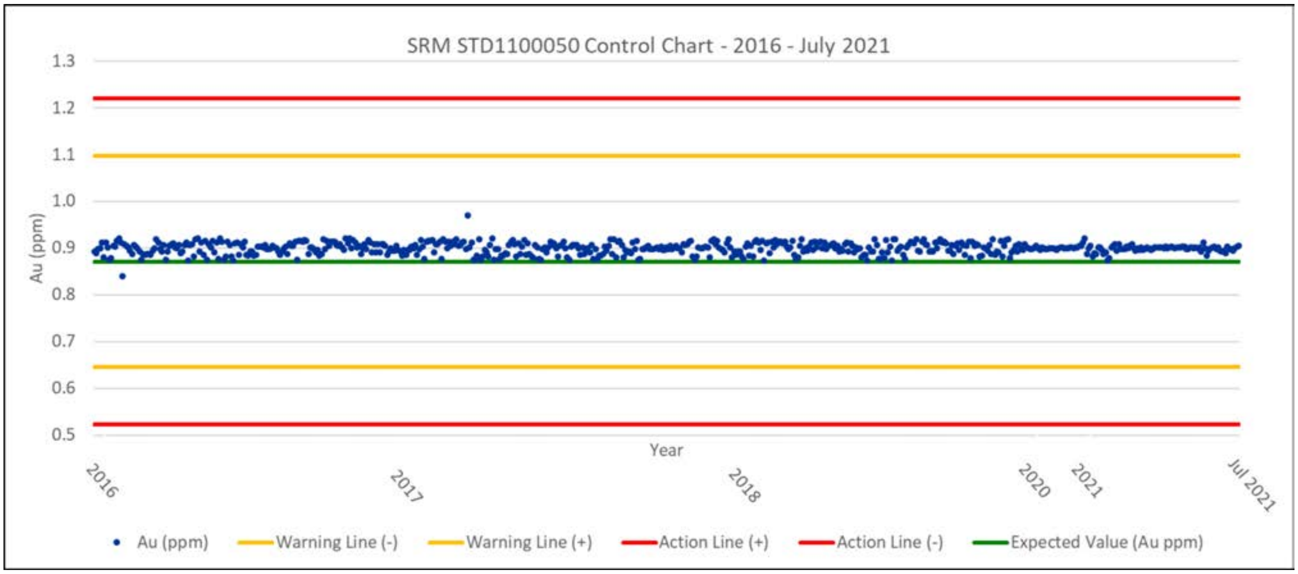
Source: PAS (2022).

Figure 11.3 Chart of Au analyses of med-grade Standard ST00005 (CERTIMIN Lab)



Source: PAS (2022).

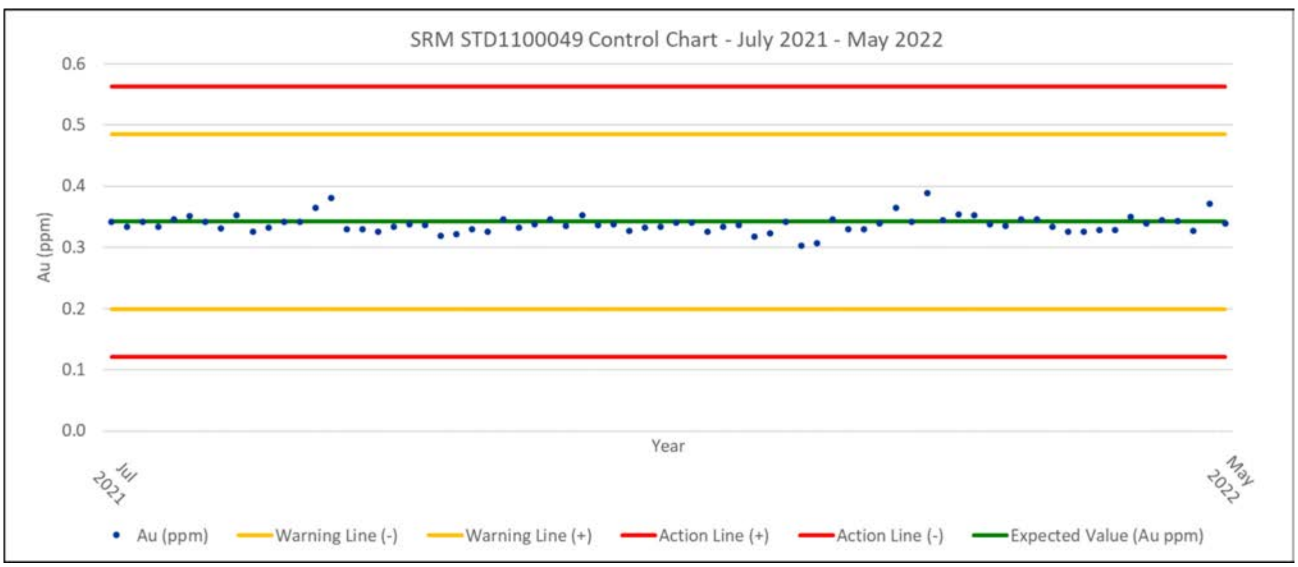
Figure 11.4 Chart of Au analyses of high-grade Standard ST00050 (CERTIMIN Lab)



Source: PAS (2022).

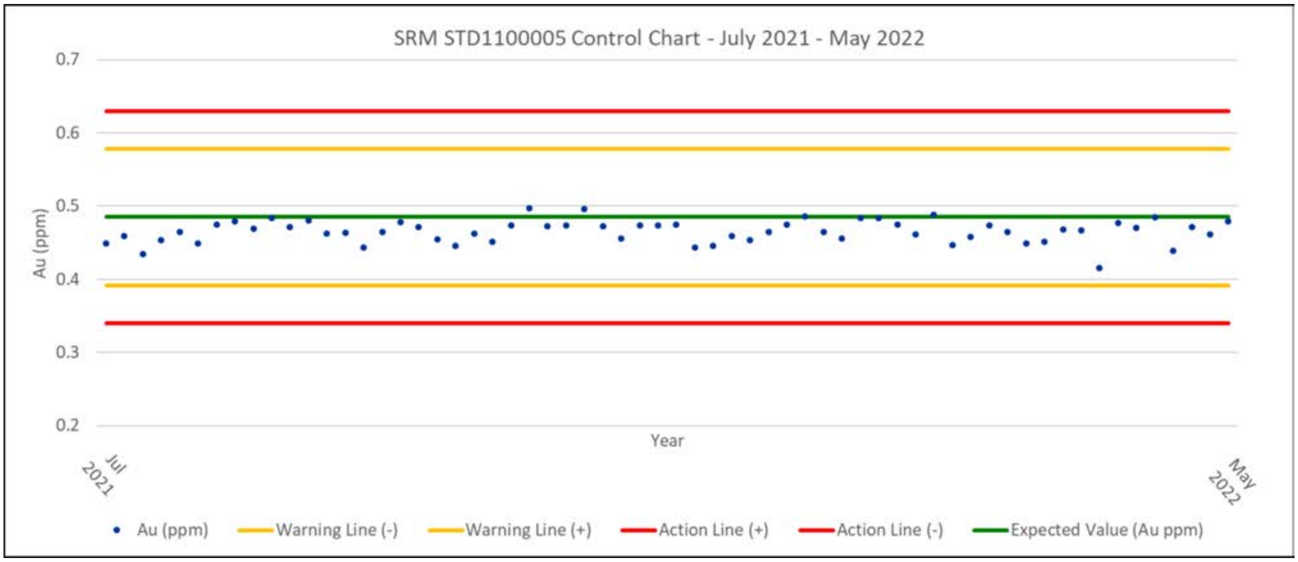
SGS Laboratory

Figure 11.5 Chart of Au analyses of low-grade Standard ST00049 (SGS Lab)



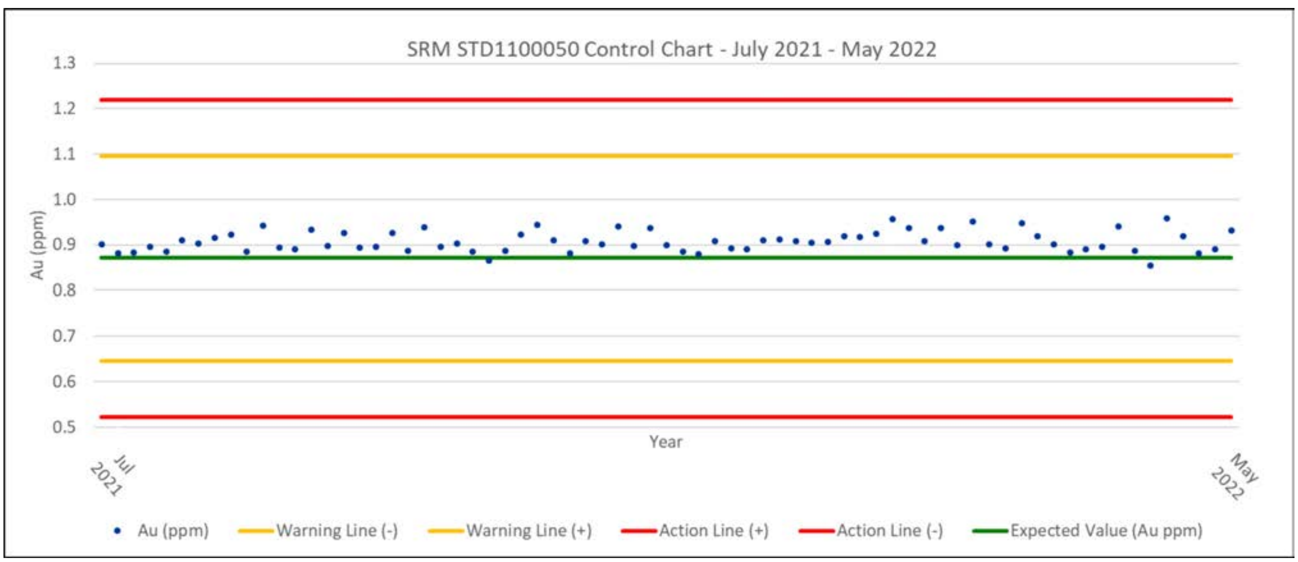
Source: PAS (2022).

Figure 11.6 Chart of Au analyses of low-grade Standard ST00005 (SGS Lab)



Source: PAS (2022).

Figure 11.7 Chart of Au analyses of low-grade Standard ST00050 (SGS Lab)



Source: PAS (2022).

The QP considers the performance of the SRMs to be acceptable, no bias or analytical drift over time is noted.

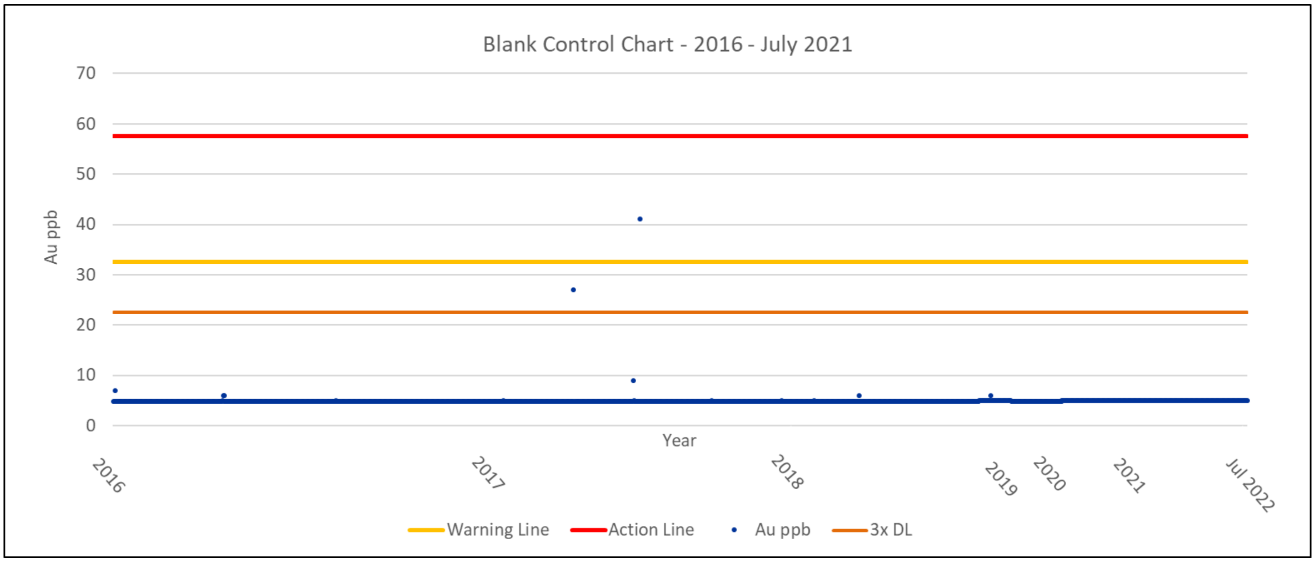
11.7.4 Blanks

Coarse blanks test for contamination during both the sample preparation and assay process. Pulp blanks test for contamination occurring during the analytical process. The QP considers any blank recording > 10 times the detection limit will be re-analyzed. No pulp blanks were submitted during the period 2016 – May 2022.

Certified coarse blanks were purchased from Target Rocks (TR-16128) and inserted into the sample stream. Blanks were usually inserted every 50 m downhole in RC holes and at or near the end of runs of mineralization in the diamond core. During the period from July 2020 to June 2022, a total of 460 blank samples were inserted into the drillhole sample batches. No failures are observed when using 3 times the detection limit. A detection limit of 4.8 Au ppb was used.

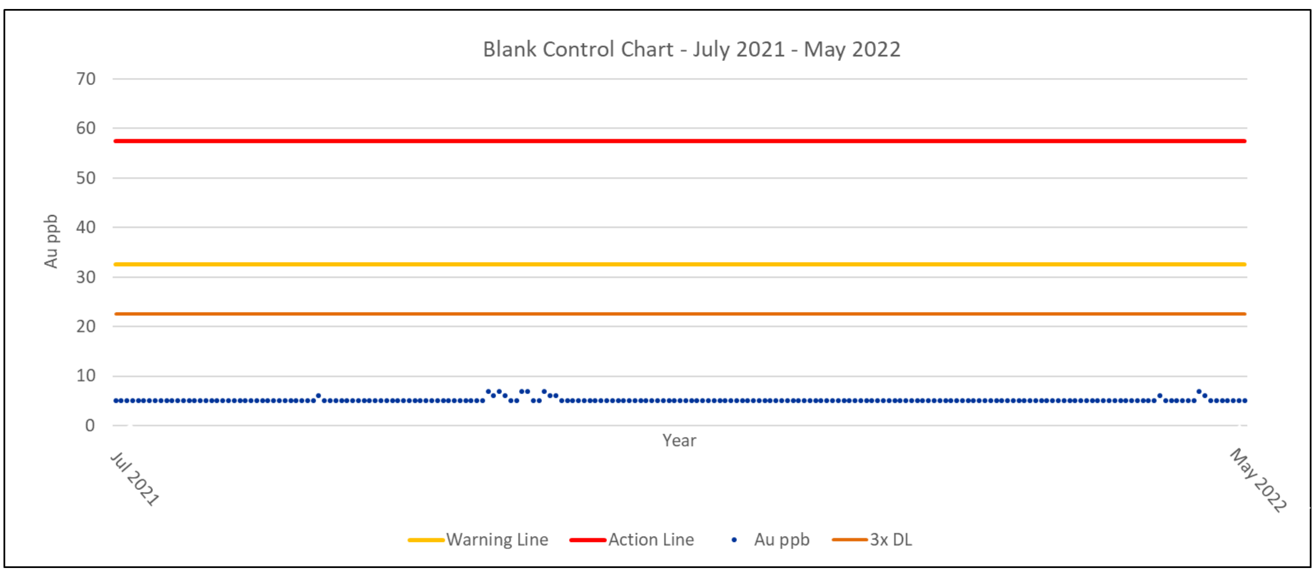
Blank control plots are shown for CERTIMIN Lab (Figure 11.8) and SGS Lab (Figure 11.9). The orange line is three times the detection limit, yellow line is 5 times the detection limit and red line is 10 times the detection limit. No failures were recorded. There is no evidence of any extra contamination after higher grades are encountered in the sample prior to the blank.

Figure 11.8 Au blank control chart – 2016 – July 2021 (CERTIMIN Lab)



Source: PAS (2022).

Figure 11.9 Au blank control chart – July 2021 – May 2022 (SGS Lab)



Source: PAS (2022).

The QP considers the performance of the coarse blanks to be acceptable.

11.7.5 Duplicates

Duplicate samples should be selected over the entire range of grades seen at the Property to ensure that the geological heterogeneity is understood; however, the majority of duplicate samples should be selected from zones of mineralization. Unmineralized or very low-grade samples should not form a significant portion of duplicate sample programs as analytical results approaching the stated limit of lower detection are commonly inaccurate, and do not provide a meaningful assessment of variance.

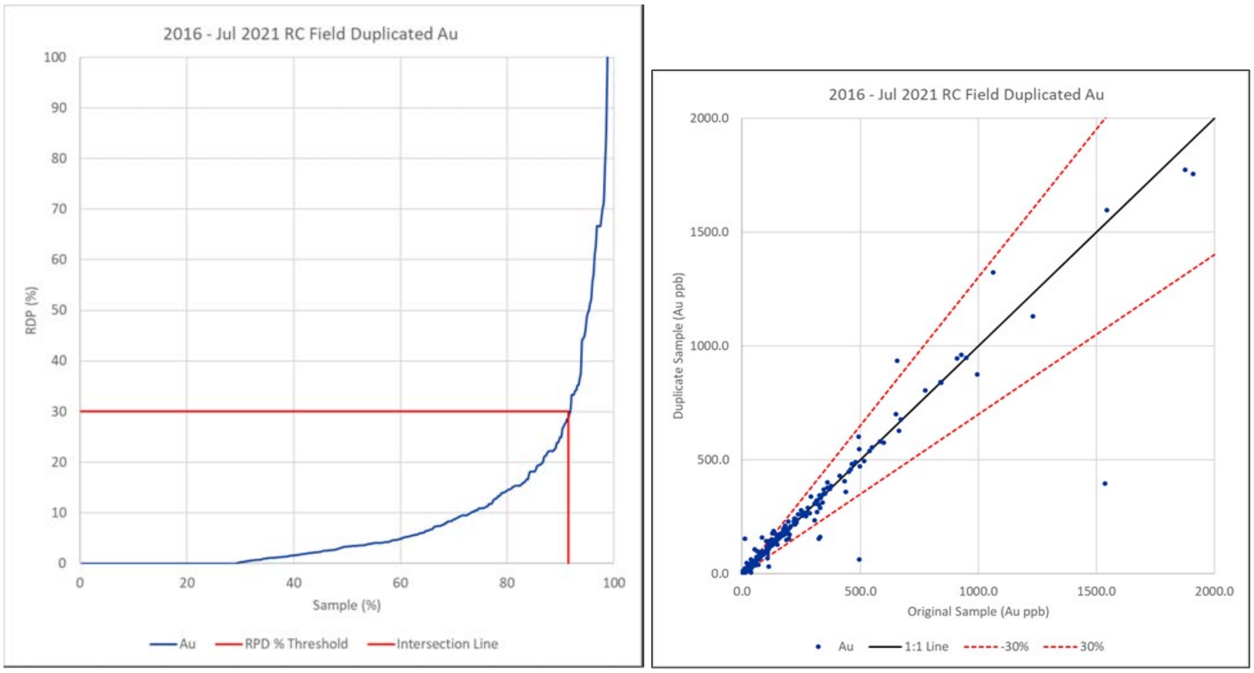
Duplicate data can be assessed using a variety of approaches. The duplicate data is typically assessed using scatter plots and relative paired difference (RPD) plots. These plots measure the absolute difference between a sample and its duplicate. For field duplicates it is desirable to achieve 80 to 85% of the pairs having less than 30% RPD between the original assay and check assay. In these analyses, pairs with a mean of less than 15 times the lower limit of analytical detection or lower detection limit (LDL) are excluded. Removing these low values ensures that there is no undue influence on the RPD plots due to the higher variance of grades expected near the lower detection limit, where precision becomes poorer (Long et al. 1997).

11.7.5.1 Field duplicates

Field duplicates monitor sampling variance, sample preparation variance, analytical variance, and geological variance. Field duplicates were inserted with core and RC samples.

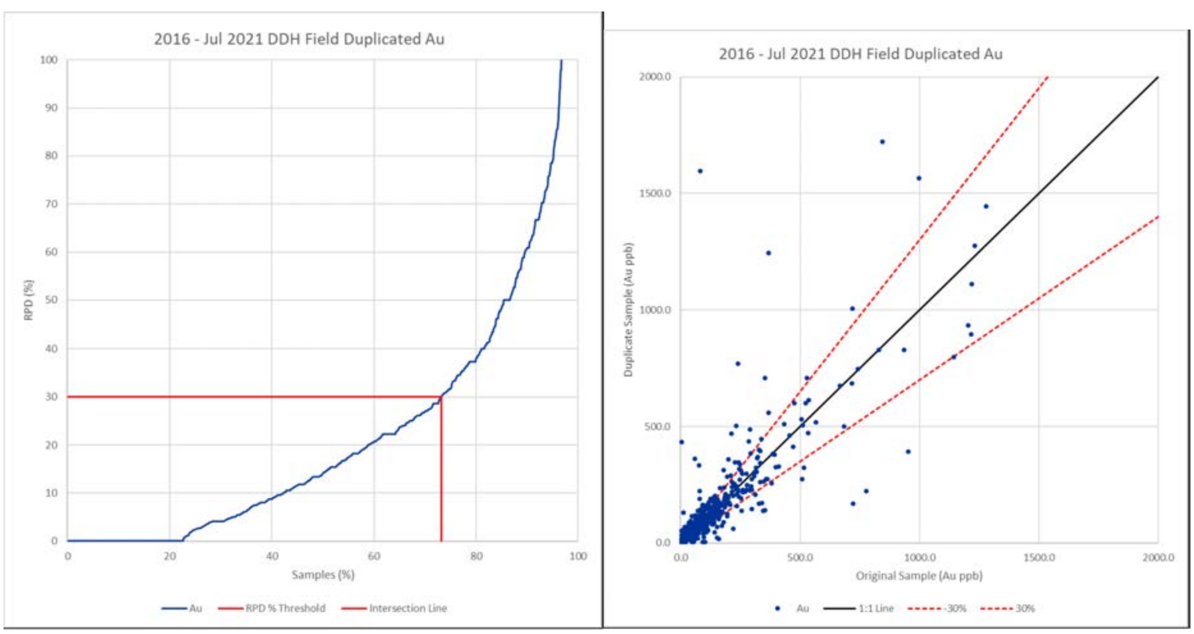
During the period from 2016 to July 2021 with CERTIMIN Laboratory, a total of 1,287 core field duplicates and 464 RC field duplicates were inserted into samples submitted to the CERTIMIN Lab. During the period from July 2021 to May 2022, a total of 74 core field duplicates and 116 RC field duplicates were inserted into samples submitted to the SGS Lab. For the purposes of assessing the field duplicate performance, the core and RC samples were separated. An LDL of 3 ppb Au was used to remove samples < 50 ppb (average with duplicate and original samples) from the analysis. An LDL of 0.2 g/t for Ag was used to remove samples < 1 ppm (average with duplicate and original samples). Figure 11.10, Figure 11.11, and Table 11.6 summarize the field duplicate performance for the CERTIMIN Lab during the period from 2016 to July 2021. Figure 11.10, Figure 11.11, and Table 11.6 summarize the field duplicate performance for the SGS Lab during the period July from 2021 to May 2022.

Figure 11.10 RPD and scatterplot Au field duplicates RC – 2016 – July 2021 (CERTIMIN Lab)



Note: Scatterplot limited to 2,000 Au ppm.
Source: PAS (2021).

Figure 11.11 RPD and scatterplot Au field duplicates core – 2016 - July 2021 (CERTIMIN Lab)



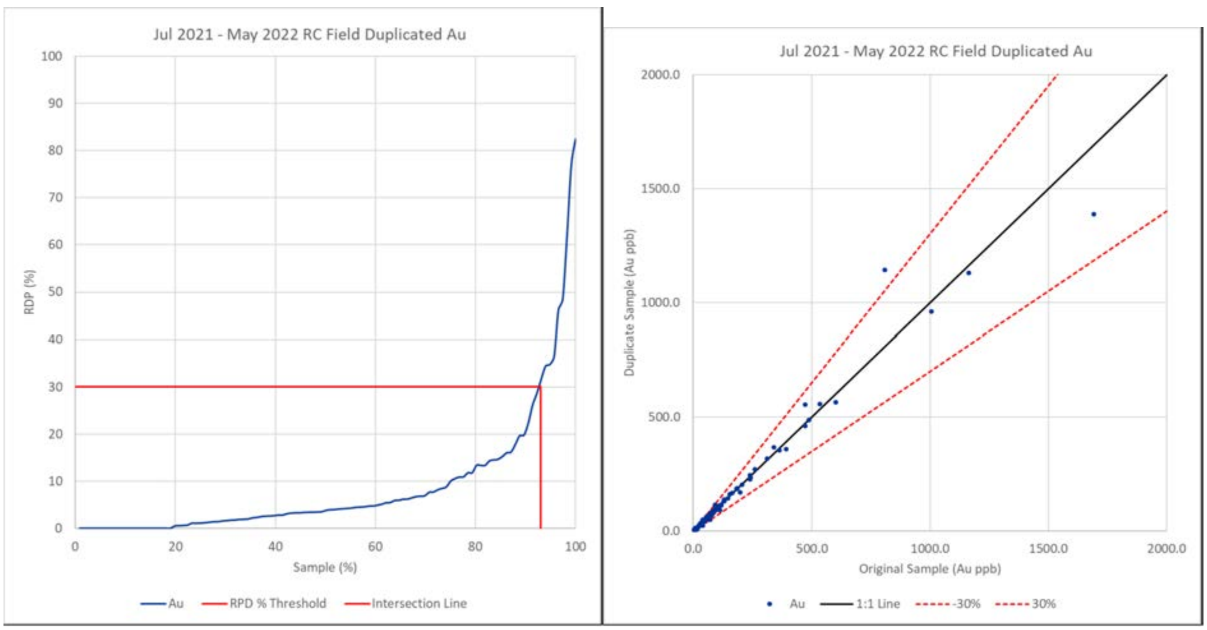
Note: Scatterplot limited to 2,000 Au ppm.
Source: PAS (2021).

Table 11.6 Summary of field duplicate performance – 2016 - July 2021 (CERTIMIN Lab)

Element		RC	Core (2016)	Core (2017)	Core (2018)	Core (2020)	Core (2016 - 2020)
Au	Field sample pairs (Pairs > 15xLDL)	464 (193)	437 (105)	489 (151)	350 (88)	11 (3)	1287 (347)
	Field sample pairs < 30% RPD	92	72	72	78	75	73
	Bias (%)	-2	0	13	17	20	11
Ag	Field sample pairs (Pairs > 15xLDL)	464 (86)	437 (66)	489 (136)	350 (72)	11 (3)	1,287 (277)
	Field sample pairs < 30% RPD	83	59	61	65	N/A	61
	Bias (%)	-4	-12	4	1	N/A	0

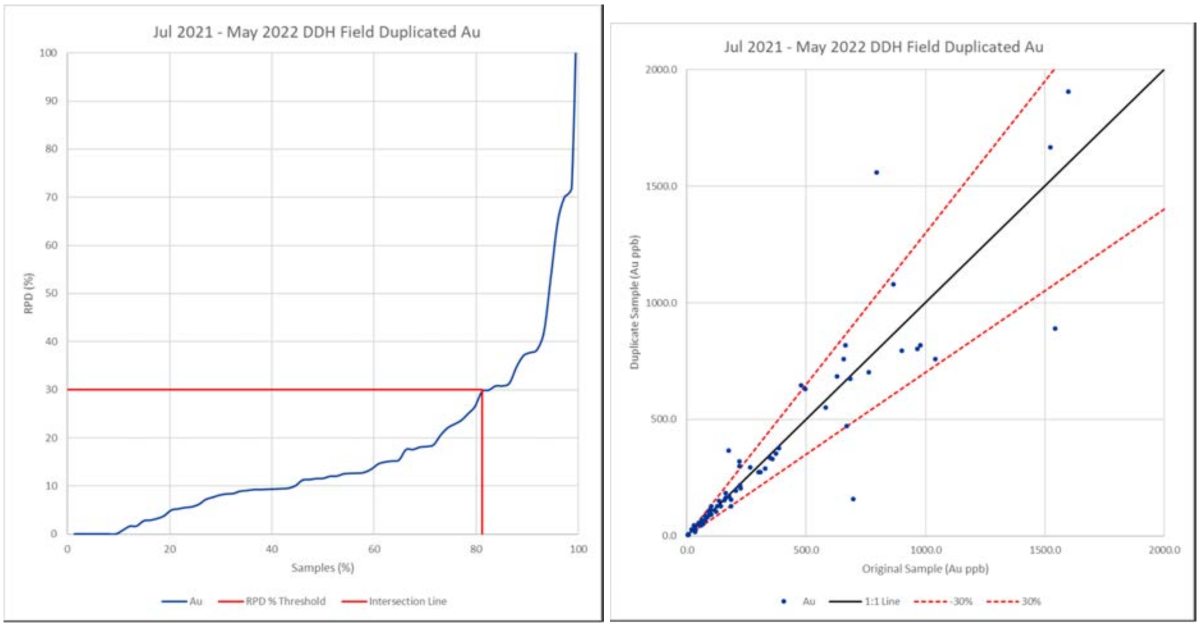
Note: Positive bias means higher mean grade in the original sample set.
Source: PAS (2021).

