FEASIBILITY STUDY TECHNICAL REPORT
AMULSAR PROJECT
ARMENIA

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NOTICE

JDS Energy & Mining, Inc. prepared this National Instrument 43-101 Technical Report, in accordance with Form 43-101F1, for Lydian International. The quality of information, conclusions and estimates contained herein is based on: (i) information available at the time of preparation; (ii) data supplied by outside sources, and (iii) the assumptions, conditions, and qualifications set forth in this report.

Lydian International filed this Technical Report with the Canadian Securities Regulatory Authorities pursuant to provincial securities legislation. Except for the purposes legislated under provincial securities law, any other use of this report by any third party is at that party's sole risk.

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1 Executive Summary

1.1 Introduction

Lydian International Ltd. (Lydian) is a gold developer focusing on the development and construction of its 100%-owned Amulsar Gold Project (Amulsar, the Project), located in south-central Armenia. Amulsar will be a large-scale, low-cost open pit mining and conventional heap leach processing operation with production targeted to average approximately 205,000 ounces annually over an initial 12-year mine life.

The ore body was discovered by the company in 2006. Construction commenced at Amulsar in October 2016, but was halted by illegal blockades which have prevented access to the Project site since June 2018.

In December 2018 JDS Energy and Mining (JDS) was engaged by Lydian to provide a re-start plan and assess several technical issues related to the Amulsar Gold Project. JDS personnel visited the site and provided a re-start plan in January 2019, after which Lydian commissioned JDS to complete an updated Feasibility Study (FS) on the project. The update to the FS was based on the NI 43-101 Technical Report Amulsar Updated Resources and Reserves, dated March 2017. The objective was to update the Proven and Probable Reserves by designing a pit shell incorporating the converted Measured and Indicated Resources from the 2016 infill drilling program. JDS was also tasked with developing a business case for the Project based on practical, fit-for-purpose solutions that maximize value and make the Project more economically viable in this gold price environment.

One impact of the increased Reserves was that more space would be required in the heap leach facility to leach the increased ore tonnage. Another impact was the production of more waste rock which has to stay in the permitted footprint of the Barren Rock Storage Facility (BRSF), JDS planned to handle the extra waste material by backfilling the pits as per the Environmental and Social Impact Assessment (ESIA). The mining and processing approach has not changed and the Project remains within the established permitted footprint.

The FS update was completed by the following independent authors:

- Golder Association Inc. (Golder);
- Samuel Engineering (SE);
- Global Resource Engineering Ltd. (GRE);
- Watts, Griffis and McQuat Limited (WGM); and
- JDS Energy & Mining Inc. (JDS).

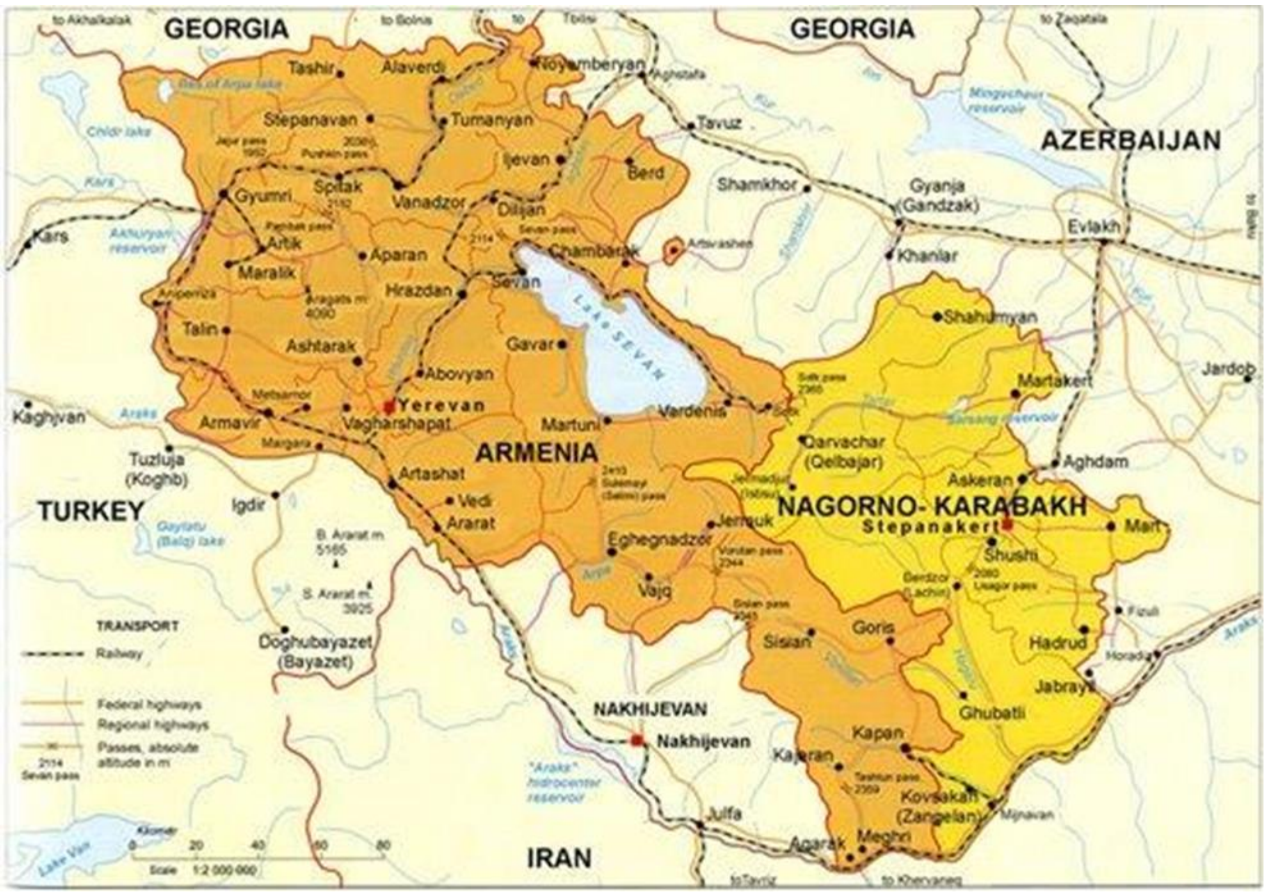
This report presents the results of the FS update using the guidance of the Canadian Securities Administrators' National Instrument (NI) 43-101 and Form 43-101F1 and Canadian Institute of Mining (CIM) guidance on Resource and Reserve Estimation.

Lydian owns 100% of the Amulsar Project and holds all of the titles, rights, benefits and obligations to the Amulsar Gold Project through their wholly-owned subsidiary Lydian Resources Armenia. In turn Lydian Resources Armenia owns 100% of Lydian Armenia CJSC (Lydian Armenia), previously Geoteam CJSC (Geoteam), an Armenian-registered Closed Joint Stock Company (CJSC), which holds 100% of the current site related prospecting license and mining license.

1.2 Property Description and Location

The Amulsar Project is located in south-central Armenia roughly 115 kilometers (km) in a direct line to the southeast of the capital Yerevan or a 170 km drive by paved road (Figure 1-1). Armenia is a democratic republic that gained independence from the former Soviet Union in 1991. It is located in the mountainous Caucasus region straddling Asia and Europe, and has a population of approximately three million. Yerevan is the capital and largest city of Armenia and one of the world's oldest continuously inhabited cities. Situated along the Hrazdan River, Yerevan is the administrative, cultural, and industrial center of the country and has a population of over one million. Yerevan's Zvartnots International Airport is the closest international airport and will be the main airport utilized for air travel. Access to the project site is from the paved highway H42 that runs to Jermuk.

Figure 1-1: Location Map for Amulsar Project



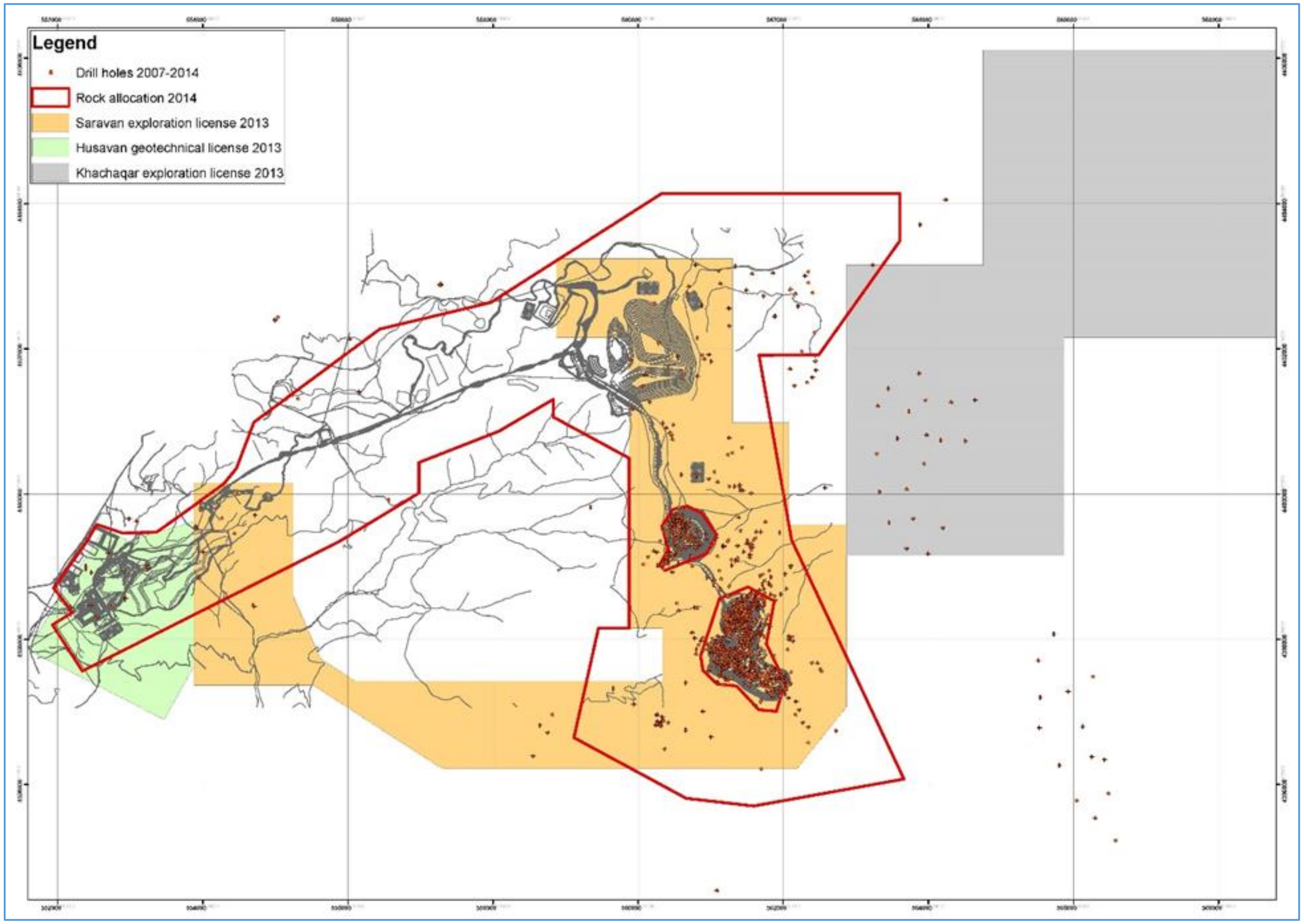
Source: Lydian (2017)

The Project straddles two administrative provinces, Vayots Dzor Marz (capital is Yeghegnadzor) and Syunik Marz (capital is Kapan). The closest town to the Project is Jermuk, situated approximately 11 km north from the Project's infrastructure. There are four rural communities in proximity to the Project, namely: Kechut (a rural community associated with the town of Jermuk), Saravan (including Saralanj and Ughedzor) and Gndevaz which are all located within Vayots Dzor Marz, and Gorayk, located in Syunik Marz. Gndevaz is the community closest to the footprint of the Project's process infrastructure, the Heap Leach Facility (HLF) area, approximately 1 km south of the village boundary.

The Amulsar Project is comprised of two exploration permits or Prospecting Permissions (PPs), one geotechnical license in the proposed heap leach area and one mining license (called the Mining Right; made up of a Mining Agreement and the Rock Allocation Area (RAA)). These licenses cover an area of 113 square kilometers (km^2) and are 100% owned by Lydian Armenia. The Amulsar Mining Right covers an approximate area of 4,000 ha.

Figure 1-2 below shows the RAA boundary for the Project.

Figure 1-2: Amulsar Rock Allocation Boundary

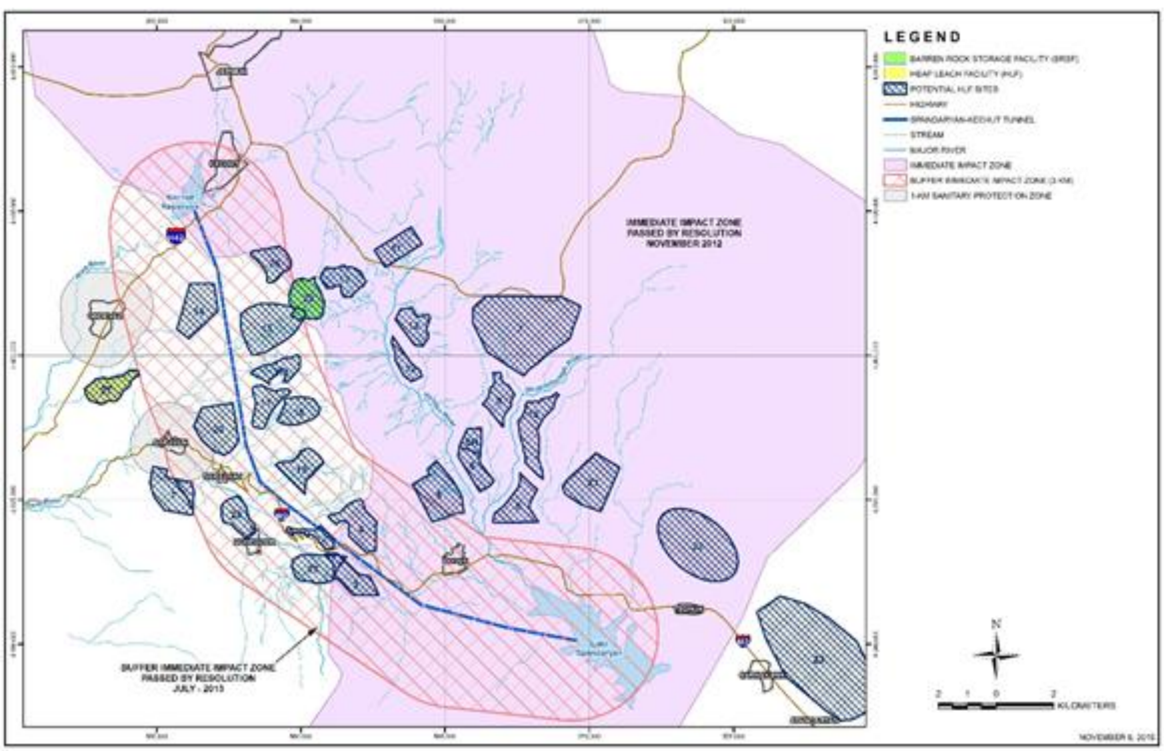


Source: Lydian (2017)

On 18 July 2013 the Government of Republic of Armenia (RoA) passed the Resolution 749-N to modify the area defined as the "Catchment Basin" of Lake Sevan. The new resolution states that: the Immediate Impact Zone (IIZ) includes the catchment basin outside the borders of the central zone to the watershed, where any activity directly or indirectly impacts the hydrophysical, hydrochemical, hydrobiological, sanitary/toxicological, sanitary and other qualitative and quantitative indicators of Lake Sevan and the rivers flowing into the Lake. The area immediately near the Lake, the territories of the catchment basins of the Arpa River (to the Kechut Reservoir), and the Vorotan River, the 3000 m buffer zone on each side of the axis of the Spandaryan-Kechut tunnel, as well as the Kechut and Spandaryan reservoirs all form part of the IIZ, where the placement of processing facilities and the use of hazardous chemicals, in particular cyanide, are prohibited.

There is also a requirement to have a 1 km buffer zone (Sanitary Protection Zone or SPZ) around all villages that excludes all Project infrastructure, as shown below in Figure 1-3.

Figure 1-3: Buffer Zones



Source: Lydian (2017)

The Amulsar property comprises mountainous terrain with the prominent feature of an approximately 7 km long northwest-southeast trending ridge that reaches a maximum elevation of 2,988 m. The Project mineable resources are located within three peaks (Erato, Tigranes and Artavasdes) on this ridge, which runs generally parallel to the Vorotan River. A natural gas pipeline passes near the eastern portion of the property in the Vorotan River valley. Vegetation across the property is generally limited to wild grasses and isolated scrub. Figure 18-1 shows the planned site layout for the Project.

Siting studies and alternatives assessments completed to-date were prepared to meet the performance standards and requirements of the International Finance Corporation (IFC), European Bank for Reconstruction and Development (EBRD), local stakeholders, and Resolution 749-N. A total of 28 sites were evaluated from 2008 through 2013 with input provided from a multi-disciplinary team of specialists on Lake Sevan protection and with additional input from other stakeholders, resulting in the final selection of Site 27 as the preferred location for the BRSF and Site 28 as the preferred location for the HLF.

Site 28, where the HLF is planned, is situated in a tributary within the Arpa River catchment below the Kechut reservoir, approximately 7 km west of the mine pit area and 1 km south of Gndevaz village. The HLF is outside the designated 3 km buffer zone on either side of the Spandaryan-Kechut tunnel, and the HLF northern limit is just south of the Gndevaz Village 1 km buffer zone limit. Portions of Site 28, mainly the gently sloping land at lower elevations, are currently used for agriculture. Networks of unpaved access roads and irrigation pipes exist within the site.

Site 27, where the BRSF is planned, is in a valley approximately 2 km north of the Erato mine pit area. Site 27 lies within the Kechut reservoir watershed zone, and the westernmost portion of the site is within the designated 3 km buffer zone on the east side of the Spandaryan-Kechut tunnel. Current vehicular access to Site 27 is mainly via the unpaved access road to the Amulsar property, which extends southeast from the main road connecting the country’s main highway to Jermuk.

Portions of Site 27, mainly the gently sloping land at lower elevations within the south portion, are currently used for agriculture (growing hay) and livestock grazing. Several access roads were constructed at Site 27 as part of the previous site investigation programs, with these roads reclaimed during the summer of 2013. Surficial springs are located along the southern hillside and on the valley floor of the site.

The Project is currently planning to get its raw make-up water from the Darb River and camp drinking water from the Gndevas Irrigation Pipe. The water abstraction permit application has been submitted to the Ministry of Environment and is expected in mid-October. Other accessible infrastructure includes fiber-optic internet cabling and gas supply through a trans-Armenian pipeline.

As a part of the company’s commitment to adding value to the local communities and building capacity in Armenia, the bulk of the steady state Amulsar workforce will be Armenian. Ideally, the majority of the workforce will be sourced from the four local towns, Gorayk, Gndevaz, Jermuk, and Saravan. However, due to lack of extractive industry in these communities, it is expected that a significant number of highly skilled workforce such as engineers, geologists, metallurgists, mechanical and electrical tradesmen with mining and processing experience will be recruited from Yerevan and other regions as required. The positions that cannot be filled by local or national Armenian workers will be staffed with suitably qualified expatriates on fixed term contracts, with the ultimate goal of developing qualified Armenians for these jobs in the future.

The total Project workforce during operation is estimated to be approximately 584 employees, 72 hauling contractors and 72 drill and blast contractors. The maximum workforce during construction may peak as high as 1200.

1.3 History

The Amulsar region was initially identified by the Armenian Soviet Expedition in 1936 to1937 as an area of “secondary quartzite”, which was deemed to host potential as a silica resource. Work aimed at testing the potential of a silica resource commenced in 1946. This work concluded that the alunite content of the silica was too high (up to 25%) and, as such, the project was of no interest as a source of quality silica. Further work in the early 1960s identified the “secondary quartzite” as metasomatic in origin, developed due to the replacement of intermediate-composition volcanic rocks (known regionally as the Amulsar Suite). Some 300 m of tunneling and 640 m^3 of trenching was also completed during this time, mostly on the north-eastern side of the Amulsar ridge. Testing of a bulk sample concluded that the silica was of sufficient quality for the production of low-grade glass. Volumetric calculations made during this time estimated some 360 million tonnes (Mt) of secondary quartzite rock at Amulsar.

Between 1951 and 1954 the Gromovskaya Expedition explored an area approximately three km north of the Erato deposit. The expedition was tasked with exploring for uranium throughout the Caucusus region. A series of four adits were completed in this area into argillic volcanics significantly lower in the geological sequence than Amulsar that are unrelated to the Amulsar deposit. The expedition concluded that there was no significant mineralization worth developing in the area. Waste dumps from this period are still visible at the toe of Site 27 and within Site 13.

Research work by the Armenia Soviet Expedition continued at Amulsar during the period 1979 to 1982. This work was focused principally on understanding and mapping the alteration zonation across the area. Silica reserves at Amulsar were never entered onto the Republic of Armenia State Balance, and no further exploration or research work was conducted by the Soviet Expedition in the area after 1982.

Historically, the region has not experienced a lot of mining activity. Extractives industry activities close to the site include a small quarry close to Gorayk and a closed metal mine near Saravan, with larger mine operations present in the south of Armenia. The Amulsar deposit is located on the border between the provinces of Vayots Dzor and Syunik. Amulsar was discovered in 2006 by company geologists and is the first new gold discovery in Armenia in 20 years.

1.4 Geology and Mineralization

The Amulsar gold deposit is hosted in an Upper Eocene to Lower Oligocene calc-alkaline magmatic-arc system that extends north-west through southern Georgia, into Turkey, and south-east into the Alborz Arc of Iran.

Volcanic and volcano-sedimentary rocks of this system comprise a mixed marine and terrigenous sequence that developed as a near-shore continental arc between the southern margin of the Eurasian Plate, and the northern limit of the Neo-Tethyan Ocean. The Neo-Tethyan Ocean closed and subduction ceased along this margin in the Early Oligocene when a fragment of continental crust was accreted with the Eurasian plate.

The Amulsar deposit is situated within a thick package of Paleogene volcano-sedimentary rocks. Locally, those flanking Amulsar, consist of multiple fining-upward cycles of volcanogenic conglomerate and mass flow breccia, fining-upward to volcanogenic and marly mudstones and locally, thin calcilutite limestone. Andesitic to dacitic volcanic and volcaniclastic units are sparsely interspersed low in the stratigraphy. The Amulsar deposit is associated with a complex alteration system and a structural complexity that has not been observed elsewhere in this sub-region. The geology of the Amulsar deposit area consists of mainly porphyritic andesites with strong argillic alteration forming strata-parallel panels with typical thicknesses of 20 m to 100 m. Interleaved with these rocks are silicified volcano-sedimentary rocks that host gold and silver mineralization. The strong stratiform control on the location of the base of the silicified volcano-sedimentary rocks has given rise to the mapping definition of Upper Volcanics and Lower Volcanics representing silicified volcano-sedimentary and altered andesites rock units respectively. The division into

Upper Volcanics and Lower Volcanics is also based on alteration and structural position. The Amulsar deposit is hosted within a zone of high structural complexity within a regionally simple structure.

Within the confines of the Amulsar Ridge the structural complexity increases whereby dips become steep and overturned. At least four different sets of structure (shears, folds, and faults) produce the final geometry, with increasingly brittle response in the younger structures. Thick slabs of Lower Volcanics arch into an antiform, before a transition across faults into the highly complex central folded zone. Within the complex zone, the andesitic slabs are more numerous and thinner. The overall pattern appears to be a footwall synform possibly below a south-east-vergent thrust. The formation of the multiple thin panels in the complex zone is that they may result from duplexing during this major thrust event. Although mineralization occurs within the complex zone in the core of this large apparent fold structure, it is the further complexity produced by the refolding of an already folded structure that creates the final host structure. Gold mineralization is intimately associated with the variably oriented accommodation faults and the large volume of fractured mineralized rock that links them. These fractures are small-scale accommodation structures that allow local deformation associated with the folding.

1.5 Exploration and Data Management

Initial exploration of the Amulsar Gold Project started in 2007 and was conducted by a joint venture between Newmont Mining Corporation and Geoteam. After Lydian acquired full ownership of the Project in 2010, all exploration work was completed by Lydian.

Newmont completed approximately 150 line km of ground magnetic surveys, and 54.6 line km of induced polarization and resistivity surveys during the joint venture period. All exploration activity on the Amulsar Project is managed through Lydian Armenia, Lydian’s subsidiary in Armenia. No material exploration work has been completed on the Amulsar Project since December 2016.

Geoteam has completed an extensive program of surface geological mapping over the Project area. In conjunction with the surface mapping program, approximately 358 (1,337 m) surface channel samples and 171 (50 m) trench samples. Channels samples are cut from outcrop faces cleared of vegetation, talus and loose rock. The average length of channel samples is approximately 2 m, with approximately 99% of samples less than 3 m in length.

In early 2012, a structural geological study of the deposit by Dr. Rod J. Holcombe of HCO & Associates (HCO) was conducted to review drill core and reverse circulation chips, conduct surface structural and geological mapping, and to assess drillhole structural data. A three-dimensional conceptual model of the deposit was generated, based on re-logging data and the integration of surface mapping and drillhole data. This led to a major revision of the geological understanding of the deposit. Additional work was completed by HCO in late 2013. This later work resulted in significant changes from the geological interpretation used previously in the 2013 and 2015 AMC Consultants (AMC) resource estimates-

Geoteam exploration personnel follow procedures outlined in an in-house comprehensive manual for diamond drilling. Diamond drilling operations are supervised by Geoteam Geologists at the drilling site. Diamond drillholes are drilled with a number of core sizes, including PQ, HQ, and NQ. Core is logged by Geoteam Geologists at the drill site. At the end of each shift, core boxes are delivered to secure core-shed facilities at Gorayk. Diamond drilling core recovery averages 96% for the Project.

Similarly, Geoteam exploration personnel follow reverse circulation drilling procedures outlined in a comprehensive manual. All reverse circulation drilling is conducted under constant supervision by the Rig Geologist. Reverse circulation drilling is undertaken using downhole hammers with face-sampling drill bits.

All drilling chips are collected from the reverse circulation cyclone. The entire chip sample is delivered to the Project core-shed facilities in Gorayk for splitting and sampling.

Dry bulk density measurements were made by Geoteam at the core-shed. Measurements were restricted to diamond core samples only, using wax-sealed core water-immersion method.

Lydian Armenia has a sample preparation facility which is adjacent to the core-shed facilities. The facility includes three jaw crushers, two rotary splitters, three high-capacity pulverizers, and two drying ovens. Rotary splitters were not operational at the time of AMC's G. David Keller's site visit as they were waiting on replacement parts. Sample preparation facilities at Gorayk operated from September 2008 to 2010, and then were restarted in late 2011. Split pulverized samples (pulps) from this facility are packaged and shipped in boxes for assay. Prior to establishing this facility, and during the period between 2010 and late 2011, all samples were sent to ALS Romania SRL laboratories in Rosia Montana for sample preparation. New containerized sample preparation facilities provided by ALS Chemex were installed in late 2011. The Gorayk laboratory is owned and operated by Geoteam.

All samples are shipped to ALS Romania laboratories for assaying. On arrival, each sample is logged, weighed, and assigned an individual bar code. A 50 g sub-sample was used from 2008 to 2010 period for gold fire assays. From 2010 to 2013 a 30 g sub-sample was used for fire assays. The ALS Romanian laboratory completed gold analyses by fire assay, with an AA finish and a gravimetric finish for all assays above 10.0 g/t gold. ALS Romania has been accredited, by the Standards Council of Canada, on 28 January 2013, with ISO/IEC 17025:2005 for gold fire assays with atomic absorption and gravimetric finish (codes Au-AA, Au-GRA, Au-AA23, Au-GRA21). The remainder of the pulp samples are sent for analysis by inductively coupled plasma mass spectrometry using a four-acid digestion (code ME-ICP61) at the ALS Laboratories in North Vancouver, Canada (ALS Canada Ltd). This analytical procedure assays 61 elements, including silver. The ALS North Vancouver laboratory is ISO/IEC 17025:2005 certified for this analysis.

Geoteam performs routine checks on laboratory submissions, upon import to the drillhole management Century Systems, Fusion database. On an ongoing basis QA/QC data is analyzed using Fusion plots for standard, scatter, quantile-quantile plots and HARD plots. Failures in quality-control data are identified by Geoteam database managers and discussed with field geological personnel. Critical failures result in the resubmission of ten samples that precede and ten samples that follow the failure sample that were submitted after the failed sample. More recently, Lydian resubmits the entire assay batch for reanalysis

Lydian provided assay quality-control data for gold and silver assays for the Amulsar Project, which AMC reviewed using a suite of analytical checks including: Scatter plots; HRD, HARD, ranked RPD, and quantile-quantile plots to evaluate field duplicates and umpire samples. Blank and certified reference material data were plotted on time-series plots using two standard deviations as acceptable limits for reference material plots.

Based on the data provided, AMC concludes that gold assay results for the Amulsar Project are appropriate for the estimation of mineral resources. Silver assay results have been found to good precision but there are problems with accuracy of silver assays which relates to umpire lab using different analytical techniques. The use of a limited certified standards for silver may also contribute to these problems.

AMC also completed a check of new data acquired after the previous resource estimate completed by AMC in 2016. Database assay values were compared with assay certificates supplied by Lydian. AMC randomly selected approximately 10% of the gold and silver assays for checking. No errors were found. AMC concludes that the Amulsar Project assay drillhole data provided by Lydian is appropriate for the estimation of mineral resources.

1.6 Metallurgical Testing and Mineral Processing

The metallurgical testing program was developed to determine:

1. Metal recoveries;
2. Most suitable Process options; and
3. Process flow sheets.

The following testwork programs have been completed to date on bulk composite samples representing the three main Amulsar deposits; Tigranes, Artavasdes and Erato. Testwork has been carried out by:

- SGS North America – 2015;
- Kappes, Cassiday & Associates (KCA) – 2012/2013;
- Wardell Armstrong International (WAI) – 2010/2011;
- SGS UK – 2009;
- SGS Lakefield – 2008; and
- KCA – Technical Review of the Design and Planned Operations of Lydian's Amulsar Project dated September 25, 2017.

Testwork has included:

- Ore characterization tests;
- Fine bottle roll leach tests;
- Coarse bottle roll leach tests; and
- Column leach tests.

Results from cyanidation tests conducted by SGS North America in 2015 on drillhole composites from Tigranes and Artavasdes were mainly used in the development of the recoveries for use in this study. Since Erato was not tested under this program, recoveries for the Erato were projected from the 2013 KCA testwork. The results of the testing program indicate excellent gold recoveries at a 19 mm crush size with low to moderate reagent requirements implying amenability to heap leaching. Silver recoveries are generally low. Column leach test results carried out on core samples by WAI, SGS and KCA generally support these conclusions.

The predicted field gold and silver recoveries, reagent consumptions, leach time and crush size based on the available testwork results and a review of the testwork by KCS in 2017 are summarized in Table 1-1.

Table 1-1: Predicted Leach Results

	Tigranes	Artavasdes	Erato
Gold Recovery (%)	87.1	87.1	87.5
Silver Recovery (%)	14.6		
NaCN Consumption (kg/t)	0.10		
Lime Consumption (kg/t)	2.0		
Leach Time (days)	60		
Crush Size (mm)	19		

Source: Lydian (2017)

1.7 Mineral Resource Estimate

The basis of this Mineral Resource statement is a resource estimate completed in a previous feasibility study completed by AMC Consultants (UK) Limited with an effective date of 27 February 2017. The Qualified Person for this estimate was G. David Keller, P.Geo. (APGO#1235).

In the intervening period between 2017 and 2019, no material changes have occurred to the resource estimate. Mining operations during this period have been shut down and no material exploration, drilling or mining of the deposit have been completed from 2017 to 2019. On this basis, a new estimate of mineral resources for the Amulsar deposit is not required as no material changes to mineral resources have occurred. Mineral resources have been restated at a lower cut-off grade to align with a reduction of the mineral reserves cut-off grade in this study as compared to the previous 2017 study.

The resource database used to evaluate the mineral resources for the Amulsar Project comprise an database updated with new drilling completed in 2016 for the Tigranes-Arshak-Artavasdes (TAA) Zone. The complete database containing previous and updated data was provided as exports from Lydian's Fusion database system. These spreadsheets contained all information for diamond core and reverse circulation drillholes, and channel samples for the Project. The database consists of the following:

Erato Zone:

- 75 diamond drillholes (11,598 m);
- 70 reverse circulation drillholes (12,085 m); and
- 31 surface channel samples (103 m).

TAA Zone:

- 215 diamond drillholes (30,800 m);
- 509 reverse circulation holes (67,054 m); and
- 210 surface channel samples (859 m).

New drilling completed in 2016 comprises 97 drillholes (9,383 m) over the TAA zone. No new drilling was completed over the Erato Zone.

Based on mining equipment selection, the selective mining unit (SMU) was changed from the previous block size of 10 × 10 × 5 m to 10 × 10 × 10 m (X, Y, Z directions). Resources were estimated using optimized ordinary kriging (OK) into the SMU blocks. This estimation procedure was used for gold and silver estimates for the Erato and TAA upper volcanic (UV) domains. Mineralization in the Erato and TAA lower volcanic (LV) domains are spatially limited and is discontinuous and therefore were estimated using OK only.

Each of the four mineralization domains were composited to 2 m intervals to provide common support for statistical analysis, variography and the estimation of gold and silver in a block model. Only silver grades for the TAA UV domain were capped to 700 g/t Ag. All other gold and silver domains were not capped. Gold and silver composite data for Erato and TAA UV domains were declustered to reduce the impact of varying sample densities on the global mean for each domain. LV domains for Erato and TAA zones were not declustered as mineralization for these domains are localized and not continuous.

Variography for the Amulsar deposit is based on Gaussian transforms of gold and silver composites which were back-transformed to gold and silver variograms. Omni-directional variograms were used for this project because of the complex structure and mineralization of the deposit.

Estimates of gold and silver for the Erato and TAA zones were made using OK to make block estimates into each SMU block. The OK estimate was "tuned" by "targeting" a tonnage and grade plot derived from a Gaussian change-of-support (COS) for gold and silver, for each of the Erato and TAA UV domains. LV domains were estimated using untuned OK estimates.

Dry Bulk Density values were assigned to each estimated model on the basis of the average measurements for each of the three zones. Average values assigned to each zone are as follows:

- Erato Zone UV: 2.28;
- TAA Zone UV: 2.39; and
- Lower Volcanics: 2.31.

The block model estimates for the UV domains were validated by comparing block grades to drillhole composite grades in 3D, comparative checks of OK estimates with nearest neighbour estimates, and plots of average block grades and declustered composites compared on the basis of 50 × 50 × 50 m blocks. LV domain estimates were compared on the basis of comparing block grades and composites in 3D only.

The mineral resources for the Amulsar deposit were classified with consideration of data quality, confidence in the geological interpretation, the spacing and orientation of drilling, and the understanding of grade continuities from observations and geostatistical analysis.

Inferred resources are defined as all blocks not classified as Indicated or Measured. Typically, these areas comprise drilling at a nominal spacing greater than 50 m and blocks estimated by second and third estimation runs.

Indicated resources are classified using a combination of the following criteria:

- Drillhole spacing at nominal 45 m or less including a mix of drillhole orientations from vertical and inclined holes to inclined holes at different azimuths;
- Drillholes must form a continuous volume exceeding a minimum extent of 150 m; and
- UV domains only: classification was extended to relatively minor amounts LV blocks adjacent to, or encapsulated by, UV units to form a uniform mineable shape.

Measured resources were classified on the basis of a combination of criteria:

- Drillholes at spacing at 40 m or less forming a grid pattern (as opposed to a single line of drillholes), a significant number of drillholes in the grid pattern, significant portion of drillholes must be at different orientations such as vertical and incline holes or inclined holes at different azimuths;
- Drillhole grids must extend for at least 200 m;
- Slope of regression values must be predominantly greater than or equal to 0.70 for the TAA Zone, this value was not used for the Erato Zone;
- UV domain blocks only; and
- Blocks classified as Measured must form mineable shapes.

In order to determine the quantities of material with reasonable prospects of economic extraction by open-pit mining, Whittle software (using a Lerchs-Grossman optimizing algorithm) was used in the 2017 Feasibility Study to develop a conceptual open-pit to evaluate the resource block model. Mine Development Associates (MDA) used the following parameters for optimization:

- Pit slope angles of 45 degrees for UV, 30 degrees for LV and 37 degrees for colluvium;
- Metal price assumption of US$1,500 per troy ounce of gold, US$25 per troy ounce silver;
- Heap leach recovery 87.2% for gold and 6.2% for silver;
- Royalties of 4% of NSR; and
- Mining costs of US$1.76 per tonne mined, processing costs, and general and administration at US$4.37 per tonne of ore.

A cut-off grade of 0.20 g/t Au was used for reporting mineral resources.

Mineral Resources for the Amulsar Project have been estimated in conformity with generally accepted CIM "Estimation of Mineral Resource and Mineral Reserves Best Practices" guidelines and are classified according to the "CIM Definition Standards for Mineral Resources and Reserves: Definition and Guidelines" (May 2014). At a cut-off grade of 0.20 g/t gold, mineral resources are estimated at 24.4 Mt at 0.76 g/t gold and 4.5 g/t silver (1.42 million ounces of gold and 8.5 million ounces of silver in the Measured category, 104.2 Mt at 0.66 g/t gold and 3.2 g/t silver (2.21 million ounces of gold and 10.8 million ounces of silver) in the Indicated category, and 85.9 Mt of gold at 0.5 g/t gold and 3.1 g/t silver in the Inferred Category. Mineral resources for the deposit are presented in Table 1-2. Mineral resources are reported inclusive of mineral reserves.

The Mineral Resource Statement was prepared by an "independent Qualified Person", G. David Keller, P.Geo. (APGO#1235), of WGM, as this term is defined in National Instrument 43-101. The effective date of the Mineral Resource Statement is 16 September 2019. Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no certainty that all, or any part of, the mineral resources will be converted into mineral reserves. WGM is unaware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant issues that may materially affect the mineral resources. This resource estimate is appropriate for a mining selectivity of 10 m × 10 m × 10 m only.

Table 1-2: Mineral Resource Statement, WGM Ltd., 16 September 2019

Classification	Quantity (kt)	Au (gpt)	Ag (gpt)	Contained Gold (Koz)	Contained Silver (Koz)
Measured	58,100,000	0.76	4.5	1,420,000	8,500,000
Indicated	104,200,000	0.66	3.2	2,210,000	10,800,000
Total Measured+Indicated	**162,400,000**	**0.70**	**3.7**	**3,650,000**	**19,200,000**
Total Inferred	85,900,000	0.50	3.1	1,380,000	8,600,000

Notes:

1. The effective date of the Mineral Resource Statement is 16 September 2019.
2. A cut-off grade of 0.20 g/t gold for this project based on an optimized open-pit shell based on a gold price of US$1,500 per ounce of gold and assuming an open-pit mining scenario.
4. Figures have been rounded to the appropriate level of precision for the reporting of Indicated and Inferred Resources in the upper and lower volcanic units.
5. Due to rounding, some columns or rows may not compute exactly as shown.
6. Mineral reserves are reported inclusive of mineral resources.
7. Mineral resources in this statement are not Mineral Reserves and do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues. Mineral reserves have been previously reported for this project using a prior Mineral Resource statement.

1.8 Mineral Reserve Estimate

The mineral reserve documented in this section was estimated based on CIM guidelines that define mineral reserves as “the economically mineable part of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A mineral reserve includes diluting materials and allowances for losses that may occur when the material is mined.”

Mineral reserves are those parts of mineral resources which, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the Qualified Person(s) making the estimates, is the basis of an economically viable project after taking account of all relevant processing, metallurgical, economic, marketing, legal, environment, socio-economic and government factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the mineral reserves and delivered to the treatment plant or equivalent facility. The term ‘mineral reserve’ need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

To convert mineral resources to mineral reserves, estimates of gold price, mining dilution, process recovery, refining/transport costs, royalties, mining costs, processing, and general and administration costs were used to estimate cut-off grades (COG) for each deposit. Along with geotechnical parameters, the COG formed the basis for the selection of economic mining blocks.

The Qualified Persons (QPs) have not identified any known legal, political, environmental, or other risks that would materially affect the potential development of the mineral reserves, except for the risk of not being able to secure the necessary permits from the government for development and operation of the project. The QPs are not aware of any unique characteristics of the Project that would prevent permitting.

A summary of the mineral reserves for the project are shown in Table 1-3 using a cut-off grade of 0.20 g/t within the designed final pits for the Artavasdes, Tigranes and Erato deposits. The effective date of the mineral reserve contained in this report is September 16, 2019.

Table 1-3: Summary of Mineral Reserves

Area	Classification	Ore (Mt)	Diluted Gold Grade (g/t)	Contained Gold (koz)	Diluted Silver Grade (g/t)	Contained Silver (koz)
Artavasdes + Tigranes	Proven	47.8	0.78	1,202	4.6	6,998
	Probable	45.8	0.73	1,074	3.7	5,472
	Total	**93.7**	**0.76**	**2,276**	**4.1**	**12,469**
Erato	Proven	4.1	0.66	88	3.2	416
	Probable	21.5	0.67	464	2.2	1,549
	Total	**25.6**	**0.67**	**552**	**2.4**	**1,965**
All	**Total**	**119.3**	**0.74**	**2,828**	**3.8**	**14,435**

Note: Mineral reserves are included within mineral resources. Numbers may not add due to rounding.
Source: JDS (2019)

1.9 Mining

The Amulsar deposit will be developed by open pit mining by mining 10 m benches using 22 m^3 front shovels, and 180-tonne trucks. Approximately half of the mining equipment has already been purchased and delivered to site.

Over the life of mine, three deposits will be mined and will be split into seven mining phases. The Tigranes and Artavasdes deposits are mined first, having higher value (combination of higher grades and a lower strip ratio) than the Erato deposit. Ore will be processed at a nominal production rate of 27,400 tonnes per day (tpd) (10 Mtpa). Table 1-4 summarizes the overall material contained within the open pits.

Table 1-4: Material Contained in the Artavasdes, Erato and Tigranes Pit Designs

Deposit	Ore (Mt)	Grade Au (g/t)	Waste (Mt)	Strip Ratio Waste/Ore
Artavasdes + Tigranes	93.7	0.76	154.4	1.6
Erato	25.6	0.67	89.2	3.5
Totals	**119.3**	**0.74**	**243.6**	**2.0**

Source: JDS (2019)

Initially, all waste material will be placed within the external BRSF. Over time, the waste will transition to be placed within the mined out portion of the Tigranes and Artavasdes pits.

Low-grade ore will be stockpiled containing material if grades are less than 0.30 g/t and greater than 0.20 g/t. The stockpile is located close to the crusher, on top of the BRSF.

1.10 Recovery Methods

The process flowsheet includes a two-stage crushing plant followed by a heap leach operation. Gold is extracted in an adsorption-desorption-recovery (ADR) carbon plant utilizing zinc precipitation to recover gold and silver. The process flowsheet and design criteria are based on a heap leach processing rate of 10 million tonnes per annum (Mtpa) at an average feed grade of 0.74 g/t gold and 3.76 g/t silver. The anticipated overall recovery for gold and silver is approximately 87.1% and 14.6%, respectively. The process plant will be located near the HLF to minimize pumping and pipeline requirements for pregnant and barren solutions. The processing facility will consist of two-stage crushing, screening and overland conveying to the truck loadout bin. From there, the percent passing (P_{94}) 19 mm crushed ore will be transported via trucks to the leach pad for heap leaching. Pregnant leach solution (PLS) from the heap will be treated in a Carbon-in-Column (CIC) circuit. Gold will be recovered by an ADR circuit where the final product will be doré.

1.10.1 Crushing and Ore Handling

Run-of-mine ore will be trucked from the pits and normally dumped directly into the primary jaw crusher at a rate of approximately 27,400 tpd. The primary crusher will discharge onto a conveyor feeding a crushed ore stockpile. The feeders under the stockpile will withdraw material and combine with the secondary cone crusher product to feed three screens. Screen oversize will be conveyed back to one of three secondary cone crushers. The screen undersize, at a target P_{94} 19 mm, will feed the overland conveyor for transport to the loadout bin, crushed ore will be transported to HLF by trucks. Lime will be added before being deposited on the Heap Leach Pad (HLP) for pH control.

The overland conveyor will transport crushed ore to the crushed ore stockpile at an average rate of 1,522 tonnes per hour (tph), where trucks will be loaded and dumped on the HLP for spreading and stacking. The crushing plant will operate 365 days per year.

1.10.2 Processing Plant

The PLS from the HLP will be pumped from the process pond at a nominal rate of 1,032 m^3/h (design 1,200 m^3/h) to the process plant building. The PLS will feed the CIC. PLS will discharge from the final carbon column will flow over the carbon safety screen before reporting to the to the barren solution sump. Cyanide solution, to maintain a concentration of 250 ppm cyanide, caustic solution and anti-scalant are added to the barren solution pump discharge as needed. The loaded carbon from the first carbon column is advanced to the elution circuit. The loaded carbon, 8 tpd in two 4 t batches, will be acid washed and gold and silver will be recovered from the carbon in the elution vessel.

The pregnant solution from the elution vessel will flow to the zinc precipitation. At the conclusion of the elution cycle, the stripped carbon will be thermally regenerated in the carbon reactivation kiln.

Gold and silver from the pregnant solution will be precipitated using zinc and filtered. The filter cake will be dried using a mercury retort, mixed with fluxes and then smelted to produce doré and slag. The doré will be stored in a vault while waiting for transport off site to a refinery for further purification. Slag is processed to remove prills for re-melting in the furnace.

A laboratory facility will be equipped to perform sample preparation and assays by atomic absorption, fire assay, and cyanide (CN) soluble analyses. The facility will process samples for the mill, mining operations and environmental group.

1.11 Infrastructure

There is reasonably modern infrastructure surrounding the Amulsar Project. This includes an asphalt highway which runs from the main sealed highway between Yerevan to the most southern town of Meghri, high voltage power lines and substations, a gas pipeline, year round water from the Vorotan, Arpa and Darb Rivers, and a fiber optic internet cable.

Because the Project construction was already underway prior to the suspension of work, the infrastructure installation has commenced and is in the intermediate stages of construction.

The Project will require the completion of the following facilities:

- The open pit and mining operation areas;
- Mine haul road RD3;
- BRSF;
- Low and high grade ore stockpiles;
- The mine surface facilities, including the truck shop, mobile equipment wash bay, fuel storage and fueling area, mine support office trailers, and explosives storage area;
- The crushing plant area and the MSE wall;
- The screening building;
- Overland conveyor and utility corridors;
- The truck load out facility at the bottom of the overland conveyor;
- The ADR plant;
- HLF pad, pregnant solution piping and storage ponds;
- Onsite site roads and construction access;
- Power line tie into the local utility;
- Electrical houses, site power distribution and power supply to equipment;
- Raw water ponds and site distribution;
- Contact water conveyances, collection ponds, and passive treatment systems (PTS);
- Saravan access road; and
- ROM pad by the crusher.

A camp facility was constructed in 2017 on the PL-8 location which consists of 12’ x 20’ bedroom blocks, a kitchen and dining area, cleaning facilities, medical clinic, administration and recreational area. The facility contains 920 beds for on double occupancy rooms and 20 beds for single occupancy rooms.

During the construction phase, overflow from the camp will be evaluated and carefully managed using limited short-term agreements with existing hotel and apartment facilities.

The Phase 1 HLP, PLS Pond (PD-5) and initial Storm Pond (PD-1) have been partially constructed during the 2017-2018 construction seasons. The majority of the earthworks including much of the clay liner has been completed including construction of perimeters roads, the upstream diversion pond (D-1) and other perimeter surface water diversions. The primary high density polyethylene (HDPE) geomembrane liner was installed in a portion of PD-5 however it was not completed prior to the blockade so will need to be replaced. The remaining portion of the HLF will therefore need completed.

Similarly a portion of the BRSF was constructed during the 2017-2018 construction seasons. Portions of the underdrain system were completed and the earthworks for contact water Pond PD-7T was completed. Portions of the subgrade where clayey soils were located in-situ were partially completed. The remaining portion of the BRSF will therefore need to be completed.

Based on the revised mine schedule and increase in reserves, a fifth phase was added to the design of the HLF such that the HLF now provides capacity for stacking of up to 120.5 Mt of ore. The Phase 5 expansion will require partial removal of diversion dam, D-1 and construction of a new diversion dam, D-2 to manage upstream run-off. In addition, the addition of Phase 5 will require that a portion of the BRSF Pipeline, PL-15, be relocated concurrent with construction of the Phase 5 expansion.

The Sitewide Water Balance was also updated based on all of the changes to the mine plan and infrastructure to ensure that all surface water (classified as either contact water, impacted water, or non-contact water) is managed in accordance with requirements mandated by the ESIA.

1.12 Environment and Social Impact

An ESIA was developed in 2014 for the Amulsar Project in accordance with International Finanace Corporation (IFC) Performance Standards and Guidelines, and EBRD Performance Requirements. The ESIA includes a suite of management plans, a Commitment Register and the foundation for the Environmental and Social Management System (ESMS) and the Occupational Health and Safety Management System (OHSMS). It is recognized that the scope and layout changes developed in the 2015 Value Engineering Optimization changed some of the Project parameters that were previously assessed; Lydian updated the impact assessment and disclosed the updated ESIA in 2nd quarter 2016.

The ESIA developed for the Amulsar Project fully describes the policy, legal and administrative framework under which the Project will be developed and under which the assessment was completed; as well as a description of the Project covering geographical, ecological, social and temporal considerations. The ESIA includes a detailed analysis of the baseline data that provides an accurate description of the physical, biological, cultural and historical conditions of the land within the Project footprint and those areas that would be affected during the course of the development (the Project Affected Area). The ESIA also reports the environmental and social impacts associated with Project implementation. The mitigation measures that are needed to minimize or control potential impacts to an acceptable level are presented, together with an analysis of feasible alternatives. Key management plans covering environmental management, Acid Rock Drainage (ARD) management, biodiversity, safety, social management and community development among others, have been formulated and presented, for the delivery of the Project from construction to operation and mine reclamation, closure and rehabilitation.

For the Project approval in the Republic of Armenia, an application was first made to the Ministry of Energy and Natural Resources (this Ministry had been renamed in October 2016 into the Ministry of Energy Infrastructures and Natural Resources) to update the existing Mining Right was made in March 2016. The application consisted of updated Mine Plan, an Armenian EIA and Mine Closure Plan. The updated EIA was subject to review and scrutiny the Ministry of Nature Protection (MNP) and the Ministry of Emergency Situations. During this process, the MNP processed the EIA reports and held the four formal Public

Hearings. The updated EIA was approved in April 2016 and the Technical Safety expertise approval was granted in March 2016. The Mining Rights update was approved in May 2016.

For the development of the mine, several permits and licenses will be required, including water abstraction, water discharge and air emissions, and are detailed in Table 20-1. Lydian Armenia has revised and submitted a water abstraction permit for water from the Darb River located on the southern side of the project. Approval of the water abstraction permit from the Ministry of Environment is expected mid-October 2019.

The Project footprint within the RAA will be approximately 609 ha. The Project footprint constitutes the area that will be directly disturbed by placement of new infrastructure and groundworks. An additional disturbed area, demarcated by a nominal 50 m buffer around the Project footprint, has been used to determine the additional area that is likely to be disturbed by Project activities – such as increased levels of dust deposition, increased noise and vibration, and other factors. This additional area amounts to approximately 452 ha in addition to the Project footprint.

There will also be a restricted area around the Project footprint and disturbed area, which will be those regions of land that are fenced or have physical barriers to access, or will have controlled or restricted access due to safety concerns and the mine's duty of care to keep the public safe from harm. This restricted area adds another 477.2 ha to the Project.

There are two Important Bird Areas (IBAs) in the vicinity of the Project, Jermuk and Gorayk. The IBAs constitute "Key Biodiversity Areas" (KBA). The current design is avoiding the IBAs; however, the Lesser Kestrels, which are the primary designated feature of the Gorayk IBA, hunt in the Project Affected Area.

The closest National Park to the site is the Sevan National Park located approximately 44 km to the north-northwest of the Project. Three specially protected State Sanctuaries are located in the vicinity of the Project: Jermuk (2.9 km north), Her-Her Open Woodland (5.1 km, west) and Jermuk Hydrological (6.4 km, north).

Most land within the concession area is "natural" habitat (albeit with many anthropogenic influences such as grazing). Habitat type and vegetation distribution has been analyzed using satellite imagery and further details of the density of vegetation within each of the Project components has been considered. The upper slopes of Amulsar are located in Critical Habitat per IFC's requirements for Potentilla porphyrantha (P. porphyrantha), a rare plant, and Critical Habitat for P. porphyrantha and Brown Bear per EBRD's requirements.

The Project may also further affect biodiversity as a result of land use change, disturbance, induced demographic and social changes and other environmental changes that affect a wider area.

Depending on their exposure and sensitivity to impacts, specific mitigation measures are identified in the ESIA for impacts on these receptors. Mitigation measures are also identified for impacts on other biodiversity receptors considered to be relatively widespread and resilient in order to achieve "No Net Loss" of biodiversity overall as a result of the Project.

The Project is expected to have a residual longer-term impact on native and natural vegetation and on certain fauna species; therefore a biodiversity offset is planned for the entire footprint of the Project for impacts on natural vegetation due to its species richness and the presence of regional endemic plants. The Project also affects P. porphyrantha, an Armenian Red Book Plant which has part of its population within the mine pit areas. Residual impacts are also likely on animal populations including populations of breeding and migratory raptors, and the Brown Bear (and Bezoar Goat, Lynx and Wolf) known to use habitat on

Amulsar Mountain. The Project will not have direct effects on Jermuk or Gorayk IBA, but does provide feeding area that supports the bird species for which these areas are designated. Land use changes throughout the Project affected area could affect availability of prey items for birds of prey. The availability of undisturbed hunting habitat for Lesser Kestrel and feeding habitat for Egyptian Vulture and other raptors is being monitored as part of plans to develop offset opportunities to ensure that the Project does not cause irreversible declines in species or habitats in the longer term. To that effect Biodiversity Offset project will be established as the Jermuk National Park where surveys and assessments carried out in 2015 and 2016 indicate that it should be suitable to Lydian's requirements for a natural habitat offset.

Protection to a proportion of the remaining population of P. porphyrantha has been afforded through a Set-Aside located in an area named Arshak (southern part of Amulsar), within which no Project activities are authorized. This area incorporates the southern part of the Critical Habitat, and will be protected to safeguard the remaining proportion of the P. porphyrantha population on Amulsar as well as other important biodiversity receptors, mainly fauna. Research, plant translocation and field trials have been initiated in partnership with the Academy of Science of Armenia and the Institute of Botany and Cambridge University Botanic Garden (UK) to establish effective techniques for restoring the vegetation types affected by the Project.

The Project has a risk for Acid Rock Drainage (ARD) from the oxidation of sulphide minerals in the barren rock, pit backfill, and pit wall rock. Section 25.2 describes the ARD characterization efforts, the ARD management strategy, and the potential water quality impacts resulting from mine development. Using industry-practice mitigation measures, the ARD has been shown to have no significant local or regional water quality impact (Wardell Armstrong, 2016).

During exploration activities and stakeholder engagement, it has become apparent that local people are generally supportive of the Project. The IFC conducted a comprehensive survey in September 2016 and subsequently disclosed the following statement:

> *'IFC has determined that there is Broad Community Support (BCS) for the Amulsar Gold Mine project. IFC's determination of BCS took into account: i) the level of Informed Consultation and Participation (ICP), ii) project documentation of the consultation process and iii) interviews with key stakeholder in the area of influence.*

The potential benefits from employment were welcomed, however in all settlements (Gorayk, Gndevaz and Saravan) community expectations remain high.

Other positive impacts relate to improvements in local livelihoods through direct employment by the Project, as well as knock-on economic growth; and macroeconomic growth through taxation, land rent and other revenues paid by Lydian Armenia. Positive impacts range from minor to moderate; provided enhancement measures are implemented.

Effective implementation of the mitigation measures defined in the ESIA will be essential to derive and maintain positive benefits associated with the Project through the construction and operational phases. Lydian's social policy and strategy and on-going community development measures are expected to provide additional benefits to local communities, over and above the Project impacts.

Social impacts at mine closure stage have also been assessed; depopulation, economic decline and breakdown of some community services are the main impacts expected. Mitigation measures have been identified and involve progressive social investment, community development, economic diversification and capacity building activities within the operational stage.

The details of mitigation and enhancement measures are considered in the ESIA; the associated management plans have been defined and will be incorporated into operational controls, as well as Lydian's ESMS and OHSMS.

Following a change in the Government of Armenia in May 2018, demonstrations and road blockades occurred sporadically throughout the country. These initial protests primarily targeted the mining sector, including the Amulsar Gold Project. A continuous illegal blockade at Amulsar has been in place since 22 June 2018, causing construction activities to be suspended since this date. Access has generally been limited to activities related to contractor demobilization and winterization.

The current Government of Armenia has publicly announced their intolerance of illegal road blockades and has committed to its application of the "rule of law" to remove such blockades. However, no steps have been taken by the Armenian government so far to remove the blockades. Through-out this period the company has continued to engage with the communities. The message from the communities is that they are waiting for the Government to support the Project and open the roads. Once construction has resumed, Lydian Armenia has planned a revised social recovery plan as described in Section 20.8.7.

1.13 Capital Cost Estimate

The remaining initial capital costs address the completion of engineering, procurement, and construction activities, and the start-up of the Amulsar Project. All costs are expressed in United States dollars ($) unless otherwise noted.

The total estimated cost to finish development, start-up the process facility, and produce first gold is $168.6 million (M), inclusive of the mine, HLF, Owner's cost and all capital requirements of the Project.

The Table 1-5 summarizes the remaining Project initial costs by major categories.

Table 1-5: Remaining Initial Capital Cost Estimate Summary

Description	Cost ($USM)
Site Development	10.2
Crushing and Material Handling	18.7
HLF	5.9
Process Plant	6.0
BRSF	5.7
Mine Facilities	0.8
Services, Utilities & Misc. Facilities	2.3
Indirect Costs	37.5
Owner's Costs (includes working capital)	44.0
Mining	28.3
Contingency	9.2
Total Remaining Initial Capital Spend	**168.6**

Source: JDS (2019)

In recognition of the degree of detail on which the estimate is based, a contingency of $9.2 M has been included in the capital cost estimate for these facilities. This equates to an overall Project contingency on the initial cost of approximately 6.3%.

The total sunk cost of the project spent on the previous development to date is $361.9 M. Table 1-6 provides the sunk cost by category.

Table 1-6: Sunk Capital Cost

Description	Sunk Cost ($USM)
General (Owner's Cost)	37.1
Site Development	12.2
Crushing and Material Handling	77.3
HLF	24.9
Process Plant	12.4
BRSF	2.9
Mine Facilities	7.3
Services, Utilities & Misc. Facilities	8.5
Indirect Costs	96.3
Owner's Costs	42.4
Mining	40.5
Total Sunk Capital	**361.9**

Source: JDS (2019)

The total Net LOM capital cost is estimated at $710.9 million, and includes the $361.9 M sunk costs, $168.6 M remaining preproduction, $144.0 M for sustaining, and $36.4 M for closure capital. Table 1-7 summarizes the capital cost over the life of the mine.

Table 1-7: Life of Mine Capital Cost Summary

Description	LOM Cost ($USM)
Costs to date	361.9
Remaining Preproduction Capital	168.6
Sustaining Capital	144.0
Closure Capital	36.4
Total LOM Capital	**710.9**

Source: JDS (2019)

1.14 Operating Cost Estimate

Life of mine (LOM) operating costs for the project average $11.25/tonne leached, including:

- Mining;
- Processing; and
- General and Administration (G&A).

The cost per tonne of ore processed is based on an annual ore tonnage of 10,000,000 t.

The LOM operating cost of $11.25/tonne leached excludes off-site costs (such as shipping and refining) and royalties. These ancillary costs are used to determine the net smelter return (NSR) and are described in Section 23.

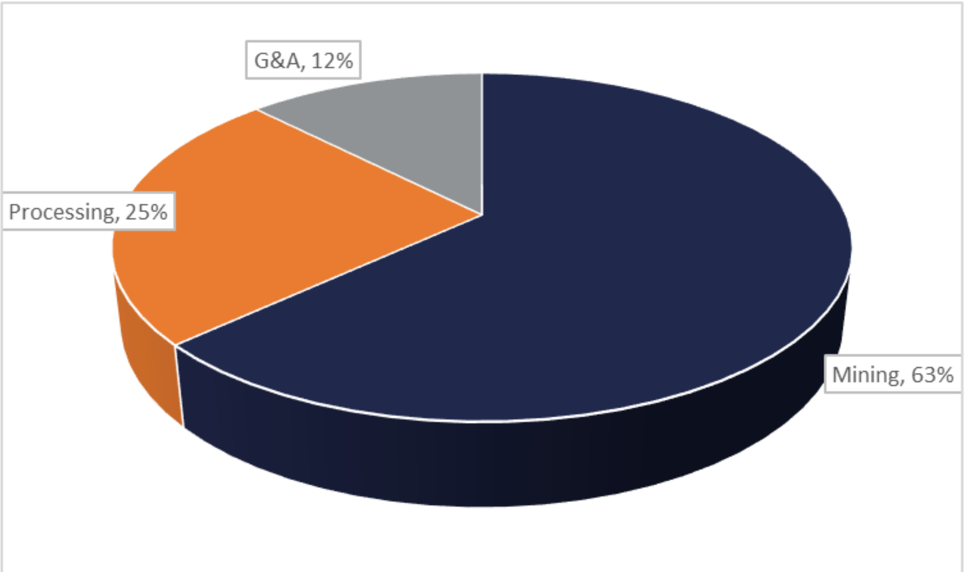
Table 1-8 presents a summary of the LOM operating costs, expressed in US$ with no escalation. Figure 1-4 illustrates the distribution of operating costs amongst the cost sectors.

Table 1-8: Operating Cost Summary

Operating Costs	LOM Cost (US$ M)	US$/t-mined	US$/t-leached
Mining	**847.7**	**2.36**	**7.11**
Drill	131.0	0.36	1.10
Blast	57.4	0.16	0.48
Load	101.3	0.28	0.85
Haul	344.2	0.95	2.88
Mine General	156.2	0.43	1.31
Mine Maintenance	38.7	0.11	0.32
Technical Services	18.7	0.05	0.16
Process	**328.0**	**-**	**2.75**
Labour	39.5	-	0.33
Power & Fuel	44.8	-	0.38
Maintenance & Operating Consumables	236.4	-	1.98
Services	7.4	-	0.06
G&A	**166.4**	**-**	**1.39**
Accommodations	10.0	-	0.08
Equipment	1.7	-	0.01
Labor	50.1	-	0.42
Office Operations	8.8	-	0.07
Outside Services	47.0	-	0.39
Programs	41.3	-	0.35
Software/Equipment	3.5	-	0.03
Supplies	2.9	-	0.02
Utilities & Services	1.1	-	0.01
Total Operating	**1,342.1**	**-**	**11.25**

Source: JDS (2019)

Figure 1-4: Distribution of Operating Costs



Source: JDS (2019)

1.15 Economic Analysis

1.15.1 Main Assumptions

Table 1-9 outlines the metal prices and exchange rate assumptions used in the economic analysis.

The reader is cautioned that the metal prices and exchange rates used in this study are only estimates based on recent historical performance and there is absolutely no guarantee that they will be realized if the Project is taken into production. The metal prices are based on many complex factors and there are no reliable long-term predictive tools.

Table 1-9: Metal Prices and Exchange Rates

Parameter	Units	Value
Gold (Au) Price	US$/oz	1,300
Silver (Ag) Price	US$/oz	16.00
Foreign Exchange Rate	Dram:USD	480

Source: JDS (2019)

Mine revenue is derived from the sale of doré bars into the international marketplace. No contractual arrangements for refining currently exist. Table 1-10 indicates the NSR parameters that were used in the economic analysis.

Table 1-10: NSR Parameters

Parameter	Units	Value
Mine Operating Days	days/a	365
Gold (Au) Recovery	%	87.1%
Silver (Ag) Recovery	%	14.6%
Gold (Au) Payable	%	99.95%
Silver (Ag) Payable	%	99.90%
Refining Charges	US$/pay GEQ oz	2.22

Source: JDS (2019)

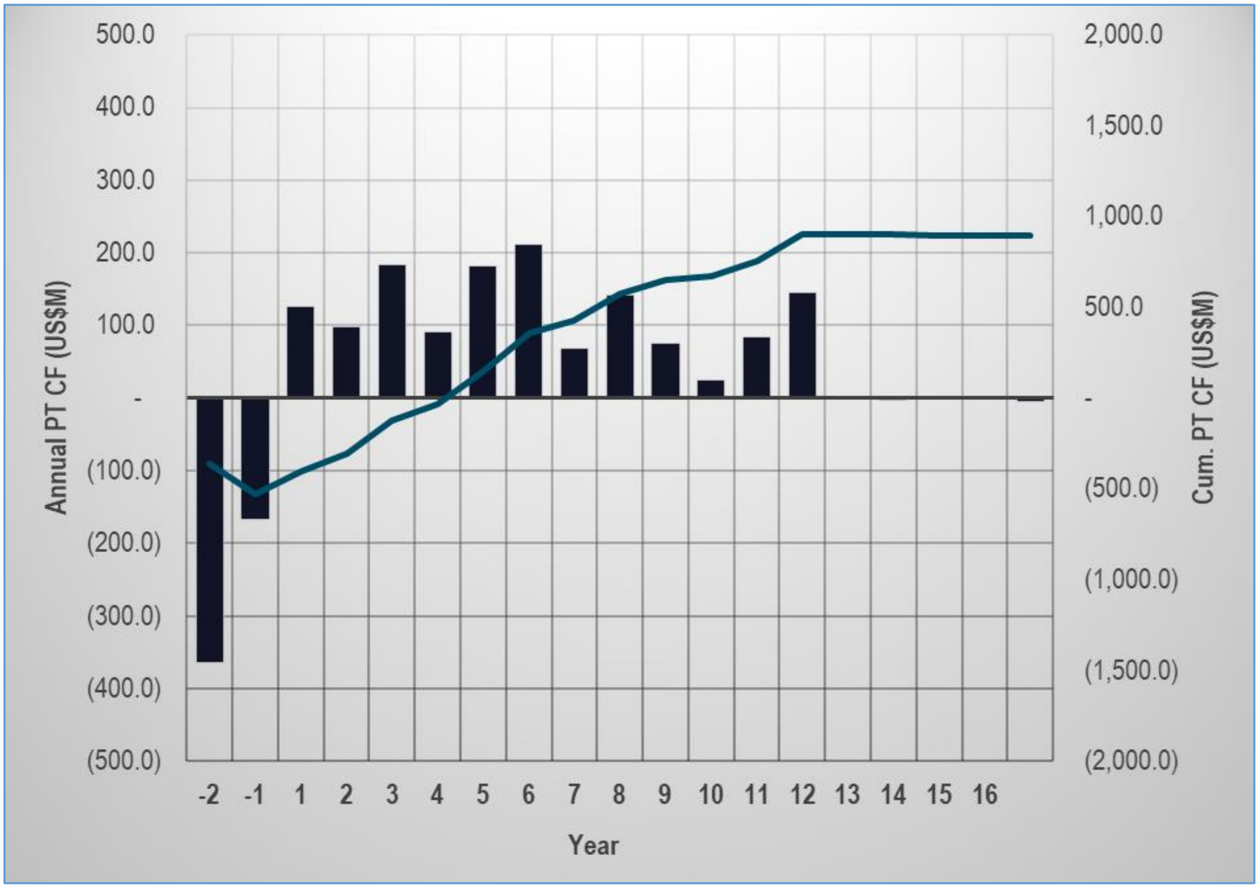
1.15.2 Results

The Project has an after-tax IRR of 14.9% and a net present value (NPV) using a 5% discount rate ($NPV_{5\%}$) of $362.6 M using the metal prices described in Section 23.1. These results include costs incurred to date. Figure 23-2 shows the projected cash flows by year, and Table 23-6 summarizes the economic results of the Project.

The after-tax break-even gold price is approximately US$882/oz, based on the LOM plan presented herein, and a silver price of US$16.00/oz. This is the gold price at which the Project NPV @ 0% discount rate is zero.

The life of mine all-in sustaining cost (AISC) and AISC (net of by-product) is US$744/oz, and US$731/oz respectively. The straight AISC cost is calculated by adding the refining, transport, royalty, operating, and sustaining and closure costs together and dividing by the total payable ounces of gold. This metric does not consider the value of silver in the calculation. The AISC (net of by-product) is a similar calculation – it adds the refining, transportation, royalty, operating and sustaining and closure costs but subtracts the value of the silver before dividing by total payable ounces of gold.

Figure 1-5: Annual After-Tax Cash Flow



Source: JDS (2019)

Table 1-11: Summary of Results

Parameter	Units	Value
AISC*	US$/oz	744.2
AISC (Net of By-Product)	US$/oz	730.6
Capital Costs		
Incurred to Date	US$ M	361.9
Remaining to Spend	US$ M	168.6
Sustaining and Closure	US$ M	180.4
Total Capital	US$ M	710.9
Pre-Tax Cash Flow	US$ M	893.4
Taxes	US$ M	189.7
After-Tax Cash Flow	US$ M	703.7
Economic Results		
Pre-Tax NPV (5%)	US$ M	503.9
Pre-Tax IRR	%	18.4%
Pre-Tax Payback	Years	4.2
After-Tax NPV (5%)	**US$ M**	**362.6**
After-Tax IRR	**%**	**14.9%**
After-Tax Payback	**Years**	**4.7**

*All-in Sustaining Cost is calculated as: (Refining & shipping costs + royalties+ operating costs + sustaining and closure capital)/payable gold ounces.

**All-in Sustaining Cost (Net of By-product) is calculated as: (Refining & shipping costs + royalties+ operating costs + sustaining capital + closure capital - payable Ag value)/payable gold ounces.

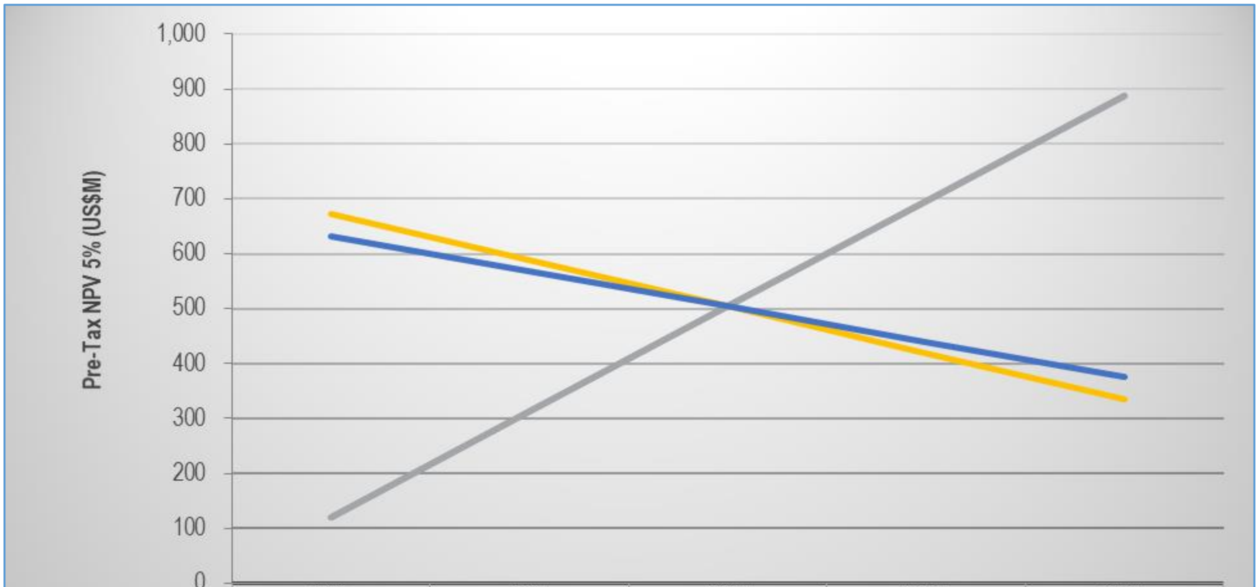
Source: JDS (2019)

1.15.3 Sensitivity

A univariate sensitivity analysis was performed to examine which factors most affect the Project economics when acting independently of all other cost and revenue factors. Each variable evaluated was tested using the same percentage range of variation, from -20% to +20%. This may not be truly representative of market scenarios, as metal prices may not fluctuate in a similar trend. The variables examined in this analysis are those commonly considered in similar studies – their selection for examination does not reflect any particular uncertainty.

Notwithstanding the above noted limitations to the sensitivity analysis, which are common to studies of this sort, the analysis revealed that the Project is most sensitive to head grade. The Project showed the least sensitivity to capital costs. Figure 1-6 shows the results of the sensitivity tests, while Table 1-12 shows the NPV at various discount rates.

Figure 1-6: Pre-Tax Sensitivity Analysis



	80%	90%	100%	110%	120%
Metal Prices	119.1	311.5	503.9	696.3	888.7
Head Grade	119.9	311.9	503.9	695.9	887.9
OPEX	671.9	587.9	503.9	419.9	335.8
CAPEX	631.4	567.6	503.9	440.1	376.4

Source: JDS (2019)

Table 1-12: Project Net Present Value (NPV) at Various Discount Rates

Discount Rate (%)	Pre-Tax NPV (US$ M)	After-Tax NPV (US$ M)
0	893	704
5	**504**	**363**
6	445	311
7	391	264
8	341	220
10	253	144
12	178	78

Source: JDS (2019)

1.16 Plan of Execution

The Lydian Project Team, supported by JDS, have prepared a project restart execution plan to support the Project cost estimate and Project Master Schedule (PMS). Figure 25-1 presents a summarized version (level 1, AAEC) schedule for the development of the Amulsar Project. Key activities that have been completed in the current Project planning process include the following:

- Developed detailed project Work Breakdown Structure (WBS) and associated Cost Breakdown Structure (CBS);
- Developed Project Master Schedule in Primavera® P6 format;
- Utilize existing contractors and vendors that are meeting project performance criteria;
- Reviewed existing Project Management plans to use for construction activities consistent with the following:
  - Project's ISO 18001-based Health and Safety Management System (HSMS),
  - Project's ISO 14001-based Environmental and Social Management System (ESMS) in development,
  - International Cyanide Management Institute (ICMI) Cyanide Management Code,
  - IFC General Environmental, Health and Safety Guideline,
  - IFC Environmental, Health and Safety Guideline for Mining, and
  - EU Directives for consistency with EBRD Performance Requirements;
- Re-instate existing Project Occupational Health and Safety Management Plan (OHSMP) for 2020 site-wide activities, including:
  - Combined Health, Safety, Environmental and Social inductions,
  - Hazard recognition training,
  - Job Hazard Analysis and daily toolbox meetings,
  - Expanded incident reporting and follow-up.
- Completed preparation of Preliminary Contract Package Plan;
- Developed Project Organization and staffing plans for project duration; and
- Developed Operations organization structure and staffing plan.

Project planning for implementation is best visualized by the Project Master Schedule (PMS). A critical path schedule has been developed using Primavera P6® on the basis of the WBS scope content and estimated effort appropriate for this phase of project development. The schedule has not yet been resource loaded with manpower or quantity values for each scope activity; this information will be developed and loaded during the initial Project Management set up phase of the Project.

1.17 Conclusions and Recommendations

The Feasibility Study update summarized in this technical report contains adequate detail and information to support the positive economic outcome shown for the project. Standard industry practices, equipment and design methods were used.

The Amulsar project contains a substantial resource that can be mined by open pit methods and recovered with heap leach processing.

Based on the technical and economic results contained in this study, and taking into consideration that Project construction was already underway prior to the suspension of work, Lydian should proceed with the development of the Amulsar project as soon as practical.

The total estimated cost to finish development, start-up the process facility, and produce first gold is $168.6 M, inclusive of the mine, HLF, Owner's cost includes working capital and all capital requirements of the Project.

1.17.1 Project Risks

As with most mining projects there are many risks that could affect the economic viability of the Project. External risks are, to a certain extent, beyond the control of the Project proponents and are much more difficult to anticipate and mitigate, although, in many instances, some risk reduction can be achieved. External risks are things such as the political situation in the Project region, metal prices, exchange rates, changes in regulatory requirements and government legislation.

The most significant potential risks associated with the project are, operating and capital cost escalation, permitting and environmental compliance, unforeseen schedule delays, ability to raise financing, gold price and exchange rate. These risks are common to most mining projects, many of which can be mitigated with adequate planning and pro-active management.

The Lydian team has completed multiple Project Risk Assessment workshops in which environmental and social risk elements were considered. Table 26-1 identifies what are currently deemed to be the most significant Project risks associated with the Project Schedule, Mining and Operations, Water Management, Infrastructure and CAPEX. Approaches for avoidance, minimization, mitigation and offset are provided in the table.

1.17.2 Project Opportunities

There are significant opportunities that could improve the economics, timing, and/or permitting potential of the Project. The major opportunities that have been identified at this time are summarized in Table 26-2, excluding those typical to all mining projects, such as changes in metal prices, exchange rates, etc.

One of the more significant Project opportunities is the potential to extend the LOM beyond the current twelve year period. Significant inferred mineral resources and potentially mineralized zones exist below and adjacent to current reserves for the Erato and TAA zones. Targets include inferred mineralized zones outside of the current reserves pit design that may be upgraded to measured and indicated categories with delineation drilling programs. Exploration drilling targets also exist below current mineral resources and in areas with potentially mineralized UV rocks that have been inferred at depth.

2 Introduction

Lydian International Limited (Lydian) is developing the Amulsar Gold Project located in south-central Armenia, which was discovered by the company in 2006. Project development has advanced continuously since that time.

Lydian Armenia owns 100% of the Amulsar Project and holds all titles, rights, benefits and obligations to the Amulsar Gold Project, along with the current site-related prospecting license and mining license.

This technical report summarizes the results of the FS update and was prepared by JDS for Lydian Armenia to support the Canadian Securities Administrators' National Instrument 43-101 and Form 43-101F1.

2.1 Purpose

In December 2018 JDS Energy and Mining (JDS) was engaged by Lydian to provide a re-start plan and assess several technical issues related to the Amulsar Gold Project. JDS personnel visited the site and provided a re-start plan in January 2019, after which Lydian commissioned JDS to complete an updated Feasibility Study (FS) on the project. The update to the FS was based on the *NI 43-101 Technical Report Amulsar Updated Resources and Reserves*, dated March 2017. The objective was to update the Proven and Probable Reserves by designing a pit shell incorporating the additional Measured and Indicated Resources. JDS was also tasked with developing a business case for the project based on practical, fit-for-purpose solutions that maximize value and make the Project more economically viable in this gold price environment.

One impact of the increased Reserves was that more space would be required in the HLF to leach the increased ore tonnage. Another impact was the production of more waste rock which has to stay in the permitted footprint of the BRSF, JDS planned to handle the extra waste material by backfilling the pits. The mining and processing approach has not changed and the Project remains within the established permitted footprint. The following summarizes the general scope of work covered in the FS update;

- Resource modeling and estimation, cut-off grade for the resource estimate lowered from 0.24 g/t (reported in the FS update in 2017) to 0.20 g/t;
- Mine design included: revised mine design criteria, further pit optimization and design, an update of the mine production schedule, an update equipment selection and required mine infrastructure and a new cost model;
- BRSF stacking plan developed in phases and based on the mine production schedule, with the intent of reducing the initial capital and taking into consideration seasonal construction constraints;
- HLF expansion requirements, including leach pad design and associated infrastructure;
- Refinement of haul roads and site-wide roads to minimize excavation and fill requirements;
- Refinement of the site-wide water management program;
- Added construction execution plan and schedule;
- Project capital cost updated to cover required initial capital cost, sustaining costs, owner costs and contingency;

- Project operating cost included mining cost, process plant operating cost, general and administration costs;
- Economic model built based on the updated capital and operating costs;
- Project risks and opportunities updated with potential impacts; and
- Updated recommendations on future work.

In addition to the above, constructability review of input and current pricing identified key areas of cost increases from that stated in previous work.

This FS update technical report is a compilation of the results of the Amulsar development efforts up to this point in time.

For clarification, only Sections 6 to 12 remain mostly unchanged from the recent March 2017 Technical Report titled “NI 43-101 Technical Report Amulsar updated Resource and Reserves Armenia”.

2.2 Qualifications and Responsibilities

The following individuals, by virtue of their education, experience and professional association, are considered QP as defined in the NI 43-101 standard for this report and are members in good standing of appropriate professional institutions. The QPs are responsible for specific sections as follows:

Table 2-1: List of Qualifications and Responsibilities

Qualified Person	Company	Report Sections Responsibility
Ali Sheykholeslami, P.Eng.	JDS Energy & Mining	1, 2, 3, 4, 5, 19, 20, 22, 23, 24, 26, 27, 28, 29
Richard Boehnke, P.Eng.	JDS Energy & Mining	18 (except 18.2.8, 18.3 and 18.4), 21 (except 21.9), 25.1
Tysen Hantelmann, P.Eng.	JDS Energy & Mining	15, 16
Mark Erickson, P.E.	Samuel Engineering	13, 17.5
Kelly McLeod, P.Eng.	JDS Energy & Mining	17 (except 17.4.7, 17.5)
Richard Kiel, P.E.	Golder Associate Inc.	17.4.7, 18.2.8, 18.3, 18.4, 20.5.3, 20.5.4, 21.9
G. David Keller, P.Geo.	WGM Ltd.	6, 7, 8, 9, 10, 11, 12, 14
J. Larry Breckenridge, P.E.	Global Resource Eng. Ltd.	25.2

*Indicates responsibility for portions of that section.
Source: JDS (2019)

2.3 Site Visit

Ali Sheykholeslami – JDS Project Manager visited the property 3 to 12 December 2018.

G. David Keller – Principal Geologist of WGM visited the property 12 to 14 December, 2012 and 28 November to 3 December 2016.

J. Larry Breckenridge - Principal Environmental Engineer of GRE visited the property in November 2016.

Richard E. Kiel – Principal Geological Engineer of Golder visited the property in June / September / October 2011, in July / November 2012, in April / August 2013, in March 2014, and in March 2017.

Kelly McLeod, Richard Boehnke, Tysen Hantelmann and Mark Erickson did not visit the project site and relied on the other QPs for their information.

Other consultants that have visited the site in support of this technical report include:

- Kevin Mather, JDS President visited the property 3 to 12 December 2018; and
- Elizabeth Kidner, Golder – July 2015.

2.4 Units, Currency and Rounding

Every effort has been made to clearly display the appropriate units being used throughout this technical report. Unless otherwise specified or noted, the units used in this technical report are metric. Currency is in US dollars (US$ or $) unless otherwise stated.

This report includes technical information that required subsequent calculations to derive subtotals, totals and weighted averages. Such calculations inherently involve a degree of rounding and consequently introduce a margin of error. Where these occur, the QPs do not consider them to be material.

2.5 Sources of Information

The sources of information include data and reports supplied by Lydian personnel along with Lydian's consultants as well as documents cited throughout the report and referenced in Section 28. In particular, background project information was taken directly from the most recent technical report entitled *NI 43-101 Technical Report Amulsar Updated Resource and Reserves Armenia* prepared by Samuel Engineering, with an effective date of 27 March 2017.

3 Reliance on Other Experts

This report has been prepared by JDS Energy and Mining Inc. (JDS) for Lydian Armenia. The information, conclusions, opinions, and estimates contained herein are based on:

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

The QPs used their experience to determine if the information from previous reports was suitable for inclusion in this technical report and adjusted information that required amending. The QPs have taken reasonable measures to confirm information provided by others and take responsibility for the information.

This report is directed solely for the development and presentation of data with recommendations to allow Lydian Armenia to reach informed decisions. As such, this report is intended to be read as a whole, and sections should not be read or relied upon out of context. This report is based on the professional opinions of the contributors to this report and other consultants, based on information available at the time of preparation. The quality of the information, conclusions and estimates contained herein are consistent with the intended level of accuracy as set out in this report, as well as the circumstances and constraints under which the report was prepared, which are also set out herein.

3.1 Ownership

JDS has relied on ownership information provided by Lydian Armenia. JDS has not researched property title or mineral rights for the Amulsar Project and expresses no opinion as to the ownership status of the property. Lydian Armenia has provided information regarding the land position and mining claims covering the Project.

A land title opinion was provided by Fidelity Legal & Partner LLC, Lydian's in-country legal firm, dated 23 August 2015: "We hereby confirm that the above described permits are valid, duly exist, and held free and clear 100% by 'GEOTEAM' CJSC. That the current owner of Company received no inquires demands or notices in relation to statements and reports, inspections and warnings of the regulatory bodies."

3.2 Environmental and Permitting

The Environmental, Permitting, and Social or Community Impact Section has been updated by Lydian Armenia. Rodney Stuparyk P. Eng. reviewed this section and assumes responsibility for its content.

3.3 Taxes and Royalties

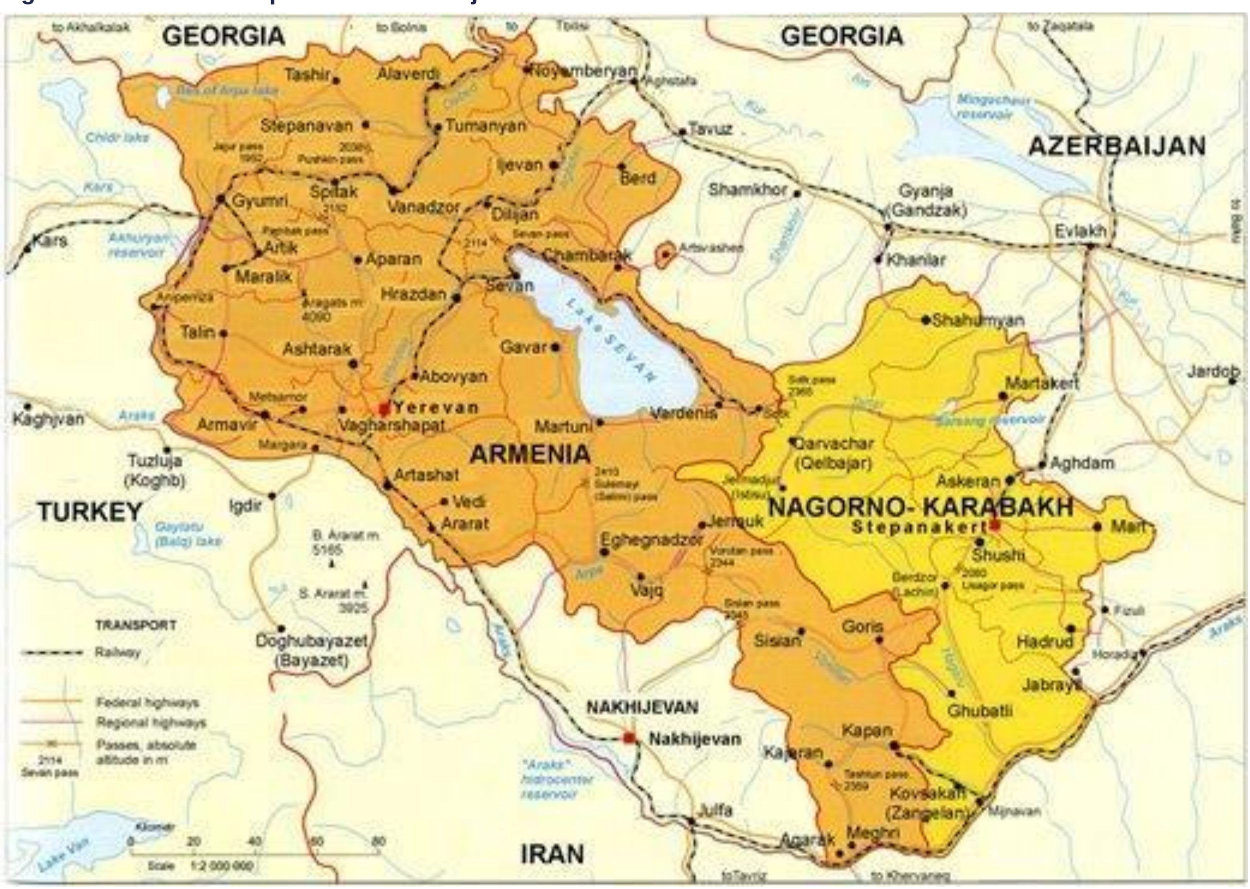
With regards to Armenian taxes and royalties, Lydian International provided the basis for these calculations within the economic analysis. Bill Dean, Chief Financial Officer for Lydian International reviewed this information and assumes responsibility for its content.

4 Property Description and Location

4.1 Location

The Amulsar Project is located in south-central Armenia roughly 115 km in a direct line to the southeast of the capital Yerevan or a 170 km drive by paved road (Figure 4-1). Armenia is a democratic republic that gained independence from the former Soviet Union in 1991. It is located in the mountainous Caucasus region straddling Asia and Europe and has a population of approximately three million. Yerevan is the capital and largest city of Armenia and one of the world's oldest continuously inhabited cities. Situated along the Hrazdan River, Yerevan is the administrative, cultural, and industrial center of the country and has a population of just over one million. Yerevan's Zvartnots International Airport is the closest international airport and will be the main airport utilized for air travel.

Figure 4-1: Location Map for Amulsar Project



Source: Samuel Engineering (2017)

The Project straddles two administrative provinces, Vayots Dzor Marz (capital is Yeghegnadzor) and Syunik Marz (capital is Kapan). The closest town to the Project is Jermuk, which is situated approximately 11 km from the Project's infrastructure. There are four rural communities in proximity to the Project, namely:

Jermuk (consolidated communities Gndevaz, Jermuk, Her-Her, Karmrashen), Zaritap (consolidated Saravan, Zaritap, Martiros, Gneshik, Gomk, Khndzorut, communities) all located within Vayots Dzor Marz, and Gorayk (consolidated communities of Tskhuk, Spandaryan, Gorayq, Sarnakunq), which is located in Syunik Marz. Gndevaz is the community closest to the footprint of the Project's process infrastructure, which is the HLF area approximately 1 km south of the village boundary.

4.2 Property Description

The Amulsar Mining Right covers an approximate area of 4,000 hectares (ha). The Project area is largely open in landscape with no areas of woodland and is characterized by a temperate climate. Higher altitudes have long cold winters and short cool summers. The typical landscape at the Project area is shown in Figure 4-2 below.

Figure 4-2: Typical Landscape at the Project

Source: Samuel Engineering (2017)

The Amulsar gold deposit is located on the ridge peaks in the region of Amulsar Mountain, within the Northern Zangezur mountain chain at an altitude of between 2,500 and 2,988 meters above sea level (masl). The wider area is characterized by mountains, undulating hills, river valleys and gently inclined plateaus at lower elevations. The mountain meadow landscape supports grasslands used for summer grazing. At lower elevations, agricultural use is more diverse, and a range of crops is grown in the area.

Surface water run-off from the slopes of the Project area contributes to the catchments of the Arpa, Darb and Vorotan Rivers. The Vorotan River flows to the east of the Project and the Darb River flows to the south of the Project area and joins the Arpa River flowing west.

Access to the Project is off the M-2 Magisterial road, via the H-42 Republic road, which is the main road to Jermuk.

The partial construction of the project has altered the rural nature of the property in directly affected areas. The valleys which house for the BRSF and HLF have been cleared of topsoil, which has been stockpiled for future use, and the placement of the mineral liners advanced (Figure 4-3). Access and haul roads have been partially constructed as have platforms for the ROM pad, crusher, overland conveyor and load out area, equipment maintenance area and the HLF, process plant and associated ponds. Construction of the crusher facility (Figure 4-4) overland conveyor and electricity distribution network (Figure 4-5), and process plant (Figure 4-6) is also well advanced.

Figure 4-3: Construction at HLF, ADR Platform and Process Ponds

Source: Lydian (2019)

Figure 4-4: Construction at PL12 (Crusher)

Source: Lydian (2019)

Figure 4-5: Construction of Overland Conveyer and Power Distribution

Source: Lydian (2019)

Figure 4-6: Construction of ADR Plant and Associated Facilities

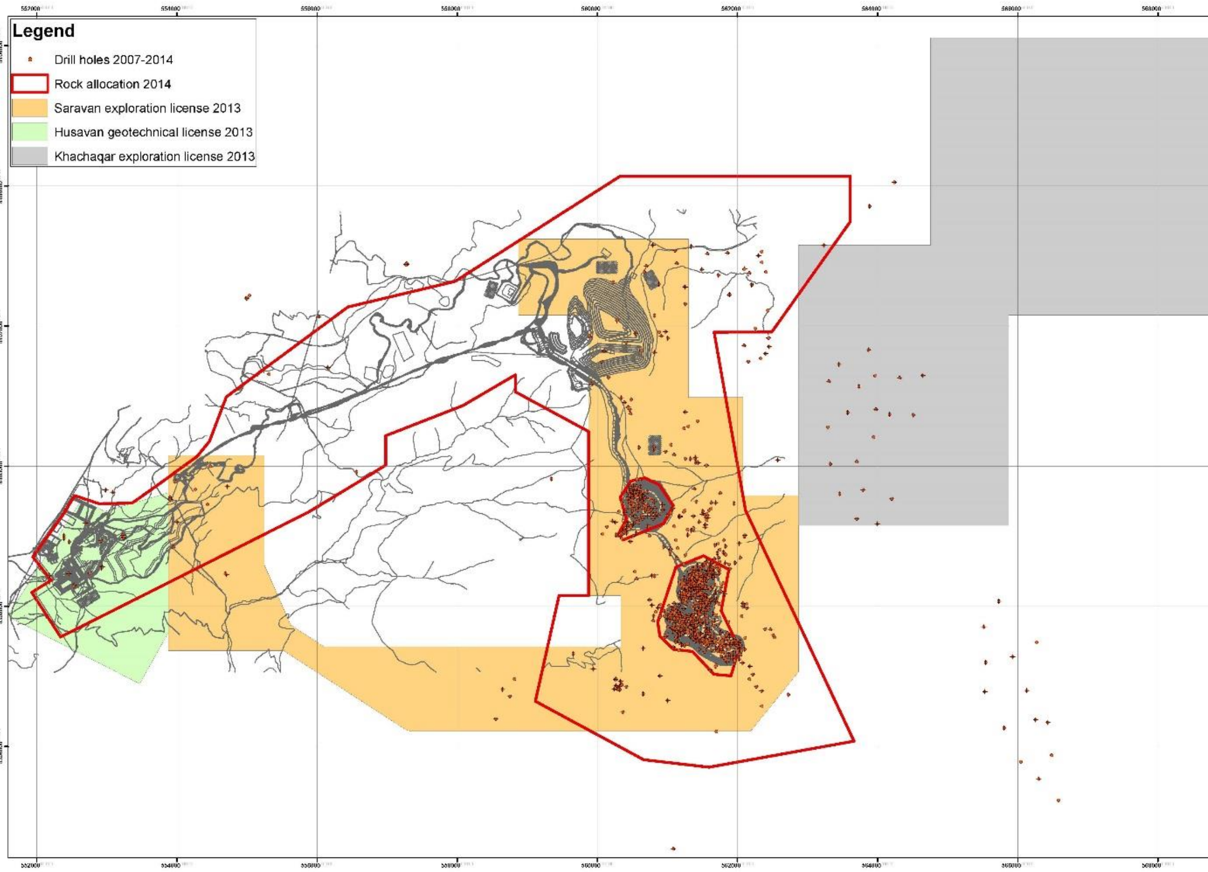
Source: Lydian (2019)

4.3 Ownership

Lydian Armenia owns 100% of the Amulsar Project and holds all of the titles, rights, benefits and obligations for Amulsar Gold Project., which holds the current site under related prospecting and mining licenses, discussed below in Section 4.8.

Figure 4-7 below shows the license area and the Rock Allocation Area (RAA) boundary for the Project.

Figure 4-7: Amulsar License Area and Rock Allocation Boundary



Source: Samuel Engineering (2017)

4.4 Exceptions to the Title Opinion

There are no exceptions, inquires, demands or notices in relation to statements and reports, inspections and warnings of the regulatory bodies.

4.5 Armenia Royalty and Taxes

The current fiscal regime in Armenia for mining operations, enacted in early 2012, consists of royalties and income taxes, as follows:

1. The royalty is calculated as:
    a. The mine revenue multiplied by the royalty interest rate. The royalty interest rate calculation is the following:

       R = 4 + (P / (S x 8)) x 100, where

       R – royalty interest percentage rate.

P – profit (in AMD) before taxation; i.e., revenue less any deductions allowed by the Armenian Law "On Profit Tax" (except financial costs and tax losses for the previous years).

S – revenue from the sale of products net of VAT.

Royalty payers are Armenian or foreign legal and natural persons who work metallic deposits or produce metal concentrate in the Republic of Armenia.

The royalty is calculated for every accounting reference period on the basis of the revenue and the royalty interest rate referred to above and the reporting period is the calendar year.

2. A general corporate income tax which is levied at 20% of taxable profits (after deductions for expenses, the preceding royalty, and allowable depreciation).

4.6 Newmont Joint Venture Agreement

On 23 April 2010, Lydian purchased from Newmont Mining Corporation all of Newmont's interest in the former joint venture between Lydian and Newmont known as the Caucasus Venture, including all of Newmont's interest in the Amulsar gold property in Armenia. The consideration was a mixture of committed and contingent payments. The committed payments included the issuance by Lydian of three million ordinary shares to Newmont on the closing of the transaction, and three payments of $5 M of which the first was paid in 2010, the second was due on 31 December 2011 and paid on 13 March 2012, together with interest owing thereon. The third and final payment was made 25 October 2013.

In addition, Lydian agreed to pay Newmont, following the start of commercial production at the Amulsar Project, at 3% NSR. However, as provided for in the purchase agreement, on 9 April 2018 Lydian exercised its option to terminate the 3% NSR, and in lieu thereof, elected the quarterly payment option to pay Newmont the aggregate sum of $20 M, without interest, in 20 equal quarterly installments of $1 M each, commencing on the first day of the third calendar month following the start of commercial production. On 3 July 2018, Maverix Metals Inc. acquired the NSR and quarterly installments from Newmont. Furthermore, Lydian has a one-time option, prior to the commencement of commercial production, to prepay these quarterly installments in a single cash payment, using an annual discount rate of 10%. This equates to a single payment of approximately $15.6 M upon commencement of operations.

4.7 Existing Environmental Liabilities

Since construction of the project is well advanced there are now closure and rehabilitation liabilities, as described in Sections 20 and 21.9. These are mostly related to the establishment of a vegetative cover on exposed area and the demolition and removal of steelworks. The mine camp will also need to be removed and the area rehabilitated. Lydian has paid into the closure and rehabilitation fund for the project in accordance with the requirements of Armenian legislation and estimates that there are sufficient funds set aside for the necessary works.

There are two known existing environmental liabilities in the Amulsar Project area, related to mining exploration in the 1950s. At Site 13, there is an exploration adit portal that discharges ARD and a waste pile that produces ARD leachate. There is a similar collapsed portal at Site 27 as well as two waste piles that create ARD. The Project will mitigate the Site 27 waste pile with the creation of the BRSF. However, the Site 13 waste falls outside of the mine's zone of impact.

Figure 4-8: Existing Environmental Liabilities

Source: Samuel Engineering (2017)

It is also critical to note there is naturally-occurring ARD in the Project area resulting from the oxidation of the sulfide-rich Lower Volcanics (LV) formation (see Section 7.2.1) that has nothing to do with operations. As a result, many natural seeps and springs in the Project area do not meet Armenian water discharge standards.

4.8 Permitting

Lydian is required to operate under normal environmental regulations, as set out by the relevant Armenian authorities, as well as mining and water legislation (including the law regarding Lake Sevan and respective government resolutions and decrees). Lydian has undertaken full permitting of the entire Project as it is described herein and regulated by the Armenian Mining Code. With the exception of the water abstraction permit, detailed in Section 20.3.1, all the necessary permits to undertake exploration and mining at Amulsar have been obtained.

4.8.1 Mining Rights

The mining sector in Armenia is regulated by the Mining Code, which was adopted in January 2012. The key permit is the Mining Right, which triggers the process for obtaining other permits required for the operations phase. Under the Mining Code, Lydian was required to submit to the Ministry of Energy and Natural Resources (MENR) a Mining Permit application 754 consisting of four main separate documents:

1. Mining Plan;
2. EIA;
3. Technical Safety Program (TSP); and
4. Mine Closure Plan.

Once a positive resolution from the ministries reviewing the application documents is issued, Lydian then prepares a Mining Agreement and an application for the Rock Allocation Area (RAA). When the Mining Agreement is signed with MENR and the RAA is approved, Lydian can then receive the formal Mining Right.

- In May 2009 a Mining License (Right) (No. SHATV-29/245) was granted by MENR which covers the Tigranes area;
- In September 2012 the Mining Right was updated by the MENR to cover the Tigranes and Artavasdes areas;
- In November 2014 the Mining Right was again updated by the MENR to cover the Tigranes and Artavasdes as one combined pit and Erato as a separate pit. In addition to ore extraction, the Mining Rights cover the entire ore processing circuit (crushing, conveyor, heap leaching and ADR). The Mining Right is valid until 1 January 2034; and
- In May 2016, the Mining Right was amended by the MENR to reflect changes resulting from Lydian's NI 43-101 Technical Report dated 20 November 2015, "Amulsar Value Engineering and Optimization Armenia". The Mining Right, as amended, is valid until 1 January 2034.

In June 2019, the mining authority in Armenia was transferred under the Ministry of Territorial Administration and Infrastructure (MTAI). Lydian received an extension of the construction permit under the Mining Right on 11 July 2019 which made the construction period valid from 1 July 2019 through 31 December 2020.

Reports to MTAI are submitted on an annual basis and are focused totally on the activities carried out per the work plan attached to the license or permits and a section on the environment.

Reports to ME are submitted on a quarterly basis with one annual summary. These are related to the environmental payments, e.g. water consumed, air emissions, etc. After every approval from the regional environmental inspectorate based in Vayots Dzor Marz, Lydian Armenia then makes payments.

4.8.2 Additional Permits

For the continued development of the mine, additional permits and licenses are required, as outlined in Table 20-1.

A total of 72 design and construction approvals have been received from the Jermuk Municipality for construction work packages during the project. 20 have expired or will expire in the next three months and will need to be extended prior to recommencing construction or commissioning of the facilities. A consolidation and rationalization of all the construction permitting documentation was also undertaken in April 2019 and determined that nine constructions permit applications for PL-12, PL-3 and PL-2 need to be drafted and submitted for approval. The expertise for the nine applications was completed in early June and the permits have been submitted for approval to the Jermuk Municipality, along with the along with the 20 which have expired. Lydian Armenia has been informed by the municipality that once the roads were open and the project was given the restart, these would be approved.

4.9 Mine Closure Requirements

There are several resolutions and regulations on "mine closure":

1. Decree of the Ministry of Energy and Natural Resources N 249-N dated on 30 December 2011 on "Requirements for prior environmental impact assessment, environmental impact assessment and

mine closure plan enclosed to the application for mining rights". Annex 3 of this Decree provides the requirements for the preparation of mine closure plans;

2. Government Resolution N 1079-N dated on 23 August 2012 on "The procedure of using the Nature and Environment preservation fund and calculating the amounts of allocations, as well as the composition of the professional committee";
3. Decree of the Ministry of Nature Protection N 365-N dated on 24 December 2012 on "The procedure of cost estimation and indexing of reclamation works". This Decree regulates the estimation of closure costs and indexing of reclamation activities by mining companies; and
4. Decree 22-N implemented on 10 January 2013, provides specific requirements for the procedures and estimation of costs required for monitoring of the mine operations during the active operating, closure, and post-closure periods inclusive of the communities affected to ensure the safety and health of the population.

4.10 Other Property Constraints

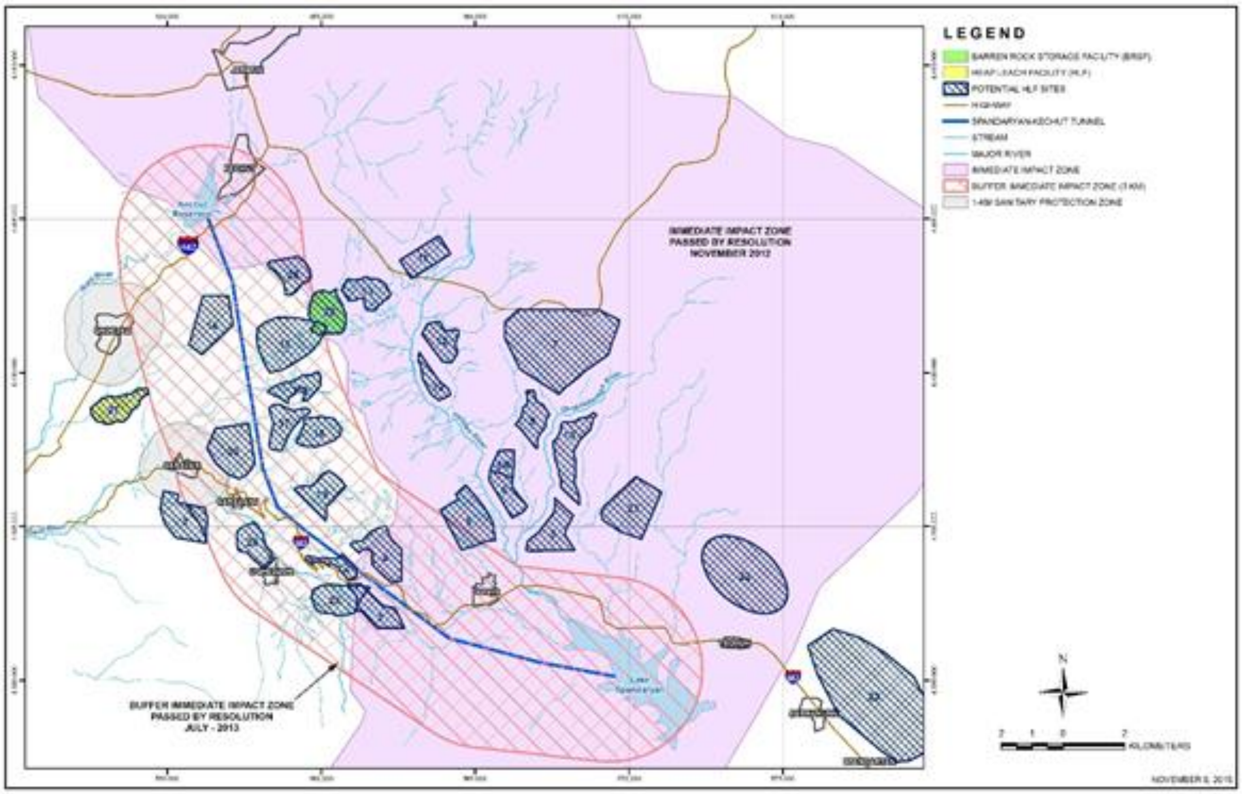
Lake Sevan is located some 52 km north-north-west from the Project and is categorized as an 'ecosystem of strategic importance' and has specific regulations, including the Lake Sevan Law (LS Law), governing its protection. The catchment basin of Lake Sevan as defined by Sevan Law states: The territory where all surface and ground waters flow into Lake Sevan is known to be Sevan Lake Water Catchment which is divided into three ecological zones: i) the Central Zone, ii) the Immediate Impact Zone; and iii) the Non-Immediate Impact Zone.

The Vorotan, Darb and Arpa rivers, located near the Project, are tributaries of the River Araks, which forms the border between Armenia and Iran and flows south-east to the Caspian Sea. These rivers are therefore not part of the natural Lake Sevan catchment. However, an operational tunnel links the Arpa River at Kechut Reservoir to Lake Sevan to compensate for declining water levels in the latter. To further boost water inflows to Lake Sevan, a supplementary 22 km-long tunnel was constructed between the Spandaryan Reservoir and the Kechut Reservoir. That tunnel has never been commissioned or used to divert Vorotan flows and, as such, the Vorotan River currently remains isolated from the Lake Sevan catchment.

In 2013 the Government of RA passed the Resolution 749-N to modify the zoning of Lake Sevan. The new resolution states that: the immediate impact zone includes the catchment basin outside the borders of the central zone to the watershed, where any activity directly or indirectly impacts the hydrophysical, hydrochemical, hydrobiological, sanitary/toxicological, sanitary and other qualitative and quantitative indicators of Lake Sevan and the rivers flowing into the Lake. The area immediately near the Lake, the territories of the catchment basins of the Arpa River (to the Kechut Reservoir), and the Vorotan River, the 3000-meter buffer zone on each side of the axis of the Spandadaryan-Kechut Tunnel, as well as the Kechut and Spandaryan reservoirs all form part of the immediate impact zone, where the placement of processing facilities and the use of hazardous chemicals, in particular cyanide, are prohibited.

There is also a requirement to have 1 km buffer zones (Sanitary Protection Zone or SPZ) around all villages that excludes all Project infrastructures, as shown below in Figure 4-9.

Figure 4-9: Buffer Zones



Source: Samuel Engineering (2017)

4.11 Encumbrances and Liens

The following material instruments encumber the titles, rights and interests of the Amulsar Gold Project owned or controlled by Lydian Armenia. For additional details, refer to other public disclosure of Lydian on SEDAR at www.sedar.com.

4.11.1 Orion / RCF Stream Agreement

On 30 November 2015, Lydian Armenia, Lydian, Orion CO IV Limited, and Resource Capital Fund VI L.P. (Purchasers) entered into a purchase and sale agreement, as amended, (Stream Agreement) pursuant to which Lydian Armenia is obligated to sell to the Purchasers 6.75% of the refined gold and 100% of the refined silver produced from the Amulsar Project. In July 2017, Orion sold its position in the Stream Agreement to Osisko Bermuda Limited.

The Stream Agreement will apply to the Amulsar Project until the earlier of (i) the date that 142,454 ounces of refined gold (Aggregate Gold Quantity) and 694,549 ounces of refined silver (Aggregate Silver Quantity) have been delivered, and (ii) 40 years. When the Aggregate Gold Quantity and Aggregate Silver Quantity have been delivered, the Stream Agreement will cease to apply to the Amulsar Project. Lydian Armenia has certain options, upon making additional payments to the Purchasers, to reduce the Aggregate Gold Quantity and Aggregate Silver Quantity by 50%.

Under the terms of the Stream Agreement, the Purchasers made up-front payments to Lydian Armenia totaling $60 M. Such payments represent prepayment of a portion of the purchase price payable for the Designated Gold Quantity and Designated Silver Quantity. The Purchasers shall, in addition to the up-front prepayments, pay to Lydian Armenia the lesser of the then-current market prices or US$400 per ounce of refined gold and US$4.00 per ounce of refined silver, subject to an increase of 1% per annum beginning three years after the commercial production date.

Security for performance of the obligations under the Stream Agreement include, among other things: guarantees of Lydian and its subsidiaries, share pledges, and a mortgage over the assets and rights of Lydian Armenia, including the Amulsar Gold Project. This security is identical to security for the Orion/RCF Credit Agreement (see Section 4.11.2 below) and will rank on an equal footing with the security for the Orion/RCF Credit Agreement.

4.11.2 Orion / RCF / Osisko Credit Agreement

On 30 November 2015, Lydian Armenia, Lydian, Orion, and RCF entered into a credit agreement, as amended (Credit Agreement). Under the terms of the Credit Agreement, Orion and RCF will make available a term loan in an amount up to $160 M and a cost overrun facility in an amount up to $14 M. In January of 2018 Lydian Armenia, Lydian, Orion, RCF, and Osisko entered in to a thirteen Amending agreement where all unfunded Commitments under the Term Facility were cancelled and replaced with the Commitments of the Term Facility B Lenders. In addition, all unfunded Commitments under the Cost Overrun Facility were cancelled and the applicable Lenders had no further obligation to make any Advance under the Term Facility or the Cost Overrun Facility. The term Facility and Cost Overrun facility were replaced by a Facility B which is intended to fund the company during the illegal blockade.

Lydian Armenia, Lydian, Orion, RCF, and Osisko agreed that all terms under the Credit Agreement are applicable to a Term Facility B Loan. For purposes of funding Advances under the Term Facility B, the parties agreed the Applicable Percentages would be: 48.08% in respect of Orion; 34.37% in respect of Osisko; and 17.55% in respect of RCF.

Security for the Credit Agreement is identical to security for the Orion/RCF Stream Agreement (see section 4.11.2 below), and will rank on an equal footing with the security for the Orion/RCF Credit Agreement.

4.11.3 Osisko / RCF Offtake Agreement

In connection with the Stream Agreement and Credit Agreement, gold production from Amulsar is also subject to an offtake agreement with Orion and RCF (Offtake Agreement). In July 2017, Orion sold its position in the Offtake Agreement to Osisko Bermuda Limited. The Offtake Agreement applies to 100% of gold production up to 2,110,425 refined ounces, less the 142,454 gold ounces deliverable under the Stream Agreement. Orion and RCF will pay for refined gold based on prevailing market prices during a six-day quotational period, subject to reduction if certain conditions are met, following each delivery.

4.11.4 Ameriabank Term Facility

On 17 November 2016, Lydian Armenia entered into a $24 M secured credit facility (“Ameriabank Term Facility”) with Ameriabank. Proceeds of the Ameriabank Term Facility were used for equipment purchases. The principle security consists of specific Amulsar equipment financed by Ameriabank.

4.11.5 Cat Finance Term Facility

On 22 December 2016, Lydian Armenia entered into a secured credit facility with Cat Financial for a maximum principal amount of $42 M ("Cat Term Facility"). Proceeds of the Cat Term Facility were used to purchase Cat® mobile mining equipment for Amulsar. Principal security consists of specific equipment financed by Cat Financial.

4.11.6 ING Term Facility

On 8 February 2017, Lydian Armenia entered into a secured credit facility with ING Bank for a maximum principal amount of up to $50 M ("ING Term Facility"). Proceeds of the ING Term Facility were used to purchase crushing, conveying and electrical equipment. Principal security consists of specific equipment financed by ING Bank and a guarantee covering 85% of principal and interest under the ING Term Facility has been issued by the Swedish Export Credits Guarantee Board.

4.12 Property Risks

Illegal Blockades - Following a change in the Government of Armenia in May 2018, demonstrations and road blockades occurred sporadically throughout the country. These initial protests primarily targeted the mining sector, including the Amulsar Gold Project. Despite court rulings in favor of the Company, a continuous illegal blockade at Amulsar has been in place since 22 June 2018, causing construction activities to be suspended since this date. The Company has been dislocated from the Amulsar site and access has been limited to contractor demobilization and winterization during the fourth quarter of 2018 and one day of limited, Police escorted access in the second quarter of 2019.

Financing - The Government of Armenia has not enforced the rule of law to remove the illegal blockades at Amulsar and prosecute other illegal acts carried out against the Company. Furthermore, the Government of Armenia has taken certain actions and failed to act on other matters. The Government of Armenia's actions and inactions have substantially restricted the Company's access to capital and caused conditions to occur that were deemed events of default by the senior lenders, stream financing providers, and equipment financiers mentioned above. As a result, the Company entered into several agreements with its senior lenders, stream financing providers, and equipment financiers which included a "Forbearance Agreement, deferring principal and interest payments. Under this agreement Lydian is required to follow a strict budget prescribed in an itemized schedule which focuses on implementing a conservation plan and strategy anchored in asset stewardship, value preservation and site recovery, and implementing a strategic transaction. At the time of publication of the 43-101 report, the Company was making a request to extend the current Second A&R Forbearance Agreement and funding under the Fourteenth Amending Agreement until 31 December 2019.

Third Audit – In March 2019, the Government of Armenia commenced its third-party assessment of the Amulsar Gold Project's environmental impact on water resources, geology, biodiversity and water quality. The scope of work also includes a review of the Company's ESIA and EIA. This happened despite that the Company's EIA was previously approved by the Armenian Government in accordance with Armenian law before the Company began constructing the Amulsar Gold Project. Earth Link and Advanced Resources Development (ELARD) was selected by the Armenian Government as the professional firm to perform the assessment. This is the third audit on environmental matters that the Company has been obliged to participate in.

The Government of Armenia was provided the final conclusions from the ELARD audit on 7 August 2019 and during a televised cabinet meeting chaired by the Prime Minister of Armenia, it was announced that the Company had answered all questions and issues raised during the audit, the exchange of information during the audit was exhaustive, and there is no likelihood of any need for additional time or clarifications for the audit to come to a final conclusion. The Company provided over 300 documents composed of over 20,000 pages of information and participated in extensive technical discussions during the audit over the past four months. It was also announced that the Government of Armenia expected to conclude on the matter the following week. Over the course of several meetings and discussions between the Government and the Company in September 2019, the Armenian PM said:

1. Lydian has affirmed its commitment at the highest level to meet EIA performance standards and there was to be no impact on air, water, soil, flora, fauna, etc. beyond standards;
2. Participatory monitoring would be implemented while the GOA ramps up its own monitoring capability and would continue afterward - including during the construction phase;
3. The GOA has monitoring and rapid response intervention rights under the relevant legislation and could act if needed;
4. Deviations from EIA performance standards must be cured within times allowed by statute or the GOA can strip away rights; and
5. The dispute between ELARD and Lydia experts on the baseline data and any changes requiring another EIA can be dealt with by the PM exercising his prerogative, either formally or informally.

At the time of the publication of this 43-101 report Lydian Armenia heard informally that there would not be a formal assessment requirement to address the dispute over base line data/design changes from what was approved under the EIA, but there could be an inspection to ensure compliance to date. Lydian continues to seek a line of sight on how and when the initial ‘inspection’ is intended to proceed but are still anticipating open gates to be established shortly.

Technical Water Supply - A letter from the Armenian Ministry of Environment was received on 28 June informing Lydian that the application for approval to extract water from the Arpa River, using the Gndevas Irrigation Pipeline had been declined. The use of water from the Arpa River was included in the Project EIA/ESIA and had been the subject of a prior contract with the Yeghegnadzor Water Users Association (WUA). Lydian was informed by the WUA that the contract was cancelled in November 2018 at the instruction of the Ministry of Energy and Natural Resources (now Ministry of Territorial Administration and Infrastructure) citing that this water is designated for irrigation/agricultural purposes and not for industrial use.

Lydian Armenia has initiated an appeal process under Armenian legislation for the Arpa River application with a notification letter sent to the Ministry of Environment on 1 August 2019. Along with the appeal process, Lydian Armenia submitted a water-use application permit on 4 July for water from the Darb River located on the southern side of the project in line with its’ prior contingency planning and included in the initial capital cost developed for this 43-101 report. The Ministry of Environment deadline for a response to the Company’s application is 3 September as posted on their website and this has been returned by the Ministry for further clarification on abstraction rates and location. Clarification has been provided by Lydian Armenia and approval is expected mid-October 2019.

5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

5.1 Accessibility and Physiography

The Amulsar Mining Right covers an approximate area of 4,000 ha, located in south-central Armenia about 115 km in a direct line to the southeast of the capital Yerevan, or a 170 km drive by paved road. The property straddles the boundary between the Vayots-Dzor and Syunik Marz provinces, and incorporates part of the country's main highway running southeast from Yerevan to Iran.

The Amulsar property comprises mountainous terrain with the prominent feature of an approximately 7 km-long northwest-southeast trending ridge that reaches a maximum elevation of 2,988 m. The Project mineable resources are located within three peaks (Erato, Tigranes and Artavasdes) on this ridge, which runs generally parallel to the Vorotan River. A natural gas pipeline passes near the eastern portion of the property in the Vorotan River valley. Vegetation across the property is generally limited to wild grasses and isolated scrub.

The planned Amulsar Project site layout is shown on Figure 18-1.

Siting studies and alternatives assessments completed to-date were prepared to meet the performance standards and requirements of the International Finance Corporation (IFC), EBRD, local stakeholders, and Resolution 749-N. A total of 28 sites were evaluated from 2008 through 2013 with input provided by a multi-disciplinary team of specialists on Lake Sevan protection as well as additional input from other stakeholders, resulting in the final selection of Site 27 as the preferred location for the BRSF and Site 28 as the preferred location for the HLF.

Site 28, where the HLF is being constructed, is situated in a tributary within the Arpa River catchment below the Kechut reservoir, approximately 7 km west of the mine pit area and 1 km south of Gndevaz village. The HLF is outside the designated 3 km buffer zone on either side of the Spandaryan-Kechut tunnel, and the HLF northern limit is just south of the Gndevaz Village 1 km buffer zone limit. Current vehicular access to Site 28 is mainly via an unpaved road extending east from highway H42 to Gndevaz and Jermuk. The site is also accessible from the east via an unpaved road running between Gndevaz and Saravan villages. Portions of Site 28, mainly the gently sloping land at lower elevations, are currently used for agriculture. Networks of unpaved access roads and irrigation pipes exist within the site.

Site 27, where the BRSF is being constructed, is in a valley approximately 2 km north of the Erato mine pit area. Site 27 lies within the Kechut reservoir watershed zone, and the westernmost portion of the site is within the designated 3 km buffer zone on the east side of the Spandaryan-Kechut tunnel. Current vehicular access to Site 27 is mainly via the unpaved access road to the Amulsar property, which extends southeast from the main road connecting the country's main highway to Jermuk. The existing exploration camp is along this access road and is situated adjacent to Site 27 to the southeast.

Portions of Site 27, mainly the gently sloping land at lower elevations within the south portion, are currently used for agriculture (growing hay) and livestock grazing. Several access roads were constructed at Site 27 as part of the previous site investigation programs, with these roads reclaimed during the summer of 2013.

5.1.1 Airport

Yerevan's Zvartnots International Airport is the closest international airport and will be the main airport utilized for air travel.

5.1.2 Port

Ocean shipments are received in Poti Seaport, in the neighboring country of Georgia, and then transported on trucks over highways to Yerevan, and then to site. Shipments can also be received from Russia, or Russian ports, and transported to site by truck.

5.2 Climate

Armenia exhibits a climate that is dry and continental due to the influence of the high mountain ranges. The ranges of the Lesser Caucasus Mountains prevent humid air masses from reaching the inner regions of Armenia. Regional climatic variations are considerable. Except in high altitude areas, summers are long and hot, and winters are generally temperate, although invasions of Arctic air do occur occasionally causing the temperatures to drop sharply. Snow falls on the higher elevations during the winter months and can remain from early November through late March. Data from the State Meteorological Station at Vorotan Pass (Vorotan Pass weather station) located near the Amulsar Project property indicates maximum and minimum air temperatures of 34.2°C and –27.6°C, respectively, and an average relative humidity of 76.0%.

5.2.1 Climate Data

Golder Associates Inc. (Golder) prepared the analysis of climate data for the Amulsar Gold Project for use in future water balance analysis and design criteria for the Project. The climate data analysis uses raw data provided for the Jermuk and Vorotan Climate Stations, both of which are near the Project as shown on Figure 5-1 and Table 5-1.

Climate data analysis previously conducted and documented includes the following:

- Processed Climate Data Summaries memo from Samuel Engineering dated 14 June 2016;
- Environmental and Social Impact Assessment (ESIA) submitted in February 2015 – Chapter 4.2 and 6.10; and
- Climate Data Analysis Calculation Memo from Golder Associates dated 25 June 2012

The climate analysis summarized is based on climate data from the Jermuk and Vorotan Climate Stations provided by Lydian Armenia on 9 June 2016 with data current up to 31 December 2015. Table 5-2 provides elevations and distances from key mine components to the climate stations.

For the updates on the water balance and design criteria, climate data recorded for 2016 and 2017 by the Lydian Armenia was consulted. When comparing the historical data with the 2016 and 2017 data collected by Lydian Armenia, no anomalies or discrepancies were noted.

As the most recent climate data which received from Lydian stations in 2019 are not officially registered, they have not been consulted in the report. However they have been compared with historical data.

