**REPORT NI 43-101**

# TECHNICAL REPORT ON THE MINERAL RESOURCES AND RESERVES OF THE SANGDONG PROJECT, SOUTH KOREA

**Prepared for**

**Almonty Industries**

**by**


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# 1 SUMMARY

## 1.1 Introduction and Overview

This report was prepared to provide a Technical Report compliant with the provisions of National Instrument 43-101 - Standards of Disclosure for Mineral Projects, ("NI 43-101"), and comprises a review and summary of a Resource and Reserve Estimation for the Sangdong project, as of the end of August 2015. The Sangdong deposit is considered as a potential underground operation, and is located in the Gangwon Region of South Korea. The principal potential products are tungsten and molybdenum.

This report was prepared by Adam Wheeler, at the request of Mr. N. Alves, Almonty Industries ("Almonty"). Assistance and technical detail were supplied by the technical personnel of the Sangdong Mining Corp. Adam Wheeler visited the Sangdong site on August 24th- 26th, 2015, along with other Almonty technical personnel.

Previous underground mining at Sangdong took place at various times since the original discovery in 1916. The last main operation was from 1952 to closure in 1992.

This document describes an update to the previous 43-101 completed in December 2015, as a consequence of the updated Phase 7 diamond drilling in 2016.

## 1.2 Ownership

Almonty Industries Inc ("Almonty"), is a corporation governed by the Canada Business Corporations Act (the "CBCA"). Almonty trades on the TSX Venture Exchange (TSX-V) under the symbol "AII". Almonty acquired a 100% ownership interest in Woulfe Mining Corp. on September 10, 2015 by way of a Plan of Arrangement. Woulfe Mining Corp., through its wholly owned subsidiary, Almonty Korea Tungsten Corporation (AKT) [formerly Sangdong Mining Corporation], owns a 100% interest in the Sangdong mine.

## 1.3 Geology and Mineralisation

The Korean Peninsula is situated on the eastern margin of the North China– Korea Platform, a craton composed of three blocks of Archean age, the Nangrim- Pyeongnam Block and the Gyeonggi and Yeongnam Massifs that are separated by the northeast-trending Imjingang and Okcheon mobile belts of Phanerozoic age. The Property is located within the Okcheon Belt.

The Sangdong Project is situated on the southern limb of the east-west orientated Triassic age Hambaek Syncline. Cambro-Ordovician limestone, shale, and quartzite of the Chosun System unconformably overlie the Pre-Cambrian Taebaeksan schist and gneiss.

The tungsten mineralisation of the Sangdong deposit is contained in several tabular, bedding-conformable skarns in the Myobong Shale; these skarns have been interpreted as comprising carbonate-bearing horizons that were altered and mineralised by fluids ascending from the underlying Sangdong Granite. From uppermost to lowermost, these horizons are termed the Hangingwall, Main, and Footwall horizons. Calc-silicate layers from 0.50 – 1.0m in thickness have developed on the upper and lower contacts of the Main and Footwall horizons.

The Hangingwall horizon is located near the upper contact of the Myobong shale and varies in thickness from approximately 5.0 to 30.0m because of the irregular boundary of the shale with the overlying Pungchon Limestone. This zone has a strike length of about 600m and a down-dip extent of about 800m. Above the most highly-altered portion of the Main horizon, the Hangingwall horizon is not tabular, but extends steeply and irregularly into the overlying limestone. The base of the Hangingwall horizon is approximately 14m above the upper contact of the Main horizon.

The Main horizon strikes about 100° and dips northerly between 15° and 30°. The strike length is in excess of 1,300m and thickness varies from 5.0 – 6.0m. Alteration (skarnification) within the Main horizon forms three concentric, roughly circular zones.

The Footwall horizons comprise multiple layers: Footwall Zone 1 (F1) normally occurs 1m below the Main horizon and is approximately 2m thick; Footwall Zones 2 and 3 (F2, F3) are situated approximately 35.0 to 40.0m below the Main horizon and are less than 1m thick. Further Footwall Zones have been identified beyond F3 and are collectively referred to as F4.

The Oriental Minerals ownership period started in 2006. The total number of drillholes (surface and underground) and total metres drilled at Sangdong before and after 2006 comprise 870/84,014m and 507/42,730m respectively.

## 1.4 Database and Resource Estimation

The sample database, in the form of an Excel spreadsheet, is comprised of data from all available surface and underground drillholes, over recent and historical drilling campaigns. This database has separate tables for drillhole collars, survey data, assay data, RQD, lithology data, drillhole recovery, geotechnical logging, density measurements, structural orientation and mineralised intersections.

The resultant spacing of samples with these different historical campaigns has ended up being fairly sporadic, with sections spaced at distances from 30m to 100m. Most of the surface holes are vertical, as are the very deep underground holes. Most of the underground holes are angled up or down so as to give good intersections with the overall mineralised structures, which generally dip at approximately $25^{o}$.

The database also included physical string and wireframe data, for previous interpretations, mined-out limits, surface and underground topography. This data was also augmented by information from the different resource estimation studies over the last four years: primarily from the Tetra-Tech and AMC consultancy companies.

An updated mineral resource estimation was completed, during July 2016, by the Qualified Person. This estimation employed a three-dimensional block modelling approach, using CAE Datamine software. Two main resource blocks models were developed. The relatively thick hanging wall (HW) zone was modelled using a conventional block model structure. All of the other skarn zones were modelled using the initial generation of 3D digital terrain models (DTMs) for the zone centre-points, onto which thicknesses and grade-accumulations were estimated, using ordinary kriging. This enabled a 3D block model of all these zones to be developed – with columnar sub-blocks representing the vertical in-situ thickness of the mineralised skarn bodies. Density values were also estimated from sample measurements.

The models generated were derived from the interpretation of skarn zones, as generated by SMC geologists, with additional intersection checks and refinements by the QP. The defined skarn intersections have been based on a lithological skarn identification, as well as 0.1% $WO_3$ cut-off grade. Additional mined-out limits for the principal skarn structures were applied, as well as a 50m remnant surface pillar below the surface topography.

In the resource estimation, a minimum thickness of 2.2m was applied, such that thinner blocks were diluted to 2.2m.

Resource class categories were set, such that indicated resources, for the Main and F beds, only used assay data from drillholes after 2006, along with drilling grid criteria.

## 1.5 Mine Planning

The majority of the ore zones to be mined are relatively shallow dipping, with dips between 20° and 30°, so ore will not naturally flow by gravity on the footwall. In the A-Z Feasibility Study, the methods proposed were inclined panel (IP) mining, to be applied in thick orebody areas, with panels that would be mined in different sections; and up-dip panel mining (UP), which would be applied in narrow areas with slushers and hand-held drilling equipment.

For this present study, it was decided not to rely on hand-held drilling equipment and slushers. Instead, methods applied would be planned for the use of mechanized mobile diesel powered mining equipment in all areas. Based on this requirement and the latest understanding of the orebody geometry and mining areas, and evaluation of the resources, including in-situ thickness variations, it was decided to apply two proposed mining methods, as summarised below:

- Mechanized Inclined Panel mining (MIP) – areas where the thickness less than 3 metres.
- Cut-and-Fill (CAF) – for areas where the thickness is greater than 3 metres.

A mine plan was developed, based on the application of these stoping methods. Stope blocks were laid out as plan perimeters, bounded by horizontal parts on each level, where the footwall contact of each zone cut through level's reference elevation. In general, most stope blocks were limited to a maximum of 100m along strike. Stope blocks were only laid out in those parts of each zone predominantly demarcated as containing indicated resources. Any inferred resource blocks within stope outlines were treated as planned dilution with mineralised waste, with any grades greater than 0.2% $WO_3$ set to 0.2%.

Mining will use almost exclusively mobile diesel-powered equipment. All newly stoped areas will be backfilled with paste backfill.

In the evaluation of stope blocks, additional unplanned mining factors of 5% dilution and 5% losses were also applied. Maps of maximum span distances have previously been prepared in a geotechnical study by Turner Mining and Geotechnical Pty Ltd (TMG) in 2014. These maximum span properties were superimposed onto the laid-out stopes in each skarn zone, so that higher cut-offs were applied to those zones requiring higher support costs. The applicable cut-offs varied from 0.23% - 0.36% $WO_3$.

Additional level development has been laid out so as to enable access to the identified reserve areas, and to allow truck haulage from these new stoping areas. Main access to the underground mine will use the old entry portals on the Sangdong and Taebak levels as well as a new portal on the -1 level, that will enable ore haulage out from the mine directly into the valley, on approximately the same elevation as the intended mill position.

## 1.6 Mineral Processing

Processing will utilize crushing, grinding (rod and ball mills) and flotation for scheelite concentration. The processing plant will treat the run-of-mine (ROM) ore from underground at a nominal feed rate of 1,920 tpd. A new processing plant will be constructed, based on the valley, to the south of the Sangdong adit entrance.

A marketable tungsten concentrate grade of 65% $WO_3$ will be produced. Processing plant recoveries, based on metallurgical testwork, are estimated to average 81%. The main process steps for treating the Sangdong ore are primary, secondary and tertiary crushing and stockpiling; grinding; flotation divided into two (2) sub-circuits (sulphide flotation and tungsten flotation); thickening; filtration and packaging section; a waste water treatment facility; and services section

The processing plant will require a manpower complement of 36 personnel of which 8 are management, technical staff and supervision.

The plant design will encompass crushing, grinding and flotation for scheelite concentration. In the future, test work will also investigate the recovery of molybdenum into a sulphide flotation concentrate, ahead of the scheelite flotation circuit.

## 1.7 Infrastructure

Existing infrastructure to be used includes the access road to site; site roads; powerline and stepdown substation, potable water supply and communications and internet service. It also includes some old KTMC buildings that will be reused and the KTMC slope support at the zone of the plant and water treatment plant.

To return the mine to operation the existing Sangdong infrastructure will be reconfigured and supplemented by new facilities as required. To accommodate the new waste storage facility the existing buildings at the Sangdong portal level will be demolished to allow for placement of waste from mine development. New site infrastructure will be built in the valley, on the footprint of old KTMC installations. It will include a new mine/administration building, assay laboratory, warehouse, maintenance shop, recreational facilities for employees, fuel storage, potable and process water supply and water and sewage treatment facilities. The mine backfill plant will be placed at Sangdong Terrace.

The surface services and general administration manpower complement will total 27 personnel.

## 1.8 Mineral Resource and Reserve Estimates

The evaluation work was carried out and prepared in compliance with Canadian National Instrument 43-101, and the mineral resources in this estimate were calculated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May, 2014. The current in-situ resource estimation is shown in Table 1-1.

**Table 1-1. Sangdong – Mineral Resources**
**As of 31st July, 2016**

| $WO_3$ Cut-Off | Resource Class | Tonnes Kt | $WO_3$ % | $MoS_2$ % |
|---|---|---|---|---|
| 0.15% | Indicated | 8,029 | 0.51 | 0.06 |
| | Inferred | 50,686 | 0.43 | 0.05 |
| 0.20% | Indicated | 7,864 | 0.51 | 0.06 |
| | Inferred | 47,630 | 0.44 | 0.05 |
| 0.30% | Indicated | 7,316 | 0.53 | 0.06 |
| | Inferred | 36,466 | 0.50 | 0.06 |

**Notes**

. Bed models diluted to a minimum thickness of 2.2m
. Resources shown are inclusive of reserves
. 50m surface pillar material removed
. Indicated HW material based on all samples, with a maximum search of 35m x 50m (along-strike x down-dip)
. Indicated material in all other beds are based on only PO-P6 samples, with a maximum search of 50m, and sample grid required
. Inferred material based on all samples, up to a maximum search of :
105m x 150m in HW
100m x 100m in all other beds

These resources have been used in the development of a mine plan. To start the mine operations, the blocked-out stopes have enabled a reserve evaluation to be made, as summarised in the table below.

**Table 1-2. Sangdong – Mineral Reserves**
**As of 31st July, 2016**

| | *Probable Reserves* | |
|---|---|---|
| | **Tonnes** | **$WO_3$** |
| | **Kt** | **%** |
| **HW** | 3,759 | 0.47 |
| **MAIN/F1** | 1,328 | 0.34 |
| **F2** | 1,495 | 0.48 |
| **F3** | 1,249 | 0.46 |
| **F4** | 65 | 0.33 |
| **TOTAL** | **7,896** | **0.45** |

**Notes**

**. All reserves have a probable category**

**. $WO_3$ Cut-offs applied:**

**0.36% Max Spans <=3m**

**0.28% Max Spans >3m <=6m**

**0.23% Max Spans +6m**

**. Level restrictions:**

**. Down to -1 level (633m) for the non-HW zones**

**. Mining Factors applied**

**. Minimum thickness = 2.2m**

**. Unplanned dilution = 5%**

**. Unplanned losses = 5%**

## 1.9 Conclusions

The following conclusions have been reached:

a) The Phase 7 drilling completed in 2016, which was focussed on the HW zone, has helped to verify the old KTMC data available in the HW zone. This has helped to support the use of both KTMC and Phase 0 – Phase 7 drillhole data for the estimation of indicated HW resources.

b) The updated Feasibility Study calculations have identified Probable Reserves of 7.9 Mt, which with an assumed mill capacity of 640 ktpa, will sustain a mining operation for approximately 12 years.

c) Based on the forecast operating parameters and capital and operating costs estimates for the Sangdong project, the returns from the project are very positive and the project economics are extremely robust to potential reasonably expected variances from the base case assumptions. The mine will employ 170 people, including mine contractors.

d) The very large inferred resource base represents a very large source of potential future reserves, as more exploration drilling can be completed.

e) There are more areas of the deposit down-dip and north-east which have not been currently evaluated.

f) Most of the deposit has not yet been delineated off at depth.

# 2 INTRODUCTION

## 2.1 Introduction

This Technical report was prepared in compliance with the provisions of National Instrument 43-101 - Standards of Disclosure for Mineral Projects, ("NI 43-101"), and comprises a Resource and Reserve estimate for the Sangdong project, as of the end of July 2016. It represents an update to the previous 43-101 completed by Adam Wheeler in December 2015.

This report was prepared by Adam Wheeler, at the request of Mr. N. Alves, of Almonty Industries. Assistance and technical detail were supplied by the technical personnel at Sangdong, which is a wholly owned by Almonty Korea Tungsten Corp (AKT), and in which Almonty has a 100% ownership interest. Adam Wheeler visited the Sangdong site from August 24$^{th}$-26$^{th}$, 2015.

## 2.2 Terms of Reference

The resource and reserve estimation work was commissioned by Almonty Industries, and completed by Adam Wheeler, an independent mining consultant.

Adam Wheeler was retained by Almonty to provide an independent Technical Report on the Mineral Resources and Reserves at Sangdong, and is considered current as of July 31$^{st}$, 2016. This Technical Report has been prepared to be compliant with the provisions of National Instrument 43-101 - Standards of Disclosure for Mineral Projects ("NI 43-101").

The Qualified Person responsible for the preparation of this report is Adam Wheeler (C. Eng, Eur.Ing), an independent mining consultant. In addition to a site visit, Adam Wheeler carried out a study of all relevant parts of the available literature and documented results concerning the project and held discussions with technical personnel of Sangdong, who have been doing project development work at Sangdong since 2012.

The purpose of the current report is to provide an independent Technical Report and update of the resources for the Sangdong project, in conformance with the standards required by NI 43-101 and Form 43-101F1. The estimate of mineral resources contained in this report conforms to the CIM Mineral Resource and Mineral Reserve definitions (May 2014) referred to in NI 43-101.

## 2.3 Sources of Information

In conducting this study, Adam Wheeler has relied on reports and information connected with the Sangdong project. The information on which this report is based includes the references shown in Section 27.

Adam Wheeler has made all reasonable enquiries to establish the completeness and authenticity of the information provided, and a final draft of this report was provided to Almonty, along with a written request to identify any material errors or omissions prior to finalisation.

## 2.4 Units and Currency

All measurement units used in this report are metric, and currency is expressed in US Dollars unless stated otherwise. Costs derived from Republic of Korea Won were converted at a rate of $US 1 = Won 1180.

# 3 RELIANCE ON OTHER PROJECTS

Adam Wheeler has reviewed and analysed data provided by Almonty and has drawn his own conclusions therefrom. Adam Wheeler has not performed any independent exploration work, drilled any holes or carried out any sampling and assaying.

While exercising all reasonable diligence in checking and confirmation, Adam Wheeler has relied upon the data presented by Almonty, and previous reports on the property in formulating his opinions.

Title to the mineral lands for the Sangdong property has not been confirmed by Adam Wheeler and Adam Wheeler offers no opinion as to the validity of the exploration or mineral title claimed.

# 4 PROPERTY DESCRIPTION AND LOCATION

The deposit is located at Sangdong in the south-eastern Korean Peninsula, about 170km east south east of the capital city of Seoul, 20km southwest of Taebaek and 55km south east of Wonju, in Yongweol County of Kangwon-Do Province (37°08'N Latitude and 128°50'E Longitude) as shown in Figures 4.1 and 4.2. The main adit is at the head of a short, south-flowing tributary of the Oktong-ch'on (river).

**Figure 4-1. Sangdong Project Location Map**

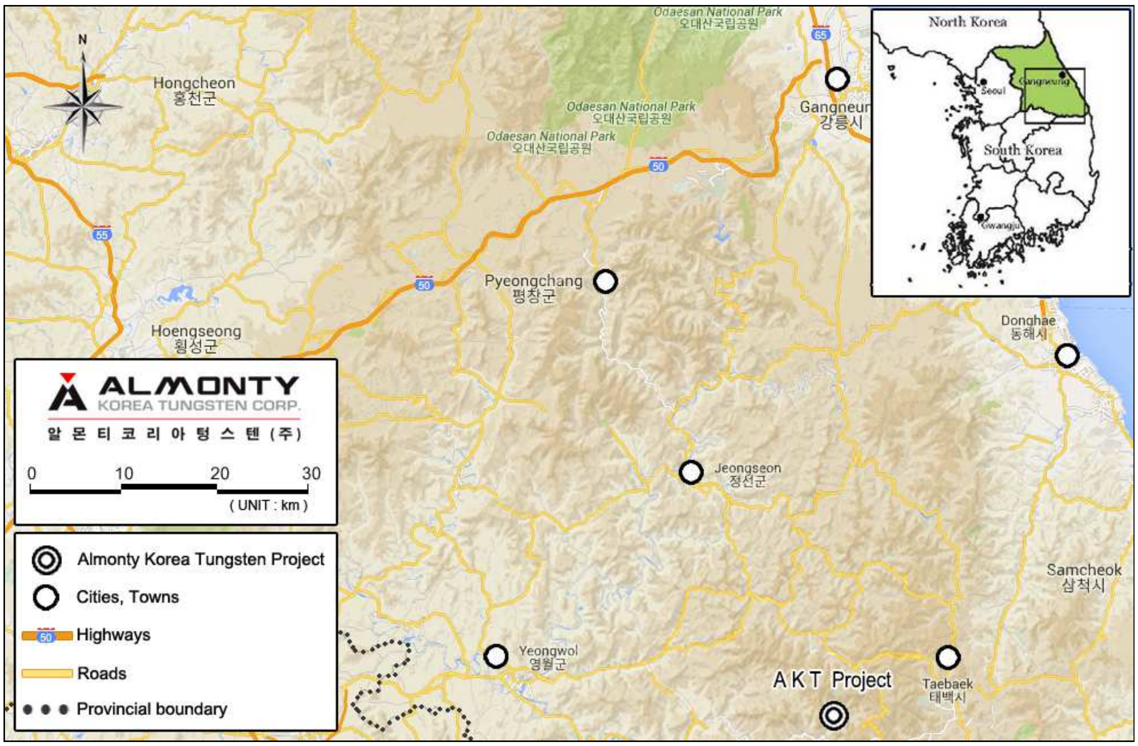
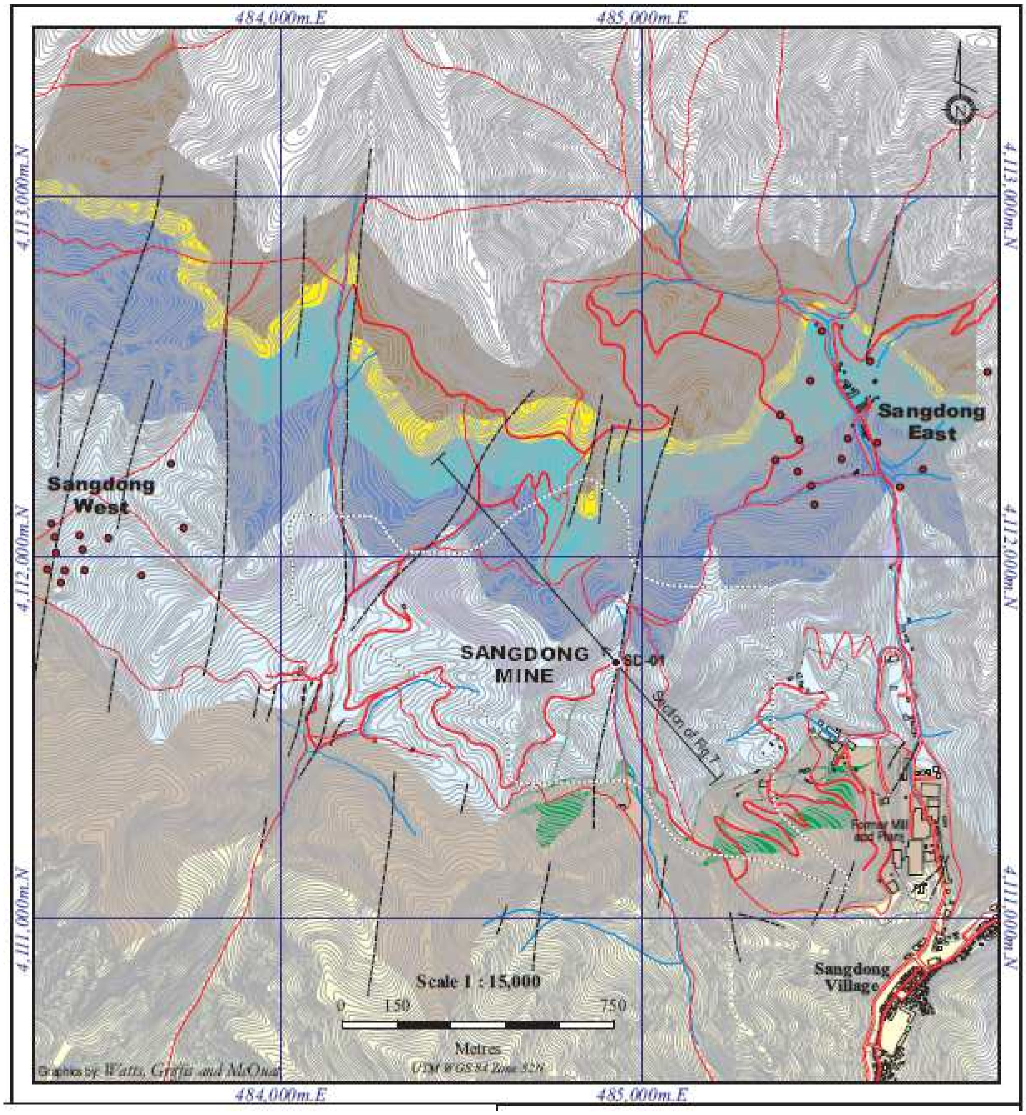


**Figure 4-2. Sangdong Mine Area**

Showing Sangdong East and West Deposits and Infrastructure




The Property comprises 12 Mining Rights with an aggregate area of 3,173ha, held in the name of Se Woo. The licence areas are shown in Figure 4.3 and details of the licences in Table 4.1.

**Figure 4-3. Sangdong Project: Mineral Rights Areas**

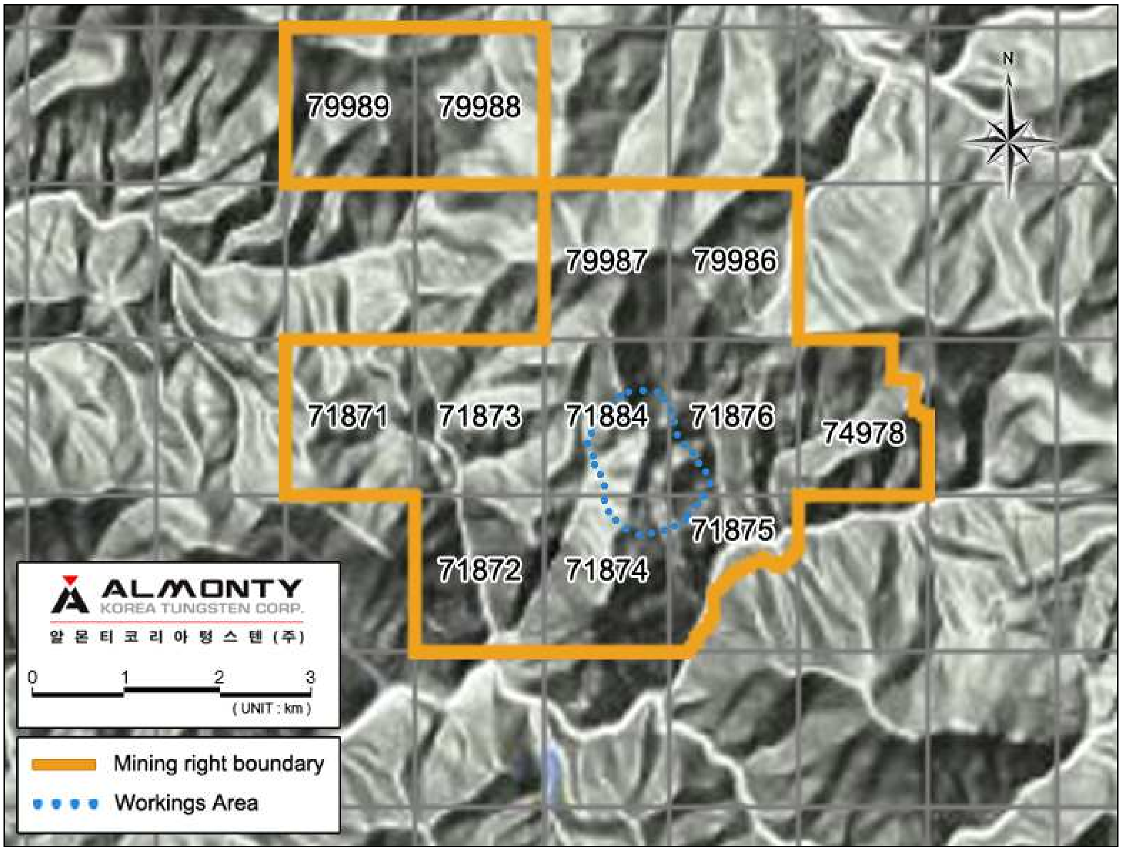


**Table 4-1. Sangdong Project – Licence Details**

| Sector | District | Block No. | Registration No. | Area (ha) | Mineral | Registration Date | Location Latitude / Longitude |
|---|---|---|---|---|---|---|---|
| Sangdong | Seobyeok | 121 | 71871 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi, Si | 01-Jun-01 | 37° 09′ ~ 37° 10′ 128°47′10″~128°48′ 10″ |
| | Seobyeok | 112 | 71872 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi, Si | 01-Jun-01 | 37° 08′ ~ 37° 09′ 128°48′10″~128°49′ 10″ |
| | Seobyeok | 111 | 71873 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi, Si | 01-Jun-01 | 37° 09′ ~ 37° 10′ 128°48′10″~128°49′ 10″ |
| | Seobyeok | 102 | 71874 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi, Si | 01-Jun-01 | 37° 08′ ~ 37° 09′ 128°49′10″~128°50′ 10″ |
| | Seobyeok | 92 | 71875 | 185 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi, Si | 01-Jun-01 | 37° 08′ ~ 37° 09′ 128°50′10″~128°51′ 10″ |
| Sangdong 2 | Seobyeok | 91 | 71876 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi | 02-Jun-01 | 37° 09′ ~ 37° 10′ 128°50′10″~128°51′ 10″ |
| | Seobyeok | 101 | 71884 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo, Bi | 08-Jun-01 | 37° 09′ ~ 37° 10′ 128°49′10″~128°50′ 10″ |
| Sangdong 6 | Seobyeok | 81 | 74978 | 248 | Au, Ag, Cu, Pb, Zn, W, Mo | 30-Sep-05 | 37° 08′ ~ 37° 09′ 129°51′10″~129°52′ 10″ |
| Sangdong 7 | Homyeong | 100 | 79986 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo | 22-Nov-11 | 37° 11′ ~ 37° 12′ 128°48′10″~128°49′ 10″ |
| | Homyeong | 110 | 79987 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo | 22-Nov-11 | 37° 11′ ~ 37° 12′ 128°47′10″~128°48′ 10″ |
| | Homyeong | 119 | 79988 | 274 | Au, Ag, Cu, Pb, Zn, W, Mo | 22-Nov-11 | 37° 10′ ~ 37° 11′ 128°50′10″~128°51′ 10″ |
| | Homyeong | 129 | 79989 | 273 | Au, Ag, Cu, Pb, Zn, W, Mo | 22-Nov-11 | 37° 10′ ~ 37° 11′ 128°49′10″~128°50′ 10″ |

Source: WMC 2014

The existing exploration and mining permits cover all the active exploration and mining areas discussed in this Technical Report. The exploration permits provide the right to carry out all contemplated exploration activities with no additional permitting required. Exploration permits are subject to exploration rights usage fees (a fixed annual charge), and applicable taxes. Mining permits are subject to mining-right usage fees (a fixed annual charge), mineral resource compensation fees, and applicable mineral resource taxes. The renewal of mining permits and extending mining depth and boundaries occur in the ordinary course of business as long as mineral resources exist, are defined, the required documentation is submitted, and the government resources royalties are paid.

Mining permits are subject to mining-right usage fees (a fixed annual charge), mineral resource compensation fees, and applicable taxes. The renewal of mining permits and new applications for extending boundaries occur in the ordinary course of business as long as mineral resources exist, are defined, the required documentation is submitted, and the government resources taxes are paid. The mining permits give the right to carry out full mining and mineral processing operations in conjunction with safety and environmental certificates. Approval for installation of mining facilities (Sangdong Portal, Woulfe Portal, Taeback Portal and Baekun Portal) have been issued by East Mine Registration Office of the Ministry of Trade, Industry & Energy. Environmental certificates (Temporary Forest Land Use) have been issued by the Department of Environmental Forest of Yeongwol County. There are no known or recognized environmental issues that might preclude or inhibit a mining operation in this area.

Surface rights for mining purposes are not included in the permits but AKT have leased some of land use for mining and processing plant activities by effecting payment of a purchase fee based on the appraised value of the land. The rest of the necessary lands for mining, waste disposal and processing plant activities (processing plant, offices and accommodations etc.) were guaranteed by Yeongwol County, through written official documentation. There are no significant factors and risks that may affect access, title, or the right or ability to perform work on the Property known at this time. A summary of the lease areas is shown in Figure 4-4.

**Figure 4-4. Lease Areas**


| Plot No. | Land Category | Total Area (m²) | Area (m²) to be leased | Remarks |
|---|---|---|---|---|
| 106 | Building Site | 4,539 | 4,539 | To be purchased or leased |
| 109 | Building Site | 3,068 | 3,068 | |
| 110 | Building Site | 4,241 | 4,241 | |
| 112 | Building Site | 3,088 | 3,088 | |
| 114-6 | Building Site | 996 | - | AKT have leased |
| 114-5 | Forest | 11,006 | 700 | To be permitted for temporary land use ( AKT have leased 5474㎡ for 114-4, 3939㎡ for Mt.64) |
| 114-4 | Forest | 21,278 | 14,526 | |
| Mt.64 | Forest | 95,061 | 3,422 | |

Korea has an established Mining Industry Act which defines the mining rights guaranteed by the government of Korea.

Korea has a 10% Value Added Tax (VAT) on sales of concentrates and on articles such as 1) supply of goods or services by entrepreneurs, 2) importation of goods. However there is non-tariff and VAT-free in case of concentrates exportation to overseas. Income tax rate is a maximum of 22%. There is local resource and facility tax payable to the local government at a rate of 0.5% of the value of mined minerals. There is no VAT surtax on sales.

Except for relatively small areas in the south in the main river valley and a few small areas of vegetable farms, the Sangdong property is on government land. On government (i.e. non private) land, an environmental security bond must be lodged. On private land, access must be negotiated with the individual landowner(s). In the case of mining, there is no formal mediated process for land disturbance, and the purchase or lease of the surface rights would have to be negotiated with the landowner(s).

Environmental certificates have been issued by the Department of Environmental Forest of Yeongwol County and there are no known or recognized environmental issues that might preclude or inhibit a mining operation in this area. Some major land purchases may be required in the future for mine infrastructure purposes (processing plant, waste disposal and offices). There are no significant factors and risks that may affect access, title, or the right or ability to perform work on the Property known at this time.

There are no Royalties imposed on minerals by government agencies in South Korea. The 2% net smelter royalty (NSR) retained on the Project in South Korea from the vendor, Se Woo Mining Co.Ltd. (Se Woo), as part of the Sangdong Acquisition Agreement with Oriental Minerals Inc. was purchased for CDN$3.5M.

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

## 5.1 Topography, Elevation and Vegetation

The Sangdong area is in the central portion of the most rugged part of the Taebaek-san in one of the deep valleys running north-south on the southern slopes of Baegun Mountain (Baegun-san 1,428m amsl). The highest outcrop of the Sangdong orebodies is about 800m amsl, the main adit is at about 650m amsl, and the old mine offices will be located on the floor of the valley at 550m amsl.

Many peaks in the Sangdong area, e.g. Sunkyeong-san (1,152mamsl), Maebong-san (1,282mamsl) to the SE and Jang-san (1,408mamsl) consist of Jangsan Quartzite and form long narrow ridges paralleling the axis of the Baegun-san Syncline. These peaks are separated by V shaped valleys in general, forming a dendritic pattern. However, the dominant trend of the valleys in the Sangdong mine area is north-south.

Despite the terrain, access is well developed countrywide and a paved road passes within several hundred metres of the old mill site and forestry roads traverse the Property. The highest local peak in the range is Taebaek-san, about 8km southeast of the Property.

Vegetation in the Taebaek district is dominated by dwarf pines. Thick dense undergrowth, consisting of scrubby thorny vegetation develops in June after the first heavy rains, making access very difficult off walking tracks. The scrub browns and dies out rapidly in October-November at the onset of winter.

## 5.2 Accessibility

The Sangdong Project is located approximately 175km east-southeast of Seoul, in Yongweol County of Kangwon-Do Province on the eastern side of South Korea. Sangdong is easily reached by paved roads from all directions and is a 3.5hr drive from Seoul. The project is well served by the Yeondong Expressway 50 from Seoul, the Jungang Expressway 55 from Wonju, Highway 38 from Jechon to Yongweol then Highway 31 to Sangdong. The road journey takes approximately 3.5hrs. A bus journey from Dong Seoul Bus Terminal typically takes 4hrs to Taebaek. Taebaek (population of over 50,000) is located 25km to the east of Sangdong by paved road and is an established coal mining town with most modern facilities, including reasonable accommodation facilities and some mining equipment support

Access throughout the Sangdong Project area is generally very good, with sealed roads forming a network throughout the district, together with numerous unsealed farm tracks up the river valleys. Sangdong, a small rural village with a population of approximately 600, is situated 2km to the south of the mine.

The national rail network system services the region. The train journey takes 4.5hrs to Taebaek from Seoul Station. The closest railhead is situated at Yemi 5km north of Sangdong.

## 5.3 Climate

The Meteorological weather station nearest to the Project site is Yeongwol Weather Station. The Project experiences seasonal climatic conditions and at Yeongwol can be described as cloudy with a distinct hot wet season followed by a cold dry season during the winter.

The wet season from June to August, is hot and humid and 75% of the annual rainfall occurs during this period. Daily temperatures average 27°C and rise to a maximum of approximately 30°C. Daily thunderstorms are common in August and the occasional “typhoon” may occur in coastal areas.

During September to October, the climate becomes cooler, with daily temperatures reaching 20°C. The winter “dry” season lasts from October to March, with snow falling from December to February. Freezing temperatures occur during this time, occasionally reaching as low as -30°C. Mild temperatures in the spring produce slush and muddy conditions on unsealed roads from March to April.

The average relative humidity is 68.10%, the maximum relative humidity is approximately 80.81% in July and the minimum relative humidity approximately 55.46% in April.

The average annual rainfall at the Yeongwol Weather Station is 1,261.52mm. The most rainfall is concentrated in the rainy season between June and August with approximately 904.7 mm of precipitation. The maximum monthly average rainfall is approximately 310.3 mm occurring in July. Snow accumulations can be as much as 1m between December and February.

The annual average wind velocity is 1.46m/sec and the range of the monthly average wind velocity is 1.20-1.95m/sec according to the observation data for a recent 10-year interval (1997-2006) in the Yeongwol area. The maximum average wind velocity is 2.34m/sec when the main wind direction is south-westerly.

The average monthly daylight hours in the Yeongwol area are 175.5. The average daylight hours for the month of March are 209.7 hours, representing the maximum daylight hours in the year.

On average there are 129 freezing days each year, 112 days of rainfall and 106 frost days. Of these days, on average, each year there are 105 overcast days, 92 clear days, 29 foggy days, 26 snow days and 19 thunderstorm days.

## 5.4 Local Resources

The former Sangdong Mine was a major employer in the area, but ceased operations in 1992. It is therefore unlikely that a skilled mining workforce adequate for a new mining operation still exists in the immediate area. Workers with the required skills and provided training would be available locally and from elsewhere within Korea.

Potential sources of surface run-off water supply for future mining and milling operations exist in local streams and rivers. There are also reasonable sources of groundwater contained in the limestones overlying the tungsten skarn.

Sites adequate for the co-disposal of tailings and waste rock exist within the Property in the immediate area west of the former mine. There are extensive deposits of limestone available on the Sangdong Project area for use as neutralising/buffer media for acid generating materials as well as aggregate. The Pungchon Limestone overlies the tungsten skarn of the Myobong Slate. It would provide useful coarse rock aggregate for use in a “french drain” type arrangement at the base of the dry stack waste-tailings storage facility. It could also be potentially mined for the production of lime in a cement manufacturing plant.

There is no local logging industry within the property. The forest is administered by the Youngwol Forest Service. There is only minor agricultural land within the Property and it is understood that local residents are allowed by the government to grow crops, mostly cabbage, in forest clearings where there is road access.

## 5.5 Infrastructure

A power line passes within several kilometres of the Property and two high tension power lines cross over the Property Mining Rights boundary, servicing Sangdong village and the Kangwon High Golf and Ski Resorts, situated to the north of the Sangdong Project. 20MVA of electrical supply capacity will be provided for the Sangdong Project mining and milling operation, and the Uljin nuclear power station facility is situated nearby on the coast and would be capable of providing a reliable, long-term and low cost energy supply for the mine.

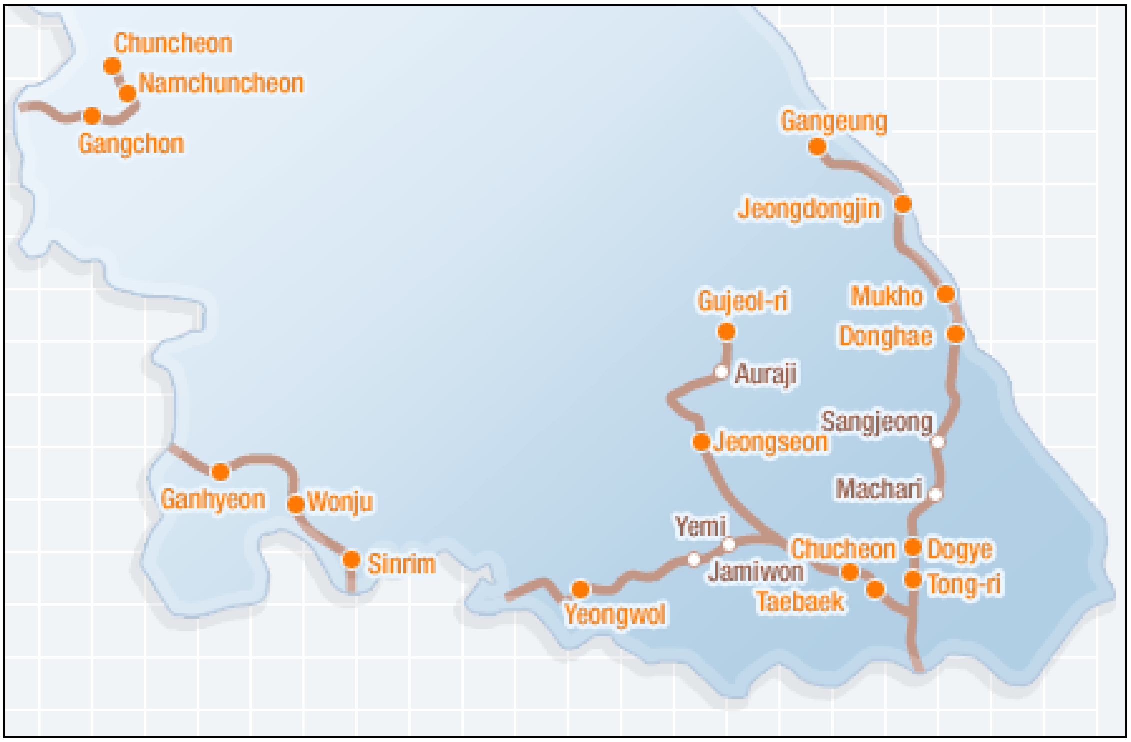
The rail network (Figure 5.1) is used for passenger service but also the transport of bulk cargoes, including cement, limestone and aggregates, mineral concentrates, sulphuric acid tankers, refrigerated goods and fuel cells.

Uljin is the closest port facility for the Sangdong Project, situated 50km east of Sangdong on the east coast whilst Donghae, an additional port facility is situated 56 km northeast of Sangdong. Donghae is a port mainly used for the export of cement clinker.

**Figure 5.1: Rail network in the Yongweol-Taebaek area.**

Sangdong is situated 5km south of the Yemi railhead

*(Scale 1:1,300,000 approx - N Vertical Lines)*



# 6 PROJECT HISTORY

## 6.1 Operations 1916-1949

Tungsten mineralisation was discovered on the Property in 1916 and mining took place at two locations for several years, but then ceased. Operations at both locations recommenced in 1933 and the main Sangdong deposit was discovered during the period 1939 to 1940. The Sangdong Mine was operated during World War II by Sorim Resources Co. and during the period 1946 to 1949, under the jurisdiction of the United States military government office.