Figure 11.12 RPD and scatterplot Au field duplicates RC – July 2021 – May 2022 (SGS Lab)



Source: PAS (2022).

Figure 11.13 RPD and scatterplot Au field duplicates DDH – July 2021 – May 2022 (SGS Lab)



Source: PAS (2022).

Table 11.7 Summary of field duplicate performance – July 2021 – May 2022 (SGS Lab)

Element		RC	Core (2016)
Au	Field sample pairs (Pairs > 15xLDL)	116 (54)	74 (54)
	Field sample pairs < 30% RPD	93	81
	Bias (%)	-5	5
Ag	Field sample pairs (Pairs > 15xLDL)	116 (20)	74 (51)
	Field sample pairs < 30% RPD	68	80
	Bias (%)	2	-16

The QP notes the following:

- The RC field duplicates performed better than the core field duplicates.
- The performance of the core duplicates shows consistently that the original sample is higher than the duplicate sample.
- There are too few sample pairs > 15 times the LDL for Ag to make a meaningful conclusion about the performance. However, the RC duplicates performed better than the core duplicates.
- Future QA/QC programs will aim to include more duplicate with higher-grades to obtain a larger database of samples from which to make meaningful analysis of the duplicate performance.

The QP considers the field duplicate performance acceptable. The slightly lower than expected performance of the core field duplicates is most likely related to the distribution of mineralization in the core.

11.7.5.2 Coarse duplicates

Coarse reject samples monitor sub-sampling variance, analytical variance, and geological variance. No coarse reject samples were submitted during the period from 2016 to May 2022.

11.7.5.3 Pulp duplicates

Pulp duplicates monitor analytical and geological variance. No pulp duplicate samples were submitted during the period from 2016 to May 2022.

11.7.5.4 Umpire (check-lab) duplicates

Umpire laboratory duplicates are pulp samples sent to a separate laboratory to assess the accuracy of the primary laboratory (assuming the accuracy of the umpire laboratory). Umpire duplicates measure analytical variance and pulp sub-sampling variance. No umpire samples were submitted during the period from 2016 to May 2022.

11.8 Summary statement

The sampling methods, security, and analytical procedures are considered to be adequate. The QA/QC performance indicates reasonable levels of accuracy and precision. This is shown in the low failure rate of the SRMs and the good performance of the RC field duplicates. Laboratory hygiene is confirmed by the good results of the coarse blank samples. The absence of coarse, pulp, and umpire duplicates is noted. This precludes the full assessment of laboratory precision in both sample preparation and sample analysis.

However, the QP considers that the data is suitable for inclusion in the Mineral Resource estimate.

12 DATA VERIFICATION

The Shahuindo drillhole database has been subjected to four audits prior to resource estimates in 2004, 2009, 2012, and 2015. The following is a summary of the key features of those audits conducted prior to the resource estimate reported herein.

Pan American affirms that there are no limitations nor has there been a failure in the past to conduct verification of all Shahuindo project data.

12.1 Prior data verification programs

12.1.1 Met-Chem 2003 / 2004 audit

- Site visits were conducted in 2003 and 2004.
- The drill database was compared to the hardcopy assay certificates and geologic logs with no major errors were noted.
- A total of 102 check samples were collected and sent to secondary laboratories for analysis, with occasional local high variation encountered on individual samples; however, global averages of gold and silver from the check samples were in line with the primary samples.
- The overall conclusion was that the database was sufficient for global resource estimates (Saucier and Poulin 2004; Saucier and Buchanan, 2005).

12.1.2 AMEC 2009 database audit and verification

- AMEC collected 14 check samples; the results of which occasionally showed local high variability, though there was global agreement to grades reported by Sulliden for both gold and silver.
- AMEC completed a comprehensive database audit which included review of the project geology, drill hole logs, interpretations and drill collar locations, and 286 re-analyses of pulp rejects, duplicate pulps, coarse crushed rejects, and field duplicates from reverse circulation cuttings from the 1994-2007 drill programs. AMEC concluded the results of the work were sufficient to support mineral resource estimation (Wright et al., 2010a, 2010b).

12.1.3 MDA 2012 database audit

- The focus of the MDA audit was on the drill hole collar, downhole survey, and assay data. Spot checks of geological and geotechnical data were also completed. The Shahuindo database was considered to be of high quality sufficient to support the resource estimate and classification (Defilippi, et al., 2012).
- MDA verified approximately 15 percent of the pre-2010 drill data to serve as a confirmation of the AMEC 2009 audit. If any discrepancies were identified, MDA checked additional holes from the same drill campaign.
- A comprehensive review of 2,599 inserted standards clearly displayed a constant small negative bias of the primary laboratory (ALS) from both standards and pulp duplicates, when compared to the check laboratory (SGS).
- There were 1,843 analyses of blank material, with only two counting as failures at a nominal 0.01 g/t failure line.
- A high level of repeatability was observed in all forms of field duplicates.

12.1.4 Tahoe 2015 database audit

- Tahoe conducted an audit of the 2014-2015 Rio Alto assay database (data through April 15, 2015) by comparing the analytical results reported in the hard copy certificates received from the laboratory (CERTIMIN) to the digital database used for the resource estimate. Tahoe compared 100% of the gold and silver assays in the database against the laboratory certificates with no errors detected.

12.2 Pan American Pre–Resource Estimation verification

The following is a summary of the key features of data verification conducted under the supervision of the QP, prior to the 2022 Mineral Resource estimate.

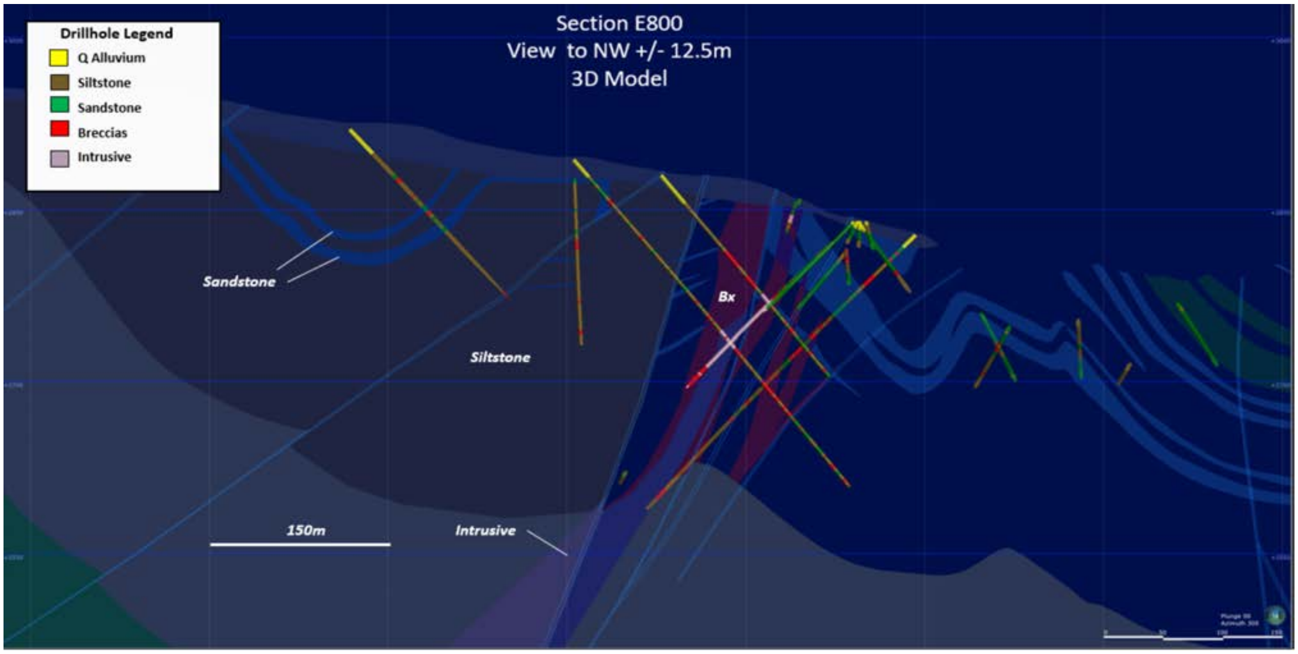
An audit of the 2020 - 2022 Shahuindo assay database (data through May 2022) was carried out by comparing the analytical results reported in the digital copy certificates received from the CERTIMIN laboratory to the digital database used for the Mineral Resource estimate. 100% of the gold and silver assays in the database were compared against the laboratory certificates with no errors detected.

The site generated geologic and lithological models and economic grade-shell models were peer reviewed by the corporate geology group with observations resubmitted to site for final model modifications and adjustments prior to generation of Mineral Resource estimates. Specific data reviewed and verified included the following:

- **Geologic model:** Reviewed three-dimensional (3D) solids for lithologic units, structure zones, and breccia compared to drillhole geologic data and geologic interpretation on 100 m spaced cross sections. Only minor discrepancies between solids and interpreted geology were observed.
- **Ore zone model:** 3D solids for oxide, transition, and sulfide zones were compared to drillhole ore zone modeled on 50 m spaced sections. Modeled ore zone solids compared very well with drillhole data and only four instances of minor modifications recommended.
- **Geomet model:** 3D solids of geomet classes were compared against geomet drillhole data on cross sections at 100 m spacing. Only minor discrepancies between solids and interpreted geology were observed and these were corrected.
- **Grade-shell model:** 31 independent grade shells were modeled at a 0.1 g/t Au threshold. These solids were reviewed on 100 m spaced sections and 25 m spaced bench levels referencing raw drillhole gold grades and composites (> 8 m @ 0.1 g/t actual thickness) to identify significant mineralized intersections. Grade-shell solids were found to be correctly distributed and oriented with faults, breccia zones and stratigraphic trends in all oxide, transition, and sulfide zones. Only minor modifications were identified for modification in the final model.

Examples of sections utilized for verification of geological, ore zone, and grade-shell models are shown in Figure 12.1 to Figure 12.4.

Figure 12.1 Geology - 3D lithology solids vs. drillhole lithologies

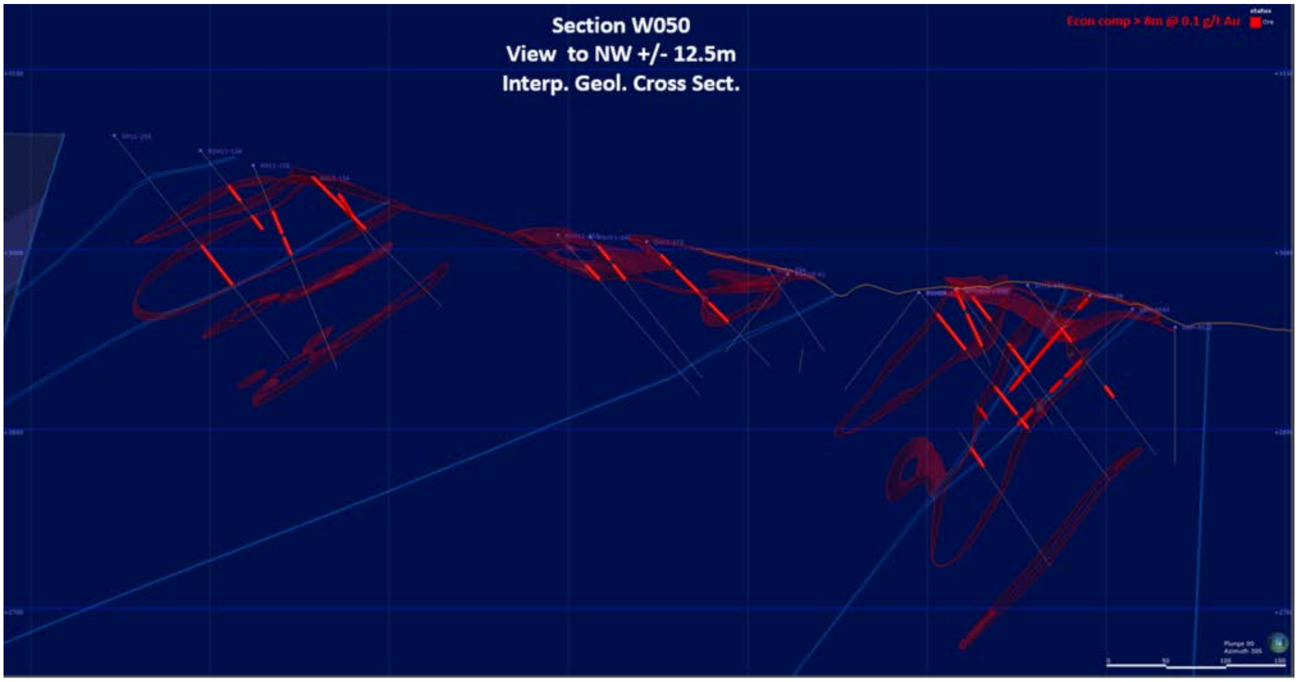


Source : PAS (2021).

Figure 12.2 Ore zone - solids vs. drillhole ore types

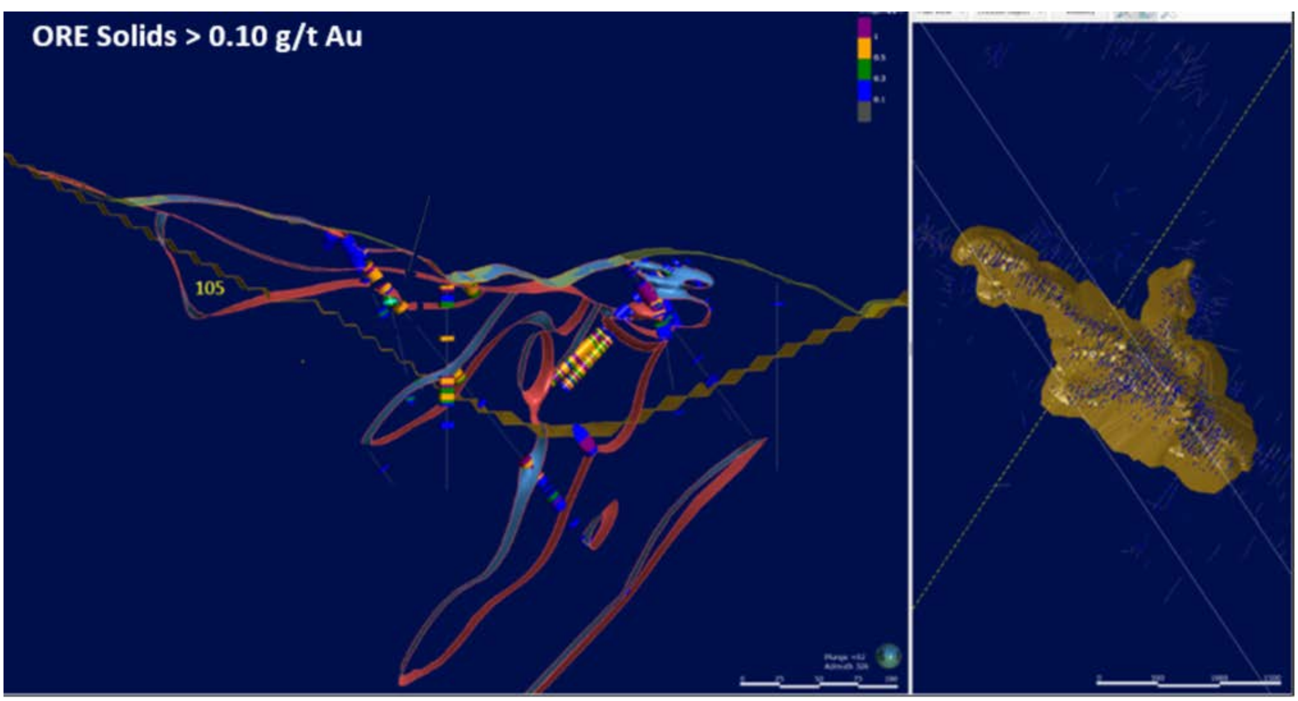
Source: PAS (2021).

Figure 12.3 Grade shell - solids vs. drillhole gold assay composites



Note: Solids built on a 0.1 g/t Au threshold and drillhole gold composites on a >8 m @ 0.1 g/t Au.
Source: PAS (2021).

Figure 12.4 Grade shell - solids vs. drillhole gold assays



Source: PAS (2021).

12.3 Geology data reviews

Prior to and following the acquisition of the Property from Tahoe in early 2019, Pan American undertook extensive geological data verification reviews. These reviews included compiling the available information and conducting reviews of downhole surveys in the database against the original photographic disks, visual reviews of the drillhole location in mining software, reviews of the drillhole collar coordinates against the surveyed topography, and extensive reviews of the assays in the database. The assay reviews included checking around 2,600 assays in the database against the original assay certificate, with particular attention paid to samples with relatively high silver and gold grades and unusual gold to silver ratios. A minor number of discrepancies were noted and corrected. Since acquiring the Property, Pan American routinely undertakes reviews of the assay and geology database and monitors reconciliation between the Mineral Reserve estimate, the grade control estimate, and mine production data.

Pan American affirms that there are no limitations nor has there been a failure in the past to conduct verification of all Shahuindo project data.

12.4 Mine engineering data reviews

Pan American routinely undertakes reviews of the mine engineering data, including the mining fleet and mine operational and production data, grade control data including dilution and ore loss, geotechnical and hydrological studies, pit walls stability data, waste disposal requirements, environmental and community factors, the heap leach operations and production data, the development of the LOM plan including production and recovery rates, capital and operating costs for the mine and processing facilities, transportation, logistics, power and water consumption and future requirements, taxation and royalties, and the parameters and assumptions used in the economic model, and used in the calculation of gold cut-off grades.

12.5 Metallurgy data reviews

Pan American routinely undertakes reviews of metallurgical test work, operational data and performance, heap leach operations, and production data.

12.6 Data adequacy

It is the opinion of the QPs responsible for the preparation of this Technical Report that the data used to support the conclusions presented here are adequate for the purposes used in this Technical Report.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Metallurgical testing summary

Cyanidation (including column leach tests), agglomeration testing and flotation testing programs have been conducted on composite samples from Shahuindo by various companies starting around 1996, including ongoing test programs conducted at site as summarized in Table 13.1.

Table 13.1 Cyanide and flotation testing programs on Shahuindo

Year	Laboratory (relationship) / company whom requested the testwork
1996	Dawson Metallurgical Laboratories (Third party / Independent) / Asarco (called Boti Project)
2003-2004	Heap Leach Consultants (Third party / Independent) / Minera Algamarca
2009-2012	KCA (Third party / Independent) / Sulliden
2014	KCA (Third party / Independent) / Rio Alto
2014-2015	SGS (Third party / Independent) / Tahoe (Rio Alto)
2014-2015	Rio Alto's La Arena facilities (in-house tests) / Tahoe
2016	Shahuindo (Pilot test heaps in-house) / Tahoe
2017	Knight Piésold (Third party / Independent) / Tahoe
2018	Shahuindo (in-house tests) / Tahoe
2019-present	Shahuindo (in-house tests) / Pan American

Cyanidation tests were conducted by KCA from 2009 to 2012, by Rio Alto in 2014 and 2015, by Tahoe in 2015, and on drill core and surface sample composites by Pan American beginning in 2019. Additionally, pilot test heaps on ROM material were conducted by Tahoe in 2016. The results of the testing programs indicated excellent gold recoveries at both ROM and coarse crush sizes with low to moderate reagent requirements, and generally low silver recoveries. Shahuindo has been in operation since 2015 primarily as a ROM heap leach operation with a LOM realized gold recovery of 79% in Pad 1, 75% in pad 2A, and 65% in pad 2B/C.

Compacted permeability and agglomeration tests have been conducted by KCA, Anddes, and Knight Piésold as well as on site by Shahuindo SAC as part of ongoing optimization and heap quality test work. The results identified specific ore types with known permeability issues. Subsequent additional tests have evaluated permeability at different simulated heap loads for various material blends. Ongoing test results suggest that blending is a viable method for managing permeability issues at the heap.

The projected field gold and silver recoveries, reagent requirements, and leach times on ROM oxide material based on the available test work and production results are summarized in Table 13.2.

Table 13.2 Metallurgical test work results and processing parameters

Parameter	ROM
% Au recovery	80%
% Ag recovery	10%
NaCN consumption	0.4 kg/t
Lime addition	3.6 kg/t

13.2 Pre-2016 metallurgical test summary

Tests were conducted early in Shahuindo's life by Dawson Metallurgical Laboratories (Dawson), KCA and Heap Leach Consultants (HLC) and later by SGS Minerals Services, Anddes, and PUCP (Catholic University, Lima) under the direction of Rio Alto in 2014 and Tahoe Resources in 2015.

Material tested by Dawson for Asarco included fifteen oxide and four sulfide composites made from RC drill cuttings. Cyanide bottle roll tests on the oxide composites and flotation tests on the sulfide samples were conducted.

Material tested by HLC for Minera Algamarca included bulk surface oxide samples which were used for column leach tests at varying size fractions ranging from "as received" to minus 25 mm. The test program initiated by Asarco is of limited use as the work was preliminary in nature and heap leach column tests were not conducted. The test program by HLC had significant permeability issues and did not produce any meaningful results. As such, these programs are not mentioned further in this discussion.

Multiple programs were conducted by KCA between 2009 and 2014 utilizing composite samples from HQ and PQ drill core intervals and bulk surface samples, including multiple column, agglomeration, and bottle roll leach tests. The results of the Column Leach Test average: ROM gold recovery 77%, all crushed ore gold recovery 89%, crushed ore with <0.1% sulfides 90% gold recovery, crushed ore with >0.1% sulfide 83% gold recovery; the average screened size fraction at +100 mm 54% gold recovery, at -100 mm + 50 mm screened fraction 71% gold recovery and at -50 mm screened fraction 85% gold recovery. Sodium cyanide consumption average 0.5 kg/t, lime addition of 3 kg/t and cement addition of 6 kg/t.

Column leach tests on composites generated from bulk surface samples and drill core intervals by personnel at Rio Alto's La Arena facility were conducted between 2014 and 2015. Samples for testing were composited based on rock type and by drill hole, including a sulfides sample. Rio Alto Column Leach Test results on surface samples ranged from 68% to 84% gold recovery with an average of 78% gold recovery. Sodium cyanide consumption averages 0.4 kg/t and lime addition averages 2.1 kg/t. Column Leach Test results on drill core samples ranged from 73% to 89% gold recovery with an average of 85% gold recovery, and the sulfide samples result in 20% Au Rec and 3% Ag Rec. Sodium cyanide consumption averages 1.1 kg/t and lime addition averages 1.3 kg/t, and 1.7 kg/t cyanide consumption for the sulfide sample.

13.3 2016 through 2022 ongoing site test programs

Ongoing metallurgical test work since commencing operations focused on improving recovery includes pilot test heaps, monthly composite leach tests, leaching optimization tests, permeability tests and chemical analyses encompassing numerous column leach tests, bottle roll leach tests, quick leach tests, compacted permeability tests, and other lab test work. Only select test work which is representative and relevant for the current operation is presented and discussed in this Technical Report.

13.3.1 2016 test heap program

Two pilot test heap programs were conducted during 2016 with the first program beginning in February, and the second program in July. In total six pilot test heaps were constructed and leached with the objective of evaluating the metallurgical behavior of the ROM ore at varying blends of sandstone and siltstone. Test heaps 2 through 4 were from the Chalarina and Choloque pits, and test heaps 5 through 7 were sourced entirely from the Chalarina pit.

Recoveries for gold ranged from 29% to 79% and silver recoveries ranged from 3% to 22%. The lowest observed recovery was from test pad No.5, which was composed of 100% siltstone material and was observed to have some permeability issues requiring a reduced irrigation rate. For all of the test pads, leaching of gold was still occurring when the tests were concluded, and additional metal recoveries would be expected with additional leaching. Sodium cyanide consumption averaged 0.3 kg/t ore with lime addition averaging 1.8 kg/t.

13.3.2 2020 Choloque Pit test program

Test work on material from the Choloque Pit was conducted during 2020 which included columns from ROM size to 1 inch particle size, and bottle roll leach tests as well as compacted permeability tests on composite samples with the following material description:

- Sample M1 – Argilized Siltstone
- Sample M2 – Siltstone with weak silicification
- Sample M3 – Siltstone with high silicification

Column leach tests results show good recoveries for gold ranged from 78% to 97%, averaging 90%, silver recoveries ranged from 2% to 50% averaging 23% with minimal recovery improvements for each material type at finer product sizes and variable silver recoveries. Reagent consumption for sodium cyanide average 1.5 kg/t and lime addition average 3.7 kg/t. Based on compacted permeability tests, the M1 and M2 material type have permeability above the irrigation rate and the M3 material type have a permeability more than 10 times the irrigation rate at the simulated ultimate heap height of 90 m.

13.3.2.1 2020 heap leach pad samples column leach tests – monthly ROM samples

ROM samples for column leach and permeability tests were collected from the heap leach pad for the months of June through October 2020. Variability tests were conducted on samples collected for the months of September and October to evaluate the effect of sodium cyanide concentration on recovery, with the October composite sample being cured with 1,800 ppm NaCN prior to leaching. Additionally, two samples from the September composite were crushed to 80% passing 25 mm.

Results from the ROM column leach tests showed high overall recoveries for gold, ranged from 81% to 93% averaging 90% and silver recoveries ranged from 6% to 30% averaging 16%. Average cyanide consumption for the composites was 0.36 kg/t and lime addition averaged 2.5 kg/t. All of the composites have permeabilities of more than 10 times the irrigation rate up to a 90 m simulated heap height.

13.3.3 2021 / 2022 geometallurgical program

A PQ drilling program was carried out in 2020 including 27 planned met holes totaling 3,500 m. as described in section 7.6 of the current report. Holes were planned in principal zones to provide the greatest distribution and exposure to a variety of metallurgical classes. The zones include Choloque mine area, Choloque SW, Santa Rosa zone, and San Jose zone. Initial testing included 255 quick leach tests and a series of compacted permeability tests. These were conducted at site during 2021 in order to evaluate the permeability of different material types under compressive loads. In total, 24 composite samples were generated from PQ core which were classified based on material type and pit.

Each of the composites were then subjected to compacted permeability tests at staged compressive loads up to 90 m equivalent heap height, mineralogy analysis, full ICP, and load / permeability test on blending and agglomerates on selected composites.

The compacted permeability tests show that up to 90 m heap heights several material classifications do not require blending or agglomeration for heap permeability. The results also indicate that blending less competent material with more competent material types may be a viable alternative to agglomerating with cement. A minimum blending ratio of 1.4:1 of competent material to less competent material is the blending ratio that is currently being applied at the operation.

13.3.4 2021 column leach tests – monthly ROM samples

ROM samples for column leach tests and permeability tests were collected from the heap leach pads 2B and 2C for the months of March through December, 2021. Variability tests were conducted on samples collected for the months of March through June to further evaluate the effect of cyanide curing (irrigating with a high cyanide concentration and leaving to cure for 4 days) on recovery as well as the addition of a commercial chemical advertised to improve ore wetting.

Recoveries for the standard composites ranged between 77% and 88% for gold and 8% and 26% for silver, with average recoveries of 84% and 17%, respectively. Cyanide consumption averaged 0.68 kg/t and lime addition averaged 2.8 kg/t. Results for compacted permeability tests were primarily positive with permeabilities of more than 10 times the application rate with only the April and June composites having permeabilities above the application rate at the ultimate 90 m simulated heap height.

Monthly composites for March, April, and June included variability tests for NaCN curing prior to leaching. These composites were cured with 1,500 ppm or 1,800 ppm NaCN, followed by leaching. Recoveries for the composites tested averaged 2% higher for gold and 4% higher for silver compared to the standard composites with marginally higher NaCN consumption. Test results did not show any correlation between leach time and NaCN curing.

13.4 Estimated field recoveries, leach times, and reagent requirements

Column leach tests on ROM (including monthly production composite columns) and coarse crushed column leach tests were used in estimating field recoveries. Average recovery for gold and silver from the tests is 82% and 16%, respectively, and is presented in Table 13.3. A 2% field deduction for gold and 6% deduction for silver are considered with the final field recoveries estimated at 80% for gold and 10% for silver, which are supported by actual heap performance to date.

Since 2019, consumption of sodium cyanide and lime addition at Shahuindo operation averaged 0.30 kg/t and 3.1 kg/t, respectively, and is presented in Table 13.4. Both cyanide and lime usage per tonne of ore has increased each year since 2019. The increase in cyanide consumption is primarily a result of the increased cyanide concentration being used for leaching with lime consumption being more variable. For the purposes of this Technical Report, consumptions for NaCN and lime are conservatively estimated at 0.4 kg/t and 3.6 kg/t, respectively.