Table 5-1: Climate Station Locations and Elevations

Climate Station	Elevation (m asl)	Latitude	Longitude
Vorotan	2,392	39° 41’ 22.8” N	45° 43’ 21.8” E
Jermuk	2,066	39° 49’ 27.6” N	45° 40’ 31.6” E

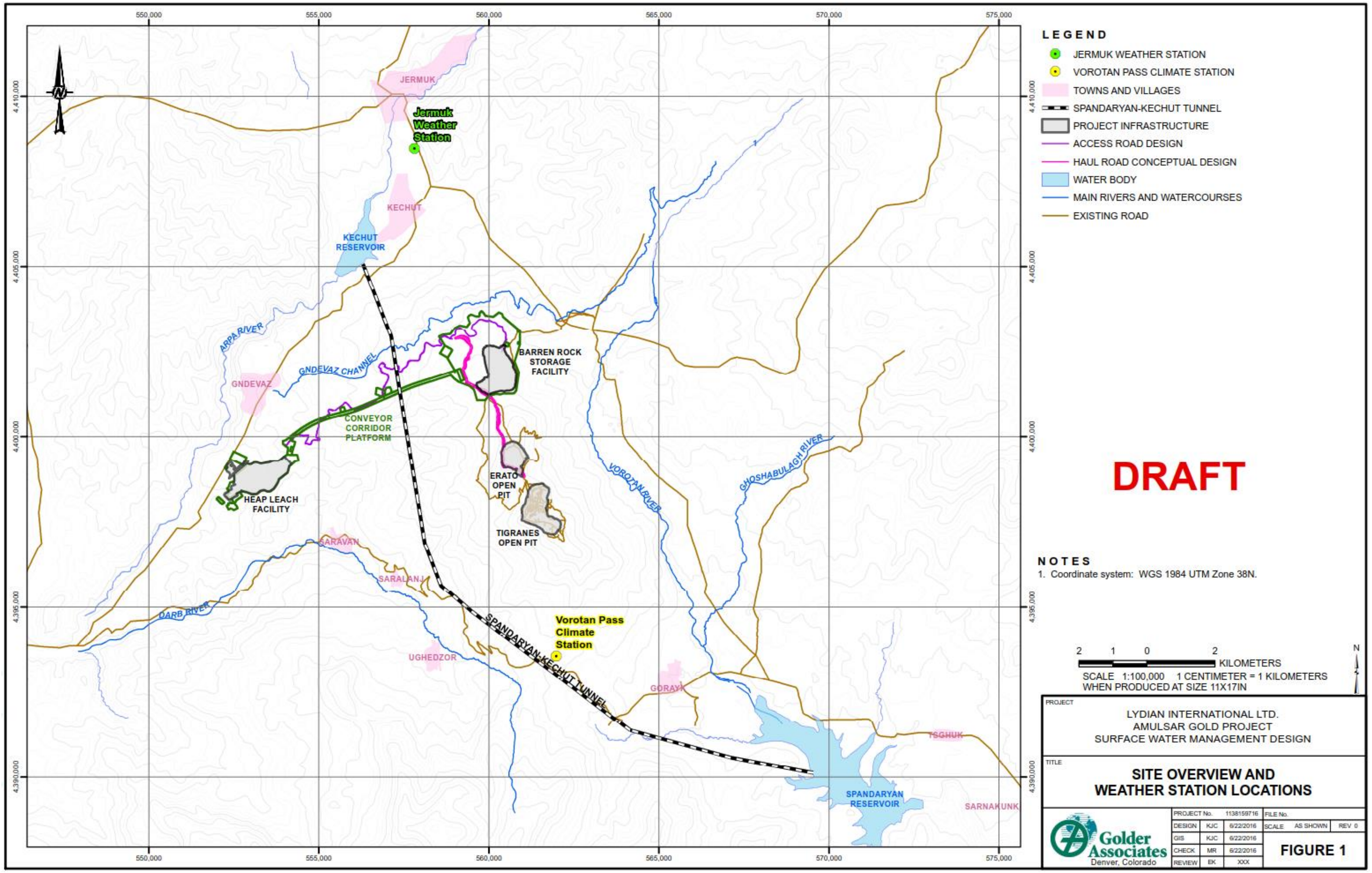
Source: Golder Associates (2019)

Table 5-2: Mine Component Elevations and Distances from Climate Stations

Mine Component	Approximate Elevation (m asl)	Distance to Climate Station (km)	
		Vorotan	Jermuk
Mine Pit 1 – Erato (MP-1)	2,900	5.6	9.8
Mine Pit 2 – Tigranes (MP-2)	2,950	4.1	11.5
Barren Rock Storage Facility (BRSF-1)	2,625	7.5	6.5
Heap Leach Facility (HLF-1)	1,800	9.2	10.0

Source: Golder Associates (2019)

Figure 5-1: Site Overview and Weather Station Locations



Source: Golder Associates (2019)

5.2.1.1 Climate Stations

The Jermuk and Vorotan Climate station data includes the following:

- Precipitation (mm);
- Air Temperature (°C);
- Snow Depth (cm);
- Evaporation (mm);
- Relative Humidity (%);
- Wind Speed and Direction (m/s);
- Atmospheric Pressure (kPa);
- Sunshine (per hour); and
- Cloudiness.

The available information extends for most parameters from 1966 to 2015. Detailed breakdown of the available data is included in Table 5-3.

Table 5-3: Available Data at Vorotan and Jermuk Climate Stations

Parameter	Frequency of Measurements	Available Data Range	
		Voroton Station	Jermuk Station
Evaporation (mm)	Monthly[1]	1966-2015	1966-2015
Precipitation (mm)	Every 3 Hours	1966-2015 *Data Gaps in 1988 and 1995-99*	1966-2015 *Data Gaps in 1977, 1984-85, 1988, and 1990-91*
Air Temperature (°C)		1966-2015 *Data Gaps in 1995-99*	1966-2015 *Data Gaps in 1960-61, 1972, and 1977-83*
Relative Humidity (%)		1966-2015 *Data Gaps in 1995-99*	1966-2015 *Data Gaps in 1977 and 1991*
Wind Speed and Direction (m/s)		1966-2015 *Data Gaps in 1995-99 and 2015*	1966-2015 *Data Gaps in 1977 and 1991*
Atmospheric Pressure (kPa)		1966-2015 *Data Gaps in 1995-99*	1966-2015 *Data Gaps in 1977 and 1991*
Cloudiness		1966-2015 *Data Gaps in 1995-99*	1966-2015 *Data Gaps in 1977 and 1991*
Snow Depth (cm)	Daily	1962-2015 *Data Gaps in 1996-99*	1956-2015 *Data Gaps in 1996-1999*
Sunshine (per hour)	Hourly	1980-2015 *Data Gaps in 1981, 1995-99, and 2002*	1987-2015 *Data Gaps in 1988-91, 2001-03*

Note: (1) Total of 10 monthly measurements annually with one measurement for December through February
Source: Golder Associates (2019)

Solar radiation data was provided in 2010 by Lydian. This data included up to five interval measurements in kW/m² recorded once per month, with monthly totals recorded in MJ/m². The available data range includes 1980 to 2007 with data gaps in 1993-99, 2002-02, and 2007.

5.2.1.2 Climate Station Data Analysis

5.2.1.2.1 Precipitation Results

Precipitation was assessed by obtaining monthly averages, maximums, and minimums by processing the daily data and excluding data if less than five days of data was available in a given month. The results of this analysis are shown in Table 5-4.

Table 5-4: Monthly Precipitation Data

Month	Vorotan Climate Station			Jermuk Climate Station		
	Minimum (mm)	Average (mm)	Maximum (mm)	Minimum (mm)	Average (mm)	Maximum (mm)
January	11.8	46.8	81.5	2.1	65.8	182.2
February	11.7	49.0	132.2	12.0	70.5	268.5
March	4.5	60.8	158.0	13.9	80.7	151.5
April	17.1	83.0	180.8	39.9	105.1	255.9
May	26.5	93.6	213.7	29.4	98.8	178.0
June	2.0	65.7	199.7	11.2	68.4	173.2
July	0.0	44.0	196.0	4.4	42.8	125.5
August	0.0	27.7	98.8	0.7	26.0	97.9
September	0.0	26.8	158.5	0.0	29.3	154.5
October	2.2	53.5	148.1	7.6	64.5	157.6
November	0.0	45.4	100.3	0.0	57.1	170.2
December	5.3	47.3	117.6	2.9	63.8	190.3
Average	6.8	53.6	148.8	10.3	64.4	175.4
Totals		**643.6**			**772.8**	

Source: Golder Associates (2019)

Total annual and 24-hour peak precipitation was assessed from the historical data. A frequency analysis was conducted to determine 5-, 10-, 50-, and 100-year precipitation events. The results of this analysis are provided in Table 5-5.

Table 5-5: Climate Station Precipitation Summary

Parameter	Vorotan Climate Station[1]	Jermuk Climate Station[1]
Total Annual Precipitation		
Average	644	773
Maximum Historical	926	1,072
Minimum Historical	302	520
5-Year	793	873

Parameter	Vorotan Climate Station[1]	Jermuk Climate Station[1]
10-Year	851	940
50-Year	931	1,070
100-Year	952	1,120
24-hr Peak Precipitation		
Maximum Historical	73.8	103.3
5-Year	50.0	41.8
10-Year	59.8	50.1
50-Year	81.8	76.1
100-Year	91.3	91.4

Note: (1) All units in millimeters
Source: Golder Associates (2019)

5.2.1.2.2 Temperature Results

Temperature was assessed by obtaining monthly averages, maximums, and minimums by processing the daily data and excluding data if less than five days of data was available in a given month. The results of this analysis are shown in Table 5-6.

Table 5-6: Monthly Temperature Data

Month	Vorotan Climate Station			Jermuk Climate Station			Average Difference (°C)
	Minimum (°C)	Average (°C)	Maximum (°C)	Minimum (°C)	Average (°C)	Maximum (°C)	
January	-13.7	-8.4	-2.5	-11.8	-7.1	-1.0	1.4
February	-11.8	-7.8	-3.3	-10.7	-6.3	-2.2	1.6
March	-8.4	-4.3	-0.3	-7.2	-2.0	2.5	2.3
April	-3.2	1.6	5.8	0.8	4.0	7.7	2.4
May	3.7	6.6	9.1	6.0	8.7	10.7	2.1
June	7.6	10.7	15.2	10.0	13.0	16.4	2.3
July	10.4	13.4	15.9	13.9	16.4	19.5	3.0
August	11.0	13.7	17.2	13.9	16.7	19.9	3.0
September	7.2	11.0	13.6	10.1	13.0	15.4	2.0
October	0.1	5.5	8.8	2.4	6.8	9.4	1.3
November	-6.2	-0.9	3.5	-4.9	0.4	4.6	1.4
December	-10.9	-6.2	-0.1	-10.0	-4.8	0.0	1.3
Annual Average Difference							**2.0**

Source: Golder Associates (2019)

5.2.1.2.3 Snow Depth

Snow depth was assessed by obtaining monthly averages, maximums, and minimums by processing the daily data and excluding data if less than five days of data was available in a given month. If no depth data was provided, zeros were not added to the data, which would bias the data set. Rather, if no data was recorded, no data was included in the analyses for that time period. The results of this analysis are shown in Table 5-7.

Table 5-7: Monthly Snow Depth Data

Month	Vorotan Climate Station			Jermuk Climate Station		
	Minimum (cm)	Average (cm)	Maximum (cm)	Minimum (cm)	Average (cm)	Maximum (cm)
October	3.5	10.0	35.5			
November	2.5	15.9	51.6	2.6	11.6	36.1
December	10.0	36.1	78.6	5.0	25.4	61.0
January	10.0	58.0	102.1	4.6	47.0	97.4
February	10.0	78.7	131.1	10.0	69.3	148.5
March	10.0	91.0	156.6	14.9	63.2	134.7
April	10.8	64.5	133.5	2.0	29.7	85.5
May	2.7	33.6	66.6			
June						
July						
August						
September						

Notes:
1. Vorotan data in May and October limited to 15 and 13 years of data, respectively.
2. Jermuk data in May and October not included because less than 5 years of data is available.
Source: Golder Associates (2019)

5.2.1.2.4 Evaporation

The provided evaporation data was recorded in a vessel with a larger diameter and depth than the standard Class A evaporation pan. Therefore, evaporation was calculated using the Penman-Monteith method (Allen, et al., 1998) from the following parameters:

- Net Solar Radiation (MJ/m²);
- Maximum and Minimum Air Temperature (°C);
- Maximum and Minimum Relative Humidity (%);
- Wind Speed (m/s);
- Height of Wind Speed Measurement (m) – assumed to be 10 m;
- Elevation (masl); and
- Soil Heat Flux Coefficient – assumed to be 0.1.

This method was applied to the daily climate parameters available. The monthly averages, maximums, and minimums were then calculated by processing the daily evaporation and excluding data if less than five days was available in a given month. The results of this analysis are shown in Table 5-8.

Table 5-8: Monthly Evaporation Data

Month	Vorotan Climate Station			Jermuk Climate Station			Average Difference (mm)
	Minimum (mm)	Average (mm)	Maximum (mm)	Minimum (mm)	Average (mm)	Maximum (mm)	
January	15.9	24.4	35.7	22.0	28.0	34.9	3.6
February	19.2	27.6	40.7	25.5	33.9	40.1	6.3
March	33.4	44.0	59.4	44.4	54.7	71.0	10.7
April	34.7	58.5	83.6	57.4	67.6	85.4	9.2
May	72.7	89.3	113.8	87.6	98.3	111.6	8.9
June	103.7	123.6	160.0	123.2	138.1	167.5	14.4
July	102.7	143.6	208.9	140.6	158.8	181.6	15.1
August	111.5	143.5	178.3	129.1	153.8	176.3	10.0
September	81.9	115.4	150.0	95.6	114.2	131.8	-1.1
October	50.0	68.3	87.0	59.5	68.5	77.6	0.2
November	22.3	36.7	54.5	27.9	38.6	46.4	1.9
December	18.0	25.9	44.3	22.2	28.2	38.4	2.3
Average	55.5	75.1	101.4	69.6	81.9	96.9	6.8
Totals	**666.0**	**900.8**	**1,216.2**	**834.7**	**982.7**	**1,162.7**	**81.8**

Notes:

1. Vorotan and Jermuk evaporation calculated based on Penman-Monteith method.

Source: Golder Associates (2019)

Analysis was also conducted to provide an adjusted estimate of evaporation for a wet day and a dry day. The daily average evaporation for each month was obtained separately for wet days (when there was some precipitation), and dry days (when there was no precipitation). The results of this analysis are shown in Table 5-9 and Table 5-10.

Table 5-9: Daily Evaporation Data for Wet Day

Month	Vorotan Climate Station			Jermuk Climate Station			Average Difference (mm)
	Minimum (mm)	Average (mm)	Maximum (mm)	Minimum (mm)	Average (mm)	Maximum (mm)	
January	0.5	0.7	1.1	0.7	0.9	1.1	0.2
February	0.6	0.9	1.1	0.8	1.2	1.4	0.3
March	0.8	1.2	1.7	1.4	1.7	2.1	0.5
April	1.0	1.7	2.4	1.8	2.2	2.8	0.4
May	2.1	2.6	3.5	2.7	3.1	3.6	0.5
June	2.9	3.7	4.9	3.9	4.4	5.2	0.7
July	3.1	4.0	6.6	4.1	4.9	6.1	0.9
August	2.8	3.9	4.8	3.9	4.6	5.7	0.7
September	2.2	3.1	5.3	3.0	3.5	4.6	0.4
October	0.8	1.8	2.4	1.5	2.0	2.4	0.3
November	0.5	0.9	1.5	0.9	1.2	1.5	0.3
December	0.5	0.7	1.0	0.7	0.9	1.1	0.2
Average	1.5	2.1	3.0	2.1	2.6	3.1	0.5
Totals	**17.8**	**25.2**	**36.3**	**25.4**	**30.6**	**37.6**	**5.4**

Source: Golder Associates (2019)

Table 5-10: Daily Evaporation Data for Dry Day

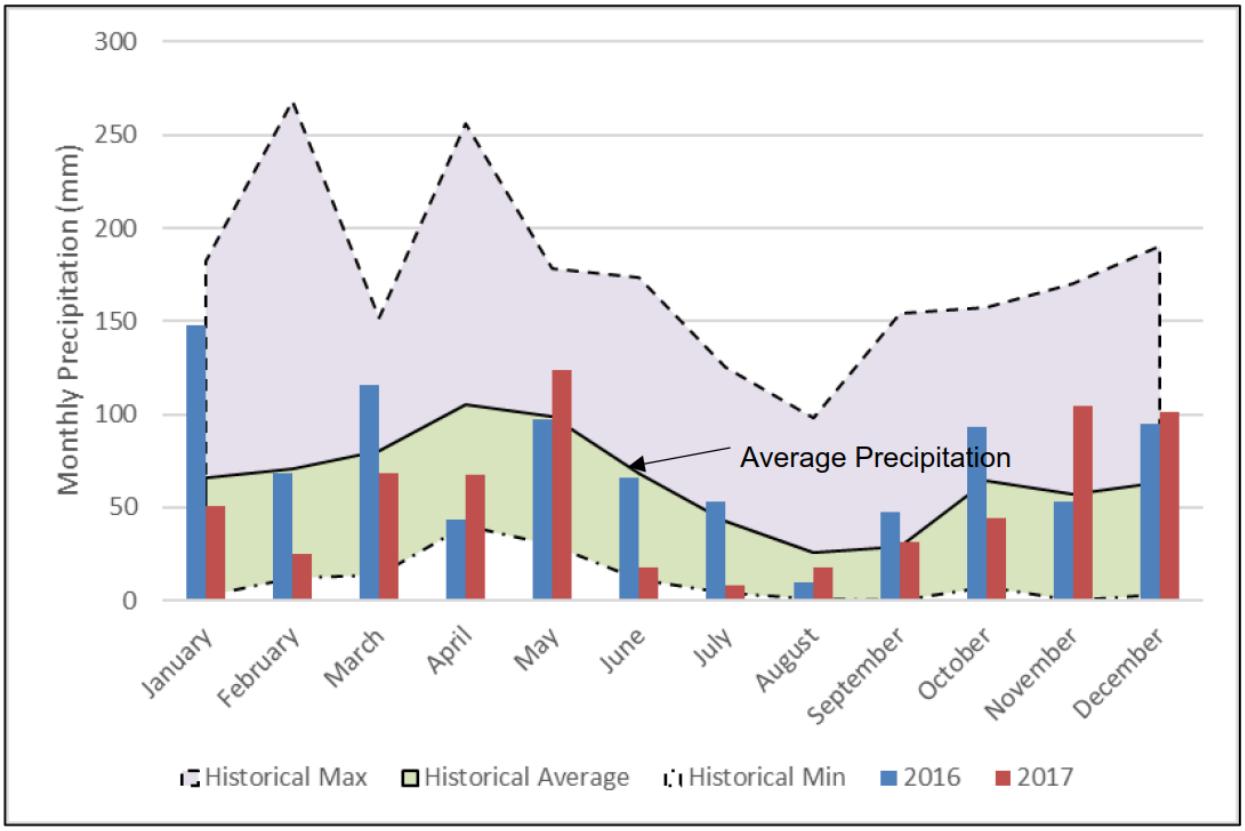
Month	Vorotan Climate Station			Jermuk Climate Station			Average Difference (mm)
	Minimum (mm)	Average (mm)	Maximum (mm)	Minimum (mm)	Average (mm)	Maximum (mm)	
January	0.5	0.8	1.4	0.7	0.9	1.1	0.1
February	0.6	1.0	1.6	0.9	1.2	1.5	0.2
March	1.1	1.5	2.0	1.5	1.8	2.4	0.3
April	1.3	2.2	3.0	1.9	2.4	3.2	0.2
May	2.4	3.2	4.0	2.8	3.4	3.7	0.2
June	3.6	4.4	5.6	4.3	4.7	5.7	0.4
July	3.5	4.8	6.8	4.6	5.2	6.0	0.4
August	3.7	4.8	6.1	4.2	5.0	5.8	0.3
September	3.1	4.0	5.1	3.3	3.9	4.4	-0.1
October	1.8	2.4	3.0	2.1	2.3	2.6	-0.1
November	0.8	1.3	1.9	0.9	1.3	1.6	0.0
December	0.6	0.9	1.4	0.8	0.9	1.3	0.0
Average	1.9	2.6	3.5	2.3	2.8	3.3	0.2
Totals	**23.0**	**31.3**	**41.9**	**28.0**	**33.0**	**39.3**	**1.9**

Source: Golder Associates (2019)

5.2.1.3 Climate Date Comparison

For the Golder Associates updates for the site water balance and checking design criteria, the climate data recorded for 2016 and 2017 has been collected by the Lydian Armenia. Comparisons are made of the monthly precipitation and average temperature of both the Voroton and Jermuk weather stations compared to the historical tabularized data shown above. Figure 5-2 shows a comparison of the monthly precipitation recorded in 2016 and 2017 to the historical record and the Voroton weather station. The precipitation in 2017 was in the normal range of historic data.

Figure 5-2: 2016 – 2017 Monthly Precipitation Records from the Vorotan Weather Station Compared to Historical Data



Source: Golder Associates (2019)

5.3 Local Resources and Infrastructure

5.3.1 Local Infrastructure

The Project site is well positioned in terms of road connectivity and other infrastructures. Located approximately 4 km to the south of the mine, the main tarmac road (M2) connects to Yerevan, the capital city of Armenia. The highway is flanked by high voltage power transmission lines.

The Project site is connected to the small town of Jermuk via a 15 km dirt road. The town, in turn, is connected by paved roads, including the main road (H42) connecting to M2. Jermuk has several natural hot springs, health resorts and spas, and hosts established mineral water bottling plants and emerging tourist industries. There are an additional four rural communities in proximity to the Project, namely: Kechut (a rural community associated with the town of Jermuk), Saravan (including Saralanj and Ughedzor) and Gndevaz, all located within Vayots Dzor Marz; and Gorayk, which is located in Syunik Marz.

Water can be sourced from the Darb River, which is located south of the ADR Plant. The Project is currently planning to get its raw make-up water from the Darb River and camp drinking water from the Gndevas Irrigation Pipe. At the time of release of this technical report, the application for the Darb River abstraction permit was submitted to the Republic of Armenia Ministry of Environment and pending approvals.

Other infrastructure supporting the project includes fiber-optic internet cabling for communications, and natural gas supply through the local distribution network.

5.3.2 Power

Power is available through the Armenian electrical grid at 110 kV distribution. A line has been constructed to site to supply power for operations and the final stages of the Project's construction. Power will be stepped down to 35 kV for site distribution. The equipment has been installed, and will be connected during construction completion. Substation equipment installed is shown in Figure 5-3.

Figure 5-3: Site Substation for Power Grid Connection

Source: JDS (2019)

5.3.3 Human Resources

As a part of the company's commitment to adding value to the local communities and building capacity in Armenia, the bulk of the steady-state Amulsar workforce will be Armenian. Ideally, most the workforce will be sourced from the four local towns: Gorayk, Gndevaz, Jermuk, and Saravan. During initial recruitment, from the first half of 2018, almost 50% of the successful candidates were selected form the four local towns. However, a significant number of highly skilled workers such as engineers, geologists, metallurgists, and mechanical and electrical tradesmen with mining and processing experience will be recruited from other regions of Armenia. The positions that cannot be filled by local or national Armenian workers will be staffed with suitably qualified expatriates on fixed term contracts, with the goal of developing qualified Armenians for these jobs in the future. This commitment is managed by two initiatives, the Local Employment Plan (LEP) and the Local Procurement Plan (LPP). The initial expatriate numbers are assumed to be less than 8% of the workforce with an expected reduction as national staff gains the necessary skills to replace them.

Personnel recruited locally will continue to be based in their home-town, while those recruited from greater Armenia as well as expatriates will be accommodated initially in the Amulsar Camp and then to housing in available in the four local towns. The bulk of the workforce will be employed in the mining and processing plant departments. As on-the-job training will re-commence during the construction period, it is expected that by the time the plant is commissioned the mine operation roles such as equipment operator, drill and blast assistant, survey assistant and service crew will be filled almost entirely by local employees.

Literacy rates in Armenia are exceptionally high for the adult population. This rate, coupled with universities in Yerevan offering degrees in engineering, mining, geology and finance means that there is a readily accessible pool of graduates with the appropriate skills to fill the technical and support functions at the mine. Again, in the early years they will be supported by experienced expatriates to set up operating procedures but in time this requirement will reduce and it is expected that the bulk of middle management at the mine will be Armenian, with expats being retained in training and advisory roles.

Salaries have been benchmarked against comparable operations in Armenia and it is expected that given the working schedule Amulsar should be able to attract and retain people from outside the local region.

The total Project workforce during operation is estimated to be approximately 584 employees, 72 hauling contractors and 72 drill and blast contractors. The maximum workforce during construction may peak as high as 1200.

Table 5-11 summarizes the personnel required during initial operations by department.

Table 5-11: Summary of Operations Personnel

Department	Number of Personnel
Mining (included Hauling, Drill and Blast Contractors)	479
Processing (included Laboratory Labor)	154
General & Administration	95
Total	728

Source: JDS (2019)

Throughout the construction and operations phase of Amulsar, the company intends to develop the following through its recruitment and training practices:

- Improvement of local skills to facilitate initiatives that benefit both Amulsar and the local community;

- The development and dissemination of international best practices to the company and contractor workforces;
- Investment in local businesses to upgrade their ability and increase the amount of goods and services sourced from local communities around the mine; and
- Coaching and mentoring programs for high potential local employees selected for supervision and management roles.

6 History

Due to its location within a tectonically active collision zone between the Arabian and Eurasian plates, Armenia has been endowed with large porphyry-style copper-molybdenum deposits, polymetallic and gold-bearing vein systems. Large-scale metal production began in the early 19th century with the opening of the Alaverdi and Kapan polymetallic mines. In the 1950s, the Zangezur Copper-Molybdenum Combine developed the world-class Kajaran deposit in the south of Armenia, which produces 3% of the world's molybdenum output. The dissolution of the Soviet Union, coupled with low metal prices, severely disrupted Armenia's mining industry in the 1990s, but a new legislative framework and improved market conditions led to a significant upturn during recent years. Metal production comes from:

- Kajaran (Cronimet) and Agarak (GeoProMining) copper-molybdenum porphyry deposits;
- Kapan project vein-type polymetallic deposit (Chaarat Gold Holdings); and
- Zod gold mine (GeoPro Mining).

Foreign mineral exploration companies active in Armenia include Global Gold Corporation and GeoProMining.

The Amulsar region was initially identified by the Armenian Soviet Expedition in 1936 to 1937 as an area of "secondary quartzite", which was deemed to host potential as a silica resource. Work aimed at testing the potential of a silica resource commenced in 1946 with the development of small-scale exploration adits. This work concluded that the alunite content of the silica was too high (up to 25%) and that, as such, the project was of no interest as a source of quality silica. Further work in the early 1960s identified the "secondary quartzite" as metasomatic in origin, developed due to the replacement of intermediate-composition volcanic rocks (known regionally as the Amulsar Suite). Some 300 m of tunnelling and 640m3 of trenching was also completed during this time, mostly on the north-eastern side of the Amulsar ridge. Testing of a bulk sample concluded that the silica was of sufficient quality for the production of low-grade glass. Volumetric calculations made during this time estimated some 360 Mt of secondary quartzite rock at Amulsar.

Between 1951 and 1954 the Gromovskaya Expedition explored an area approximately 3 km north of the Erato deposit. The expedition was tasked with exploring for uranium throughout the Caucuses region. A series of four adits and several drillholes were completed in this area into argillic volcanics significantly lower in the geological sequence than Amulsar that are unrelated to the Amulsar deposit. The expedition concluded that there was no significant mineralization worth developing in the area. Waste dumps from this period are still visible at the toe of Site 27 and the base of Site 13.

Research work by the Soviet Expedition continued at Amulsar during the period 1979 to 1982. This work was focused principally on understanding and mapping the alteration zonation across the area. Silica reserves at Amulsar were never entered onto the Republic of Armenia State Balance, and no further exploration or research work was conducted by the Soviet Expedition in the area after 1982.

6.1 Historical Study and Evaluation Work

Amulsar was discovered in 2006 by company geologists and is the first new gold discovery in Armenia in 20 years. Initial geochemical studies of the site's soil, undertaken during 2006 and 2007, ascertained an area of 3.5 km x 0.5 km.

A further soil sampling, done in 2010, expanded the field of gold mineralization to approximately 3.6 km by one km. The new soil data helped to determine more drilling targets and extensions, as well as identifying the Tigranes, Artavasdes and Erato target areas.

A total of five scout drillholes measuring 593 m in all were drilled in 2007. An additional 18 diamond holes and 74 reverse circulation (RC) holes were drilled in 2008. During the 2009 drilling program, eight diamond holes and 101 RC holes were drilled.

A further 60 diamond holes and 129 RC holes were completed in the year 2010. In 2011, the company drilled 40,000 m to identify the exploration potential in the Tigranes North, Tigranes East, Artavasdes West, Artavasdes South and Arshak areas.

In 2016, Company's completed a drill program that covered the Tigranes-Arshak-Artavasdes (TAA) area and included 95 reverse circulation and diamond drillholes for a total of 9,058 drilled meters. The objectives of the program were to target conversion of inferred mineral resources that were within the currently designed pit boundaries and increase drill density in certain areas for mine planning purposes. In addition, AMC incorporated updated topographic data for the entire project.

Study work to support the development of the Amulsar Project is summarized in Table 6-1.

Table 6-1: Amulsar Study Work Completed to Date

Date	Study
December 2018	JDS Amulsar Gold Project – Restart Plan
February 2017	NI-43-101 Technical Report Amulsar Update Resources and Reserves Armenia
November 2015	NI 43-101 Technical Report Amulsar Value Engineering and Optimization Armenia
May 2015	SGS 2015 Amulsar NI 43-101 Feasibility Study
October 2014	SGS 2014 Amulsar NI 43-101 Feasibility Study
December 2012	SNC Lavalin Crushing Circuit Trade-off Study
September 2012	KD Engineering 2012 Heap Leach NI 43-101 Feasibility Study
August 2011	Preliminary Economic Assessment
April 2009	CSA Technical Report NI 43-101
November 2008	Golder Associates Scoping Study

Source: Lydian (2019)

6.2 Historical Mineral Resources and Reserve Estimates

Several previous mineral resource and reserves estimates have been completed in addition to the study work discussed above, presented in Table 6-2 below.

Table 6-2: Amulsar Study Work Completed to Date

Date	Study
February 2017	AMC NI 43-101 Resources and Reserves Report
May 2013	AMC NI 43-101 Resources and Reserves Report
April 2013	AMC NI 43-101 Mineral Resource Estimate Update
September 2012	Resource Update
March 2012	IMC Mineral Resource Estimate
January 2012	IMC Mineral Resource Estimate
May 2011	CSA Mineral Resource Estimate
March 2010	CSA Mineral Resource Estimate

Source: Lydian (2019)

7 Geological Setting and Mineralization

7.1 Regional Geology

The Amulsar gold deposit is situated in south-central Armenia and is hosted in an Upper Eocene to Lower Oligocene calc-alkaline magmatic-arc system that extends north-west through southern Georgia into Turkey, and south-east into the Alborz-Arc of Iran.

Volcanic and volcaniclastic rocks of this system comprise a mixed marine and terrigenous sequence that developed as a near-shore continental arc between the southern margin of the Eurasian Plate and the northern limit of the Neo-Tethyan Ocean. In the Early Oligocene, the Neo-Tethyan Ocean closed, and subduction ceased along this margin when a fragment of continental crust, known as the Sakarya continent, collided at the trench axis and accreted with the Eurasian plate. The location of Amulsar within this arc is shown in Figure 7-1.

The Amulsar deposit is hosted by a thick package of Paleogene volcano sedimentary rocks. Locally, these rocks consist of multiple fining-upward cycles of volcanogenic conglomerate and mass flow breccia fining-upward to volcanogenic and marly mudstones to thin micritic limestone. Andesitic to dacitic volcanic and volcaniclastic units are sparsely interspersed low in the stratigraphy, but increase in frequency as higher stratigraphic levels are exposed on the flanks of the Amulsar ridge. Strata peripheral to the deposit are sub-horizontal to gently dipping, with little internal structure except where cut by steep faults.

The Amulsar deposit is located within the Amulsar Ridge, which trends north-northeast for about 5 km and rises to a height of 1,000 m above the surrounding terrain. The ridge is a geologically anomalous feature comprising volcano sedimentary rocks that while broadly similar to lower structural elevations contains a larger component of lenticular mass flow deposits. The Amulsar deposit is associated with a complex alteration system and a structural complexity that has not been observed in this sub-region. Flanking the deposit is an anomalous cluster of small plutonic and subvolcanic intrusives composed of slightly altered magnetite-bearing intermediate rocks and fresh medium to fine grained, silicic rocks.

Figure 7-1: Regional Geology, Upper Eocene to Lower Oligocene Calc-Alkaline Magmatic Arc System

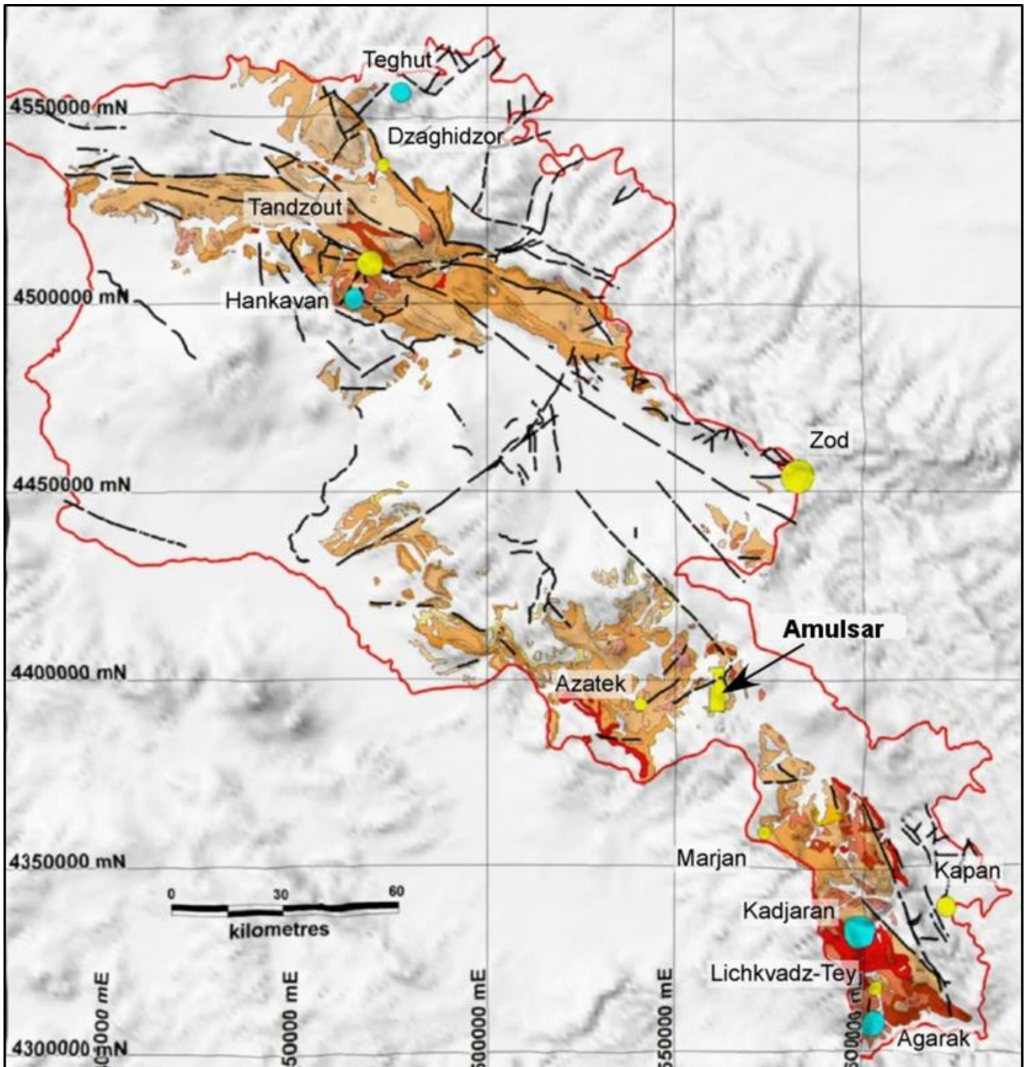


Figure 3. Distribution of prospective Eocene-Oligocene arc-magmatic rocks and major known occurrences draped on SRTM DEM. Blue circles indicate copper-molybdenum resources, yellow circles gold dominant resources

Source: Lydian (2013)

7.2 Deposit Geology

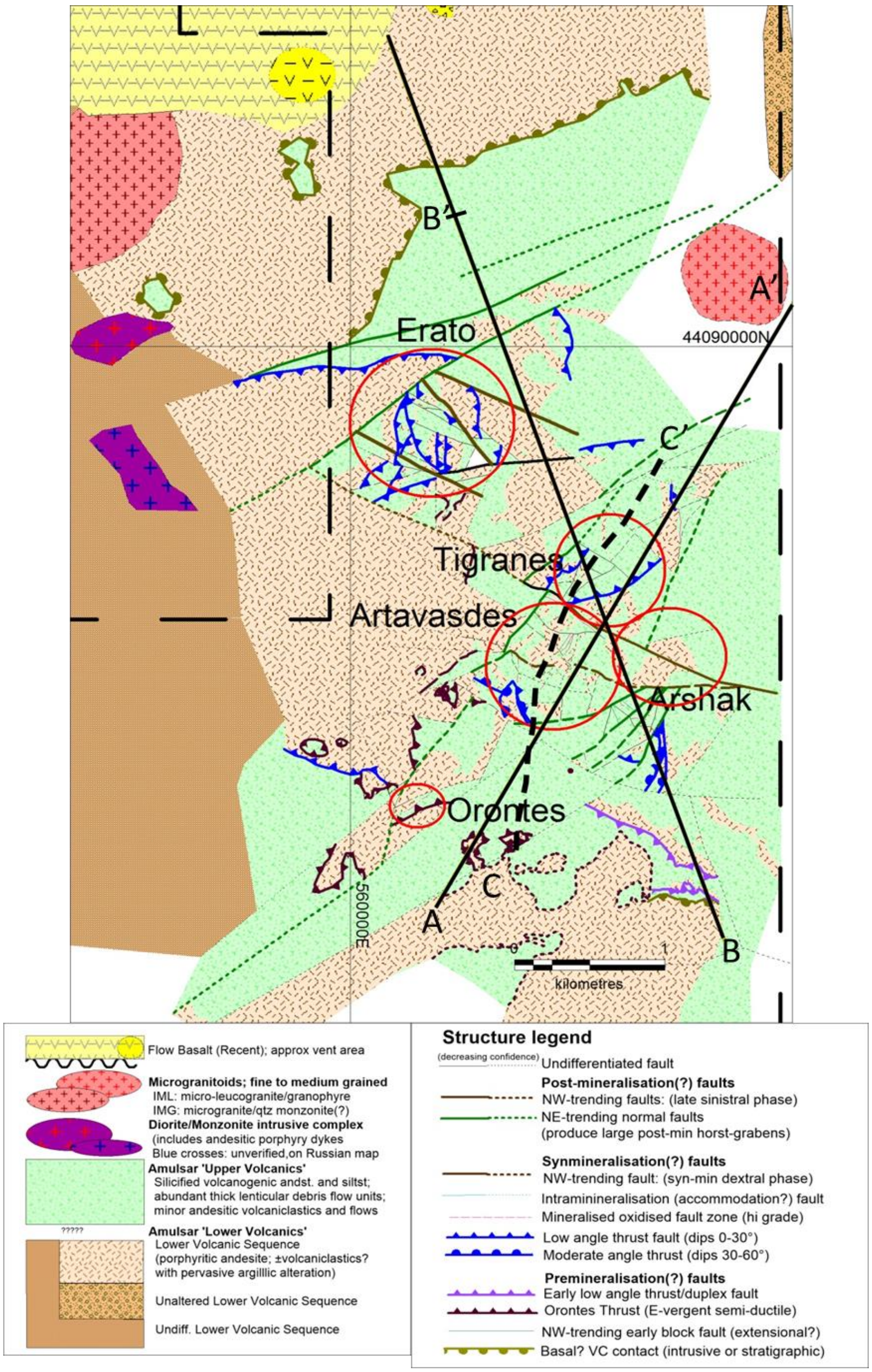
The geology of the Amulsar deposit consists of mainly porphyritic andesites with strong white-cream clay alteration forming strata stratiform bodies with typical thicknesses of 20 m to 100 m. Interleaved with these rocks are silicified volcaniclastic rocks that host gold and silver mineralization. The silicified rocks and altered andesite bodies only occur above a stratiform/structural level or basal contact. In some localities the basal contact has similarities to a disconformity. Below this level, the clay-altered rocks persist to below present drilling depths. The rocks immediately below the contact are dominantly porphyritic andesite. Distally, the clay alteration merges into stratified and unaltered rocks. There is some question about how much of the interleaving of the bodies is a primary sill intrusion (andesite dominated by intrusive textures), and how much of it is structural imbrication (low angle faults). Sparse occurrences of fragmental rocks in some argillic bodies may indicate derivation from lower levels.

The strong stratiform control of the base of the silicified volcano sedimentary rocks has given rise to the map definition of Upper Volcanics (UV) and Lower Volcanics (LV) representing silicified volcaniclastic and altered andesite rock units, respectively. The division into Upper Volcanics and Lower Volcanics is also based on alteration and structural position, rather than actual stratigraphic criteria. A map of the Amulsar area is presented in Figure 7-2 showing the distribution of major rock types and structural elements. Geological cross-sections for the deposit are also presented in Figure 7-3.

Small plutons occur around the periphery of the deposit. These fall into two classes: a suite of slightly altered magnetite-bearing intermediate rocks (diorite, monzonite, hornblende-porphyritic andesite), and a fresh medium- to fine-grained, silicic suite (micro-leucogranite, granite to quartz monzonite).

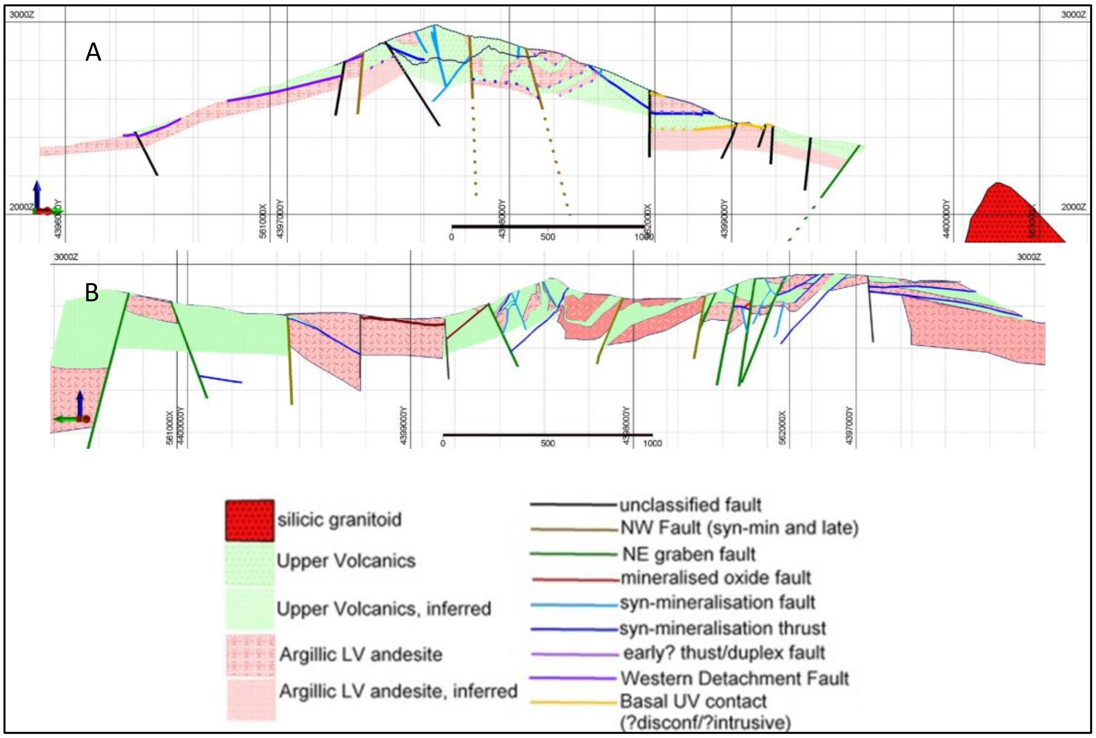
Quaternary to Recent volcanic rocks occur throughout the region. At Amulsar, a volcanic vent occurs at the north-eastern margin of the Amulsar license which has erupted as a single thick basalt flow covering Paleogene rocks.

Figure 7-2: Geological Map of Amulsar Deposit and Section Line Locations



Source: Lydian (2014)

Figure 7-3: Geological Cross-Sections for Amulsar Deposit



A section line A-A', B section line B-B' from Figure 7-2.
Source: Lydian (2014)

7.2.1 Rock Types

The main rock units recognized by Lydian at the Amulsar Project are:

Upper Volcanics (UV) - Sparsely bedded volcanogenic conglomerate, feldspathic sandstone and minor siltstone are interbedded with abundant thin and thick lenticular debris flow units; minor andesitic flow volcanics and volcanogenic/volcaniclastic breccia. Debris flow units are dominated by pebble and cobble breccia with sparse large boulder components. Significantly, clasts in some of the debris flow breccias appear to have been silicified prior to deposition. Examples of representative lithologies for UV are provided in Figure 7-4.

Lower Volcanics (LV) - Strong argillic alteration strongly masks the protolith of these rocks, but the dominant rock type is a feldspar-porphyritic andesite, generally without any flow alignment or other flow characteristics. Some rocks contain hornblende phenocrysts, and are most likely subvolcanic intrusives. Locally they contain silicic volcanic fragments or possible xenoliths. Minor pebble to cobble fragmental rocks and indeterminate rock types also occur, as well as minor feldspar-amphibole porphyritic andesite and a single reported occurrence in drill core of amphibole-magnetite andesite. Examples of representative lithologies for LV are provided in Figure 7-4.

Local Intrusive Suites - Two different intrusive suites occur within or adjacent to the licence area: small, radiometrically-above background, fresh-looking silicic plutons (micro-leucogranite; quartz monzonite); and an extensive suite of slightly altered, silica-poor, intermediate plutons and subvolcanic dykes (diorite, monzonite porphyritic andesite) that are characteristically magnetite-bearing. The latter are in contact only with argillically altered rocks of the Lower Volcanics; whereas one of the fresh silicic plutons is surrounded by Upper Volcanics. Some of the dykes have similar porphyritic textures to the clay-altered intrusive andesite within the Upper Volcanics, although any connection has not been established.

Figure 7-4: Representative Rock Types of the Amulsar Deposit

a. UV unit, polymictic conglomerate fining upwards to laminated sandstone with small basal loading structures in the overlying conglomerate, west Artavasdes.

b. UV unit, polymictic matrix supported breccia (primary or volcaniclastic), north Tigranes.

c. LV unit, strongly altered feldspar-phyric andesite, west Artavasdes.

d. LV unit, moderately altered feldspar-hornblende porphyritic andesite from core sample, Artavasdes.

7.2.2 Structure

The Amulsar deposit is within a zone of high structural complexity within a regionally simple structure. Within the confines of the Amulsar Ridge the structural complexity increases, as structures become steep and overturned. At least four different sets of structure (shears, folds, and faults) produce the final geometry, with increasingly brittle response in the younger structures.

The most prominent post-mineralization structures are a north-east-trending set of normal faults that cross the ridge obliquely and subdivide it into a series of horst-graben blocks that expose the mineralization along these structures (Figure 7-5, structure 13). A slightly younger sinistral reworking of an older NW-trending set of faults locally offsets these graben faults (Figure 7-5, structure 12), and is the youngest of the main fault events.

On the margins of the project area, the structure is simple; strata are sub-horizontal to gently dipping, and the silica-altered rock units consistently overlie the argillically altered rocks. On the eastern side, the contact between the lower argillic rocks and the silicic rocks occurs at an undeformed stratigraphic contact (Figure 7-5, structure 1). This stratiform contact is referred to as the ‘basal contact’, although its nature is under review. It also appears at the same general structural/stratigraphic level at both the southern and northern ends of the Amulsar ridge.

On the western side of the ridge, the lowest contact observed is a west-tilted, low angle semi-ductile fault zone (Figure 7-5, structure 2), with steeply dipping, locally folded, silicified rocks overlying the argillic rocks. The sense of vergence indicated by the overturned beds and cleavage relationship is to the north-east. Termed the ‘western detachment’ fault, it is most likely an early north-east-vergent thrust. This structure partially wraps over the central horst block between Tigranes and Erato so predates some of the subsequent deformation. A narrow east-dipping mylonitic zone, with vague east-vergent kinematics, occurs on the eastern flank of the ridge and may be the same structure on the opposite limb.

The structural complexity increases towards the mineralized zones along the ridge. On the eastern and southern margins, one or two sub-horizontal units of clay-altered andesite are stacked at intervals above the ‘basal’ contact. In some instances, the bases of these sheets appear to be faults, in others the nature of the contact is ambiguous and may be intrusive.

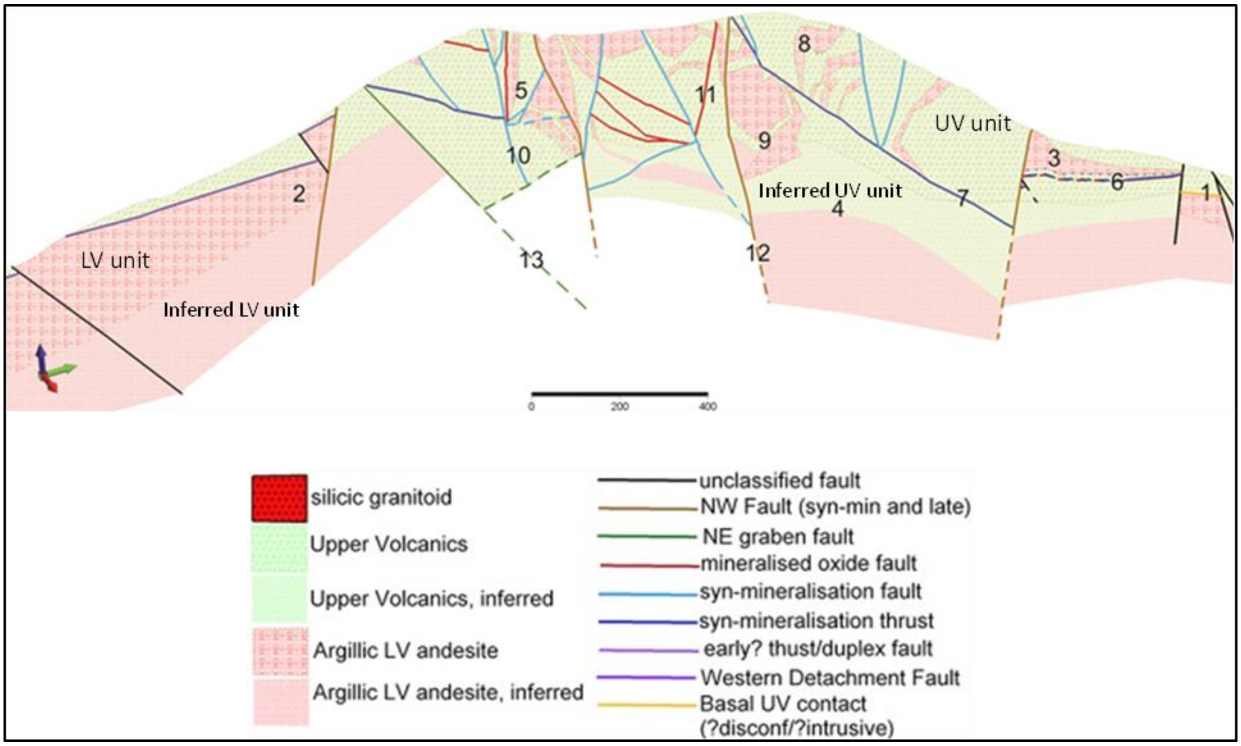
In the south and south-east, the thick lower andesite slabs, and the ‘basal’ contact, arch into a gentle antiform (Figure 7-5, structure 4) before a transition across faults into the highly complex central folded zone. Within the complex zone, the andesitic slabs are more numerous and thinner. The overall pattern appears to be a footwall synform possibly below a south-east-vergent thrust. The formation of multiple thin bodies in the complex zone may be the result of duplexing during this major thrust event.

Although mineralization occurs within the complex zone in the core of this large apparent fold structure, it is the further complexity produced by the refolding of an already folded structure that creates the final host. Gold mineralization is intimately associated with the variably oriented accommodation faults (Figure 7-5, structure 10 and 11) and the large volume of fractured mineralized rock that links them. These fractures are small-scale accommodation structures that allow local deformation associated with the folding.

The folds in the thin andesite bodies related to these host linkage structures have steep east-west- trending axial planes and widely varying plunges (Figure 7-5, structures 8 and 9). They show marked plunge changes across a set of large north-east dipping spoon-shaped thrusts (Figure 7-5, structure 7). This syn-mineralization thrust appears to correlate with a thrust fault that emerges at the surface as a thin mylonite zone. This mylonite has south-west vergence, consistent with the inferred vergence of the thrusts, and lies at the top of a syn-mineralization silica-hematite breccia that partly overprints the mylonite.

Mineralization lies within about 800 m either side of a prominent, steeply dipping NW-trending fault (Figure 7-5, structure 12) that transects the deposit. It is likely that all of the syn-mineralization structures (Figure 7-5, structures 6, 7, 8, 9, 10 and 11) are linked, and occur within a general zone of dextral transpression about 1.6 km wide, around this central fault.

Figure 7-5: Structural Profile Tigranes-Artavazdes-Arshak Areas, Section C-C'



View looking down at 32° toward WNW. Black numbers reference structural types discussed in this section.
Source: Amulsar (2014)

7.2.3 Alteration

The Amulsar deposit is characterized by strong pervasive alteration which affects all rock units. Lydian has identified three alteration styles for the Amulsar deposit:

Silicification - Strong silicification predominantly confined to UV rocks of the Amulsar deposit. Minor development in LV unit, mainly restricted to discrete sub-vertical channels up to several meters wide and local bodies up to several meters thick, commonly near boundaries with UV rocks.

Argillic alteration - Strong argillic alteration with typical mineralogy of clay+quartz+hematite with rare alunite. Alteration occurs predominantly in LV, locally overprinting phyllic alteration (sericite+quartz+pyrite). Minor occurrences of argillic alteration overprinting silicification in UV rocks.

Supergene alteration - Typically affecting hematite-rich rocks and can be often associated with leisegang rings and porous gossanous material replacing hematite. Typical minerals associated with alteration are goethite and limonite. This alteration style is mainly associated with UV rocks.

Strong pervasive alteration at the Amulsar area declines to weak or no alteration towards the periphery of the Amulsar license. The pervasive argillic alteration in the LV rocks extends to the depth of drilling.

Supergene alteration associated with the formation of gossanous iron hydroxides have been logged to depths of about 200 m.

Oliver (2013) completed a review of multi-element geochemical analyses of core and reverse circulation samples, which indicated a kilometer-scale enrichment of potassium, copper, and silica, with a corresponding decrease in calcium and possibly sodium as well as other alkali elements. Based on these findings the widespread alteration is believed to indicate an early distal circulation of basinal and/or magmatic fluids.

Analysis of hematite-iron oxide alteration samples indicate an enrichment of iron and copper, as well as other trace elements such as arsenic, molybdenum, antimony and lead, and a poor correlation with sulphur.

7.2.4 Mineralization

Gold and silver mineralization at Amulsar is hosted predominately in UV rocks. Some mineralization occurs in LV rocks but usually in the vicinity of UV-LV contacts. The main gold mineralization is recognized as a hematite-gold event where mineralizing fluids deposited hematite, gold, probably silver, and traces of other metals. The hematite-gold event is thought to be a late event in the development of the Amulsar deposit. The 2016 drilling campaign has demonstrated that the character of mineralization has not changed from previous interpretations and understanding.

Gold mineralization is controlled by the following features:

- Complex structural zones, particularly areas with variably oriented accommodation faults and fractures that link them;
- Porous and permeable lithological units, including hydrothermal and volcaniclastic breccias; and
- Leached vuggy volcanics – allowing lateral migration of fluids away from structurally controlled conduits.

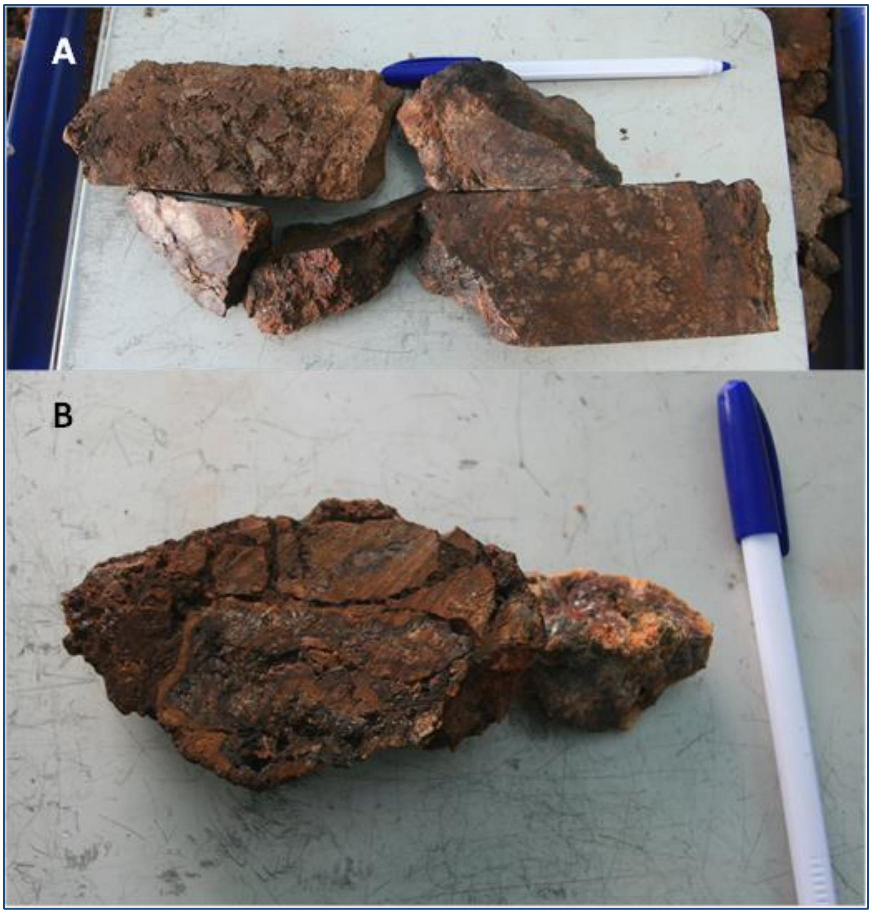
The bulk of the mineralization at Erato and TAA is associated with complex structural zones and related linkage faults and fractures at variable orientations. Additionally, mineralization in the LV zone observed in core is related to mineralized structures that penetrate into the LV zone. Examples of gold mineralization in drill core in UV rocks are shown in Figure 7-6.

Silver mineralization is present at the Amulsar Project, but the genesis and distribution is not well understood. Silver mineralization does not correlate with gold mineralization. Average silver grades range from 2 g/t to 5 g/t and locally can occur in the 100 g/t to 200 g/t range.

A small silver mining project adjoins the Amulsar license to the north-west, exploiting a structurally controlled argentiferous galena vein. This deposit is located at a lower stratigraphic level than the Amulsar deposit.

Based on work by Oliver (2013), gold mineralization is correlated with enrichments in iron and copper and traces quantities of metals such arsenic, zinc, antimony, and lead. This together with poor correlations with sulphur indicates similarities to a low temperature variant of iron oxide copper gold (IOCG) deposits.

Figure 7-6: Examples of Gold Mineralization in Core Samples, Drillhole DDA-047



Notes:

A: Brecciated UV unit, highly altered, strong iron oxidization, 96.1 to 96.5 m, 96.0-97.0 at 5.67 g/t Au.

B: Brecciated UV unit, highly altered, strong iron oxidization, 97.0 to 97.1 m, 97.0-98.0 at 13.7 g/t Au.

Source: Samuel Engineering (2017)

8 Deposit Types

The Amulsar Project is a high-sulphidation epithermal deposit, but its close association with syn-depositional deformation adds a signature characteristic of orogenic gold systems. The deposit also has some characteristics of low temperature variants of typical Iron Oxide Copper Gold (IOCG) deposits.

The Amulsar deposit is hosted in a thick pile of volcanogenic rocks thought to be related to the Tethyan magmatic arc/back-arc system. High-sulphidation epithermal deposits are associated normally with alteration grading from a central zone, dominated by silica-alunite alteration minerals, to an outer zone of argillic-kaolinite alteration mineral assemblages. At Amulsar, a similar sequence of alteration is observed, but the silica-alunite zone appears to be restricted to the mineralized volcaniclastic and breccia rocks of the UV zone, and the argillic-kaolinite alteration is dominantly restricted to rocks of the LV zone. Both rock types are now strongly structurally interleaved, and mineralization is associated with subsequent deformation of this interleaved package.

The background alteration is characteristic of high-sulphidation epithermal systems in which fluids which are commonly highly oxidized and rich in magmatic volatiles cool and migrate to elevated crustal settings. Mineralization at Amulsar is associated with iron oxides, and iron sulphides have not been observed in significant quantities within the mineralized structures. The lack of micaceous alteration minerals associated with the gold mineralization indicates that fluid temperatures were likely less than 300°C and within the range of temperatures associated with epithermal deposits. These oxidized fluids were injected into faults, fractures, and dilatant structures during an orogenic deformation that overprints the high-sulphidation alteration. However, the general absence of veining and, in particular, quartz veins, is atypical of most orogenic gold systems.

The Amulsar deposit was likely developed within a volcanic edifice with a protracted high-sulphidation fluid history that gradually developed into an epithermal level orogenic gold system that was perhaps still being fed by highly oxidized magmatic fluids.

Holcombe (2013b) and Oliver (2013) have identified deposit features that indicate similarities to low-temperature variants of IOCG deposits including:

- Geochemical enrichment of iron and poor correlation with sulphur;
- Bulk addition of iron above pre-existing pyrite;
- Presence of hematite matrix in high-grade breccias;
- Local presence of hypogene low-sulphur copper minerals, at the interface with hematite and surrounding clay+phyllic or silicification; and
- Eocene to Miocene felsic to intermediate intrusions probably similar in age to mineralization.

The Amulsar deposit can be considered as a hybrid deposit type; there are few deposit types or examples that are similar.

9 Exploration

9.1 Introduction

Initial exploration of the Amulsar Gold Project started in 2007 and was conducted by a joint venture between Newmont Mining Corporation and Lydian. After Lydian acquired full ownership of the Project in 2010, all exploration work was completed by Lydian.

No material exploration work has been completed on the Amulsar project since December 2016.

9.2 Newmont Joint Venture (2007 – 2010)

Newmont completed approximately 150 line-km of ground magnetic surveys, with lines spaced at 100 m and 200 m. A total of 54.6 line-km of induced polarization and resistivity surveys were also completed by Newmont during the joint venture period. Details of the geophysical surveys are discussed in a CSA Global (2011) report.

9.3 Lydian (2010 – 2013)

All exploration activity on the Amulsar Project is managed through Geoteam, Lydian's subsidiary in Armenia. Geoteam has conducted limited geophysical work since the acquisition of the property, being limited to developing three-dimensional modelling of Newmont magnetic and resistivity data, the results of which were used successfully to generate targets for exploration drilling.

Geoteam has completed an extensive program of surface geological mapping for the Project. In conjunction with the surface mapping program, approximately 358 (1,337 m) surface channel samples and 171 (50 m) trench samples were taken.

Lydian commissioned a structural geological study of the deposit by Dr. Rod J Holcombe in early-2012 and 2013. The study included three visits by Dr Holcombe and associates to review drill core and reverse circulation chips, surface geological and structural mapping, and to review drillhole structural data. This study resulted in a major revision of the geological understanding of the deposit which required recoding and re-logging of core and reverse circulation chip samples. A three-dimensional conceptual model of the deposit was then generated based on re-logging data and the integration of surface mapping and drillhole data.

Holcombe (2013a) recognized two major volcanic sequences (upper and lower volcanic units) for the deposit, and also identified a complex structural framework including thrust and folding events.

9.4 Methodology

9.4.1 Survey

Drillhole collars for diamond and reverse circulation holes as well as topography are surveyed by Lydian Armenia surveyors. The survey coordinate system is UTM Zone 38N, WGS84 datum. Total station survey equipment is used for all surveys and are tied in to established government cadastral monuments.

Lydian commissioned PhotoStat of Vancouver to provide a digital elevation model (DEM) for the project. The DEM for the project is a high accuracy one-meter resolution model based on Pleiades satellite data. Data was reprocessed to 1 m, 5 m and 10 m contours. The DEM datum used was NUTM38/WGS84.

9.4.2 Channel Samples

Geoteam collected 358 channel sample lines, for a total of 1,337 m of sampling. Channel samples are cut from outcrop faces that were cleared of vegetation, talus, and loose rock. An angle grinder with two diamond saw blades was used to cut a channel into the rock face approximately 3 cm wide and 2 cm deep. Perpendicular cuts were made to facilitate sampling which was undertaken using a hand chisel and a hammer. The average sample length of channel samples is approximately 2 m with approximately 99% of samples less than 3 m in length. A location map of channel samples collected for the Project is provided in Figure 10-1. No additional channel samples have been collected by Lydian since the 2012 AMC resource estimate.

All channel samples collected were transported to the Gorayk secure core-shed facilities by Geoteam staff.

9.4.3 Trench Samples

Geoteam excavated trench samples to a depth of 2 m. Samples were collected at the base of the trench at 1 m to 2 m intervals. A total of 171 samples were collected from trenches. Trench samples were not used for the modelling of geological units, or for the estimation of resources.

10 Drilling

Lydian has explored the Amulsar deposit using a combination of diamond and reverse circulation drilling. Drilling has been undertaken from 2010 onwards.

Drilling for the Amulsar project has been carried out by Drill-Ex International from 2010 to present, with reverse circulation holes drilled by Vahan Atlas Copco for 2012 and NorGeo and Drill-Ex in 2016. Depending on availability, drilling on the project is carried out using two diamond rigs and two reverse circulation rigs. In addition to exploration drilling, Lydian has completed 19 (1,563 m) water holes, 9 (1,098 m) metallurgical holes, and 101 (1,831 m) geotechnical holes. A listing of drilling completed on the project up to 2016 is summarized in Table 10-1. A map of drillhole collars and chip sample locations is provided in Figure 10-1. Diamond drilling in operation during 2012 is shown in Figure 10-2.

Lydian has not completed any exploration or in-fill drilling on the project since 2016.

10.1 Newmont Joint Venture (2008 – 2010)

Exploration under the joint venture was comprised of diamond core drilling, reverse circulation drilling, and geophysical surveys completed from 2008 to early 2010. During this period, exploration drilling was carried out in the Erato and Tigranes-Artavazdes-Arshak (TAA) areas. A total of 31 diamond core (4,363 m) and 175 reverse circulation holes (22,809 m) were completed.

10.2 Lydian (2010 – 2013)

All exploration activity on the Amulsar project is managed through Geoteam, Lydian’s subsidiary in Armenia. From 2010 through 2013, Geoteam has conducted a program of core and reverse circulation exploration drilling over Erato and TAA, completing a total of 248 and 340 core and reverse circulation drilling, for a total drilled distance of approximately 35,256 m and 50,734 m respectively.

10.3 Lydian (2014 – 2015)

Lydian has not completed any exploration drilling in the period between 2014 and 2015. However, a significant number of geotechnical holes (53) were drilled throughout the deposit and construction sites (Site 14,28, Haul Road, ADR Plant, BRSF). Seventeen holes, totalling 547 m were drilled during the 2014, whilst 36 holes totalling 713 m were drilled in 2015.

10.4 Lydian (2016)

During 2016, a focused program was initiated targeting to convert inferred resources within the TAA pit area and included a round of tightly-spaced drilling to evaluate appropriateness of the modelling. The 2016 program included 21 and 76 core and reverse circulation holes, respectively, for a total of 3,221 m and 6,162 m, respectively. This represents 130 new drillholes and 16,475 drilled meters completed since the 2013 resource estimate completed by AMC. A view of the tightly spaced drilling is provided in Figure 10-3.

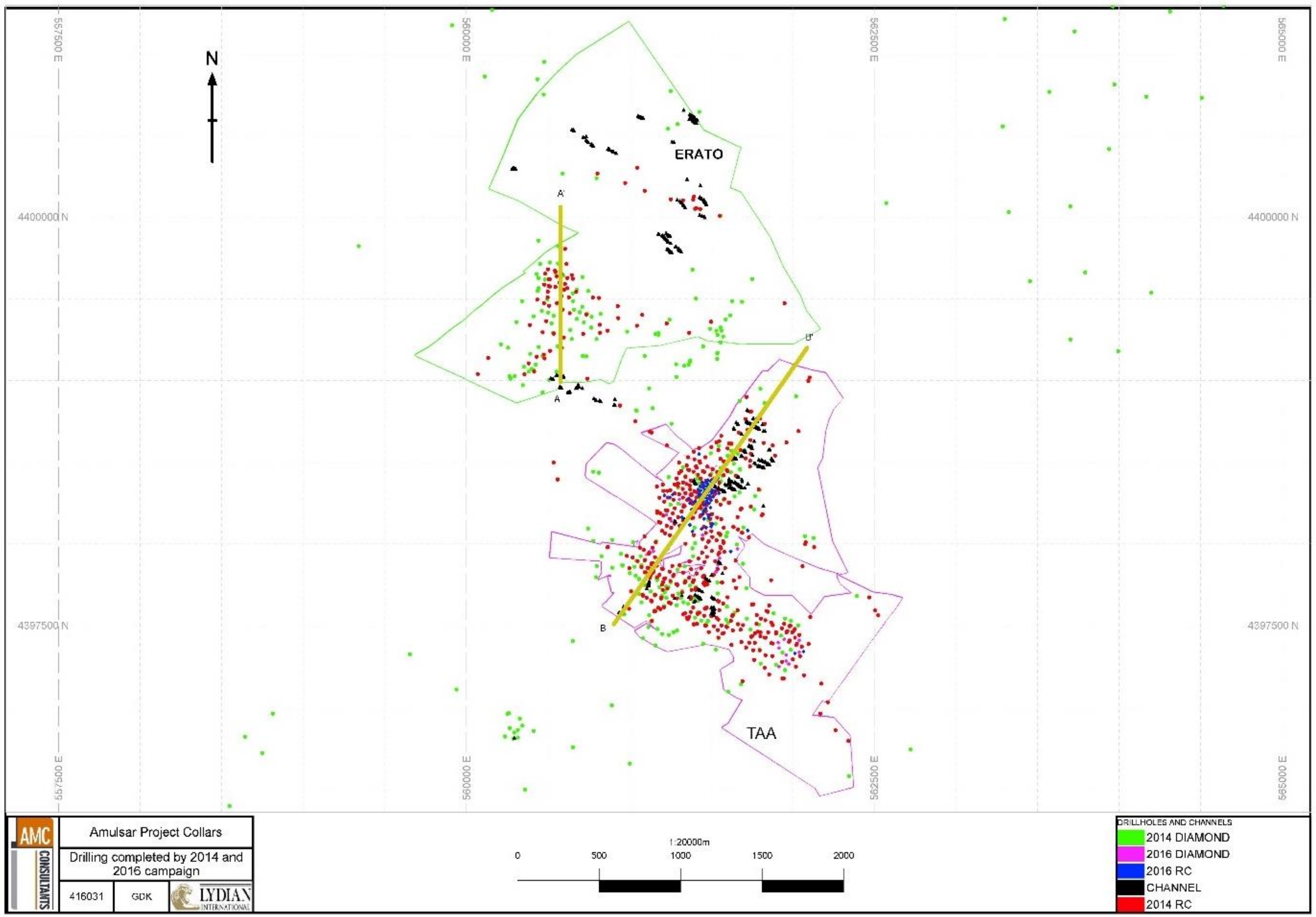
Table 10-1: Summary of Drilling Completed for the Amulsar Project

Year	Number of Holes	Meters Drilled	Drillhole Series	Exploration Area
2007	5	593	DDA-001 to DDA-005	TAA*,ERATO
2008	18	2,680	DDA-006 to DDA-023	TAA,ERATO
	74	10,363	RCA-001 to RCA-074	TAA,ERATO
2009	8	1,090	DDA-024 to DDA-031	TAA,ERATO
	101	12,446	RCA-075 to RCA-175	TAA,ERATO
2010	45	7,117	DDA-032 to DDA-078	TAA,ERATO
	3	421	DDAM-068 to DDAM-071[2]	TAA,ERATO
	4	184	DDAW-001 to DDAW-004	Waste Dump
	7	554	DDGW-001 to DDGW-007[3]	Gorhayk
	126	16,742	RCA-176 to RCA-303	TAA,ERATO
	3	294	RCAW-286 to RCA289	TAA,ERATO
2011	115	13,608	DDA-079 to DDA-271	TAA,ERATO
	2	139	DDAC-172,DDAC-176	TAA,ERATO
	8	921	DDAG-154 to DDAG-251[3]	TAA,ERATO
	67	769	DDAGLP-189 to DDAGLP-269[3]	Site 6, 11, 12,Waste Dump
	6	677	DDAM-130 to DDAM -174[2]	TAA,ERATO
	3	29	DDGG-001 to DDGG-003[3]	Site 6
	142	22,014	RCA-304 to RCA-455	TAA,ERATO
	12	1,085	RCAW-399 to RCAW-408	TAA,ERATO
2012	78	12,697	DDA-272 to DDA-374	TAA,ERATO
	26	1,141	DDAG-387 to DDAG-371[3]	Crusher, waste dump
	4	18	DDGG-004 to DDGG-007[3]	ADR Plant, Mine Camp
	46	6,720	RCA-456 to RCA-500	TAA,ERATO
2013	10	1,834	DDA-375 to DDA-383A	ERATO
	10	755	DDAW-005 to DDAW-013	ERATO,Site 27
	24	1,517	GGDW-001 to GGDW-016A[3]	Site 14, 28
	52	656	GGSC-001 to GGSC-050[3]	Site 14, 27, 28
	23	5,258	RCA-501 to RCA-523	TAA,ERATO
2014	7	356	DDAG-385 to DDAG-392[3]	ERATO, Crusher
	2	99	DDAW-390 to DDAW-393	TAA
	8	92	GGSC-051 to GGSC-058[3]	Site 14, 28,Crusher
2015	2	56	DDAG-394 to DDAG-395	Haul Road
	13	399	DDGG-008 to DDGG-019[3]	Site 14, Crusher, ADR Plant
	1	44	GGDW-017[3]	Site 28
	20	214	GGSC-059 to GGSC-077[3]	Site 14, 28, Haul Road, BRSF
2016	21	206.5	GGSC-78 toGGSC098[3]	BRSF, HLF, Landfill, Truck Loadout, West Slope of Phase 1, Facilities/Admin, Mine Warehouse, ADR Plant

Year	Number of Holes	Meters Drilled	Drillhole Series	Exploration Area
	21	3,221	DDA-396 to DDA-413	TAA,ERATO
	2	34	DDGG-020 to DDGG-021[3]	HLF
	8	176.2	DDGW-018 to DDGW-025[3]	BRSF
	76	6,162	RCA-524 to RCA-599	TAA,ERATO
2017	7	255	RCGG-001 to RCGG-007[3]	Crusher
	7	78	GGSC-99 to GGSC-105[3]	Toe Pond-BRSF
	17	475	DDGG-22 to DDGG-038[3]	Crusher, Toe Pond-BRSF, Dust Suppression Storage pond, Fine Ore Stockpile, Conveyor Corridor Platform, Truck shop, Mine Facilities, Fuel Storage
	9	140	DDGW-026 to DDGW-029, 029A; DDGW-030, 030A; DDGW-031 to DDGW-032[3]	HLF, Mine Landfill, Toe Pond-BRSF
Total RC Holes	603	81,084		
Total Diamond Holes**	320	44,073		
Total Geotech Holes	311	8,076		
Total Metallurgical Holes	9	1,098		
Total	**1,243**	**134,331**		

Source: WGM (2019)
** includes Water Holes
2 Metallurgical Holes
3 Geotechnical Holes

Figure 10-1: Location of Drillholes and Chip Samples and Section Lines A-A' and B-B'



Source: AMC (2016)

Figure 10-2: Drilling Operations Amulsar Project

Source: Samuel Engineering (2017)
Note: Truck-mounted diamond core wireline rig and diesel electric generator.

Figure 10-3: TAA Tightly Spaced Drilling, Looking North-West

Source: Samuel Engineering (2017)
A: Erato Zone, B: Tightly spaced drilling area, foreground

10.5 Drilling Methodology

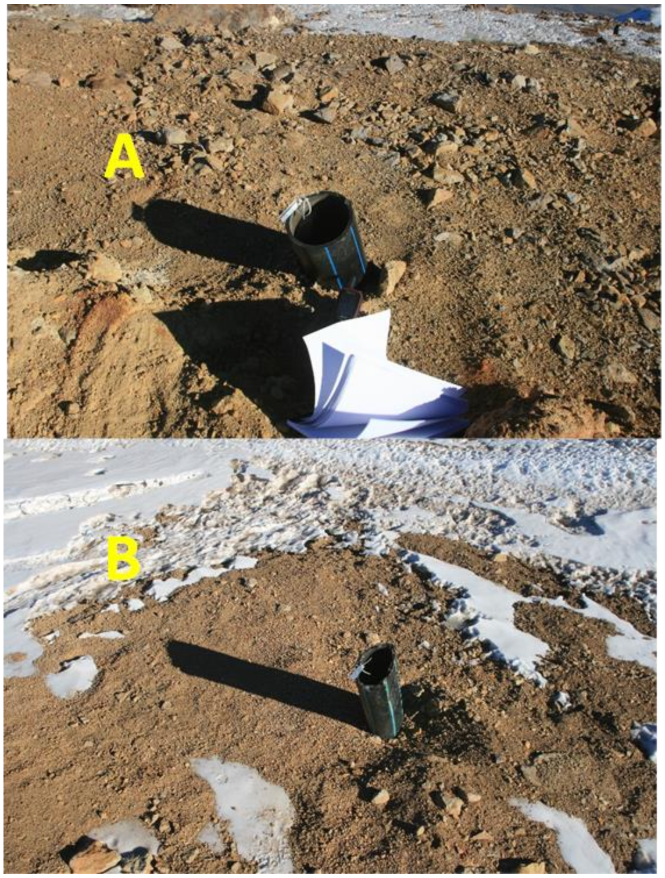
Drillholes were drilled on grid patterns of approximately 40 m intervals for closely spaced drilling and 80 m or more at the peripheries of identified mineralized zones. Drillholes were drilled vertically or inclined at approximately -60°. Inclined drillholes were drilled mainly at azimuths of 120° or 300°. Exploration drilling was conducted to a maximum depth from surface of approximately 350 m.

All drillhole collars are initially positioned by geological personnel using a hand-held GPS. Drillhole collar locations are marked with pegs and flagging tape to indicate the azimuth direction.

10.5.1 Drillhole Collar Coordinates

Drillhole collars for diamond and reverse circulation drillholes on the Amulsar project are surveyed by Geoteam surveyors. The survey coordinate system is UTM Zone 38N, WGS84 datum. Total station survey equipment is used for all surveys. After the completion of drilling, all drillhole collar positions are marked with a PVC pipe. Drillhole numbers are clearly marked with metal tags on each concrete base and attached to the top of the PVC pipe as shown in Figure 10-4.

Figure 10-4: TAA Drillhole Collars 2016 Drilling Campaign



Source: Samuel Engineering (2017)
A: RCA-561, B: RCA-564

10.5.2 Downhole Surveys

Downhole surveys are conducted by the drilling contractor using Globaltech Pathfinder single-shot survey instruments. Drillholes were surveyed at approximately 20 m to 30 m intervals for most holes. Downhole survey data for each hole is reviewed by geological personnel before being entered into the drillhole database system.

Core orientation surveys are routinely completed by Geoteam personnel on all diamond core drillholes. Geoteam uses the EzyMark core orientation system for orientating drill core. Measurements are made at approximately 30 m intervals for the entire length of the drillhole. Each orientation survey is scrutinized by the Rig Geologist. If the survey fails, another orientation survey is completed in the following run. Each EzyMark Ori-Block is placed in the core box where the orientation measurement was made.

10.5.3 Diamond Core Drilling Protocols

Geoteam exploration personnel follow procedures outlined in a comprehensive manual for diamond drilling procedures. Diamond drilling operations are supervised by Geoteam Geologists at the drilling site.

Diamond drillholes are drilled with a number of core sizes, including PQ (85 mm core diameter), HQ (63.5mm), and NQ (47.6mm) size core.

Core is transferred directly from the core barrel to plastic core boxes. Wooden markers are placed between runs recording the drilling depth. All core boxes are labelled with drillhole number, starting and ending depths for the core box, and box number. Core is logged by Geoteam geologists at the drill site. At the end of each shift, core boxes are delivered to secure core-shed facilities at Gorayk.

Diamond drilling core recovery averages 96% for the project. Approximately 90% of drill core intervals have a core recovery exceeding 90%. Approximately 5% of exploration drillhole core do not have core recovery information; excluding geotechnical and metallurgical holes.

10.5.4 Reverse Circulation Drilling Protocols

Geoteam exploration personnel follow procedures outlined in a comprehensive manual for reverse circulation drilling procedures. All reverse circulation drilling is conducted under constant supervision by the Rig Geologist.

Reverse circulation drilling is undertaken using downhole hammers with face-sampling drill bits. The diameter of drill bits used by NorGeo and Drill-Ex is 127mm, while Vahan Atlas Copco used a 139 mm drill bit.

The first few meters of reverse circulation drilling is open-hole percussion (OHP) drilling, using either hammer or tri-cone bits, or air-coring depending on ground conditions. OHP drilling is used to allow PVC to be emplaced as casing, sealed by an expanding polymer. The stuffing box is secured over the end of the casing for air return.

All drilling chips are collected from the reverse circulation cyclone. Wet samples are recorded by the Rig Geologist and collected in poly-weave bags to assist in drying of the chip samples. The entire chip sample is delivered to the core-shed facilities in Gorayk for splitting and sampling.

10.6 AMC Comments

Protocols undertaken by Lydian for the Amulsar project, including drilling, core handling, logging, and database preparation, have been undertaken using procedures that meet industry standard practices as considered by the Qualified Person for this section. While reverse circulation sample recovery has been reviewed in the previous reports by CSA Global (2011) and IMC (2012), AMC believes that procedures can be improved by routine monitoring of reverse circulation sample recovery for each drilling run.

As the Amulsar project has been developed, understanding of the geology and structure has improved significantly. This process is typical of most advanced exploration projects. In this process, the delineation and lithological and structural units has necessitated reinterpretation of drillhole lithological data and structural domains within the deposit. It is important to continue updating lithological coding and continuing structural investigations to provide the basis for a resource estimate with a high-confidence level.

11 Sample Preparation, Analyses and Security

11.1 Sampling Method and Approach

11.1.1 Dry Bulk Density Measurements

Dry bulk density (DBD) measurements were made by Lydian Armenia at the Project core shed. These measurements were restricted to diamond core samples only, using full core intervals with an average length of 20 cm to 30 cm. Measurements were made using a wax-sealed core water-immersion method. All core samples are dried before measurements are taken. AMC understands DBD quality-control measures are not regularly implemented for DBD measurements.

The equipment used by Lydian Armenia to measure DBD is shown in Figure 11-1.

Figure 11-1: Station for Measuring Dry Bulk Density at Gorayk Core Shed Facilities

Source: Samuel Engineering (2017)

11.1.2 Diamond Drill Core Samples

All diamond drill core is photographed and logged at the drill site. Logging is completed at each drill site using hard-copy logging forms. Orientated core is reassembled and marked with an orientation line, using a permanent marker. Geological logging includes primary and detailed lithology units, alteration, porosity type, and iron sulphide and oxide percentages, geological structures and their orientations using alpha and beta angles. Lydian Armenia geologists log geotechnical core data including: rock quality designation (RQD), fracture count, rock strength classification, and core recovery for each drill run.

After logging, core boxes are delivered to the core shed facilities, and core logs are reviewed by senior geological personnel. Core samples are marked using colored wax-markers at 1 m intervals, and may be adjusted at Upper and Lower Volcanic unit contacts. Core drillholes are mainly sampled along the full length, particularly in the Upper Volcanic unit. In some cases, in the Lower Volcanic unit, intervals that are clearly unmineralized are not sampled. Core cutting lines are marked 2 cm clockwise of the orientation lines. Sample intervals are assigned sequential sample and quality-control sample numbers by Lydian Armenia technical personnel under supervision of Lydian Armenia geologists.

Drill core is split at the core shed using a diamond saw. Prior to cutting each sample the entire saw is flushed with water, including the catchment basin below the core tray. After the sample is cut, rock fragments and fine particles from the core are collected in the catchment basin and placed in a plastic sample bag, along with half the cut core, which is placed in a cotton sample bag. For sample intervals with disaggregated core, half of the material is taken directly form the core box. The remaining core is replaced in the core boxes, which are stored securely in core racks at the core shed facility.

Quality-control samples are submitted at a target frequency of about 1 in 15. This includes core field duplicates consisting of quarter splits of sampled core, blank samples of unmineralized sand, pulp duplicates, and certified reference material.

11.1.3 Reverse Circulation Hole Samples

Reverse circulation drilling samples are routinely collected at 1 m intervals. Drill cuttings for each drilled meter are collected in plastic bags at the rig cyclone. Lydian Armenia reports that pressurized air blow-backs are routinely used after every meter of advance, so that all the material within the drill stem is displaced into the sample bag prior to advancing to the next meter. The entire samples are weighed, logged, bagged, labelled, and sealed at the drill site. Lydian Armenia geologists log the reverse circulation chips in detail, including primary and detailed lithology units, alteration, and iron sulphide and oxide percentages. Representative chips for each interval are placed in plastic chip trays, which are marked with drillhole number sample number and sample intervals. Samples and chip sample trays are collected daily and transported to the core shed facilities for splitting and archiving.

Samples are split at core shed facilities using a 1:8 riffle splitter to produce a 1.5 kg to 2 kg sample. The remaining chip sample material is stored at the facilities as an archive. The riffle splitter is cleaned between samples by brushing and using compressed air. Individual weights for the entire 1 m sample and the final sample were recorded. The split sample is placed in a cotton bag, labelled, and delivered to the sample preparation laboratory adjacent to the core shed facilities.

11.2 Sample Preparation and Analysis

Lydian has a sample preparation facility which is adjacent to core shed facilities at Gorayk. The facility includes three jaw crushers, two rotary splitters, three high-capacity pulverizers, and two drying ovens.

Rotary splitters were not operational during the visit as they were waiting on replacement parts to be delivered. Sample preparation facilities at Gorayk operated from September 2008 to 2010, and then were restarted in late 2011. Split pulverized samples (pulps) from this facility are packaged and shipped in boxes for assaying. Prior to establishing this facility, and during the period between 2010 and late 2011, all samples were sent to ALS Romania SRL Laboratories in Rosia Montana (ALS Romania) for sample preparation. A new, containerized, sample preparation facility, provided by ALS Chemex was installed in late 2011. The Gorayk laboratory is owned and operated by Lydian Armenia.

Core and channel samples are collected from the core shed area and placed directly into drying racks which are moved into drying ovens. After drying at 110 °C for about 12 hours, samples are crushed to -2 mm. For core samples, fragments and fines from cutting the core are added at this stage to the core sample, and the combined sample is passed through the crushers. After crushing, the material is transferred using crusher bins to the rotary splitter where the sample is split to a sub-sample of approximately 2 kg. The entire 2 kg sample is pulverized and then split into 200 g to 250 g and 650 g pulps, where the former is used for assays, the latter as reference. An additional 200 g to 250 g duplicate pulp is split from the pulverized sample at a frequency of 1 in 20.

Reverse circulation samples are placed in an oven as described above and then pulverized in their entirety and are not usually passed through the crushing stage. After pulverizing, the sample is split using a rotary splitter into 250 g and 650 g pulps, with the former for assaying and the latter held by Lydian Armenia for reference. Similar to core procedures, a 200 g to 250 g duplicate pulp is split from the pulverized sample at a frequency of about 1 in 20.

All samples for assaying are shipped to ALS Romania laboratories for gold assaying. On arrival, each sample is logged, weighed, and assigned an individual bar code. A 50 g sub-sample was used from 2008 to 2010 period for gold fire assays. From 2010 to 2013 a 30 g sub-sample was used for fire assays. The ALS Romanian laboratory completed gold analyses by fire assay, with an AA finish and a gravimetric finish for all assays above 10.0 g/t gold. ALS Romania has been accredited, by the Standards Council of Canada, on 28 January 2013, with ISO/IEC 17025:2005 for gold fire assays with atomic absorption and gravimetric finish (codes Au-AA, Au-GRA, Au-AA23, Au-GRA21). The remainder of the pulp samples are sent for analysis by inductively coupled plasma mass spectrometry using a four-acid digestion (code ME-ICP61) at the ALS Laboratories in North Vancouver, Canada (ALS Canada Ltd). This analytical procedure assays 61 elements, including silver. The ALS North Vancouver laboratory is ISO/IEC 17025:2005 certified for this analysis.

11.2.1 Amulsar Assay Quality Control Procedures

Lydian Armenia performs routine checks on laboratory submissions upon import to the drillhole management Century Systems, Fusion database. On an ongoing basis QA/QC data is analyzed using Fusion plots for standard, scatter, and quantile-quantile plots. Failures in quality-control data are identified by the Lydian Armenia database manager and discussed with field geological personnel. Critical failures result in the resubmission of assay batches, or ten samples that precede the failed sample and samples following the failed sample. Quality-control samples for gold and silver assays are summarized in Table 11-1. These results comprise all QA/QC data including all updates data from drilling completed to the end of 2016.

Quality-control samples are routinely submitted by Lydian Armenia during all exploration sampling programs. For gold assays, five quality-control samples are submitted independently of the assay laboratory comprising of: field duplicates, blanks, and certified reference material. Field duplicates consist of split core for diamond drill samples and coarse rejects after the crushing of reverse circulation samples. Pulp duplicates for umpire samples are submitted by the sample preparation laboratory at Gorayk for both core and reverse circulation holes. Umpire samples were submitted to Alfred H Knight Services, St Helens, England, at the request of Independent Mining Consultants (IMC, 2012). Routine umpire samples are submitted to Acme Laboratories, Vancouver, Canada (Acme). Material for blank samples was replaced from unmineralized rock from the Amulsar area to low-grade certified reference material, GLG911-1 sourced from Geostats Pty Ltd. in 2012.

Silver assay quality-control samples were limited to field duplicates for core and reverse circulation samples, blanks and standards.

Table 11-1: Summary of Independent Assay Quality Control Samples

Analyte	Quality Control Sample	Standard	Certified Value (g/t)	Number of Samples	Ratio to Total Assays
Gold	Field Duplicates Core			1213	1.01%
	Field Duplicates RC			1931	1.61%
	Blanks			2543	2.12%
	Umpire Samples (AHK)			1210	1.01%
	Umpire Core (Acme)			1370	1.14%
	Umpire RC (Acme)			1914	1.60%
	Standards	6302-2	2.50	125	0.10%
		G302-3	8.66	642	0.60%
		G303-2	4.15	694	0.58%
		G306-3	8.66	412	0.34%
		G307-2	1.08	548	0.46%
		G300-7	1.00	419	0.35%
		G312-6	2.42	125	0.10%
		G398-6	2.94	667	0.56%
		G399-6	2.52	47	0.0%
		G900-6	2.56	243	0.20%
		6904-8	5.53	872	0.73%
		G905-8	2.55	80	0.10%
		GBMS 304-4	5.67	299	0.25%
		GBMS 304-5	1.62	293	0.24%
		GLG 302-2	0.01667	360	0.30%
		GLG 304-1	0.15391	1062	0.89%
		GLG 307-1	0.00286	328	0.30%
	Blank	GLG 911-1	0.003	554	0.46%
		OXD57	0.413	54	0.0%
	Total			**18130**	**15.12%**
Silver	Field Duplicates Core			1213	1.07%
	Field Duplicates RC			1760	1.55%

Analyte	Quality Control Sample	Standard	Certified Value (g/t)	Number of Samples	Ratio to Total Assays
	Umpire Core (Acme)			1368	1.20%
	Umpire RC (Acme)			1918	1.69%
	Blanks			3097	2.72%
	Standards	GBMS 304-5	0.8	294	0.26%
		GBMS 304-4	3.4	300	0.26%
	Total			**9950**	**8.75%**

Source: Samuel Engineering (2017)

11.2.2 Amulsar Assay Quality-Control Data Review

AMC reviewed the updated quality-control data using a suite of analytical techniques including:

- Bias scatter plots;
- Mean versus half relative deviation (Mean versus HRD) graphs;
- Ranked absolute relative paired difference plots;
- Relative pair difference frequency plots;
- Quantile-quantile plots; and
- Time series plots of certified reference material assays.

11.2.3 Umpire Quality Control Samples

Umpire pulp samples test the precision of assay results using an external laboratory.

Combined data (2008 to 2016) gold umpire results show high correlation coefficients above 0.99 and minimal bias in errors as indicated in trend lines of the Mean versus HRD plots. Scatter and quantile-quantile plots have good correlation of grade regression lines at lower grades form 0.2 g/t to approximately 5 g/t Au. Scatterplot regression trend lines and quantile plots deviate significantly from the X-Y line at higher grades. The scatterplot regression lines and quantile-quantile plots trends trend downwards, indicating an underestimation of grade at higher grades. This high-grade trend is likely caused by a significant nugget effect in gold grades at high grades as well as some outliers that are related to errors in the submission of samples. Precision plots, ranked absolute RPD plot have 86% to 91% of data within a 15% variance of the data. In addition, looking at only 2016 data (reverse circulation only) there is no significant differences in precision measurements between combined and 2016 results. Results for Acme umpire samples demonstrates that results indicate that precision checks of umpire pulp samples are acceptable.

Silver umpire results also show a relatively high correlation coefficient in the range of 0.97 and 0.99 for both core and reverse circulation umpire samples. There is a distinct trend of underestimation of original assays grade compared to the umpire laboratory which is observed at grades above 2 g/t Ag in both scatter and quantile-quantile plots. This underestimation bias is also observed in Mean versus. HRD plots for silver with the trend line almost systematically below the zero-bias line. Precision plots, ranked absolute RPDs show that 47% to 58% of the data is within a variance of 15% which is considered low for pulp samples. Umpire samples indicate precision problems with ALS and Acme silver assays most likely related to analytical procedures or equipment. A summary of umpire and duplicate quality control data plots are in the Samuel Engineering Report (2017).

11.2.4 Duplicate Quality Control Data

Duplicate samples test the precision of sample preparation and analytical process for samples submitted to the ALS laboratory. Split core was used for core sample duplicates and coarse reject material was used for reverse circulation samples.

Gold duplicate correlation coefficients were relatively high at 0.92 and 0.86 (diamond and reverse circulation). Variability is high for core samples and moderately high for reverse circulation data indicated from scatter plots and quantile-quantile plots. High variability in gold data is expected, as mineralization is significantly variable with a marked nugget-effect at higher grades. This variable is expected to be high for split core samples and is a function of deposit mineralization. Slightly lower variability of grades is observed in reverse circulation samples and is a function of the drilling method.

Scatterplot assay regression lines for gold in both core and reverse circulation plots are reasonably unbiased for lower grades from 0.2 g/t to about 2 g/t Au. At higher grades the regression lines deviate significantly from the Y-X line. AMC considers these departures are related to high variability at these grade ranges and sample error.

AMC notes two major outliers in gold duplicates in the 2016 drilling campaign. The assay batch for ARC75937 was re-assayed with the same results. Lydian considers this value a possible mixed-up sample number where ARC75938 might be ARC75939. The sequence of samples is preceded by high-grade values in the range of ARC75937. Lydian has not completed re-assays of the assay batch with ARC78666. Removal of these probable errors improves the quality-control plots but does not change the conclusion that the duplicate precision is appropriate.

Gold duplicates errors show no significant bias in errors based on Mean versus HRD plots. Precision quality based on ranked absolute RPD plots are acceptable at 34% of the data within 15% of variance for split core samples and 72% for reverse circulation data (coarse rejects).

Silver duplicate data have high correlation coefficient values from 0.91 and 0.96 (core and reverse circulation). Scatter plots and quantile-quantile plots show good regression of silver grades at lower grades to approximately 10 g/t Ag, with significant dispersion of values at higher grades away from the X-Y line. Some high-grade outliers are most likely due to samples errors. Precision characterization based on ranked absolute RPD grades are within acceptable ranges of 67% for split core and 76% for reverse circulation within 15% of variance. Mean versus HRD plots show no significant bias for errors. Duplicate results are acceptable for gold values. Duplicate results for silver are consistent and show good precision but contrast sharply with problematic umpire results. These issues seem to be related to accuracy issues rather than precision issues.

11.2.5 Certified Reference Material Standards

AMC reviewed selected standard plots for gold and silver certified reference material (CRM) that contain approximately 50 or greater CRM assays from the 2016 drilling campaign including blanks.

Six gold CRMs were reviewed:

- G398-6
- G312-6

- G307-2
- G302-2
- GBMS 304-5
- GLG304-1

AMC reviewed two CRMs for silver:

- G304-4
- GBMS 304-5

Gold CRM blanks reviewed comprised:

- GLG302-2
- GLG991-1

Reviewed gold CRMs range from 0.017 g/t to 2.94 g/t which provides an appropriate range of standard values to check gold assay accuracy. Of the six standards, only GLG404-1 has some results that exceed +/- two and three standard deviations for the 2016 assays. GLG404-1 values above these ranges are most likely related to sample errors. The variance between mean of CRM assays and certified values are all within one standard deviation and represent minor differences in the second decimal of assays results. For the GLG304-1 standard the difference is slightly higher, possibly influenced by outlier values. In all cases this comparison shows a high-confidence level for gold assay accuracy.

Silver CRM results are poor for both GBMS304-4 and GBMS304-5. A significant number of assay results for these standards are outside of the +/- two and three standard deviations ranges. Possible causes for poor standard performance is ascribed to an ALS detection limit of 0.5 g/t Ag. However, the poor performance GBMS304-4 is not explained by this detection limit. Results for the 2016 drilling campaign for Ag CRM data have not improved. Quality-control accuracy results for silver are assigned a low level of confidence. As a minimum indication, low-confidence estimated for silver will be reported at one decimal place only. Results of selected CRM's are provided in in the Samuel Engineering report (2017).

11.3 AMC Comments

Quality control data for the project indicates that gold assay results continue to be at a high level of confidence for the 2016 drilling campaign. Silver quality control data show a poor confidence level for all silver assays. Together with low silver grades for the deposit and low metallurgical recoveries, the contribution of silver to the economic value of the project is negligible. Silver grades will be estimated and reported but these grades are not reliable and not significant to project economics.

AMC recommends that quality-control procedures for DBD measurements should be implemented. These procedures should include:

- In-house standards that can be made from existing core – these standards can be measured daily or weekly, to ensure that equipment is accurate and that measuring procedures are consistently implemented;
- Periodic checks of electronic balance using standard reference weights; and
- Umpire DBD measurements.

AMC also recommends that criteria used for batch failures should be formalized into a clearly outlined set of procedures. Although no sample preparation issues are evident, it is recommended that procedures for transferring samples to the preparation laboratory can be improved by the following procedures:

- Packaging sample bags from the core shed into sealed barrels or large bags that are then delivered to the laboratory;
- Barrels or large bags are unpacked by laboratory personnel; and
- Barcodes are assigned to each sample that enters the laboratory and used to log samples out of the laboratory.

AMC concludes that sampling and analytical techniques used for the Amulsar Project are appropriate for estimating resources. However, AMC suggests that the procedure of adding fragments and fines from the core cutting process should be further investigated, to determine if this material contains significant mineralization.

12 Data Verification

12.1 Verification by Lydian

The Amulsar Project data is maintained by Lydian Armenia personnel using the Century Systems Fusion database system. Lydian Armenia personnel routinely verify drillhole data and assay data. Detected database errors or inconsistencies are discussed with senior geological personnel and rectified.

Data security and integrity is maintained by daily back-ups of the Amulsar database at the Lydian Armenia offices in Yerevan.

12.2 Verification by AMC

12.2.1 Site Visit

In accordance with National Instrument 43-101 guidelines, Mr. G. David Keller, P.Geo. of WGM Ltd., visited the Amulsar Gold Project from 28 November 2016 to 3 December 2016. Mr. Keller was assisted by Lydian Armenia's Chief Geologist, Argam Snkhchyan; Mine Technical Manager, David Tyler; and by Alan Turner, Manager Technical Services.

The purpose of the site visit was to review the drillhole database, validation procedures, and exploration procedures; define geological modelling procedures; examine drill core, interview Project personnel and arrange for receipt by AMC of all relevant information for the preparation of a mineral resource model and the compilation of a technical report.

AMC briefly reviewed core for mineralized sections for three diamond drillholes. RC chips for three RC holes were also reviewed. The diamond core drillholes and RC chips examined by AMC are listed in Table 12-1.

As the deposit geology has undergone a number of reinterpretations, most drillholes have been updated to the current definition of major lithological units comprising Upper Volcanic and Lower Volcanic units. The update and review of lithological codes by Geoteam is now complete, but was not completed for all drillholes at the time of AMC's site visit. Logging reviewed by AMC was found to be generally consistent. In some cases, lithological units were not identified correctly or needed to be reviewed on the basis of Upper and Lower Volcanic unit classification. The re-evaluation of lithology in terms of the two broad volcanic units has been completed. Summary drillhole logs are overall consistently logged, with only minor inconsistencies. The Upper and Lower Volcanic units are more difficult to identify on the basis of lithological logging that was completed prior to the introduction of summary logs.

Diamond core and reverse circulation logging procedures, as discussed with Geoteam personnel, are carefully undertaken, and meet best-practice standards as considered by the Qualified Person for this section. A review of drill cuttings from the reverse circulation chip library shows that Upper and Lower Volcanic units are readily identified by these samples.

Access to the Project drillhole locations was partially limited because of snow cover but access to parts of the TAA zone was possible. Using a hand-held GPS, AMC was able to confirm the UTM coordinates for two RC holes drilled in 2016: RCA-561 and RCA-564 with a maximum error of 3.5 m to surveyed coordinates.

AMC visited the Lydian exploration camp during the site visit. No drilling by diamond drilling or reverse circulation drilling was active during the time of the site visit.

Table 12-1: Drillholes Reviewed by AMC

Drillhole	Drillhole Type
DDA-398	Diamond
DDA400	Diamond
DDA-406	Diamond
RCA-572	Reverse circulation
RCA-581	Reverse circulation
RCA-583	Reverse circulation

Source: Samuel Engineering (2017)

12.2.2 Assay Database Verification

AMC completed standard validation checks to the entire database to ensure that the drillhole database provided to AMC does not contain duplicated data, overlapping intervals, unmatched drillhole identifiers, and incorrect data values. No matters of concern were identified.

AMC also completed a check of new database assay values added for the 2016 drilling campaign. AMC randomly selected approximately 10% of the gold and silver assays which were checked against assay certificates supplied by Lydian. No errors were found.

AMC concludes that the Amulsar Project gold assay drillhole data provided by Lydian is appropriate for the estimation of mineral resources.

No additional assay data has been reviewed since 2016. No further drilling on the project has been completed in the period 2017 to 2019.

13 Mineral Processing and Metallurgical Testing

13.1 Introduction

The metallurgical testing program was developed to determine:

1. Metal recoveries;
2. Most suitable Process options; and
3. Process flow sheets

The following testwork programs have been completed to date on bulk composite samples representing the three main Amulsar deposits; Tigranes, Artavasdes and Erato:

- SGS North America – 2015;
- Kappes, Cassiday & Associates (KCA) – 2012/2013;
- Wardell Armstrong International (WAI) – 2010/2011;
- SGS UK – 2009; and
- SGS Lakefield – 2008.

Testwork has included:

- Ore characterization tests;
- Fine bottle roll leach tests;
- Coarse bottle roll leach tests; and
- Column leach tests.

Results from cyanidation tests conducted by SGS North America in 2015 on drillhole composites from Tigranes and Artavasdes were the primary source used to develop the recovery estimates reported in this study. Since Erato was not tested under this program, recoveries for the Erato were projected from the 2013 Kappes, Cassiday & Associates (KCA) testwork. The results of the testing program indicate excellent gold recoveries at a 19 mm crush size with low to moderate reagent requirements, implying amenability to heap leaching. Silver recoveries are generally low. Column leach test results carried out on core samples by WAI, SGS and KCA generally support these conclusions.

Kappes, Cassiday & Associates performed a re-review of Lydian's Amulsar Heap Leach Project (Section 13.14) and issued a report titled Technical Review of the Design and Planned Operations of Lydian's Amulsar Project dated 25 September 2017.

In the 2019 update of this report, the total tonnage to be put under leach was increased from 100 Mt to 120 Mt. These additional 20 Mt would be sourced from the three mine locations and therefore would have similar metallurgical characteristics and response to heap leaching.

The additional 20 Mt would be mined as per the mine plan, the production plan and the resultant gold model. The gold model was updated to incorporate these additional ore tonnes and timing sequence of the mine development.

The predicted field gold and silver recoveries, reagent consumptions, leach time and crush size based on the available testwork results as per the 2017 Feasibility Report and the review of the testwork by KCA. The results are summarized in Table 13-1.

Table 13-1: Predicted Leach Results

	Tigranes	Artavasdes	Erato
Gold Recovery (%)	87.1	87.1	87.5
Silver Recovery (%)	14.6		
NaCN Consumption (kg/t)	0.10		
Lime Consumption (kg/t)	2.0		
Leach Time (days)	60		
Crush Size (mm)	19		

Source: Samuel Engineering (2019)

Table 13-2 provides an overview of the testwork presented in the 2017 Feasibility Study.

Sections 13.2 to Section 13.15 provide further detail of the testwork programs.

Table 13-2: Testwork Summary

Date	Testwork Program / Area	Description	Conclusions / Outcomes
2008	SGS Lakefield Research	The purpose of the program was to evaluate the response of the sample to basic metallurgical processes.	For all tests, a gold recovery of 90% was established after only 8 hours, and reached 95% after 24 hours, both with modest to moderate sodium cyanide (NaCN) consumptions;
			The results suggested that the mineralization is amenable to heap leaching and conventional whole ore cyanidation. The recovery of gold was in the range of 96% to 97%, leaving a residue assay of 0.03 to 0.06 g/t gold;
			The reagent consumptions were very low, below 0.1 kg/t NaCN and 0.3 kg/t lime.
2009	SGS Mineral Services UK Ltd.	Focused on coarser fractions and lower cyanide concentration solution than previous testwork and included column leach tests on large fraction half-core to simulate minimal or no crushing.	The results of the column leach test would tend to indicate that gold leach extraction is dependent on the crush, or liberation size, i.e., the finer the crush size the higher the gold leach extraction.
	Two different size fractions, 75 µm and 2 mm, were used for cyanidation bottle roll tests.	The testwork was conducted on three master composites (labelled A, B, and C) of half drill core samples from different parts of the Tigranes and Artavasdes areas. The composites are differentiated by alteration, gold and multi-element distribution. The three composites have head grades ranging from 1.09 g/t to 1.29 g/t Au.	A review of all final gold recovery results for all tests shows that, of the three composites, composite A produced the highest level of gold recovery in all but the -38 mm column test. The overall final gold recovery attainable for each composite and testing of whole ore and coarse cyanidation bottle roll leach tests and column leach tests is summarized in Table 13-9. The results show that there is a reduction in gold extraction with increasing particle size.
		Metallic screens of the composites show that greater than 98% of the gold has a size fraction less than 106 µm. The results confirm the observations made in previous work, indicating that a gravity concentration step is not warranted with insignificant coarse gold component present.	These initial scoping testwork results suggest attractive processing economics of the Amulsar Project. Bulk mining of low-grade ore with a heap leach operation requiring only a minor crush, or possibly ROM ore dump leaching, are feasible.

Date	Testwork Program / Area	Description	Conclusions / Outcomes
2010	Wardell Armstrong International	Lydian commissioned Wardell Armstrong International (WAI) to undertake a further program of laboratory testwork (WAI 2011) on samples from the Amulsar deposit (Erato, Tigranes and Artavasdes), through further bottle rolls and column tests on the two composite samples originally tested by SGS. The testwork generally focused on leaching at finer crush sizes and using higher cyanide concentrations than were used in the SGS testwork.	Based on the results in Table 13-10, WAI concluded that the optimum crush size for both samples is probably 12 mm and the optimum cyanide concentration is 0.05%. However, after reviewing the leach residue data based in Table 13-11, it can be concluded that statistically there was no difference in residue grade with crush size or cyanide concentration. The difference in percent extraction is due to the difference in the calculated head grade.
			Tests using the higher cyanide concentrations also gave higher cyanide consumptions and the additional gold recovery achieved needs to be related to the additional cyanide costs. The same is true for the additional capital and operating costs of crushing to the finer sizes.
			The outcome from these tests provided an indication of metallurgical performance with respect to gold and silver leach recoveries, as well as reagent consumptions. It was concluded that the Amulsar ore types were amenable to processing using heap leach technology, and both a high gold leach recovery and low reagent consumptions were achievable.
2011	Wardell Armstrong International	The December 2011 WAI testwork program consisted of coarse cyanidation bottle roll leach & column leach tests. The testwork program was conducted on master composites representing Tigranes, Artavasdes & Erato, plus the four main rock types; Medium Pervasive Iron Oxide MPF, Siliceous Breccia (SB), Fault Gouge (FG), and Gossan (GSN), to determine any metallurgical variability. Testwork did not evaluate crush size but only the rock types, although test were carried out at 12 & 19 mm.	Based on these tests it was concluded that the optimum crush size was -12 mm. Gold leach recoveries for the Tigranes, Artavasdes and Erato master composites were 89.5%, 95.1% and 97.7% respectively, after 47 days of leaching as demonstrated in Table 13-13 below. The variability column leach tests conducted on pervasive iron oxide, siliceous breccia, fault gouge, and gossan rock types showed respective gold leach recoveries of 96.6%, 85.9%, 92.4% and 84.4%.
2012	Kappes Cassiday & Associates	Ore Characterization & Fine Bottle Roll Cyanidation Leach Tests	CWi values for the Erato deposit are higher compared to those measured for Tigranes and Artavasdes deposits. The ore at Erato is found deeper in the geological system where the ore is more silicified i.e. harder.
		Ore characterization tests;	The average abrasion index for all of the samples tests from the three deposits was 0.3479g. The Amulsar ores would be considered moderately abrasive and is directly related to the degree of silicification.
		Fine cyanidation bottle roll leach (simulating conventional CIL); and	Average gold leach recoveries for the bulk samples, half core and full core column leach tests were 90.0%, 94.6% and 91.9% respectively, after 60 to 70 days of leaching. The calculated gold recovery to doré for the Tigranes and Artavasdes deposits is 88.1%, and 86.3%. Silver recovery to doré for the Tigranes and Artavasdes deposits is calculated to be 30.3% and 31.8% respectively.
		Column leach tests (simulating heap leaching).	Average cyanide and lime consumption for the column leach tests was 0.20 kg/t and 2.01 kg/t ore.
2013	Kappes Cassiday & Associates	Testwork completed in 2013 was carried out on samples from the Erato deposit. Test parameters followed those used for the earlier test programs. Samples were composited, crushed, split into duplicate head samples and assayed for gold and silver.	As expected, the 12.5 mm crush samples showed lower extractions than the pulverized samples with P80's of 75 µm. Testwork results are shown in Tables 13-18 and 13-19.
		Details of the results for copper, mercury, and ICP multi-element	A summary of results in Table 13-20 show the gold and silver extractions achieved.

Date	Testwork Program / Area	Description	Conclusions / Outcomes
		analysis are available in the KCA reports, "Amulsar Project Erato Zone Report of Metallurgical Testwork" February, 2013 and in the report, Amulsar Project – Metallurgical Testwork, KCA Report No. KCA0120006_03, March, 2012.	
		A screen analysis of the crushed materials was performed to determine the distribution of precious metals values prior to leaching. That analysis was compared to the measured head grades for each composite as shown below in Table 13-15:	Reagents averaged 0.49 kg/t cyanide consumption and 1.55 kg/t lime addition
2015	SGS North America	Sample Preparation and Head Sample Chemical Characterization by Size Fraction;	Reagents averaged 0.49 kg/t cyanide consumption and 1.55 kg/t lime addition
	In February 2015, SGS North America Inc., Tucson, Arizona	Cyanidation Bottle Roll Testing;	Agitated cyanide bottle roll tests indicated final gold extractions ranging from 58% to 96%. The bottle rolls were performed 45% solids by weight, pH of 11.0 and a sodium cyanide concentration of 250 ppm. Sodium cyanide (NaCN) consumptions ranged from 0.002 kg/t to 0.092 kg/t. Lime (CaO) consumptions ranged from 0.65 kg/t to 3.51 kg/t.
		Locked Cycle Column Leach Testing at 19 mm and 12.5 mm Crush Sizes (P100), in both single columns and 3-in-series columns, with analysis of daily solution samples;	Column leach testing was conducted on the twelve composites and the results are summarized in Table 13.25. Each of the twelve composites was subjected to column leach testing. Testing was conducted at two crush sizes: P100 of 19 mm and P100 of 12.5 mm. Testing was conducted in either single-stage tests or three-in-series tests. In total, twelve single column tests and six series column tests were conducted, representing a total of 30 column tests. Each of the twelve composites was tested at a crush size P100 of 19 mm, while six of the composites were additionally tested at crush size P100 of 12.5 mm. Final gold extractions ranged from 55.1% to 98.4%. Trends comparing bottle roll test final gold extraction data to column test final gold extraction data were generally consistent.
		Activated Carbon Adsorption and Analysis; and	Column test final gold extractions at a crush size of 12.5 mm were generally higher than that at a crush size of 19 mm, based on the six composite samples tested at both crush sizes. However, the difference in residue grade between the two crush sizes is 0.01 g/t which is within sampling and assay error.
		Residue Preparation and Assay.	Final silver extractions ranged from 1.9% to 35.4%. Sodium cyanide (NaCN) consumptions ranged from 0.01 kg/t to 0.21 kg/t. Lime (CaO) consumptions ranged from 0.49 kg/t to 4.95 kg/t.

Source: Samuel Engineering (2019)

13.2 SGS Lakefield Research (2008)

In June 2008, a gold recovery test program was undertaken at SGS Lakefield in Canada on a crushed continuous half drill core from the entire 146 m length of drillhole DDA-004, a scout hole from the 2007 drill program. The purpose of the program was to evaluate the response of the sample to basic metallurgical processes. The following results were achieved:

- For all tests, a gold recovery of 90% was established after only 8 hours, and reached 95% after 24 hours, both with modest to moderate sodium cyanide (NaCN) consumption;

- The results suggested that the mineralization is amenable to heap leaching and conventional whole ore cyanidation. The recovery of gold was in the range of 96% to 97%, leaving a residue assay of 0.03 to 0.06 g/t gold; and
- The reagent consumptions were very low, below 0.1 kg/t NaCN and 0.3 kg/t lime.

13.3 SGS Mineral Services UK Ltd. (2009)

During 2009, Lydian engaged SGS Mineral Services UK Ltd to conduct further testwork, focusing on coarser fractions and lower cyanide concentration solution than previous testwork, and included column leach tests on large fraction half-core to simulate minimal or no crushing.

The testwork was conducted on three master composites (labelled A, B, and C) of half drill core samples from different parts of the Tigranes and Artavasdes areas. The composites are differentiated by alteration, gold and multi-element distribution. The three composites have head grades ranging from 1.09 g/t to 1.29 g/t Au.

Metallic screens of the composites show that greater than 98% of the gold has a size fraction less than 106 µm. The results confirm the observations made in previous work, indicating that a gravity concentration step is not warranted with insignificant coarse gold component present.

Two different size fractions, 75 µm and 2 mm, were used for cyanidation bottle roll tests.

13.3.1 -75 µm Bottle Roll Leach Tests

Bottle roll leach tests were conducted at -75 µm to determine leach recoveries attainable by conventional CIL. Results of the whole ore cyanidation bottle roll leach tests are shown in Table 13-3.

Table 13-3: Whole Ore Cyanidation Leach Tests

Leach Period, hours	Au Recovery, %		
	Comp A	Comp B	Comp C
24	83.7	81.8	80.8
48	96.2	90.2	89.1

Source: Samuel Engineering (2017)

Cyanide and lime consumptions were in the range of 0.05 kg/t to 0.10 kg/t and 1.13 kg/t to 1.32 kg/t respectively.

13.3.2 -2 mm Bottle Roll Leach Tests

Bottle roll leach tests were conducted at -2 mm to determine leach recoveries attainable by heap leach technology. Results of the coarse ore cyanidation bottle roll leach tests are shown in Table 13-4.

Table 13-4: Coarse Ore Cyanidation Leach Test

Leach Period, days	Au Recovery, %		
	Comp A	Comp B	Comp C
1	89.1	81.2	78.2
14	95.1	91.8	89.2

Source: Samuel Engineering (2017)

Cyanide and lime consumptions were in the range 0.08 kg/t to 0.09 kg/t and 1.06 kg/t to 1.20 kg/t respectively.

13.3.3 Column Leach Tests

Column leach tests were carried out at crush sizes of minus 38 mm and minus 19 mm. The column leach tests were carried out for a total of 144 days, at a crush size of minus 38 mm, and for 72 days at a crush size of minus 19 mm.

Results of the column leach tests at a crush size of minus 38 mm are shown in Table 13-5. Cyanide and lime consumptions were in the range 0.18 kg/t to 0.31 kg/t and 0.63 kg/t to 0.97 kg/t respectively.

Results of the column leach tests at a crush size of minus 19 mm are shown in Table 13-6. Cyanide and lime consumptions were in the range 0.10 kg/t to 0.13 kg/t and 0.90 kg/t to 1.14 kg/t respectively.

Table 13-5: Column Leach Tests (-38 mm)

Leach Period, days	Au Recovery, %		
	Comp A	Comp B	Comp C
70	56.7	71.0	53.1
144	68.5	80.3	64.4

Source: Samuel Engineering (2017)

Table 13-6: Column Leach Tests (-19 mm)

Leach Period, days	Au Recovery, %		
	Comp A	Comp B	Comp C
35	86.0	85.1	73.0
72	89.1	88.6	76.5

Source: Samuel Engineering (2017)

The results of the column leach test would tend to indicate that gold leach extraction is dependent on the crush, or liberation size, i.e., the finer the crush size the higher the gold leach extraction.

Data from the leach residue shows significant improvement at the -19 mm crush size when compared to the -38 mm crush size as presented in Table 13-7. It should be noted here that the -38 mm sample had over 75% of the material greater than 25 mm which is not a representative size distribution.

Table 13-7: SGS Column Test Gold Residue

Composite A			
Size, mm	**Head, g/t**	**Residue, g/t**	**Extraction, g/t**
19	1.19	0.10	1.09
38	1.29	0.40	0.88
Composite B			
Size, mm	**Head, g/t**	**Residue, g/t**	**Extraction, g/t**
19	1.14	0.13	1.01
38	1.19	0.23	0.96
Composite C			
Size, mm	**Head, g/t**	**Residue, g/t**	**Extraction, g/t**
19	1.58	0.37	1.21
38	1.79	0.64	1.15

Source: Samuel Engineering (2017)

A review of all final gold recovery results for all tests shows that, of the three composites, composite A produced the highest level of gold recovery in all but the -38 mm column test. The overall final gold recovery attainable for each composite, including whole ore and coarse cyanidation bottle roll leach tests and column leach tests is summarized in Table 13-8. The results show that there is a reduction in gold extraction with increasing particle size.

These initial scoping testwork results suggest attractive processing economics of the Amulsar Project. Bulk mining of low-grade ore with a heap leach operation requiring only a minor crush, or possibly ROM ore dump leaching, are feasible.

Table 13-8: Final Gold Recovery Summary by Test and Composite

Liberation Size	Test Type	Au Recovery, %		
		Comp A	Comp B	Comp C
80% -75 µm	Bottle roll	95.8	95.2	93.2
-2 mm	Bottle roll	95.1	91.8	89.2
-19 mm	Column	89.1	88.6	76.5
-38 mm	Column	68.5	80.3	64.4

Source: Samuel Engineering (2017)

13.4 Wardell Armstrong International (2010)

Previous testwork programs undertaken by SGS have indicated that the gold mineralization is readily extracted using cyanidation leaching, with gold recoveries of 94% to 97% being achieved after grinding to between 75 µm and 150 µm.

Column leach testing on two composite samples, designated “A” and “B” gave gold recoveries of approximately 90%, at a crush size of 100% passing 19 mm after 70 days of leaching. Bottle roll testing had indicated that gold recoveries of up to 94.7% were achievable at a crush size of minus 12 mm.

Lydian commissioned Wardell Armstrong International (WAI) to undertake a further program of laboratory testwork (WAI 2011) on samples from the Amulsar deposit (Erato, Tigranes and Artavasdes), including further bottle rolls and column tests on the two composite samples originally tested by SGS. The testwork generally focused on leaching at finer crush sizes and using higher cyanide concentrations than were used in the SGS testwork.

The two samples tested were “Sample A” (HWA 149, weighing 120 kg) and “Sample B” (HWA 150, weighing 330 kg).

The program of column testwork was undertaken using cyanide concentrations of 0.075%, 0.050% and 0.025%. The crush sizes investigated were 100% passing 38 mm, 25 mm, 18 mm and 12 mm. The columns were irrigated at a rate of 10 L/m^2/h, and the leach period was 68 days. The column leach test results are given in Table 13-9.

Table 13-9: Column Leach Test Results Summary

Sample	P_{100} Crush Size, mm	Cyanide Conc, %	Au Recovery, %
A	25	0.05	91.9
A	19	0.05	93.5
A	12	0.05	94.8
B	38	0.05	88.6
B	25	0.05	88.6
B	25	0.075	89.1
B	19	0.025	89.2
B	19	0.05	93.1
B	19	0.075	92.3
B	12	0.025	89.3
B	12	0.05	90.7
B	12	0.075	94.9

Source: Samuel Engineering (2017)

Based on the results in Table 13-9, WAI concluded that the optimum crush size for both samples is probably 12 mm and the optimum cyanide concentration is 0.05%. However, after reviewing the leach residue data based in Table 13-10, it can be concluded that statistically there was no difference in residue grade with crush size or cyanide concentration. The difference in percent extraction is due to the difference in the calculated head grade.

Table 13-10: Summary of Extraction Using Residue

Composite	P_{100}, mm	Cyanide Concentration, ppm	Head, g/t	Residue, g/t	Extraction, g/t
A	25	500	1.68	0.14	1.54
A	25	500	1.18	0.08	1.11
A	19	500	1.34	0.08	1.27
A	19	500	1.24	0.10	1.14
1	12	500	1.26	0.08	1.18

Composite	P_{100}, mm	Cyanide Concentration, ppm	Head, g/t	Residue, g/t	Extraction, g/t
A	12	750	0.93	0.09	0.85
B	25	250	0.98	0.17	0.81
B	25	500	1.02	0.12	0.90
B	19	750	1.09	0.10	0.99
B	19	250	1.24	0.08	1.16
B	12	500	1.22	0.13	1.09
B	12	750	1.32	0.11	1.21

Source: Samuel Engineering (2017)

Tests using the higher cyanide concentrations also indicated higher cyanide consumptions and the additional gold recovery achieved needs to be weighted against the additional cyanide costs. The same is true for the additional capital and operating costs of crushing more finely.

The outcome from these tests provided an indication of metallurgical performance with respect to gold and silver leach recoveries, as well as reagent consumption. It was concluded that the Amulsar ore types were amenable to processing using heap leach technology, and both a high gold leach recovery and low reagent consumption were achievable.

13.5 Wardell Armstrong International (2011)

The December 2011 WAI testwork program consisted of coarse cyanidation bottle roll leach and column leach tests. The testwork program was conducted on master composites representing Tigranes, Artavasdes and Erato, plus the four main rock types; Medium Pervasive Iron Oxide MPF, Siliceous Breccia (SB), Fault Gouge (FG), and Gossan (GSN), to determine any metallurgical variability. Testwork did not evaluate crush size but only the rock types, although tests were carried out at 12 mm and 19 mm.

Results of column leach tests carried out on the different rock types are shown in Table 13-11.

Table 13-11: Summary of Column Test Results, Rock Types

Sample	Head Grade				Residue Grade			Recovery	
	WAI Assay (Au g/t)	Fractions (Au g/t)	Calc. (Au g/t)	WAI Assay (Ag g/t)	Bulk (Au g/t)	Fractions (Au g/t)	WAI Assay (Ag g/t)	Au (%)	Ag* (%)
MPF	0.427	0.429	0.430	1.58	0.015	0.024	0.70	97%	56%
SB	0.383	0.304	0.365	2.12	0.054	0.060	0.70	86%	67%
FG	2.055	1.924	2.064	1.58	0.156	0.170	1.00	92%	37%
GSN	3.76	3.282	3.128	3.25	0.474	0.477	2.08	84%	36%
							Average	**90%**	**49%**

Sample	$T_s:T_s$ Ratio	Cyanide Consumption (kg/t)	Slump %	Days	Au Recovery	
					to Solution (mg)	to Carbon (mg)
MPF	3.59	0.667	0.12	47	18.68	19.13
SB	2.96	0.413	0.61	47	15.67	16.02
FG	6.41	0.684	0.20	75	95.37	95.10
GSN	11.34	2.002	0.72	114	120.79	122.15

Note: Ag* - Ag recovery based on head and leach residue assays
Source: Samuel Engineering (2017)

Based on these tests it was concluded that the optimum crush size was -12 mm. Gold leach recoveries for the Tigranes, Artavasdes and Erato master composites were 89.5%, 95.1% and 97.7% respectively, after 47 days of leaching, as demonstrated in Table 13-12 below. The variability column leach tests conducted on pervasive iron oxide, siliceous breccias, fault gouge, and gossan rock types showed respective gold leach recoveries of 96.6%, 85.9%, 92.4% and 84.4%.

Table 13-12: Summary of Master Composites Head Grades and Samples Recovery

Sample	Head Grade				Recovery		Au Recovery	
	WAI Assay (Au g/t)	Fractions (Au g/t)	Calculated (Au g/t)	WAI Assay (Ag g/t)	Au (%)	Ag* (%)	to Solution (mg)	to Carbon (mg)
MC 068 - Erato	0.843	0.849	0.845	1.81	98%	64%	40.20	41.86
MC 070 - Artavasdes	0.703	0.761	0.747	2.24	95%	77%	35.08	35.21
MC 071 - Tigranes	1.833	1.485	1.766	2.39	89%	57%	72.70	74.43
Averaged Recoveries					**94%**	**66%**		

Source: Samuel Engineering (2017)

Average cyanide consumption for the master composite column leach tests was 0.47 kg/t ore.