## 6.2 Korea Tungsten Mining Company Ltd. (KTMC)

In 1949 the Korean Tungsten Mining Company, a government agency, assumed control and operated the mine until 1951. In 1952, the Korean Tungsten Mining Company changed its name to Korea Tungsten Mining Co. Ltd. (KTMC) and resumed mining, producing tungsten and scheelite, bismuth, and molybdenum concentrates.

The mine operated until 1992, with annual rates of production of up to 600,000t of ore. By the time of closure, the mine had been developed on 20 levels, between the elevations of 242 and 755masl, with a cumulative length of 20km of workings in addition to six inclines totalling 3.8 km, a ventilation incline and a 450m vertical shaft (Lee, 2001). The mine had tracked haulage ways.

Historical mining employed underground room and pillar methods, and concentrated on four main tungsten horizons: the Upper (H1), Main (M1), Lower II (F2), and Lower III (F3) listed in stratigraphic order. Mining occurred mostly on the M1 horizon, with lesser operations on H1, and only very minor workings on F2 and F3.

Production figures over the life of the mine are not available, having either been lost or having never been fully documented. During the period 1952 to 1987, annual production of tungsten concentrate varied between 994t (1955) and 3,268t (1961) and total production was 74,911t. There are indications that in the period between 1987 and 1992 mine production was limited and concentrate production was derived from toll treatment. Various quantities of ammonium paratungstate (APT), tungsten metal and tungsten steel were also produced

Between 1961 and 1987, 2,930t of bismuth were recovered. Also 2,725t of paramolybdate or molybdenum oxide were produced during the period 1967 to 1987. Gold and silver were also recovered, with maximum annual production rates of 37kg of gold (1987) and 531kg of silver (1974), apparently from the bismuth concentrate.

Based on tabulated data on longitudinal sections from the beginning of 1981 to the end of 1988, it is evident that the great proportion of the ore-grade mineralisation was produced from the 3.5m to 5m thick Main horizon: 3.918Mt. During the same period of time, about 2.041Mt were mined from the Hangingwall (Upper) horizon in widely spaced stopes as deep as the -8 level. Data suggest that little, if any, production came from the horizon prior to that period.

In 1981-1988, about 88,000t came from the Footwall (Lower) II horizon, mostly in the upper three levels, and 167,000t from the Footwall (Lower) III horizon, also mostly in the three upper levels of the mine.

Although no statistics are available for production from the various individual horizons, it is evident from the 1989 longitudinal sections that there appear to be only pillars remaining at most levels in the core of the mine area, to at least the -15 level. Most of the remaining resources at that time were in peripheral, and probably lower grade, parts of the deposit, and in the “East Orebody".

Statistics for the period from 1987 to the mine’s closure in 1992 are unavailable; however there are indications that mine production was limited and concentrate production was derived from toll treatment. Various quantities of APT, tungsten metal, and tungsten steel were also produced

In 1959, a synthetic scheelite plant began operation, improving the grade and recovery of concentrates. In 1961, a bismuth refining plant was opened, producing 99.9% bismuth metal. The following year, a plant to produce tungsten metal was commissioned and in 1972, an ammonium paratungstate ("APT") plant was built. From 1974 to 1987, up to 1,182t of APT was produced annually, totalling 10,624t, but between 1978 and 1987, less than 170t of tungsten metal and steels were produced. The drop in tungsten prices in the mid-1980’s caused the mine to reduce production and eventually shut down in 1992. The Korea Tungsten Mining Co Ltd was finally dissolved in 1998.

Mr Jae Youl Sim (Se Woo Mining Co.Ltd) acquired 23 Mining Rights over the Sangdong deposit in June 2001.

## 6.3 Woulfe Mining Corporation (Oriental Minerals Inc)

On October 19, 2006, Oriental Minerals Inc. entered into an agreement with Se Woo Mining Co. Ltd. ("Se Woo"), a private company based in Seoul, Republic of Korea, whereby Oriental could earn up to 100% interest in 23 Mining Rights with a total area of 5,924ha (59.24 $km^2$).

Ownership of the 23 Mining Rights was transferred to Oriental Minerals Inc. 100%-owned Korean subsidiary Oriental Hard Metals Korea Co., Ltd. upon closing of Sangdong Purchase Agreement and acceptance by the TSX-V on 7 January 2007.

The terms of Oriental's Sangdong Acquisition Agreement were as follows:

- On the basis of a previous memorandum of understanding, Oriental paid Se Woo US$8,000, and a further US$16,000 on January 8, 2007.
- Oriental, as operator of the project, earned a 51% interest in the Properties by:
- Paying Se Woo US$80,000 upon execution of the Agreement;
- Paying Se Woo upon Closing, US$720,000 cash and $800,000 in any combination of cash or Oriental shares (by February 28, 2007);
- Paying Se Woo US$2,400,000 in cash and US$800,000 in any combination of Oriental common shares and cash at six months after closing; the same amounts was to be paid again 18 months and 30 months after closing;
- Spending a minimum of US$800,000 on exploration and related activities in each of first and second years; and
- Spending US$2,400,000 on exploration and related activities during each of the third, fourth and fifth years after closing on the Sangdong properties or any other properties of Se Woo; and spending at least US$16,000,000 if undertaking commercial production.
- Oriental could earn an additional 19% interest by the completion of a pre-feasibility study within five years of closing, and a final 30% interest in the property by delivering an independent feasibility study by the fifth anniversary after closing; that period could be extended for up to 18 months without Orientals' loss of any rights.
- A 2% net smelter return royalty was payable to Se Woo on all production.

*["Closing" is defined as being subject to regulatory and shareholder approval, as well as other conditions].*

On the 25 February 2010, Oriental Minerals Inc. changed its name to Woulfe Mining Corp. This was a re-branding exercise and it appears that no other changes occurred in the company at this time.

Subsequently the project area was reduced to 12 Mining Rights with an aggregate area of 3,173ha. In November 2011 Woulfe gained 100% interest in the property. The 2% net smelter royalty retained on the Sangdong tungsten-molybdenum project in South Korea from the vendor, Se Woo Mining Co. Ltd., was purchased for CDN $3.5M, of which CDN$500,000 was paid on execution of the agreement and the balance of which was payable by December 19, 2011. In addition, the Company negotiated an amendment to the acquisition agreement originally dated October 9, 2006 in respect of the Sangdong project, such that the final outstanding 30% interest in the mining titles vested to the Company immediately as part of the completion of the payments noted above.

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## 6.4 Historical Resource Estimates

### 6.4.1 KTMC historical estimates

Two historic tungsten resource estimates (Table 6.1) were prepared for the Sangdong Mine, in 1985 and 1989. The 1985 estimate, prepared by the mine staff, contained a total of about 20Mt at a grade of 0.5% $WO_3$. The 1989 estimate, prepared by Korea Resources Corp., contained about 18.8Mt at an average grade of 0.5% $WO_3$.

The second estimate includes about 1.4Mt attributed to the Sangdong East deposit and therefore the difference between the two estimates does not represent the tonnage mined in the interim. These were polygonal estimates and used a relative density of 2.9. Tungsten mineralisation in Sangdong East is lower-grade than in the main mine area. Drillhole data indicate that the Hangingwall (Upper) horizon is 1.5-10.93m thick and contains 0.01-0.24% $WO_3$; the partially mined Main horizon is 1.03-8.83m in width and contains 0.01-0.65% $WO_3$. Low-molybdenum, blue-fluorescent scheelite is dominant.

**Table 6-1. Historic Resource Estimates, Sangdong Mine**

| Ore Body | Sangdong Exploration 1985 | | Korea Resources Co. 1989 | |
|---|---|---|---|---|
| | Reserves (t) | $WO_3$ (%) | Reserves (t) | $WO_3$ (%) |
| **Main** | 5,588,042 | 0.54 | 4,616,010 | 0.57 |
| **Lower II** | 2,284,752 | 0.57 | 2,339,980 | 0.57 |
| **Lower III** | 2,218,252 | 0.54 | 2,064,830 | 0.53 |
| **Upper** | 9,853,034 | 0.45 | 9,803,610 | 0.43 |
| **Total** | **19,944,080** | **0.50** | **18,824,430** | **0.50** |

West (W) Sangdong was estimated to contain 2.3Mt at an average grade of 0.5% $WO_3$ but no details of the estimation process or the number of holes employed in the estimate are known. It is unknown on how many drillholes this was based, but because of the wide spacing of the drillholes (200m or more), the resource could at best be considered *Inferred* under currently accepted resource evaluation methodologies.

As reported by Lee, drill intercepts in the Main horizon varied from 0.24-0.8% $WO_3$ across 0.8-2.8m. Other intersections included 0.11-0.28% $WO_3$ across 2.3-6.8m in the Upper vein; and 0.1-3.0% $WO_3$ across 0.6-2.0m in the Lower vein. In drillhole 86-6 in the Hwajeolchi area, a roughly 15m interval in the Hangingwall (Upper) horizon of interlayered limestone and calc-silicate rock (about 50% each) was intersected, with one 3.5m interval containing 0.32% $WO_3$.

A large molybdenite-quartz vein stockwork deposit located above a granitic intrusion was identified and drilled between 1980 and 1987 (22 vertical holes; 12,390m core drilling). In 1985, KTMC estimated a high grade "Prospective Ore Reserve" of 16.3Mt grading 0.40% $MoS_2$ for this Deep Moly deposit. A low grade global resource of 120Mt grading 0.13% $MoS_2$ was also estimated. This estimate is considered neither reliable nor relevant.

The estimates predate the institution of NI 43-101 and do not necessarily conform to the reporting requirements of Sections 1.2 and 1.3 of that instrument. The estimates are of unknown reliability but are included as an indication of the order of magnitude of tonnes and grades of mineralisation present. All Mineral Resource or Mineral Reserve estimates that pre-date both NI 43-101 and WMC's involvement in the Sangdong Property should not be considered to be material.

### 6.4.2 Woulfe Mining Corporation

#### *6.4.2.1 Tetra Tech (Wardrop) (2012)*

The 2012 global resource (Table 6.2) estimated by Tetra Tech (TT) focused on the data acquired from the 2006-2008 drilling programmes, completed by Woulfe, as well as the compilation of historical data for the upper quarter of the known dip length of the mine i.e. the section from surface to just below the water level.

The historical drilling data used in the Tetra Tech (Wardrop)/Woulfe April 2010 scoping study was not used for the 2012 estimate, meaning that any down dip extension of the mineralised zones was not represented as a Resource. The classification conformed to the CIM Definition Standards for Mineral Resources and Mineral Reserves (2010). The Resource was split into two sections by elevation, representing the down dip potential of the deposit below current waterline.

**Table 6-2. Sangdong, 2012 Global Resource Estimate**

Reporting Cut-off 0.15% $WO_3$*

| Resource Category | Mineralised Zone | Tonnes | Density | $WO_3$ (%) | $MoS_2$ (%) | MTU |
|---|---|---|---|---|---|---|
| 'Indicated' | F2 | 2,298,000 | 2.98 | 0.63 | 0.04 | 1,448,000 |
| 'Indicated' | F3 | 2,604,000 | 2.96 | 0.56 | 0.05 | 1,458,000 |
| 'Indicated' | HALO | 5,576,000 | 2.91 | 0.27 | 0.03 | 1,505,000 |
| 'Indicated' | MAIN | 5,952,000 | 3.25 | 0.50 | 0.03 | 2,976,000 |
| **Ind Total** | | **16,431,000** | **3.04** | **0.45** | **0.04** | **7,387,000** |
| 'Inferred' | F2 | 2,680,000 | 2.91 | 0.50 | 0.03 | 1,340,000 |
| 'Inferred' | F3 | 2,712,000 | 2.90 | 0.49 | 0.03 | 1,329,000 |
| 'Inferred' | HALO | 6,523,000 | 2.88 | 0.23 | 0.02 | 1,500,000 |
| 'Inferred' | HW | 7,191,000 | 2.96 | 0.58 | 0.08 | 4,171,000 |
| 'Inferred' | MAIN | 259,000 | 2.92 | 0.52 | 0.02 | 135,000 |
| **Total Inferred** | | **19,368,000** | **2.92** | **0.44** | **0.05** | **8,475,000** |
| 'Inferred' | F2 | 4,097,000 | 2.85 | 0.60 | 0.07 | 2,458,000 |
| 'Inferred' | F3 | 4,315,000 | 2.85 | 0.57 | 0.06 | 2,460,000 |
| 'Inferred' | HALO | 5,973,000 | 2.85 | 0.21 | 0.06 | 1,254,000 |
| 'Inferred' | HW | 15,924,000 | 2.84 | 0.69 | 0.11 | 10,988,000 |
| 'Inferred' | MAIN | 4,208,000 | 2.85 | 0.60 | 0.03 | 2,525,000 |
| **Total Inferred Down Dip** | | **34,519,000** | **2.85** | 0.47 | 0.07 | **19,685,000** |

**Figures may not reconcile as a consequence of rounding*

- *A Metric Tonne Unit ("MTU") is equal to ten kilograms per metric tonne and is the standard weight measure of tungsten. Tungsten prices are generally quoted as US dollars per MTU of tungsten trioxide ($WO_3$). Theoretically pure scheelite concentrate can contain 80.5% tungsten metal, but in practice the grade of concentrate products acceptable for sale ranges from about 62% $WO_3$ to about 72% $WO_3$.*

The previous estimate in the Wardrop 2010 scoping study was made on a very different basis to the 2012 estimate, the former relying on the holes drilled underground by KTMC and on a coarse geological interpretation of the mineralised zones; the 2010 Resource was classified as *Inferred*.

The 2012 estimate relied entirely on the more recent drilling programmes with associated sample quality control; however, it only covered approximately the upper quarter of the known dip length of the mineralised zones, and therefore comparison of the two estimates would be unreliable.

In order to estimate the down-dip resource potential at the Sangdong mine (Table 6.2 above), Tetratech (Wardrop) completed a separate estimation of the down-dip resource using all available samples, including those samples which could not be included in the up dip *'Indicated'* Resource.

Due to the unreliability of the historic data described above the Resource was classified as *'Inferred'* but was included in order to reconcile the 2010 and 2012 estimates.

*6.4.2.2 AMC Consultants Pty Ltd (AMC) 2014*

Resources were estimated using a block modelling approach, with three dimensional (3D) ordinary kriging and Datamine's™ dynamic anisotropy application2 being employed.

Table 6.3 shows the Mineral Resource estimate and metal content for the Property as of 15 September 2014. The cut-off grade of 0.4% $WO_3$ was provided by WMC and was based on an assumed mining method, production rate, metallurgical recovery and metal prices. AMC reviewed these assumptions and considered that they met the requirement of reasonable prospects of eventual economic extraction. It appears that AMC used some results from the pre-2006 drilling in the Resource estimation.

**Table 6-3. AMC 2014 Mineral Resource Estimate**

| Resource Category | Mineralized Zone | Mtonnes | Density ($t/m^3$) | $WO_3$ (%) | $MoS_2$ (%) | Contained $WO_3$ metal (Mt) |
|---|---|---|---|---|---|---|
| Measured | Main | 0.55 | 3.19 | 0.61 | 0.066 | 0.33 |
| | F2 | 0.86 | 3.01 | 0.56 | 0.057 | 0.48 |
| | F3 | 0.74 | 3.06 | 0.55 | 0.057 | 0.41 |
| **Measured Total** | | **2.15** | **3.07** | **0.57** | **0.059** | **1.22** |
| Indicated | HW | 0.19 | 2.90 | 0.46 | 0.095 | 0.09 |
| | Main | 0.31 | 3.19 | 0.62 | 0.031 | 0.19 |
| | F2 | 0.58 | 2.96 | 0.55 | 0.029 | 0.32 |
| | F3 | 0.57 | 2.97 | 0.53 | 0.026 | 0.31 |
| **Indicated Total** | | **1.66** | **3.00** | **0.55** | **0.036** | **0.91** |
| **Measured + Indicated** | | **3.81** | **3.04** | **0.56** | **0.049** | **2.12** |
| Inferred | HW | 7.93 | 2.90 | 0.68 | 0.089 | 5.38 |
| | Main | 0.34 | 2.93 | 0.74 | 0.047 | 0.26 |
| | F2 | 0.93 | 2.91 | 0.53 | 0.073 | 0.49 |
| | F3 | 0.76 | 2.91 | 0.48 | 0.047 | 0.37 |
| | F4 | 1.31 | 2.92 | 0.52 | 0.053 | 0.69 |
| **Inferred Total** | | **11.28** | **2.90** | **0.64** | **0.080** | **7.18** |

Changes that occurred between the 2012 and the 2014 resource estimates included:

- 11,348m additional Resource definition drilling.
- Change in the estimation method from modelling the volume and geometry of mineralisation using the underground development surveys (TT), to using the actual drillhole intersections (AMC).
- Change in the estimation method from assigning grades to each mineralisation zone using the mineralisation coding in the database (TT), to using the spatially referenced drillhole intersections in 3D to estimate grade for each mineralisation zone (AMC).

- Change in the estimation method from a single mineralisation grade threshold of 0.15% $WO_3$ (TT), to splitting the mineralisation into three grade thresholds and estimating each independently (AMC).
- Using the interpreted faults to constrain the Mineral Resource estimate.
- Significant additional underground mapping carried out and incorporation of these data in the Mineral Resource estimate.
- Change in the definition of the Mineral Resource categories.

Table 6.4 compares the TT 2012 estimate with the AMC 2014 estimate. Both estimates are reported at 0.15 % $WO_3$ cut-off grade in this table for comparison purposes.

The following observations were made from the comparison table:

- Approximately half of the *Indicated* tonnes in the previous estimate were converted to *Measured* Mineral Resources due to the increased drilling and improved understanding of the geology gained through underground mapping.
- *Measured* plus *Indicated* tonnes increased by 12% overall, while the *Inferred* tonnes increased by 5% overall between the two estimates.
- The change in density is not significant.
- *Measured* plus *Indicated* grades decreased by 46%, while *Inferred* grades decreased by between 68% between the two estimates.
- The net result in the *Measured* plus *Indicated* categories was a decrease in the contained tungsten metal of 29%.
- The net result in the *Inferred* category represents a decrease in the contained tungsten metal of 59%.

AMC considered that the decrease in grades was mainly due to the previous method (TT) of creating the mineralisation volumes from the underground development surveys, and then estimating grade into those volumes from the coded intersections in the database. The coding in the database is not based on a 3D interpretation but is interpreted on a drillhole-by-drillhole basis.

## Table 6-4. Comparison of 2012 and 2014 Mineral Resource Estimates

| Resource Category | Mineralized Zone | Mtonnes TT12 | Mtonnes AMC14 | % Difference | Density TT12 (t/cm3) | Density AMC14 (t/cm3) | % Difference | WO3 TT12 (%) | WO3 AMC14 (%) | % Difference | Contained WO3 metal TT12 (Mt) | Contained WO3 metal AMC14 (Mt) | % Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Measured** | Main | | 1.84 | | | 3.20 | | | 0.36 | | | 0.66 | |
| | F2 | | 3.49 | | | 3.01 | | | 0.33 | | | 1.14 | |
| | F3 | | 3.11 | | | 3.04 | | | 0.32 | | | 0.99 | |
| **Measured Total** | | | **8.44** | | | **3.06** | | | **0.33** | | | **2.79** | |
| **Indicated** | HW | | 1.65 | | | 2.90 | | | 0.28 | | | 0.46 | 100% |
| | Main | 5.95 | 1.72 | -247% | 3.25 | 3.16 | -3% | 0.50 | 0.31 | -61% | 2.98 | 0.53 | -460% |
| | F2 | 2.30 | 3.22 | 29% | 2.98 | 2.97 | 0% | 0.63 | 0.29 | -115% | 1.45 | 0.94 | -54% |
| | F3 | 2.60 | 3.57 | 27% | 2.96 | 2.94 | -1% | 0.56 | 0.28 | -100% | 1.46 | 1.00 | -46% |
| | Halo | 5.58 | | | 2.91 | | | 0.27 | | | 1.51 | | |
| **Indicated Total** | | **16.43** | **10.15** | -62% | **3.04** | **2.98** | -2% | **0.45** | **0.29** | -56% | **7.39** | **2.93** | -153% |
| **Measured + Indicated** | | **16.43** | **18.59** | **12%** | **3.04** | **3.02** | -1% | **0.45** | **0.31** | -46% | **7.39** | **5.72** | -29% |
| **Inferred** | HW | 23.12 | 30.74 | 25% | 2.88 | 2.90 | 1% | 0.66 | 0.35 | -87% | 15.16 | 10.76 | -41% |
| | Main | 4.47 | 1.75 | -155% | 2.85 | 2.95 | 3% | 0.60 | 0.31 | -90% | 2.66 | 0.55 | -384% |
| | F2 | 6.78 | 3.65 | -86% | 2.87 | 2.91 | 1% | 0.56 | 0.31 | -82% | 3.80 | 1.12 | -239% |
| | F3 | 7.03 | 8.53 | 18% | 2.87 | 2.91 | 1% | 0.54 | 0.25 | -115% | 3.79 | 2.14 | -77% |
| | Halo | 12.50 | | | 2.87 | | | 0.22 | | | 2.75 | | |
| | F4 | | 12.21 | | | 2.92 | | | 0.25 | | | 3.09 | |
| **Inferred Total** | | **53.88** | **56.87** | **5%** | **2.87** | **2.91** | **1%** | **0.52** | **0.31** | -68% | **28.16** | **17.66** | -59% |

*6.4.2.3 A-Z Mining Professionals Ltd./Tetratech (Wardrop) Feasibility Study June 2015*

1. Mineral Resources

In 2014, AMC Consultants Pty. Ltd. was commissioned by Woulfe Mining Corp. to develop a resource block model completely independent of the Tetra Tech geology block models. On an A-Z Mining review of the completed AMC model, A-Z Mining and Woulfe decided not to retain the AMC resource model due to the technical methodology employed.

The Feasibility Study relied on the Tetra Tech 2015 updated resource block model, which included the 2013 Phase 4 drilling programme (7,200m of additional definition drilling to significantly increase confidence in the resources).

The *Indicated* Mineral Resource in the Tetra Tech phase 4 updated model is shown in Table 6.5 reported at 0.15% $WO_3$ cut-off grade above 600mrl. The resource is only reported above -3 level (600mrl).

The Tetra-Tech reported resources were limited to the -3 level (594mRL).

**Table 6-5. Tetra Tech Sangdong Resources, June 2015**

At 0.15% $WO_3$ Cut-off Grade,

Resources shown are above 600mrl

| Resource Category | Mineralised Zone | Tonnes | Density | $WO_3$ (%) | $MoS_2$ (%) |
|---|---|---|---|---|---|
| Indicated | F2 | 2,140,000 | 3.06 | 0.62 | 0.04 |
| Indicated | F3 | 2,040,000 | 3.08 | 0.62 | 0.04 |
| Indicated | Main | 5,120,000 | 3.33 | 0.46 | 0.05 |
| **Total Indicated** | | **9,300,000** | **3.21** | **0.53** | **0.04** |
| Inferred | F2 | 900,000 | 3.06 | 0.45 | 0.04 |
| Inferred | F3 | 800,000 | 3.01 | 0.45 | 0.03 |
| Inferred | Halo | 8,300,000 | 3.01 | 0.28 | 0.04 |
| Inferred | Hangingwall | 24,700,000 | 3.12 | 0.42 | 0.05 |
| **Total Inferred** | | **34,700,000** | **3.09** | **0.39** | **0.05** |

The phase 4 Mineral Resource Estimate update included changes from previous estimates, specifically the 2012 Tetra Tech Feasibility Estimate.

- The hangingwall ground conditions were better understood up-dip, so a greater proportion of the hangingwall was reclassified in *Inferred,* rather than just the bottom 3 levels above the current waterline.

- The *halo* mineralisation surrounding the Footwall Zone had reduced in importance with better definition of the Footwall 2 and Footwall 3 zones from the phase 4 drilling and this is reflected in the resource categories.

- The *Indicated* Main and Footwall zones' resources were largely unchanged from the previous estimate as the Phase 4 infill programme had not changed the results significantly.

2. Mineral Reserves

The Mineral Reserves (derived from the Mineral Resource block model *Measured* and *Indicated* Mineral Resources) were identified as being economically extractable, incorporating mining loses and the addition of mining dilution, by A-Z Consultants. *Measured* and *Indicated* Resources were outlined from the -2 to Taebaek levels (Refer to Figure 10.3 below – Section 10 Drilling) as almost all resources below -2 Level were *Inferred*. The *Measured* and *Indicated* Resources were further separated into the F2/F3 and Main Zones. The resources in a 50m surface pillar allowance were subsequently removed.

Using an average processing plant recovery of 81%, a concentrate quality of 65% $WO_3$ and revenue per tonne of concentrate of $US15000, a cut-off grade of 0.275% $WO_3$ was determined.

Mining recoveries of 100% in primary (rock walls, floor and back) stopes and 95% in secondary stopes (backfill on both sides of stope) were assigned, based on industry norms and experience in mining in these types of conditions.

Dilution for the stopes included waste inside the stope outlines in the stopes, and backfill sloughing from primary stopes in the secondary stopes. Backfill dilution was included at 5% at a 0% $WO_3$ grade. Development ore was not separated from stoping ore in the reserves.

The *Proven* and *Probable* Reserves in the combined F2 and F3 Zones were estimated to be 3.9Mt with a grade of 0.610% $WO_3$. The *Proven* and *Probable* Reserves in the Main Zone were 2.0Mt at a grade of 0.492% $WO_3$.

*6.4.2.4 Adam Wheeler Feasibility Study Update December 2015*

The A-Z feasibility Study was updated during 2015, with a 43-101 report produced by Adam Wheeler in December 2015. At a 0.15% $WO_3$ cut-off grade, indicated resources of 5.18Mt were reported, along with inferred resources of 52.8Mt. Mineral reserves were determined of 4.7Mt, at a grade of 0.42% $WO_3$.

# 7 GEOLOGICAL SETTING AND MINERALISATION

## 7.1 Regional Geology

The Korean Peninsula is situated on the eastern margin of the North China– Korea Platform, a craton composed of three blocks of Archean age, the Nangrim- Pyeongnam Block and the Gyeonggi and Yeongnam Massifs that are separated by the northeast-trending Imjingang and Okcheon mobile belts of Phanerozoic age. The Sangdong deposit is located within the Okcheon Belt (Figure 7.1).

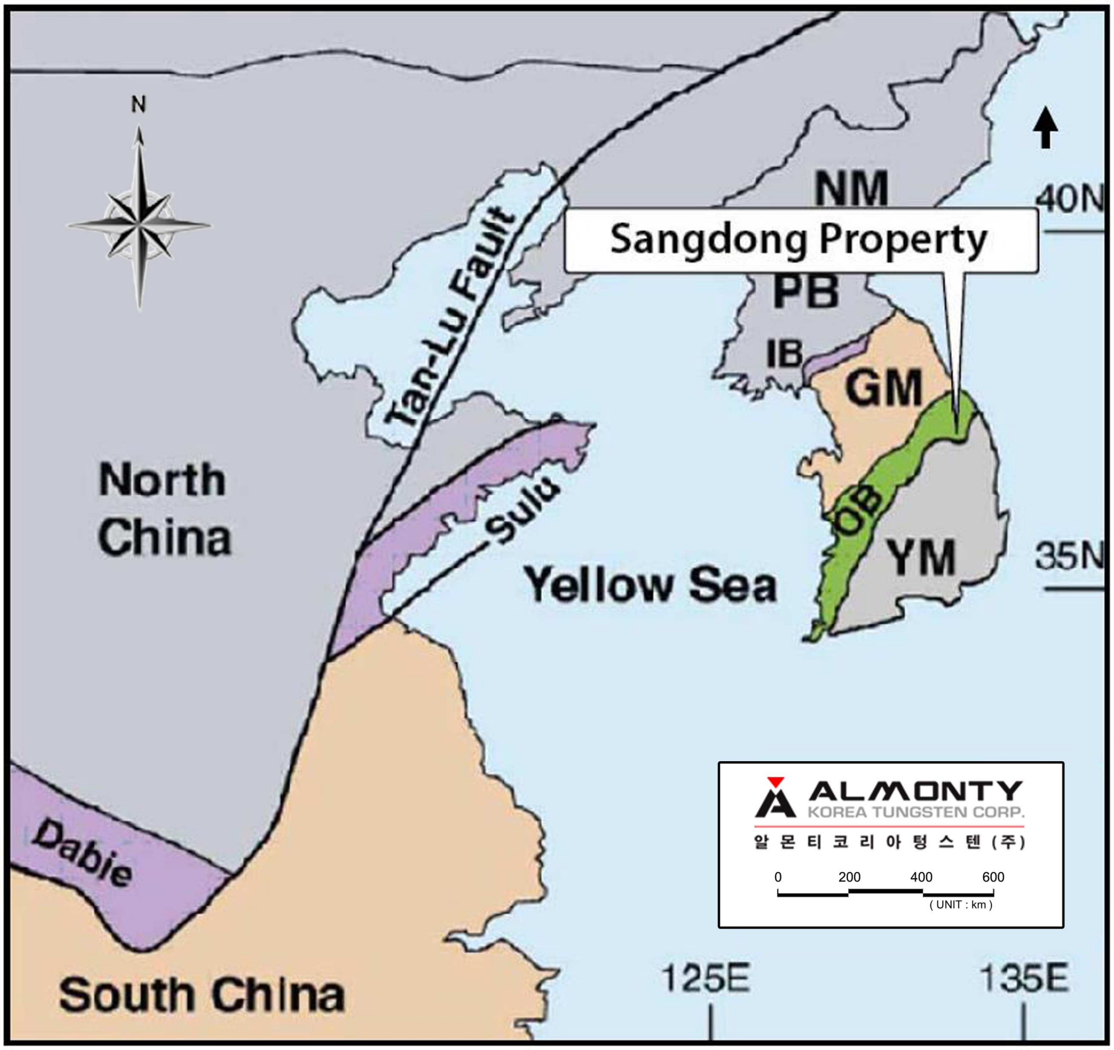
The Okcheon Belt is a fold-and-thrust belt sandwiched between the Gyeonggi massif to the northwest and the Yeongnam massif to the southeast. The Belt has been divided into the southern Okcheon and northern Taebaeksan Basin or Zone.

The Okcheon Zone, in which the Property is located, is composed of low to medium-grade metasedimentary and metavolcanic rocks of Cambrian to Ordovician age. The Taebaeksan Zone contains weakly-metamorphosed shallow-marine Paleozoic sedimentary rocks and marginal-marine to non-marine Early Mesozoic, sedimentary rocks that contain economically important coal measures. These rocks rest unconformably upon Precambrian gneiss and metasedimentary rocks of the Yulli Group of the Yeongnam massif.

In the Sangdong area, the Cambro-Ordovician strata belong to the Joseon System that is divided into the lower Yangdeok and overlying Great Limestone Series. The Yangdeok Series is composed of two formations, the basal Jangsan and overlying Myobong. The Great Limestone Series is subdivided into six formations, from oldest to youngest, the Pungcheon, Sesong, Hwajeol, Dongjeom, Dumudongl and Makdong Formations.

Plutonism occurred primarily during the Jurassic and Cretaceous Periods and most intrusions are biotite granite in composition.

**Figure 7-1. Regional Geology**




Note: Crustal Blocks and massifs of the Korean Peninsula and adjacent northeast Asia: Nangrim massif (NM); Pyeongnam basin (PB); Imjingang Belt (IB); Gyeonggi massif (GM); Okcheon Belt (OB); Yeongnam massif (YM).

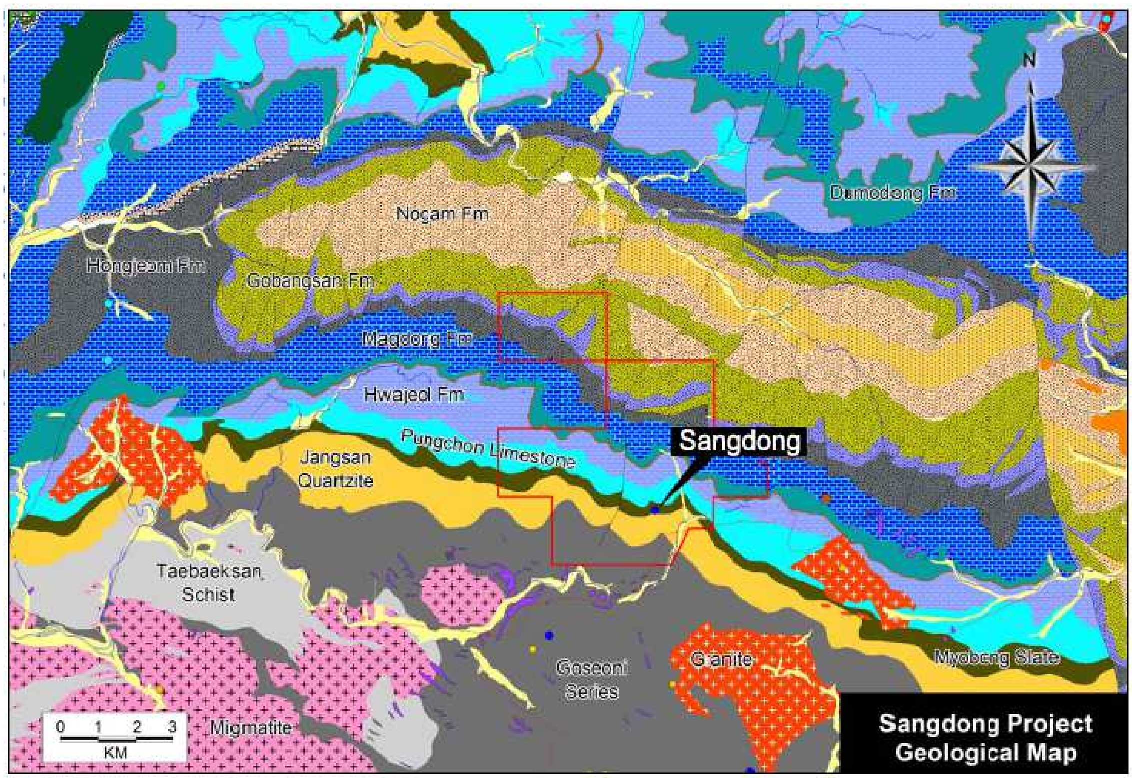
## 7.2 Property Geology

The Sangdong Project is situated on the southern limb of the east-west orientated Triassic age Hambaek Syncline. Cambro-Ordovician limestone, shale, and quartzite of the Chosun System unconformably overlie the Pre-Cambrian Taebaeksan schist and gneiss.

The Property area is underlain by metasedimentary rocks belonging to the Yangdok and Great Limestone Series that are situated on the south limb of a syncline that plunges gently to the southeast; strata strike at approximately 110° and dip to the north-northeast at 20° to 30° (Figure 7.2).

The local geology is summarised in Figure 7-3, with a brief description of each formation in ascending stratigraphic order in Table 7.1.

**Figure 7-2. Sangdong Project Area – Geological Map *(TN - vertical grid lines)***




***(The area outlined in red represents the original 23 Mineral Rights areas)***

**Figure 7-3. Sangdong Project: Local Geology (Scale 1:30,000)** ***(TN - vertical grid lines)***

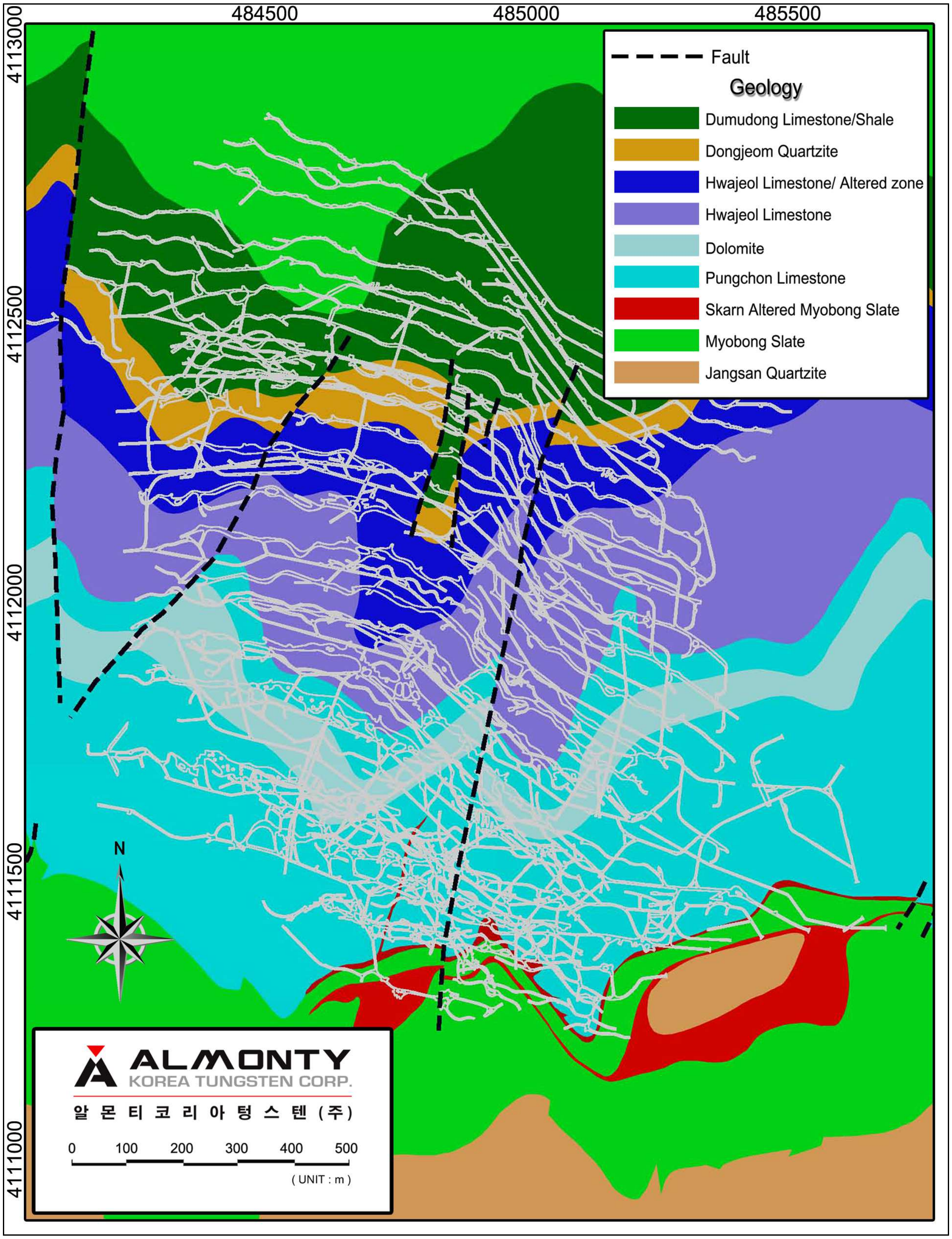


**Table 7-1. Stratigraphy of the Sangdong Project Area**

| Geologic Era | Period | System | | Formation | Thickness | Remarks |
|---|---|---|---|---|---|---|
| Mesozoic | Cretaceous | | | Imog Granite | | 94 M. A. |
| | | | | Eopyong Granodiorite | | 107 M. A. |
| | | | | Sangdong Granite | | 85 M. A. |
| | Jurassic | | | | | |
| | Triassic | Pyungan | | Nogam Sandstone | 1,000± | |
| Paleozoic | Permian | | | Kobansan Sandstone | 500± | |
| | Carboniferous | | | Sadong Sandstone | 200± | Interbedded coal |
| | | | | Hongjeom Shale | 300± | |
| | Devonian | | | | | |
| | Silurian | | | | | |
| | Ordovician | Chosun | Great Limestone Series | Makdon Limestone | 300± | |
| | | | | Dumudong Limestone | 200± | |
| | | | | Dongieom Quartzite | 30± | |
| | Cambrian | | | Hwajeol Limestone | 200± | |
| | | | | Seson Shale | 80± | |
| | | | | Pungchon Limestone | 300± | |
| | | | Yangduk Series | Myobong Slate | 150± | Mineralized W, Mo, Bi |
| | | | | Jangsan Quartzite | 250 | Mineralized Mo |
| Pre-Cambrian | | Taebaeksan | | Schist | | |
| | | | | Naeduk Granite | | |
| | | | | Nonggeori Granite | | |

### 7.2.1 Taebaeksan Series

The Sangdong Project area is situated in the northeastern region of the Sobaeksan Massif, a Precambrian basement complex. The Taebaeksan region of this massif has been subdivided into the Taebaeksan Gneiss, Taebaeksan Schist, and Goseoni Series according to metamorphic episodes, and the Naeduk and Nonggeori Precambrian granite complexes. At least three episodes of regional metamorphism are recognised.

The Precambrian strata of the Taebeksan Series consist of interbedded biotite schist, sericite schist, quartzite, crystalline limestone, hornfels and hornblende schist.

Migmatization, anatexis and potassic metasomatism due to partial melting of the Precambrian basement formed the Naeduk and Nonggeori Granite Complexes.

### 7.2.2 Yangdok Series

*7.2.2.1 Jangsan Quartzite*

The basal unit of the Yangdok Series of the Chosun System is the Jangsan Quartzite, which unconformably overlies the Taebaeksan Schist and is about 200m thick. The Jangsan Quartzite consists of mainly grey, white cream coloured, coarse grained quartzites, which form hard, well-jointed resistant outcrops and prominent cliffs and bluffs. The quartzites are well bedded and cross bedded, with some beds containing well rounded pebbles.

Quartz-molybdenite veins are developed in the Jangsan Quartzite and host the Deep Moly deposit, situated below the tungsten skarn. Recrystalization and intense brecciation within the quartzite has occurred in this area below the tungsten skarn ore body hosted in Myobong Slate. It is possible the “Deep Moly deposit forms a “breccia pipe” like feature above a granite intrusion.

*7.2.2.2 Myobong Slate*

A marine transgression occurred following the deposition of the Jangsan Quartzite, represented by the Myobong slate. The Myobong Slate consists of a 150m thick sequence comprising black, dark greenish gray, brownish gray shales with some 7-8 thin limestone beds. These limestone beds have been altered to skarn with accompanying tungsten skarn mineralisation in the Sangdong Project area.

Fossils assemblages identified include microfossils, trilobites, brachipods and a cephalopod. On the basis of this palaeontological evidence, the Myobong Slate is dated as Early-Middle Cambrian.

The depositional environment of the Myobong Slate is uncertain, with several settings proposed, including a littoral shelf environment or an unstable shelf - deep marine miogeosynclinal basin environment.