Table 13.3 Column leach test results for field recoveries estimations

	Sample description	Head grade		Au Rec	Ag Rec	NaCN	Lime
		Au, g/t	Ag, g/t	%	%	kg/t	kg/t
1	Global Master composite	0.94	3.1	**85%**	22%	0.5	6 kg or cement
2	P1, Zona Este, Huangamarca	0.20	0.4	**83%**	25%	0.2	6 kg or cement
3	Composito 1:1	1.10	7.1	**89%**	10%	0.7	3.1
4	Composito 1:2	1.05	6.4	**89%**	10%	0.7	3.0
5	Arenisca - drum leftover	0.17	7.1	**84%**	4%	0.2	1.1
6	Arenisca primer muestreo	0.33	4.7	**75%**	5%	0.2	2.3
7	Arenisca intercalada	1.76	8.8	**76%**	3%	0.3	1.8
8	Arensica of medium grain	0.47	2.1	**78%**	13%	0.2	1.8
9	Limolita and arenisca of fine grain	0.97	3.5	**84%**	11%	0.3	1.9
10	Arenisca intercalada	0.86	2.0	**70%**	13%	0.3	2.0
11	Limolita and arenisca of fine grain	1.38	4.0	**78%**	14%	0.4	2.5
12	Arenisca of fine grain	1.06	3.3	**68%**	14%	0.5	2.6
13	Arensica of medium grain	0.47	2.5	**81%**	17%	0.5	2.2
14	Limolita argilizada (Calicata M-1)	0.63	22.8	**82%**	2%	1.2	3.5
15	Limolita Silicificada Débil (Calicata M-2)	0.71	2.1	**97%**	37%	1.0	3.8
16	Limolita Silicificada Intensa (Calicata M-3)	0.79	7.0	**86%**	23%	0.7	3.3
17	Feldespato	0.30	5.4	**73%**	22%	0.3	3.3
18	Mineral Pad 2B Compósito Junio	1.06	6.1	**90%**	18%	1.0	3.5
19	Mineral Pad 2B Compósito Julio	0.41	4.8	**81%**	11%	0.6	2.8
20	Mineral Compósito Agosto	0.40	3.3	**86%**	30%	0.6	2.6
21	Material Compósito Setiembre	1.25	7.0	**90%**	14%	0.8	2.4
22	Arenisca- limolita (SDST) con silicificación 2	0.29	1.8	**86%**	45%	0.6	1.5
	Average	**0.76**	**5.2**	**82%**	**16%**	**0.5**	**2.6**

Table 13.4 Reagent consumptions from operations

Reagent	Units	2019	2020	2021	2022	Average
NaCN	Kg/t	0.20	0.33	0.36	0.40	0.32
CaO	Kg/t	2.36	3.49	3.59	3.59	3.27

13.5 Recommendations and conclusions

The results of the laboratory testing program indicate excellent gold recoveries for ROM oxide ore with low to moderate reagent requirements, which are in line with current production data. Silver recoveries are generally low. Maintaining heap permeability and minimizing channeling at higher heap heights constitutes a risk to the project which is currently being mitigated by blending of less permeable material types with more competent ore.

Preliminary test data suggests that there may be an opportunity to improve recoveries by curing the ore with a high-strength NaCN solution prior to leaching, with initial results showing a modest improvement in recovery for gold compared to standard leaching. Additional test work is recommended to further evaluate this option, including a trial on a section of the operating heap leach.

Metallurgical testing results on samples of sulphide mineralization that became available after June 30, 2022 has led to the conclusion that the previously reported sulphide Inferred resource does not meet the criteria for reasonable prospects for eventual economic extraction at this time. As such, the deeper sulphide mineralization is not included in the estimated Mineral Resources at the Property.

14 MINERAL RESOURCE ESTIMATES

14.1 Introduction

Pan American updates Mineral Resources on an annual basis following reviews of metal price trends, operational performance and costs experienced in the previous year, and forecasts of production and costs over the LOM. Infill and near-mine drilling is conducted as required through the year and is incorporated into the model. The drillhole data cut-off date for the commencement of the current geological interpretation was May 31, 2022 and the effective date of the Mineral Resource estimate is June 30, 2022.

Mineral Resources were prepared by Pan American staff under the supervision of and reviewed by Christopher Emerson, FAusIMM, Vice President, Business Development and Geology of Pan American, who is a Qualified Person as that term is defined by NI 43-101. They have been estimated in accordance with the CIM Estimation of Mineral Resources and Mineral Reserves, Best Practice Guidelines (2019), and reported according to the CIM Definition Standards (2014).

Table 14.1 tabulates a summary of the total Mineral Resources for the Property at June 30 2022. This total includes contributions from the open pit and stockpile locations. The cut-off applied varies according to mining type and process route. These are listed in the footnotes and in Table 14.1.

Table 14.1 Summary of Mineral Resources at June 30, 2022

Classification	Tonnes	Grade		Contained metal	
	Mt	Au g/t	Ag g/t	Au koz	Ag koz
Measured	8.3	0.29	5	77	1,279
Indicated	13.2	0.23	4	98	1,800
Measured + Indicated	**21.6**	**0.25**	**4**	**175**	**3,079**
Inferred (Oxide)	**14.6**	**0.41**	**8**	**194**	**3,724**

Notes:
- CIM Definition Standards (2014) were used for reporting the Mineral Resources.
- Mineral Resources exclude those resources converted to Mineral Reserves.
- Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
- Mineral Resource estimates were prepared under the supervision of, or were reviewed by Christopher Emerson, FAusIMM, Vice President, Business Development and Geology of Pan American who is the QP.
- Mineral Resources have been estimated using heap leaching metal recovery and cost parameters.
- Mineral Resources at June 30, 2022 are based in ROM 1 Au Cut-off grade = 0.032 g/t, FIRO Au cut-off grade = 0.207 g/t, ROM 2 Au cut-off grade = 0.159 g/t.
- Metal prices used are gold at $1,700/oz and silver at $22/oz.
- Mineral Resources were constrained within a Whittle shell to conform with RPEEE.
- The drillhole database was closed at May 31, 2022.
- Totals may not compute exactly due to rounding.

There are no known environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the potential development of the Mineral Resources. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. Mineral Resources reported in Table 14.1 and Table 14.15 are in addition to Mineral Reserves.

14.2 Database

The drilling database used for this Mineral Resource estimate contains 1,822 drillholes totaling 288,127 m. All drill data corresponding to the RC and diamond drill data from the corresponding drill campaigns were reviewed and verified. The date of closure of the database was May 31, 2022.

The information on which this estimate is based includes collar, downhole survey, assay, lithologic, and oxidation data.

The topographic survey of the location of drilling collars was made by the Shahuindo survey group. Drillhole downhole surveys were made at nominal 50 m intervals using an SLR - Gyro method.

All historical data have been transformed from PSAD Datum 56 to Datum WGS 84 using the transformation indicated in the table below. Drill collars in 2014 to 2022 were surveyed directly in Datum WGS 84 coordinates.

Table 14.2 Grid transformation applied to collar data in database

Datum WGS 84		PSAD Datum 56	Transformation
EASTING WGS 84	=	EASTING PSAD56	- 260.9878149 m
NORTHING WGS 84	=	NORTHING PSAD56	- 368.5484922 m

Shahuindo SAC has executed exploration campaigns, from 1994 to date. These campaigns include diamond drilling and RC drilling. The following table summarizes the number of holes and drilled meters in the data base as of May 31, 2022.

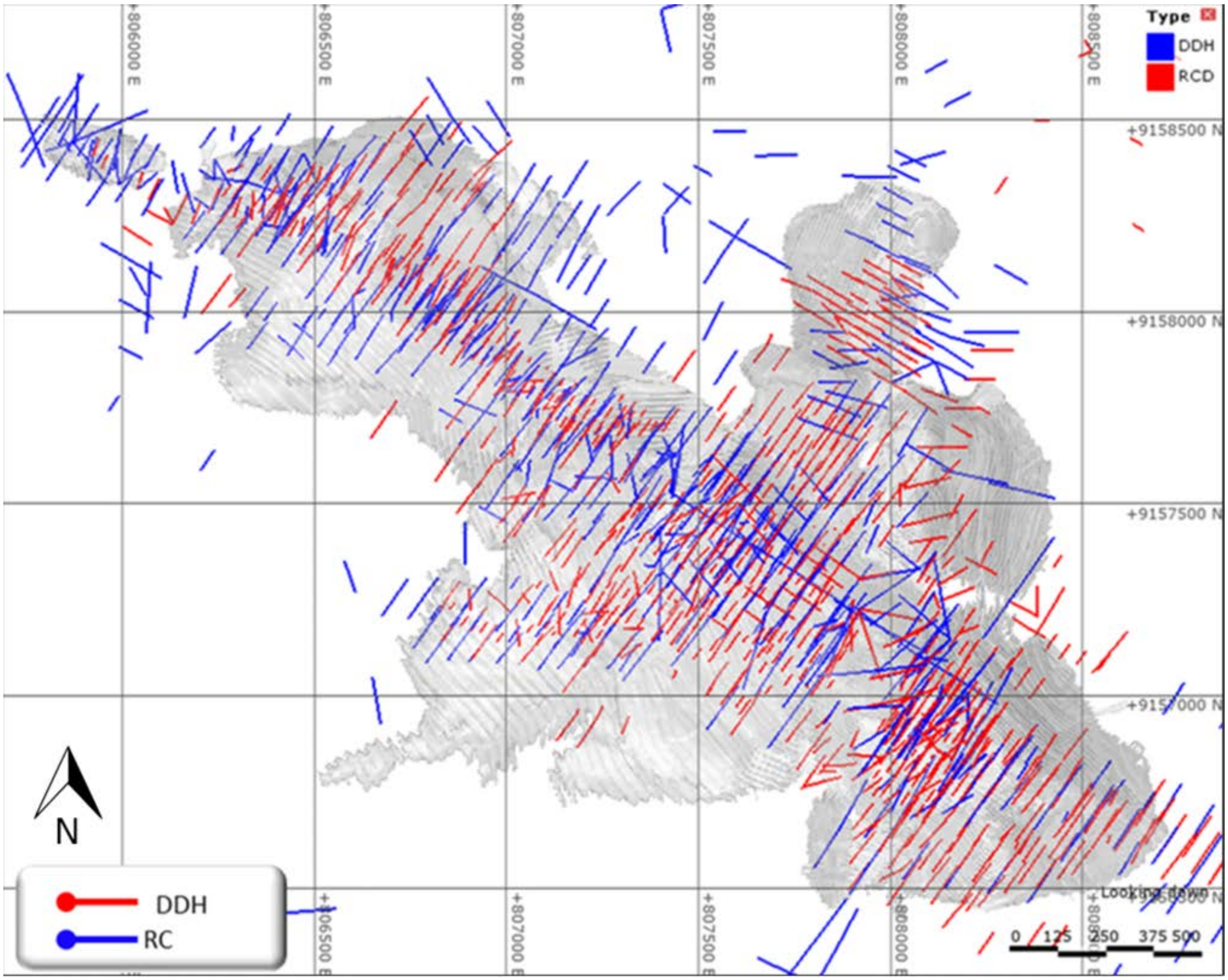
Table 14.3 Composition of the data base

Drilling type	Holes	Metres	Samples
Diamond drilling	859	154,963	96,253
RC Drilling	963	133,164	72,680
Total	**1,822**	**288,127**	**168,933**

The majority of the drilling was carried out on a nominal 50 m x 50 m grid with infill RC drilling on a nominal grid of 25 m x 25 m grid, predominantly within the near surface oxide zone. Sulfide mineralization is drilled more sporadically due to its secondary importance to Shahuindo. Figure 14.1 shows the location of the total drilling recorded in the data base and used in the estimation.

Sub-detection assays were set at 50% of the detection limit.

Figure 14.1 Drillholes included in the Mineral Resource estimation



Source: PAS (2022).

14.3 Geological modeling

14.3.1 Lithologic domains

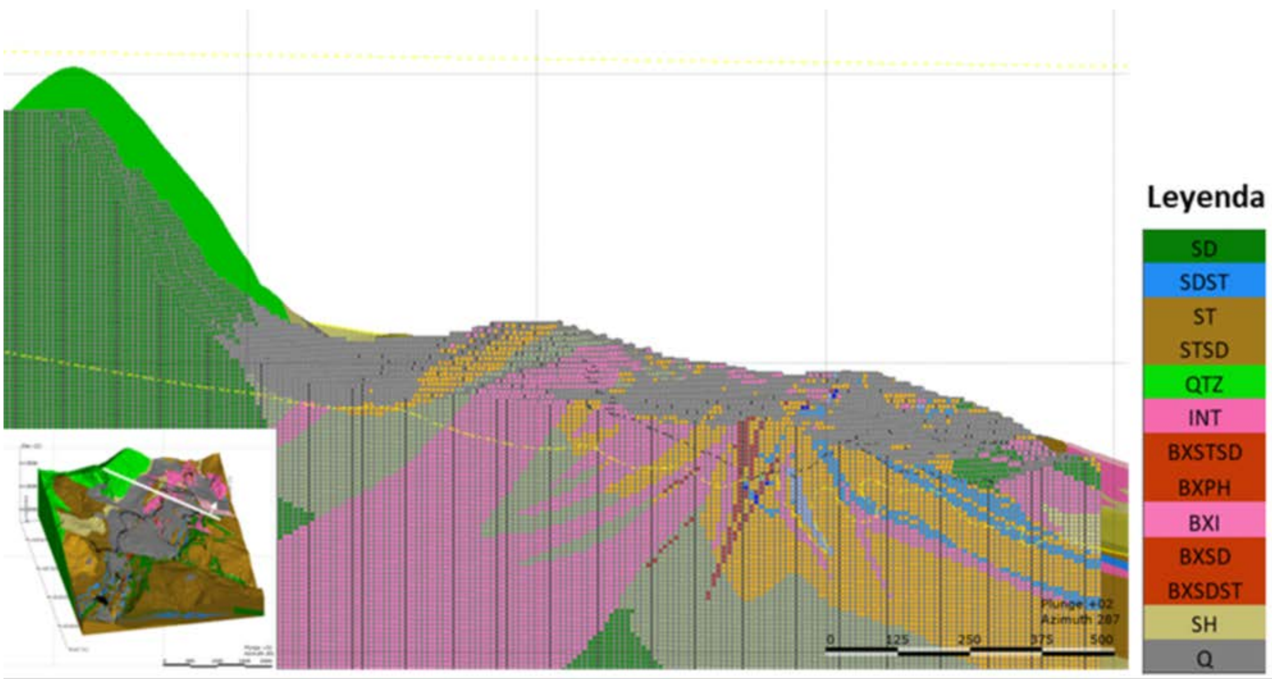
Lithological domains were updated for the 2022 Mineral Resource and new domains were added based on new data and interpretations. There are currently 13 interpreted lithologies as listed in Table 14.4. Lithology domains were built by creating solids using Leapfrog's® implicit modeling tools, based on interpretation on 50 m spaced cross sections.

Table 14.4 Lithological domain codes

Code_id	Code	Lithology
10	SD	Sandstone
20	SDST	Sandstone interbedded with siltstone (predominately sandstone)
30	ST	Siltstone
40	STSD	Siltstone interbedded with sandstone (predominately siltstone)
50	QTZ	Quartzite
60	FPD	Porphyry
70	BXH-STSD	Hydrothermal breccia – Siltstone interbedded with sandstone (predominately siltstone)
71	BXPH	Phreatomagmatic breccia
72	BXI	Intrusive breccia
73	BXH-SD	Hydrothermal breccia - Sandstone
74	BXH-SDST	Hydrothermal breccia - Sandstone interbedded with siltstone (predominately sandstone)
80	SH	Shale
99	Q	Quaternary

The 13 lithology solids were used to code the block model. An example section is shown in Figure 14.2, which is a cross section looking northwest. A good visual correlation was seen when compared to the 50 m sections.

Figure 14.2 Cross section showing lithologic codes in block model



Source: PAS (2022).

14.3.2 Structural model

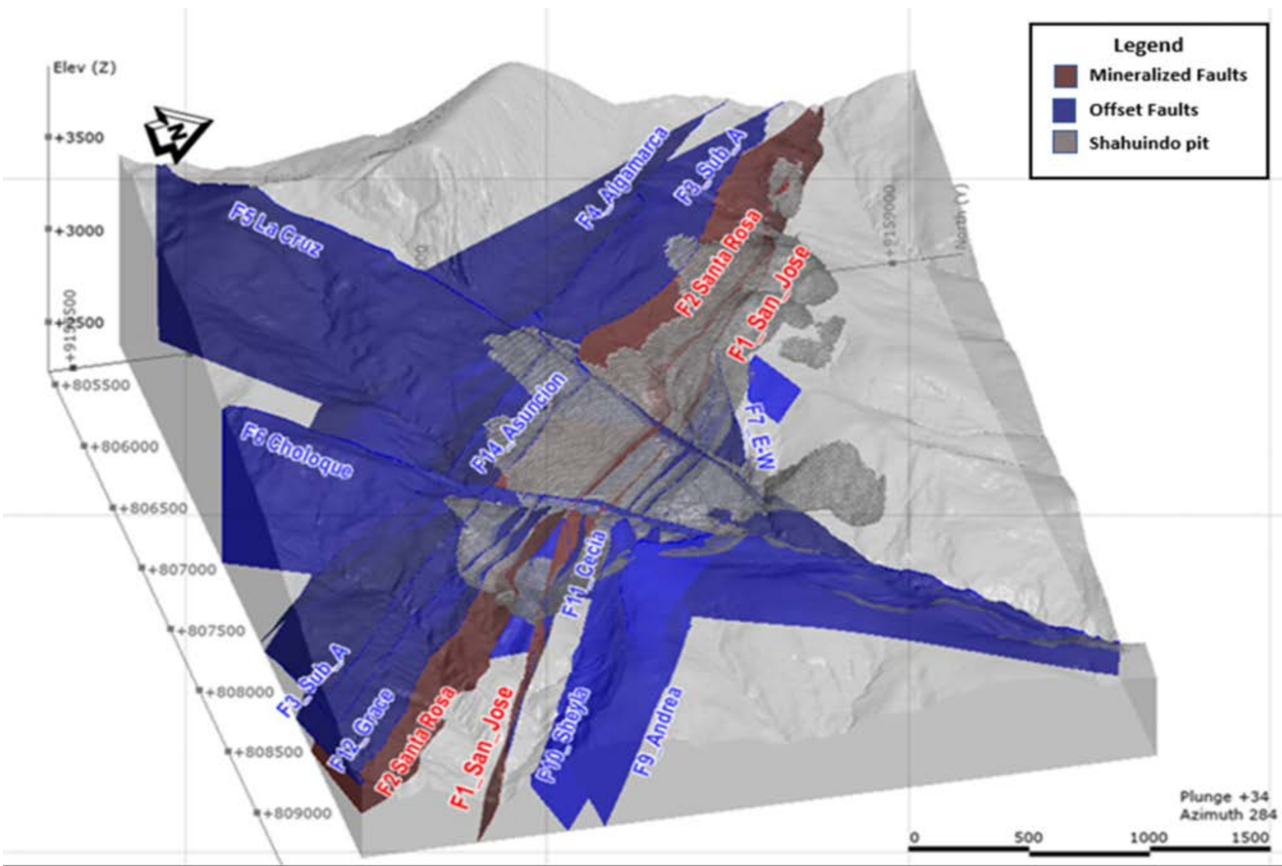
There is a strong structural control to Shahuindo mineralization. A total of 23 structures were modeled using Leapfrog's® implicit modeling tool.

Table 14.5 Structural codes

Code	Fault	Code	Fault
F1	F1_San José	F13	F13_Milagros
F2	F2_Santa Rosa	F14	F14_Asunción
F3	F3_Sub A	F15	F15_Int
F4	F4_Algamarca	F16	F16
F5	F5_La Cruz	F17	F17
F6	F6_Choloque	F18	F18
F7	F7_E-W	F19	F19
F8	F8_Inversa	F20	F20
F9	F9_Andrea.	F21	F21
F10	F10_Sheyla	F22	F22
F11	F11_Ceclia	F23	F23
F12	F12_Grace		

Source: PAS (2022).

Figure 14.3 Isometric view of Shahuindo faults



Source: PAS (2022).

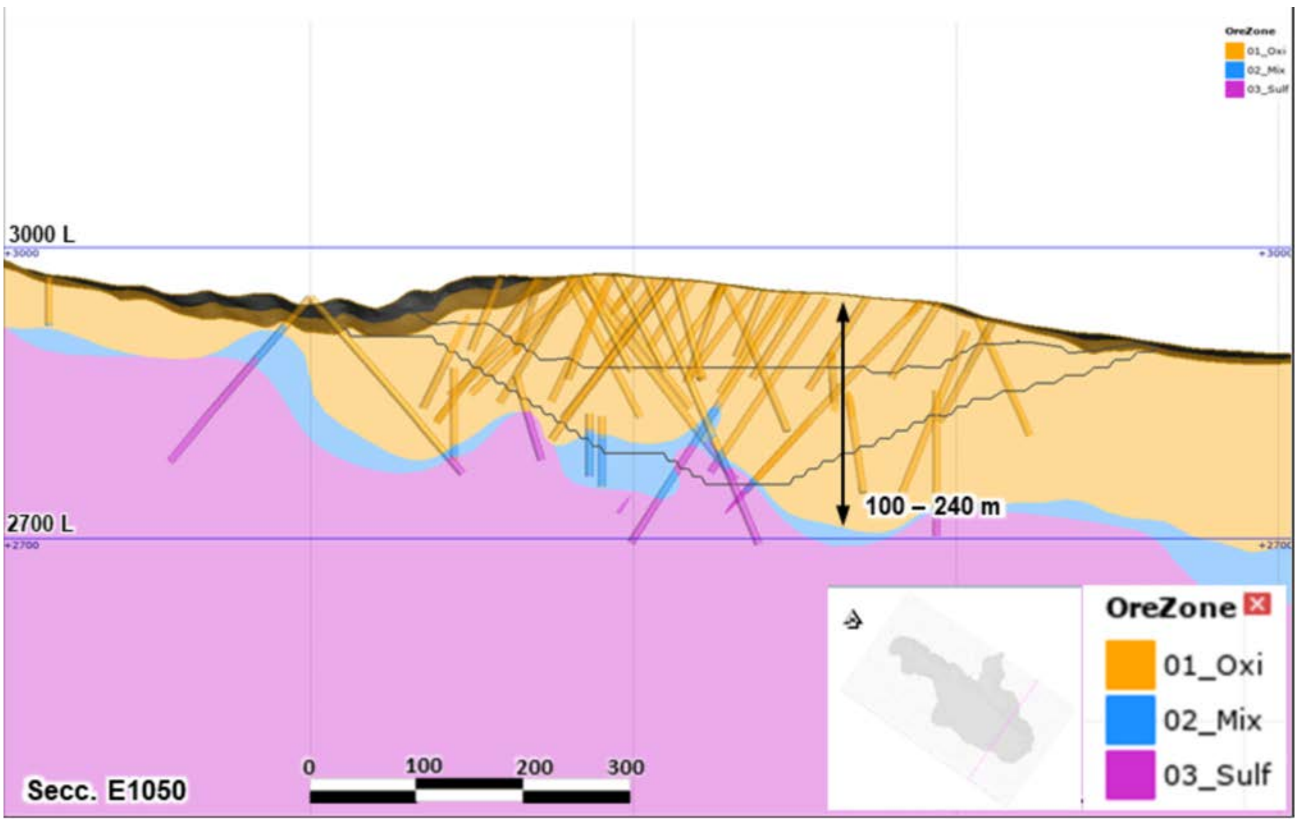
14.3.3 Oxidation domains

The deposit oxidation model defined three zones: an oxide zone, a mixed oxide / sulfide transition zone and a sulfide zone. These zones are based on cross-sectional interpretations cross checked with the drillhole geologic database.

Preference was given to coding the transition material as sulfide, particularly when reviewing total sulfur tests. The oxide / sulfide interface was generated using Leapfrog® software.

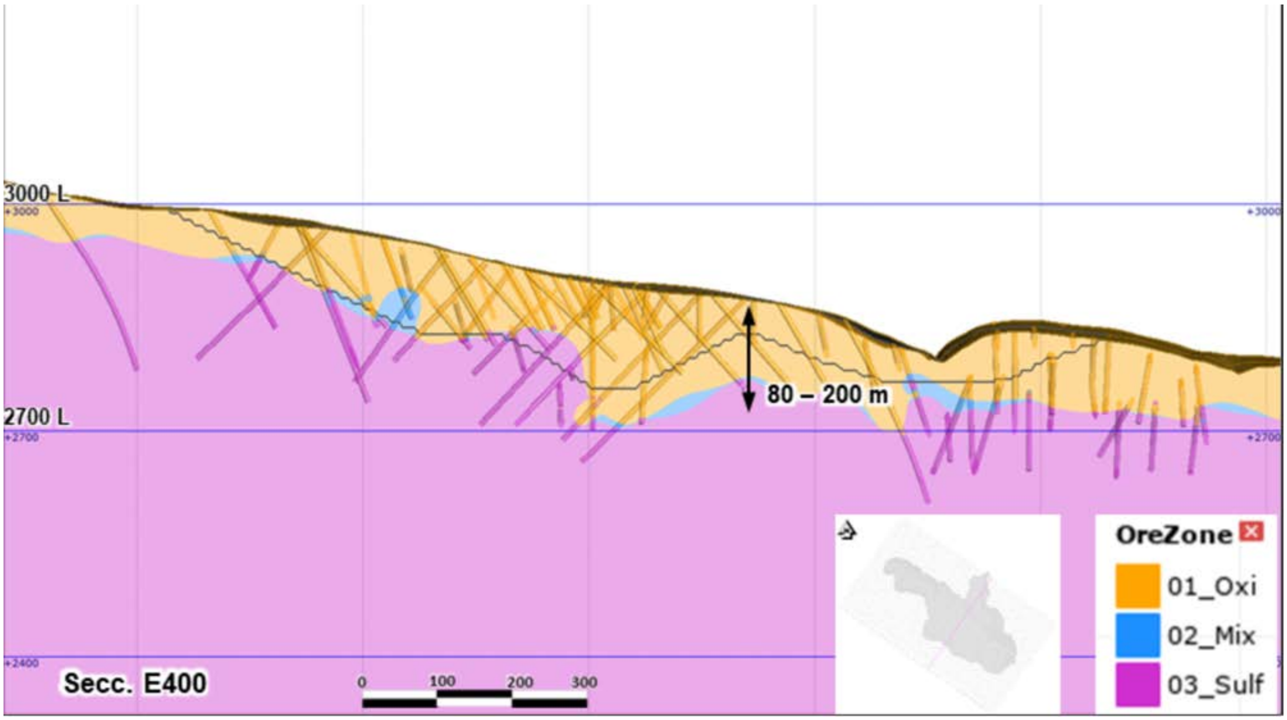
Figure 14.4, Figure 14.5, and Figure 14.6 represent sections E1050, E400, and W300 in the model respectively. In addition to the morphology of the base of the oxide, the actual depths are annotated. All sections are viewed looking northwest.

Figure 14.4 Section E1050



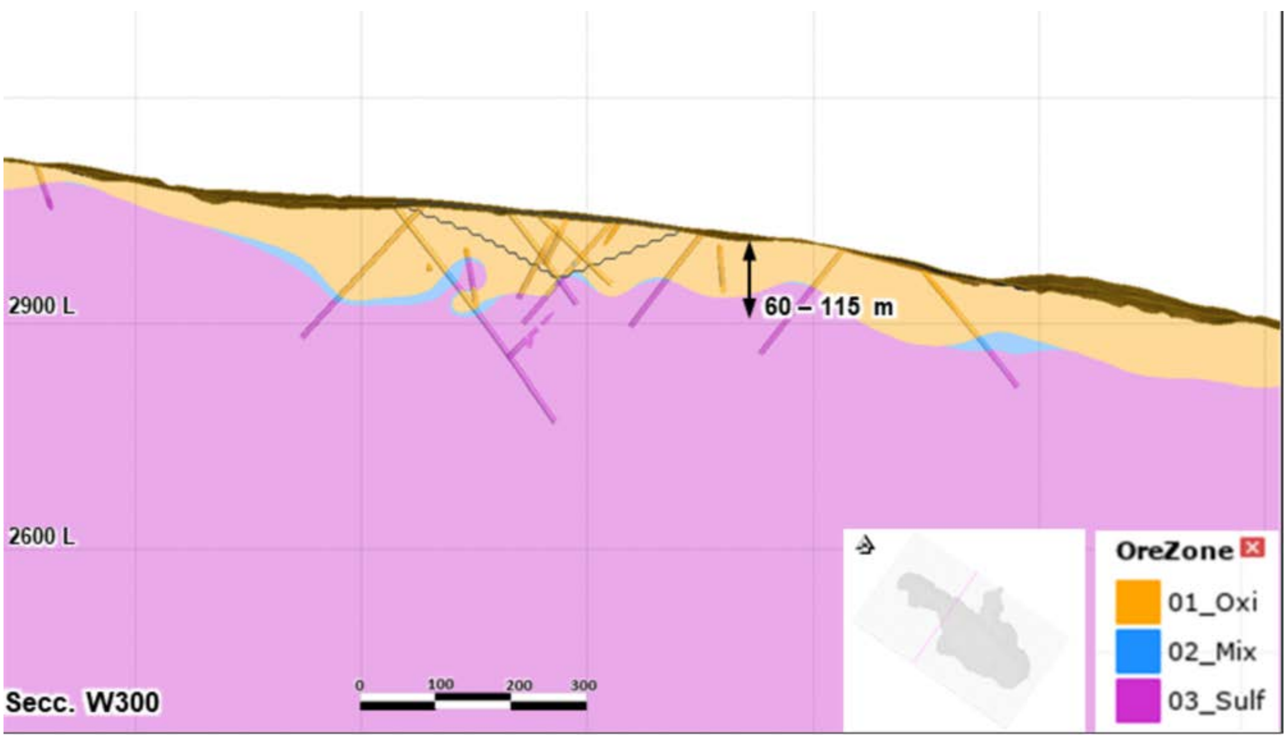
Source : PAS (2022).