13.6 Kappes Cassiday & Associates (2012)

As part of the testwork requirements for the "Amulsar Feasibility Study", Kappes Cassiday and Associates (KCA) carried out a metallurgical testwork program consisting of:

- Ore characterization tests;
- Fine cyanidation bottle roll leach (simulating conventional CIL); and
- Column leach tests (simulating heap leaching).

The testwork program was conducted on master composites prepared from selected intervals taken from bulk ore samples, half and whole core – representing Tigranes and Artavasdes drillholes located within the starter and final pit shells.

13.6.1 Ore Characterization

Ore characterization tests included crushing work index and abrasion index. Core samples from the Tigranes, Artavasdes and Erato deposits were tested. A total of 20 pieces of core were selected for crushing work index (CWi) testing. Testwork results are shown in Table 13-13.

Table 13-13: Crushing Work and Abrasion Index Test Results

Sample	Depth	Abrasion Index (20-12mm)	Crushing Work Index (75 - 50mm)		Comments
			(kW-hr/ton)	(kW-hr/tonne)	
Erato DDAM-068	21.4-26.2 m	0.2716	17.03	18.78	Massive silicates volcanics
	44.9-50.0 m	0.2519	10.53	11.61	Vuggy silica volcanics
	101.8-107 m	0.1348	8.22	9.06	Massive silica volcanics
Artavasdes DDAM-070	41.5-46.0 m				Highly weathered/fractured & non-competent sample, consisting of firm-soft clay and gravel within clay matrix.
	106.0-111.8 m				
	127.0-133.8 m	0.1885	11.37	12.53	Massive silica breccia
Tigranes DDAM-071	54.1-58.9 m	0.4908	8.31	9.16	Massive silica volcanic
	90.2-95.5 m	0.3786	7.5	8.27	Faulted & FeOx volcanics
	119.0-124.4 m	0.0080	3.07	3.39	Porphyry, contact

Source: Samuel Engineering (2017)

CWi values for the Erato deposit are higher compared to those measured for Tigranes and Artavasdes deposits. The ore at Erato is found deeper in the geological system where the ore is more silicified, i.e., harder.

The average abrasion index for all of the sample tests from the three deposits was 0.3479 g. The Amulsar ores would be considered moderately abrasive and is directly related to the degree of silicification.

13.6.2 Fine Bottle Roll Cyanidation Leach Tests

The fine bottle roll cyanidation leach tests were conducted at minus 75 µm, while the column leach tests were conducted at P_{100} of minus 12.5 mm. Results of the fine bottle roll cyanidation leach tests and column leach tests are summarized in Table 13-14 and Table 13-15.

Table 13-14: Fine Cyanidation Bottle Roll Leach Tests (Tigranes/Artavasdes)

KCA Sample No.	KCA Test No.	Description	Grind Size, (mm)	Head Average (g Au/t)	Calc. Head (g Au/t)	Extracted (g Au/t)	Avg. Tails (g Au/t)	Au Extracted (%)	Leach Time (days)	Consumption NaCN (kg/t)	Addition $Ca(OH)_2$, (kg/t)
Bulk Sample Composites											
61723	61737A	TM-1 thru TM-18	0.075	4.470	4.317	3.987	0.330	92	2	0.63	2.00
61724	61737B	ATM-1 thru ATM-26	0.075	0.647	0.641	0.576	0.065	90	2	0.44	1.00
½ Split Core Composites											
61730	61765A	DDA-018	0.075	0.528	0.594	0.582	0.012	98	2	0.17	1.00
61731	61765B	DDA-022 and DDA-055	0.075	0.500	0.430	0.400	0.029	93	2	0.07	1.00
61732	61765C	DDA-033	0.075	0.997	0.947	0.927	0.020	98	2	0.28	2.00
61733	61766A	DDA-035 and DDA-055	0.075	1.059	1.178	1.130	0.048	96	2	0.17	1.50
61734	61766B	DDA-046 and DDA-076	0.075	1.497	1.401	1.370	0.031	98	2	0.30	2.50
61735	61766C	DDA-055	0.075	1.044	1.081	1.060	0.021	98	2	0.26	1.50
61736	61766D	DDA-076	0.075	2.413	2.536	2.468	0.068	97	2	0.31	1.50
Whole Core Composites											
61768B	62501A	DDAM-130	0.075	1.312	1.348	1.290	0.058	96	4	0.13	2.00
61769B	62501B	DDAM-137	0.075	1.557	1.520	1.470	0.050	97	4	0.24	1.50
61770B	62501C	DDAM-140	0.075	1.403	1.490	1.421	0.069	95	4	0.40	1.50
61771B	62501D	DDAM-148	0.075	0.734	0.792	0.754	0.038	95	4	0.28	1.50
61772B	62502A	DDAM-169	0.075	0.461	0.408	0.379	0.029	93	4	0.35	1.50
61773B	62502B	DDAM-174	0.075	0.759	0.777	0.678	0.099	87	4	0.56	2.50

Source: Samuel Engineering (2017)

Table 13-15: Column Leach Test Results - Tigranes/Artavasdes

Deposit	Sample – KCA Sample Number/Test Number	Calc Head Assay, g/t		Extraction, %		Reagent Consumption, kg/t	
		Au	Ag	Au	Ag	NaCN	$Ca(OH)_2$
Tigranes	Bulk – 61723/61738	4.50	8.72	91	5	0.34	1.5
Artavasdes	Bulk – 61724/61741	0.67	4.11	89	48	0.12	1.0
Tigranes	Split Core – 61730/61744	0.56	0.52	96	34	0.18	2.0
Artavasdes	Split Core – 61731/61747	0.50	1.21	92	43	0.17	2.0
Artavasdes	Split Core – 61732/61750	0.95	0.76	93	22	0.15	2.5
Artavasdes	Split Core – 61733/61753	1.13	13.21	91	37	0.22	2.5
Tigranes	Split Core – 61734/61756	1.64	1.30	97	73	0.32	3.1
Tigranes	Split Core – 61735/61759	1.18	1.44	96	48	0.18	2.0
Tigranes	Split Core – 61736/61762	2.44	0.47	97	30	0.23	1.5
Tigranes	Whole Core – 61768/61775	1.27	1.35	92	20	0.14	2.0
Tigranes	Whole Core – 61769/61778	1.60	1.16	92	9	<0.05	2.0
Artavasdes	Whole Core – 61770/61781	1.38	4.77	85	9	0.17	2.0
Artavasdes	Whole Core – 61771/61784	0.76	3.91	89	8	<0.05	2.0
Artavasdes	Whole Core – 61772/61784	0.45	8.90	92	93	0.17	2.0
Tigranes	Whole Core – 61773/61790	0.76	1.75	75	66	0.27	1.8

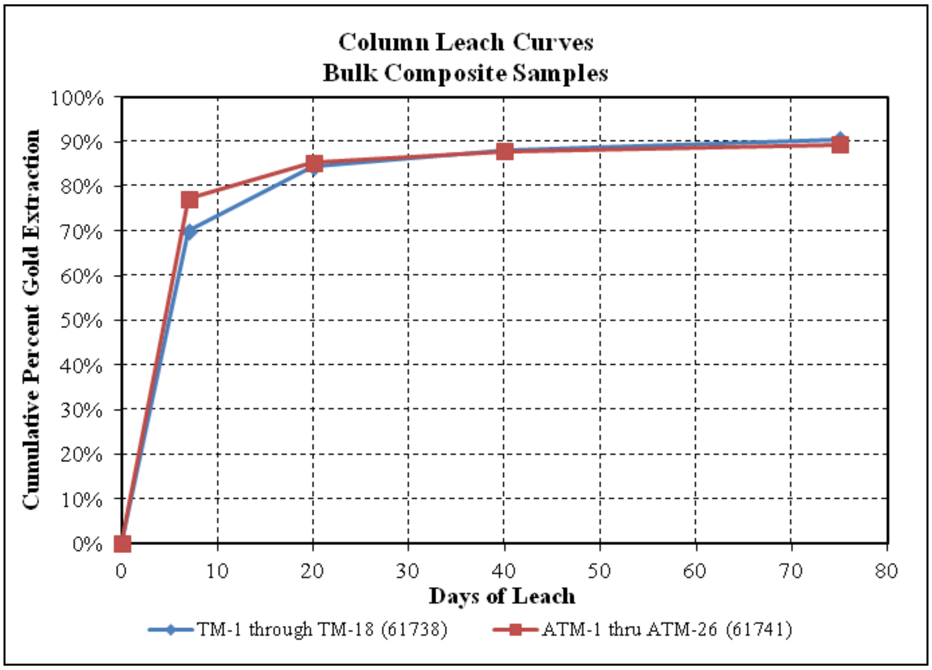
Source: Samuel Engineering (2017)

Average gold leach recoveries for the bulk samples, half core and full core column leach tests were 90.0%, 94.6% and 91.9%, respectively, after 60 to 70 days of leaching. The calculated gold recovery to doré for the Tigranes and Artavasdes deposits is 88.1%, and 86.3%, respectively. Silver recovery to doré for the Tigranes and Artavasdes deposits is calculated to be 30.3% and 31.8% respectively.

Average cyanide and lime consumption for the column leach tests was 0.20 kg/t and 2.01 kg/t ore.

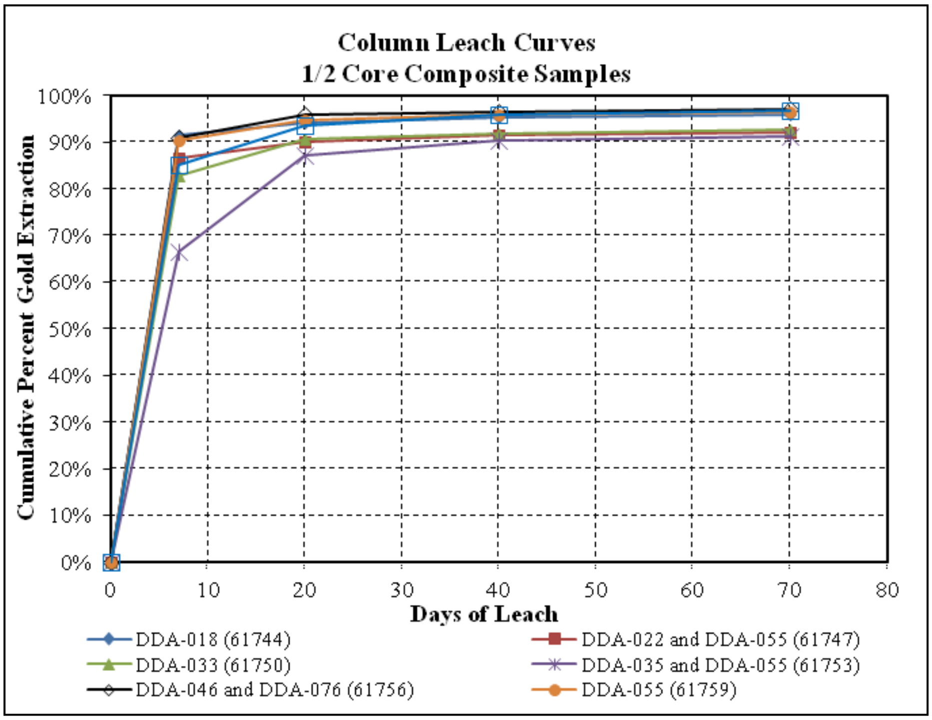
The gold leach curves for the bulk, half, and full core composites are represented graphically in Figure 13-1 to Figure 13-3.

Figure 13-1: Gold Leach Curves (Bulk Composite)



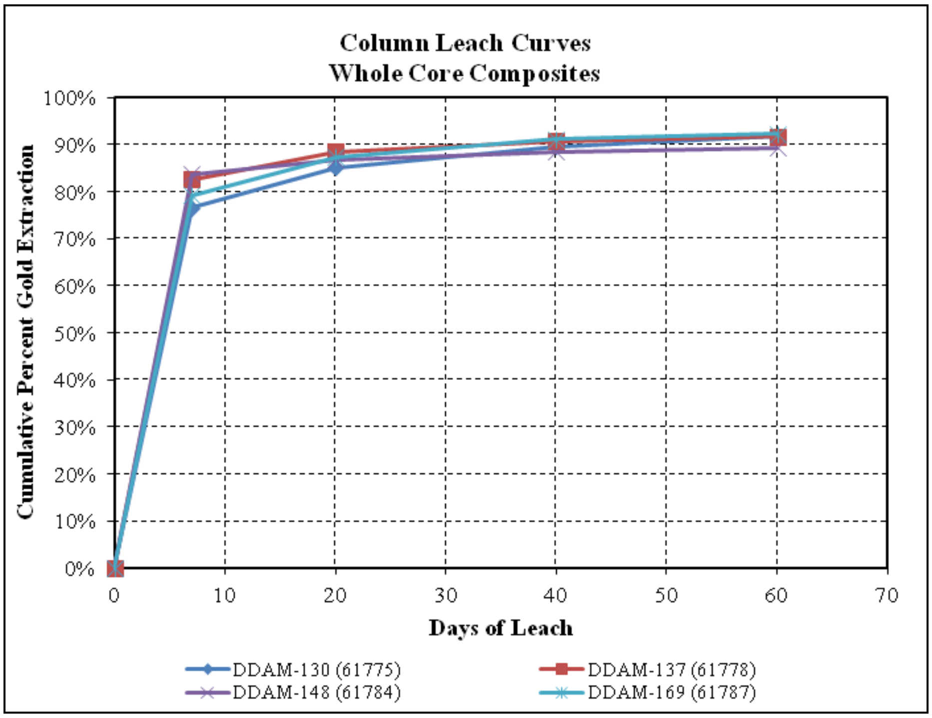
Source: Samuel Engineering (2017)

Figure 13-2: Gold Leach Curves (Half Core Composites)



Source: Samuel Engineering (2017)

Figure 13-3: Gold Leach Curves (Whole Core Composites)



Source: Samuel Engineering (2017)

13.7 Kappes Cassiday & Associates (2013)

Testwork completed in 2013 was carried out on samples from the Erato deposit. Test parameters followed those used for the earlier test programs. Samples were composited, crushed, split into duplicate head samples and assayed for gold and silver.

Details of the results for copper, mercury, and ICP multi-element analysis are available in the KCA reports, “Amulsar Project Erato Zone Report of Metallurgical Testwork” February 2013 and in the report, Amulsar Project – Metallurgical Testwork, KCA Report No. KCA0120006_03, March 2012.

A screen analysis of the crushed materials was performed to determine the distribution of precious metals values prior to leaching. That analysis was compared to the measured head grades for each composite as shown below in Table 13-16:

Table 13-16: Head Grade Analyses – Erato Zone

KCA Sample No.	Description	Measured Head Grade		Calculated from Screen Fractions	
		Au g/t	Ag g/t	Weighted Avg. Au g/t	Weighted Avg. Ag g/t
62513	DDA-030, 0.94 g/t Au	1.186	5.37	1.053	5.16
62514	DDA-030, 1.07 g/t Au	0.938	4.59	0.891	4.30
62515	DDA-278, 0.96 g/t Au	1.015	3.91	1.026	3.39
62516	DDA-276, 1.06 g/t Au	1.042	2.19	1.040	2.04
62517	DDA-290, 0.81 g/t Au	0.852	2.40	0.739	2.12
62518	DDA-340, 1.04 g/t Au	1.101	2.71	0.948	2.52
62544	DDAM - 130/148	1.125	2.40	0.967	0.84
62558	N2 Composite (DDA-103)	0.744	1.41	0.595	0.58
62559	N3 Composite (DDA-350)	1.221	2.50	1.203	1.46
62560	N4 Composite (DDA-358)	1.250	2.81	1.237	2.26
62561	N5 Composite (DDA-367)	1.203	2.76	1.229	1.92
Average		1.062	3.01	0.993	2.42

Source: Samuel Engineering (2017)

Bottle roll tests were conducted on both pulverized and crushed materials for samples 62513 through 62518. Additional samples, 62544, 62558 to 62561, were tested at 0.075 mm only. The purpose of these tests is to show ultimate extraction rates at different particle sizes under similar conditions. As expected, the 12.5 mm crush samples showed lower extractions than the pulverized samples with P_{80} of 75 µm. Testwork results are shown in Table 13-17 and Table 13-18.

Table 13-17: Bottle Roll Test Results for 12.5mm Crush Size – Erato Zone

KCA Sample No.	Description	Crush Size, mm	Calculated Head, Au g/t	Au Extracted, %	Consumption NaCN, kg/t	Addition $Ca(OH)_2$, kg/t
62513	DDA-030, 0.94 g Au/t	12.5	1.011	79	0.19	1.10
62514	DDA-030, 1.07 g Au/t	12.5	0.849	76	0.11	0.50
62515	DDA-278, 0.96 g Au/t	12.5	1.091	79	0.13	0.70
62516	DDA-276, 1.06 g Au/t	12.5	1.101	91	0.11	0.90
62517	DDA-290, 0.81 g Au/t	12.5	0.748	89	0.11	0.50
62518	DDA-340, 1.04 g Au/t	12.5	1.042	72	0.13	0.70
Average			0.974	81	0.13	0.73

Source: Samuel Engineering (2017)

Table 13-18: Cyanidation Bottle Roll Test Results for Pulverized Samples – Erato Zone

KCA Sample No.	Description	Target P_{80} Size (mm)	Calculated Head (Au g/t)	Au Extracted, (%)	Consumption NaCN (kg/t)	Addition $Ca(OH)_2$ (kg/t)
62513	DDA-030, 0.94 g Au/t	0.075	1.088	96	0.23	2.50
62514	DDA-030, 1.07 g Au/t	0.075	1.039	85	0.20	1.00
62515	DDA-278, 0.96 g Au/t	0.075	1.039	93	0.67	1.50
62516	DDA-276, 1.06 g Au/t	0.075	1.086	95	0.76	2.00
62517	DDA-290, 0.81 g Au/t	0.075	0.821	93	0.22	1.00
62518	DDA-340, 1.04 g Au/t	0.075	1.073	94	0.54	1.50
62544	DDAM-130/148	0.075	0.952	95	0.96	1.50
62544	DDAM-130/148	0.075	0.964	96	1.14	1.50
62558	N2 Composite (DDA-103)	0.075	0.710	94	0.86	1.50
62559	N3 Composite (DDA-350)	0.075	1.001	97	0.72	1.50
62559	N3 Composite (DDA-350)	0.075	1.018	96	0.79	1.50
62560	N4 Composite (DDA-358)	0.075	1.241	96	0.10	1.50
62561	N5 Composite (DDA-367)	0.075	1.154	96	0.65	1.50
Average			1.025	94	0.52	1.55

Source: Samuel Engineering (2017)

Column testwork was conducted on crushed materials with a target P_{100} of 12.5 mm and a final P_{80} for the residues of 9 mm. A summary of results in Table 13-19 show the gold and silver extractions achieved.

Table 13-19: Column Leach Test Head Grades and Extractions – Erato Zone

KCA Sample No. / Test No.	Description	Calculated Head, Au g/t	Calculated Head, Ag g/t	Extracted, % Au	Extracted, % Ag
62513/62519	DDA-030, 0.94 g Au/t	1.117	2.23	87	26
62514/62522	DDA-030, 1.07 g Au/t	0.951	2.79	85	18
62515/62525	DDA-278, 0.96 g Au/t	1.014	2.67	88	11
62516/62528	DDA-276, 1.06 g Au/t	1.143	1.90	95	14
62517/62531	DDA-290, 0.81 g Au/t	0.799	2.16	93	26
62518/62534	DDA-340, 1.04 g Au/t	1.037	2.27	82	25
62558/62567	N2 Composite (DDA-103)	0.756	0.82	88	52
62559/62570	N3 Composite (DDA-350)	1.182	1.56	94	52
62560/62573	N4 Composite (DDA-358)	1.331	2.34	95	53
62561/62576	N5 Composite (DDA-367)	1.233	1.23	94	24
Average		1.056	2.00	90	30

Source: Samuel Engineering (2017)

Columns were operated for 62, 73, and 59 days with lime additions varying from 1.0 kg/t to 2.51 kg/t, cyanide consumption from 0.41 kg/t to 0.62 kg/t and solution to ore ratios from 4.01 kg/t to 5.36 kg/t. Reagent consumption averaged 0.49 kg/t for cyanide and 1.55 kg/t for lime, as summarized in Table 13-20.

Table 13-20: Column Leach Test Parameters - Erato Zone

KCA Sample No.	Description	Days of Leach	Calculated Tail P_{80} Size, mm	Solution to Ore Ratio	Consumption NaCN, kg/t	Addition $Ca(OH)_2$, kg/t
62513	DDA-030, 0.94 g Au/t	62	9.2	4.01	0.62	1.51
62514	DDA-030, 1.07 g Au/t	62	9.9	4.23	0.47	1.01
62515	DDA-278, 0.96 g Au/t	62	9.7	4.08	0.50	1.01
62516	DDA-276, 1.06 g Au/t	62	9.7	4.32	0.51	1.00
62517	DDA-290, 0.81 g Au/t	62	9.6	4.20	0.41	1.00
62518	DDA-340, 1.04 g Au/t	62	9.7	4.41	0.43	1.01
62558	N2 Composite (DDA-103)	59	9.6	4.24	0.61	2.00
62559	N3 Composite (DDA-350)	59	9.5	4.25	0.43	2.00
62560	N4 Composite (DDA-358)	59	9.3	4.33	0.53	2.00
62561	N5 Composite (DDA-367)	59	9.3	4.46	0.40	2.00
Average			9.6	4.25	0.49	1.45

Source: Samuel Engineering (2017)

13.8 SGS North America (2015)

In February 2015, SGS North America Inc. (SGS) conducted a metallurgical study at the SGS facility in Tucson, Arizona. The scope of work included:

- Sample Preparation and Head Sample Chemical Characterization by Size Fraction;
- Cyanidation Bottle Roll Testing;
- Locked Cycle Column Leach Testing at 19 mm and 12.5 mm Crush Sizes (P100), in both single columns and 3-in-series columns, with analysis of daily solution samples;
- Activated Carbon Adsorption and Analysis; and
- Residue Preparation and Assay.

Twelve composite samples were prepared for this test program. The composites for each deposit are summarized in Table 13-21.

Table 13-21: Composite Deposit Location

Tigranes	Composite 01, Composites 3-4, and Composites 10-11
Artavasdes	Composites 05 thru 9 and Composites 12-13

Source: Samuel Engineering (2017)

Head assay values ranged from 0.2 g/t Au to 2.9 g/t Au. Assay results are summarized in Table 13-22 and Table 13-23.

Table 13-22: Amulsar Project – Head Assays – Summary of Results for P_{100} 19 mm

SAMPLE ID	Calculated Head (1)		Assay Head (2)	
	Au, ppm	Ag, ppm	Au, ppm	Ag, ppm
COMPOSITE-1 (DDAM-174 111m-120m)	2.25	12.7	2.23	11.8
COMPOSITE-3 (DDAM-174 125m-135m)	1.78	13.9	1.78	13.0
COMPOSITE-4 (DDAM-174 135m-145.5m)	0.23	2.7	0.22	2.5
COMPOSITE-5 (DDAM-148 67m-89m)	0.75	4.4	0.68	4.4
COMPOSITE-6 (DDAM-140 47m-77m)	2.89	15.3	2.91	15.4
COMPOSITE-7 (DDAM-140 77m-107m)	1.15	2.8	1.10	2.7
COMPOSITE-8 (DDAM-140 107m-117m)	0.78	4.1	0.81	4.2
COMPOSITE-9 (DDAM-140 117m-127m)	0.18	3.0	0.18	2.9
COMPOSITE-10 (DDAM-130 0m-75m)	0.27	1.6	0.28	1.6
COMPOSITE-11 (DDAM-137 13m-88m)	0.64	1.9	0.63	2.1
COMPOSITE-12 (DDAM-140 0m-31m)	0.26	2.8	0.29	3.0
COMPOSITE-13 (DDAM-148 90m-120m)	0.62	8.8	0.60	8.8

Notes: (1) Calculated Based on Screen Fraction Assays
(2) Pulverized Composite Assays
Source: Samuel Engineering (2019)

Table 13-23: Amulsar Project – Head Assays – Summary of Results for P_{100} 12.5 mm

SAMPLE ID	Calculated Head (1)		Assay Head (2)	
	Au, ppm	Ag, ppm	Au, ppm	Ag, ppm
COMPOSITE-6 (DDAM-140 47m-77m)	2.96	14.8	2.89	15.1
COMPOSITE-7 (DDAM-140 77m-107m)	1.15	2.9	1.17	3.0
COMPOSITE-10 (DDAM-130 0m-75m)	0.28	1.9	0.27	2.1
COMPOSITE-11 (DDAM-137 13m-88m)	0.68	2.2	0.67	2.3
COMPOSITE-12 (DDAM-140 0m-31m)	0.26	2.7	0.28	2.7
COMPOSITE-13 (DDAM-148 90m-120m)	0.59	8.6	**0.64**	**8.6**

Notes: (1) Calculated Based on Screen Fraction Assays
(2) Pulverized Composite Assays
Source: Samuel Engineering (2019)

Agitated cyanide bottle roll tests indicated final gold extractions ranging from 58% to 96%. The bottle rolls were performed at 45% solids by weight, pH of 11.0 and a sodium cyanide concentration of 250 ppm. Sodium cyanide (NaCN) consumption ranged from 0.002 kg/t to 0.092 kg/t. Lime (CaO) consumption ranged from 0.65 kg/t to 3.51 kg/t. Bottle results are presented in Table 13-24.

Table 13-24: Bottle Roll Test - Summary of Results

Test Number	Sample ID	Head Assay		Calculated Head		% Extraction		Reagent Consumption	
		Au, g/t	Ag, g/t	Au, g/t	Ag, g/t	Au, %	Ag, %	NaCN, kg/t	CaO, kg/t
BR-01	Composite 1	2.25	12.7	2.27	13.9	62.7	55	0.092	3.51
BR-02	Composite 3	1.78	13.9	1.75	15	58.4	52	0.039	1.66
BR-03	Composite 4	0.23	2.7	0.24	3	78.9	12	0.005	1.57
BR-04	Composite 5	0.75	4.4	0.79	4.5	93.7	10.7	0.086	0.65
BR-05	Composite 6	2.89	15.3	1.58	16.2	79.2	12.8	0.002	1.52
BR-06	Composite 7	1.15	2.8	1.1	3.2	87.3	12.5	0.043	0.73
BR-07	Composite 8	0.78	4.1	0.8	4.3	83.8	12.9	0.026	0.81
BR-08	Composite 9	0.18	3	0.13	3.3	68.2	19.5	0.013	0.67
BR-09	Composite 10	0.27	1.6	0.25	2	92.1	14.3	0.026	0.65
BR-10	Composite 11	0.63	1.9	0.62	2.7	95.1	7.3	0.017	0.84
BR-11	Composite 12	0.26	2.8	0.27	2.7	85.1	21	0.029	1.42
BR-12	Composite 13	0.62	8.8	0.54	8.9	96.3	7.2	0.038	0.97

Source: Samuel Engineering (2019)

Column leach testing was conducted on the twelve composites and the results are summarized in Table 13-25. Testing was conducted at two crush sizes: P_{100} of 19 mm and P_{100} of 12.5 mm. Testing was conducted in either single-stage tests or three-in-series tests. In total, twelve single column tests and six series column tests were conducted, representing a total of 30 column tests. Each of the twelve composites was tested at a crush size P_{100} of 19 mm, while six of the composites were additionally tested at crush size P_{100} of 12.5 mm. Final gold extractions ranged from 55.1% to 98.4%. Trends comparing bottle roll test final gold extraction data to column test final gold extraction data were generally consistent.

Table 13-25: Locked Cycle Column Leach Test Result Summary

Test No.	Sample ID	Crush Size P_{100} (mm)	Head Assay (g/t)		Lime Dose		Under Leach (days)	Final PLS			Final Residue (Assay Head)		Final Extraction (PLS)		Reagent Consumption	
			Au	Ag	BR (kg/t)	Added (kg/t)		Au (g/L)	Ag (g/L)	pH	Au (g/t)	Ag (g/t)	Au (%)	Ag (%)	NaCN (kg/t)	CaO (kg/t)
CL-01	Composite-01	19.0	2.25	12.6	3.51	2.00	90	0.01	0.18	11.20	0.88	7.06	57.8	35.40	0.21	4.95
CL-02	Composite-03	19.0	1.78	13.9	1.66	0.75	90	0.01	0.17	10.54	0.81	7.52	55.1	31.10	0.09	1.92
CL-03	Composite-04	19.0	0.23	2.7	1.57	0.75	60	0.01	0.01	10.39	0.07	2.50	68.5	3.90	0.05	1.07
CL-04	Composite-05	19.0	0.75	4.4	0.65	0.25	60	0.01	0.01	10.34	0.08	3.95	90.7	6.70	0.06	0.58
CL-05	Composite-06	19.0	2.89	15.3	1.52	0.50	60	0.01	0.04	11.34	0.27	12.97	90.8	5.30	0.11	2.5
CL-06	Composite-06	12.5	2.96	14.8	1.52	0.50	60	0.01	0.04	10.80	0.26	14.45	91.1	5.10	0.15	2.88
CL-07	Composite-07	19.0	1.15	2.8	0.73	0.25	60	0.01	0.01	10.54	0.17	3.00	86.4	3.40	0.03	0.58
CL-08	Composite-07	12.5	1.15	2.9	0.73	0.25	60	0.01	0.01	10.22	0.16	2.80	87.1	3.90	0.07	0.61
CL-09	Composite-08	19.0	0.78	4.1	0.81	0.25	60	0.01	0.01	10.44	0.14	4.30	83.8	2.60	0.03	0.64
CL-10	Composite-09	19.0	0.18	3.0	0.67	0.25	60	0.01	0.01	10.51	0.04	2.92	78.5	13.70	0.04	0.59
CL-11	Composite-10	19.0	0.27	1.6	0.65	0.25	60	0.01	0.01	10.96	0.02	1.78	93.1	6.20	0.02	0.72
CL-12	Composite-10	19.0	0.27	1.6	0.65	0.25	60	0.01	0.03	10.46	0.01	4.70	95.4	4.30	0.01	0.79
CL-13	Composite-10	19.0	0.27	1.6	0.65	0.65	60	0.01	0.01	10.26	0.02	1.87	94.5	6.90	0.03	0.51
CL-14	Composite-10	12.5	0.28	1.9	0.65	0.25	60	0.01	0.01	10.38	0.01	1.58	95.8	9.40	0.04	0.76
CL-15	Composite-10	12.5	0.28	1.9	0.65	0.25	60	0.01	0.01	10.33	0.01	2.06	94.5	5.70	0.04	0.55
CL-16	Composite-10	12.5	0.28	1.9	0.65	0.65	60	0.01	0.01	10.07	0.01	1.59	95.5	7.70	0.06	0.61
CL-17	Composite-11	19.0	0.63	1.8	0.84	0.50	60	0.01	0.01	10.99	0.04	2.39	94.4	2.90	0.04	1.05
CL-18	Composite-11	19.0	0.63	1.8	0.84	0.50	60	0.01	0.01	10.80	0.05	2.24	93.1	2.00	0.02	0.88
CL-19	Composite-11	19.0	0.63	1.8	0.84	0.84	60	0.01	0.01	10.40	0.05	1.97	92.9	2.90	0.04	0.8
CL-20	Composite-11	12.5	0.68	2.2	0.84	0.50	60	0.01	0.01	10.54	0.05	2.13	93.2	3.30	0.04	1.08
CL-21	Composite-11	12.5	0.68	2.2	0.84	0.50	60	0.01	0.01	10.57	0.05	2.25	92.8	2.60	0.04	0.99

Test No.	Sample ID	Crush Size P_{100} (mm)	Head Assay (g/t)		Lime Dose		Under Leach (days)	Final PLS			Final Residue (Assay Head)		Final Extraction (PLS)		Reagent Consumption	
			Au	Ag	BR (kg/t)	Added (kg/t)		Au (g/L)	Ag (g/L)	pH	Au (g/t)	Ag (g/t)	Au (%)	Ag (%)	NaCN (kg/t)	CaO (kg/t)
CL-22	Composite-11	12.5	0.68	2.2	0.84	0.84	59	0.01	0.01	10.30	0.05	2.18	92.6	1.90	0.05	0.86
CL-23	Composite-12	19.0	0.26	2.8	1.42	0.50	60	0.01	0.01	10.13	0.03	2.35	88.3	10.50	0.08	2.61
CL-24	Composite-12	19.0	0.26	2.8	1.42	0.50	60	0.01	0.01	11.32	0.04	2.41	82.9	9.80	0.07	2.35
CL-25	Composite-12	19.0	0.26	2.8	1.42	1.42	60	0.01	0.01	10.38	0.04	2.54	82.7	8.60	0.05	1.43
CL-26	Composite-12	12.5	0.26	2.7	1.42	0.50	60	0.01	0.01	11.48	0.03	2.60	86.7	10.00	0.11	2.72
CL-27	Composite-13	19.0	0.62	8.8	0.97	0.50	60	0.01	0.01	11.29	0.01	8.52	97.9	3.20	0.04	1.43
CL-28	Composite-13	19.0	0.62	8.8	0.97	0.50	60	0.01	0.01	11.08	0.02	8.55	97.7	3.00	0.03	1.23
CL-29	Composite-13	19.0	0.62	8.8	0.97	0.97	59	0.01	0.01	10.50	0.01	8.60	98.2	3.00	0.04	0.92
CL-30	Composite-13	12.5	0.59	8.6	0.97	0.50	60	0.01	0.01	11.14	0.01	8.90	98.4	3.30	0.06	1.65

Source: Samuel Engineering (2019)

Column test final gold extractions at a crush size of 12.5 mm was generally higher than extraction at a crush size of 19 mm, based on the six composite samples tested at both crush sizes. However, the difference in residue grade between the two crush sizes is 0.01 g/t which is within sampling and assay error. Results are presented below in Table 13-26.

Table 13-26: Effect of Crush Size

Sample ID	Avg Au % Extraction		Avg Au Residue Grade, (g/t)	
	19 mm	12.5 mm	19 mm	12.5 mm
Composite-06	90.8	91.1	0.27	0.26
Composite-07	86.4	87.1	0.17	0.16
Composite-10	94.4	95.2	0.02	0.01
Composite-11	93.5	92.9	0.05	0.05
Composite-12	85.5	86.7	0.04	0.03
Composite-13	97.9	98.4	0.01	0.01

Source: Samuel Engineering (2019)

Final silver extraction ranged from 1.9% to 35.4%. Sodium cyanide (NaCN) consumption ranged from 0.01 kg/t to 0.21 kg/t. Lime (CaO) consumption ranged from 0.49 kg/t to 4.95 kg/t.

13.9 Metallurgical Samples and Locations

The metallurgical testwork programs as outlined in Section 13.2 to Section 13.8 have been carried out on bulk, half and full core composite samples from the three main deposits.

A summary of the various metallurgical samples, their respective crush size, drillhole number, and deposit location is detailed in Table 13-27 and Figure 13-4 and Figure 13-5.

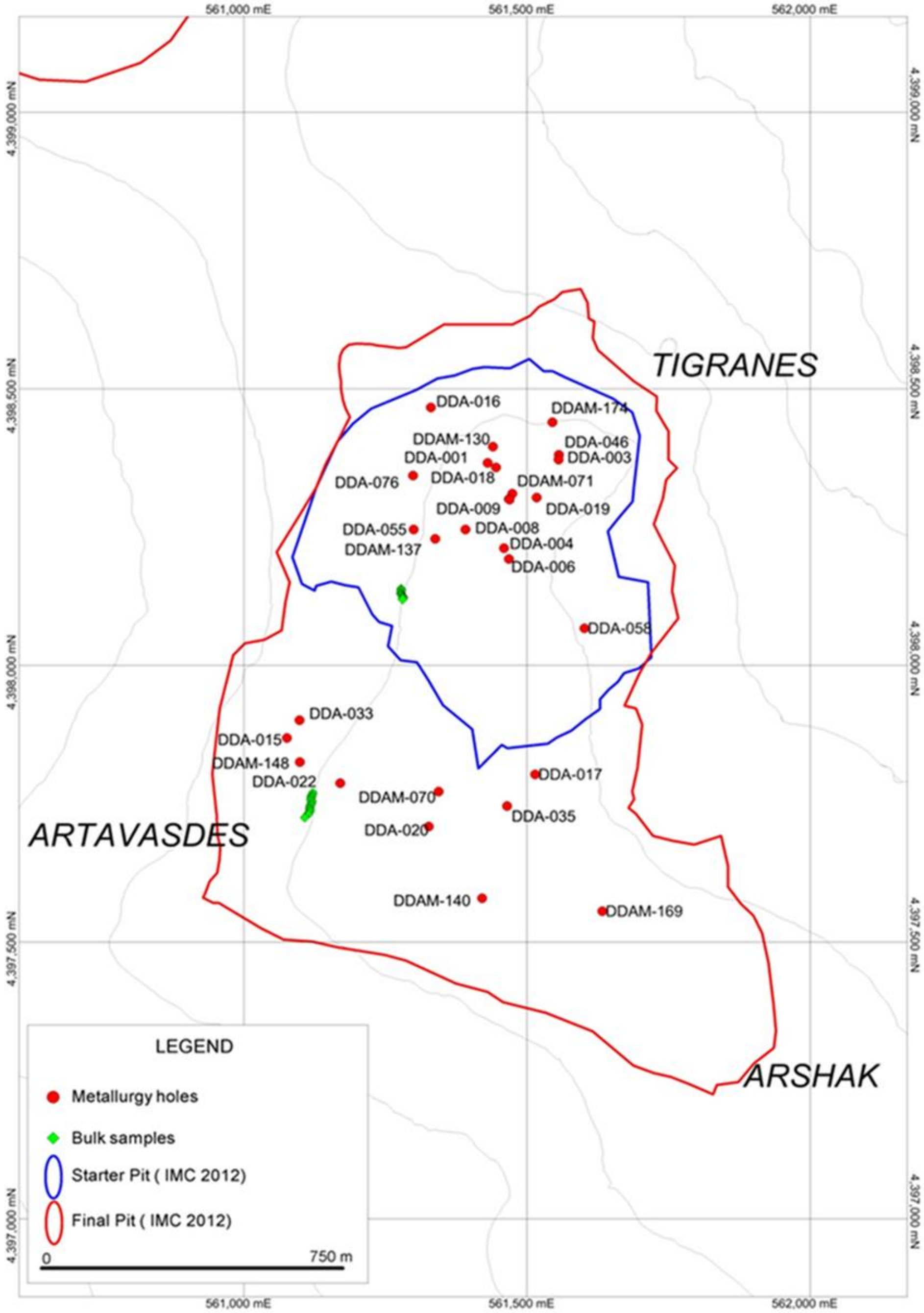
Table 13-27: Metallurgical Testwork Composite Summary

Testwork Program	Year	Deposit	No.	Crush Size, mm	DDH #	Core Size	Sample Description
SGS	2010		3	-38	Mix	Half	Composites A, B & C
			3	-19	Mix	Half	Composites A, B & C
SGS	2010		12	-12 to -38	Mix	Half	Composites A & B
WAI	2011	Tigranes	1	-12	MC070	Full	Met drillhole
		Artavasdes	1	-12	MC071	Full	Met drillhole
		Erato	1	-12	MC068	Full	Met drillhole
		Litho	4	-12		Full	Met drillhole
KCA	2012	Tigranes	1	-12.5		Bulk	Outcrop sample
		Artavasdes	1	-12.5		Bulk	Outcrop sample
		Tigranes	1	-12.5	DDAM 130	Full	Met drillhole
			1	-12.5	DDAM 137	Full	Met drillhole
			1	-12.5	DDAM-174	Full	Met drillhole
		Artavasdes	1	-12.5	DDAM-140	Full	Met drillhole

Testwork Program	Year	Deposit	No.	Crush Size, mm	DDH #	Core Size	Sample Description
			1	-12.5	DDAM-148	Full	Met drillhole
			1	-12.5	DDAM-169	Full	Met drillhole
		Tigranes	1	-12.5	DDA-018	Half	Geological reserve
			1	-12.5	DDA-055	Half	Geological reserve
			1	-12.5	DDA-076	Half	Geological reserve
		Artavasdes	1	-12.5	DDA-033	Half	Geological reserve
		Mixed	1	-12.5	DDA-022/DDA-055	Half	Geological reserve
			1	-12.5	DDA-035/DDA-055	Half	Geological reserve
			1	-12.5	DDA-046/DDA-076	Half	Geological reserve
KCA	2013	Erato	1	-12.5	DDA-030	Half	Geological reserve
			1	-12.5	DDA-030	Half	Geological reserve
			1	-12.5	DDA-276	Half	Geological reserve
			1	-12.5	DDA-278	Half	Geological reserve
			1	-12.5	DDA-290	Half	Geological reserve
			1	-12.5	DDA-340	Half	Geological reserve
			1	-12.5	DDA-103	Half	Geological reserve
			1	-12.5	DDA-350	Half	Geological reserve
			1	-12.5	DDA-358	Half	Geological reserve
			1	-12.5	DDA-367	Half	Geological reserve
SGS	2015	Tigranes	3	-12.5	DDAM-130	Full	Met drillhole
			3	-12.5	DDAM-137	Full	Met drillhole
			3	-19	DDAM-174	Full	Met drillhole
			3	-19	DDAM-130	Full	Met drillhole
			3	-19	DDAM-137	Full	Met drillhole
		Artavasdes	1	-12.5	DDAM-148	Full	Met drillhole
			3	-12.5	DDAM-140	Full	Met drillhole
			4	-19	DDAM-148	Full	Met drillhole
			7	-19	DDAM-140	Full	Met drillhole
		Total	**80**				

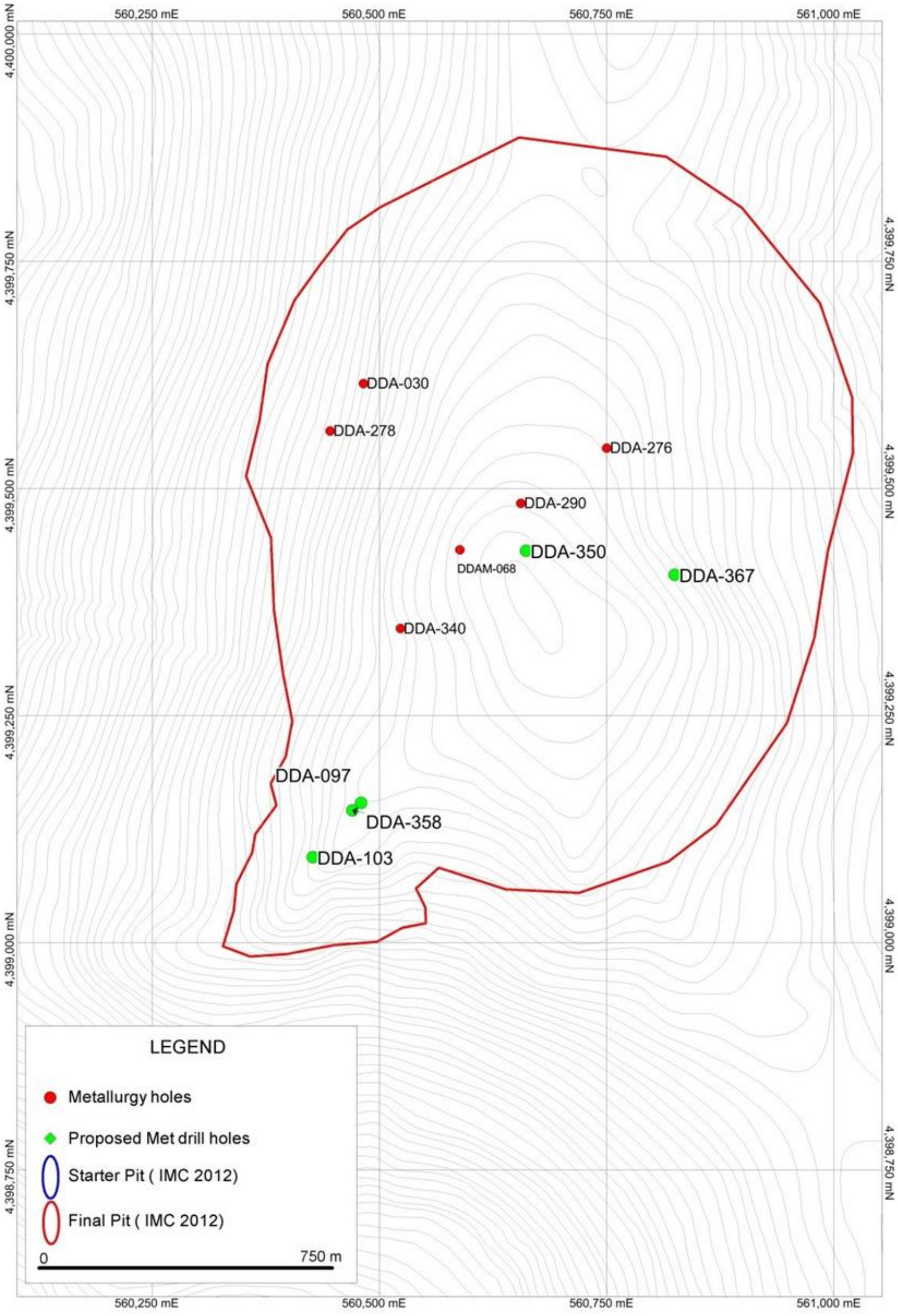
Source: Samuel Engineering (2019)

Figure 13-4: Tigranes and Artavasdes Metallurgical Sample Drillhole Location Map



Source: Samuel Engineering (2019)

Figure 13-5: Erato Metallurgical Sample Drillhole Location Map



Source: Samuel Engineering (2019)

13.10 Cold Climate Column Leach Test

In order to simulate cold weather climatic conditions at Amulsar, a single column leach test was conducted at 3°C with a crush size of 100% passing 12.5 mm. The material used for the cold climate column test was a bulk composite of drillhole intervals selected from the Tigranes and Artavasdes deposits. Results of the cold climate column leach test are detailed in Table 13-28.

Table 13-28: Column Leach Test Head Grades and Extractions – Tigranes/Artavasdes Zone

KCA Sample No.	Description	Calculated Head, Au g/t	Calculated Head, Ag g/t	Extracted, % Au	Extracted, % Ag
62544	DDAM-130/148	1.064	0.89	92	35

Source: Samuel Engineering (2019)

The column leach test parameters are detailed in Table 13-29.

Table 13-29: Column Leach Test Parameters – Tigranes / Artavasdes Zone

KCA Sample No	Description	Days of Leach	Calculated Tail P_{80} Size, mm	Solution to Ore Ratio	Consumption NaCN, kg/t	Addition $Ca(OH)_2$, kg/t
62544	DDAM-130/148	73	9.7	5.36	0.46	2.51

Source: Samuel Engineering (2019)

Bottle roll cyanidation tests were run on sample 62544 at ambient conditions to determine ultimate recoveries for the same ore tested in the cold climate column. Results of the fine cyanidation bottle roll leach test conducted on the Tigranes / Artavasdes composite sample are detailed in Table 13-30.

Table 13-30: Fine Cyanidation Leach Test Head Grades and Extractions – Tigranes/Artavasdes Zone

KCA Sample No.	Description	Target P_{80} Size, mm	Calc. Head, Au g/t	Extracted, % Au	Consumption NaCN, kg/t	Addition $Ca(OH)_2$, kg/t
62544	DDAM-130/148	0.075	0.952	95	0.96	1.5
62544	DDAM-130/148	0.075	0.964	96	1.14	1.5
Average			0.965	95.5	1.05	1.5

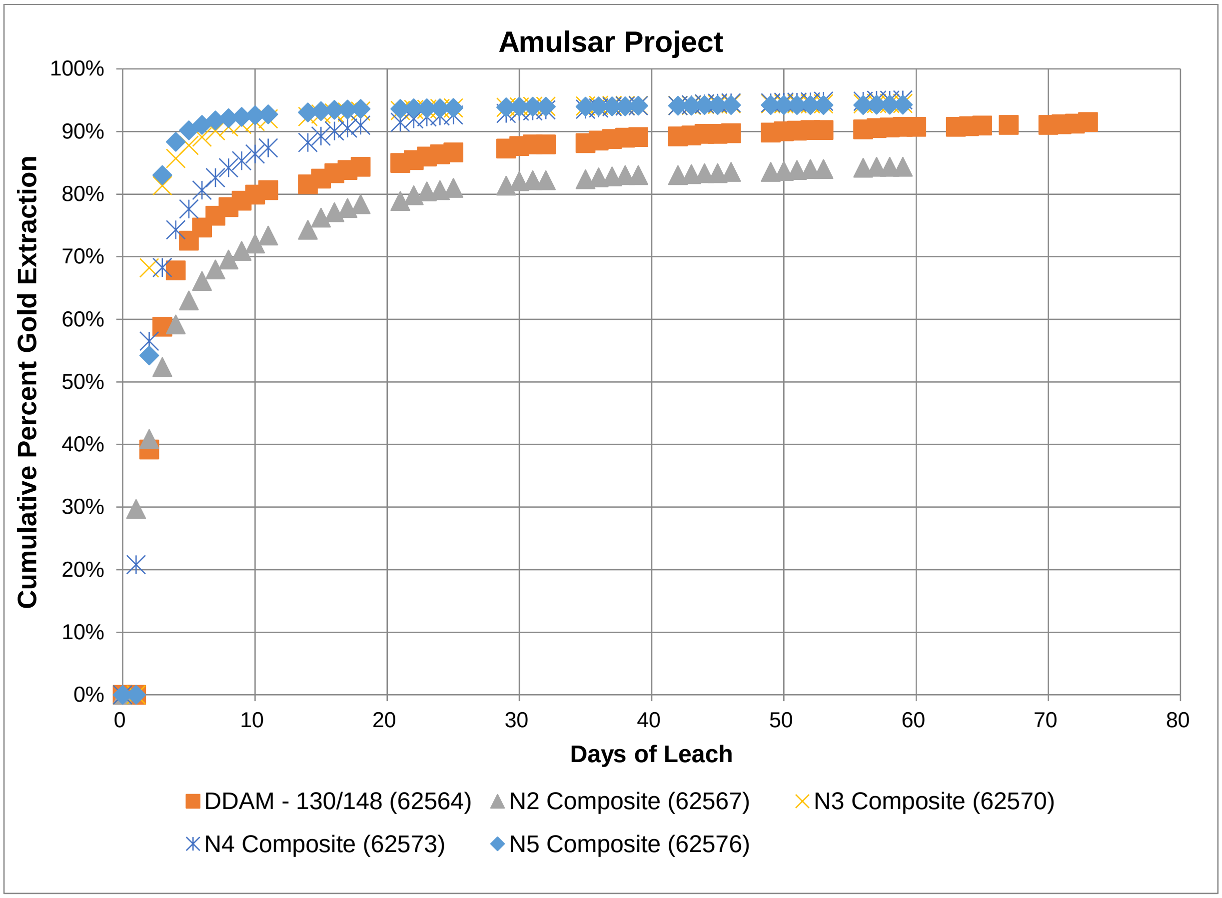
Source: Samuel Engineering (2019)

Samples 62588A, 62559A, 62560A and 62561A were column leached for 59 days at 22°C, while sample 62544 was leached at 3°C for 73 days. The four samples run at 22°C finished leaching between 45 to 52 days. Leaching is observed to be ongoing for the cold column test (sample 62544) at the time it was terminated after 73 days, indicating that leach kinetics were affected but that final recoveries were not significantly impacted.

The effect of the simulated cold climate on the leach kinetics can be seen in Figure 13-6.

It is evident that the effects of cold temperatures have slowed the leach kinetics; however, the final gold leach recovery was similar to that achieved for the Tigranes / Artavasdes column leach tests conducted at ambient temperature, for a similar gold head grade and ore composition.

Figure 13-6: Simulated Cold Climate Tigranes, Artavasdes and Erato Leach Curves



Source: Samuel Engineering (2019)

13.10.1 Fragmentation

Lydian retained Golder Associates Ltd. to carry out a Run-of-Mine fragmentation study to support value engineering efforts. The aim of the study is to produce a ROM fragmentation model for the Amulsar Project to determine whether ROM fragmentation can be optimized to allow for cost savings in the crushing circuit. The study is intended to maximize the percentage of fragmented rock with a diameter of <0.25 m delivered to the primary crusher and to minimize potential oversize (i.e. diameter of >0.60 m) that could bridge the crusher opening. The original open pit blast designs proposed by Lydian used 203 mm diameter blastholes. Five alternate blast designs have been proposed (totaling six designs analyzed) using both 203 mm and 187 mm diameter blastholes. Five of the six designs implemented an ammonia nitrate and fuel oil explosive agent (ANFO).

13.10.2 Upper Volcanics

The degree of alteration within the UV significantly affects the rock quality parameters and the ability to fragment a rock mass by blasting. The ability to fragment a given rock mass by blasting depends on rock parameters such as in-situ block size, joint spacing and orientation, specific gravity, Young's modulus and intact uniaxial compressive strength. In order to reflect the significant differences in these parameters within the Amulsar Project area, the fragmentation assessment for the UV has been divided into good, average and poor-quality rock.

Table 13-31, Table 13-32 and Table 13-33 summarize the predicted rock fragmentation size distribution for the proposed alternate blast designs in good, average and poor quality upper volcanic rocks.

Table 13-31: Fragmentation Size Assessment for Good Rock in Upper Volcanics

Rock Unit	Design ID	Hole Diam. (mm)	50% Passing (mm)	% Passing at 250 mm	% Passing at 600 mm
UV	1*	203	220	54	90
UV	2	203	165	68	96
UV	3	203	135	78	98
UV	4	187	158	71	97
UV	5	187	155	72	97

Source: Samuel Engineering (2019)

Table 13-32: Fragmentation Size Assessment for Average Rock in Upper Volcanics

Rock Unit	Design ID	Hole Diam. (mm)	50% Passing (mm)	% Passing at 250 mm	% Passing at 600 mm
UV	1*	203	168	67	99
UV	2	203	122	81	100
UV	3	203	100	89	100
UV	4	187	119	84	100
UV	5	187	116	85	100

Source: Samuel Engineering (2019)

Table 13-33: Fragmentation Size Assessment for Poor Rock in Upper Volcanics

Rock Unit	Design ID	Hole Diam. (mm)	50% Passing (mm)	% Passing at 250 mm	% Passing at 600 mm
UV	1*	203	60	100	100
UV	2	203	44	100	100
UV	3	203	37	100	100
UV	4	187	43	100	100
UV	5	187	42	100	100

Source: Samuel Engineering (2019)

Fragmentation is expected to be finest in the poor-quality rock due to the decreased joint spacing, reduced rock strength and smaller in-situ block size.

The fragmentation predicted by the proposed models does not include any breakage and degradation that would occur during the excavation, transport and handling of the ore that would occur prior to it being leached. Due to the brittle nature of the rock and the large number of discontinuities, this degradation could be significant.

13.10.3 Lower Volcanics

As with the Upper Volcanics, the degree of alteration within the Lower Volcanics significantly affects the rock quality parameters. In order to reflect this, the fragmentation assessment for the Upper Volcanics has been divided into good and average quality rock. The poor quality Lower Volcanics have qualities that more resemble soil and are considered inappropriate for the fragmentation model.

Table 13-34 and Table 13-35 summarize the predicted rock fragmentation size distributions for the proposed blast designs in good and average rock in the LV, respectively.

Table 13-34: Fragmentation Size Assessment for Good Rock in Lower Volcanics

Rock Unit	Design ID	Hole Diam. (mm)	50% Passing (mm)	90% Passing at (mm)	% Passing at 600 mm
LV	1*	203	153	438	93
LV	6	229	182	585	91

Source: Samuel Engineering (2019)

Table 13-35: Fragmentation Size Assessment for Average Rock in Lower Volcanics

Rock Unit	Design ID	Hole Diam. (mm)	50% Passing (mm)	90% Passing at (mm)	% Passing at 600 mm
LV	1*	203	146	373	100
LV	6	229	157	435	99

Source: Samuel Engineering (2019)

The study results indicate a significant increase in the fragmentation with the proposed blast design changes. In particular, the cumulative percentage passing 250 mm increased from 54% (Design 1) to 78% (Design 3) in good quality rock and from 67% (Design 1) to 89% (Design 3) in average quality rock. All of the proposed production designs are likely to produce excellent fragmentation results in poor quality rock.

13.11 Metallurgical Data Interpretation and Predictions

13.11.1 Preferred Process Option

Testwork carried out by the various laboratories included both:

- Whole ore cyanidation leach tests - Conventional CIL technology; and
- Coarse bottle roll / column leach tests - Heap leach technology.

Based on the metallurgical performance obtained from column leach tests the Amulsar ore types can be considered very amenable to heap leach processing.

Capital and operating costs for heap leach processing are lower than those of conventional CIL, for the same recovered gold ounces, therefore resulting in improved project economics.

13.11.2 Heap Permeability

13.11.2.1 Particle Size Distribution

As part of the Wardell Armstrong testwork program, all head samples were subjected to a screen analysis at sizes between 12.0 mm and 0.038 mm.

The samples were initially wet screened at 0.038 mm, the oversize dried and then screened to give the fractions for particle size analyses. The P_{80} values (80% passing size) of the column leach samples are given in Table 13-36. The results of the percent weight in each size range and selected ranges are given in Table 13-37 and Table 13-38. A graphical representation of the percent weight in each size range is given in Figure 13-7.

Table 13-36: Head Sample 80% Passing Size

Sample	P_{80} (mm)
MFP 068	10.8
Siliceous Breccia (SB) 071	11.2
Fault Gouge (FG)	10.5
Gossan (GSN)	9.6
MC Erato – 068	9.8
MC Artavasdes – 070	9.8
MC Tigranes - 071	10.8

Source: Samuel Engineering (2019)

Table 13-37: Head Sample Size Distribution

Size Range	Total Weight Percent in Size Range						
	GSN	SB	FG	MPF	MC 068	MC 070	MC 071
+5.0mm	52.5	67.6	55.7	50.0	65.6	53.3	59.0
-5.0 +1.0mm	26.0	25.6	22.4	27.9	22.4	28.6	27.5
-1.0 +0.5mm	4.4	2.2	4.3	5.9	3.1	4.8	4.1
-0.5 +0.01mm	5.9	2.1	6.1	7.8	3.7	5.5	4.6
-0.01 +0.075mm	0.9	0.3	0.8	0.9	0.5	0.7	0.6
-0.075 +0.053mm	0.9	0.3	0.8	0.9	0.5	0.6	0.6
-0.053 +0.038mm	0.9	0.3	0.8	0.9	0.4	0.6	0.5
-0.038mm	8.3	1.6	9.2	5.6	3.8	5.9	3.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

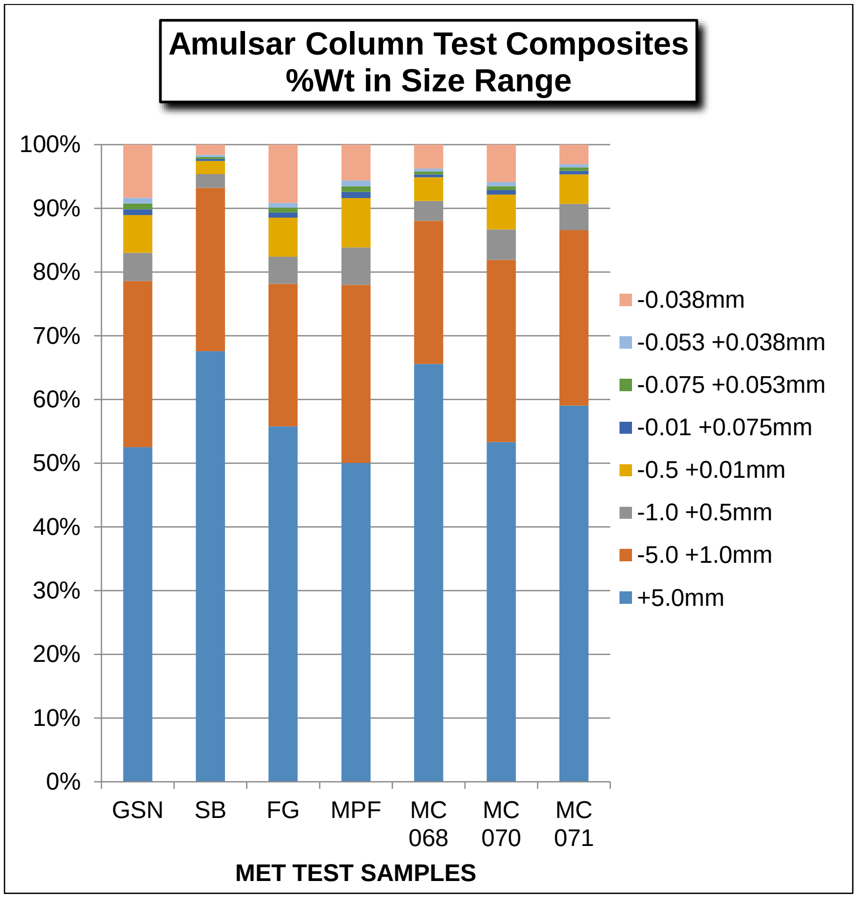
Source: Samuel Engineering (2019)

Table 13-38: Head Sample Selected Size Distribution

Size Range	Total Weight Percent in Size Range						
	GSN	SB	FG	MPF	MC 068	MC 070	MC 071
-0.075mm	10.1	2.3	10.7	7.5	4.7	7.2	4.1
-0.053mm	9.2	2.0	9.9	6.6	4.2	6.5	3.6
-0.038mm	8.3	1.6	9.2	5.6	3.8	5.9	3.1

Source: Samuel Engineering (2019)

Figure 13-7: Percentage Weight Size Distribution



Source: Samuel Engineering (2019)

Results of the particle size analyses show that the P80 size of the samples ranged from 9.8 mm (MC 068 and MC 070) to 11.2 mm (Siliceous Breccia). The results of the selected size ranges show that less than 10% of any of the samples material was in the -0.053 mm size range. Two of the samples, GSN and SB, gave results that were marginally greater than 10% in the sub 0.075 mm size range.

The results in Table 13-38 suggested that it was not necessary to agglomerate the ore prior to column leaching as the samples contained relatively few fines. A good “rule of thumb” is that the feed particle size distribution should preferably have 8 % to 12% passing 200 mesh (75 µm). If the ore sample contains more fines than that, depending on the pad height, then > 12% fines in the -75 µm size fraction can result in a percolation issue. Consequently, the column leach tests were undertaken without agglomeration and percolation tests were carried out at the end of column leaching.

13.12.2.2 Percolation Tests

Each column test was subjected to standard percolation tests. The percolation results are given in Table 13-39.

Table 13-39: Percolation Test Results

Duration (h): 8	Column Ø (m): 0.15	Area (m^2): 0.01767
Sample	Percolation Test	
	Water 8 hrs (l)	Rate (L/h/m^2)
MPF	201.63	1,462.2
GSN	352.83	2,495.8
FG	439.71	3,110.3
10 SB	451.43	3,193.2
MC 068	354.35	2,506.5
MC 070	495.39	3,504.2
MC 071	488.09	3,452.5

Source: Samuel Engineering (2019)

With respect to percolation rates, the measured percolation rate for the ore ideally needs be to be at least one, but preferably two, orders of magnitude more permeable than the design irrigation rate. Therefore, at the design solution application rate of 6 L/hr/m^2, the required permeability should be 60 to 600 L/hr/m^2.

Results in Table 13-39 show that good percolation rates were achievable for most of the tests. Slightly lower percolation rates were achieved for the MPF and GSN lithologies due to their higher clay content.

Six samples representing the planned ore heap to be stacked on the Amulsar leach pad were sent to Golder by WAI after WAI conducted column leach percolation tests on the samples at their laboratory in the UK. The sample identifications are MPF, FG, SB, MC-068, MC-070 and MC-071, and 80% to 90% of the samples were finer than 12 mm size according to their gradations sent by WAI. Two of the samples (MC-068 and MC-071) were tested by Golder for consolidation/permeability under varying confining pressures. The test results are presented in Table 13-40.

Table 13-40: Consolidation / Permeability Test Results

Sample ID	Sample Height (cm)	Dry Density (kN/m^3)	Confining Pressure (kN/m^2)	Permeability (m/sec)
MC-068	26.0	15.22	414	1.4 x 10-2
	25.6	15.47	827	1.3 x 10-2
	25.3	15.66	1,655	1.1 x 10-2
MC-071	28.3	15.57	414	1.8 x 10-2
	28.0	15.74	827	1.7 x 10-2
	27.7	15.96	1,655	1.6 x 10-2

Source: Samuel Engineering (2019)

The measured permeability rates under load are acceptable.

13.11.3 Deleterious Elements

13.11.3.1 Copper

Cyanide soluble copper levels of up to 20 mg/kg were measured in the column test head assays. Cyanide soluble copper can build up in the leach solution and therefore there needs to be a strategy in place to deal with the copper in the ADR plant and gold room.

Cyanide soluble copper can be prevented from loading onto activated carbon by maintaining high free cyanide levels. Should copper load onto the activated carbon in significant quantities then a cold strip can be adopted to remove the copper ahead of a hot strip to recover gold and silver. The use of Merrill-Crowe allows for separation of copper from the gold and silver.

13.11.3.2 Mercury

There are trace levels of mercury in the column leach head assays, particularly for the Erato ore samples. Mercury also forms a cyanide complex and can load onto the activated carbon in the CIC circuit.

An allowance for a mercury retort in the gold room has been made to deal with any mercury that loads onto carbon.

13.11.3.3 Total Organic Carbon

Total organic carbon levels of 0.04% were measured in the Erato ore head assays. However, there is no evidence whatsoever of preg robbing in the column leach tests.

13.11.4 Predicted Metallurgical Recoveries

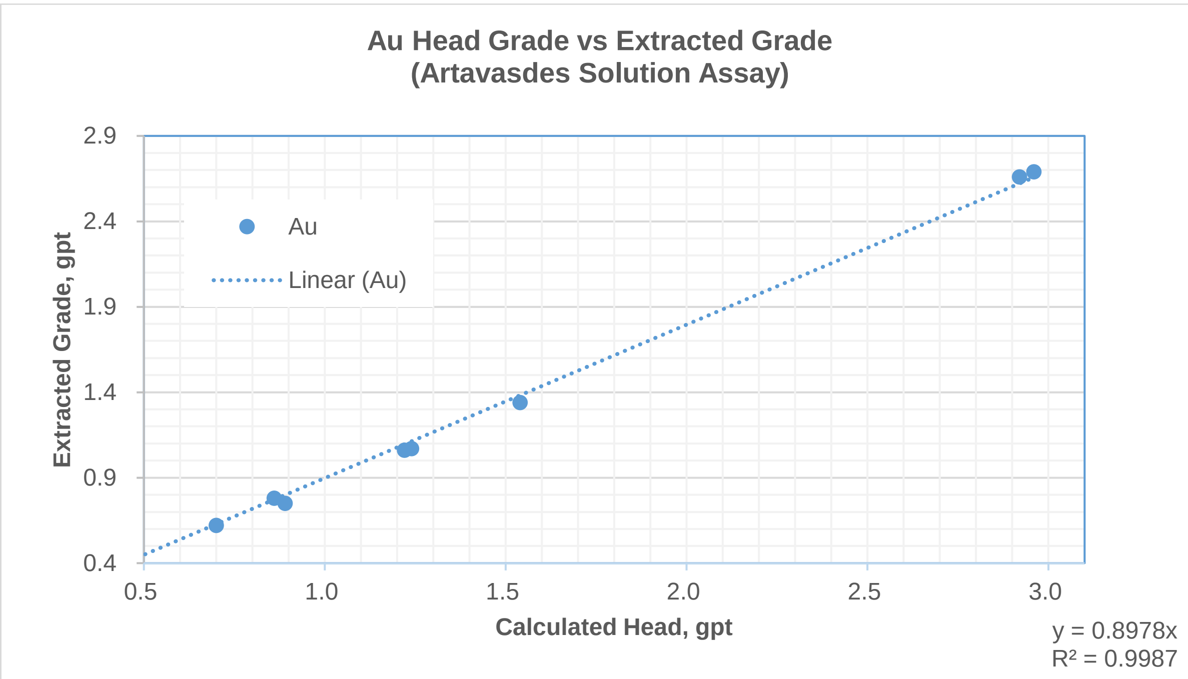
13.11.4.1 Gold

Gold recoveries from the SGS and KCA column tests for both 12.5 mm and 19 mm demonstrate a strong correlation between the head grade and the extracted grade as determined by the amount of gold extracted per unit of ore mass. This indicates that recovery is constant with respect to head grade. The difference in extraction between the 12.5 mm and 19 mm crush sizes for the ore bodies are below the statistical tolerance for establishing any variation in extraction based on the crush size. The mean of the recovery and standard deviation for both data sets was calculated and any data that was outside one standard deviation was rejected from the recovery projection.

The Artavasdes Calculated Head vs Extracted grades curve in Figure 13-8 shows a linear regression trendline (intercept set at the origin) for the data.

- Data determined from screen assays of head and tails;
- Data determined from solution assays (calculated head); and
- Data determined from carbon assays (calculated head).

Figure 13-8: Artavasdes Gold Head Grade versus Extraction Grade at 12.5 mm and 19 mm Crush Size



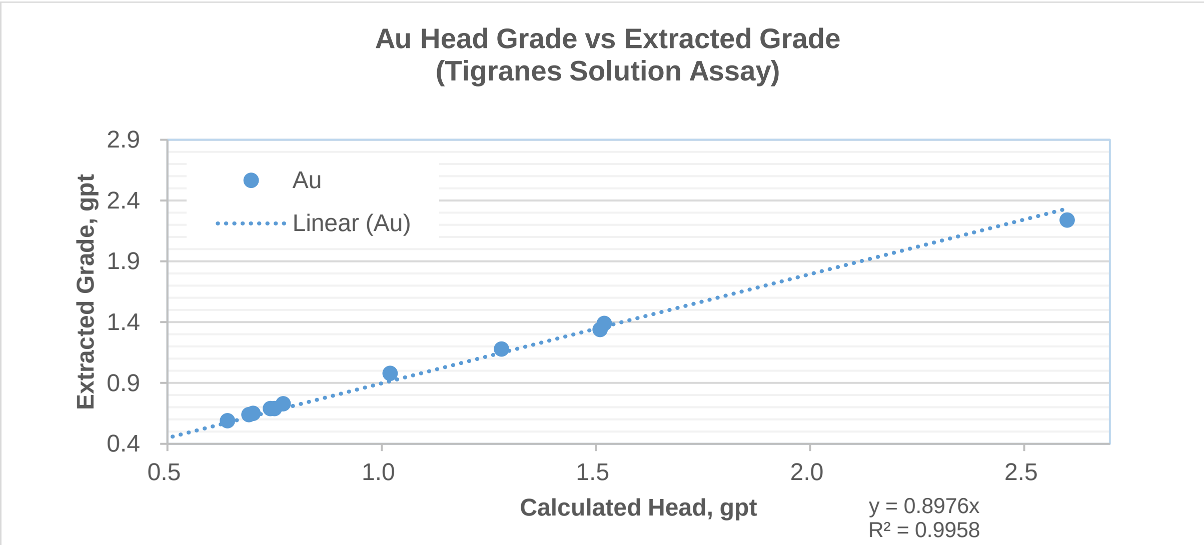
Source: Samuel Engineering (2019)

From the slopes, a formula for determining expected extraction grades and, thus recoveries were generated:

- Extracted grade = 0.8978 × Head Grade; and
- Recovery = Extracted Grade ÷ Head Grade.

The slope of the curve is equal to the predicted recovery. Three percent of gold recovery was deducted from the laboratory column recovery for scale-up and losses in the ADR plant and gold room, yielding an estimated 87.1% gold recovery for the Artavasdes deposit.

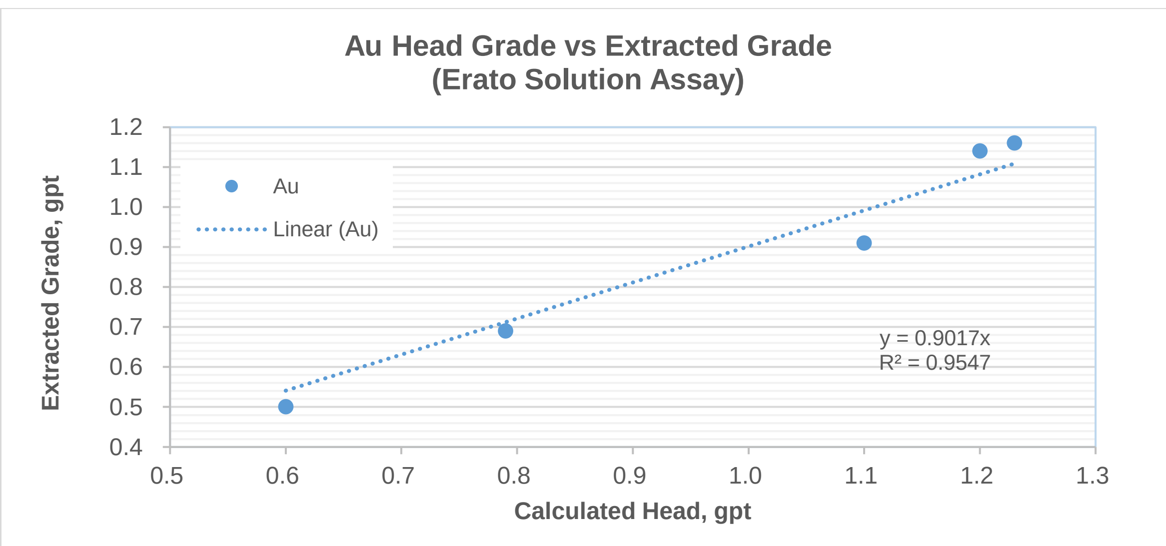
Figure 13-9: Tigranes Gold Head Grade versus Extraction Grade at 12.5 mm and 19 mm Crush Size



Source: Samuel Engineering (2019)

The Tigranes curves indicate an average recovery (slope) of 89.8%. Three percent of gold recovery was deducted from the laboratory column recovery for scale-up and losses in the ADR plant and gold room yielding an estimated 87.1% gold recovery for the Tigranes deposit.

Figure 13-10: Erato Gold Head Grade versus Extraction Grade at 12.5 mm Crush Size



Source: Samuel Engineering (2019)

The Erato curves indicate an average recovery (slope) of 90.2% as shown in Figure 13-10. Three percent of gold recovery was deducted from the laboratory column recovery for scale-up and losses in the ADR plant and gold room yielding an 87.5% gold recovery for the Erato deposit.

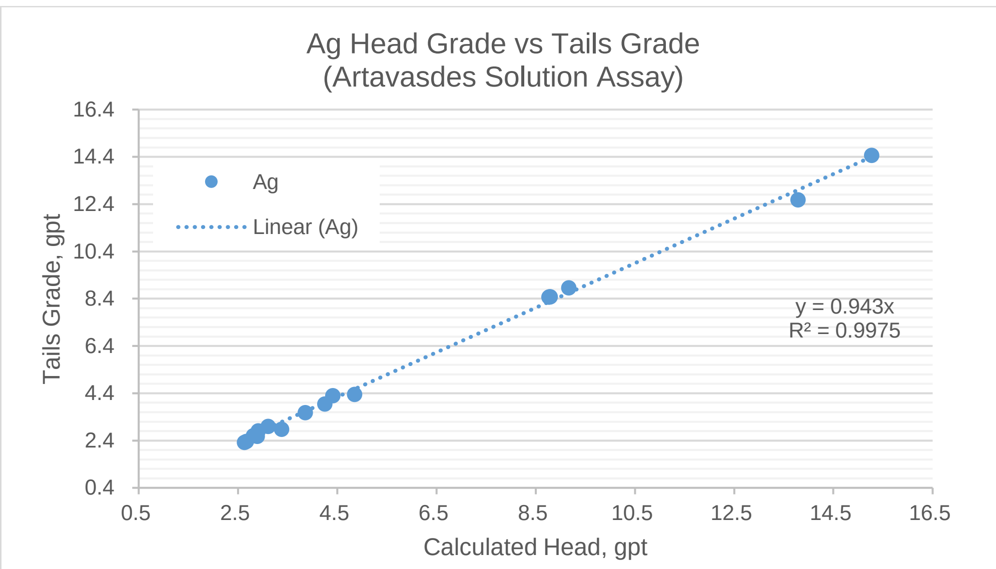
13.11.4.2 Silver

Similar graphs were generated for silver using the results from the column tests. A strong correlation was found between the head grade and the tails grade, once again indicating that recovery is constant with respect to head grade. As with the gold recoveries, the mean of the recovery and standard deviation for both data sets was calculated and any data that was outside one standard deviation was rejected from the recovery projection.

Figure 13-11 below shows head grade versus tails grade for the Artavasdes deposit. The formula generated from the trendline relates the expected tails grade to the head grade:

- Tails Grade = 0.9430 × Head Grade;
- Recovery = (Head Grade – Tails Grade) ÷ Head Grade = 1 – (Tails Grade ÷ Head Grade); or
- Recovery = (1 – 0.9430)*100 = 5.70%.

Figure 13-11: Artavasdes Silver Head Grade versus Tail Grade at 12.5 mm and 19 mm Crush Size

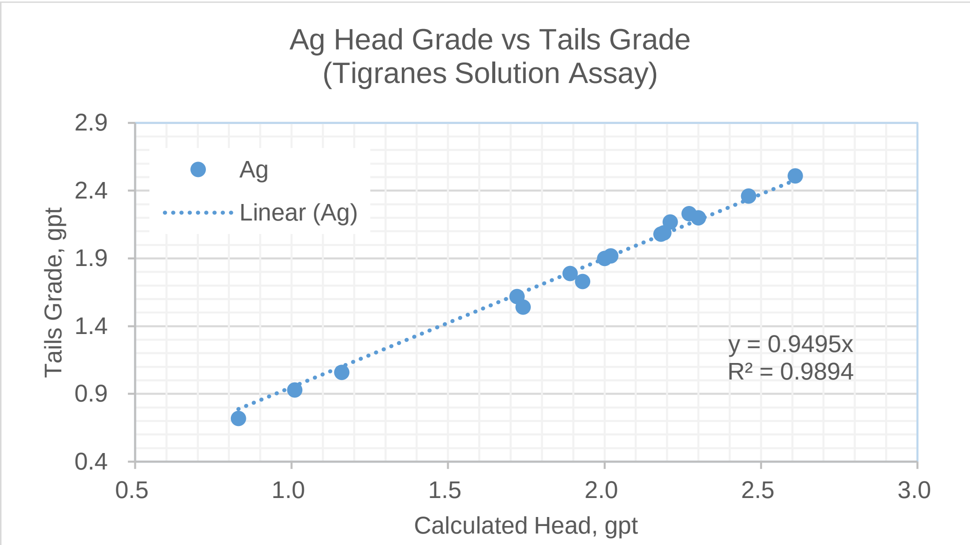


Source: Samuel Engineering (2019)

The indicated silver recovery for Artavasdes by best fit linear trendline (with the Y intercept set to zero) is 5.70%, with an R-squared Value of 0.9975, indicating a strong correlation between the trendline and the data. Five percent of silver recovery was deducted for scale up and losses in the ADR plant and gold room, yielding a 5.4% silver recovery for the Artavasdes deposit.

The Tigranes Head vs. Tails Grade curves are show in the Figure 13-12.

Figure 13-12: Tigranes Silver Head Grade versus Tail Grade at 12.5 mm and 19 mm Crush Size

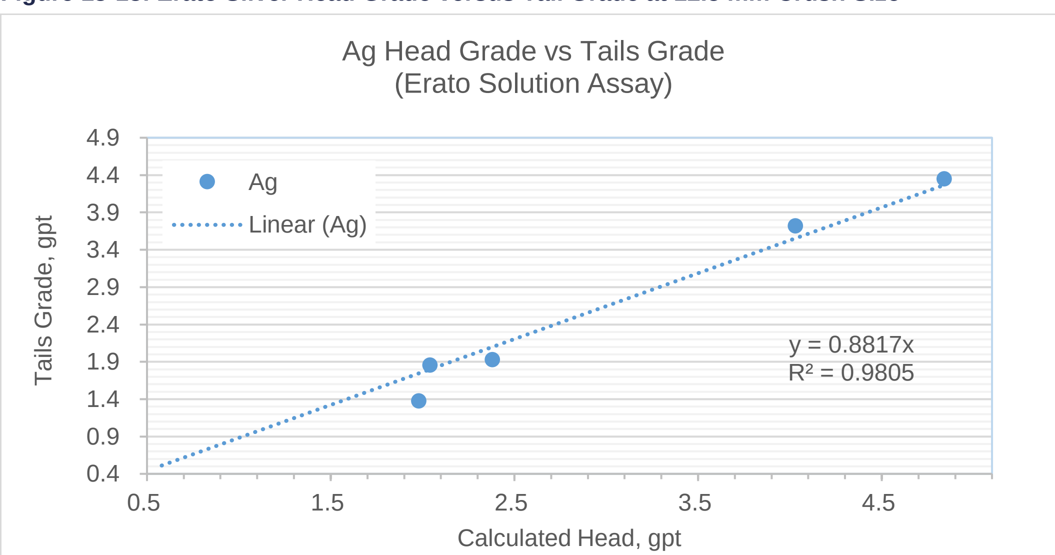


Source: Samuel Engineering (2019)

The resulting slope of the average of the solution and carbon calculated head curve is 0.9495, indicating a constant recovery of 5.1%. Five percent of silver recovery from the laboratory column recovery was deducted for scale-up and losses in the ADR plant and gold room, yielding a 4.8% silver recovery for the Tigranes deposit.

The Erato Head vs. Tails Grade curves are show in the Figure 13-13.

Figure 13-13: Erato Silver Head Grade versus Tail Grade at 12.5 mm Crush Size



Source: Samuel Engineering (2019)

The resulting slope of the average of the solution and carbon calculated head curve is 0.8817, indicating a constant recovery of 11.8%. Five percent of silver recovery from the laboratory column recovery was deducted for scale-up and losses in the ADR plant and gold room, yielding an 11.2% silver recovery for the Erato deposit.

13.11.5 Predicted Reagent Consumptions

Based on the SGS column leach testwork the projected reagent consumption rates are:

- NaCN consumption: 0.10 kg/t
- CaO consumption: 2.0 kg/t

Full scale reagent consumption rates are typically lower than those in the laboratory. Laboratory column leach tests are typically conducted in open cycle while in the full scale heap the solution is recirculated around the heap in a closed loop.

13.11.6 Predicted Moisture Content and Drain Down

SGS measured the rate of solution drain down from each column leach test. After termination of column irrigation, the volume of PLS was measured after 24-, 48-, and 72-hour periods. The moisture retained after drain- down was obtained by oven drying the leached residue. The moisture under leach, drain down, and retained moisture for the 20 column tests, all on a dry basis, are shown in the following table.

Table 13-41: Valley Fill Leach Pad Moisture

SGS Test No.	Moisture Under Leach, Drain Down Rate, Retained Moisture, All Dry Basis			
	Under Leach, %	24 h Drain, %	48 h Drain, %	Retained, %
CL-01	15.7	14.0	13.4	13.1
CL-02	12.5	10.8	10.2	9.9
CL-03	12.6	11.5	11.2	10.2
CL-04	8.9	7.2	6.9	6.1
CL-05	12.7	11.1	10.7	10.1
CL-07	8.0	6.5	6.2	5.4
CL-09	8.1	6.4	6.1	5.0
CL-10	9.4	7.6	7.1	5.8
CL-11	7.9	6.2	5.9	4.8
CL-12	9.9	8.1	7.7	7.2
CL-13	8.3	6.7	6.3	5.7
CL-17	10.5	8.8	8.5	7.5
CL-18	12.2	10.3	10.0	9.1
CL-19	12.1	10	9.4	8.7
CL-23	12.4	10.5	10.2	9.3
CL-24	12.7	10.8	10.4	9.8
CL-25	13.2	11.3	10.8	9.9

SGS Test No.	Moisture Under Leach, Drain Down Rate, Retained Moisture, All Dry Basis			
	Under Leach, %	24 h Drain, %	48 h Drain, %	Retained, %
CL-27	13.9	12.2	11.9	10.9
CL-28	14.9	13.0	12.6	11.8
CL-29	14.8	13.0	12.6	11.9
Average	**11.5**	**9.8**	**9.4**	**8.6**

Source: Samuel Engineering (2019)

13.12 Detoxification Testwork

Following the leaching period, detoxification testwork utilizing a hydrogen peroxide (copper catalyzed peroxide) detoxification method was conducted on two selected column leach tests utilizing material crushed to minus 12.5 mm; KCA Test Nos. 61781 (DDAM-140) and 61790 (DDAM-174).

The purpose of the detoxification test is to determine the time, and the amount of hydrogen peroxide and copper sulfate, needed to achieve acceptable total and WAD cyanide levels discharging from the column material.

The detoxification procedure was continued until a WAD cyanide value less than 0.2 mg/L was obtained for three consecutive days. The final detox solution from the detoxified columns was sampled on the third consecutive day with WAD cyanide values less than 0.2 mg/L.

The initial and final values for total and WAD cyanide are presented in Table 13-42.

Table 13-42: Summary of Detoxification Test Results

KCA Composite No.	KCA Test No.	Sample Description	Detoxification Period, Days	Initial Total Cyanide, mg/L	Final Total Cyanide, mg/L	Initial WAD Cyanide, mg/L	Final WAD Cyanide, mg/L
61770 B	61781	DDAM-140	26	125.76	0.48	113.84	0.10
61773 B	61790	DDAM-174	26	106.85	1.15	103.45	0.08

Source: Samuel Engineering (2019)

Total chemical additions are summarized in Table 13-43.

Table 13-43: Summary of Reagent Additions

KCA Composite No.	KCA Test No.	Sample Description	Column Weight, kg	35% H_2O_2 Applied, mL	10 gpL $CuSO_4.5H_2O$	100% H_2O_2 Applied g/t	Cu Added g/t
61770 B	61781	DDAM-140	51.72	66.5	850	450.02	41.83
61773 B	61790	DDAM-174	56.06	71.5	850	446.40	38.59

Source: Samuel Engineering (2019)

13.13 Multi-Element Analysis

As part of the Wardell Armstrong testwork program, ICP multi-element assays were conducted on the barren solution and carbon residue. The results of the solution assays are given in Table 13-44. The results show that carbon adsorption of gold from the pregnant solution was very effective with the SB solution registering the greatest amount; assaying in the range 3.24 to <0.02 ppb. Most solutions registered in the range, <0.05 ppb to <0.02 ppb.

Results of the loaded carbon assays are detailed in Table 13-45.

Table 13-44: Barren Solutions Multi-Element Assay Results

Sample			Barren Solution						
			MPF	FG	SB	GSN	MC 068	MC 070	MC 071
Assay	Antimony	mg/L	0.053	0.03	0.202	0.088	0.022	0.024	0.017
	Arsenic	mg/L	1.06	0.658	0.529	4.19	0.194	0.326	0.103
	Copper	mg/L	0.667	0.901	0.765	1.52	0.551	0.507	0.384
	Gold	µg/L	<0.50 <0.020	1.45 <0.020	3.24 <0.020	1.79 <0.020	<0.50 <0.020	<0.50 <0.020	<0.50 <0.020
	Iron	mg/L	0.0808	0.221	0.152	0.403	0.0691	0.121	0.201
	Lead	mg/L	<0.0050 <1.0	<0.0050 <1.0	<0.0050 <1.0	1.3 <0.0050	<0.0050 <1.0	<0.0050 <1.0	0.0061 3.9
	Mercury	µg/L	0.038	0.189	<0.010	0.93	0.017	0.042	0.044
	Selenium	mg/L	<0.010 <5.0	<0.010 <5.0	<0.010 <5.0	8.0 <0.010	<0.010 <5.0	<0.010 <5.0	<0.010 <5.0
	Silver	mg/L	<0.0010 <1.0	<0.0010 <1.0	<0.0010 <1.0	<1.0 <0.0010	<0.0010 <1.0	<0.0010 <1.0	0.0039 3.8
	Zinc	mg/L	0.969	1.34	0.815	2.17	0.713	0.854	0.538

Source: Samuel Engineering (2019)

Table 13-45: Summary of Elements Loaded onto Carbon

Sample	Ag ppm	Cu ppm	Fe %	Pb ppm	Zn ppm	Hg ppm	Se ppm
MC 068	1.73	200.0	8.92	27.7	15	1.9	15
MC 070	2.30	92.3	6.23	127.5	10	1.9	7
MC 070	2.19	142.5	4.38	36.9	5	1.2	4
MFP	1.41	166.5	5.86	21.9	14	3.0	9
Gossan	2.74	510.0	27.70	5,380.0	71	2.5	16
Fault Gouge	2.07	145.5	8.42	1,165.0	21	1.5	9
Siliceous Breccia	1.71	88.1	2.36	78.3	4	0.9	2

Source: Samuel Engineering (2019)

13.14 Kappes, Cassiday & Associates (2017)

Kappes, Cassiday & Associates performed a re-review of Lydian's Amulsar Heap Leach Project and issued a report titled Technical Review of the Design and Planned Operations of Lydian's Amulsar Project dated 25 September 2017.

From the KCA report, "KCA's data review indicated silver recoveries averaged 19.9%, 18.4%, and 33.8% for the Artavasdes, Tigranes, and Erato deposits, respectively. The recoveries should be down-graded for commercial operation by 5% to give commercial recoveries of 15%, 13% and 29%, respectively."

A summary of the differences between the SE and KCA's reports are presented in Table 13-46.

Table 13-46: Summary of Silver Dissolution for Erato, Artavasdes and Tigranes

Silver	Condition (Erato)	Erato	Condition (Artavasdes)	Artavasdes	Condition (Tigranes)	Tigranes
Samuel – Ag		11.2%		5.4%		4.8%
KCA – Ag		33.8%		19.9%		18.4%
Bottle Roll Test	@ 75 microns	60.1% avg (31% - 74%)	@ 75–106 microns	58% avg (28%-96%)	@ 75-106 microns	95.4% (87%-98%)
Column	@12 mm	34.0% avg. (7% - 64%)	@ 12-19 mm	19.8% (3%-93%)	@ 12-19 mm	19% (2%-70%

Source: Samuel Engineering (2019)

It should be noted that:

- The silver recovery varied greatly across the bottle roll tests; and
- In addition, there was an error in the silver bottle roll tests for Tigranes. Apparently KCA copied the table from the gold and didn't change the silver bottle roll test results for Tigranes.

As a result of the Kappes, Cassiday & Associates re-review of the Lydian Amulsar Heap Leach Project report results, dated 25 September 2017, the silver recoveries were increased to an average of 14.6%. The silver recovery of 14.6% was used in both the gold model and the economic model for the project.

14 Mineral Resource Estimate

14.1 Overview of Estimation Strategy

Lydian International Limited (Lydian) commissioned Watts, Griffis and McOuat Limited to restate the Mineral Resources for the Amulsar Gold Project for a restart of operations feasibility study. For this report the resources from the 2017 NI 43-101 Technical Report, Amulsar Updated Resource and Reserves, Armenia (effective date February 27, 2017) have been restated at a lower cut-off grade than previously reported in the 2017 feasibility study. From 2017 to 2019 no additional exploration work, sampling or drilling related to mineral resources has been completed on the Amulsar Gold Project. Therefore, there have been no material changes to the estimation of mineral resources since the 2017 report.

Based on the equipment selection, Lydian requested a change in the selectivity of the smallest mining unit (SMU) from 10 m × 10 m × 5 m to 10 m ×10 m × 10 m. To accommodate this change, the estimation strategy was changed from previous localized multiple indicator kriging (“LMIK”) to directly estimating into 10 m × 10 m × 10 m SMU blocks using optimized ordinary kriging (OK), this method allows a rapid estimation that in part relies on previous LMIK estimates. This OK estimation procedure was used for Erato and TAA UV domains.

The LV domains are spatially very limited and discontinuous within the Amulsar deposit. This unit represents a small proportion of mineralization in both the Erato and TAA zones (6%). For a unit of limited distribution and that is highly localized, a change of support (“COS”) calculation/approach has limited utility and therefore was not used to optimize the OK SMU estimate for these domains.

AMC used Datamine Studio 3, Datamine Studio RM, Isatis, and GSLib software for the resource estimation study.

14.2 Geological and Assay Database

The resource database used to evaluate the mineral resources for the Amulsar gold project comprised Excel™ spreadsheets updated with drilling completed in 2016 for the TAA Zone. As no additional drilling was completed for the Erato Zone, the 2014 database was used for resource estimation for this zone. Erato and TAA drillhole spreadsheet data was exported from Lydian’s Fusion database system. The spreadsheets contained all the available information for diamond core and reverse circulation drillholes, and channel samples for the project. The database extract consists of 1,108 drillholes and channel samples (122,499 m excluding drillholes outside of the TAA and Erato zones) completed between 2007 and 2016.

Drillholes in the Erato Zone comprise a total of 176 drillholes and channel samples (12,085 m). The data is comprised of 75 diamond drillholes (11,598 m), 70 reverse circulation drillholes (12,085 m), and 31 channel sample lines (103 m). No new drilling was completed during 2016 in this zone.

Drillholes in the TAA Zone comprise a total of 934 drillholes and channel samples (98,713 m). This includes 215 diamond drillholes (30,800 m), 509 reverse circulation holes (67,054 m), 210 channel sample lines (859 m). Drilling completed in 2016 as a sub-set of the above drilling comprises 97 diamond drillholes (9,383 m) representing 10% more drillholes and 10% more meters drilled for the TAA Zone.

The drillhole data is comprised of gold and silver assays, lithological codes, alteration data, structural orientations, and geological descriptions. Lydian also provided geotechnical data for diamond core drillholes including RQD, core recovery, and fracture count measurements. Chip sample data contained only gold and silver assay values. The resource data provided by Lydian was validated by:

- Reviewing collar and downhole survey data;
- Checking the minimum and maximum values for each field in the drillhole database and confirming those values outside of expected values;
- Checking for gaps, overlaps, and out-of-sequence intervals; and
- Generating drillholes in Datamine™, and then reviewing drillholes on a section-by-section basis to ensure that mineralization and alteration are consistent with drilling.

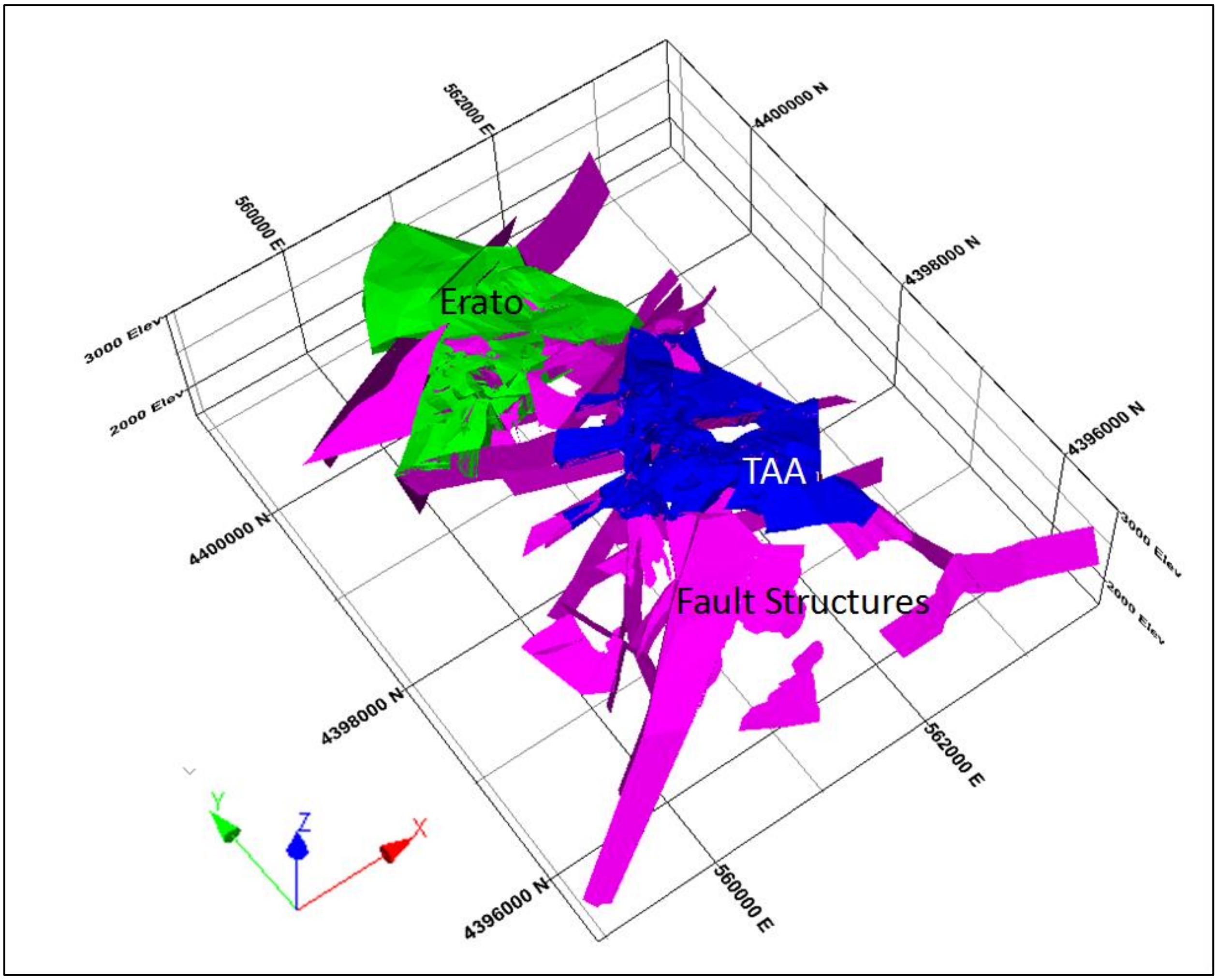
Good reliability of diamond core drilling is indicated by average recovery values for UV and LV zones of 96 to 99%. The TAA Zone averaged 97% core recovery with less than 4% of drilling with a core recovery less than 70% for the UV Zone and 96% core recovery with 5% of drilling with a core recovery of less than 70% for the LV Zone. Reverse circulation drilling chip recovery was not measured by Lydian. Risks related to reverse circulation drilling were not quantifiable by AMC.

Following this review, AMC considers that the Amulsar database provided by Lydian is sufficiently reliable to interpret with confidence the boundaries of the gold and silver mineralization, and that the assay data is sufficiently reliable to support resource estimation.

14.3 Geological Modelling and Interpretation

The Amulsar deposit has a complex history of structural events, including east- and west-directed thrusting and related complex deformation, and two episodes of extensional faulting within large north-east-trending grabens. This has resulted in a complex of structurally positioned blocks of upper volcanic and lower volcanic rocks. Mineralization is predominantly confined to rocks of the UV Zone. The LV Zone is generally not mineralized, except near contacts with mineralized UV rocks or related mineralized structures. The UV Zone was subdivided into the Erato Zone to the north and the TAA Zone to the south, as shown in Figure 14-1. The two units are structurally distinct, with the Erato Zone having a slightly lower tenor of gold mineralization.

Figure 14-1: Wireframe Models for Amulsar UV Units and Interpreted Faults



Source: Samuel Engineering (2017)
Note: Interpreted faults in magenta.

The interpretation of Erato and TAA UV units is based on the integration of the following data sets which includes:

- Lithology codes from drillhole logging;
- Gold and silver assays;
- Alteration logging;
- Interpreted geochemical-lithological units;
- Surface geological and structural mapping completed in 2012 and 2013; and
- Structural interpretation of main faults based on surface mapping and drillhole logs.

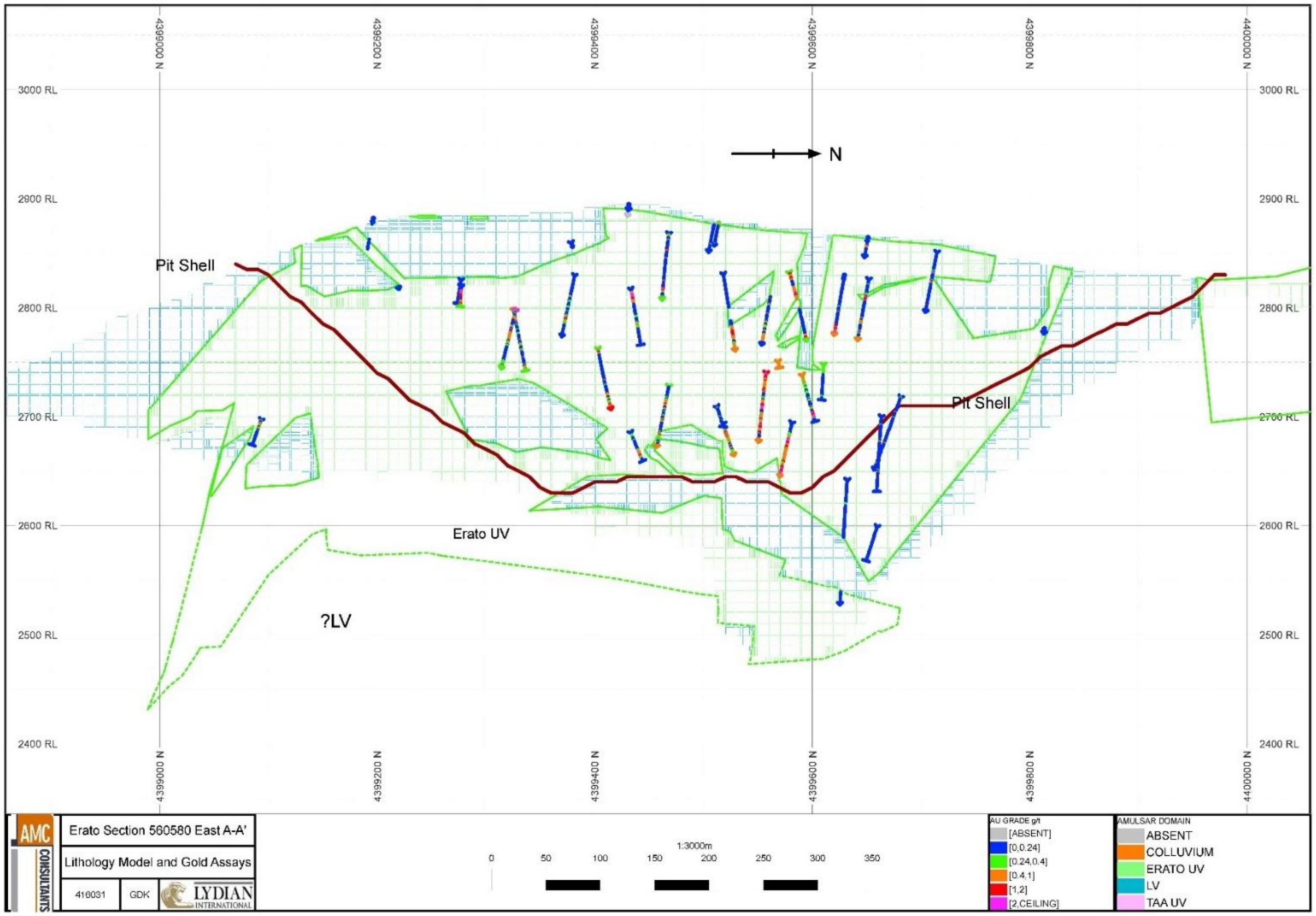
Wireframes for UV were constructed by extending wireframe triangles from interpreted structural blocks to interpreted contacts. UV Contacts are complicated by multiple inferences for contacts, rapid changes in lithologies, alteration and mineralization over a scale of 1 meter to 10s of meters. Contacts were snapped to drillhole intersections as much as possible; however, due the complexity of contacts, contacts needed to be interpreted through a number of drillhole intersections without being snapped to each interval intersection. The methodology of building the interpretation triangle by triangle necessarily includes a complex combination of small and larger triangulations which provide a complex volumetric surface in detail but provides a reasonable average of mineralization boundaries.

Colluvium was modelled based on drillhole intersections of near-surface material including talus, boulders, and exposed weathered rock. This material was modelled based on only larger areas logged as colluvium. Similar to the UV wireframe, contacts were snapped to drillhole intersections as much as possible, but due to complexity and variable coding of lithology, these wireframes were interpreted over a number of drillhole intersections, which were not coded as colluvium. Colluvium is generally thinly deposited over the Erato and TAA areas and does not form a significant volume of material over the zones.

Resources were not estimated for the colluvium unit. AMC considers this material low-grade or unmineralized.

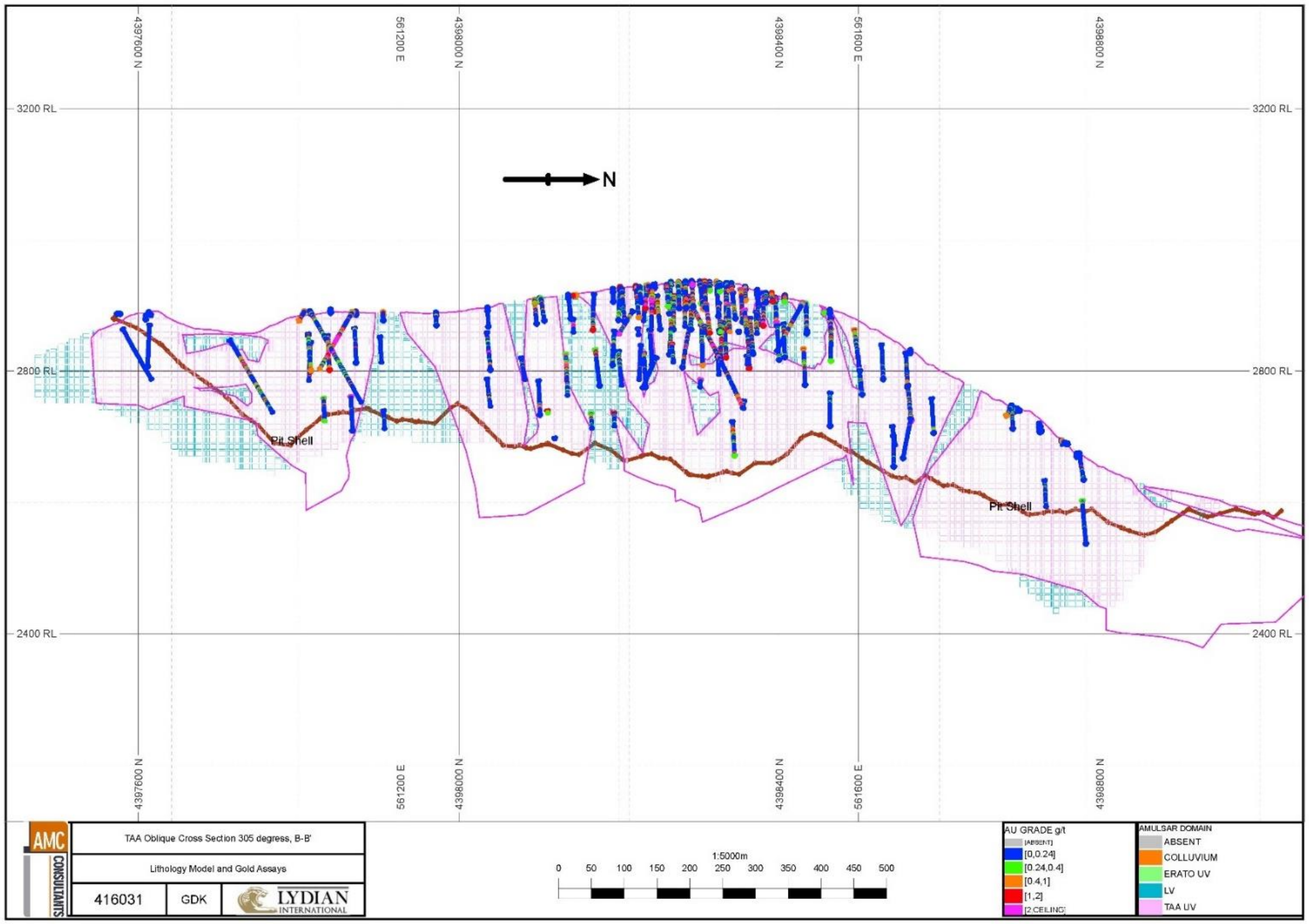
The TAA UV wireframe was completely reviewed and updated to 2016 drilling. As no drilling was undertaken in the Erato Zone the 2014 interpretation was used for resource estimation. Sectional views of the lithology block models for Erato and TAA zones are shown in Figure 14-2 and Figure 14-3.

Figure 14-2: Erato Interpreted Block Model Lithology Cross Section



Source: Samuel Engineering (2017)

Figure 14-3: TAA Interpreted Block Model Lithology Cross Section



Source: Samuel Engineering (2017)

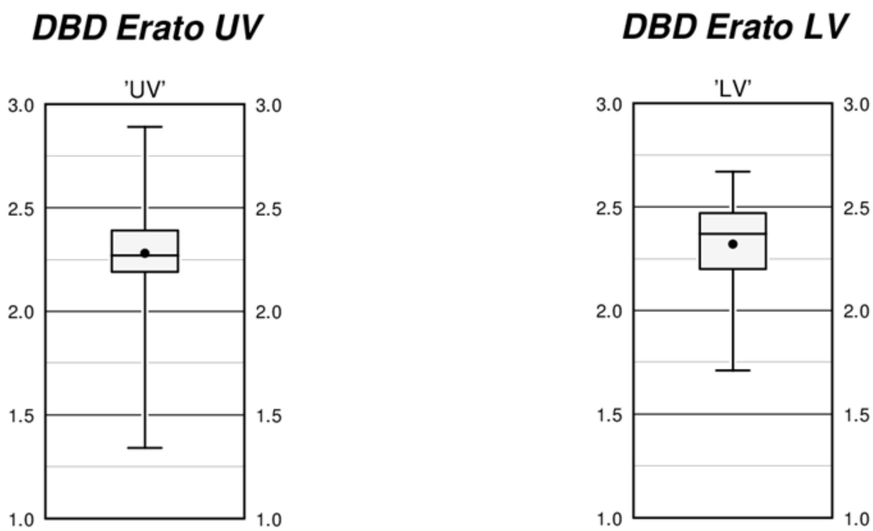
14.4 Dry Bulk Density

Dry bulk density (DBD) measurements were subdivided into UV and LV units for Erato and TAA zones. During the 2016 drilling campaign, 200 additional DBD measurements were completed by Lydian in the TAA Zone. The new measurements included 146 for UV and 74 for LV units.

Summary statistics for each zone are in Figure 14-4 and Figure 14-5. AMC determined that the most appropriate method of representing DBD is to average the DBD values for each main unit modelled.

AMC considers the variability of LV and UV DBD measurements relatively minor and will be assigned averages for each lithological unit. Erato and TAA UV zones are appropriate for resource estimation. Since Erato and TAA LV averages differ by 0.01 the average value of TAA will be used for all LV units.

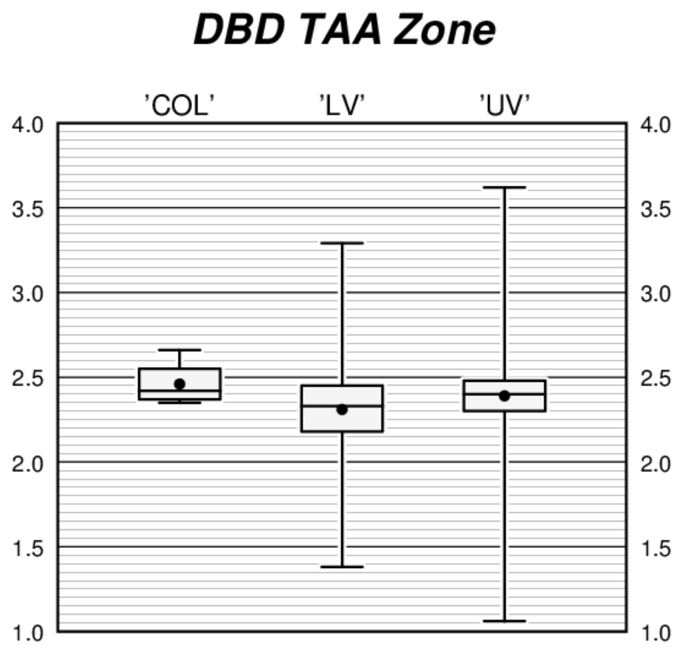
Figure 14-4: Summary Statistics for Dry Bulk Density Measurements by Zone



	DBD Erato UV	DBD Erato LV
Number of data	238	105
Mean	2.28	2.32
Std. Dev.	0.17	0.2
Coef. of Var.	0.07	0.09
Maximum	2.89	2.67
Upper quartile	2.39	2.47
Median	2.27	2.37
Lower quartile	2.19	2.2
Minimum	1.34	1.71

Source: Samuel Engineering (2017)
Note: Sample length weighted statistics.

Figure 14-5: Summary Statistics for DBD Measurements by Zone



	'COL'	'LV'	'UV'	
Number of data	4	131	825	Number of data
Mean	2.46	2.31	2.39	Mean
Std. Dev.	0.12	0.23	0.18	Std. Dev.
Coef. of Var.	0.05	0.1	0.08	Coef. of Var.
Maximum	2.66	3.29	3.62	Maximum
Upper quartile	2.55	2.45	2.48	Upper quartile
Median	2.42	2.33	2.4	Median
Lower quartile	2.37	2.18	2.3	Lower quartile
Minimum	2.35	1.38	1.06	Minimum

Source: Samuel Engineering (2017)
Note: Sample length weighted statistics.

14.5 Topography

Topography for the resource estimate is based on a high-resolution, 1-meter contour satellite digital elevation model ("DEM") (commissioned by Lydian – PhotoSat in 2014). AMC imported the model as an ArcGIS Shape file into Datamine RM to generate a wireframe topography model for the project. Checks of drillhole collars with topography indicate minor differences in drillhole collar elevations in the range of approximately 1 m to 2 m. This topography data is considered to be appropriate for estimation of resources.

14.6 Resource Database

The drillhole and chip sample database used for estimation of resources consists of 26,911 gold assays and 25,627 silver assays, and excludes geotechnical, metallurgical, and condemnation drillholes. AMC excluded eight drillholes completely and partially excluded intervals for eight other drillholes that were not assayed for silver or gold. These drillholes were assayed with different analytical methods, or only partially sampled. Excluded drillholes are summarized in Table 14-1. In addition, silver assays taken at 6-m intervals were also excluded from the database.

Table 14-1: Drillholes and Intervals Removed from the Drillhole Database

BHID	INTERVAL
DDA-032	all
DDA-281	all
DDAC-172	all
DDAM-071	all
DDAM-070	all
DDAG-162	all
DDAG-170	all
DDAG-162	all
DDAG-154A	29.80-35.40
DDAG-154B	49.00-66.20
DDAG-175	84.00-142.00
DDAG-251	55.00-134.20
DDA-026	0.00-31.50
RCA-433	0.00-6.00
RCA-433	10.0-15.00
RCA-433	16.00-17.00

Source: Samuel Engineering (2017)

Drillhole intervals for each of the four zones were coded using the wireframe models for Erato and TAA, and colluvium. Due to the complexity of wireframe configurations, some intervals lying on the wireframe boundaries were duplicated between some of the four zones. These duplicates were removed from one data set according to the following criteria:

- All duplicated intervals coded by the colluvium wireframe were assigned to either UV or LV units; and
- Duplicated intervals coded in Erato or TAA zones and LV zones were assigned to the appropriate data set units, based on lithological coding. Duplicated intervals coded as LV lithologies were removed from the UV data set, and duplicated intervals coded as any other lithologies were assigned to the UV data set.

Approximately 10% of the drillhole database did not have silver assays for corresponding gold assays. These missing silver assays were not used in compositing or the estimation of silver resources. All trace assays were assigned 0.0025 g/t for gold and 0.005 for silver g/t.

All unsampled intervals within the database were assigned a trace value of 0.0025 g/t for gold and 0.005 g/t for silver.

Erato gold assays for the UV domain form a highly positively skewed log-normal-like distribution with approximately 65% of assays below a nominal cut-off value of 0.2 g/t. Average gold assay is 0.33 g/t, the domain has a relatively moderately high variability of gold grades as suggested by a coefficient of variation (COV) of 2.5. Similarly, silver assays form a highly positively skewed log-normal-like distribution with a high proportion of low-grade assays. The average of silver assays is 1.93 g/t. This domain also shows significant variability of low-grade assays, COV is 2.2.

The Erato LV domain is characterized by a large proportion of unmineralized rock with very localized and limited zones of mineralization. This is reflected by a large proportion of the gold and silver assays at low grades and typified by low average grades of 0.13 g/t Au and 1.0 g/t Ag. A large bulk of low-grade material with a small proportion of higher grades results in high variance of gold and silver grades indicated by COV of 5.2 and 13.4.

TAA UV domain gold assays show a highly positively skewed log-normal-like distribution with approximately 60% of assays below a nominal cut-off of 0.2 g/t Au. The average gold grade is 0.44 g/t. The gold grades for this domain have a relatively high variability, as suggested by a COV of 3.7. Similarly, silver assays show a highly skewed log-normal-like distribution with a significate proportion of low-grade assays.

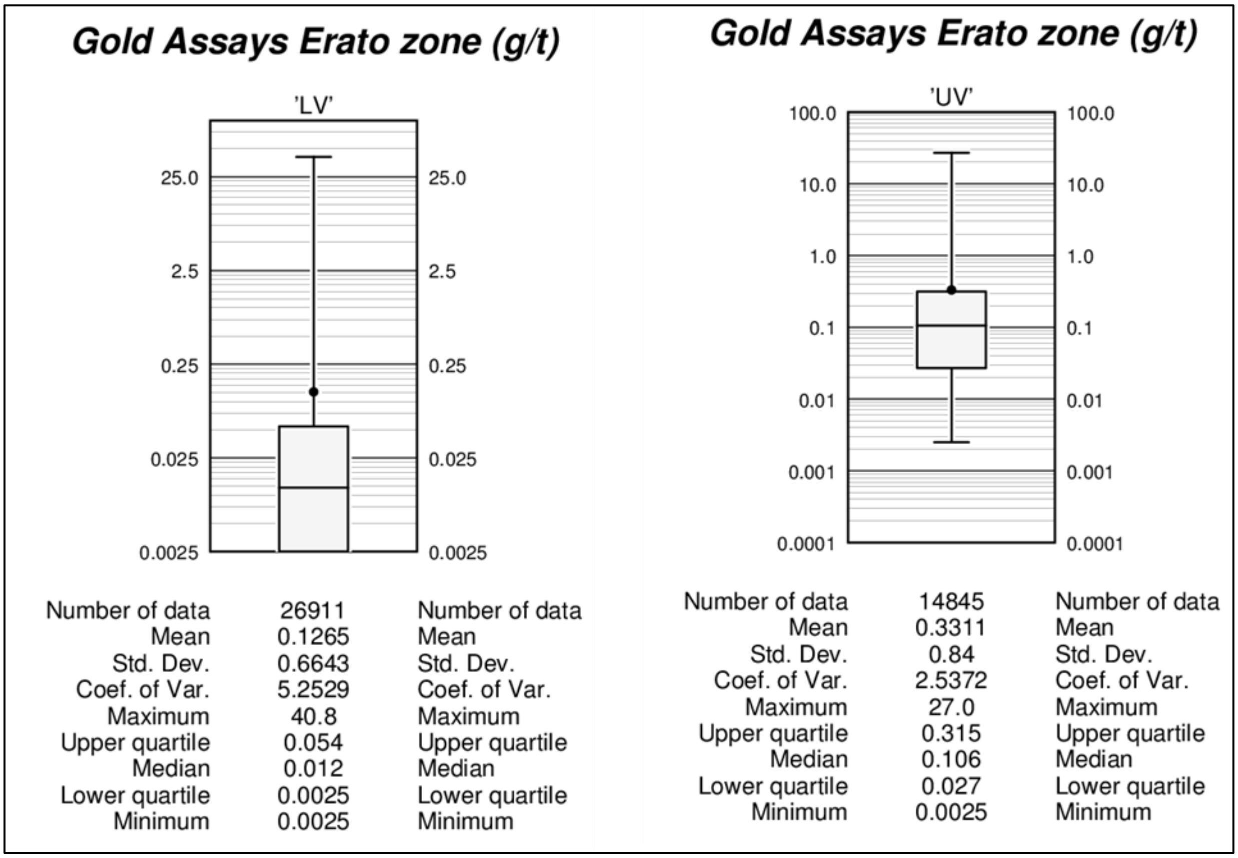
The average silver grade is 3.1. Assays show a high variance of silver values as indicated by a COV of 4.8. A maximum of silver assay of 2,248 g/t is an outlier value.

TAA LV domain is also characterized by a large proportion of unmineralized rock with very localized and limited zones of mineralization. This is reflected by a large proportion of the gold and silver assays at low grades and typified by low average grades of 0.10 g/t

Au and 0.68 g/t Ag. Relatively high variability of the data set is indicated by COV of 4.7 for gold and 2.9 for silver.

Summary gold and silver statistics are provided in Figure 14-6 and Figure 14-7 for the Erato Zone and Figure 14-8 and Figure 14-9 for the TAA Zone. Histograms and probability plots are provided in the Samuel Engineering Report (2017).

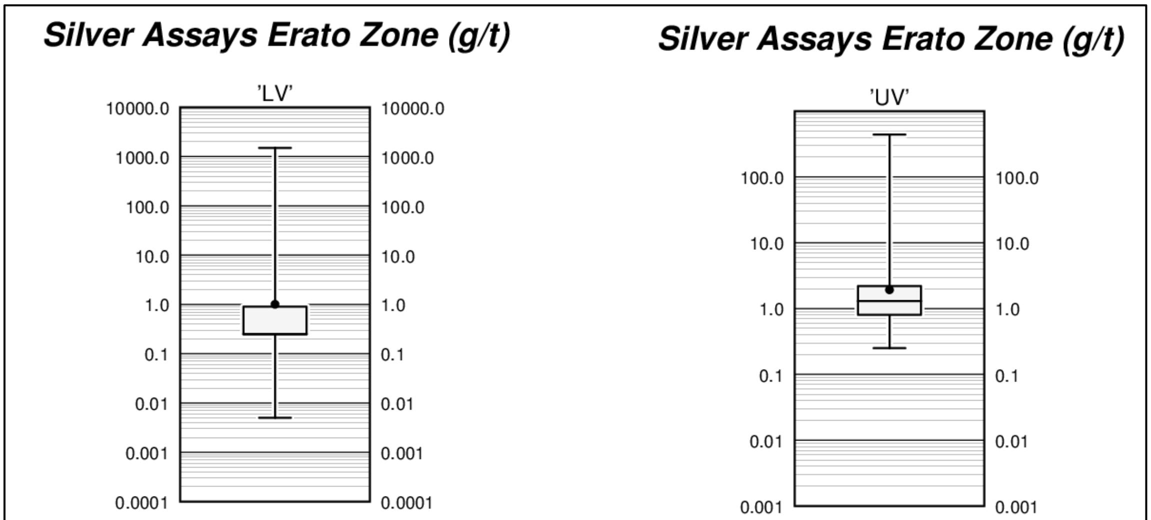
Figure 14-6: Summary Statistics for Gold Assays Erato Zone



Source: Samuel Engineering (2017)

Note: Sample length weighted statistics

Figure 14-7: Summary Statistics for Silver Assays Erato Zone



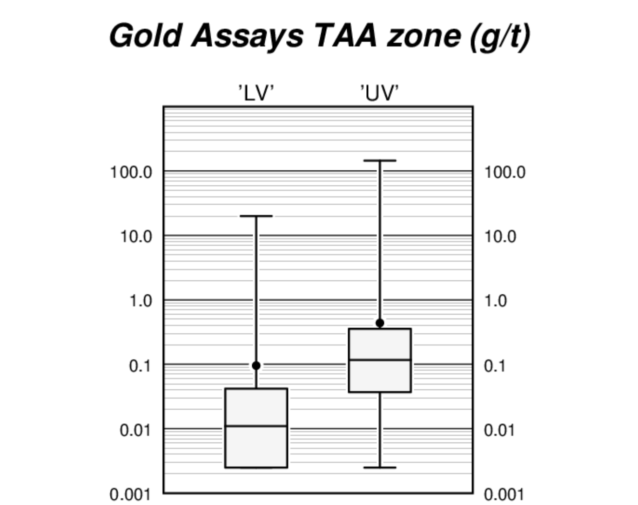
'LV'		
Number of data	25672	Number of data
Mean	1.0035	Mean
Std. Dev.	13.4833	Std. Dev.
Coef. of Var.	13.4358	Coef. of Var.
Maximum	1500.0	Maximum
Upper quartile	0.9	Upper quartile
Median	0.25	Median
Lower quartile	0.25	Lower quartile
Minimum	0.005	Minimum

'UV'		
Number of data	14030	Number of data
Mean	1.9285	Mean
Std. Dev.	4.204	Std. Dev.
Coef. of Var.	2.1799	Coef. of Var.
Maximum	440.0	Maximum
Upper quartile	2.2	Upper quartile
Median	1.3	Median
Lower quartile	0.8	Lower quartile
Minimum	0.25	Minimum

Source: Samuel Engineering (2017)

Note: Sample length weighted statistics

Figure 14-8: Summary Gold Assays TAA Zone

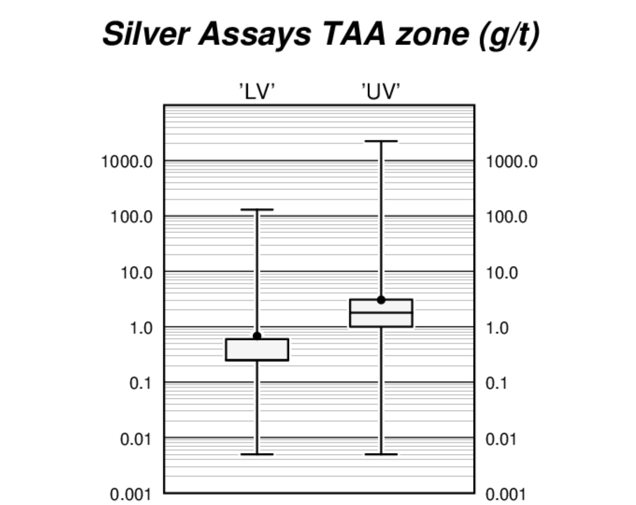


	'LV'	'UV'	
Number of data	18849	74062	Number of data
Mean	0.0953	0.4378	Mean
Std. Dev.	0.4504	1.6333	Std. Dev.
Coef. of Var.	4.7254	3.7309	Coef. of Var.
Maximum	19.95	144.0	Maximum
Upper quartile	0.042	0.354	Upper quartile
Median	0.011	0.116	Median
Lower quartile	0.0025	0.037	Lower quartile
Minimum	0.0025	0.0025	Minimum

Source: Samuel Engineering (2017)

Note: Sample length weighted statistics

Figure 14-9: Summary Statistics for Silver Assays TAA Zone



	'LV'	'UV'	
Number of data	17616	70681	Number of data
Mean	0.68	3.053	Mean
Std. Dev.	1.956	14.702	Std. Dev.
Coef. of Var.	2.876	4.816	Coef. of Var.
Maximum	130.0	2240.0	Maximum
Upper quartile	0.6	3.1	Upper quartile
Median	0.25	1.8	Median
Lower quartile	0.25	1.0	Lower quartile
Minimum	0.005	0.005	Minimum

Source: Samuel Engineering (2017)
Note: Sample length weighted statistics

14.7 Compositing, Capping and Declustering

Drillholes were composited into four domains:

- Erato UV
- Erato LV
- TAA UV
- TAA LV

Each of the four zones were composited to 2 m to provide common support for statistical analysis, variography, and estimation for gold and silver. Approximately 99% of assay samples were sampled at 2-meter intervals or less.