This formation is about 150 to 200m thick in the Property area and is the host of all significant tungsten mineralisation there.

### 7.2.3 Great Limestone Series

The Great Limestone Series, of Cambrian to Ordovician age, is composed of six formations that have a cumulative thickness in excess of 1,000m. These formations are largely composed of limestone and dolomite with interbedded shale, quartzite, calcareous shale, and sandstone. They comprise the following:

#### *7.2.3.1 Pungchon Limestone*

The Pungchon Limestone is the basal unit of the Great Limestone Series. It conformably overlies the Myobong Shale and consists of white-gray massive limestones and dolomites, with occasional intraformational limebreccia, shale and marl. Thickness of the Pungchon Limestone is estimated to be 150-300m.

Palaeontological evidence indicates a Middle Cambrian age for the formation.

The limestone is generally poorly bedded and mostly pure in composition. It is considered to have been deposited in a deep miogeosynclinal setting, although a shallow lagoonal environment is proposed for the dolomitic limestone members.

#### *7.2.3.2 Sesong Shale*

The Sesong Shale conformably overlies the Pungchon Limestone and consists mainly of bluish gray to dark gray shales, marls and arenaceous shales, with intercalations of thin bedded fine grained sandstones and white-light pink limestones. Some graded bedding is observed. Thickness of the shale varies from 10m to 30m in the vicinity of Sangdong Project.

The interbedded limestones are partly altered to skarn in the vicinity of the tungsten mineralisation.

#### *7.2.3.3 Hwajeol Limestone*

The Sesong Shale grades into the vermicular limestone of the Hwajeol Limestone. Interbedded gray to dark gray shales are found near the bottom of the unit, with several quartzite beds (Hwajeol Quartzite) observed in the middle of the formation. Thickness of the lower part of the formation varies from 200-260m.

The Hwajeol Limestone is characterised by vermicular structure, a so called “worm-eaten” surface weathering feature. Diagnostic fauna, Cruziana-like trails and rain drop features have been identified, suggesting a shallow water miogeosynclinal depositional environment.

Local skarn alteration minerals are observed near the Sangdong Project.

*7.2.3.4 Dongjeum Quartzite*

Conformably overlying the Hwajeol Limestone, the Dongjeum Quartzite consists of light-dark gray and dark green medium grained quartzites. Interbedded black shale is present at the base, with thin bedded siliceous limestone in places. Thickness of the formation is 10-50m.

The dark grey quartzite contains some hematite crystals and some calcareous components in the matrix. The formation is interpreted to be wind-blown aeolian sediment deposited in shallow water.

*7.2.3.5 Dumudong Limestone*

The Dumudong Limestone conformably overlies the Dongjeom Quartzite and consists of light brown calcareous shale, dark gray shale, and light gray limestone. The formation is estimated to be 150-200m thick.

Conodont microfossils have been recorded from the formation, together with trilobites, brachipods, mollusks and echinoderms. Depositional environment was deeper than the Dongjeom Quartzite, but mud cracks indicate it was uplifted and exposed in places.

The Dumodong Limestone displays weak skarn alteration minerals near the Sangdong Project.

*7.2.3.6 Makdong Limestone:*

The Makdong Limestone forms the uppermost unit of the Great Limestone Series. It conformably overlies the Dumudong Limestone and consists mainly of dark-light gray limestone, with light brown calcareous shale, intraformational breccia, limestone breccia (Yemi Lime Breccia) and black shale interbedded with each other. The Makdong Limestone is estimated to be 300-400m thick.

In the immediate area of the Sangdong deposit, the Changsan, Myobong, Pungchon and several overlying formations have been affected by thermal metamorphism

### 7.2.4 Granitic Intrusions

Several granitoid intrusions occur around the Sangdong mine:

- Pre-Cambrian Nonggeori Granite (4km to the south)
- Pre-Cambrian Naeduk Granite (5km to the south)
- Cretaceous Imok Granite (94Ma, 12km to the west) intruded Pre-Cambrian schist and gneiss.

- Cretaceous Eopyung Granodiorite (107Ma, 4km to the east) intruded Cambro-Ordovician Chosun System.
- Sangdong Granite (85Ma) bearing scheelite, molybdenite, and bismuthinite is directly 700m below main ore body of the Sangdong Mine.

Drilling by Oriental Minerals (subsequently Woulfe Mining Corporation Ltd) intersected a flow banded endoskarn quartz porphyry intrusive body. Although the endoskarn alteration is intense (comprising garnet-epidote-fluorite assemblage), quartz eyes are intact suggesting a rhyolitic affinity. This intrusion is most probably a porphyry molybdenum phase of the Sangdong Granite.

Pegmatite veins related to the Precambrian granitoids occur within the Taebaeksan Series, 4km to the south-southeast from the Sangdong Mine. These veins contain a significant tin resource at Sunkyong (2Mt @ 0.10% Sn) and are most probably related to the Sangdong Granite.

#### 7.2.5 Structure

In the upper mine levels, pre-mineralisation bedding plane thrusts were developed within the Main mineralised zone. In addition, pre-mineralisation shear zones striking approximately northeast-southwest caused local upwarping or folding of the Myobong slate and Pungchon Limestone. These shear zones caused large strike changes in the orientation of the mineralisation.

The dominant post-mineralisation structures strike approximately northeast-southwest and are near vertical. Horizontal displacement on these structures is commonly observed from mapping to be >2 m but rarely >10 m. Vertical displacement is not well documented.

## 7.3 Mineralisation

The tungsten mineralisation of the **Sangdong deposit** is contained in several tabular, bedding-conformable skarns in the Myobong Shale; these skarns have been interpreted as comprising carbonate-bearing horizons that were altered and mineralised by fluids ascending from the underlying Sangdong Granite.

From uppermost to lowermost, these horizons are termed the Hangingwall, Main, and Footwall horizons, as shown in Figure 7-4 and Figure 7-5 below. Calc-silicate layers from 0.50 – 1.0m in thickness have developed on the upper and lower contacts of the Main and Footwall horizons.

The **Hangingwall** horizon is located near the upper contact of the Myobong shale and varies in thickness from approximately 5.0 to 30.0m because of the irregular boundary of the shale with the overlying Pungchon Limestone. This zone has a strike length of about 600m and a down-dip extent of about 800m. Above the most highly-altered portion of the Main horizon, the Hangingwall horizon is not tabular, but extends steeply and irregularly into the overlying limestone. The Hangingwall horizon contains diopside, garnet, fluorite, zoisite, quartz, hornblende, wollastonite and up to 50% calcite and although there is some zonal variation in mineral assemblages (diopside-, hornblende- and quartz-rich zones) the zonation is not as well-developed as in the underlying Main horizon. The tungsten values show some zonation and decrease in value up-dip. The base of the Hangingwall horizon is approximately 14m above the upper contact of the Main horizon.

The **Main** horizon strikes about 100° and dips northerly between 15° and 30°. The strike length is in excess of 1,300m and thickness varies from 5.0 – 6.0m. Alteration (skarnification) within the Main horizon forms three concentric, roughly circular zones. A central quartz-rich zone consisting of muscovite, biotite, quartz and minor chlorite is about 350m in diameter and plunges down the Main horizon at N05°W and is coincident with the higher tungsten grade portion of the deposit. The central zone is succeeded outward by a hornblende-rich zone containing diopside, hornblende or tremolite, chlorite, fluorite and calcite. A diopside-rich zone occurs both horizontally beyond and stratigraphically above the hornblende-rich zone and contains garnet, diopside, quartz, fluorite, zoisite and plagioclase. The diopside zone is typically poorly-mineralised. Boundaries between these zones are diffuse and transitional.

The **Footwall** horizons comprise multiple layers: Footwall Zone 1 (F1) occurs 1m below the Main horizon and is approximately 2m thick; Footwall Zones 2 and 3 (F2, F3) are situated approximately 35.0 to 40.0m below the Main horizon and are less than 1m thick. Further Footwall Zones have been identified beyond F3 and are collectively referred to as F4. Areal dimensions of these horizons and the zonal distribution of calc-silicate minerals in them are similar to those of the Main horizon. F1 has sometimes been mined with extraction of the Main Zone. Some parts of F2 and F3 have been mined in the upper section of the mine.

Age determinations of metapelites beneath the footwall of the Main horizon gave potassium-argon ages of 81.2 and 84.0Ma, consistent with the age (Late Cretaceous) of the underlying Sangdong Granite and implying that this intrusive was responsible for the alteration and mineralisation (Lee 2001).

The Sangdong deposit contains scheelite, minor wolframite, molybdenite, bismuthenite and native bismuth. Molybdenum also occurs in substitution with scheelite and about 30% of the molybdenum produced at Sangdong was scheelite-related. Gold and silver occur in association with bismuthinite and native bismuth and were recovered from the bismuth concentrate. Tellurides, arsenopyrite, pyrite, chalcopyrite and sphalerite also occur.

Mineralisation is largely associated with quartz veins within those horizons, with the exception of the central portion of the Hangingwall horizon. Quartz veins are most abundant within a central, quartz-rich portion of the deposit, parallel to and discordant with the calc-silicate layering. Veining ranges from one to ten centimetres in width and is best developed in the lower portions of the mineralised horizons.

The abundance of scheelite within the mined portion of the Main horizon is concentrically zoned, increasing with alteration intensity, depending on temperature. Scheelite abundance in the Hangingwall horizon is more variable and less clearly concentrated in zones.

Molybdenum and bismuth are concentrically zoned in a similar pattern to tungsten in the Main horizon.

Lee (2001) states that the mineralisation is hydrothermal in nature and that there were two stages of mineral deposition; the first molybdenum-poor scheelite mineralisation was related to skarn alteration, which was followed by quartz-scheelite-molybdenite-bismuthenite vein emplacement.

The area is cut by steeply north dipping reverse and normal faults which have resulted in offsets of the mineralised horizons by as much as 50-100m.

**Figure 7-4. Schematic Section of the Sangdong Deposit**

(*looking at 245°*)

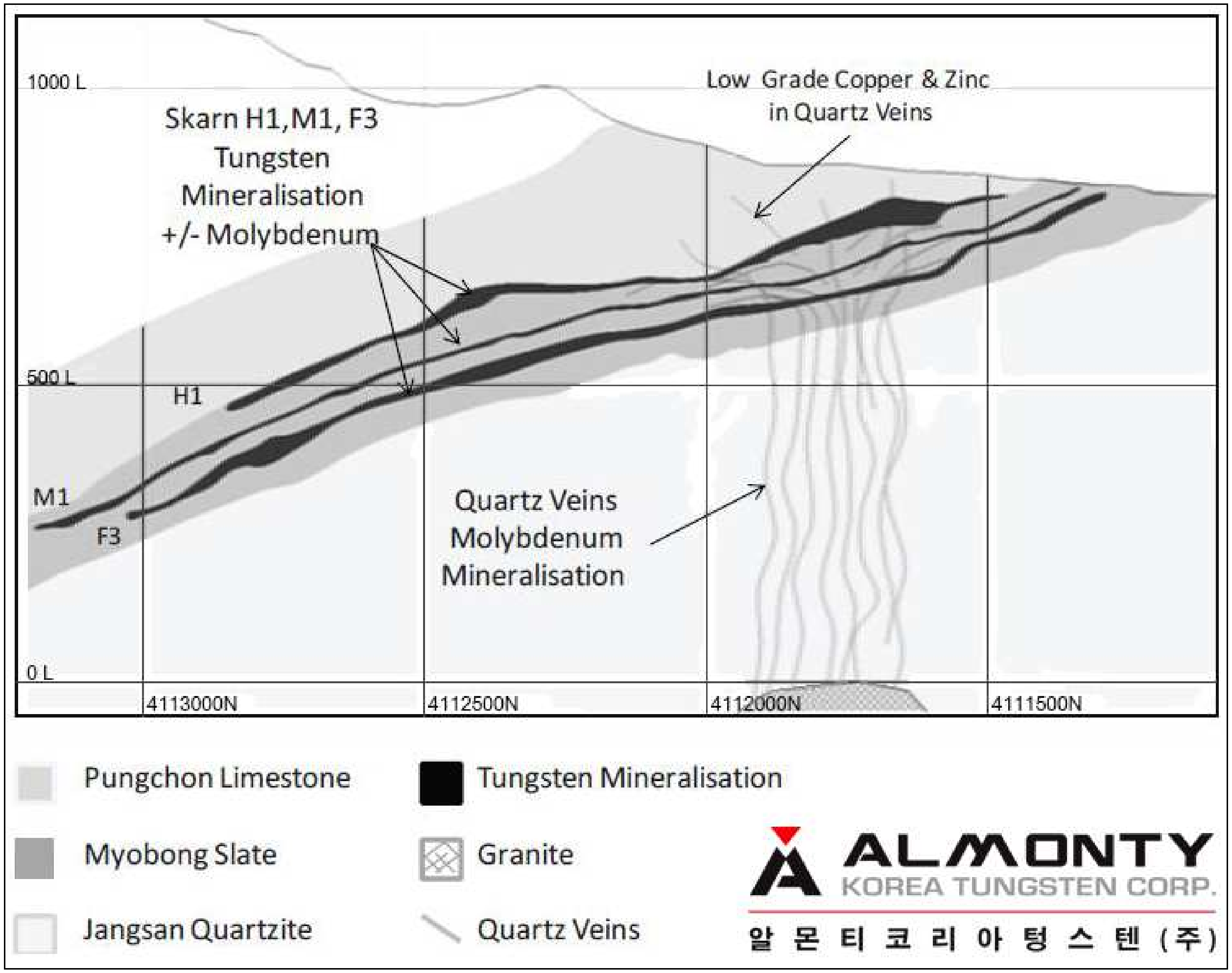
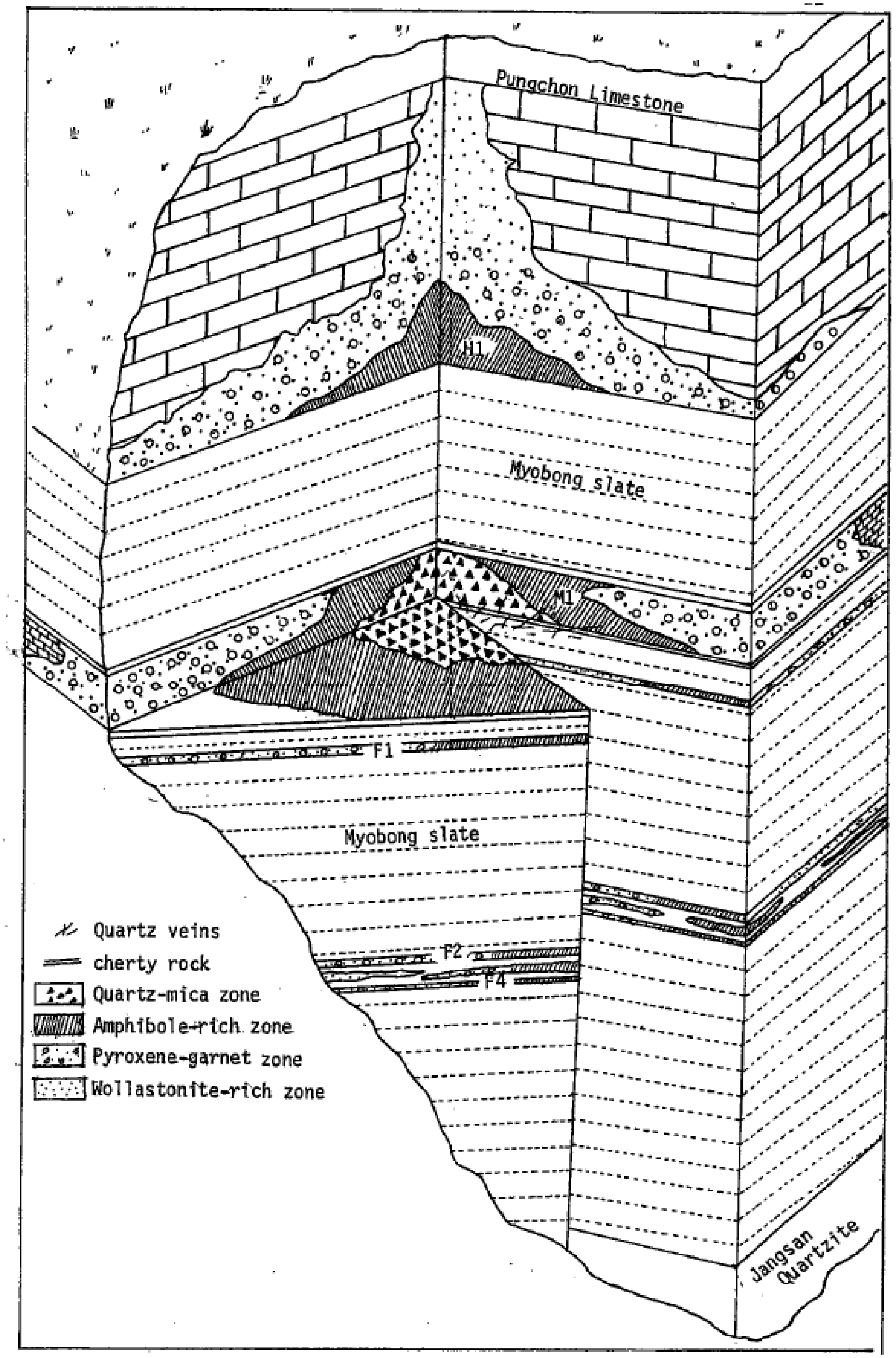


**Figure 7-5. Schematic View of the Property Lithology**

**(*Moon 1984)***



**Sangdong East** ("East WO3 Orebody") is located about 1km to the east from the Main deposit. It is essentially an extension of the main mine area, and stratigraphy and lithologies are similar. In contrast, however, the Hangingwall (Upper) horizon, Main horizon, and Footwall (Lower) horizons are thinner, and have a lower frequency of quartz veins. The constituent minerals are pyroxene and garnet with accessory plagioclase, quartz, apatite, hornblende and wollastonite.

In the **Sangdong West** area ("West $WO_3$ Orebody"), mineralisation and stratigraphy are similar to the main Sangdong Mine, but skarn horizons are thinner, and there is a lower frequency of quartz veining than in the Main horizon. The vein width and grade of tungsten mineralisation do, however, increase northward to the Hwajeolchi area. Scheelite and molybdenite occur together in quartz veins, which, according to Lee (2001), is rare in the Myobong Shale.

# 8 DEPOSIT TYPES

## 8.1 Tungsten Skarns

The Property contains a tungsten skarn deposit; skarns are contact metasomatic deposits, exploited for tungsten, with accessory molybdenum, copper, tin and zinc.

They typically form in continental marginal settings, associated with syn-orogenic plutons that intrude and metamorphose deeply buried sequences of carbonate-shale sedimentary sequences. Skarn mineralisation is typically hosted by pure and impure limestones, calcareous to carbonaceous pelites. Due to their contact metamorphic nature, mineralisation has a close spatial association with calc-alkaline granitic intrusives (tonalite, granodiorite, quartz monzonite and granites). Deposits form stratiform, tabular and lens-like deposits, which can be continuous for hundreds of metres along intrusive contacts.

Principal and subordinate mineralogy comprises scheelite ± molybdenite ± chalcopyrite ±pyrrhotite ± sphalerite ± arsenopyrite ± pyrite ± powellite. Trace wolframite, fluorite, cassiterite, galena, marcasite and bornite also occur. Reduced types are characterised by pyrrhotite, magnetite, bismuthinite, native bismuth and high pyrrhotite: pyrite ratios. Variable amounts of quartz-vein stockwork (with local molybdenite) can cut both the exo- and endoskarn.

Exoskarns occur at, and outside the granite which produced them, and comprise alterations of wall rocks. Endoskarns, including greisens, form within the granite mass itself, usually late in the intrusive emplacement and consist of cross-cutting stockworks, cooling joints and around the margins and uppermost sections of the granite itself.

Exoskarns display the following alteration zonation:

- an innermost zone of massive quartz may be present.
- an inner zone of diopside-hedenbergite ± grossular-andradite ± biotite ± vesuvianite.
- an outer barren wollastonite-bearing zone.

There is commonly a late-stage alteration assemblage, comprising spessartine ± almandine ±biotite ±amphibole ± plagioclase ± phlogopite ± epidote ± fluorite ± sphene. Reduced types are characterised by hedenbergitic pyroxene, iron-rich biotite, fluorite, vesuvianite, scapolite, and low garnet: pyroxene ratios, whereas oxidised types are characterised by salitic pyroxene, epidote and andraditic garnet and high garnet: pyroxene ratios. The exoskarn envelope can be associated with extensive areas of biotite hornfels.

Endoskarn alteration exhibits the following:

- pyroxene ± garnet ± biotite ± epidote ± amphibole ± muscovite ± plagioclase ± pyrite ±pyrrhotite ± trace tourmaline and scapolite.
- local greisen developed.

The location of mineralisation is usually controlled by:

- the presence of carbonate rocks in extensive thermal aureoles of intrusions.
- gently-inclined bedding and intrusive contacts.
- structural and/or stratigraphic traps in sedimentary rocks and irregular parts of the pluton/country rock contacts.

## 8.2 Granite Related Molybdenum

Due to the paucity of information about the molybdenum-mineralised system beneath the Sangdong underground workings, it is difficult to characterise a model for this mineralisation. However, important molybdenum mineralisation falls into two classes: porphyry-type and granite-related molybdenum-tungsten-tin systems. There is some overlap between the two.

The tungsten mineralisation of the Sangdong Deposit is contained within a series of tabular skarn horizons within the Myobong Slate. Calcium carbonate horizons within the slate have undergone metasomatic replacement to mineralised skarn by hydrothermal fluids. The source of these fluids is thought to be the underlying Sangdong Granite. Potassium-Argon age determination of phyllites within the Myobong Formation are consistent with the age of the granite below.

Swarms of quartz veins have ascended upward through the Jangsan Quartzite into the Myobong Formation where they can be seen to follow the bedding planes and also cross cut the formation (Moon, 1984). There is a correlation between the presence of quartz veins and the grade of mineralisation.

Although hydrothermal alteration (skarn formation) is widespread in the Sangdong area from Sangdong West to Sangdong East and beyond, there is no evidence of a pervasive porphyry-style alteration system. Country rock above the Sangdong granite is hornfelsed, but not pervasively altered.

Vein- and greisen-type hydrothermal molybdenum-tungsten or tin-tungsten mineralisation is connected with shallow-seated, highly differentiated, relatively K-rich granites (Cerny and others, 2005). Regional zoning of tin, tungsten and molybdenum may be apparent. Where greisen is absent, mineralisation may be within a sheeted or stockwork system contained within the apical portion of a granite body, or in overlying country rocks. Veins may vary from subhorizontal to vertical, and replacement (skarn) bodies may be present in the wallrocks. Fluorine is an important constituent, and bismuth minerals may also be present.

There is no recorded alteration system (i.e. greisen) at Sangdong, and therefore the deep molybdenum mineralisation is likely to comprise a system of sheeted or stockwork veins.

# 9 EXPLORATION

It was stated by Klepper (1947) that exploration in 1939 and 1940 led to the discovery of the Sangdong scheelite body although no further details are available.

Mineral Resource definition drilling is the only form of exploration that has been completed by WMC and AKT on the Sangdong Property since becoming operators in 2006, and there is no record of exploration other than drilling by previous operators.

An aeromagnetic map of the area was reproduced in a scoping report by Sennitt (2007) but the origin is unknown.

# 10 DRILLING

## 10.1 KTMC Drilling

A summary of the different KTMC drilling campaigns is shown in Table 10-1. Between 1980 and 1985, 15 holes (8,940 aggregate metres) were drilled to investigate the East Tungsten mineralised zone, now referred to as Sangdong East, approximately 1km to the east of the main Sangdong Mine and the deposit was further investigated with a drift approximately 1km long. About 100,000t were mined here in 1990. No additional work has been completed in this area to date.

Between 1979 and 1989, 18 holes (16,502 aggregate metres) were drilled in the West Tungsten mineralised zone, now referred to as Sangdong West, approximately 2 km northwest of the Sangdong Mine area. This zone has not been further explored.

Between 1980 and 1987, 22 vertical holes (12,390 aggregate metres) were drilled underground from the Sangdong Mine workings to investigate the extent of molybdenum mineralisation in the quartzite unit that underlies the main skarn zone. No additional work has been completed in this area to date.

During an unknown period, about 780 holes with an aggregate length of 30,000m were drilled underground to explore the mineralised zones. These historical holes were used in the 2010 scoping study (Wardrop 2010).

**Table 10-1. KTMC Drillhole Summary**

| Drillhole series | Target | Drilled from |
|---|---|---|
| F_ xx | Drilling for FW Zone | Underground |
| H_xx | Drilling for HW Zone | Underground |
| M_xx | Drilling for MAIN Zone | Underground |
| 90_03 | Drilled in 1990, 3rd Hole for either Moly Resource, West Potential or East MAIN Zone | Surface and Underground |
| DLE_xx | Drilling for East MAIN Zone | Underground |
| EM_x | Drilling for East MAIN Zone | Underground |

This data set does not have associated quality assurance/quality control information for the assay results, nor is the collar or downhole survey information adequately documented. Comparison of grade values in pre-WMC drillholes with nearby WMC drillholes showed significant differences that were considered (AMC) as unlikely to be a result of natural variability only. Therefore, the results suggested that the pre-WMC location information and/or grade values were suspect.

AMC used the KTMC drillholes in their Mineral Resource estimate to estimate grade and tonnes below -3 level (594mRL) **only** where WMC had not completed any drilling (Refer Figure 10.2). The uncertainty in the location and/or grade below -3 level is reflected in the Mineral Resource classification.

## 10.2 Woulfe Mining Corporation

The exploration work undertaken by Woulfe at the Sangdong Property was the surface drilling programme completed between November 2006 and July 2008. From June 2010 an underground resource definition drilling programme was designed and the first phase completed.

### 10.2.1 2006-2008 Drilling Programme

Woulfe (as Oriental Minerals) conducted a drill programme on the Sangdong Property between November 2006 and July 2008. Ninety HQ/NQ surface core holes were completed, with an aggregate length of 22,800m. HQ and NQ cores are nominally 63.5mm and 47.6mm in diameter respectively.

The holes were largely drilled within the area of the former underground Sangdong tungsten deposit. Analyses for $WO_3$, $MoS_2$, bismuth and other minerals were completed and this dataset comprises some 20,355 analyses.

The holes were all drilled in the south eastern portion of the deposit, where the mineralisation occurs near surface or is outcropping, on a bearing of 135°, parallel or nearly so, to geological strike; about 30% were drilled on the opposite bearing of 315°.

The majority were drilled at a dip of 70°, although several were vertical or at a dip of about 80°.

The holes were designed to test all three principal horizons of mineralisation and, with several accidental exceptions, all penetrated well into the Jangsan Quartzite that underlies the host Myobong Formation. Difficulty was often experienced in penetrating the lower horizons due to the mined out areas of the skarn mineralisation.

The drill hole collar locations were surveyed by global positioning survey (GPS – sub 0.2m accuracy) and the down-hole positions of the holes were measured at 50m intervals. There were some uncertainties with regard to the collar elevations and Woulfe subsequently undertook additional surveying work to resolve the situation and consolidate the survey of the site in general.

Holes drilled on bearings of both 135° and 315° intersected strata and mineralisation obliquely, the intersected thickness of mineralisation being about a 30% greater than the true thickness. .

### 10.2.2 2009 – 2014 Drilling Programmes

Once access was gained to the underground workings WMC began a programme of infill and resource definition drilling. The drilling was largely completed from the underground workings supplemented by additional surface holes where underground access was not possible.

Underground drilling was either NQ core from a Sandvik Onram 1000 wireline rig, or BQ core from 3 Kempe pneumatic screwdrive open hole core rigs. Orientations vary based on access and the need to intersect all three ore horizons. Conical drilling patterns are common as a result of fanning out in all directions from the underground drilling platforms. Collar locations were surveyed using a Leica 1203 total station with sub-decimetre accuracy). Downhole surveys were conducted approximately at the end of hole as the majority of holes are <30 m depth. A Camteq™ multiple shot camera was used, with a stated accuracy of ± 0.5° on azimuth and ± 0.2° on dip. The downhole camera was routinely calibrated to ensure maximum performance, using a purpose designed jig.

### 10.2.3 2016 Drilling Programme

AKT have completed a Phase 7 underground drilling campaign in 2016. This was focussed in improving the resource categorisation of the HW Zone, and consisted of 20 holes, drilling just over a 1,000m in total.

## 10.3 Drilling Summaries

The total number of recorded boreholes drilled at Sangdong is summarised in Table 10.2 and Table 10.3 below and graphically represented in Figure 10-1.

**Table 10-2. Summary of AMC Dataset used in Resource Estimation 2014**

| Drilling phase | No. of drillholes | Meters drilled | No. of downhole surveys | No. of assays |
|---|---|---|---|---|
| pre-2006 | 863 | 82,829 | 775 | 9,757 |
| 2006-2008 | 94 | 23,270 | 589 | 22,128 |
| 2009-2014 | 405 | 19,190 | 405 | 23,293 |
| **Total** | **1,362** | **125,289** | **1,769** | **55,178** |

**Table 10-3. Summary of Historic Drilling Programmes (2006-2014)**

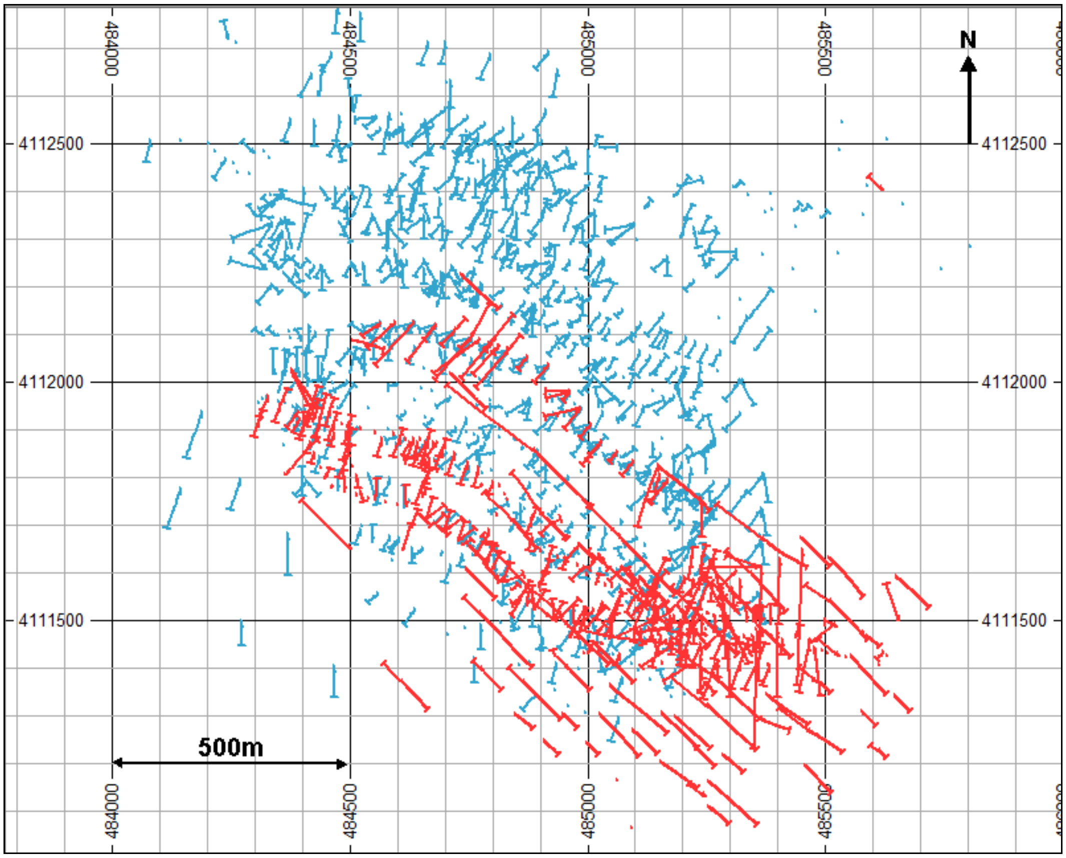
**Source: Tetra Tech/Wardrop 2012**

| Phase | Period | Target | Drilled from | Drillhole series | No. of Holes | Drilled (m) | No. of samples | Ave. drill center |
|---|---|---|---|---|---|---|---|---|
| 0 | Oct.2006-Aug.2008 | HW, MAIN, FW & Moly | Surface | (SD_01 - SD_90) | 90 | 22,801 | 21,100 | 100m x 100m |
| 1 | Nov.2010-May.2011 | MAIN, FW | Surface and Underground | (SD_91 - SD_99), WSDD0002 - WSDD0028 | 38 | 4,265 | 4,507 | 80m x 80m |
| 2 | Jun.2011-Oct.2011 | MAIN, FW | Underground | (WSDD0029 - WSDD0080) | 51 | 3,673 | 5,577 | |
| 3 | Nov.2011-Apr.2012 | HW, FW, MAIN | Underground | (WSDD0081 - WSDD0174) | 93 | 4,049 | 6,526 | 50m x 50m |
| 4 | May.2012-Apr.2013 | HW, FW, MAIN | Underground | (WSDD0175 - WSDD0279) | 104 | 4,217 | 6442 | 40M x 40M |
| 5 | April.2014-June.2014 | FW, MAIN | Underground | (WSDD0318 - WSDD0446) | 121 | 3,083 | 5010 | 20M x 20M |

There are minor discrepancies in the totals e.g. 2006 – 2008 90 holes/22800m (Tetra Tech Wardrop 2012) – 94 holes/23,270m (AMC 2015) and 407 holes/19287m (Tetra Tech Wardrop 2012) and 405 holes/19190m (AMC 2015).

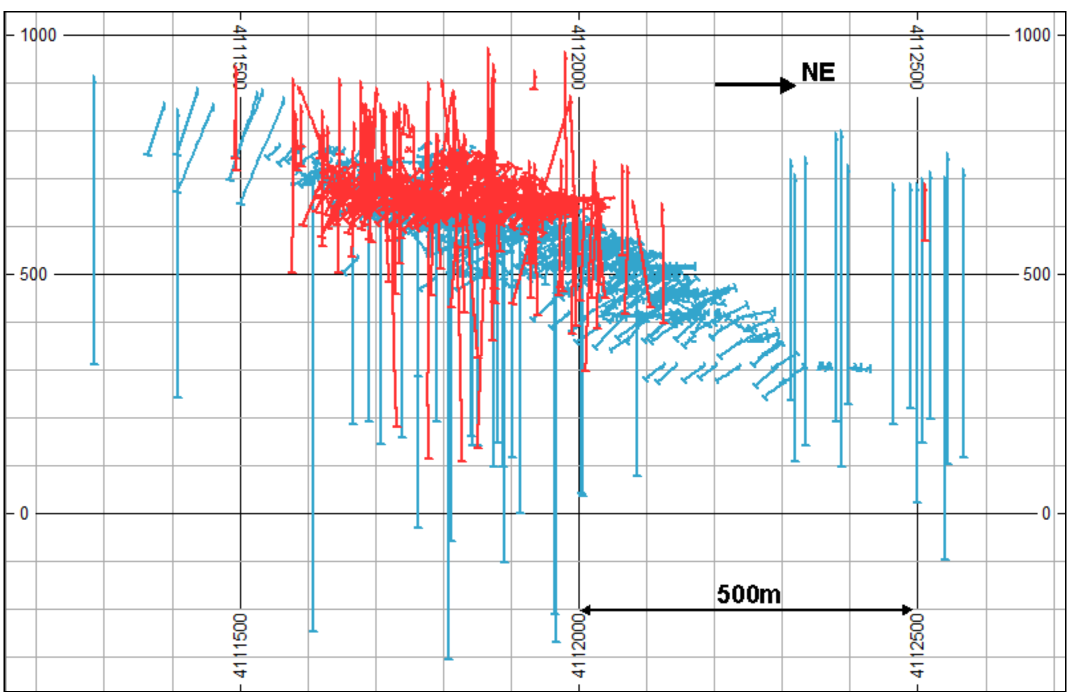
Figure 10-1 shows a drillhole plan and Figure 10.2 shows a SW – NE reference section through the deposit, clearly demonstrating the absence of down dip borehole intersections from the more recent drilling programmes.

**Figure 10-1. Drillhole Plan Plot**




***Red Traces – Modern WMC Drilling; Blue Traces – Historical KTC Drilling***

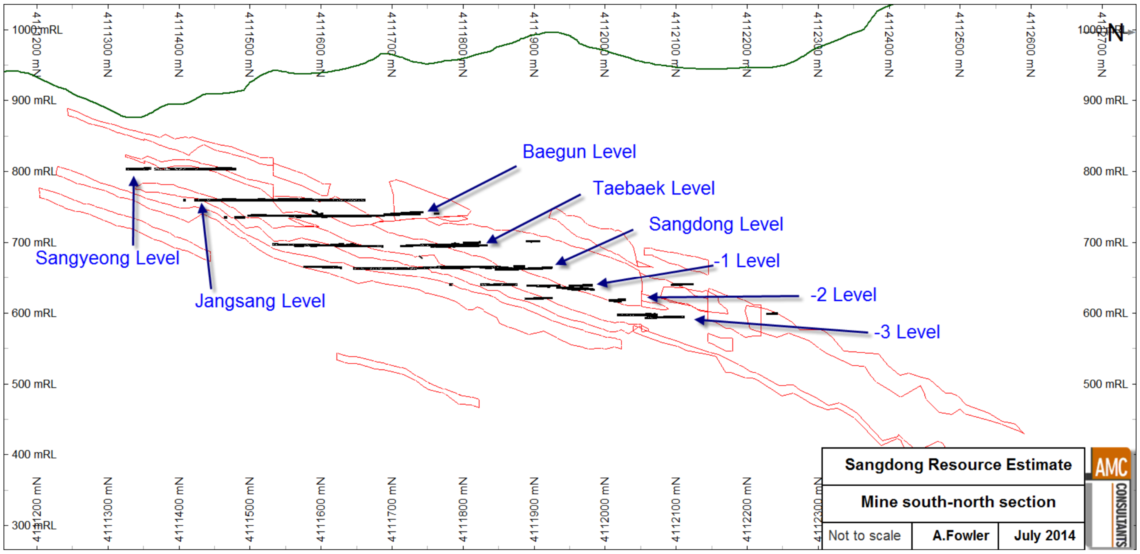
**Figure 10-2. SW - NE Reference Section**



## 10.4 Drilling Results

Outlines of >0.1% $WO_3$ and development levels are shown in Figure 10.3.

**Figure 10-3. Mine South-North Reference Section**




***Note: Mineralisation interpretation >0.1 % $WO_3$ is shown as red outlines; mine levels are shown as black line; surface topography is shown as a green line.***

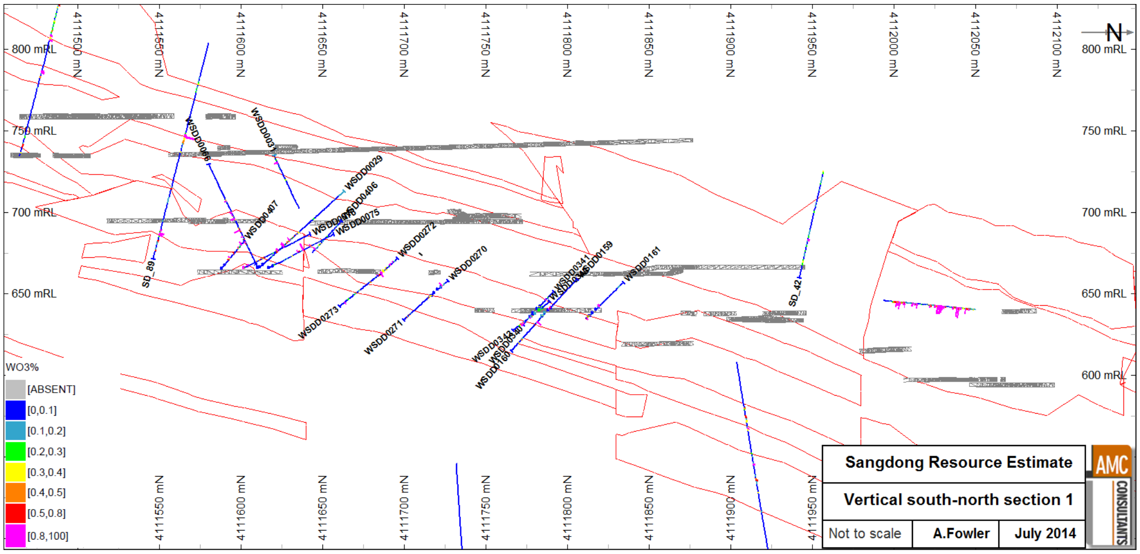
Table 10.4 summarises the results of the drilling programmes completed between 2012 and 2014.

**Table 10.4: Summary of Drilling 2012 - 2014**

| Mineralized zone | Mine level | Number of intersections | Downhole thickness (m) | True thickness (m) | WO3 % |
|---|---|---|---|---|---|
| Hangingwall | 1 level | 4 | 5.75 | 5.40 | 0.35 |
| | Sangdong | 7 | 2.93 | 2.79 | 0.47 |
| | Baegun | 20 | 4.44 | 3.59 | 0.39 |
| **Hangingwall Total** | | **31** | **4.27** | **3.64** | **0.40** |
| Main | 1 level | 15 | 4.98 | 4.25 | 0.62 |
| | Sangdong | 31 | 4.21 | 2.91 | 0.61 |
| | Taebaek | 8 | 4.19 | 2.96 | 0.71 |
| | Baegun | 14 | 3.63 | 1.60 | 0.41 |
| **Main Total** | | **68** | **4.26** | **2.94** | **0.58** |
| F1 | 1 level | 14 | 1.34 | 1.16 | 0.66 |
| | Sangdong | 20 | 1.84 | 1.28 | 0.85 |
| | Taebaek | 3 | 1.67 | 1.33 | 0.64 |
| | Baegun | 4 | 1.25 | 0.73 | 1.20 |
| **F1 Total** | | **41** | **1.60** | **1.19** | **0.81** |
| F2 | 1 level | 59 | 1.96 | 1.66 | 0.64 |
| | Sangdong | 73 | 2.29 | 1.97 | 0.83 |
| | Taebaek | 14 | 2.75 | 2.29 | 0.75 |
| **F2 Total** | | **146** | **2.20** | **1.88** | **0.75** |
| F3 | 1 level | 56 | 2.33 | 2.00 | 0.73 |
| | Sangdong | 69 | 2.00 | 1.70 | 0.62 |
| | Taebaek | 15 | 1.95 | 1.48 | 0.75 |
| **F3 Total** | | **140** | **2.13** | **1.79** | **0.68** |

Figure 10.4 shows a representative section with mineralisation thickness and grades for each intersection referenced in Table 10.5.