Figure 14.5 Section E400



Source : PAS (2022).

Figure 14.6 Section W300



Source: PAS (2022).

14.3.4 Mineralized domains

Grade shells were constructed using Leapfrog's® implicit modeling tools. At Shahuindo, a total of 23 grade shells were modeled using a 0.1 g/t Au threshold.

Structure and lithology exert important controls on the location, shape, and orientation of mineralized zone and therefore on grade shells. Important structural elements such as fold flanks, axial fold surfaces, fold-related fractures, faults, extension-related fractures, dikes, and intrusive contacts as well as favorable stratigraphy were used in modeling.

The domains for Shahuindo are tabulated in Table 14.6 with their associated solids, and then discussed individually below.

Table 14.6 Model domains for Shahuindo

Domain	Domain codes
1.1	LG_100, LG_101, LG_102, LG_106, LG_111, LG_114.
1.2	LG_103, LG_107, LG_108.
2.1	LG_104
2.2	LG_105
3	LG_109, LG_201, LG_202, LG_203, LG_204, LG_205
4	LG_112, LG_116, LG_300, LG_301
5	LG_113, LG_117
6	LG_110
7	LG_991, LG_992, LG_993
8	LG_115

Domain 1; associated with the San José Fault: (solid LG_100) This domain corresponds to the main mineralized body and is defined by hydrothermal breccia, veins, veins, fractured and breached intrusive-sedimentary contacts along the San José Fault, which follows a N125° orientation with variable dips (-90° to -50°). The domain is dissected into three zones by two non-Andean faults. The three zones are the East Zone (Chalarina), Central Zone (Choloque), and West Zone (San José). Exposure levels along this zone vary from weak erosion in the northwest and southeast to intense erosion in the central Choloque zone. Two sub-domains are related to the San Jose Fault:

- Lower subdomain (1.1) (solids LG_101, LG_106, LG_111, LG_114): includes mineralization affected by fractures and breccia channels along the footwall of the main fault (greater presence in the area of Choloque and San José zones). This sub-domain also includes the sub-parallel Cecilia Fault.
- Upper subdomain (1.2) (solids LG_103, LG_107, LG_108): includes stratigraphic mineralization within the Carhuaz Fm. sandstones on the SW flank of the San José anticlinal. The zone occupies the hanging wall of the San Jose Fault and is oriented N125° with moderate -35° to -45° dips.

Domain 2; associated with the Santa Rosa Fault: This structure has greater importance in the East zone (Chalarina) and is defined as a low-angle imbricate structure oriented N125° with moderate (-35° to -40°) dips to the southwest. Two subdomains are modeled in the upper and lower portions of the Santa Rosa Fault:

- Lower subdomain (2.1) (solid LG_104): includes stratigraphic mineralization hosted exclusively in Farrat Fm. sandstones on the southwest flank of the San José anticline.
- Upper subdomain (2.2) (solid LG_105): includes mineralization within fractures and breccias of other competent lithologic units.

Domain 3; Parallel Santa Rosa system (solids LG_109, LG_201, LG_202, LG_203, LG_204, LG_205): this domain lies along the southwest margin of the Santa Rosa Fault, and follows a similar trend. Domain mineralization is related to parallel fractures controlled by the Milagros and Algamarca Faults.

Domain 4; associated with Sandstone stratigraphy (Solids LG_112, LG_116, LG_300, LG_301): located on the eastern flank of the San José anticline (Chalarina zone). The zone follows a N305° trend with moderate (~35°) northeast dips. This domain is defined by mineralization within the Farrat Fm. quartz sandstones (Chalarina and San Lorenzo zones) and Carhuaz Fm. quartz-feldspathic sandstones of the (San José area).

Domain 5; associated with the N-S Fault (solids LG_113): This domain is recognized on the east margin of the Choloque (Chalarina) Fault, with a north-south, subvertical orientation. Domain mineralization is characterized by the presence of hydrothermal breccia that cut sandstones and siltstone beds on the eastern flank of the San José anticline. The N-S Fault splays into the Choloque Fault to the north. Another north-south trending fault is observed in the Choloque area that extends northeast towards the San Lorenzo zone.

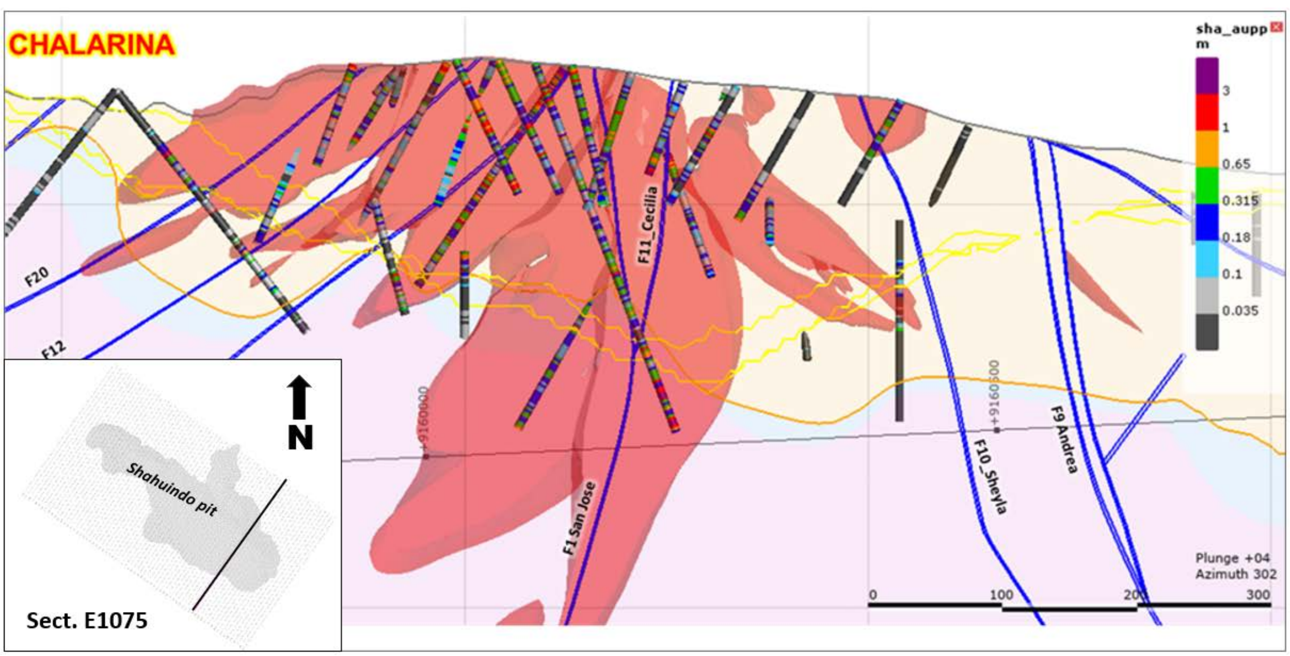
Domain 6 (solid LG_110): This domain recognized locally only at depth in the West Zone. This domain is characterized by hydrothermal breccias that cut phreatic breccias in sandstone. The zone aligns with intrusives that NW-SE with NE dips.

Domain 7; (solid LG_991, LG_992, LG_993): corresponds to domains within Quaternary colluvial material.

Note Figure 14.7 to Figure 14.9 show the grade shells modeled at a 0.1 g/t Au threshold for Sections E1050, E400, and W300. These sections are looking to the northwest.

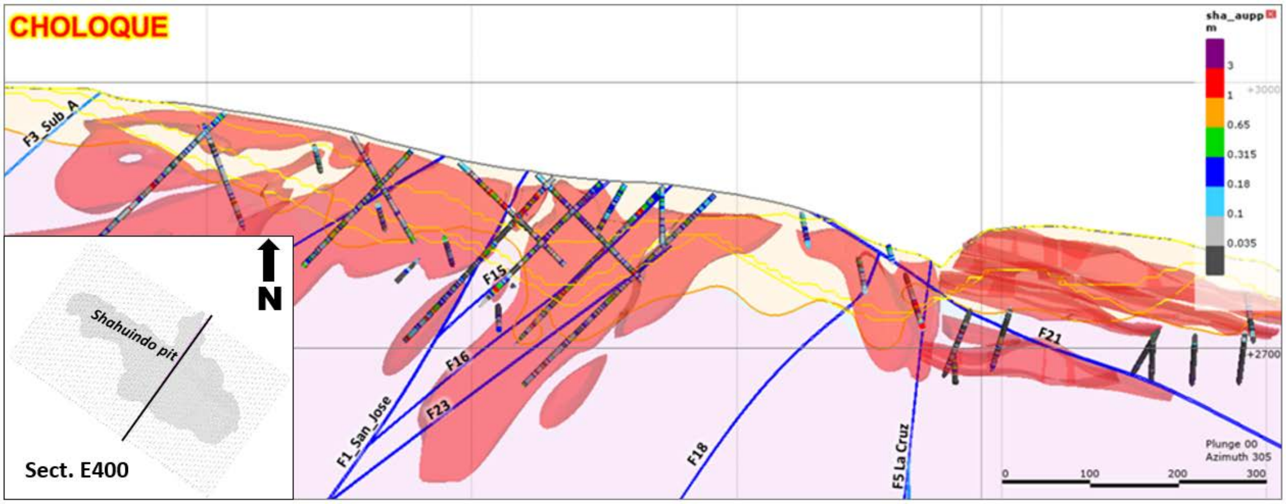
Figure 14.10 is a plan view of the domains and associated faults.

Figure 14.7 Section E1050 : 0.1 g/t Au grade shell



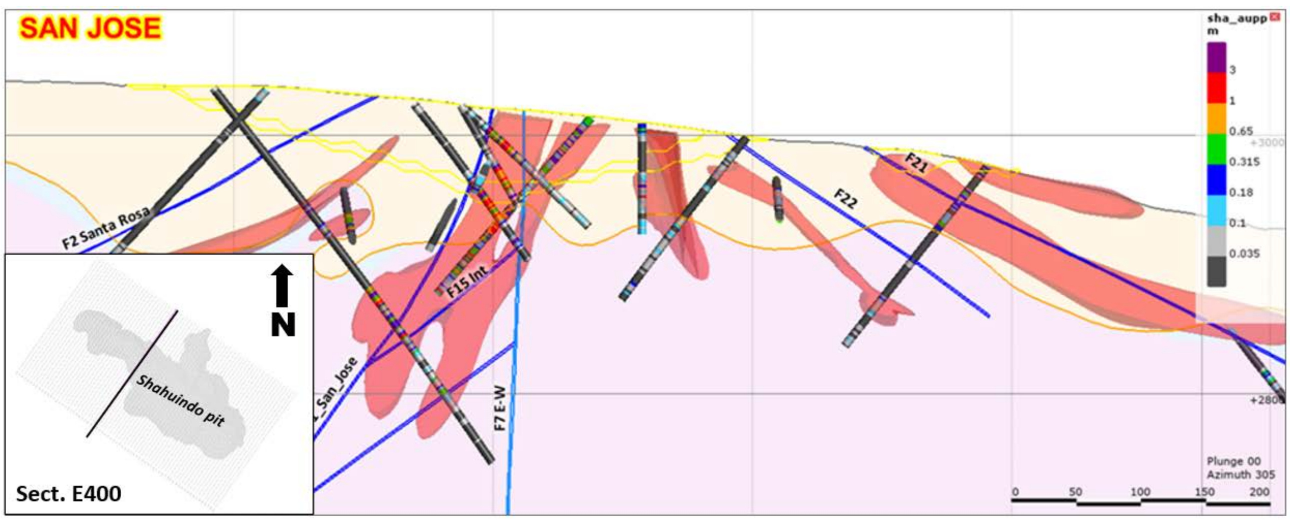
Source: PAS (2022).

Figure 14.8 Section E400 : 0.1 g/t Au grade shell



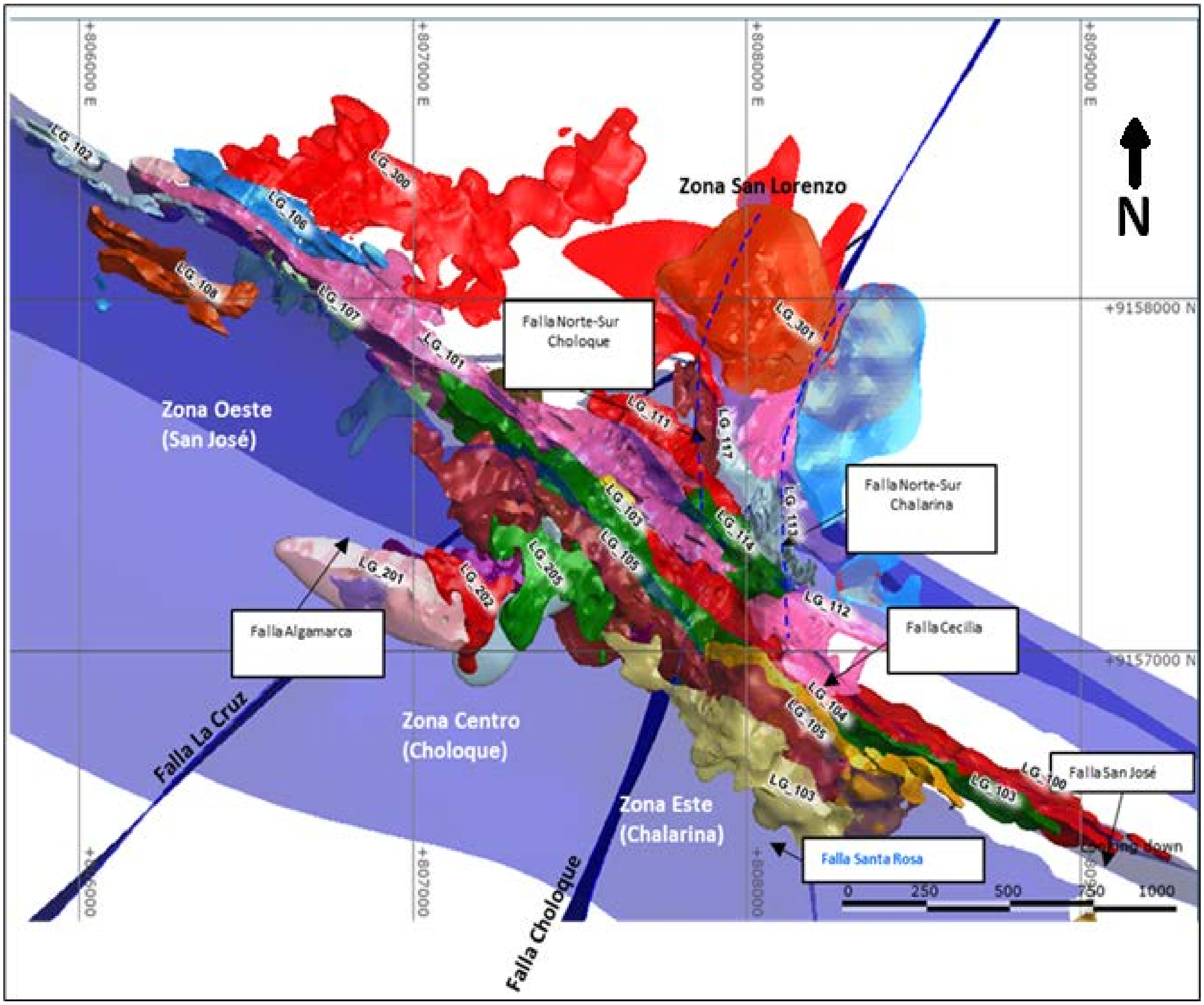
Source: PAS (2022).

Figure 14.9 Section W300 : 0.1 g/t Au grade shell



Source: PAS (2022).

Figure 14.10 Plan view: 0.1 g/t Au grade shell domains



Source: PAS (2022).

14.4 Grade estimation domains

14.4.1 Gold estimation domains

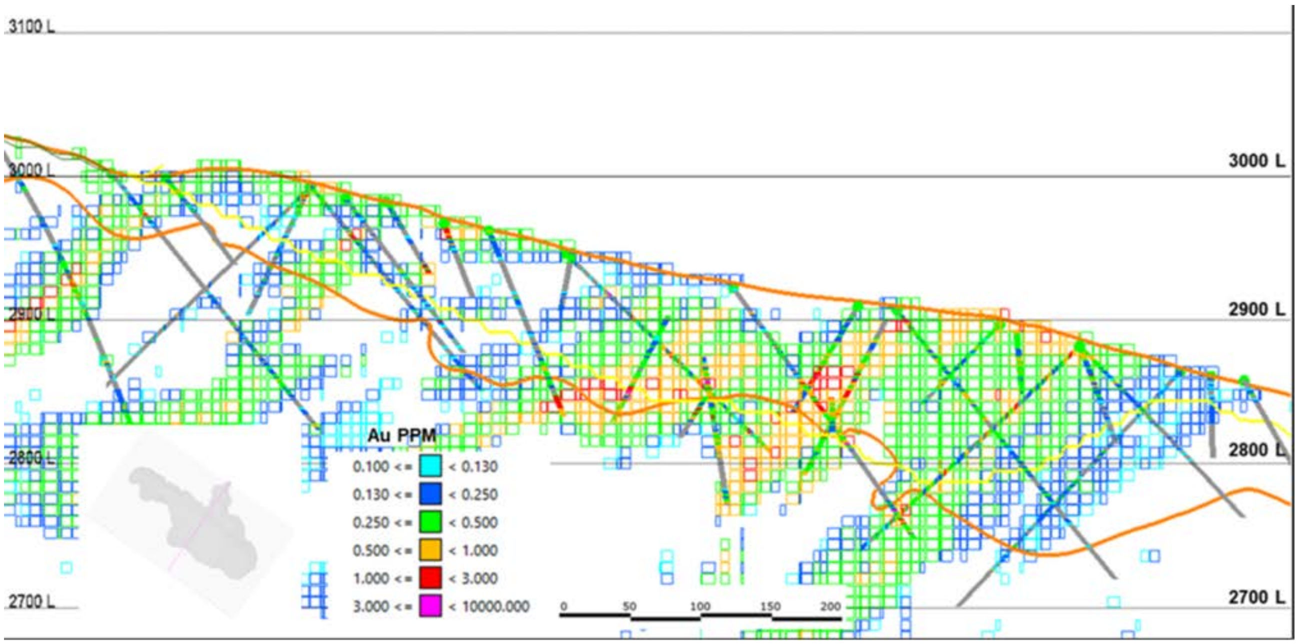
Gold estimation grade shell domains were interpreted using a cut-off limit of 0.1 g/t Au. There is no clear statistical boundary between the domains, so domains were joined into a single low-grade shell domain for estimation.

This effect of high grades on structures is controlled with Locally Varying Anisotropy (LVA) also known as dynamic anisotropy in each of the domains. Each domain has its own anisotropy.

The results from close spaced (25 m X 25 m) infill drillholes do not support the use of higher-grade gold domains, as there is discontinuity in higher grade mineralization. The limit of the 0.1 g/t Au domain-grade shell transgresses all sedimentary rocks and presents high grades that follow main structures which are controlled with dynamic anisotropy (LVA) in each of the domains.

Domains of 0.1 g/t Au are considered sufficient to constrain gold grade interpolation, given the reasonably dense drilling completed within the area of 0.1 g/t Au mineralization. Interpolation of higher grades was restricted by distance in the estimation process (discussed later in Section 14.8).

Figure 14.11 Section showing gold estimation relative to drillholes



Source: PAS (2022).

14.4.2 Silver estimation domains

There is a close correlation between the distribution of gold and silver grades in the Shahuindo deposit thus the 0.1 g/t gold domains were considered appropriate to restrict the silver grade interpolation. Very rare cases exist where some isolated silver grades fall outside the 0.1 g/t Au domains. In these cases, grade was restricted by distance.

14.4.3 Other estimation domains

Other minor elements were estimated in the model. Minor elements include sulfur, copper. Domains were built using threshold grades of 100 ppm for copper and 0.1% for sulfur.

14.4.4 Sample selection and compositing

Data from both RC and diamond drilling were used in this estimate. Samples were composited based on the 0.1 g/t gold grade shell domain. Composites were generated along 2 m adjusted lengths instead of a standard length which ensures that no sample is lost during compositing.

The database of composites for estimation was generated in the Vulcan® software using the grades from the assay database.

14.5 Statistics

14.5.1 Bulk density

Bulk density was interpolated in the model using inverse distance cubed (ID^3). LVA was utilized and ID^3 were extrapolated by lithology and Ore zones where no interpolation occurred.

Density values by rock type are presented in the following table.

Table 14.7 Density values by rock type in oxide zone & mixed oxide / sulfide transition zone, a sulfide zone

Density values by rock type in oxide zone

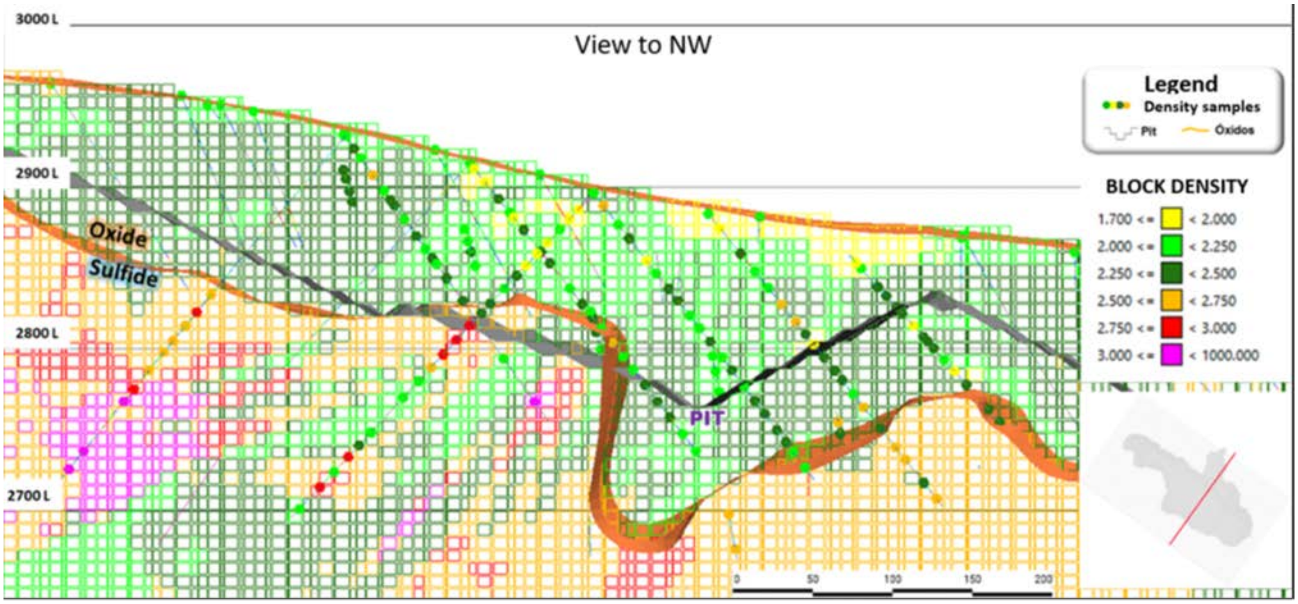
Variable	Litho	Count	Mean	Std	Variance	CV	Min	Max	Kurtosis
Density in oxide zone	10 SD	126	2.43	0.2	0.04	0.08	1.66	3.21	3.08
	20 SDST	477	2.41	0.2	0.04	0.08	1.18	3.82	9.45
	40 STSD	1817	2.31	0.2	0.04	0.09	1.29	3.68	2.08
	60 INT	560	2.16	0.23	0.05	0.1	1.45	3.1	0.82
	70 BXSTSD	974	2.22	0.24	0.06	0.11	1.2	3.92	3.14
	71 BXPH	2	2.48	0.14	0.02	0.06	2.38	2.58	0
	73 BXSD	122	2.41	0.21	0.04	0.09	1.76	2.8	1.13
	74 BXSDST	107	2.3	0.22	0.05	0.1	1.69	2.72	-0.24
	80 SH	6	2.23	0.38	0.14	0.17	1.62	2.55	-0.56
	99 Q	244	2.27	0.29	0.08	0.13	1.25	2.9	-0.42

Density values by rock type in mixed oxide / sulfide transition zone, a sulfide zone

Variable	Litho	Count	Mean	Std	Variance	CV	Min	Max	Kurtosis
Density in mixed oxide and sulfide zone	10 SD	3	2.6	0.03	0	0.01	2.57	2.63	5.7
	20 SDST	81	2.58	0.16	0.03	0.06	2.03	3.3	8.77
	40 STSD	1147	2.63	0.24	0.06	0.09	1.09	4.25	0.06
	50 QTZ	4	2.72	0.05	0	0.02	2.65	2.78	0.05
	60 INT	333	2.37	0.23	0.05	0.1	1.66	3	0.05
	70 BXSTSD	245	2.66	0.33	0.11	0.12	1.72	4.03	0.12
	71 BXPH	7	2.64	0.05	0	0.02	2.57	2.7	1.62
	73 BXSD	34	2.59	0.1	0.01	0.04	2.38	2.94	3.86
	74 BXSDST	5	2.5	0.25	0.06	0.1	2.1	2.75	1.45
	80 SH	256	2.7	0.19	0.04	0.07	1.81	3.8	6.9

Figure 14.12 shows the density estimation in the model using ID^3 in tonnes per cubic metre (t/m^3) with the oxide limit surface and the final pit at end June 2022. In general, sulfide densities present higher values than oxides.

Figure 14.12 Section showing block model density estimation



Source: PAS (2022).

14.5.1.1 Anisotropic Model (LVA)

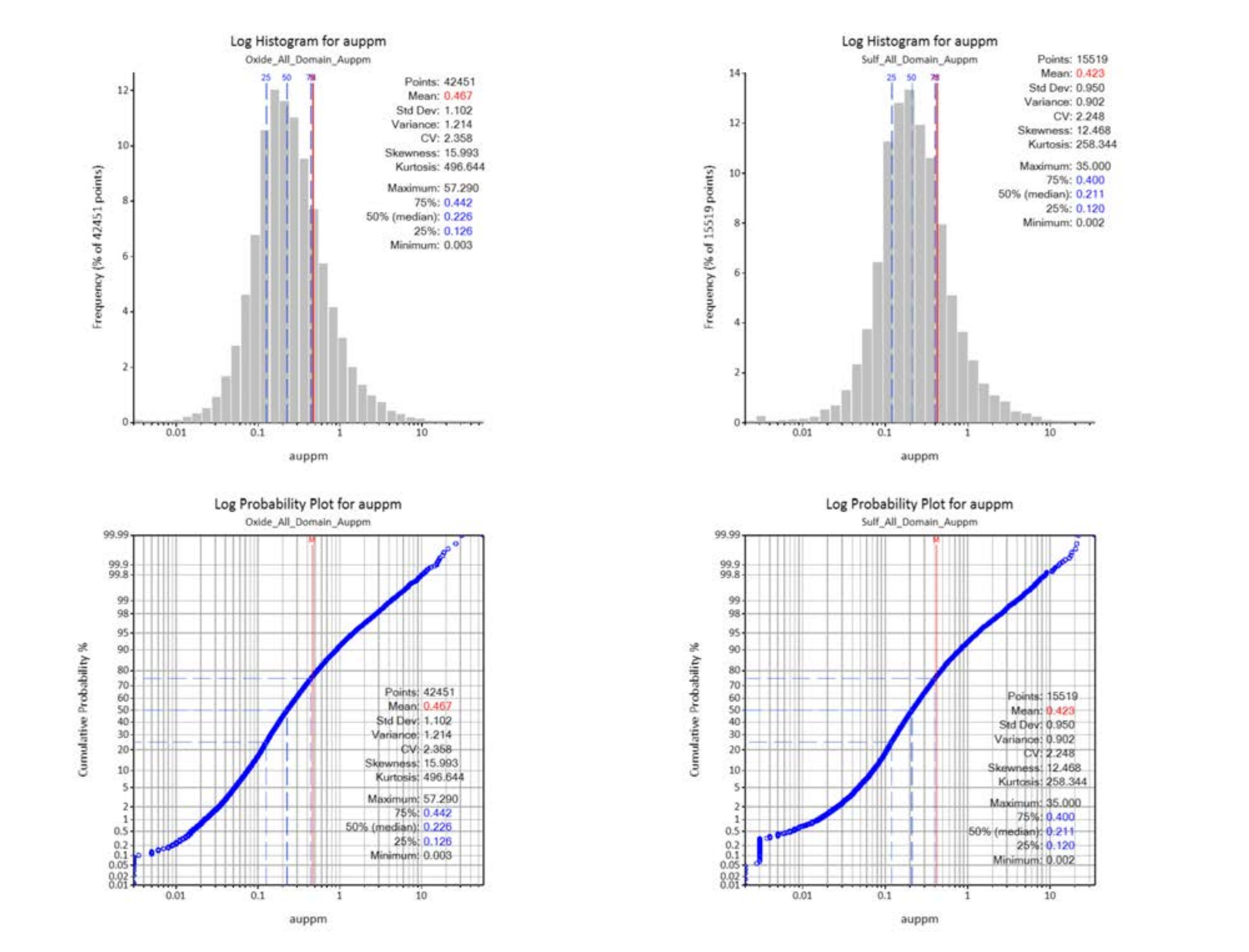
Given the difficulty to determine the preferential orientation of the continuity of mineralization in complex structures, the LVA application in Vulcan was utilized. LVA builds an anisotropic model from modeled structures by generating variations in orientation over short distances. This allows orientation of mineralization continuity to be incorporated with greater precision into the estimation.