Summary statistics for gold and silver composites are provided in Figure 14-10 and Figure 14-11.

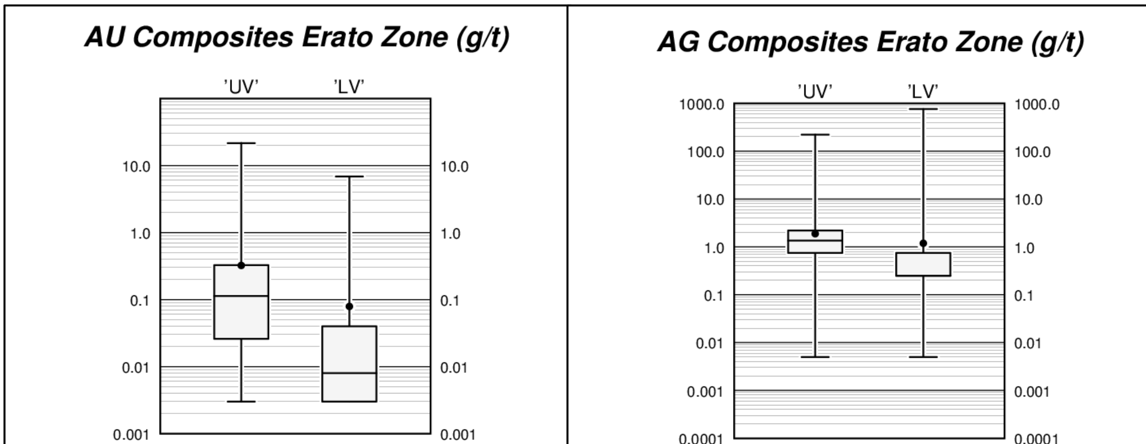
Gold and silver values in the composites correlate poorly for both TAA and Erato UV domains, this is shown in a correlation correlation coefficient between gold and silver values is 0.14. This poor correlation can also be observed by examining drillholes in 3D, and is also observed in drillhole assays. The poor correlation is likely related to different mineralizing events and different mineralizing conditions for each of the metals. A scattergram for TAA UV gold and silver composite is provided in Figure 14-12.

Histograms, cumulative frequency, probability plots, metal content plots, and analysis of the spatial distributions of gold composites for each of the four composite sets were reviewed to identify high-grade outlier values. This analysis indicates that capping of high gold grades for the Erato and TAA Zone UV and LV units is not required as higher grades are not considered isolated outliers and are supported by other higher grades in the same drillhole or in nearby drillholes. Summary histograms and probability plots for gold and silver capped composites are provided in in the Samuel Engineering report (2017).

Similarly, histograms, cumulative frequency, probability plots, metal content plots, and analysis of the spatial distributions of silver composites were reviewed for the four composite data sets separately. This analysis indicates that capping of high silver grades is required for TAA UV unit. For this data set silver composites were capped at 700 g/t Ag. The remaining TAA LV unit and Erato Zone UV and LV units did not require capping of silver composites as higher grades are not isolated outliers and are supported by other higher grades in the same drillhole or in nearby drillholes, which implies some continuity of high-grade silver values.

A cell declustering method was applied to reduce the impact of varying sampling densities on the global-mean for Erato and TAA gold and silver composites. For TAA UV gold composites, a declustering cell size of 330 m × 330 m × 35 m for gold and 270 m × 270 m × 28 m for silver was applied. Erato UV unit composites cell declustering cell size was 143 m × 143 m × 52 m for gold and 84 m × 84 m × 42 m for silver. Declustering was not applied to LV units as mineralization is localized and not continuous for either the Erato and TAA zones. Gold composites for the LV unit and silver composites for Erato, TAA, and LV units were not declustered prior to variography.

Figure 14-10: Summary Statistics Erato Zone Composites

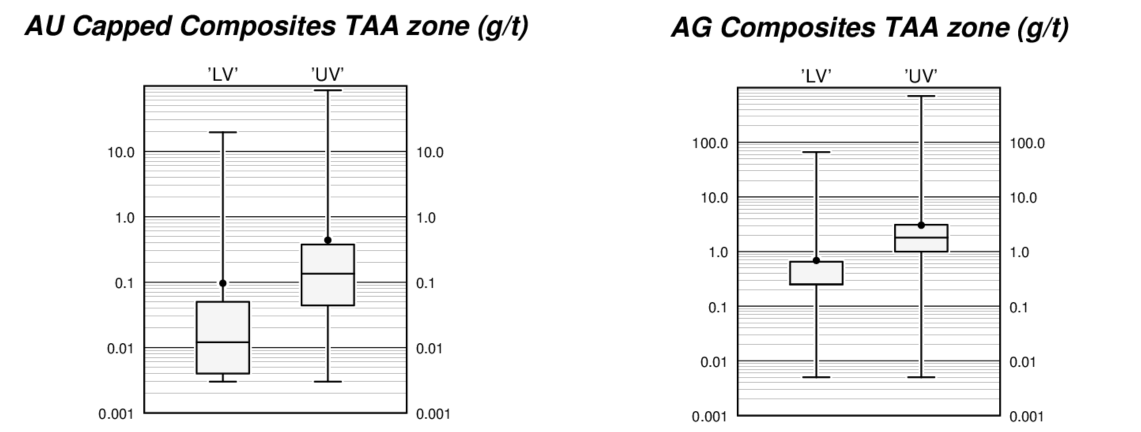


AU	'UV'	'LV'
Number of data	8373	4718
Mean	0.323	0.079
Std. Dev.	0.779	0.29
Coef. of Var.	2.409	3.684
Maximum	21.6	6.86
Upper quartile	0.326	0.04
Median	0.113	0.008
Lower quartile	0.026	0.003
Minimum	0.003	0.003

AG	'UV'	'LV'
Number of data	8365	4725
Mean	1.881	1.188
Std. Dev.	3.27	16.587
Coef. of Var.	1.739	13.958
Maximum	220.9	757.5
Upper quartile	2.2	0.75
Median	1.35	0.25
Lower quartile	0.75	0.25
Minimum	0.005	0.005

Source: Samuel Engineering (2017)

Figure 14-11: Summary Statistics TAA Zone Composites



AU Capped Composites TAA zone (g/t)

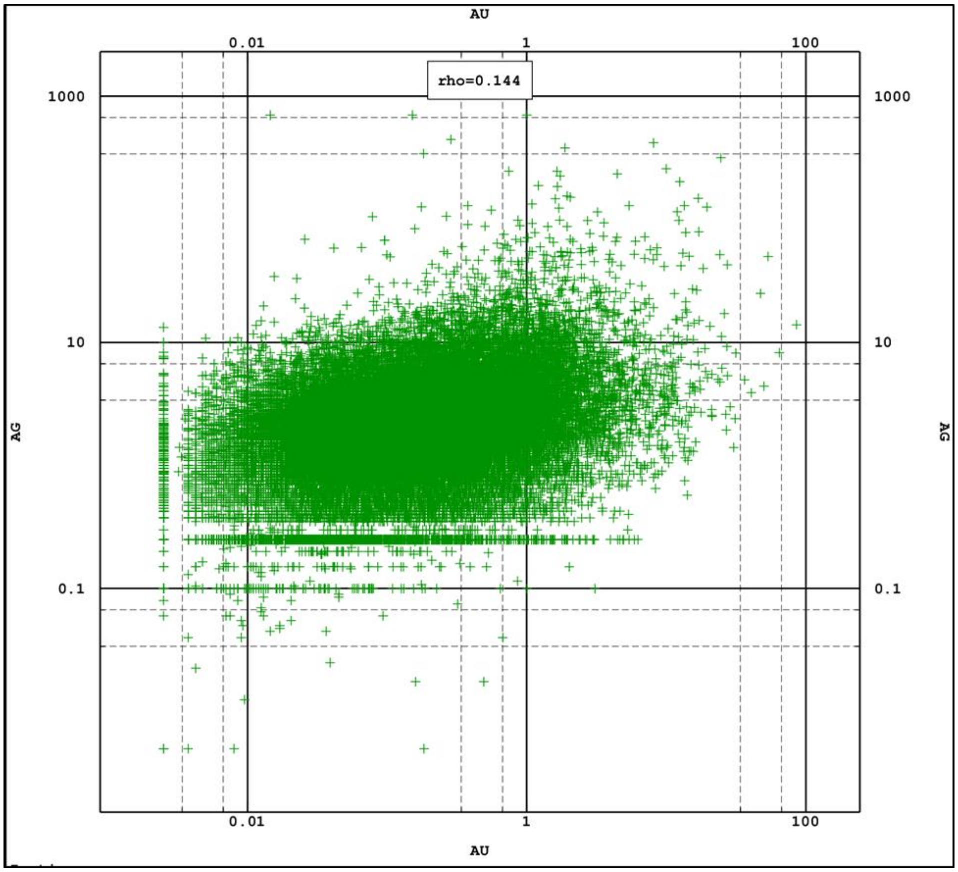
	'LV'	'UV'
Number of data	10322	39266
Mean	0.096	0.438
Std. Dev.	0.4	1.417
Coef. of Var.	4.162	3.233
Maximum	19.6	85.7
Upper quartile	0.05	0.376
Median	0.012	0.134
Lower quartile	0.004	0.044
Minimum	0.003	0.003

AG Composites TAA zone (g/t)

	'LV'	'UV'
Number of data	9048	36015
Mean	0.687	3.035
Std. Dev.	1.636	9.906
Coef. of Var.	2.383	3.264
Maximum	65.85	700.0
Upper quartile	0.65	3.1
Median	0.25	1.8
Lower quartile	0.25	1.0
Minimum	0.005	0.005

Source: Samuel Engineering (2017)

Figure 14-12: Scattergram for TAA Zone UV Gold and Silver Composites



Source: Samuel Engineering (2017)

14.8 Variography

Variography for the Amulsar deposit is based on Gaussian transforms of gold and silver composites which were back-transformed to gold and silver variograms. Declustering weights were used for Erato and TAA Zone UV gold and silver variograms. However, declustering weights were not used for Erato and TAA Zone LV variograms as mineralization in these domains is localized.

Omni-directional variograms are considered appropriate for this project based on:

- Structural trends and faults related to mineralization are orientated in a number of different orientations;
- Mineralization is, in part, associated with lithology changes, brecciation, and fractures that are not continuous at the scale of the drill spacing; and
- Anisotropic orientations in trial variograms are weakly controlled by data configuration and therefore are not considered appropriate.

A lag distance of 40 m was used for all omni-directional variograms. Nugget values were determined using omni-directional down-the-hole variograms.

A total of eight variograms models were made for the Amulsar gold project. All nuggets and sills were normalized to 1. A summary of variogram models for the project is provided in Table 14-2 for Erato and Table 14-3 for TAA. Variogram model detailed figures are in Appendix 3 of the 2017 FS. The variogram model for TAA UV domain is provided in Figure 14-13.

Table 14-2: Summary of Omni-directional Variogram Models Erato Zone

Variable	Domain	Estimator	*C_0	*CC	Structure Model	Rx [m]	Ry [m]	Rz [m]
AU	UV	OK	0.083	0.420	Spherical	47.0	47.0	47.0
				0.418	Spherical	144.0	144.0	144.0
				0.079	Spherical	370.0	370.0	370.0
AG	UV	OK	0.141	0.479	Spherical	45.0	45.0	45.0
				0.221	Spherical	97.0	97.0	97.0
				0.159	Spherical	283.0	283.0	283.0
AU	LV	OK	0.851	0.047	Spherical	40.0	40.0	40.0
				0.082	Spherical	60.0	60.0	60.0
				0.020	Spherical	182.0	182.0	182.0
AG	LV	OK	0.063	0.623	Spherical	5.0	5.0	5.0
				0.228	Spherical	28.0	28.0	28.0
				0.072	Spherical	72.0	72.0	72.0
				0.013	Spherical	170	170	170

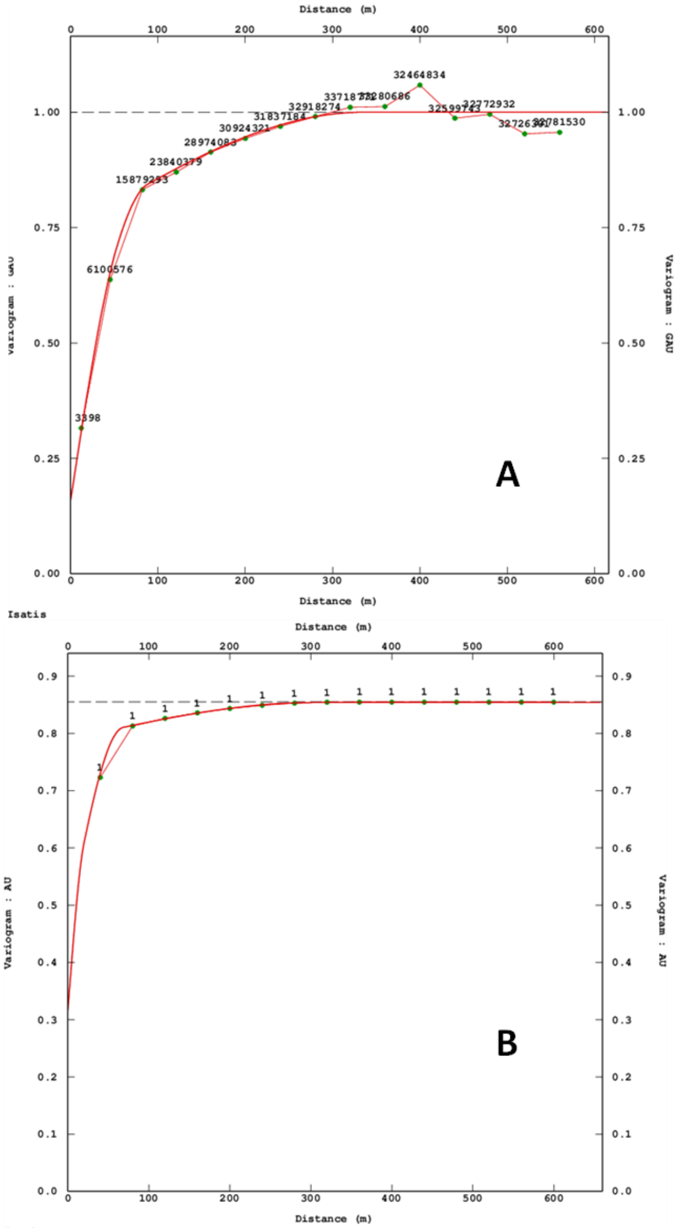
Source: Samuel Engineering (2017)

Table 14-3: Summary of Omni-directional Variogram Models TAA Zone

Variable	Domain	Estimator	*C_0	*CC	Structure Model	Rx [m]	Ry [m]	Rz [m]
AU	UV	OK	0.370	0.172	Spherical	20.0	20.0	20.0
				0.382	Spherical	68.0	68.0	68.0
				0.076	Spherical	305.0	305.0	305.0
AG	UV	OK	0.095	0.693	Spherical	40.0	40.0	40.0
				0.156	Spherical	126.0	126.0	126.0
				0.057	Spherical	470.0	470.0	470.0
AU	LV	OK	0.335	0.573	Spherical	46.0	46.0	46.0
				0.092	Spherical	217.0	217.0	217.0
AG	LV	OK	0.372	0.238	Spherical	21.0	21.0	21.0
				0.391	Spherical	50.0	50.0	50.0

Source: Samuel Engineering (2017)

Figure 14-13: Omni-directional Gold Variogram Models TAA UV Domain



Source: Samuel Engineering (2017)

A: Gold variogram for Erato plus LV composites.

B: Gold indicator variogram for Erato plus LV composites at 0.130 g/t.

14.9 Block Model Parameters

The Amulsar resource estimate is based on a block size of 10 m × 10 m × 10 m. These blocks represent the smallest or selective mining unit (SMU). The model is not rotated with respect to UTM system northing, easting, and elevations. Details of block model definitions are summarized in Table 14-4.

Table 14-4: Block Model Definition

Coordinates	Origin (m)	Block Size	No. Blocks	Distance (m)	Extent (m)
X:	559,600	10	312	3,120	562,720
Y:	4,396,300	10	492	4,920	4,401,220
Z:	2,270	10	73	730	3,000

Source: Samuel Engineering (2017)

14.10 Estimation Procedures

14.10.1 Gold Estimates for Erato and TAA Zones

Resources were estimated for the Erato and TAA UV and LV domains only. Metal grades were not estimated for colluvium as this unit is considered unmineralized.

The SMU for the deposit was increased from the previous resource estimate to reflect changes in the physical and economic evaluation of the deposit. The previous SMU blocks of 10 m × 10 m × 5 m were changed to 10 m × 10 m × 10 m, thereby reducing the selectivity of the resource estimate. With this change in selectivity the resource estimate is appropriate for mining at a scale of 10 m × 10 m × 10 m blocks only. This resource would not be appropriate for mining selectively on either a smaller or larger scale.

Estimates of gold and silver for the Erato and TAA zones were made using ordinary kriging (OK) to estimate block grades for each SMU block. The OK estimate was “tuned” by “targeting” a tonnage and grade plot derived from a Gaussian change-of-support (COS) for gold and silver, for each of the Erato and TAA UV domains. This procedure was used to limit over-smoothing and conditional bias that might result from using an “untuned” OK estimate. This process consisted of iteratively adjusting estimation parameters to arrive at a best-fit to the COS tonnage and grade plot for the domain.

The LV unit is sparsely mineralized, with very localized mineralization above cut-off (0.20 g/t Au). .AMC considers that COS for this unit may be unreliable and therefore has chosen to estimate this zone by using “untuned” OK estimates. The materiality of this unit is limited as it represents 6% of mineral resources.

Estimation parameters for the resource estimate are in Table 14-5 and Table 14-6. Tonnage and COS and OK estimate tonnage and grade plots for Erato UV and TAA UV gold estimates are provided in Figure 14-14 and Figure 14-15. The grade plots for the Erato and TAA OK estimates plot reasonably closely to the respective COS grade plots at cut-off ranges from 0.2 g/t Au to an upper range of about 2.5 g/t Au, indicating grades have been estimated appropriately.

14.10.2 Dry Bulk Density (DBD)

DBD values were assigned to each estimated model on the basis of the average DBD measurements for each of the three zones. Average values assigned to each zone are as follows:

- Erato Zone UV: 2.28;
- TAA Zone UV: 2.39; and
- Lower Volcanics: 2.31.

Table 14-5: Erato Estimation Parameters

							Ranges [m]			Search Ellipsoid Rotation*		
Variable	**Estimator**	**Zone**	**Estimation Run**	**Minimum**	**Maximum**	**Octant Search**	**SVx (m)**	**SVy (m)**	**SVz (m)**	**Z AXIS**	**X-AXIS**	**Z-AXIS**
AU	OK	UV	1	6	8	NO	70	70	40	0	0	0
			2	6	8	NO	140	140	80			
			3	6	8	NO	490	490	280			
AG	OK	UV	1	8	12	NO	70	70	40	0	0	0
			2	8	12	NO	140	140	80			
			3	8	12	NO	490	490	280			
AU	OK	LV	1	6	10	NO	50	50	30	0	0	0
			2	6	10	NO	100	100	60			
AG	OK	LV	1	6	10	NO	50	50	30	0	0	0
			2	6	10	NO	100	100	60			

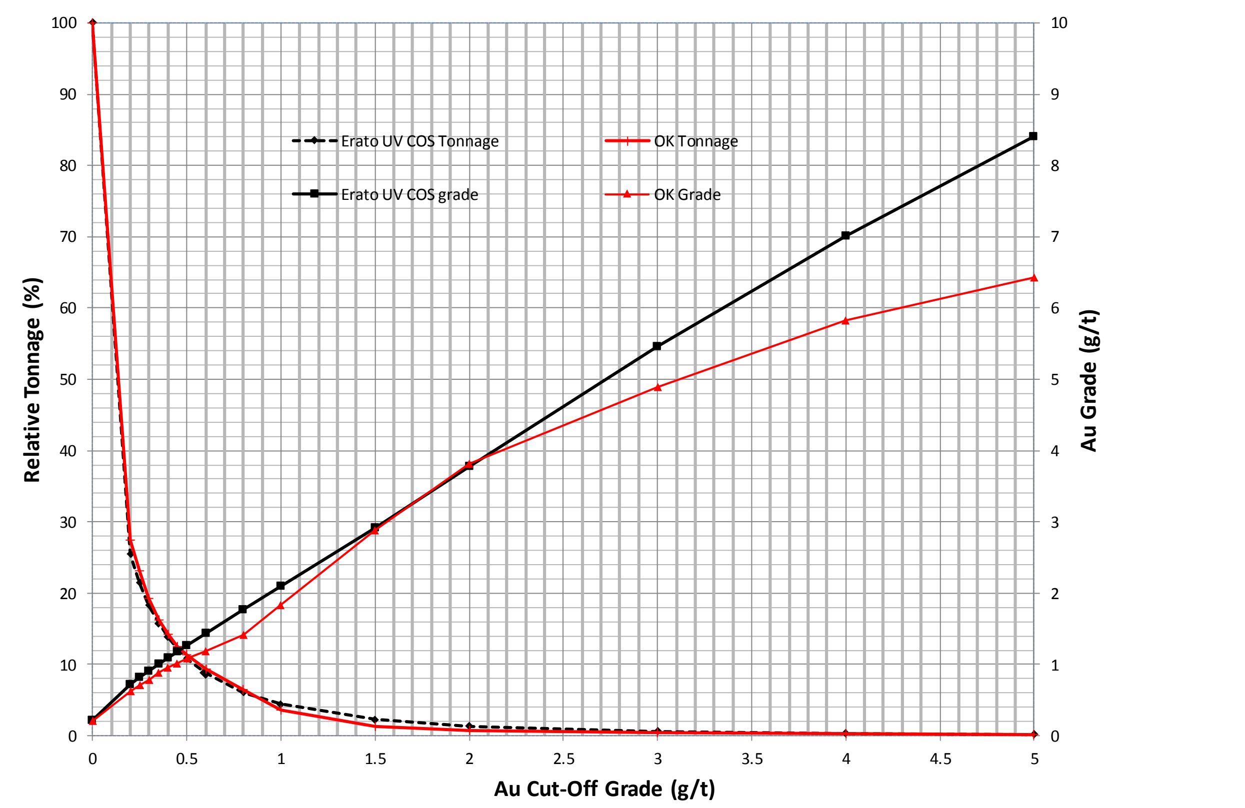
Source: Samuel Engineering (2017)

Table 14-6: TAA Estimation Parameters

							Ranges [m]			Search ellipsoid rotation			
Variable	Estimator	Zone	Estimation Run	Min.	Max.	Octant search	SVx [m]	SVy [m]	SVz [m]	Z- AXIS	X-AXIS	Z-AXIS	Maximum Composites per drillhole
AU	OK	UV	1	6	8	NO	70	70	50	0	0	0	3
			2	6	8	NO	140	140	100				3
			3	6	8	NO	490	490	350				3
AG	OK	UV	1	2	8	NO	70	70	40	0	0	0	3
			2	2	8	NO	140	140	60				3
			3	2	8	NO	490	490	350				3
AU	OK	LV	1	2	10	NO	50	50	30	0	0	0	3
			2	2	10	NO	100	100	100				3
AG	OK	LV	1	2	10	NO	50	50	30	0	0	0	3

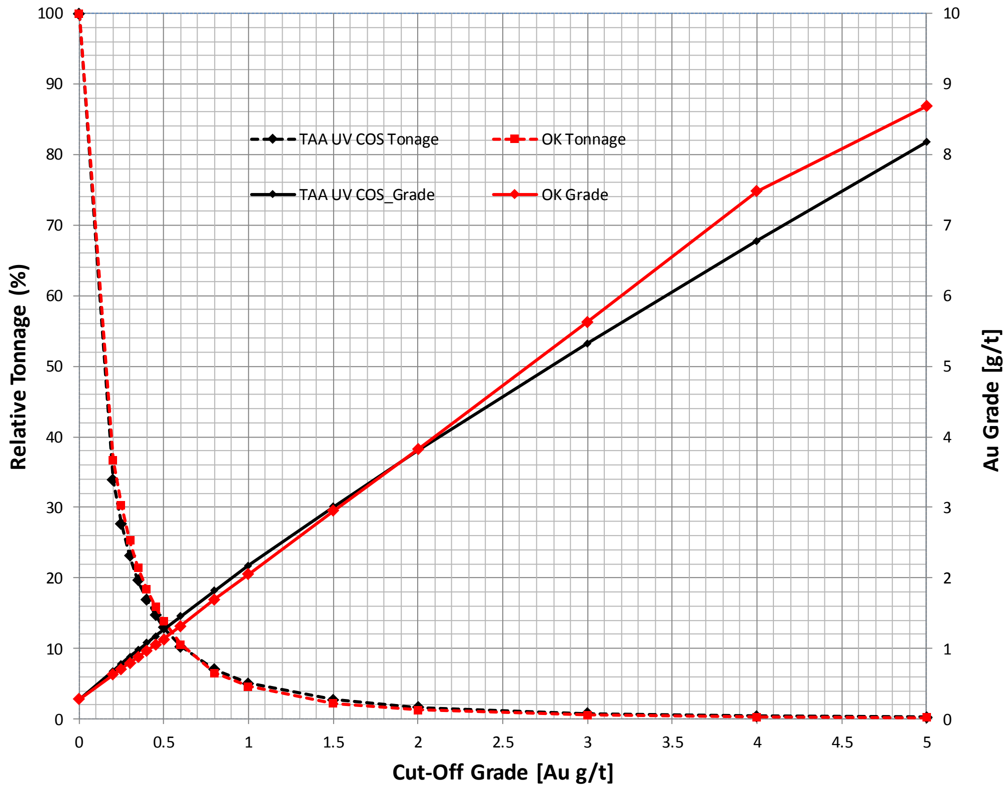
Source: Samuel Engineering (2017)

Figure 14-14: COS and OK Gold Estimate Tonnage and Grade Plot for Erato UV Domain



Source: Samuel Engineering (2017)

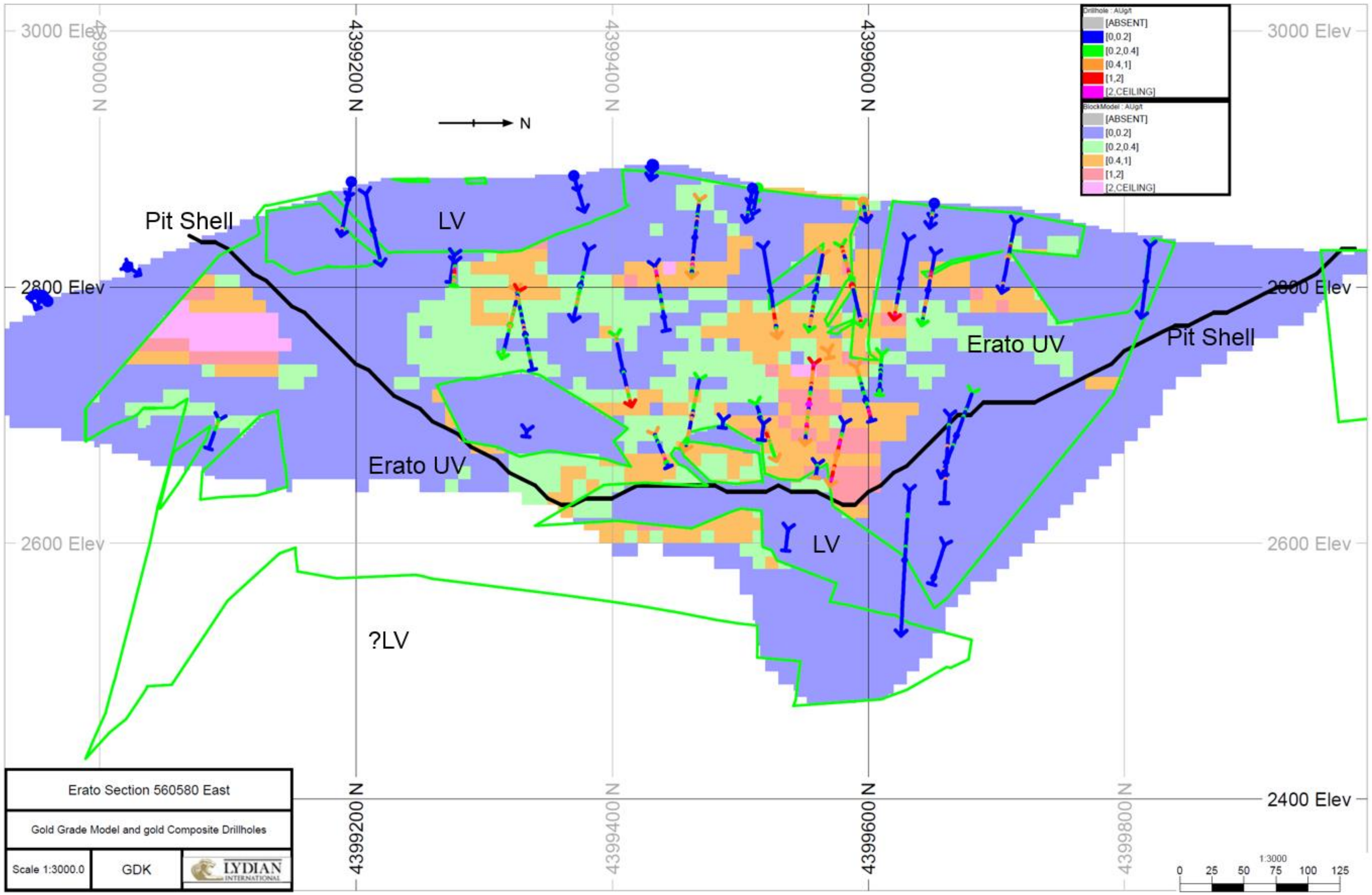
Figure 14-15: COS and OK Gold Estimate Tonnage and Grade Plot for TAA UV Domain



Source: Samuel Engineering (2017)

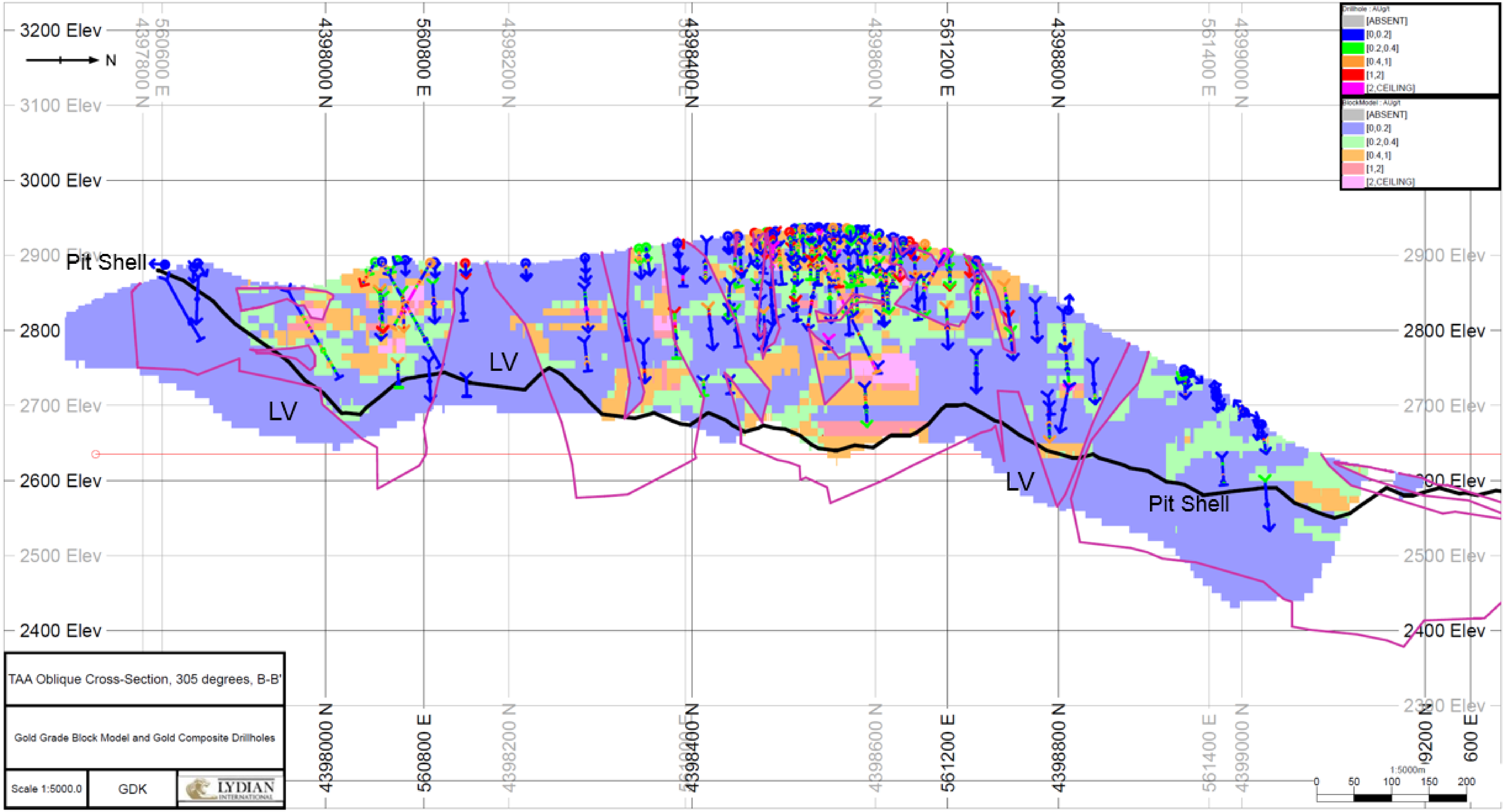
Cross-sections of the Amulsar model with estimated gold and silver grades are provided in Figure 14-16 and Figure 14-17 for gold, and Figure 14-18 and Figure 14-19 for silver.

Figure 14-16: Cross-section of Erato Gold Grade Block Model and Composites for Gold



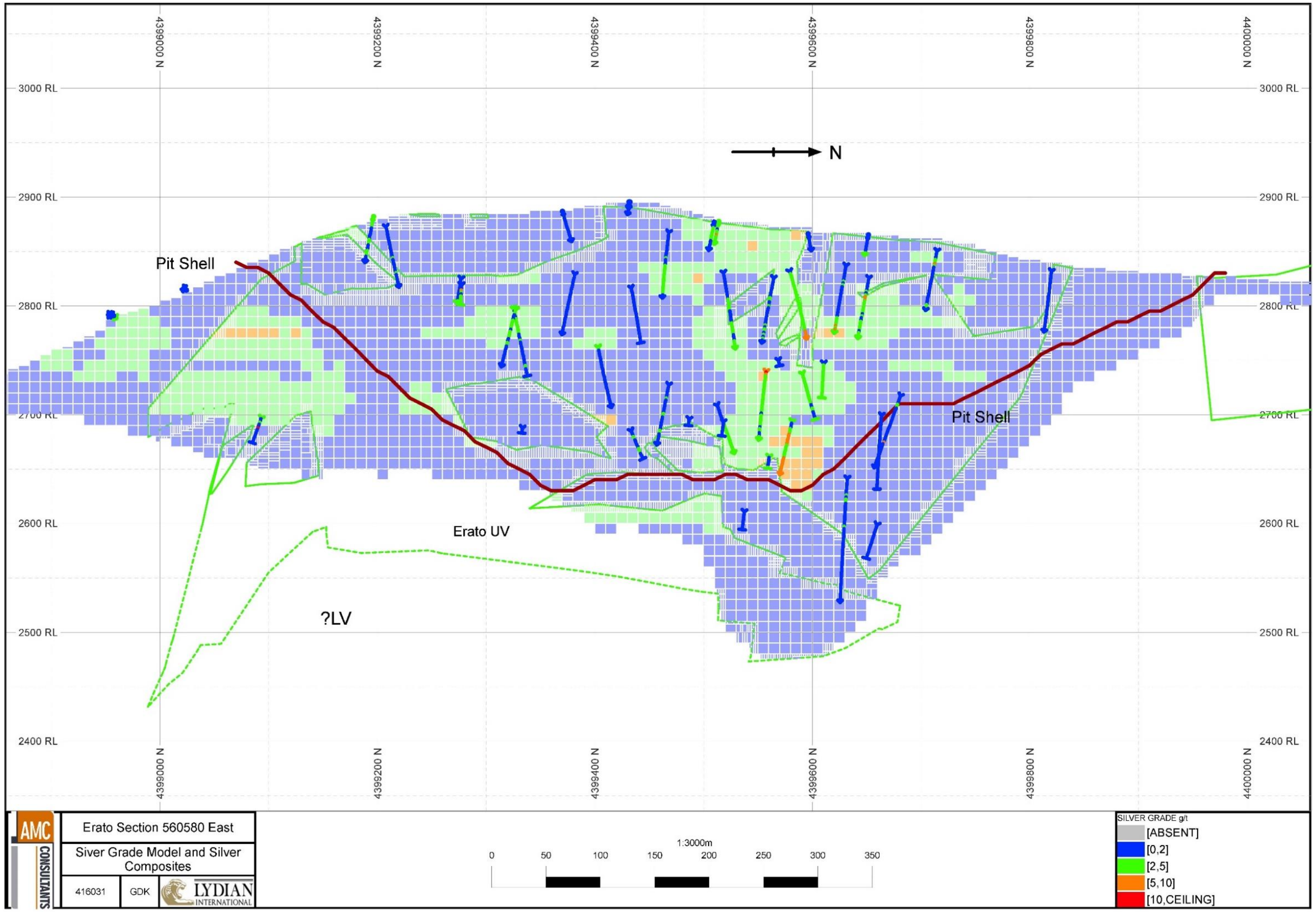
Source: GDK (2019)

Figure 14-17: Oblique Cross-section of TAA Gold Grade Block Model and Composites for Gold



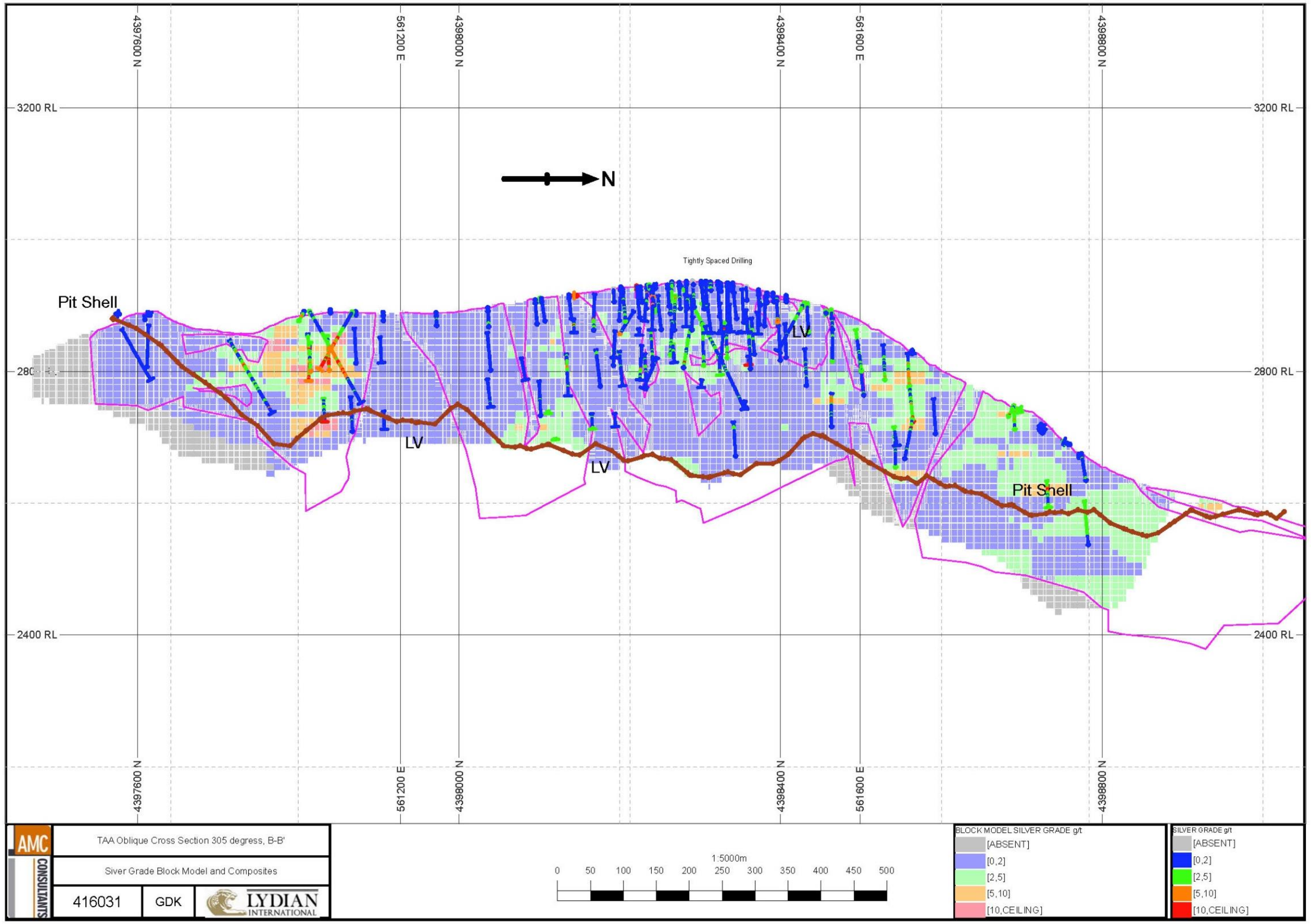
Source: GDK (2019)

Figure 14-18: Cross-section of Erato Silver Grade Block Model and Composites for Silver



Source: Samuel Engineering (2017)

Figure 14-19: Cross-section TAA Silver Grade Block Model and Composites for Silver



Source: Samuel Engineering (2017)

14.10.3 Validation

Validation checks were completed for all UV domain gold and silver estimates. Checks included the following:

- Review of estimated block grades and composites in 3D;
- Comparative grade and tonnage checks for OK estimate with COS using nearest neighbour (NN) estimates;
- Comparative check of TAA UV declustering with tightly spaced drilling and without; and
- Plots of average estimated block gold grades and declustered composites compared on the bases of large blocks (50 m × 50 m × 50 m blocks).

Large block comparison of block grades and composites for the UV domains are presented in Figure 14-20 and Figure 14-21. Plots use a moving average of composites values to provide a trend line that can be compared to estimated block grades.

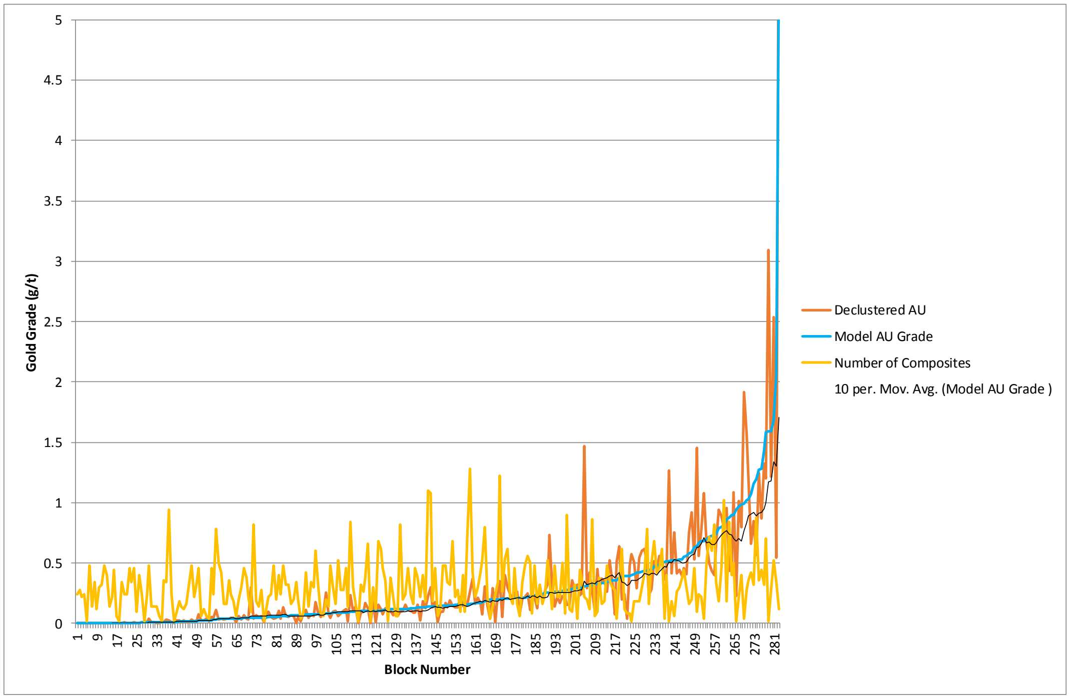
Erato UV plots show good correlation between composites and block grades from approximately 0.7 to 1.5 g/t Au. A slight change in the composite trend-line moving below the model grades (about 0.7 to 1.5 g/t Au) is largely a factor of limited number of composites. Overall, the plot indicates that the variability in the declustered data is reasonably reflected in the block model.

Similarly, the TAA UV plots show a good correlation between composite and block grades albeit with more variability than the Erato UV. Grades above 1.3 g/t Au show significant variability between block grades and composites caused by localized high grades composite for some large blocks. The overall trend of composites and block grades is considered reasonably.

Validation checks confirm that block model estimates for gold and silver for the Amulsar project are appropriate, and reasonably reflect the underlying sampling data.

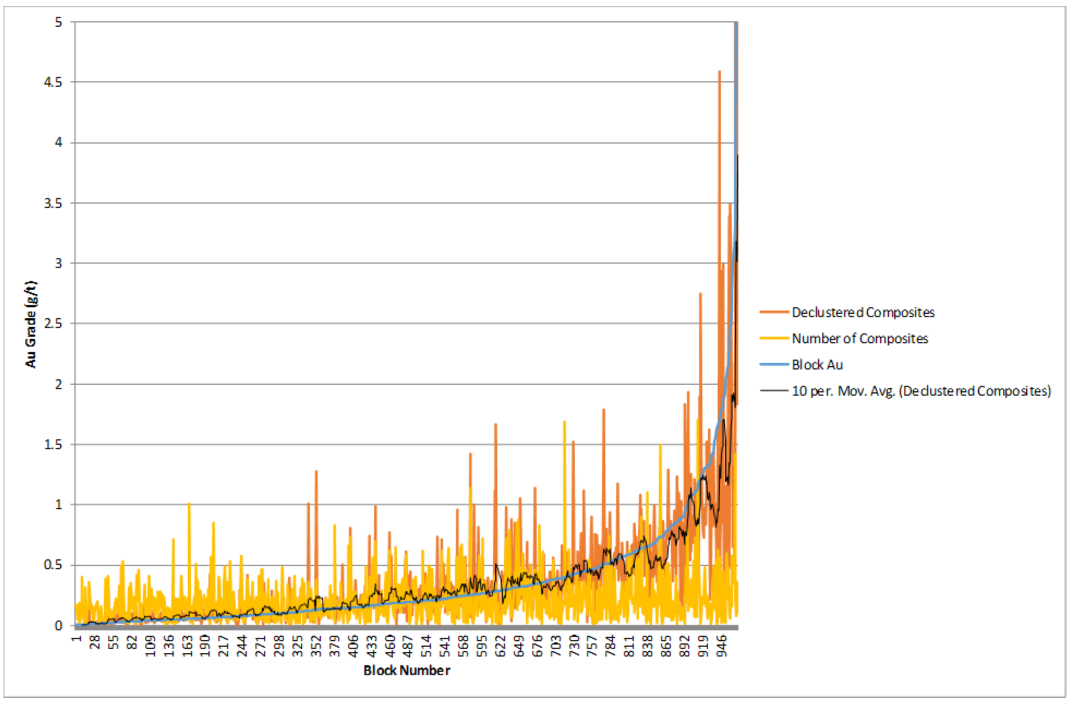
Validation checks of LV domains were limited to a review of block grades and composites in 3D as COS is not used for LV estimates.

Figure 14-20: Large Block Averages of Declustered Composites and Block Model Grades for Erato UV



Source: Samuel Engineering (2017)

Figure 14-21: Large Block Averages of Declustered Composites and Block Model Grades for TAA UV



Source: Samuel Engineering (2017)

14.11 Resource Classification

Mineral resources for the Amulsar project have been estimated in conformity with generally accepted CIM "*Estimation of Mineral Resource and Mineral Reserves Best Practices*" guidelines and are classified according to the "*CIM Definitions Standards for Mineral Resources and Mineral Reserves*" (November 2010).

Estimated resources have been classified with consideration of the following criteria:

- Quality and reliability of data (sampling, assaying, surveying).
- Confidence in the geological interpretation.
- Number, spacing, and orientation of intercepts through mineralized zones.
- Knowledge of grade continuities gained from observations and geostatistical analyses.

Gold mineralization at the Amulsar deposit is characterized by short-range continuities at variable orientations, particularly if considering grades above potentially economic cut-offs. This short-scale continuity is controlled primarily by a complex system of fractures, faulting, and folded structures contemporaneous with mineralization. Mineralization-related fractures and structures are variably orientated. Short ranges and variable orientations of grade continuity are supported by variograms as well as a lack of discernible directionality. It is, therefore, important to identify low-confidence areas which have been estimated by one or two drillholes in an isolated area, regions at depth where estimates are highly influenced by a single drillhole, or regions that have been estimated at longer distances from any drillholes. AMC considers that estimates based on these circumstances do not meet the requirements of Inferred category resources. Using the boundary between the Erato and TAA zone second and third estimation runs as a guide, AMC developed a wireframe surface which constrained the extent of reportable estimated resources. The boundary also excluded blocks estimated by isolated drillholes or blocks estimated by drillholes that are significantly isolated from other drillholes at depth. This wireframe was applied to the final block model containing Erato and TAA UV domains and LV estimates, such that all blocks below this boundary were removed from the model as unclassified material. The wireframe is based on exclusion of areas that are poorly informed by drilling only.

Inferred resources are defined as all blocks not classified as indicated or measured. Typically, these areas comprise drilling at a nominal spacing greater than 50 m and blocks estimated by second and third estimation runs.

Indicated resources are classified using a combination of the following criteria:

- Drillhole spacing at nominal 45 m or less including a mix of drillhole orientations from vertical and inclined holes to inclined holes at different azimuths;
- Drillholes must form a continuous volume exceeding a minimum extent of 150 m; and
- UV domains only, classification was extended to relatively minor amounts of LV blocks adjacent to, or encapsulated by, UV units to form a uniform mineable shape.

Measured resources were classified on the basis of a combination of criteria:

- Drillholes at spacing at 40 m or less forming a grid pattern (as opposed to a single line of drillholes), a significant number of drillholes in the grid pattern, a significant portion of drillholes must be at different orientations, such as vertical and inclined holes or inclined holes at different azimuths;

- Drillhole grids must extend for at least 200 m;
- Slope of regression values must be predominantly greater than or equal to 0.70 for the TAA Zone; this value was not used for the Erato Zone;
- UV domain blocks only; and
- Blocks classified as Measured must form mineable shapes.

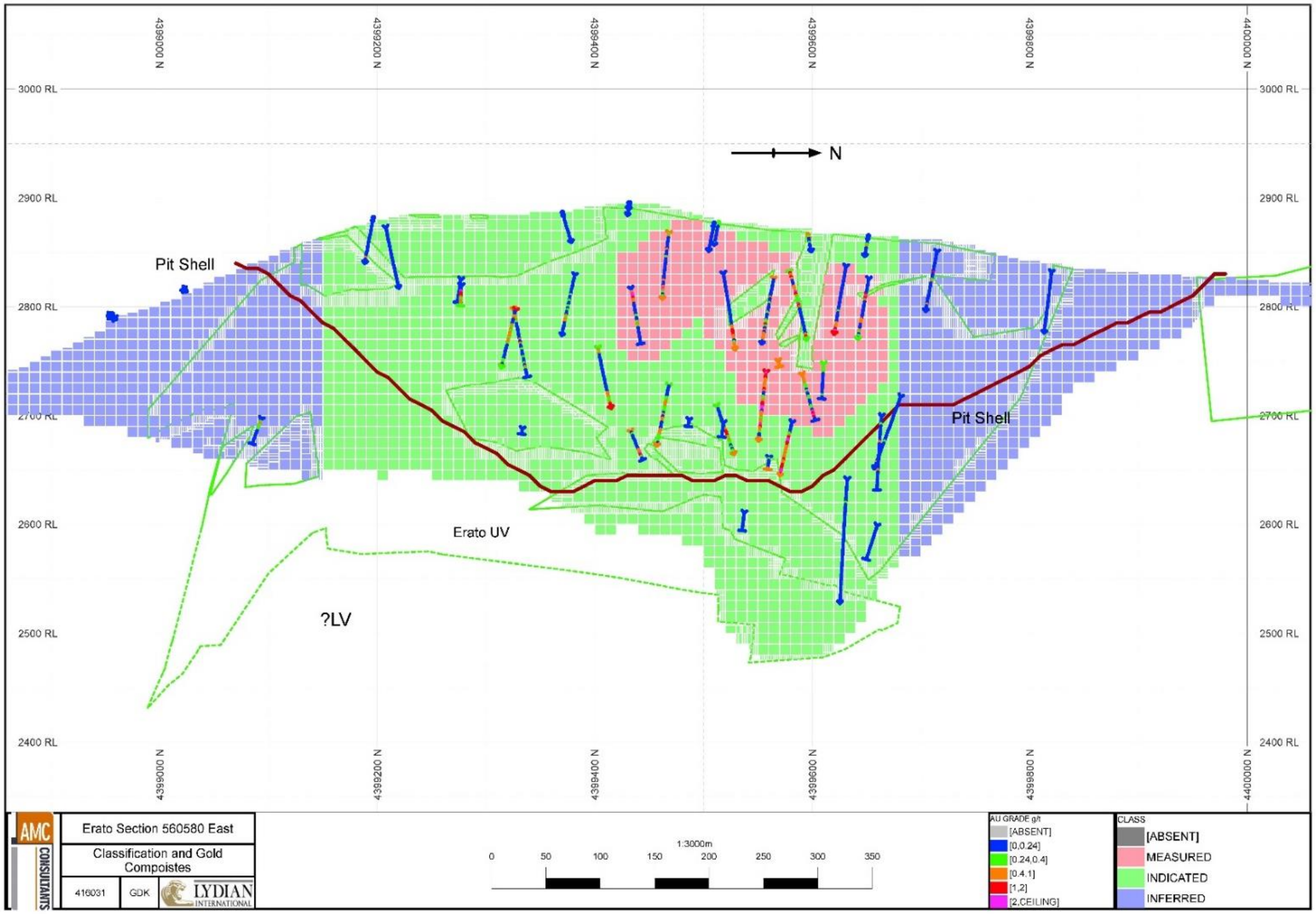
In order to determine the quantities of material with reasonable prospects of economic extraction by open-pit mining, Whittle software (using a Lerchs-Grossman optimizing algorithm) was used by MDA to provide AMC with a conceptual open pit to evaluate the resource block model. MDA used the following parameters for optimization:

- Pit slope angles of 45 degrees for UV, 30 degrees for LV and 37 degrees for colluvium;
- Metal price assumption of US$1,500 per troy pounce of gold, US$25 per troy ounce silver;
- Heap leach recovery of 87.2% for gold and 6.2% for silver;
- Royalties of 4% of NSR; and
- Mining costs of US$1.76 per tonne mined, processing costs, and general and administration costs of US$4.37 per tonne of ore.

An appropriate gold cut-off grade for the mineral resources for both TAA and Erato zones was discussed between Lydian and WGM. A cut-off grade of 0.20 g/t Au for this project based on an optimized open-pit shell was determined appropriate for the deposit. Typical cross-sections of the classified resource model are provided in Figure 14-22 and Figure 14-23.

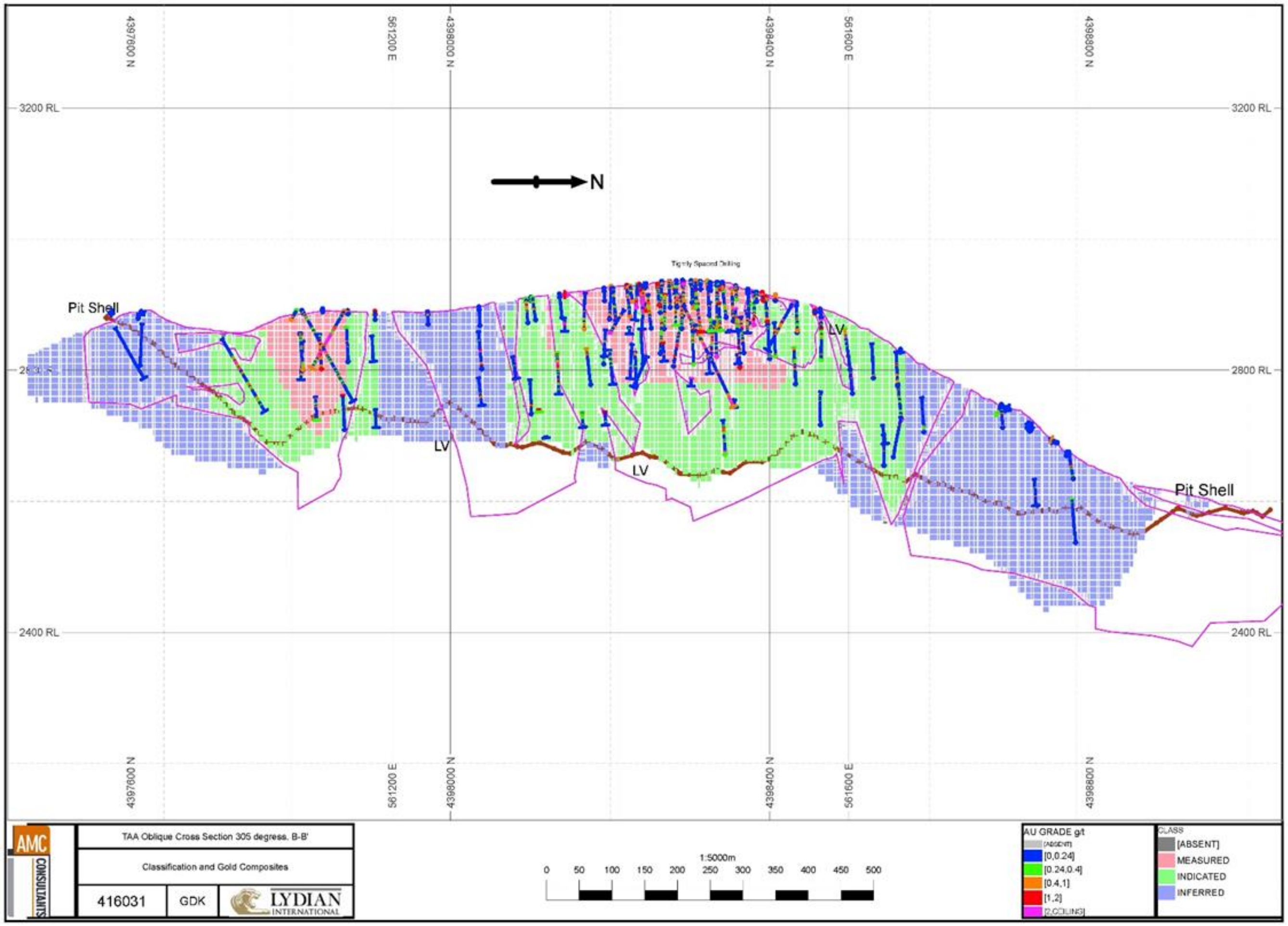
Mineral resources are reported on the basis of all estimated blocks that are contained within this pit shell. Cross-sections of the Amulsar classified model are provided in Figure 14-22 and Figure 14-23 and in 3D view in Figure 14-24.

Figure 14-22: Cross-section Erato Zone Classified Model



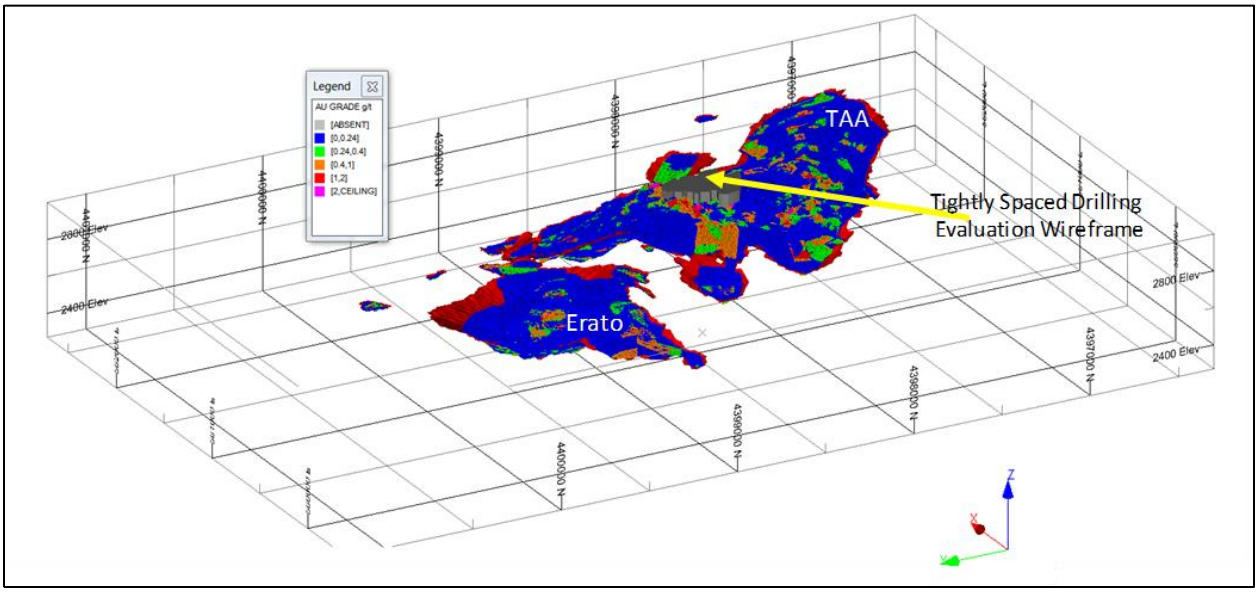
Source: Samuel Engineering (2017)

Figure 14-23: Cross-section TAA Zone Classified Model



Source: Samuel Engineering (2017)

Figure 14-24: Amulsar Resource Model and Pit Shell



Source: Samuel Engineering (2017)

14.12 Mineral Resource Statement

The basis of this Mineral Resource statement is a resource estimate completed in a previous feasibility study completed by AMC Consultants (UK) Limited with an effective date of 27 February 2017. The Qualified Person for this estimate was G. David Keller, P.Geo. (APGO#1235).

Since the 2017 Feasibility Study no material changes have occurred to the resource estimate. Mining operations during this period have been shut down and no material exploration, drilling or mining of the deposit have been completed. On this basis, a new estimate of mineral resources for Amulsar deposit is not required, as no material changes to mineral resources have occurred. Mineral resources have been restated at a lower cut-off grade in alignment with a reduction of the mineral reserves cut-off grade in this study compared to the previous 2017 study. No site visit was completed by the QP between 2017 and 2019.

Mineral resources for the 2019 Amulsar Project have been estimated in conformity with generally accepted CIM "Estimation of Mineral Resource and Mineral Reserves Best Practices" -guidelines and are classified according to the "CIM Definition Standards for Mineral Resources and Reserves: Definition and Guidelines" (May 2014). At a cut-off grade of 0.20 g/t gold mineral resources are estimated at 58.1 Mt at 0.76 g/t gold and 4.5 g/t silver (1.42 million ounces of gold and 8.5 million ounces of silver in the measured category, 104.2 Mt at 0.66 g/t gold and 3.2 g/t silver (2.21 million ounces of gold and 10.8 million ounces of silver) in the indicated category, and 85.9 Mt of gold at 0.5 g/t gold and 3.1 g/t silver in the inferred category. Mineral resources for the deposit are presented in Table 14-7. Mineral resources are reported inclusive of mineral reserves.

The Mineral Resource Statement was prepared by an "independent Qualified Person", G. David Keller, P.Geo. (APGO#1235), of Watts, Griffis and McOuat Limited ("WGM"), as this term is defined in National Instrument 43-101. The effective date of the Mineral Resource Statement is 3 September 2019. Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no certainty that all, or any part of, the mineral resources will be converted into mineral reserves. AMC is unaware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant issues that may materially affect the mineral resources. This resource estimate is appropriate for a mining selectivity of 10 m × 10 m × 10 m only.

Table 14-7: Mineral Resource Statement, WGM Ltd., 16, September 2019

Classification	Quantity [t]	Au [gpt]	Ag [gpt]	Contained Gold (toz)	Contained Silver (toz)
Measured	58,100,000	0.76	4.5	1,420,000	8,500,000
Indicated	104,200,000	0.66	3.2	2,210,000	10,800,000
Total Measured+Indicated	**162,400,000**	**0.70**	**3.7**	**3,650,000**	**19,200,000**
Total Inferred	85,900,000	0.50	3.1	1,380,000	8,600,000

Source: WGM (2019)

1. The effective date of the Mineral Resource Statement is 16 September 2019.
2. A cut-off grade of 0.20 g/t gold for this project based on an optimized open-pit shell based on a gold price of US$1,500 per ounce of gold and assuming an open-pit mining scenario.
3. Figures have been rounded to the appropriate level of precision for the reporting of Indicated and Inferred Resources in the upper and lower volcanic units.
4. Due to rounding, some columns or rows may not compute exactly as shown.
5. Mineral reserves are reported inclusive of mineral resources.
6. Mineral resources in this statement are not Mineral Reserves and do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues. Mineral reserves have been previously reported for this project using a prior Mineral Resource statement.

14.13 Previous Resource Estimates

Resources for the Amulsar project were previously estimated by AMC Consultants (UK) Limited with an effective date of 27 February 2017 as presented in the report “NI 43-101 Technical Report, Updated Resources and Reserves, Armenia.

The resource estimate for this study is based on the 2017 resource estimate as no material changes have been made to the 2017 resource estimate. WGM has restated the mineral resources using a lower gold cut-off grade 0f 0.20 g/t gold.

Restated mineral resources for measured category have increased by 11% difference from 51.5 Mt to 58.1 Mt with a corresponding 9% difference decrease of gold grade from 0.83 g/t to 0.76 g/t (a 4% difference increase in of contained gold from 1.37 Moz to 1.42 Moz. Indicated resources have increased by 13% difference from 90.7 Mt to 104.2 Mt with a corresponding 11% difference decrease in gold grade from 0.73 g/t to 0.66g/t (a 4% difference increase in contained gold from 2.13 Moz to 2.21 Moz). Inferred resources have increased by 16% difference from 72.2 Mt to 85.9 Mt with a corresponding 10% decrease in grade from 0.55 g/t to 0.50g/t (a 7% difference increase in contained gold from 1.28 Moz to 1.38 Moz.

The changes in restated mineral resources are solely due to reporting resources at a lower cut-off grade. Typically, a decrease in cut-off grade results in an increase in tonnage and a decrease in grade with a corresponding increase in contained metal.The previous AMC 2017 Mineral Resource Statement for the Amulsar Project is presented in Table 14-8.

Table 14-8: Mineral Resource Statement AMC Consultants (UK) Limited, 27 February 2017

Classification	Quantity (t)	Au (gpt)	Ag (gpt)	Contained Gold (toz)	Contained Silver (toz)
Measured	51,500,000	0.83	4.7	1,370,000	7,700,000
Indicated	90,700,000	0.73	3.4	2,130,000	9,800,000
Total Measured+Indicated	**142,200,000**	**0.76**	**3.8**	**3,470,000**	**17,500,000**
Total Inferred	72,200,000	0.55	3.3	1,280,000	7,600,000

Source: Samuel Engineering (2017)

1. The effective date of the Mineral Resource Statement is 27 February 2017.
2. A cut-off grade of 0.24 g/t gold for this project based on an optimized open-pit shell based on a gold price of US$1,500 per ounce of gold and assuming an open-pit mining scenario.
3. Figures have been rounded to the appropriate level of precision for the reporting of Indicated and Inferred Resources in the upper and lower volcanic units.
4. Due to rounding, some columns or rows may not compute exactly as shown.
5. Mineral reserves are reported inclusive of mineral resources.
6. Mineral resources in this statement are not Mineral Reserves and do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues. Mineral reserves have been previously reported for this project using a prior Mineral Resource Statement.
7. The resource is appropriate for a mining selectivity of 10 m x 10 m x 10 m blocks only.

14.14 Sensitivity Analysis

14.14.1 Grade Sensitivity Analysis

The Mineral resource for the Amulsar Project is sensitive to the selection of the reported cut-off grade. To illustrate this sensitivity, the global tonnage and grade estimates are presented in Table 14-9 at different gold cut-off grades. The reader is cautioned that the figures presented in this table should not be construed as a Mineral Resource Statement. The figures are presented only to show the sensitivity of the block model estimates to the selection of cut-off grades. Figure 14-25, Figure 14-26 and Figure 14-27 presents the sensitivity as grade and tonnage plots.

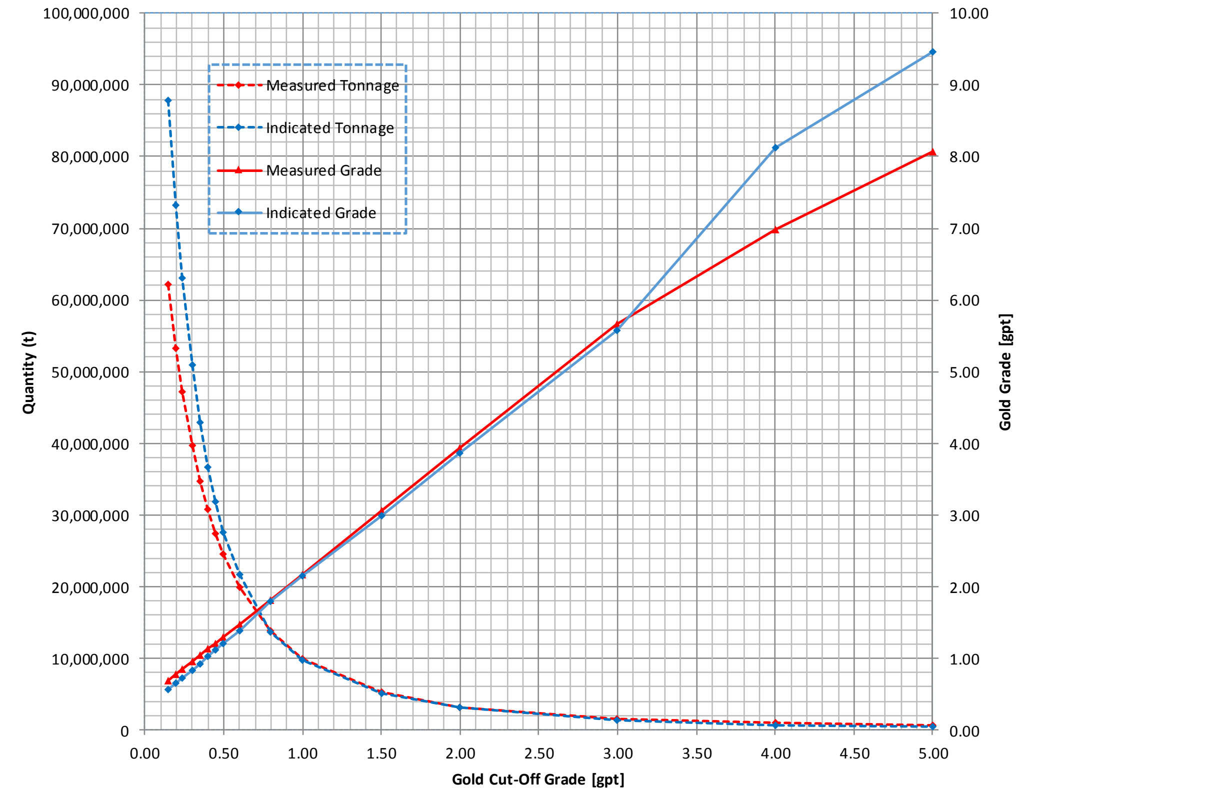
Table 14-9: Resource Model Sensitivity to Cut-off Grades

Classification	Cut-Off	Quantity (t)	Au (g/t)	Ag (g/t)	Contained Au (oz.)	Contained Ag (oz.)
Measured	0.15	67,700,000	0.68	4.3	1,480,000	9,400,000
	0.20	58,100,000	0.76	4.5	1,420,000	8,500,000
	0.24	51,500,000	0.83	4.7	1,370,000	7,700,000
	0.30	43,400,000	0.93	4.9	1,300,000	6,800,000
	0.35	38,000,000	1.02	5.1	1,250,000	6,200,000
	0.40	33,700,000	1.10	5.2	1,190,000	5,600,000
	0.45	29,900,000	1.19	5.4	1,140,000	5,100,000
	0.50	26,800,000	1.27	5.5	1,090,000	4,700,000
	0.60	21,800,000	1.44	5.8	1,010,000	4,100,000
	0.80	15,000,000	1.77	6.3	860,000	3,100,000
	1.00	10,700,000	2.13	6.7	730,000	2,300,000

Classification	Cut-Off	Quantity (t)	Au (g/t)	Ag (g/t)	Contained Au (oz.)	Contained Ag (oz.)
	1.50	5,500,000	3.02	7.3	530,000	1,300,000
	2.00	3,300,000	3.90	8.0	410,000	800,000
	3.00	1,500,000	5.61	7.8	270,000	400,000
	4.00	900,000	6.94	8.7	210,000	300,000
	5.00	700,000	8.05	9.6	170,000	200,000
Indicated	0.15	123,700,000	0.58	3.0	2,310,000	12,100,000
	0.20	104,200,000	0.66	3.2	2,210,000	10,800,000
	0.24	90,700,000	0.73	3.4	2,130,000	9,800,000
	0.30	73,800,000	0.83	3.6	1,970,000	8,400,000
	0.35	62,200,000	0.93	3.7	1,860,000	7,400,000
	0.40	53,400,000	1.02	3.9	1,750,000	6,600,000
	0.45	46,700,000	1.10	4.0	1,650,000	6,000,000
	0.50	40,600,000	1.20	4.1	1,570,000	5,300,000
	0.60	32,300,000	1.37	4.4	1,420,000	4,500,000
	0.80	21,300,000	1.72	5.0	1,180,000	3,400,000
	1.00	15,000,000	2.06	5.4	990,000	2,600,000
	1.50	7,500,000	2.91	6.2	700,000	1,500,000
	2.00	4,300,000	3.82	7.6	520,000	1,000,000
	3.00	2,000,000	5.43	8.9	340,000	600,000
	4.00	1,000,000	7.31	10.9	240,000	400,000
	5.00	700,000	8.52	13.5	200,000	300,000
Inferred	0.15	107,200,000	0.43	2.9	1,480,000	10,100,000
	0.20	85,900,000	0.50	3.1	1,380,000	8,600,000
	0.24	72,200,000	0.55	3.3	1,280,000	7,600,000
	0.30	56,700,000	0.63	3.6	1,150,000	6,500,000
	0.35	47,200,000	0.69	3.7	1,050,000	5,700,000
	0.40	40,100,000	0.75	3.9	970,000	5,000,000
	0.45	34,900,000	0.80	4.0	900,000	4,500,000
	0.50	30,600,000	0.84	4.2	830,000	4,100,000
	0.60	21,800,000	0.96	4.8	670,000	3,300,000
	0.80	12,400,000	1.17	5.3	470,000	2,100,000
	1.00	6,400,000	1.43	4.7	300,000	1,000,000
	1.50	1,500,000	2.28	3.8	110,000	200,000
	2.00	600,000	3.05	3.5	60,000	100,000
	3.00	200,000	5.00	2.7	30,000	0
	4.00	100,000	5.43	2.7	20,000	0
	5.00	100,000	5.91	2.7	20,000	0

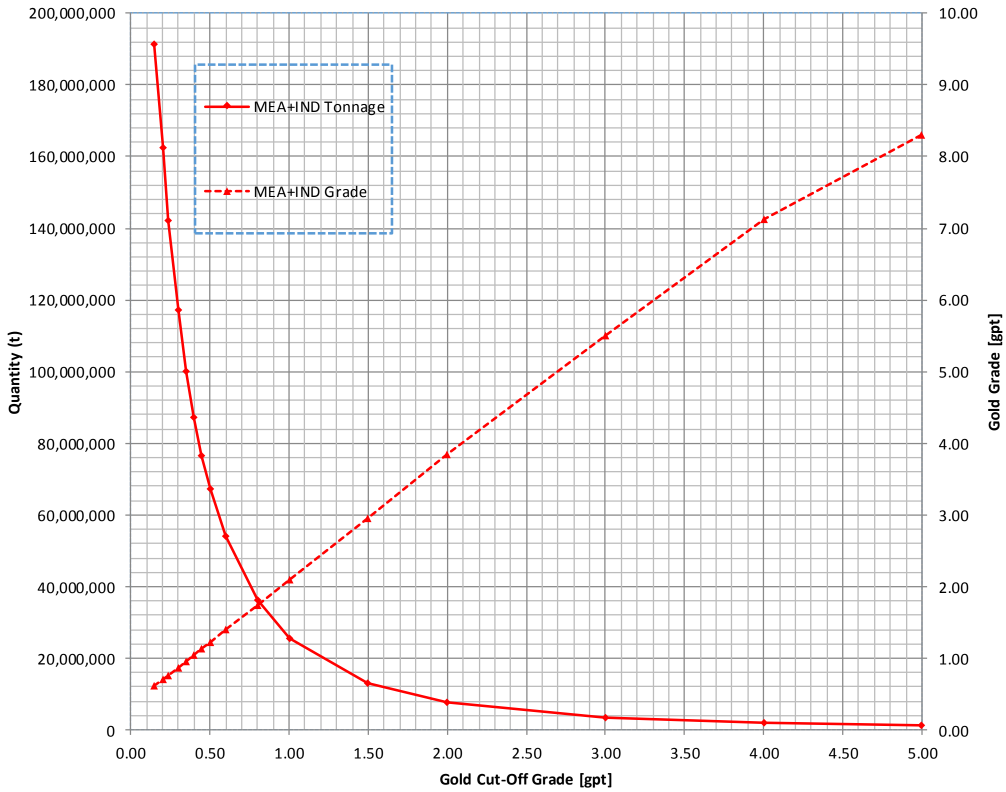
Source: WGM (2019)

Figure 14-25: Resource Grade and Tonnage Plots, Measured and Indicated



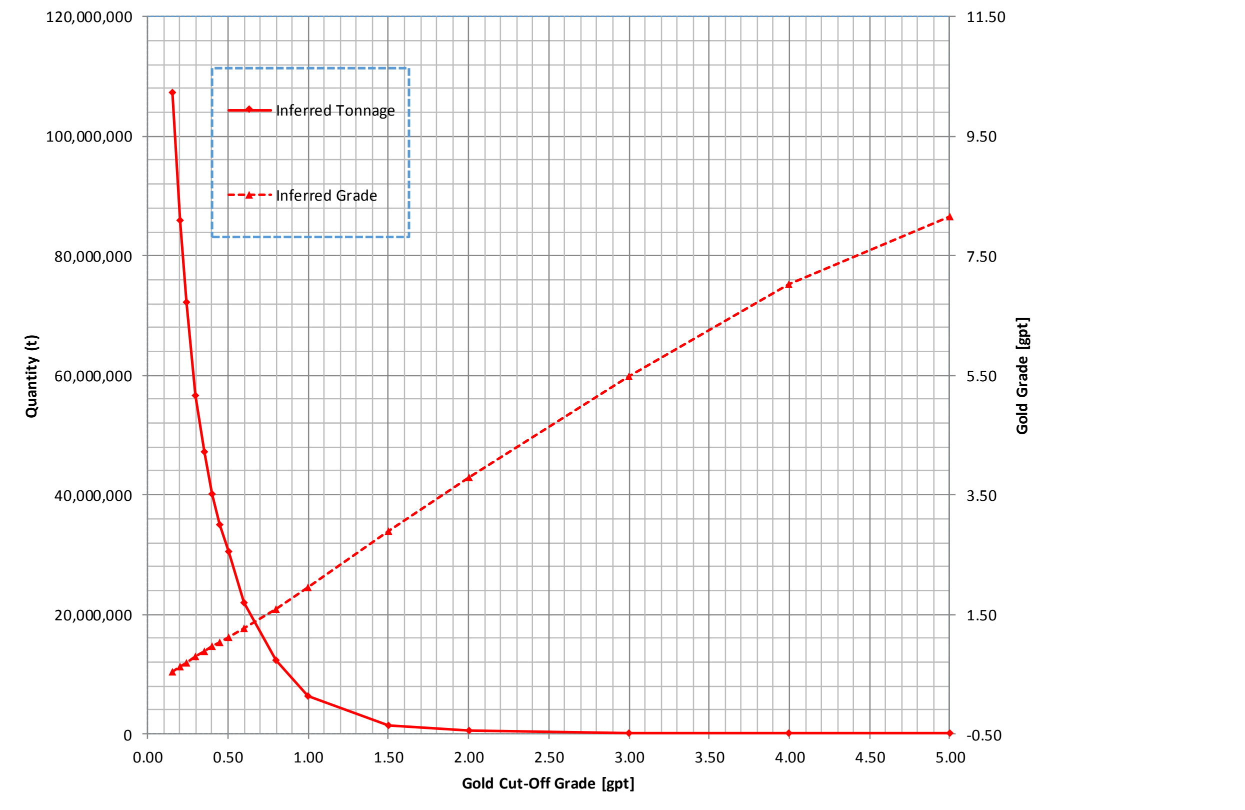
Source: WGM (2019)

Figure 14-26: Resource Grade and Tonnage Plots, Measures Plus Indicated



Source: WGM (2019)

Figure 14-27: Resource Grade and Tonnage Plots, Inferred



Exploration and Delineation Drilling for the Amulsar Deposit
Source: WGM (2019)

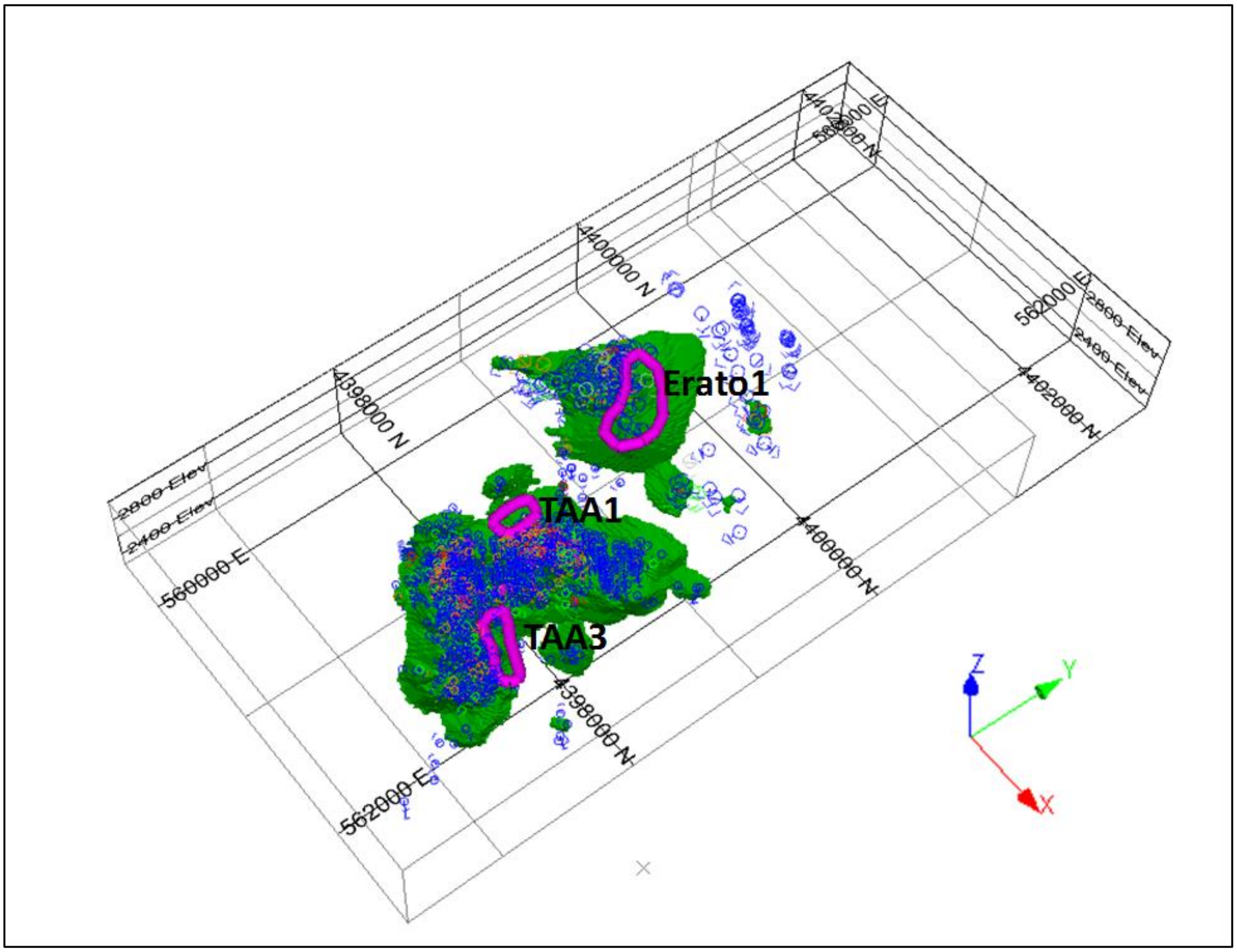
14.14.2 Delineation Drilling

Delineation drilling completed during the 2016 drilling campaign has covered the TAA area in the central area of the TAA connecting mineralization between the two areas and moving inferred resources to measured and indicated. Limited delineation drilling was completed in the west and north-east parts of the of the TAA zone.

The purpose of the delineation drilling is to identify or confirm possible mineralization in sparsely drilled areas located around the boundaries of defined mineral resources. The delineation drilling should focus initially on confirming significant mineralization trends in target areas. If mineralization is confirmed additional drilling may be required to move these areas to indicated or measured resources.

Targets areas are provided in Figure 14-28. The Erato1 target covers the north-east border of the Erato resource that is limited to widely-spaced drilling. The TAA1 target is designed to test limited higher grade intersections or possibly structurally displaced mineralization. The TAA3 target is designed to test a possible extension of Arshak area mineralization to the north-east that is covered by widely spaced drilling. High priority has been assigned to TAA1 and TAA3 delineation drilling as this area will be mined initially according to the LOM. Medium priority is assigned to Erato1 as this area will be mined at a later stage of mining.

Figure 14-28: Delineation Drilling Targets for Erato and TAA with 2017 Resource Pit Shell and Drillholes



Source: Samuel Engineering (2017)

14.14.3 Exploration Drilling

The potential for significant upper volcanic unit mineralization below the current mineral resources has been identified for the Erato and TAA zones. These areas have been identified on the basis of:

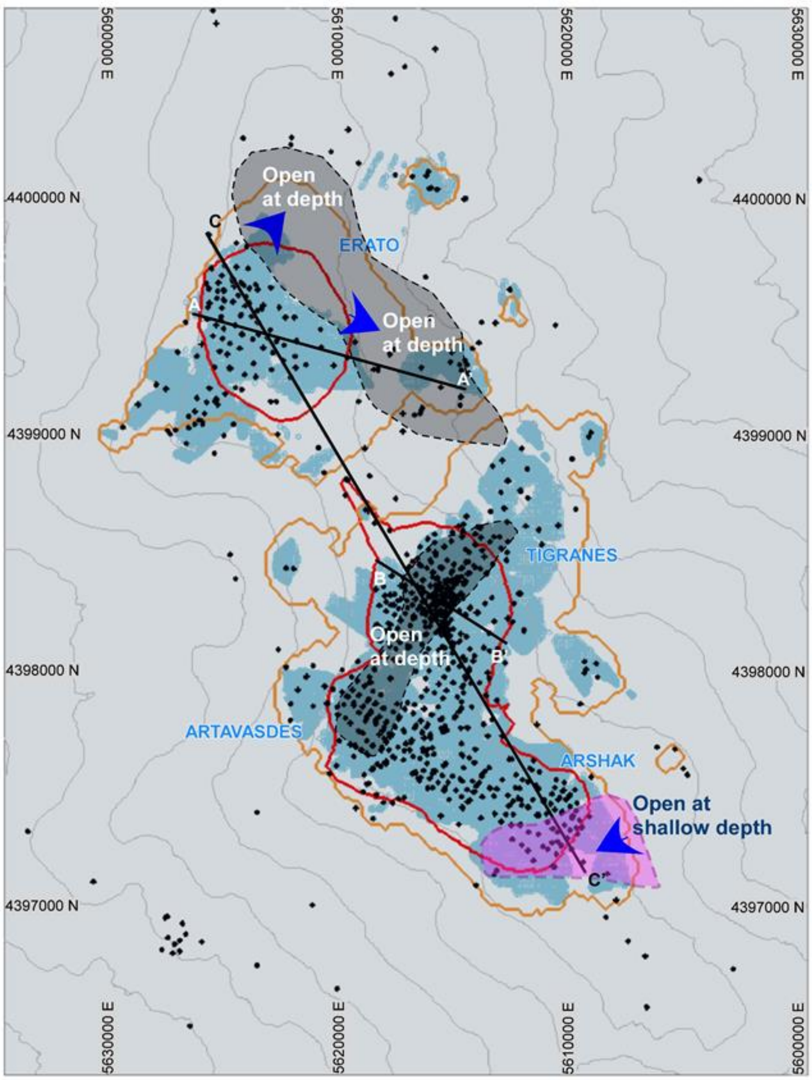
- Identification of geophysical resistivity anomalies at depth below mineral resources;
- Drillholes that have ended in significant mineralization below defined resources or near or at maximum depth of drilling; and
- Drillholes and structural interpretation that provide an indication of possible UV below defined resources or at the maximum depth of drilling.

Three target areas have been identified and outlined in plan section, Figure 14-29.

The Erato target is located beneath and to the east of current resources as shown in sections A-A' and C-C', Figure 14-30 and Figure 14-31. This target ranges from depths greater than 250 m to 300 m below surface.

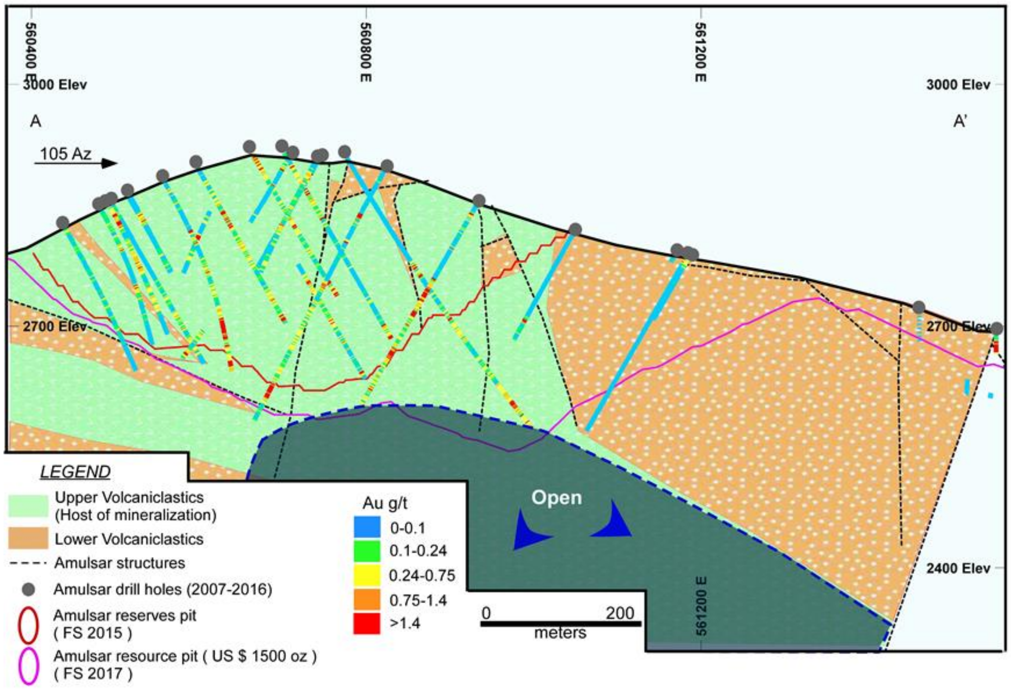
For the TAA zone, the northern target straddling the Artavasdes-Tigranes areas has been identified as a deep target area at depths greater than about 250 m from surface. This target is shown in section B-B', Figure 14-32. A second TAA target is located on the periphery Arshak area, starting at shallow depths to the south and below defined resources. Mineralization for this target is potentially at depths greater than 50 m below surface, Figure 14-29.

Figure 14-29: Exploration Targets for Erato and TAA Zones and Section Lines



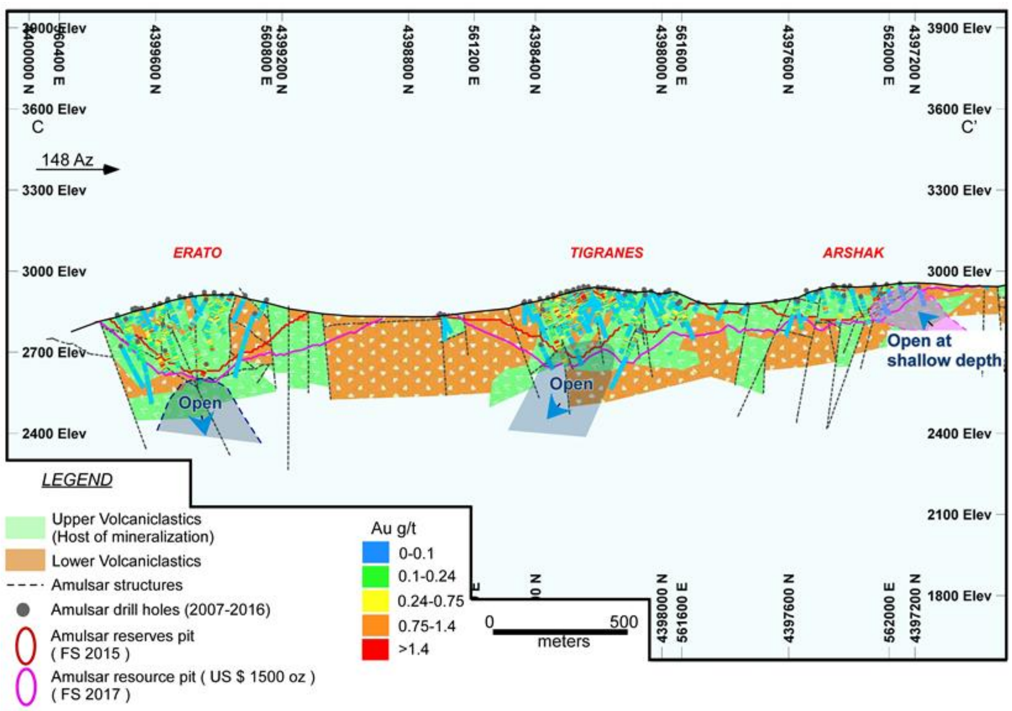
Source: Lydian (2017)
Orange line, resources pit. Red line, reserve pit
Exploration targets: Grey-deep exploration target; pink-shallow exploration target

Figure 14-30: Erato Exploration Target, Section A-A'



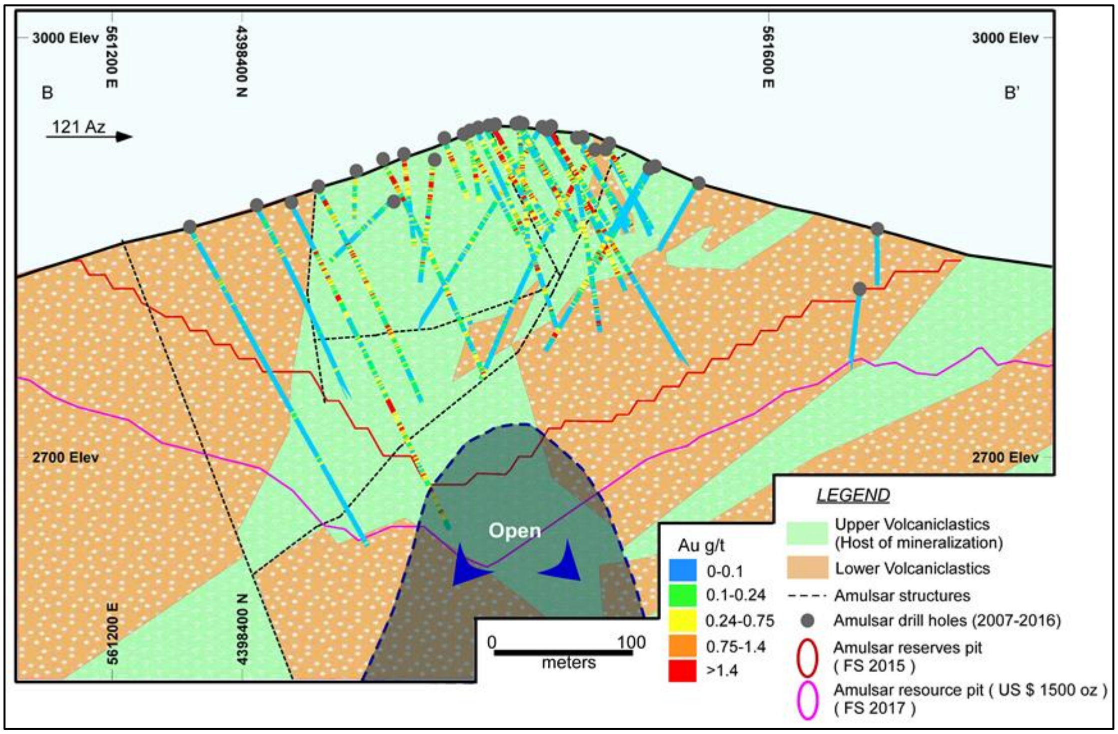
Source: Lydian (2017)

Figure 14-31: Erato and TAA Exploration Targets, Section C-C'



Source: Samuel Engineering (2017)

Figure 14-32: TAA Artavasdes-Tigranes Exploration Target, Section B-B'



Source: Samuel Engineering (2017)

15 Mineral Reserve Estimate

The mineral reserve documented in this section was estimated based on Canadian Institute of Mining (CIM) guidelines that defines mineral reserves as “the economically mineable part of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A mineral reserve includes diluting materials and allowances for losses that may occur when the material is mined.”

Mineral reserves are those parts of mineral resources which, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the Qualified Person(s) making the estimates, is the basis of an economically viable Project after taking account of all relevant processing, metallurgical, economic, marketing, legal, environment, socio-economic and government factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the mineral reserves and delivered to the treatment plant or equivalent facility. The term ‘mineral reserve’ need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

To convert mineral resources to mineral reserves estimates of gold price, mining dilution, process recovery, refining/transport costs, royalties, mining costs, processing, and general and administration costs were used to estimate cut-off grades (COG) for each deposit. Along with geotechnical parameters, the COG formed the basis for the selection of economic mining blocks.

The QPs have not identified any known legal, political, environmental, or other risks that would materially affect the potential development of the mineral reserves, except for the risk of not being able to secure the necessary permits from the government for development and operation of the project. The QPs are not aware of any unique characteristics of the project that would prevent permitting.

A summary of the mineral reserves for the project are shown in Table 15-1 using a cut-off grade of 0.20 g/t within the designed final pits for the Artavasdes, Tigranes and Erato deposits. The effective date of the mineral reserve contained in this report is 16 September 2019.

Table 15-1: Summary of Mineral Reserves

Area	Classification	Ore (Mt)	Diluted Gold Grade (g/t)	Contained Gold (koz)	Diluted Silver Grade (g/t)	Contained Silver (koz)
Artavasdes + Tigranes	Proven	47.8	0.78	1,202	4.6	6,998
	Probable	45.8	0.73	1,074	3.7	5,472
	Total	**93.7**	**0.76**	**2,276**	**4.1**	**12,469**
Erato	Proven	4.1	0.66	88	3.2	416
	Probable	21.5	0.67	464	2.2	1,549
	Total	**25.6**	**0.67**	**552**	**2.4**	**1,965**
All	**Total**	**119.3**	**0.74**	**2,828**	**3.8**	**14,435**

Note: Mineral Reserves are included within Mineral Resources
Source: JDS (2019)

15.1 Open Pit Mineral Reserve Basis of Estimate

The mineral reserve for the property is based on the Mineral Resource estimate completed by QP G. David Keller (P.Geo) with an effective date of 10 September 2019.

The mineral reserves were developed by examining each deposit to determine the optimum and practical mining method. COGs were then determined based on appropriate mine design criteria and the adopted mining method. A truck and shovel open pit mining method was selected for the deposits. Only measured and indicated mineral resources were included in the optimization process. Inferred resources were considered as waste.

A thorough analysis of the optimized shells was then conducted in order to select the shells to be used as guides to the subsequent detailed pit designs.

15.1.1 Mining Method and Mining Costs

The deposits at the Amulsar site are amenable to extraction by open pit methods. For the purposes of the preliminary optimization, a mining costs of US$2.43/t mined was assumed. The open pit cost estimate was generated from first principles and took into account any contracts that had been previously negotiated during the recent start-up.

Ore will be hauled to the primary crusher located to the North of the deposits close to the external waste storage facility. Ore will be processed at a nominal production rate of 27,400 tpd (10 Mtpa).

15.1.2 Dilution

The AMC resource model was noted to account for normal mining dilution. To reflect the mining selectivity for the expected mining equipment, the block model was reblocked from 10 x 10 x 5 m blocks to 10 x 10 x 10 m blocks. The 2017 report states:

"For the Amulsar deposit, a decrease in mining selectivity has resulted in approximately 10% increase in tonnage and a 10% to 15% decrease in grade."

No additional external dilution was applied for reserve reporting.

15.1.3 Geotechnical Considerations

Pit slope geotechnical design criteria were developed by Golder Associates Inc (2012). This previous work served as the basis for the FS update analyses and design recommendations. No additional field data collection or laboratory testing were completed as part of this FS update.

The recommended pit slope design parameters are summarized in Table 15-2 and were used during the detailed pit designs. For the pit optimization work, the overall slopes angles which include in-pit ramps were measured from the 2017 FS pit designs to provide a better estimate in determining the optimum pit size and shape.

Table 15-2: Recommended Pit Slope Design Parameters

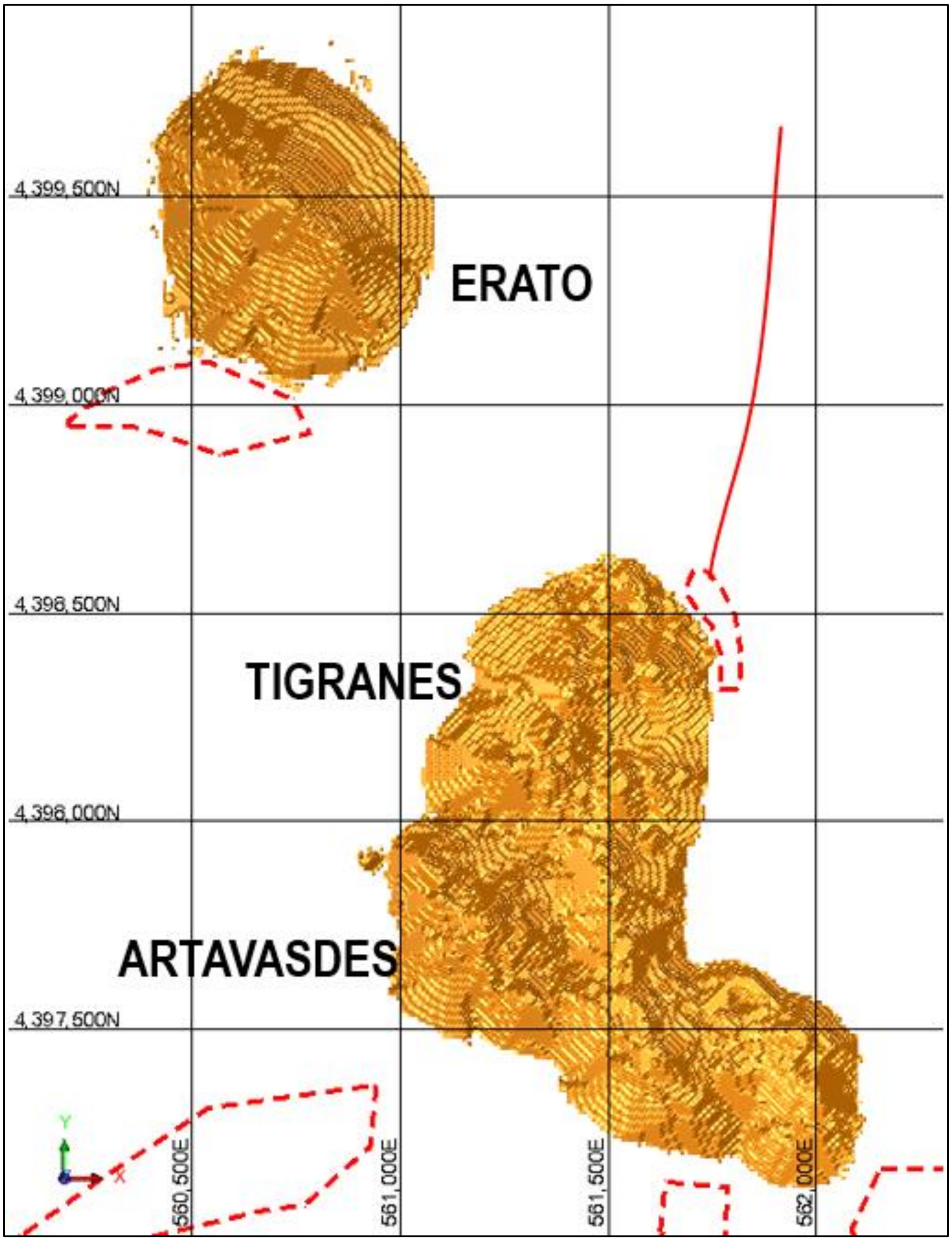
Geotechnical Unit	Dip Azimuth of Pit Slope	Operating Practice	Bench Configuration and Height (meters)	Design Catch Bench Width (meters)	Design Bench Face Angle (degrees)	Design Inter-ramp Slope Angle (degrees)
Colluvium	All	No blasting	5 m wide bench on top of bedrock	5	37	29
Volcanic Rock	Tigranes (90 to 360) Artavasdes (all)	Excellent trim blast and scaling	Double-bench 2 x 10 m	8.5	60	45
			Single Bench 1 x 10 m	6.5	65	42
	Tigranes (360 to 90)	Excellent trim blast and scaling	Double-bench 2 x 10 m	10.5	60	42
			Single Bench 1 x 10 m	8.1	65	38
Andesite Porphyry	All	Buffer blasting and scaling, dozer trim in soil-like material	Single Bench 1 x 10 m	11.5	60	30 (inter-ramp slope angle limited by rock mass strength)

Source: Golder (2012)

15.1.4 Potentilla Areas

Potentilla plants are a protected species and are not to be disturbed by mining activities. Transplanting may be a future option, but for this study, the pit optimization and design are restricted to leave these areas untouched. Removing this restriction has the potentially increase reserves by approximately 1.8 Mt at a grade of 0.79 g/t. The location of potentillas in the open pit areas are within the red outlines shown in Figure 15-1.

Figure 15-1: Areas Where Potentilla Plants Have Been Located



Source:

15.1.5 Lerchs-Grossman Optimization

The sizes and shapes of the ultimate open pits were determined using the Lerchs-Grossman (LG) pit optimization algorithm as implemented in DataMine NPV Scheduler (NPVS) software. Key inputs used for the LG runs are presented in Table 15-3.

Table 15-3: Mine Planning Optimization Input Parameters*

Parameter	Unit	Value
Revenue, Smelting & Refining		
Gold price	US$/oz Au	$1,300
Silver contribution	%	3
Payable metal	%	99.9
TC/RC/Transport	US$/oz Au	6.00
Royalty @ 5% NSR	US$/oz Au	65.00
Net gold value per ounce	US$/oz	1,267
Net gold value per gram	US$/g	40.72
OPEX Estimates	To	
OP Waste Mining Cost	US$/t waste mined	2.43
OP Ore Mining Cost	US$/t ore mined	2.43
Strip Ratio (estimated)	W:O	2.24
OP Mining Cost	US$/t processed	7.87
Heap Leach Processing	US$/t processed	3.00
G&A	US$/t processed	1.80
Sustaining Capex (All Areas)	US$/t processed	0.90
Total OPEX Cost (excluding mining)	US$/t processed	5.70
Total OPEX Cost (including mining)	US$/t processed	13.57
Recovery and Dilution		
External Mining Dilution	%	0
Mining Recovery	%	95
Gold Recovery		
Artavasdes & Tigranes	%	87.1
Erato	%	87.5
Cut-off Grades		
Incremental Artavasdes & Tigranes	g/t AuEq	0.17
Incremental Erato	g/t AuEq	0.17
Elevated Cut-off (All)	g/t AuEq	0.20

Note: These parameters differ slightly from those used in the economic model due to subsequent, more detailed estimation work but the differences are not considered material.

Source: JDS (2019)

A separate series of pit optimization runs was completed for each deposit to determine the final open pit shapes. The results of the pit optimizations for both the TAA and Erato deposits are shown in Table 15-4 and Table 15-5.

Based on the analysis of the shells and preliminary mine schedule, the base case ultimate shell was selected for each deposit. In all cases, ultimate shells were selected on the basis of maximizing NPV but also minimizing additional lower grade and higher strip ratio material (i.e. higher incremental strip ratios with minimal increases in value) that have minimal benefit to the overall NPV. For the both deposits, the selected pit shell was based on a revenue factor of 80% which represents a gold price of US$1,013/oz.

The optimizations used an elevated cut-off grade above the incremental cut-off to help limit the amount of lower-grade ore that will be stockpiled during operations. While technically any mineralize material that is above the incremental cut-off has the potential to generate positive revenue for the project, there is limited stockpile capacity on the site, and therefore; the lowest grade material (below 0.20 g/t AuEq) was wasted. The open pit Mineral Reserves comprise only of mineralized material with grades equal to or above the elevated cut-off grade (0.20 g/t AuEq).

Table 15-4: TAA Pit Optimization Results

Pit #	Revenue Factor	Gold Price	Life	Diluted Ore					Waste	Total Material	Strip Ratio	Total Cash Flow	Discounted Cash Flow (Best)	Discounted Cash Flow (Worst)
	(%)	(US$/oz)	(yrs)	(Mt)	Au (g/t)	Ag (g/t)	Au (k Oz.)	Ag (k Oz.)	(Mt)	(Mt)	wst:ore	(M $)	(M $)	(M $)
Pit 25	50%	$633	6.71	67.05	0.84	4.2	1.81	9.00	86	153	1.3	1,273	1,117	1,044
Pit 26	52%	$659	7.05	70.50	0.83	4.1	1.88	9.25	92	163	1.3	1,311	1,144	1,068
Pit 27	54%	$684	7.53	75.26	0.82	4.2	1.98	10.07	100	176	1.3	1,359	1,177	1,094
Pit 28	56%	$709	7.65	76.55	0.81	4.2	2.00	10.23	102	178	1.3	1,371	1,185	1,100
Pit 29	58%	$735	7.98	79.75	0.80	4.3	2.06	11.02	107	186	1.3	1,396	1,203	1,111
Pit 30	60%	$760	8.10	80.97	0.80	4.3	2.08	11.18	108	189	1.3	1,405	1,209	1,115
Pit 31	62%	$785	8.19	81.88	0.80	4.3	2.09	11.29	110	192	1.3	1,412	1,213	1,118
Pit 32	64%	$811	8.51	85.12	0.79	4.2	2.16	11.58	119	204	1.4	1,439	1,230	1,132
Pit 33	66%	$836	8.69	86.95	0.79	4.2	2.20	11.75	124	211	1.4	1,454	1,240	1,139
Pit 34	68%	$861	8.79	87.94	0.78	4.2	2.21	11.85	126	214	1.4	1,461	1,244	1,143
Pit 35	70%	$887	8.98	89.80	0.78	4.2	2.26	12.07	134	224	1.5	1,475	1,254	1,150
Pit 36	72%	$912	9.07	90.74	0.78	4.2	2.27	12.16	136	226	1.5	1,481	1,257	1,152
Pit 37	74%	$937	9.19	91.93	0.78	4.1	2.29	12.25	138	230	1.5	1,487	1,261	1,155
Pit 38	76%	$963	9.27	92.66	0.77	4.1	2.30	12.31	139	232	1.5	1,490	1,263	1,156
Pit 39	78%	$988	9.33	93.26	0.77	4.1	2.31	12.37	141	234	1.5	1,492	1,264	1,156
Pit 40	**80%**	**$1,013**	**9.52**	**95.15**	**0.76**	**4.1**	**2.34**	**12.65**	**144**	**239**	**1.5**	**1,498**	**1,268**	**1,157**
Pit 41	82%	$1,039	9.62	96.21	0.76	4.1	2.35	12.75	147	243	1.5	1,502	1,270	1,157
Pit 42	84%	$1,064	9.67	96.71	0.76	4.1	2.36	12.81	148	244	1.5	1,503	1,271	1,157
Pit 43	86%	$1,089	9.72	97.23	0.76	4.1	2.37	12.86	149	246	1.5	1,504	1,272	1,157
Pit 44	88%	$1,115	9.95	99.55	0.75	4.1	2.40	13.05	156	255	1.6	1,509	1,275	1,159
Pit 45	90%	$1,140	10.05	100.52	0.75	4.1	2.42	13.13	158	259	1.6	1,512	1,277	1,159
Pit 46	92%	$1,165	10.10	101.02	0.75	4.1	2.42	13.20	159	260	1.6	1,512	1,277	1,158
Pit 47	94%	$1,191	10.23	102.35	0.74	4.0	2.45	13.29	165	268	1.6	1,514	1,278	1,158
Pit 48	96%	$1,216	10.35	103.48	0.74	4.0	2.46	13.37	169	272	1.6	1,516	1,279	1,158
Pit 49	98%	$1,241	10.46	104.63	0.74	4.0	2.48	13.47	172	277	1.6	1,517	1,280	1,156
Pit 50	**100%**	**$1,267**	**10.73**	**107.33**	**0.73**	**4.0**	**2.51**	**13.92**	**177**	**284**	**1.6**	**1,517**	**1,280**	**1,148**
Pit 51	102%	$1,292	10.82	108.23	0.72	4.0	2.52	14.01	179	288	1.7	1,517	1,280	1,147
Pit 52	104%	$1,317	10.87	108.74	0.72	4.0	2.53	14.06	180	289	1.7	1,517	1,280	1,146
Pit 53	106%	$1,343	10.93	109.26	0.72	4.0	2.53	14.13	182	291	1.7	1,517	1,280	1,145
Pit 54	108%	$1,368	10.97	109.69	0.72	4.0	2.54	14.17	184	293	1.7	1,517	1,279	1,144
Pit 55	110%	$1,393	11.04	110.42	0.72	4.0	2.55	14.22	187	297	1.7	1,516	1,279	1,143
Pit 56	112%	$1,419	11.11	111.09	0.72	4.0	2.56	14.28	190	301	1.7	1,515	1,278	1,142
Pit 57	114%	$1,444	11.15	111.53	0.72	4.0	2.57	14.31	192	303	1.7	1,514	1,278	1,141
Pit 58	116%	$1,469	11.17	111.73	0.72	4.0	2.57	14.35	193	304	1.7	1,514	1,278	1,140
Pit 59	118%	$1,495	11.19	111.92	0.72	4.0	2.57	14.36	194	306	1.7	1,514	1,278	1,140
Pit 60	120%	$1,520	11.21	112.11	0.71	4.0	2.58	14.38	194	306	1.7	1,513	1,277	1,139

Source: JDS (2019)

Table 15-5: Erato Pit Optimization Results

Pit #	Revenue Factor (%)	Gold Price (US$/oz)	Life (yrs)	Diluted Ore (Mt)	Au (g/t)	Ag (g/t)	Au (k Oz.)	Ag (k Oz.)	Waste (Mt)	Total Material (Mt)	Strip Ratio wst:ore	Total Cash Flow (M $)	Discounted Cash Flow (Best) (M $)	Discounted Cash Flow (Worst) (M $)
Pit 17	50%	$633	0.17	1.72	0.66	2.6	0.04	0.14	1	3	0.5	25	25	25
Pit 18	52%	$659	0.18	1.82	0.65	2.7	0.04	0.16	1	3	0.5	26	25	25
Pit 19	54%	$684	0.20	1.97	0.64	2.6	0.04	0.17	1	3	0.6	27	27	27
Pit 20	56%	$709	0.72	7.16	0.62	2.8	0.14	0.64	11	19	1.6	76	75	74
Pit 21	58%	$735	0.74	7.35	0.62	2.8	0.15	0.66	12	19	1.6	79	77	77
Pit 22	60%	$760	1.63	16.34	0.69	2.4	0.36	1.24	44	60	2.7	174	165	163
Pit 23	62%	$785	1.67	16.73	0.69	2.4	0.37	1.27	44	61	2.6	178	168	166
Pit 24	64%	$811	2.27	22.71	0.68	2.4	0.50	1.79	63	86	2.8	229	214	210
Pit 25	66%	$836	2.30	23.02	0.68	2.4	0.50	1.81	64	87	2.8	232	217	212
Pit 26	68%	$861	2.31	23.14	0.68	2.5	0.51	1.82	64	88	2.8	233	218	213
Pit 27	70%	$887	2.31	23.15	0.68	2.5	0.51	1.83	64	88	2.8	233	218	213
Pit 28	72%	$912	2.33	23.29	0.68	2.5	0.51	1.84	65	88	2.8	234	218	214
Pit 29	74%	$937	2.33	23.30	0.68	2.5	0.51	1.84	65	88	2.8	234	218	214
Pit 30	76%	$963	2.52	25.20	0.69	2.4	0.56	1.98	75	100	3.0	246	229	223
Pit 31	78%	$988	2.55	25.53	0.68	2.4	0.56	2.01	76	101	3.0	248	231	224
Pit 32	80%	$1,013	2.57	25.68	0.68	2.5	0.56	2.02	76	102	3.0	249	232	225
Pit 33	82%	$1,039	2.59	25.90	0.68	2.5	0.57	2.04	77	103	3.0	250	232	225
Pit 34	84%	$1,064	2.60	26.04	0.68	2.4	0.57	2.05	77	103	3.0	250	233	225
Pit 35	86%	$1,089	2.64	26.38	0.68	2.5	0.58	2.08	79	105	3.0	251	233	226
Pit 36	88%	$1,115	2.64	26.40	0.68	2.5	0.58	2.08	79	105	3.0	251	233	226
Pit 37	90%	$1,140	2.64	26.44	0.68	2.5	0.58	2.08	79	105	3.0	251	234	226
Pit 38	92%	$1,165	2.73	27.27	0.67	2.5	0.59	2.15	82	109	3.0	253	235	227
Pit 39	94%	$1,191	2.73	27.32	0.67	2.5	0.59	2.16	82	110	3.0	253	235	227
Pit 40	96%	$1,216	2.73	27.33	0.67	2.5	0.59	2.16	82	110	3.0	253	235	227
Pit 41	98%	$1,241	2.75	27.49	0.67	2.5	0.59	2.17	83	111	3.0	253	235	227
Pit 42	100%	$1,267	2.75	27.52	0.67	2.5	0.59	2.18	83	111	3.0	253	235	227
Pit 43	102%	$1,292	2.78	27.75	0.67	2.5	0.60	2.19	84	112	3.0	253	235	226
Pit 44	104%	$1,317	2.78	27.79	0.67	2.5	0.60	2.20	84	112	3.0	253	235	226
Pit 45	106%	$1,343	2.78	27.82	0.67	2.5	0.60	2.20	84	112	3.0	253	235	226
Pit 46	108%	$1,368	2.79	27.90	0.67	2.5	0.60	2.20	85	113	3.0	253	235	226
Pit 47	110%	$1,393	2.79	27.90	0.67	2.5	0.60	2.20	85	113	3.0	253	235	226
Pit 48	114%	$1,444	2.81	28.08	0.67	2.5	0.60	2.22	86	114	3.1	252	234	226
Pit 49	116%	$1,469	2.82	28.17	0.67	2.5	0.60	2.22	86	114	3.1	252	234	225
Pit 50	118%	$1,495	2.82	28.17	0.67	2.5	0.60	2.22	86	114	3.1	252	234	225
Pit 51	120%	$1,520	2.84	28.40	0.67	2.5	0.61	2.25	88	117	3.1	251	233	224

Source: JDS (2019)

15.1.6 Open Pit Design

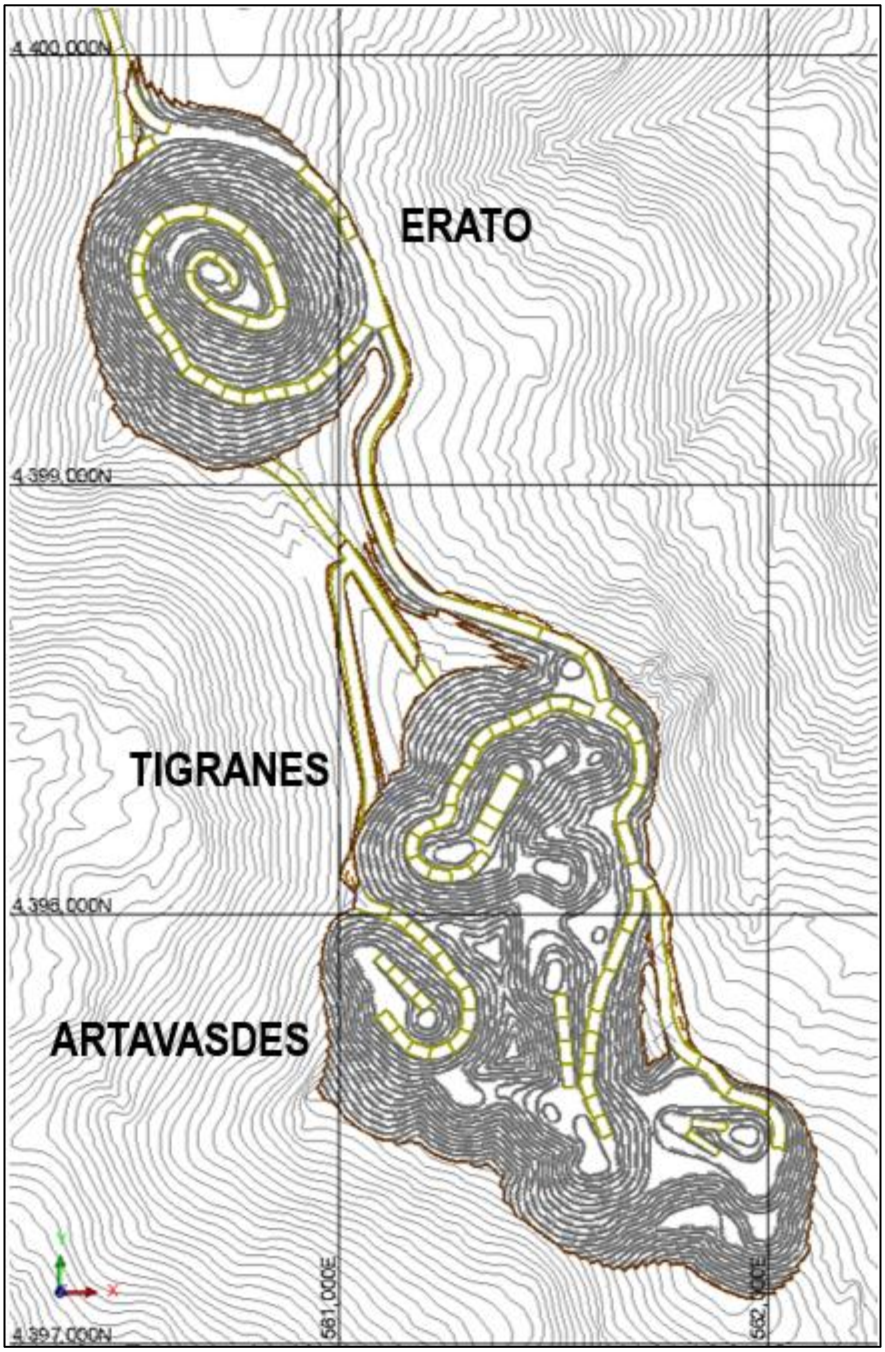
The selected optimized pit shells were converted into detailed operational open pit mine designs, which is discussed further in Section 16. The main parameters used in determining the pit designs are highlighted in Table 15-6. To simplify the designs, single-benches were used everywhere. While the Geotechnical pit slope recommendations show that there is potential to steepen the walls in volcanic rock, the pit walls change frequently between rock types, so a conservative approach was taken in the designs.