**Figure 10-4. Example vertical section showing drillholes relative to mineralisation**




***Drillholes displaying $WO_3$ % grade (legend displayed); red lines are >0.1 % $WO_3$ mineralisation interpretation; grey wireframes represent underground development levels.***

**Table 10-4. Significant Intersections for Drillholes Displayed in Figure 10.4**

| Hole No. | Collar Easting (m) | Collar Northing (m) | Collar Elevation (m) | From (m) | To (m) | Interval (m) | true width (m) | WO3% | Lode | Level | Azi/Dip (0) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WSDD0075 | 484784 | 4E+06 | 665.59 | 22.5 | 27.5 | 5.0 | 3.77 | 0.77 | F3 | Sangdong | 29.77/24.4 |
| WSDD0075 | 484784 | 4E+06 | 665.59 | 32.0 | 33.0 | 1.0 | 0.75 | 0.82 | F2 | Sangdong | 29.77/24.4 |
| WSDD0076 | 484798 | 4E+06 | 665.56 | 14.0 | 15.5 | 1.5 | 1.14 | 0.41 | F3 | Sangdong | 27.75/24.6 |
| WSDD0076 | 484798 | 4E+06 | 665.56 | 24.5 | 26.0 | 1.5 | 1.14 | 0.58 | F2 | Sangdong | 27.75/24.6 |
| WSDD0159 | 484803 | 4E+06 | 639.61 | 0.5 | 2.5 | 2.0 | 1.88 | 0.55 | F2 | 1 level | 20.25/45.4 |
| WSDD0160 | 484802 | 4E+06 | 637.55 | 7.0 | 8.5 | 1.5 | 1.41 | 1.20 | F3 | 1 level | 204/-45.7 |
| WSDD0161 | 484773 | 4E+06 | 639.99 | 2.5 | 3.5 | 1.0 | 0.93 | 1.19 | F2 | 1 level | 12.55/44 |
| WSDD0270 | 484811 | 4E+06 | 651.99 | 2.0 | 4.5 | 2.5 | 2.25 | 0.61 | F2 | 1 level | 21.08/39.2 |
| WSDD0271 | 484810 | 4E+06 | 650.12 | 2.0 | 4.0 | 2.0 | 1.81 | 0.28 | F3 | 1 level | 200.83/-40 |
| WSDD0272 | 484794 | 4E+06 | 663.69 | 5.5 | 6.5 | 1.0 | 0.91 | 0.93 | F2 | 1 level | 22.03/40.2 |
| WSDD0273 | 484794 | 4E+06 | 662.42 | 0.0 | 2.5 | 2.5 | 2.21 | 1.09 | F3 | 1 level | 198.82/-37 |
| WSDD0340 | 484778 | 4E+06 | 637.85 | No significant intersections | | | | | | 1 level | 202/-47.1 |
| WSDD0341 | 484779 | 4E+06 | 640.09 | 8.0 | 9.0 | 1.0 | 0.94 | 0.46 | F2 | 1 level | 19.53/45 |
| WSDD0342 | 484816 | 4E+06 | 637.43 | 9.0 | 12.0 | 3.0 | 2.63 | 0.84 | F3 | 1 level | 196/-36.5 |
| WSDD0406 | 484766 | 4E+06 | 665.22 | 17.0 | 18.8 | 1.8 | 1.66 | 0.56 | F3 | Sangdong | 29.5/43.1 |
| WSDD0407 | 484813 | 4E+06 | 665.38 | 7.0 | 9.0 | 2.0 | 1.87 | 0.66 | F3 | Sangdong | 32.5/45.5 |
| WSDD0407 | 484813 | 4E+06 | 665.38 | 17.0 | 21.0 | 4.0 | 3.74 | 0.62 | F2 | Sangdong | 32.5/45.5 |

## 10.5 Sampling and Logging Procedures

The drill core was collected from the drill site by WMC personnel on a daily basis and brought to a core logging facility beside the WMC field office. Core was measured for recovery and rock quality designation (RQD) and logged geologically, including the following characteristics:

- Lithology
- Weathering
- Alteration
- Structural features, and orientations were the core is orientated
- UV fluorescence
- Fracture frequency, planarity, roughness, infill, rock strength: for the calculation of geotech parameters

The UV fluorescence was logged in a semi-quantitative way, on an intensity scale from one to five, and by colour (i.e. yellow or blue) and the core marked up for sampling. Samples were collected continuously at one metre increments from the collar or from the uppermost practical limit of bedrock and did not cross geological boundaries.

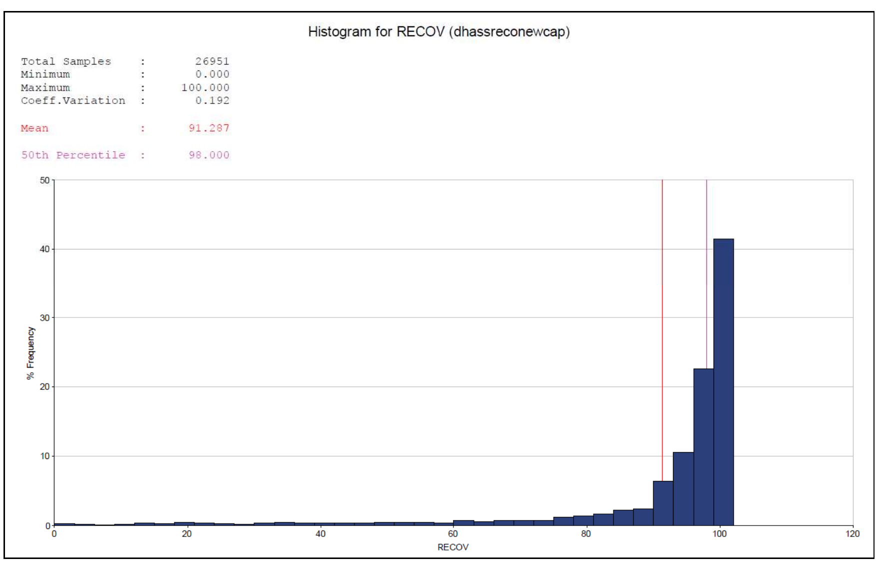
Core was photographed wet and dry and scanned with an ultraviolet lamp to detect the presence of scheelite. The abundance of scheelite was logged in a semi-quantitative way, on an intensity scale from one to five.

The AMC representative (2014) observed the logging process which related to all the logging undertaken by WMC and Oriental.

## 10.6 Core Recovery

The mean core recovery for the WMC drilling was 91%, while the median value was 98% (Refer Figure 10.5). The recovery was considered to be suitable to support a Mineral Resource Estimate.

**Figure 10-5. Core Recovery Histogram**



## 10.7 Bulk Density

Density measurements were routinely determined every 20m using the volume displacement method in a purpose designed tubular jig. Sample lengths for density measurements were approximately between 0.10 and 0.30m. This is considered to be an appropriate method considering the generally solid nature of the core proximal to the ore zones within Sangdong.

In the current resource estimation work, density values ($t/m^3$) have been estimated from the measurements taken. Blocks without estimated density values after the second estimation pass were assigned average zone density values.

# 11 SAMPLE PREPARATION, ANALYSES AND SECURITY

## 11.1 Sample Preparation

An overall summary of quality control samples taken during the WMC drilling campaigns is shown in Table 11-1.

**Table 11-1. Summary of WMC Quality Control Samples**

| | | Phase#1 | Phase#2 | Phase#3 | Phase#4 | Phase#5 | Phase#6 | Phase #7 | Phases #1 - #7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Period(Drilled) | | Nov. 2010 ~ May 2011 | June 2011 ~ Oct. 2011 | Nov. 2011 ~ Apr. 2012 | May 2012 ~ Apr. 2013 | Apr. 2014 ~ June 2014 | Nov. 2014 ~ Dec. 2014 | ~ Jan 2016 Jun 2016 | | |
| Batch | | #1 ~ #9 | #13 ~ #23 | #25 ~ #34 | #35 ~ #36 | #38 ~ #43 | #44 ~ #45 | #47 | | |
| | | Number | Number | Number | Number | Number | Number | Number | Number | Prop % |
| No. of total Samples | | 4,448 | 5,556 | 6,508 | 6,442 | 5,010 | 1,054 | 1,203 | 29,018 | |
| No. of core half Samples | | 3,867 | 4,830 | 5,655 | 5,599 | 4,359 | 912 | 906 | 25,222 | |
| No. of Repeat | | 193 | 243 | 284 | 280 | 217 | 46 | 52 | 1,263 | 5.0% |
| No. of Standard | Sum | 194 | 240 | 285 | 280 | 217 | 46 | 52 | 1,262 | 5.0% |
| | W-1 | 52 | 61 | 77 | 78 | 55 | 11 | 13 | 334 | 1.3% |
| | W-2 | 57 | 63 | 76 | 79 | 56 | 12 | 13 | 343 | 1.4% |
| | W-3 | 47 | 61 | 84 | 75 | 47 | 12 | 13 | 326 | 1.3% |
| | W-4 | - | - | - | - | 59 | 11 | 13 | 70 | 0.3% |
| | MoS-1 | 38 | 55 | 48 | 48 | - | - | - | 189 | 0.7% |
| No. of Blanks | | 194 | 243 | 284 | 283 | 217 | 50 | 53 | 1,271 | 5.0% |
| | | | | | | | | | Total | 20.1% |

Sample preparation from core to pulps for analysis is completed on-site. Core is sawn in half, half placed in a plastic sample bag and half replaced in the core box for archival storage. Sample tags are placed in the core box and in the sample bag and the sample number is written on the sample bag as well. Standards are placed into the sample stream at this point in the sampling process, in accordance with a sample list that has been drawn up by the geologist responsible for logging the hole.

Core samples are dried, split, crushed and pulverized on-site by WMC personnel in a preparation lab that was purchased as a modular unit from Marc Technologies in Perth, Australia. Equipment is cleaned by brushing and the use of compressed air between each sample. WMC staff employed in the sample preparation facility have been trained by SGS Australia Pty Ltd. (SGS Australia), Perth, Australia.

An approximately 50g split portion of the pulverized sample is sent to SGS Australia in Perth, Australia for analysis. Blanks are inserted one in every twenty samples to ensure there is no contamination (see Section 11.4).

## 11.2 Analyses

From 2006 to 2008 samples were analysed at the ALS laboratory in Brisbane by inductively coupled plasma mass spectrometry (ICP- MS) for 41 elements and for ore grade quantities of specific elements by *aqua regia* or four-acid digestion followed by ICP analysis.

From 2010, molybdenum, tin and tungsten were analysed at the SGS laboratory in Perth by X-ray fluorescence (XRF). The sample is fused in a platinum crucible using lithium metaborate/tetraborate flux and the resultant glass bead is irradiated with X-rays and the elements of interest quantified. All quantities are reported in parts per million (ppm). XRF detections limits are given in Table 11-2.

**Table 11-2. SGS XRF Detection Limits**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fe2O3 | 0.01 – 100% | SiO2 | 0.01 – 100% | Al2O3 | 0.01 – 100% | CaO | 0.01 – 40% |
| Cr2O3 | 0.01 – 60% | K2O | 0.01 – 70% | MgO | 0.01 – 60% | MnO | 0.01 – 100% |
| P2O5 | 0.01 – 20% | SO3 | 0.01 – 60% | TiO2 | 0.01 – 100% | V2O5 | 0.01 – 10% |
| Mo | 0.01 – 15% | W | 0.01 – 65% | Bi | 0.01 – 10% | Cu | 0.01 – 20% |
| Pb | 0.01 – 10% | Zn | 0.01 – 10% | As | 0.01 – 10% | Ce | 0.01 – 15% |
| Co | 0.01 – 10% | Hf | 0.01 – 10% | La2O3 | 0.01 – 20% | Na | 0.01 – 20% |
| Nb | 0.01 – 35% | Nd | 0.01 – 15% | Ni | 0.01 – 10% | Sb | 0.01 – 10% |
| Sn | 0.01 – 65% | Sr | 0.01 – 10% | Ta | 0.01 – 40% | Th | 0.01 – 10% |
| U | 0.01 – 10% | Zr | 0.01 – 60% | | | | |

### 11.3 Sample Security and Chain of Custody

The sample preparation facility comprised a fenced area beside the WMC accommodation facility. Sample tags are placed in the sample bag and the sample number is written on the sample bag as well. A split portion of the pulp from each sample and coarse rejects is retained in a locked facility at the project site. The pulps are placed in brown paper envelopes by the sample preparation manager, then packed in cardboard boxes, sealed and sent by DHL courier to SGS Australia in Perth by a WMC geologist.

### 11.4 Quality Assurance/Quality Control

The QA/QC protocol included the insertion of the following control samples in the assay batches:

- Pulp duplicates (one in 50, or 2%), consisting of second splits of the pulverized samples that are submitted to the primary laboratory for analysis in the same batches as the original samples, but with different numbers.

- Certified reference materials (CRMs, three in 50, or 6%).

- Coarse blanks (one in 50, or 2%) and fine blanks (one in 50, or 2 %), consisting of coarse (approximately 1” diameter) and pulverized material, respectively, whose blank character was demonstrated by analysis conducted at SGS Laboratories. Initially ground glass was used as blank for Phases #1 to #4 drilling, but was subsequently changed to coarse crystalline feldspar for Phase #5 drilling.

- Check samples (two in 50, or 4%), collected from pulps that were previously assayed at the primary laboratory, are resubmitted to a Bureau Veritas Laboratory in Perth Australia (BV) for external control. The check sample batch includes an appropriate proportion of control samples (pulp duplicates, CRMs and fine blanks).

- In addition, the QA/QC protocol includes independent granulometric checks on crushed and pulverized samples (1 in 20 for each type, or 5% each) that are conducted by geological personnel.

Table 11-3 summarises the QA/QC sample submission rates.

**Table 11-3. QA/QC Sample Submission Rates**

| QA / QC Sample type | Frequency of submission | Measure | Error |
|---|---|---|---|
| Internal lab duplicate | 1 in 50 | Precision | Crushing/splitter performance, sample mix up. |
| External lab duplicate | 1 in 200 | Precision | Analytical bias and precision |
| CRM (standard) | 3 in 50 | Accuracy | Analytical bias. |
| Blank | 1 in 20 | Procedures | Contamination and sample mix up. |

### 11.4.1 Precision

Precision is the measure of variability or repeatability of an assay result. Knowing the precision of a set of assays allows for correction to any bias or accuracy problems that may occur. A lack of precision may be the result of the sample collection process, laboratory preparation process, and/or the analytical process.

#### *11.4.1.1 Internal Laboratory Duplicate Results*

Internal laboratory duplicates are two split pulps of the same pulverized sample. These laboratory duplicates are considered to demonstrate good precision if the absolute relative paired difference (RPD) is < 10%, 90% of the time. Internal laboratory duplicates quantify the precision of the chain of laboratory sample preparation and analytical procedures.

During the Jan 2012- Sept 2014 reporting period, 819 samples were re-assayed. Tungsten internal laboratory duplicate summary statistics are presented in Table 11-4. Molybdenum internal laboratory duplicate summary statistics are presented in Table 11-5.

**Table 11-4. Tungsten Laboratory Duplicate Summary**

| Statistic | Original | Duplicate |
|---|---|---|
| Number of samples | 819 | 819 |
| Mean | 1295.82 | 1307.55 |
| Maximum | 29800.00 | 29800.00 |
| Minimum | 1.00 | 1.00 |
| Pop Std Dev. | 3022.11 | 3049.06 |
| CV | 2.33 | 2.33 |
| Bias | -0.91% | |
| Cor Coeff | 1.00 | |
| Percent Samples <10% RPD | 98.05 | |

**Table 11-5. Molybdenum Laboratory Duplicate Samples**

| Statistic | Original | Duplicate |
|---|---|---|
| Number of samples | 819 | 819 |
| Mean | 254.08 | 252.75 |
| Maximum | 10400.00 | 10300.00 |
| Minimum | 1.00 | 1.00 |
| Pop Std Dev. | 823.57 | 816.34 |
| CV | 3.24 | 3.23 |
| Bias | 0.52% | |
| Cor Coeff | 1.00 | |
| Percent Samples <10% RPD | 86.21 | |

- The correlation coefficient for both tungsten and molybdenum show excellent agreement between the original and duplicate assays.
- The tungsten RPD results also show excellent agreement between the original and duplicate assays with 98% of samples below the 10% RPD threshold.
- The molybdenum RPD results show poorer agreement between the original and duplicate assays with 86% of samples below the 10% RPD threshold. This is less than the 90% threshold.
- The scatterplots show three outliers in the tungsten results and one outlier in the molybdenum results.

Tetra-Tech considered that the outliers were not material to the Mineral Resource estimation and that the duplicate results demonstrate the precision of the tungsten assay results and that they supported the use of the SGS results in Mineral Resource estimation.

#### *11.4.1.2 External Laboratory Duplicate Results*

Independent re-assaying of selected pulps from the primary sample by a second laboratory provided a measure of both precision and accuracy. WMC sent 133 samples previously assayed by SGS Perth to BV Perth as an external laboratory check. These external laboratory duplicates are considered to demonstrate good precision if the absolute relative paired difference (RPD) is < 20%, 90% of the time.

Tungsten duplicate summary statistics, for the Jan 2012- Sept 2014 reporting period, are presented in Table 11-6.

**Table 11-6.** Tungsten External Laboratory Duplicate Summary

| Statistic | Original | Duplicate |
|---|---|---|
| Number of samples | 133 | 133 |
| Mean | 0.55 | 0.55 |
| Maximum | 2.60 | 2.61 |
| Minimum | 0.16 | 0.16 |
| Pop Std Dev. | 0.52 | 0.52 |
| CV | 0.94 | 0.94 |
| Bias | -0.65% | |
| Cor Coeff | 1.00 | |
| Percent Samples <20% RPD | 99.25 | |

- The correlation coefficient shows excellent agreement between the two laboratories.
- The RPD results also show excellent agreement between the two laboratories with 99% of samples below the 20% RPD threshold.
- The scatterplot shows one outlier.

The outliers are not considered material for the Mineral Resource estimate.

The BV results demonstrate the precision and accuracy of the SGS assay results and that they support the use of the SGS results use in Mineral Resource estimation.

### 11.4.2 Accuracy

Accuracy is the measure of how close the assay is to the actual sample grade. Poor accuracy can be caused by various sampling or analytical problems, including problems with analytical equipment or procedures such as machine calibrations. These problems can occur at any time. Accuracy of the analytical process must be quantified on a batch by batch basis to enable samples to be re-assayed over time periods by inserting assay Certified Reference Material (CRM) standards into each batch of samples and monitoring the results.

A CRM is a standard sample that has been manufactured by a certified company, and is itself certified. The manufacturing process creates a homogenized sample that has undergone an extensive and rigorous certification process. This process generates an expected value and acceptable limits for all elements in the sample.

Laboratories use CRMs to ensure that their analytical processes are accurate between calibrations of the machines. Where drift is observed, it is normal procedure for a machine to be recalibrated. It is possible for internal laboratory CRM assay results to be altered and it is now industry standard for laboratory clients to submit their own CRM samples in order to be able to monitor the accuracy of the laboratory.

#### *11.4.2.1 Certified Reference Material Results*

Four certified reference materials (CRM) for tungsten and one for molybdenum are in use by WMC. These, along with a blank and a re-split coarse duplicate are inserted routinely at every 20th sample interval. The CRM's were produced by CDN Resource Laboratories, Canada. A summary of the CRM's is given in Table 11-6. Note that CRM values are reported here as W% or Mo ppm not $WO_3$ or $MoS_2$%. If a CRM falls outside the 1SD range, re-analyses of 10 samples before and 10 samples after the failed CRM sample are requested from SGS Labs.

**Table 11-7. CRM Summary**

| CRM | Variable | Expected value | 2 Std Dev. |
|---|---|---|---|
| CDN-W-1 | W (%) | 1.04 | 0.1 |
| CDN-W-2 | W (%) | 2.78 | 0.39 |
| CDN-W-3 | W (%) | 1.73 | 0.19 |
| CDN-W-4 | W (%) | 0.366 | 0.024 |
| MoS-1 | Mo (%) | 0.065 | 0.008 |

Figures 11-1 to 11-5 show the CRM results for the reporting period (30 01 2012 – 15 09 2014).

**Figure 11-1. CRM Results – Tungsten Standard CDN-W1**

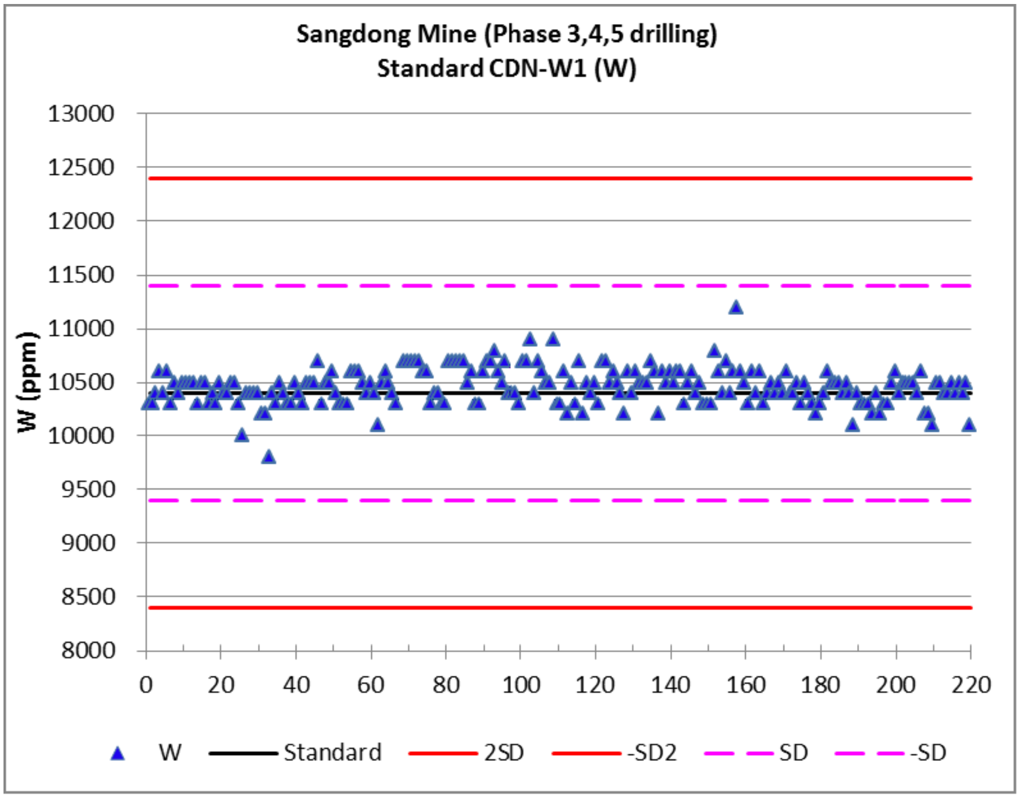



**Figure 11-2. CRM Results – Tungsten Standard CDN-W2**

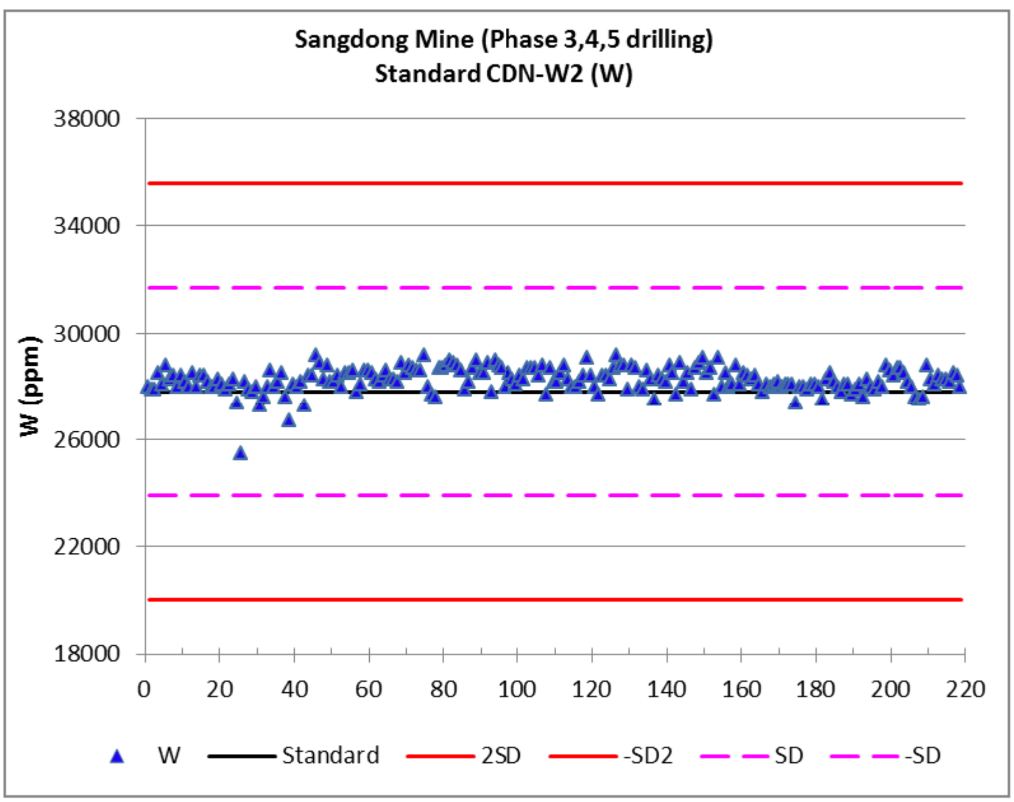


**Figure 11-3. CRM Results – Tungsten Standard CDN-W3**

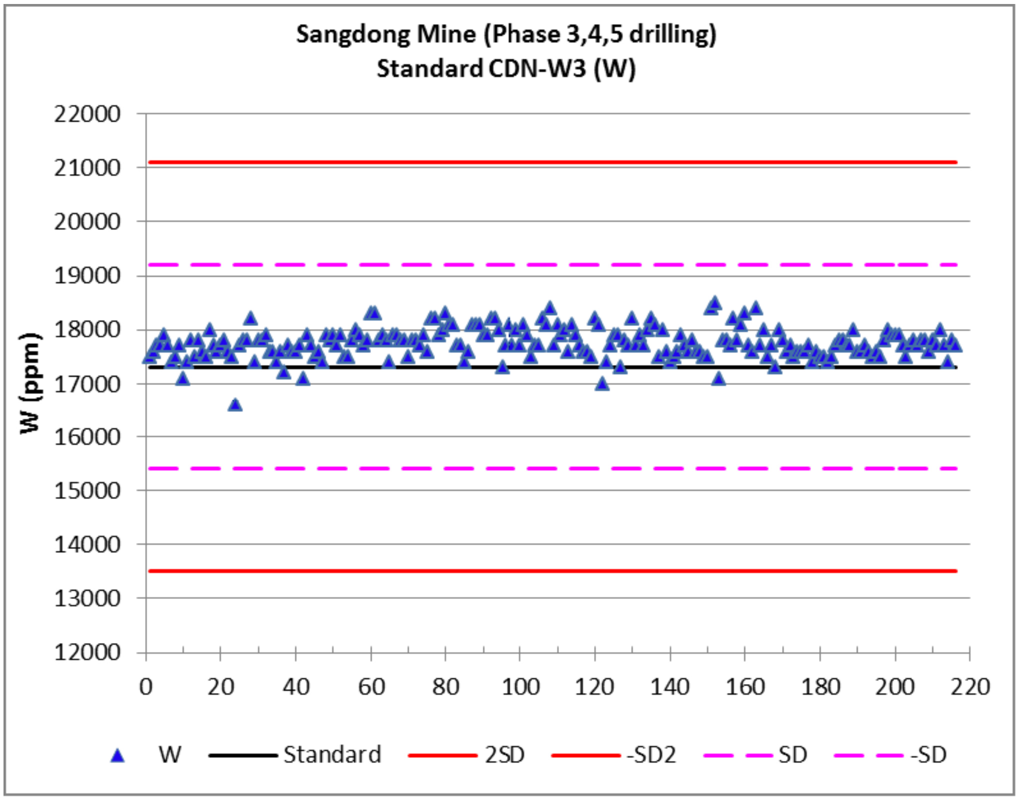



**Figure 11-4. CRM Results – Tungsten Standard CDN-W4**

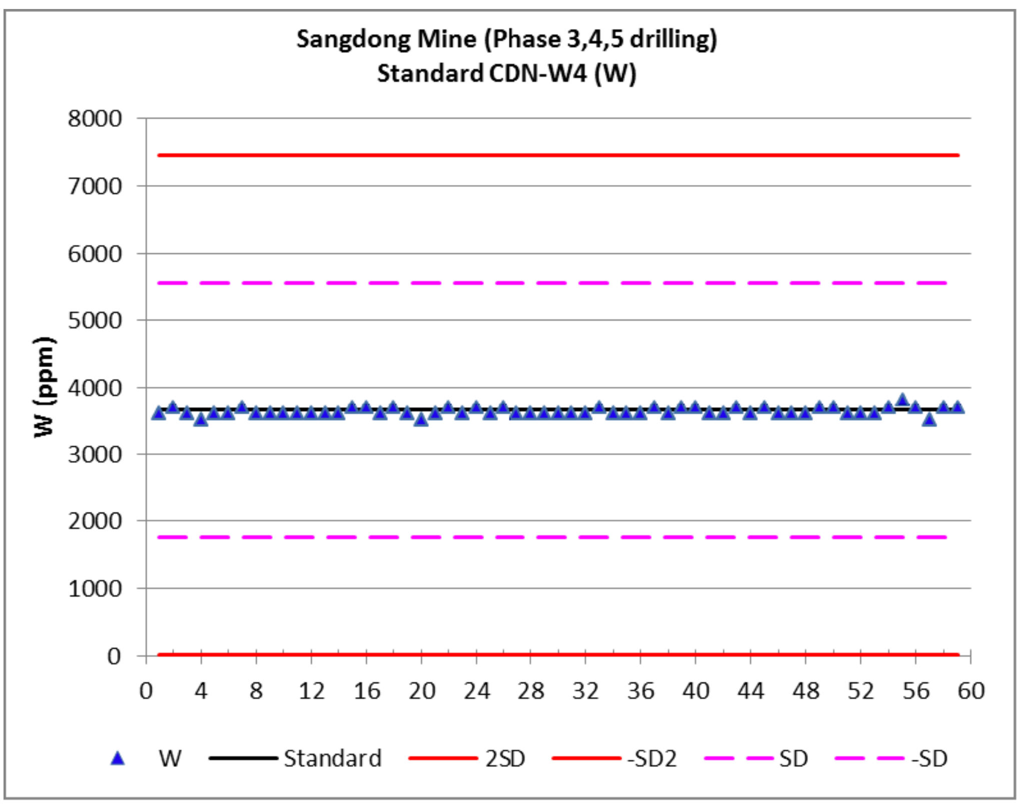
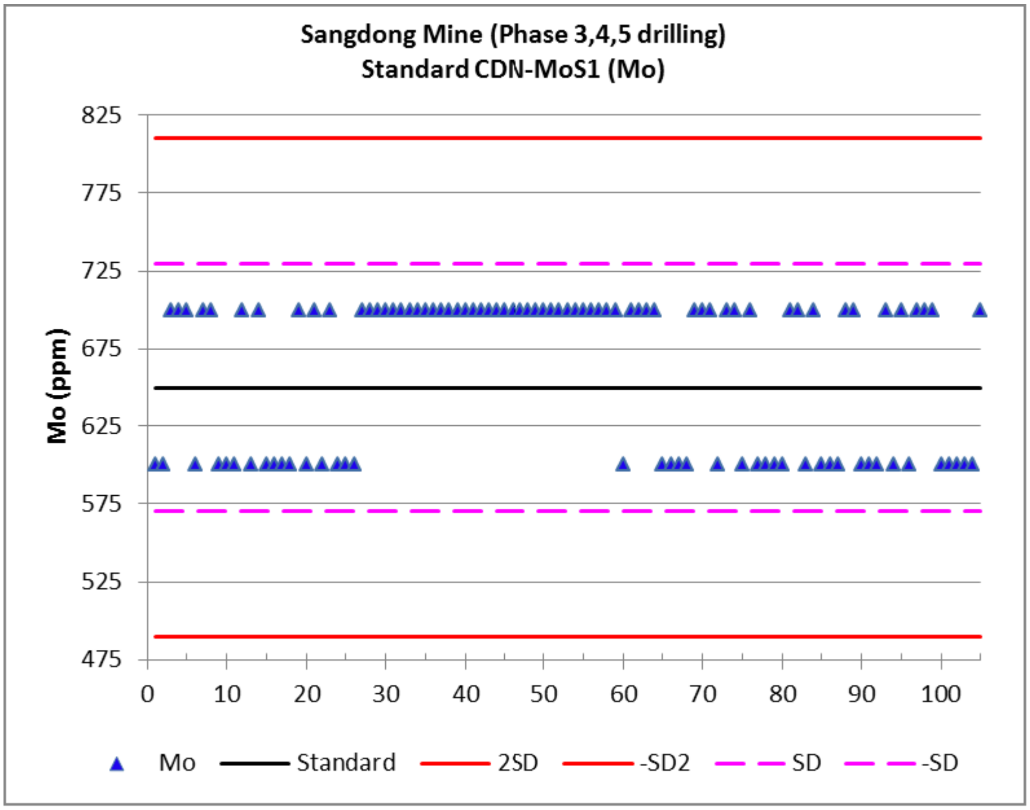


**Figure 11-5. CRM Results – Molybdenum Standard CDN-MoS1**

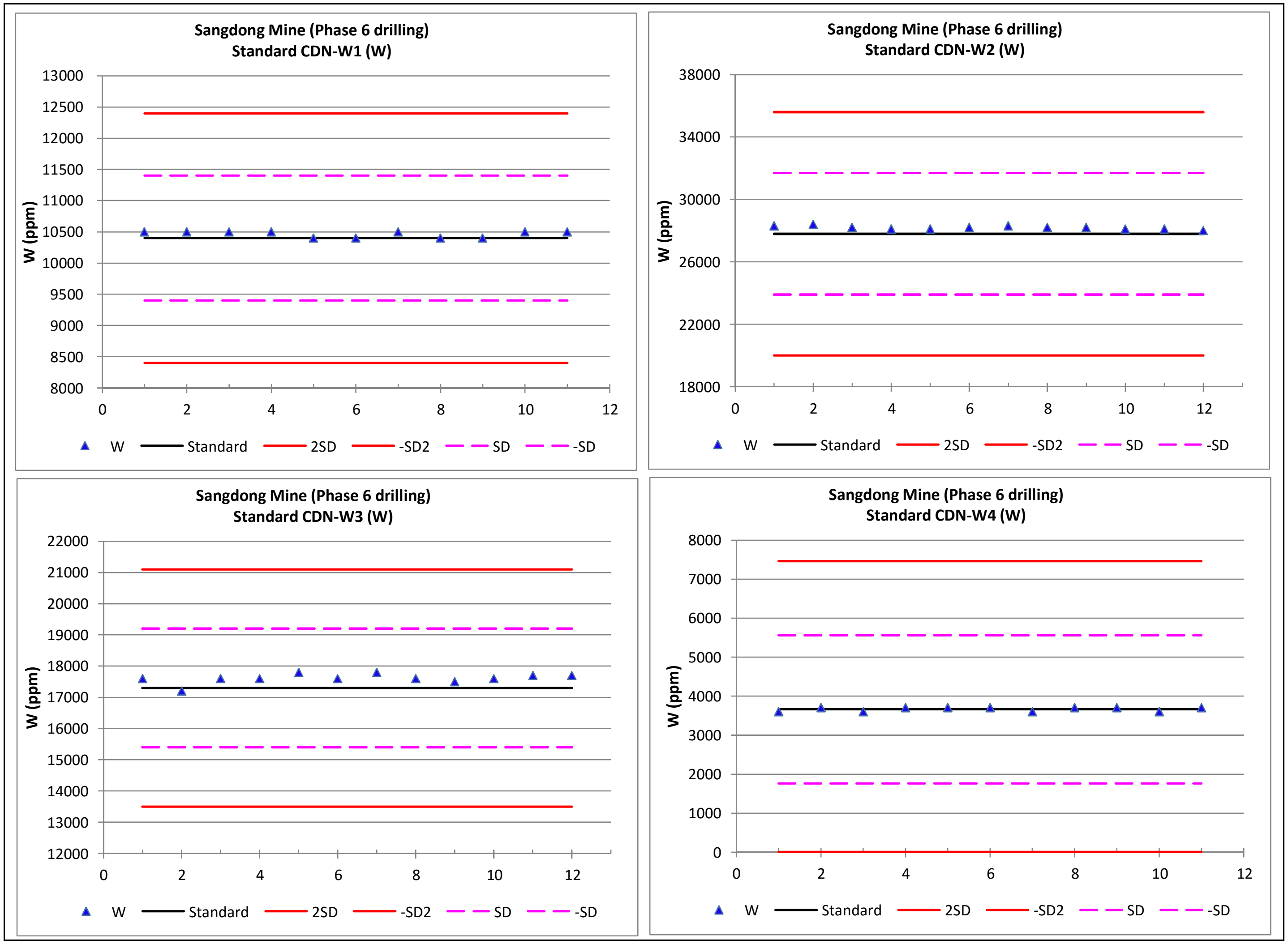



- The CRMs show good compliance for the reporting period.
- The CRMs CDN-W1, CDN-W2 and CDN-W3 display a slight high bias in the middle third of the reporting period of up to approximately 5 % but still well under 1 standard deviation of the lab mean.
- No significant bias is observed for the rest of the reporting period or for the other CRMs.
- The molybdenum CRM is too close to the detection limit to be a useful CRM for the Project.

Tetra Tech considered that the bias observed in the CRM plots is not material for the Mineral Resource Estimate, but recommended continuous monitoring of CRM performance by batch. The results demonstrated the accuracy of the assay results and support their use in Mineral Resource estimation.

Tungsten standard results for Phase 6 are shown in Figure 11-6. The QP, after also checking the Phase 7 results, considers these results to be demonstrating the same accuracy as previously, which therefore supports their use in Mineral Resource Estimation.

**Figure 11-6. CRM Results – Tungsten Standards, Phase 6**



### 11.4.3 Blank Results

Blanks are required to be inserted into the sample sequence by both the laboratory and the laboratory client. Laboratory blanks are usually flux or pure silica and are a test for cleanliness within the laboratory, where poor cleaning of equipment may result in sample contamination.

The coarse crystalline feldspar blank material used by WMC during the period to test for contamination during the sample preparation was certified to contain no metal. Tetra Tech considered assays of blank material to be acceptable if they were less than three times the practical detection limit of the laboratory.

Figure 11-7 and Figure 11-8 show the blank results for the Jan 2012- Sept 2014 reporting period. The tungsten results show three blank values out of 822 are above the acceptable limits while the molybdenum results show two blank values out of 822 that are above the acceptable limits. Tetra Tech considers that the blank value results are acceptable and demonstrate adequate care is taken by WMC staff during sample preparation and the lab employs correct cleanliness procedures. There were also no unacceptable blank values for the Phase 6 blank results.

The QP considers that the sample preparation, security, analytical procedures and supporting QA/QC results that were used to inform the Sangdong Property block model estimate were collected in line with industry good practice as defined in the Canadian Institute of Mining and Metallurgy and Petroleum (CIM) Exploration Best Practice Guidelines and the CIM Mineral Resource, Mineral Reserve Best Practice Guidelines.