The anisotropic model uses individually defined angles of rotation based on local trends. These are assigned to each model cell assuming constant ellipsoid dimensions. A point file with immersion value and direction is then created between the foot and hanging wall of each structure. These points show the variability of structural preferential direction.

14.5.2 Gold statistics

The statistics for 2 m composites are very similar for oxide and sulfide domains and support the use of a boundary between the oxide and sulfide domains for estimation purposes (Figure 14.13).

Figure 14.13 Gold statistics for oxide and sulfide domains



Source: PAS (2022).

The gold distribution of the 2 m composites is usually well structured, with minimal outliers. However, distance restrictions were applied to the outliers to avoid over estimation.

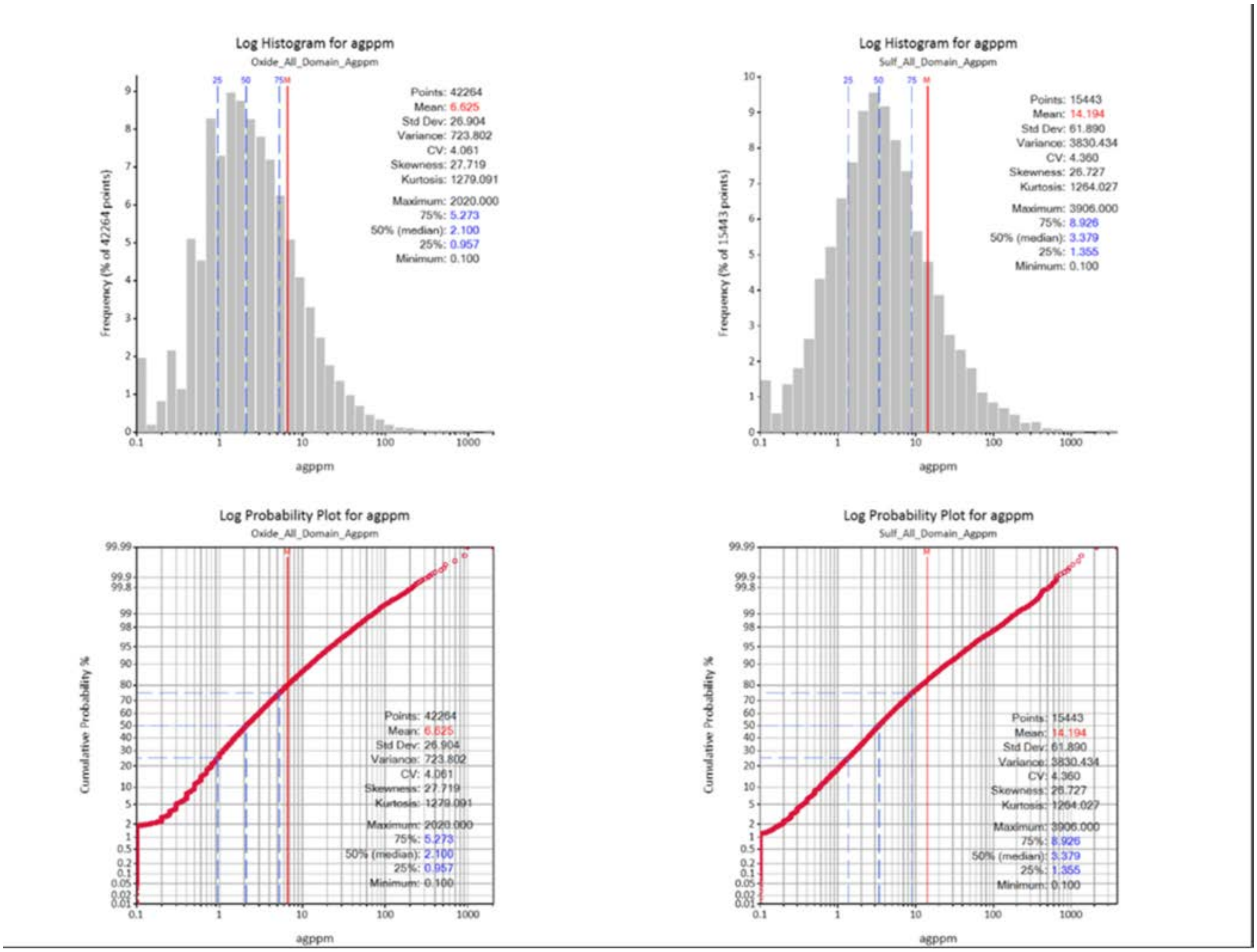
The sulfide domain is not classified as Mineral Resource and is not currently a priority for Shahuindo. Similar criteria have been applied to upper cut offs in sulfide domain gold composites as for the oxide domains.

14.5.3 Silver statistics

Statistics for the silver distribution (within the 0.1 g/t gold domains) show sufficient differences between the oxide and sulfide domains to warrant a stricter estimation limit (Figure 14.14). This is also evident when reviewing cross-sections. The upper end of distributions is slightly less consistent than the gold populations and therefore slightly more aggressive top-cuts have been applied to silver composites in an attempt to reduce the risk of grade overestimation, particularly in domains with smaller amounts of data.

Detailed statistics are for oxide and silver domains in Table 14.9. The sulfide domain has little importance to Shahuindo at this stage of development.

Figure 14.14 Silver statistics for oxide and sulfide domains



Source: PAS (2022).

14.5.4 Minor elements

Other elements including sulfur and copper, were reviewed to assist with the sterile rock characterization studies. These elements are considered "minor" as they have little or no direct economic impact on the oxide Mineral Resource or Mineral Reserve estimation.

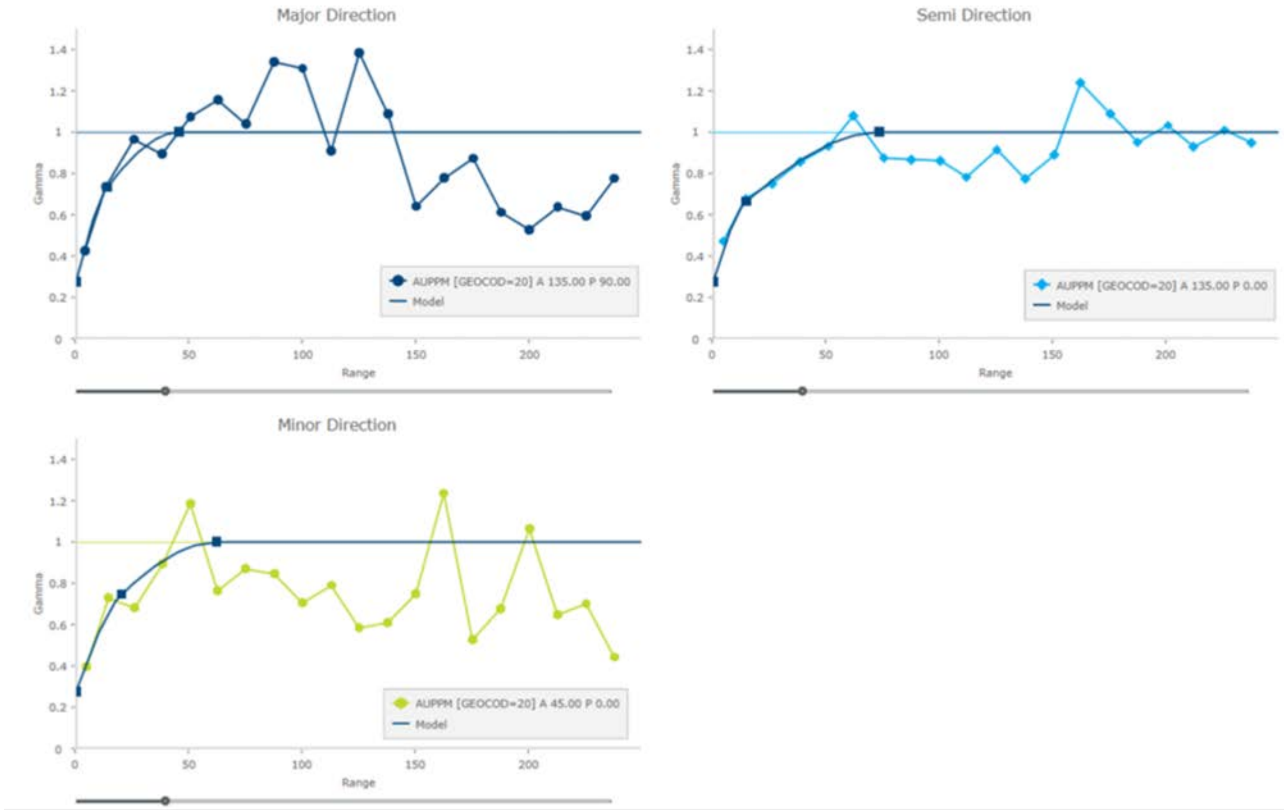
A review of each element was carried out in three dimensions and statistically to determine the appropriate domains for the estimation. A variety of constraints were applied where appropriate, based on combinations of rock type and oxidation state. No grade capping was applied to either of these elements for estimation. Hard domains were used for the estimation of both minor elements.

14.6 Variography

Variographic analysis (correlograms) was performed for each element (Au, Ag, Cu, and S) using 2 m composites for each domain. The Cu grade shell threshold was 100 ppm and S grade shell a threshold was 0.1%. The variograms were evaluated in several directions, selecting the result with the best directions, and then modeling it according to the parameters indicated below. Code 20 corresponds to solids greater than thresholds and code 10 corresponds to the background values outside grade shell domains.

Code 30 corresponds to grade shell within sandstone (SD).

Figure 14.15 Variogram for gold



Source: PAS (2022).

Table 14.8 Table of correlogram results

Domain	Variable	Model type	Nugget	Sill differential	Bearing rot. about z	Plunge rot. about y	Dip rot. about x	Major axis	Semi-major axis	Minor -axis
10	Au ppm	SPHERICAL	0.29	0.368	120	0	-60	16	20	12
		SPHERICAL		0.342	120	0	-60	100	130	100
20	Au ppm	SPHERICAL	0.29	0.368	120	0	-60	16	20	12
		SPHERICAL		0.342	120	0	-60	100	130	100
10	Ag ppm	SPHERICAL	0.338	0.465	120	0	-60	20	13	12
		SPHERICAL		0.197	120	0	-60	100	70	45
20	Ag ppm	SPHERICAL	0.350	0.484	120	0	-60	30	11	15
		SPHERICAL		0.166	120	0	-60	75	51	56
10	Cu ppm	SPHERICAL	0.400	0.300	110	0	-60	70	10	20
		SPHERICAL		0.300	110	0	-60	130	70	50
20	Cu ppm	SPHERICAL	0.320	0.430	120	0	-50	15	18	30
		SPHERICAL		0.250	120	0	-50	80	100	100
10	S %	SPHERICAL	0.110	0.223	120	-50	-80	120	80	135
		SPHERICAL		0.667	120	-50	-80	350	350	230
20	S %	SPHERICAL	0.110	0.223	120	-50	-80	120	80	135
		SPHERICAL		0.667	120	-50	-80	350	350	230

14.7 Block modelling

The block model corresponds to a regular model from a sub-cell model built using Maptek Vulcan™ mining software.

A sub-cell model was used. To define the size of the cells the geometry and volume of the grade shell domains for each element (Au, Ag, Cu, and S), lithological domains, alteration and ore zone type were taken into account. The dimensions of the sub-blocked model were 8 m x 8 m x 8 m for parent cells and 2 m x 2 m x 2 m for sub-cells. Subsequently the blocks are regularized to cells of 8 m x 8 m x 8 m on the X, Y, Z axes. The block model is converted to Minesight format for planning purposes and is named “sh2207.dat”.

Table 14.9 Block model parameters

	Origin	Block size (m)	Number of blocks	Dimension (m)	Sub block (m)
X	805,400	8	500	4,000	2
Y	9,155,700	8	425	3,425	2
Z	2,500	8	135	1,080	2

Note: Origin is bottom left corner cell.

Table 14.10 Model variable descriptions

Variable	Description
IJK	Parent Cell Identifier
XC	Centroid of cell easting
YC	Centroid of cell northing
ZC	Centroid of cell RL
XINC	Cell easting dimension
YINC	Cell northing dimension
ZINC	Cell RL dimension
crs	Geomet CRS
orezone	Orezone
lito	Litologia
auppm	Estimacion_Au - diluted Au ppm
agppm	Estimacion_Ag - diluted Ag ppm
cuppm	Estimacion_cu - diluted Cu ppm
sperc	Estimacion_S - diluted S%
categ	categorizacion recursos
densidad	densidad
Finos	Porcentajes de finos, malla -200
Materiales	Clasificacion de Materiales tabla v 15

14.8 Grade estimation

The following elements were estimated using ordinary kriging (OK): gold in g/t, silver in g/t, copper in g/t, and sulfur in %.

The Au grade shell was modeled at 0.1 g/t Au into a single domain (code 20) using statistics, p-plot and a high-grade population related to the structures previously mentioned. The gold grade shells are controlled with the LVA. A second domain (code 10) was modeled as background.

The estimation was defined with 3 passes with incremental search radii restricted by outliers, number of minimum and maximum composites, the minimum and maximum number of drillholes and number of composites per drillholes so that the grade interpolation respects the local and global informing of composites.

Table 14.11 Search parameters used for estimation

Estimation parameters for Au, Ag, Cu, and S										
Dom	Grade shell	Estimation method	Pass	Search ellipse radius			No. composites		Max samples per dh	Anisotropy (LVA)
				Major	Semi-major	Minor	Min.	Max.		
10	Background	Ordinary kriging	1	70	50	12.5	5	24	2	yes
		Ordinary kriging	2	140	80	25	3	15	2	yes
		Ordinary kriging	3	300	120	50	2	4	2	yes
20	0.1 Au g/t	Ordinary kriging	1	70	50	12.5	5	24	2	yes
		Ordinary kriging	2	140	80	25	3	15	2	yes
		Ordinary kriging	3	300	120	50	2	4	2	yes
30	0.035 Au g/t	ORDINARY KRIGING	1	70	50	12.5	5	24	2	yes
		ORDINARY KRIGING	2	140	80	25	3	15	2	yes
		ORDINARY KRIGING	3	300	120	50	2	4	2	yes

A distance restriction was applied to the interpolation of the background domain (domain 10), for values greater than 0.25 Au g/t.

Table 14.12 Restriction parameters

envau	Variable	High yield limit threshold	Restriction by distance		
			Major	Semi-major	Minor
10	Au ppm	1	24	24	24
20	Au ppm	20	24	24	24
30	Au ppm	18	24	24	24

A soft boundary was used for gold and silver estimates. When reviewing cross-sections and statistics, there is no clear change in the distribution of metal grades along the base of oxidation.

14.9 Mineral Resource model validation

Different methods were carried in order out to validate the block model. This also assists in finding better estimation parameters. Visual comparison between drillhole grades and block grades was carried out initially and the composite grades were well represented in the model.

A comparison of the model grades estimated by OK and the gold and silver data composited at 2 m for the Measured and Indicated Mineral Resource, in the oxidation zone, was made.

As shown in Table 14.13, the gold and silver values compare favorably to the block model grades, with slightly higher grades shown in the Mineral Resource model. The estimate of the Au grade is slightly higher (<1%) than the Au grade of the composites, and the silver model grades are 7% higher, due to the usage of the same gold ellipse for silver estimation.

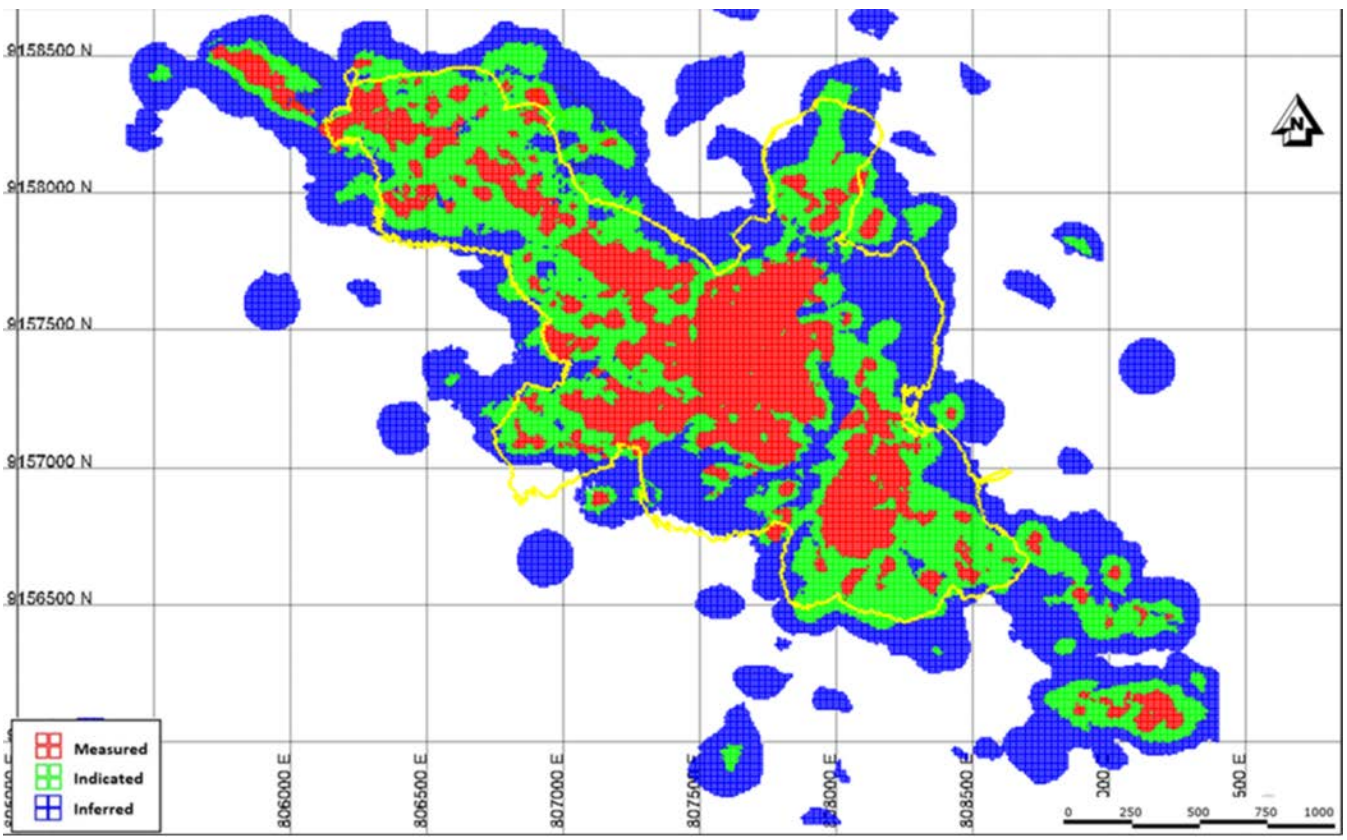
Table 14.13 Comparison of composites and block grades

Domain grade shell	Composites			Mineral Resource model		
	Samples	Au g/t	Ag g/t	Blocks	Au g/t	Ag g/t
20 Oxide_All_Domain	37,739	0.492	6.892	159,850	0.440	6.608
30 Oxide_All_Domain	4,727	0.266	4.501	23,602	0.232	4.057

14.9.1 Mineral Resource classification

The estimate was classified into spatially continuous measured, indicated, and inferred categories based on distance, number of drillhole composite samples. Measured Mineral Resources were assigned where drillhole spacing is less than 25 m and defined by at least 10 composites. Indicated Mineral Resources were assigned where drillholes are more widely spaced, generally 50 m or less, and defined by at least 8 composites. Inferred Mineral Resources were assigned where regularly spaced drillholes demonstrate continuity of approximately 100m defined by a minimum of four composites. Figure 14.16 shows the classification of the block model according to the criteria above.

Figure 14.16 Plan showing Mineral Resource classification



Source: PAS (2022).

14.10 Reasonable prospects for eventual economic extraction

RPEEE was addressed by reporting the Mineral Resources within a constraining open pit shell. This shell used the input parameters listed in Table 14.14.

Table 14.14 Input parameters for constraining pit shape

Item	Units	Cost
Gold price	$/oz	1,700
Silver price	$/oz	22
Open pit mining cost	$/t	1.80
Processing costs	$/t ore	4.32
G&A costs	$/t ore	2.67
Gold recovery	%	80%
Silver recovery	%	10%
Marginal cut-off grade	$/t	0.16

The cut-off is applied to segregate material into ROM which is what is reported.

Metallurgical testing results on samples of sulphide mineralization that became available after June 30, 2022 has led to the conclusion that the previously reported sulphide Inferred resource does not meet the criteria for RPEEE at this time. As such, the deeper sulphide mineralization is not included in the estimated Mineral Resources at the Property.

14.11 Mineral Resources

Mineral Resources for Shahuindo at June 30, 2022, are shown in Table 14.15. This tabulation includes insitu potentially economic material at metal prices of $22 per ounce of silver and $1,700 per ounce of gold, classified as Measured, Indicated, and Inferred Mineral Resources. The open Mineral Resources are constrained within an optimized pit shell which is also the Mineral Reserve pit design. See Section 15 for more detail.

Table 14.15 Mineral Resources at June 30, 2022

Classification	Tonnes	Grade		Contained metal	
	Mt	Au g/t	Ag g/t	Au koz	Ag koz
Measured	8.3	0.29	5	77	1,279
Indicated	13.2	0.23	4	98	1,800
Measured + Indicated	**21.6**	**0.25**	**4**	**175**	**3,079**
Inferred (Oxide)	**14.6**	**0.41**	**8**	**194**	**3,724**

Notes:

- CIM Definition Standards (2014) were used for reporting the Mineral Resources.
- Mineral Resources exclude those resources converted to Mineral Reserves.
- Mineral Resources do not have demonstrated economic viability.
- Mineral Resource estimates were prepared under the supervision of, or were reviewed by Christopher Emerson, FAusIMM, Vice President, Business Development and Geology of Pan American who is the QP.
- Mineral Resources have been estimated using heap leaching metal recovery and cost parameters.
- Resources at end June 30, 2022 are based in ROM 1 Au cut-off grade = 0.032 g/t, FIRO Au cut-off grade = 0.207 g/t, ROM 2 Au cut-off grade = 0.159 g/t.
- Metal prices used are gold at $1,700/oz and silver at $22/oz.
- Mineral Resources were constrained within a Whittle shell to conform with RPEEE.
- The drillhole database was closed at May 31, 2022.
- Totals may not compute exactly due to rounding.

15 MINERAL RESERVE ESTIMATES

15.1 Introduction

The Mineral Reserve estimates conform to CIM Definition Standards referred to in NI 43-101. All design and scheduling have been completed using the Mineral Resource model and estimate described in Section 14.

Pan American updates Mineral Reserves on an annual basis following reviews of metal price trends, operational performance and costs experienced in the previous year, and forecasts of production and costs over the life of the mine. The Mineral Reserve is based on Measured and Indicated Mineral Resources estimated as at June 30, 2022. The effective date of the Mineral Reserve estimate is June 30, 2022.

Mineral Reserve estimates are based on assumptions that include mining, metallurgical, infrastructure, permitting, taxation, and economic parameters. Increasing costs and taxation and lower metal prices will have a negative impact on the quantity of estimated Mineral Reserves. There are no other known factors that may have a material impact on the estimate of Mineral Reserves.

The estimated Proven and Probable open pit Mineral Reserves for the Shahuindo deposit are summarized in Table 15.1.

Table 15.1 Mineral Reserve as June 30, 2022

Classification	Tonnes Mt	Au grade g/t	Ag grade g/t	Au koz	Ag koz
Proven	56.0	0.52	8.35	944	15,044
Probable	45.3	0.41	6.07	604	8,847
Proven & Probable	**101.3**	**0.48**	**7.33**	**1,548**	**23,891**
Stockpiles	2.85	0.30	3.06	28	281
Total Reserves	**104.2**	**0.47**	**7.22**	**1,575**	**24,171**

Notes:
- Mineral Reserves are in addition to Mineral Resources.
- Figures in the tables may not compute exactly due to rounding.
- The Mineral Reserves at end June 2022 are based on a cut -off grade of ROM 1 Au cut-off grade = 0.04 g/t, FIRO Au cut-off grade = 0.26 g/t, ROM 2 Au cut-off grade = 0.18 g/t.
- Cut-off values are based on a gold price of $1,500/oz, silver price of $19/oz.
- Metallurgical recoveries are based on feed grade and metallurgical algorithms. No adjustment of the model was necessary to account for dilution.
- Mineral Reserves are reported on a 100% ownership basis; Pan American owns 100% of Shahuindo SAC.

15.2 Modifying factors and cut-off grade estimation

The Mineral Resources for Shahuindo have been converted to Mineral Reserves based upon the modifying factors in Table 15.2.

Table 15.2 Shahuindo Mineral Reserve economic modifying factors

Economic Parameters	Units	Reserves ROM
Sales Ag price	$/oz	19
Sales Au price	$/oz	1,500
Metallurgical recovery Ag	%	10
Metallurgical recovery Au	%	80
Mining costs	$/t	1.80
Process costs	$/t ore	4.32
G&A costs	$/t ore	2.67
Mineral Reserve COG	g/t	0.18

In this Technical Report, Mineral Reserves do not include Mineral Resources.

This is an operating mine and there are no identified legal, environmental, social, or governmental factors which will prevent the Mineral Reserve from being mined.

The modifying factors including the mining costs are used in the optimization process to define the optimum pit shell on which the pit design is based. The COGs have been estimated based on a breakeven generating sufficient revenue to cover processing and General and Administration (G&A) costs only, for the material mined within that pit design.