Table 15-6: Pit Design Parameters

Description	Value
Ultimate Pit Design Parameters – All Pits	
Bench Height	10 m (single)
Face Angle	60° to 65°
Berm Width	6.5 m to 11.5 m
Inter-ramp Angle (IRA)	30° to 42°
Ramp Width – Double lane	30 m
Ramp Width - Single lane (lower benches)	20 m
Ramp Gradient – Double lane	10
Ramp Gradient – Single lane (lower benches)	12
Overall Slope Angle (OSA)	28° to 38°

Source: JDS (2019)

Figure 15-2: Final Pit Designs



Source: JDS (2019)

16 Mining Methods

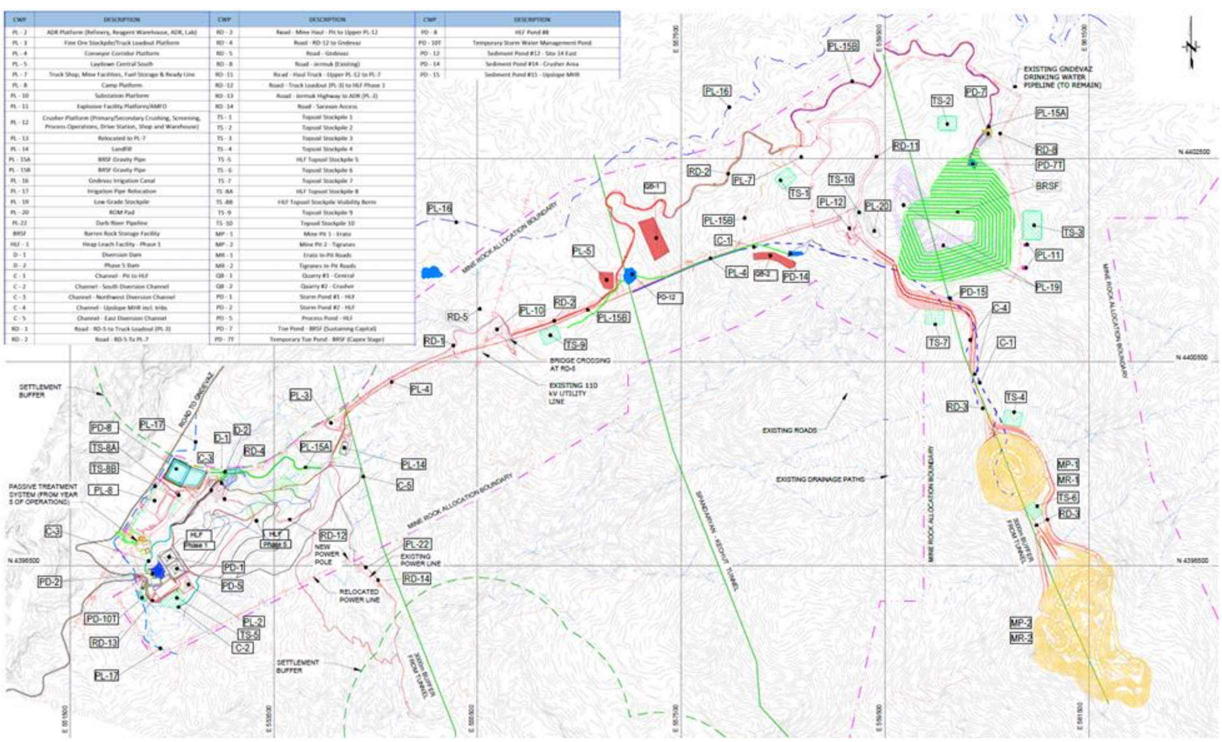
16.1 Introduction

The Amulsar deposit will be developed by open pit mining by mining 10 m benches using 22 cubic meter front shovels, and 180-t trucks. This configuration works well to maximize equipment utilization and productivity. Approximately half of the mining equipment has already been purchased and delivered to site.

Over the life of mine (LOM), three deposits will be mined and will be split into seven mining phases. The Tigranes and Artavasdes deposits are mined first, having higher value (combination of higher grades and a lower strip ratio) than the Erato deposit. Ore will be processed at a nominal production rate of 27,400 tpd (10 Mtpa). Ore material is either sent directly to the primary crusher, located several kilometers down-hill to the North of the open pits, or to stockpiles located close to the primary crusher. Waste material will initially be placed in the BRSF also located several kilometers down-hill to the North of the open pits. Over time, placement of the waste material will transition to being placed in-pit within the mined-out portions of the TAA open pits. The overall site layout is shown in Figure 16-1.

Several contracts related to mining activities that had been negotiated during the previous start-up were included in this study. These contracts include, a maintenance and repair contract (MARC), a drill and blast contract, and a small equipment/road maintenance contract.

Figure 16-1: Overall Site Layout



Source: JDS (2019)

16.2 Open Pit Design

Industry-standard methodologies for pit limit analysis, mining sequence, cut-off grade optimization, and detailed design were adopted.

The main steps in the planning process were:

- Assignment of economic criteria to the geological resource models;
- Definition of optimization parameters such as gold price, preliminary operating cost estimates, pit wall angles, preliminary dilution and metallurgical recovery estimates for each mine area and material type;
- Calculation of economic ultimate pit limits for the various deposits using open pit optimization software (applies the Lerchs-Grossmann algorithm to define optimal mining shells);
- Establishment of an economic scheduling sequence using a series of optimum nested pits as guides; and
- Development of detailed ultimate pit designs and mining phases (incorporating pit accesses and appropriate bench heights and pit geometry).

Details of the open pit optimization is discussed in Section 15. Both the pit shell generation and detailed designs were constrained to exclude areas where potentilla plants are known to exist. The location of the plants are shown in Figure 15-1. Transplanting these plants may be a future option to remove this restriction, and has the potential to increase reserves by approximately 1.8 Mt at a grade of 0.79 g/t.

16.2.1 Open Pit Slope Angles

Geotechnical pit slope design criteria were developed by Golder Associates Inc. (2012). This previous work served as the basis for the FS update analyses and design recommendations. No additional field data collection or laboratory testing were completed as part of this FS update.

The recommended pit slope design parameters are summarized in Table 16-1 and were used to develop the detailed pit designs. In order to have more realistic pit designs, single-benches were used throughout. While the Geotechnical pit slope recommendations show that there is potential to steepen the walls in volcanic rock, the pit walls change frequently between rock types, so a more realistic and practical approach was taken in the designs.

Table 16-1: Recommended Pit Slope Design Parameters

Geotechnical Unit	Dip Azimuth of Pit Slope	Operating Practice	Bench Configuration and Height (meters)	Design Catch Bench Width (meters)	Design Bench Face Angle (degrees)	Design Inter-ramp Slope Angle (degrees)
Colluvium	All	No blasting	5 m wide bench on top of bedrock	5	37	29
Volcanic Rock	Tigranes (90 to 360) Artavasdes (all)	Excellent trim blast and scaling	Double-bench 2 x 10 m	8.5	60	45
			Single Bench 1 x 10 m	6.5	65	42
	Tigranes (360 to 90)	Excellent trim blast and scaling	Double-bench 2 x 10 m	10.5	60	42
			Single Bench 1 x 10 m	8.1	65	38
Andesite Porphyry	All	Buffer blasting and scaling, dozer trim in soil-like material	Single Bench 1 x 10 m	11.5	60	30 (inter-ramp slope angle limited by rock mass strength)

Source: Golder (2012)

16.2.2 Haul Road and Ramp Design Parameters

The primary haulage roads are required between the various open pit deposits and the primary ore crusher, and waste rock facilities. Roads are planned to be constructed using cut-and-fill techniques, utilizing waste rock sourced from the open pits, to achieve the designed alignment and grade. Roads within the waste rock storage facilities are designed to be all-fill construction.

The main in-pit haul roads and ramps are designed to have an overall road width allowance of 30 m. The selected road allowance is adequate for accommodating three times the width of the largest haul truck (180 tonne), with additional room for drainage ditches and safety berms as summarized in Table 16-2.

Table 16-2: In-Pit Haulage Road Design Parameters

Item	Metres
Truck (180 tonne) operating width	7.0
Running surface - 3x truck width	21.0
Berm height (3/4 tire height)	2.6
Berm width	6.0
Ditch width	3.0
Total Road Allowance	**30.0**

Source: JDS (2019)

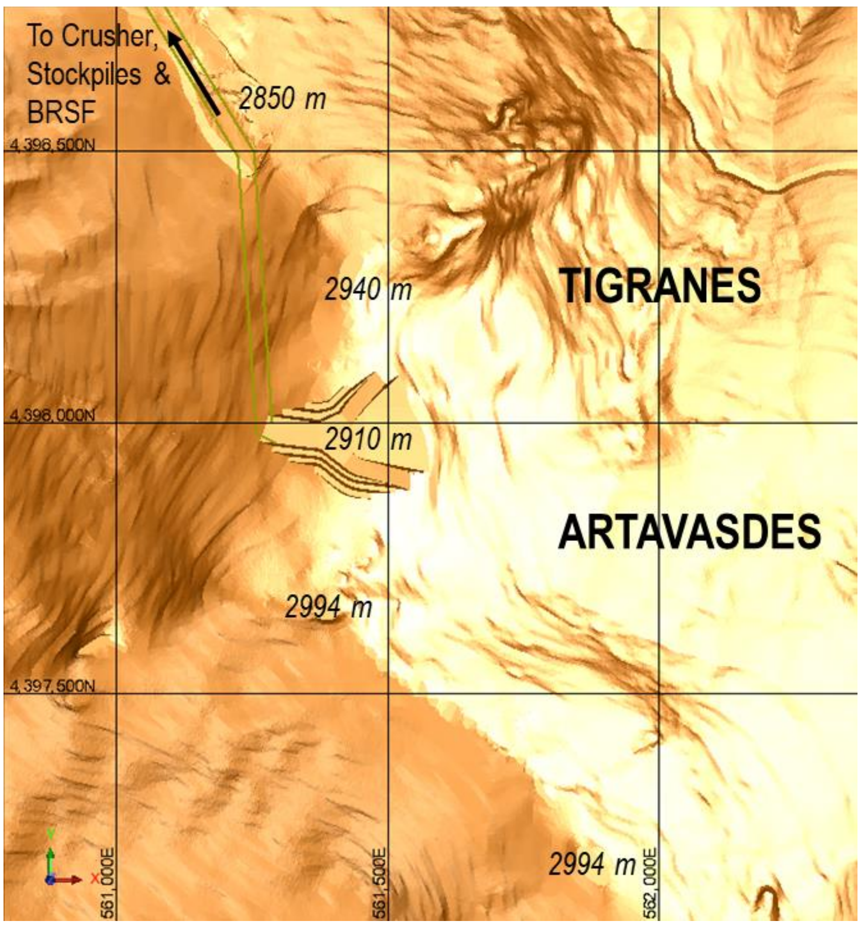
Most ramps are designed with a maximum grade of 10% but were steepened to 12% for final access to lower portions of the open pits. External roads are designed to allow access to roads connecting the various pits to the crusher and waste dumps and are also planned to be a maximum of 30 m wide.

16.2.3 Open Pit Mining Phases

The three deposits will be mined via two open pits split into seven mining phases to aid in smoothing production rates during operations. The individual mining phases will be mined sequentially based on overall value. Approximate phase shapes were selected from the generated pit shells as part of the pit optimization process. The designed mining phases also take into account the need for back-fill capacity once the BRSF reaches its capacity.

Figure 16-2 shows the initial cut at the top of the TAA deposits. This material is non-acid generating waste which will be used for road construction and building initial containment in the BRSF for future acid-generating waste material. This phase has a maximum elevation of 2,940 m and is mined down to 2,910 m.

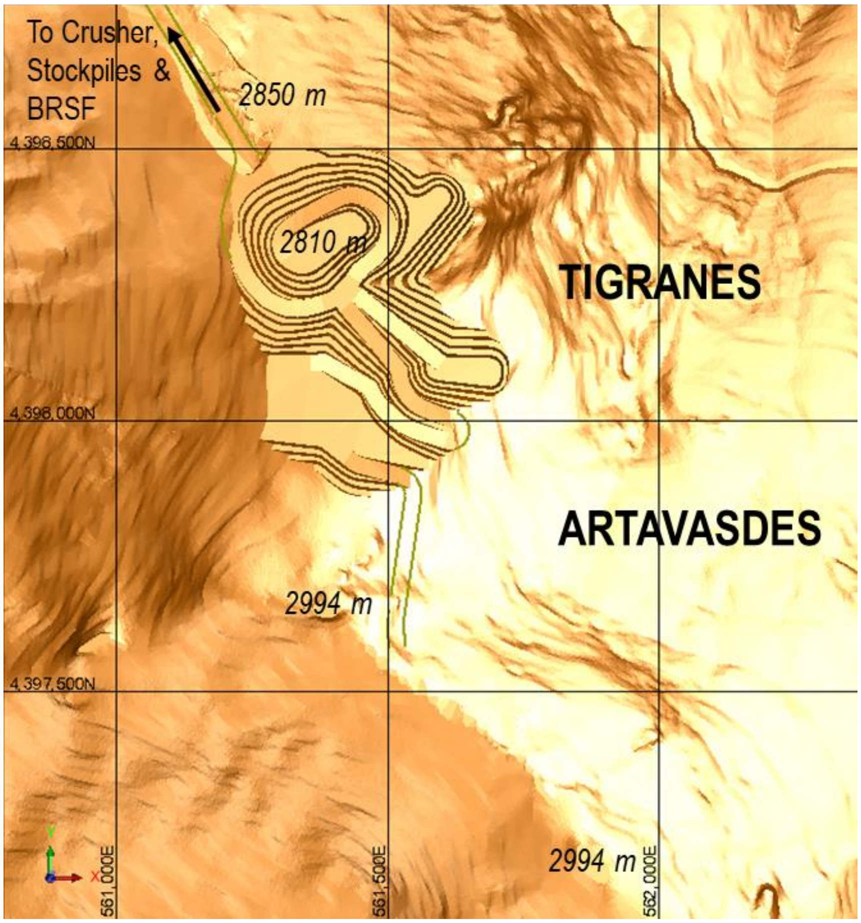
Figure 16-2: Phase 1 (Waste Cut)



Source: JDS (2019)

Figure 16-3 shows the first main production phase within the Tigranes deposit. This is the highest value phase with both, the highest average grade, and lowest strip ratio. This phase has a maximum elevation of 2,940 m and is mined down to 2,810 m.

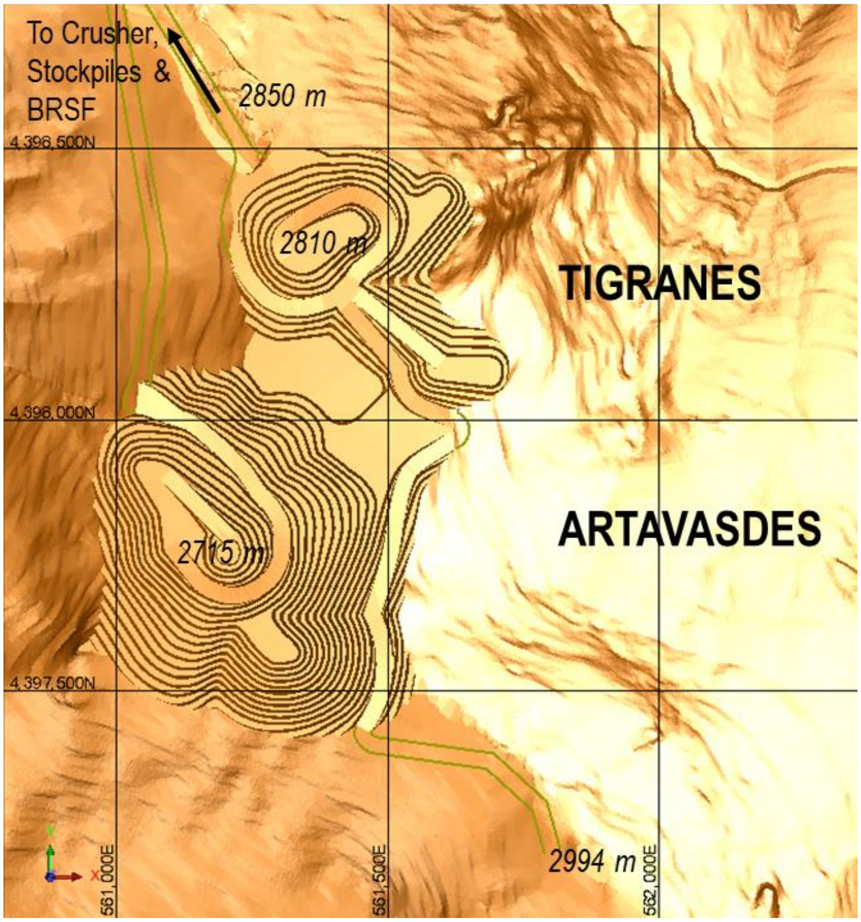
Figure 16-3: **Phase 2 (Tigranes 1)**



Source: JDS (2019)

In the third phase, Mining will transition over to the Artavasdes deposit as shown in Figure 16-4. Once mining is complete, this phase will be available to backfill.

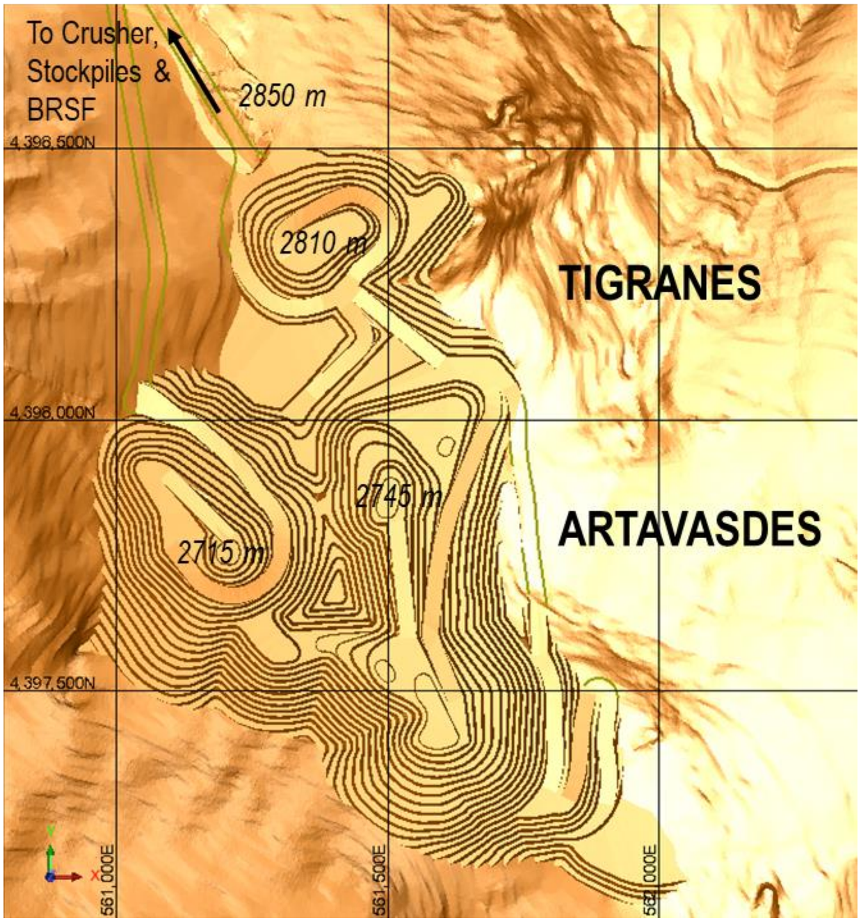
Figure 16-4: **Phase 3 (Artavasdes 1)**



Source: JDS (2019)

The fourth Mining Phase is shown in Figure 16-5 and will provide additional backfill space once complete. This phase has a maximum elevation of 2,994 m and is mined down to 2,745 m.

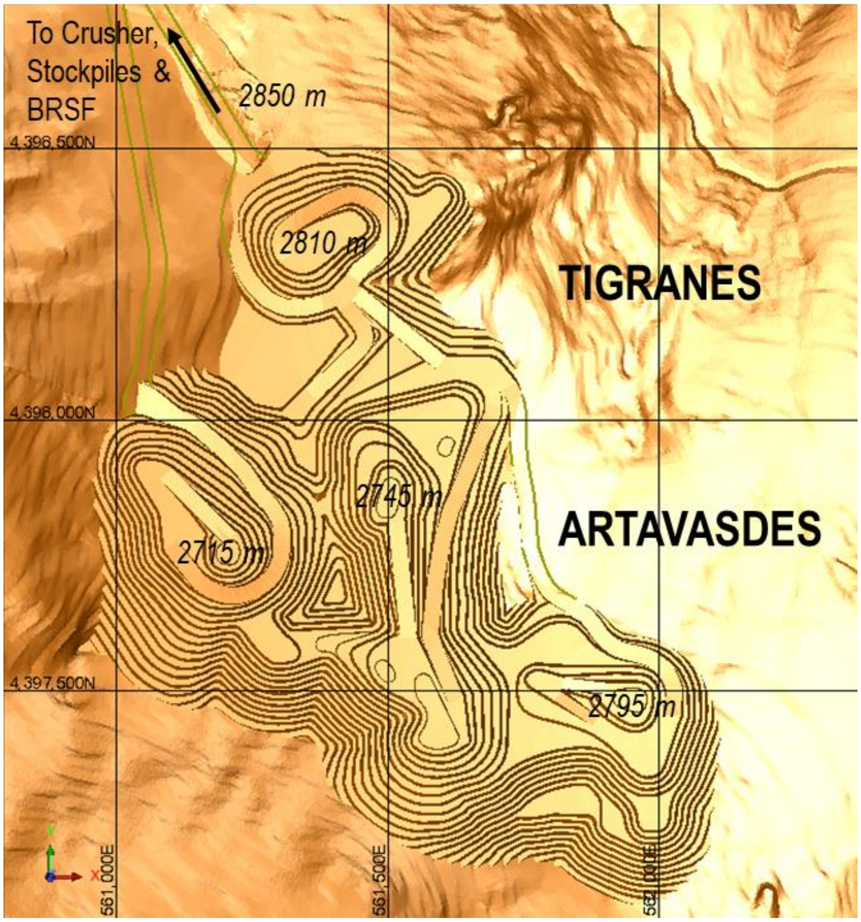
Figure 16-5: **Phase 4 (Artavasdes 2)**



Source: JDS (2019)

The fifth Mining Phase is shown in Figure 16-6 and will provide additional backfill space once complete. This phase has a maximum elevation of 2,950 m and is mined down to 2,795 m.

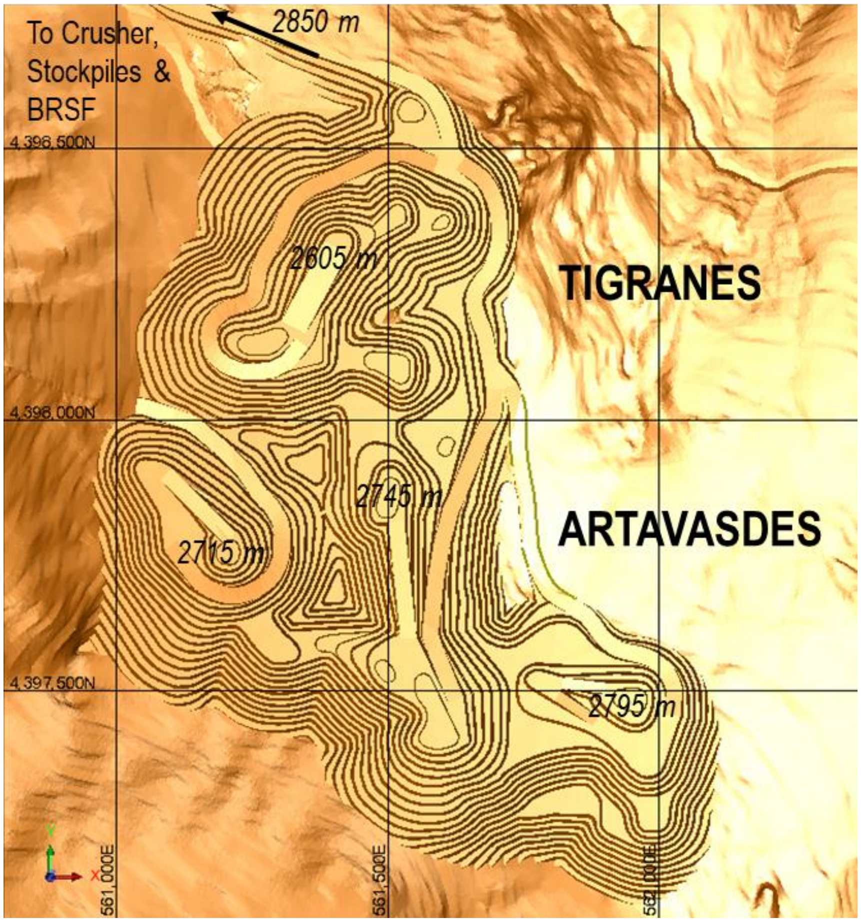
Figure 16-6: **Phase 5 (Artavasdes 3)**



Source: JDS (2019)

Figure 16-7 shows the final pit configuration for the TAA deposits. The main access is re-routed to the East side of Erato as the main road to the crusher will be mined out. This phase has a maximum elevation of 2,890 m and is mined down to 2,690 m.

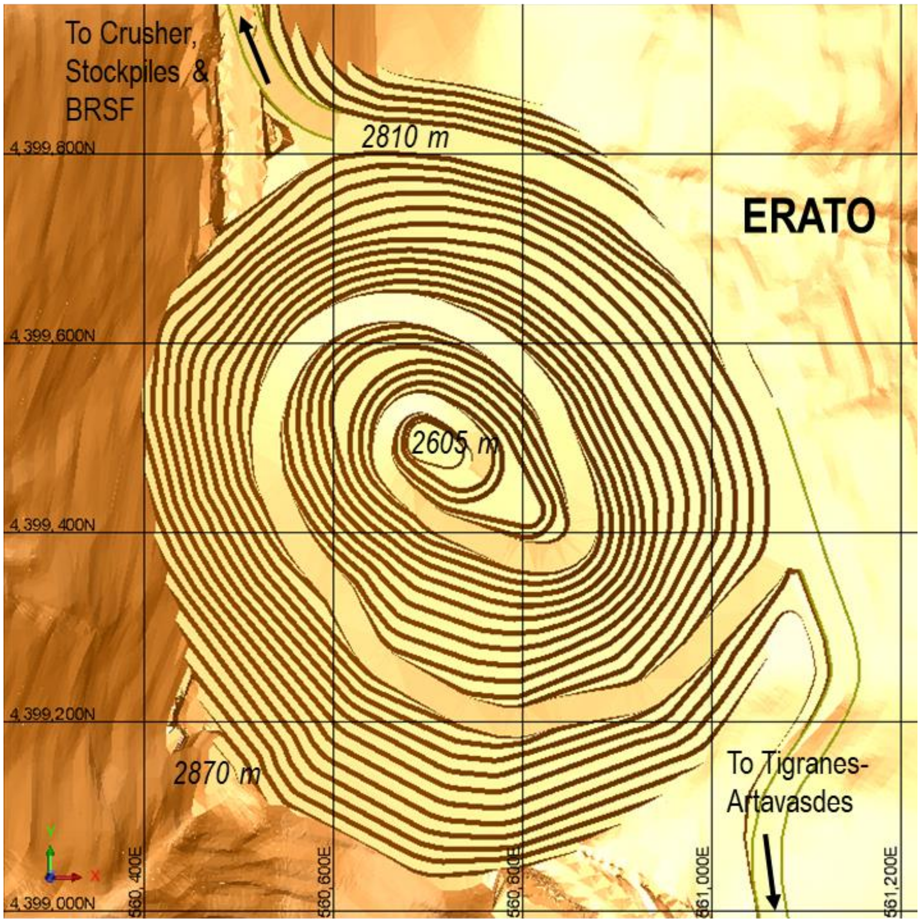
Figure 16-7: **Phase 6 (Tigranes 2)**



Source: JDS (2019)

Figure 16-8 shows the Final pit configuration at the Erato deposit. Internal phasing was not deemed required due to the pit size and ore geometry. The top of the Erato pit starts at an elevation of 2,910 m and is mined down to 2,605 m.

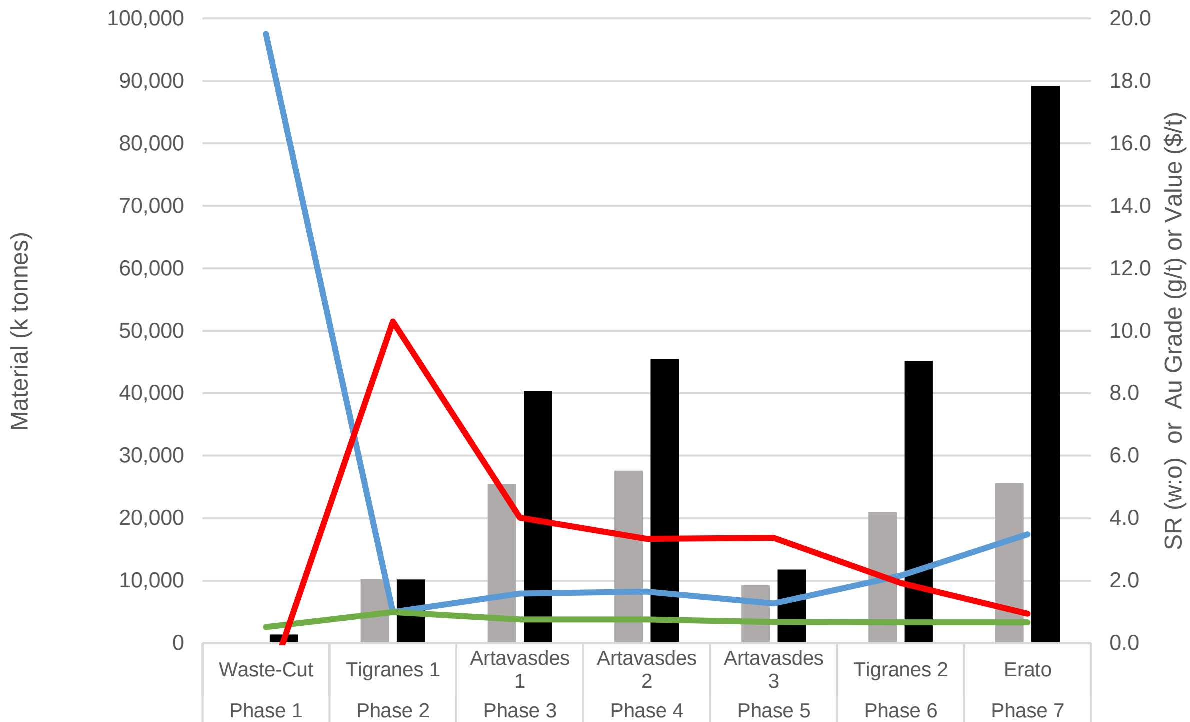
Figure 16-8: Phase 7 (Erato)



Source: JDS (2019)

The detailed pit designs were used in the determination of the Mineral Reserve estimate for each deposit (see Section 15 for additional detail). Figure 16-9 further summarizes the pit and phase designs for each of the deposits, illustrating ore and waste mined tonnages, gold grade, strip ratio and contained value. The contained value, which drives the optimized mining sequence, is based on the mine design criteria taking into account net metal price, operating costs and heap leach gold recoveries. Ore is based on a 0.20 g/t cut-off grade.

Figure 16-9: **Mining Phase Summary**

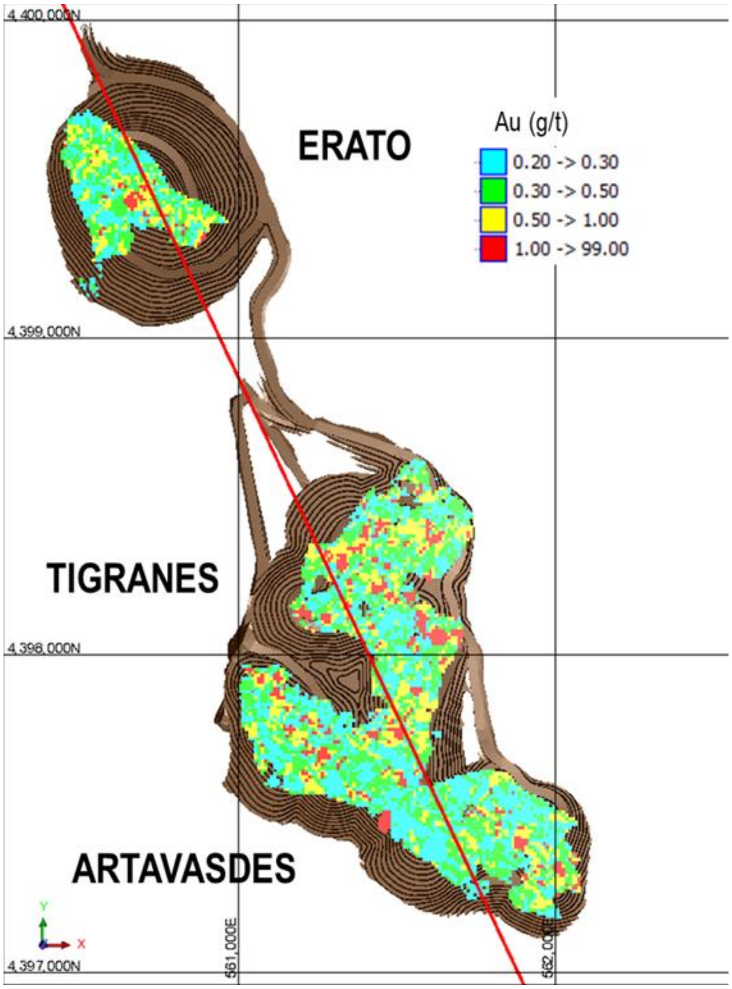


	Waste-Cut Phase 1	Tigranes 1 Phase 2	Artavasdes 1 Phase 3	Artavasdes 2 Phase 4	Artavasdes 3 Phase 5	Tigranes 2 Phase 6	Erato Phase 7
Ore kt	71	10,254	25,493	27,633	9,295	20,931	25,626
Wst kt	1,381	10,186	40,386	45,485	11,772	45,192	89,190
SR w:o	19.5	1.0	1.6	1.6	1.3	2.2	3.5
Au Grade g/t	0.51	0.99	0.76	0.75	0.68	0.67	0.67
Value $/t	-1.6	10.3	4.0	3.3	3.4	1.9	0.9

Source: JDS (2019)

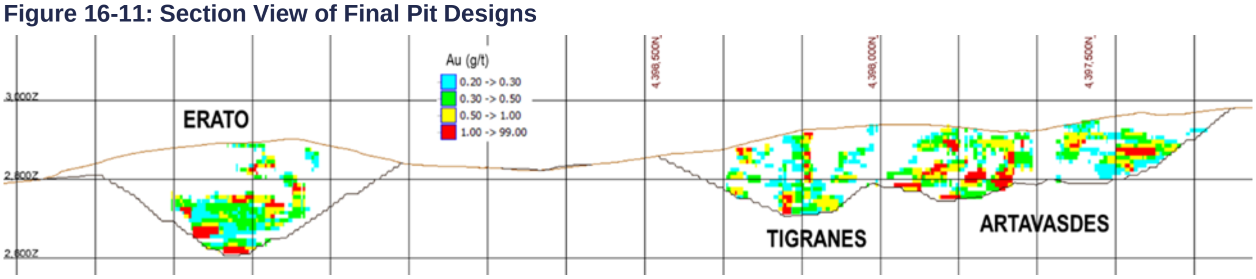
The final pit configuration with the location of ore material is shown in Figure 16-10 and section through the final pits is shown in Figure 16-11. For the TAA deposits, the topography has a maximum elevation of 2,994 m and the final pit design extend down to 2690 m with an approximate exit elevation of 2,850 m. For the Erato deposit, the topography has a maximum elevation of 2910 m and the final pits design extends down to 2,605 m with an approximate exit elevation of 2,810 m. The crusher is located to the North of the pits at an approximate elevation of 2,600 m.

Figure 16-10: Plan View of Final Pit Designs



Source: JDS (2019)

Figure 16-11: Section View of Final Pit Designs



Source: JDS (2019)

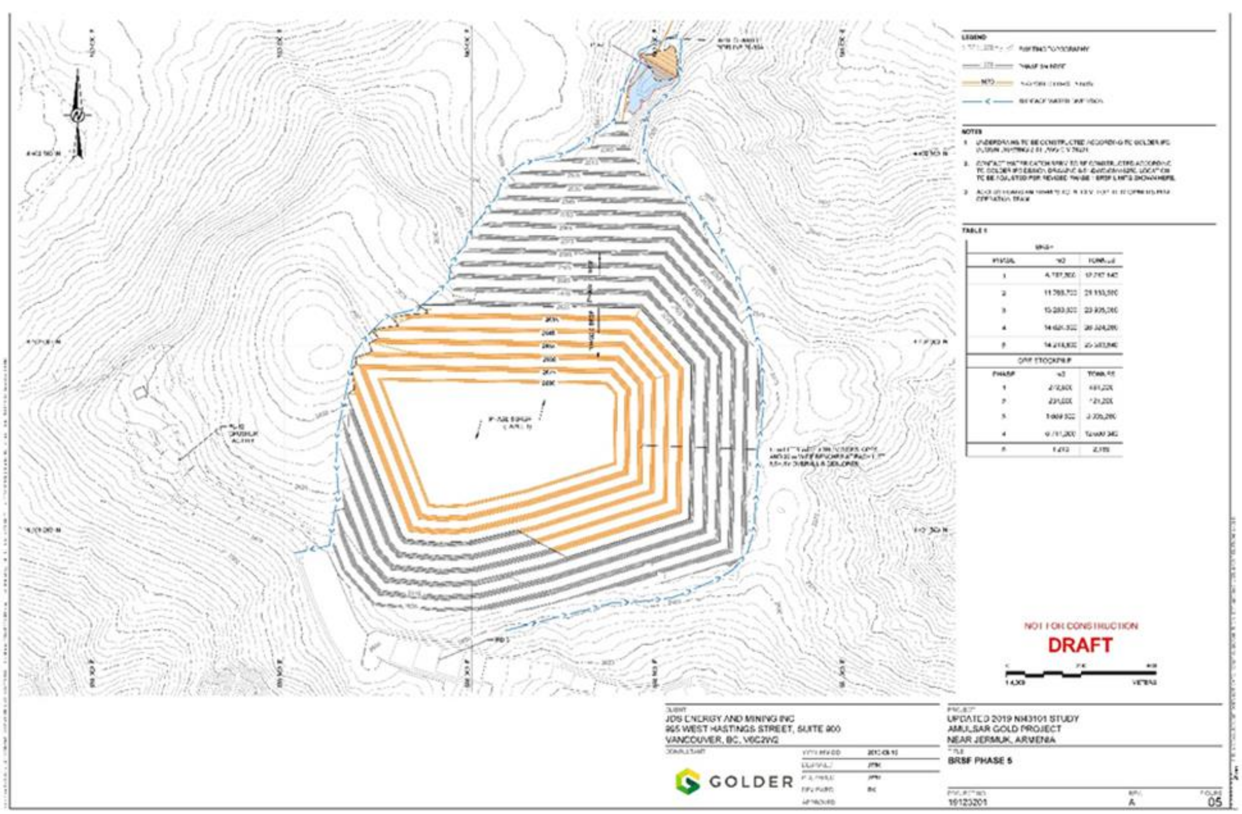
16.3 Waste Storage Design

A total of 244 Mt of waste material will be mined over the mine life. A relatively small amount of the waste will be used to construct haul roads, with the remainder either be placed within the BRSF, or within the Tigranes-Artavasdes open pits as backfill material.

16.3.1 Barren Rock Storage Facility (BRSF)

Approximately 110 Mt of waste is stored within the BRSF and is located several kilometers North and down-hill of the open pits. Additional details on the BRSF design are discussed in detail in Section 18. A complete design report for the BRSF was prepared by Golder in June 2017 (Golder 2017) and is contained in Appendix 13 which can be found in the report Design Documents, located on Lydian's website. As part of the 2019 Technical Report Update, Golder provided an update of the phased development based on the updated mine schedule contained in this report. The BRSF design is shown in Figure 16-12.

Figure 16-12: BRSF Final Design



Source: Golder (2019)

16.3.2 In-pit Backfill

The remainder of the open pit waste (approximately will be 134 Mt of waste is stored in-pit within the TAA open pits. The in-pit backfill design uses the following parameters:

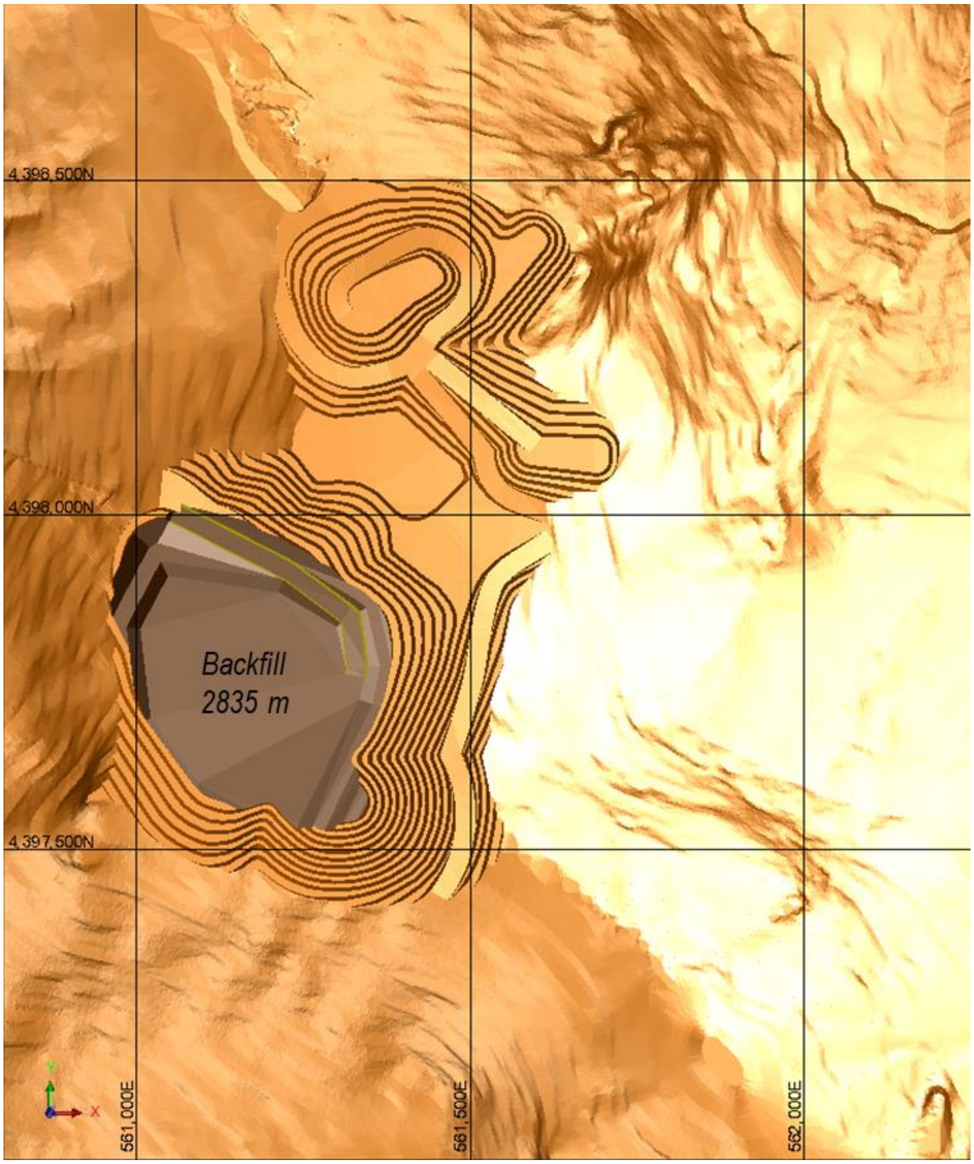
- Material Density = 2.35 t/m^3;

- Swell Factor = 30%;
- Lift height = 10 m;
- Face slope = 1.3H:1V; and
- Overall slope = 3H:1V.

Operationally, the backfill material can be placed in the pit bottom in larger, more productive lifts. Once the backfill extends above topography, backfill material will be placed in 10 m lifts for overall stability and consideration to future reclamation.

The TAA pit phases were designed such that as each mining phase is completed, additional in-pit storage becomes available. The first in-pit storage becomes available once TAA Phase 3 is complete unlocking approximately 14 Mt of in-pit storage and is shown in Figure 16-13.

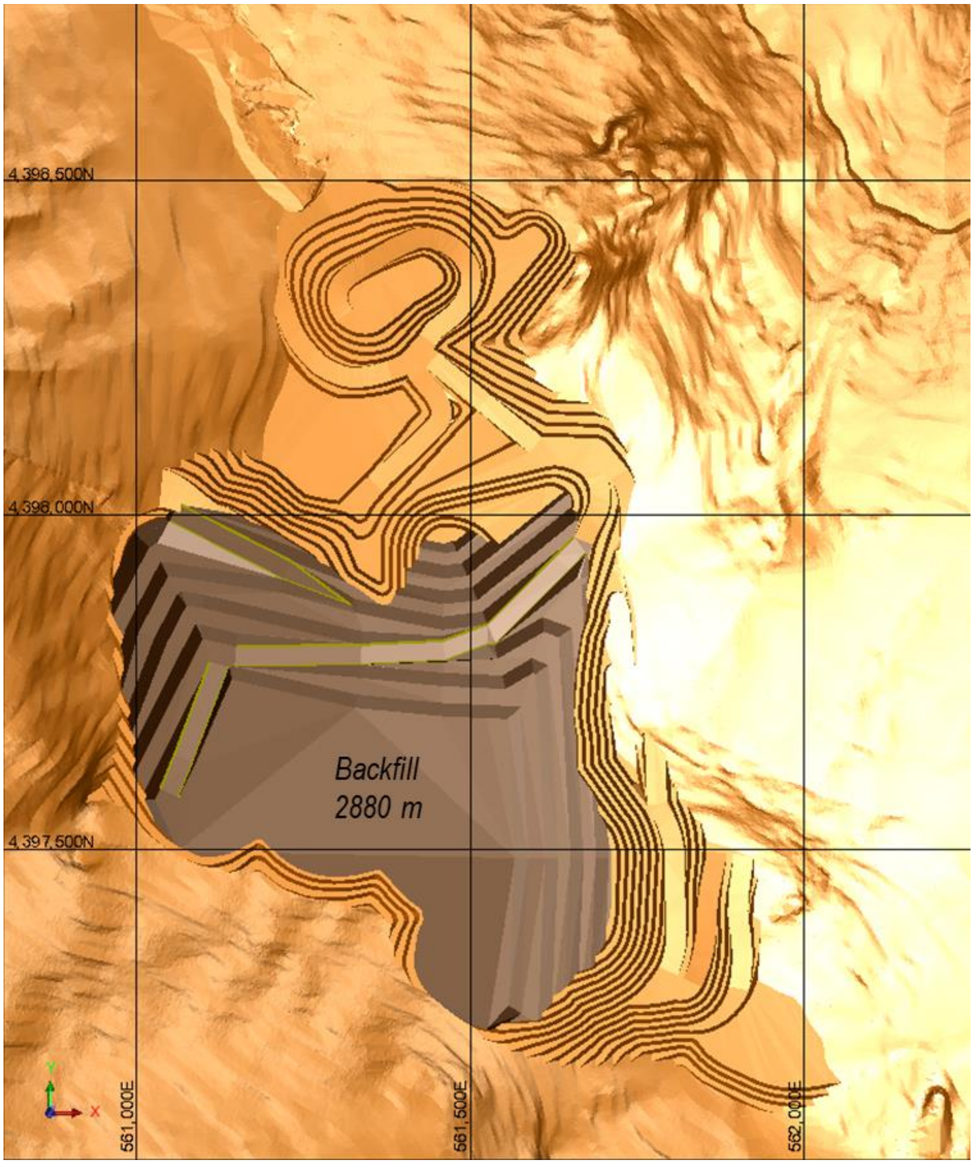
Figure 16-13: **In-pit Phase A**



Source: JDS (2019)

Figure 16-14 shows an additional 30 Mt of storage when TAA Phase 4 is complete.

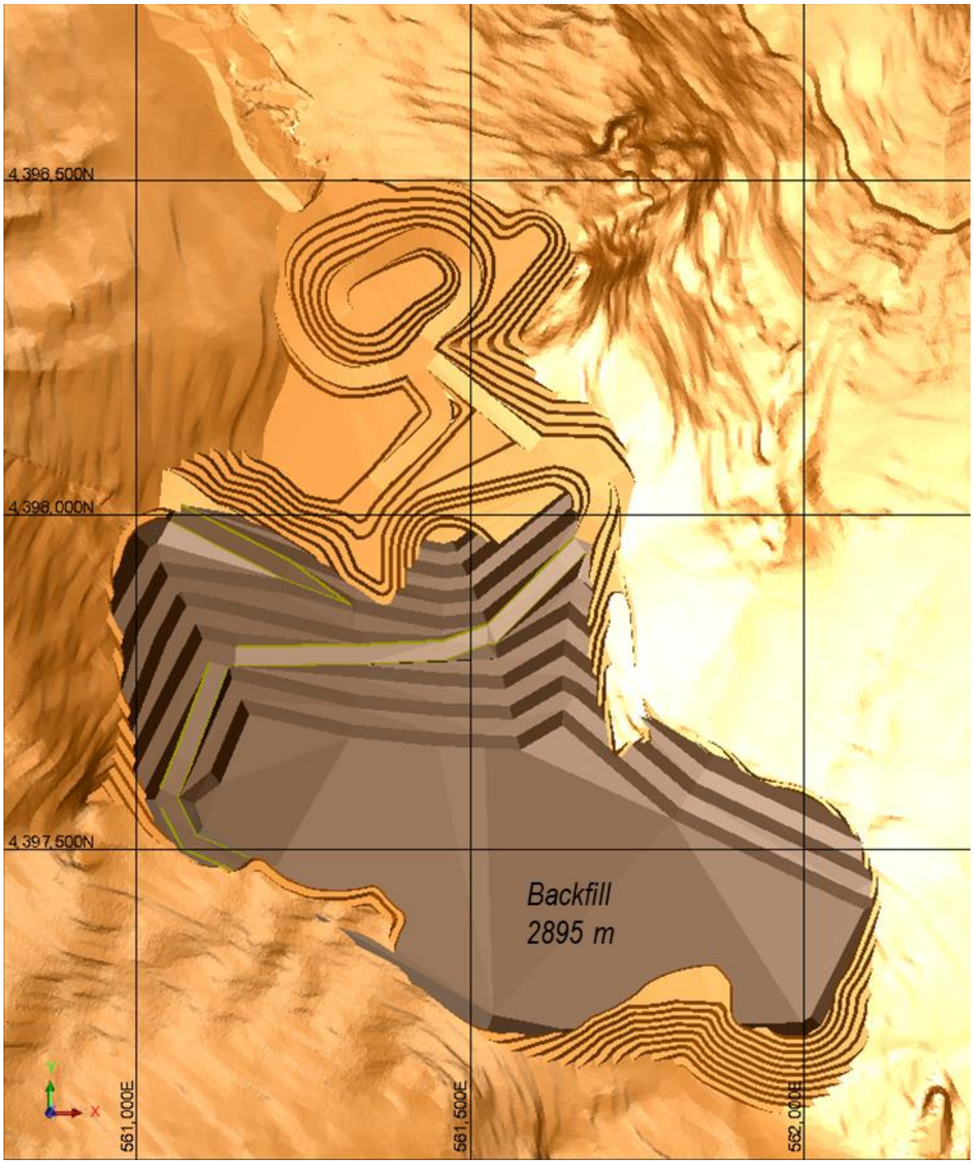
Figure 16-14: In-pit Phase B



Source: JDS (2019)

Figure 16-15 shows an additional 20 Mt of storage when TAA Phase 5 is complete.

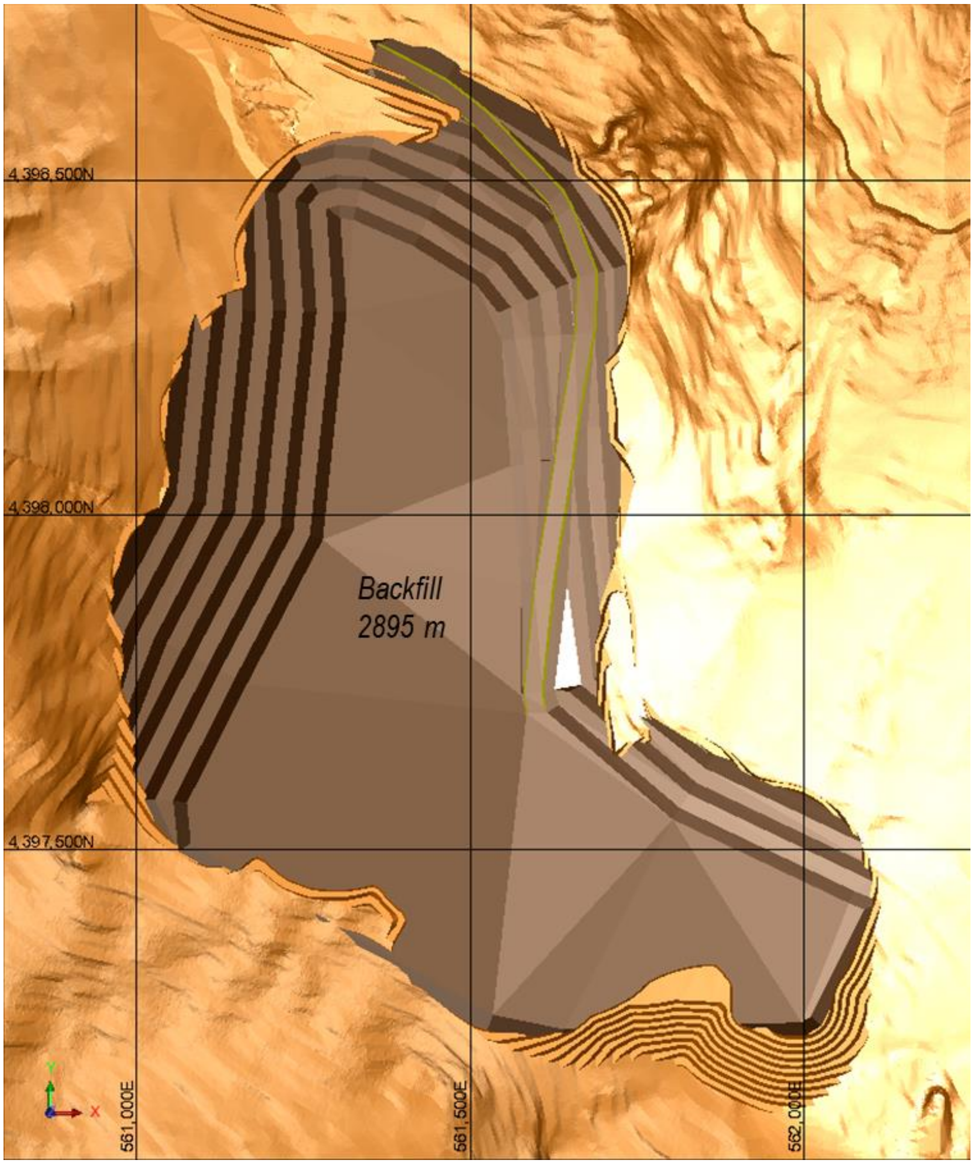
Figure 16-15: **In-pit Phase C**



Source: JDS (2019)

Figure 16-16 shows an additional 70 Mt of storage when TAA Phase 6 is complete. This is the final configuration.

Figure 16-16: **In-pit Phase D (Final)**



Source: JDS (2019)

16.4 Mine Production Schedule

16.4.1 Key Production Schedule Criteria

The basic criteria used for the development of the LOM production schedule are to:

- Maximize NPV of the project;
- Maximize the value in the early years of the operation through the use of stockpiles (when no stacking of heap leach) and concurrent open pit mining of the various phases;

- Ensure heap leach ore loading of 10 Mt/a;
- Minimize pre-production mining while ensuring adequate waste material suitable for construction is produced in the pre-production period;
- Limit mine production until the end of year 1, to not exceed the capacity of existing the existing on-site equipment (~60 ktpd);
- Limit the loading production to two 22 m^3 shovels and one 17 m3 front-end loader over the LOM. Resultant maximum total yearly mine open pit production is 34 Mt;
- Establish a low-grade stockpile (>0.20 g/t and < 0 .30 g/t) to provide a buffer during periods of low ore supply from the mine; and
- Plan on operating the open pit mine 365 days per year, allowing for 30 non-operating days per year due to weather delays during winter months.

16.4.2 Production Schedule

The pit sequencing corresponds to the detailed pit designs described in Section 16.2. Pit sequence focuses on achieving the required heap leach feed production rate, mining of higher value material early in the mine life, while balancing gold grade and strip ratios.

The pre-production period is up to the end of Year -1. Open pit mining activities during this period are scheduled to provide sufficient ore exposure for heap leach start-up and mining focuses on providing sufficient waste rock for construction (haulage roads and BRSF containment). A small amount of ore mined during the pre-production period is planned to be stockpiled and re-handled during crusher and heap leach stacking operations.

Table 16-3 summarizes the ore and waste movement by year and by pit over the LOM along with the heap leach feed schedule.

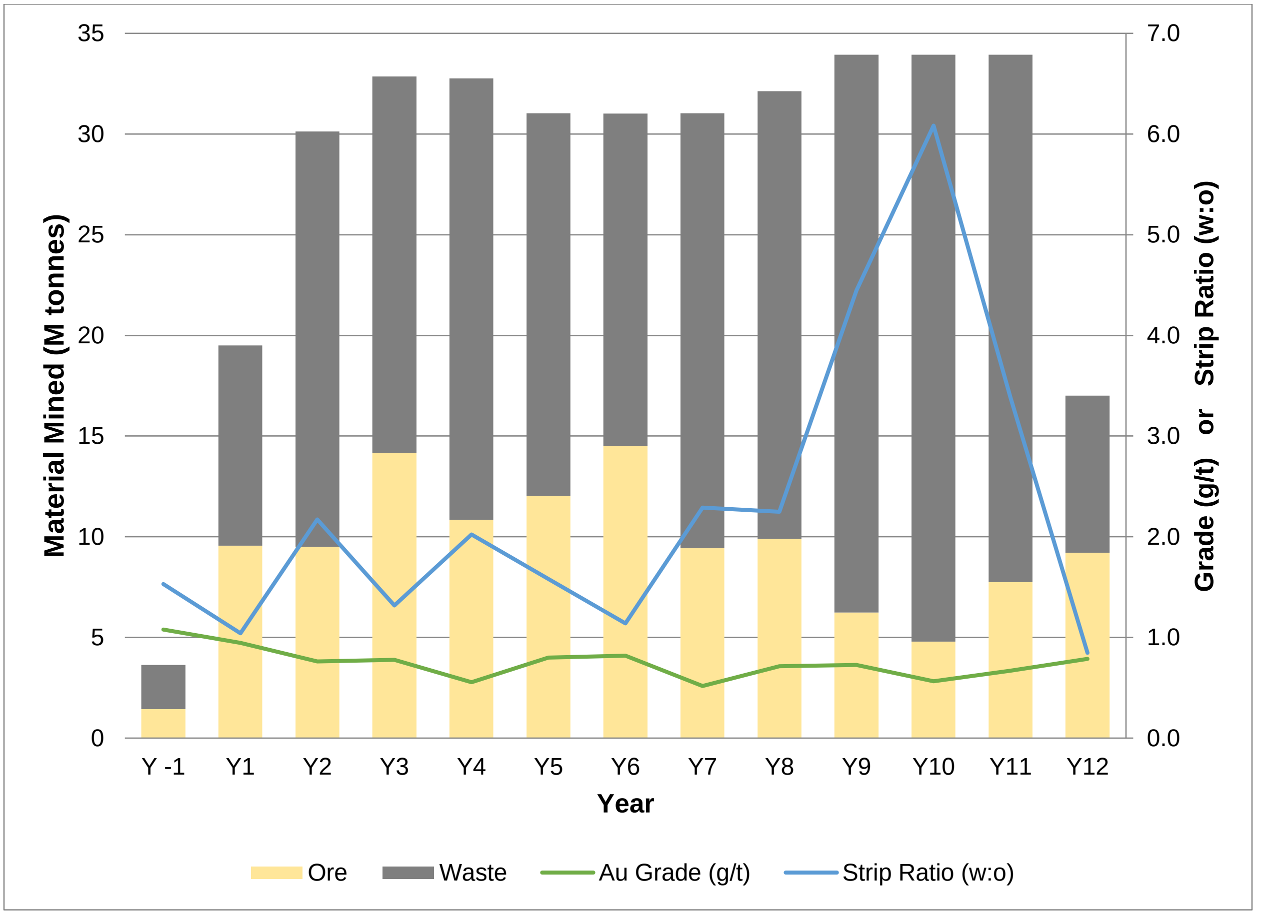
Table 16-3: **LOM Production Schedule**

	Unit	Life of Mine Total	Y -1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Mining															
Production															
Ore Mined	ktonnes	119,303	1,435	9,553	9,496	14,169	10,840	12,019	14,507	9,427	9,886	6,231	4,792	7,743	9,205
Au Grade	g/t	0.74	1.08	0.94	0.76	0.78	0.56	0.80	0.82	0.52	0.72	0.73	0.56	0.67	0.79
Contained Au	troy koz	2,828	50	290	233	354	194	308	382	157	227	146	87	167	233
Ag Grade	g/t	3.8	1.8	2.8	5.2	4.1	3.8	4.4	6.7	3.2	2.3	2.2	2.2	2.4	2.6
Contained Ag	troy koz	14,435	81	853	1,599	1,875	1,327	1,711	3,142	970	725	436	335	599	780
Waste Mined	ktonnes	243,593	2,196	9,947	20,625	18,682	21,921	19,006	16,517	21,598	22,236	27,713	29,153	26,204	7,797
Strip Ratio	w:o	2.0	1.5	1.0	2.2	1.3	2.0	1.6	1.1	2.3	2.2	4.4	6.1	3.4	0.8
Total Mined	ktonnes	362,895	3,631	19,499	30,121	32,851	32,761	31,025	31,024	31,025	32,121	33,943	33,945	33,946	17,002
Mining Rate	(tpd)		19,900	53,400	82,500	90,000	89,800	85,000	85,000	85,000	88,000	93,000	93,000	93,000	46,600

Source: JDS (2019)

Figure 16-17 summarizes the LOM annual material movement.

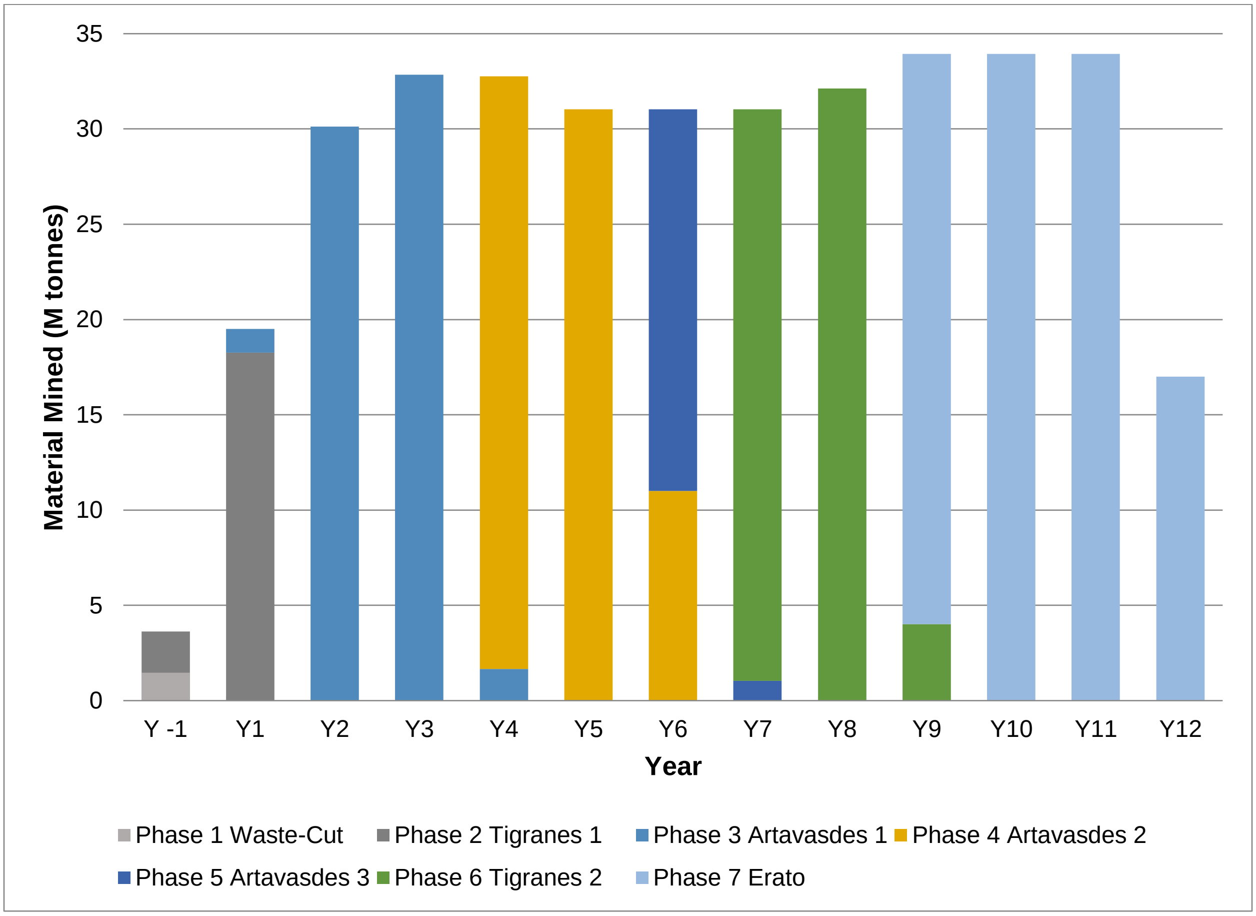
Figure 16-17: LOM Annual Material Movement, Grade and Strip Ratio



Source: JDS (2019)

Figure 16-18 summarizes the LOM annual material movement by phase.

Figure 16-18: LOM Annual Material Movement by Phase



Source: JDS (2019)

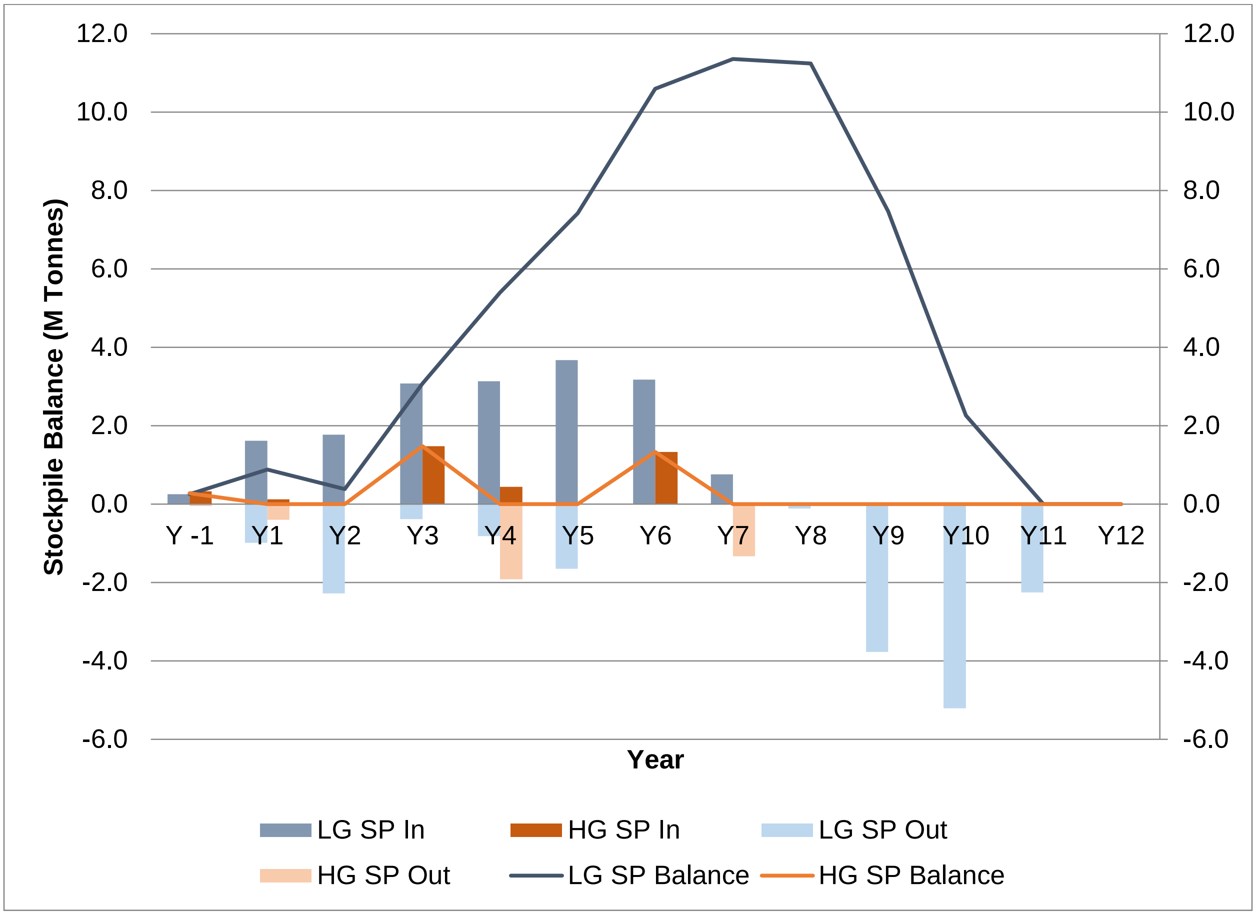
Figure 16-19 displays LOM annual ore tonnes and contained gold.

Figure 16-19: LOM Ore Tonnages and Contained Gold

Source: JDS (2019)

Figure 16-20 illustrates the stockpile closing balances. The low grade (LG) stockpile is built on top of the BRSF and therefore, there is limited stockpile capacity early in the mine life. As the BRSF expands, stockpile capacity increases. Approximately 12 Mt of ore is needed to be stockpiled before the Erato deposit is mined to ensure the mine can maintain ore feed to the HLP in the later years. Stockpiled material is rehandled mainly by an 11.5 m^3 High-Lift FEL into the mine haul truck fleet as required. The larger 21 m^3 FEL is also available for loading. The rehandled ore is trucked a short distance over to the primary crusher.

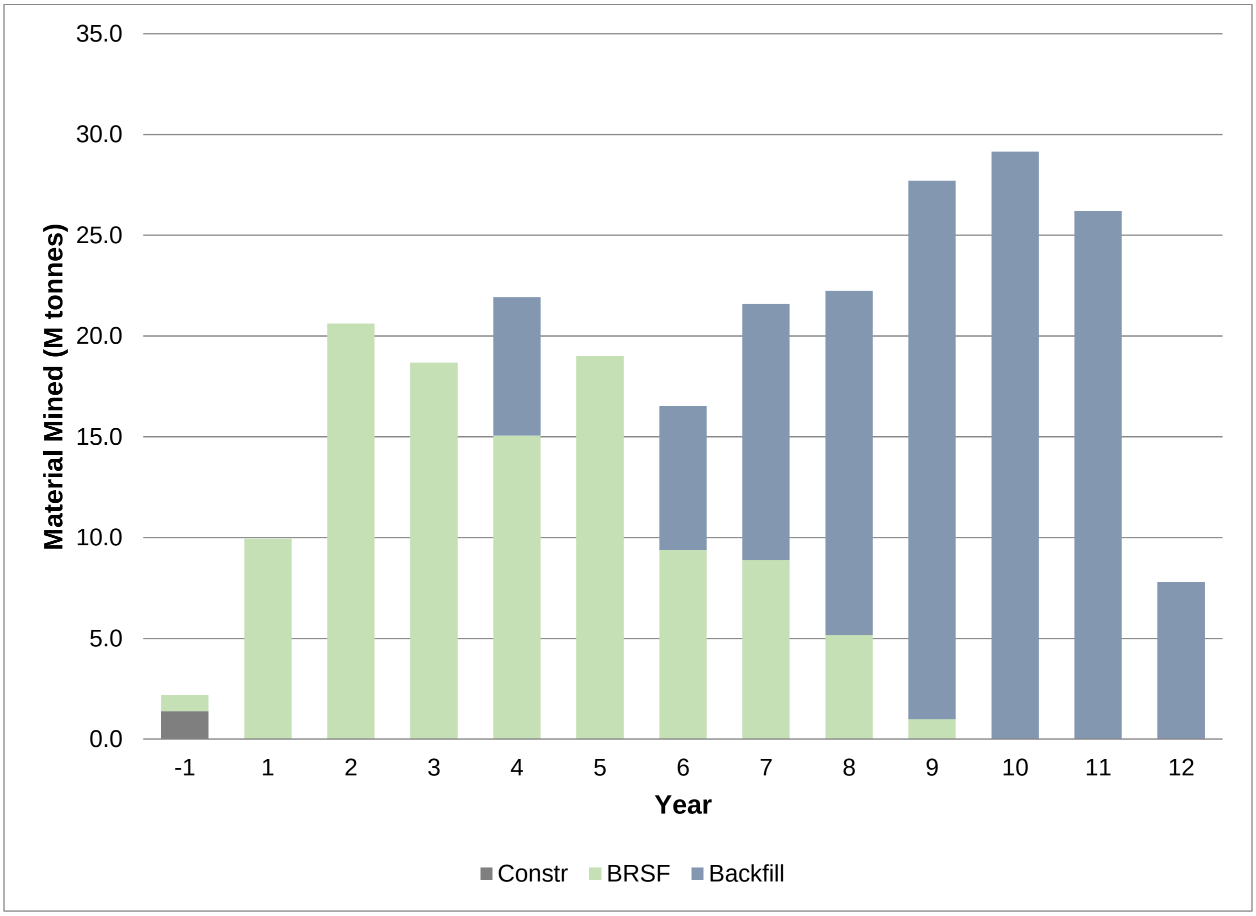
Figure 16-20: **Stockpile Balance**



Source: JDS (2019)

All of the mine waste rock will initially be hauled to the BRSF located several kilometres North and down-hill of the open pits. Once the BRSF reaches its maximum capacity, all the waste rock will then be place within the TAA pits. Of the 244 Mt total waste material mined, approximately 110 Mt will be contained within the BRSF, with the remainder being place in-pit. Figure 16-21 summarizes annual waste volumes allocated by destination.

Figure 16-21: Annual Waste Allocations by Destination



Source: JDS (2019)

16.4.3 Open Pit Development

Year -1: This period covers the pre-production period. Open pit mining commences with development of the RD3 road and targeting non-acid generating waste materials at the top of the Tigranes deposit (Phase 1 and Phase 2). Waste rock is planned to be used for construction of roads and the initial BRSF containment. Ore is either stockpiled or crushed for the initial HLP lifts. A total of 3.6 Mt of material is mined in this period. End of pre-production is shown in Figure 16-22.

Year 1: First year of gold production. Ore production ramps up to full capacity by mid-year. There is limited stockpile capacity so most of the ore is sent directly to the crusher. Mine production is limited to the existing on-site loading equipment (1x 22 m^3 Shovel + 1x 21 m^3 FEL). Mining activity is mainly focused in the high-grade zone of Tigranes (Phase 2), and later starting development of the next phase in Artavasdes (Phase 3). End of Year 1 is shown in Figure 16-23.

Year 2: Mining in Artavasdes (Phase 3) continues. Additional stockpile capacity is available as the BRSF is built-up. An additional mining fleet arrives on site (1x 22 m^3 Shovel + Trucks) increasing production rates up to a maximum of 100 ktpd. End of Year 2 is shown in Figure 16-24.

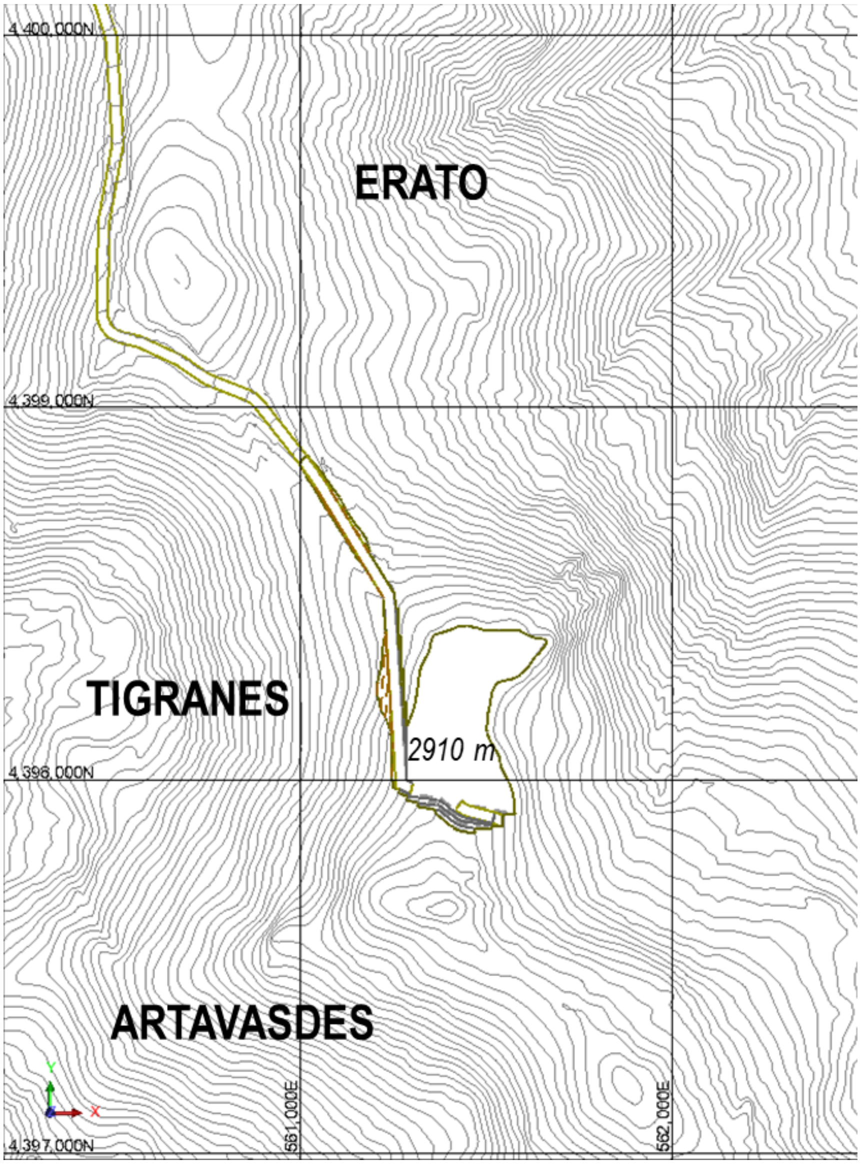
Years 3: Mining in Artavasdes (Phase 3) is almost complete. Additional stockpile capacity is available as the BRSF is built-up. End of Year 3 is shown in Figure 16-25.

Years 4 to 5: Mining in Artavasdes (Phase 3) is completed and backfilling of the open pit commences. Additional stockpile capacity is available as the BRSF is built-up. Mining transitions into Phase 4 (Artavasdes). End of Year 5 is shown in Figure 16-26.

Years 6 to 8: Mining progresses from Phase 4 and 5 in Artavasdes to Phase 6 in Tigranes. Backfilling of the open pits continues as area becomes available and the BRSF is filled to its maximum capacity. The low-grade stockpile builds to its maximum size to prepare for lower ore availability when mining the Erato deposit. End of Year 8 is shown in Figure 16-27.

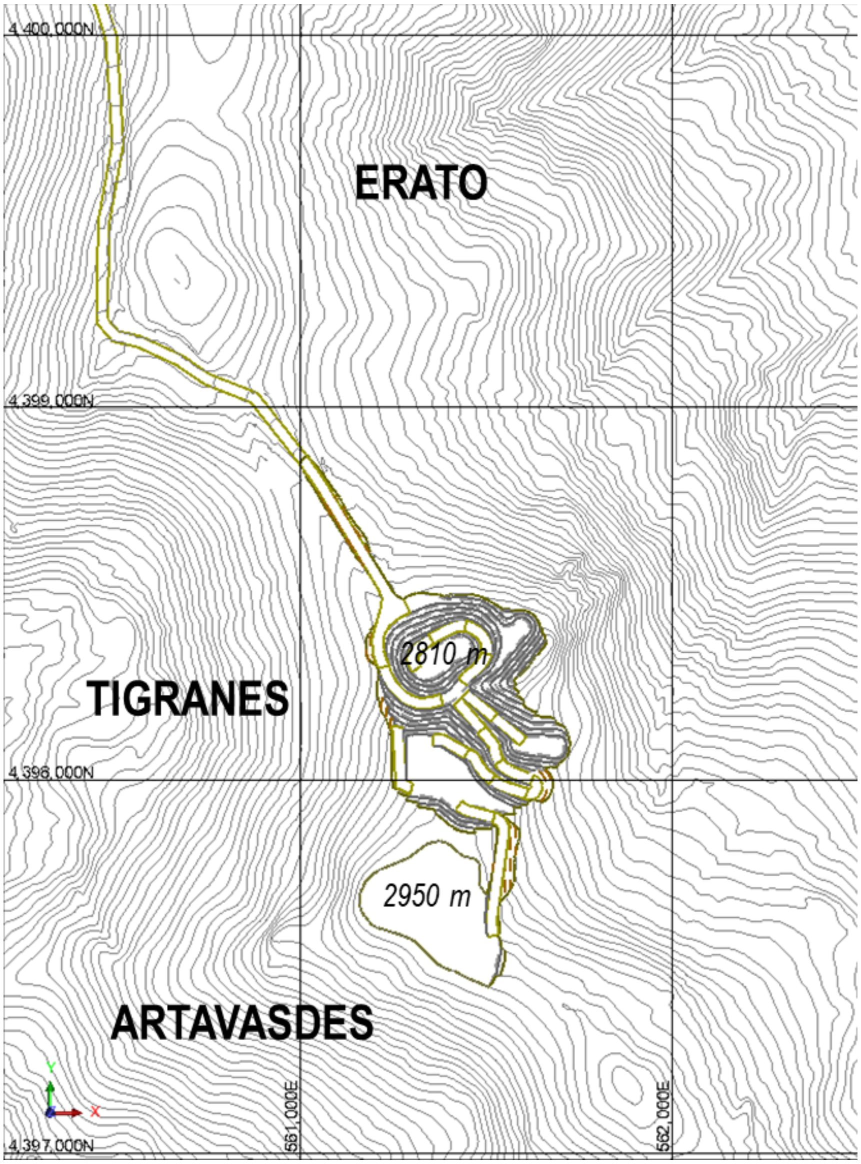
Years 9 to 12: Mining is completed in Tigranes and transitions into and completing Erato by the end of Year 12. All waste is placed as backfill in TAA. End of Year 12 is shown in Figure 16-28.

Figure 16-22: **Annual Map Year -1**



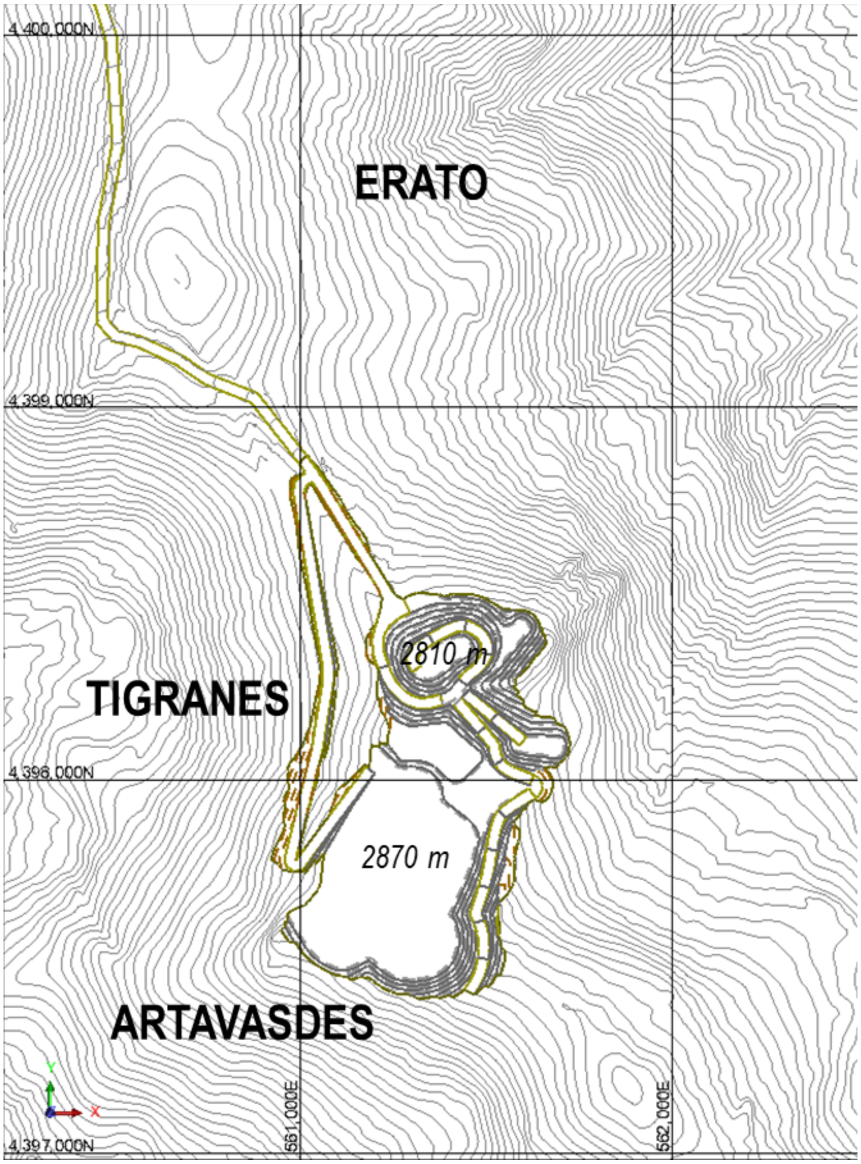
Source: JDS (2019)

Figure 16-23: Annual Map Year 1



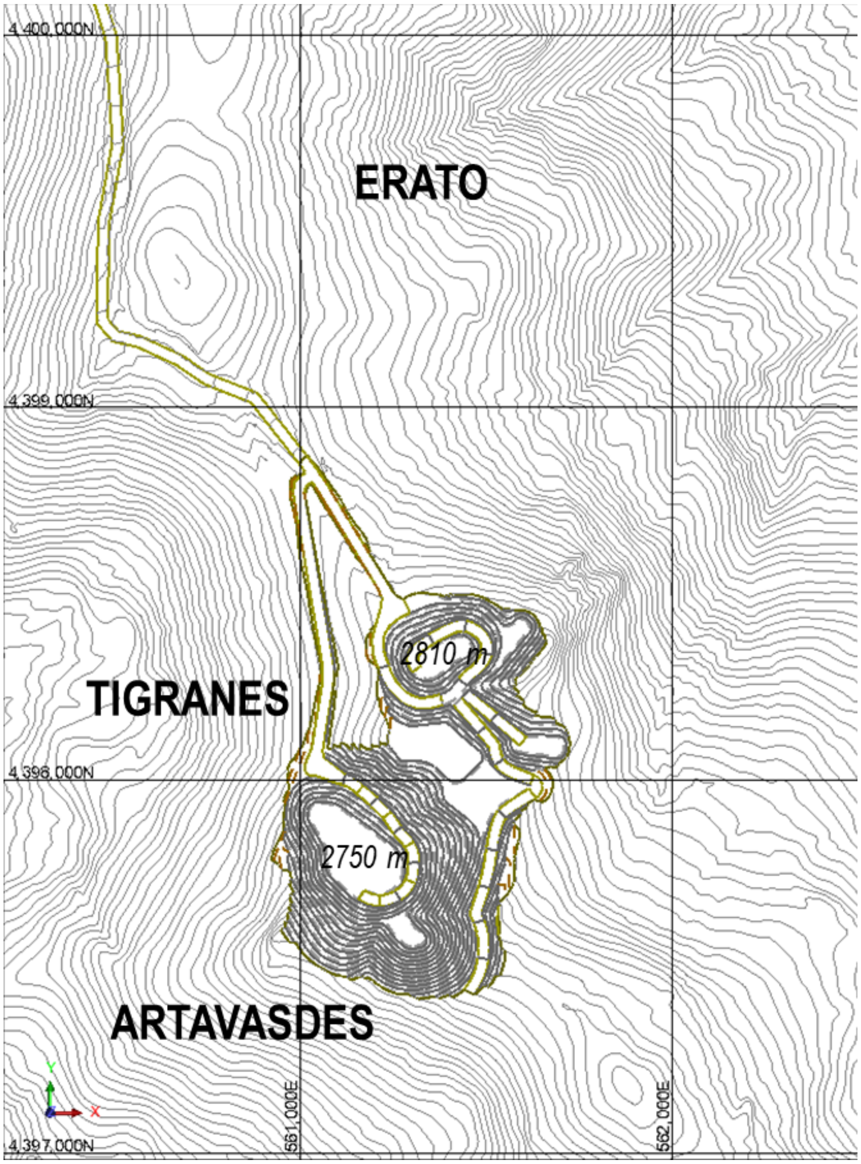
Source: JDS (2019)

Figure 16-24: Annual Map Year 2



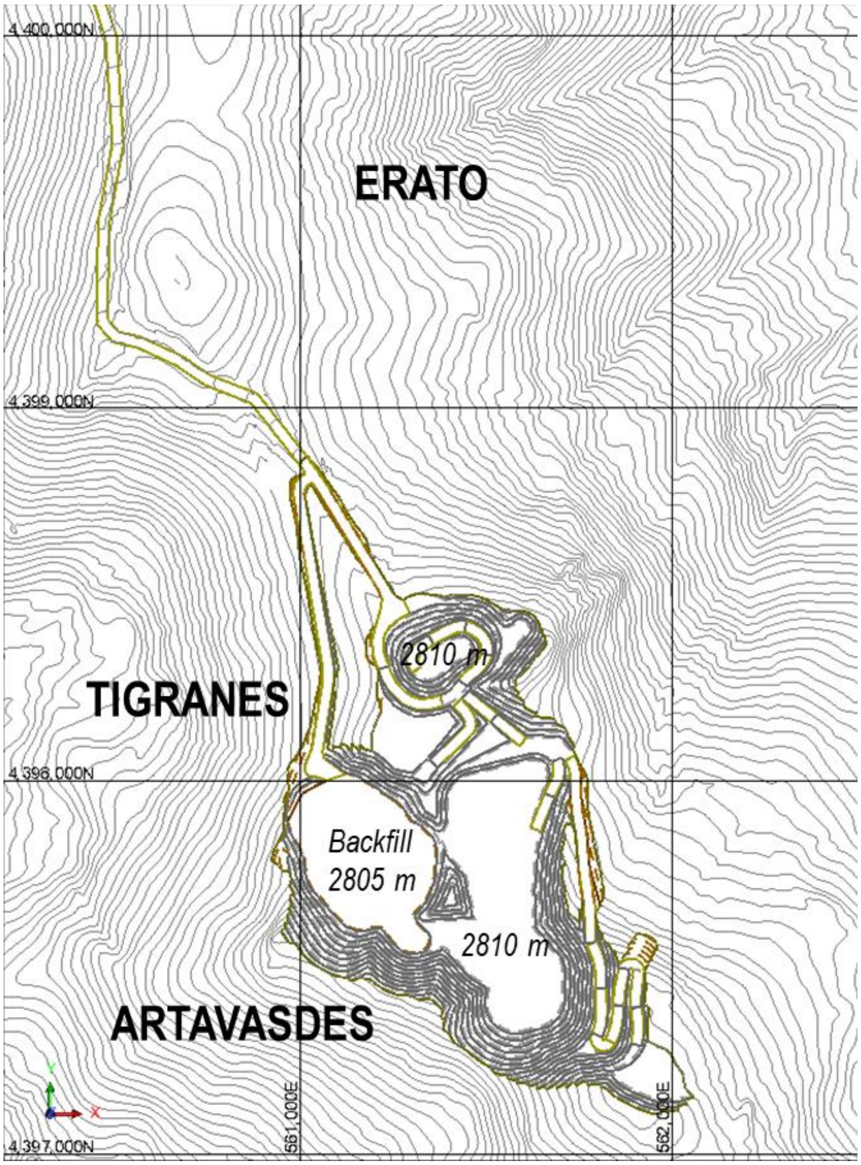
Source: JDS (2019)

Figure 16-25: **Annual Map Year 3**



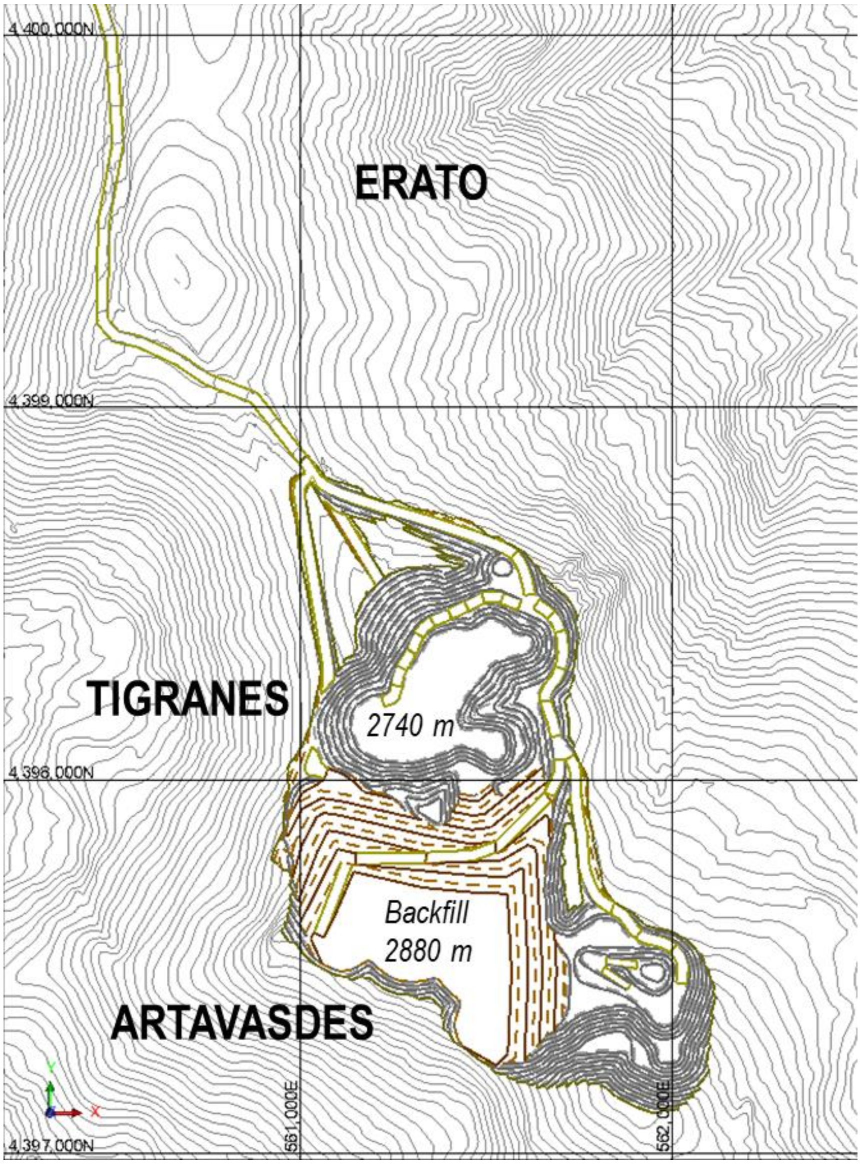
Source: JDS (2019)

Figure 16-26: **Annual Map Year 5**



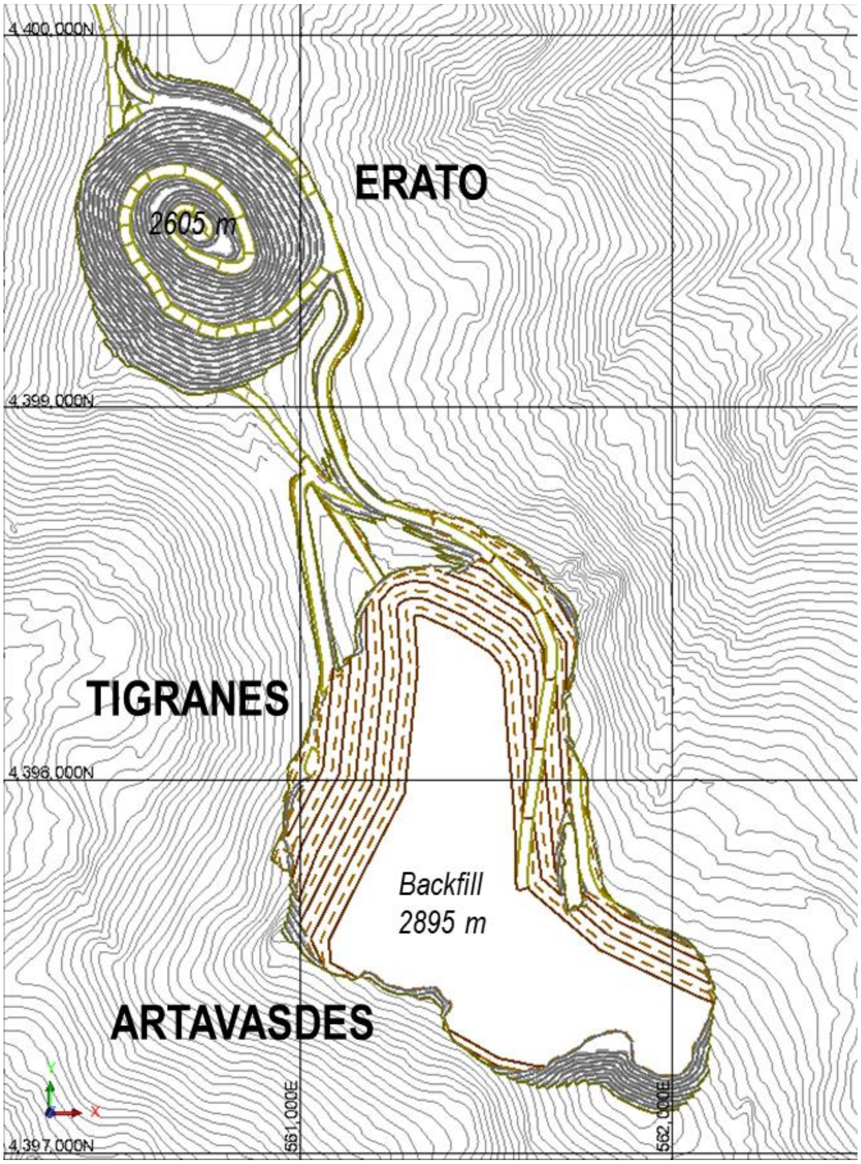
Source: JDS (2019)

Figure 16-27: Annual Map Year 8



Source: JDS (2019)

Figure 16-28: Annual Map Year 11 (LOM)



Source: JDS (2019)

16.5 Mine Equipment

16.5.1 Introduction

The open pit mining activities were assumed to be undertaken by a conventional drill, blast, load and haul. Bulk excavation of material will be by mainly by hydraulic excavators with a front-end loader as back-up. An initial fleet consisting of 1x 22 m^3 Shovel, 1x 21 m^3 FEL and 9x 180-tonne haul trucks has already been purchased and delivered to site. Given the overall scale of operations and equipment requirements, the fleet will be diesel-powered.

The open pits are designed with 10 m benches in both waste and ore with adequate phase geometry to achieve a maximum production rate of 34 Mt/year. Mining is scheduled to advance sequentially through the pit phases generally one at a time. Given the required production rate and pit geometries, vertical advance rates average 10 benches per year, with frequent requirement for ramp development and opening of new benches.

16.5.2 Use-of-Time Definitions and Work Schedules

Time definitions, work regime structure, and standard standby and delay parameters were applied to the mine equipment selection. During winter (4 months), an additional 30 days of standby time was applied to account for restricted visibility at the mine.

Production will be on a 4 days / 4 days off – 4 nights / 4 days off – rotating with 4 operating shifts. The standard shift is 12 hours.

The time model used for calculating open pit equipment hours is shown in Table 16-4.

Table 16-4: Time Model Structure

<table>
<tr><td colspan="4">Total Available Hours</td></tr>
<tr><td colspan="3">Available Hours</td><td>Maintenance</td></tr>
<tr><td colspan="2">Operational Hours</td><td>Standby</td><td></td></tr>
<tr><td>Effective Hours</td><td>Operational Losses</td><td></td><td></td></tr>
</table>

Source: JDS (2019)

The definitions used in the time model are:

- Total available hours:
  - Hours in a calendar year. At 24 hours per day and 365 days per year, the total available hours is 8,760 per year;
- Available hours:
  - Total available hours less maintenance hours per piece of equipment;
- Maintenance hours:
  - Includes waiting for maintenance personnel, waiting for maintenance equipment or spare parts, travel time to and from the shop, actual maintenance time, movements and waiting time within the shop;
- Standby hour:
  - The unit is mechanically operable but is not manned or used (e.g. schedule loss, safety meetings, meals, breaks, blasting, shift change, weather outages, refueling, and training);
- Operational hours:
  - Available hours less standby time; used for costing purposes;
- Operational loss hours:

  - The equipment is operating but not performing its specific production duty (drill rig setup, shovel/drill moves, cleaning of work faces);
- Effective hours:
  - Operational hours less standby time;
- The criteria for lost time have been applied through the following factors:
  - Mechanical availability - (measure of maintenance down time), is expressed as available hours divided by total available hours.
- Use of availability – operational hours divided by available hours;
- Operating efficiency – effective hours divided by operational hours; and
- Overall effective utilization – product of mechanical availability, utilization, operator efficiency and operational losses.

On this basis, the target equipment availability and utilization were defined for each of the major equipment units shown in Table 16-5.

Table 16-5: Equipment Effective Utilization

Open Pit Equipment	Effective Utilization - Normal (%)	Effective Utilization – Winter (%)
Diesel, 22 m^3 Front Shovel	69	52
Diesel, 17 m^3 Wheel Loader	67	50
180-tonne Haul Truck	66	50

Source: JDS (2019)

16.5.3 Blasthole Drilling and Blasting

All Drilling and Blasting will be performed by contractors. All equipment will be supplied by the contractor.

16.5.4 Loading

Bulk material loading will be carried out but 22 m^3 Diesel hydraulic excavators as the primary loading equipment, supported by 21 m^3 front-end loaders (FEL). A smaller 11.5 m^3 High-Lift FEL will also be used for rehandling stockpile material as required. The main criterion for loading equipment is the ability to effectively load trucks with payloads of 180 t, while allowing for somewhat selective mining. The performance of the primary loading units was calculated on the basis of the operational equipment productivities and the truck loading times for both ore and waste material.

The number of passes and fill factors are summarized in Table 16-6. In addition to the loading time, the loading unit productivities include waiting, maneuver and unproductive time estimates. Based on these parameters, operating hours for the loading fleet were estimated by the amount of material to be moved within a specified period and the associated productivities. The fleet size was then calculated using total operating hours for the period and the operating hours per unit within the period.

Table 16-6: Loading Parameters

Item	Unit	Value
Dry density (in situ)	t/m^3	2.35
Material swell factor	%	30
Production Delays	min/op hr	10
Hydraulic Excavator		
Bucket Size	m^3	22
Bucket Fill Factor	%	98
Size of truck to load	t	181
Avg. buckets to load	#	5.0
Avg. bucket cycle time	sec	40
Avg. spot time	sec	30
Total time to load	min	3.8
Front-end Wheel Loader		
Bucket Size	m^3	21.4
Bucket Fill Factor	%	98
Size of truck to load	t	181
Avg. buckets to load	#	5.0
Avg. bucket cycle time	sec	60
Avg. spot time	sec	30
Total time to load	min	5.5

Source: JDS (2019)

16.5.5 Hauling

A fleet of nine 180 tonne trucks has already been purchased and delivered to site. Haulage profiles were estimated for the mine plan for every bench over the mine life to each destination. The haul profiles were run through simulation software to estimate individual cycle times. Table 16-7 summarizes the haul cycle parameters used in calculating truck productivities. Truck performance was calculated for every loading unit and period of the mine plan. It reflects travel time and other fixed times of the load / haul / dump cycle.

Table 16-7: Haulage Cycle Parameters

Description	Unit	Value
Rated payload	tonnes	181
Travel time (loaded/empty)	min/load	simulated
Dump time at crusher / stockpile	min/load	1.5
Dump time at waste dump	min/load	1.0
Stopped time (non-hauling)	% of Net operating hour	10

Source: JDS (2019)

16.5.6 Support and Auxiliary Equipment

The support and auxiliary equipment selection was made considering the size and type of the primary loading and hauling fleet, the geometries of the various open pits, and the number of roads and waste material destinations that would be in operation at any given time.

The following items were also included in the list of owner's support equipment:

- Track dozers, primarily used for maintenance of waste storage locations, road construction, stockpile maintenance, highwall cleaning and other activities as needed;
- Rubber tire dozers to be used to support pattern cleanup, shovel floor maintenance, and stockpile maintenance;
- Graders to be used primarily for road maintenance and pit and dump floor maintenance, road construction;
- Water trucks for dust suppression;
- Snow plow for dealing with drifting snow;
- Fuel trucks for the supply of diesel fuel to all the hydraulic diesel excavators, dozers;
- Low-boy transporter trailer for transportation of dozers, drills, small back hoe and major equipment components;
- Light vehicles for supervisors/technical personnel; and
- Mobile lights for lighting of pits, waste dumps and construction areas.

Both a maintenance and repair contract and a drill and blast contract are planned for in this study. Any necessary equipment required to support these areas will be supplied by the contractor.

16.5.7 Equipment Summary

An annual summary of the open pit fleet requirement is shown in Table 16-8. In terms of equipment replacements, equipment suppliers provided estimates for equipment life, and where information was lacking, industry standards and JDS experience were used. Given the 12-year mine life, it is estimated that limited replacements will be necessary; these include the FELs, track dozers, wheel dozer and graders.

Table 16-8: Annual Mine Equipment Requirements

	Units	Pre-production	Production											
		Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Shovel (22.0 m^3, 6040)	#	1	1	2	2	2	2	2	2	2	2	2	2	2
FEL (21.4 m^3, 994K)	#	1	1	1	1	1	1	1	1	1	1	1	1	1
FEL (11.5 m^3, 992K)	#	0	1	1	1	1	1	1	1	1	1	1	1	0
Haul Truck (181t , 789D)	#	6	13	22	23	23	23	22	18	18	18	15	15	10
Track Dozer (600 hp, D10)	#	1	2	3	3	3	3	3	3	3	3	3	3	2
Track Dozer (436 hp, D9)	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Wheel Dozer (4.6 m, 834K)	#	1	1	2	2	2	2	2	2	2	2	2	2	1
Grader (4.9 m, 16M)	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Grader (7.3 m, 24M)	#	0	1	2	2	2	2	2	2	2	2	2	2	2
Water Truck	#	1	1	2	2	2	2	2	2	2	2	2	2	1
Excavator	#	0	1	1	1	1	1	1	1	1	1	1	1	1
Skid Steer	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Lowboy Tractor&Trailer	#	0	1	1	1	1	1	1	1	1	1	1	1	1
Fuel Truck	#	1	1	2	2	2	2	2	2	2	2	2	2	1
Tire Manipulator	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Passenger Bus	#	1	1	2	2	2	2	2	2	2	2	2	2	1
Light Vehicles	#	16	20	24	24	24	24	24	24	24	24	24	24	16
Portable Light Plants	#	10	10	10	10	10	10	10	10	10	10	10	10	10

Source: JDS (2019)

16.6 Mine Personnel

16.6.1 Basis

The work schedule assumes a 24-hour/day, 7-days/week and 365-days/year mining operation. Operations and maintenance personnel who support the 24-hour operation will work two 12-hour shifts per day. The roster for this group is defined as 4 days / 4 days off – 4 nights / 4 days off – rotating with 4 operating shifts. Production, maintenance and technical services personnel including management will follow the statutory requirements of 40 hours/per week. Normally this will be Monday-Friday days shift however it may be adjusted as per operational requirement to provide coverage during the week.

Grade control technicians and any other roles who have to follow operational schedule will share the same shift rotation as the production crews.

Equipment operator labour requirements are based on the number of equipment units, operating requirements and shift rotations. Maintenance labour requirements are based on the number of equipment units to be maintained, estimates of mechanical availability, and estimates on the ratio of maintenance labour requirements to the number of units for each open pit fleet type.

16.6.2 Personnel Activities

The mining operation will be headed by the mine manager, who will report to the general manager.

Under the direction of the mine superintendent, the mine operations department will be responsible for the mining operation. This includes drilling, blasting, loading, and hauling of ore and waste, waste rock storage facility operations, haul road construction and maintenance, and mine dewatering. Each crew will be led by a mine shift foreman. All drilling and blasting will be done by contactor.

The mine maintenance will be handled under and maintenance and repair contact (MARC).

The engineering department will be led by the chief engineer and will be responsible for providing short, medium and long term mining plans.

The geology department under the chief geologist will be responsible for updating the resource models, calculating ore resources and reserves, and undertake ore grade control.

Annual personnel requirements excluding contractors are summarized in Table 16-9.

Table 16-9: Annual Personnel Requirements

	Units	Pre-production		Production										
		Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
MINE OPERATIONS	#													
Shovel/Loader Operator	#	4	9	12	12	15	12	11	12	12	16	17	15	6
Truck Driver	#	22	54	93	90	92	92	88	65	64	69	58	57	39
Support Operator	#	12	23	38	39	40	39	40	40	40	40	40	40	28
MINE GENERAL	#													
Operations Manager	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Mining Superintendent	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Shift Foreman	#	12	12	12	12	12	12	12	12	12	12	12	12	12
Clerk	#	2	2	2	2	2	2	2	2	2	2	2	2	2
Trainer	#	4	4	4	4	4	4	4	4	4	4	4	4	4
Translator	#	4	4	4	4	4	4	4	4	4	4	4	4	4
TECHNICAL SERVICES	#													
Technical Services Manager	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Mining Engineer	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Mine Engineer	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Engineer 1	#	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Engineer 2	#	2	2	2	2	2	2	2	2	2	2	2	2	2
Chief Geologist	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Geologist	#	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Geologist	#	2	2	2	2	2	2	2	2	2	2	2	2	2
Technician	#	4	4	4	4	4	4	4	4	4	4	4	4	4
Surveyor	#	3	3	3	3	3	3	3	3	3	3	3	3	3
Survey Assistant	#	2	2	2	2	2	2	2	2	2	2	2	2	2

Source: JDS (2019)

17 Process Description / Recovery Methods

17.1 Introduction

The information contained in this report referring to Recovery Methods was derived from the 2017 Amulsar NI 43-101 completed by Samuels Engineering. No new metallurgical testwork had been completed since the 2017 report and no changes have been made to the original flowsheet with the exception a third secondary crusher and ancillary equipment. The majority of the major process equipment has been installed. The mine plan has changed, and the average LOM yearly tonnage has decreased to 10.0 Mtpa compared to 10.4 Mtpa in the 2017 study.

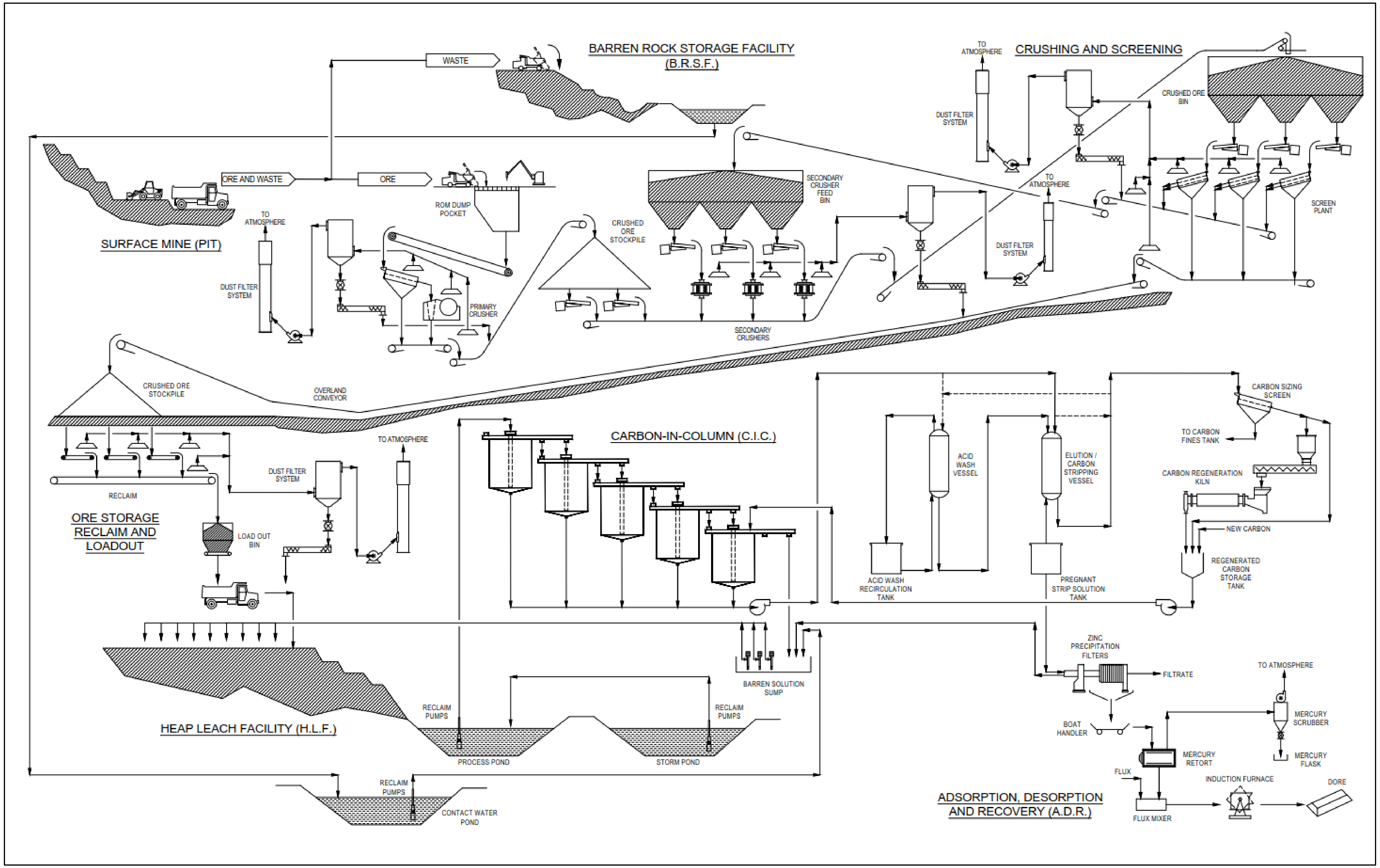
The Amulsar processing facility will receive ROM ore by haul trucks at a nominal rate of 27,400 tpd. The processing facility will consist of a crushing circuit followed by heap leaching of the crushed ore. Barren leach solution will be pumped to the heap and allowed to percolate through the heap before being recovered as pregnant leach solution. Pregnant leach solution is treated in a carbon-in-column (CIC) circuit. Gold will be recovered by an adsorption-desorption-recovery (ADR) circuit where the final product will be doré.

17.2 Block Flow Diagram

The following flow diagram (Figure 17-1) was developed for the value engineering and optimization requirements for the Amulsar process facilities which encompass the following unit operations:

- Primary Crushing;
- Screening Facility;
- Secondary Crushing;
- Overland Conveying;
- Crushed Ore Stockpile and Truck Load-out Facility;
- Heap Leach Facility;
- Carbon Adsorption (Carbon-in-Column, CIC), Desorption and Regeneration;
- Refining;
- Reagents; and
- Utility Facilities.

Figure 17-1: Conceptual Block Flow Diagram



Source: Samuel Engineering (2017)

17.3 Plant Operating Design Criteria

The process operating design criteria are present in Table 17-1.

Table 17-1: Process Operating Design Criteria

Operating Schedule	Unit	Balance	Design
Mine Life	years	12	
Crushing Availability	%	80	
Heap and ADR Availability	%	95	
Crushing Operating Days Per Year	days	365	
Crushing Hours per Day	h	19.2	
Heap and ADR Days Per Year	days	365	
Heap and ADR Hours Per Day	h	22.8	
Ore Characteristics			
Ore % Moisture	%	3%	4%
Ore Specific Gravity		2.41	
Feed Particle Size			
Primary Crusher Feed P80	mm	120	
Secondary Crusher Feed P80	mm	99	
Overland Conveyor Feed P80	mm	18	
Crushing Work Index (LOM Average)	kWh/t	11.3	
Artavasdes	kWh/t	12.5	
Tigranes	kWh/t	6.3	
Erato	kWh/t	13.2	
Abrasion Index (LOM Average)	g	0.2619	
Artavasdes	g	0.1885	
Tigranes	g	0.4347	
Erato	g	0.2618	4%
Production Rates			
Annual (balance)	tpy	10,000,000	
Crushing Daily	tpd	27,400	30,000
Crushing Hourly	tph	1,522	1,563
Heap and ADR Daily	tpd	27,400	30,000
Heap and ADR Hourly	tph	1,124	1,188
Gold			
Grade (LOM Average 2019 Gold Model)	gpt	0.74	
Recovery (LOM Average)	%	87.1	
Artavasdes	%	87.1	
Tigranes	%	87.1	
Erato	%	87.5	

Operating Schedule	Unit	Balance	Design
Silver			
Grade (LOM Average 2019 Gold Model)	gpt	3.76	
Recovery (LOM Average)	%	14.6	

Source: Samuel Engineering (2017), Production Rates updated by JDS (2019)

17.4 Process Description

The Amulsar processing facility will receive ROM ore by haul trucks at an average LOM nominal rate of 10 Mtpa or 27,400 tpd. Ore is processed through two stages of crushing to a target crush size P_{94} 19 mm. The crusher unit operations include a primary jaw crusher, and a secondary screening and crushing system. The crushed ore storage bin, secondary crushing feed bin, and crushed ore stockpile provides crushing surge capacity for the facility. The ore is fed from the screening plant to an overland conveyor to the fine ore stockpile and truck loadout bin. From there, crushed ore will be transported via trucks to the leach pad for heap leaching. Pregnant leach solution (PLS) from the heap will be treated in a CIC circuit. Gold will be recovered by an adsorption-desorption-recovery (ADR) circuit where the final product will be doré.

17.4.1 Primary Crushing

Run-of-mine (ROM) ore is transported to the primary crushing area by haul truck and dumped directly into a dump hopper with 600 t live capacity or to a 540,000 t ROM stockpile which provides surge between mining and crushing operations. A rock breaker will be available to service the crusher dump hopper when there are oversized rocks.

ROM from the dump hopper is removed via an apron feeder and feeds a vibrating grizzly feeder in which oversized material feeds the jaw crusher and undersize material falls to the jaw crusher discharge conveyor. The primary crusher reduces the ROM ore to a nominal P_{80} 91 mm. Crushed ore drops to the crusher discharge conveyor, joining the grizzly undersize material. The crusher discharge conveyor transfers the crushed ore via the crushed ore stockpile to the crushed ore bin feed conveyor that feeds the crushed ore bin.

The primary crushing area is equipped with a crane for maintenance and also a dust collection system to minimize dust at all transfer points.

17.4.2 Screening Area

The crushed ore storage bin will provide 1,600 t of live storage. Ore is reclaimed from the bin via three belt feeders, each discharging onto a vibrating triple deck multi slope screen. Screen undersize, at P_{85} 18 mm falls to the product conveyor for transfer to overland conveying. Screen oversize reports to the secondary crushing circuit feed conveyor. A crushed ore sampler at the transfer point between the product conveyor and the overland conveyor will periodically sample the product stream for analysis and metallurgical accounting.

The screening area is equipped with a crane for maintenance and a dedicated dust collection system to minimize dust at all transfer points.

17.4.3 Secondary Crushing

The secondary crushing system is a parallel circuit utilizing three cone crushers producing a product material of approximately P_{85} 18 mm. The crushed product combines with the primary crushing circuit project to feed the screening circuit.

Dust in the area is controlled using the primary crushing dust control system.

17.4.4 Overland Conveying

Screen undersize is sampled by the crushed ore sampler and transferred to the overland conveyor. The overland conveyor transports the crushed ore approximately 5.3 km down slope (700 m elevation drop) to the crushed ore stockpile. The overland conveyor will have a regenerative drive system that will provide approximately 3 MW of power back into the electrical system. Estimated power consumption in the crushing circuit is around 3MWhr which is provided from the recovered power generated from the overland conveyor.

17.4.5 Stockpile Reclaim and Truck Loadout

The ore stored at the crushed ore stockpile, with live capacity of 5,000 t, will be reclaimed by three pan feeders underneath the stockpile which transfer the ore to the loadout bin feed conveyor. Pebble lime is added to the crushed ore as it is conveyed to the loadout bin by a screw feeder from 200 tonne capacity lime silo. Lime will be metered to ensure proper pH control for heap operation.

The loadout bin feed conveyor transfers the crushed product with lime to the 100 tonne loadout bin. A full bin will stop the pan feeders and the loadout feed conveyor. The loadout bin is sized to hold a volume of ore to fill three truck loads. Ore from the loadout bin is dumped into the heap haul truck via clam shell gates. The crushed ore will then be hauled by trucks to the HLP for stacking and leaching.

17.4.6 Heap Leach Stacking

A local contractor will be used to haul the crushed ore from the loadout bin to the leach pad utilizing 30 tonne haul trucks. A dozer will be utilized to maintain the tip head and to rip the leach pad surface prior to irrigation. The number of trucks required for the initial Phase 1 leach pad has been estimated at 13 (assuming 75% availability). The number of trucks required will vary over the life of the operations as the heap height increases (increasing cycle times) and as additional phases come on line (decreasing haul distances).

17.4.7 Heap Leach Facility

The heap leach process consists of stacking crushed ore on the leach pad in lifts and leaching each individual lift to extract the gold and silver. Barren Leach Solution (BLS) containing dilute sodium cyanide will be applied to the ore heap surface using a combination of drip emitters and sprinklers at a design application rate of 6 L/hr/m^2. The design leaching cycle of the ore heap is 60 days.

The solution will percolate through the ore to the drainage system above the pad liner, where it will be collected in a network of perforated drain pipes embedded within a 0.6 m minimum thickness granular cover drain fill layer above the liner. The solution will gravity flow to the process pond. PLS collected in the process pond will be pumped to the process plant to extract the gold and silver.

Leach Pad

The HLF is located at Site 28. The terrain is valley-shaped and undulating in some areas, with the valley generally sloping downward to the southwest. The pre-development site grades range from 4% to 6% in the valley bottoms to 55% on the upper valley sides. The design includes site grading fill placed in the valley bottom in the Phase 1 leach pad downgradient toe area to establish a toe bench with a 1% downhill gradient to facilitate ore heap stability

The leach pad will be constructed in five phases with approximate areas of 395,100 m^2, 174,050 m^2, 215,550 m^2, 406,300 m^2 and 157,900 m^2 for Phases 1 through 5, respectively, with a total Phases 1-5 pad area will be approximately 1,348,900 m^2.