**Figure 11-7. Tungsten Blank Results**

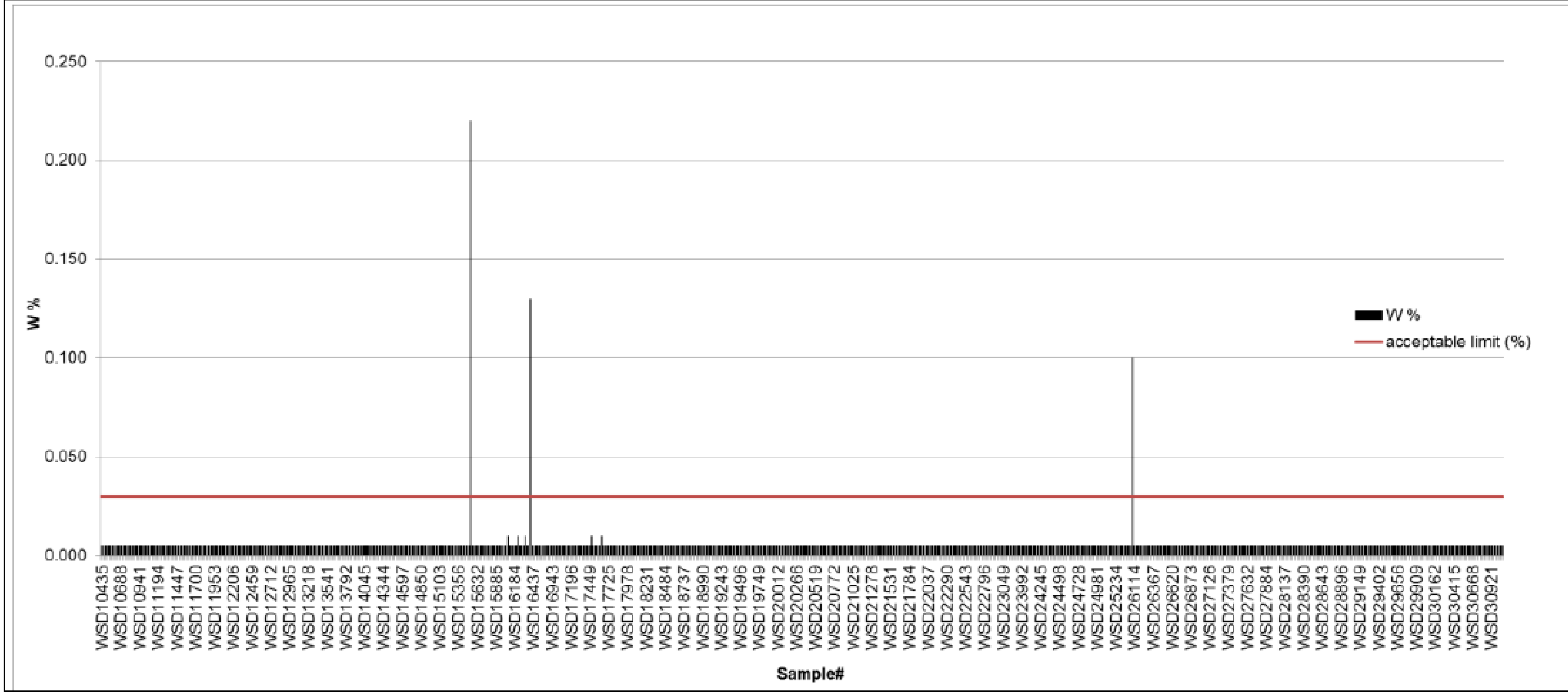
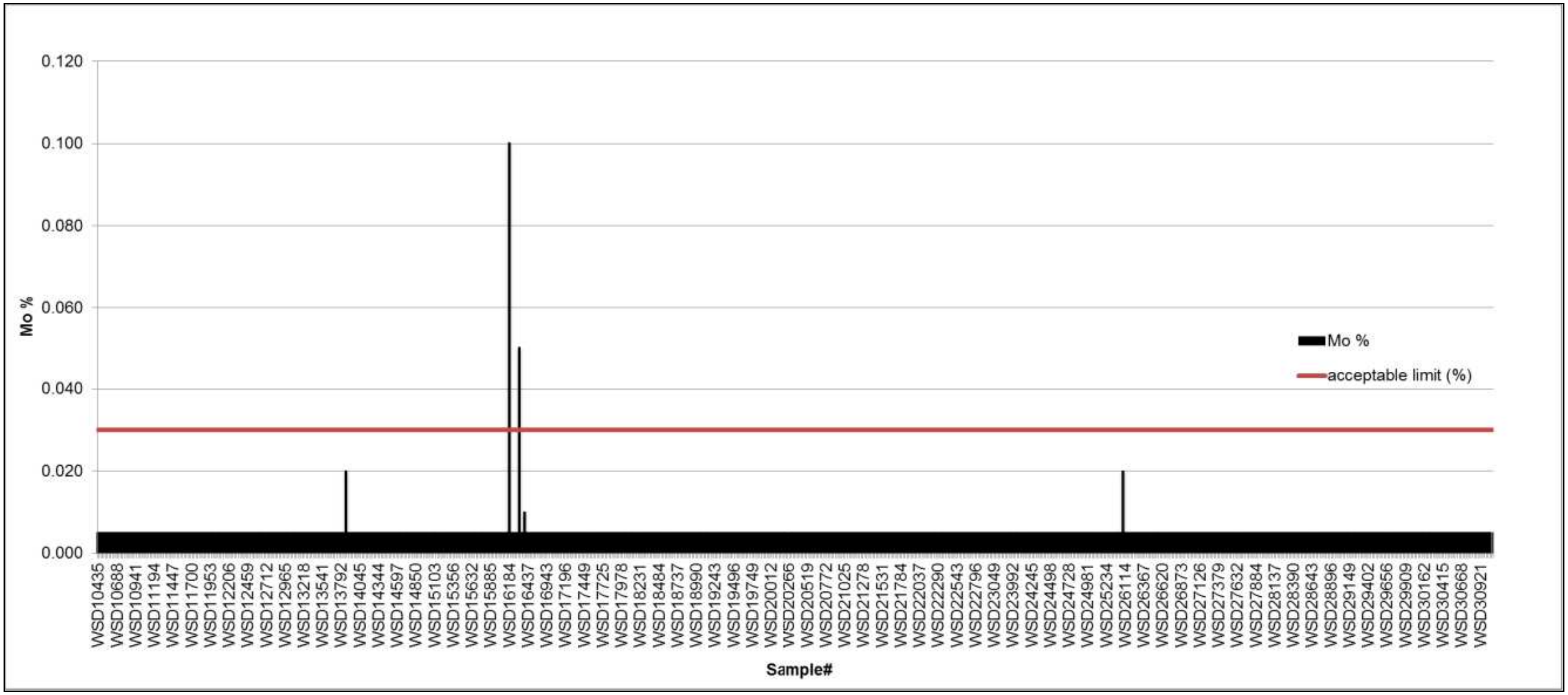


**Figure 11-8. Molybdenum Blank Results**



# 12 DATA VERIFICATION

The data verification procedures applied by various qualified persons at the Sangdong Project since 2006 are summarised below.

## 12.1 Watts, Griffis and McQuat 2006

### 12.1.1 Sampling and Analytical Procedures

The Sangdong Mine underground workings were either inaccessible or, if open, of unknown condition. This restricted WGM's independent sampling to low-grade outcrops and waste dump material. Given the long documented record of tungsten production at the mine, the sampling done during WGM's site visit on November 20, 2006, was clearly not intended to be definitive, rather simply to independently confirm that economically significant grades of tungsten, in particular, were present.

All samples were put into bags and closed with uniquely numbered, locking plastic ties; they remained under lock and key or in WGM's possession during their representative's time in Korea. They were taken as personal baggage to Mississauga, Ontario, and shipped by courier to SGS Mineral Services ("SGS") in Lakefield, Ontario. Samples were assayed for tungsten (reported as %$WO_3$) and molybdenum.

SGS normally inserted one blank per batch of 100 (maximum) samples, one duplicate per 20 samples, and one reference standard every 20 samples.

After drying, if necessary, the samples were crushed to 75% passing 9 mesh (2mm), and riffle split to produce a reject portion and a smaller portion which was pulverized to 85% passing 200 mesh (74µm). A 0.2g charge of each pulverized sample was roasted for 20 minutes and mixed with 5g of potassium pyrosulphate. The mixture was then fused, ground and pressed into a disk. Samples were analysed by the wavelength dispersion X-ray fluorescence (WD-XRF) method having detection limits of 0.05% for each of W and Mo. The XRF method was chosen because normal ICP methods have an upper detection limit of 1% W, and it was suspected that at least two of the Sangdong samples contained appreciably more than this amount of tungsten.

### 12.1.2 Discussion of Results

Analytical results for the independent WGM samples, together with location and sample descriptions, are presented in Table 12.1.

**Table 12-1. Analytical Results from Independent WGM Sampling**

| Sample | Location | Description | %Mo | $\%WO_3$ |
|---|---|---|---|---|
| 72117 | 484816E/4111601N Forestry road south of drillhole SD-1 | 1 m chip sample; part of 8 m wide steeply dipping (65°) structural zone with quartz veins (see photo w CS) | <0.05 | 0.07 |
| 72118 | 485320E/4111401N Outcrop of skarn east of adit above main adit | Composite sample, mostly of subhorizontal quartz veins (up to 10 cm), with some skarn. Minor scheelite. | <0.05 | <0.05 |
| 72119 | Dump near main adit | Composite grab. Scheelite-bearing skarn | <0.05 | 2.27 |
| 72120 | Upper adit dump | Grab sample. Fine-grained skarn. Minor quartz-carbonate veinlets and abundant irregularly distributed scheelite. | <0.05 | 9.16 |
| 72121 | Upper adit dump | Grab sample. Fine-grained skarn with 1 cm quartz veinlet and molybdenite coating on fracture surface. Very minor scheelite. | 0.12 | 0.21 |

Significant amounts of blue-white-fluorescing scheelite were observed in two dump samples from the upper and main adit levels (72119 and 72120) and lesser amounts from a third (72121), confirmed upon analysis. All samples were of compact, fine-grained dark green (amphibole-rich) skarn. The coarse character of the scheelite in sample 72120 is noteworthy.

The outcrop sampled near the upper adit portal consists of diopside-garnet skarn with subhorizontal quartz veins. There was a minor amount of local scheelite.

The most surprising result of 0.07% $WO_3$ was from an 8m wide, steeply dipping (about -65°) structural zone, with multiple quartz veins, in Myobong Shale on the forestry road. Mineralised quartz veins cutting across skarn-type mineralisation are documented in the Sangdong Mine, but apparently at not such a steep inclination. Other similar structural (fault or shear) zones were observed by WGM on the forestry road south of the set-up for drillhole SD-1. Oriental (WMC) had planned to sample this area in some detail.

## 12.2 Sennitt 2007

The Sangdong Project database, residing in MS ACCESS database files, includes all drill collar location, assay, quality assurance and geological data, as well as core recovery, visual estimates of key minerals and bulk density data.

The collar, assay, geological (rock type codes only) and core recovery data were extracted and input into the GEMCOM® modelling software system.

As a test of data integrity, checking of 10% of the data was made against original assay certificates. Collar coordinates were checked against the original survey forms. Results from the data checks showed zero error rate. It was concluded that the assay and survey database used for the mineral resource update was sufficiently free of error to be adequate for resource estimation.

## 12.3 Tetra Tech/Wardrop 2012

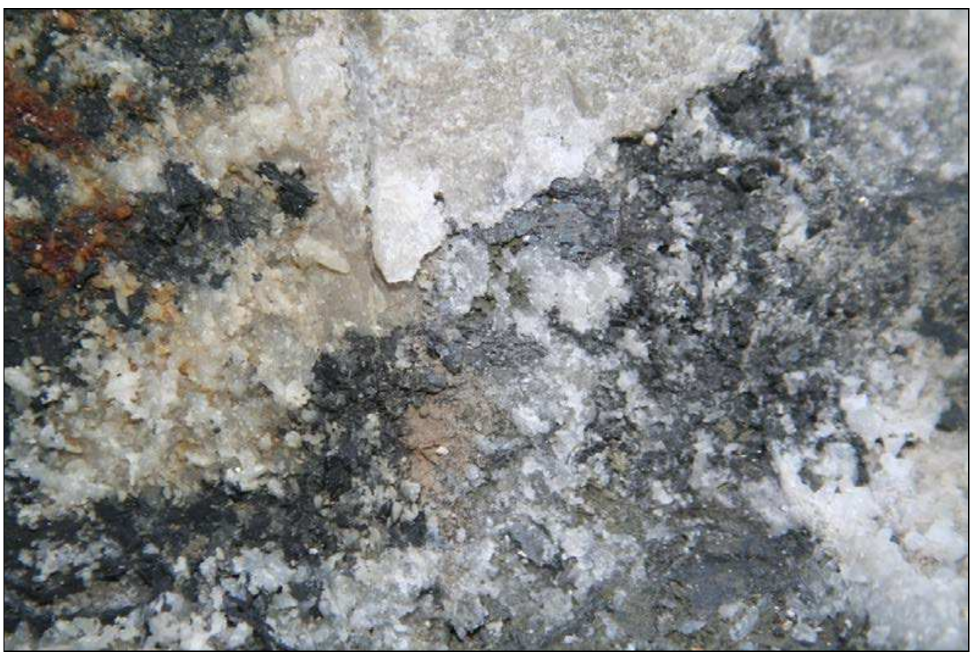
Verification activities conducted during the site visit included:

- Multiple site visits to the Sangdong Property, the last in October 2011, inspection of the exposed host skarn, veining and associated lithologies. The skarn and quartz veining are illustrated in Figure 12.1 and Figure 12.2. Mineralisation in hand specimen is shown in Figure 12.3.

**Figure 12-1. Gently Dipping Skarn at Sangdong**

**Figure 12-2. Concordant Quartz Veining at Sangdong**

**Figure 12-3. Hand Specimen of Mineralisation at Sangdong**



- Core logging (lithology, mineralisation) of selected Sangdong diamond drill holes from the latest drilling programme, at the Sangdong facilities.
- Observation and review of core storage, core logging, core sampling, core cutting and sample preparation procedures, standard reference sample and reject sample storage facilities at the Sangdong facilities.
- Detailed discussion with Woulfe staff was undertaken during the visit to the Sangdong facilities.

Verification activities subsequent to the site visit included:

- Selection of between 5% and 10% of the Sangdong drill holes for verification of handwritten geological logs, original field sample sheets and original ALS assay certificates against corresponding records in the Sangdong database supplied. Copies and scans of original data were supplied by Woulfe in order to carry out the verification exercise off-site.

Very minor discrepancies and errors were encountered during these processes and referred to Woulfe for clarification or correction.

Overall it was concluded by Tetra Tech/Wardrop that appropriate care and attention in data entry, validation and QA/QC procedures had been applied by Woulfe and that analytical issues were identified and appropriate remedial action taken. A possible exception related to downhole surveys of relatively short drillholes, but otherwise industry standard practices had been followed and the quality of the Sangdong database meets NI 43-101 standards and Canadian Institute of Mining, Metallurgy and Petroleum (CIM) best practice guidelines.

Tetra Tech/Wardrop concluded that the combination of the latest sampling and understanding derived from the wealth of historical mining data provided adequate information for the purpose of their resource estimation and Technical Report.

Tetra Tech/Wardrop did not complete any independent exploration work, drill any holes or perform any programme of sampling and assaying on the property. During the field visit (October 2011) Wardrop did not collect any samples from the Sangdong project but was satisfied from visual inspection of the presence of mineralisation at Sangdong.

## 12.4 Tetra Tech/A-Z Mining Professionals 2015 Report

From the *17th of August 2013 to the 1st of September 2013 inclusive*, Tetra Tech full-time employee and Qualified Person Mr. Joe Hirst made a personal inspection of the Sangdong Property and undertook the following data verification steps;

Discussions with site geologists regarding:

- Sample collection
- Sample preparation
- Sample storage
- QA/QC
- Data validation procedures
- Underground mapping procedures

- Survey procedures
- Geological interpretation
- Exploration strategy
- A review of underground back and wall mapping (drifts and rises).
- An inspection of the core sheds and some recent drill core intersections from the Property.
- 100 random cross-checks of the mineralised assay results in the database with original assay results from the reporting period.

Tetra-Tech made the following observations:

- Site geologists are appropriately trained and are conscious of the specific sampling requirements of disseminated mineralisation with high grade lenses.
- Cross-checking the database with the original assay results did not uncover any errors.

## 12.5 AMC 2014

Between the *5th and 15th of August 2014,* AMC full-time employee and QP Dr A P Fowler visited the Sangdong Property; the data verification steps and conclusions were identical to those summarised in the Tetra Tech section above.

## 12.6 Adam Wheeler 2015-2016

Adam Wheeler visited the Sangdong site in August 2015, and discussed with site geologists all aspects of sample collection, preparation and storage, as well as visiting the core storage and sample preparation areas. The updated sample database has also been reviewed in 2015 and 2016, and during the resource estimation process, many aspects of the drillhole data were checked by communication with the Sangdong geologists.

In the QP's opinion, the geological data used to inform the Sangdong Property block model estimates were collected in line with industry good practice as defined in the Canadian Institute of Mining and Metallurgy and Petroleum (CIM) Exploration Best Practice Guidelines and the CIM Mineral Resource, Mineral Reserve Best Practice Guidelines, and were suitable for use in the estimation of Mineral Resources.

# 13 MINERAL PROCESSING AND METALLURGICAL TESTING

## 13.1 Beneficiation of Scheelite Ore from The Sangdong Mine.

[Korea (US Department of the Interior 1954)]

From the test work on the Sangdong scheelite ore, the following conclusions were drawn:

- By crushing and grinding through 28-mesh in equipment selected to produce a minimum of fines, enough scheelite can be liberated to warrant concentration by shaking tables. Removal of the scheelite from the circuit in as coarse a size as possible reduces grinding and subsequent slime loss. Gravity concentration allows direct recovery of approximately 40% of the total tungsten values. Such a gravity concentrate is readily cleaned to market grade, whereas a flotation concentrate (the alternative) is not. The table concentrate can be cleaned simply by sulphide flotation and magnetic separation. It was demonstrated that the sulphur, bismuth, and molybdenum contents of the scheelite table concentrate were effectively removed by sulphide flotation.
- A bismuth-bearing by-product could be made by cleaning the scheelite table concentrate and selectively floating the table tails.
- After proper grinding (90 to 95% minus 200 mesh) a scavenger flotation operation recovered a major portion of the sulphide minerals and the remaining scheelite in 2 selective concentrates. The tungsten flotation concentrate was of low grade (approximately 14% tungsten trioxide); however, such a concentrate is suitable for beneficiation by hydrometallurgical methods.
- The scheelite in the ore submitted was locked with the gangue to the extent of 50% in the minus 20 mesh plus 200 mesh fraction, and 100% in the plus 20 mesh fraction. The grind for flotation work demonstrated good liberation of scheelite below 200 mesh.

The test work on the Sangdong low-grade scheelite concentrate indicated the feasibility of' a soda-ash roast-leach extraction of sodium tungstate to precipitate an artificial scheelite product. The product made from the first part of this calcium chloride precipitation met market specifications in both tungstic oxide content and maximum molybdenum content allowable. The subsequent precipitation products were high in molybdenum, even though the minimum grade for tungstic oxide was met.

Separation of the molybdenum from the tungsten in the pregnant solution was not attempted, as it was beyond the scope of the investigation. However, a process was used by the U.S. Vanadium Co. to make this molybdenum tungsten-separation.

A calculated combination of the results of these two beneficiation procedures was made. This calculation was made to demonstrate the results possibly obtainable if a sample of the Sangdong scheelite ore were treated by tabling, flotation, magnetic separation, and roasting and leaching of low·grade scheelite concentrates for reprecipitation of artificial scheelite products, as indicated by the test work. The hypothetical results indicated that the following marketable products might be prepared:

- A combined natural and artificial scheelite of 63.4% tungstic oxide and 0.65% molybdenum, accounting for 73.6% of the tungstic oxlde;
- A bismuth by-product of 11.1% bismuth and 0.57 and 2.8oz/t of gold and silver, respectively, with recovery of 46.3%.

Further detailed beneficiation study probably would improve the overall metallurgical results. This applies particularly to the scavenger flotation circuit where 18.9% of the tungsten was lost in a tailing containing 0.23% tungstic oxide. It is also probable that cleaning of the table concentrate by sulphide flotation would yield a final tungsten product acceptably free of molybdenum, bismuth and sulphides and at the same time increase the bismuth recovery in the bismuth by-product.

Part of the molybdenum should be recoverable from the sulphide flotation concentrates. The portion entering the pregnant solution may be precipitated with sodium sulphide solution and filtered off before tungsten precipitates. Neither of these steps was attempted, since they were part of existing metallurgical technology; the latter technique has been applied to Korean concentrates, and it was therefore simply assumed that these methods would apply to this ore. These conjectures point to the possibility of better metallurgical results; however, the beneficiation work done has demonstrated that the Sangdong scheelite ore, as approximated by the sample submitted for beneficiation, is amenable to concentration into marketable grade products by a combination of tabling, flotation, magnetic separation, and chemical treatment.

## 13.2 Tetra Tech/Woulfe Mining Corporation (2010 Scoping Study)

The following is a summary, extracted from the Mineral Resource Estimate (TT/WMC 2012), of the mineral processing and metallurgical testing completed during the 2010 Scoping Study.

Mineralogical studies and preliminary metallurgical test work have been conducted on four composite core samples taken from the Sangdong deposit by SGS Mineral Services Europe (SGS). The samples represented the four historical mineralised horizons, namely A,B,C and D+E combined (*although not stated the horizons are assumed to correspond to the Hangingwall, Main and Footwall (F1, F2 and F3*) *horizons*.

The key points arising from SGS test work were:

- The primary economic minerals in the ore are scheelite and molybdenite.
- The sample average head grades were 0.22% $WO_3$ and 0.03% $MoS_2$.

- Fluorite, rhenium, gold, silver, copper and bismuth are present but at sub-economic levels.
- The bond work index was determined as 18.7kW/h/t and the ore is classified as medium hard
- Scheelite becomes increasingly liberated below 500µm with ultimate liberation at approximately 50µm.
- Scheelite is not associated with molybdenite or bismuthinite. Provided the ore minerals are sufficiently liberated from the host rock silicates then separation should be relatively straightforward.
- The relative density of the ore falls between 2.87 and 3.03 and averages 2.90.
- Preconcentration by gravity has been shown to give recoveries of 63% for tungsten and 55% for molybdenum.

***Although theoretical grade and recovery curves were established as part of the quantitative mineralogical programme, process grade and recovery data remained to be established.***

## 13.3 A-Z Mining Professionals Ltd./WMC

Since publication of the Tetra Tech Feasibility Study in 2012 a pilot plant scale test was completed on a bulk sample from the Sangdong deposit in late 2012. The pilot plant testwork was carried out by the Guangzhou Research Institute of Non-ferrous Metals in China producing a report entitled "Research Report on Pilot-plant Test of Mineral Processing for Sangdong Mining Ore from Korea" dated September 2012. The results of this pilot plant testwork are summarised below:

- Though the grade of the sample processed was lower than that used in bench scale testing, comprehensive recovery can still be achieved. All products can be separated into saleable products by processing or hydrometallurgy.

- The strong magnetic minerals in the ore should be removed to prevent adverse effects on scheelite concentrate grade.

- The advised grinding fineness was recommended to be 78-80% -75µm for the Main Zone and 90% -75µm for the FW Zone.

- The pilot plant testwork on the Main Zone used a 78.5% -75µm grind and a molybdenum flotation-sulphide flotation-scheelite rougher flotation. The scheelite concentrate using rougher flotation and heated floatation is produced with a mass yield of 9.13% assaying 65.26% $WO_3$ with an overall recovery of 81.13%. FW Zone testwork used a 95% -75µm grind and a molybdenum flotation-sulphide flotation-scheelite rougher flotation. The scheelite concentrate using rougher flotation and heated flotation is produced with a mass yield of 8.95% assaying 66.07% $WO_3$ with an overall recovery of 78.81%.

- Main and FW Zones mineralogy are similar with the same flowsheet recommended for the two ore types.

***The overall conclusion from the pilot plant testwork was that the flowsheet proposed by Tetra Tech in the 2012 Feasibility Study and technological conditions provided by the pilot plant test could be used as the design basis for the processing plant.***

### 13.3.1 Chinese Collector Alternative

In the pilot plant testwork by the Guangzhou Research Institute of Non-ferrous Metals in China GYWA a proprietary Chinese collector was used in the plant; because of security of supply concerns an alternative to this collector was sourced and tested. The conclusions from testing the R3-3F unit from South Africa were:

- Scouting tests showed each collector capable of producing high grade (circa 20% $WO_3$) $WO_3$ rougher concentrates, albeit at non-optimised recoveries.
- Overall better rougher flotation results were achieved with the R3-3F collector than with GYWA, probably due to the reagent dosages selected.
- Heated cleaner flotation tests had yet to be conducted; however, rougher $WO_3$ grades are approximately double those achieved in China.
- Mo and Bi recoveries to the Mo and sulphide concentrates (which are independent of the $WO_3$ collector used) were low at 17.3 to 19.6% Mo and 29.2 to 32.0%Bi recovery. Mo and sulphide flotation requires optimisation. Losses of $WO_3$ to these concentrates were correspondingly low at 0.5 to 0.8% of the $WO_3$, although these losses will increase slightly when these circuits are optimised.
- Future Work will proceed to optimise the Mo and sulphide circuits ahead of maximising $WO_3$ recovery into the $WO_3$ rougher concentrate.
- Heated cleaner flotation will follow to achieve sales grade $WO_3$ concentrates and confirm this can be achieved with the Chinese collector and the South African collector.

**The validity of the Tetra Tech flowsheet and the projected tungsten recovery were confirmed by the pilot plant and collector alternative testwork, in addition to the original metallurgical testwork presented in the Tetra Tech report.**

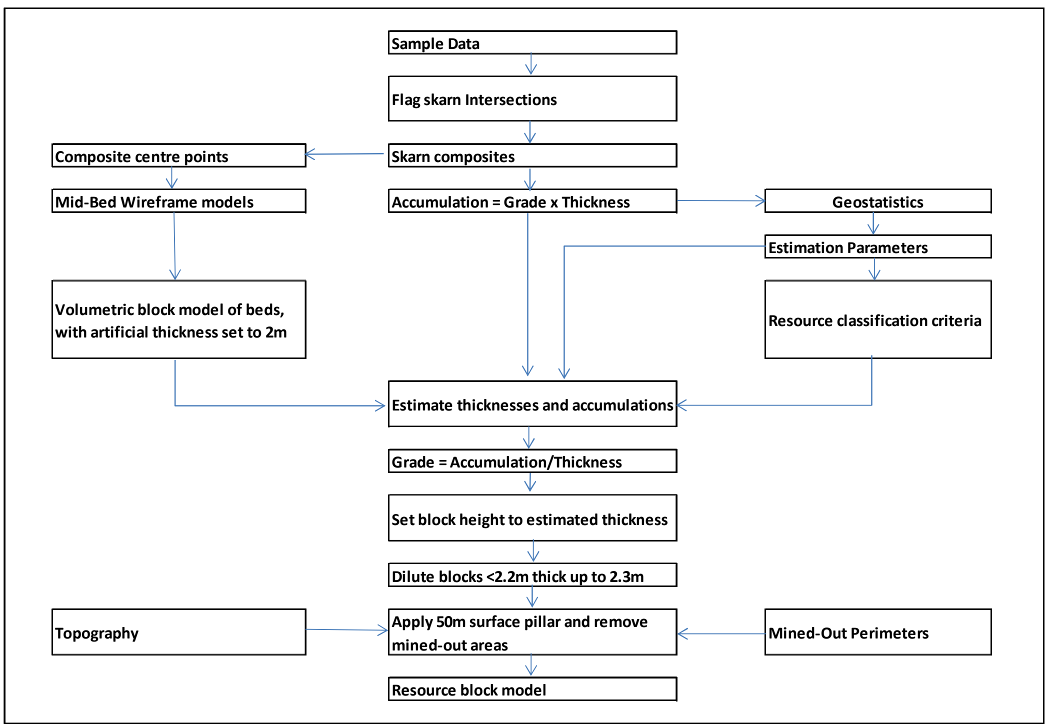
**The testwork also de-risked the processing plant flowsheet and reagents used.**

# 14 MINERAL RESOURCE ESTIMATES

## 14.1 General Methodology

An updated mineral resource estimation was completed, during June-July 2016, by the Qualified Person. This estimation employed a three-dimensional block modelling approach, using CAE Datamine software. Two main resource blocks models were developed. The relatively thick hanging-wall (HW) zone was modelled using a conventional block model structure. All of the other bed-like skarn zones were modelled using the initial generation of 3D digital terrain models (DTMs) for the zone centre-points, onto which thicknesses and grade-accumulations were estimated. This general methodology is described in the flowsheet in Figure 14-1.

**Figure 14-1. Block Modelling Methodology – Thin Skarn Zones**




The interpretation of skarn zones has been generated by SMC geologists, with additional intersection checks and refinements by the QP. The defined skarn intersections have been based on a lithological skarn identification, as well as 0.1% $WO_3$ cut-off grade. Additional mined-out limits for the principal skarn structures were applied, as well as a 50m remnant surface pillar below the surface topography.

## 14.2 Sample Database

The sample database, in the form of an Excel spreadsheet, is comprised of data from a number of surface and underground drillholes, over a number of recent and historical drilling campaigns. A summary of the available sample data is shown in Table 14-1. Plans of all these sample data are shown in Figure 14-2, colour-coded by sampling campaign, and in Figure 14-3, colour-coded by drillhole type – surface or underground. Overlain on these plots are outlines of the mineralised zones.

The different tables in supplied database include:

- Drillhole collars.
- Drillhole survey data.
- Assay data, generally for tungsten, molybdenum, zinc lead, copper, bismuth and gold. Tungsten and molybdenum assays were converted into $WO_3$ and $MoS_2$ grades.
- RQD and fracture spacing.
- Lithology data and weathering index.
- Drillhole recovery.
- Geotechnical logging, including codes and description of joint infilling.
- Density measurements.
- Structure orientation and width data for mapped fault structures.
- Mineralised intersections.

As can be seen from the plan plots, the resultant spacing of samples with these different historical campaigns has ended up being fairly sporadic, with sections spaced at distances from 30m to 100m. Most of the surface holes are vertical, as are the very deep underground holes. Most of the underground holes are angled up or down so as give good intersections with the overall mineralised structures, dipping at approximately $25^{o}$. The lithology codes assigned during logging are summarised in Table 14-1.

**Table 14-1. Exploration Drillhole Lithology Codes**

| CODE | DESCRIPTION |
|---|---|
| CSC | Colluvium |
| DUG | Underground Disturbance |
| DUS | Mine Stope / Cavity |
| DUV | Natural Cavity / Vugh |
| FLT | Fault |
| FMS | Felsic Schist |
| QTZ | Quartz |
| SCL | Limestone |
| SMK | Skarn |
| SMQ | Quartzite (Leptite) |
| SMS | Slate |

Drillhole recoveries were not consistently good. In the recorded recovery data, with over 75% of the holes having a recovery of over 90%.

**Table 14-2. Summary of Sample Database**

| | | Surface Holes | | | Underground Holes | | | All Holes | | | $WO_3$ | | $MoS_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company | Code | Holes | Length m | Average Length / Hole m | Holes | Length m | Average Length / Hole m | Holes | Length m | Average Length / Hole m | Samples | Holes With Samples | Samples | Holes With Samples |
| Korea Resource Corp | KORE | 7 | 1,185 | 169 | | | | 7 | 1,185 | 169 | 795 | 7 | 672 | 7 |
| Korea Tunsten Mining Corp | KTMC | 51 | 38,970 | 764 | 812 | 43,859 | 54 | 863 | 82,829 | 96 | 7,758 | 752 | 4,961 | 660 |
| Oriental Minerals | P0 | 91 | 22,801 | 251 | | | | 91 | 22,801 | 251 | 21,111 | 91 | 8,226 | 88 |
| Woulfe Mining Corp | P1 | 9 | 1,744 | 194 | 29 | 2,521 | 87 | 38 | 4,265 | 112 | 3,867 | 32 | 3,867 | 32 |
| | P2 | | | | 51 | 3,673 | 72 | 51 | 3,673 | 72 | 4,830 | 48 | 4,830 | 48 |
| | P3 | | | | 93 | 4,049 | 44 | 93 | 4,049 | 44 | 5,655 | 91 | 5,655 | 91 |
| | P4 | | | | 103 | 4,214 | 47 | 103 | 4,214 | 41 | 5,599 | 101 | 5,599 | 101 |
| | P5 | | | | 121 | 3,084 | 25 | 121 | 3,084 | 25 | 4,359 | 121 | 4,359 | 121 |
| | P6 | | | | 10 | 643 | 64 | 10 | 643 | 64 | 912 | 7 | 912 | 7 |
| AKT | P7 | | | | 20 | 1,004 | 50 | 20 | 1,004 | 50 | 905 | 20 | 905 | 20 |
| **Total** | | **158** | **64,700** | **409** | **1,239** | **63,048** | **51** | **1,397** | **127,748** | **91** | **55,791** | **1,270** | **39,986** | **1,175** |

**Figure 14-2. Plan of Exploration Sample Data – By Campaign**

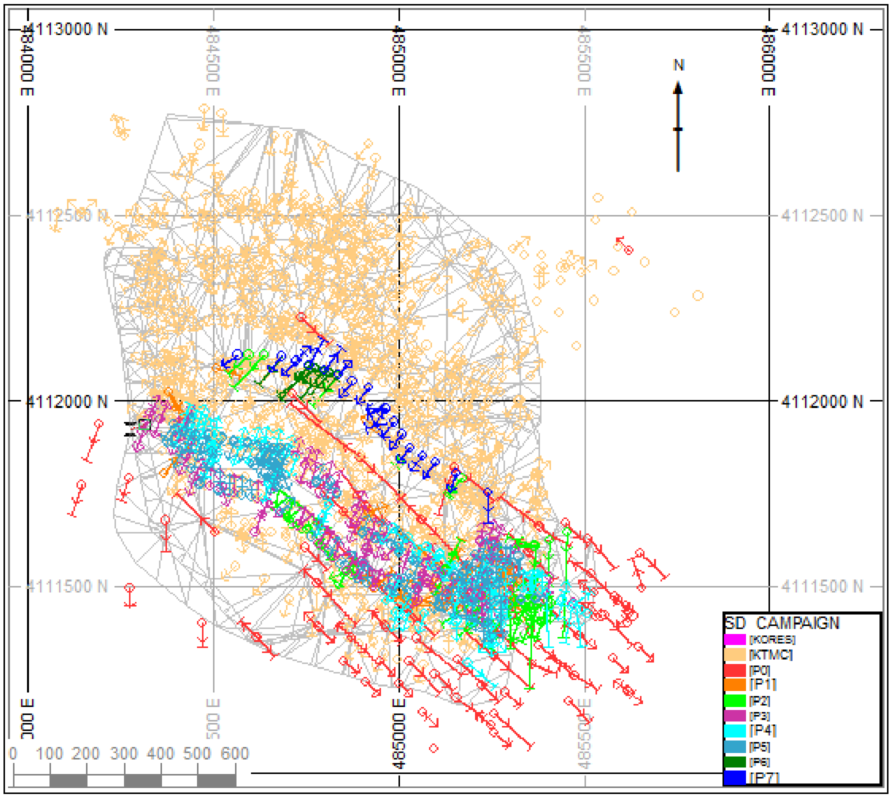
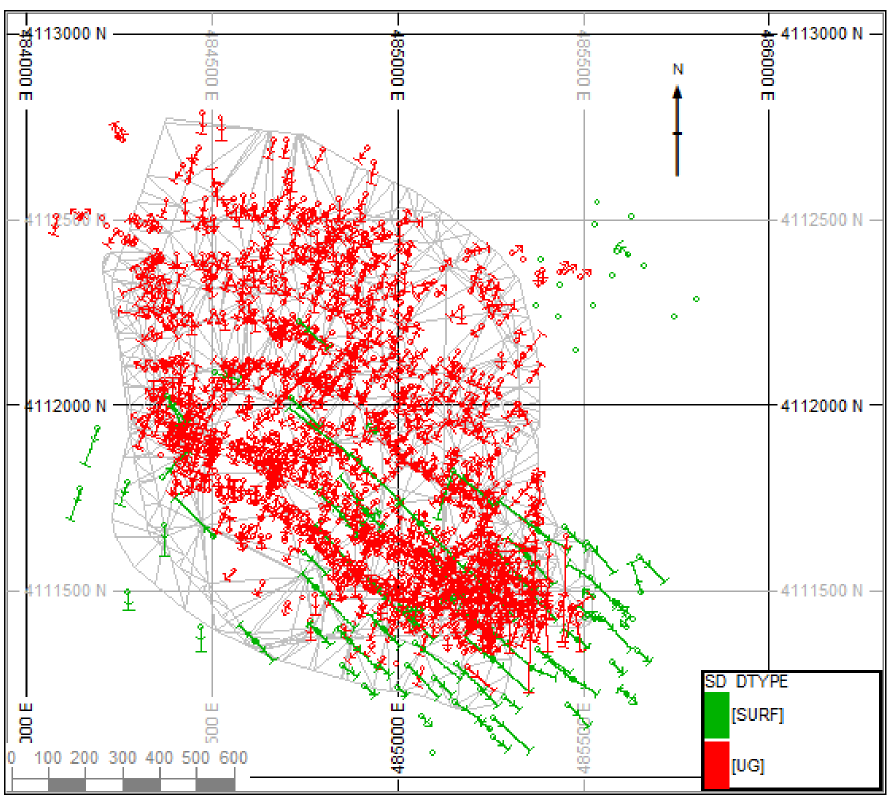



**Figure 14-3. Plan of Exploration Sample Data – By Drillhole Type**



## 14.3 Interpretation

The tungsten and molybdenum mineralisation is principally contained within tabular calc-silicate horizons, that are the product of skarn alteration of calcareous layers within the Myobong Shale. These horizons dip at approximately 25$^{o}$, and have a dip direction of approximately 025$^{o}$. The underlying Jangsan Quartzite also contain molybdenum mineralisation related to quartz veining and stockwork development (described in to 2010 Wardrop scoping study). The current estimate work is only focused on the tungsten mineralised skarn horizons. The updated interpretation has been built up using the following procedure:

1. The initial zone intersections recorded by SMC geologists have been taken, and used to demarcate the different primary mineralised intersections in each hole.

2. On importing the data into Datamine, checks have made for any illogical sequencing of intersections, according to the basic top to bottom zone sequence shown below. Any errors found were corrected. Communication with Sangdong geologists was also very important in this process.

   Zone Sequence
   HW
   MAIN
   F1
   F2
   HALO
   F3
   F4
   F5

3. For the HW zone, those relatively older holes (marked with H- prefix) holes were those generally drilled into or near the HW zone. For those holes which did not have any specific identifications flagged, HW intersections were automatically generated based on a cut-off of 0.2%$WO_3$. For the all of the HW data, the top-most and bottom-most intersections were then flagged in each hole. Between these extreme points, 5m composites were created in each flagged hole. Points of the hanging-wall and foot wall contacts for the HW zone were created, and DTMs of these surfaces were generated.

4. For all the other zones, the mineralised intersections were converted into three-dimensional composites. The centre-points of these composites were used to generate

central DTMs for each zone. In this DTM generation process, limiting edge perimeters were also created for each zone.

5. The DTMs generated by the steps above were then used to test for any errors or intersections. Sections throughout the deposit were also examined. This process enabled many errors to be corrected, along with communication and checking by SMC geologists, after which steps 2-4 were repeated again.

In this error checking process, particular types of intersections were also flagged for the HW zone, marking valid intersections, but which are not representing footwall and or hanging wall contacts. An example of the final intersections is shown in Figure 14-4, corresponding with data for the same holes summarised in Table 14-4. Assay data for the surface hole SD_63 is also shown in Table 14-5.

There are a number of post-mineralisation faults. These are generally steep and oriented from north to 040°. The overall deposit is approximately bounded by major faults to the west and east of the deposit. Within the deposit there areas of smaller faults, typically spaced at 50m apart. The vertical throw of these faults is typically 1-4m. These faulted structures have not been specifically built into the current resource model. However, the DTMs generated directly from the drillhole intersections do have sharp angular deviations, reflecting the overall displacements produced by intersected faults.

An overall summary of the interpreted mineralised zones is shown in Table 14-3. As can be seen from this table, the individual beds below the HW structure generally have an average thickness of 1-4m. Most of these beds also outcrop. The overall thickness of the entire mineralised tungsten suite of skarn bodies is approximately 130 m.