15.3 Dilution and ore loss

Historical performance has been compared against the Mineral Resource model the Mineral Reserve is based on. This has indicated that the model generally underestimates the contained metal and grades compared to the quantity of metal produced. Hence no additional ore loss or dilution has been applied in estimating the Mineral Reserve

15.4 Geotechnical parameters

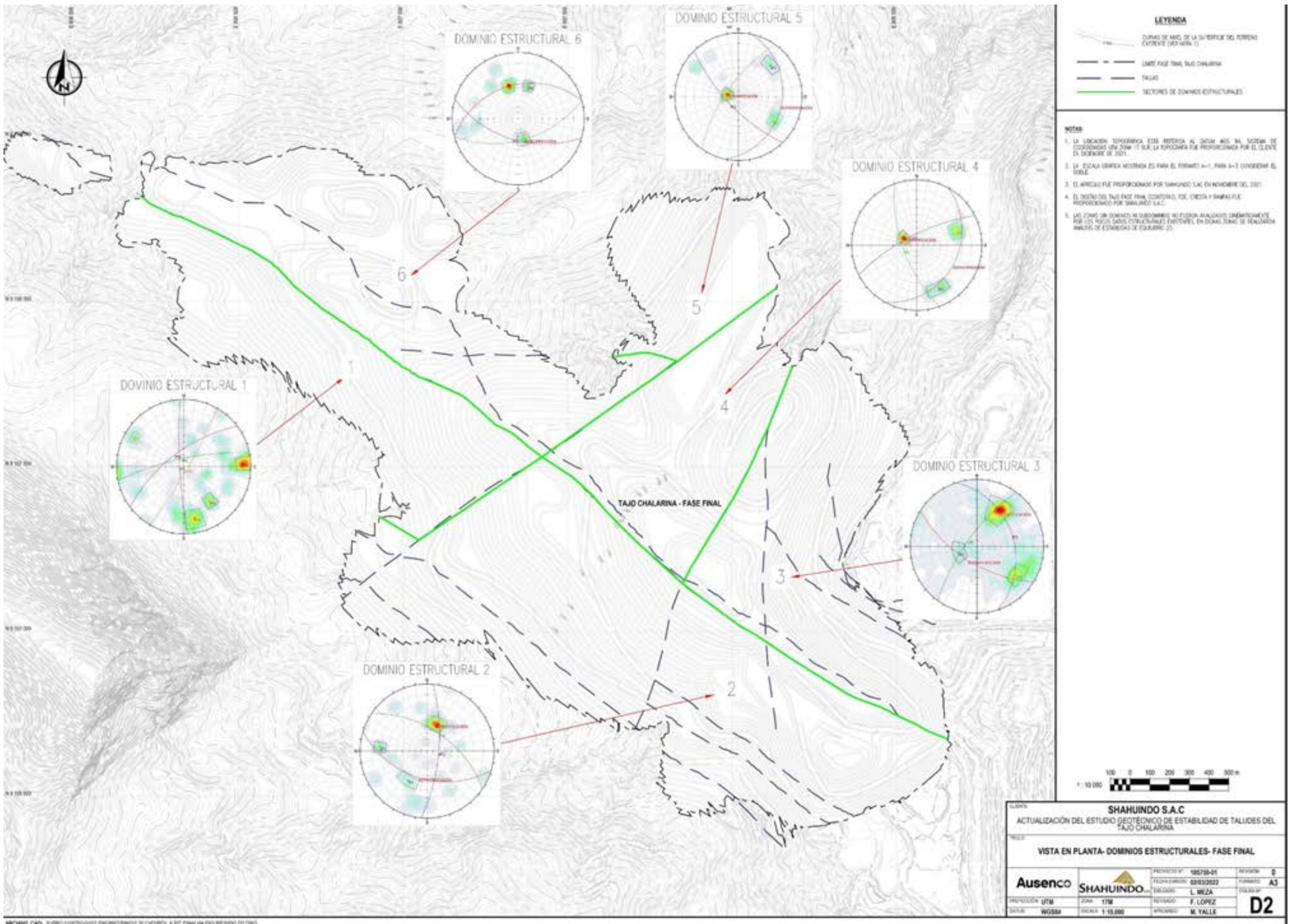
A number of geotechnical studies were completed prior to commencement of operations in 2016. In March 2022 Ausenco reviewed all of the geotechnical studies that have been completed to date. These include the following:

- Tagus Slope Research at Feasibility Level - Golder Associates Inc. (2012).
- 3D geological solid containing the lithology and structural information provided by Shahuindo SAC.
- Design of Open Pit Slopes - Anddes Asociados S.A.C. (2015).
- Technical Report on the Shahuindo Mine - Tahoe Resources (2016).
- Seismic Hazard Study - Shahuindo Project - Environmental Impact Study Seismic Hazard Analysis - Anddes Asociados S.A.C. (2016).
- Complementary Hydrogeological Evaluation for MEIA of the Shahuindo Project - Global Yaku Consultores S.A.C. (2016).
- Update of the Design of Open Pit Slopes - Anddes Asociados S.A.C. (2017).
- Detail Engineering of DME Sur - Anddes Asociados S.A.C. (2018).
- Update of the Hydrogeological Study and Complementary Studies for the Shahuindo Mining Unit - Ausenco Perú S.A.C. (2021).
- Slope Stability Assessment of the Chalarina Open Pit Extension – ITS 7 - Ausenco Peru S.A.C. (2021).
- West Wall Drainage Evaluation Tajo Chalarina - Ausenco (2021).
- Geotechnical Research Report - Ausenco Perú S.A.C. (2021).

- Seismic Hazard Analysis – Ausenco Perú S.A.C. (2021).

Figure 15.1 summarizes the six structural domains that Ausenco's identified for the final pit design.

Figure 15.1 Geotechnical domains – final pit

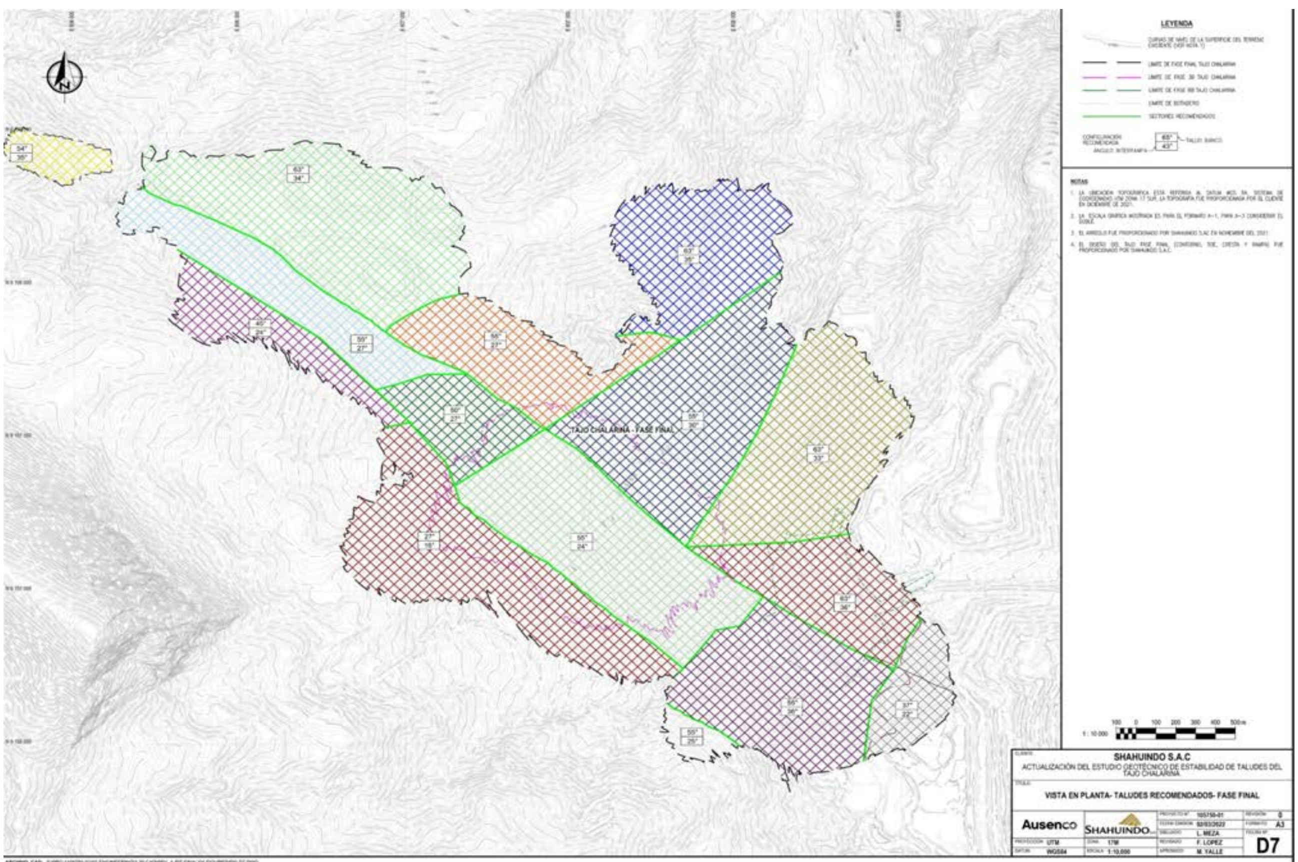


Slope design parameters are summarized in Table 15.3 and illustrated in Figure 15.2. These wall parameters align with those which have been used successfully to date at Shahuindo.

Table 15.3 Mineral Reserve slope design parameters

SECTOR	IRA (°)	BFA (°)	Bench height (m)	Berm width (m)	Bench slope (m)	OVERALL 1-RAMP (°)	OVERALL 2-RAMP (°)
1	24	45	8	10.0	8.00	22.4	21.1
2	25	55	8	11.6	5.60	22.9	21.2
3	27	50	8	9.0	6.71	26.0	25.1
4	16	27	8	12.2	15.70	15.5	15.1
5	36	63	8	6.9	4.08	34.7	33.4
6	33	63	8	8.2	4.08	31.8	30.8
7	35	63	8	7.3	4.08	33.7	32.4
8	34	63	8	7.8	4.08	31.7	29.7
9	35	54	8	5.6	5.81	32.8	30.8
10	25	55	8	11.6	5.60	22.9	21.2
11	25	55	8	11.6	5.60	24.3	23.6
12	24	55	8	12.4	5.60	22.4	21.1
13	24	45	8	10.0	8.00	20.4	17.8

Figure 15.2 Mineral Reserve slope design area



Other observations noted by Ausenco (2022) included the following:

- Rock mass rating (RMR) classification (after Bieniawski 1989) varies between 23 and 48 (regular to very bad rock mass) which has led to the relatively low inter-ramp wall angles.
- The values of the geological strength index (GSI) vary between 28 to 53.
- Disturbance factors are expected to range between 1.0, 0.75, 0.50, and 0.0.
- The results of the probabilistic seismic hazard assessment indicate that for a 10% exceedance probability in a 50-year exposure period (475-year return period), the value of the maximum ground accelerations (PGA) of the study zone in a site classification BC (Vs30 = 760 m/s) and C (Vs30 = 450 m/s) corresponds to 0.29 g and 0.346 g respectively. In the area where Pan American operates, this corresponds to a site classification of BC ((East-Farrat) and C (West-Carhuaz).

Ground control monitoring systems include the following:

- A real-time ground movement radar monitoring system (Ground Probe).
- An automated robotic prism monitoring system.

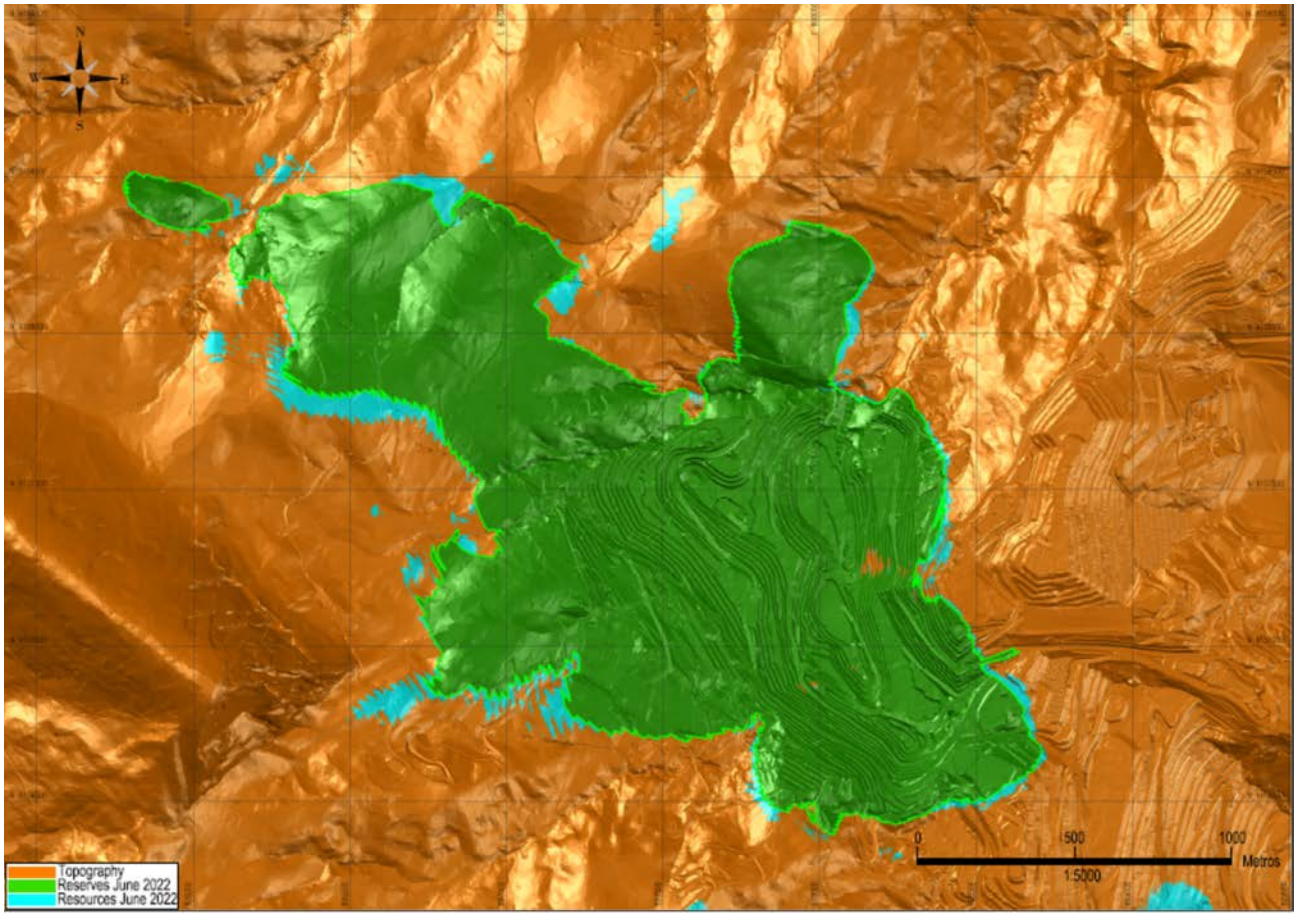
15.5 Pit design

The Mineral Reserve estimate was completed by first identifying the optimal pit limits using the economic parameters detailed in Table 15.2 and Lerch-Grossman pit optimization techniques using Whittle™ software. The results of the optimization were used to guide the detailed pit design which included ramp access for mine equipment and personnel, and the detailed batter slope and berm configurations. A comparison between the LOM pit design and the Whittle optimization showed a close alignment with minor differences due to:

- Slope parameters in the design incorporating individual geotechnical sectors, where the Whittle optimization assumed an overall slope angle.
- Waste tonnes were increased slightly due to including LOM haul roads while maintaining the minimum mining width.

A sequence was identified which targeted higher value material and deferred waste which enhanced the economics of Shahuindo. Pan American used this sequence to design phased pits. This inventory was scheduled using the Whittle™ open pit net present value (NPV) scheduler software to optimize the NPV under a set of mining constraints and costs based on the previous LOM plan. The extent of the Mineral Reserve pit is compared to the extents of the shell which defined the Mineral Resource in Figure 15.3.

Figure 15.3 Mineral Reserve pit extent vs Mineral Resource extent



Source: Shahuindo Technical Team (2022).

16 MINING METHODS

16.1 Open pit mining operations

Shahuindo consists of an open pit mine and heap leach processing facility that is currently in production and has been operating since 2016. The open pit is being mined in a sequence of phased cutbacks. The mining method utilizes conventional drill and blast, loading of ore and waste is by diesel powered 90 t excavators into 42 t and 46 t heavy duty highway rigid frame dump trucks. This type of truck is common in this style of operation in Peru. The ore and waste are hauled to the leach pad or waste dumps correspondingly.

Mining is based on an owner operator model, with operations managed and controlled by Pan American utilizing Pan American employees. Mining is carried out on two 12-hour shifts, operating 7 days a week.

The mine design utilizes 8 m benches which are suitable for the size of equipment employed and align with those used since 2016 which have delivered the dilution and ore loss outcomes used for this Mineral Reserve.

Grade control uses a mixture of blast hole drill samples and short RC holes that are drilled on a campaign basis.

Drilling and blasting utilize 156 mm diameter blast holes and powder factors of 0.20 – 0.25 kg/BCM using a bulk emulsion explosive. Drill penetration rates are consistent between ore and waste, and the deeper benches do not show any changes in the mechanical properties of the rock mass with only the oxide zone being mined (there are some local less oxidized zones that are easily distinguishable by their black colour that, where possible, are identified by grade control drilling and sent to waste because of low metallurgical recoveries). The unconfined compressive strength (UCS) varies from 16 MPa in high alteration areas up to 120 MPa in the bedrock. The average penetration rate is 40 m/h which corresponds approximately to the rate anticipated when the UCS is around 32 MPa.

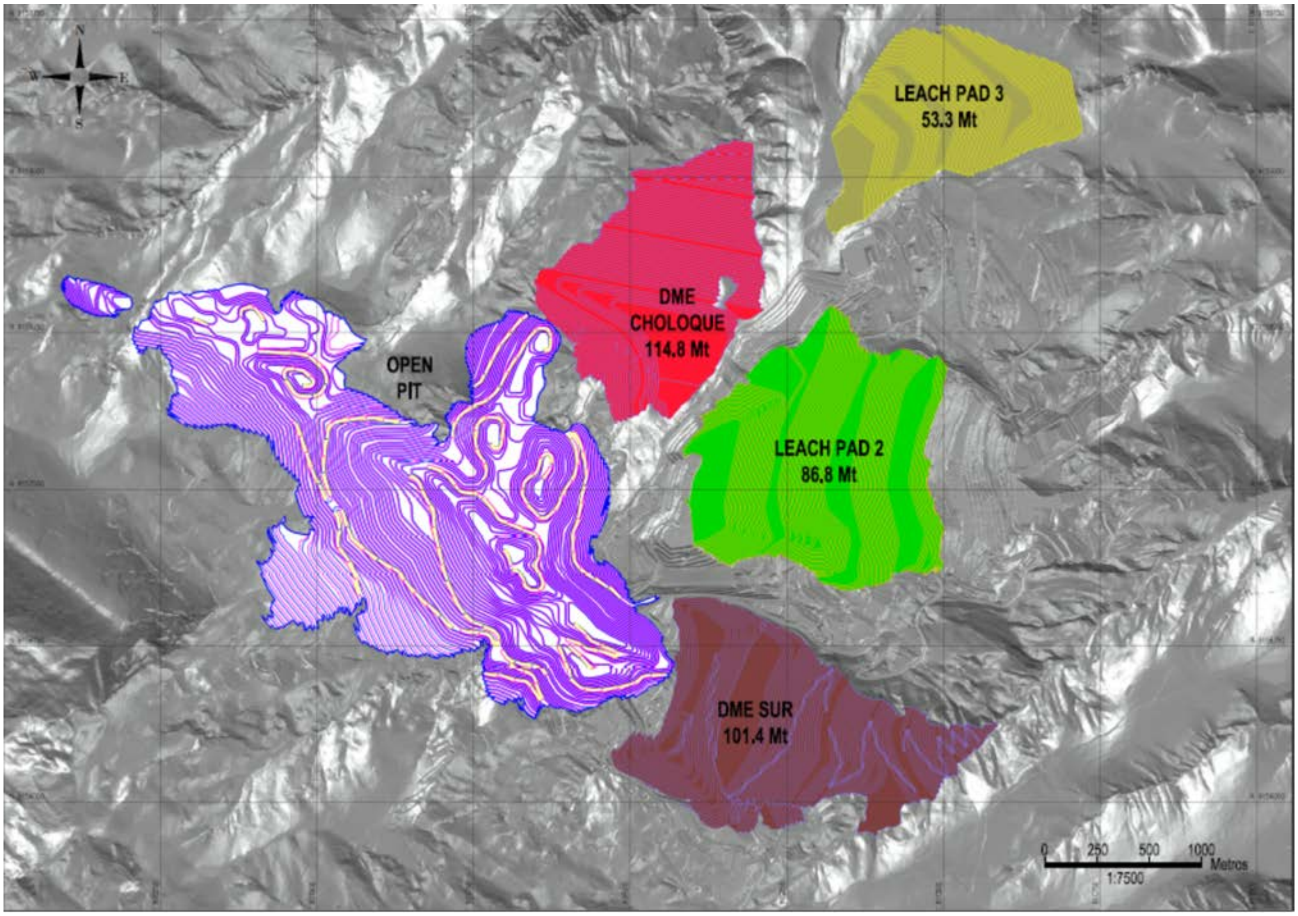
The designs employ a minimum cutback width of 50 m with 14 m haul roads (11 m operational width plus 3 m for berms and drainage) to allow two-way roads for 46 tonne capacity haul trucks that have an operating width of 2.96 m. The maximum center line haul road gradient is 10%, though some of the initial haul roads were designed on steep terrain with gradients of 12%.

A series of phases have been designed considering the best ramp positions, pit access, geotechnical recommendations, and overall volume. The Phases allow variability in material movements and ore supply between period to be managed, and for the most valuable and lowest strip ratio areas to be targeted first to maximize the value of the operation.

The mine waste facilities have been designed to the southeast and north of the pit, and the leach pads are to the east and northeast. The mine site layout is shown in Figure 16.1. There is significantly more capacity in the waste storage and leach pad designs than is required in the Mineral Reserve schedule.

The mine site layout has been designed taking into consideration the potential future expansion of the Shahuindo open pit and infrastructure.

Figure 16.1 Pit and waste dump locations



Note: DME = waste dump.
Source: Shahuindo Technical Team (2022).

Table 16.1 Waste storage and leach pad quantities

Description	Leach pad	Waste dump (DME)
Capacity (Mt)	140.1	216.2
Mining plan (Mt)	124.2	172.2
Percentage of use	89%	80%

16.2 Mine life and production schedule

The Mineral Reserve discussed in Section 15 gives a mine life of 10 years through to 2032 at an initial production rate of 6 million tonnes (Mt) for the second half of 2022, and 13.1 million tonnes per annum (Mtpa) in average for period 2023 – 2027, 9.4 Mtpa in average for period 2028 – 2030 and 6.6 Mtpa in average for last two years of mine production.

16.3 Mining fleet

Detailed analysis has been performed as part of a haul truck optimization study to estimate the mining fleet and personnel numbers. Truck productivity is based on haulage routes and travel speeds. The haulage routes were drawn from the pit designs to each of the potential destinations. Additional haulage lines were drawn for each bench within the pit designs. The speeds were flagged into the haulage string description fields based on location and haul gradient.

HEXAGON MinePlan™ and Maptek Vulcan™ software were used to calculate the truck hours based on assigned speeds for loaded and empty trucks along each of the haul routes. Resulting haulage strings were drawn by HEXAGON MinePlan™ and verified to ensure proper routing of haulage was followed.

The available hours per day were adjusted by mechanical availability and operator efficiency. The mechanical availabilities start at 88%, the operator efficiency or utilization factor used is 80%, which accounts for break times, lunches, and shift start-ups and shutdowns.

The mining fleet is shown in Table 16.2 and the personnel list is shown in Table 16.3.

Table 16.2 Mining fleet

Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Drills DM45	2	2	2	2	2	2	2	2	2	2	1
Excavators CAT 395		5	5	5	5	5	3	3	3	3	3
Excavators CAT 390	4	-	-	-	-	-	-	-	-	-	-
Excavators CAT 336	1	1	1	1	1	1	1	1	1	1	1
Trucks 42 t	32	-	-	-	-	-	-	-			
Trucks 46 t	31	49	58	58	58	62	46	46	46	46	42
Bulldozer D9T	1	1	1	1	1	1	1	1	1	1	1
Bulldozer D8T	3	3	3	3	3	3	3	3	3	3	3
Graders CAT16	4	4	4	4	4	4	4	3	3	3	3
Water Trucks 400GL	3	3	3	3	3	3	3	3	3	3	3
Crane RT-700E	1	1	1	1	1	1	1	1	1	1	1
Excavators CAT320	2	2	2	2	2	2	2	2	2	2	2
FEL CAT966	1	1	1	1	1	1	1	1	1	1	1
Light Vehicles	8	8	8	8	8	8	8	8	8	8	8
Lighting Plants	8	8	8	8	8	8	8	8	8	8	8
Fuel Truck	1	1	1	1	1	1	1	1	1	1	1
Lubricant Truck	1	1	1	1	1	1	1	1	1	1	1

Table 16.3 Personnel

Description	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Company	626	620	620	619	618	617	603	353	603	603	353
Mining contractor	520	800	800	800	800	800	800	400	400	400	400

The fleet and numbers of people are appropriate for realizing the Mineral Reserve mining schedule.

16.4 Hydrogeology and hydrology

The Hydrogeological Conceptual Model of the Tajo Chalarina was updated based on historical information obtained between 2020 and 2021, supported by Ausenco, with the aim of maintaining safe conditions of the walls and the bottom of the pit which will allow defining the conditions with respect to the deepening of the pit and thus evaluate the need for drainage or dewatering.

With the annual mining plan, it is defined in which year the groundwater level will be intercepted, in this sense, based on the geometry of the pit by 2032, the deepest zone in the central sector reaches Level 2,680 masl, while in the southeast and northwest sectors it reaches Level 2,688 masl and Level 2,936 masl, respectively.

Existing information and hydrogeological investigations (piezometers) were reviewed, with which the groundwater level was defined and the drainage of the Tajo Chalarina in the central and northwest sector was evaluated. In the indicated sectors there is the presence of geological structures (San Jose Fault, La Cruz Fault and NE Fault) that possibly behave as preferential flow paths or may be hydraulic barriers, such as the Choloque Fault. 15 open tube piezometers were installed, of which nine are simple and three are double.

Regarding structural geology, the Tajo Chalarina and its environment are influenced by the regional and local structures, folds, and faults, with direction NW-SE and SW-NE. The fields identified are the Anticlinal Algamarca and the Anticlinal San Jose, whose axes have a NW-SE direction.

The hydrological characterization is important to estimate the magnitude of the recharge to the Tajo Chalarina hydrogeological system; therefore, it is important to analyze the hydrological variables (precipitation and evaporation) to establish the available water in the micro-basin by means of the water balance method. The hydrological variables were obtained from the Hydrological Analysis Technical Memorandum (104925-01-MT-003), prepared by Ausenco in June 2021. For the analysis of regional precipitation, 18 meteorological stations operated by SENAMHI with records up to 2019 were used. Stations are located between altitudes that vary from 1,501 masl to 3,763 masl, while the U.M. Shahuindo is located at an approximate average altitude of 2,800 masl. Local precipitation was determined using the pluviometric records of the local Shahuindo station operated by PAS. Precipitation information is found at the hourly level with records from 2013 to March 2022, which presents annual rainfall between 726 mm/year and 1,453 mm/year, with an average of 1,008 mm/year.

The multiannual average evaporation assigned to the U.M. Shahuindo is 1,300 mm/year and the maximum evaporation occurring between the months of June to November, with the maximum value being 155 mm, recorded in August. The minimum values occur between the months of December to May, with the minimum value being 78 mm, recorded in March.

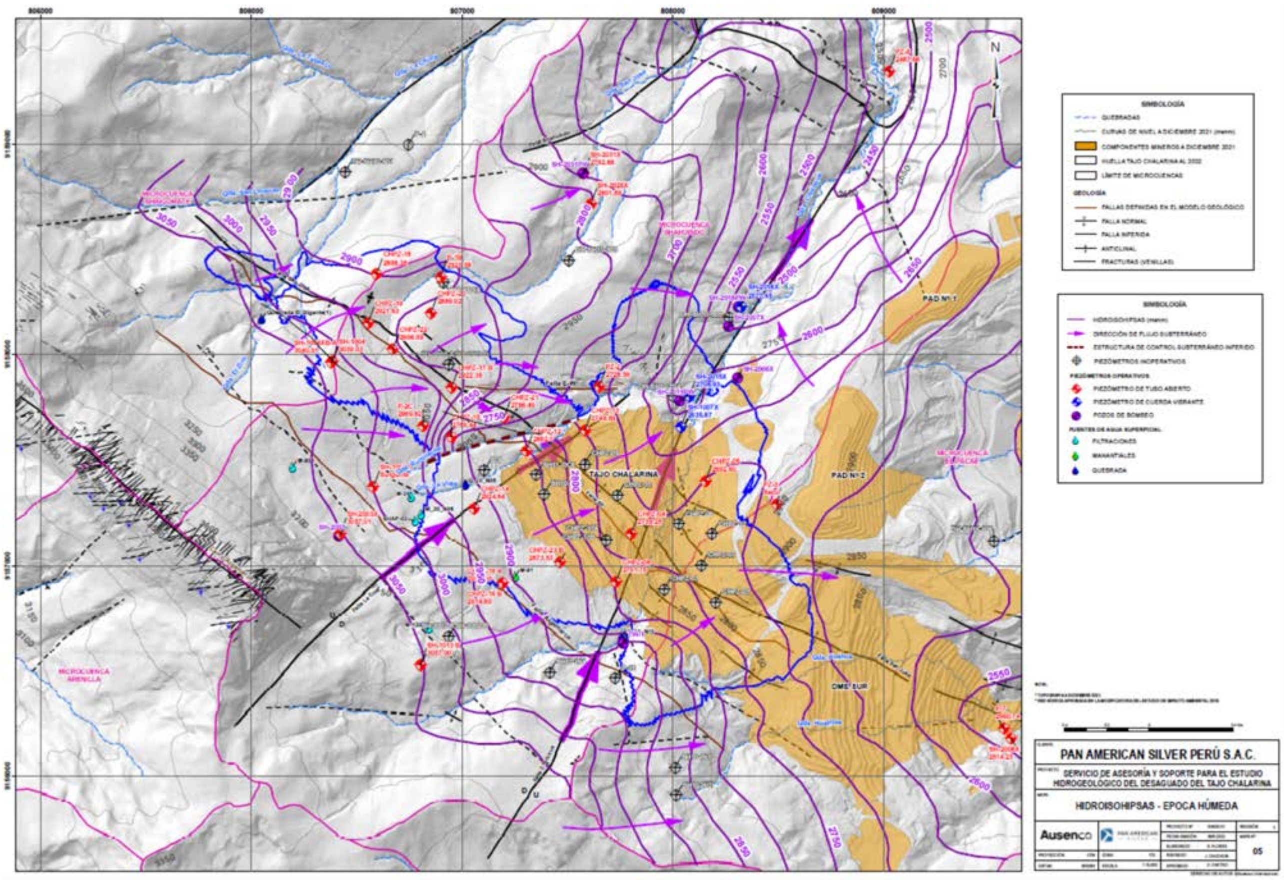
The hydric dynamics of the aquifer in the area of the U.M. Shahuindo are mainly associated with the available water sheet, estimated from the water surplus between the contribution given by precipitation and the loss of water by evaporation. The water surplus, represented by the available water sheet, is 211 mm per year, a value that allows the formation of runoff and recharge to the underground system. Likewise, based on these results, it is possible to specify that the aquifer is recharged during the rainy season from December to April, to later (dry season) contribute to the surface water system, thus conforming to the maintenance of the base flow of the streams and springs.