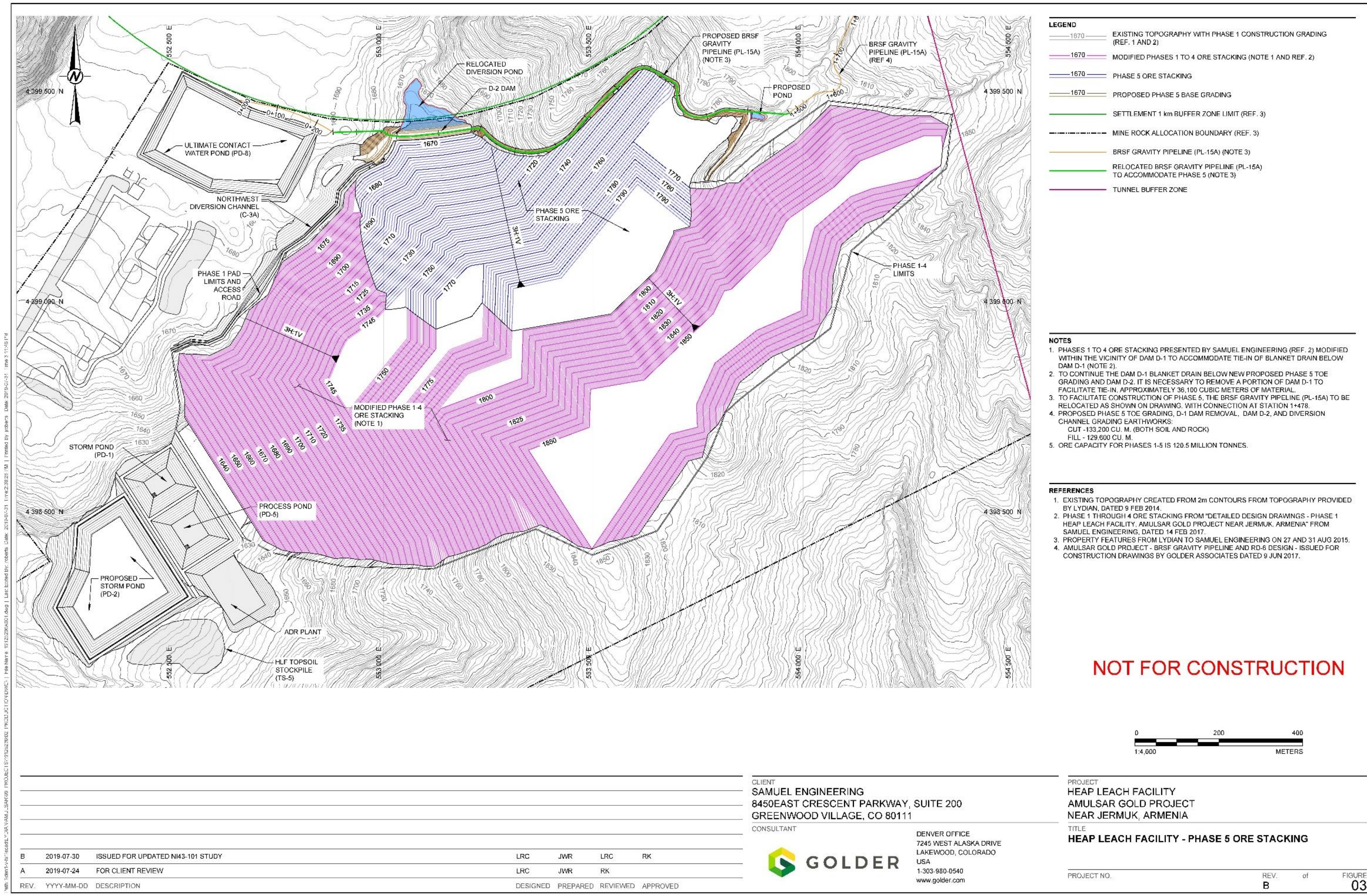
The leach pad will have a composite liner system consisting of a LLDPE geomembrane underlain by a 0.3 m minimum thickness compacted low-permeability soil liner, or geosynthetic clay liner (GCL) in areas steeper than 2.5H:1V. The geomembrane will be 1.5-mm (60-mil) thick in the pad areas where the ultimate ore heap height is 60 m or less, and 2-mm (80-mil) thick elsewhere. The geomembrane will be single-side textured with texturing at bottom (in contact with the soil liner layer or the GCL) in the stability-critical area at the pad's southwestern edge, and in the toe region of Phase 5, and smooth elsewhere.

A drain pipe network will be constructed above the pad liner and will be embedded within a 0.6 m minimum thickness liner cover drain fill layer, which will consist of free-draining, hard, and durable granular material. Solution and storm/snowmelt runoff and infiltration flows collected by the drain pipe network will gravity-drain to the process pond.

A stock-proof mesh fence with locking gates will be constructed around the perimeter of the leach pad to prevent wildlife from reaching the pad. An additional purpose of the fence is for public safety and to deter unauthorized access into the pad area.

Figure 17-2 shows the planned Phase 1 to 5 leach pad and ore heap plan.

Figure 17-2: Planned Phase 1 to 5 Leach Pad and Ore Heap Plan



Source: Golder Associates (2019)

Ore Heap

The fully stacked Phases 1-5 leach pad will have a nominal capacity of 120 Mt of ore heap to be stacked in 12 years at a stacking rate of 10.0 Mtpa. The ore heap on the leach pad is planned to be stacked in 8 m thick, horizontal lifts in five stages to a nominal maximum heap height of 120 m above the pad liner.

The Phase 1 pad will accommodate the Stage 1 heap of approximately 9.3 Mt, which will constitute the first four heap lifts to a nominal top surface elevation of 1,664 m and will be stacked during the first year of operations.

The Phase 2 pad expands the pad uphill to the east, providing for the stacking of the Stage 2 heap with six additional horizontal lifts above the Stage 1 heap level to a nominal top surface elevation of 1,712 m. The Stage 2 heap will add 20.7 Mt, which is projected to be stacked through the end of Year 3 of operations.

The Phase 3 pad expands the pad further uphill to the east, providing for the stacking of the Stage 3 heap with seven additional lifts above the Stages 1-2 heap level to a nominal top surface elevation of 1,768 m. The Stage 3 heap will add 31.4 Mt, which is projected to be stacked through the end of Year 6 of operations.

The Phase 4 pad expands the pad further uphill to the east, providing for the stacking of the Stage 4 heap with 10 additional lifts above the Stages 1-3 heap level to a nominal top surface elevation of 1,850 m. Stacking of the Stage 4 heap will continue till the end of Year 10 of operations and will provide an additional 42.7 Mt.

The Phase 5 pad expands up the valley beyond Dam D-1 to the east and north of the ridge defining the northern limits of Phase 2-3, providing for additional stacking of the Stage 5 heap to an elevation of 1,790 m. Stacking of the Stage 5 heap will continue to Year 12 and will provide a total ore heap capacity on the Phases 1-5 pad of 120 Mt (excluding haulage and conveyor bench setback considerations).

Collection Ponds

The HLF collection ponds will include the process pond (PD-5), Storm Pond 1 (PD-2), and Storm Pond 2 (PD-2). The collection ponds were sized in accordance with the Project design criteria using the results of the HLF water balance calculations. The process pond and Storm Pond 1 will be constructed during Phase 1 pad construction, with Storm Pond 2 constructed during Phase 3 pad construction.

Process solution and storm/snowmelt water flows within the leach pad will gravity-drain to the pad's lowest point and through a spillway to the process pond. A cascading spillway system will be constructed between the process pond, Storm Pond 1 and Storm Pond 2 for potential solution and storm/snowmelt runoff during pad operations. The storm ponds will be configured to cascade downgradient starting with Storm Pond 1.

The process pond is designed to contain:

1. 8 hours of solution during normal operational flow;
2. 24 hours of solution of emergency draindown flow from the ore heap in case of operational shutdown due to pump failure or power loss;
3. The maximum cumulative excess water volume predicted for the Phase 1 pad under typical wet year climatic conditions; and
4. The maximum cumulative excess water volume predicted for Phases 1-2 pad under average year climatic conditions.

Storm Pond 1 is designed to contain:

1. The maximum cumulative excess water volume predicted for Phases 1-2 pad under typical wet year climatic conditions, less the excess water volume that can be stored in the process pond; and
2. The maximum cumulative excess water volume predicted for Phases 1-4 pad under average year climatic conditions, less the excess water volume that can be stored in the process pond.

Storm Pond 2 is designed to contain the maximum cumulative excess water volume predicted for Phases 1-5 pad under typical wet year climatic conditions, less the sum of the excess water volume that can be stored in the process pond and Storm Pond 1, plus an additional 20% capacity as required by the Amulsar Project Environmental Design Criteria.

Standby pumps and an independent backup power supply system will be provided at the storm ponds to evacuate the ponds during large storms and power outages, if needed to prevent pond overflow into the natural drainage.

The process pond will have a composite double-geomembrane liner system comprised of top (primary) and bottom (secondary) geomembranes, with an intermediate LCRS layer, and underlain by a 0.3 m minimum thickness compacted low-permeability soil liner layer. The bottom geomembrane will be 1.5-mm (60-mil) smooth LLDPE, and the top geomembrane will be 2-mm (80-mil) single-side textured HDPE with texturing at top for traction. The LCRS between the two geomembranes will be a transmissive geocomposite (drainage net) that is connected to the pond's LCRS sump. The geocomposite will be 5-mm (200-mil) geonet heat-laminated on both sides with 270-g/m² (8-oz/yd²) nonwoven geotextiles. Should a leak ever occur through the top geomembrane, it would flow through the geocomposite to the LCRS sump, where it would be removed via a pump. The design intent of the LCRS is to ensure that no hydraulic head occurs on the bottom geomembrane, thereby removing any driving force required for seepage to occur through that geomembrane.

Storm Pond 1 will initially have a single-geomembrane composite liner system consisting of 2-mm (80-mil) single-side textured HDPE geomembrane with texturing at top for traction, underlain by a 0.3-m minimum thickness compacted low-permeability soil liner layer. The pond will be double-geomembrane-lined and a LCRS geocomposite added between the geomembranes during Phase 3 pad construction. The added top geomembrane will be 2-mm (80-mil) single-side textured HDPE with texturing at top for traction, and the geocomposite will be 5-mm (200-mil) geonet heat-laminated on both sides with 270 g/m² (8-oz/yd2) nonwoven geotextiles.

Storm Pond 2 will have a single-geomembrane composite liner system consisting of 2-mm (80-mil) single-side textured HDPE geomembrane with texturing at top for traction, underlain by a 0.3-m minimum thickness compacted low-permeability soil liner layer.

A stock-proof mesh fence with locking gates will be constructed around the perimeter of the collection ponds to prevent wildlife from reaching the fluids in the ponds. An additional purpose of the fence is for public safety and to deter unauthorized access into the collection ponds area.

Drainage Control

Diversion embankments and channels will be constructed around the perimeter and upgradient of the HLF to divert storm and snowmelt runoff from upstream catchments away from the pad and collection ponds. The leach pad will have perimeter berms to prevent applied solution and rainfall/snowmelt water within the pad from overflowing the pad.

Underdrains will be constructed at the locations of existing drainages and seeps within the leach pad and collection pond footprints to drain groundwater/subsurface seepage to downgradient of the ponds. The underdrains will discharge into a collection sump, where the discharge water quality will be monitored as required.

As part of the Phase 5 development, Dam D-1 will be abandoned, and a new stormwater dam, D-2 constructed further upslope in the same drainage to the limits of the 1 km Settlement Buffer zone limit. As part of the development a portion of the upstream slope of Dam D-1 will be removed to accomplish a connection of the dam blanket drain and to tie-in to the underdrain system which will be extended into the Phase 5 pad.

BRSF Pipeline Relocation in Phase 5

The planned BRSF Pipeline (PL-15) that will be constructed as part of initial construction is designed to be located at the northern perimeter of Phases 1-4 and is routed towards the PD-8 contact water pond. As part of Phase 5 construction, the pipeline will require relocation outside of the Phase 5 footprint, along the northern extent of Phase 5.

Environmental Protection Measures

As part of the International Cyanide Management Code requirements, environmental monitoring and protection features will be incorporated in the HLF construction to minimize potential impacts on the surrounding environment, wildlife, surface water and groundwater. These features, as discussed above, will include the following:

- Diversion systems to divert storm and snowmelt runoff from upstream catchments away from the leach pad and collection ponds;
- Underdrains beneath the leach pad and collection pond footprints to drain groundwater/subsurface seepage to a collection sump located downgradient of the ponds, where the underdrain discharge water quality will be monitored as required;
- A composite liner system for the pad consisting of a geomembrane underlain by a compacted low-permeability soil liner layer or GCL;
- Process solution and storm/snowmelt water collection and drainage system above the pad composite liner consisting of a network of drain pipes within a free-draining granular fill layer designed to enhance fluids collection and maintain a low hydraulic head on the liner;
- Placement of wear sheets beneath the large-diameter drain pipes within the pad to reduce the potential for wear and damage to the pad geomembrane liner from pipe movement;
- A toe berm with a minimum height of 1.5 m, and perimeter berms with a minimum height of 1 m around the pad phases, for solution and storm/snowmelt water containment;
- A 4 m minimum setback between the crests of the pad toe berm, perimeter berms and phase berms and the ore heap toes to reduce the risk of solution release due to upset conditions during operations;
- Stock-proof fencing around the pad to prevent access;
- A process pond with sufficient capacity to contain the required solution normal operational flow and emergency draindown flow from the ore heap;
- Storm ponds with sufficient capacity to contain the storm/snowmelt flows from the HLF areas;

- A composite double-geomembrane liner system for the process pond comprised of a top (primary) geomembrane and a bottom (secondary) geomembrane, with an intermediate LCRS layer. The bottom geomembrane will be underlain by a compacted low-permeability soil liner;
- An initial composite single-geomembrane liner system for Storm Pond 1 consisting of a geomembrane underlain by a compacted low-permeability soil liner. This storm pond will be double-geomembrane-lined and an intermediate LCRS layer added to its liner system during Phase 3 pad construction to contain potential process solution overflow from the process pond during Phases 3-5 pad operations;
- A composite single-geomembrane liner system for Storm Pond 2 consisting of a geomembrane underlain by a compacted low-permeability soil liner;
- Placement of wear sheets above the geomembrane liners of the collection ponds, underneath pipes and in the corner sump areas, for geomembrane protection from pipe movement and pumping operations;
- Standby pumps and an independent backup power supply system at the storm ponds to evacuate the ponds during large storms and power outages, if needed to prevent pond overflow into the natural drainage;
- Stock-proof fencing around the collection ponds to prevent access;
- Birdballs have been specified for pond cover, rather than netting. Sufficient birdballs to be ordered to cover pond surface at maximum operational capacity.
- Bangers and rotating mirrors (eagle eye bird control) will be installed around the perimeter of the ponds to divert birds; and
- Monitoring wells around the HLF for monitoring groundwater quality.

Monitoring wells will be installed around the HLF to monitor the groundwater quality during operations and after closure. The number of wells and their locations and depths will be determined, and the wells installed prior to HLF construction so that baseline data can be compiled. A groundwater quality and environmental monitoring program has been developed for the facility.

17.4.8 Adsorption, Desorption, Recovery

The process plant consists of an Adsorption, Desorption, Recovery (ADR) plant, refining, and reagent makeup and delivery systems. The ADR plant will be located to the southeast of the HLF collection ponds, and the plant area is lined to contain spills and any overflow from the plant will be routed to the process pond.

The plant extracts precious metals from the pregnant leach solution (PLS) onto activated carbon. The ADR circuit adorbs metals from the PLS in carbon columns and moves the carbon from the columns into strip vessel where the metal is eluted into solution at higher tenors. This new PLS is treated with zinc which causes gold and silver to precipitate from solution. Once the precious metals are precipitated, the solution is filtered and the cake is dried, mixed with flux and smelted to produce doré bars. The doré bars are then shipped to a refinery for further refining. The ADR circuit also regenerates the carbon through acid washing and a regeneration kiln to maintain the carbon’s ability to adsorb metals in the carbon columns. Once regenerated the carbon is returned as fresh carbon to the carbon columns.

Carbon Adsorption

PLS is pumped from the process pond to the adsorption feed head tank. From there, the PLS discharges to a single train of 5 carbon adsorption columns. These columns are used to adsorb the metals from the solution. The PLS enters carbon column 1, flows through the Carbon-in-column (CIC) circuit, finally discharging from carbon column 5 over a carbon safety screen to the barren solution tank.

The carbon columns are stepped down to allow solution to flow by gravity from one column to the next. Because the pregnant solution is anticipated to come in at various flowrates, either due to altering process condition or due to weather events, the carbon columns will be flared to allow for different flowrates while maintaining up flow rates to keep carbon bed expansion at approximately 70% by volume.

Carbon is advanced counter-current, upstream, through the columns using a recessed impeller pump. Loaded carbon from column 1 is pumped to either the elution column for desorption, or to the acid wash column. Fresh or reactivated coconut carbon is added to the last column (number 5) in the CIC circuit. Each column has the capacity for 4 t of carbon.

In line samplers are installed on the PLS line prior to addition to the CIC circuit, and also on the barren solution exiting the CIC train.

Desorption

Metals are desorbed from the carbon using the Anglo-American Research Laboratories (AARL) method. The elution column is designed to hold 4 t of carbon and run two batches per day. A strip solution, containing 3% NaCN and 2% NaOH, is pumped from the strip solution tank at 115 °C to the elution vessel and soaked for approximately 30 minutes. Six bed volumes of water, at approximately 115°C, is then pumped through the pressurized elution vessel to produce the pregnant eluent. One cool rinse is pumped through the carbon at the same two bed volumes per hour rate before the carbon is transferred to the next stage in the process. The next stage could be either carbon regeneration at the regeneration kiln, acid wash, or returned directly to the fifth carbon column for adsorption.

Pregnant solution from the elution column flows through heat exchangers where heat is recovered and used to preheat the incoming elution stream. The eluted solution is collected in the pregnant strip solution tank.

Acid Wash

In the AARL process, elution is proceeded by acid washing the carbon. The acid will remove inorganic contaminants, such as calcium, from the carbon surface. Loaded carbon is pumped from the CIC circuit to the acid wash tank which has a carbon capacity of 4 t. A dilute nitric acid solution is circulated though the carbon bed for a period of one to two hours.

Upon completion of the acid wash, the carbon is rinsed to ensure that acids and chlorides do not enter the strip circuit. Neutralization is achieved through in-line injection using a dilute caustic solution comprised of roughly 2% to 5% NaOH. Once the cycle is complete, carbon is pumped to either the elution column, carbon dewatering screen, or regeneration feed dewatering screen.

The acid wash area is equipped with a dedicated sump pump which returns solutions to the carbon safety screen and on to the barren solution tank.

Carbon Reactivation

When reactivation is required, stripped carbon is pumped over the regeneration feed dewatering screen to remove water and fine carbon which is generated during the AARL process. The screen undersize (the transfer solution and fine carbon) flow to the carbon fines tank. The oversize (larger than 12 mesh) is collected in a 4 t bin.

A screw feeder meters the carbon into a rotating reactivation kiln. Organic fouling is removed from the carbon surfaces in a reducing atmosphere with high temperature steam at temperatures between 550°C and 700°C. The kiln discharge is sealed under water by a seal pot to prevent oxygen from entering the system. Carbon discharging the kiln is quenched in the carbon quench tank and pumped to a carbon dewatering screen to remove carbon finer than 12 mesh. Fine carbon particulates report to the carbon fines tank. Reactivated carbon is returned to the process or stored in the carbon dewatering tank.

Carbon Handling

Fresh carbon is attrited prior to use in the adsorption circuit. The carbon is placed into the carbon attrition tank with process solution and mechanically agitated for 20 to 30 minutes. This process breaks off any easily removable platelets or sharp corners which would otherwise collect in the adsorption columns. Fines generated in this step can amount to 3% to 5% of the initial carbon weight.

The attrited carbon is pumped over the carbon dewatering screen to remove the fines prior to storage in the reactivated carbon dewatering tank. Fine carbon and transfer solution report to carbon fines tank.

The carbon slurry in the fine carbon storage tank is removed and packaged in bulk bags for off-site shipment and treatment.

17.4.9 Refinery

Smelting operations are performed in a secure refinery. Access to the refinery is limited to specific personnel, controlled by electronic and physical barriers, and is actively monitored.

The pregnant strip tank is designed for a capacity of 3 days or 6 elution cycle of pregnant eluate solution. Pregnant strip solution is pumped from the pregnant strip solution tank to the precipitation filters. Zinc powder is added to the solution after the filter feed pump and before the in-line zinc mixer. The precipitation of gold and silver is rapid and will have occurred before the solution reaches the precipitation filter. The pregnant strip solution is pumped through two plate and frame precipitation filters. Filtrate flows to the filtrate holding tank and eventually recycled to the barren solution tank.

The filter cake is collected into retort pans and transferred by cart to the mercury retort area. The mercury retort system is installed to capture any trace mercury that may be present during the life of the mine. This retort package, designed by the supplier, recovers mercury from the cake by gradually heating the cake to temperatures between 600°C and 700°C. The retort collects the mercury fumes in a distillation process and condenses them into a collection flask.

Dry cake removed from the mercury retort is fluxed and smelted into doré bars using a direct fired furnace. Off-gases are captured in a baghouse dust collection system where precious metal dust is captured and returned to the system. The slag produced from smelting is crushed and screened to recover any metal prill that may have become entrained with the slag. This prill is then collected and saved for the next pour. The crushed slag is stored in the slag bin before shipping to off-site smelter. The doré is packaged and stored in a safe for off-site shipment.

17.4.10 Reagent Handling

Sodium Cyanide

Sodium cyanide will be applied to the heap at 250 milligrams per liter as the leaching agent for extraction of both gold and silver from the ore. The sodium cyanide delivery, storage, mix and handling systems were designed utilizing The International Cyanide Management Code. The cyanide mixing system and storage tank will be placed in containment of at least 110% of the volume of the largest vessel within that containment area. Hydrogen cyanide detection systems and appropriate ventilation will be in place so that any leakage is detected and ventilated to mitigate risk to operators. A reagent make-up system is required for the production of liquid sodium cyanide (NaCN). NaCN is delivered to site as a solid in bulk bags contained in boxes or in 18 tonne ISO containers. The NaCN is dissolved in raw water in the NaCN mix tank to obtain a liquid reagent concentration of 20% by weight. The NaCN solution transfer pump recirculates the solution through the NaCN briquettes and the NaCN solution storage tank. Metering pumps supply NaCN solution from the storage tank to the strip solution tank, the barren solution tank, and the barren solution pumps. The standby reagent system is equipped with a hoist for handing of the bulk bags.

Sodium Hydroxide

Sodium hydroxide is used as pH control for the carbon elution circuit and trim for pH control of barren solution. A reagent make-up system is also required for the production of liquid sodium hydroxide (NaOH). NaOH arrives on site in solid briquettes stored in bulk bags. The briquettes are dissolved in raw water to create liquid NaOH at roughly 25% by weight. The NaOH transfer pump recirculates the solution through the mix tank as well as a heat exchanger to remove heat produced in the mixing process. The transfer pump also supplies NaOH to the barren solution tank, the strip solution tank, and the acid mix tank. The reagent system is equipped with a hoist for handing of the bulk bags.

Nitric Acid

Nitric acid is used for acid wash for the carbon during the processing of loaded carbon through ADR circuit. After use the acid is neutralized using sodium hydroxide. The acid is supplied on site in 240 kg drums and is contained within the acid wash area. The acid will be diluted to roughly 3% in the acid mix tank.

Antiscalant

Three separate metering pumps deliver antiscalant directly from totes to the strip solution pumps, the barren solution pumps, and the pregnant solution pumps.

Diatomaceous Earth

Diatomaceous earth is use as a filter pre-coat to facilitate filtration of the gold precipitate from the Zinc precipitation circuit. It also helps to prevent the filter cake from sticking to the filters during the cake removal process. Diatomaceous earth is transferred by hand into the agitated diatomaceous earth mix tank where it is combined with raw water. The mix is then pumped by the diatomaceous earth transfer pump for use in the plate and frame precipitation filters.

17.5 Gold Model

17.5.1 Introduction

The supporting metallurgical data for ultimate gold recovery for the three ore types was presented in Section 13. An ultimate gold recovery of 87.1% was used in the gold model. The gold model is developed from a combination of metallurgical testing data, mine production schedule, heap leach stacking plan, and the leaching plan for the application of barren solution to the heaps.

17.5.2 General Methodology

Along with the life of mine production schedule, a life of mine heap leach stacking schedule has been generated. This details the tonnages, grades, and the associated contained and recoverable gold over the life of the mine. The steps to generate the gold production model were:

- Tracking of ore stacking on the HLP, contained gold, and ultimate recoverable gold on a monthly basis for the first year, quarterly Years 2 to 4, and yearly thereafter; and
- Based on the operational equation,

$$\% \, Au\, extracted = MP * a * ln(months\, leached) + b$$

  - Where a = 0.1144
    b = 0.5709
    MP (Rate Enhancement Factor) = 1.0

  the percentage of the ultimate gold recovery at that point in time was determined; and
- All of the in-process inventory will only be recovered after all mining and additions to the HLP have ceased. At that time leaching and the process plant will continue to recover the in-process inventory.

17.5.3 Gold Leaching and Processing: Description and Timing

The heap leach process consists of stacking crushed ore on the leach pad in lifts and leaching each individual lift to extract the gold and silver. Barren Leach Solution (BLS) containing dilute sodium cyanide at a concentration of 250 ppm or 0.10 kg/t will be applied to the ore heap surface using drip emitters and sprinklers at a design application rate of 6 L/hr/m^2. The design leaching cycle of the ore heap is 60 days.

The solution will percolate through the ore to the drainage system above the pad liner, where it will be collected in a network of perforated drain pipes embedded within a granular cover drain fill layer above the liner. The solution will gravity-flow to the process pond. PLS collected in the process pond will be pumped to the ADR plant for processing to extract the gold and silver. The ADR plant will be located to the southeast of the process pond. The ADR plant will be lined to contain spills and any overflow from the plant will be routed to the process pond.

The leach pad will not be divided into separate cells, as requested by Lydian. The primary drain pipes from the entire pad meeting at the lowest point of the pad (southwest edge) will connect to transfer pipes, which will route flows from the pad through a spillway to the process pond.

Table 17-2 provides details of the gold production model.

Table 17-2: Gold Production Model

ecovery ===>	Year -2												Year -1												Year 1												Year 2				Year 3				Year 4											
overy ===>	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Time Period Mined Below																																																								
Year -2	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year -1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.65	0.70	0.73	0.76	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.82	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.78	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Year 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87	0.87	0.87	0.87	0.87
Year 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87	0.87	0.87	0.87
Year 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87	0.87	0.87
Year 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87	0.87
Year 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87	0.87
Year 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.87

	Unit	Life of Mine Total							1												2				3				4				5	6	7	8	9	10	11	12
			M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Y	Y	Y	Y	Y	Y	Y	Y
						Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec																						
MINING																																								
PRODUCTION																																								
Ore Mined	ktonnes	119,303	35	9	24	142	537	688	558	537	824	803	727	732	724	982	821	1,012	908	924	3,038	2,774	2,175	1,510	2,215	3,701	3,825	4,427	2,277	2,731	3,233	2,598	12,019	14,507	9,427	9,886	6,231	4,792	7,743	9,205
Au Grade	g/t	0.74	0.72	0.26	0.33	2.95	1.08	0.75	0.91	0.66	0.98	0.82	0.81	0.63	0.61	0.77	1.27	1.73	1.27	0.54	0.62	0.75	0.71	1.14	0.80	0.71	0.73	0.86	0.57	0.44	0.59	0.62	0.80	0.82	0.52	0.72	0.73	0.57	0.67	0.79
Contained Au	troy koz	2,828	1	0	0	13	19	17	16	11	26	21	19	15	14	24	33	56	37	16	61	67	50	55	57	84	90	123	42	39	62	52	308	382	157	227	146	87	167	233
Ag Grade	g/t	3.8	5.14	0.41	2.20	2.14	1.78	1.50	2.12	1.45	1.79	2.00	1.42	1.83	2.06	1.73	2.86	7.11	2.61	4.35	5.74	6.82	3.76	3.44	3.21	3.61	4.19	4.93	3.30	3.74	4.65	3.28	4.43	6.74	3.20	2.28	2.18	2.18	2.41	2.64
Contained Ag	troy koz	14,435	6	0	2	10	31	33	38	25	47	52	33	43	48	55	76	232	76	129	561	609	263	167	229	429	516	701	241	328	484	274	1,711	3,142	970	725	436	335	599	780
Waste Mined	ktonnes	243,593	266	292	426	456	364	392	701	752	827	848	922	917	926	818	980	937	668	651	3,880	5,416	6,016	5,314	5,155	5,398	5,277	2,852	5,003	6,370	5,867	4,682	19,006	16,517	21,598	22,236	27,713	29,153	26,204	7,797
Strip Ratio	w:o	2.0	7.6	32.1	17.5	3.2	0.7	0.6	1.3	1.4	1.0	1.1	1.3	1.3	1.3	0.8	1.2	0.9	0.7	0.7	1.3	2.0	2.8	3.5	2.3	1.5	1.4	0.6	2.2	2.3	1.8	1.8	1.6	1.1	2.3	2.2	4.4	6.1	3.4	0.8
Total Mined	ktonnes	362,895	301	301	450	599	901	1,080	1,260	1,289	1,650	1,651	1,649	1,649	1,650	1,800	1,801	1,949	1,576	1,575	6,917	8,190	8,190	6,824	7,371	9,099	9,102	7,279	7,279	9,101	9,100	7,281	31,025	31,024	31,025	32,121	33,943	33,945	33,946	17,002
SAG_W	ktonnes	46,470	0	2	5	7	0	0	15	27	25	95	103	56	46	77	187	263	115	8	167	685	746	759	1,049	1,450	1,725	421	0	0	79	38	2,302	798	4,958	6,167	6,691	8,529	7,829	817
MAG_W	ktonnes	53,070	42	22	124	109	112	115	339	159	156	121	264	198	422	365	245	230	73	9	892	1,548	1,662	1,152	934	1,046	905	349	129	119	713	826	3,076	1,538	5,465	2,872	9,839	7,590	8,536	558
NAG_W	ktonnes	144,052	224	267	298	341	252	277	348	567	646	631	555	663	458	377	547	444	480	635	2,821	3,182	3,608	3,403	3,173	2,902	2,646	2,082	4,873	6,251	5,075	3,818	13,628	14,180	11,174	13,196	11,183	13,034	9,839	6,422
Mining Rate	(tpd)		10,000	10,000	15,000	20,000	30,000	36,000	42,000	43,000	55,000	55,000	55,000	55,000	55,000	60,000	60,000	65,000	52,500	52,500	76,000	90,000	90,000	75,000	81,000	100,000	100,000	80,000	80,000	100,000	100,000	80,000	85,000	85,000	85,000	88,000	93,000	93,000	93,000	46,600

	Year 1												Year 2				Year 3				Year 4												
	1	2	3	4	5	6	7	8	9	10	11	12	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Cummulative Tonnes under Leached	410,000	1,158,946	2,008,740	2,933,740	3,941,740	4,949,740	5,941,755	6,773,177	7,606,177	8,439,177	9,272,177	10,104,719	12,603,062	15,103,062	17,603,062	20,103,062	22,601,247	25,099,625	27,598,373	30,097,159	32,597,159	35,097,159	37,597,287	40,097,287	50,097,287	60,097,056	70,095,939	80,095,939	90,095,939	100,095,939	110,095,939	119,302,637	119,302,637
Cummulative Contained Au Oz under Leach	14,996	34,467	67,247	96,073	123,741	147,359	169,706	192,793	226,297	280,996	317,480	332,785	389,148	453,916	506,330	569,611	629,062	703,170	781,964	885,118	931,945	971,491	1,027,243	1,078,218	1,370,726	1,713,091	1,878,327	2,106,501	2,281,851	2,410,068	2,594,807	2,827,612	2,827,612
Ultimate Rec Au Oz by Period	8,561	12,305	20,954	20,453	20,625	18,903	18,370	18,951	25,157	38,323	30,312	18,310	48,178	56,414	49,591	57,433	55,261	64,595	68,541	86,229	49,237	40,898	49,485	49,223	262,965	297,411	146,724	197,743	153,566	112,423	160,012	202,013	3,685
	8,561	20,866	41,820	62,273	82,898	101,802	120,172	139,122	164,279	202,602	232,914	251,224	299,402	355,816	405,407	462,840	518,101	582,695	651,236	737,465	786,702	827,600	877,085	926,307	1,189,273	1,486,684	1,633,408	1,831,151	1,984,717	2,097,140	2,257,153	2,459,166	2,462,850

Source: Samuel Engineering (2019)

18 Project Infrastructure and Services

18.1 Introduction

There is reasonably modern infrastructure surrounding the Amulsar Project. This includes an asphalt highway which runs from the main sealed highway between Yerevan to the most southern town of Meghri, high voltage power lines and substations, a gas pipeline, year-round water from the Vorotan, Arpa and Darb Rivers, and a fiber optic internet cable.

Because the Project construction was already underway prior to the suspension of work, the infrastructure installation has commenced and is in the intermediate stages of construction. The site has established road access to all construction areas, a power line and substation for connection to local power grid, an on-site camp, security facilities, and significant amount of site construction.

18.2 Existing Infrastructure and Services

18.2.1 Infrastructure Development Completed

The following items have already been completed construction at site:

- Guard station / gate;
- RD-13, RD-4, PL-5, RD-8 Guard stations;
- On-site roads
- Amulsar Camp with Kitchen and Dining Hall;
- Medical Clinic at the Camp;
- Lower Site Warehouse and Storage Yard; and
- Temporary Construction Offices.

18.2.2 Facilities Still to Complete Installation

The Project will require the completion of the facilities as described in Table 18-1:

Table 18-1: Facilities to Complete

Description	Status	Comments
Open pit and mining operation areas	Construction initiated	Need to construct the Tigranis haul roa, , develop the initial Tigranis bench, and then perform initial pit development work
Mine haul road RD3	Construction underway with some completed section	Owner's mining fleet to complete construction linking pits to crusher and ROM storage area
BRSF	Construction initiated	PD7-T has been excavated, and the underdrains installed, and embankments constructed. The liner prep and installation, and ancillary items still to be completed. The main BRSF area is still to be cleared and constructed.

Description	Status	Comments
Low-grade, high-grade ore stockpiles, and ROM storage pad	Not started	Some of the areas for the ore stockpiles has been cleared and excavated as part of previous RD3 construction work, but the majority of this area still to be constructed, in conjunction with the BRSF
Mine support facilities	Construction in progress	Pad PL-7 cleared and prepared Access roads RD 11, and connecting portion of RD2 completed Truck shop foundation complete, ready for steel and building erection Fuel storage and dispensing equipment purchased, to be installed Mobile equipment wash bay to be constructed Explosive storage facilities to completed installation
Crushing plant and mechanically stabilized earth (MSE) wall	Construction in progress	The primary crusher area pad PL-12 is excavated and cleared, and foundation work approximately 70% completed Crusher buildings foundations completed, and steel erection initiated MSE wall excavation initiated, and wall still to install
Screening Building	Construction in progress	Foundation work completed Steel erection and mechanical equipment installation in progress
Overland conveyor	Construction in progress	Clearing and excavating of conveyor corridor complete Foundations approximately 70% complete Approximately 60% of the conveyor galleries are installed
Truck load-out facility	Construction in progress	Majority of earthworks and foundation work completed. Still to install corrugated tunnel. Steel erection and mechanical equipment installation in progress
ADR Plant	Construction in progress	Foundation work completed Steel erection and mechanical equipment installation in progress
HLF pad, pregnant solution piping and storage ponds	Construction in progress	Stage 1 area cleared and stripped, and rough grading completed. Clay under liner, HDPE liner and over drains still to be installed
Onsite site roads	Construction in progress	RD-5, RD-11, RD-13 and RD-14 completed RD-2, RD-4 and RD-12 still to complete
Saravan Access Road	Not started	Design to be approved and construction contract still to be awarded
Power supply	Construction in progress	Powerline from grid to the site substation installed. The main substation awitchgear installed, a few minor modifications need to be done. Substation still to be connected to power grid.
On-site power distribution	Construction in progress	The last few power poles from the main substation to the crusher E-house still to be installed.
Saravan Access Road	Not started	Design to be approved and construction contract still to be awarded

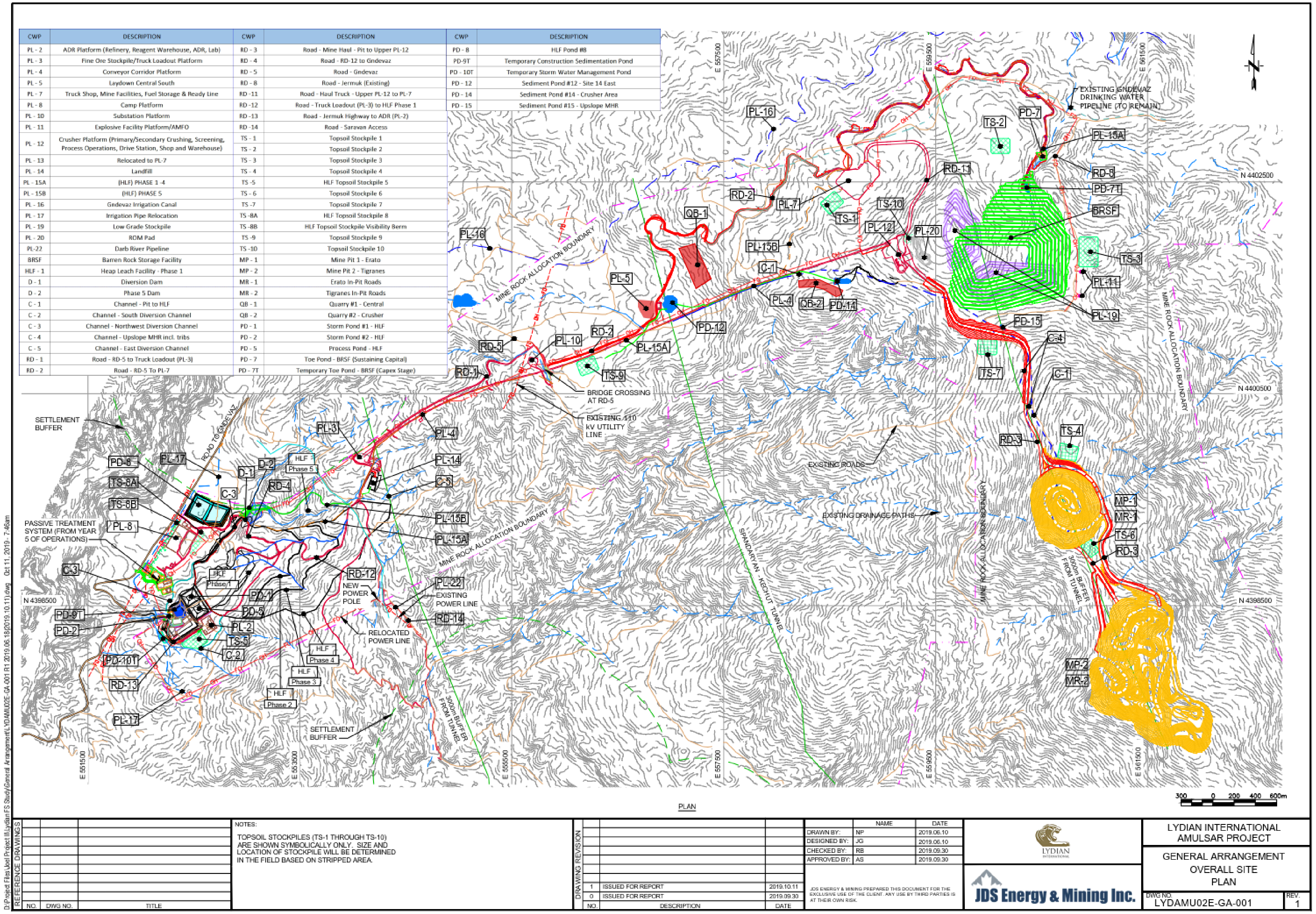
Description	Status	Comments
Raw water ponds and site water distribution	Construction initiated	Earthworks excavations initiated for raw water collection on site. Pipe for site water distribution purchased, to be installed. Fittings and valves still to purchase
Raw water make-up pump station and supply line from DARB River	Not started	Design to be approved and construction contract still to be awarded.
Contact water conveyances and collection ponds	Construction in progress	Pond PD-8 has initiated construction, PD-1 and PD-5 are complete preparation for liner. Liner initiated, but must be re-done. Piping purchased for BRSF contact water pipeline, still to be installed. Passive treatment systems will be installed during operational years

Source: JDS (2019)

Lydian’s sustainability team provided regular input during the feasibility study preparation into the site selection and design decisions for all major infrastructures to ensure that environmental, health, safety and social considerations are included in the site infrastructure.

The proposed overall general arrangement layout drawing is shown in Figure 18-1.

Figure 18-1: Overall Site General Arrangement Layout



CWP	DESCRIPTION	CWP	DESCRIPTION	CWP	DESCRIPTION
PL - 2	ADR Platform (Refinery, Reagent Warehouse, ADR, Lab)	RD - 3	Road - Mine Haul - Pit to Upper PL-12	PD - 8	HLF Pond #8
PL - 3	Fine Ore Stockpile/Truck Loadout Platform	RD - 4	Road - RD-12 to Gndevaz	PD-9T	Temporary Construction Sedimentation Pond
PL - 4	Conveyor Corridor Platform	RD - 5	Road - Gndevaz	PD - 10T	Temporary Storm Water Management Pond
PL - 5	Laydown Central South	RD - 8	Road - Jermuk (Existing)	PD - 12	Sediment Pond #12 - Site 14 East
PL - 7	Truck Shop, Mine Facilities, Fuel Storage & Ready Line	RD -11	Road - Haul Truck - Upper PL-12 to PL-7	PD - 14	Sediment Pond #14 - Crusher Area
PL - 8	Camp Platform	RD -12	Road - Truck Loadout (PL-3) to HLF Phase 1	PD - 15	Sediment Pond #15 - Upslope MHR
PL - 10	Substation Platform	RD -13	Road - Jermuk Highway to ADR (PL-2)		
PL - 11	Explosive Facility Platform/AMFO	RD -14	Road - Saravan Access		
PL - 12	Crusher Platform (Primary/Secondary Crushing, Screening, Process Operations, Drive Station, Shop and Warehouse)	TS - 1	Topsoil Stockpile 1		
		TS - 2	Topsoil Stockpile 2		
PL - 13	Relocated to PL-7	TS - 3	Topsoil Stockpile 3		
PL - 14	Landfill	TS - 4	Topsoil Stockpile 4		
PL - 15A	(HLF) PHASE 1 -4	TS -5	HLF Topsoil Stockpile 5		
PL - 15B	(HLF) PHASE 5	TS - 6	Topsoil Stockpile 6		
PL - 16	Gndevaz Irrigation Canal	TS -7	Topsoil Stockpile 7		
PL - 17	Irrigation Pipe Relocation	TS -8A	HLF Topsoil Stockpile 8		
PL - 19	Low Grade Stockpile	TS -8B	HLF Topsoil Stockpile Visibility Berm		
PL - 20	ROM Pad	TS -9	Topsoil Stockpile 9		
PL-22	Darb River Pipeline	TS -10	Topsoil Stockpile 10		
BRSF	Barren Rock Storage Facility	MP - 1	Mine Pit 1 - Erato		
HLF - 1	Heap Leach Facility - Phase 1	MP - 2	Mine Pit 2 - Tigranes		
D - 1	Diversion Dam	MR - 1	Erato In-Pit Roads		
D - 2	Phase 5 Dam	MR - 2	Tigranes In-Pit Roads		
C - 1	Channel - Pit to HLF	QB - 1	Quarry #1 - Central		
C - 2	Channel - South Diversion Channel	QB - 2	Quarry #2 - Crusher		
C - 3	Channel - Northwest Diversion Channel	PD - 1	Storm Pond #1 - HLF		
C - 4	Channel - Upslope MHR incl. tribs	PD - 2	Storm Pond #2 - HLF		
C - 5	Channel - East Diversion Channel	PD - 5	Process Pond - HLF		
RD - 1	Road - RD-5 to Truck Loadout (PL-3)	PD - 7	Toe Pond - BRSF (Sustaining Capital)		
RD - 2	Road - RD-5 To PL-7	PD - 7T	Temporary Toe Pond - BRSF (Capex Stage)		

Source: JDS (2019)

18.2.3 Roads and Site Access

Roads form the main transport network in Armenia. With an underdeveloped railway network, principally due to its difficult terrain, the road system is of vital importance for the development of the country. The Amulsar site area is located 170-km from the capital city of Yerevan via the M2, a sealed asphalt road which goes to the southernmost part of the country to a town called Meghri. The turn off from the M2 is onto the H42 Jermuk Highway. The Amulsar property is located 8 km from the turn off and there are currently three main access points off the H42 onto the Amulsar property: RD13 which leads to the ADR and HLF, RD-4 which leads to the Amulsar Camp, and RD-5 which is an existing public road that leads to RD-2 accessing the upper site. There is a gravel community road on the east side of the property which links the town of Jermuk to the community of Gorayk through the Vorotan Valley. A service road, RD-8, was constructed off this gravel road and leads to the back side of the property. Jermuk Security control points are located on RD-13, RD-4 and RD-2 and seasonally on RD-8. Lydian has plans to upgrade an existing road to provide additional access on the south side of the project from the M2 close to the community of Saravan.

The only internal road linking the lower site to the upper site is a service road along the overland conveyor and is only suited for light vehicles.

Supplies, material and equipment will be shipped to the ports of Poti or Batumi, in Georgia, and then trucked through Georgia and Armenia to the Amulsar Project site, as has been done previously. Airfreight will come through the Zvartnots International Airport in Yerevan.

18.2.4 Buildings

Lydian Armenia has an established lab in the local village of Gorayk'. This facility provides exploration sample preparation, core/sample storage facility and offices for the Project. Lydian has also started renovation of parts of the building to provide wider laboratory support for the Project.

The buildings currently built to support construction and operations are listed in Section 18.2.1.

The following buildings have completed foundations, and have either partially or fully completed steel works:

- Mine truck shop;
- Crushing;
- Screening;
- Drive House for overland conveyor;
- ADR Plant and Refinery; and
- Laboratory.

18.2.5 Power Supply

The country has an abundance of electric power from nuclear, hydro and thernal power plants. Power lines and sub-station infrastructure are located in close proximity to the Project area. The supply of power in Armenia is controlled by the Armenian Electrical Networks company (AEN) that owns the country's distribution channels in an arrangement whereby in this region power is purchased from the AEN distribution grid.

A substation for connecting the new mine to an existing Jermuk 110kV overhead power transmission line, running along the Vayk-Jermuk road has been installed. This substation is a 110/35kV substation with 15MVA capacity, and will be connected, tested and commissioned using Armenian power engineers working with ABB technical support. Power will be distributed on site via 35kV overhead power lines.

The indoor 110/35kV (main) substation includes a 15MVA transformer and 35kV switchgear. The 35kV switchgear will provide power to a distantly located crushing substation that will distribute power to the crushing circuit and ancillary facilities as well as to overland conveying, ADR plant, solution management pumping, ancillary facilities and water distribution systems. At each process location, the 35kV power is stepped down to 6000V and/or 400V depending on the load requirements at each location. In general, these process electrical locations are made up of a step-down transformer unit substation, a PDC kiosk, and the corresponding 6000V medium voltage controller and/or 400V low voltage motor control center

For the Project, the total installed power is around 16.3MW, while the total average electrical power demand required is 6.0MW. The overland conveyor will have the capability to regenerate power and feed this power back into the distribution grid, which explains the large difference between these two figures.

A temporary 10kV overhead power line and a temporary 630kVA substation have been installed to supply required power during the construction. This power supply and substation arrangement can be also be used for backup power supply to the ADR plant in the future.

18.2.6 Power Distribution

A total electrical demand of approximately 6.3MWhr was determined. The total connected power is 16.3MW, summarized in Table 18-2.

Table 18-2: Mine Connected Power

Area	Effective Electrical Load, MW
Truck Shop	0.6
Fuel Storage	0.4
Crushing & Screening	4.3
Overland Conveying*	3.0
Stockpile Reclaim & Truck Loadout	0.6
Heap Leach	1.5
ADR Plant + Solution Management Pumping	4.9
ADR Plant Lab	0.5
Water Systems	0.4
Camp	0.1
Total	**16.3**

Source: Lydian (2019)

The mine site is provided with a grounding grid to which all building steel, equipment, etc. are connected for safety. This grounding grid consists of a #4/0 AWG bare copper conductor buried below ground connecting all items previously mentioned. All above ground connections except connections to building steel are mechanical type connections so that equipment can be removed or replaced easily. All underground connections including those to building steel will be of the thermoweld type. A test well will be provided for periodically measuring/testing the resistance of the ground grid. Grounding design will follow the federal, state and local standards.

Lighting will be of the high intensity discharge type. High pressure sodium type light fixtures will be utilized for exterior areas and high bay interior applications. Metal halide lighting fixtures will be utilized indoors for low bay application and where color rendition is a factor. Fluorescent lighting fixtures will be used in interior applications such as office lighting, electrical rooms, etc. All areas will be equipped with emergency light fixtures utilizing battery packs which will provide a minimum of 90 minutes of illumination. Lighting levels will be designated by the Illumination Engineering Society (IES) published guidelines.

A computer-based data gathering system, supervisory control and data acquisition system (SCADA), will be incorporated in the control and monitoring of all process operations. The SCADA system will use remote termination devices to channel appropriate control and monitoring signals from field locations back to the central processing unit (CPU) computer where an operator can physically operate equipment from his computer work station. The SCADA system will be based on equipment types preferred and designated by the Owner. The configuration of the SCADA will be based on the latest industrial standards. A programmable logic controller (PLC) system will be installed in respective areas, gathering information from the input and output signals from instruments and motor control equipment. The SCADA will process and record all communications with respective PLCs. An uninterruptable power supply (UPS) will provide power to each PLC.

Standby diesel generators will be provided to handle emergency situations at the ADR plant and PLS pond. These standby generator stations will be rated 6kV, 1500kW and 1000kW, respectively, and provide power to select solution management pumps and other equipment that may affect the process production line should they stop operating. The UPS will provide backup power to the control system and emergency light fixtures will utilize battery packs, when power supply fails. There will also be two 250 kW low voltage (400V) standby diesel generators in the crushing area to keep critical equipment operating for providing a safe shutdown.

18.2.7 Communications

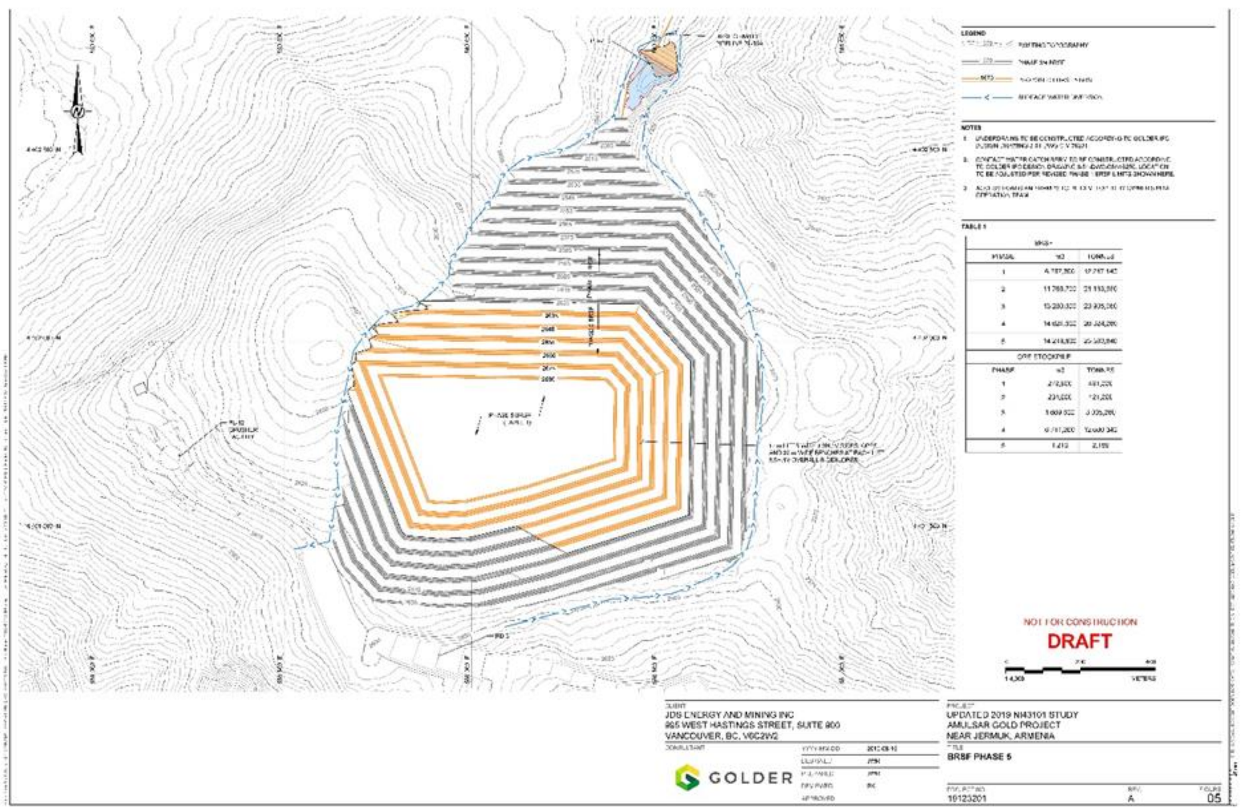
The Project site is currently serviced by a fiber optic line tapped directly into the North-South Armenia cable which runs adjacent to the gas line. The cable provides communication to the upper and lower site and the site infrastructure on PL-7 and PL-12 will link to this fiber optic line after the facilities are established.

18.2.8 Barren Rock Storage Facility

A BRSF will be constructed at Site 27 to store some of the barren rock generated during mining of the Erato and Tigranes/Artavasdes pits, with the remainder used to backfill the Tigranes/Artavasdes pit and for partial backfill of the Erato pit to avoid formation of pit lakes later in the mine life. A complete design report for the BRSF was prepared by Golder in June 2017 (Golder 2017) and is contained in Appendix 13 which can be found in the report Design Documents, located on Lydian's website. As part of the 2019 Technical Report Update, Golder provided an update of the phased development based on the updated mine schedule prepared by JDS. Total barren rock planned for storage at the BRSF was reduced to 109.2 Mt from 125 Mt in the 2017 Technical Report. The changes in the mine schedule have resulted in additional and more complete backfilling of the Tigranes/Artavasdes pits.

The BRSF is located approximately 2 km north of the Erato open pit. Barren rock will be transported by truck to the BRSF and will be developed in 5 phases to reduce the active work area and to limit the amount of contact water (water potentially contaminated by project activities) generated from the BRSF during the early Project years. Phase 1 of the BRSF was partially constructed until the project was halted in mid-2018. The remaining phases of the BRSF will be constructed as required to meet the mine schedule with construction of each phase occurring during the year prior to when barren rock storage is required. Phase 3 may be constructed in two seasons depending on the actual mine schedule and to facilitate construction during a typical 6-month construction season (May to October). A temporary low-grade stockpile will be placed along the south and west sides of the BRSF concurrent with the phased construction, but will be removed and processed during the last two years of the Project life. The BRSF consists of a valley bordered by ridgelines on the east, south, and west and a water collection pond located at the BRSF toe, PD-7. One temporary collection pond will be constructed to manage contact water during the phased construction (PD-7 TEMP or PD-7T) and will be replaced by PD-7 during Phase 3. Figure 18-2 shows the general layout of the facility.

Figure 18-2: BRSF Layout



Source: Golder (2019)

18.2.8.1 Design Components

The design components of the BRSF include the following:

- Underdrain system;
- Clay liner system;
- Water collection ponds for containment of contact water;

- Surface water diversions of non-contact water; and
- Potentially acid generating (PAG) material encapsulated design.

The design elements listed above are designed to minimize ARD generation, to capture any impacted leachate, and to facilitate the geotechnical stability of the BRSF.

PAG Encapsulation Design

The BRSF is designed to encapsulate PAG material within the interior of the facility to prevent the generation of ARD from the facility. A 2 to 5-meter-thick buffer zone of non-acid generating (NAG) material will be placed beneath the facility and along the BRSF perimeter to surround the PAG material generated throughout the Project life. This NAG encapsulation layer is most critical beneath the BRSF where it will lie on top of the drainage system. As such, the lower NAG encapsulation layer can best be described as a uniform blanket drain (blanket layer).

Each phase of construction will contain a discrete PAG zone to accommodate the amount of PAG barren rock generated by the mining operation. These areas will experience incidental compaction from truck traffic and it is anticipated that the argillic clay minerals will facilitate compaction and a reduction in hydraulic conductivity within the PAG cells. The results of the ARD block model confirm that the acid-generating waste is correlated with argillized LV (See Section 25.2). These PAG cells would be isolated from seepage and groundwater flow from below via separation from the clay liner system and basal NAG layer, and will limit precipitation from above via the post-closure Evapotranspiration Cover (see Section 25.2).

Slope Stability

Slope stability analyses were performed for the BRSF and low grade ore stockpile (LGS) to evaluate the stability of the facility under static and seismic loading conditions. The analysis utilized drilling and testing data from the 2014 and 2016 geotechnical studies. Calculated factors of safety under static conditions for all cross-sections meet the required design criteria. Calculated Pseudo-static factors of safety range from 0.5 to 1.0 and deformation analyses were performed to estimate potential movement. Deformation analyses for the BRSF (all phases) indicate that movement greater than 1 m may occur during a significant shaking event, applicable for both the Operating Basis Earthquake (OBE) and the Maximum Design Earthquake (MDE). However, post-seismic factors of safety remain above unity (FS – 1.0), indicating that the BRSF will regain stability following the cessation of shaking. This requires that Lydian should be prepared to re-grade and re-contour the BRSF (as required) should a significant seismic event occur. Under an extreme scenario, remedial measures may be required to address potential damage to the liner and/or overdrain/underdrain systems.

Contact Water Management

Water that has come into contact with the BRSF is considered contact water. This includes stormwater runoff from the BRSF, and flows collected from the drainage layer underneath the facility. The contact water is collected in PD-7T or PD-7 located at the toe of the facility and transferred to PD-8, located near the HLF. A low-level outlet in PD-7T or PD-7 will convey flows whenever there is water in the pond. The ponds will be operated at a low level to allow for available storage to manage storm events. PD-7T and PD-7 have been designed to manage the 1% annual exceedance probability 24-hour storm event as well as the wet event from the probabilistic water balance model. Contact water from the BRSF is either consumed during operations, or is treated to regulatory discharge standards and released to the Arpa River below the Kechut dam (outside the Lake Sevan drainage basin).

There are several springs located in the BRSF footprint. The spring flows will be collected underneath the BRSF soil liner system in an underdrain system. The spring flows will not come into contact with the barren rock or contact water in the BRSF drainage system and therefore are classified as non-contact water. The spring flows will be conveyed downstream of PD7T and PD7 and discharged back into the environment.

18.2.9 Worker Accommodations and Meals

A camp facility was constructed in 2017 on the PL-8 location which consists of 12' x 20' bedroom blocks, a kitchen and dining area, cleaning facilities, medical clinic, administration and recreational area. The facility contains 920 beds for on double occupancy rooms and 20 beds for single occupancy rooms.

The camp policy during construction will be for a closed and dry accommodations facility. This policy will be evaluated and transitioned during operations. Adequate entertainment facilities are installed with the recreational room and a gym to reduce the need to travel out of the camp. The camp will continue to be utilized for the first four-years of operations and then phased out as Lydian employees move into the communities.

During the construction phase, overflow from the camp will be evaluated and carefully managed using limited short-term agreements with existing hotel and apartment facilities. These accommodations will be used if needed for non-resident Lydian employees, Project management staff, and construction personal.

Mid-shift meals will be supplied to all workers during construction and operations. Construction contractors will be accountable to provide all employees meals at contractor-provided eating areas in accordance with nutritional and sanitation requirements stipulated in the individual contracts. The camp dining areas have been established for Lydian Armenia employees and senior staff during construction and operations.

Bottled water or water bottle re-filling stations will be provided in all areas and two potable water systems used at site, one at the camp and one at the mine facilities platform on PL-7. There will be a change house for all mine's employees who can shower and change into their street clothes prior to being transported back to their homes or accommodations. The employees who live in the surrounding communities of Jermuk, Gndevaz, Saravan, Gorayk or other nearby towns will be transported to and from the mine site by busses or vans.

18.3 Site-Wide Water Management

Golder Associates Inc. (Golder) prepared a site-wide water balance (SWWB) model and an initial revision to the surface water management plan (SWMP) that were developed to support the October 2015 TR update for the Amulsar Project, with a further update prepared in 2017 prior to initial construction and in support of the March 2017 TR update. An additional update to the SWWB was completed based on the revised mine plan and schedule to support this TR Update (Golder, 2019). A summary of the changes incorporated into the current SWWB model from the SWWB model that was developed to support previous versions of the NI 43-101 TR (2015 and 2017) and the 2016 ESIA for the Amulsar Gold Mine Project (dated October 2015) are presented below:

- Modified the SWWB based on design advancements, including production schedule and facility footprint development;
- Climate and Runoff Inputs:
    - Updated the climate study with additional weather records;

    - Included a probabilistic climate tool using the Jermuk Climate Station data for facilities below elevation 2,200 m. Previously, all facility models were based on the Vorotan weather station. The Vorotan weather station continues to be used for facilities above elevation 2,200 m;
    - Added a snow factor which estimates the average snowmelt which reports to runoff;
    - Included sublimation based on elevation; and
    - Included routing losses for pond discharges to engineered channels and natural waterways;
- Included the mine pits in the probabilistic model:
    - A runoff model was developed using the probabilistic climate generation tool and runoff coefficients to provide a continuous time series of inflows into the pit sumps. The runoff model includes snow removal within the pit footprints;
    - Inflows into the pit from perched groundwater and local recharge are included; and
    - Updated pit footprints and backfill areas based on the 2019 mine plan provided by JDS;
- Included the HLF in the probabilistic model:
    - Developed a runoff model for the HLF based on the probabilistic climate generation. The HLF was modelled using the same input parameters and methods used in the HLF Design Report (SE, 2016); and
    - The model reflects the updates to the design, such as pond sizing and production schedule, as provided by SE during the detailed design of the facility (SE, February 2017) with minor modifications to accommodate the 2019 mine plan (JDS, 2019) and updated HLF Conceptual Design (Golder, 2019);
- Included the BRSF in the probabilistic model:
    - The BRSF will have a constructed low-permeability soil liner, an overdrain to collect contact water, and an underdrain to collect non-contact water (spring flows). The non-contact water is conveyed downstream of the BRSF and toe pond and released back into the environment;
    - A runoff model was developed using the probabilistic climate generation tool and runoff coefficients to provide a continuous time series of inflows into the toe pond. The areas contributing to the toe pond were updated based on the 2019 mine plan; and
    - The BRSF includes permanent water storage within the facility that is not expected to contribute to the toe pond during the operational life of the facility;
- Updates to the non-contact water system:
    - Added a pipeline from PD-12 to the drainage area D-1 to minimize impacts to the watershed contributing to the Gndevaz Reservoir. The option to discharge water from PD-12 to the Gndevaz Reservoir was removed;
    - Discharge non-contact water along roads to the environment after passing through energy dissipator and sediment control Best Management Practice (BMP) design elements; and
    - The make-up water sources have been updated from the Arpa River to the Darb River.

Water consumption rates and water demands are updated based on input from Lydian.

The Site-Wide Water Management plan covers the following types of water:

- Potable water;
- Construction water;
- Operations-phase water management; and
- Makeup water supply.

18.3.1 Potable Water Supply

Potable water will be used for drinking water, cleaning, change rooms, laboratory water and safety showers. Potable water is provided by treating raw water in two small water treatment systems located in the Amulsar Camp and on the PL-7 Mine platform. Potable water storage tanks will provide live volume to the safety showers and other downstream users.

If additional potable water is required at PL-8 it can be provided from the city of Jermuk. If potable water is required at other locations it is available and can be purchased from local community supplies.

18.3.2 Construction Water

During the construction phase, water will be required for dust suppression and concrete production. The construction water will be drawn from D-1, local stormwater catchments, and treated wastewater for construction activities located near the HLF. The construction water will be sourced from Benik's Pond, the BRSF internal stormwater pond, and local stormwater runoff catchments for construction activities located on the upper mountain. A water line will be installed from the Darb River to supply make-up water demands in 2020 and can be used as construction water once available.

Sediment ponds have been constructed as part of initial construction as part of the Surface Water Management Plan (SWMP) in order to manage the sediment coming from disturbed surfaces and include Pond PD-9T below the HLF, PD-7T below the BRSF and other temporary sediment ponds as required. These temporary sediment ponds can also be used to supply construction water demands.

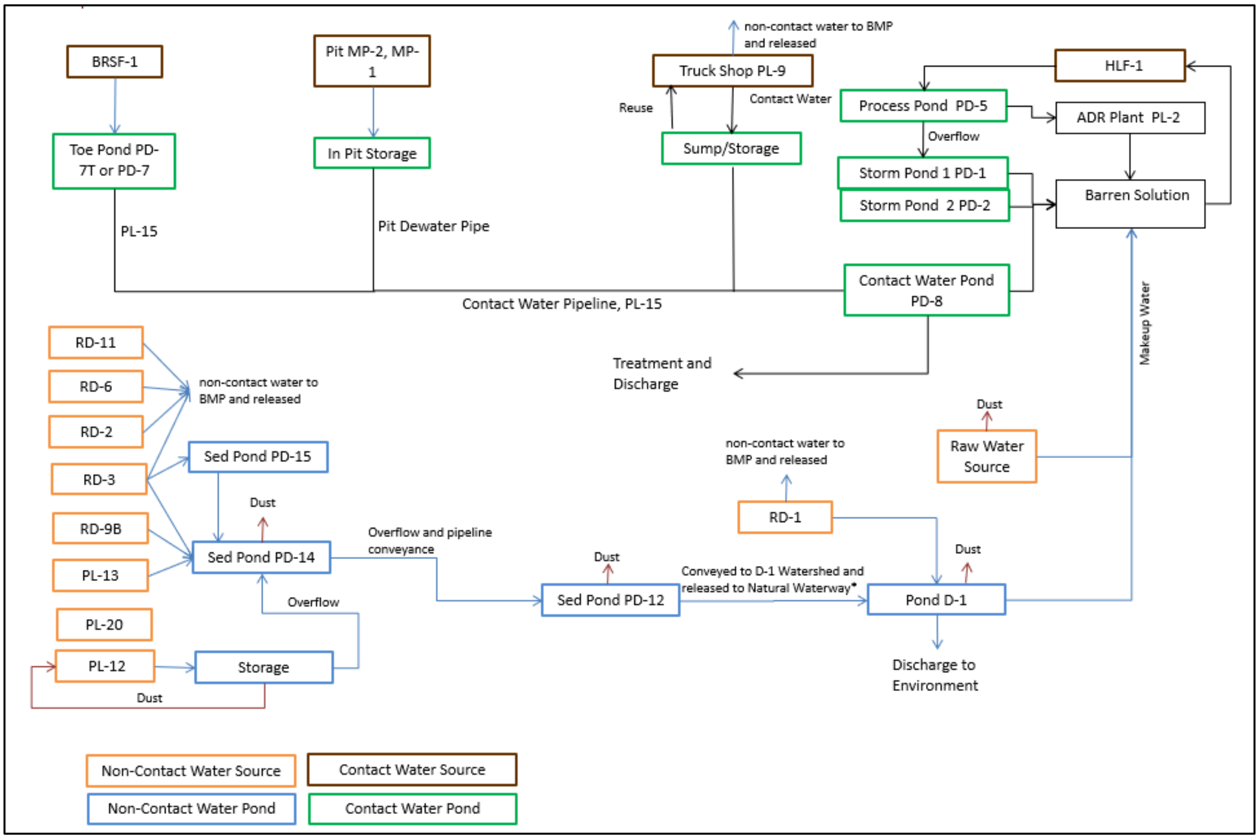
18.3.3 Operations Phase Water Management

The SWWB model tracks the water volume through the following facilities:

- Mine pits;
- HLF;
- BRSF;
- Crusher, Area;
- Truck Shop, Area; and
- Undisturbed ground storm water runoff contributing to conveyance channels.

The operations-phase water management plan is shown in Figure 18-3.

Figure 18-3: Operational Water Management Plan



Source: Golder (2019)

Surface water at Amulsar is classified by the ESIA as contact water, impacted water, or non-contact water, as determined by the land type generating the runoff and the predicted water quality from that land type. Contact water is runoff derived from pit dewatering, facilities containing PAG waste rock, truck shop facility and heap leach areas. Runoff from both the BRSF and low-grade stockpiles is considered contact water. Impacted water is surface water runoff derived from the haul roads, crushing, conveyor, waste rock classified as non-acid generating (NAG), and top soil stockpiles that are potentially sediment-laden. Non-contact water is surface water runoff derived from undisturbed natural ground, (i.e., areas outside of the disturbed areas of the mine, BRSF and mineral process plant development areas). Contact water is water that has come into contact with the mine process and would likely require additional monitoring and/or treatment beyond sediment management prior to meeting discharge water quality standards. For the purpose of the SWWB, impacted and non-contact water are grouped together because this water is assumed to not require additional treatment prior to release to the environment.

Starting from the mine pit area the non-contact system, as shown schematically on the bottom of Figure 18-3, water is conveyed along the RD-3 haul road between the pits and the crusher in roadside channel C-1. The water is conveyed under the haul road in a series of culverts and released to the environment after passing through Best Management Practices (BMPs) to manage sediment, such as energy dissipaters, rock check structures, and straw bales. Crown ditches are located above the exposed cut slope of RD-3, conveying the non-contact water to identified down-chutes that convey the water down the cut slope to one of the road culverts. A secondary channel, C-4, is located approximately along an existing drill site access track to divert noncontact water away from the haul road cut slopes until it can be conveyed via a down-chute channel to one of the haul road culverts and discharged to PD-15. PD-15 is designed as a stilling basin. The water from PD-15 is then conveyed in a pipeline to PD-14.

The water from PL-13, RD-3 along the saddle and RD-9B is collected and conveyed to a PD-14 sediment pond located southwest of the crusher. PD-14 sediment pond allows for solids to settle out of suspension as well as to provide a water source for dust suppression supply for the roads and crusher. The overflow from PD-14 is primarily conveyed via a pipeline located along the conveyor corridor to sediment pond, PD-12. The 400 mm pipeline is sized to convey the approximated 25-year, 24-hour peak event, with flows in excess of the 25-year peak event conveyed as overland flow along the conveyor corridor. PD-12 serves a dual function as an energy dissipater and water source. PD-12 will be used as a dust suppression water source or will discharge to a conveyance to the raw water pond (D-1). Pond D-1 may be used as dust suppression or process make-up water at the HLF. Excess water from D-1 will be discharged to the environment.

The majority of water from the undisturbed drainage area that flows toward the access roads RD-1, RD-2, RD-11, and RD-6 will be conveyed under the roads in a series of culverts. The culverts will be placed at topographic low points along the road and will include BMP's at the outlets to dissipate energy, minimize erosion, and allow for water to spread out into overland flow in the natural topography.

Point-source discharge from sediment ponds to the environment are from D-1. Contingency measures, such as flocculation systems, may be warranted at point-source discharge locations to manage sediment to meet regulatory discharge requirements for suspended solids. The runoff from the area between MP-1 and MP-2 will be managed with BMPs to provide sheet flow to Benik's pond, similar to the existing natural conditions. An active monitoring and maintenance program will be implemented to monitor these areas for erosion and/or channelized flow that may result in increased sediment load in the runoff.

The contact water is depicted starting at the top-left of Figure 18-3. Pit dewatering is accomplished by pumping excess contact water from the pits where it is then conveyed along RD-3 in a pipeline, around the Crusher, and along the conveyor corridor. The BRSF contact water is collected in the BRSF toe pond (PD-7T and PD-7) and conveyed in a gravity pipeline to the contact water pond located near the HLF (PD-8). The wash bay water at the truck shop is also considered contact water. It will be collected in a separate pond and treated with oil/water separators. The oil will be collected for approved disposal and the water will be recirculated in the wash bay, used as dust suppression water in approved locations, or controlled within the contact water system.

The BRSF toe pond, PD-7 has an ultimate capacity of approximately 60,000m^3, with an interim PD-7T stage capacity of approximately 32,000m^3, both of which are designed to contain runoff from the BRSF during the wet year event including the 100-year 24-hour event (1% annual exceedance probability), and an additional 20% freeboard contingency without overtopping. The water collected in this pond is conveyed to the contact water pond (PD-8) located near the HLF. The excess water from the BRSF being conveyed to the contact water pond may be reduced by various evaporation or treatment methods at the pond locations and on the BRSF during periods when the mine does not require contact water as makeup process water.

From the BRSF toe pond PD-7 (or PD-7T), water is conveyed to the contact water pond, PD-8, located north of the HLF. The required ultimate design capacity of Pond PD-8 is 508,000m^3 with 250,000m^3 required for Phase 1 (Aug 2020 to April 2021), 385,000m^3 required for Phase 2 (April 2021 to Nov 2027) and 508,000m^3 required for Phase 3 (Nov 2027to LOM). The design of Pond PD-8 considered construction in two phases. The contact water pond, PD-8, is the primary storage location for Acid Rock Drainage (ARD). It is from the contact water pond that water is pumped to the ADR Plant where it is conditioned for use as HLF barren solution. The excess contact water expected in Year 4 will be sent to the passive contract water treatment system for treatment and discharge.

The contact water pond PD-8 will be constructed with diversion channels or earth berms on all sides if needed to prevent runoff from non-contact water drainage areas from mixing with the contact water stored in the pond. Two storm ponds, PD-1 and PD-2 are also located at the HLF and assist in the management of HLF solution.

Enhanced evaporation techniques or other treatment methods may be used at the contact water ponds and contact water facilities to reduce stored volumes in periods of excess contact water. An operational water management model that is frequently updated will help evaluate operational risk associated with make-up water and storage requirements.

PD-8 is the preferred source of make-up water from the HLF. The water is sourced first from the Process Pond PD-5, and then the HLF storm ponds (PD-1 and PD-2), followed by the contact water pond PD-8, non-contact water pond D-1, and finally from an external makeup water source. The makeup water is required in the dry months and winter months for the first four years (coinciding with Phase 1 and 2 of the HLF). The makeup water will be pumped from the Darb River via 4 km pipeline to the HLF ADR plant. The maximum required makeup water is approximately 104,000m^3/month.

Contact water treatment is needed starting in year 2025. The contact water treatment facility is a bioreactor-based water treatment system located near the HLF and will be supplied by water from PD-8. The maximum capacity of the contact water treatment is 40m^3/hr. Details of the contact water treatment facility are presented in Section 25.2.

The current water balance shows that the on-site storage and treatment is sufficient to manage the 100-year, 24-hour storm event or the 100-year wet year without discharging untreated mine contact water to the environment.

18.3.4 Sewage Waste Water Treatment

Sewage is treated with a Bio-Disk System which was installed at the camp in 2017. The system requires full commissioning and a discharge permit to complete. Until complete, the discharge from the treated effluent holding tank is being trucked to the Jermuk Sewage facility

Storage tanks for sewage waste water treatment will be installed at the mine staging area personnel facility on PL-7, at the ADR process plant, the crushing plant and truck shop.

Temporarily, until the camp water treatment systems are fully operational, construction will utilize the waste storages and transport effluent to the off-site treatment system.

18.3.5 Water and Utilities

Raw water for system makeup, dust suppression, and fire water is pumped from either the Darb River, Benik’s Pond, or from Ponds PD-12 or D-1.

Fire water will be supplied by storage tanks at the ADR and Crushing Facilities, which will be filled from the same make up water suppliy sources listed above.

18.4 Waste Disposal

A mine landfill was designed (Golder, 2017) to accept non-hazardous industrial and domestic waste within separate lined waste management units in compliance with the 24 November 2004, "Law of the Republic of Armenia on Waste" and in general accordance with commonly accepted waste management practices in the European Union and meeting IFC requirements. The design and analysis for the mine landfill included stability assessment of the landfill embankments, hydrogeological and landfill gas risk assessment, surface water management, a landfill operations plan, and conceptual closure and aftercare plan.

The mine landfill was designed in a multi-cell manner with three cells and overall multi-cell capacity to contain a total of approximately 25,000m^3 of inert industrial, domestic, and solid non-hazardous waste from mine activities. The capacity of Cell 1 is approximately 10,000m^3. The determination of the design capacity of the mine landfill was based in part on estimates for solid waste determined by Gone Native, LLC, in their July 2013 technical memorandum ("Amulsar Project – Solid Waste Landfill Guidance and Conceptual Sizing," Gone Native, LLC, July 2013) plus an allowance for a contingency of factor of safety of over 3 on the estimated waste generation over a 15-year life for the mine landfill facility.

Lydian Armenia completed the Integrated Waste Management Plan (IWMP), Version 6, in May 2016 that outlines the major issues and general strategy for managing wastes generated at the mine. To the extent practicable, used materials and equipment will be placed in their original shipping containers and returned to the supplier for proper disposal or recycling. All waste cyanide will be disposed of in accordance with International Finance Corporation's (IFC) Environmental, Health and Safety (EHS) Guidelines. The Lydian Environmental Design Criteria or EDC (Lydian, 2016) provides details of the planned mine waste sorting and recycling system and disposal of hazardous solid wastes and liquids to specialized facilities in Armenia.

The Mine Landfill includes liner systems, and a leachate collection and recovery system (LCRS) for management of leachate. A description of the landfill components is discussed in the following sections.

The landfill liner system consists of a 0.5 m thick compacted clay layer with maximum hydraulic conductivity of 1×10^{-9} m/s, a geosynthetic clay liner (GCL), a 2 mm thick HDPE geomembrane and a geotextile protection layer along the base and upstream side slopes for added protection. The LCRS system includes a sump and collection pipes to allow leachate to be pumped to a vacuum truck where leachate can be periodically disposed of within one of the lined ponds at the HLF or in the contact water pond PD-8.

The landfill capping system design includes the following sections from the top of the final waste surface: a minimum 200mm thick regulating or cover layer; a GCL; a 500mm thick drainage layer; and a 1 m thick soil cover layer consisting of 800mm of subsoil and 200mm of topsoil. The cover slopes are designed with 5H:1V slopes that slope away from the center point of the landfill cell.

19 Market Studies and Contracts

19.1 Marketing Studies

The saleable products from the Amulsar Project will be refined gold and silver bullion conforming to the London Bullion Market Association specifications for good delivery. Semi-refined gold and silver will be shipped from Amulsar in the form of doré bars, containing a mixture of gold and silver and other impurities. The precious metal content of the bars is estimated to be between 90% and 99% (gold plus silver). Doré bars will be weighed and samples collected for assaying by Lydian Armenia prior to shipping and the selected refinery will do the same upon receipt of the doré. The weight of the bar combined with the assay values allows the calculation of gold and silver contained in each bar and thus the overall value. If Lydian Armenia and the refinery are within agreed assay splitting limits, the payable gold and silver content will be settled at the average of the two assays. Should the two assays fall outside the agreed splitting limits, an independent umpire assay will be obtained. The assay closest to the umpire assay will then be used to determine the payable metal content.

Typically, gold and silver bullion is sold through commercial banks and metal dealers. Sales prices are obtained using the current COMEX quoted contract prices adjusted for the metal delivery date and are easily transacted. However, Lydian Armenia has entered into a Stream Agreement and an Offtake Agreement in connection with its financing arrangements for Amulsar. The Stream Agreement is summarized in Section 4.11, and is more fully described in Lydian's public disclosure available on SEDAR at www.sedar.com. For gold bullion not delivered under the terms of the Stream Agreement, Lydian Armenia will deliver the remaining metal to Orion and RCF under the terms of the Offtake Agreement. After fulfilling its obligations under the Stream Agreement and Offtake Agreement, Lydian Armenia will then utilize the sales mechanisms set out above.

The doré bars will be shipped by a secure carrier to an LBMA (London Bullion Market Association)-certified precious metal refiner capable of outturning metal conforming to the LBMA specifications for good delivery. Commonly utilized refiners meeting this standard are located in Europe, Canada, USA or Asia. Upon arrival at the refinery, the bars are weighed and samples are taken to determine the precious metal content. The refiner will schedule periodic processing of the Amulsar doré in dedicated crucibles. The products from the refinery are separate refined gold and silver ingots known as good delivery bars. The option exists to take physical metal or to employ a trading account to monetize the bullion, subject to requirements to deliver bullion under the Stream Agreement and Offtake Agreement. Typical shipping and refining costs are approximately $6.00 per ounce of gold refined.

19.2 Contracts

Lydian Armenia had entered into certain significant contractual agreements with third-parties in connection with development activities at Amulsar. These include contracts for construction management services, land acquisition and leases, mining fleet, materials handling system, gold-recovery plant, electrical systems, and worker accommodations. Additional contracting and procurement activities are ongoing.

By the end of December 2018, all construction contracts had been terminated as a result of the ogngoing blockades and negotiations were governing standby charges, final payments and demobilization were completed. All contractors were requested to consider significant discounts on unpaid invoices and to waive standby charges for the month of October. The Company also terminated all supply contracts while assessing whether all the materials have been received.

A listing of contract packages has been developed by Lydian Armenia for the restart of the project. A number of these will be sent out to competitive bidders, while some single source. All new contractors will go through a vetting process though Lydian International beforehand and references attained as much as possible

Lydian International and Lydian Armenia have completed various financing transactions and entered into additional credit agreements to provide funding for Amulsar. These transactions are more fully described in Lydian's public disclosure available on SEDAR at www.sedar.com. Refer to Section 4.11 for encumbrances and liens associated with these transactions.

19.3 Gold & Silver Pricing

Gold and silver prices used for this study are $1,300 and $16.00 per ounce. This is below current market conditions, but consistent with the current three-year trailing averages of approximately $1,282/oz gold and $16.34/oz silver.

19.4 Royalties

The Project is subject to three royalties included in the economic analysis and cash flow model. Table 19-1 outlines the royalty terms. Total royalties for the Project amount to US$304.0 M over the LOM.

Table 19-1: Royalty Assumptions

Parameter	Units	Value
Newmont Royalty	US$M	20.0*
Royalty 1	% payable	4.0%
Royalty 2	effective % of adjusted profit	4.7%

*Paid quarterly up to US$20 M.
Source: JDS (2019)

20 Environmental Studies, Permitting and Social or Community Impacts

20.1 Corporate Governance

Lydian is committed to ensuring that all company activities are carried out in a way which complies with the principles of sustainable development. All of Lydian activities are carried out in accordance with a range of environmental and community related policies which include:

- Code of Conduct;
- Environmental Policy;
- Human Resources Policy;
- Occupational Health and Safety Policy;
- Security Policy; and
- Social Policy.

All policies are reviewed and confirmed by the company board on an annual basis.

In addition, oversight of corporate responsibilities relating to Sustainability (nominally Health, Safety, Security, Environmental, and Social (Community)) issues and the management of the associated risks to the Company is delivered through The Sustainability Committee which is appointed by the Board of Directors of Lydian International Limited. The Charter for the Sustainability Committee can be found on the Lydian International website.

20.2 Location, Environmental and Social Setting

The Amulsar site is located in central southern Armenia and straddles two administrative provinces, or Marzer, namely Vayots-Dzor and Syunik. The Project area is largely open in nature with no areas of woodland and is characterized by a temperate climate of long cold winters and short relatively cool summers. The typical landscape (summer) at the Project is shown in Figure 20-1 below.

Figure 20-1: Typical Landscape at the Project

Source: Samuel Engineering (2015)

The proven gold ore deposits have been defined on the ridge peaks in the region of Amulsar Mountain, within the Northern Zangezur mountain chain at an altitude of between 2,500 and 2,988 masl. The wider area is characterized by mountains, undulating hills, river valleys and gently inclined plateaus at lower elevations. Surface water run-off from the slopes of the Project Affected Area contributes to the catchments of the Arpa, Darb and Vorotan rivers. The Vorotan River flows to the east of the Project and the Darb River flows to the south of the Project, and joins the Arpa River flowing west. The land within the Project Affected Area is characterized by Sub-Alpine and mountain meadow landscape which typically supports grasslands used for summer grazing. At lower elevations agricultural use is more diverse and a range of crops are grown in the area.

Regional climate variation within Republic or Armenia is pronounced, with the foothills at lower altitudes having longer and hotter summers, averaging around 25°C, and winter temperatures at an average of -5°C compared to the average of -12°C which can be recorded in the mountains. Annual rainfall is also influenced by the mountains and more rainfall is experienced at higher elevations; an average of approximately 800 mm of rainfall per year would be typical for Amulsar site (elevation of up to 3000 m above sea level). Snow cover is present on the mountain in the period November to April and can exceed a depth of 3 m, depending on weather conditions.

The Project Affected Area straddles Vayots Dzor Marz (the capital of which is Yeghegnadzor) and Syunik Marz (the capital of which is Kapan). The closest town to the Project is Jermuk, which is situated approximately 7 km from the nearest part of the Project's infrastructure. Jermuk has several natural hot springs, health resorts and spas. Jermuk hosts established mineral water bottling plants and has an established tourism industry. There are four rural communities in the proximity of the Project, namely: Kechut (a rural community associated with the town of Jermuk), Saravan (including Saralanj and Ughedzor) and Gndevaz all located within Vayots Dzor Marz, and Gorayk, which is located in Syunik Marz. Gndevaz is the community closest to the footprint of the Project's infrastructure, which is the HLF over 1 km south and east from the nearest residential property of the village.

20.3 Permitting, EIA and ESIA

20.3.1 Permits and Licensing

For the development of the mine, several permits and licenses are required, outlined in Table 20-1 below. Since construction commenced in 2016, 72 constructions permits have been received for various Lydian facilities. There are 20 permits that had, or will, expire after getting back on site after the blockades given depending on their validity period of one or two years. The renewal of these permits has thus far been a formality with an application made to the Municipality of Jermuk one month prior to the commencement of work.

Table 20-1: RA Permits Required for Development of Amulsar Mine

License / Permit Title	Application / Provision	Status Comment
Existing or Applied For		
Gosudarstvenni Komitet Po Zapasam (GKZ) Resource approval	Approves the resources and puts on the State Balance	• Tigranes deposit: granted in 2009. • Tigranes/Artavazdes deposit: granted in 2011. • Erato deposit: granted in 2013.
Initial Mining Permit License issued 28.12.2009	Permit for extraction of ore (only Tigranes/Artavazdes pit) under old Mining Concession Law	Granted, valid until 2034 and in September 2013 extended until 2040.
The Mining Right is conferred on the project by the granting of the Mining Permit, the Rock Allocation Area and the Mining Agreement		
The Mining Permit is approved for the project when the Technical Safety and EIA are approved by the authorities		
Technical Safety	Approve that the design follows all Armenian safety regulations.	Granted in 2014 and updated 2016. Valid during the life of the Mining Right unless there are changes in the design of the Open Pit operations.
EIA expertise (details provided below)	Approve that the design and operations impact on the environment is within the Republic of Armenia acceptable limits	• EIA on Tigranes – granted in 2009 • EIA exploration (Saravan) – granted in 2010 • EIA on ore processing (site 6) – granted in 2011 • EIA exploration (Khachakar) – granted in 2012 • EIA on Tigranes and Artavazdes – granted in 2012

License / Permit Title	Application / Provision	Status Comment
		• Positive opinion ("expertiza") on EIA received from Ministry of Nature Protection (MNP) on 17 October 2014 following Mining Permit application in late July 2014. • Updated following VE and approval granted April 2016.
Rock Allocation Area	Change in land use from agriculture to industrial required to accommodate all mining infrastructure and to obtain construction permit(s).	Granted and valid until 2034.
Mining Agreement (MA)	Requirement under the new Mining Code. The Agreement defines the conditions and term of providing the mineral deposit, the coordinates of the allotment, the rights and duties of the parties, the provisions relating to the payment of fees (the environmental fees, for the nature management and for formation of the nature and the environment protection fund, as well as of the monitoring fees), the environmental management plan, and the provisions on termination of the subsurface use right (the notification, waiver, amendment), the provisions on the scope and terms of the commitments to the social-economic development of the community, the provisions on the mining site closure, as well as other provisions required by law.	• Submission of the proposed Mining Agreement document based on the template per Annex N1 to the RA Government Resolution N437-N of March 22, 2012 to MENR for signature by both parties. Current Mining Agreement was signed in November 2014. • The updated Mining Agreement was signed in May 2016. • Under the mining license an 18 month extension was provided to Lydian on 11 July 2019 which made the construction period valid from 1 July through to 31 December 2020.
Mine Closure Plan	Mine closure should be part of general Mine Plan.	• Submitted with the Mining Permit documents in late July 2014. According to Section 49 (6) of the Subsoil Code of Armenia, the mine closure design is distinct from the project design but was submitted along with the permit application. • The closure plan was submitted in 2016. • Two years prior to the actual closure of the operations the final design should be submitted for final approval.
Potentilla porphyrantha Red Book Plant Translocation	The Decree allows Lydian to translocate Red Book listed Plants to three locations – a) botanic gardens, b) National Parks (protected areas) and, c) to other known listed habitats.	• The permit application was submitted to the MNP in December 2014. • The translocation contract with the MNP was signed on 7 of August 2015 to translocate 1,500 Potentilla plants located in the footprint of the pits. These plants were planted at Lake Sevan Botanical Garden. • Two further small-scale translocations, to artificial rockeries on North Erato, were carried out in 2016 with a total of 150 plants moved. In 2017 76 plants were moved to Sevan Botanic Gardens.
ICMC cyanide supplier and transportation	All cyanide producers and transporters used by Lydian must be Cyanide Code complaint (or working towards compliance)	Lydian was ICMI certified on a pre-operational basis in early 2018. The company will become operationally certified one year after delivery

License / Permit Title	Application / Provision	Status Comment
		of the first cyanide during the commissioning of the ADR and the CN producer and transporter will be compliant as well.
Waste Passports	To give the class of hazard to the different waste types and permit the locating of the waste and its disposal.	• Waste passports have, where required, been obtained for wastes generated during construction. Remaining passports (construction) will be obtained when required. • Plan in place for operations only passports. • Waste passports have no expiry date.
Water Usage Permit.		
Water intake part of usage permit	To allow the abstraction of water for make-up water from offsite sources.	• Two Water Abstraction Permit applications have been made for the abstraction of water from the Arpa and Darb rivers. Notification from the Ministry of Environment is expected by the end of October 2019 • A water abstraction permit was received in 16 June, 2019 for 2 l/s for the Beniq's Pond located on the Upper Site.
Water discharge component of usage permit	To allow the discharge of water/effluent.	There are no discharges from the project at this time. During construction, sewage effluent is collected and trucked to the Jermuk sewage treatment works for disposal. The Mine Camp's sewage treatment plant needs to be fully operational, and at steady state, so that samples of effluent can be analyzed as part of the application process. The treated sewage plant effluent will be used for dust control and investigations are planned to determine if the water can be combined with make-up water for the HLF. An application to amend the Water usage Permit will also be required for discharge from the Passive Water Treatment plant and will be obtained when the project has excess predicted in Year 5.
Air emission permit	To permit the emissions to the Air	The project team has identified eight sources which require an air emission permit for operations. A single permit will be obtained which will cover all sources. The permit will be valid for three years after which it can be renewed.
Explosives permit (store, transport, use)	To permit the use and storage of explosives at the project.	Lydian's contracted drill and blast will have both blasting and storage permits. Lydian Armenia has included this requirement in the contract procurement process for the drill and blast service and will not need to obtain these permits.

License / Permit Title	Application / Provision	Status Comment
Landfill license	No permit is required for the project non-hazardous landfill.	If a decision was taken in the future to dispose of hazardous waste in the project landfill than a permit would be required. The approvals process would require some form of environmental assessment.
License for the importation, transport and use of CN	A 'one-time' license must be obtained from the Ministry of Environment to import each individual shipment of CN. No permit / license is required to transport CN in Armenia. No permit / license is required to use CN in Armenia.	Applications will be submitted as required to ensure operational requirements are met. A small emergency stockpile of CN will be maintained to alleviate the effects of interruption in supply.
Construction and Architecture permits	To confirm that all facility complies to Armenian Standards and Norms a design is completed by an Armenian Design company, then provided for expertise to a state approved design institute, and registered in the municipality	A list of 72 required permits are approved for the various facilities onsite. There are 20 permits that had, or will, expire prior to returning to site after the blockades and applications have been submitted for their extensions.
Hazardous facilities	Facilities or objects classified as hazardous under the Armenian Safety Legislation requires additional approval by the RA Ministry of Emergency Situations prior to being accepted into operation	Permit applications are being prepared and will be submitted one month prior to when construction is completed. These will include permits for: • Reagents warehouse • Cyanide storage and use areas • Primary and secondary crushers, screen-house and overland conveyor • Fuel storage facilities • Conveyors (CV-1,CV-2, CV-3, CV-4,CV-5, CV-6 & CV-7) • Explosive magazines • Fuel storage facility (PL8) • Bridge cranes in various facilities
Gas and power use designs and construction expertise and permits	To permit the gas and power use.	Applications will be submitted when the installations are complete. The Armenian electrical and gas service providers are working directly with the company as part of the installations

Source: Lydian (2019)

20.3.2 Republic of Armenia Environmental Impact Assessment (EIA)

The requirements under the Republic of Armenia Environmental Impact Assessment procedure ('ShMAG') differ from thos e required of an ESIA for international financing, with respect to the process, method and presentation required. Therefore, the two assessment processes were undertaken following parallel programs for delivery and based on common baseline data and project parameters. The Ministry of Energy and Natural Resources granted to Geoteam CJSC (now Lydian Armenia), Lydian International's 100% owned subsidiary, the Mining Right for the Amulsar Gold Project in November 2014. This represented the final stage of the mining permitting process and granted the Company the right to develop the Amulsar Project in line with the parameters detailed in the feasibility study. The approval covers i) all project infrastructure, including the location for crushers, the conveyor and HLF, ii) a mining permit applicable to the pits, iii) definition of the area within which operating activities may take place, and iv) a mining agreement that outlines the nature and duration of mining operations.

Granting of the Mining Right followed an extensive application, consultation, and review process. Previously, Lydian received approval of its environmental impact assessment ("EIA") from the Armenian government's Ministry of Nature Protection, acting under the Armenian Mining Code and EIA Law, based on expert reviews and public discussions. In parallel, the Ministry of Emergency Situations approved the Technical Safety Program ("TSP").

An application to the Ministry of Energy and Natural Resources (this Ministry had been renamed in October 2016 into the Ministry of Energy Infrastructures and Natural Resources) to update the existing Mining Right was made in March 2016. The application consisted of updated Mine Plan, EIA and Mine Closure Plan.

The updated EIA was subject to review and scrutiny the Ministry of Nature Protection (MNP) and the Ministry of Emergency Situations. During this process the MNP processed the EIA reports and held the four (4) formal Public Hearings. The updated EIA was approved in April 2016 and the Technical Safety expertise approval was granted in March 2016. The Mining Rights update was approved in May 2016.

20.3.3 International Environmental and Social Impact Assessment (ESIA)

The project ESIA is not a requirement of permitting for the project. However, it was developed meet the additional of the international lenders including the IFC Performance Standards and EBRD Performance Requirements. The comprehensive ESIA was finalised in 2016 and disclosed publicly on 17 May 2016. The ESIA describes the policy, legal and administrative framework under which the assessment was completed and under which the development of the Project commenced; as well as a description of the Project covering geographical, ecological, social and temporal considerations. The ESIA includes a detailed analysis of the baseline data that provides an accurate description of the physical, biological, cultural and historical conditions of the land within the Project footprint and those areas that have already been affected during the course of the development (the Project Affected Area), or could be in the future. The ESIA identifies and assesses the potential environmental and social effects (positive and detrimental) associated with project construction, operation and closure.

Although the Amulsar Project has the potential to create environmental and social impacts, the ESIA demonstrates that potential impacts can be avoided, prevented or reduced in magnitude such that the Project will be constructed, operated, and closed in accordance with IFC Performance Standards, EBRD Performance Requirements and all applicable Armenian and international standards. The mitigation measures that have been, or will be, implemented to minimize or control potential impacts to an acceptable level are presented in the ESIA, together with an analysis of possible alternatives.

Key management plans covering areas such as environmental protection, health and safety, social management and community development among others, have been formulated for the delivery of the Project from construction to operation and through to mine reclamation, closure and rehabilitation (see Section 20.9). These management plans are at various stages of implementation. By adopting a range of impact management and mitigation measures, it is considered that any potential residual environmental impacts will be reduced to a moderate or low (or below) level. Mitigation measures that formed part of the design incorporate ESIA commitments and have been included in the development costs.

Core to the management plans is the adoption of continuous improvement where additional data and information, coupled with technological advances will be reviewed and where necessary modifications made to the management plans (i.e. Adaptive Management) to deliver the project to the highest standards of environmental and social/community performance.

20.3.4 Design Modifications since ESIA / EIA

There have been no significant changes to the project design since the 2016 ESIA/EIA. There have been a small number of minor modifications developed during detailed design and construction and these have been evaluated in accordance with the project's environmental and social impact screening procedure. None of the design modifications have been resulted in a material change to the conclusions of the ESIA/EIA.

Future planned modifications to the design, which do not materially alter the finding of the EIA and ESIA are:

- Rerouting of RD1. It is planned to construct RD1 along the same infrastructure corridor as the overland conveyor and electrical distribution network between PL3 (ore loadout) and PL10 (main power distribution substation). This modification is considered an environmental and social gain as it will reduce land take for the project and concentrate disturbance within a single infrastructure corridor;
- Improvements to the Saravan to project area road. A small unmade road links the project (ADR/HLF area) to the M2 near the village of Saravan. It is planned to widen and improve this road as an emergency and service access route. The improvement is supported by the community of Saravan. The work will only be carried out once environmental surveys and any associated works are completed in accordance with the Project ESMS. This modification is considered an environmental and social gain as it will reduce traffic on the H43 (Jermuk road) as well as improving access to agricultural areas for land users; and
- Additional phase/extension to HLF. The new Phase 5 of the HLF lies within the existing project footprint and outside the 1 km exclusion zone from the nearest residential property determined by the Armenian Ministry of Health. This is considered a significant change to the project and will require permitting about 2 years before the start of Phase 5 construction. The permitting process is likely to require the preparation of an addendum to the EIA/ESIA

20.4 Significant Project Consumption and Releases

The ESIA details the potential effects (both positive and negative) of the Project on environmental and social receptors. Potential impacts to water have been discussed in Section 18.4 and Section 25.2. Other significant consumptions and releases are summarized here:

20.4.1 Land Take

The Project footprint within the Rock Allocation Area will be approximately 609 ha. The Project footprint constitutes the area that will be directly disturbed by placement of new infrastructure and groundworks. An additional disturbed area, demarcated by a nominal 50 m buffer around the Project footprint, has been used to determine the additional area that is likely to be disturbed by Project activities – such as dust deposition, increased noise and vibration, and other disturbances. This additional area amounts to approximately 345.2 ha in addition to the Project footprint.

There will also be a restricted area around the Project footprint and disturbed area, which will be those regions of land that are fenced or have physical barriers to access, or will have controlled or restricted access due to safety concerns and the mine's duty of care to keep the public safe from harm. This restricted area adds another 477.2 ha to the Project.

Land take of the Project and Project components is quantified in Table 20-2.

Table 20-2: Project Component Land Take

Project Component	Footprint of Project component (ha)	Additional Disturbed area (ha)	Additional Restricted area (ha)
Open Pits, of which:	137.0	32.6	323.2
• Tigranes/Artavasdes	96.8	26.4	323.2
• Erato	40.5.	6.2	
BRSF including Landfill, Contact Water Pond and Explosives Magazines	139.2	22.8	59.5
Construction Camp	6.3	41.7	
HLF and Ancillary Infrastructure	165.5	37.3	94.5
Overland Conveyor and Discharge Structure	19.3	57.4	
Maintenance Workshop and Substation	12.6	22.5	
Crushing Facilities	13.9	-	
Misc. Stockpiles, Laydown Areas & Ponds	31.8	-	
Haul and Access Roads	78.8	121.0	
Facilities Platform	6.1	5.6	
Quarries	9.1	4.3	
Total of Project components	***609.0***	***345.2***	***477.2***
Total Land Take and Restricted Land		**1,431.4**	

Source: Lydian (2019)

20.4.2 Particulate Matter (PM10 and PM2.5) and Dust

Fugitive dust emissions are measured as Total Suspended Particulate matter (TSP). The size fractions of concern to human health or the environment are suspended particulate matter (PM10 and PM2.5) and larger particle size nuisance dust. Particles up to 10 µm that are inhalable into the upper respiratory tract are known as PM10 and particles up to 2.5 µm, which are respirable deep into the lungs, are known as PM2.5.

The main project related sources of TSP will be dust emissions from mining (including blasting), haulage, tipping, conveyor transfer points, crushing activities, and vehicle traffic. A Dust Management Plan was developed to minimise dust emissions which involves the use of water trucks, sprinkler systems and dust suppressants.

20.4.3 Greenhouse Gas Emissions

The Amulsar Project will generate greenhouse gas (GHG) emissions. GHG emissions will result from mine activities and will be associated with the use of fossil fuels in construction and operations equipment, transportation vehicles for employees, land use change during construction, use of explosives, and from CO_2 emissions from diesel backup electricity generation. GHG mitigation opportunities have been built into the design. Measures include the selection of conveyor transport, generation of electricity from the downhill run of the conveyor, and procurement of modern high efficiency equipment. Further opportunities for additional reductions in GHG emissions exist and will be investigated during the Life of Mine.

GHG emission have been calculated and reported in the annual Lydian Sustainability Report since the start of construction. Based on data obtained from Lydian's procurement department and contractors working on the project, a cumulative total of 43,275 tCO_2e has been generated by the Project to the end of 2018.

20.5 Environmental Context

20.5.1 Geology and Soils

Soil types, broad characteristics and indicative pH have been identified in the Project affected area and over 2,000 exploration soil samples have been tested for heavy metal content. Targeted samples have also been tested for extended environmental suites including potentially toxic metals, inorganic parameters, radiological parameters, hydrocarbons, cyanide and microbiology. A geotechnical investigation within the proposed footprints of major mine infrastructure has been undertaken which confirmed the soil classification, depth of the soil resource and its' structural integrity.

Soil analysis completed for the ESIA baseline (in 2008, 2010 and 2014) identified naturally elevated concentrations of As, Co, Cu, Pb, Mn, Ni and Sb. These were above the applicable Armenian Maximum Acceptable Concentrations. Lydian carries out soil monitoring on a three-year cycle and samples collected during construction in 2017 recorded results consistent with the baseline dataset.

20.5.2 Radioactivity

The potential of radioactivity arising from the Project dust or in the form of radon has been assessed. Uranium (U) and thorium (Th) concentrations from over 2,000 samples of soil and 46,000 samples of rock (ore and barren rock) have been tested during the company's extensive exploration program.

The concentrations of uranium and thorium were assessed by Radman Associates, a UK based firm of accredited Radiation Protection Advisors to calculate maximum activity levels (Bq kg^{-1}) and the results compared with typical levels of these elements in Armenian soils (United Nations Scientific Committee on the Effects of Radiation (UNSCEAR[1])).

The maximum values measured from the site were slightly in excess of the maximum values reported for Armenian soil. However, the mean values were lower indicating that only a few of the 2,399 samples analysed had elevated uranium and/or thorium concentrations with the majority being within the reported natural values. The assessment indicated that estimated radiation doses would be below threshold levels.

Elevated radon levels exist in the rural areas around the Project, especially in Gorayk. The radon is unrelated to Project activity and is a consequence of the underlying geology. Measures to protect workers

[1] UNSCEAR (2000) Sources and Effects of Ionising Radiation

from potential risks associated with radon have been incorporated into the project design and monitoring has been initiated during construction.

Targeted monitoring has been undertaken during construction to add to Lydian understanding of the potential risks associated with the gas. The data obtained confirms the suitability of the planned radon exposure reduction measures in the ESIA to manage occupational exposure risks.

20.5.3 Earthquakes and Seismic Hazard

Armenia is situated within the Caucasus region near the boundary of the Eurasian and Arabian tectonic plates. Collision of these two plates has resulted in the formation of major crustal faults, folds, and active volcanoes near the plate boundary. Ongoing crustal deformation from plate collision generates small to large earthquakes along the faults and the surrounding area such that the Amulsar Gold Project site is in a region of moderate to high earthquake occurrence.

Detailed studies to evaluate the regional seismic setting and site-specific seismic hazard in the Project area were completed by Golder in 2016 based on information on seismicity and active faults provided by Armenian experts. This information and the seismic hazard results were included in the *Amulsar Gold Project Site-Specific Seismic Hazard Analysis* (Golder, 2016). Golder's site-specific seismic hazard analysis was originally developed in 2014 and updated in 2016. The Project's Environmental Design Criteria uses the updated 2016 results.

The results of the 2016 site-specific seismic hazard study were used to develop seismic design criteria for major mine infrastructure in accordance with international guidelines and Armenian and international building codes (e.g., Eurocode 8, ASCE 7-10). The site-specific studies concluded that there was no evidence of any seismically active fault within the Project area and that the risk of surface fault rupture at the site is very low.

20.5.4 Water Resources

Groundwater

Groundwater on Amulsar mountain exhibits a classic high-elevation pattern with deep water levels on the top of the mountains, and discharge zones in the valleys further down the slope. The TAA pit will likely be dry at total depth, and only the lowest portions of the Erato pit may encounter the water table. The bottom of the TAA and Erato pits are hosted in geothermally-altered LV rocks with low hydraulic conductivity.

Further down the mountain, seep and spring surveys within the BRSF indicate that much of the eastern area (underlain by argillized Lower Volcanic [LV] andesite) is a groundwater discharge area. Ephemeral and perennial springs exist in this area, associated with changes in lithology.

The bedrock underlying the south-eastern portion of the BRSF does not have significant groundwater supply potential because of the low permeability. Basalts underlying the north-western portion of the BRSF and extending north-west of the facility are moderately permeable and may have some groundwater recharge potential. Springs discharging from the basalt at lower elevation approximately 3.7 km north of the BRSF are used for drinking water supply. Groundwater modelling indicates that these springs are not situated hydraulically down-gradient of the BRSF and the basalts are not otherwise used for drinking water supply. The BRSF foundation design incorporates a compacted clay seal with an overdrain and an underdrain to isolate potential BRSF leachate from the groundwater.

The HLF area is situated overlying slightly-fractured andesites of the LV unit. Two ephemeral springs have been observed within the facility footprint associated with localized heterogeneity in the LV bedrock. A localized shallower water table is observed in the center and north-east of the HLF footprint, supported by a lower permeability horizon in the upper LV bedrock. However, the HLF construction will not excavate into the saturated subsurface.

On a regional scale, stable isotope analyses demonstrated that there is a significant distinction between Jermuk thermal water sources and samples obtained from surface water and groundwater on the Amulsar mountain. It can therefore be concluded that the Jermuk thermal mineral water system is not in hydraulic connection with shallow groundwater and surface water on the Amulsar mountain and hence there is no pathway for an impact from the project on Jermuk waters (Golder 2019, Golder 2013).

The ESIA presents information on the baseline groundwater quality and quantity, the Project Area groundwater flow model, site-wide water balance, and an assessment of groundwater impacts arising from construction, operation and closure of the major facilities.

Since completion of the ESIA baseline studies, an ongoing program of groundwater monitoring has been in place. Prior to and during construction, a network of wells have been monitored on a quarterly basis for a suite of analytes. Additional monitoring wells have been installed downstream of the HLF, BRSF and project landfill and further additional wells are planned to further improve the resolution of the monitoring network. All samples are analyzed by an internationally-accredited laboratory.

Data collected since the ESIA has demonstrated no changes to water quality, other than seasonal variations identified in the baseline.

Surface Water

Amulsar Mountain forms the watershed (hydrologic divide) along a north-south ridge through the Project Area, with the Arpa and Darb River catchments to the west; and the Vorotan River catchment to the east. Of the main infrastructure associated with the Project, a portion of the open pits will be located within the Darb sub-basin of the Arpa catchment. The BRSF is located in the Arpa catchment upstream of Kechut reservoir; the HLF, ADR and crusher plant will be situated wholly within the Arpa catchment, draining downstream of the Kechut Reservoir. During the operational phase make-up water is planned from the Arpa and Darb Rivers to supplement water captured and stored on site. Parts of the open pits will be within the Vorotan catchment.

Lake Sevan is the largest lake in Armenia, and in the Caucasus Region. Its basin makes up one sixth of the total territory of Armenia. The lake water is of unusually high quality for a lake of its size and position. During the Soviet period, flows were artificially increased from the lake, leading to dramatic falls in lake surface area, and, among other impacts, a decline in biodiversity and water quality. The lake remains an important national resource for water supply, electricity, fishing and recreation. Measures to restore the quality and size of the lake have been ongoing since the 1980’s, including a tunnel linking the Arpa River basin to the Lake.

This tunnel takes water from the Kechut Reservoir located in the Arpa basin to Lake Sevan. Beneath the Project footprint, there is a second water tunnel named Spandaryan-Kechut Tunnel linking the Spandaryan Reservoir (in the Vorotan River basin) to the Kechut Reservoir. This second tunnel was never commissioned nor is it functional.

Lake Sevan has a specific law governing its protection as it is considered to be of national importance. The ‘immediate impact zone’ identified by this law includes the Kechut Reservoir and its tributaries, including the Spandaryan-Kechut Tunnel, and ore processing is prohibited in the zone. The HLF and ADR plant and Passive Water Treatment facility have therefore been located outside the immediate impact zone. The BRSF lies within the 'immediate impact zone' of Lake Sevan but waste rock disposal is not prohibited by the legislation.

Surface water flows in both the Arpa and Vorotan catchments have been significantly altered by human intervention, including the following:

- The Spandaryan-Kechut tunnel was constructed to divert flow from the Spandaryan reservoir on the Vorotan River to the Kechut Reservoir on the Arpa River Subsequent geochemical analysis indicates that water discharging from the tunnel is chemically distinct from waters in the Spandaryan Reservoir and is likely groundwater (Golder 2013);
- Hydropower stations; the Spandaryan Hydropower Plant is located near Shaqhat at altitude of 1.694 m. It is the upper hydroelectric power plant on Vorotan cascade commissioned in 1989. It is the upper hydroelectric power plant on the Vorotan cascade commissioned in 1989. Its water intake infrastructures in a pressure tunnel, a spillway culvert, and the Spandaryan-Kechut tunnel as described above.
- The Gndevaz Irrigation Channel located to the north and west of Amulsar Mountain, was sourced from the Vorotan River basin and runs westwards towards Gndevaz village, approximately 1 km north of the BRSF. The channel had not been used for many decades; until it was refurbished by Lydian in 2016/2017;
- The Gndevaz drinking water pipelines located to the north and west of Amulsar Mountain, was sourced from the Vorotan River basin and runs westwards towards Gndevaz village, approximately 1 km north of the BRSF; and
- Numerous minor permanent and temporary seasonal diversions are in place to facilitate irrigation of crops and stock-watering in the Darb and Arpa catchments adjacent to the Project.

Baseline studies have identified that the Vorotan River has relatively steady flow during the winter months, which increases rapidly during the spring snow melt. The Arpa, in comparison to the Vorotan, appears to have a steadier flow during monitored snowmelt months, reflecting the artificial control at the Kechut Reservoir.

There are no surface water courses or springs within the footprints of the proposed open pits. Perennial and ephemeral streams (many fed by springs) drain the areas proposed for some of the mine facilities. The mountain slopes and valleys where the proposed mine facilities will be located do not contain major surface watercourses.

No major infrastructure or facilities associated with the Project are proposed within the flood plains of the Vorotan, Darb or Arpa Rivers. As a result, a fluvial flood risk assessment for the main rivers is not required. Project facilities are all located several hundreds of meters above the adjacent Vorotan and Arpa floodplains.

The HLF, BRSF and most roadways are situated within the Arpa River catchment. However, the Water Management Plan (see Section 18.4) provides for the collection and management of all mine contact water so that it will not discharge to the Arpa River upstream from the reservoir. The project has been designed as a zero-discharge facility for untreated contact water. Any water that has the potential to be polluted by mine related activities will be treated to meet Armenian discharge standards before being released.

All water containment structures have been designed for extreme events (including the 100-year 24-hour storm event) to prevent a spill or discharge of mine contact water to this sensitive catchment basin.

Since completion of the ESIA baseline studies, an ongoing program of surface water monitoring has been in place. Prior to and during construction water has been monitored on a quarterly basis for an extensive suite of analytes. All samples are analyzed by an internationally accredited laboratory.

Data collected since the ESIA has demonstrated no changes to water quality, other than seasonal variations identified in the baseline.

Community Water Supplies

Domestic and municipal water supplies are predominantly sourced from spring water originating from shallow perched water or from groundwater.

The residents of Jermuk are supplied with drinking and domestic water from four main groups of springs located approximately 3 km north of the town. The residents of Kechut are supplied with domestic water from a group of springs located approximately 2 km east of the town. Water for drinking and domestic use for the village of Gorayk is supplied by a network of three springs. Gravity-fed pipelines transport water from the springs to two central reservoirs in Gorayk. Drinking and domestic water for Saravan, Saralanj and Ughedzor is sourced from a series of springs.

The residents of Gndevaz are supplied with domestic water from two groups of springs: the Seven Springs located 17 km northeast of the village; and the Darayurt springs located 11 km north of the village, west of Kechut reservoir. Water from both spring groups is conducted to Gndevaz via gravity-fed pipelines. A detailed Springs and Water Users Study was completed in June 2014.

Early in the construction phase Lydian undertook, at the request of the Gndevaz community, significant upgrade works to the Gndevaz irrigation channel. This open channel, which links the Seven Springs to Gndevaz Reservoir had been in a state of disrepair for many years, and in 2017 water once again flowed.

20.5.5 Biodiversity

Protected Areas

The Project lies on the southern edge of the Caucasus Mixed Forest Ecoregion, which is a Global 200 Ecoregion (Ecoregions identified by WWF as priorities for global conservation because of their important biodiversity and high levels of threat). The Caucasus Mixed Forest Ecoregion covers a wide area of 170,300 square kilometers including portions of Georgia, Russia, and Azerbaijan as well as Armenia. It has been assigned a status of “critical/endangered” due to rapid land use changes, including widespread deforestation. The Project Affected Area itself does not currently support forests of the type prioritized within the Ecoregion, but some scattered remnants remain in the surrounding landscape and potentially offer scope for restoration.

The closest National Park to the site is the Sevan National Park located approximately 44 kilometers to the north-northwest of the Project. Three specially protected State Sanctuaries are located in the vicinity of the Project as illustrated in Figure 20-2, below: Jermuk (2.9 km north), Her-Her Open Woodland (5.1 km, west) and Jermuk Hydrological (6.4 km, north).

The project design avoids direct effects on both the Gorayk and Jermuk Important Bird Areas (IBAs). However, the Lesser Kestrel (*Falco naumanni*), which is a species of concern in the Gorayk IBA, are known to hunt in the Project Affected Area. The status of Lesser Kestrel on the IUCN Red List has decreased from

Vulnerable down to Least Concern though it is still listed as Vulnerable on the Armenian Red List and the only breeding colony in the country is at Gorayk, making it important in a national context. The Gorayk IBA also was designated because of a large number of other species including Egyptian Vulture (*Neophron percnopterus*) which is listed as Endangered by IUCN, several other raptor species and a large number of passerine and wetland birds.

The Jermuk IBA has very varied habitats for birds, including mountains, montane meadows and meadow steppes and also the Jermuk/Arpa Gorge, which provides important raptor nesting habitat including Egyptian Vulture, as well as being important for the conservation of other taxonomic groups, notably mammals. The Jermuk IBA, together with other existing protected areas adjoining it, forms part of the planned new Jermuk National Park.

The Project will not have direct effects on Jermuk or Gorayk IBA, but does provide feeding area that supports the bird species for which these areas are designated. Land use changes throughout the Project affected area could affect availability of prey items for birds of prey. The availability of undisturbed hunting habitat for Lesser Kestrel and feeding habitat for Egyptian Vulture and other raptors is being monitored as part of plans to develop offset opportunities to ensure that the Project does not cause irreversible declines in species or habitats in the longer-term.

Habitats

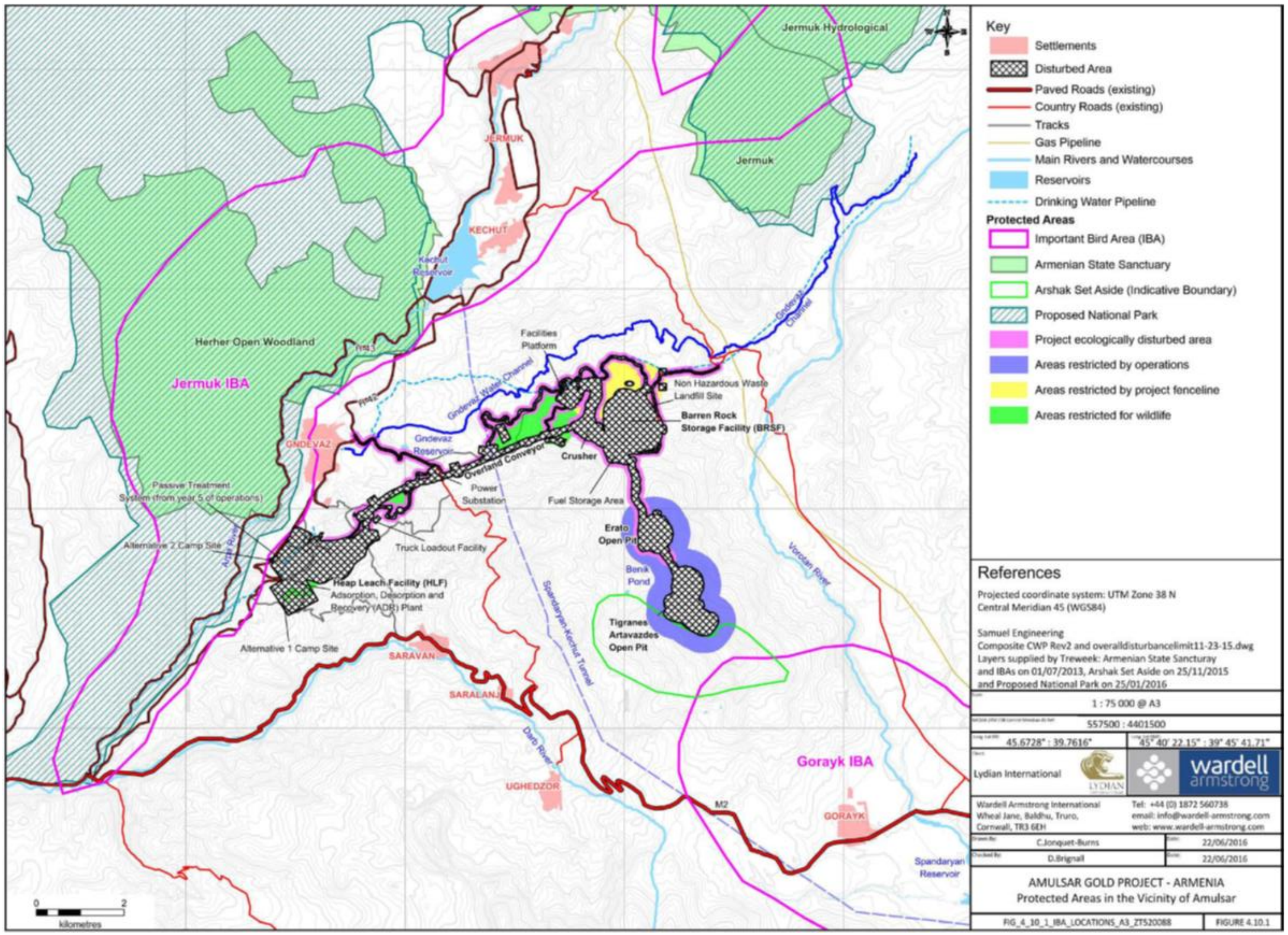
Most land within the concession area is “natural” habitat (albeit with many anthropogenic influences such as grazing). Habitat type and vegetation distribution has been analyzed using satellite imagery and further details of the density of vegetation within each of the Project components has been considered.

The main vegetation/habitat types found in the Project Affected Area are cultivated land, montane meadow, montane meadow steppe, sub-alpine meadow, sub-alpine meadow with alpine elements, rocks/scree, vegetation with shrubs, wetland and riparian. While Amulsar does not support alpine vegetation as defined within the Armenian classification, plant species do occur which are typical of the alpine zone and a new description (sub-alpine meadow with alpine elements) was defined to describe the type of vegetation found on the highest areas of the mountain. A vegetation type including shrubs was also included because of the conservation importance of remaining shrub habitat and the fact that it is one of the characteristic vegetation types of the Caucasus Mixed Forest Ecoregion.

The flora within the Project study area is characterized by a sub-alpine and alpine meadow landscape, which is typical of much of the central region of the Republic of Armenia (approximately 28% of the national area). The vegetative climatic range for alpine meadows is generally over 2,100 m and up to 3,400 masl. Within the Project area, Mount Amulsar, at an elevation of 2988 masl, has vegetation that is typical of alpine meadows. The main components of development, including the mine pit, crushing plant and barren rock storage facility plus ancillary facilities are all located within the grasslands that can be characterized as alpine meadows. Sub-alpine meadows occur in the foothills and support more productive agriculture typical of the principal pasture land in the country. Within the Project area the footprint of the HLF plus ancillary facilities are located within grasslands that are characterized as sub alpine meadows.

There are several wetland habitats present within the Project area, generally within the Vorotan River catchment. This includes valleys and tributaries that form an extensive network of surface drains within the Project area. Habitats include the Benik pond, Vorotan River and tributaries, suspended marsh and mires wet meadow; some of which form part of the functioning ecosystem supporting the species identified within the IBA.

Figure 20-2: Protected Areas in the Vicinity of Amulsar



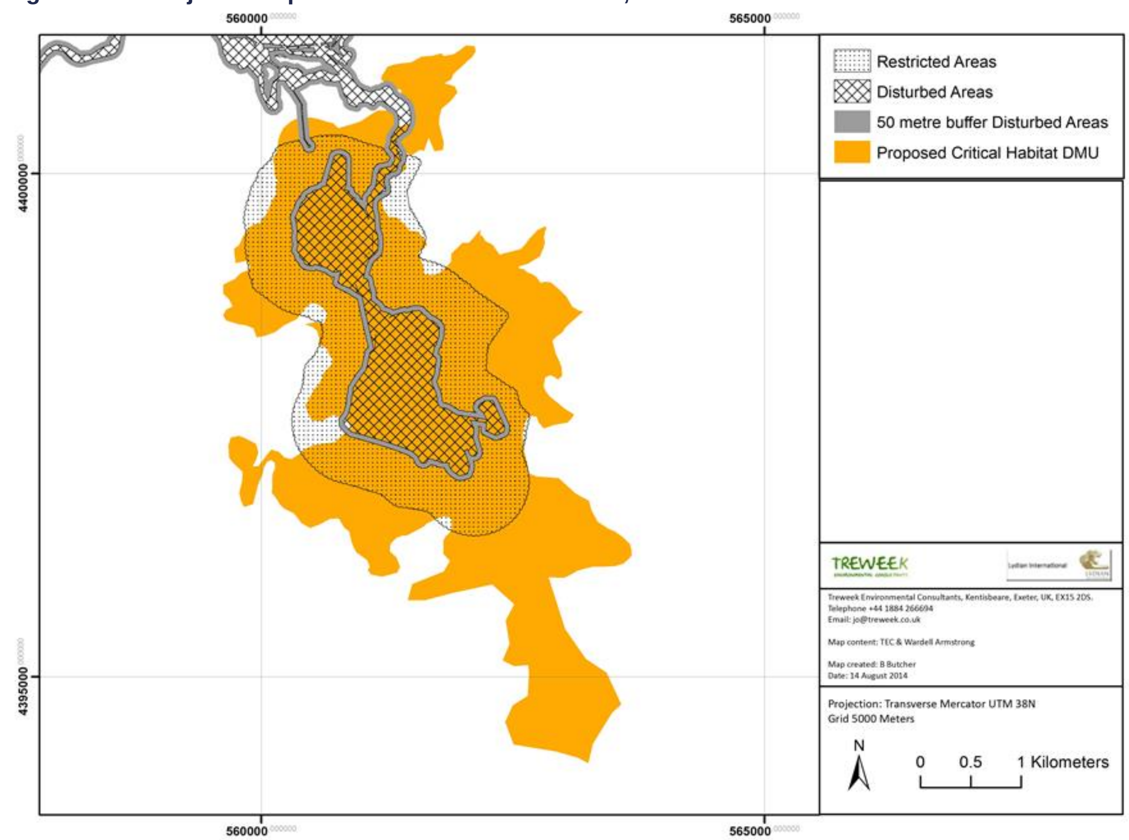
Source: Wardell Armstrong (2016)

Protected Species

Potentilla porphyrantha

Desk study and field observations indicate that several IUCN listed and Armenian Red Book (2010) species are present, or have a high potential to occur, in the Project area. In 2012, an Armenian Red Book plant species - *Potentilla porphyrantha* (*P.porphyrantha*) - was identified in the area of the open pits. Further baseline work was conducted to clarify the importance of the Amulsar *P.porphyrantha* population in a national and international context. It was found that the sub-population of *P.porphyrantha* at Amulsar is one of only five known extant sub-populations globally, and this resulted in upper elevations of the project footprint being designated Tier 1 Critical Habitat[2] (Figure 20-3) (IFC Performance Standard 6).

Figure 20-3: Project Footprint on Tier 1 Critical Habitat, Selected for the Plant Potentilla



Source: Samuel Engineering (2017)

In recognition of the importance of *P.porphyrantha* a species-specific Action Plan was developed during the ESIA process and has been implement since then. The plan sets out a series of actions to ensure delivery of a Net Positive Impact for this plant. Guided by the Action Plan research, plant translocation and field trials have been conducted in partnership with the national herbarium, the Academy of Science of

[2] The Amulsar sub-population is therefore believed to meet one of the thresholds for Tier 1 critical habitat - habitat with known, regular occurrences of Critical or Endangered species where that habitat is one of 10 or fewer discrete management sites globally for that species

Armenia and the Institute of Botany and Cambridge University Botanic Garden (UK) to establish effective techniques for restoring *P.porphyrantha* and other vegetation types affected by the Project.

The results of the ongoing studies and monitoring are reported to the Ministry of Nature Protection. To date the results have been positive and suggest that successful translocation of *P.porphyrantha* is possible and therefore the reintroduction of the plant in suitable mining affected areas will be effective during site rehabilitation.

Brown Bear (Ursus arctos)

Tracks and feces of Brown Bear (*Ursus arctos*) were observed in and around the project area during early project related activities. Subsequent detailed surveys looking at the presence and behaviour of *Ursus arct*os at Amulsar and in the wider region were undertaken, using a network of 34 motion-activated, infrared camera traps and hair sample collection (for DNA analysis) from specially designed traps and its presence was confirmed and suggested that up to 10 bears could be directly affected by the project.