**Table 14-3. Overall Mineralisation Dimensions**

| | | | Vertical Limits | | | True Width | | | |
|---|---|---|---|---|---|---|---|---|---|
| Zone | Strike Length *m* | Dip Length *m* | Minimum Base Elevation *m RL* | Maximum Elevation *m RL* | Max. depth *m* | Max *m* | Average *m* | Dip Range *(°)* | Average Dip *(°)* |
| HW | 1,300 | 1,430 | 330 | 900 | 740 | 73.0 | 17.4 | 0-45 | 25 |
| MAIN | 1,600 | 1,410 | 300 | 870 | 580 | 14.9 | 4.7 | 16-40 | 24 |
| F1 | 1,300 | 740 | 555 | 850 | 370 | 5.2 | 1.3 | 14-36 | 24 |
| F2 | 1,540 | 1,070 | 435 | 870 | 510 | 8.4 | 3.5 | 17-32 | 25 |
| HALO | 820 | 450 | 570 | 760 | 185 | 3.3 | 1.1 | 15-45 | 25 |
| F3 | 1,300 | 960 | 430 | 815 | 550 | 9.2 | 2.6 | 7-39 | 23 |
| F4 | 1,220 | 980 | 386 | 800 | 580 | 5.7 | 2.7 | 10 | 24 |
| F5 | 1,020 | 580 | 535 | 780 | 420 | 4.5 | 2.5 | 15-36 | 24 |
| Overall Mineralisation | 1,770 | 1,500 | 300 | 900 | 740 | 150 | 130 | 10-45 | 25 |

**Figure 14-4. Example Cross-Section of Interpretation**

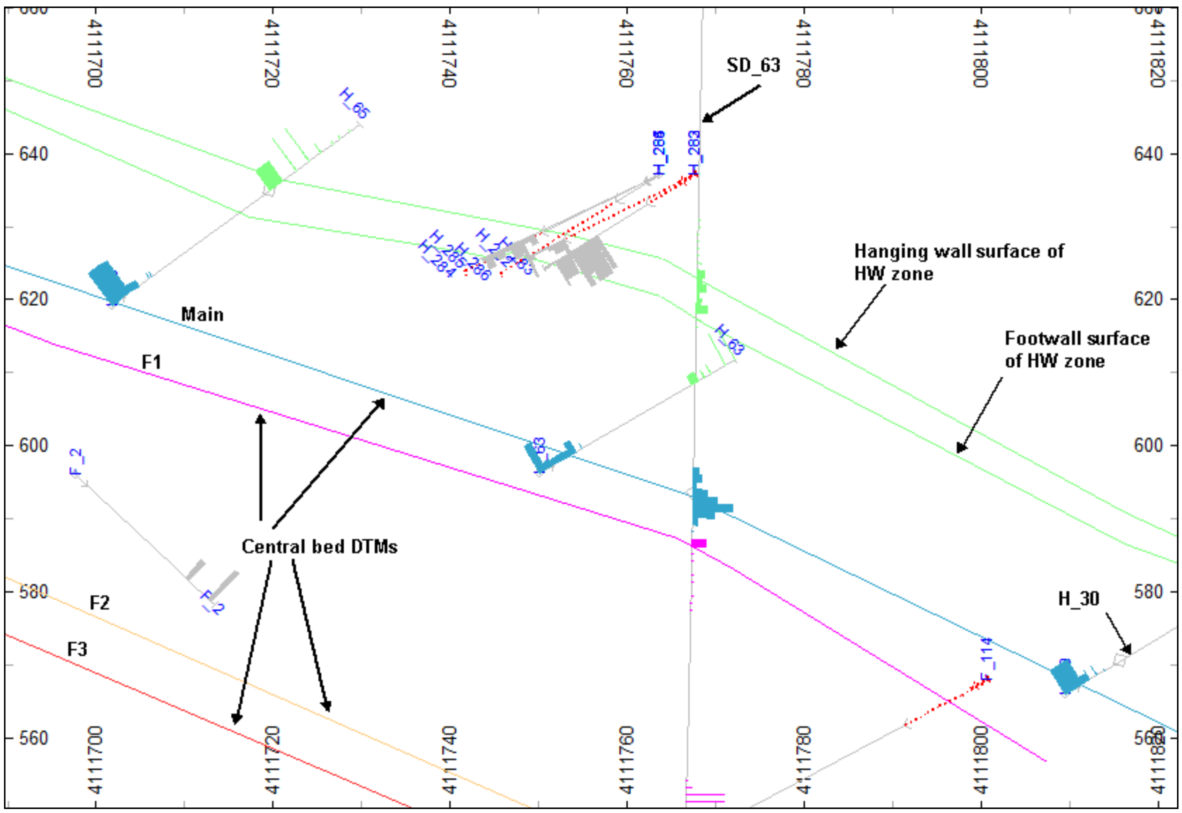



**Table 14-4. Example Mineralised Zone Intersections**

| HOLE_ID | FROM | TO | AZONE |
|---|---|---|---|
| SD_63 | 257.0 | 263.0 | HW |
| SD_63 | 285.0 | 293.0 | MAIN |
| SD_63 | 295.0 | 296.0 | F1 |
| SD_63 | 339.0 | 342.0 | F2 |
| SD_63 | 345.0 | 349.0 | F3 |
| SD_63 | 388.0 | 391.0 | F4 |
| H_65 | 0.0 | 4.5 | MAIN |
| H_65 | 26.7 | 29.0 | HW |
| H_63 | 0.0 | 5.8 | MAIN |
| H_63 | 24.1 | 25.1 | HW |
| H_30 | 0.0 | 4.7 | MAIN |
| H_30 | 33.7 | 39.4 | HW |

**Table 14-5. Example of Assays in Hole SD_63**

| HOLE_ID | SAMP_ID | FROM | TO | WO3 % | |
|---|---|---|---|---|---|
| SD_63 | 18200 | 252 | 253 | 0.05 | |
| SD_63 | 18201 | 253 | 254 | 0.03 | |
| SD_63 | 18202 | 254 | 255 | 0.04 | |
| SD_63 | 18203 | 255 | 256 | 0.05 | |
| SD_63 | 18205 | 256 | 257 | 0.11 | |
| SD_63 | 18206 | 257 | 258 | 0.19 | |
| SD_63 | 18207 | 258 | 259 | 0.13 | |
| SD_63 | 18208 | 259 | 260 | 0.22 | HW |
| SD_63 | 18209 | 260 | 261 | 0.04 | |
| SD_63 | 18210 | 261 | 262 | 0.13 | |
| SD_63 | 18211 | 262 | 263 | 0.29 | |
| SD_63 | 18212 | 263 | 264 | 0.13 | |
| SD_63 | 18213 | 264 | 265 | 0.05 | |
| SD_63 | 18214 | 265 | 266 | 0.01 | |
| SD_63 | 18215 | 266 | 267 | 0.00 | |
| SD_63 | 18216 | 267 | 268 | 0.00 | |
| SD_63 | 18217 | 268 | 269 | 0.00 | |
| SD_63 | 18218 | 269 | 270 | 0.00 | |
| SD_63 | 18219 | 270 | 271 | 0.00 | |
| SD_63 | 18220 | 271 | 272 | 0.00 | |
| SD_63 | 18221 | 272 | 273 | 0.00 | |
| SD_63 | 18222 | 273 | 274 | 0.01 | |
| SD_63 | 18223 | 276 | 277 | 0.00 | |
| SD_63 | 18225 | 277 | 278 | 0.01 | |
| SD_63 | 18226 | 278 | 279 | 0.00 | |
| SD_63 | 18227 | 279 | 280 | 0.00 | |
| SD_63 | 18228 | 280 | 281 | 0.00 | |
| SD_63 | 18229 | 281 | 282 | 0.00 | |
| SD_63 | 18230 | 282 | 283 | 0.00 | |
| SD_63 | 18231 | 283 | 284 | 0.00 | |
| SD_63 | 18232 | 284 | 285 | 0.01 | |
| SD_63 | 18233 | 285 | 286 | 0.15 | |
| SD_63 | 18235 | 286 | 287 | 0.25 | |
| SD_63 | 18236 | 287 | 288 | 0.09 | |
| SD_63 | 18237 | 288 | 289 | 0.37 | MAIN |
| SD_63 | 18238 | 289 | 290 | 0.61 | |
| SD_63 | 18239 | 290 | 291 | 2.36 | |
| SD_63 | 18240 | 291 | 292 | 0.54 | |
| SD_63 | 18241 | 292 | 293 | 0.13 | |
| SD_63 | 18242 | 293 | 294 | 0.07 | |
| SD_63 | 18243 | 294 | 295 | 0.02 | |
| SD_63 | 18245 | 295 | 296 | 0.38 | F1 |
| SD_63 | 18246 | 296 | 297 | 0.00 | |
| SD_63 | 18247 | 297 | 298 | 0.06 | |
| SD_63 | 18248 | 298 | 299 | 0.01 | |

## 14.4 Sample Selection and Compositing

As described in the previous section, samples were selected by two methods:

1. For the HW zone, samples were initially selected as those marked as HW intersections in the SMC database. For the relatively older holes (marked with an H- prefix), as well as all Phase 6 holes, which did not have any specific identifications flagged, HW intersections were also automatically generated based on a cut-off of 0.2%$WO_3$. For all of the HW data, the top-most and bottom-most intersections were then flagged in each hole. Those unflagged samples between these contacts were flagged as waste samples (AZONE=WAST). In addition to this, a customised set of HW contact point exceptions was created, where flagged HW samples were not to be used for upper or lower contacts.

2. For all the other skarn MAIN and F- beds, samples were selected based on those sampled flagged as such by SMC geologists, as well as additional corrections applied by the QP. The original selection criteria by SMC geologists were based on a combination of logged lithologies, as well as a cut-off of 0.1% $WO_3$ for continuity.

Based on this selection process, a separate selected sample file was created, as summarised in Table 14-6. In this table, the information has also been broken down between the older KTMC/KORES era of sampling, as compared with the more recent sampling associated with Oriental Minerals and WMC.

A histogram of sample lengths is shown in Figure 14-5. It can be seen from this that the two most common sample lengths are 0.5 m and 1 m.

**Figure 14-5. Histogram of Sample Lengths**

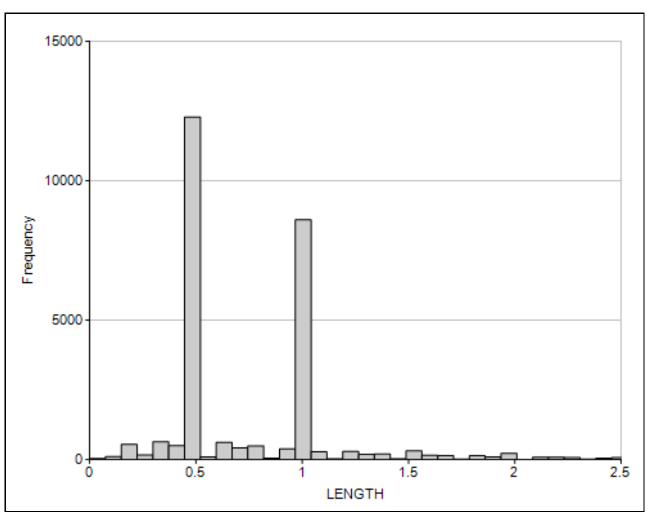


**Table 14-6. Selected Sample Summary**

| Campaigns | Code | Holes: Holes | Holes: Length m | Holes: Average Length / Hole m | $WO_3$: Samples | $WO_3$: Holes With Samples | MoS2: Samples | MoS2: Holes With Samples |
|---|---|---|---|---|---|---|---|---|
| KTMC / KORES | HW | 294 | 3,289 | 11.2 | 2,328 | 835 | 1,681 | 606 |
| | MAIN | 63 | 444 | 7.0 | 331 | 63 | 168 | 49 |
| | F1 | 6 | 6 | 1.1 | 10 | 6 | 7 | 4 |
| | F2 | 2 | 6 | 2.8 | 4 | 2 | 2 | 2 |
| | F3 | 2 | 2 | 1.2 | 3 | 2 | 2 | 2 |
| | F4 | 1 | 5 | 4.5 | 9 | 1 | 9 | 1 |
| Oriental Minerals/ WMC | HW | 97 | 1,259 | 13.0 | 1,825 | 252 | 1,786 | 249 |
| | MAIN | 151 | 1,007 | 6.7 | 1,583 | 150 | 1,524 | 147 |
| | F1 | 119 | 224 | 1.9 | 374 | 119 | 367 | 112 |
| | F2 | 246 | 1,035 | 4.2 | 1,704 | 246 | 1,616 | 240 |
| | HALO | 118 | 175 | 1.5 | 308 | 118 | 299 | 111 |
| | F3 | 236 | 836 | 3.5 | 1,402 | 236 | 1,308 | 223 |
| | F4 | 92 | 263 | 2.9 | 375 | 92 | 301 | 84 |
| | F5 | 41 | 117 | 2.8 | 155 | 41 | 118 | 38 |
| AKT | HW | 19 | 287 | 15.1 | 276 | 64 | 276 | 64 |
| All | HW | 410 | 4,836 | 11.8 | 4,429 | 1,151 | 3,743 | 919 |
| | MAIN | 214 | 1,451 | 6.8 | 1,914 | 213 | 1,692 | 196 |
| | F1 | 125 | 230 | 1.8 | 384 | 125 | 374 | 116 |
| | F2 | 248 | 1,040 | 4.2 | 1,708 | 248 | 1,618 | 242 |
| | HALO | 118 | 175 | 1.5 | 308 | 118 | 299 | 111 |
| | F3 | 238 | 838 | 3.5 | 1,405 | 238 | 1,310 | 225 |
| | F4 | 93 | 267 | 2.9 | 384 | 93 | 310 | 85 |
| | F5 | 41 | 117 | 2.8 | 155 | 41 | 118 | 38 |

**Notes:**

KORE Korea Resource Corp
KTMC Korea Tunsten Mining Corp
WMC Woulfe Mining Corporation
AKT Almonty Korea Tungsten Corporation

For the generation of composites from the selected sample sets, the presence of grade outliers was also tested, to determine if top-cut levels should be applied. This outlier analysis included:

- Observations from log-probability plots
- Decile analyses
- Coefficient of variation (CV) analyses.

The results of all three tests were considered in the selection of appropriate threshold limits for applying top-cuts. The coefficient of variation (CV) is calculated as follows:

CV = Standard deviation / Mean

In CV analysis, CV values are calculated above progressively higher lower-most grade values of each main zone and grade field. A graph is then plotted of the CV values against its ranking in the CV list. Marked breaks in this variation index indicate particular thresholds at which marked changes in the grade population occur. A similar procedure was repeated for all the principal zones. These threshold levels were then applied during the compositing process, so as to top-cut any outlier values above these top-cut levels. Because of the variable sample lengths, the top-cut levels were applied before the composites were created.

Log probability plots for $WO_3$ grades in the selected samples are shown in Figure 14-6. Example CV plots of $WO_3$ grades for the HW and MAIN zones are shown in Figure 14-7, with the selected top-cut levels, and example decile analysis results for the HW and MAIN zones are shown in Table 14-8. Using these methods of analysis, the top-cut levels in Table 14-7 were selected. Log-probability plots, CV plots and decile analyses for all zones are shown in Appendix A.

**Table 14-7. Top-Cut Levels**

| AZONE | $WO_3$ | $MoS_2$ |
|---|---|---|
| | % | % |
| HW | 4.0 | 1 |
| MAIN | 4.0 | 1 |
| F1 | 3.2 | 1 |
| F2 | 3.4 | 1 |
| HALO | 1.6 | 2 |
| F3 | 4.1 | 1.5 |
| F4 | 1.6 | 0.7 |
| F5 | 1.4 | 0.8 |

**Figure 14-6. Log Probability Plot for WO3 Grades in Selected Samples**

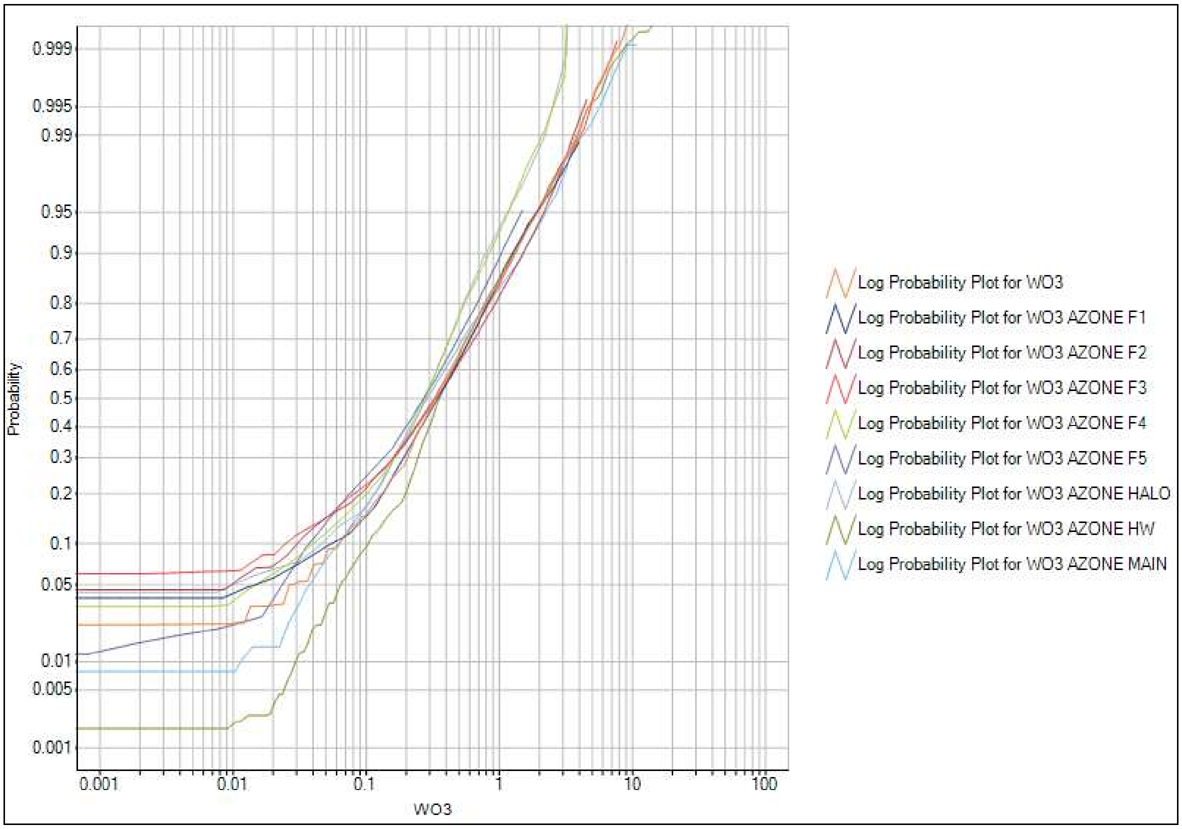



**Figure 14-7. Example Coefficient of Variation Plots**

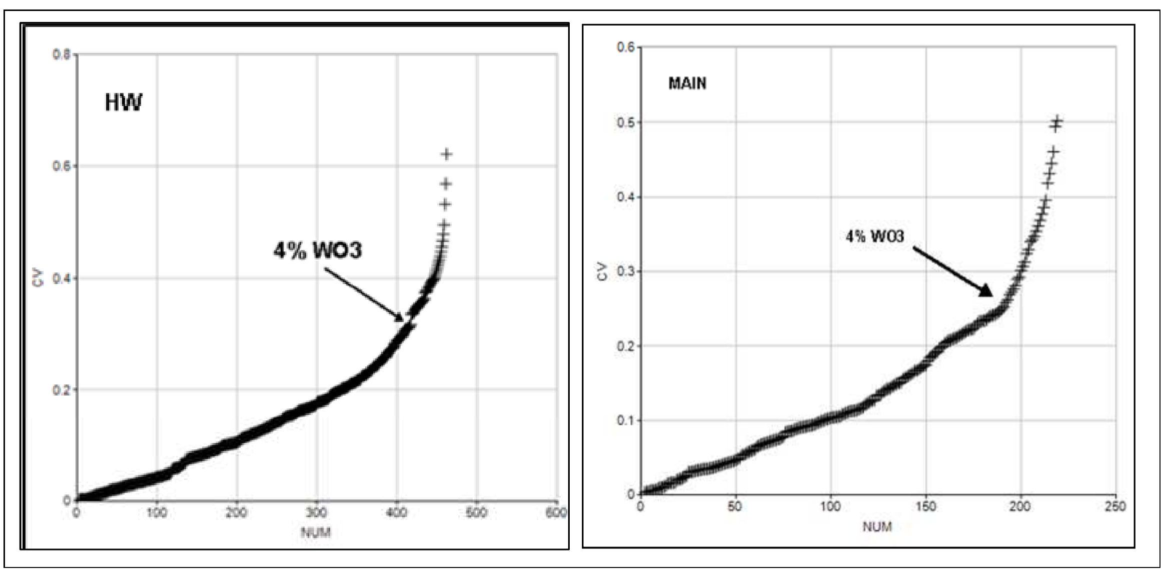


**Table 14-8. Decile Analyses of WO3 Sample Grades in HW and MAIN Zones**

| AZONE | Q%_FROM | Q%_TO | NUMBER | MEAN | MINIMUM | MAXIMUM | METAL | METAL% |
|---|---|---|---|---|---|---|---|---|
| MAIN | 0 | 10 | 258 | 0.05 | 0.01 | 0.08 | 6.37 | 0.8 |
| | 10 | 20 | 195 | 0.10 | 0.08 | 0.12 | 13.09 | 1.7 |
| | 20 | 30 | 217 | 0.15 | 0.12 | 0.17 | 19.81 | 2.5 |
| | 30 | 40 | 237 | 0.20 | 0.17 | 0.23 | 26.82 | 3.4 |
| | 40 | 50 | 188 | 0.25 | 0.23 | 0.28 | 33.91 | 4.3 |
| | 50 | 60 | 217 | 0.33 | 0.28 | 0.38 | 45.25 | 5.7 |
| | 60 | 70 | 234 | 0.44 | 0.38 | 0.51 | 59.82 | 7.6 |
| | 70 | 80 | 221 | 0.64 | 0.51 | 0.81 | 85.90 | 10.9 |
| | 80 | 90 | 233 | 1.07 | 0.81 | 1.46 | 145.07 | 18.4 |
| | 90 | 100 | 233 | 2.59 | 1.46 | 11.63 | 351.40 | 44.6 |
| | 90 | 91 | 29 | 1.51 | 1.46 | 1.57 | 20.41 | 2.6 |
| | 91 | 92 | 25 | 1.65 | 1.59 | 1.70 | 22.05 | 2.8 |
| | 92 | 93 | 20 | 1.79 | 1.70 | 1.85 | 23.45 | 3.0 |
| | 93 | 94 | 15 | 1.92 | 1.86 | 1.96 | 26.10 | 3.3 |
| | 94 | 95 | 20 | 2.04 | 1.97 | 2.12 | 28.29 | 3.6 |
| | 95 | 96 | 27 | 2.28 | 2.13 | 2.42 | 31.86 | 4.0 |
| | 96 | 97 | 20 | 2.59 | 2.46 | 2.66 | 34.66 | 4.4 |
| | 97 | 98 | 26 | 2.95 | 2.67 | 3.13 | 39.76 | 5.0 |
| | 98 | 99 | 26 | 3.40 | 3.14 | 3.96 | 46.59 | 5.9 |
| | 99 | 100 | 25 | 5.69 | 4.06 | 11.63 | 78.22 | 9.9 |
| | 0 | 100 | 2233 | 0.58 | 0.01 | 11.63 | 787.44 | 100.0 |
| HW | 0 | 10 | 730 | 0.08 | 0.01 | 0.14 | 40.17 | 1.5 |
| | 10 | 20 | 489 | 0.19 | 0.14 | 0.22 | 91.67 | 3.5 |
| | 20 | 30 | 471 | 0.24 | 0.22 | 0.26 | 113.35 | 4.3 |
| | 30 | 40 | 455 | 0.28 | 0.26 | 0.30 | 133.36 | 5.1 |
| | 40 | 50 | 436 | 0.33 | 0.30 | 0.36 | 158.23 | 6.0 |
| | 50 | 60 | 450 | 0.40 | 0.36 | 0.44 | 189.48 | 7.2 |
| | 60 | 70 | 432 | 0.49 | 0.44 | 0.54 | 231.74 | 8.8 |
| | 70 | 80 | 484 | 0.62 | 0.54 | 0.72 | 296.00 | 11.3 |
| | 80 | 90 | 515 | 0.88 | 0.72 | 1.11 | 419.00 | 16.0 |
| | 90 | 100 | 613 | 2.00 | 1.11 | 18.10 | 950.37 | 36.2 |
| | 90 | 91 | 55 | 1.13 | 1.11 | 1.16 | 52.57 | 2.0 |
| | 91 | 92 | 48 | 1.20 | 1.17 | 1.24 | 55.37 | 2.1 |
| | 92 | 93 | 53 | 1.28 | 1.24 | 1.33 | 63.49 | 2.4 |
| | 93 | 94 | 54 | 1.38 | 1.33 | 1.43 | 65.04 | 2.5 |
| | 94 | 95 | 61 | 1.52 | 1.44 | 1.61 | 71.90 | 2.7 |
| | 95 | 96 | 63 | 1.71 | 1.62 | 1.80 | 80.50 | 3.1 |
| | 96 | 97 | 66 | 1.95 | 1.80 | 2.10 | 92.45 | 3.5 |
| | 97 | 98 | 66 | 2.25 | 2.10 | 2.42 | 107.72 | 4.1 |
| | 98 | 99 | 70 | 2.76 | 2.43 | 3.29 | 130.00 | 5.0 |
| | 99 | 100 | 77 | 4.84 | 3.35 | 18.10 | 231.34 | 8.8 |
| | 0 | 100 | 5075 | 0.55 | 0.01 | 18.10 | 2623.37 | 100.0 |

The selected and top-cut samples were then composited. For the samples in the HW zone intersections, the following composite controls were applied :

1. Based on samples being flagged as either WASTE or HW within each overall intersection, zonal control was applied, such that separate waste and mineralised composites were created, split on the original sample division.

2. Composite length 5m. This compositing length was applied as slightly variable, such that an equal composite length of approximately 5m was applied across each intersection. This length was chosen to represent vertical selectivity with respect to subsequent underground mining.

3. Minimum composite length = 0.3m.

4. Minimum/maximum gap length = 1m / 2m.

For the samples in the MAIN and footwall zones, the following composite controls were applied :

1. Complete intersection composites were created, across each skarn body defined by its AZONE identifier.

2. Minimum composite length = 0.3m.

3. Minimum/maximum gap length = 1m / 2m.

4. Based on the central DTM of each skarn zone, local dip and dip directions were assigned to all of the composites. Stemming from these dip variables, the intersected composite lengths were used to calculate true thickness and vertical thickness values for each intersection composite.

5. For all of the MAIN and F- skarn composites, grade accumulations were calculated, for subsequent analysis and estimation purposes. These accumulations were calculated as follows, using the calculated vertical thickness of each intersection.

   WO3ACC = WO3 * VERTHK
   MOS2ACC = MOS2 * VERTHK

## 14.5 HW Analysis

With the new results available from the Phase 7 drilling campaign, there is now much more recent (P0-P7) data available for the HW zone, than there has been previously. This has enabled a much more thorough analysis of these more recent P0-P7 HW samples, as a means of potentially verifying the older historical KTMC data for the HW zone.

Summary statistics of selected samples and 5m composites, for the HW zone, are shown in Table 14-9. Separate statistics have also been calculated for the older KTMC data, as compared with the more recent PO-P7 data. It can be seen that these statistical parameters compare very closely for the different sample sources.

**Table 14-9. Summary Statistics – HW Samples and Composites**

**Samples**

| FIELD | CODE | NUMBER | MINIMUM | MAXIMUM | MEAN | VARIANCE | STANDDEV | CV |
|---|---|---|---|---|---|---|---|---|
| WO3 | K | 2,506 | 0.00 | 4.61 | 0.57 | 0.29 | 0.54 | 0.9 |
| WO3 | P | 2,578 | 0.00 | 18.10 | 0.50 | 0.79 | 0.89 | 1.8 |
| WO3 | All | 5,084 | 0.00 | 18.10 | 0.55 | 0.45 | 0.67 | 1.2 |
| MOS2 | K | 1,988 | 0.00 | 2.51 | 0.08 | 0.03 | 0.17 | 2.3 |
| MOS2 | P | 2,539 | 0.00 | 4.32 | 0.10 | 0.04 | 0.19 | 2.0 |
| MOS2 | All | 4,527 | 0.00 | 4.32 | 0.08 | 0.03 | 0.18 | 2.2 |
| DENSITY | P | 82 | 2.50 | 3.73 | 3.28 | 0.06 | 0.25 | 0.1 |

**Composites**

| FIELD | AZONE | NUMBER | MINIMUM | MAXIMUM | MEAN | VARIANCE | STANDDEV | CV |
|---|---|---|---|---|---|---|---|---|
| WO3 | K | 1,027 | 0.15 | 3.82 | 0.54 | 0.14 | 0.37 | 0.7 |
| WO3 | P | 358 | 0.15 | 2.55 | 0.51 | 0.15 | 0.39 | 0.8 |
| WO3 | All | 1,385 | 0.15 | 3.82 | 0.53 | 0.14 | 0.37 | 0.7 |
| MOS2 | K | 824 | 0.00 | 1.00 | 0.07 | 0.01 | 0.10 | 1.4 |
| MOS2 | P | 355 | 0.00 | 0.49 | 0.10 | 0.01 | 0.09 | 0.9 |
| MOS2 | All | 1,179 | 0.00 | 1.00 | 0.08 | 0.01 | 0.10 | 1.2 |
| DENSITY | p | 60 | 2.50 | 3.73 | 3.24 | 0.07 | 0.27 | 0.1 |

**Notes**

**. All statistics length-weighted**
**. K = KTMC/KORE campaigns**
**. P = P0-P7 campaigns**
**. CV = Coefficient of variation**

Comparative log-probability plots for the different sample groups are shown in Figure 14-8. These show very similar grade populations between the KTMC and P0-P7 sample groups. Pairs of intersections were selected where the P0-P7 intersection is very close to an existing KTMC drillhole i.e. effectively a twin sample. Sections of these paired intersections were examined, and generally showed good correspondence, as shown in the example in Figure 14-9, for both samples and composites.

**Figure 14-8. HW Zone – Comparative $WO_3$ Log-Probability Plots**

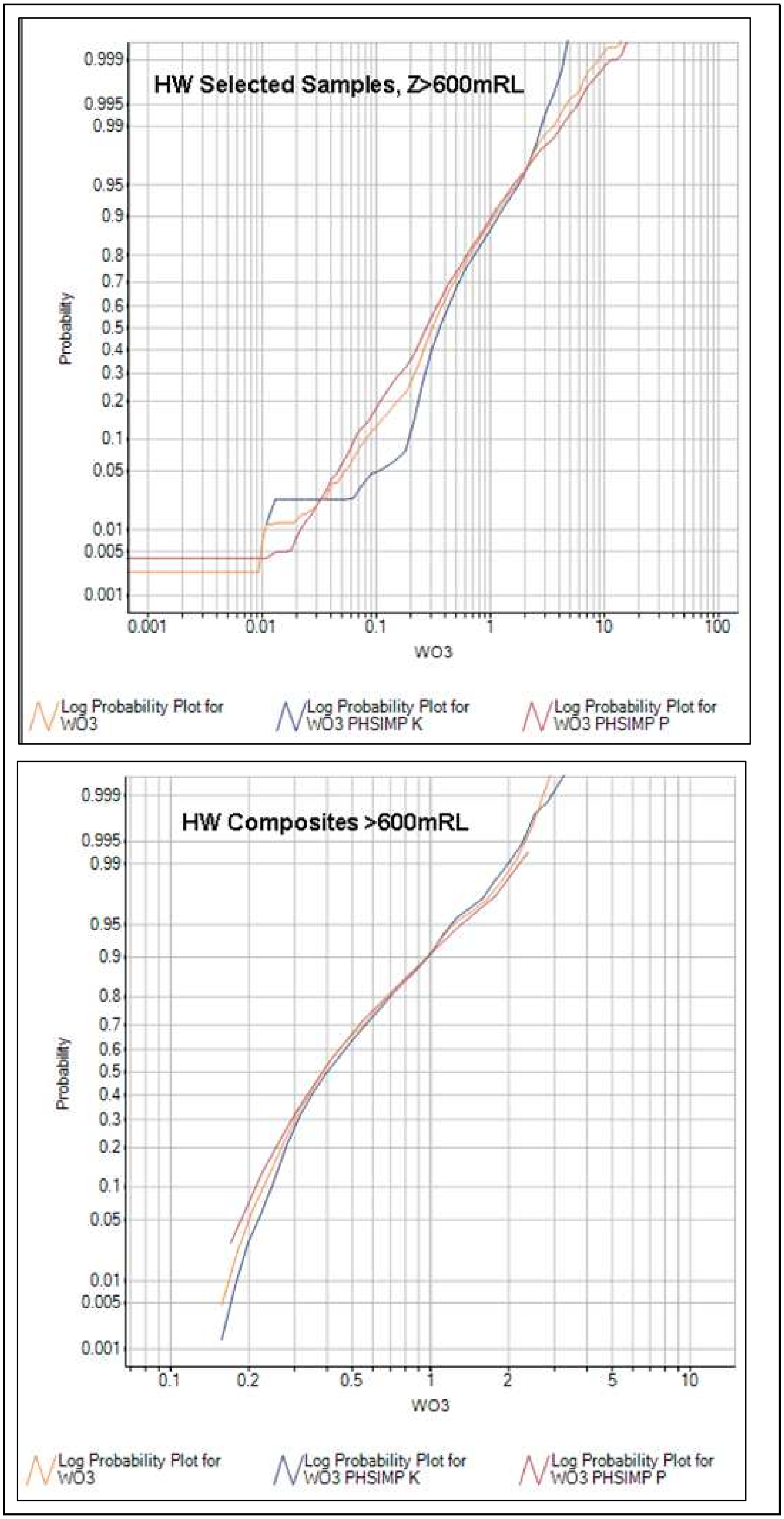
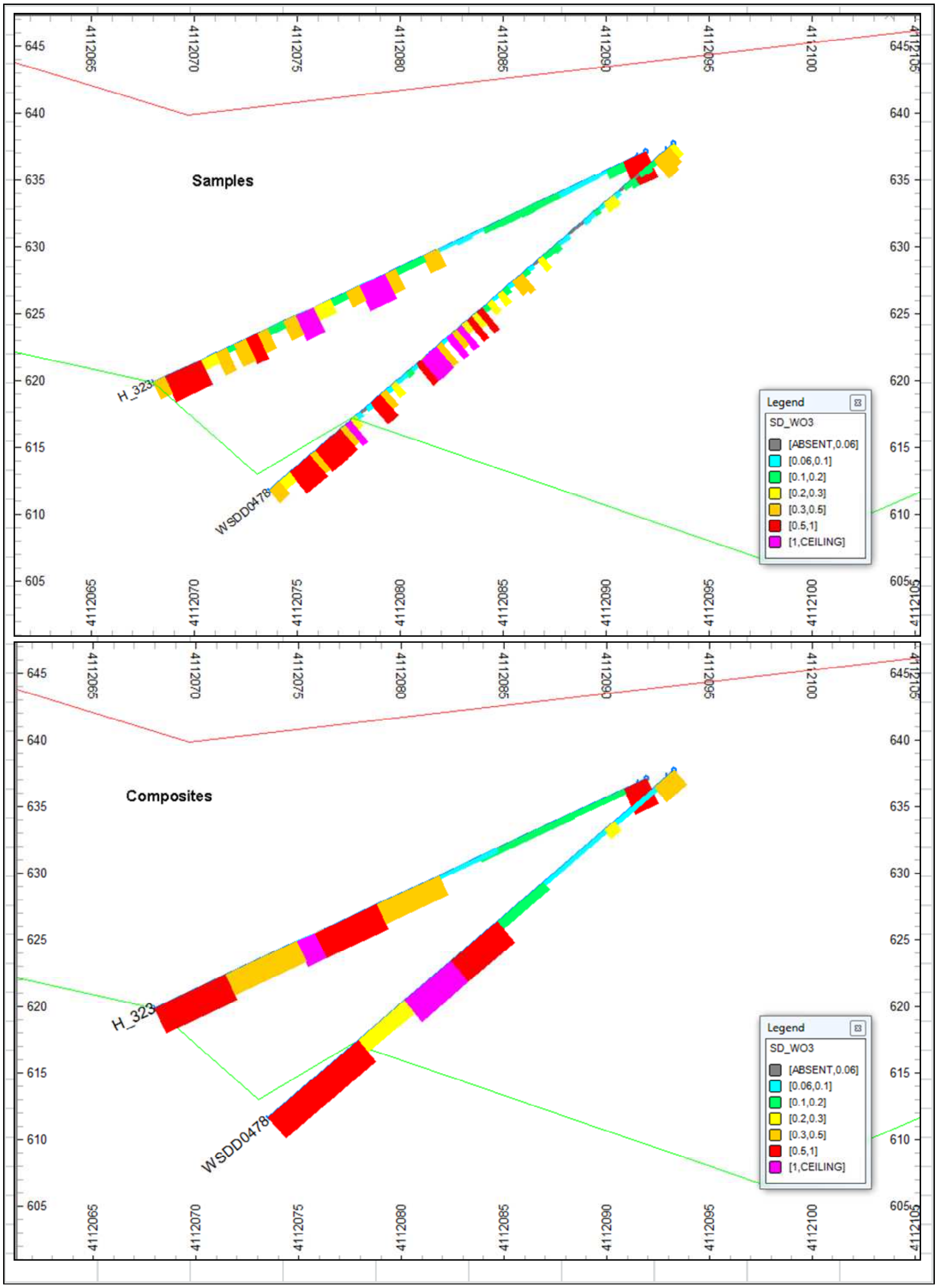


**Figure 14-9. Twin Holes: H_323 and WSDD0478**




The phase 7 drilling includes results from 20 drillholes, covering 1,004m. The QAQC measures taken as previously have been applied, and the results are acceptable. There is now a high proportion of P0-P7 data available for the HW zone (>25% of all the HW samples), along with a very good correspondence obtained with statistical parameters, grade distributions and twin-holes, when comparing the P0-P7 data with the older KTMC data.

The quantity and coverage of the new Phase 7 drilling results have now enabled a much improved analysis between the more recent (PO-P7) drilling results and the older KTMC data. This statistical analysis, along with a comparison of specific twin-hole pairs, has supported the validity of the older KTMC data. Given this evidence, it is the opinion of the QP that the KTMC data for the HW zone has now been effectively verified. The KTMC data may therefore be used for the estimation of the HW zone, without any restrictions.

All of the available data has therefore been used for the estimation of both indicated and inferred HW resources. This has therefore enabled a substantial increase in the proportion of indicated resources, for the HW zone.

## 14.6 Geostatistics

A statistical summary of the selected samples is shown in Table 14-10. These statistics are divided by zone assignment. It can be seen that all of the coefficient of variation (CV) values for $WO_3$ are generally just over 1.

**Table 14-10. Summary Statistics of Selected Samples**

| FIELD | AZONE | NUMBER | MINIMUM | MAXIMUM | MEAN | VARIANCE | STANDDEV | SKEWNESS | LOGESTMN | COEFF OF VARIATION |
|---|---|---|---|---|---|---|---|---|---|---|
| $WO_3$ | HW | 5,084 | 0.00 | 18.10 | 0.55 | 0.45 | 0.67 | 7.13 | 0.56 | 1.2 |
| | MAIN | 2,269 | 0.00 | 11.63 | 0.57 | 0.68 | 0.83 | 4.12 | 0.68 | 1.5 |
| | F1 | 514 | 0.00 | 4.96 | 0.52 | 0.43 | 0.65 | 3.24 | 1.32 | 1.3 |
| | F2 | 2,185 | 0.00 | 5.19 | 0.52 | 0.44 | 0.67 | 2.66 | 1.78 | 1.3 |
| | HALO | 415 | 0.00 | 3.80 | 0.36 | 0.16 | 0.40 | 3.56 | 0.94 | 1.1 |
| | F3 | 1,880 | 0.00 | 8.46 | 0.49 | 0.47 | 0.68 | 3.84 | 2.58 | 1.4 |
| | F4 | 454 | 0.00 | 3.67 | 0.35 | 0.13 | 0.37 | 3.62 | 0.63 | 1.1 |
| | F5 | 167 | 0.00 | 2.16 | 0.38 | 0.14 | 0.37 | 1.87 | 0.53 | 1.0 |
| $MoS_2$ | HW | 4,527 | 0.00 | 4.32 | 0.083 | 0.032 | 0.18 | 8.69 | 0.17 | 2.2 |
| | MAIN | 2,070 | 0.00 | 4.20 | 0.046 | 0.023 | 0.15 | 16.25 | 0.25 | 3.3 |
| | F1 | 503 | 0.00 | 0.83 | 0.043 | 0.010 | 0.10 | 5.44 | 0.23 | 2.3 |
| | F2 | 2,095 | 0.00 | 3.75 | 0.045 | 0.038 | 0.20 | 11.19 | 0.14 | 4.4 |
| | HALO | 406 | 0.00 | 3.50 | 0.042 | 0.061 | 0.25 | 11.45 | 0.05 | 5.9 |
| | F3 | 1,786 | 0.00 | 2.30 | 0.034 | 0.024 | 0.15 | 10.28 | 0.07 | 4.5 |
| | F4 | 380 | 0.00 | 2.12 | 0.040 | 0.027 | 0.16 | 8.53 | 0.16 | 4.1 |
| | F5 | 130 | 0.00 | 1.47 | 0.033 | 0.016 | 0.13 | 8.30 | 0.13 | 3.9 |
| DENSITY | HW | 82 | 2.50 | 3.73 | 3.28 | 0.06 | 0.25 | -1.13 | 3.28 | 0.1 |
| | MAIN | 97 | 2.57 | 3.68 | 3.25 | 0.07 | 0.26 | -0.25 | 3.25 | 0.1 |
| | F1 | 32 | 2.71 | 3.39 | 3.02 | 0.03 | 0.17 | 0.02 | 3.02 | 0.1 |
| | F2 | 129 | 2.46 | 3.48 | 3.02 | 0.02 | 0.14 | 0.50 | 3.02 | 0.0 |
| | HALO | 25 | 2.73 | 3.22 | 2.97 | 0.01 | 0.11 | 0.00 | 2.97 | 0.0 |
| | F3 | 129 | 2.49 | 3.50 | 3.05 | 0.03 | 0.17 | 0.06 | 3.05 | 0.1 |
| | F4 | 19 | 2.84 | 3.57 | 3.05 | 0.03 | 0.18 | 0.98 | 3.05 | 0.1 |
| | F5 | 1 | 3.12 | 3.12 | 3.12 | | | | | |

A statistical summary of the generated composites is shown in Table 14-11, with corresponding log-probability plots from Figure 14-10 and Figure 14-11. It can be seen from

Table 14-11 that the coefficient of variation values for $WO_3$ have been reduced to well below 1.0, by the effect of compositing and top-cut application. Individually the zones' grade populations show very clear log-normal populations.

**Table 14-11. Summary Statistics of Composites**

| FIELD | AZONE | NUMBER | MINIMUM | MAXIMUM | MEAN | VARIANCE | STANDDEV | SKEWNESS | LOGESTMN | COEFF OF VARIATION |
|---|---|---|---|---|---|---|---|---|---|---|
| $WO_3$ | HW | 1,385 | 0.15 | 3.82 | 0.53 | 0.14 | 0.37 | 2.82 | 0.52 | 0.7 |
| | MAIN | 213 | 0.09 | 3.87 | 0.54 | 0.09 | 0.30 | 2.42 | 0.54 | 0.6 |
| | F1 | 125 | 0.02 | 2.46 | 0.51 | 0.13 | 0.36 | 1.86 | 0.51 | 0.7 |
| | F2 | 248 | 0.05 | 1.79 | 0.52 | 0.07 | 0.27 | 1.56 | 0.52 | 0.5 |
| | HALO | 118 | 0.04 | 1.60 | 0.35 | 0.06 | 0.25 | 3.16 | 0.34 | 0.7 |
| | F3 | 238 | 0.15 | 1.69 | 0.49 | 0.07 | 0.26 | 2.05 | 0.49 | 0.5 |
| | F4 | 93 | 0.01 | 1.60 | 0.34 | 0.02 | 0.14 | 3.16 | 0.35 | 0.4 |
| | F5 | 41 | 0.19 | 1.40 | 0.37 | 0.02 | 0.15 | 1.91 | 0.36 | 0.4 |
| $MoS_2$ | HW | 1,179 | 0 | 1.00 | 0.077 | 0.009 | 0.10 | 4.03 | 0.09 | 1.2 |
| | MAIN | 196 | 0.00 | 0.34 | 0.042 | 0.002 | 0.04 | 3.00 | 0.05 | 1.1 |
| | F1 | 116 | 0.00 | 0.31 | 0.044 | 0.003 | 0.06 | 2.51 | 0.11 | 1.3 |
| | F2 | 242 | 0.00 | 0.55 | 0.038 | 0.003 | 0.05 | 4.04 | 0.05 | 1.5 |
| | HALO | 111 | 0.00 | 0.58 | 0.037 | 0.007 | 0.08 | 3.64 | 0.10 | 2.3 |
| | F3 | 225 | 0.00 | 0.76 | 0.033 | 0.004 | 0.06 | 5.54 | 0.06 | 1.9 |
| | F4 | 85 | 0.00 | 0.47 | 0.034 | 0.004 | 0.06 | 3.95 | 0.04 | 1.9 |
| | F5 | 38 | 0.00 | 0.80 | 0.030 | 0.004 | 0.06 | 8.18 | 0.05 | 2.1 |
| TRUETHK | F1 | 125 | 0.18 | 7.49 | 1.39 | 1.34 | 1.16 | 2.59 | 1.37 | 0.8 |
| | F2 | 248 | 0.13 | 10.92 | 3.16 | 4.36 | 2.09 | 1.31 | 3.24 | 0.7 |
| | F3 | 238 | 0.09 | 9.30 | 2.74 | 3.13 | 1.77 | 1.41 | 2.79 | 0.6 |
| | F4 | 93 | 0.46 | 7.00 | 2.44 | 2.14 | 1.46 | 0.72 | 2.52 | 0.6 |
| | F5 | 41 | 0.24 | 5.32 | 2.45 | 2.07 | 1.44 | 0.27 | 2.59 | 0.6 |
| | HALO | 118 | 0.02 | 4.70 | 1.11 | 1.02 | 1.01 | 1.72 | 1.12 | 0.9 |
| | MAIN | 214 | 0.05 | 24.44 | 4.77 | 12.95 | 3.60 | 2.04 | 5.24 | 0.8 |

**Notes**

**. TRUETHK = True thickness**

**. Statistics for $WO_3$ and $MoS_2$ weighted by true thickness**

Experimental variograms were generated for the generated composite data sets. Consistent with the estimation of variable thicknesses of the skarn beds, variograms were generated for grade accumulations, as well as thickness values. Example experimental and model variograms are shown in Figure 14-12 and Figure 14-13. In general, for the non-HW zones there was no particular directional anisotropy observed. Most of these skarn bed variograms have ranges of influence from 50-100m. For the HW zone, the $WO_3$ variograms range of influence is longer down-dip (50m) as compared to along-strike (35m). All of the modelled variogram parameters are summarised in Table 14-12.