To determine the percentage of recharge, it is assumed that the water system is in balance between the volume of recharge and discharge. For this, the results of the water balance (available water = 211 mm/year) and the discharge sources in an area of 8.04 km^2 have been considered.

As background, Ausenco Vector (2012) estimated the recharge for baseline conditions at 7.0% of the total annual precipitation (900 mm/year). Similarly, MWH (2015) estimated 6.0% (2000 mm/year) according to the water balance obtained from the Soil and Water Assessment Tool (SWAT) hydrological model. Likewise, Consultant G y C Engineering S.A.C, Peru assumed that the average recharge is 6.0%, with zones of high recharge (between 4% and 7%, where outcrops and anticlines are exposed) and zones of minimum recharge (0.2% in low altitude zones). Finally, the percentage of recharge estimated through water availability is higher than in previous studies; this is due to the inclusion, in the estimate, of the discharge of the underground medium because of pumping. Therefore, the recharge to the underground environment is between 6.0% and 9.87% of the total annual precipitation.

Based on the monitoring of the piezometric levels of 2020-2021 and water levels found during the drilling of the CHPZ-12 to CHPZ-23 piezometers, the hidroisohipsas have been built for the wet season, a more conservative condition to evaluate the drainage of the Tajo Chalarina.

Figure 16.2 Ground water level isopach map



Based on the groundwater surface (hidroisohipsas) and the geometry of the pit in accordance with the year-by-year mining plan (LOM 2032), the interception between both surfaces has been evaluated:

- Between the years 2021 to 2025, the surfaces of the mining plan do not intercept the groundwater level.
- From the year 2026 to 2028, in the central sector of the pit (between the La Cruz and San Jose faults) it is projected that at an elevation of 2,824 masl, the geometry of the pit intersects with the water level, initiating the activities of drainage with well PB-07. At the end of this period, well PB-04 stops operating due to mining progress and is replaced by well PB-12.
- In the year 2029, the outcrop of water extends to the south of the intersection of the La Cruz and San Jose faults, because of the deepening of the pit that reaches a height of 2,808 masl. For this reason, it is planned to start drainage activities in this sector with well PB-09, which is located 160 m south of well PB-07 on the margins of the La Cruz fault.
- In the year 2030, continuing with the deepening of the pit, the outcrop of water is evidenced from 2,744 masl, extending 240 m to the southeast of the intersection of the La Cruz and San Jose faults. Due to the length of the extension of the water outcrop, the drilling of a contingency well (PB-08) will be evaluated to help with drainage in the sector, in case the wells PB-07 and PB-09 do not meet the objective of lowering the groundwater level. Additionally, 160 m south of the intersection of the Choloque and San Jose faults, water outcrops can be seen at an elevation of 2,736 masl. In this sense, it is necessary to start the operation of well PB-02 for the drainage of this sector.

- In the year 2031, to the north of the intersection of the Choloque and San Jose faults, there is evidence of water outcropping from elevations of 2,688 and 2,712 masl, due to the progress of the mining plan, for which the start of operation of the well PB-10 will help with the drainage of this area.
- Finally, in the year 2032, near the final footprint of the pit in the southern sector, it is expected that the deepening of the pit to an elevation of 2,752 masl will intercept the groundwater. In this sense, the start of operations of the PB-11 well is projected to control the water levels in this sector.
- Regarding the drainage of the west wall of the Chalarina pit, specifically in the sector where the El Shinshe Grande M-91 spring is located, there is evidence of water seepage, which generates instability in the slope. In this sense, the quaternary material and fractured rock present in the west wall must be depressurized. For this purpose, a pumping well (PB-04) approximately 100 m deep and sub-horizontal drillings with lengths between 100 m and 150 m will be implemented, for drainage purposes and to help reduce pore pressure. Due to the progress of the mining plan in the year 2028, the El Shinshe Grande M-91 spring will be impacted and will probably improve slope stability.

17 RECOVERY METHODS

Shahuindo is an open pit heap leach operation which has been developed in multiple phases since beginning operations in late 2015. The current operation uses truck stacking ROM ore onto a multiple-lift heap leach pad at an average rate of 36,000 tonnes per day (tpd) in approximately 8 m lifts. Pebble lime (CaO) is added to the ore at the leach pads for pH control before the stacked ore is leached with a dilute sodium cyanide solution. Pregnant leach solution discharged from the heap flows by gravity to a pregnant solution pond and is pumped to a carbon-in-column (CIC) adsorption circuit where gold and silver are loaded onto active carbon. Loaded carbon from the CIC circuit is periodically transferred to the recovery plant where the carbon is acid washed and stripped in four and ten tonne batches. Gold and silver are recovered by electrowinning with the resulting electrowinning sludge being dried and smelted onsite to produce the final doré product. A flow sheet of the ROM leaching operation is illustrated in Figure 17.1.

Two parallel single stage crushing and screening circuits with drum agglomeration were installed at Shahuindo with capacity to process 36,000 tpd (12,000 tpd and 24,000 tpd, respectively).

The crushing and agglomeration circuit is currently not being utilized and is not planned to be utilized for future operations. Permeability issues with argilized ore are currently being managed by blending with more competent material which has been proven to be successful for the heap leaching operation.

17.1 ROM processing

17.1.1 ROM truck stacking

ROM ore from the various pits is delivered to the active heap stacking area by 42-ton haul trucks and dumped on the leach pad to form lifts at an average rate of 36,000 tpd. Pebble lime for pH control is added to the ore at the leach pads by the mining fleet while forming the lifts. Lime consumption to date (2019 to present) has averaged 3.1 kg/tonne ore.

The haul trucks operate on top of the lift being constructed and utilize ramps constructed on the heap to reach to the top of each current lift. Ore is direct dumped on the current lift and a dozer is utilized to push ore over the edge of the lift to form the expanding heap. After stacking, the ore is cross ripped with a dozer prior to leaching. The ore is stacked in 8 m high lifts with a maximum planned heap height of 90 m above the liner.

17.1.2 Heap leach facility and solution handling

Leach pad designs have been completed by Anddes SAC and Ausenco, with Anddes being the Engineer of Record (EoR). As of the effective date of this Technical Report, approximately 55.4 Mt of ore has been stacked onto leach pads 1A, 2A, and 2B/C with remaining capacity estimated to be 136 Mt depending on future Mineral Reserve growth if any. The heap leach pads are expanded in phases each year to keep ahead of production; only the required mine capacity will be constructed. The leach pad design criteria are summarized in Table 17.1.

Table 17.1 Leach pad design criteria

Description	Unit	Design criteria
Dry tonnes per day	tpd	36,000
Bulk density	t/m^3	1.79
Overall slope	H:V	2.5H:1V
Nominal irrigation rate	$L/h/\ m^2$	10
Irrigation type	-	wobblers /emitters
Maximum irrigation flow	m^3/hr	1,850
Maximum height	M	90

Following truck stacking, the ROM ore is irrigated uniformly with a sodium cyanide solution by an irrigation system. Barren solution from the barren solution tank is pumped using horizontal pumps to the active leaching area where it is distributed using HDPE pipes and applied to the heap using No. 7 wobbler sprinklers in a 6 m x 6 m triangular pattern. The ore is irrigated at a rate between 8 to 10 liters per hour per square metre of leaching area for 55 days. As the solution passes through the lift, gold and silver are dissolved, forming a pregnant solution. The pregnant solution percolates through the lifts and flows into the pregnant solution pond. The pregnant solution is pumped from the pregnant solution pond to the carbon adsorption circuit where the gold and silver values are loaded onto activated carbon.

Pond capacities are based on water balance studies conducted by Anddes (2015) with an updated water balance being prepared by Ausenco in 2021. Currently there is not excess water but is planned the use of raincoats in the future and / or with an excess water treatment plant. Water balance to be updated and an excess water treatment plant is being studied.

17.1.3 Adsorption

Five closed-top carbon adsorption column trains are currently available for the treatment of pregnant solution with each column train consisting of six carbon adsorption columns. Columns in the first two trains each hold approximately four tonnes of activated carbon, with each column in the remaining trains holding five tonnes. The activated carbon adsorbs the gold, silver, and some minor impurities such as mercury and copper. The adsorption circuit has a total treatment capacity of 1,850 m^3/h.

Pregnant solution from the pregnant solution pond is pumped to the adsorption circuit and the resulting barren solution leaving the last column in the train returns to the leach circuit through the barren tanks. Concentrated cyanide solution and antiscalant are added at the barren tank prior to being fed back into the process.

Adsorption of gold and silver from pregnant leach solutions from the heap circuit will be a continuous process. Once the carbon in the lead column achieves the desired precious metal load, it is advanced to the elution (desorption) circuit using eductors. Carbon in the remaining columns is advanced counter current to the solution flow to the next column in series. New or acid washed / regenerated carbon is added to the last column in the train.

17.1.4 Desorption, electrowinning, and refining

The loaded carbon from the adsorption columns, containing approximately 3 kg of gold per tonne carbon, is advanced to the desorption plant where the gold is extracted from the carbon using a sodium hydroxide solution in either of two 4 tonne desorption reactors or in a 10 tonne desorption reactor. Gold and silver are recovered through electrowinning to obtain a precipitate that is dewatered using press filters prior to drying and smelting to obtain the doré bars.

A specific process has been designed for capture, condensation, and storage of mercury during the precipitate drying process. The mercury is removed and disposed of by a qualified third-party transporter. The plant design includes retort furnace storage to prevent mercury vaporization at ambient temperatures.

Slag produced as part of the smelting process is crushed and any prills of gold are recovered and recycled for smelting.

17.1.5 Carbon acid wash and regeneration

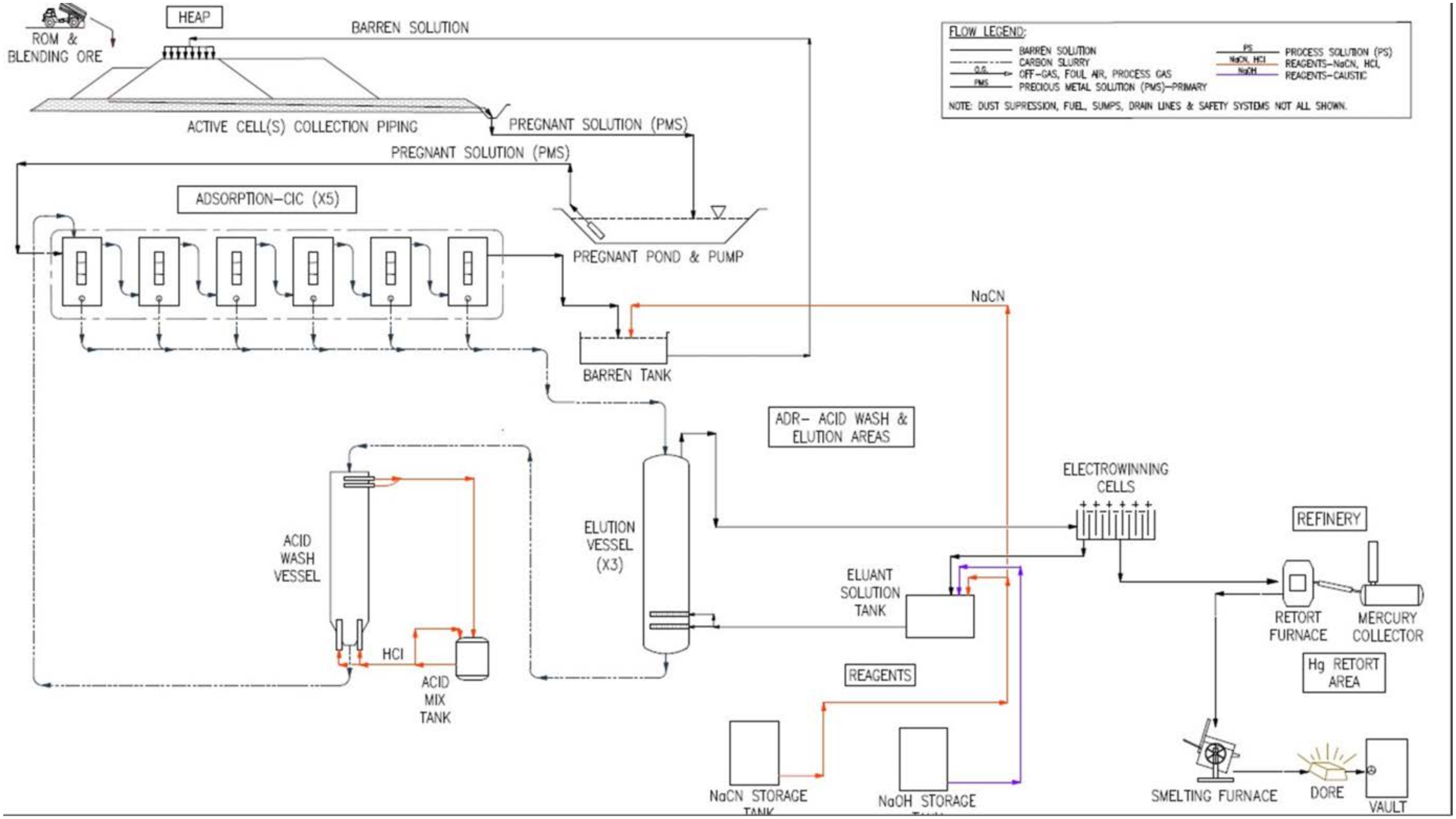
Carbon regeneration takes place in batches in two steps:

1. Acid wash every desorption cycle.
2. Thermal regeneration every 3 desorption cycles.

The acid wash adsorption cycle consists of thoroughly washing the carbon with fresh water to ensure that no entrainment of cyanide solution is present. It is then washed with hydrochloric acid (HCl) at a concentration of 5% until the pH stabilizes below 2. The acid wash is required to dissolve and remove carbon scale; the duration of this step, including water rinsing, takes approximately three hours.

The thermal regeneration cycle involves dewatering the carbon solution on a vibrating screen and then heating the carbon up to 650°C for 10 to 15 minutes in the regeneration kiln, which regenerates the carbon. After the regeneration kiln, the carbon is dropped into a water quenching tank at room temperature and is then dewatered and screened to remove fines (minus 6 mesh). The coarse fraction of carbon (6 x 12 mesh) returns to the adsorption circuit, while the fine carbon is filtered and stored. The fine fraction weight is calculated to be approximately 0.5 tonne of carbon per month depending on the quality of the carbon.

Figure 17.1 ROM process flow sheet

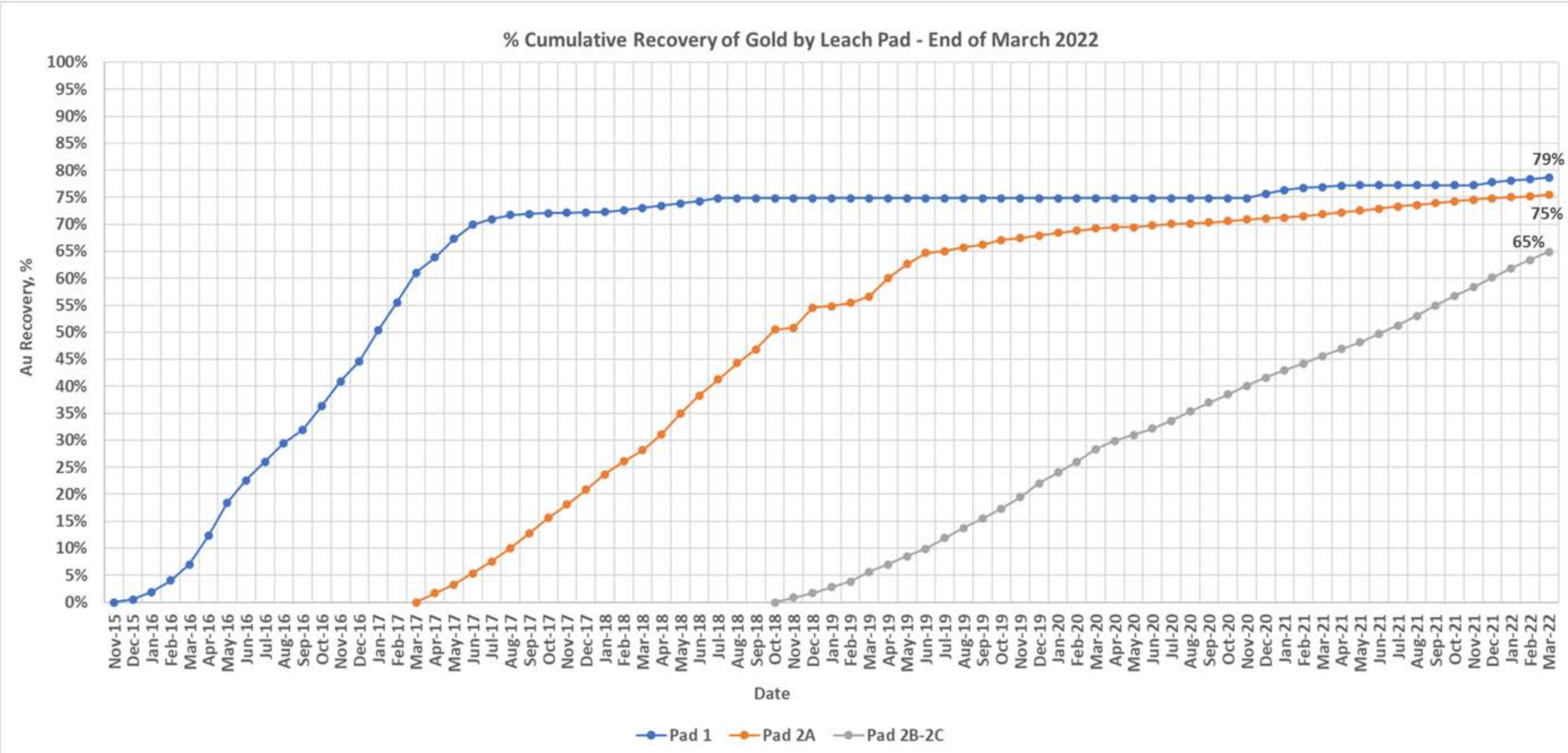


Source: Kappes, Cassiday & Associates (2022).

17.2 Operational performance

The cumulative gold recovery for each of the different leach pads is presented in Figure 17.2. Gold recoveries for Leach Pad 1 is 79%, with a process of injection of cyanide solution which will get underway in 2022, that is expected to increase the recovery to over 80%. Recoveries for Leach Pad 2A and Leach Pad 2B-2C are still steadily increasing. Realized recovery for gold for Leach Pad 2A is currently 75% and recovery for Leach Pad 2B/C is 65%. These results lend confidence to the assumed endpoint gold recovery of 80% which has been estimated from test work to date.

Figure 17.2 Cumulative Gold recovery by leach pad



Source: Shahuindo SAC (2021).

18 PROJECT INFRASTRUCTURE

The operating mine is mature and site infrastructure including site roads are fully developed to support the existing mine production of 13 Mtpa.

The infrastructure and services to support Shahuindo include the following major components:

- Site Access Road.
- Power supply including back-up power and distribution.
- Water supply for process water, potable water, and fire water.
- Sewage system and solid waste disposal.
- Project buildings including truck shop, explosive magazines, warehouse, maintenance / process warehouse, fuel station, and offices.
- Camps for construction and operations including dining facilities.
- Miscellaneous site services such as security, first aid clinic and communications.

18.1 Services and infrastructure

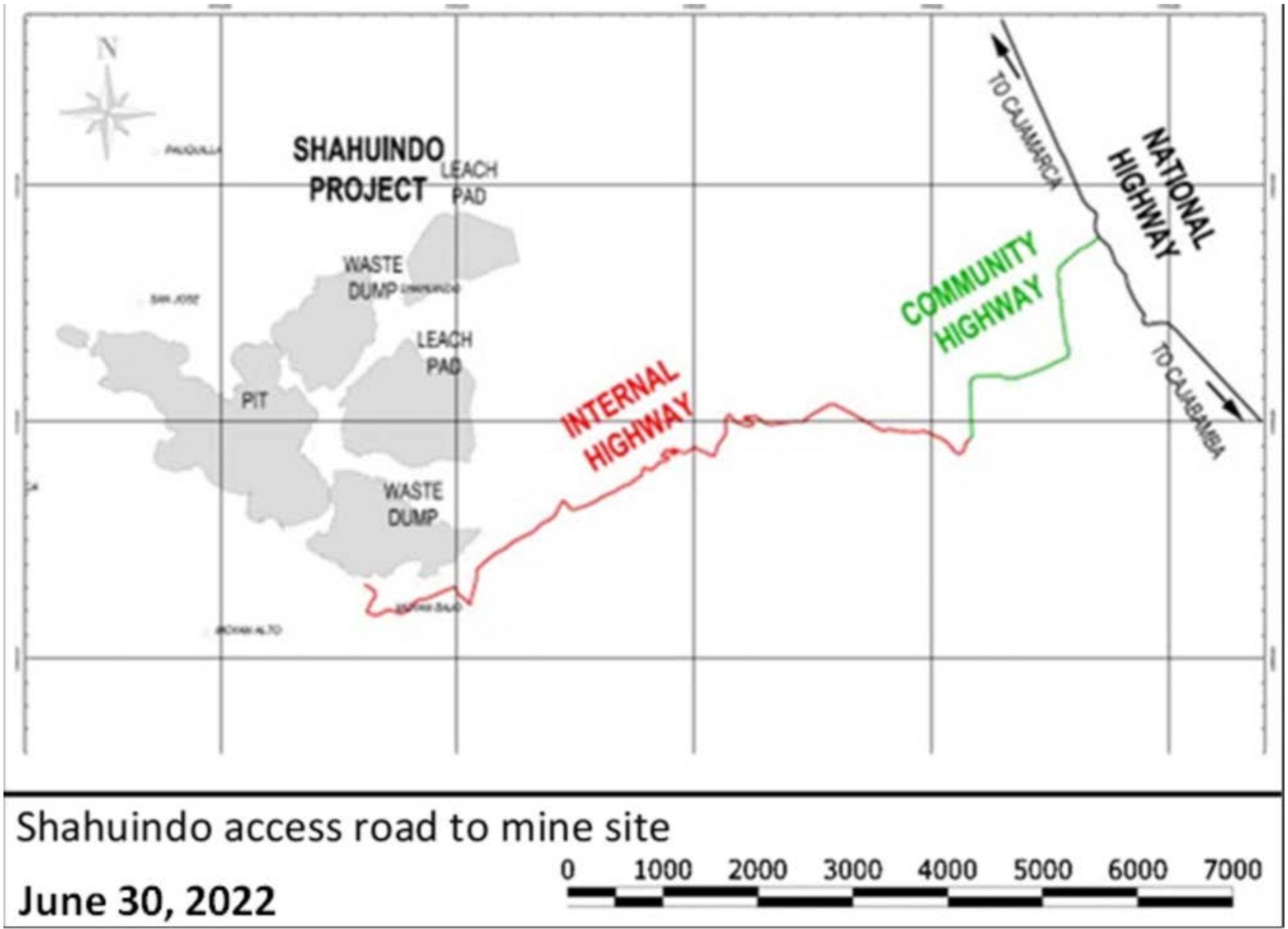
18.1.1 Roads

Access to Shahuindo is via a national highway that runs north-south along the east side of the Condebamba river. From the highway, Shahuindo is west of the junction at Pomabamba on an unsealed road 4 km long. There is a concrete bridge on concrete piers which crosses the Condebamba river. The bridge over the river is 90 m long and 3.5 m wide, built approximately 20 years ago. In 2019 Pan American built another bridge near the old bridge. The new one is 101 m long and 6.7 m wide. The new bridge opened to traffic in February 2020.

A private road enters the mine property a few kilometres from the west side of the bridge. This 11 km unsealed road provides access to the camps, offices, mine, process plant, and other project facilities. This road receives frequent maintenance by Shahuindo SAC.

All site access and haul roads are designed according to Pan American's internal standards (Shahuindo Internal Transit Standard) for widths and grade to ensure safe and efficient operations. The location of the access roads is shown in Figure 18.1.

Figure 18.1 Mine access road



Source: PAS (2022).

18.1.2 Power supply

The startup power supply was from generators supplying 1.2 MW. Permanent power supply for Phase 2, current operations at 36,000 tpd is from the National Commercial Grid. The total long-term power requirement is calculated to be 7.4 MW.

The temporary power demand for Phase 1 (operating at 12,000 tpd) was supplied by three small diesel generators for loads near the process plant (800 kilowatts (kW); warehouse, camp, and offices (350 kW), and at the maintenance workshops (250 kW). Following the connection to the national grid, the small generators were replaced by one 1.8 MW diesel generator as a back-up power source for the site.

The Shahuindo substation is now connected to the national grid at 220 kV, distributed on site at 23 kV and further stepped down to 4160 V, 460 V, 220 V, and 110 V. The substation is located at 9152654N 806437E, 4.9 km from the mine and 6.5 km from the process plant.

Power for crushing, agglomeration and ore stacking is supplied from the process plant substation via a 22.9 kV electric overhead line to a secondary distribution system of three small motor control centres located close to the crushing plant, overland conveyors, and mobile stacking system. There are no plans at present to operate the agglomeration plant however, this may change depending on exploration success in mineralization that requires agglomeration.

An internal 22.9 kV line provides electrical power from the grid to the camps, workshops, and offices.

18.1.3 Water supply

The total freshwater consumption for Shahuindo averages 25.5 l/s in the dry season. This water is sourced from deep groundwater wells such as the SH-2003X, SH-2018PW, and SH-2031PW wells which are located between 500 m to the northeast, 1,000 m to the north and 1,700 m to the west of the Chalarina pit. Wells SH-2018PW and SH-2031PW flow by pumping to storage ponds 2006A and 2006B.

The non-fresh water supply for Shahuindo comes from a collection pond (Dorita sump) which collects runoff during rainy season, with a capacity of 108,000 m^3 (6.94 l/s), which is located at the bottom of the pit and is used exclusively for road dust control. The water is treated to meet quality requirements of the Environmental Management Instrument.

Currently there is no pit dewatering. The current LOM plan considers that pit dewatering may be required from 2026 on. A hydrogeological test was performed in a well with a low water flow rate of 2.5 l/s as part of a depressurization of west wall of the Chalarina pit area. This water source is currently in the permit process with the governmental authority for use as part of the fresh water supply for Shahuindo.

Fresh water for the heap leaching flows by pumping from the 2006A and 2006B storage ponds to the PLS1 pond through a 150 mm diameter by 3.2 km long HDPE pipe.

Currently there are two drinking water plants (Vivero and Tauna camps) with an average flow of 250 m^3/day (5.78 l/s) for drinking water and cooking.

For fire water, an exclusive fire water reserve of 600 m^3 is stored in the bottom half of the process water tank, located in the crusher and agglomeration area.

18.1.4 Sewage system

There are sewage systems on site with sufficient capacity for the camps, kitchens, and other requirements. Sludge from these plants is used on site for compost production and treated sewage water is reused to the processing plant (ARD) and for dust control on internal roads.

18.1.5 Solid waste disposal

Solid waste generated on site is handled carefully and disposed fully in compliance of Peruvian regulations. There is currently a waste storage facility where hazardous and non-hazardous waste is temporarily stored for final disposal, a security landfill for hazardous waste, a landfill (non-hazardous waste) and waste is also disposed of through commercializing (recycled waste).

Specific hazardous waste such as used oil and batteries must be disposed of by a Specialized Solid and Dangerous Waste service provider. A certified transport and disposal company collects all waste to transport offsite for final disposal.

18.2 Project buildings

Shahuindo buildings include administration offices, mine warehouse, maintenance shop, explosive magazine, construction camp and permanent camp, dining facilities, fuel storage, kitchen, security buildings and medical centre.

18.2.1 Truck shop

The mining fleet consists of 54 Volvo 8 x 4 46-tonne trucks, four Cat 390 excavators, one Cat 336 excavator, one D-9 dozers, three D-8 dozers and a road grader. The truck shop is designed with a semi-open arrangement to include repair bays for small trucks, ancillary equipment, light vehicles, wash, and welding areas.

During 2022, the truck fleet was replaced such that the mining fleet will consist of 54 Volvo 8 x 4 46-tonne trucks, maintaining same number of excavators and support mining equipment. During 2023, it is expected to have five Cat 390 excavators for the rest of the LOM. The mining fleet will have a capacity for 36,000 tpd of total material as required by the mine plan. An improved truck shop will be built in 2023 to accommodate and service the larger equipment.