Ursus arctos is a protected species in Armenia and is included in the national Red Data Book with a status of Vulnerable. Although classified as Least Concern by IUCN, it is listed in Annex IV of the EU Habitats Directive, which means that degradation of its habitat is prohibited under EU law. This is of significance to the Project because of its commitment to comply with the EBRD PR6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) - which assumes compliance with EU law.

The presence of this mobile protected species necessitated specific mitigation measures which include the provision of wildlife crossings to allow the animals to cross the project conveyor. Crossing number 5, nearest the crusher platform and bear habitat is specifically designed to accommodate the movement of bears. Other crossing included in the project design are multi-functional and positioned to allow the movement of wildlife, herders and other community users across the conveyor line.

As with *P.porphyrantha* the importance of the Brown Bear was recognized by the company and a species Action Plan developed and implemented. The Action Plan builds of the work completed during the baseline studies with a focus on monitoring in the immediate Amulsar area (using field observations and fixed, motion activated camera traps).

Furthermore, a significant area of land (Jermuk National Park) was agreed to offset any residual impacts of the project on the Brown Bear (see Section 20.4).

Reptiles

The Project-affected area also provides good habitat for several species of reptile, particularly at lower elevations. Three species which are listed in the RA Red Book have been observed in the Project area: Armenian Mountain-steppe Viper (Pelias (Vipera) eriwanensis), Radde's/Armenian Rock Viper (Montivpera raddei), and Cat Snake (Telescopus fallax). These species, however, also have suitable habitat in the wider landscape. Training on snake identification is provided to all employees and contractors and any snake(s) found during construction works are captured and relocated to suitable habitat outside the project area.

Other Protected Species

One species of beetle, *Dorcadion bistriatum* Motsch, listed in the RA Red Book, was recorded in the Gorayk area. Other notable beetle species include *Dorcadion sisianum* Lazar and *Dorcadion scabricolle sevangense* which are the most vulnerable endemics of Armenia and are a conservation priority. These both occur in the Gorayk area, outside the Project Footprint. A rich butterfly assemblage is found in and around the project area including the Apollo butterfly which was the only species recorded which is listed in the IUCN Red List (as Vulnerable). The Apollo butterfly has not been recorded in the project footprint and the project design ensured that an area of its food plant was avoided.

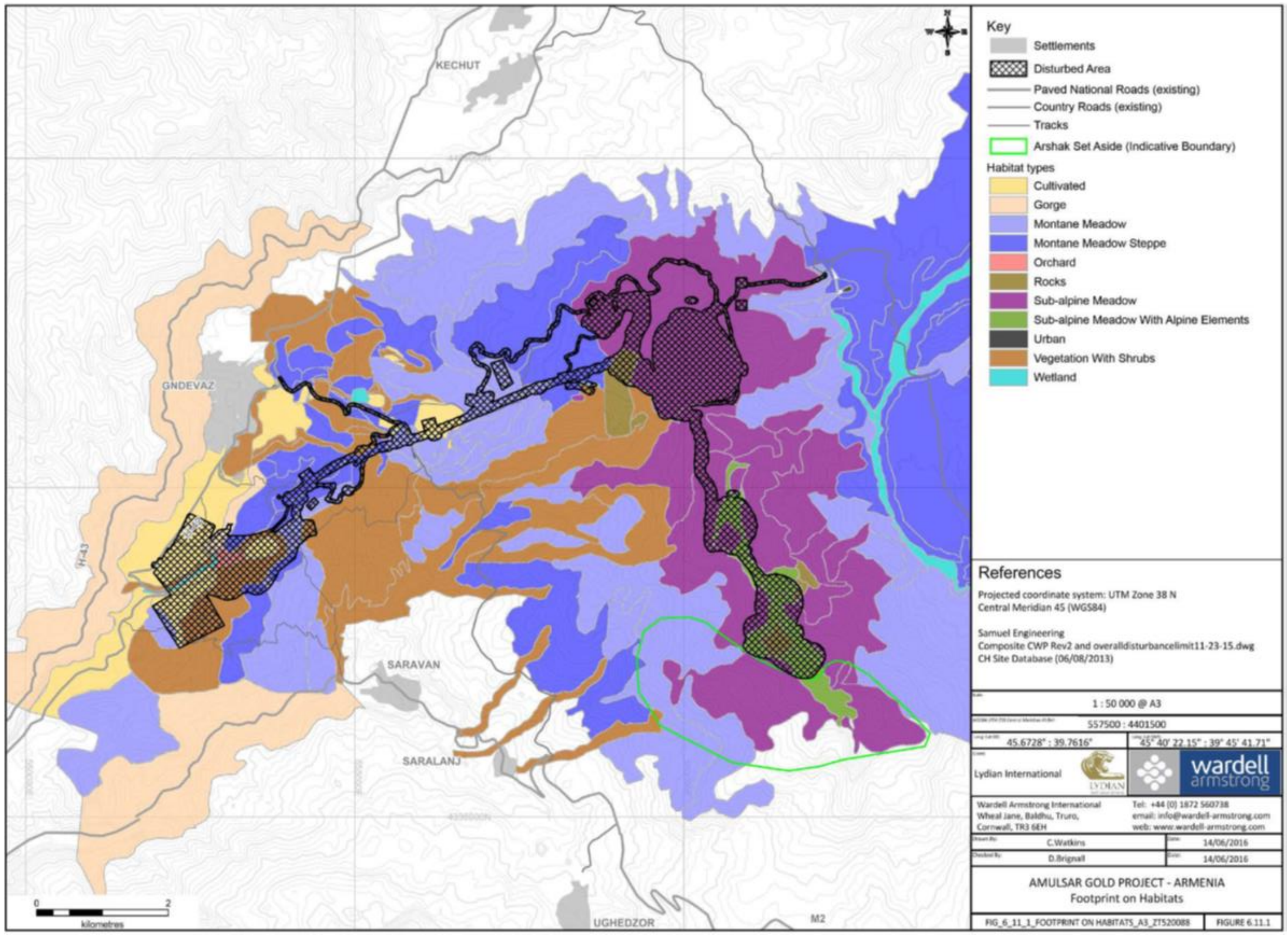
No Red Listed fish have been recorded.

Arshak Set-aside

A formal set-aside (referred to as the “Arshak Set-aside”) was identified to avoid / safeguard a viable proportion of the *P.porphyrantha* population south of Arshak Peak within which no Project activities are authorized (Figure 20-4). This incorporates the southern part of the Critical Habitat. Elsewhere, individual occurrences of the plant have been marked, and access routes required during exploration activities have been designed to avoid them. The Arshak Set-aside also preserves important breeding habitat for Brown Bear (*Ursus arctos*), high quality examples of sub-alpine meadow vegetation, habitat for other species of conservation importance (Eurasian Lynx, Wolf, Bezoar Goat), and habitat for bird species included on the RA Red List.

Monitoring of the set-aside during construction has confirmed that Brown Bear has continued to use the area for breeding.

Figure 20-4: Project Footprint on Footprint on Habitat Types, including Arshak Set-Aside (green irregular outline)



Source: Lydian (2019)

Offset land: Jermuk National Park (JNP)

A permanent footprint on natural habitat is likely as a result of the project and therefore offsets are considered necessary to achieve "no net loss" of vegetation types defined as "natural" per IFC PS6 and EBRD PR6. In addition, there are some globally endangered species which are known to use, or have used, the project area. These include the Brown Bear, Caucasus leopard (an endangered sub-species), the Eurasian Lynx (listed as 'Endangered' at European level by IUCN) and the Bezoar goat. It should be noted that only Brown Bear has been recorded in the immediate area of project for many years. Therefore, Lydian committed to an 'offset'[3] for these residual impacts on natural habitat and developed the Project's Biodiversity Offset Strategy that was included in the ESIA.

The Republic of Armenia had previously prioritized the creation of a new National Park at Jermuk. The creation of Jermuk National Park (JNP) would provide a framework for implementing offset activities to enhance the diversity and condition of native vegetation and associated wildlife populations. Lydian therefore established and financed a project to follow best international practice for establishment of a protected area using participatory and transparent approaches. A Memorandum of Understanding signed with the Ministry of Nature Protection in December 2016 and an implementing team was established and an operating budget agreed for an initial 5-year establishment phase. A series of comprehensive baseline surveys were completed, and a Stakeholder engagement focused on local communities and land users in the proposed territory of the JNP. Initial budget estimates associated with the establishment and start-up of the JNP were $5.7 M and updated costs are included in the project G&A.

Baseline surveys of the proposed JNP footprint were completed in 2015, 2016 and 2017. The data from these baseline surveys together with feedback and opinion gathered through stakeholder engagement will used to develop the eventual park management strategy.

In 2017 the Project Implementation Unit was established to facilitate the establishment of the park. A draft Decree for legal establishment of the Jermuk National Park was also drawn up in 2017 but has yet to be enacted by Government. Due to the lack of progress in enacting the legislation to establish the park Lydian advised the Government that alternative options for investment in the biodiversity offsets would be needed for the project. In October 2018 all activities relating to the JNP were formally suspended due to the blockades.

20.5.6 Ecosystems Services

The Project affects ecosystems which supply important ecosystem services to local communities. It will affect the supply of these services as well as the ability of local communities to access them. Community activities affected by the Project include pastures for grazing, meadows for hay production and grasslands for collection of herbs and medicinal plants, due to restrictions from the project on access and changes in land management. Others affected are cultural services such as traditional ways of life and the role of Amulsar Mountain in providing a reference landscape and supporting national conservation of biodiversity and natural heritage. Further consultation with local communities is needed to establish the extent to which current levels of use are valued and depended on by local communities and therefore the extent to which community activities affected by the Project can be substituted or addressed through livelihood

[3] Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization and restoration measures have been taken (IFC Performance Standard 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources. 2012

interventions as part of the Livelihood Restoration Plan. Plans to offset impacts on natural habitats also need to be reviewed in relation to current use of proposed areas by local communities.

Grasslands support seasonal grazing for sheep and cows; in the foothill zones medicinal species are also known to be present. A questionnaire has been undertaken to assess which areas are foraged by local people for wild plants and the types used for household/dietary and medicinal/homeopathic purpose. The results provide information on the relative abundance and local availability of the species used and have been used in the assessment of impacts on ecosystem services and land uses.

20.5.7 Air Quality

There are no significant urban or industrial emission sources within the area, and therefore the existing levels of related gasses (SO_2, NO_x) and particulates are generally low.

Baseline monitoring of particulates (PM10, PM2.5 and Total Deposition) and gases (including SO_2 and NO_x) at the Project site and nearest communities will continue and will be supplemented by construction and operational monitoring in order to assess and control (if necessary) emissions to air. A new baseline survey was undertaken in 2015 to refine the data acquired until 2014.

Since completion of the ESIA baseline studies, an ongoing program of air quality monitoring has been in place. Prior to and during construction air quality has been monitored in accordance with the Environmental Monitoring Plan. Routine monitoring includes nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) and dust and fine particles using fixed and portable measurement equipment.

Data collected since the ESIA has demonstrated no changes to SO_2 and NOx as a result of project activities. There have been some occurrences of excessive fugitive dust generation during construction works in 2017 which resulted in community complaints. Generally, works had been halted and corrective actions taken before any complaint had been received. The dust mainly came from dry areas of exposed earth (e.g. the HLF area), partly constructed topsoil stockpiles and rock crushing plant. A formal Dust Management Program with water trucks, sprinkler systems and dust suppressant trials were established in 2018 under the Mine Operations team.

20.5.8 Noise and Vibration

There are no major urban centers or industrial activities in the region that would result in significant levels of noise. The small hydro-electric power plant on Vorotan River results in a negligible noise impact in the Project area.

The M-2 public highway to the south of the Project experiences relatively constant traffic but at a low-density although there are some seasonal variations. However, the baseline local traffic flows on the road links in the study area are very low and within the local village residential receptors, traffic noise is generally considered inaudible.

The baseline noise environment is typical of the rural setting, and experiences very low background levels throughout the day and night.

Since completion of the ESIA, baseline studies an ongoing program of noise monitoring has been in place. Data collected since the ESIA has demonstrated no changes to the noise setting as a result of project activities.

Ground vibration and air overpressure result from blasting at construction and mining projects. There are no operations of a similar nature in the locality, and the effects are absent in the current baseline conditions.

The potential for adverse impacts associated with blasting fall into two categories; those causing nuisance and those with the potential for causing damage to structures. The principal source of vibration and overpressure will result from blasting to remove rock from the open pits, but these activities are a long distance from the nearest residential receptors.

Monitoring undertaken during construction have recorded some elevated over-pressure (noise) readings during blasting but these have been rectified through improved blast design and control in the field. Importantly during blasting for the construction of the mine haul road (i.e. in an area where pit development blasts will take place) vibration and overpressure measurements have, at the nearest receptors, returned results no different from baseline levels.

20.5.9 Archaeology and Cultural Heritage

Armenia's archaeological and historical wealth is evident in this region from vestiges of both local prehistoric cultures and later foreign influences. The country contains a heritage resulting from occupation by the Assyrians, Greeks, Romans, Byzantines, Arabs, Mongols, Persians, Ottoman Turks and Russians.

Baseline studies in the Project area identified some 487 potential cultural heritage sites. Additional investigations continued into the construction phase. Of the 487 identified sites, 81 are within 50 m of the project footprint and were evaluated as requiring further investigation (excavation) or were not directly affected by the project development. A total of 65 sites have been excavated by a contracted Cultural Heritage NGO affiliated with the Ministry of Culture.

None of the features identified have required in-situ preservation which could affect the progression of development. There are no known uninvestigated cultural heritage sites within the project footprint.

A Cultural Heritage Management Plan is in place which includes a Chance Finds Procedure to reduce impacts to sites encountered during excavation, grading and similar ground disturbing should potential site and/or artifacts be identified or found during any project related activities.

20.5.10 Visual and Landscape

A key component of the ESIA was a detailed assessment of landscape and visual impacts considering potential impacts during construction, operation, closure and rehabilitation and post-closure monitoring of the mine.

The potential landscape and visual impacts generated by the Project have been assessed for six defined landscape character types that cover the study area and 14 representative viewpoints, in order to determine potential impacts upon specific landscape and visual receptors. Mitigation measures are proposed and integrated into the Project FS level design to avoid or reduce the occurrence of significant landscape and visual effects.

Viewers will experience significant residual visual impact. The majority of these effects will be experienced throughout the construction and operation phases of the Project, with many diminishing over time through the closure and post-closure monitoring phases of the Project.

As vegetation becomes re-established in the longer-term, effects may be regarded as neutral; landscape and views will remain permanently altered, but the closure and rehabilitation measures will result in these areas gradually blending back into the surrounding landscapes. Adequate visual screens and a progressive reclamation program will be implemented at the all project facilities as suitable areas become available.

Visual screening berms and topsoil stockpiles have already been vegetated to aid screening and stability and, maintain soil condition.

Overall, the significant effects on landscape and visual receptors will be largely localized within 5 km of the Project site area. Many of the significant landscape and visual effects identified will be short to medium-term and will become neutral following the cessation of operations, removal of Project components and implementation of closure restoration measures and post-closure monitoring. Significant landscape and visual effects arising from the open pits, HLF and BRSF will be permanent albeit that they will reduce in significance over time, with some remaining following the post-closure monitoring phase of the Project. As the rock weathers, and vegetation returns, the changes will become progressively less apparent.

20.5.11 Cyanide Management

Lydian Armenia is a signatory of the International Cyanide Management Code (the Cyanide Code). In 2017 the project was subject to an independent pre-operational audit by an auditor certified by the International Cyanide Management Institute. The company was pre-operationally certified in January 2018, and must undergo a full operational audit within one year of its first receipt of cyanide.

Under the Cyanide Code, the company must purchase cyanide from a certified producer. Both the producer's certification and the transportation route certification must be in place prior to Lydian's operations certification audit. The cyanide on site at the time of the operational audit must be from a certified producer. The company has a commitment from the preferred supplier to fulfil this certification requirement.

20.5.12 Waste Management

Waste management at the project will comply with Republic of Armenia legislation and commitments made in both the Environmental Impact Assessment (EIA) required for state approval, and the Environmental and Social Impact Assessment (ESIA) undertaken in compliance with good international industry practice (GIIP) and according to Project stakeholder (including financiers) requirements.

Since the completion of the ESIA the design of the projects non-hazardous waste landfill was completed, and its construction started. Armenian legislation requires wastes to have a 'passport' prior to any off-site disposal and Lydian has obtained those required for construction wastes. Contractors have been identified for the removal and disposal/recycling of hazardous wastes (including cyanide boxes) and the passport application process is ongoing.

An area adjacent to the project landfill will be used as a secure waste transfer station.

20.6 Social Context and Baseline

Armenia has ten administrative regions (marzes), including Vayots Dzor (population 53,200) and Syunik marzes (population 142,000), where the Amulsar Gold Mine is located. The industry of Vayots Dzor contributes by only 1% in the annual total industrial product of Armenia. Industry is mainly based on water bottling, alcoholic drink production (mainly wine), food-processing, and dairy products. Vayots Dzor has the poorest agricultural index among the Armenian provinces, forming 2.2% of the annual total agricultural product of Armenia. Around 82.5% (1,903 km²) of the total area of the total area of the province arable lands, out of which only 8.5% (162 km²) are ploughed.

20.6.1 Demographic, Family Structure and Migration Patterns

The study area for socio-economic considerations is comprised of the villages of Gorayk, Saravan (including Saralanj and Ughedzor), and Gndevaz, all of which lie within a 9 km radius around the Project, as well as the city of Jermuk (and the associated village of Kechut), located 14 km from the Project. In context with the marzes mentioned above, Sarvan, Gndevaz and Jermuk are in Vayots Dzor while Gorayk is in Syunik Marze. Socio-economic baseline data were obtained through reconnaissance visits, household surveys covering all rural households and a sample of Jermuk households, focus groups with community members, and semi-structured interviews with a range of community members, community leaders and administrators.

The total population of the study area is approximately 6,700 people; with some 5,200 of these people living in the town of Jermuk (including the associated village of Kechut) and some 1,500 in the three rural communities of Gndevaz, Saravan and Gorayk. The total figure includes an estimated 60 seasonal (summer) herders based in Ughedzor and in many other locations in and around the Project area, with main herder camps being focused around the site of the BRSF.

Household sizes in the study area averaged five to seven in the rural areas, while Jermuk averages three or more members per family. Family life and family allegiance are important to the local communities. Often family units consist of different generations, with sons bringing their wives into the family home. Mother and daughter-in-law relationships are paramount, with the mother-in-law managing the household assisted by daughters and daughters-in-law. Although women have an important role in the household, men are regarded as the head of the family and community affairs are predominantly managed by men.

Since the baseline studies for the ESIA, Lydian has worked with local community leaders to monitor migration (in/out) from project affected communities through a program called the Village Passport Scheme.

20.6.2 Household Income

The livelihood strategies of the local households are multiple and flexible, with household members engaging in a multitude of subsistence and cash-based activities. In general, women engage in subsistence food production and agricultural product-based small-scale business (cheese, butter). Men take care of crop and fodder cultivation and seek formal employment where available. Livelihoods in the rural communities of Gndevaz, Gorayk and Saravan are dominated by agriculture. The majority of household income levels are under AMD 70,000 ($170) per month. Economic activity in Jermuk is based on tourism and local services.

The data collected for the settlement study mentioned above has been incorporated into the impact assessment process. Barriers to economic growth have also been identified. Potential employment in the mining industry is seen both as a benefit for the unemployed and as a deterrent to agricultural growth.

While the bulk of the steady state Amulsar workforce will be Armenian, Lydian Armenia has set itself a target of 30% local employment for direct employees and contractors. This is defined as employees from the project affected communities or other nearby villages. During the construction phase completed to date this number was exceeded and levels of 50% local recruitment were realized with the operations recruitment during the first half of 2018.

20.6.3 Land Use

The predominant land use in the vicinity of the mine site is agro-pastoral, including cattle grazing, cultivating grains and other crops, fruit orchards, beekeeping and hay cropping. Agricultural land is subdivided into arable land, hayfields, irrigated arable land, agricultural lands and pasture. Within the Project area, most of the land use is for extensive summer grazing. The location of the HLF and associated infrastructure (including the conveyor corridor) has reduced the land available for the cultivation of apricots and other crops by residents from the community of Gndevaz. However, a compensation system was implemented, and a three-year livelihood restoration plan enacted for Gndevaz residents affected by the project. The land acquisition and compensation processes were completed in 2016 and detailed in Section 20.8.4

20.6.4 Social Impact Assessment

Historically, the region has not experienced significant mining activity. Extractives industry activities close to the site include a small quarry close to Gorayk and a closed metal mine near Saravan, with larger mine operations present in the south of Armenia. During exploration activities and stakeholder engagement, it has become apparent that local people were generally supportive of the Project.

The potential benefits from employment were welcomed, however in all settlements (Gorayk, Gndevaz and Saravan) community expectations were high.

Other positive impacts relate to improvements in local livelihoods through direct employment by the Project, as well as knock-on economic growth; and macroeconomic growth through taxation, land rent and other revenues paid by the company through activities such as local procurement. Positive impacts range from minor to moderate; provided enhancement measures are implemented.

Effective implementation of the mitigation measures defined in the ESIA will be essential to derive and maintain positive benefits associated with the Project through the construction and operational phases. The company's social policy and strategy and planned community development measures are expected to provide additional benefits to local communities, over and above the Project impacts.

Social impacts at mine closure stage have also been assessed; depopulation, economic decline and breakdown of some community services are the main impacts expected. Mitigation measures have been identified and involve progressive social investment, community development, economic diversification and capacity building activities within the operational stage.

The details of mitigation and enhancement measures are considered in the ESIA. The associated management plans have been defined and will be incorporated into operational controls, as well as the ESMS.

20.7 Cumulative Impacts

Cumulative impacts are those that result from the incremental impact of a project when added to other existing, planned, and/or reasonably predictable future projects and developments, and natural variations such as climate change. The ESIA (Chapter 7) assessed cumulative impacts on identified Valued Environmental and Social Components (VECs) and where necessary confirmed the effectiveness of existing mitigation measures or defined additional strategies to manage impacts.

20.8 Environmental and Social Management

20.8.1 Environmental and Social Management System (ESMS)

Lydian has developed an Environmental and Social Management System (ESMS) as well as a Health and Safety Management System (HSMS), which outlines its commitments to environmental and social management, mitigation and monitoring.

The Environmental and Social Management Plan (ESMP) is part of the ESIA, and is described in the revised in the ESIA v10 including a detailed Commitment Register (CR). The ESMP comprises numerous management plans and procedures for the implementation, monitoring and reviewing of the environmental, health, safety and community impact mitigation measures identified in the ESIA and ensuring that they are adequately implemented during construction and operation. Management plans will be reviewed periodically and updated over the life of the Amulsar Project. The review will take into consideration internal and external reviewer and stakeholder comments, any regulatory changes, amendments in mining operations and any process which will affect the content and scope of the plan in question.

The following management plans have been developed and where appropriate have been implemented during construction:

- Stakeholder Engagement Plan (SEP);
- Occupational Health and Safety Plan (OHSP);
- Footprint Management Plan (FMP);
- Emergency Preparedness and Spill Response Plan (SPSRP);
- Transport Management Plan (TMP);
- Cyanide Management Plan (CMP);
- Environmental Monitoring Plan (EMP);
- Solid Waste Management Plan (SoWaMP);
- Air Quality, Noise and Vibration Management Plan (AQNVMP);
- Dust Management Program;
- Community, Health and Safety Plan (CHSP);
- Community Development Plan (CDP);
- Cultural Heritage Management Plan (CHMP);
- Preliminary Mine Reclamation, Closure and Rehabilitation Plan (pMRCRP);
- Acid Rock Drainage Management Plan (ARDMP);
- Biodiversity Action Plan (BAP), including Annex 1 - Species Action Plan for P.porphyrantha, and Annex 2 - Species Action Plan for Brown Bear Ursus arctos and the Biodiversity Offset Strategy (BOS);
- Biodiversity Management Plan (BMP);

- Surface Water Management Plan (SWMP);
- Land Access and Livelihood Restoration Plan (LALRP);
- Contractor Management Plan (CMP); and
- Participatory Monitoring Program (PMP)

All the management plans were updated to reflect the outcomes of the optimization work, and where necessary lessons learnt during early construction works.

In 2013, Lydian developed an Environmental and Social Management System (ESMS) for the exploration phase at Amulsar. This ESMS was updated for the construction phase, and is the mechanism for implementation of the ESMP.

Selected Management Plans which have been updated since the previous 2017 – 43-101 Feasibility Study are further described below.

20.8.2 Stakeholder Engagement Plan (SEP)

The project Stakeholder Engagement Plan governs the process of stakeholder engagement for the project and includes all community engagement process. The project stakeholder engagement plan was updated in 2018.

Community engagement is carried out at informally through the Amulsar Information Centres (AIC), and formally through the community committees. The project has established an AIC in each of the project affected communities (Jermuk, Gndevaz, Saravan and Gorayk). AICs are staffed on a full-time basis by community liaison assistants and provide a mechanism for community members to ask questions about the project, register grievances and access key project documentation (e.g. EIA and quarterly environmental monitoring reports) which is kept in them. Disruptions caused by the blockade of the project resulted in the temporary closure of the Gndevaz AIC but community liaisons keep in touch with community members on cellphones and informal meetings.

The main vehicle for formal community engagement was the monthly Community Liaison Committee meeting in each community. From the beginning of 2019, these were halted during the site blockades although essential community engagement maintained through, individual or small group meetings.

20.8.3 Environmental and Social Monitoring Plan

Since the publication of the ESIA (v10), Lydian continues to build on the existing environmental and social baseline monitoring program, via the introduction of targeted and refined monitoring programs, suitable for the construction phase of the Project. The purpose of the monitoring plan is to outline the key monitoring requirements identified by the ESIA process to evaluate the environmental and social performance of the project. The plan is reviewed continuously and adapted as appropriate for the construction, operation, closure, and post-closure mine phases.

The overall objectives of the monitoring plan activities are to:

- Ensure regulatory requirements are met;
- Check that impacts do not exceed Project, national and international standards thresholds;
- Verify predictions made in the ESIA by obtaining real time measurements;

- Verify that mitigation measures are effective and implemented properly;
- Identify, track and provide early warning of potential environmental impacts;
- Regulate process efficiency of mining activities;
- Inform future operations; and
- Contribute to continuous improvement of Project environmental and social management.

During project construction additional groundwater monitoring wells were installed down stream of the HLF and BRSF. Additionally, two measurement flumes were installed to continuously measure surface water flow. These flumes are located in Site 13 in the Vorotan drainage, and at Benik's pond, in the Darb drainage.

In 2017 the monitoring plan was updated to incorporate a series of construction related activities, revised Standard Operating Procedures and incorporate legislative changes relating to the monitoring of mining wastes.

20.8.4 Land Acquisition and Resettlement

Economic Resettlement for the project was executed under the Land Acquisition and Livelihood Restoration Plan (LALRP) and completed by the end of 2017. The LALRP provided a framework for all resettlement activities and was designed and implemented to ensure compliance with Armenian legislation and applicable international standards (IFC PS5 and EBRD PR5). Following the 2016 value engineering of the project, an addendum to the LALRP was prepared to accommodate the various changes. The LALRP and 2016 addendum were included as an appendix to the 2016 ESIA.

By the end of 2016, all 278 private land plots required for the project had been acquired from 150 affected households. These plots comprised approximately 139 ha of arable land, orchards and pasture/hay land. An additional 34 plots of private land covering a total surface of 13 ha were also been acquired for the conveyor. Only one resident required resettlement and this was completed in 2017. Forty-five affected seasonal herders were also provided various forms of compensation.

All land acquisition and resettlement for the project was completed on a voluntary basis with no compulsory purchase or similar non negotiated measures required. No further resettlement is necessary to execute the project.

20.8.5 Livelihood Restoration Plan and Other Social Investment Programs

Since project approval was received, the company has implemented its community/social development (all communities) and Livelihood Restoration Plan (LRP) (Gndevaz only).

The LRP was a 3-year commitment which started in 2016, with 2018 being its final year. The LRP was based on extensive engagement with stakeholder groups in Gndevaz who identified several areas that they would want to see developed over the life of the LRP. The plan had five goals as set out below:

I. Economy- equality, employment as livelihood source
II. Economic diversification via business development to reduce dependency on mine
III. Enhance local capacities in tourism
IV. Income - improved livelihoods and income generation through new technologies

V. Physical capital - improve rural infrastructure as development opportunity

Despite the illegal blockades of the site and associated local disruption the final year of the LRP was completed.

The annual budget for delivering the LRP) was $140,000. However, additional major infrastructure improvements for the benefit of Gndevaz residents were added to the plan, including the Gndevaz irrigation channel and a herder road upgrade, and the final cost of delivering the LRP was $1.3 M.

The LRP delivery was subject to periodic internal monitoring 3rd party audit and at the end of the 3-year implementation period an evaluation study was completed. Of the 34 targets for the LRP 29 were fully implemented, of the remaining five, 4 achieved 90% completion with the final target achieving 50% of its target.

Wider community development investments (outside the Gndevaz focused LRP) included a range of development types including high value crop related initiatives (honey and organic produce), road upgrades and street lighting tourism development, business management training program. Community investment programs were significantly reduced following the halt of construction works at the project.

Total social and LRP funding expended by Lydian since 2007 was $3,753,611 (Table 20-3), with over 70% in direct social investments and 30% through LRP contributions.

Table 20-3: Total Social / LALRP Investments to Date

Target Community	US$	Percentage
Gndevaz	1,329,114	35.4
Jermuk/Kechut	813,907	21.7
Gorayk	517,509	13.8
Saravan	292,490	7.8
Four communities (above)	409,127	10.9
Other	241,463	6.4
Vayk Hospital	150,000	4.0
Total	3,753,610	100.0

Source: Lydian (2019)

20.8.6 Shared Vision

In November 2017 Lydian conducted a Shared Vision Survey in project affected communities. The aims of the survey were to:

- Ensure participation of communities in shaping the general vision and community investment strategies for the operational phase of the Project;
- Shared vision, shared resources - identify the vision(s) that is shared by communities and identify and promote ways to share the "burden" of its implementation;
- Promote a change of mind-set from dependency to independence, with the company moving away from its central role in community development;
- Match community vision with Company business case for mutual benefits; and

- Revisit Community Investment Strategy with a renewed focus on sustainability of social investment approaches based on Shared Vision Survey findings.

The findings of the Survey were subsequently shared with all communities through focus groups and key stakeholders. Based on these agreed findings, Lydian drafted a 3-year Community Investment Strategy Outline to cover the early years of operations. The strategy sets out investment goals, strategic objectives, approaches, etc. with the goal of Lydian acting as the catalyst for positive and sustained development. The strategy has not been implemented due to the delays caused by the illegal blockades of access road to the project.

The Shared Vision findings form the basis of the Community Support Recovery Plan (CSRP) which was developed in response to the change in relationship between the company and project affected communities during the blockade of the site. The CSRP provides the framework by which Lydian plans to regain and maintain its Social License to Operate.

20.8.7 Blockades to the Amulsar Project

Since the drafting of the original feasibility study and through the ESIA process Lydian developed a strong Social Licence to Operate based on audits from the IESC (Section 20.8.9). Unfortunately, the SLO was in part lost during construction activities due to key main issues:

1. During 2017 the construction of the HLF short term, but significant fugitive dust was generated. These dust releases were sporadic and usually lasted less than 1-hour but landed on nearly apricot orchards and resulted in a number of complaints from landowners. An improved dust management plan was implemented in for 2018 and no complaints were received prior to the suspension of works.
2. In November 2017 one of the two potable water supply pipes to the village of Gndevaz was broken during excavation work performed during powerline construction. This pipe was repaired when ground conditions were suitable. Then, during test-pitting in February 2018 the second pipe was broken, and repairs were completed within 24 hours. On 13 May 2018, breaks to both pipes, identified as failures of the previous repairs, were reported and repairs work was completed on 17 May 2018. On 18 May 2018, the drinking-water supply to Gndevaz was ‘contaminated’ by sediment entering the water line supply from another failed repair. This was quickly repaired but on 19 May.

These events coupled with the associated growth in the confidence of civil society to affect change, following the “Velvet Revolution” in Armenia, resulted in Amulsar Project becoming the target of protest groups. On 28 April 2018, anti-Amulsar activists staged an awareness raising campaign with the slogan “Amulsar without mining”. On 18 May 2018 protests against the project started in Vayots Dzor province, which fuelled by local unrest associated with the damage to the potable water pipeline, led to the first illegal blockade of roads leading to the site the following day. This initial blockade lasted 5 days, and subsequently on 22 June 2018 the protesters established permanent blockades. In April 2019 the Administrative Court of the Republic of Armenia ruled and instructed the police to remove trespassers and their property from the Amulsar site and assure Lydian free passage to Amulsar. At the time of developing this technical report the Armenian Prime Minister vocally showed support for the project and committed to opening the roads.

Throughout the illegal blockades and the government inspections process (see below) Lydian has continued in its efforts to maintain a constructive dialogue with the government, community leaders, NGOs and protesters. Lydian urged the government to assist in the removal of the illegal blockades and to complete the various inspections and audits it has convened in a timely manner while allowing resumption of construction activities. A Community Support Recovery Plan has been developed to regain support for the Project from those elements of the local communities that, as a result of Project-related incidents and other political circumstances, lost confidence in the project. This loss of support is manifested mainly in Jermuk/Kechut, and Gndevaz. The objective of the plan is to restore community support or 'social license to operate' in the two communities, and to ensure support in the other local communities (Saravan and Gorayk) is maintained, based on lessons learned from the recent experiences.

The plan includes:

- Enhance community engagement, information disclosure and dissemination including:
  - Focused meetings on employment, local procurement and educational sessions;
  - Regular progress updates;
  - Increased technical knowledge in Community Information Centres (particularly Gndevaz);
  - Participatory monitoring;
  - Increased Human Resources presence in communities and improved recruitment processes to enable local employment; and
  - Closer monitoring of construction activities- especially those with the potential to impact on the SLO;
- Increased sanctions for employees and contractors who fail to comply with project guidelines and requirements; and
- Costs for implementing the Community Support Recovery Plan are included in G&A costs and will commence upon restart of the project construction activities.

20.8.8 Government Inspections and Audits

During a meeting between the deputy prime minister and protesters in May 2018 the Deputy Prime Minister informed protestors that the government would be conducting transparent and comprehensive inspections of all mining operations in the country and the protestors suspended the illegal blockades. Armenian PM Nikoly Pashinyan also announced that he had ordered the inspections. The company volunteered to have Amulsar audited first.

On 4 June 2018 illegal blockades were reinstated by the protestors due to perceived inaction by the government in commencing the promised audits. The following day the company publicly announced it was ready to cooperate and welcomed any objective audit by qualified persons to resolve the situation. On the same day the deputy prime minister met with the protesters to explain that the Government needed 25 days to organize the inspections and that Amulsar would be the first project to be audited. Following this meeting the illegal blockades were lifted by the protesters.

One week later the prime minister announced that there were to be some changes to the Mining and Environmental Protection Inspectorate, and once they were completed, the audits would officially begin. On 6 July 2018, the Mining and Environmental Protection Inspectorate started its first inspection of the Amulsar Project. It was also announced that the Inspectorate would be assisted by a working group with the aim of supporting the introduction of responsible mining policies in Armenia in accordance with international standards. The working group review of the Amulsar Project started on 9 August 2018.

The Mining and Environmental Protection Inspectorate concluded its activities in August 2018 and provided its non-conformance report to Lydian. The report required Lydian to take certain actions to mitigate a number of deficiencies before 10 October 2018. Many of the actions were administrative (e.g. filling of routine reports to relevant ministries). Lydian requested and was granted a delay to address some of the deficiencies requiring site access for their completion.

Lydian received over ten reports from the working group on 5 September 2018. The final reports covered water (the Vorotan-Arpa Tunnel/Lake Sevan, ground and spring waters, isotope studies and acid rock drainage), geology/mineral resources, mining, biodiversity, legislation/compliance, and socio-economics issues. Lydian responded to all the reports on 28 September 2018. Amulsar is the only project to have been subject to scrutiny by the government inspectorate and Working Group to date.

On 2 September 2018, the Prime Minister announced that the findings of the inspections provided only interim conclusions and announced that an audit by international experts would also be undertaken. The government stated that an international expert review was required as it did not have the in-country capacity to properly evaluate the data and that it wanted to base any final decision on the facts. This international audit commenced in March 13, 2019 with a Beirut based consultancy ELARD (Earth Link & Advanced Resources Development) conducting the audit under a Republic of Armenia Special Investigative Committee (SIC).

Lydian and its technical advisors provided the SIC and ELARD with direct access to all personnel and supporting information for over three months, including over 300 reports representing over 20,000 pages of data and materials that had been developed over an 8-year period relating to environmental aspects of the Amulsar Project

On 14 August 2019 the ELARD Report was made public and the Prime Minister welcomed the findings of the report and credited the Amulsar Project for setting a new benchmark against which other mining projects in Armenia would be compared. As a follow-up Lydian, supported by the ESIA consultants, reviewed ELARD's final audit report and noted that none of the claimed 'gaps' and 'deficiencies' had no reference to any supporting standard or good practice. A memorandum was developed for the ROA that identified all the 'deficiencies', 'inaccuracies' referred to in the audit report. There were a number of recommendations in the ELARD report and these will be addressed under the Environmental and Social Management Plan (ESMP) as shown previously in Section 20.8.1

20.8.9 Review, Audit and Continuous Improvement

In order to ensure that the Project's ESIA, ESMP as well as the aspect-specific management documents remain fit for purpose and are being properly implemented, the project has been subject to a number of formal audits and reviews as described below.

Primary oversight has come from the Independent Environmental and Social Consultant (IESC). In 2014, Knight Piésold and Co. was retained by the project lenders group to serve as the IESC. The IESC has regularly scrutinized the environmental, social, security and health and safety performance of the project and provided guidance and advice to ensure full compliance, in both spirit and intent, with relevant Armenian legislation and permits, International lender requirements (EBRD Performance Requirements and IFC Performance Standards), Lydian corporate mandates and Good International Industry Practice that defines leading industry best practices. The last audit of the project completed by the IESC was in spring 2018 and the project was reported to be in full compliance with the evaluation criteria.

In addition, in April 2017, the Independent Advisory Panel was formally established to monitor the performance of the Amulsar Project and to provide objective and authoritative advice on a range of sustainable development issues. The Panel (participating in their personal capacities) comprised of Armenian and international experts from various sustainability fields, including water, cyanide management, biodiversity, public health and socio-economic specialists, and with experience of extractive industry best-practice standards. The panel members participated in their personal capacities and did not represent any organization.

The IAP released its first annual report on the project in May 2018 covering activities during 2017. The report recognised that in some areas the Amulsar Project is going beyond what are normal environmental or social practices in the Armenian mining sector. In particular, the company's work on biodiversity during the ESIA/EIA process, its engagement with local communities and its commitment to transparency demonstrate a strong commitment to sustainability and to a high standard of mining practice.

As part of the commitment to operate the Amulsar Project in a socially and environmentally transparent manner, Lydian Armenia took an active role in the Extractive Industries Transparency Initiative (EITI) in 2017 and continues to participate actively as a member of the Armenian Multi-Stakeholder Group.

20.9 Reclamation, Closure and Rehabilitation

For a mining project to leave a positive contribution to the sustainable development of a community or region, closure objectives and impacts must be considered from Project inception. Closure and reclamation goals include:

- Future public health and safety are not compromised;
- Any residual environmental impacts are minimized and environmental resources will not be subjected to related physical and chemical deterioration over the long term;
- After-use of the site is beneficial and sustainable in the long term and acceptable to the mine owners, the local communities and the regulatory authorities;
- Any adverse impacts on the local communities are minimized;
- All socio-economic benefits are maximized; and
- Closure and rehabilitation will be fully funded without recourse to the public purse.

In accordance with international best practice for the mining industry and following the company's environmental policy, a preliminary Mine Reclamation, Closure and Rehabilitation Plan (MRCRP) was developed for the Amulsar site as part of the ESIA of the Amulsar Project. Preliminary closure and rehabilitation costs including engineering planning and environmental monitoring were developed by Golder (Golder, 2015) based on the feasibility-level designs and were updated by Golder based on the planned changes discussed in this updated Technical Report. The closure and rehabilitation plan and associated closure cost model is intended to serve as a template for future updates that include progressive and final reclamation plans. A summary of the costs developed for the feasibility study are included in Chapter 21.

A pMRCRP was submitted to the MENR as a part of the Mining Right approvals process. The Plan will be reviewed and updated during the detailed design and construction phases, once as-built details are available. Thereafter, the plan will undergo a high-level annual review, to verify financial provisions, as well as to consider the importance of key issues in relation to the plan. It will also be necessary to ensure the plan remains consistent with national laws as may apply from time to time.

The final mine closure plan will be submitted to the respective authorities for approval 2 years prior to the closure of the mine; however, Lydian is committed to rehabilitation of disturbed areas during the exploration and construction activities will be rehabilitated as part of progressive rehabilitation during mine operations.

On signing the 2014 Mining Agreement, the company deposited 15% of the estimated closure costs into the reclamation bond fund which is regulated by the Ministry of Territorial Administration and Development and the Mining Code. A further three payments has since been placed into the bond account with payments of the remaining funds for the bond being spread equally over the mine life.

21 Capital Cost Estimate

21.1 Capital Cost Summary

LOM project capital costs total US$710.9 M, consisting of the following distinct phases:

- Pre-Production Capital Costs:
  - Costs to Date – Costs incurred to date to develop the Project (US$361.9 M);
  - Remaining Capital Requirements – All costs remaining to complete the project development until first gold is produced (US$168.6 M, including US$9.2 M for contingency). Remaining construction activities are expected to occur over a 13 month period; and
- Sustaining & Closure Capital Costs – All costs related to the acquisition, replacement, or major overhaul of assets during the mine life required to sustain operations, and costs related to the progressive and final closure. Sustaining and closure capital costs total $180.4 M (no contingency in sustaining) and are expended in operating Years 1 through 17.

The capital cost estimate was compiled utilizing input from previous construction contracts and vendors, and experienced engineers. Wherever possible, existing designs and contract pricing were used in the estimates, and where necessary, bottom up first principle costs were developed and benchmarked against other projects of similar size and site conditions.

Table 21-1 presents the capital cost summary for pre-production, sustaining, and closure capital costs in Q3 2019 US dollars with no escalation.

Table 21-1 Capital Cost Estimate Summary

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total ($USM)	Sustaining & Closure Total ($USM)	Life of Mine Total ($USM)
General	37.1	-	37.1	-	37.1
Site Development	12.2	10.2	22.4	6.1	28.5
Crushing and Material Handling	77.3	18.7	96.0	5.5	101.5
HLF	24.9	5.9	30.8	42.6	73.4
Process Plant	12.4	6.0	18.5	1.1	19.6
BRSF	2.9	5.7	8.6	9.4	18.1
Mine Facilities	7.3	0.8	8.1	8.5	16.6
Services, Utilities & Misc. Facilities	8.5	2.3	10.8	0.3	11.1
Indirect Costs	96.3	37.5	133.8	2.1	135.9
Owner's Costs	42.4	44.0	86.4	-	86.4
Mining	40.5	28.3	68.8	68.4	137.2
Contingency	-	9.2	9.2	-	9.2
Closure	-	0.0	0.0	36.4	36.4
Total CAPEX	**361.9**	**168.6**	**530.5**	**180.4**	**710.9**

Source: JDS (2019)

21.2 Basis of Estimate

The Project capital estimates include all costs to develop and sustain the project at a commercially operable status. Sunk Costs related to capital expenditures already incurred as part of the previous construction work are included in this estimate.

The following key assumptions were made during development of the capital estimate:

- The capital estimate is based on the contracting strategy, execution strategy, and key dates described within the Project Execution Plan described in Section 25.2 of this report;
- Open pit mine development and construction activities for developing the road RD-3 will be performed by The Owner's team;
- All other surface construction (including earthworks) will be performed by contractors; and
- Working capital is based on the first 3 months of operating costs.

The following key parameters apply to the capital estimates:

- Estimate Class: The capital cost estimates are considered Class 3[4] feasibility cost estimates (with an accuracy of -15%/+15%). The overall project definition is estimated at 70%;
- Estimate Base Date: The base date of the capital estimate is Q1 2019. No escalation has been applied to the capital estimate for costs occurring in the future. Proposals and quotations supporting the Feasibility Study Estimate were received in Q4 of 2018 and Q1 of 2019. Existing costs from previous construction contracts have been increased 5% for inflation;
- Units of Measure: The International System of Units (SI) is used throughout the capital estimate, except pipe sizes which are included in Nominal Pipe Size (NPS) inches; and
- Currency: All capital costs are expressed in US$. Table 21-2 presents the exchange rates used for costs estimated in foreign currencies and the portions of the capital costs estimated in those currencies.

Table 21-2: Foreign Currency Exchange Rates

USD	Exchange Rates	Currency
1 USD =	480	AMD
1 USD =	0.885	EUR
1 USD =	1.33	CAD

Source: JDS (2019)

21.3 Mine Capital Cost Estimate

Capital cost estimates are based on a combination of purchase prices from equipment suppliers, budgetary quotations, and in-house cost databases from similar mine projects. Costs incurred to date are actual costs provided by Lydian, already spent to procure equipment and do the mine development achieved to date. Table 21-3 summarizes the open pit mine capital cost estimate, including costs incurred to date.

[4] ACEE defines a Class 3 estimate as a budget authorization estimate based on 10% to 40% project definition, semi-detailed unit costs with assembly level line items, and an accuracy of between -20%/+30% and -10%/+10%.

Table 21-3 Mine Capital Costs

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total (US$M)	Sustaining & Closure Total (US$M)	Life of Mine Total (US$M)
Incurred to date	40.5	-	40.5	-	40.5
Pre-Stripping	-	16.4	16.4	-	16.4
Production Equipment	-	8.2	8.2	47.0	55.2
Support Equipment	-	1.8	1.8	12.9	14.8
Ancillary Equipment	-	1.9	1.9	5.6	7.5
Fixed Equipment	-	-	-	1.8	1.8
Spare Parts	-	-	-	1.0	1.0
Total Mining (excl. Contingency)	**40.5**	**28.3**	**68.8**	**68.4**	**137.2**

Source: JDS (2019)

21.3.1 Open Pit Pre-Stripping

Open pit pre-stripping costs include all labour and consumables related to pre-production waste stripping. Costs were assembled from first principles using the mining schedule as the basis. Database unit costs were applied to labour, equipment, and material requirements.

21.3.2 Production and Support Equipment

The production and support open pit mining equipment quantities were determined through buildup of mine plan quantities and associated equipment utilization requirements. Previously negotiated unit prices supplied by Lydian were applied to the required quantities.

21.3.3 Ancillary and Fixed Equipment

Pit ancillary and fixed equipment includes equipment and materials related to the mining process, such as fuel truck, skid steer loader, maintenance vehicles, dewatering pumps / piping, survey equipment, and tools. Requirements were determined through buildup of mine plan quantities and associated equipment utilization requirements. Lydian unit prices from previous purchases, or recent database prices were applied to the required quantities. Benchmark allowances were used for small items such as field tooling and mine support gear.

21.3.4 Spare Parts

An allowance of 5% was applied to new equipment purchases for spare parts costs.

21.4 Project Construction Costs

The Project construction costs include the remaining site development, crushing plant, overland conveyor and truck load out facility, HLF, BRSF, ADR processing plant, site roads, ponds, and on-site and off-site infrastructure completion. These cost estimates are primarily based on a site review of work left to complete, engineering designs and material take offs, and already negotiated purchase and contractor costs, with factors applied for inflation since the previous project start. Table 21-4 presents a summary basis of estimate for the various commodity types within the surface construction estimates.

Table 21-4: Construction Cost Basis of Estimate

Commodity	Basis
Contractor Labour Rates	Rates developed from previous Armenian contractor rates, with allowances for contractor indirect costs and overheads. Productivity factors developed for the Armenian contractors is also applied to the construction labour estimate.
Bulk Earthworks, Including On-Site Roads	Estimate volumes from engineering designs and MTOs Unit rates for earthworks and liners installation based on contractor rates
Concrete	Quantities developed based on site visit review in 2018 Unit rates based on contractor rates
Structural Steel	Quantities developed based site visit review of work in 2018, of work remaining to complete Contract labour and equipment costs for erection
Pre-Engineered Buildings	Remaining installation work for building erection based on site review. Any costs for new or replacement, based on existing contracts
Modular Buildings & Warehouses	Budgetary quotations and recent database values from similar projects for the mine personnel lockers and change facility, offices, mine maintenance building, and mine warehouse
Mechanical Equipment	Actual equipment costs based on prior purchases and contracts. Install hours based on equipment size determined after site review, with labour productivity factor applied.
Piping	Material take offs for piping based on engineering designs, and site visit review of work still to complete. New piping based on previous pipe purchases or recent budgetary quotations
Electrical and Instrumentation	Estimate of work still to complete developed during site review
On-site Power Distribution	Estimate of work still to complete developed during site review
Contractor Construction Equipment	Allowances by construction activity based on database and benchmarked rates to account for contractor support equipment

Source: JDS (2019)

21.5 Infrastructure Cost Estimate

The infrastructure capital cost estimate was developed based on a site review of work still to complete, engineering designs, contractor rates, and database costs for minor items not accounted for in existing designs. The infrastructure scope of estimate includes the completion of the following onsite and off-site items:

- Site development:
  - Civil construction and earthworks, including the crusher MSE wall;
  - Saravan Access Road;
  - Surface water diversions and management structures, including sediment ponds, ditches, and the BRSF gravity pipeline to PD-8;
  - Overland piping installations; and
  - Minor civil works structures including fuel storage liner and berms, solid and liquid waste management, fencing and security access;

- BRSF;
- Mine support facilities:
  - Mine maintenance facilities and wash bay;
  - Explosives storage facilities; and
  - Mine office and personnel facilities
- Utilities and services:
  - Power supply and distribution;
  - Mobile equipment and vehicles; and
  - Miscellaneous support facilities, such as truck scale, potable water treatment system and small remote power generators for field pumps.

Infrastructure costs are provided in Table 21-5.

Table 21-5 Infrastructure Capital Costs

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total ($USM)	Sustaining & Closure Total ($USM)	Life of Mine Total ($USM)
Site Development	**12.2**	**10.2**	**22.4**	**6.1**	**28.5**
Incurred to Date	12.2	-	12.2	-	12.2
Site Clearing & Civil Works	-	2.6	2.6	0.9	3.5
Access & Plant Roads	-	1.6	1.6	3.8	5.4
Water Diversion Works	-	3.2	3.2	0.8	4.0
Water Management Structures	-	0.2	0.2	0.0	0.2
Sediment Ponds	-	0.2	0.2	0.1	0.3
Overland Piping	-	2.0	2.0	0.4	2.4
BRSF	**2.9**	**5.7**	**8.6**	**9.4**	**18.1**
Incurred to Date	2.9	-	2.9	-	2.9
BRSF - Main Facility	-	5.4	5.4	9.4	14.9
Low Grade Ore Stockpile	-	0.2	0.2	-	0.2
Mine Facilities	**7.3**	**0.8**	**8.1**	**8.5**	**16.6**
Incurred to Date	7.3	-	7.3	-	7.3
Mine Support Facilities	-	0.2	0.2	1.7	1.9
Truck Shop	-	0.6	0.6	5.1	5.8
Explosives Area	-	0.0	0.0	0.1	0.1
Mine Offices	-	-	-	0.4	0.4
Drill Maintenance Facilities	-	-	-	16.8	16.8
Services, Utilities & Misc. Facilities	**8.5**	**2.3**	**10.8**	**0.3**	**11.1**
Incurred to Date	8.5	-	8.5	-	8.5

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total ($USM)	Sustaining & Closure Total ($USM)	Life of Mine Total ($USM)
High Voltage Transmission Line (110KV)	-	-	-	0.2	0.2
Main Substation Are 713 & Power Distribution	-	0.2	0.2	-	0.2
Low voltage power line (36kV)	-	0.3	0.3	0.1	0.4
Potable Water System	-	0.1	0.1	-	0.1
Truck Scales	-	0.1	0.1	-	0.1
Raw Water Pumps	-	0.4	0.4	-	0.4
Camp	-	0.0	0.0	-	0.0
Mobile Equipment	-	1.3	1.3	-	1.3
Total Infrastructure CAPEX	**31.0**	**18.9**	**49.9**	**24.3**	**74.2**

Source: JDS (2019)

21.6 Processing Cost Estimate

The processing capital cost estimate was developed based on a site review of work still to complete, engineering designs, contractor rates, and database costs for minor items not accounted for in existing designs. The processing facility scope of estimate includes the completion of the following items related to ore processing:

- Ore crushing, screening, and transfer conveyors:
- Overland crushed ore conveyor;
- Truck load out facility;
- HLF;
- HLF ponds; and
- Process plant

Processing capital costs are provided in Table 21-6.

Table 21-6 Processing Capital Costs

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total (US$M)	Sustaining & Closure Total (US$M)	Life of Mine Total (US$M)
Crushing & Material Handling	**77.3**	**18.7**	**96.0**	**5.5**	**101.5**
Incurred to Date	77.3	-	77.3	-	77.3
Primary Crushing Concrete	-	1.1	1.1	-	1.1
Primary Crushing Mechanical & Piping	-	0.3	0.3	0.9	1.2
Primary Crushing Steel & Architectural	-	1.9	1.9	-	1.9
Secondary Crusher M&P	-	0.6	0.6	2.6	3.2
Secondary Crusher Structural and Architectural	-	4.2	4.2	-	4.2
Screening Facility M&P	-	0.2	0.2	1.2	1.4
Screening Facility Steel and Architectural	-	1.1	1.1	-	1.1
Overland Conveyor SMP & Architectural	-	2.6	2.6	-	2.6
Truck Loadout, Sampler & Lime Facility M&P	-	0.7	0.7	0.8	1.5
Truck Loadout Structural & Architectural	-	3.3	3.3	-	3.3
Material Handling Electrical	0.7	2.8	2.8	-	2.8
HLF	**24.9**	**5.9**	**30.8**	**42.6**	**73.4**
Incurred to Date	24.9	-	24.9	-	24.9
Earthworks, Liner & Drains		3.4	32.6	36.0	3.4
Process Water & Contact Water Pond		2.4	8.3	10.7	2.4
Diversion Dams		0.1	1.7	1.8	0.1
Process Plant	**12.4**	**6.0**	**18.5**	**1.1**	**19.6**
Incurred to Date	12.4	-	12.4	-	12.4
Process Facilities Structural Concrete	-	0.8	0.8	-	0.8
ADR SS and Arch	-	1.4	1.4	-	1.4
ADR M&P	-	1.4	1.4	0.3	1.6
Refinery M&P	-	0.5	0.5	0.1	0.6
Sodium Cyanide & Sodium Hydroxide M&P	-	0.1	0.1	0.0	0.1
ADR Barren Solution Facilities	-	0.2	0.2	0.4	0.7
ADR - Pregnant Solution Facility	-	0.1	0.1	0.2	0.2
ADR Electrical Install	-	1.5	1.5	0.1	1.7
Total Processing CAPEX	**114.6**	**30.6**	**145.2**	**49.2**	**194.4**

Source: JDS (2019)

21.7 Indirect Cost Estimate

Indirect costs are those that are not directly accountable to a specific cost object. Table 21-7 presents the scope and basis for the indirect costs within the capital estimate.

Table 21-7: Indirect Costs Basis

Commodity	Basis
Site Services	Site services costs are developed from construction requirement build ups and benchmarked database cost rates. The following are categorized as these services: • General site services • Construction waste management • Contract equipment support • Communications • On-site construction personnel facilities • Temporary materials storage facilities
Accommodations	Accommodations costs are developed according to on-site project management and construction requirement build ups, applied to daily meals and housing cost provided by Lydian, based on previous work at site.
Construction Field Indirect Costs	Required specialty tooling based on quoted prices, and benchmarked allowance for miscellaneous field purchases and fuel consumption during construction
Construction Equipment	The construction equipment rental is based on a buildup of required equipment not supplied by local contractors, i.e. cranes and man lifts, during the construction period on a monthly basis, using contracted and database cost rates.
Project Management	Staffing plan built up against the development schedule for project management, health and safety, construction management, field engineering, project controls, contract administration and the start-up and commissioning, with current hourly rates. Includes allowance for additional FSU personnel to work with ex-pat field supervision.
Engineering	Based on a review of remaining engineering activities required, using current cost rates
Construction QA/QC	Benchmarked allowances for 3rd party quality assurance and quality control activities of construction activities
Capital Spares and First Fills	Factor (4%) of direct equipment costs for spare parts 2 months of grinding media, 1 set of liners, and 1 month of process plant re-agents
Vendor Representatives	A buildup of vendor representatives based on quoted cost rates applied against the execution schedule for construction supervision, field verification, and start up and commissioning of equipment.
Freight & Logistics	A build-up of remaining major shipments with budgetary quotations, including any off-site warehousing and storage, with benchmarked allowances for in-country logistics, duties and expediting services.

Source: JDS (2019)

The indirect capital costs estimate is provided in Table 21-8.

Table 21-8: Indirect Costs

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total (US$M)	Sustaining & Closure Total (US$M)	Life of Mine Total (US$M)
Incurred to Date	96.3	-	96.3	-	96.3
Site Services	-	2.8	2.8	-	2.8
Accommodations and Meals - Construction	-	3.1	3.1	-	3.1
Tools and Supplies	-	0.4	0.4	-	0.4
Procurement	-	3.0	3.0	-	3.0
Support Equipment	-	2.6	2.6	-	2.6
Project Management	-	12.4	12.4	-	12.4
Engineering & Design Activities	-	1.8	1.8	0.7	2.5
QA/QC	-	1.2	1.2	1.1	2.3
Vendor Construction Support	-	1.0	1.0	0.1	1.1
Vendor Commissioning	-	1.1	1.1	0.1	1.3
Fuel & Gasses	-	2.3	2.3	-	2.3
Spare Parts & Initial Fills	-	1.9	1.9	-	1.9
Logistics	-	3.8	3.8	-	3.8
	96.3	**37.5**	**133.8**	**2.1**	**135.9**

Source: JDS (2019)

21.8 Owners Cost Estimate

Owner's costs are expenses incurred during the construction phase and capitalized, which are included within the operating costs during production. The main cost elements described are the pre-production General & Administration and processing operations start-up. These are the costs of the Owner's labour and expenses (safety, finance, security, purchasing, management, etc.) incurred prior to commercial production, and are described in more detail in Section 22. The Owner's capital costs are listed in Table 21-9.

Table 21-9: Owner's Costs

Description	Costs to Date (US$M)	Remaining Capital Spend (US$M)	Pre-Operation Total ($USM)	Sustaining & Closure Total ($M)	Life of Mine Total ($M)
General	**37.1**	**-**	**37.1**	**-**	**37.1**
Incurred to Date	37.1	-	37.1	-	37.1
Owner's Costs	**42.4**	**44.0**	**86.4**	**-**	**86.4**
Incurred to Date	42.4	-	42.4	-	42.4
Process PPD	-	3.7	3.7	-	3.7
G&A PPD	-	18.1	18.1	-	18.1
Working Capital	-	22.2	22.2	-	22.2
TOTAL CAPEX	**79.5**	**44.0**	**123.5**	**-**	**123.5**

Source: JDS (2019)

21.9 Closure Cost Estimate

Preliminary closure and rehabilitation costs including engineering planning and environmental monitoring were developed by Golder (Golder, 2015) based on the feasibility-level designs and were updated based on the planned changes discussed in this updated feasibility study. The schedule assumes that progressive reclamation will be implemented on the BRSF northern outslopes, beginning in Year 7, based on the mine plan, progressing to the south through Year 12. Therefore, final Reclamation, Closure and Rehabilitation (RC&R) of the BRSF will begin in Year 13. A passive water treatment system will be constructed, north of the contact water pond, PD-8 of the HLF, in year 4, to treat long-term seepage from the BRSF. A second passive water treatment system will be constructed, near PD-8, in year 15, once rinsing and active evaporation is complete, to treat long-term seepage from the HLF.

Closure costs are based on calculations using the Standardized Reclamation Cost Estimator (SRCE) model, developed by the United States' Nevada Department of Environmental Protection, Bureau of Mining Reclamation and Regulation for estimating mine closure costs. SRCE was developed to standardize estimating rehabilitation and bonding costs for mine closure in Nevada. The model uses standardized and accepted methods to calculate rehabilitation quantities, productivity, and costs. Although originally developed for Nevada, the model is applicable to any geographic region, as the user provides local labor, equipment and material rates. The unit costs used to develop this preliminary estimate are based on SRCE, with the estimated owner equipment rates and operating costs based on rates as directed by Lydian to be similar to those used during the mining operations with unit labor costs derived from local Armenian wages and costs, and from estimates for active and passive water treatment provided by GRE and Sovereign. Some unit rates are from contractor estimates or standard rates for Nevada included as defaults in the SRCE model. Given the similarities in climate of the Project to the higher elevations in Nevada, the SRCE model is considered an appropriate cost-estimating tool for this stage of the Project.

The Preliminary RC&R Plan cost estimate includes the full RC&R closure costs, including both technical rehabilitation costs and non-technical costs such as retrenchment, community support, retraining, or any additional support to local communities for offsetting social impacts. The cost estimate includes a 6% contingency that is added for Project unknowns and identified risks. An additional 4% is added for Engineering, Design and Construction Plans that may be necessary to provide detail on the reclamation needed to contract for required work. The cost assumes that Lydian will self-perform the closure, work; therefore, no contractor profit is included.

The cost estimate is summarized on an annual basis in Table 21-10. All costs are based on a 2019 Net Present basis. The costs include sustaining capital costs comprised of $3.9 M related to passive water treatment systems and an additional $24.8 M related to reclamation and closure planning, and progressive and final closure work. In addition, $7.7 M in operating costs related to the operation of the water treatment system and solution evaporation is included in the estimate for a total of $36.4 M.

Table 21-10: Closure, Reclamation & Rehabilitation Cost Estimate

Year	Sustaining Capital and Operating Cost $US'000's
0	$40.0
1	$25.0
2	$25.0
3	$25.0
4	$2,865.8
5	$126.9.
6	$421.5.
7	$418.4
8	$860.3
9	$1,154.9
10	$520.3
11	$570.3
12	$6,744.1
13	$13,254.4
14	$2,844.3
15	$1,507.5
16	$317.3
17	$317.3
18	$203.9
19	$127.4
20	$1,068.9
29	$2,261.1
40	$726.0
Total	$36,425.6

Source: Golder (2019)

A summary of the detailed costs for reclamation and closure is provided in Table 21-11.

Table 21-11: Summary of Detailed Reclamation and Closure Costs

Item	Estimated Cost ($US'000's)
EARTHWORK / RE-CONTOURING	
Roads	$218.8
Well Abandonment	$65.6
Pits	$38.3
Quarries and Borrow Areas	$218.6
Process ponds	$39.7
HLF	$1,720.1
Barren Rock Disposal	$1,921.0
Landfill	$14.8
Foundation and Buildings Areas	$16.0
Yards, etc.	$216.6
Drainage and Sediment Control	$8,783.8
General Material Hauling	$664.6
Place HLF Detention Pond Riprap	$581.7
TOTAL	**$14,499.7**
REVEGETATION / STABILIZATION	
Roads	$232.8
Well Abandonment	N/A
Pits	$95.7
Process Ponds	$23.9
Quarries and Borrow Areas	$170.2
HLF	$310.9
Barren Rock Disposal	$486.8
Landfill	$4.2
Foundation and Buildings Areas	$8.8
Yards, etc.	$182.8
Drainage and Sediment Control	$61.9
General Material Hauling	$102.5
TOTAL	**$1,680.5**
DETOXIFICATION / WATER TREATMENT / DISPOSAL OF WASTES	
Solid waste – on-site	$2.0
Construct HLF PWTS	$962.8
Construct BRSF PWTS	$2,582.5
Hazardous materials	$7.9
Hydrocarbon Contaminated Soils	$9.7
HLF Draindown Evaporation	$988.0

Item	Estimated Cost ($US'000's)
Decontamination (Rinsing ADR tanks and piping)	$764.0
Reconfigure Two Sediment Ponds	$30.0
Monitoring and Maintenance Passive Water Treatment Systems	$5,934.4
TOTAL	**$11,281.3**
STRUCTURE, EQUIPMENT AND FACILITY REMOVAL AND MISC.	
Foundation and Buildings Areas	$38.7
Equipment Removal	$0
Fence Removal	$41.0
Power Line Removal	$717.2
Transformer Removal	$86.6
Construct Pit Wall Diversion	$19.2
TOTAL	**$883.5**
MONITORING	
Rehabilitation Monitoring and Maintenance	$385.0
Ground and Surface Water Monitoring	$130.6
TOTAL	**$410.6**
CONSTRUCTION MANAGEMENT AND SUPPORT	
Construction Management	$407.8
Road Maintenance	$67.7
TOTAL	**$475.4**
CLOSURE PLANNING, G&A, HUMAN RESOURCES	
Closure Planning, Studies and Design	$400.0
General Administration	$250.0
Human Resources (retrenchment, retraining and social / community projects)	$2,953.2
TOTAL	**$3,778.2**
CLOSURE COSTS SUB-TOTAL	**$33,114.2**
Engineering, Design and Construction Plan (4%)	$1,324.6
Contingency (6%)	$1,986.9
GRAND TOTAL	**$36,425.6**

Source: Golder (2019)

21.10 Contingency

Contingency has been applied to the estimate as a deterministic allowance by assessing the level of confidence of the scope definition, and then applying an appropriate weighting to each of the estimate areas.

Table 21-12: Contingency Applied by Commodity

Commodity	Contingency Applied
Civil and Earthworks	20%
Concrete	15%
Structural Steel	5%
Architectural Works	5%
Mechanical Installations	5%
Piping Installations	10%
Electrical	5%
Indirect Costs	10%
Mining Costs	0%
Owner's Costs	0%

Source: JDS (2019)

The overall recommended pre-production contingency resulted in approximately 6.3% of direct, indirect, and Owner's costs.

21.11 Capital Cost Exclusions

The following items have been excluded from the capital cost estimate:

- Financing costs;
- Currency fluctuations;
- Lost time due to severe weather conditions beyond those expected in the region;
- Lost time due to force majeure;
- Additional costs for accelerated or decelerated deliveries of equipment, materials or services resultant from a change in Project schedule;
- Warehouse inventories, other than those supplied in initial fills, capital spares, or commissioning spares;
- Sales or value added taxes;
- Closure bonding; and
- Escalation cost.

22 Operating Cost Estimate

22.1 Operating Cost Summary

Life of mine (LOM) operating costs for the project average $11.25/tonne leached, including:

- Mining;
- Processing; and
- General and Administration (G&A).

The cost per tonne of ore processed is based on an annual throughput of 10,000,000 t.

The LOM operating cost of $11.25/tonne leached excludes off-site costs (such as shipping and refining) and royalties. These ancillary costs are used to determine the net smelter return (NSR) and are described in Section 23.

Table 22-1 presents a summary of the LOM operating costs, expressed in US$ with no escalation. Figure 22-1 illustrates the distribution of operating costs amongst the cost sectors.

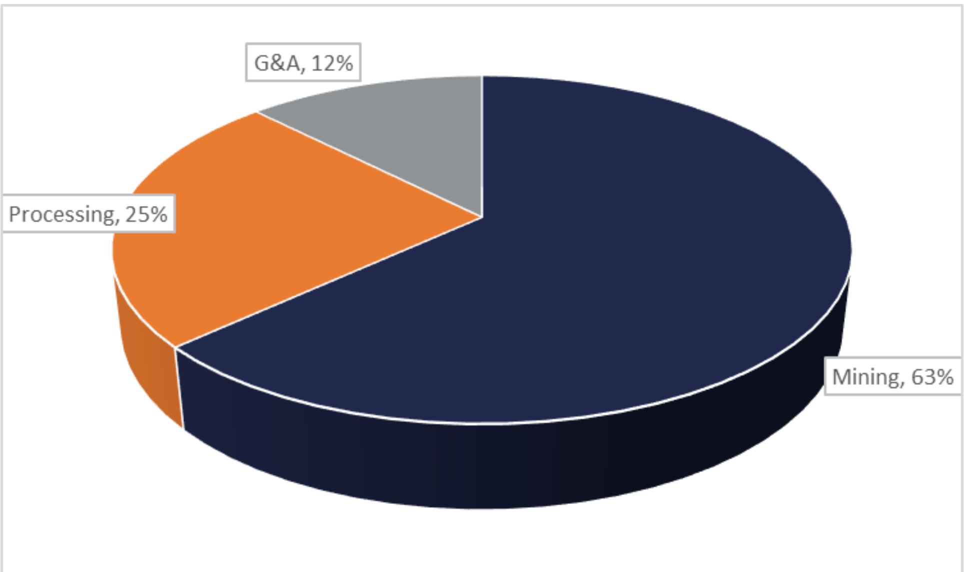
Table 22-1: Operating Cost Summary

Operating Costs	LOM Cost (US$ M)	US$/t-mined	US$/t-leached
Mining	**847.7**	**2.36**	**7.11**
Drill	131.0	0.36	1.10
Blast	57.4	0.16	0.48
Load	101.3	0.28	0.85
Haul	344.2	0.95	2.88
Mine General	156.2	0.43	1.31
Mine Maintenance	38.7	0.11	0.32
Technical Services	18.7	0.05	0.16
Contingency	-	-	-
Process	**328.0**	**-**	**2.75**
Labour	39.5	-	0.33
Power & Fuel	44.8	-	0.38
Maintenance & Operating Consumables	236.4	-	1.98
Services	7.4	-	0.06
G&A	**166.4**	**-**	**1.39**
Accommodations	10.0	-	0.08
Equipment	1.7	-	0.01
Labor	50.1	-	0.42
Office Operations	8.8	-	0.07
Outside Services	47.0	-	0.39
Programs	41.3	-	0.35

Operating Costs	LOM Cost (US$ M)	US$/t-mined	US$/t-leached
Software/Equipment	3.5	-	0.03
Supplies	2.9	-	0.02
Utilities & Services	1.1	-	0.01
Total Operating	**1,342.1**	**-**	**11.25**

Source: JDS (2019)

Figure 22-1: Distribution of Operating Costs



Source: JDS (2019)

22.2 Mine Operating Cost Estimate

Mine operating costs are derived from vendor quotations and historical data collected by JDS and Lydian, and include labor, maintenance, component repairs, fuel and consumables. The mining operating costs include the following functional areas:

- Drilling;
- Blasting;
- Loading;
- Hauling;
- Mine General;
- Mine Maintenance; and
- Technical Services.

Table 22-2 provides the values for major consumables used to support the open pit mining operating costs arrived at for the study.

Table 22-2: OP Major Consumable Prices

Item	Unit	Average
Cost Details		
Diesel Fuel	US$/litre	0.95
Crank Case/Engine Oil	US$/litre	6.0
Tires - Haul Trucks	US$/each	42,000
Blasting Supplies		
Ammonium Nitrate	US$/kg	0.48
Cast boosters	US$/unit	4.3
Nonel surface delay/in-hole detonator	US$/unit	8.5

Source: JDS (2019)

Operating hours on each piece of equipment has been estimated based on equipment capacity and the mine production schedule. Equipment efficiency was estimated based on Project conditions (e.g. haul routes for each phase). Local labour rates and diesel fuel pricing estimates were utilized for estimation purposes. Unit hours are multiplied by the hourly consumption rates for consumables and unit operating costs to calculate the total operating cost for each year of operation.

Mining costs include the rehandling of stockpiled material. Over the LOM approximately 21 Mt will rehandled at a unit cost of $0.60/t rehandled.

Several contracts related to mining activities that had been negotiated during the previous start-up were included in this study. These contracts include, a maintenance and repair contract (MARC), a drill and blast contract, and a small equipment/road maintenance contract.

Table 22-3: Mining Operating Cost Summary

Description	LoM Cost (US$ M)	US$/t-mined	US$/t-leached
Drilling	**131.0**	**0.36**	**1.10**
Labour	-	-	-
Fuel	15.0	0.04	0.13
Lube/Oil	-	-	-
R&M Parts	-	-	-
Wear Parts	-	-	-
Services & Equipment Rentals	116.1	0.32	0.97
Blasting	**57.4**	**0.16**	**0.48**
Labour	-	-	-
AN & Emulsion	37.6	0.10	0.31
Blasting Accessories	7.3	0.02	0.06
Fuel	5.4	0.02	0.05
Services & Equipment Rentals	7.1	0.02	0.06
Loading	**101.3**	**0.28**	**0.85**
Labour	3.4	0.01	0.03
Fuel/Power	50.0	0.14	0.42

Description	LoM Cost (US$ M)	US$/t-mined	US$/t-leached
Lube/Oil	6.9	0.02	0.06
Tires	0.8	0.00	0.01
R&M Parts	35.8	0.10	0.30
Wear Parts	4.6	0.01	0.04
Services & Equipment Rentals	-	-	-
Hauling	**344.2**	**0.96**	**2.88**
Labour	11.7	0.03	0.10
Fuel	191.5	0.53	1.60
Lube/Oil	29.4	0.08	0.25
Tires	65.0	0.18	0.54
R&M Parts	46.5	0.13	0.39
Services & Equipment Rentals	-	-	-
Mine General	**156.2**	**0.43**	**1.31**
Labour	22.3	0.06	0.19
Fuel	52.7	0.15	0.44
Lube/Oil	4.3	0.01	0.04
Tires	3.7	0.01	0.03
R&M Parts	18.3	0.05	0.15
Wear Parts	9.0	0.03	0.08
Tools & Supplies	0.1	0.00	0.00
Services, Equipment Rentals & Lease Payments	45.9	0.13	0.38
Mine Maintenance	**38.7**	**0.11**	**0.32**
Labour	-	-	-
Tools & Supplies	-	-	-
Services & Equipment Rentals	38.7	0.11	0.32
Technical Services	**18.7**	**0.05**	**0.16**
Labour	15.0	0.04	0.13
Tools & Supplies	0.1	0.00	0.00
Services & Rentals	3.6	0.01	0.03
Mine Operating Cost Total	**847.7**	**2.36**	**7.11**

Source: JDS (2019)

22.2.1 Mobile Equipment

A summary of equipment requirements can be found in Section 16. Operating costs for each piece of equipment were calculated taking into account operating hours per year, fuel consumption, lube, overhaul, and maintenance costs.

Parts, non- energy consumables, and miscellaneous operating costs were based on the mining fleet requirements described in Section 16 of this report which included detailed haul profile calculations, major equipment requirements and the LOM material schedule.

22.2.2 Labour

The open pit labour requirements used for determining the overall mining cost are based on experience for similar gold operations of this size. Positions were broken into three major groups: mine operations, mine general, and technical services. Mine operations refers to equipment operators (excluding drill and blasting which will be performed by contractors), mine general refers to supervisory roles and administrators, and technical services includes engineering and geology positions which support mine activities. The labour requirements are further divided into salaried and hourly personnel. Maintenance positions will be provided by contractors. The number of contractors was estimated to help estimate General & Administrative costs provided in Section 22.4 but not included as part of the Mining cost.

Local labour rates are based on information gathered regarding salaries of various skill levels. Table 22-4 summarizes the mine labour costs. Additional information on Mining labour can be found in Section 16.6.

Table 22-4: Mine Labour

Personnel	Maximum Number of Employees	Total Salary (US$/a)
Mine Operations		
Shovel/Loader Operator	17	22,846
Truck Driver	92	13,666
Support Operator	40	18,256
MINE GENERAL		
Operations Manager	1	369,160
Mining Superintendent	1	316,908
Mine Shift Foreman	12	27,625
Clerk	2	9,203
Trainer	4	18,200
Translator	4	18,200
Technical Services		
Technical Services Manager	1	288,908
Chief Mining Engineer	1	288,908
Senior Mine Engineer	1	65,314
Mine Engineer 1	2	25,921
Mine Engineer 2	2	18,200
Chief Geologist	1	288,908
Senior Geologist	1	65,314
Mine Geologist	2	18,200
Technician	4	6,671
Surveyor	3	25,921
Survey Assistant	2	12,876
Total	**193**	

Source: JDS (2019)

22.2.3 Explosives

Explosives quantities were based on using 100% ANFO and a powder factor of 0.51 kg/m^3 which is based on the recommendations from a previously completed fragmentation study (Golder 2015). Blast holes are expected to be primarily dry. Annual explosive consumption was calculated based on mine scheduling and drill productivity.

22.2.4 Contractors

Several contracts related to mining activities that had been negotiated during the previous start-up were included in this study.

A maintenance and repair contract ("MARC") will provide the labour and tools to maintain all mining equipment. This contract was quoted to start at $1.8 M per year for the initial mine fleet and will increase to $3.4 M per year by the start of year 2 once the mine fleet has expanded.

All drilling and blasting will be contracted over the LOM. All equipment and labour will be provided. During pre-production, the contract will be at a unit rate of $1.25/tonne blasted. During production, the cost will be based on the following variable and fixed rates:

- $13/m drilled;
- $900,000 per year for drilling labour/supervision;
- $16/m^3 for blast hole stemming; and
- $516,000 per year for blasting labour/supervision.

Small equipment/road maintenance contract is setup to maintain the road from the plant site up to the crusher. The contractor will supply all equipment and labour. The cost for this is expected to be $3.0 M per year. The owner's fleet will maintain all roads from the crusher to the open pits.

22.3 Processing Operation Cost Estimate

Processing operating costs include all gold and silver recovery activities to produce unrefined gold and silver doré on-site. The crushing and HLF were designed for a nominal LOM average throughput of 27,400 tpd. Process operating costs total approximately US$2.75/t milled or US$328 M over the life of mine.

The summarized results are provided in Table 22-5.

Table 22-5: Processing Operating Costs by Category: LOM and Unit Cost per Tonne Processed

Processing Operating Cost Category	LOM Total (US$ M)	Unit Cost (US$/t processed)
Labour	39.5	0.33
Power & Fuel	44.7	0.38
Maintenance & Operating Consumables	236.4	1.98
Services	7.4	0.06
Total	**328.0**	**2.75**

Source: JDS (2019)

22.3.1 Mineral Processing Labour

Milling operations and maintenance staffing levels have been built up based on experience at similar operations, in-country staffing requirements and labour rates for the area. Labour costs are based on fully burdened staffing wages. The labour force for plant operations and maintenance is estimated at 154 people, with annual salaries and wages provided by Lydian. The labour cost estimate is based on providing a labour force to support continuous operations operating 24 hour a day 365 days per year.

22.3.2 Mineral Processing Power

Electrical power consumption has been based on the equipment connected loads, discounted for operating time and the anticipated operating load level. Power regenerated from the overland conveyor, up to a maximum of 3 MW, will be has been accounted for in the annual power consumption. The available power will supplement the majority of the crushing circuit power requirements.

The total estimated annual process plant energy consumption is approximately 48MWh/year. At an estimated power cost of $0.07/kWh, the LOM power cost is $44.7 M ($0.38/t processed).

22.3.3 Consumables

Liners for the crushers have been estimated based on Vendor quotes, ore hardness, and on experience at similar operations. Budgetary quotations for liners and recommended spares for one year were received from equipment Vendors.

22.3.4 Reagents

Reagent consumption rates have been determined from the metallurgical test data presented in the 2017 FS. Unit pricing is based on budgetary quotations from local suppliers obtained through the site team. Table 22-6 presents a summary of annual estimated reagent requirements and costs.

Table 22-6: Reagent Requirements and Costs

Reagents	Reagent Consumption (t/a)	Unit Reagent Cost (US$/t)	Annual Cost (US$)
Cyanide	1,040	2,250	2,339,741
Lime (CaO)	20,000	156	3,120,027
Carbon	60	3,072	183,011
Caustic Soda	192	727	139,736
Nitric Acid	175	549	96,216
Zinc Dust	36	4,425	157,780
Antiscalant	43	3,580	155,027
Diatomaceous Earth	30	688	20,625
Total			**6,212,163**

Source: JDS (2019)

22.3.5 Maintenance Parts

Annual maintenance parts costs have been factored at a rate of 4% of the direct capital costs of the equipment within each area. The 4% factor has been applied based on JDS benchmarking and Vendor estimated maintenance spares costs compared to equipment costs.

22.4 General and Administration Operating Cost Estimate

General and administrative costs are those expenses not directly related to the mining and processing of gold. G&A operating costs were developed based on input costs provided by Lydian and include personnel, safety and emergency response, security, IT, training, administrative vehicles and buildings, insurance, Human Resources, environmental and permitting, and community relations. The G&A operating costs are provided in Table 22-7 by cost center.

Table 22-7: General & Administration Operating Cost Summary

Description	LoM Cost (US$ M)	US$/t-leached
Site Services	-	-
Site Administration	5.6	0.05
Commercial/Procurement/Contracts	13.8	0.12
Warehouse	5.0	0.04
Commuting	2.6	0.02
Camp Operations	27.0	0.23
Human Resources	5.8	0.05
Medical Services	1.6	0.01
Site Security	14.7	0.12
Worker Health and Safety	6.1	0.05
Environment & Sustainability	42.3	0.35
Information Technology	3.4	0.03
Finance & Accounting	6.5	0.05
Regional Administration	18.5	0.16
Stakeholder Relations	-	-
Communications & PR	1.3	0.01
Business Intelligence	-	-
Community Relations	6.4	0.05
Permitting & GIS	2.8	0.02
Amulsar Construction Project	2.8	0.02
G&A Operating Cost Total	**166.4**	**1.39**

Source: JDS (2019)

Labor rates are fully burdened and include:

- Base salary;

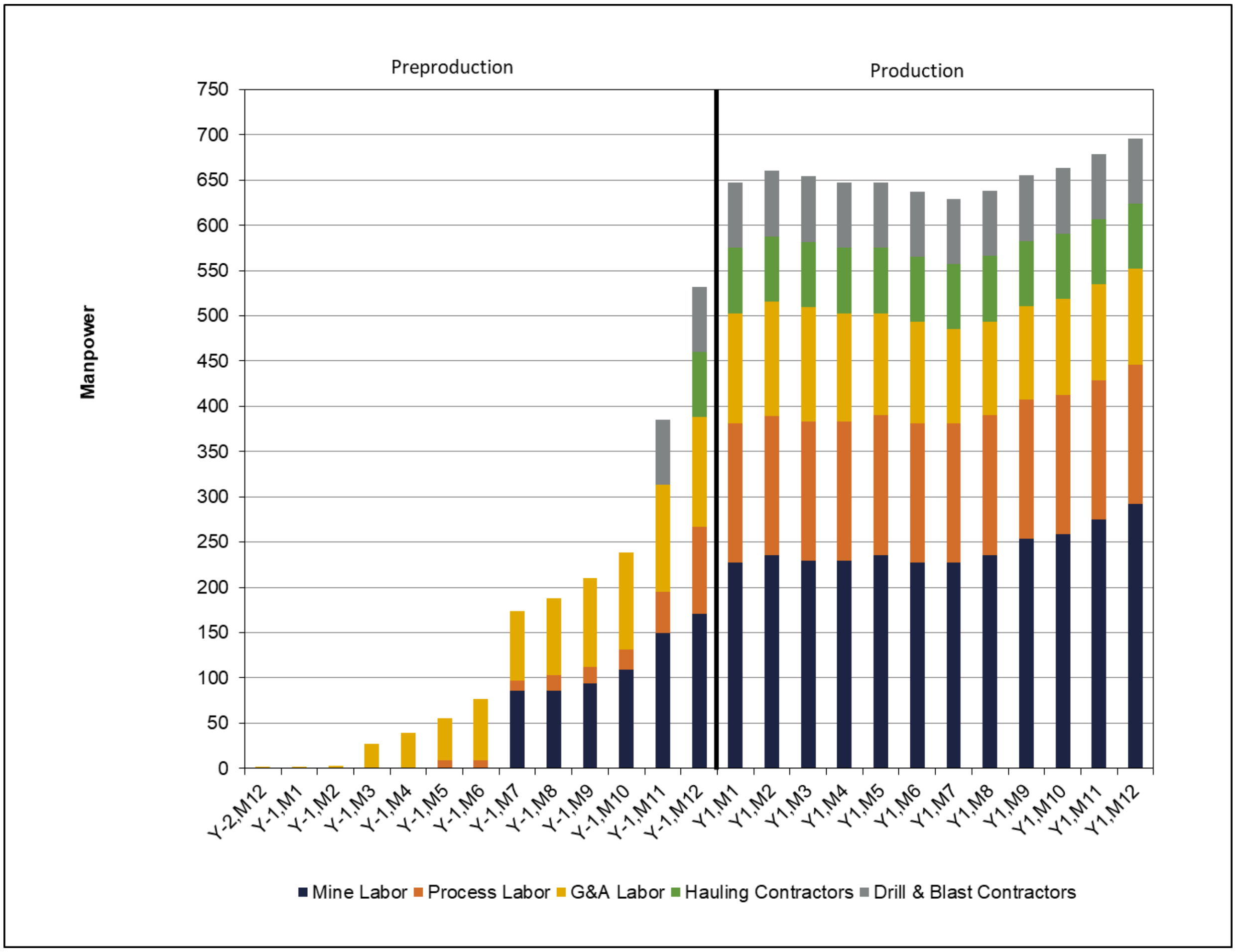
- Housing (where applicable);
- Transportation (where applicable);
- International Travel (where applicable);
- Medical;
- Life;
- Personal Accident; and
- Critical Illness.

Manpower at site will average approximately 179 staff during pre-production and 700 staff during production, including:

- Mine labor;
- Process labor;
- G&A labor;
- Hauling contractors;
- Drill and blast contractors; and
- EPCM labor.

Ramp-up of manpower over the first 24 months of the Project is shown in Figure 22-2.

Figure 22-2: Ramp-Up Manpower



Source: JDS (2019)

Most staff consists of local Armenian labor, and where applicable, expats and/or Russian management members. It is Lydian's goal to phase out expats over time and increase the Armenian labor team with training. It is assumed housing will be provided for 50% of the Project labor and contractors, with the exception of the EPCM team.

23 Economic Analysis

An engineering economic model was developed to estimate the Project's monthly cash flows. Univariate sensitivity analyses were performed for variations in metal prices, head grades, operating costs, capital costs, and discount rates to determine their relative importance as Project value drivers (presented in Section 23.6).

Pre-tax estimates of Project values were prepared for comparative purposes, while after-tax estimates were developed to calculate the true investment value. It must be noted, however, that tax estimates involve many complex variables that can only be accurately calculated during operations and, as such, the after-tax results are only approximations. The tax model used for this analysis was prepared by Lydian's Chief Financial Officer.

This technical report contains forward-looking information regarding commodity price assumptions, projected mine production rates, construction schedules and forecasts of resulting cash flows. The mill head grades are based on a level of sampling that is sufficient and reasonably expected to be representative of the realized grades from actual mining operations. Factors such as the ability to obtain permits to construct and operate a mine, or to obtain major equipment or skilled labor on a timely basis, to achieve the assumed mine production rates at the assumed grades, may cause actual results to differ materially from those presented in this economic analysis.

The estimates of capital and operating costs have been developed specifically for this Project and are summarized in Section 21 and Section 22 of this report (presented in 2019 dollars). The economic analysis has been run with no inflation (constant dollar basis).

23.1 Assumptions

The summary of the mine plan and payable metals produced is outlined in Table 23-1.

Table 23-1: Life of Mine (LOM) Summary

Parameter	Units	Value
Mine Life	Years	12
Total Ore Production	kt	119.3
Gold (Au) Grade	g/t	0.74
Silver (Ag) Grade	g/t	3.8
Process Rate	Mtpa	10.0
Gold (Au) Payable	LOM koz	2,462
	koz/a	205
Silver (Ag) Payable	LOM koz	2,100
	koz/a	175

Source: JDS (2019)

Other economic factors include the following:

- Discount rate of 5%;

- Nominal 2019 dollars;
- Revenues, costs, and taxes are calculated for each period in which they occur rather than actual outgoing/incoming payments;
- Working capital calculated as three months of operating costs (mining, process, and G&A) in Year 1, Month 12;
- No management fees or financing costs (equity fund-raising was assumed); and
- The model includes all pre-development and sunk costs, capital required to build the facility to date has been included. However the model which is run on a spreadsheet platform is configured to exclude the sunk costs if required.

Table 23-2 outlines the metal prices and exchange rate assumptions used in the economic analysis.

The reader is cautioned that the metal prices and exchange rates used in this study are only estimates based on recent historical performance and there is absolutely no guarantee that they will be realized if the Project is taken into production. The metal prices are based on many complex factors and there are no reliable long-term predictive tools.

Table 23-2: Metal Prices and Exchange Rates

Parameter	Units	Value
Gold (Au) Price	US$/oz	1,300
Silver (Ag) Price	US$/oz	16.00
Foreign Exchange Rate	Dram:USD	480

Source: JDS (2019)

23.2 NSR Parameters

Mine revenue is derived from the sale of doré bars into the international marketplace. While discussions with international buyers had commenced, no contractual arrangements for refining currently exist. Table 23-3 indicates the NSR parameters that were used in the economic analysis based on discussions with potential gold purchasers.

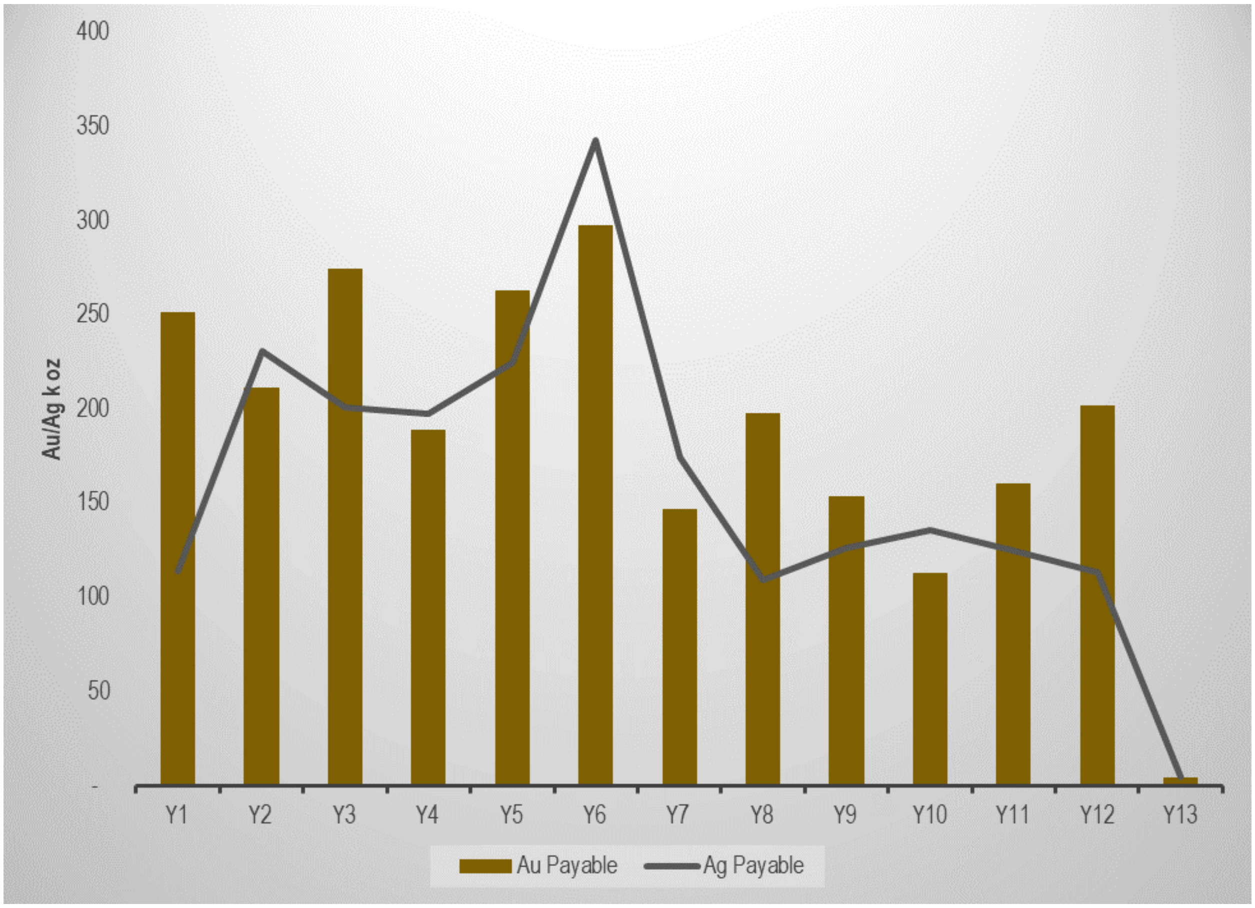
Table 23-3: NSR Parameters

Parameter	Units	Value
Mine Operating Days	days/a	365
Gold (Au) Recovery	%	87.1%
Silver (Ag) Recovery	%	14.6%
Gold (Au) Payable	%	99.95%
Silver (Ag) Payable	%	99.90%
Refining Charges	US$/pay AuEq oz	2.22

Source: JDS (2019)

Figure 23-1 shows the grade and the amount of gold (Au) and silver (Ag) recovered during the mine life. A total of 2,462 koz of gold and 2,100 koz of silver are projected to be produced over the life of mine. Gross Project revenues are divided as follows: 99.0% gold and 1.0% silver.

Figure 23-1: LOM Payable Gold and Silver



Source: JDS (2019)

23.3 Royalties

The Project is subject to three royalties included in the economic analysis and cash flow model. Table 23-4 outlines the royalty terms. Total royalties for the Project amount to US$304.0 M over the LOM.

Table 23-4: Royalty Assumptions

Parameter	Units	Value
Newmont Royalty	US$M	20.0*
Royalty 1	% payable	4.0%
Royalty 2	effective % of adjusted profit	4.7%

*Paid quarterly up to US$20 M.

Source: JDS (2019)

23.4 Taxes

The Project has been evaluated on an after-tax basis to provide a more indicative, but still approximate, value of the potential Project economics. A tax model has been developed by Lydian. The tax model contains the following assumptions:

- Corporate Income Tax: 20% applied on adjusted net income including carry backs;
- Capital cost allowances were applied using a units of production method with recovered gold ounces as the basis;
- Initial tax loss carry forwards of $3.9 M and later year loss carry forwards were calculated and provided by the client. These losses were applied against tax liabilities as available;
- Total capital allowances for taxation is $652.2 M; and
- Total taxes for the Project amount to US$189.7 M.

23.4.1 Value-Added Tax (VAT)

For the purposes of the economic model, VAT has been excluded from this analysis, with the exception of diesel and power price.

As Lydian will be an exporter of its doré product, sales transactions will be considered as zero-rated in terms of VAT. Under Armenian tax legislation Lydian is required to pay VAT on goods, services and imports. Inputs into VAT then will be refunded to the company based either on export of its product or semi-annually. Currently, the company has three categories of VAT: deferred VAT, non-current VAT and current VAT. Deferred VAT is a postponed payment of VAT for imported goods, and deferral is granted to the company by law and as a tax privilege as an investment project. Non-current VAT relates to former legislation periods, it is input in to VAT refund of which is delayed before the vendors will be paid (inter-company debt). Current VAT is input into VAT which is refundable to the company on semi-annual basis or based on export sales transactions.

Currently there are significant deferred VAT payments planned which commence at the end of 2019 and throughout 2020 as shown in Table 23-5 below. These need to be discussed with the Government of Armenia and will form part of a Framework Agreement going forward. The inclusion of deferred VAT payments without a clear timeframe for reimbursements by the government, could skew the cash flow model and hence it may and not representative of the actual project NPV It should be noted, however, that the total quantum of potential VAT refunds amounts to less than $13.7 M, or 1.5% of LOM project cash flows.

Table 23-5: VAT Payments by Period

Payment Month	Value (AMD)	Value (USD)
Dec-19	62,630,100	$127,817
Jan-20	-	-
Feb-20	-	-
Mar-20	-	-
Apr-20	-	-
May-20	64,061,640	$130,738

Payment Month	Value (AMD)	Value (USD)
Jun-20	56,785,165	$115,888
Jul-20	140,675,454	$287,093
Aug-20	367,082,728	$749,148
Sep-20	1,946,915,200	$3,973,296
Oct-20	1,096,893,731	$2,238,559
Nov-20	1,783,737,938	$3,640,282
Dec-20	945,883,769	$1,930,375
Jan-21	37,642,224	$76,821
Feb-21	105,842,149	$216,004
Mar-21	76,192,456	$155,495
Apr-21	11,512,186	$23,494
May-21	-	-
Jun-21	-	-
Jul-21	-	-
Aug-21	-	-
Sep-21	-	-
Oct-21	-	-
Nov-21	-	-
Dec-21	-	-
Total	**6,695,854,740**	**$13,665,010**

Source: JDS (2019)

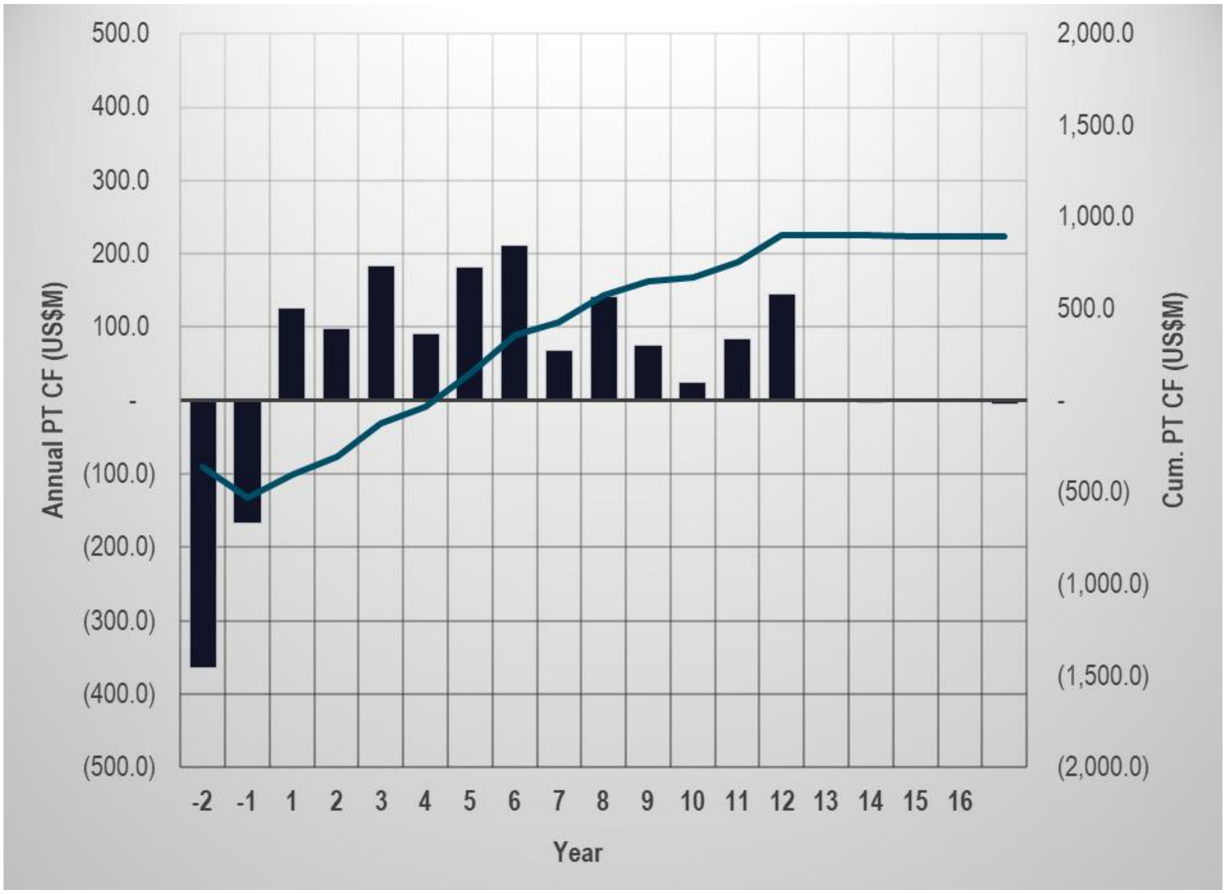
23.5 Results

The Project has an after-tax IRR of 14.9% and a net present value using a 5% discount rate ($NPV_{5\%}$) of $362.6 M using the metal prices described in Section 23.1. These results include costs incurred to date. Figure 23-2 shows the projected cash flows by year, and Table 23-6 summarizes the economic results of the Project.

The after-tax break-even gold price is approximately US$882/oz, based on the LOM plan presented herein, and a silver price of US$16.00/oz. This is the gold price at which the Project NPV @ 0% discount rate is zero.

The life of mine all-in sustaining cost (AISC) and AISC (net of by-product) is US$744/oz, and US$731/oz, respectively. The straight AISC cost is calculated by adding the refining, transport, royalty, operating, and sustaining and closure costs and dividing by the total payable ounces of gold. This metric does not consider the value of silver in the calculation. The AISC (net of by-product) is a similar calculation – it adds the refining, transportation, royalty, operating and sustaining and closure costs but subtracts the value of the silver before dividing by total payable ounces of gold.

Figure 23-2: Annual After-Tax Cash Flow



Source: JDS (2019)

Table 23-6: Summary of Results

Parameter	Units	Value
AISC*	US$/oz	744.2
AISC (Net of By-Product)	US$/oz	730.6
Capital Costs		
Incurred to Date	US$ M	361.9
Remaining Expenditure	US$ M	146.4
Sustaining and Closure	US$ M	144.0
Total Capital	US$ M	688.6
Pre-Tax Cash Flow	US$ M	893.4
Taxes	US$ M	189.7
After-Tax Cash Flow	US$M	703.7
Economic Results		
Pre-Tax NPV (5%)	US$M	503.9

Parameter	Units	Value
Pre-Tax IRR	%	18.4%
Pre-Tax Payback	Years	4.2
After-Tax NPV (5%)	**US$M**	**362.6**
After-Tax IRR	**%**	**14.9%**
After-Tax Payback	**Years**	**4.7**

*All-in Sustaining Cost is calculated as: (Refining & shipping costs + royalties+ operating costs + sustaining and closure capital)/payable gold ounces.

**All-in Sustaining Cost (Net of By-product) is calculated as: (Refining & shipping costs + royalties+ operating costs + sustaining capital + closure capital - payable Ag value)/payable gold ounces.

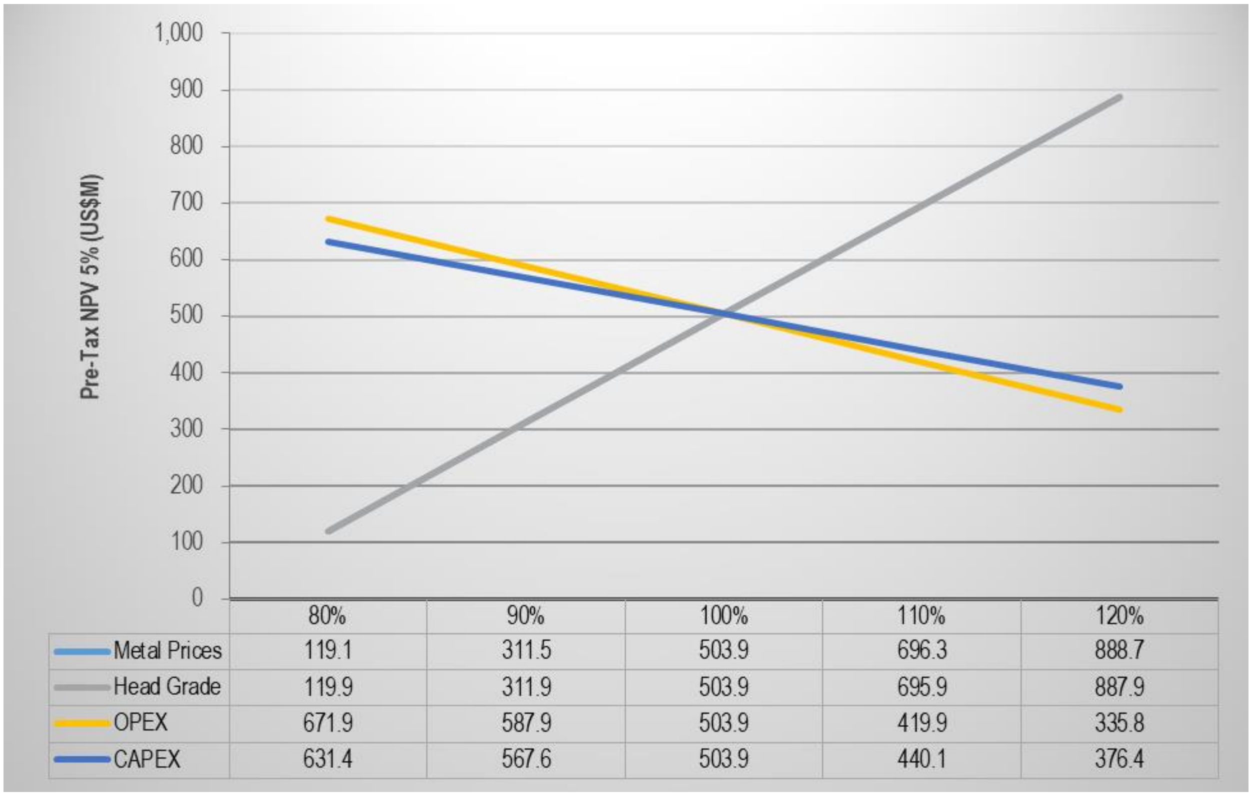
Source: JDS (2019)

23.6 Sensitivities

A univariate sensitivity analysis was performed to examine which factors most affect the Project economics when acting independently of all other cost and revenue factors. Each variable evaluated was tested using the same percentage range of variation, from -20% to +20%. This may not be truly representative of market scenarios, as metal prices may not fluctuate in a similar trend. The variables examined in this analysis are those commonly considered in similar studies – their selection for examination does not reflect any particular uncertainty.

Notwithstanding the above noted limitations to the sensitivity analysis, which are common to studies of this sort, the analysis revealed that the Project is most sensitive to head grade and metal prices. The Project showed the least sensitivity to capital costs. Figure 23-3 show the results of the sensitivity tests, while Table 23-7 shows the NPV at various discount rates.

Figure 23-3: Pre-Tax Sensitivity Analysis



Source: JDS (2019)

Table 23-7: Project Net Present Value (NPV) at Various Discount Rates

Discount Rate (%)	Pre-Tax NPV (US$ M)	After-Tax NPV (US$ M)
0	893	704
5	**504**	**363**
6	445	311
7	391	264
8	341	220
10	253	144
12	178	78

Source: JDS (2019)

24 Adjacent Properties

24.1 Introduction

Lydian Armenia conducted a desktop review of the Azatek and Voskedzor deposits owned by the Vayk Gold property to determine if the oxide ore from those deposits could be leached on the Amulsar HLF.

The company, called “Coeur Gold Armenia”, are in a partnership with a national company “Vayk Gold Limited”. Several other companies have been interested in the ownership of Coeur Gold, including Asia-Pacific Strategic Investments, Anglo-African Minerals, Grange Mining Ltd. and a number of others.

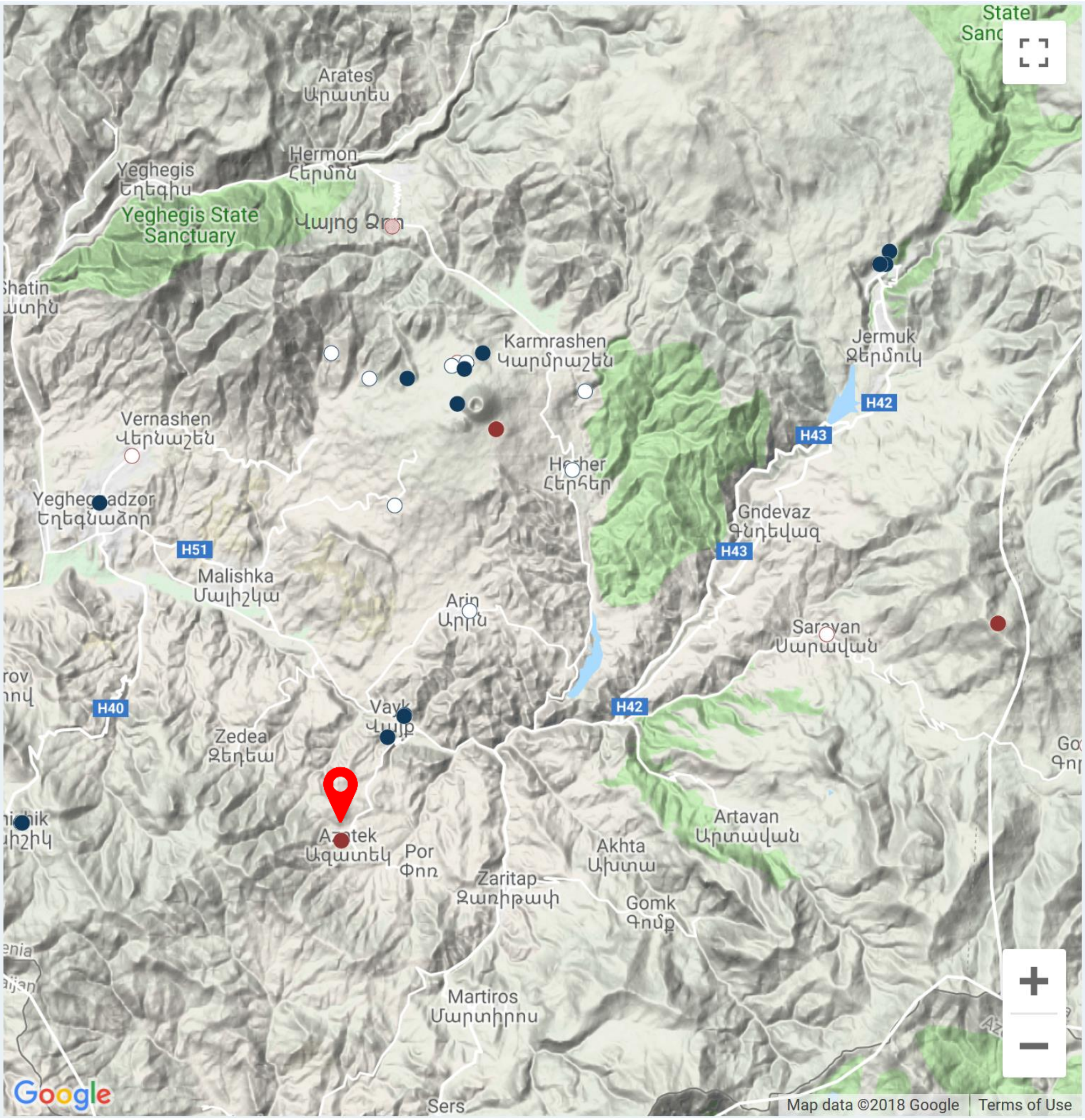
https://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=242796549

They have been exploring the Azatek and Voskedzor deposits nearby Vayk. They obtained a mining license in 2012 and in 2014 they completed a JORC-compliant mineral resource report. Earlier owners completed a Prefeasibility Study. Apparently, there has been $30 M invested in the project over the last 10 years, Coeur Gold Armenia are looking for a partnership to develop the operation.

Azatek is a polymetallic, gold antimony deposit. It is a sulfide ore body with an oxide cap. It is estimated that Coeur Gold Armenia have a 400,000 t stockpile of oxide material and an additional 20 Mt of oxide ore available in the deposit. Further work on the estimate of the ore types in the deposit is needed.

The Azatek deposit is located to the southwest of Vayk, near the village of Azatek, as shown in Figure 24-1.

Figure 24-1: Vayk Gold Location (near Azatek village, Armenia)



Source: Lydian (2019)

The tonnage and grade of the oxide stock pile and the leachability would require further evaluation determine the polymetallic component of the Vayk Gold resources.

GBM Minerals Engineering Consultants Limited (GBM), listed the Azatek project as having completed engineering work and a pre-feasibility study. The work was completed for Grange Mining. A second pre-feasibility study was completed for Anglo-African Minerals in 2011.

Property information is primarily gleaned from the 1994 GKZ reports, available from the mining ministry.

24.2 Ownership

Table 24-1: Ownership

Information Taken from Transparency.am, 2014	
Executive Director	Ashot Hovhannisyan
Contact Information and Shareholders	Vardan Ayvazyan (20%), (Ex Minister of Nature Protection 2001)
	Janna Muradyan (50%)
	Ashot Hovhannisyan (50%)
Metals	Au, Ag, Cu, Pb, Zn, Cd, Sb, T, S, B, Ga

Note: Ownership percentages as reported do not add to 100%.
Source: Lydian (2019)

24.3 Geology and Resources

1994 Reserves

The 1994 report was prepared by the geological laboratory of "Institute of Mining Metallurgy" jointly with Armeniak LLC, primarily based on the data from the report "On the findings of geological exploration activities at Azatek Deposit for 1951-1993, with estimation of reserves for 1/1, 1994". The resources are not differentiated between oxide and sulfide resources.

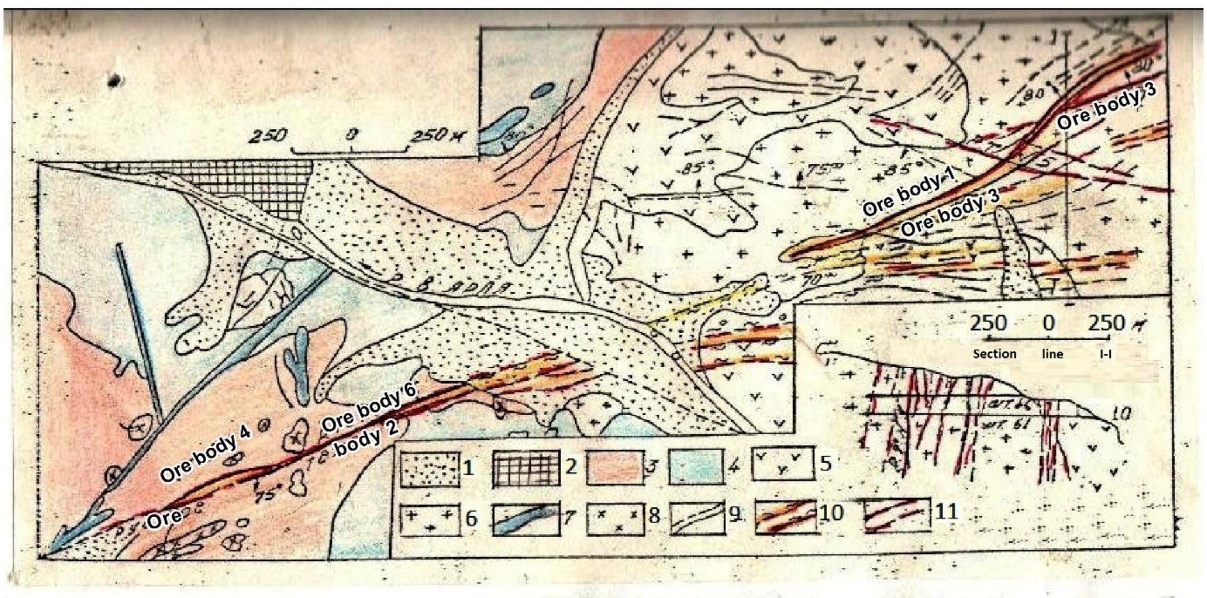
Table 24-2: GKZ 1994 Resources

Indicator		Unit	1-Jan-1994 Resources			
			Balanced			Of-balanced, C2
			C1	C2	C1+C2	
Resources	Ore	Thou. T	709.31	202.67	911.98	16.28
	Gold	Kg	1742.32	468.1	2210.42	16.43
	Silver	Kg	31695.51	8139.56	39835.07	257.39
	Copper	t	1404.03	36.83	1440.86	3.21
	Antimony	t	1813.61	40.02	1853.63	0
	Lead	t	3365.01	1016.22	4381.23	11.26
	Zinc	t	912.55	72.03	984.55	3.22
Content	Gold	g/t	2.46	2.31	2.42	1.01
	Silver	g/t	44.68	40.16	43.68	15.81
	Copper	%	0.2	0.02	0.16	0.02
	Antimony	%	0.26	0.02	0.2	0
	Lead	%	0.47	0.5	0.48	0.07
	Zinc	%	0.13	0.04	0.11	0.02

Table 24-3: 2007 GKZ Resources

Open Pit	Ore body	Indicators		Unit	Resources			
					Balance			Of balance, C2
					C1	C2	C1+C2	
Total: Pit 1 and pit 2		Resources	Ore	Tz/t	709.31	202.67	911.98	16.28
			Au	Kg	1742.32	468.1	2210.42	16.43
			Ag	Kg	31695.51	8139.56	39835.07	257.39
			Cu	T	1404.03	36.83	1440.86	3.21
			Sb	T	1813.61	40.02	1853.63	0
			Pb	T	3365.01	1016.22	4381.23	11.26
			Zn	T	912.55	72.03	984.55	3.22
		Content	Au	g/t	2.46	2.31	2.42	1.01
			Ag	g/t	44.68	40.16	43.68	15.81
			Cu	%	0.2	0.02	0.16	0.02
			Sb	%	0.26	0.02	0.2	0
			Pb	%	0.47	0.5	0.48	0.07
			Zn	%	0.13	0.04	0.11	0.02

Figure 24-2: Sketch Map of Azatek Deposit Geology



Sketch Map of Azatek Deposit Geology

1. Quaternary deposits and pebbles of the Arpa river bed. 2. Andesitic basalts (Pliocene). 3. Tuffites, tuffaceous sandstones, siltstones, argillites. 4. Plagioclase porphyrites. 5. Hornfelsed rocks. 6.Granodiorites, monzonites, diorites. 7. Syenites and quartz syenites. 8. Hornfels-pyroxene and quartz diorite dykes. 9. Tectonic dislocations. 10. Hydrothermally altered zones. 11. Quartz-sulphide gold-bearing ore bodies.

24.4 Mineralization

Material Composition of Ore and Host Rocks:

The ores of Azatek gold-polymetallic deposits have diverse composition and divide into two groups:

1. Primary elements (gold, silver, copper)
2. Associated elements (lead, zinc, arsenic, arsenic, bismuth, cadmium, tellurium, etc.)

In general, four main phases of mineralization have been identified in the deposit due to their unique mineral structures. These phases are:

1. Polymetallic phase - represented by small-scale quartz-pyrite veinlets with sphalerite and galena. Considerable content of arsenopyrite occurs at this stage associated with the occurrence of the above basic minerals and considered one of the widespread minerals of the mine. Arsenopyrite has widespread occurrence in the ore bodies. Two visible grains of gold with 0.01 mm in size were found in the main ore minerals of polymetallic phase.
2. Sulphoantimonite (antimony sulfosalt) phase: Represented by veins with lead and copper sulphoantimonite impregnations. Formation of this phase takes place in 2 stages: initially, galena, sphalerite and pyrite occur, associated with one or two close lead sulphoeantimonites (boulangerite (Pb5Sb4S11) and plagionite (Pb5Sb8S17)), and then only zinkenite (Pb9Sb22S42) and quartz occur.
3. Antimonite (Stibnite) phase: Represented by quartz veins. Stibnite (Sb2S3) and quartz are main minerals of this stage. Pyrite and sphalerite occur in small amounts.
4. Quartz-carbonate-barite phase: Represented by irregular quartz, carbonate and veins. Basic mineral composition of this phase consists quarts and pyrite, and small amounts of chalcopyrite, sphalerite, galenite and sulfides with surface oxidation.

The oxidation zone has slight occurrence in the deposit. Limonite, antimony ocher (stibiconite ($Sb^{3+}Sb^{5+}{}_2O_6(OH)$ and cervantite ($Sb^{3+}Sb^{5+}O_4$), cerrusite ($PbCO_3$), covellite (CuS), malachite ($Cu_2(CO_3)(OH)_2$) and azurite ($Cu_3(CO_3)_2(OH)_2$) also occur in this zone.

In the deposit, gold occurs in the form of inclusions. It is also found both in ore veinlets and near-deposit altered zones.

Gold was found in tennantite ($Cu_{12}As_4S_{13}$), pyrite, chalcopyrite, arsenopyrite, galenite, sphalerite, stibnite, quartz and carbonates in the form of fine inclusions.

Despite the diversity of above minerals, the overwhelming majority of gold is associated with certain minerals. Approximately 45% of visible gold have been found in tennantite, 35% in quartz and 20% in pyrite. Based on X-ray analyzes, silver makes up 13.19% in the content of gold in Azatek deposit.

24.5 Conclusion

This property has a little or no value to Lydian Armenia at this time, due to the uncertainty associated with treating this ore. The primary issue is the metallurgical complexity of the both the oxide and sulfide ores and considerable further analysis and testing is required. The oxide zone mineralogy contains soluble copper minerals and the sulfide zone contains copper, antimony and arsenic minerals. The crush size will have to be determined that will appropriately liberate the gold, as 35% of the gold is contained in quartz and 20% in pyrite. The arsenic and antimony minerals will cause a long-term issue, if left on the pad due to the ability to prevent gold from leaching through surface coating.

No information was available online to determine the viability of leaching or to describe the oxide portion of the deposit. Economics were not considered at this point. Further analysis would require access to the JORC-compliant resource and metallurgical reports completed for the project.

25 Other Relevant Data and Information

25.1 Project Execution Plan

25.1.1 Introduction

The Amulsar Project Execution Plan (PEP) describes the project development strategies that were considered for the FS capital cost estimate and project schedule, and provide the future framework for organizing the engineering, procurement, and construction. The PEP will also serve as a guide in:

- Promoting safety in design, construction, and operations;
- Promoting sustainable social investment and community relations within the area during the planning, construction and operations phases;
- Ensuring all environmental aspects and potential impacts of the project are considered completely and comprehensively during the construction, operational and post-operational phases of the project; and
- Negotiating contracts with suppliers, contractors, and engineers and ensuring that these adhere to the Project's HSE standards.

Although the PEP provides guidance for executing the Project, the planning stage will evaluate alternate execution strategies and other opportunities that add further value. This may include items such as variations to portions of the execution strategy (i.e. EPCM, Engineering, Procurement and Construction (EPC), Engineering, Procure and Supply (EPS), etc.) or inclusion of Owner resources for smaller scopes of work.

25.1.2 Project Development Schedule

An execution schedule was developed for the Project based on a thorough review of the remaining project management, procurement, engineering, and construction tasks to complete. The Project completion period is 13 months from the restart of construction to the commencement the production of first gold Figure 25-1 presents a summarized version (level 1, AAEC) schedule for the development of the Amulsar Project.

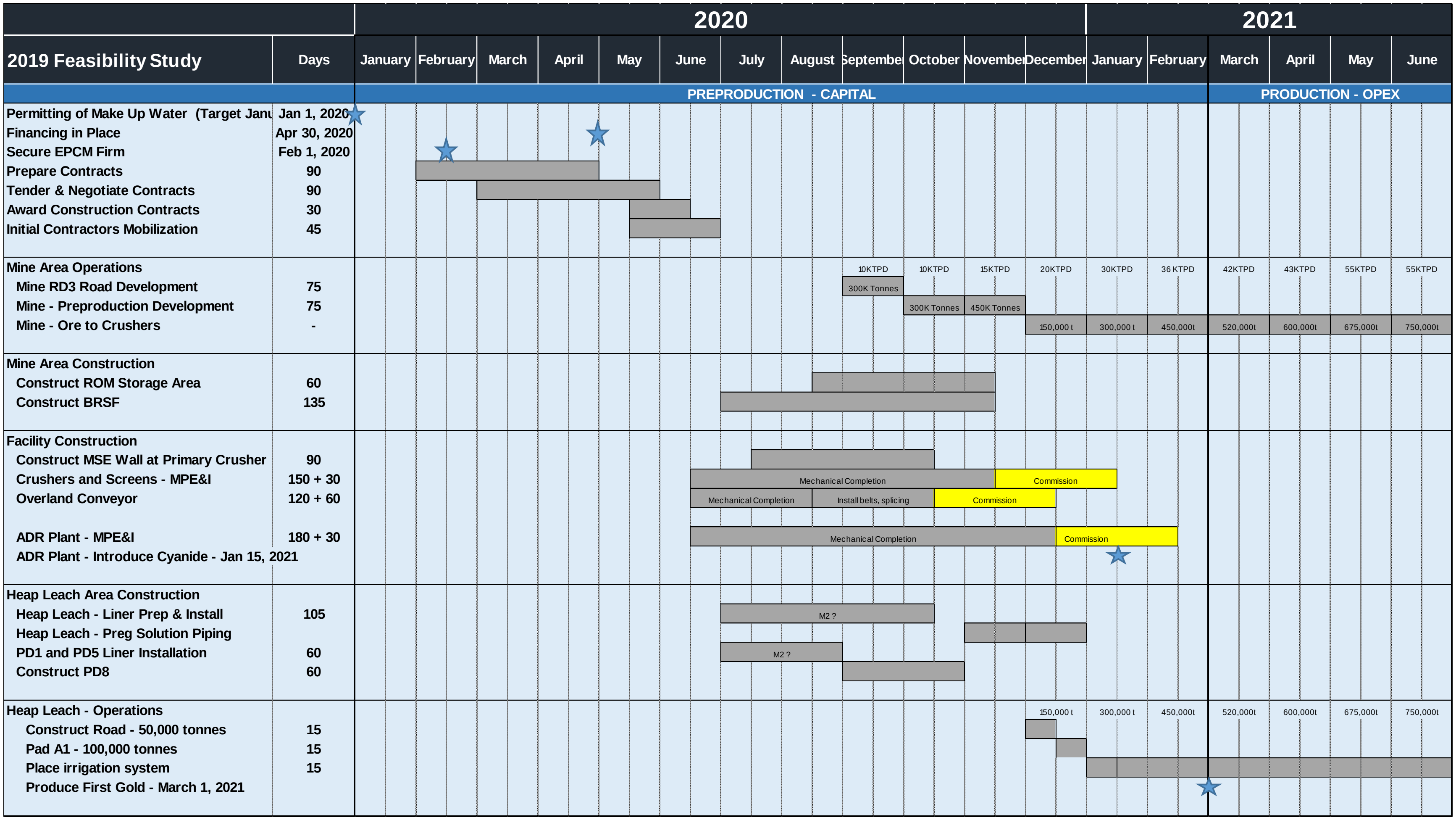
The critical path of the schedule runs through the following activities:

- EPCM contracts formation and project initiation;
- Establish project team, Owner and EPCM;
- Initiate mining pre-production operations;
- Crusher MSE wall, and crushers installation;
- Conveyor installation and commissioning;
- HLF stacking; and
- Gold processing: ADR plant and refinery.