**Figure 14-10. Log Histogram – $WO_3$ – Composites**

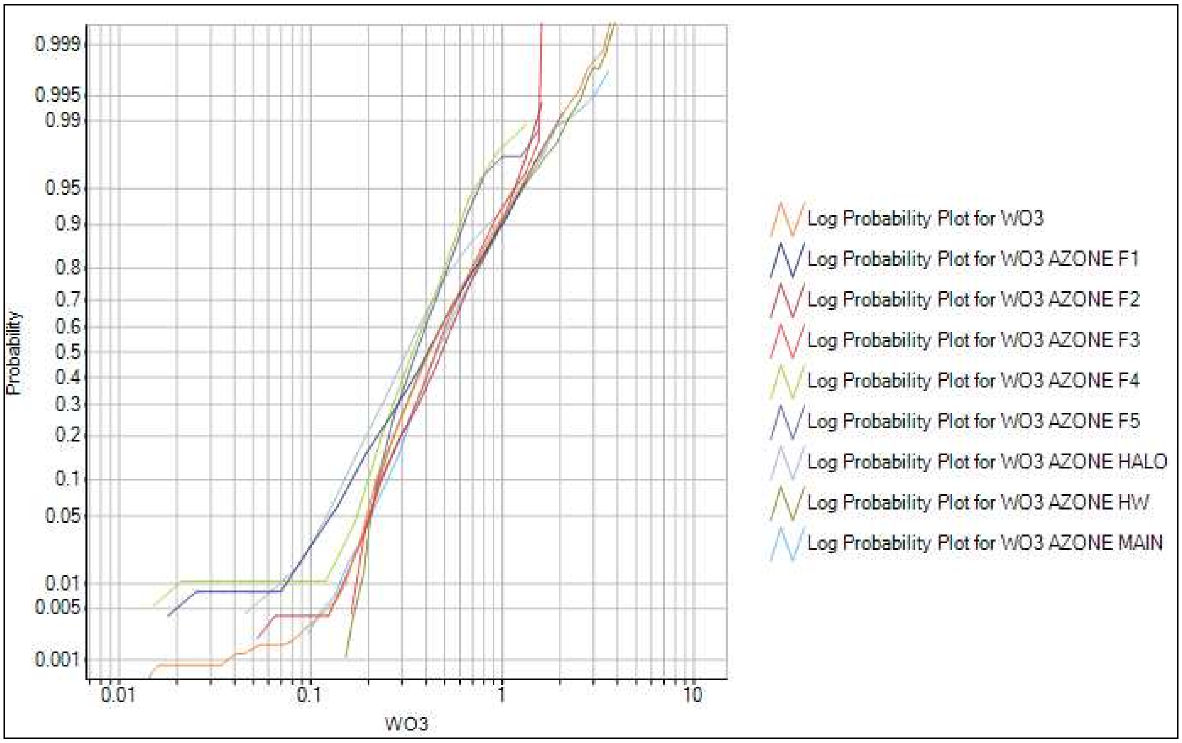



**Figure 14-11. Log-Probability Plot – $MoS_2$ – Composites**

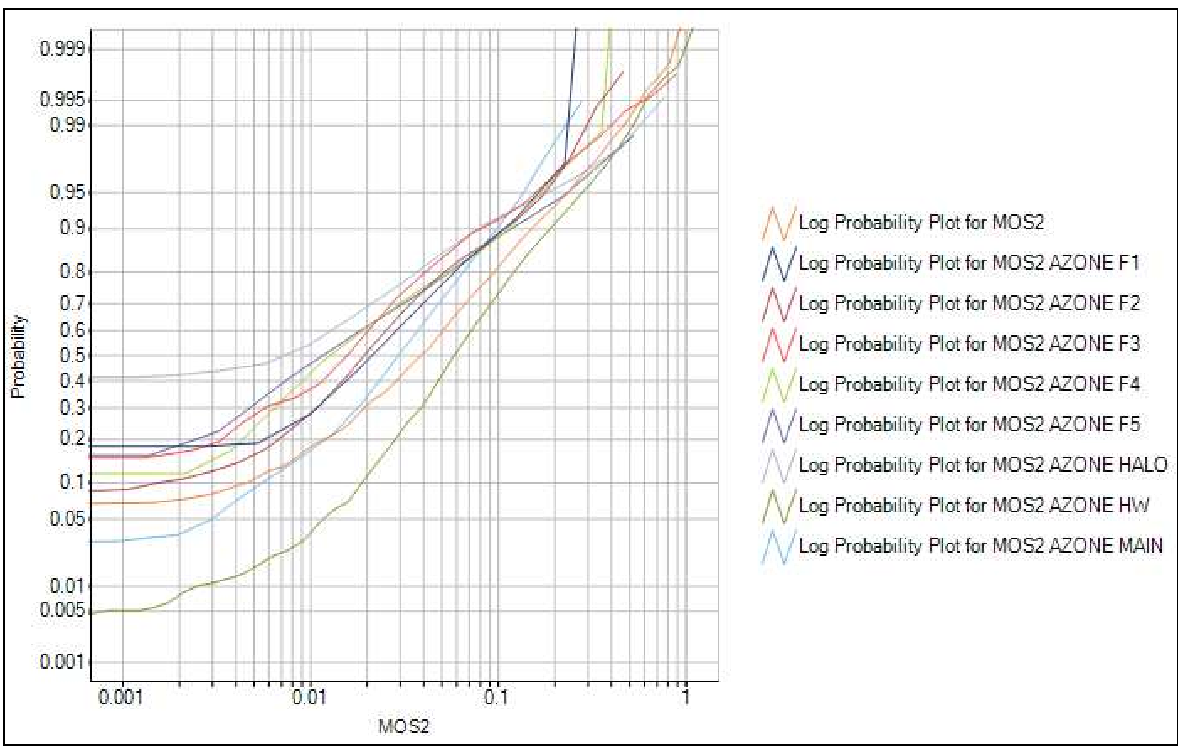


**Figure 14-12. Experimental and Model Variograms – WO3 Accumulation - MAIN**

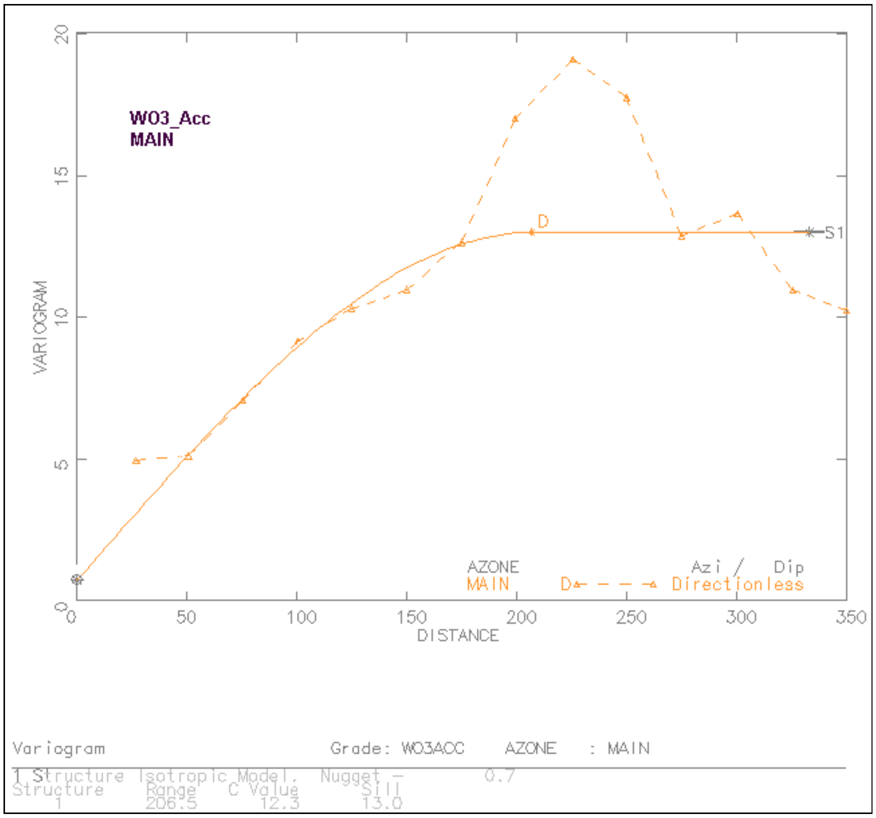



**Figure 14-13. Experimental and Model Variograms – $WO_3$ – HW**

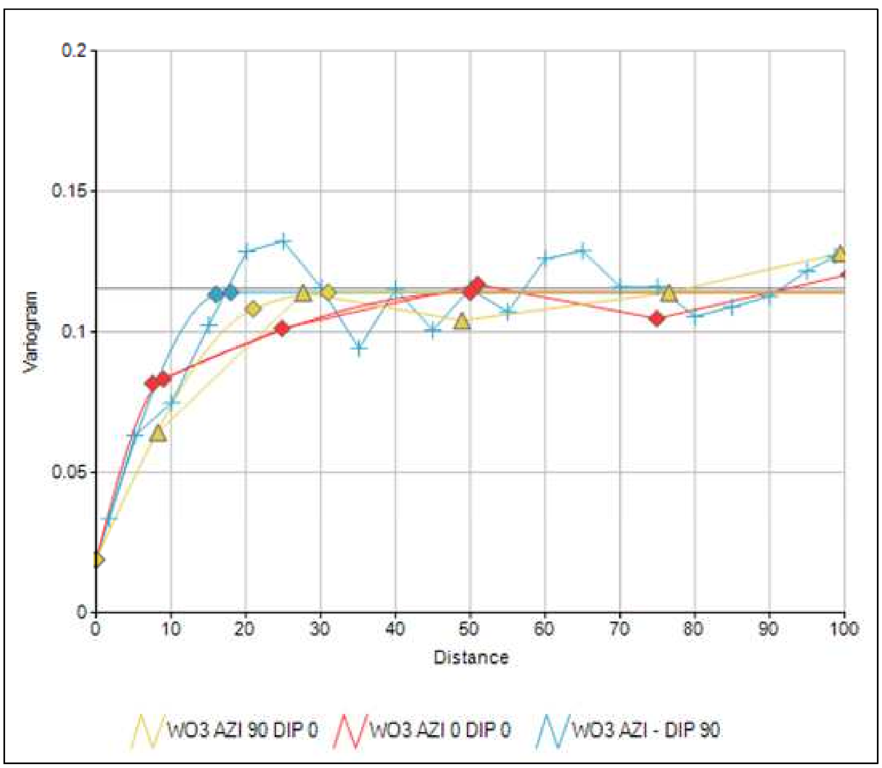


**Table 14-12. Model Variogram Parameters**

| VREFNUM | AZONE | FIELD | TYPE | NUGGET | Range 1 (m) | | | C1 | Range 2 (m) | | | C2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | | 1 | 2 | 3 | |
| 1 | MAIN | $WO_3$ | Accum | 0.733 | 206.5 | 206.5 | 206.5 | 12.261 | - | - | - | - |
| 2 | F1 | $WO_3$ | Accum | 0.066 | 84.5 | 84.5 | 84.5 | 0.983 | 121.8 | 121.8 | 121.8 | 0.530 |
| 3 | F2 | $WO_3$ | Accum | 1.057 | 325.2 | 325.2 | 325.2 | 1.146 | - | - | - | - |
| 4 | F3 | $WO_3$ | Accum | 0.913 | 84.8 | 84.8 | 84.8 | 0.472 | - | - | - | - |
| 5 | MAIN | $WO_3$ | Thickness | 3.761 | 181.1 | 181.1 | 181.1 | 17.834 | - | - | - | - |
| 6 | F1 | $WO_3$ | Thickness | 0.892 | 90.5 | 90.5 | 90.5 | 1.128 | - | - | - | - |
| 7 | F2 | $WO_3$ | Thickness | 3.002 | 257.5 | 257.5 | 257.5 | 3.123 | - | - | - | - |
| 8 | F3 | $WO_3$ | Thickness | 1.798 | 39.2 | 39.2 | 39.2 | 1.861 | 75.1 | 75.1 | 75.1 | 0.841 |
| 9 | MAIN | $MoS_2$ | Accum | 0.065 | 134.5 | 134.5 | 134.5 | 0.097 | - | - | - | - |
| 10 | F1 | $MoS_2$ | Accum | 0.001 | 72.0 | 72.0 | 72.0 | 0.022 | - | - | - | - |
| 11 | F2 | $MoS_2$ | Accum | 0.015 | 112.1 | 112.1 | 112.1 | 0.028 | - | - | - | - |
| 12 | F3 | $MoS_2$ | Accum | 0.006 | 61.7 | 61.7 | 61.7 | 0.033 | - | - | - | - |
| 13 | HW | $WO_3$ | Grade | 0.019 | 21.0 | 9.0 | 16.0 | 0.053 | 31.0 | 50.0 | 18.0 | 0.042 |
| 14 | HW | $MoS_2$ | Grade | 0.009 | 39.2 | 39.2 | 39.2 | 0.008 | - | - | - | - |

**Notes:**

**HW anisotropy directions:**

**1 Along-strike**
**2 Down-dip**
**3 Cross-strike**

## 14.7 Volumetric Modelling

Two separate resource models were generated: one with a parent block structure of 10m x 10m x 10m blocks (for the HW zone), and the other with a columnar block structure for all the other skarn zones. In the columnar block structure used, parent blocks were sized 10m x 10m, and in the vertical dimension single sub-blocks were generated, with a height equivalent to the vertical height of the skarn structure being modelled. In both models, sub-blocks were also generated down to 5m x 5m in the XY directions. Both model structures were orthogonal – no rotation was applied. A summary of the model prototypes is shown in Table 14-13.

**Table 14-13. Resource Model Prototypes**

| | | | | HW | | MAIN+F Beds | |
|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Range | Size | Number | Size | Number |
| X | 483,900 | 486,000 | 2,100 | 10 | 210 | 10 | 210 |
| Y | 4,110,900 | 4,113,000 | 2,100 | 10 | 210 | 10 | 210 |
| Z | 0 | 1,000 | 1,000 | 5 | 200 | 1000 | 1 |

Physical controls used, during the generation of the volumetric block models, included:

- Natural topography wireframe model.
- Top and bottom contact DTMs for the HW zone.
- The central skarn bed DTMs, for the MAIN and F- beds.
- Perimeters demarcating the extent of previous mining for the HW, MAIN, F2 and F3.

For the MAIN and F- beds, an artificial vertical thickness of 2m was set onto model blocks. The vertical thickness of these blocks was subsequently estimated on these blocks and then used for the actual bed thickness.

Attribute fields set into the volumetric block models included:

AZONE Mineralised zone identifier

MINED Mined flag code (0 = unmined, 1 = mined)

## 14.8 Densities

Density measurements have been made during the recent WMC and AKT campaigns, as summarised in Table 14-14. A histograms of the skarn density measurements is shown in Figure 14-15. Histograms for each skarn zone are shown in Appendix A. There does not appear to be particular relationship between density and $WO_3$ grade values, as shown in Table 14-14. The approach taken in this study was to estimate density values from the sample measurements, using inverse-distance weighting, up to a maximum within-bed distance of 100m. Beyond this distance, where no density samples were available, the average values shown in Table 14-14 were applied.

**Table 14-14. Summary of Density Measurements**

| AZONE | Number of measurements | Average Density $t/m^3$ |
|---|---|---|
| HW | 82 | 3.28 |
| MAIN | 97 | 3.25 |
| F1 | 32 | 3.02 |
| F2 | 129 | 3.02 |
| HALO | 25 | 2.97 |
| F3 | 129 | 3.05 |
| F4 | 19 | 3.05 |
| F5 | 1 | 3.12 |
| Waste | 564 | 2.87 |
| Total | 1078 | |

**Figure 14-14. Density vs $WO_3$ Scatterplot**

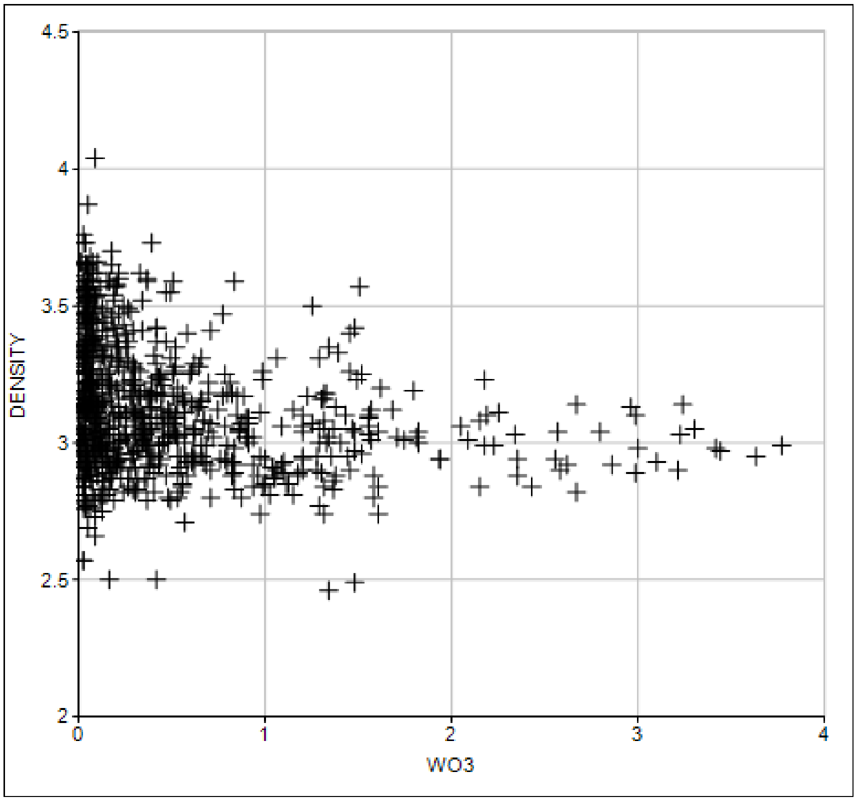
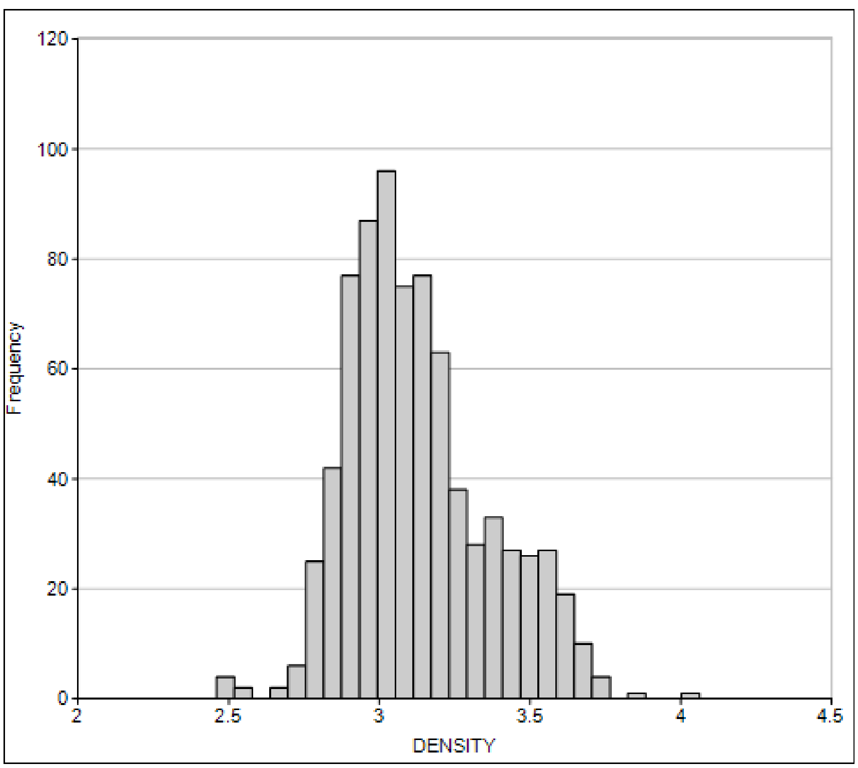



**Figure 14-15. Histogram of Skarn Density Values**



## 14.9 Grade Estimation

For the HW zone, composites were first flagged with indicator (0/1) values, according to whether they were proper mineralised HW composites (IND=1), or if they were representing internal waste within the overall limits of the HW structure (IND=0). These indicator values were then estimated into the HW volumetric block model, thus flagging blocks as either mineralised or waste. $WO_3$ and $MoS_2$ grades were then estimated, using the corresponding mineralised/waste composites for each block. Progressive search distances were applied, so that if the initial search criterial were not met, another search was then applied with bigger search distances and/or more relaxed parameters. The process was repeated until all mineralised blocks received estimated grades. The initial search applied for the HW zone was 35m x 35m x 5m, oriented parallel with the HW zone. Dynamic anisotropy was applied so that the search orientation varied according to the actual HW zone structure.

For the MAIN and F skarn beds, vertical thicknesses and grade-accumulations were estimated into the volumetric block model, both using ordinary kriging (OK). The estimated vertical thicknesses were then used to set the actual vertical thicknesses of the model blocks. Grades were then back-calculated from the estimated accumulations, such that:

Grade = Accumulation / Thickness

Progressive searches were also applied for estimation in the MAIN/F beds, starting off with a horizontal distance of 50 m . This is equivalent to a vertical search distance of 24m, which is generally less than the 30m level interval. An octant search was also applied, so that initial searches were only successful if composites were encountered in at least 3 octants.

For all zones, primary grades were estimated using ordinary kriging (OK). For validation purposes, alternative grades were also estimated using inverse-distance weighting (ID) and nearest neighbour (NN) methods. The grade estimation parameters are summarised in Table 14-15.

Example plans of the $WO_3$ and thickness variation in the MAIN zone are shown in Figure 14-16 and Figure 14-17, respectively. Plans depicting grade and thickness variations in all zones are shown in Appendix B.

## Table 14-15. Grade Estimation Parameters

| | MAIN/F Beds | | | | HW Zone | | | |
|---|---|---|---|---|---|---|---|---|
| Search No. | Distance (m) X Y | Min. No. of Composites | Min. No. of Drillholes | Octant Control | Distance (m) X Y Z | Min. No. of Composites | Min. No. of Drillholes | Octant Control |
| 1 | 50 x 50 | 3 | 3 | Yes | 35 x 50 x 5 | 7 | 3 | Yes |
| 2 | 100 x 100 | 3 | 3 | Yes | 70 x 100 x 10 | 7 | 3 | Yes |
| 3 | 100 x 100 | 1 | 1 | Yes | 70 x 100 x 10 | 1 | 1 | Yes |
| 4 | 50 x 50 | 1 | 1 | No | 70 x 100 x 5 | 1 | 1 | No |
| 5 | 100 x 100 | 1 | 1 | No | 105 x 150 x 7.5 | 1 | 1 | No |
| 6 | 200 x 200 | 1 | 1 | No | 140 x 200 x 10 | 1 | 1 | No |
| Composites | Complete bed composites | | | | 5m downhole composites | | | |
| Primary estimated variables | . Accumulations: WO3ACC and MOS2ACC<br>. Vertical thickness: VERTHK | | | | . $WO_3$<br>. $MoS_2$ | | | |
| Subsequent Calculation | . $WO_3$ = WO3ACC / VERTHK<br>. $MoS_2$ = MOS2ACC / VERTHK<br>. Model ZINC = VERTHK | | | | | | | |

**Notes:**

. Dynamic anisotropy used to orient searches such that:

X = along-strike

Y = down-dip

Z = cross-strike

. Maximum no. of composites used:

| | |
|---|---|
| MAIN/F | 24 |
| HW | 15 |

. WO3 Grades interpolated using Ordinary Kriging (OK)

. MoS2 Grades interpolated using ID for HW, OK for all other beds

. Alternative grades also determined for validation:

- Inverse-Distance (^2) weighting (ID)
- Nearest neighbour (NN)

. Octant control:

. Min. number of composites per octant = 1

. Max. number of composites per octant = 3

. Minimum octants = 3

. Density values also estimated by ID

**Figure 14-16. Plan of MAIN Zone – Resource Model $WO_3$**

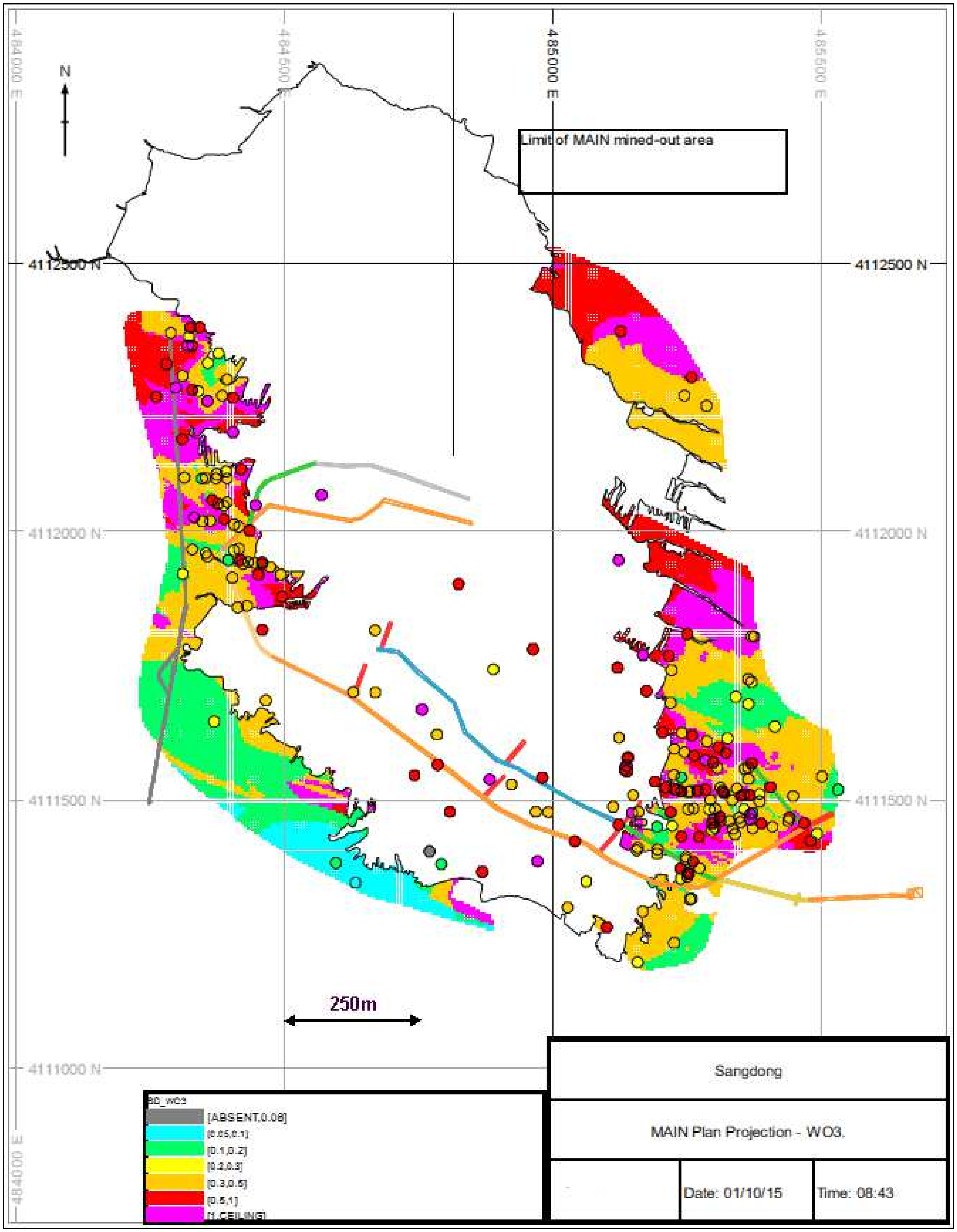
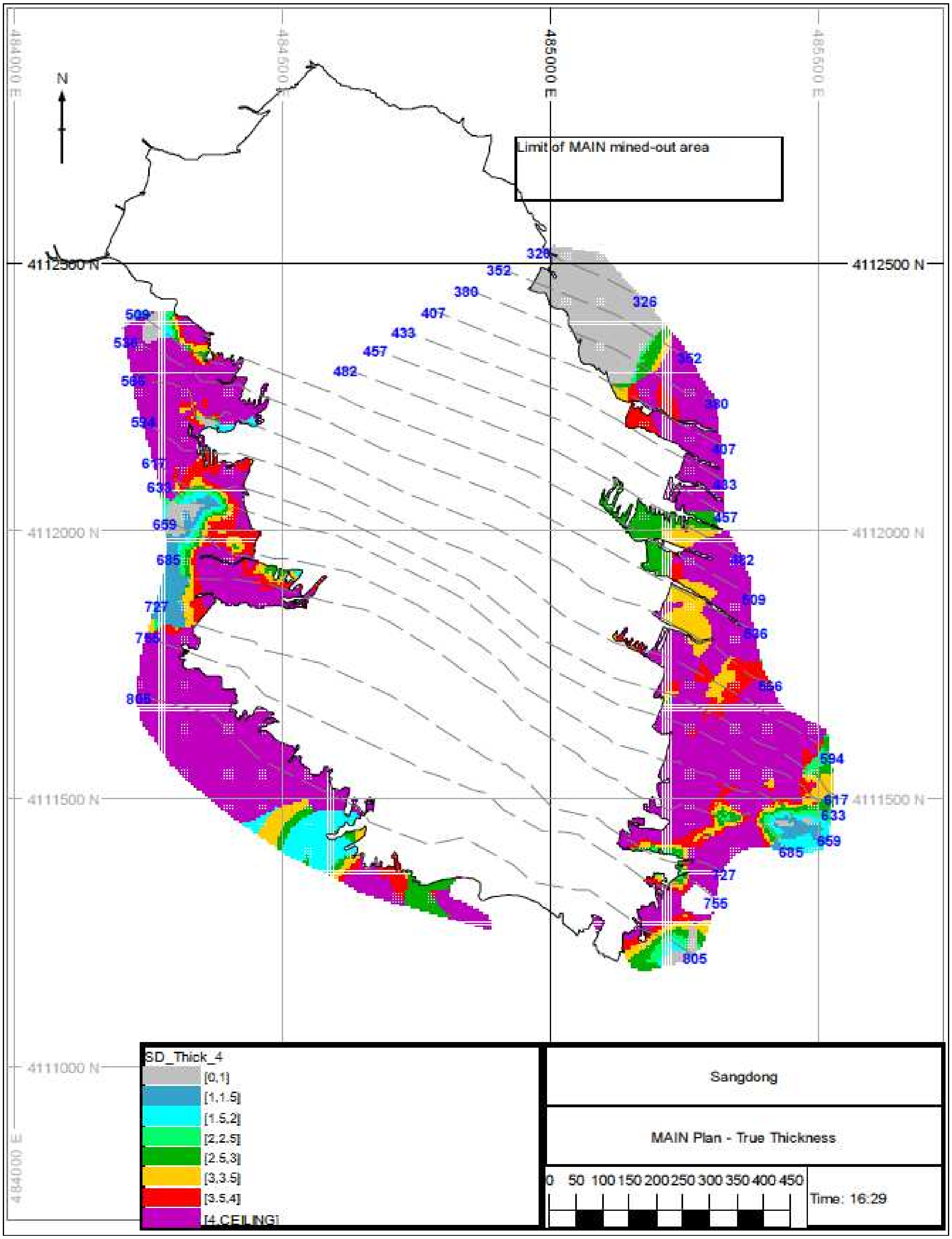


**Figure 14-17. Plan of MAIN Zone – True Thickness**



## 14.10 Mineral Resource Classification

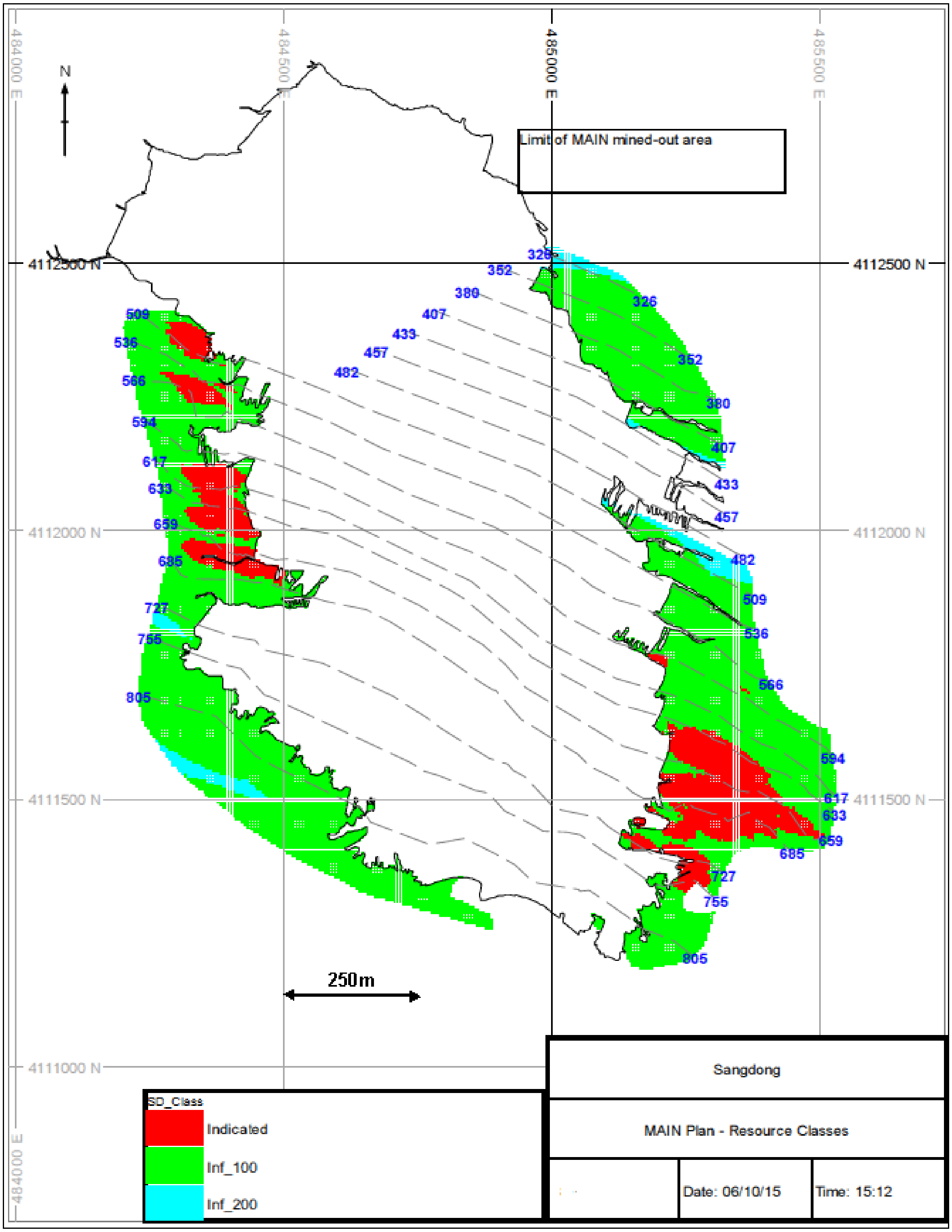
It is considered that none of the resources at the current time should be classified as measured resources, owing to the lack of detailed fault modelling. The resource classification applied are summarised in Table 14-16. As compared to the previous resource estimation in December 2015, the HW zone criteria have been updated with respect the verification of KTMC data, as described in Section 14.5.

**Table 14-16. Resource Classification Criteria**

| Category | MAIN and F Zones | HW Zone |
|---|---|---|
| Measured | (No material currently classified as measured) | (No material currently classified as measured) |
| Indicated | At least 3 full intersection composites, within at least 3 octants, with a search of 50m (along-strike) x 50m (down-dip). | At least 7 composites, within at least 3 octants, from at least 3 drillholes, with a search of 35m (along-strike) x 50m (down-dip) x 5m (cross-strike). |
| | Based on drilling from Oriental Minerals and WMC only. | Based on all available drilling. |
| | | Also delineated within defined perimeters, to ensure areas clearly covered by drilling grids. |
| Inferred | Based on all available drilling. | Based on all available drilling. |
| | Maximum extrapolation of 200m, no octant control. | Maximum extrapolation of 105 x 150m, no octant control. |

The distances applied for indicated resources stem from the variographic analysis, and generally correspond to the range or less. The 50m applied for the MAIN and F beds is equivalent to a vertical interval of approximately 24m. A plan depicting the resource classification for the MAIN zone is shown in Figure 14-18. Resource classification plans for all of the zones are shown in Appendix B.

**Figure 14-18. Plan of MAIN Zone – Resource Classification**



## 14.11 Model Validation

### 14.11.1 Visual Comparisons

Plan projection and sections were created from the resource block model, and compared with the sample composites used in grade estimation. Example plans of grade and thickness for the MAIN zones are shown in Figure 14-16 and Figure 14-17, respectively. Corresponding plans for the HW zone are shown in Figure 14-19 and Figure 14-20. Sections were also produced over the whole deposit, based on the mine section reference system shown in Figure 14-21. All of the sections are shown in Appendix B. In general, these plans and sections show a fairly good correspondence between estimated and composited sample grades.