18.2.2 Explosive magazine

Magazine Shahuindo:

- 3 Emulsion silos of 60 tonnes located behind the East wall of Shahuindo pit
- 2 Containers with explosives and accessories located near the silos but separated by earthen berms as per regulation:
  - Container with Boosters & detonation cords
  - Container with Blasting Caps & Accessories

Figure 18.2 Magazine Shahuindo

Source: PAS (2022)

Explosives are delivered by supplier trucks to the site. Each 60-tonne capacity silo is equipped with a pneumatic system for unloading. The silos are configured to have drive-through loading for the Mobile Manufacturing Unit (MMU) truck that is used to deliver the product to the drillholes. Blending and mixing of the emulsion with the gasifying agent is accomplished inside of the MMU truck.

18.2.3 Warehouse and process maintenance

There is a warehouse storage area and a covered maintenance workshop area. The warehouse storage area occupies 150 m^2 and is conformed by 11 containers. Pan American plans to build a new warehouse which is scheduled to start construction in 2022.

18.2.4 Fuel stations

The main diesel storage facility consists of two 60,000-gallon storage tanks with a total storage capacity of 120,000 gallons. This facility is complete with fuel dispensing systems. In the second half of 2022, two additional tanks will be installed to achieve a total site storage capacity of 240,000 gallons which is enough fuel to operate the site for 15 days at full mining capacity.

There is one 1,000-gallon diesel storage tank located in the process plant area to supply diesel fuel for the elution boiler, carbon regeneration kiln and the refining furnace.

Fuel is delivered to the mine site via the supplier tanker trucks. All storage tanks are placed in 110% capacity concrete containment to assure no fuel is leaked to the environment.

18.2.5 Offices

Administration buildings / offices are in place at the mine camp and include water and power supply along with sewage facilities.

18.2.6 Construction and operations camps

Shahuindo has a permanent camp in the Vivero area, next to main offices, that houses 830 people. An existing camp called Tauna camp (old Sulliden exploration camp) is located on site, with single and multi-room layouts that currently house 580 people in 35 tents. Modular bathroom / shower units are equipped with toilets, urinals, and showers for each tent including the staff module. The associated sewage treatment system can treat the amount of waste generated.

The portion of the workforce that lives in the area of Shahuindo are transported by bus from Cajabamba and surrounding villages to the site.

18.2.7 Dining facilities

Dining facilities currently present on site to cater for approximately 1,400 workers. There is a central dining room and four satellite dining rooms in operational areas for mine maintenance, the process plant, and projects.

There is an expansion project that involves the kitchen and the dining room area planned to be implemented in 2023.

18.3 Miscellaneous site services

18.3.1 Laboratory

Chemical assays for full support to Shahuindo operation were originally provided by the La Arena assay laboratory operated by a third-party lab, CERTIMIN (certified ISO 9001).

Shahuindo SAC initiated the construction of a new chemical lab in 2021. This chemical lab entered operations in August 2021. This lab allows the processing of geology and process plant assays at Shahuindo. Some improvement in specific areas of the lab will be completed in 2022.

Dore samples were preliminary assayed at the La Arena laboratory and from 2022 will be assayed at the Shahuindo Lab.

18.3.2 Security

Access to the facility is limited to several gates classified for the security level and, each access has security guards 24 hours a day, 7 days a week as well as electronical security measures.

18.3.3 Medical centre / clinic

A medical centre and ambulance are in place at the operations camp, next to the main offices. Emergency staff on site include one physician, one medical paramedic, two nurses, one chemical pharmacist and one driver / rescue person. Staffing in the medical centre has been provided by a third-party company, Salus Laboris since 2019.

In the event a high-level medical intervention is needed, the ambulance is equipped and prepared for emergency transport to either Cajabamba Hospital (40 km) or Cajamarca Hospital (100 km).

18.3.4 Communications

The communication infrastructure for radio, telephone, and internet between Shahuindo, Lima and the rest of Peru mines (La Arena, Huaron, and Morococha) is in service.

The data centre is in the administrative offices where the communication infrastructure is hosted. The communications infrastructure comprises fiber optic from the administrative offices to the agglomeration and crushing plant, process plant, maintenance truck shop and the main warehouse. Radio wave connectivity is used to smaller locations close to the aforementioned. The offices in Cajabamba and Cajamarca city have Internet access with independent connections.

19 MARKET STUDIES AND CONTRACTS

19.1 Metal contracts

Shahuindo produces gold in the form of doré bars and has contracts in place with Asahi Refining Canada, Argor Heraeus and Metalor in Switerland, for refining the doré produced on site, all of which have rates and terms within industry norm. The dore is transported to these facilities where it is refined to the London Good Delivery specification, which is defined as a minimum of 995.0 parts per thousand of fine gold and a minimum of 999.0 parts per thousand of silver. Once refined, the good delivery gold and silver is sold on the international market to bullion banks and financial institutions. To date, no issues have been encountered in securing the sale of the refined metal from Shahuindo. No hedging takes place at this time.

Pan American anticipates typical shipping and refining costs to be approximately US$1.72 per ounce of gold refined.

In the opinion of the QP the contracts in place conform to the industry norms

19.2 Mining alliance

Shahuindo SAC has entered into a mining alliance with STRACON GyM, a prominent mining contractor in Peru. The mining alliance is based on a philosophy of 'best for project' decision making and run by a board or leadership team made up of three representatives from Shahuindo SAC and three representatives from STRACON GyM. The scope of the alliance includes all civil construction and all mining operations including associated indirect support activities. STRACON GyM provides the mining fleet equipment to Shahuindo SAC.

The materials, services, pay roll and equipment used for the in-scope activities of the alliance are variously paid by Shahuindo SAC, or STRACON GyM, whichever is determined to be best for the project. STRACON GyM is compensated by reimbursement of their costs and a percent fee on all in- scope costs and is eligible for an incentive bonus at the end of each year of 10% of all fees, conditional on safety, productivity and efficiency targets being met.

The Shahuindo SAC mining alliance is very similar to the successful mining alliance currently operating at La Arena. It offers reduced capital costs to Shahuindo SAC, significant flexibility in LOM planning and fleet requirements, significant 'know how' in civil construction, mining and fleet management and significant reduction of risk to achieving the annual mine production plan.

19.3 Review by the QP

Martin Wafforn, the QP responsible for this section of this Technical Report, has reviewed the contract terms, rates, and charges for the production and sale of the silver and gold produced at Shahuindo, and consider them sufficient to support the assumptions made in this technical report.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Environmental management plan

Shahuindo SAC implements environmental management plans in compliance with our corporate Environmental Policy and standards which cover:

- Air quality
- Surface Water Quality
- Groundwater Quality
- Stream Sediment Geochemistry
- Blast Vibration
- Noise Levels
- Geochemistry
- Waste Disposal Practices
- Reagent Handling and Storage
- Reclamation and Reforestation

20.2 Environmental studies

20.2.1 Environmental Impact Statement

Shahuindo was approved for construction and operation under an initial EIA (Estudio de Impacto Ambiental) in 2013. The EIA was prepared according to MEM requirements and complies with Peruvian regulations.

Baseline studies conducted for the EIA included all physical, biological, and social aspects related to the construction and operation of the mine:

- Meteorology and climate
- Air quality
- Noise and vibration
- Geomorphology
- Geology
- Soils and land use
- Hydrology and hydrogeology
- Sediment waste rock, and ore geochemistry
- Flora and fauna
- Hydrobiology
- Archaeology
- Landscape
- Traffic
- Environmental liabilities

The 2013 EIA determined that Shahuindo will have some impacts on the environment as a result of normal construction and operation activities, although with the implementation of the designed mitigation measures, the environment will recover during the years following closure.

The first modification of the EIA was approved in 2016 including an increase in the Mineral Reserves, the pit and infrastructure footprints, and expansion of production to 36,000 tpd. Subsequent Technological Improvement Reports (ITS) included changes to the infrastructure footprints, water treatment plants, and the agglomeration plant.

20.2.2 Site monitoring

Shahuindo SAC conducts ongoing environmental monitoring programs as committed to in the EIA environmental management plans that include air quality (particulate matter and GHG), surface water and groundwater quality, geochemistry, noise levels, and vibration. Frequency of reporting to the authority (MEM, OEFA, ANA, and Ministry of Agriculture) is quarterly and biannual in the case of biological monitoring.

20.2.3 Closure plan

In accordance with Peruvian requirements, company standards, and accepted industry practices, the development, operation, and reclamation plans are designed to:

- Assure long-term physical and geochemical stability.
- Comply with national environmental regulations.
- Recover areas affected by project components.
- Mitigate pre-existing risk conditions.
- Assure that post-closure use of the altered area and its aesthetics are compatible with the environment.
- Execute a Community Relations Plan during the operation, closure, and post-closure stages.
- Complete a Progressive Closure and Final Closure of the operation, such that post-closure conditions get to a state of passive care.

The mine closure plan is regularly updated with the most recent plan approved by MEM in 2018.

A closure cost estimate for Shahuindo was prepared in 2021 according to Pan American's standard methodology, which employs the State of Nevada approved Standardized Reclamation Cost Estimator (SRCE) model. This estimate includes consideration of all surface disturbance and reclamation liability at the site and is updated on an annual basis. Shahuindo's SRCE model includes demolition of all site infrastructure, re-grading of waste rock facilities, rinsing and covering leach pads, and complete re-vegetation of the site. The current SRCE model estimates the undiscounted value of reclamation costs or environmental liability for the Property to be approximately $56.0 million.

20.2.4 Existing environmental conditions

There are surface disturbances associated with informal mining activity within the Property area, primarily in the Algamarca anticline and La Chilca Baja areas to the west of Shahuindo operations.

An inventory of existing environmental conditions within the concessions was submitted as part of the EIA process. Pan American continues to advocate for a transition to formalized mining or closure of these areas with the community and government authorities.

20.3 Permits

Pan American holds all necessary environmental and operating permits for the development and operation of the mine and is in compliance with Peruvian law in all material aspects.

The water source is currently in the permit process with the governmental authority for use as part of the fresh water supply for Shahuindo.

See Section 20.2.1 for more information.

20.4 Expected material environmental issues

There are no known environmental issues that could materially impact the mine’s ability to extract the Mineral Resources or Mineral Reserves.

20.5 Social Impact

20.5.1 Location of the study area

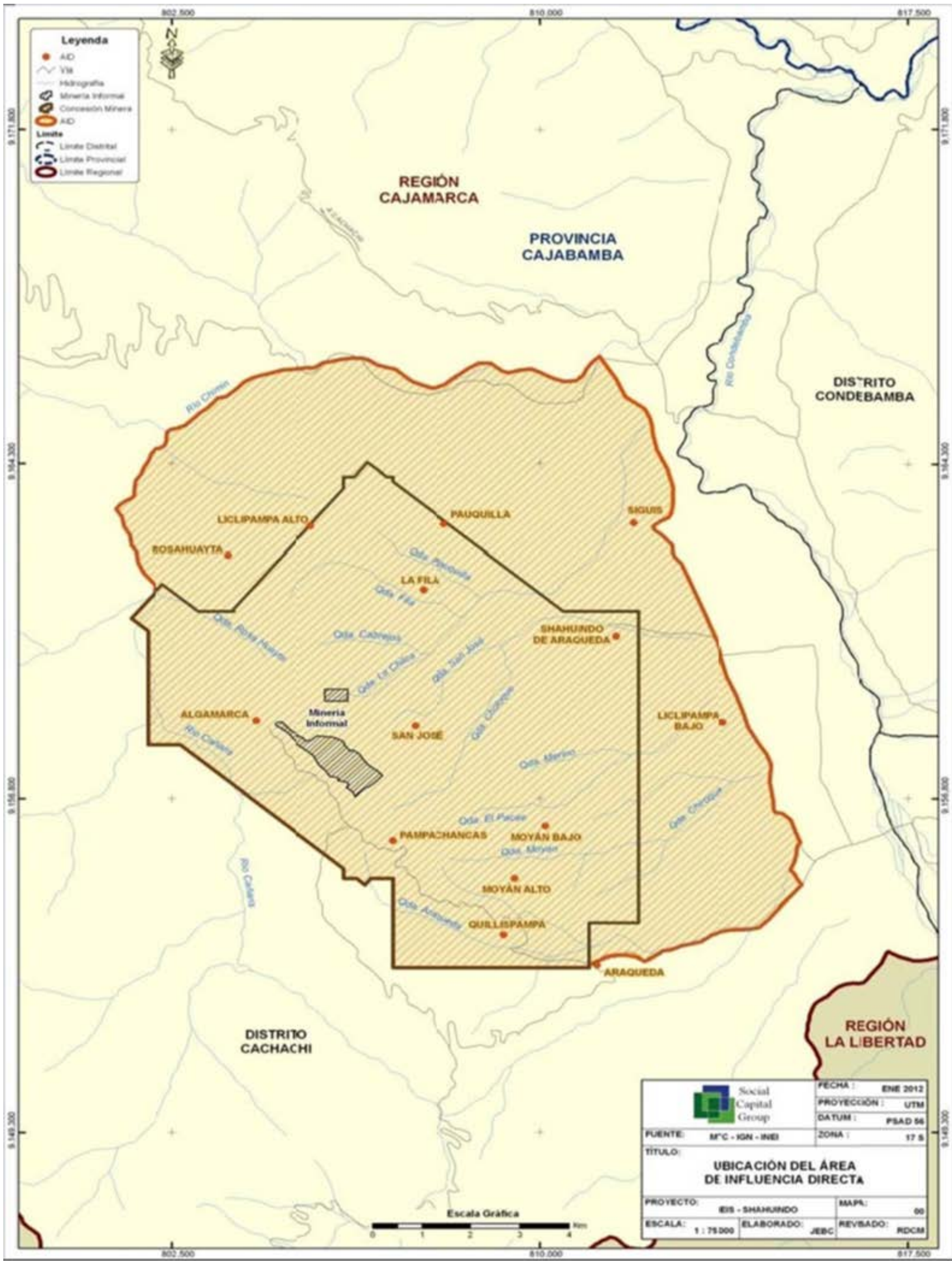
Shahuindo is located in the department of Cajamarca, in the province of Cajabamba and the district of Cachachi, (Figure 20.1). The Property area is characterized by varied topography with several areas heavily dissected by rivers and streams. Altitudes range from 2,500 m to 3,350 masl.

20.5.2 Social baseline study

According to the ESIA Modification, the Area of Influence has been further divided into Direct and Indirect Areas of Influence. The Direct Area of Influence (Figure 20.1) is defined as those people and or places which may directly experience either positive or negative social effects from Shahuindo to varying degrees. Fourteen villages have been identified within the Direct Area of Influence and include Algamarca, La Fila, Liclipampa Alto, Pauquilla, Rosahuayta, San Jose, Araqueda, Quillishpampa, Moyan Alto, Moyan Bajo, Pampachancas, Shahuindo, Liclipampa Bajo and Siguis. Within the Direct Area of Influence, the four communities of San Jose, Shahuindo, Moyan Alto and Moyan Bajo will experience some levels of resettlement. A detailed Resettlement Action Plan, structured in accordance with International Finance Corporation (IFC) Performance Standard 5 for Land Acquisition and Involuntary Resettlement has been prepared to mitigate the effects from resettlement and land acquisition.

The Indirect Area of Influence is composed of people and or places that may experience positive social impacts and reduced negative social impacts compared to those located in the Direct Area of Influence. Communities within the Indirect Area of Influence include those living in the districts of Cachachi and Condebamba.

Figure 20.1 Location of direct influence area



20.5.3 Public consultation and engagement plan

Shahuindo SAC is committed to proactive and transparent engagement with the communities, public institutions and government agencies located within the project's area of influence. Shahuindo SAC's public consultation and engagement plan is built around the following commitments:

- Compliance with Peruvian legislation regarding community consultation and engagement.
- Implementation of a consultation and communication plan in an open, honest, and transparent manner with neighboring populations and interest groups to create an atmosphere of mutual trust.

- Actions based on comprehensive understanding of the social, economic, and cultural context in which the mine is developed.
- Contributions to strengthening local social organizations through participation in the development of the mine and in the activities that may affect them.
- Engagement with local communities throughout the baseline study stage of the ESIA through a participatory monitoring program and the extension of this program throughout the construction, operation, and closure stages.

To ensure that Shahuindo SAC communicates effectively, Shahuindo SAC has established the following methods of communication and access to information:

- Two public information offices, one at the mine site and one in the town of Cajabamba.
- The development and distribution of project information.
- Use of local radio to provide information about progress of the mine.
- Guided tours of the Property.
- Informative workshops.

20.5.4 Community development program

Shahuindo SAC recognizes its role and responsibility to contribute to local sustainable development by utilizing its ability to mobilize technical and financial resources to support the implementation of initiatives for local development during the construction and operational stages of the mine.

The objectives of the community development program include:

- Strengthening the local productive capacities to generate opportunities for alternative employment for the population in the Direct Area of Influence.
- Strengthen technical capacities of the stakeholders in the areas of influence.
- Providing capacity building initiatives to local organizations and leaders to better manage local development initiatives in a transparent and participatory manner.
- Creating and consolidating channels of coordination and dialogue between the local communities and the mine.

Shahuindo SAC will focus its sustainable development initiatives in the following areas:

- **Local Employment and Purchase of Local Goods and Services.** Training for local people within the Direct Area of Influence in multifaceted disciplines and the purchase of goods and services from local providers.
- **Economic Production.** Improvement to local productive capacities and infrastructure (agriculture, livestock, and fish farming) and the sustainable management of forest resources.
- **Small Business Development and Entrepreneurship.** Promotion of entrepreneurship and small business programs.
- **Local Social Development.** Work with national, regional, and local levels of government to implement projects aimed at training to improve general employability, education, and health.
- **Strengthening Local Institutions.** Strengthen the capacity of local stakeholders, such as local governments and grassroots organizations, among others.

21 CAPITAL AND OPERATING COSTS

The estimated operating costs are based on Pan American's experience at Shahuindo. Sustaining capital expenditures include pre-stripping, equipment replacement and heap leach pad expansions. Further capital may be required if economically justified or if there are substantial increases to the Mineral Reserves.

Table 21.1 Operational costs

Item	Units	Cost
Open pit mining costs	$/t ore	1.80
Open pit mining costs	$/t waste	2.01
Process costs	$/t ore processed	2.87
Sustaining pad costs	$/t ore processed	1.46
G&A costs	$/t ore processed	2.67

21.1 Capital costs

Pan American estimates that sustaining capital expenditures in 2022 will be $54.8 million primarily for the Choloque waste dump construction, water treatment plant, surface water management, truckshop, new warehouse, infill drilling, camp kitchen expansion and the construction of heap leach pad capacity. The mine haul truck fleet that is scheduled to be replaced in 2022 will be leased. Future sustaining capital costs will be dependent on requirements and Mineral Reserve growth if any. The cost of constructing heap leach pad capacity is estimated to average $1.46 per tonne over the remainder of the Mineral Reserves.

21.2 Operating costs

For ROM heap leach ore, the cost of processing is estimated to average $2.87 per tonne plus $2.67 per tonne for G&A including Lima support (the average leach pad construction cost of $1.46 per tonne is added to the processing costs for the purposes of Mineral Reserve estimation).

Open pit mining costs are referenced to bench 2,860 and estimated at $1.80 per tonne for ore and $2.01 per tonne for waste with incremental mining costs added depending on the vertical and horizontal distances from this reference bench.

22 ECONOMIC ANALYSIS

An economic analysis has been excluded from this Technical Report as Shahuindo is currently in production and this Technical Report does not include a material expansion of current production.

23 ADJACENT PROPERTIES

There is no relevant information on adjacent properties to report.

24 OTHER RELEVANT DATA AND INFORMATION

No additional information or explanation is necessary to make this Technical Report understandable and not misleading.

25 INTERPRETATION AND CONCLUSIONS

Pan American acquired Tahoe on February 22, 2019, and thus now owns Shahuindo SAC which remains the operating company for Shahuindo. Pan American has operated the mine since then and has engaged in investments including building heap leach pad capacity.

25.1 Mineral Resources and Mineral Reserves

There are no known drilling, sampling, or recovery factors that could materially impact the reliability of the drilling results used to estimate Mineral Resources and Mineral Reserves.

There are no known significant risks and uncertainties that could reasonably be expected to affect the reliability or confidence in the Mineral Resource and Mineral Reserve estimates. Pan American routinely conducts reconciliation of the Mineral Reserve model to the grade control model and to the heap leach feed conveyor weight meter and sampler in order to monitor actual mine versus model performance.

25.2 Mineral processing, metallurgical testing, and recovery methods

The results of the laboratory testing program indicate very good gold recoveries at both ROM and moderate crush sizes with low to moderate reagent requirements implying amenability to heap leaching. Silver recoveries are generally low. Realized recoveries of gold from the existing heap leach operation are in line with expected recoveries from ongoing metallurgical test work.

25.3 Mining and financial

The mining operations are established with a good understanding of the mining parameters and cost structure.

25.4 Environment and community

The most significant environmental liabilities include surface disturbance and reclamation liabilities and issues related to the stability and containment system of the heap leach pads. Shahuindo SAC is committed to proactive and transparent engagement with the communities, public institutions and government agencies located within the project’s area of influence.

There are no known environmental or social issues that could materially impact the mine’s ability to economically extract the Mineral Resources or Mineral Reserves.

26 RECOMMENDATIONS

26.1 Mineral Resources and Mineral Reserves

Pan American updates Mineral Resources and Mineral Reserves on an annual basis following reviews of metal price trends, operational performance and costs experienced in the previous year, and forecasts of production and costs over the LOM. Infill and near-mine drilling is conducted as required through the year. Numerous oxide and sulfide exploration targets that have considerable potential to increase the Mineral Resource and Mineral Reserve base at Shahuindo have been identified through surface mapping, rock-chip and soil sampling surveys, geophysical surveys, and drilling. Drilling around the periphery of the currently designed pit limits in the second half of 2015 successfully identified mineralization outside of the northeast and southwest margins of the pit shell that will be incorporated into future mine plans. The geological interpretation will continue to be updated annually to include additional diamond and reverse circulation drilling undertaken during the year. Reviews of the geological interpretation against grade control drilling will continue to be undertaken on a regular basis to verify the reliability of the Mineral Resource and Mineral Reserve estimate.

26.2 Mineral processing, metallurgical testing, and recovery methods

Additional test work to further evaluate curing the ROM ore with a high-concentration NaCN solution prior to normal leaching, including a trial on a section of the operating heap leach, is recommended. Preliminary test work results suggest a modest recovery improvement may be realized by implementing this procedure.

26.3 Mining and financial

Shahuindo consists of an open pit mine and heap leach processing facility that is currently in production and has been operating since 2016. The open pit is being mined in a sequence of phased cutbacks. A series of phases have been designed considering the best ramp positions, pit access, geotechnical recommendations, and overall volume. The Phases allow variability in material movements and ore supply between period to be managed, and for the most valuable and lowest strip ratio areas to be targeted first to maximize the value of the operation. Recommendations have been made for continual monitoring of pit angles, water inflows and to minimize the blasting overbreak and continue work to achieve design bench face angles.

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28 QP CERTIFICATES

CERTIFICATE of QUALIFIED PERSON

I, Martin Wafforn, Senior Vice President, Technical Services and Process Optimization of Pan American Silver Corp., 1500-625 Howe St, Vancouver, BC, V6C 2T6, Canada do hereby certify that:

1. I am the co-author of the technical report titled "Technical Report for the Shahuindo Mine, Cajabamba, Peru", with an effective date of November 30, 2022 (the Technical Report).
2. I graduated with a Bachelor of Science in Mining degree from the Camborne School of Mines in Cornwall, England in 1980. I am a Professional Engineer in good standing with The Association of Professional Engineers and Geoscientists of the Province of British Columbia. I am also a Chartered Engineer in good standing in the United Kingdom. My experience is primarily in the areas of mining engineering and I have worked as an engineer in the mining industry for a total of 40 years since my graduation from the Camborne School of Mines.
3. I have read the definition of 'qualified person' set out in National Instrument 43-101 (the Instrument) and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements of a 'qualified person' for the purposes of the Instrument.
4. I have visited the Property on October 25, 2021.
5. I am responsible for Sections 2, 3, 4, 5, 15, 16, 18, 19, 20, 21, 22, 24, and 1.1, 1.8, 1.9, 1.11, 1.12, 1.13, 12.3, 12.4, 25.1, 25.3, 25.4, 26.3 of the Technical Report.
6. I am currently employed as the Senior Vice President, Technical Services and Process Optimization for Pan American Silver Corp., the owner of the Shahuindo Property, and by reason of my employment, I am not considered independent of the issuer as described in Section 1.5 of the Instrument.
7. I have had prior involvement with the Shahuindo Property that is the subject of the Technical Report; I am an employee of Pan American Silver Corp. and have conducted site visits to the Shahuindo Property, including as described in Section 2 – Introduction of the Technical Report, and most recently from October 25, 2021.
8. I have read the Instrument and Form 43-101F1, and the Technical Report has been prepared in compliance with the Instrument and that form.
9. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Vancouver, British Columbia, this 19th day of December 2022.

"signed and sealed"

Martin Wafforn, P.Eng.

CERTIFICATE of QUALIFIED PERSON

I, Christopher Emerson, Vice President, Business Development and Geology of Pan American Silver Corp., 1500-625 Howe St, Vancouver, BC, V6C 2T6, Canada do hereby certify that:

1. I am the co-author of the technical report titled "Technical Report for the Shahuindo Mine, Cajabamba, Peru", with an effective date of November 30, 2022 (the Technical Report).
2. I graduated with a Bachelor of Engineering in Industrial Geology from Camborne School of Mines, Exeter University, England, in 1998 and earned my Master of Science in Mineral Exploration from Leicester University in 2000. I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM) and a Fellow of the Geological Society of London (FGS). I have worked as a geologist in both mining and exploration for the past 22 years since my graduation from Leicester University.
3. I have read the definition of 'Qualified Person' set out in National Instrument 43-101 (the Instrument) and certify that by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfil the requirements of a 'Qualified Person' for the purposes of the Instrument.
4. I have visited the Property on October 25, 2021.
5. I am responsible for Sections 6, 7, 8, 9, 10, 11, 14, 23, 27, and 1.2, 1.3, 1.4, 1.5, 1.7, 1.14, 1.15, 12.1, 12.2, 26.1 of the Technical Report.
6. I am currently employed as the Vice President, Business Development and Geology for Pan American Silver Corp., the owner of the Shahuindo Property, and by reason of my employment, I am not considered independent of the issuer as described in Section 1.5 of the Instrument.
7. I have had prior involvement with the Shahuindo Property that is the subject of the Technical Report; I am an employee of Pan American Silver Corp. and have conducted site visits to the Shahuindo Property, including as described in Section 2 – Introduction of the Technical Report, and most recently on October 25, 2021.
8. I have read the Instrument and Form 43-101F1, and the Technical Report has been prepared in compliance with the Instrument and that form.
9. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Vancouver, British Columbia, this 19th day of December 2022.

"signed and sealed"

Christopher Emerson, FAusIMM

CERTIFICATE of QUALIFIED PERSON

I, Americo Delgado, Vice President, Mineral Processing, Tailings and Dams of Pan American Silver Corp., 1500-625 Howe St, Vancouver, BC, V6C 2T6, Canada, do hereby certify that:

1. I am the co-author of the technical report titled "Technical Report for the Shahuindo Mine, Cajabamba, Peru", with an effective date of November 30, 2022 (the Technical Report).
2. I graduated with a Master of Science in Metallurgical and Material Engineering from the Colorado School of Mines in Golden, Colorado, in 2007, and with a Bachelor of Science in Metallurgical Engineering degree from the Universidad Nacional de Ingenieria, Lima, Peru, in 2000. I am a Professional Engineer in good standing with the Association of Professional Engineers and Geoscientists of the Province of British Columbia. My experience is primarily in the areas of metallurgy and mineral processing and I have worked as a metallurgist and in mineral processing management in the mining industry for a total of 22 years since my graduation from the Universidad Nacional de Ingenieria.
3. I have read the definition of 'qualified person' set out in National Instrument 43-101 (the Instrument) and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements of a 'qualified person' for the purposes of the Instrument.
4. I visit the Property on regular basis with the last two visits on January 8-9, 2020 and September 17-19, 2021.
5. I am responsible for Sections 13, 17, and 1.6, 1.10, 12.5, 25.2, 26.2 of the Technical Report.
6. I am currently employed as the Vice President, Mineral Processing, Tailings and Dams for Pan American Silver Corp., the owner of the Shahuindo Property, and by reason of my employment, I am not considered independent of the issuer as describe in Section 1.5 of the Instrument.
7. I have had prior involvement with the Shahuindo Property that is the subject of the Technical Report; I am an employee of Pan American Silver Corp. and have conducted site visits to the Shahuindo Property, including as described in Section 2 – Introduction of the Technical Report, and most recently from September 17-19, 2021.
8. I have read the Instrument and Form 43-101F1, and the Technical Report has been prepared in compliance with the Instrument and that form.
9. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Vancouver, British Columbia, this 19th day of December 2022.

"signed and sealed"

Americo Delgado, P.Eng.