Other near-critical activities include:

- BRSF preparation; and
- HLF and ponds completion.

Figure 25-1: Summarized Project Schedule



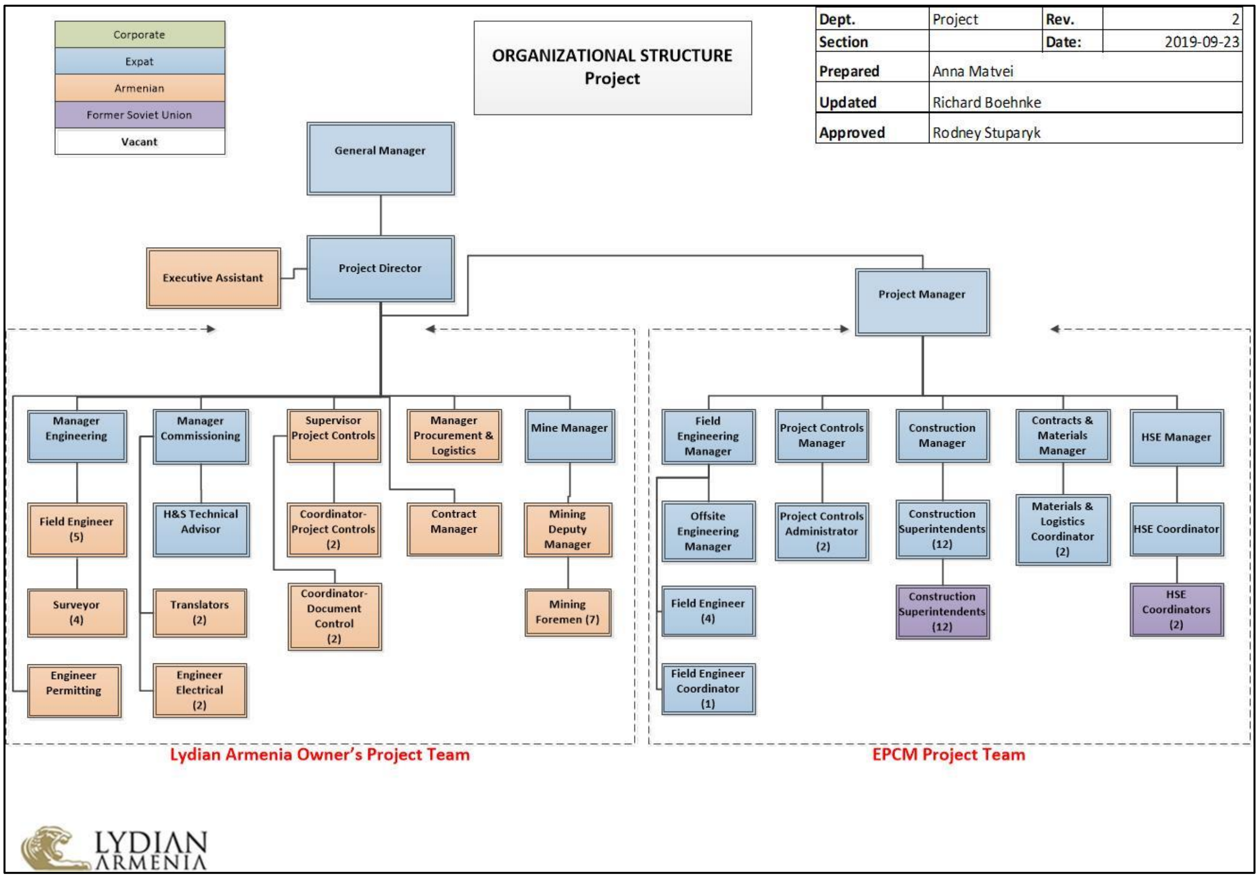
Source: JDS (2019)

25.1.3 Project Management

25.1.3.1 Organization and Responsibilities

The Project Management Team (PM Team) will be an integrated team including the Owner's personnel, the EPCM Contractor team, and the engineering and construction contractors. The PM Team will oversee and direct all engineering, procurement, and construction activities for the Project. Figure 25-2 presents the preliminary project organization chart.

Figure 25-2: Project Organization Chart



Source: Lydian (2019)

25.1.3.2 Senior Project Management

Overall delivery of the Project to its timeline and specifications is the responsibility of the Project Director. The Project Director provides high level direction to the PM Team, with support from the EPCM Contractor and the Owner's Pre-Operational team to manage Project activities.

The Project Director will be accountable for the execution of Project activities, including detailed engineering, procurement, logistics, construction, commissioning, and project controls. The Project Director is also responsible to ensure that all safety, environmental and CSR project standards, requirements, codes and regulations incorporated into the project charter, directives and management plans are adhered to.

25.1.3.3 Owner Operations Team

A portion of the Owner Operations team will be mobilized during the development phase of the Project because these functions will also be required during operations (i.e. after construction is completed). The Owner operations team will assist and work with the EPCM contractor during project execution in the following functional areas:

- Health and Safety;
- Environmental;
- Engineering;
- Project Support Services, inclusive of:
  - Supply Chain Management;
  - Information Technologies (IT);
  - Accounting;
  - Legal; and
  - Security;
- Human Resources;
- Operations, inclusive of:
  - Mining operations;
  - Process plant, including maintenance;
  - General and Administrative; and
  - Site Services (reporting to the EPCM Construction Manager during construction).

25.1.3.4 Engineering Team

The EPCM contractor Field Engineering Manager will oversee, coordinate, and integrate engineering activities. The Engineering Team will consist of various engineering sub-contractors, who will complete the detailed designs and specifications for the Project, and then transition to the field to provide quality assurance (QA), field engineering, and commissioning support.

25.1.3.5 Procurement Team

The Procurement & Contracts Manager will oversee and manage contracts administration and procurement activities undertaken by engineering contractors (formation and administration of engineering and construction contracts will be overseen and managed by EPCM Contracts personnel). The procurement team will use the prepared engineering design packages to obtain competitive tenders, and secure construction contractors to provide the appropriate goods and services.

25.1.3.6 Construction Management Team

The Construction Manager will be responsible for construction safety, progress, and quality. The Construction Management Team will coordinate and manage all site activities to ensure construction progresses on schedule and within budget.

25.1.3.7 Commissioning Team

The Commissioning Manager will oversee the commissioning team and be responsible for the timely handover of process and infrastructure systems to the owner once construction activities have been substantially completed. The commissioning team will be supported by disciplined engineering resources to complete pre-commissioning activities and to obtain technical acceptance and transfer care, custody, and control of completed systems to the owner.

25.1.3.8 Project Controls Team

The Project Controls Manager will oversee the Project controls team, and be responsible for the development, implementation, and administration of the processes and tools for Project estimating, cost control, planning, scheduling, change management, progress reporting, and forecasting.

25.1.3.9 Project Procedures

During the Project setup phase (immediately upon project approval), a Project Procedures Manual will be developed, which will outline standard procedures for project execution. This document will focus on the interfacing between the Owner, EPCM team and engineering contractors, and address delegation of authority, change management, procurement workflows, QA/QC, and reporting standards.

25.1.4 Project Support Services

The project support execution strategy for the Project will be to utilize the owner's team to provide the support services for:

- Security;
- Legal;
- Operations' supply chain management;
- IT services; and
- Accounting.

Coordination of EPCM contractors and the Lydian project support services team interfaces will be the responsibility of the Project Director.

25.1.5 Engineering

25.1.5.1 Engineering Execution Strategy

The project's detailed engineering is mostly complete, with about 25 items' SOWs still to be detailed. The general engineering execution strategy for the Project will be to utilize in-country engineering firms with specialized knowledge of their assigned scope where possible, with engineering contractors previously engaged to complete the final detailed designs for the HLF ponds and the BRSF. Coordination of engineering interfaces and overall management of engineering schedule and deliverables will be the responsibility of the EPCM Field Engineering Manager.

25.1.5.2 Engineering Management

25.1.5.2.1 Project Technical Organization

The preliminary project technical organization is as shown in Figure 25-2, under the EPCM Field Engineering Manager. The Owner's engineering team, consisting mainly of Armenian nationals, will primarily aid the coordination with in-country engineering and field verification of construction work by Armenian contractors.

25.1.5.2.2 Baseline Engineering Data

Engineering data from previous project development and from the FS, including (but not limited to) design criteria, flow sheets, material take-offs and drawings are considered the engineering baseline data, and form the basis for the capital cost estimate and schedule. Deviations from these baseline engineering inputs, beyond clarifying and finalizing scope, and detailing of designs will be subject to the project change management processes.

25.1.5.2.3 Design Criteria Approval

The Project critical path includes timely completion of engineering activities. To prevent delays or late changes in engineering deliverables and to keep efforts focused, an approval procedure will be developed and adhered to.

25.1.5.2.4 Engineering Progress and Performance Monitoring

Each engineering contractor will provide a deliverables list as part of their services proposal. Deliverables (and their associated budgets) will be grouped into logical Engineering Work Packages (EWPs), which will be used as the metric for tracking engineering progress for the Project.

25.1.6 Procurement and Contracting

25.1.6.1 Procurement Execution Strategy

The general procurement execution strategy for the Project will include utilizing known suppliers, with a preference for local or regional suppliers and construction contractors. The commercial manager (with input from the engineering manager) will have overall responsibility for most pre-purchased procurement and contract formation activities. Contract administration will be the responsibility of the commercial manager.

25.1.6.2 Construction Contracting Strategy

Table 25-1 presents a listing of the major contract packages identified for the Project. The strategy will be to re-establish contracts with existing contractors that meet the performance and pricing criteria and have not been disqualified from working at site. Based on the experience from previous construction, the vendor selection and qualification process will be streamlined and little effort will be required relative to the previous project start up.

Table 25-1: Major Construction Contracts (Capital Phase)

Contract Number	Contract
CC01	Civil Works
CP01	Specialty Pipeline Work
CB01	Concrete Works
CS01	Structural and Architectural Contractor
CM01	Mechanical Contractor
CE01	Electrical Contractor
CC02	HLF Work Package
CC03	BRSF Work Package
CM02	Overland Conveyor Splicing
CO01	Equipment Rental & Operations

Source: JDS (2019)

Construction Work Packages (CWPs) will be used from the previous construction work, modified where required, and new ones developed, if they have not been already, to manage execution of the scopes of work on site. A CWP is an executable construction deliverable that is defined by logical subdivision of the overall construction scope into manageable packages based primarily on geographical boundaries that do not overlap. It includes a budget and schedule that can be compared against actual performance and used to track construction progress. The CWPs will be used as a scoping document for Requests for Proposals, contracts, and/or portions of contracts.

The strategy for the open pit mining activities on the Project is to use the Owner's mining team to perform the construction of RD-3 haul road, pre-stripping, pre-production development, and initial ore stockpiling at the crusher.

25.1.6.3 Procurement Schedule and Critical Activities

Most of the procurement for the Project is already complete, with all major equipment already sourced, purchased and delivered to site. The remaining items left to purchase are a few auxiliary items and materials, and are not considered on the project critical path. The project purchasing team will be activated early in the project, and prepare final bid packages, sourcing and vendor selection prior to the start of construction.

25.1.6.4 Selection of Suppliers and Contractors

A review of all previous contractors with respect to past performance, price and level of competency will be conducted during the construction SOW preparation process. The strategy will be to rely on existing contractors and vendors as much as possible and to reduce the need for further contractor and vendor vetting and contract preparation work.

25.1.7 Logistics and Materials Management

25.1.7.1 Logistics Execution Strategy

The logistics execution strategy includes the following objectives:

- Ensure sufficient expediting activities to achieve schedule requirements;
- Manage global freight movements to optimize freight movement cost; and
- Identify and optimize various aspects such as logistics, customs clearance and local content.

25.1.7.2 Site Materials Strategy

The general strategy for site materials control is as follows:

- Control and supervise materials movement at site through materials/inventory control from receiving, preservation, inventory, and free-issue to contractor to meet the Project requirements for all equipment and materials procured by the construction team or EM (i.e. process equipment);
- Include in contractor's scope requirements for receipt, storage, and retrieval of procured materials required for its work;
- Utilize a common labour pool for warehouse and laydown staff (equipment operators and labourers) to support the management and movement of freight, except for items requiring special handling or rigging (such as structural steel); and
- Utilize a temporary warehouse for the receipt and storage of all equipment requiring climate controlled indoor storage. Equipment and material that do not require climate-controlled storage will be stored in laydown areas within the construction site. Use of sea containers and/or temporary shelters will be required to store goods that need to be protected during construction.

25.1.8 Construction

25.1.8.1 Construction Execution Plan Overview

The main objectives of the construction execution strategy include:

- Execute all activities with a goal of zero harm to people, assets, the environment, or reputation;
- Strive to eliminate process, operational and maintenance safety hazards;
- Meet or exceed environmental regulatory and permit requirements to minimize impact;
- Cultivate an atmosphere of positive social impact in the surrounding communities;
- Deliver a high-quality facility that meets or exceeds the defined project goals;
- Establish and maintain a high level of motivation by providing a positive working environment for all personnel;
- Identify and remove barriers that affect project progress; and
- Recognize, identify and communicate outstanding achievements during construction and commissioning of the Project.

25.1.8.2 Site Management

During the construction Phase, the Project Director (or his designate) will be responsible for the development and construction areas. The EPCM Project Manager and Lydian Project Director will closely coordinate site activities, and responsibilities will be separated for areas such as the open pit mine.

25.1.8.3 Construction Management

The EPCM Construction Team will be responsible for oversight of construction contractors.

25.1.8.4 Safety Management

The Project Safety Management Plan (SMP) will be re-issued prior to site mobilization. The SMP will address overall safety policies, procedures, and standards for the Project, including standard operating practices and emergency response plans for the site.

25.1.8.5 Quality Management

Construction quality will be managed through the implementation of a Site Quality Management Plan (SQMP), which will detail the site quality management systems to be used for all construction activities. The SQMP encompasses all activities of the Project, including design, procurement and construction. Site QA is the responsibility of the EPCM Field Engineering team, as is verification that QC is being performed by the contractor, subcontractor, laboratory and third-party inspection services.

25.1.8.6 Construction Quantities

Table 25-2 presents the estimated major commodity quantities to complete the Project before the start of operations. Quantities are based on the site review, engineering take-offs and FS capital estimate.

Table 25-2: Project Construction Work Hours by Discipline

Discipline	Commodity Quantity	
	UOM	Approximate Quantity
Concrete	m^3	2,800
New Access Road	Km	3.7
Bulk Earthworks	m^3	1,050,000
Liner Installations	m^2	507,000
Structural Steel Erection, (including buildings)	T	2,842
Mechanical	# tagged equip.	180
Piping (Surface & Overland, CS & HDPE)	Km	114
Piping (Process and Utility)	M	4,150
Power & Control Cable	Km	80

Source: JDS (2019)

25.1.9 Construction Milestones

Table 25-3 presents the major construction milestones for the Project.

Table 25-3: Major Construction Milestones

Milestone	Date
EPCM Firm Contracted and Start Work *Initiate Project Management controls, engineering and procurement activities*	Month 2
Final Financing Achieved	Month 4
Order Additional Mining Fleet *(trucks with 12-month lead time);*	Month 4
Re-Start Construction *Critical Contractors hired and mobilized to site*	Month 6
Start Mining	Month 8
HLF Ready for Ore	Month 12
Processing Facilities Complete Construction	Month 12
Crushers & Overland Conveyor Ready - Crushing and Stacking of Ore	Month 13
Introduce Cyanide	Month 13
Process Facilities Commissioning Complete and First Gold Produced	Month 14

Source: JDS (2019)

25.1.9.1 Site Workforce Loading

Since the project has already achieved a fair amount of construction, the full site manpower loading will be achieved in a relatively short time once construction is re-imitated. The initial five months prior to the start of construction will have a slow ramp of the EPCM team and the Owner's staff, including the mining personnel. Once construction is under way, the workforce will take approximately 30 days to ramp up to an average of approximately 600 people at site until commissioning is complete.

Table 25-4 provides the construction labour hours by discipline, not including the Owner's mining and process operations staff. The main disciplines listed, concrete, civil, etc. until and including structural steel, consist of contractors work hours at site. The indirect construction work hours include the site EPCM team, vendor representatives, contract site services, and construction labour for commissioning.

Table 25-4: Construction Labour by Commodity

Discipline	Commodity Quantity	
	UOM	Approximate Quantity
Concrete	hrs	47,000
Civil	hrs	419,000
Architecture	hrs	130,000
Electrical & Instrumentation	hrs	232,000
Mechanical	hrs	181,000
Piping	hrs	114,000
Structural Steel	hrs	184,000
Indirect Construction Work	hrs	141,000

Source: JDS (2019)

25.1.10 Commissioning

25.1.10.1 Commissioning Methodology

Progressive commissioning for the Project will be performed by subsystem. A system will be defined as a logical grouping of equipment or systems that is largely independent and contributes to a common purpose or functionality. Wherever possible, facilities will be commissioned early in the development schedule (as in the case of dewatering and injection wells and system, etc.) and be turned over to EM for ownership and operation. A detailed Commissioning Plan will be developed during the project controls set up and engineering period.

25.1.10.2 Commissioning Safety and Training

The Health, Safety, and Environmental Plan (HSE Plan) developed during execution will address specific safety procedures that will apply during the commissioning stage of the Project. The commissioning and turnover phase present significant and unique safety risks. A comprehensive lock-out tag-out program is an effective control to manage these risks.

25.1.10.3 Commissioning Stages

- Construction Release (Stage 1): Construction contractor completes a system subject to agreed punch list items;
- Pre-Operational Equipment Testing (Stage 2): Energize and test individual equipment within subsystems to ensure functionality includes equipment functionality tests controlled by the Plant Control System (signed off loop diagrams);
- Pre-Operational Systems Testing (Stage 3): Systems tested with water, air and insert materials, and capable of continuous and safe operation with all instrumentation connected, the control system operational, and all interlocks functional;
- Ore Commissioning (Stage 4): Plant ready to accept ore and all operating and maintenance staff are fully trained to operate and maintain the plant; individual systems operate successfully under load for a defined time period; and
- Ramp-Up (Stage 5): Increase ore feed to design throughput rate.

25.2 Geochemistry and Acid Rock Drainage (ARD) Management Plan

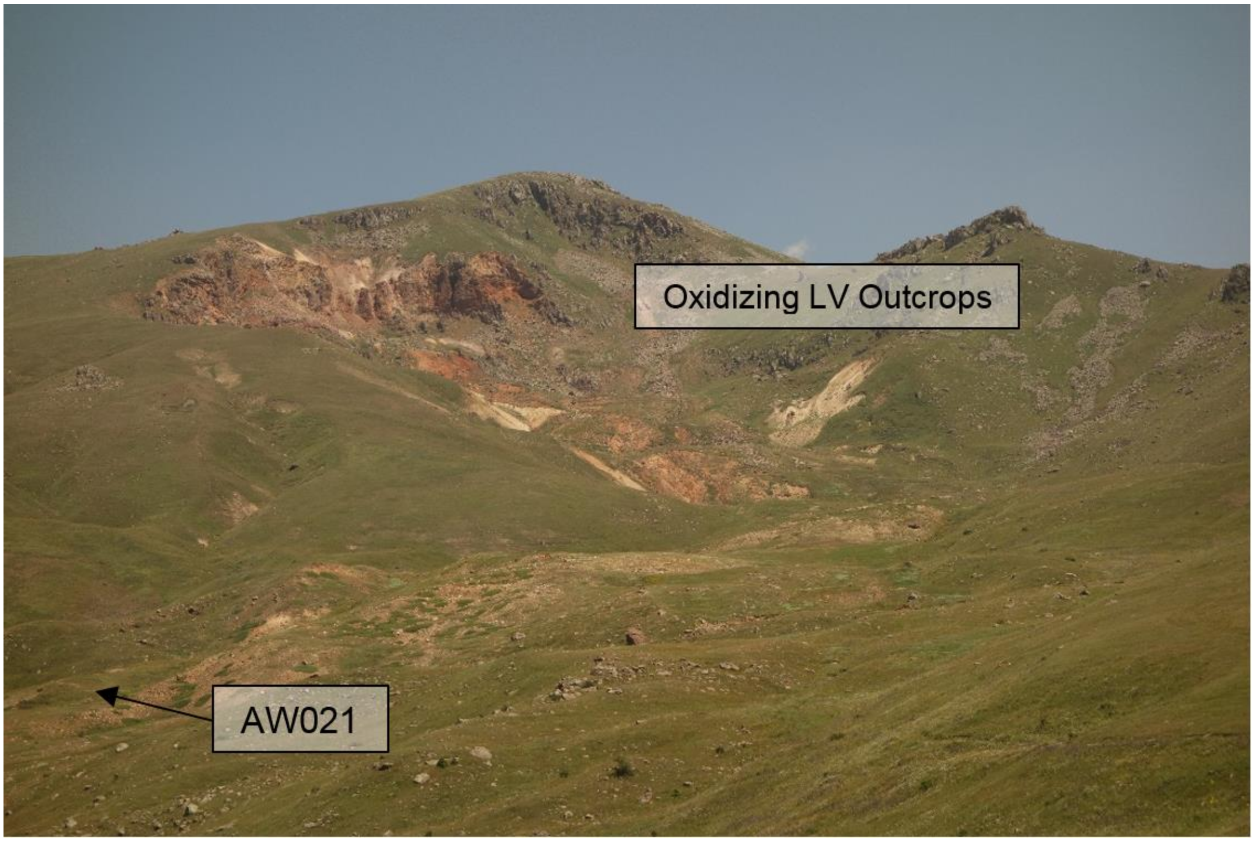
The following section describes the following:

- The current (pre-mining) ARD conditions at the Amulsar site;
- The geochemical characterization of Amulsar barren rock and spent HLF material;
- The ARD management plan during operations;
- The adaptive management plan;
- Ongoing ARD-related studies;
- The ARD mitigation and treatment plan after mine closure;

25.2.1 Existing ARD Conditions

The Amulsar site has naturally-occurring ARD (Wardell Armstrong, 2016) which is the result of the oxidation of sulfide minerals in the Upper Volcanic (UV) and Lower Volcanic (LV) rocks where they outcrop at surface, and has been occurring for centuries. One of the most significant ARD sources on Amulsar mountain is near Vorotan Pass, and is monitored by Amulsar as surface water monitoring point 21 (AW021). The source of the ARD in AW021 is an oxidizing LV outcrop that can be seen in Figure 25-3 with its distinctive ferric iron (red and orange) staining, and which has a pH of 3.4 with 80 mg/L total acidity (as $CaCO_3$) and 143 mg/L of sulfate.

Figure 25-3: Photograph of Naturally-Occurring ARD on Tigranes Mountain



Source: GRE Photograph (2018)

Another existing source of ARD are the mine waste piles left by Soviet-era mineral exploration activities in the 1960s. There is a waste pile and a mine portal at Site 13 in the Vorotan valley and another waste pile in Site 27 within the BRSF footprint. These waste piles produce ARD characteristics similar to AW021 with a pH of ~3.5, and a sulfate concentration of 45 mg/L. The Site 27 and Site 13 waste piles are a useful indication of the geochemical behavior of Amulsar rocks if left unmitigated over long periods.

Figure 25-4: Photographs of Soviet-Era Mine Waste Piles Producing ARD. Site 27 (Left), and Site 13 (Right)

Source: GRE (2014)

25.2.2 Geochemical Characterization

The characterization of the Acid Rock Drainage (ARD) properties of the Amulsar site was first reported by Golder Associates (Golder, 2013). This report has been fully-updated by GRE (refer to GRE 2014 Geochemical Characterization Report) to include the results of geochemical testing and predictive modeling associated with the up-to-date mine planning and ARD mitigation measures. The following sections present a summary of the revised geochemical characterization results.

25.2.2.1 Static Testing of Barren Rock

As mentioned in Section 18, barren rock will be placed in the BRSF or in the backfilled Tigranes-Artavazdes (TAA) pits. Static geochemical testing, which defines the ARD-generation potential and metals leaching potential of a given rock type, has been performed on this barren rock. .

The following static geochemical testing was performed:

Table 25-5: Static Geochemical Testing Program (Number of Samples)

Material Type	ABA	NAG pH Testing	Bulk Chemistry	Mineralogy	SPLP Effluent Testing	NAG Effluent Testing
Barren Rock – TAA	154	-	97	8	8	8
Barren Rock – Erato	80	50	42	12	9	12
Spent ore – TAA	6	-	-	-	6	-
Spent Ore – Erato	7	7	7	-	7	7
Borrow Materials	5	5	5	-	5	5

Source: GRE (2014)

Where:

- ABA: Acid Base Accounting by Modified Sobek
- NAG pH: Net Acid Generating pH test
- Bulk Chemistry: mineral composition by ICP-MS whole rock analysis
- Mineralogy: Mineralogy evaluation via XRF followed by mineralogical analysis.
- SPLP effluent: Synthetic Precipitation Leaching Procedure
- NAG Effluent: Testing of the NAG pH effluent.

25.2.2.2 Acid-Base Accounting (ABA): Barren Rock

ABA testing determines the total potential for acid generation of a rock sample compared to its' total neutralization potential. It is an industry-standard method for determining the potential for acid generation in a rock type. Table 25-6 shows the results of ABA testing for the TAA Barren Rock and Table 25-7 shows the ABA summary for Erato Barren Rock.

Table 25-6: ABA Summary - Tigranes/Artavezdes Barren Rock

Barren Rock	Statistics	Paste pH	AP ($TCaCO_3/kT$)	NP ($TCaCO_3/kT$)	Total S (%)	Sulfide S (%)	Sulfate S (%)
Lower Volcanics	Mean	4.86	40.94	0.26	2.51	1.31	0.36
	Std. Dev.	1.07	60.00	1.67	2.57	1.92	0.55
Upper Volcanics	Mean	5.54	4.30	0.14	0.76	0.14	0.11
	Std. Dev.	0.70	21.39	0.85	1.40	0.68	0.20
Colluvium	Mean	5.79	0.87	0.20	1.07	0.03	0.13
	Std. Dev.	0.84	1.02	0.41	1.27	0.03	0.11

Source: GRE (2014)

Table 25-7: ABA Summary - Erato Barren Rock

Barren Rock	Statistics	Paste pH	AP ($TCaCO_3/kT$)	NP ($TCaCO_3/kT$)	NAG pH	Total S (%)	Sulfide S (%)	Sulfate S (%)
Lower Volcanics	Mean	5.00	27.44	0.38	4.28	2.16	0.88	0.38
	Std. Dev.	1.04	49.26	0.96	1.12	2.23	1.58	0.60
Upper Volcanics	Mean	5.30	5.48	0.27	4.72	0.83	0.18	0.11
	Std. Dev.	0.60	24.62	0.85	0.50	1.43	0.79	0.15
Colluvium	Mean	5.75	5.33	1.08	4.92	1.69	0.17	0.20
	Std. Dev.	0.19	11.19	0.86	0.15	2.42	0.36	0.28

Source: GRE (2014)

Table 25-6 and Table 25-7 show that the Lower Volcanics (LV) formation has the highest potential for ARD generation with an average sulfide sulfur content of 1.3% for the TAA deposit and 0.9% for the Erato deposit. The Upper Volcanic (UV) rock type has some trace sulfides, but its oxidized nature and low total sulfide concentration (around 0.15%) make it so the low Acid Potential (AP) of the UV does not generate ARD. The colluvium, a low-volume waste type, does not have significant acid generating potential. None of the rocks tested have neutralizing potential in sufficient concentrations to be a mitigating factor in the formation of ARD.

Table 25-8 shows the typical guidelines for determining which samples have ARD potential based on the ABA results.

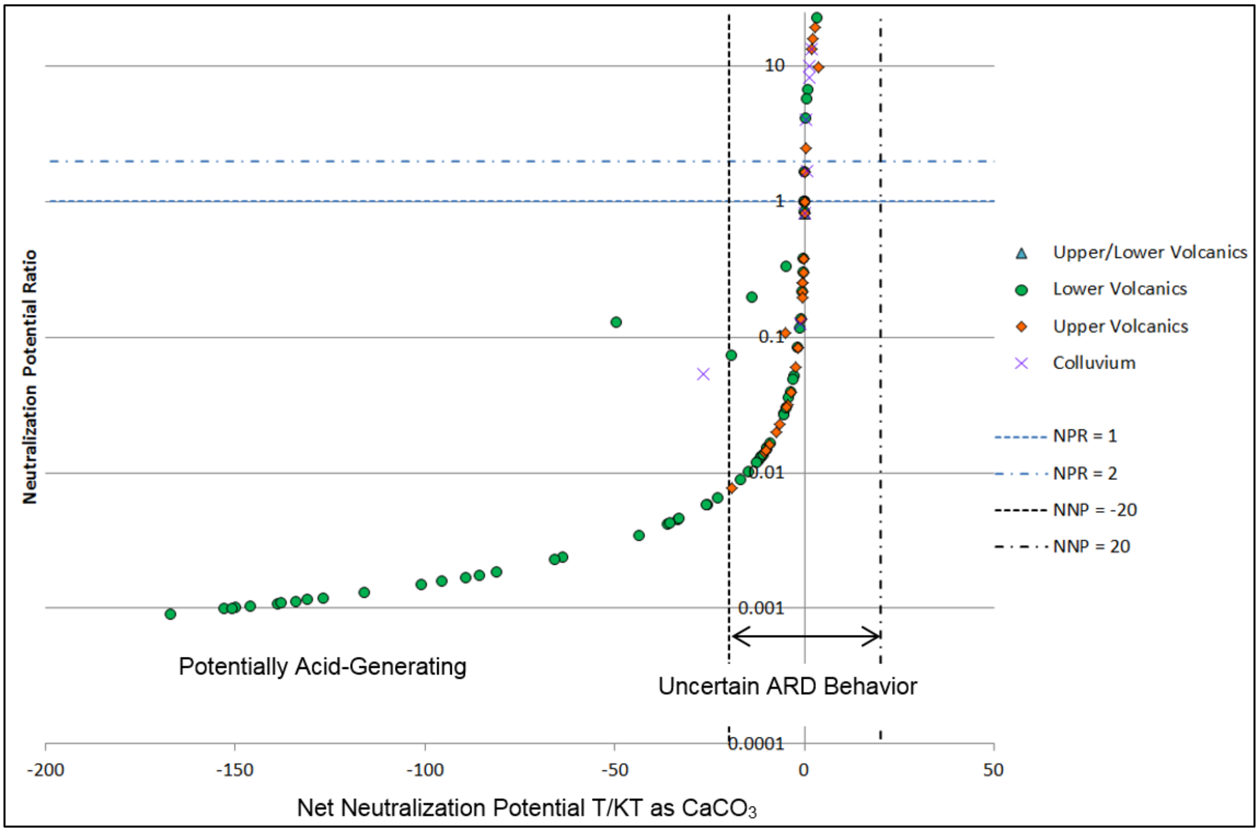
Table 25-8: Screening Guidelines for Acid Generation Potential Prediction

Material Designation	Comparative Criteria	
	NNP ($TCaCO_3/kT$)	NPR
Potentially Acid-Generating (PAG)	< -20	< 1
Uncertain	-20 < NNP < 20	1 < NPR < 2
Non Potentially Acid Generating (NAG)	> 20	> 2

Source: INAP (2009)

The NNP is total NP minus total AP. The NPR is the ratio of NP to AP. Figure 25-5 shows the results of the screening criteria in graphical format.

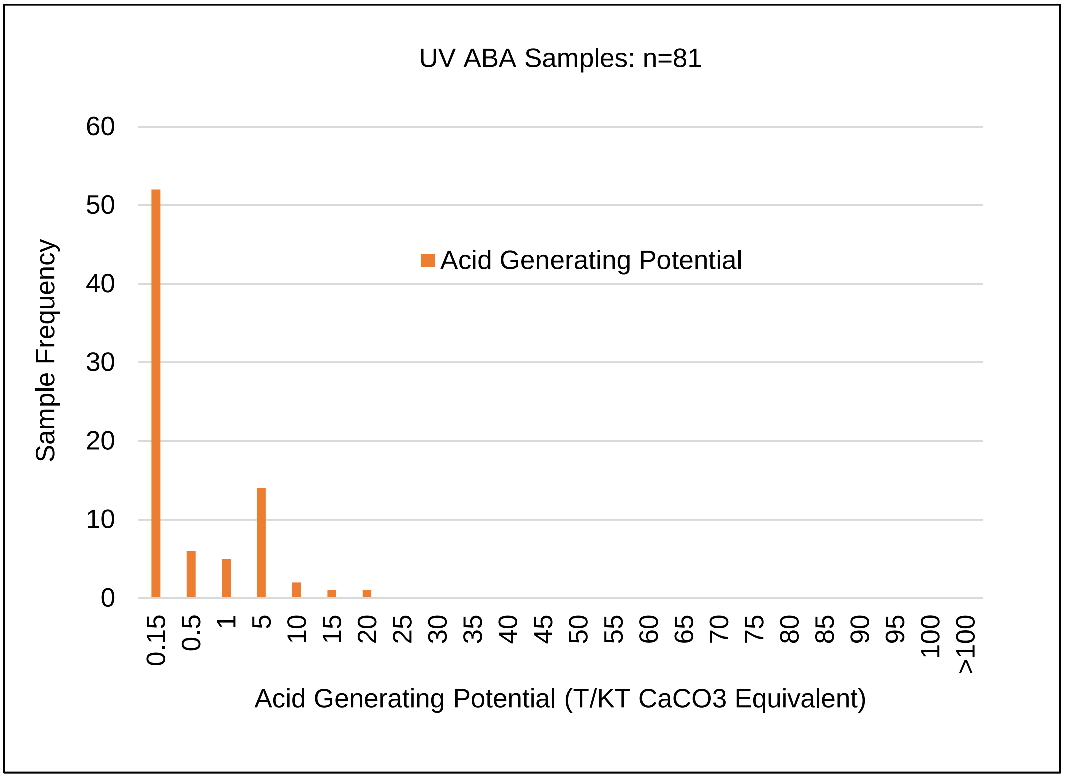
Figure 25-5: NNP vs. NPR for TAA and Erato Barren Rock



Source: GRE (2014)

Figure 25-5 shows that the Upper Volcanics (UV) falls within the Uncertain ARD range. The LV falls both in the uncertain ARD range, and the Potentially-Acid Generating (PAG) range. However, the graphs above do not capture the nature of barren rock acid generating potential at Amulsar. Figure 25-6 shows a histogram of the acid-generating potential results at Amulsar for the UV samples.

Figure 25-6: Histogram of UV ABA Acid-Generation (AP) Values

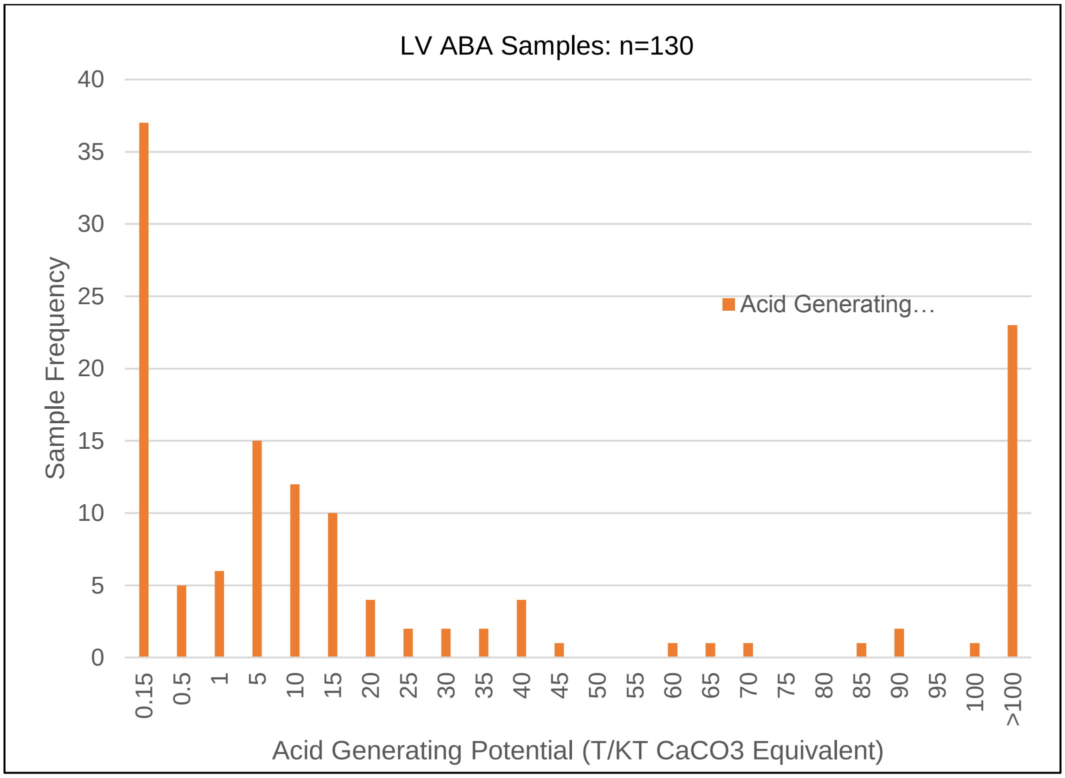


Source: GRE (2019)

In the above histogram, the 0.15 bar shows samples at the lower detection limit for AP (these samples are non-detect for sulfide minerals, but are presented as half the detection limit). The histogram also shows that the UV samples have uniform low or zero acid generating potential. Some samples may have residual sulfides and trace AP.

Figure 25-7 shows a histogram of the LV samples.

Figure 25-7: Histogram of LV ABA Acid-Generation (AP) Values



Source: GRE (2019)

The above histogram of the Lower Volanics' (LV) results show a classic bi-modal behavior with samples clustered at the low end and the high end of the results. As with the prior graph, 0.15 is non-detect for AP. The majority of the samples in the LV have no AP or trace AP while some samples have high AP with very few samples in the middle.

It is important to note that the frequency seen above cannot be directly correlated to tonnage of rock with high ARD risk. While every effort was made during sampling to capture all rock types, and to cover the full footprint of the pits, the number of samples with high AP cannot be mapped to tonnes of barren rock with high AP. To ensure the rock samples could be categorized, an ARD risk block model was created to quantify the tonnage of LV with little or no ARD risk, and the quantity with high ARD risk (see Section 25.2.7 below).

25.2.3 Acid-Base Accounting: Spent Ore

The spent ore (ore that has been leached of its precious metals) is also a mine waste product and at some projects, has the potential to produce ARD. The Project conducted ABA tests on spent ore from the TAA pit and the Erato pit. The results are in Table 25-9 and Table 25-10.

Table 25-9: ABA Results - TAA Spent Ore (includes one Erato sample)

Sample	Total Sulfur (%)	Acid Soluble Sulfate (%S)	Sulfide Sulfur (%)	AP (T $CaCO_3$/kT)	NP (T $CaCO_3$/kT)
MPF	0.04	0.02	0.02	0.63	3.06
GSN	0.58	0.05	0.53	16.50	4.31
FG	0.37	0.06	0.31	9.59	2.69
SB	0.38	0.04	0.34	10.66	2.31
MC068[1,2]	1.15	0.03	1.13	35.16	1.37
MC070[1]	0.70	0.05	0.65	20.22	2.50
MC071[1]	0.38	0.01	0.37	11.63	0.69

Notes: 1. Composite sample; 2. Erato sample
Source: GRE (2014)

Table 25-10: ABA Results - Erato Spent Ore

Sample	Total Sulfur (%)	Acid Soluble Sulfate (%S)	Sulfide Sulfur (%)	AP (T $CaCO_3$/kT)	NP (T $CaCO_3$/kT)
DDA-030	0.95	0.24	<0.01	0.31	0.30
DDA-030	0.14	0.11	<0.01	0.31	0.30
DDA-278	0.74	0.20	0.10	3.13	0.30
DDA-276	1.75	0.32	0.09	2.81	0.30
DDA-290	0.00	0.02	<0.01	0.31	0.30
DDA-340	0.53	0.24	<0.01	0.31	0.30

Source: GRE (2014)

Ore is comprised of 100% UV rocks. The AP of the spent ore is equal to the AP of the barren UV rocks discussed above. Therefore, based on the low sulfide sulfur levels and the abundant residual alkalinity present within the heap leach, the spent ore is not an ARD risk. During operations, no water from the HLF will be released from the facility under any circumstances, and the leachate from the spend HLF upon closure is considered contact water and will be treated prior to release meeting the required discharge limits.

25.2.4 Acid-Base Accounting: Borrow Materials

Four LV samples and one scoria sample were submitted for geochemical characterization to assess their suitability as potential site borrow materials. Table 25-11 shows the results of the borrow materials testing.

Table 25-11: ABA Results for Borrow Materials

Sample ID	Lithology	NNP	NPR	Sulphide Sulphur (%)	NAG pH	Paste pH
BH-305	LV	-0.10	0.83	0.02	5.44	6.65
BH-303	LV	-36.30	0.01	1.16	2.34	4.36
BH-307	LV	1.90	2.73	0.03	5.54	5.54
BH-308	LV	-31.90	0.01	1.02	4.89	5.63
BH-312	Scoria	18.00	60.00	0.01	5.92	8.59

Source: GRE (2014)

Results indicate that LV should not be used as construction materials due to an ARD and metal leaching potential, unless other mitigation measures are implemented. Scoria appears suitable, although additional characterization work is recommended, as only one sample was included in the testing program. Some in-pit waste materials are also suitable as construction material. The Upper Volcanics and Colluvium lithologic groups possess geochemically suitable construction characteristics.

25.2.5 Static Metals Leaching Testing

It is customary to test if barren rock or spent ore will leach metals. The Synthetic Precipitation Leaching Procedure (SPLP) is used to simulate the effects of rainwater flowing through barren rock or spent ore. The tests indicated that some chemical parameters and dissolved metals approached or exceeded regulatory discharge standards in the SPLP test, including barium, copper, iron, manganese, nickel and sulfate. The leachate from the SPLP tests did not include elevated concentrations of common leachable metals in ARD such as cadmium, arsenic, lead, or zinc. Selenium was also below discharge standards. This testing is useful as a screening tool for potential risks to water quality.

Metals leaching test results from the spent ore material revealed elevated sulfate concentrations, salt concentrations, and some metals near to or slightly above the Arpa II discharge standards. This testing confirmed that the spent HLF leachate cannot be directly-discharged to the environment without treatment.

25.2.6 Kinetic Geochemical Testing

Long-term humidity cell geochemical kinetic tests were performed on Amulsar barren rock using ASTM Method D5744-07e1, 2007. This test overestimates acid generation and metals leaching potential of a rock over time for the following reasons:

- The cells are held at a constant temperature of 20°C.
- The cells are kept at 100% humidity for a week, then flushed with 1L of distilled and deionized water; and
- The cells require a ~6mm crush size, far smaller than Run of Mine (ROM) waste.

Despite these limitations, long-duration kinetic cell tests are useful in determining the ARD behavior of rock types. It is generally accepted that a year of kinetic cell testing can prove that a rock sample will or will not generate acid. The test demonstrates empirically whether the potential determined in the ABA testing will be realized in the field.

25.2.6.1 ARD Geochemical Reaction Kinetics

The kinetics of an ARD reaction are critical in defining environmental impacts; the faster the reaction rate (kinetics) the greater the environmental impact. Two different chemical reactions typically form ARD from the oxidation of pyrite. Equation 1 involves the oxidation of pyrite in the presence of water and oxygen:

$FeS_2 + 7/2O_2 + H_2O = Fe^{2+} + 2SO_4^{2-} + 2H^+$ [1]

Source: INAP (2009)

This reaction commonly occurs at the Amulsar site (see Section 25.1.1). However, in the kinetic cells, a second reaction dominated the ARD behavior of some cells later in the testing period. This equation involves the oxidation of pyrite by ferric iron (Fe^{3+}). This reaction is much faster and has a higher stoichiometric ratio between pyrite and acidity (listed as H^+).

$FeS_2 + 14Fe^{3+} + 8H_2O = 15Fe^{2+} + 2SO_4^{2-} + 16H^+$ [2]

Source: INAP (2009)

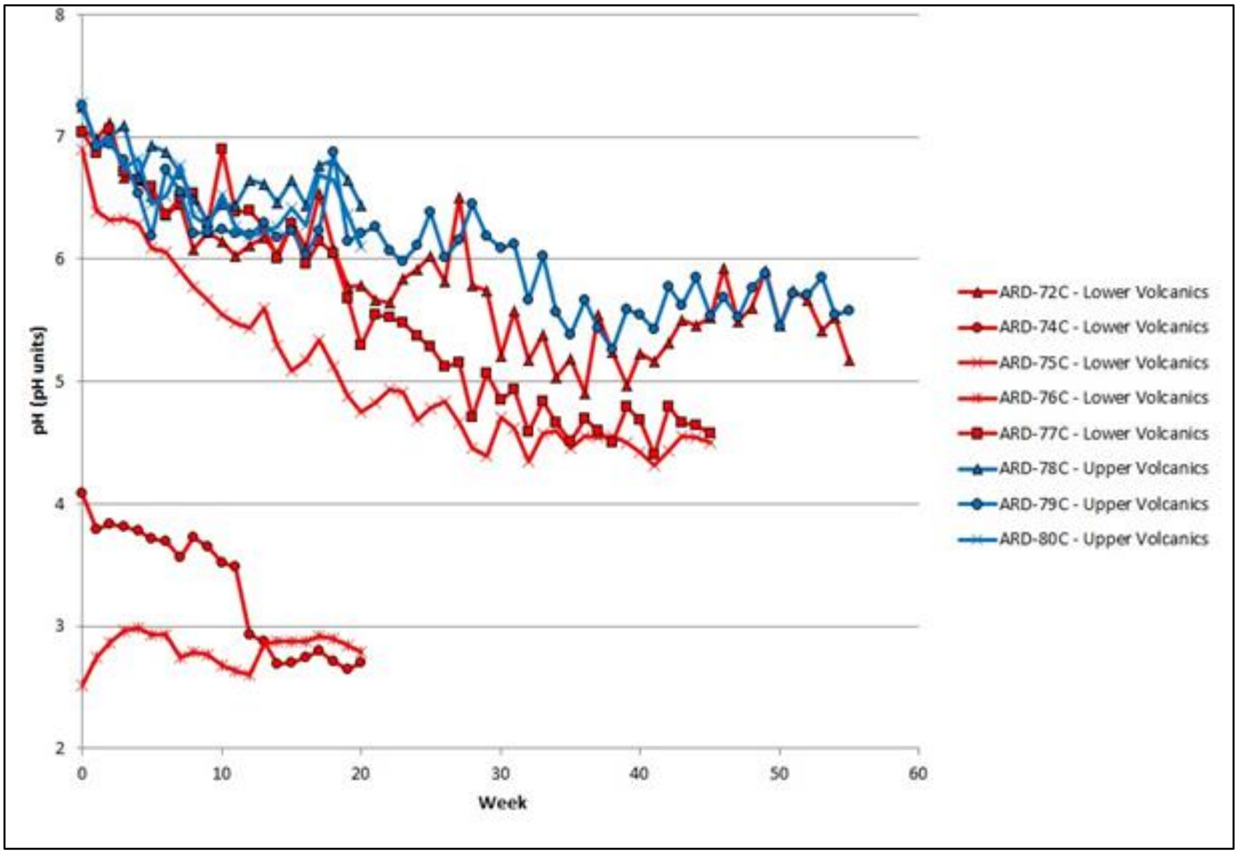
Equation 2 is catalyzed by the bacteria *Thiobacillus ferroxidans*. In subsequent sections, the changeover from ARD dominated by Equation 1 to ARD dominated by Equation 2 is referred to as: “microbially catalyzed ARD” because of the role of bacteria in the oxidation of pyrite. Looking at the combination of Equation 1 and Equation 2, ARD can be controlled by limiting the contact between sulfide minerals and oxygen, sulfide minerals and water, and by controlling the presence and population size of sulfide-oxidizing bacteria. The control of water, oxygen and microbes is therefore the foundation of ARD prevention (INAP 2009). Section 25.2.8 describes how Amulsar uses this science to reduce ARD.

25.2.6.2 Humidity Cell Results

As discussed above, humidity cells measure the worst-case conditions for ARD formation where oxygen is abundant, humidity is at 100%, and the microbial environment is ideal.

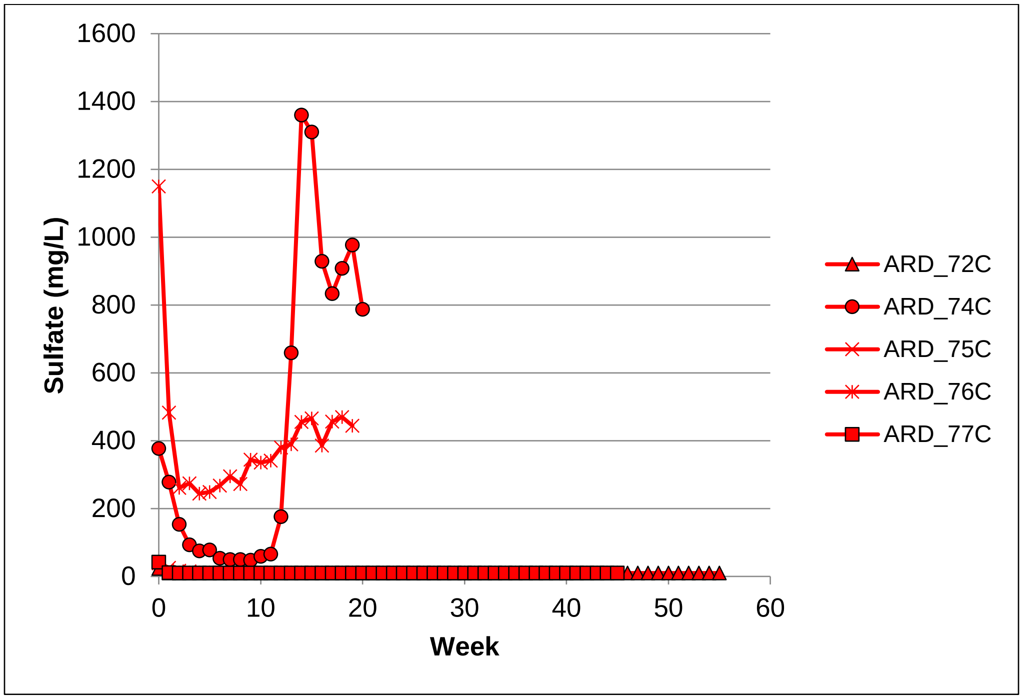
Figure 25-8 shows the pH of the kinetic cell leachate over time for Amulsar barren rock samples. Figure 25-9 and Figure 25-10 shows sulfate production over time, and Figure 25-11 shows iron production over time in LV Barren rock, and Figure 25-12 shows iron production over time for UV barren rock.

Figure 25-8: pH of Amulsar Kinetic Cell Results on Barren Rock



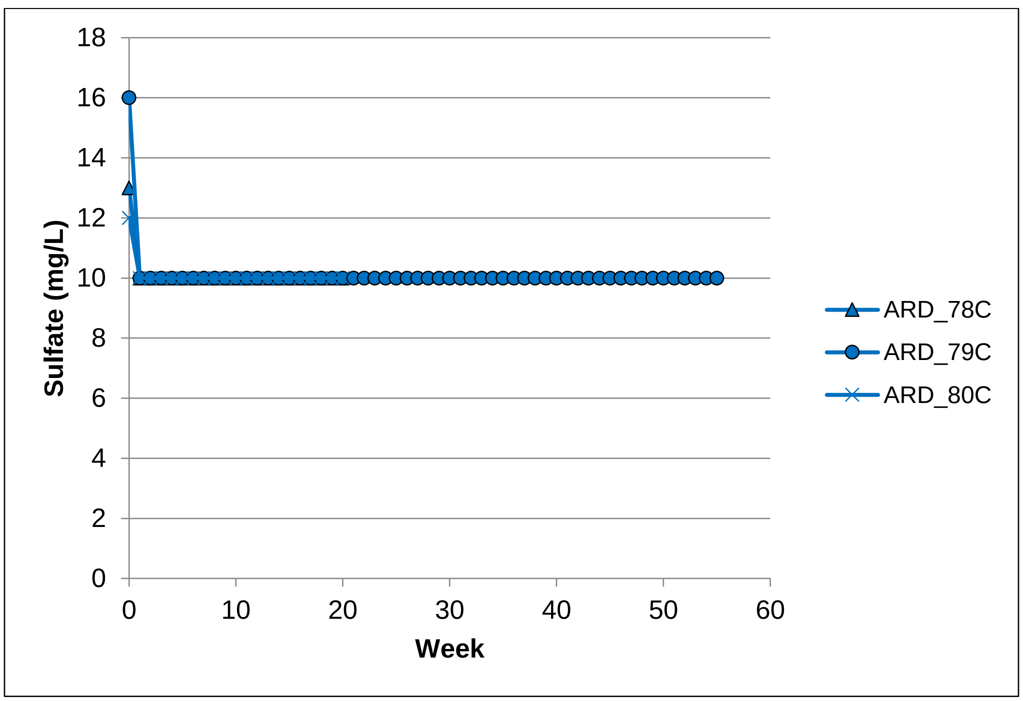
Source: GRE (2014)

Figure 25-9: Sulfate Concentration in Leachate from Amulsar Kinetic Cell Results on LV Barren Rock



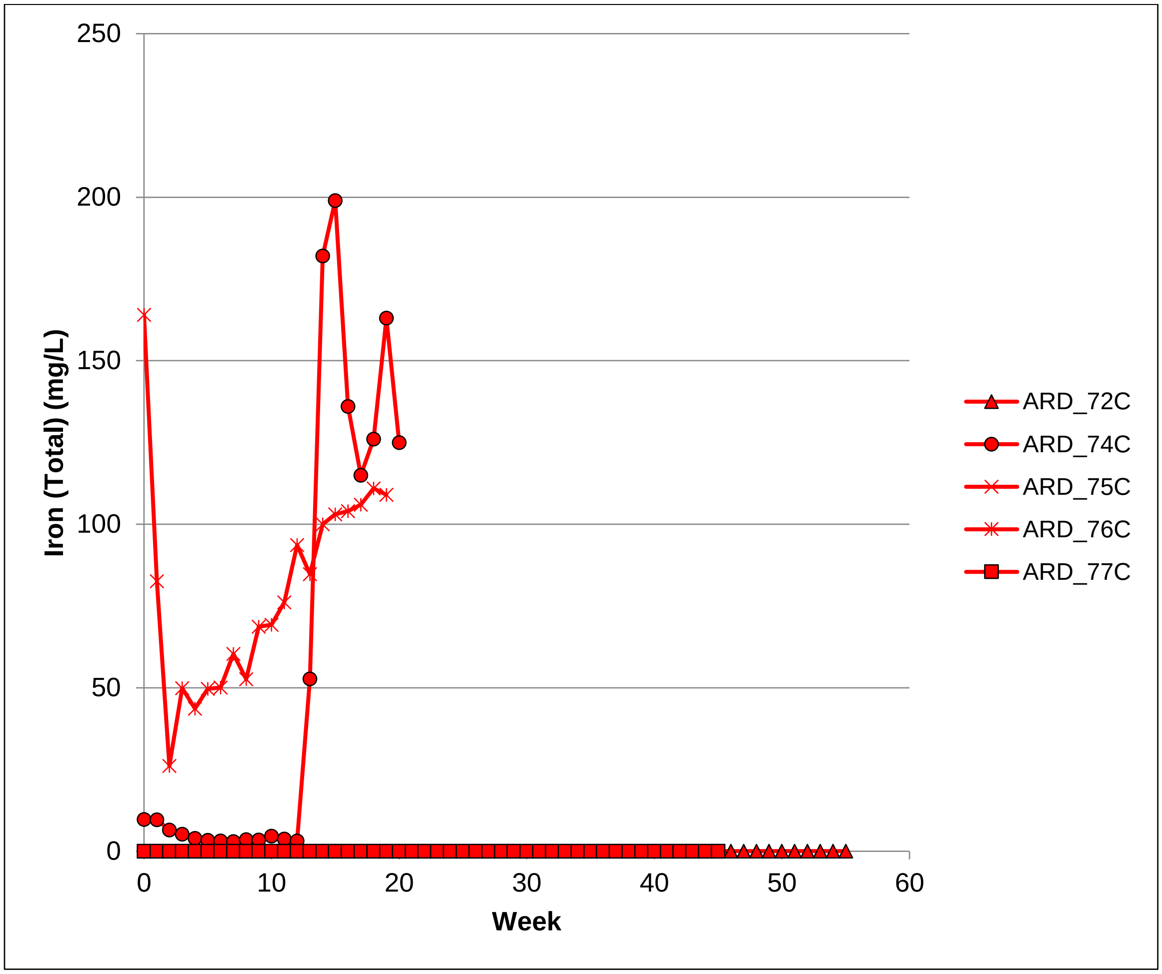
Source: GRE (2014)

Figure 25-10: Sulfate Concentration in Leachate from Amulsar Kinetic Cell Results on UV Barren Rock



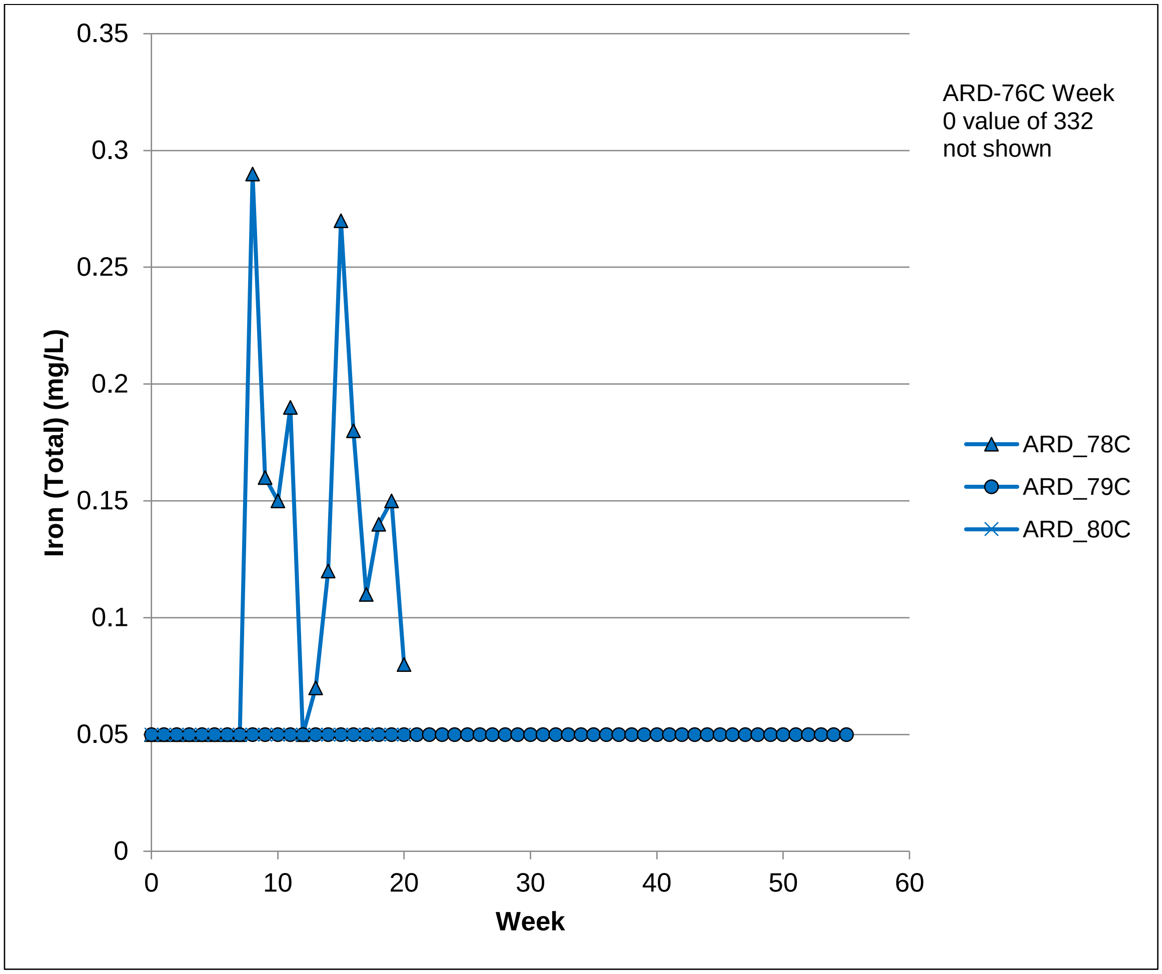
Source: GRE (2014)

Figure 25-11: Iron Concentration in Leachate from Amulsar Kinetic Cell Results on LV Barren Rock



Source: GRE (2014)

Figure 25-12: Iron Concentration in Leachate from Amulsar Kinetic Cell Results on UV Barren Rock



Source: GRE (2014)

It is clear from Figure 25-8 through Figure 25-12 that the ARD potential of the UV does not translate into strong acid generation (pH <4.0). This is due to the fact that the AP in UV rocks is very low (see Section 25.1.3). It is also clear that ARD-76-C oxidized in the core box prior to the humidity cell test, and is therefore a poor sample to use when estimating the time it takes, under ideal conditions, for strongly-acidic conditions to form.

It is also clear that three of the five LV samples generate no significant sulfate or iron in the humidity cell leachate. This is indicative of LV with insufficient pyrite to create ARD and rocks with AP values on the left (low) side of the histogram shown in Figure 25-7. However, it is also apparent that high-sulfide samples are capable of producing strong ARD over time given ideal conditions. The lag time between exposure and strong ARD conditions is approximately 12 weeks under ideal conditions but likely slower in the field.

The kinetic testing results reveal three different categories of LV barren rock:

- Strongly Acid-Generating (SAG) samples capable of producing low pH leachate and high sulfate concentration;

- Mild Acid Generating (MAG) samples that produce mild (pH >4.0) ARD; and
- NAG; Samples with very low or no sulfides. Some residual acidity may come from alunite or jarosite dissolution (Linklater & Champan, 2012). This rock produces pH with a leachate of ~4.8.

In order to manage ARD at the site, it is necessary to quantify the total tonnage of SAG, MAG and NAG LV rocks. The first step in this process is to define the quantity of these rocks using geologic modeling tools.

25.2.7 ARD Risk Block Model

The Amulsar Project has evaluated the ARD risk of each tonne of barren rock that will be excavated or will be exposed in the post-closure pit walls. This quantification was performed within the existing geologic modeling for ore-grades using the total sulfur analysis performed in each assay sample. Using total sulfur is a deliberate over-estimation of ARD risk because sulfate minerals (such as jarosite) are common at Amulsar, yet have little ARD generation capacity (Linklater & Champan, 2012). However, this modeling effort is useful in determining how much of the LV has trace or no ARD generation potential (see Section 25.2.1).

The ARD block model used all of the total sulfur sample values and many of the statistical techniques employed in ore-grade modeling to determine the concentration of AP between boreholes. The results of the ARD block model report are as follows:

Table 25-12: Classification of Mine Waste by ARD Potential Category

Waste Type	Total Tonnes	BRSF Tonnes	Backfill Tonnes*	% of total	% of BRSF	% of backfill
NAG (UV + Colluvium)	138,180,408	123,242,339	14,938,069	67.1%	70.1%	49.9%
MAG (LV)	40,503,828	32,385,454	8,118,374	19.7%	18.4%	27.1%
SAG (LV)	27,104,540	20,225,606	6,878,934	13.2%	11.5%	23.0%
Total (UV + Colluvium + LV)	205,788,776	175,853,399	29,935,377	100.0%	100.0%	100.0%

Source: GRE (2019)

SAG rock is relatively rare in the barren rock. Only 11.5% of rock scheduled for the BRSF is classified as SAG, and only 23% of the pit backfill material is classified as SAG. The block model also discovered a strong relationship between SAG rock and highly-argilized LV. This is reasonable because the same hydrothermal fluid action that precipitates the sulfide minerals also breaks down the physical structure of the LV into clayey minerals.

25.2.8 Geochemical Characterization Summary

The geochemical characterization of the Amulsar site has the following conclusions:

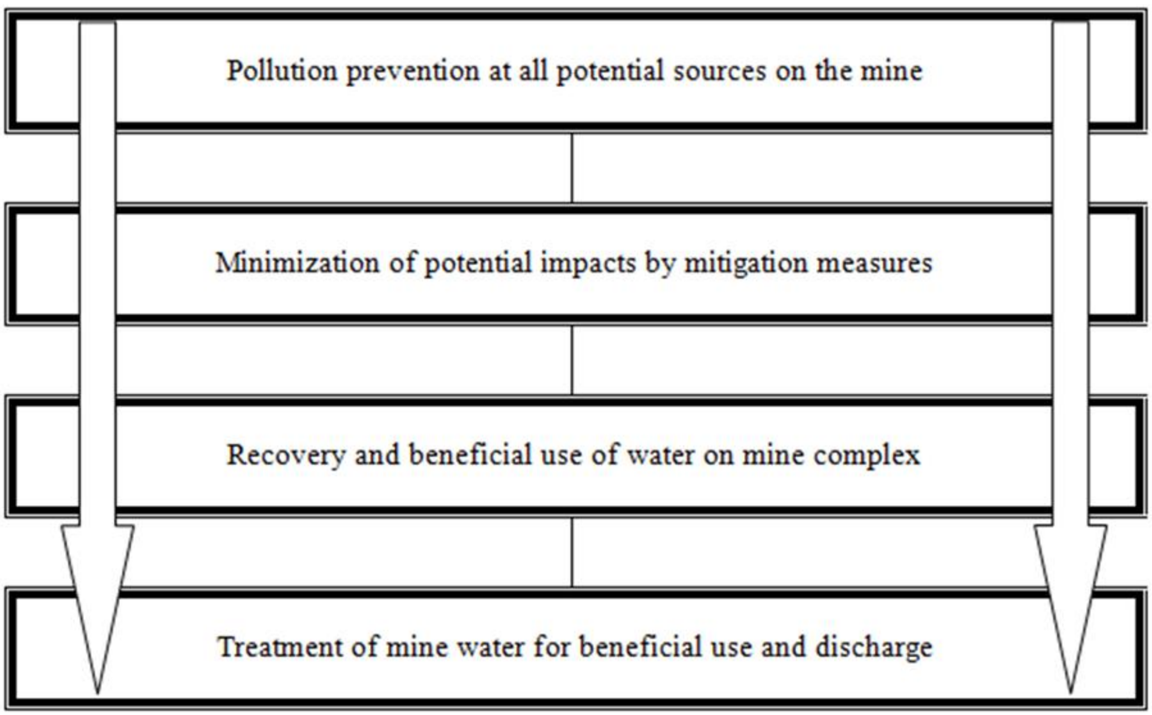
- The site has the risk of forming ARD-impacted leachate from barren rock and pit wall rocks;
- The spent HLF material has the potential for metals and salt leaching in excess of regulatory discharge standards, but no ARD risk;
- LV rocks encountered in the project area should not be used as construction or borrow materials without screening and testing to determine if they have sulfide minerals; and
- Colluvium and scoria have no ARD risk.

It is estimated that 13.2% of the LOM waste will be SAG. This material requires vigilant and careful management to prevent the formation of strong ARD at the site. Furthermore, the water quality from all barren rock and from the spent heap leach material is not expected to meet regulatory discharge standards without treatment and management. As a result, all water coming into contact with barren rock, pit walls, or spent HLF material is considered contact water and must be managed accordingly (See Section 18). Section 25.2.9 describes ARD management at Amulsar.

25.2.9 ARD Mitigation and Management

The INAP (the International Network for Acid Prevention) recommend that the following management hierarchy should be applied at all sites with an ARD risk.

Figure 25-13: ARD Management Hierarchy



Source: INAP (2009)

The Amulsar ARD Management plan follows this hierarchy with a "prevention first" approach. This approach is based on preventing the formation of ARD from all sources, with a particular focus on the SAG LV rocks. Next, the plan minimizes the volume of water coming into contact with PAG and SAG material (contact water) through the Surface Water Management Plan (SWMP). The SWMP then ensures that contact water is used as makeup water for the HLF. Finally, the Plan ensures that any water which is released from the project is treated to the applicable standards prior to discharge, only if it cannot be used by the project.

25.2.9.1 ARD Management and Mitigation Plan: Construction and Operations Phase

The following section describes the ARD management and mitigation plan during the operations phase. Management is defined as the capture, conveyance, treatment, and use of ARD-impacted water. Mitigation is defined as the operational and design elements incorporated into the Project which expressly minimize both the severity (defined based on the total acidity, the pH, and the dissolved metals concentrations) and the volume of ARD.

25.2.9.2 Construction Phase ARD Management

During construction, rock will be excavated from haul roads, building pads, and other earthworks.

In some cases, this material is expected to be acid-generating LV rock. As a result, Amulsar has implemented a construction material ARD characterization and management plan with the following elements:

On-site characterization of construction waste using industry-standard rock characterization methods including:

- Visual inspection;
- Paste pH testing; and
- Net-Acid Generating pH tests (Stewart, Miller, & Smart, 2006).

Some temporary stockpiling has been required to manage this material prior to the construction of the BRSF. Once the BRSF Phase I is complete, all PAG construction waste will be relocated to the BRSF as per the ARD Management Plan.

GRE staff trained the Amulsar staff on the construction material ARD management plan, prior to any construction activities, during a site visit in November 2016.

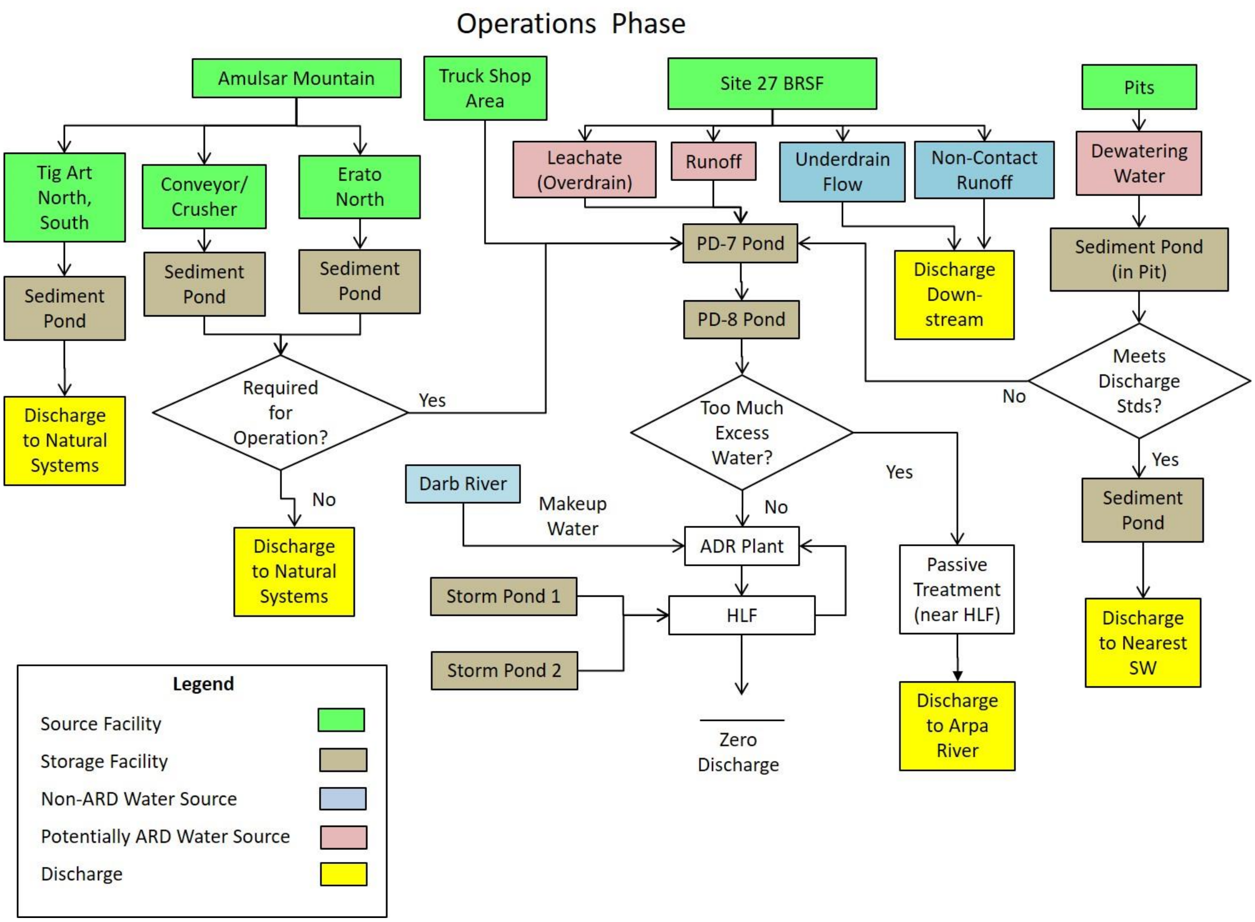
25.2.9.3 ARD Sources during Operations

There are four main sources of ARD on the Amulsar site during operations:

- Pit dewatering water;
- Runoff from LV placed in the BRSF (during operations);
- Seepage from LV waste in the BRSF; and
- Seepage from LV waste stored in the TAA pit backfill.

Figure 25-14 shows the sources of all Amulsar ARD (in red boxes) and the Project’s ARD management plan. Each source, and its management method, is described below.

Figure 25-14: ARD Management During Operations



Source:

As seen on the right-hand side of Figure 25-14, during operations, pit dewatering water from the TAA, and Erato pits is collected together and conveyed to the contact water pond PD-8 where it is consumed as makeup water or treated.

The BRSF has four sources of water: barren rock leachate, runoff, seep/spring underflow, and non-contact runoff. Leachate is water passing vertically through barren rock and is expected to be acid-generating. Runoff that comes in contact with the acid-generating LV waste is also expected to be acidic. Seep and spring water discharging beneath the BRSF (into the underdrain system beneath the clay liner) is non-contact water and may be discharged after sediment control. Water that runs off the BRSF clay-lined areas without any barren rock placement can be considered non-contact water and may be discharged after sediment control. The management of contact water and non-contact water is described in Section 18.3.3).

Figure 25-14 shows that no mine contact water is discharged to the environment without treatment.

25.2.9.4 BRSF ARD Prevention

As part of the pollution prevention hierarchy, the Amulsar Project has a multi-faceted approach to ARD prevention designed to prevent the formation of strong ARD. Several mitigation measures are used to minimize ARD within the BRSF. All are related to controlling the exposure the rock has to water, oxygen, and sulfide-oxidizing bacteria.

25.2.9.5 Encapsulation

The Lower Volcanic (LV) barren rock will be encapsulated within the BRSF to minimize contact with infiltration, seepage, and oxygen. The two to five-meter NAG buffer zone serves as the basal encapsulation layer. This upper volcanic NAG waste material overlies the BRSF clay liner and also contains an overdrain (pipes and conductive rock designed to drain seepage to the pond quickly). Beneath the clay, the BRSF has an underdrain to carry water from seeps and springs to the BRSF toe without it encountering barren rock.

As mentioned in Section 25.2.6, the SAG LV is strongly correlated with high-clay content argilized LV and the operation will utilize this to improve the encapsulation. SAG LV within the BRSF will be encapsulated in the same manner as all the other LV rock, but the high-clay content SAG will be have less permeable properties diminishing the flow of water through the SAG LV rock in the BRSF.

In addition, clay minerals are capable of storing water within their pore space, and higher-clay content materials have more storage capacity. The BRSF will utilize this behavior to store and hold water. The amount of water that can be stored within the BRSF without it producing leachate is approximately 14 M m^3 (Golder 2019). Finally, clayey SAG LV will stop the diffusion of oxygen. The BRSF Design Report (Golder, 2018) illustrates the concept of PAG encapsulation.

Once the final surface of the BRSF is in place completed areas will be concurrently capped with an Evapotranspiration Cover (ET Cover). An ET Cover is an engineered soil cover designed to minimize infiltration of water into barren rock using a store-and-release action that:

- Traps moisture in soil storage (usually underlain with a capillary break of coarse material);
- Permits the evaporation of soil from the soil surface; and
- Facilitates the formation of a vegetative cover to transpire water from the root zone and to prevent erosion.

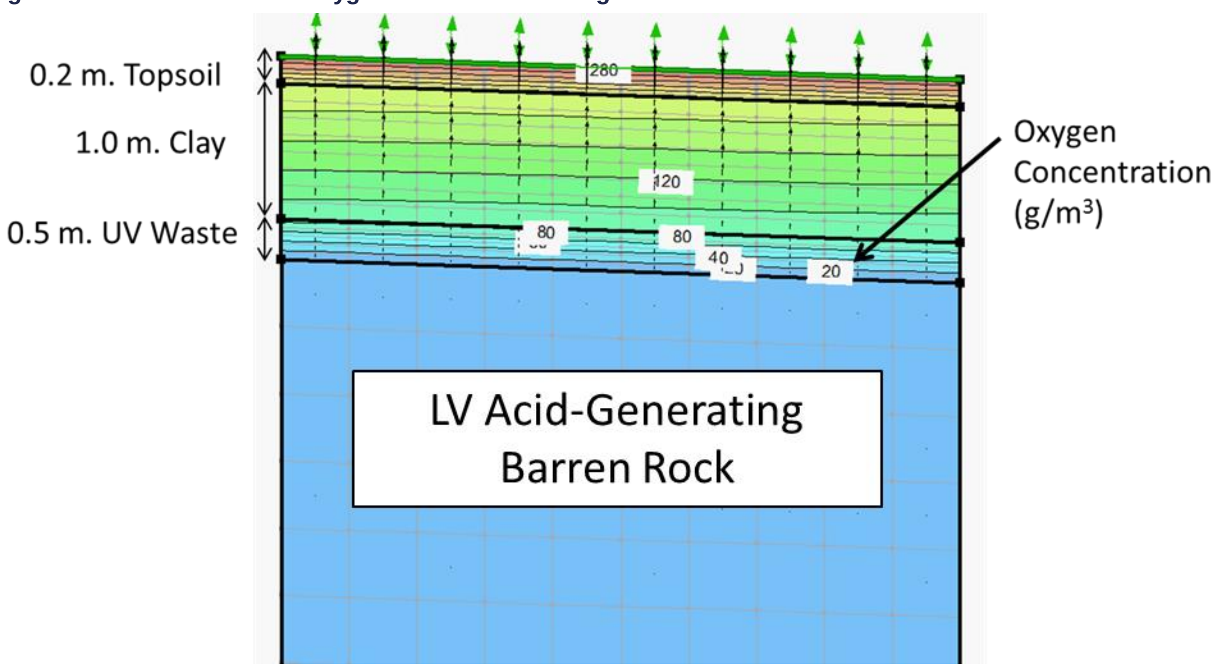
It is important to note that the ET Cover is not designed to augment runoff. Fine-grained clay-like soils are preferred in an ET Cover, but the goal is not to create an impermeable cap. Instead, the goal is to create a functioning soil cover that utilizes soil physics and vegetation to prevent vertical migration of precipitation and snowmelt. The preliminary design of the ET Cover on barren rock at Amulsar includes a 1.0-meter-thick clay layer overlain by 0.2 m of topsoil. The thickness of the cover is sufficient to store spring runoff in soil storage for evapotranspiration in the summer. The cover effectively reduced vertical migration of leachate to less than 1mm per year. These results are consistent with the performance of ET Covers in other parts of the world that have snowfall, spring rain, and dry summers (Benson, Albright, Roesler, & Abichou, 2002). The final design of the ET cover will be based on site trails and testwork including lysimeters in the vicinity of the BRSF.

Seepage modeling has shown the encapsulation to be an effective ARD mitigation measure, making the total seepage from the BRSF leachate near zero for most of the year, and peaking briefly at 200 m^3/day (2 L/s) during the height of the spring runoff (Golder 2019), using the base-case (50%) condition.

25.2.9.6 Oxygen Limitation

In addition, the encapsulation plan and ET Cover limits oxygen penetration into the barren rock. To simulate this effect, GRE utilized Vadose/W, an integrated gas and fluid unsaturated flow model to predict oxygen diffusion into the barren rock based on pressure gradients, temperature gradients, and the degree of soil saturation. Oxygen consumption rates were taken from the geochemical modeling and represent the oxygen consumed by ARD reactions in the LV material. From this analysis, GRE derived an oxygen half-life of 700 days. The results of the oxygen consumption and oxygen diffusion modeling showed that oxygen penetration is limited to the uppermost 0.5 m of the barren rock. Figure 25-15 shows the oxygen diffusion at its maximum extent in late summer, when moisture contents in the cover are at the lowest levels they reach prior to winter ground frost.

Figure 25-15: Simulation of Oxygen Penetration through the ET Cover



Source: GRE (2014)

As a result of the combined ARD-suppression measures of the encapsulation and ET Cover, and with SAG waste being a fraction of the total waste in the BRSF, the magnitude and severity of ARD formation should be mitigated within the BRSF. Geochemical modeling has predicted the water quality of BRSF leachate to be at a pH of ~3.5. This anticipated ARD is exactly analogous to on-site ARD produced from both the oxidation of sulfide minerals occurring naturally on Amulsar Mountain as previously described in Section 25.2.2.

25.2.9.7 Pit Dewatering ARD Mitigation

The pit is a fast-moving excavation; each individual bench is expected to be exposed for less than a single wet season. As a result, ARD mitigation is limited to keeping the pit as dewatered as possible during operations to limit the exposure time of acid-generating rocks to water prior to waste encapsulation in the BRSF. Even under ideal conditions, the LV waste required 10 to 12 weeks to produce strong ARD (see Section 25.2.5) therefore the natural pace of excavation is sufficient to prevent strong ARD from forming within the pit. If this is not the case, the pit walls will be treated with lime or another ARD-suppressing agent (see Section 25.2.11 below)

In addition, the mine will incidentally excavate snow from the pits during winter operations. The water balance (See Section 18.3) requires that additional snowpack be removed as an ARD mitigation measure. Removing snowpack removes water from the pit prior to the spring melt when this water can become acidic.

25.2.9.8 Pit Backfill ARD Mitigation

The TAA pit backfill will receive LV barren rock from the Erato Pit. As a result, it is predicted to produce a small quantity of ARD. The primary mitigation measure for this ARD is to cap the pit backfill with 0.5 m of clayey soil. This cover is less effective than the engineered ET Cover planned for the BRSF but due to the geometry of the pit, oxygen penetration is impossible through the sides of the facility, and a thinner cover is thus justified. The cover is effective in reducing seepage, in limiting oxygen penetration, and in establishing a vegetated reclamation surface.

The Erato pit will be partially backfilled with NAG rock. This backfilling will occur to a level above the anticipated seasonal maximum water level in the pit. This will prevent the formation of a pit lake which could be attractive to migratory birds.

25.2.9.9 Summary of ARD Mitigation and Management Measures

In summary, the ARD management and mitigation measures at the Amulsar site are designed to limit contact between sulfide minerals, water, and oxygen. Through the use of encapsulation cells within the BRSF, and ET Covers on the BRSF and pit backfill, the waste will be isolated from oxygen sources rapidly, thus inhibiting sulfide oxidation. As a result, the ARD that must be managed will have a pH of ~3.5, lower total acidity (less than 100 mg/L as $CaCO_3$), lower sulfate concentrations (~100 mg/L), and lower concentrations of metals. This permits two management options: consumption as HLF makeup water (the preferred alternative) and passive treatment and discharge.

25.2.9.10 Passive Treatment System (PTS)

A passive treatment system will be constructed near the HLF. This system will have the following design elements:

- A pipeline (with flow control devices) to the PD-8 contact water pond to provide the PTS with a steady flow rate for treatment;
- Creation of a nitrogen-reducing bioreactor to treat residual nitrates from explosives;
- The construction of anoxic limestone beds to raise the pH of the water;
- Creation of a sulfate-reducing bioreactor to reduce sulfate concentrations;
- Water polishing and oxygenating steps to treat metals and manganese; and

- Discharge structures towards natural drainages (in this case, the Arpa River) that meet Armenian requirements.

The system has been designed to meet stringent Armenian discharge standards.

A bench-scale PTS has been constructed in the Gorayk Laboratory and continues to be run for over the period of the site blockades. The treatment system effectively treated an ARD stream spiked with nitrate that is equal or greater in acidity to the anticipated water quality in PD-8. The system removed the sulfate, metals, and neutralized the acidity to levels at or below the Apra Category II discharge standards (Gusek, Fattore, & Josselyn, 2018). Furthermore, the same bench-scale passive treatment system was used to treat ARD from the Kavart mine in Southern Armenia. The water quality was significantly worse than what was anticipated at Amulsar with a pH <3.0, high iron, high aluminum, and high arsenic. The bench-scale PTS treated the Kavart water quality to Arpa II standards as well. This proved that the PTS concept is both feasible and robust. Further testwork is planned to finalize the detailed design of the PTS.

25.2.10 Adaptive Management Plan

The Amulsar Project is committed to Adaptive Management for ARD. Adaptive management involves the continuous monitoring of water quality conditions and ARD conditions on the site, and making appropriate adjustments to the ARD management plan as required. Elements of the adaptive management plan may include:

- Modifying the design of the PTS;
- Modifying water management practices;
- Applying microbial-suppression amendments to rocks that are producing stronger-than-expected ARD;
- Modifying the timeline for evaporation or PTS implementation; and
- Utilizing some form of active treatment on BRSF or pit dewatering ARD impacted solutions if the ARD is no longer treatable with the PTS.

The adaptive management strategy is designed to mitigate the risk that predictive modeling of ARD quantity and quality is not completely accurate. It provides the project a dynamic and robust response to ARD and environmental compliance challenges.

25.2.11 Ongoing Studies

As part of the Adaptive Management strategy, studies are continuing to improve and refine existing predictions of ARD behavior on site. Since the ESIA, Lydian have done the following:

- Installed lysimeters to measure the seepage through constructed ET Covers on barren rock;
- Installed Parshall flumes to measure runoff from selected drainages on Amulsar mountain to improve the contact water balance; and
- Initiated on-site kinetic cell tests to determine the in-field (rather than in-lab) oxidation kinetics of barren rock.

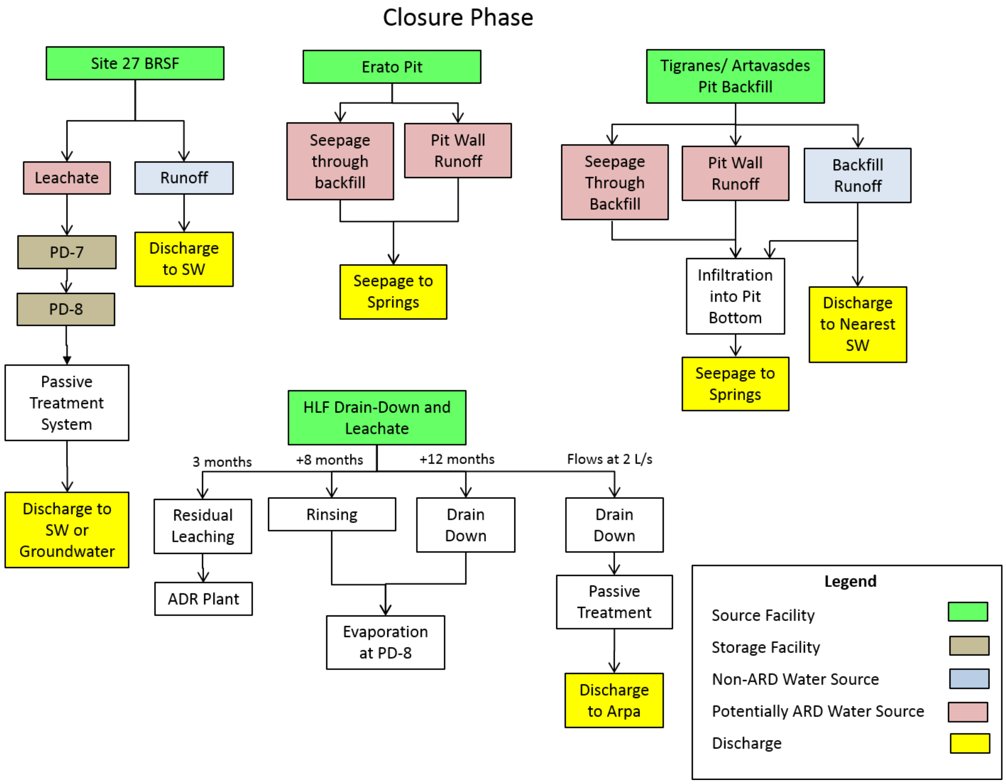
The results of these studies, and on-going testing of barren rock, will inform the future adaptive management plan.

25.2.12 ARD Management and Mitigation Plan, Closure Phase

Upon closure, the ARD management plan changes because there is no longer the opportunity to consume mine contact water in the HLF operations.

Figure 25-16 shows the ARD management plan during the closure phase.

Figure 25-16: Closure Phase ARD and HLF Leachate Management Plan



Source: GRE (2014)

During closure, there will be four discharges of mine influenced water to the environment as follows:

- Runoff from reclaimed surfaces;
- Seepage from the BRSF;
- Seepage from the HLF;
- Seepage from the TAA pit backfill; and
- Seepage from the Erato Pit.

Runoff from reclaimed surfaces is classified as non-contact water and is not a source of ARD. As such, it will be discharged to the environment without treatment or sediment control. The closure plan describes the water management and erosion control practices that will be applied upon mine closure.

The other sources of potential ARD are discussed below.

25.2.12.1 BRSF Seepage

The BRSF seepage will discharge from the overdrain into the PD-7 pond. The clay liner will prevent this seepage from entering groundwater, and the underdrain will prevent clean groundwater from mixing with the seepage. Due to the ET Cover (see Section 25.1.8.4) the total seepage from the BRSF upon closure is low ~2 L/s. Due to the mitigating effects of the ET Cover and the encapsulation, the anticipated post-closure water quality is expected to be moderately to mildly acidic with a pH of ~3.5 and less than 100 mg/L sulfate.

This water will be conveyed in the pipeline to the PD-8 pond, where it will be gravity-fed to the BRSF PTS (see Section 25.1.8.8.). The BRSF PTS is sufficiently sized to manage the post-mining BRSF seepage volume and influent water quality, and is designed and managed to mitigate BRSF seepage in perpetuity. PTS maintenance, water quality testing, and occasional rehabilitation are included in the closure plan.

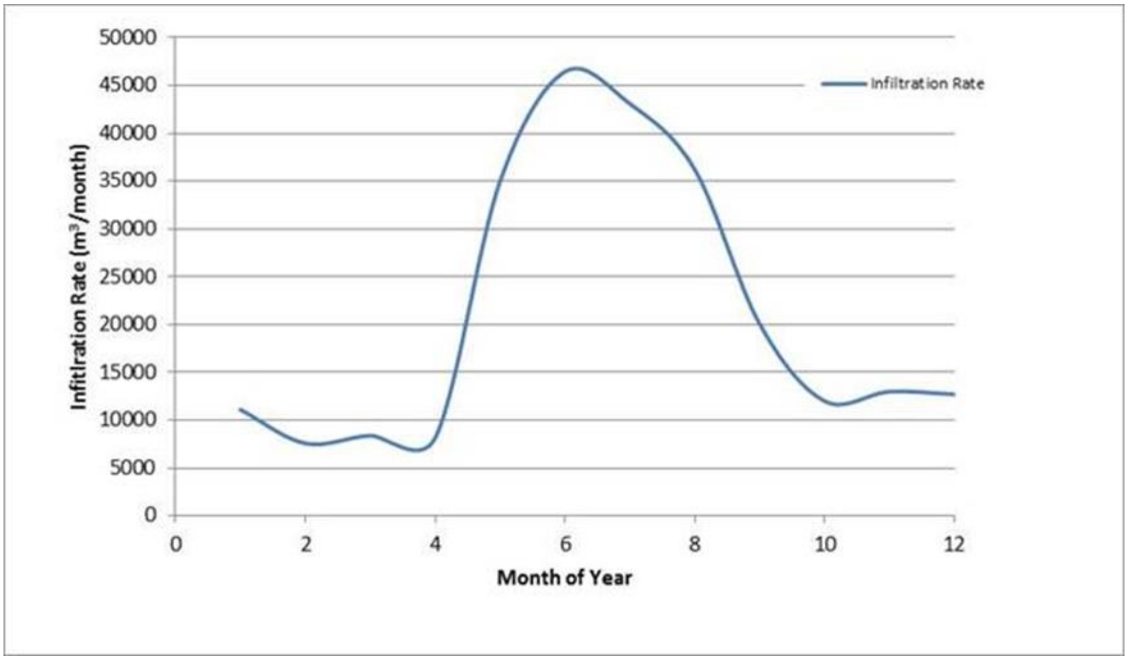
25.2.12.2 Pit Backfill Seepage

The pit backfill that will be placed in the TAA pit will create a low volume of ARD seepage upon closure. The seepage peaks at ~1.2 L/s one year after closure due to the fact that infiltration into the uncovered barren rock is much higher during operations than when the backfill is covered with an ET cover. This seepage will report to seeps and springs on the side of Amulsar Mountain that are already impacted by naturally-occurring ARD (Section 25.2.1 and Wardell Armstrong, 2016). The pits are expected to seep at 0.8 L/s in perpetuity. Modelling completed for the ESIA indicated that this small ARD seepage will have no significant impact on water quality (Wardell Armstrong, 2016).

Post-closure seepage volumes exiting the Erato pit over time are significantly higher because the pit is not completely backfilled, covered, and graded for drainage. The seepage is a function of direct precipitation and snowmelt running off the pit walls seeping into the backfill at the bottom of the pit.

Estimated average monthly seepage volumes from the Erato pit are depicted below and show a range from ~7,500 to 45,000 m^3/month, with lowest seepage rates occurring during the winter months and highest seepage rates associated with the spring runoff.

Figure 25-17: Post-Closure Seasonal Seepage from Erato Pit



Source: GRE (2014)

This seepage is mitigated by the low-conductivity rock at the bottom of the pits. Aquifer testing revealed near the Erato pit discovered a mean (geometric) hydraulic conductivity of $3.56x10^{-6}$ cm/s. This compares favorably to the HLF clay liner, which has a $1x10^{-6}$ cm/s design criteria (Golder 2013).

Predicted seepage water quality entering groundwater is similar to other predicted ARD solutions around the site with a pH of ~3.7. Sulfate concentrations of 37 mg/L, and total acidity of 40 mg/L (as $CaCO_3$). The Erato pit seepage was found to have no significant impact on local or regional water quality (Wardell Armstrong, 2016). This result is partially because the volume is low compared to the regional water balance, and partially because acidic seeps and springs currently exist on Erato mountain making this ARD source a continuation of a condition that has lasted over geologic time, rather than a new geochemical event for the area.

25.2.12.3 HLF Seepage

HLF seepage is not acid-generating. However, the drain-down water and seepage from the HLF is not anticipated to meet Armenian Discharge Guidelines without treatment. Therefore, the post-closure management of HLF has been incorporated into the project.

As seen in Figure 25-16, HLF seepage goes through several stages after the facility is no longer loaded with ore:

- Residual leaching with cyanide;
- Rinsing with cyanide destruction of leachate in the plant;
- Drain-down; and

- Final closure.

Residual leaching has two stages: the first stage is with added makeup water and cyanide to extract more gold and silver from the HLF. This will continue until it is no longer economically viable to do so. The next stage is to rinse with the cyanide present in the system without adding additional reagents or water. This stage also continues until it is no longer cost-effective to do so.

The next stage is rinsing with clean water. This continues until cyanide concentrations are below discharge standards or until the cyanide concentration has stabilized. This will be done in zones on the HLF surface moving from top to bottom, and rinsed areas will be immediately covered by a post-closure ET cover comprising 1 m of stockpiled topsoil. During this period, the volume of rinse water will be decreased by utilizing the contact water pond (PD-8) as an evaporation pond. The evaporation system will be a high-volume evaporator using snowmaking technology (see Figure 25-18).

Figure 25-18: Evaporator to Manage HLF Drain-Down

As soon as rinsing is complete, the HLF will be fully capped. At this point, the water is expected to have the chemistry equal to the worst-case meteoritic water mobility procedure (MWMP) sample taken on the spent heap material (GRE 2014).

The HLF drain down water will have sulfate, chloride, aluminum, and iron concentrations in excess of Arpa Category II discharge standards. Upon termination of pumping, it is estimated that two million meters cubed of drain-down water will exist. This water will be pumped to PD-8 and will be evaporated using a system of three large evaporators over the course of two years.

The covered HLF will drain down to a steady-state leachate production rate of ~2 L/s. A Passive Treatment System (PTS) will be constructed downgradient of the HLF to treat post-closure seepage from the HLF. This PTS will be constructed in the lined ponds at the toe of the HLF and is a different (separate) PTS than that treating water from the BRSF. The PTS for the HLF will have all the same elements as the PTS for the BRSF, except that it will not have a limestone bed for the regulation of pH, and it may have oxygenating structures for managing residual cyanide. After passing through the HLF PTS, the water will meet Armenian discharge standards. It will be discharged to natural drainages, and eventually into the lower Arpa River downstream of the Kechut Reservoir.

25.2.12.4 Summary of ARD Management Upon Closure

ARD management during closure involves the collection and passive treatment of the BRSF and HLF seepage. The passive treatment systems are expected to produce effluent that meets discharge standards. Long-term maintenance will be required for these facilities, but they will effectively manage ARD and mine impacted water in perpetuity. Some ARD will seep through the pit backfill in the Erato and TAA. As mentioned in the closure plan, the seeps and springs on Amulsar Mountain had naturally-occurring ARD, and upon closure, will be similar water quality.

26 Interpretations and Conclusions

26.1 Risks

26.1.1 Project Risk Assessment

Lydian Armenia currently uses a project risk management (PRM) approach based on the May 2015 Feasibility Study (Reference). Regular risk management reporting occurs on a monthly basis through a review of the top identified risks with mitigation plans reported in a monthly project report. On a quarterly basis, Lydian's Risk Register is reviewed at Board of Director's Sustainability Committee to ensure risks are being identified and reported, and that the PRM methodology is being followed. While the methodology presented in the 2015 report remains current with an updated risk register in place, the project risk register developed for this report also uses information from:

1. Lessons Learnt document developed by Lydian's Project Director in March 2019 with contributions from all Lydian department managers;
2. Restart Plan developed in December 2018 where JDS completed a thorough technical review of the Project and creates a detailed re-start plan (JDS December 2018);
3. Lydian's SharePoint database platform that was developed from the document control and organizational information from the previous EPCM company; and
4. Continued engagement and progression with the GOA on regulatory requirements as well as project restart.

The primary risk breakdown structure was rationalized and updated for the risk assessment as follows:

- Commercial;
- Corporate Enterprise;
- Finance;
- Operations;
- Permitting;
- Project Construction;
- Project Controls;
- Project Schedule;
- Project Engineering;
- Safety;
- Sustainability; and
- Water Management.

Sub-elements exist under each of these major headings with an example being Biodiversity, Environmental, and Social being under Sustainability.

26.1.2 Risk Evaluation

Risk evaluation involves the assignment of impact and likelihood of an event to determine the measure of risk. The analysis considers the existing or proposed risk mitigation incorporated into the project scope of works and in the economic model. The risk evaluation matrix used for the analysis is shown in Figure 26-1.

Figure 26-1: Risk Evaluation Matrix

			Consequence				
			Minor	Medium	Serious	Major	Catastrophic
Probability	**Incidence**		**1**	**2**	**3**	**4**	**5**
Almost Certain	More than 2 once per year	**A**					
Likely	1 or 2 once per year	**B**					
Possible	1 once in 10 years	**C**					
Unlikely	1 once in 10 and 100 years	**D**					
Very Unlikely (Rare)	Greater than 100-year event	**E**					

Risk Class IV	**CRITICAL**
Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention	
Risk Class III	**HIGH**
Risks that exceed the risk acceptance threshold and require proactive management and risk control	
Risk Class II	**MODERATE**
Risks that lie on the risk acceptance threshold and require regular monitoring	
Risk Class I	**LOW**
Risks that are below the risk acceptance threshold and do not require active management or resources	

Source: Lydian (2019)

The updated full risk register resides with Lydian Armenia and follows the same format as that presented on Lydian International's website at http://www.lydianinternational.co.uk. Table 26-1 below identifies the Project risks which are currently deemed to be the significant for the remaining construction phase and for the first year of operations.

Table 26-1: Project Risks

Risk Section	Risk Description	Current Risk Rating	Mitigation	Residual risk rating
1 - Project Schedule	Delays in the revised project schedule occur pushing construction into the winter period.		Early recruitment of owner's contracts management team and selection and mobilization of EPCM are required to ensure contracts are fully in place prior to June 2020	
2 - Permits	There is no supply of water for the project due to further rejection of the application of the Arpa River abstraction		The DARB River application has been developed and submitted for make-up water for the HLF process and the application includes the use of the Arpa River for camp drinking water only.	
3 - Operations	The high abrasivity of the ore in the upper benches leads to excessive wear on the crusher chutes and liners		Sandvik is willing to stock wear parts in Yerevan for the project. Suppliers are willing to bring in Hard-ox steel plates in Yerevan as needed	
4 - Water Management	Sediment laden surface drainage migrates of site during spring runoff and high rainfall events		Three sediment ponds are planned for construction at the toe of BRSF after site roads are open. A BMP document for sediment controls has been developed for Earthworks contracts and be enforced by the owner's team	
5 - Operations	The ROM Particle Size Distribution is flawed exposing bottlenecks in the crushing circuit that restrict throughput.		Once the crushing circuit is commissioned bottlenecks associated with particle size can be resolved by adjusting the operating parameters of the circuit and potentially using all three cone crushers on a full-time basis	
6 - Sustainability	Local Communities mount continued opposition to the project resulting in the company not regaining its' social license to operate (SLO)		A Community Support Recovery Plan (CSRP) was developed in response to the change in relationship between the Company and project affected communities during the blockade of the site. The CSRP is a three-year program budgeted in the economic model and has a framework by which Lydian plans to regain and maintain its SLO	
7 - Operations	Visible dust migration offsite from dry roads and blasting activities		An improved dust management program was developed and managed by the mine department in 2018 which involves the use of water trucks, sprinkler systems and dust suppressants	
8 - Operations	Fine crushing will cause leach channeling, reducing metal production and recovery		Review comparable operations with similar installation. Crushers close side setting and screens aperture can be adjusted to make suitable product	
9 - Operations	Operating recovery lower than gold and silver model recovery		Increase daily production rate (evaluate opportunity to crush low grade ore during operations)	
10 - Operations	Crusher hoppers and chutes poorly designed for mining application (loss of production)		Capital has been included in year 1 for major replacements. Consult with vendor to provide replacements on warranty, with upgrades for more durable design	
11 - Operations	HLF solution freezing, causing production delay, loss of revenue and repair cost		Accumulated snow on the heap pad to be removed before next lift, Bury drip emitters below the frost depth (2-3 feet below the surface level), using birdballs to cover ponds and barren/pregnant solution pipelines are free drain to the process pond	
12 - Operations	Cyanide delivery, handling on-site, safety incident involving cyanide spills		Code review, consultation with cyanide vendors and develop safe operating procedure for cyanide handling. Carefully adhere to ICMC guidelines and ensure continuous staff training in cyanide handling.	
13 - Operations	Ore distribution on HLF pad, truck unable to keep up with production, causing production delay, loss of revenue		Develop detailed ore handling plan on HLF pad, formalized maintenance schedule, extra trucks, multiple contractors	
14 - Operations	Equipment maintenance, production delay caused by insufficient equipment availability		Maintenance planning	
15 - Mining	Mine productivities, lower than estimated productivities, leading to higher costs		Stockpile management considered to handle surges in mine production	
16- Mining	Mining fleet, inability for mine fleet to meet targeted production schedule		Mine fleet purchasing schedule check vs production schedule. An existing 994 loader can be used as the main shovel back-up until second shovel comes in,	
17- Mining	Equipment availability, production loss caused by inability to achieve planned mine equipment availabilities (weather condition, inexperienced operators)		Established temporary truck shop, considered lower productivity factor in the wintertime	

Risk Section	Risk Description	Current Risk Rating	Mitigation	Residual risk rating
18 - Mining	Higher dilution, lower head grade		Develop grade control plan	
19 - Infrastructure	Insufficient make-up water for process		Plan to store water in the HLF ponds	
20 - Infrastructure	Lack of power on power grid, Loss of production		Emergency power generation, power generated by overland conveyor to operate crushers, and still produce ore for stacking on HLF	
21 - CAPEX & OPEX	Increase project CAPEX & OPEX		Avoid any delay in the project schedule, update and control project budget montely, avoid unnecessary scope addition. Hire strong EPCM team with related experience.	
22 - Safety	Emergency response, lacking the capacity respond effectively to an emergency and inability to handle predictable emergency situation during construction including grass and brush wildfires		The Lydian Emergency Response Team will be re-established during site remobilization with assistance from the local Republic of Armenia Ministry of Emergency Situations Developed emergency response plans and purchase equipment and supplies	
23 - Project Controls	Equipment damaged, lost, stolen during extended site blockade block period		Fixed assets and HDME were winterized as per manufacturer's recommendations during blockades. All removable assets were moved to heated warehouses offsite. Detailed onsite inspections are planned with EPCM team and project personnel immediately after roads open scenario. A line item of $5 M has been included in the project capital for equipment damage or theft	
24 - Project Schedule	Issues with belt tracking during the conveyor start up due to long length of conveyor leading to start-up delays		An installation and belt alignment procedure will be followed during construction, pre-commissioning/QC stage with a full month allowed in the schedule to commission the conveyor, after construction and belt alignment.	
25 - Operations	An unknown major fault or geologic contact located behind pit walls could lead to inter-ramp or overall slope failure		Geotechnical investigations have been done in the pit and the data is incorporated into the design. The mine department will incorporate active slope monitoring and equipment is provided for in the OPEX budget	
25.2 -- Geochemistry	Contact water quality and/or quality may not conform to the results of pre-mining predictive modeling		Adaptive management plan for ARD will modify the response so that the water is managed in a manner that is compliant with Armenian Regulations. This may include design modifications to the PTS, BRSF, or water management system.	
26 - Construction	Shortage of available in-situ clay materials for pond, HLF and BRSF liners		Purchase GCL liner as an alternative to using processed clay material on site	
	Poor productivity of local contractors, due to not having proper equipment for working at heights		Bring scaffolding and manlifts to site, Consider sourcing from out of the country; Construction equipment costs for items like these have been included in the capital construction budget	
	Conveyor start up and commissioning – Drive start up potential issues		An installation and drive test procedure will be followed during construction and pre-commissioning/QC stage post construction; A full month has been allowed for to commission the conveyor, after construction drive installation/pre-commissioning testing	
	Shortage of electrical and piping bulk material – Drive commissioning and production delay		Ask field engineer and contractors to check MTO's vs construction drawings at the early stage of construction; Contractors supply all shorts on the MTO's	
	Earthwork, underestimated cut and fill material could cause delay in construction schedule		Don't try to balance cut and fill, Design for 30% excess cut, to account for saturated materials, unsuitable materials (i.e, frozen material, oversized, etc.)	
	Lack of site services supervision		Recruit a single point site services superintendent	
	Poor Quality Assurance		Increased frequency of onsite spot checks on Quality Control; Assign dedicated employees to this activity	
	Commissioning delay – production delay		Develop early commissioning plan; Hire full time and separate commissioning team (not construction or engineering manager); Notify sub-contractors for the commissioning date way ahead of schedule;	
	Logistic, Customs delay		Need to coordinate with customs ahead of time and make proper packing list for customs clearance	

Source: Lydian (2019)

26.2 Opportunities

There are significant opportunities that could improve the Project's economics, ensure adherence to schedule, and improve the social commitment of the project. The major opportunities at this time have been summarized in Table 26-2. Once the project is into the operations phase, a Continuous Improvement Program would be introduced to provide a systematic process for opportunities and projects to be realized.

Table 26-2: Project Opportunities

Opportunity	Explanation	Potential Benefits
Successful translocation of *P.porphyrantha*	Successful transplanting of the Potentilla would remove restrictions on available areas to be mined	The southwest wall of the Erato Pit can be extended resulting in 1.8 Mt of reserves at 0.79 g/t (46 K oz) added to the mine plan
Resource Drilling	Within the deposit there are significant areas of mineralization that have not been drilled sufficiently to define measured and indicated resources and are currently classified as waste	Additional gold and silver ounces in the Measured and Indicated Resource resulting in additional gold and silver ounces in the Mining Reserves, which has potential to improve economic results
Recruitment	Competency-based recruitment used for the Process department in 2018 resulted in 58 of the first 77 local candidates being successful and eligible for recruitment	The target for local recruitment was set at 30% but a 75% success rate in local recruitment would reduce camp and housing requirements in G&A, OPEX costs benefitting both project economic and social aspects
Recruitment	50% of the mine operations department had been hired in 2018 from both the local region and province. Many of them have gone to work in Russia due to the road blockades but have kept in touch and are hopeful to come back to work in Armenia.	The initial ramp up of staff for the mining department would be quickly achieved therefore quickly allowing the focus to be put sooner on the recruitment and training of new operators thus providing cost efficiencies and ramp up time reductions
Upside with Geotechnical Stability	The Golder pit slope designs are thorough and generally in accordance with industry standards. The slope design recommendations are conservative leaving potential opportunity for improvement during operation	• Inter-ramp/overall slope safety factors for the design exceed the minimum requirements suggesting that steeper slopes may be possible provided stable bench faces and catch bench widths can be maintained; • Slope angles for northeast dipping walls in Tigranes are controlled by the layering/bedding planes in the Volcanic Rock. There is potential to use steeper slopes if bench face mapping indicates rough and irregular surfaces, lower persistence or shallower dip angles of bedding parallel joints; • The 65° bench face angle recommendation for the Volcanic Rock assume highly fractured (RQD < 40) materials and were based strictly off anecdotal evidence from other mines in other geological environments. Bench faces may perform better than anticipated resulting in steeper slope angles

Source: JDS (2019)

26.3 Geology, Exploration and Mineral Resources

The Amulsar gold silver deposit is a hybrid of high sulphidation epithermal and orogenic deposits with some features of IOCG deposit types. It has been defined as a result of systematic exploration activities undertaken during a period from 2007 to 2016. Surface geological and structural mapping, supported by a large database of orientated core measurements, has resulted in a good understanding of the geology and mineralization of gold and silver for the deposit.

Exploration work for the Project is professionally managed, using procedures that meet generally accepted industry best-practices. The Project has been explored by geophysical techniques, diamond core and reverse circulation drilling, and chip sampling. Structural geology work on the deposit in 2013 has improved the of the geology and mineralization models for the Project.

Mineral resources for the Project are based on the interpretation of two major geological units which characterize the Project. The UV unit is the primary host to gold and silver mineralization, with mineralization in the LV unit limited to contacts near mineralized UV rocks. Gold mineralization is associated with complex structural zones with variably orientated accommodation faults and fracture, porous and permeable hydrothermal and volcaniclastic breccias, leached and vuggy volcanic rocks. The bulk of mineralized areas for Erato and TAA are associated with complex structural zones and related accommodation and fractures at variable orientations. Additionally, mineralization in the LV zone is related to mineralized structures that penetrate into the LV zone.

The confidence level between and within mineralized zones is variable, in part because of the inherent characteristics of gold and silver mineralization and structural complexity, and the variability of drilling from a nominal 40 m × 40 m drillhole spacing. AMC considers it prudent to classify resources based on a range of factors including: estimation-related parameters, drillhole spacing, continuity of mineralization that have been outlined, and defining classified resources as mineable shapes. On this basis, resources for the deposit have been classified in the Measured, Indicated and Inferred categories.

Resources have been defined at a cut-off grade of 0.20 g/t gold which is based on a gold price assumption of US$1,500 per troy ounce of gold.

WGM has examined reporting of resources at a cut-off grade of 0.15 g/t gold for the Amulsar deposit. Statistical and estimation parameters used for the estimations of resources were reviewed in considering the lower cut-off. A lower cut-off grade is supported by:

- Prior LMIK estimates indicator bins support grade at and below the cut-off;
- Gold grade distributions in probability plots show a reasonably continuity grade trends around the cut-off; and
- Gold assay quality control duplicate data show reasonable correlation of duplicate assays at the cut-off.

To provide a geological aspect of a lower cut-off grade, WGM examined the distribution of drillhole assays and estimated block grades in the range from 0.2 to 1.5 g/t in order to obtain a geological picture of this low grade cut-off range. Both TAA and Erato areas were examined. WGM found that large regions within this grade range are typified by sparse higher grades drillhole intersections dispersed within a drillhole intersections of grades significantly lower than 0.15 g/t. An examination of estimated block clusters in the range of 0.20 to 0.15 showed that blocks in this grade range are generally are distributed at distances from higher grade blocks. Blocks within this grade range extend significantly outside and distantly the main higher grade clusters of mineralization. In contrast block grades in the 0.25 to 0.20 range form in part a rough halo around higher grade clusters and are in part supported by clusters of higher grades.

These observations reflect the variability of grades that is typical to this deposit. However, observations indicate that variability at a cut-off grade 0.15 may be significantly more than at grade ranges from 0.25 to 0.20. Based on this WGM concludes that observed variability of cut-grades less than 0.20 g/t are significant and therefore it would be prudent not to report resources at a grade of 0.15 g/t or lower.

Based on review of exploration data and the estimation of resources, AMC concludes that mineral resources can be expanded at depth for the UV rocks to the south-east of the Arshak area, and at depth in the Erato, Tigranes, and Artavasdes areas. Further delineation drilling will require reverse circulation drilling and some diamond core drilling to provide structural information. Continuing work on a structural analysis of the Project will be important to the accurate estimation of resource and a better geological understanding of mineralization for the Amulsar Project.

27 Recommendations

Due to the Project's positive, robust economics, Lydian should proceed with the development of the Amulsar Project as soon as practical. In the meantime, Lydian should continue its efforts to advance key activities that will shorten and/or de-risk the project execution timeline and work on identifying opportunities to enhance the Project's economic value.

Lydian should apply for necessary permits and, as practicable, order the remaining mining fleet, and award contracts and mobilize contractors in parallel with the project financing in order to de-risk the construction schedule and validate cost estimates.

From project risks and opportunities, the following were identified as important actions that have the potential to strengthen the project and further reduce risk and should be pursued as part of the project execution plan. Table 26-1 identifies what are currently deemed to be the most significant Project risks associated with the Project Schedule, Mining and Operations, Water Management, Infrastructure and CAPEX. Approaches for avoidance, minimization, mitigation and offset are provided in the table. The costs for these activities are included in the overall initial capital costs described in Section 21.

The total estimated cost to finish development, start-up the process facility, and produce first gold is $146.4 M, inclusive of the mine, HLF, Owner's cost and all capital requirements of the Project. In addition to the above development cost, $22.2 M has been allocated for working capital cost, which is equal to 3 months of operating cost.

27.1 Mining

The following studies are recommended to advance the mine production schedule to the detailed design level:

- Post-commissioning optimization and de-bottlenecking: Once operations reach a "steady state," it is frequently the case that minor adjustments or modifications can be identified which provide incremental improvements to the project economics by way of increased throughput or improved operating efficiencies. These should be actively pursued during the early project phase.
- Review de-rating of productivity during winter months and look for opportunities to increase mining production during these periods.
- Further review the ability to segregate low grade material (>0.20 g/t and < 0 .30 g/t to provide a buffer during periods of low ore supply) by developing detailed bench plans and mining cuts.

27.2 Geology, Exploration and Resources

The exploration procedures and protocols used by Lydian meet best industry practices and should be continued. Assay quality-control procedures are appropriate but could be strengthened with field duplicates for silver assays. It is AMC's experience that operating a sample preparation facility provides many benefits to exploration companies without any compromises in assay integrity or reliability. Although AMC has found no issues with the current sample preparation laboratory at Gorayk, developing protocols where samples are passed to the preparation facility in a more formalized process would be beneficial.

It is WGM's experience that the process of delivering samples from the core shed to the preparation facility should be undertaken in a similar manner to submitting samples to an outside laboratory. Some procedures that could be undertaken are:

- Packaging sample bags from the core shed into sealed barrels or large bags that are then delivered to the laboratory;
- Barrels or large bags are unpacked by laboratory staff;
- Barcodes are assigned to each sample that enters the laboratory and used to log samples out of the laboratory;
- Quality control protocols should be established for dry bulk density measurements; and
- Silver analysis should be routinely undertaken for all drilling programs and closer attention needs to be undertaken with regard to silver assays.

Structural studies of the Amulsar Project have provided important in understanding the nature of the mineralization at the Amulsar Project. WGM considers that structural studies of the deposit are a critical part of exploring and defining additional mineral resources for the project. WGM recommends that this work continues.

The Amulsar deposit has the potential to significantly extend the LOM beyond the current 12-year period. AMC recommends a two phased strategy of high-priority and medium-priority drilling, including a round of deep drilling. High-priority drilling should be focused on the TAA zone to prevent possible sterilization of inferred and potential resources within this area. The drilling and evaluation of results for this phase should be completed before Year 4 of the current LOM plan. The second-phase, medium-priority drilling should be focused on the Erato zone and should begin when mining commences at Erato or shortly thereafter.

Each phase of drilling should consist of delineation drilling of Inferred resources at a nominal drill spacing of 40 m × 40 m using a combination of reverse circulation and diamond holes. The recommended deep exploration holes component is comprised of diamond drillholes ranging from depths of 350 m to 500 m. Three drillholes have been assigned to each of the Erato and TAA zones as an initial test of deep mineralization targets. Costs for the two phases of drilling are estimated at US$6.9 M. Details for the recommended drilling strategy are summarized in Table 27-1.

Grade control drilling will be a critical part of the mining process for the Amulsar deposit. The structural complexity of the deposit, multiple phases gold mineralization, and variable orientations of mineralization trends are an inherent uncertainty in the geology of this deposit. Tightly spaced drilling in the TAA zone indicated that significant variability continues at a scale less than the closely spaced drilling although not changing the global resources significantly. The inherent variability of grade in the Amulsar deposit necessitates careful selection of the most appropriate drilling sample for grade control. Reverse circulation drilling should be consider if there are grade control issues. AMC suggests that the initial phase of mining must include geological mapping and geological structural work to develop better understanding of the deposit mineralization.

Table 27-1: Estimated Costs for Recommended Delineation Drilling

Phase	Estimated Cost $
High Priority (including analytical and support costs) 8,220 m	3,000,000
Medium Priority (including analytical and support costs) 12,130 m	3,700,000
Total	**6,900,000**

Source: Samuel Engineering (2017)

27.3 Geochemistry and ARD Management

The following studies are recommended in the area of Geochemistry and ARD Management. Some of these recommendations pertain to re-starting studies and data collection that has been stopped by the illegal blockade, while some are new studies are required to carry elements of the ARD Management Plan or Closure Plan to final-design level.

- Re-start the lysimeter study (stopped by the illegal blockade). The results will be used to finalize the design of the post-closure ET Covers;
- Re-start the on-site kinetic cell testing (also stopped by the illegal blockade). This testwork will help define the difference between field ARD-reaction kinetics and the reaction kinetics measured in the laboratory humidity cells (see Section 25.2);
- Revise and calibrate the site-wide water balance using the results from the continuous stream flow monitoring that was made possible by the installation of Parshall flumes in Site 13 and Benick's pond;
- Conduct a field-scale pilot test of the passive treatment system. A field-scale pilot plant is required to manage any issues with scale-up from the successful bench-scale passive treatment system;
- Conduct field nitrate testing to determine the concentration of nitrate that will likely be present in the runoff from the mining/blasting operations. This will be done during the initial months of mining (during the first wet season) and will involve testing runoff using a field nitrate test kit;
- Expand the monitoring and evaluation of the pit groundwater system using the future pit slope geotechnical holes (see Section 27.4.1), or future exploration holes. The program should include the installation of vibrating wire piezometers to ascertain the groundwater levels, and rock mass conductivity testing in the holes; and
- Expand the existing studies of the Erato post-closure hydrologic and hydrogeologic conditions.

27.4 Geotechnical Engineering and Investigation

27.4.1 Mine Pit Geotechnical

It is recommended that further geotechnical drilling and site investigation be conducted to potentially re-design the pit slope with steeper angles. The angle may be increased with further investigation and refinement of the design, which will reduce the amount of development needed to access the main ore bodies.

27.4.2 HLF Stacking

It is recommended that a more thorough analysis and design be conducted on the LOM HLF stacking plan. If the stacking plan design can accommodate a higher HLF, thereby reducing or eliminating the Phase 5 expansion, the costs of relocating dam D1 and the BRSF contact water pipeline in the later years can be avoided. This would include a geotechnical analysis of the ore for ultimate stacking height and any potential reduction in the side slope angles.

27.5 Ore Crushing and Handling

27.5.1 Crushing Comminution

The ROM particle size distribution (PSD) provided to the crushing system vendor, Sandvik, and used in simulation to design crushers seems fine when benchmarked against other mining operations. A comparison to other similar mines shows they are experiencing a coarser PSD at 80% passing. The Lydian crushing and screening circuit, with the operating parameters that have been set up as it has been simulated, may restrict the expected throughput. However, the circuit can be adjusted with different screens, screen angles, and crusher settings to meet the throughput demand (albeit with a coarser ROM PSD expected). It is recommended Lydian provide Sandvik with a representative ROM particle size distribution, simulate the flow through the circuit, and make the required modifications to address any throughput issues.

27.5.2 Crushing and Screening Chutes and Hoppers

It is recommended that Lydian approach Sandvik for a warranty re-design of the crushed ore bins and chutes to improve the wear plate installation and maintenance replacement. The current design does not allow for bolt-on wear plates, and plates must be welded on, which requires longer downtime for maintenance. The design should also consider the material and design of the wear plates to accommodate the abrasive nature of the ore at Amulsar and facilitate maintenance replacement. An experienced engineer with mine processing operations, either a 3rd party or Lydian senior staff, should provide input and approve the design before implementation.

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29 Units of Measure, Abbreviations and Acronyms

In this report, measurements are given in metric units. Assays have been reported in the manner in which they were received - oz/t.

Currency Unless otherwise indicated, all references to dollars ($) in this report refer to currency of the United States.

29.1 Frequently Used Acronyms, Abbreviations, Definitions and Units of Measure

Abbreviation	Definition
3-D	three dimensional
AA	atomic absorption spectrometry
ADR	Adsorption, Desorption, Recovery
Ag	silver
AI	Alberta Innovates
AMC	AMC Consultants
ARD	Acid Rock Drainage
Au	gold
BRSF	Barren Rock Storage Facility
CIC	Carbon-in-Column
CN	cyanide
C.P.G.	Certified Professional Geologist
EBA	Endemic Bird Area
EBRD	European Bank for Reconstruction and Development
EBRD-PR	European Bank for Reconstruction and Development’s Performance Requirements
EIA	Environmental Impact Assessment
EMG	Equite Montevedeo Group
EP	Equator Principles
ERM	Environmental Resources Management
ESIA	Environmental and Social Impact Assessment
G&A	general and administrative
g	grams
g/t	grams per tonne
GHG	Green House Gas
Golder	Golder Associates
GPS	Global Positioning System
GRE	Global Resource Engineering
Hg	mercury

Abbreviation	Definition
HLF	Heap Leach Facility
HLP	Heap Leach Pad
IBA	Important Bird Area
IFC	International Finance Corporation
IFC-PS	International Finance Corporation Performance Standards
ICMC	International Cyanide Management Code
ICMI	International Cyanide Management Institute
IoC	Institute of Zoology
IUCN	International Union for Conservation of Nature
K	thousands
KBA	Key Biodiversity Areas
km	kilometer
Lydian	Lydian International LTD
IRR	internal rate of return
kwh	kilowatt hour
LOM	life of mine
m	meters
$M	million dollars
Ma	million annum
MARC	Maintenance and Repair Contract
MENR	Ministry of Energy and Natural Resources
MDA	Mine Development Associates
MNP	Ministry of Nature Protection
NaCN	sodium cyanide
NAG	Non-Acid Generating
NAS	National Academy of Science
NPV	net present value
NSR	net smelter return
oz	troy ounce (14.7 oz to 1 pound)
opt	troy ounce per short ton
oz/T	troy ounce per short ton
oz/ton	troy ounce per short ton
PAG	Potential Acid Generating
P.E.	Professional Engineer
Praetorian	Praetorian Construction Management
pSWMP	preliminary Solid Waste Management Plan
QA/QC	quality assurance/quality control
RC	reverse circulation drilling method

Abbreviation	Definition
RC&R	Reclamation, Closure and Rehabilitation Plan
RoA	Republic of Armenia
ROM	run of mine
SE	Samuel Engineering, Inc.
SWWB	Site-Wide Water Balance
SWMP	Surface Water Management Plan
T	short (imperial) ton
ton	short (imperial) ton
t	metric ton
MT	metric ton
TEC	Treweek Environmental Consultants
tonne	metric ton
Tpd	(short) tons per day
TPD	(short) tons per day
USD	currency of the United States
VAT	Value Added Tax
WAI	Wordell Armstrong International
WGM	Watts, Griffis and McOuat Ltd