**Figure 14-19. Plan of HW Zone – WO3 Grades**

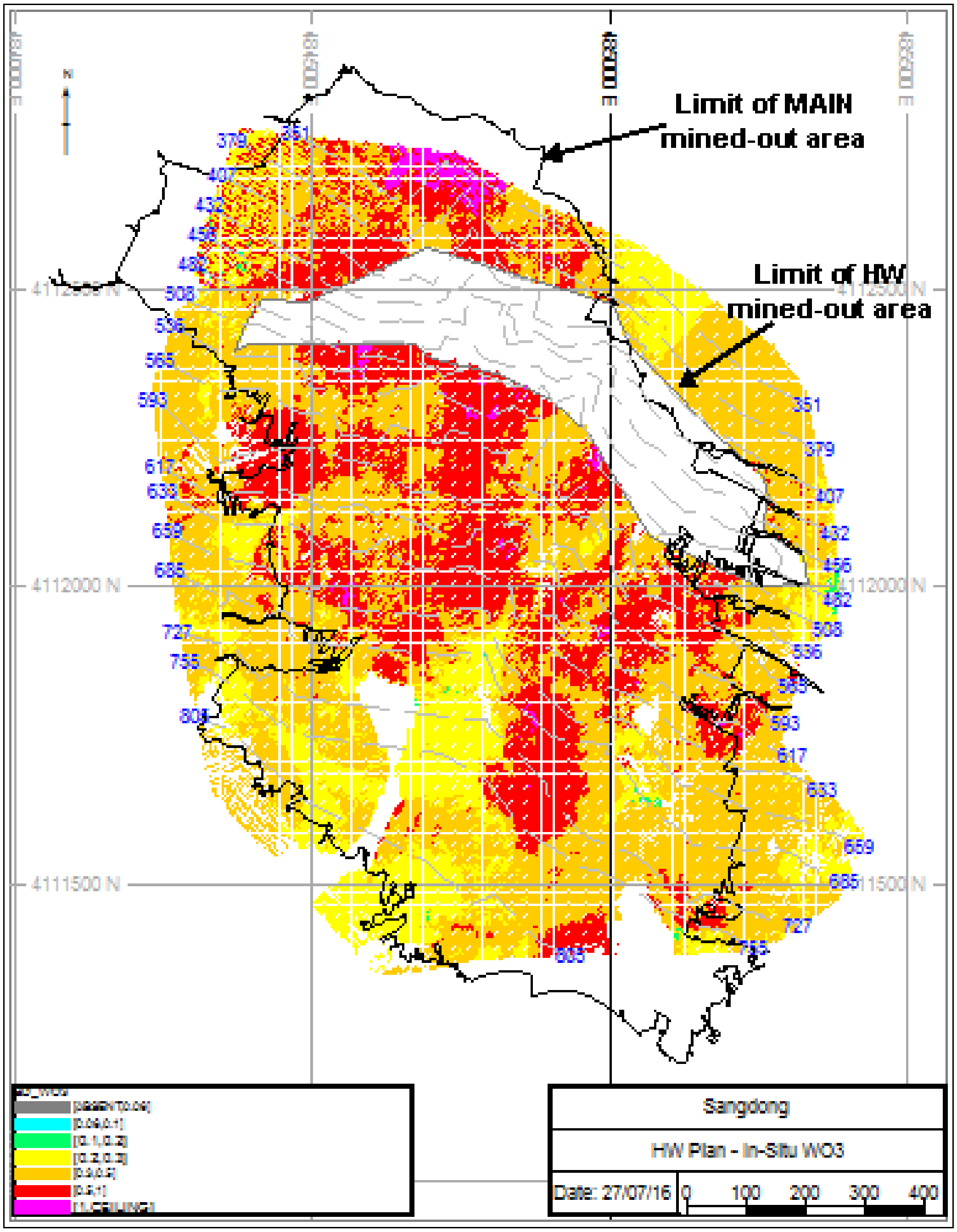


**Figure 14-20. Plan of HW Zone – Vertical Thickness**

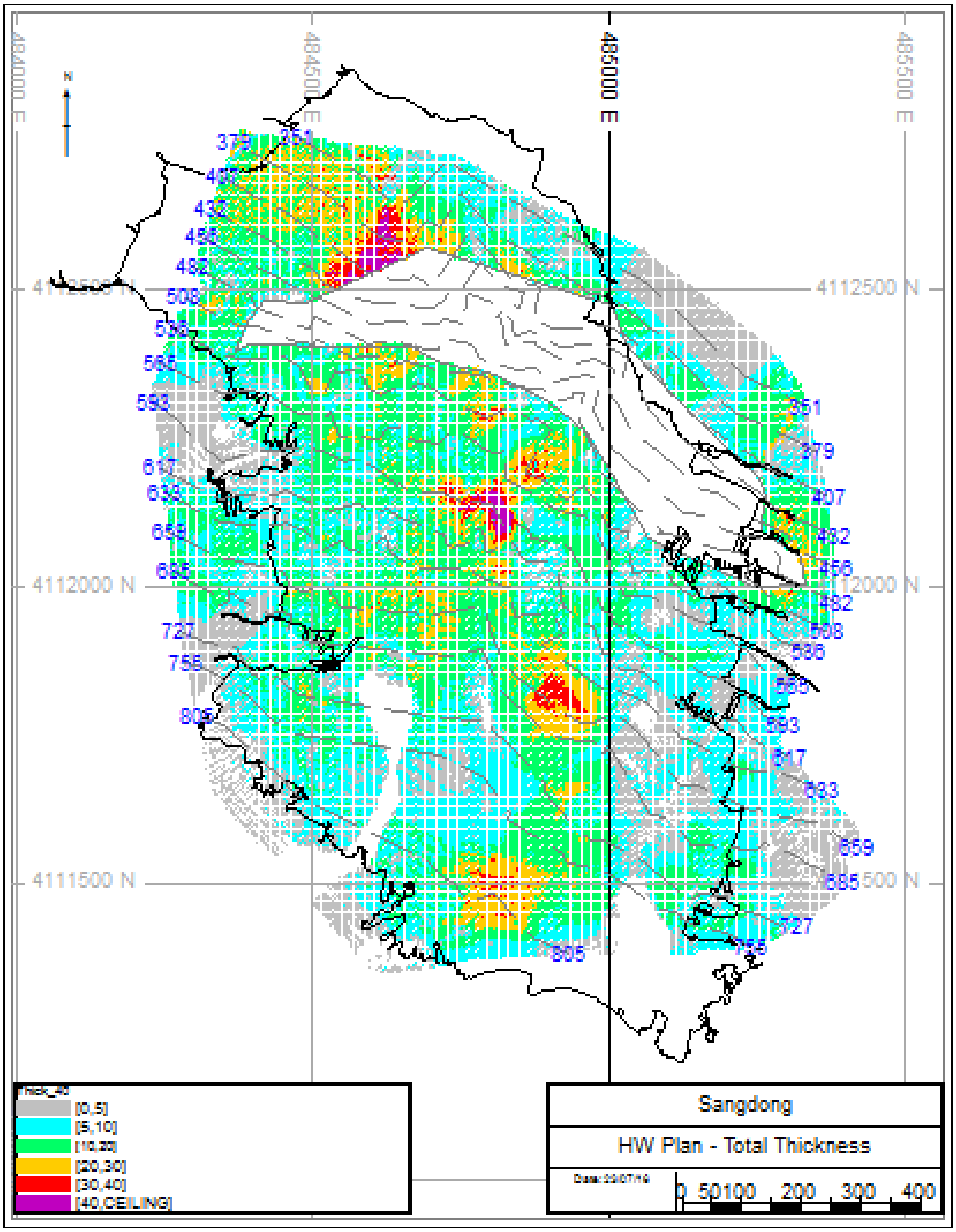
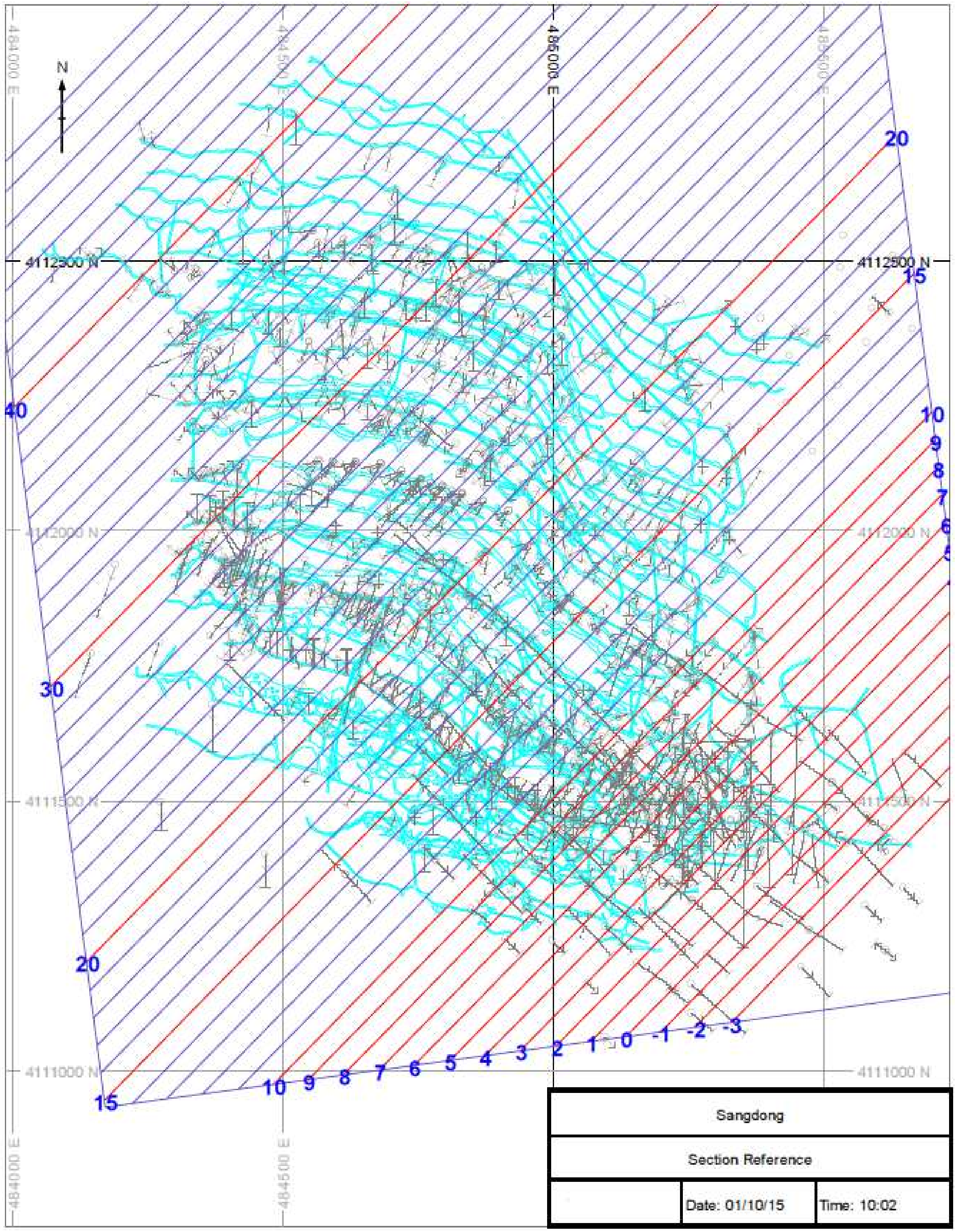
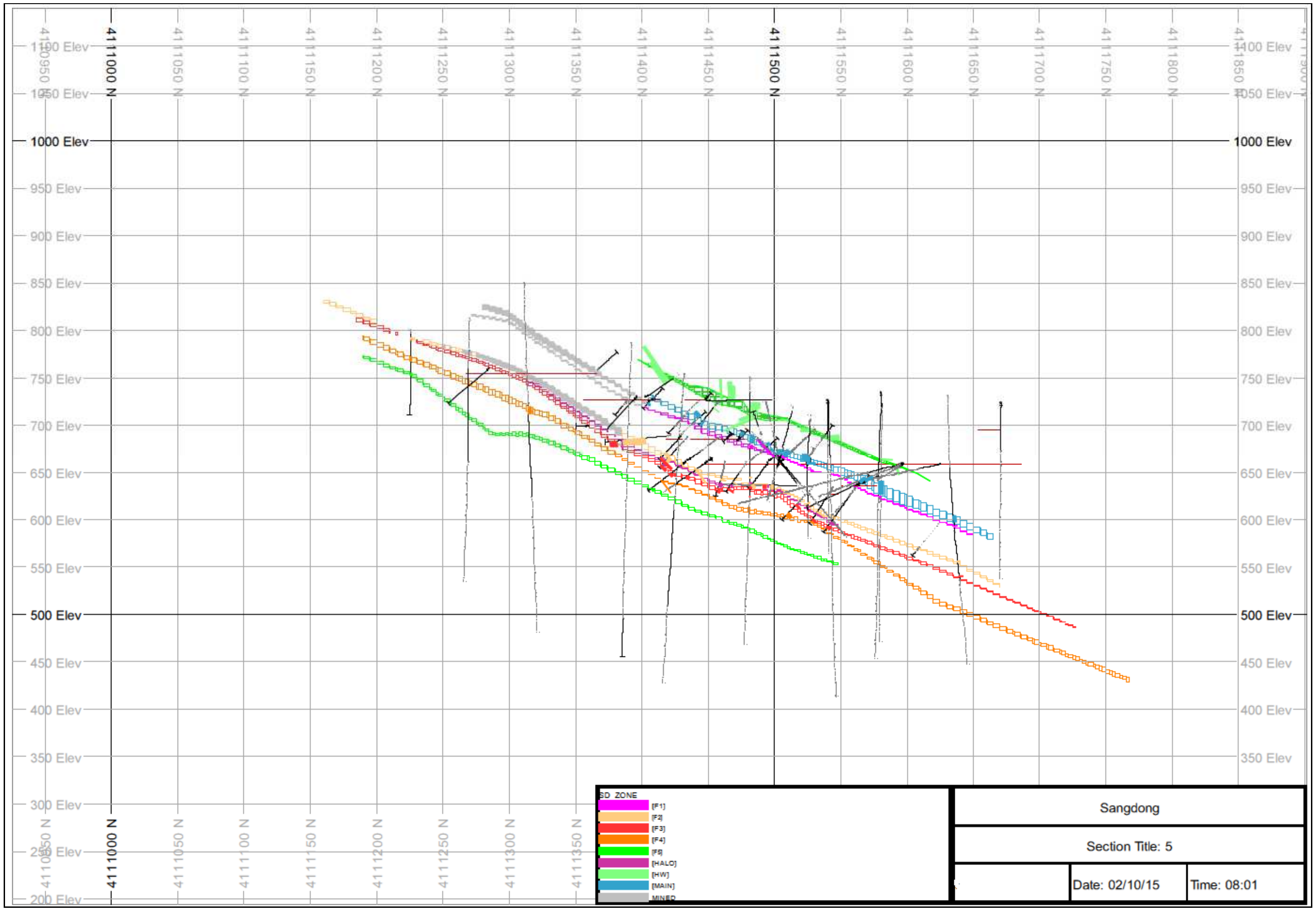


**Figure 14-21. Plan of Section Reference System**



## Figure 14-22. Section 5, Showing Block Model Structure



### 14.11.2 Comparison of Global Average Grades

Comparison of global grade averages for each separate bed, as derived from samples, composites and the resource block model. For validation purposes, alternative block model grades derived from nearest neighbour (NN) and inverse-distance (ID) estimates were also used in this comparison. The comparison was also done with alternative model estimates: one with all samples, and one with both samples data and model pertaining just to the Oriental Minerals and WMC campaigns. These results are shown in Table 14-17, and display acceptable comparisons.

**Table 14-17. Comparison of Global Grade Averages**

**Data Associated With All Campaigns**

| | $WO_3$ Average Grades | | | | | $MoS_2$ Average Grades | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Samples | Composites | OK | NN | ID | Samples | Composites | OK | NN | ID |
| HW | 0.55 | 0.53 | 0.49 | 0.49 | 0.49 | 0.08 | 0.08 | 0.06 | 0.06 | 0.06 |
| MAIN | 0.57 | 0.54 | 0.57 | 0.57 | 0.57 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 |
| F1 | 0.52 | 0.51 | 0.48 | 0.48 | 0.48 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 |
| HALO | 0.36 | 0.35 | 0.33 | 0.34 | 0.33 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 |
| F2 | 0.52 | 0.52 | 0.44 | 0.45 | 0.44 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| F3 | 0.49 | 0.49 | 0.43 | 0.43 | 0.43 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| F4 | 0.35 | 0.34 | 0.34 | 0.34 | 0.34 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| F5 | 0.38 | 0.37 | 0.35 | 0.35 | 0.35 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |

**Data Only From P0+ Campaigns - Oriental Minerals and WMC**

| | $WO_3$ Average Grades | | | | | $MoS_2$ Average Grades | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Samples | Composites | OK | NN | ID | Samples | Composites | OK | NN | ID |
| HW | 0.52 | 0.48 | 0.41 | 0.38 | 0.41 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 |
| MAIN | 0.57 | 0.55 | 0.56 | 0.56 | 0.57 | 0.05 | 0.04 | 0.03 | 0.03 | 0.04 |
| F1 | 0.51 | 0.50 | 0.47 | 0.47 | 0.47 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| HALO | 0.36 | 0.35 | 0.33 | 0.34 | 0.33 | 0.04 | 0.04 | 0.02 | 0.03 | 0.03 |
| F2 | 0.52 | 0.51 | 0.47 | 0.48 | 0.47 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| F3 | 0.49 | 0.49 | 0.47 | 0.47 | 0.47 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 |
| F4 | 0.35 | 0.34 | 0.33 | 0.33 | 0.33 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| F5 | 0.38 | 0.37 | 0.40 | 0.40 | 0.40 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |

**Notes**

**. All grades in %**
**. OK = model grades from ordinary kriging**
**. NN = model grades from nearest neighbour estimation**
**. ID = model grades from inverse-distance weighting**

### 14.11.3 Historical Comparison.

The current resource estimate was compared with principal estimates completed during the past four years, as summarised in Table 14-18. It can be seen from this comparison that different approaches have been applied to resource classification, the current one being the more conservative. However, the total resource figure compares closely the total resources estimated earlier in 2015 by Tetra-Tech.

**Table 14-18. Historical Comparison**

| | | | Indicated Resources | | | Inferred Resources | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cut-Off $WO_3$ % | Tonnes Mt | WO3 % | MoS2 % | Tonnes Mt | WO3 % | MoS2 % | Tonnes Mt | WO3 % | MoS2 % |
| **Tetra Tech** | **Jun-12** | 0.15 | 16.43 | 0.45 | 0.03 | 19.37 | 0.44 | 0.05 | 35.80 | 0.44 | 0.04 |
| **AMC *** | **Feb-15** | 0.40 | 3.80 | 0.56 | 0.05 | 11.27 | 0.64 | 0.08 | 15.07 | 0.62 | 0.07 |
| **Tetra Tech** | **Jun-15** | 0.15 | 9.30 | 0.53 | 0.05 | 34.70 | 0.39 | 0.05 | 44.00 | 0.42 | 0.05 |
| **Wheeler** | **Oct-15** | 0.15 | 5.12 | 0.49 | 0.04 | 35.24 | 0.40 | 0.06 | 40.37 | 0.41 | 0.06 |
| **Wheeler** | **Jul-16** | 0.15 | 7.06 | 0.51 | 0.06 | 29.43 | 0.41 | 0.05 | 36.49 | 0.43 | 0.05 |

**Notes**

**. All evaluations limited in depth to above -3 level (594mRL), so as to be comparable with previous reports**

**. Totals shown for comparative purposes only**

*** The AMC indicated resource figure above comprises 56% measured resources**

## 14.12 Mineral Resource Reporting

A summary of the updated Mineral Resources is shown in Table 14-19, relating to a cut-off grade of 0.15% $WO_3$ cut-off grade, for areas above 594mrl. The resources summarised for different cut-offs are shown in Table **14-20**. These resources have an effective date of End-July 2016, and are inclusive of reserves. Grade-tonnage tables, and associated curves are shown in Table 14-21. A resource breakdown by level is shown in Table 14-22. Level-Zone breakdowns are shown in Tables 14-23 to 14-25, for cut-offs of 0.15, 0.20 and 0.30 $\%WO_3$, respectively.

**Table 14-19. Resource Estimation Summary**
**As of July 31st, 2016**

| Resource Category | Mineralised Zone | Tonnes Kt | $WO_3$ % | $MoS_2$ % |
|---|---|---|---|---|
| *Indicated* | HW | 3,121 | 0.55 | 0.10 |
| | MAIN | 854 | 0.49 | 0.04 |
| | F1 | 295 | 0.44 | 0.04 |
| | F2 | 1,554 | 0.52 | 0.04 |
| | HALO | 311 | 0.22 | 0.02 |
| | F3 | 1,578 | 0.51 | 0.03 |
| | F4 | 253 | 0.33 | 0.04 |
| | F5 | 63 | 0.36 | 0.02 |
| | **Total** | **8,029** | **0.51** | **0.06** |
| *Inferred* | HW | 29,208 | 0.46 | 0.06 |
| | MAIN | 4,235 | 0.47 | 0.02 |
| | F1 | 467 | 0.27 | 0.02 |
| | F2 | 3,935 | 0.41 | 0.04 |
| | HALO | 104 | 0.20 | 0.01 |
| | F3 | 4,386 | 0.39 | 0.03 |
| | F4 | 5,800 | 0.32 | 0.03 |
| | F5 | 2,552 | 0.33 | 0.03 |
| | **Total** | **50,686** | **0.43** | **0.05** |

**Notes**

**. Cut-off = 0.15% $WO_3$**
**. Bed models diluted to a minimum thickness of 2.2m**
**. Resources shown are inclusive of reserves**
**. 50m surface pillar material removed**
**. Indicated HW material based on all samples with a maximum search of 35m x 50m (along-strike x down-dip)**
**. Indicated material in all other beds are based on only PO-P6 samples, with a maximum search of 50m, and sample grid required**
**. Inferred material based on all samples, up to a maximum search of :**
**105m x 150m in HW**
**100m x 100m in all other beds**

**Table 14-20. Resource Summaries At Different Cut-Offs**

| $WO_3$ Cut-Off | Resource Class | Tonnes Kt | $WO_3$ % | $MoS_2$ % |
|---|---|---|---|---|
| 0.15% | Indicated | 8,029 | 0.51 | 0.06 |
| | Inferred | 50,686 | 0.43 | 0.05 |
| 0.20% | Indicated | 7,864 | 0.51 | 0.06 |
| | Inferred | 47,630 | 0.44 | 0.05 |
| 0.30% | Indicated | 7,316 | 0.53 | 0.06 |
| | Inferred | 36,466 | 0.50 | 0.06 |

**Notes**

. Bed models diluted to a minimum thickness of 2.2m

. Resources shown are inclusive of reserves

. 50m surface pillar material removed

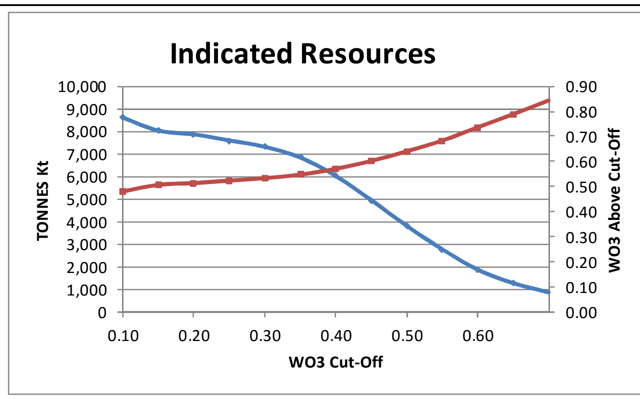
. Indicated HW material based on all samples,
with a maximum search of 35m x 50m (along-strike x down-dip)

. Indicated material in all other beds are based on only PO-P6 samples,
with a maximum search of 50m, and sample grid required

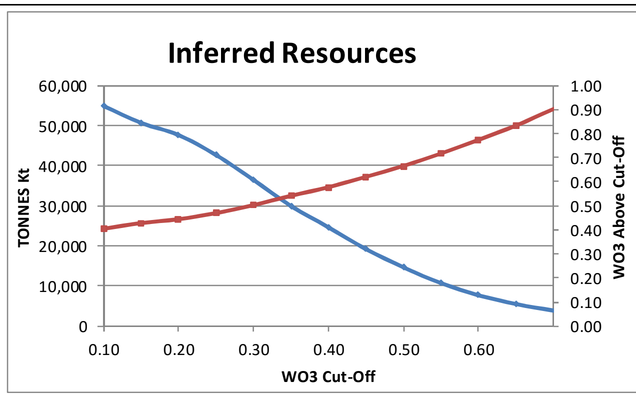
. Inferred material based on all samples, up to a maximum search of :
105m x 150m in HW
100m x 100m in all other beds

**Table 14-21. Resource – Grade-Tonnage Tables**

| WO3 Cut_off % | Tonnes Kt | WO3 % |
|---|---|---|
| 0.10 | 8,611 | 0.48 |
| 0.15 | 8,029 | 0.51 |
| 0.20 | 7,864 | 0.51 |
| 0.25 | 7,596 | 0.52 |
| 0.30 | 7,316 | 0.53 |
| 0.35 | 6,836 | 0.55 |
| 0.40 | 6,022 | 0.57 |
| 0.45 | 4,952 | 0.60 |
| 0.50 | 3,811 | 0.64 |
| 0.55 | 2,777 | 0.68 |
| 0.60 | 1,871 | 0.74 |
| 0.65 | 1,275 | 0.79 |
| 0.70 | 868 | 0.84 |




| WO3 Cut_off % | Tonnes Kt | WO3 % |
|---|---|---|
| 0.10 | 54,889 | 0.40 |
| 0.15 | 50,686 | 0.43 |
| 0.20 | 47,630 | 0.44 |
| 0.25 | 42,667 | 0.47 |
| 0.30 | 36,466 | 0.50 |
| 0.35 | 29,945 | 0.54 |
| 0.40 | 24,645 | 0.58 |
| 0.45 | 19,209 | 0.62 |
| 0.50 | 14,661 | 0.67 |
| 0.55 | 10,725 | 0.72 |
| 0.60 | 7,700 | 0.77 |
| 0.65 | 5,516 | 0.83 |
| 0.70 | 3,874 | 0.90 |



## Table 14-22. Resource Breakdown By Level

| $WO_3$ Cut-Off % | Level | CLASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | Indicated | | | Inferred | | |
| | | Tonnes Kt | $WO_3$ % | $MoS_2$ | Tonnes Kt | $WO_3$ % | $MoS_2$ |
| | Sungyeong_805 | - | | | 1,966 | 0.28 | 0.03 |
| | Jangsan_755 | 38 | 0.40 | 0.01 | 4,483 | 0.34 | 0.04 |
| | Baegun_727 | 98 | 0.44 | 0.09 | 3,210 | 0.38 | 0.03 |
| | Taebak_685 | 718 | 0.45 | 0.05 | 5,701 | 0.39 | 0.05 |
| | Sangdong_659 | 1,758 | 0.50 | 0.04 | 4,251 | 0.45 | 0.06 |
| | -1_633 | 2,234 | 0.53 | 0.06 | 4,107 | 0.45 | 0.06 |
| | -2_617 | 1,554 | 0.53 | 0.08 | 2,277 | 0.42 | 0.06 |
| | -3_594 | 654 | 0.47 | 0.05 | 4,156 | 0.44 | 0.06 |
| | -4_566 | 374 | 0.53 | 0.06 | 4,906 | 0.45 | 0.06 |
| 0.15 | -5_536 | 479 | 0.49 | 0.08 | 4,926 | 0.49 | 0.05 |
| | -6_509 | 121 | 0.50 | 0.06 | 2,582 | 0.48 | 0.03 |
| | -7_482 | - | | | 1,023 | 0.39 | 0.03 |
| | -8_457 | - | | | 1,156 | 0.41 | 0.04 |
| | -9_433 | - | | | 1,393 | 0.46 | 0.04 |
| | -10_407 | - | | | 2,299 | 0.48 | 0.05 |
| | -11_380 | - | | | 1,584 | 0.50 | 0.03 |
| | -12_352 | - | | | 600 | 0.47 | 0.02 |
| | -13_326 | - | | | 66 | 0.35 | 0.02 |
| | TOTAL | 8,029 | 0.51 | 0.06 | 50,686 | 0.43 | 0.05 |

| $WO_3$ Cut-Off % | Level | CLASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | Indicated | | | Inferred | | |
| | | Tonnes Kt | $WO_3$ % | $MoS_2$ | Tonnes Kt | $WO_3$ % | $MoS_2$ |
| | Sungyeong_805 | - | | | 1,759 | 0.29 | 0.04 |
| | Jangsan_755 | 38 | 0.40 | 0.01 | 4,065 | 0.36 | 0.04 |
| | Baegun_727 | 98 | 0.44 | 0.09 | 2,771 | 0.41 | 0.04 |
| | Taebak_685 | 704 | 0.46 | 0.05 | 5,212 | 0.41 | 0.06 |
| | Sangdong_659 | 1,683 | 0.51 | 0.04 | 4,099 | 0.46 | 0.06 |
| | -1_633 | 2,193 | 0.54 | 0.06 | 3,931 | 0.46 | 0.07 |
| | -2_617 | 1,542 | 0.53 | 0.08 | 2,184 | 0.43 | 0.06 |
| | -3_594 | 642 | 0.47 | 0.05 | 4,040 | 0.45 | 0.06 |
| | -4_566 | 372 | 0.53 | 0.06 | 4,746 | 0.46 | 0.06 |
| 0.20 | -5_536 | 472 | 0.50 | 0.08 | 4,742 | 0.50 | 0.05 |
| | -6_509 | 119 | 0.51 | 0.06 | 2,371 | 0.51 | 0.03 |
| | -7_482 | - | | | 930 | 0.41 | 0.03 |
| | -8_457 | - | | | 1,030 | 0.44 | 0.04 |
| | -9_433 | - | | | 1,321 | 0.48 | 0.05 |
| | -10_407 | - | | | 2,192 | 0.49 | 0.05 |
| | -11_380 | - | | | 1,571 | 0.50 | 0.03 |
| | -12_352 | - | | | 600 | 0.47 | 0.02 |
| | -13_326 | - | | | 66 | 0.35 | 0.02 |
| | TOTAL | 7,864 | 0.51 | 0.06 | 47,630 | 0.44 | 0.05 |

| $WO_3$ Cut-Off % | Level | CLASS | | | | | |
|---|---|---|---|---|---|---|---|
| | | Indicated | | | Inferred | | |
| | | Tonnes Kt | $WO_3$ % | $MoS_2$ | Tonnes Kt | $WO_3$ % | $MoS_2$ |
| | Sungyeong_805 | - | | | 510 | 0.45 | 0.05 |
| | Jangsan_755 | 28 | 0.45 | 0.01 | 2,446 | 0.43 | 0.05 |
| | Baegun_727 | 85 | 0.47 | 0.10 | 2,023 | 0.46 | 0.04 |
| | Taebak_685 | 651 | 0.47 | 0.06 | 4,001 | 0.46 | 0.06 |
| | Sangdong_659 | 1,533 | 0.54 | 0.04 | 3,350 | 0.51 | 0.07 |
| | -1_633 | 2,042 | 0.56 | 0.06 | 3,357 | 0.50 | 0.07 |
| | -2_617 | 1,470 | 0.54 | 0.08 | 1,903 | 0.46 | 0.06 |
| | -3_594 | 563 | 0.50 | 0.06 | 3,384 | 0.48 | 0.06 |
| | -4_566 | 356 | 0.54 | 0.06 | 4,033 | 0.49 | 0.06 |
| 0.30 | -5_536 | 472 | 0.50 | 0.08 | 4,157 | 0.54 | 0.05 |
| | -6_509 | 118 | 0.51 | 0.06 | 1,859 | 0.58 | 0.04 |
| | -7_482 | - | | | 417 | 0.63 | 0.06 |
| | -8_457 | - | | | 500 | 0.64 | 0.08 |
| | -9_433 | - | | | 1,023 | 0.54 | 0.06 |
| | -10_407 | - | | | 1,774 | 0.55 | 0.06 |
| | -11_380 | - | | | 1,237 | 0.58 | 0.04 |
| | -12_352 | - | | | 471 | 0.53 | 0.02 |
| | -13_326 | - | | | 23 | 0.55 | 0.02 |
| | TOTAL | 7,316 | 0.53 | 0.06 | 36,466 | 0.50 | 0.06 |

## Table 14-23. Resource Level- Zone Breakdown, at a 0.15%$WO_3$ Cut-Off

| CLASS | Indicated | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AZONE | | | | | | | | | | | | | | | | | |
| LEVEL | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| Jangsan_755 | - | | - | | - | | 10 | 0.41 | - | | 14 | 0.30 | 14 | 0.48 | 0 | 0.26 | 38 | 0.40 |
| Baegun_727 | 69 | 0.48 | 3 | 0.44 | 1 | 0.22 | 4 | 0.29 | 0 | 0.19 | 5 | 0.27 | 9 | 0.40 | 7 | 0.35 | 98 | 0.44 |
| Taebak_685 | 186 | 0.40 | 214 | 0.48 | 65 | 0.45 | 172 | 0.49 | 15 | 0.18 | 64 | 0.46 | - | | 2 | 0.38 | 718 | 0.45 |
| Sangdong_659 | 8 | 0.59 | 326 | 0.47 | 146 | 0.51 | 675 | 0.54 | 159 | 0.23 | 442 | 0.54 | 2 | 0.29 | - | | 1,758 | 0.50 |
| -1_633 | 633 | 0.62 | 273 | 0.54 | 72 | 0.31 | 491 | 0.56 | 113 | 0.24 | 596 | 0.52 | 49 | 0.31 | 7 | 0.55 | 2,234 | 0.53 |
| -2_617 | 1,041 | 0.58 | 37 | 0.52 | 11 | 0.27 | 117 | 0.41 | 8 | 0.17 | 254 | 0.46 | 66 | 0.32 | 20 | 0.37 | 1,554 | 0.53 |
| -3_594 | 270 | 0.57 | - | | 0 | 0.26 | 74 | 0.31 | 12 | 0.18 | 173 | 0.48 | 98 | 0.34 | 27 | 0.31 | 654 | 0.47 |
| -4_566 | 315 | 0.55 | - | | - | | 11 | 0.34 | 4 | 0.22 | 30 | 0.47 | 15 | 0.27 | - | | 374 | 0.53 |
| -5_536 | 479 | 0.49 | - | | - | | - | | - | | - | | - | | - | | 479 | 0.49 |
| -6_509 | 121 | 0.50 | - | | - | | - | | - | | - | | - | | - | | 121 | 0.50 |
| -7_482 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -8_457 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -9_433 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -10_407 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -11_380 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -12_352 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -13_326 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| TOTAL | 3,121 | 0.55 | 854 | 0.49 | 295 | 0.44 | 1,554 | 0.52 | 311 | 0.22 | 1,578 | 0.51 | 253 | 0.33 | 63 | 0.36 | 8,029 | 0.51 |

| CLASS | Inferred | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AZONE | | | | | | | | | | | | | | | | | |
| LEVEL | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | 1,284 | 0.28 | 375 | 0.20 | 9 | 0.18 | 198 | 0.40 | - | | 101 | 0.41 | - | | - | | 1,966 | 0.28 |
| Jangsan_755 | 2,339 | 0.37 | 469 | 0.28 | 77 | 0.19 | 502 | 0.34 | 0 | 0.15 | 543 | 0.33 | 499 | 0.32 | 54 | 0.27 | 4,483 | 0.34 |
| Baegun_727 | 1,657 | 0.40 | 30 | 0.38 | 7 | 0.22 | 300 | 0.49 | 31 | 0.21 | 426 | 0.34 | 469 | 0.30 | 289 | 0.29 | 3,210 | 0.38 |
| Taebak_685 | 3,114 | 0.41 | 165 | 0.45 | 73 | 0.27 | 434 | 0.53 | 50 | 0.18 | 618 | 0.37 | 796 | 0.32 | 452 | 0.35 | 5,701 | 0.39 |
| Sangdong_659 | 2,682 | 0.48 | 93 | 0.44 | 38 | 0.29 | 250 | 0.54 | 15 | 0.24 | 210 | 0.49 | 579 | 0.33 | 385 | 0.38 | 4,251 | 0.45 |
| -1_633 | 2,422 | 0.49 | 185 | 0.51 | 32 | 0.33 | 187 | 0.52 | 4 | 0.22 | 258 | 0.52 | 602 | 0.30 | 416 | 0.33 | 4,107 | 0.45 |
| -2_617 | 920 | 0.48 | 242 | 0.47 | 43 | 0.30 | 123 | 0.44 | 0 | 0.18 | 210 | 0.50 | 445 | 0.31 | 294 | 0.32 | 2,277 | 0.42 |
| -3_594 | 1,680 | 0.53 | 548 | 0.43 | 104 | 0.29 | 394 | 0.34 | 2 | 0.20 | 523 | 0.47 | 463 | 0.32 | 442 | 0.35 | 4,156 | 0.44 |
| -4_566 | 2,356 | 0.50 | 524 | 0.54 | 75 | 0.25 | 627 | 0.37 | 2 | 0.17 | 599 | 0.44 | 556 | 0.32 | 166 | 0.28 | 4,906 | 0.45 |
| -5_536 | 2,475 | 0.55 | 677 | 0.65 | 8 | 0.18 | 717 | 0.36 | - | | 541 | 0.36 | 454 | 0.37 | 54 | 0.26 | 4,926 | 0.49 |
| -6_509 | 1,288 | 0.55 | 368 | 0.65 | - | | 187 | 0.31 | - | | 281 | 0.23 | 457 | 0.36 | - | | 2,582 | 0.48 |
| -7_482 | 511 | 0.43 | 106 | 0.72 | - | | 17 | 0.36 | - | | 76 | 0.19 | 313 | 0.28 | - | | 1,023 | 0.39 |
| -8_457 | 993 | 0.44 | - | | - | | - | | - | | - | | 164 | 0.25 | - | | 1,156 | 0.41 |
| -9_433 | 1,391 | 0.46 | - | | - | | - | | - | | - | | 2 | 0.26 | - | | 1,393 | 0.46 |
| -10_407 | 2,202 | 0.49 | 98 | 0.34 | - | | - | | - | | - | | - | | - | | 2,299 | 0.48 |
| -11_380 | 1,360 | 0.52 | 224 | 0.36 | - | | - | | - | | - | | - | | - | | 1,584 | 0.50 |
| -12_352 | 488 | 0.45 | 112 | 0.53 | - | | - | | - | | - | | - | | - | | 600 | 0.47 |
| -13_326 | 48 | 0.26 | 18 | 0.59 | - | | - | | - | | - | | - | | - | | 66 | 0.35 |
| TOTAL | 29,208 | 0.46 | 4,235 | 0.47 | 467 | 0.27 | 3,935 | 0.41 | 104 | 0.20 | 4,386 | 0.39 | 5,800 | 0.32 | 2,552 | 0.33 | 50,686 | 0.43 |

## Table 14-24. Resource Level- Zone Breakdown, at a 0.2%$WO_3$ Cut-Off

| CLASS | Indicated | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AZONE | | | | | | | | | | | | | | | | | |
| LEVEL | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| Jangsan_755 | - | | - | | - | | 10 | 0.41 | - | | 14 | 0.30 | 14 | 0.48 | 0 | 0.26 | 38 | 0.40 |
| Baegun_727 | 69 | 0.48 | 3 | 0.44 | 1 | 0.22 | 4 | 0.29 | - | | 5 | 0.27 | 9 | 0.40 | 7 | 0.35 | 98 | 0.44 |
| Taebak_685 | 186 | 0.40 | 214 | 0.48 | 63 | 0.46 | 172 | 0.49 | 3 | 0.22 | 64 | 0.46 | - | | 2 | 0.38 | 704 | 0.46 |
| Sangdong_659 | 8 | 0.59 | 326 | 0.47 | 132 | 0.55 | 675 | 0.54 | 99 | 0.26 | 442 | 0.54 | 2 | 0.29 | - | | 1,683 | 0.51 |
| -1_633 | 633 | 0.62 | 273 | 0.54 | 55 | 0.35 | 491 | 0.56 | 89 | 0.25 | 596 | 0.52 | 48 | 0.31 | 7 | 0.55 | 2,193 | 0.54 |
| -2_617 | 1,041 | 0.58 | 37 | 0.52 | 10 | 0.28 | 117 | 0.41 | 1 | 0.20 | 254 | 0.46 | 65 | 0.32 | 18 | 0.40 | 1,542 | 0.53 |
| -3_594 | 269 | 0.58 | - | | 0 | 0.26 | 74 | 0.31 | 2 | 0.22 | 173 | 0.48 | 97 | 0.34 | 26 | 0.31 | 642 | 0.47 |
| -4_566 | 315 | 0.55 | - | | - | | 11 | 0.34 | 3 | 0.23 | 30 | 0.47 | 14 | 0.27 | - | | 372 | 0.53 |
| -5_536 | 472 | 0.50 | - | | - | | - | | - | | - | | - | | - | | 472 | 0.50 |
| -6_509 | 119 | 0.51 | - | | - | | - | | - | | - | | - | | - | | 119 | 0.51 |
| -7_482 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -8_457 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -9_433 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -10_407 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -11_380 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -12_352 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -13_326 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| TOTAL | 3,112 | 0.56 | 854 | 0.49 | 261 | 0.47 | 1,554 | 0.52 | 197 | 0.25 | 1,578 | 0.51 | 248 | 0.34 | 60 | 0.37 | 7,864 | 0.51 |

| CLASS | Inferred | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AZONE | | | | | | | | | | | | | | | | | |
| LEVEL | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | 1,196 | 0.28 | 320 | 0.21 | - | | 146 | 0.49 | - | | 97 | 0.42 | - | | - | | 1,759 | 0.29 |
| Jangsan_755 | 2,216 | 0.38 | 469 | 0.28 | 29 | 0.21 | 402 | 0.38 | - | | 516 | 0.34 | 378 | 0.37 | 54 | 0.27 | 4,065 | 0.36 |
| Baegun_727 | 1,406 | 0.44 | 19 | 0.49 | 4 | 0.27 | 296 | 0.50 | 15 | 0.24 | 396 | 0.36 | 347 | 0.34 | 289 | 0.29 | 2,771 | 0.41 |
| Taebak_685 | 2,737 | 0.44 | 140 | 0.50 | 50 | 0.31 | 434 | 0.53 | 10 | 0.21 | 605 | 0.38 | 785 | 0.33 | 452 | 0.35 | 5,212 | 0.41 |
| Sangdong_659 | 2,562 | 0.50 | 92 | 0.44 | 30 | 0.32 | 248 | 0.54 | 12 | 0.25 | 208 | 0.49 | 579 | 0.33 | 369 | 0.38 | 4,099 | 0.46 |
| -1_633 | 2,331 | 0.50 | 184 | 0.51 | 25 | 0.38 | 187 | 0.52 | 4 | 0.22 | 258 | 0.52 | 600 | 0.30 | 342 | 0.36 | 3,931 | 0.46 |
| -2_617 | 920 | 0.48 | 241 | 0.48 | 33 | 0.34 | 120 | 0.45 | 0 | 0.25 | 210 | 0.50 | 440 | 0.32 | 221 | 0.37 | 2,184 | 0.43 |
| -3_594 | 1,679 | 0.53 | 548 | 0.43 | 88 | 0.31 | 361 | 0.36 | 1 | 0.22 | 516 | 0.48 | 447 | 0.32 | 399 | 0.37 | 4,040 | 0.45 |
| -4_566 | 2,339 | 0.50 | 524 | 0.54 | 47 | 0.30 | 606 | 0.37 | - | | 577 | 0.45 | 502 | 0.34 | 152 | 0.30 | 4,746 | 0.46 |
| -5_536 | 2,430 | 0.55 | 677 | 0.65 | 1 | 0.25 | 678 | 0.37 | - | | 496 | 0.37 | 408 | 0.39 | 54 | 0.26 | 4,742 | 0.50 |
| -6_509 | 1,235 | 0.56 | 368 | 0.65 | - | | 129 | 0.36 | - | | 182 | 0.26 | 457 | 0.36 | - | | 2,371 | 0.51 |
| -7_482 | 458 | 0.45 | 106 | 0.72 | - | | 12 | 0.42 | - | | 40 | 0.21 | 313 | 0.28 | - | | 930 | 0.41 |
| -8_457 | 867 | 0.48 | - | | - | | - | | - | | - | | 164 | 0.25 | - | | 1,030 | 0.44 |
| -9_433 | 1,319 | 0.48 | - | | - | | - | | - | | - | | 2 | 0.26 | - | | 1,321 | 0.48 |
| -10_407 | 2,094 | 0.50 | 98 | 0.34 | - | | - | | - | | - | | - | | - | | 2,192 | 0.49 |
| -11_380 | 1,347 | 0.53 | 223 | 0.36 | - | | - | | - | | - | | - | | - | | 1,571 | 0.50 |
| -12_352 | 488 | 0.45 | 112 | 0.53 | - | | - | | - | | - | | - | | - | | 600 | 0.47 |
| -13_326 | 48 | 0.26 | 18 | 0.59 | - | | - | | - | | - | | - | | - | | 66 | 0.35 |
| TOTAL | 27,672 | 0.48 | 4,137 | 0.48 | 306 | 0.31 | 3,620 | 0.43 | 41 | 0.23 | 4,100 | 0.41 | 5,422 | 0.33 | 2,332 | 0.35 | 47,630 | 0.44 |

## Table 14-25. Resource Level- Zone Breakdown, at a 0.3%$WO_3$ Cut-Off

| CLASS | Indicated | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL | AZONE | | | | | | | | | | | | | | | | | |
| | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| Jangsan_755 | - | | - | | - | | 10 | 0.41 | - | | 5 | 0.39 | 14 | 0.49 | - | | 28 | 0.45 |
| Baegun_727 | 65 | 0.49 | 3 | 0.47 | - | | 2 | 0.34 | - | | 0 | 0.31 | 9 | 0.40 | 6 | 0.37 | 85 | 0.47 |
| Taebak_685 | 186 | 0.40 | 193 | 0.50 | 48 | 0.52 | 162 | 0.50 | - | | 61 | 0.47 | - | | 2 | 0.38 | 651 | 0.47 |
| Sangdong_659 | 8 | 0.59 | 319 | 0.47 | 78 | 0.76 | 675 | 0.54 | 20 | 0.34 | 432 | 0.55 | 0 | 0.30 | - | | 1,533 | 0.54 |
| -1_633 | 630 | 0.62 | 269 | 0.55 | 31 | 0.42 | 475 | 0.57 | 12 | 0.34 | 590 | 0.53 | 29 | 0.35 | 7 | 0.55 | 2,042 | 0.56 |
| -2_617 | 1,029 | 0.58 | 37 | 0.52 | 4 | 0.35 | 94 | 0.45 | - | | 252 | 0.46 | 38 | 0.36 | 17 | 0.41 | 1,470 | 0.54 |
| -3_594 | 269 | 0.58 | - | | - | | 45 | 0.35 | - | | 173 | 0.48 | 62 | 0.39 | 14 | 0.36 | 563 | 0.50 |
| -4_566 | 313 | 0.55 | - | | - | | 9 | 0.34 | - | | 30 | 0.47 | 3 | 0.33 | - | | 356 | 0.54 |
| -5_536 | 472 | 0.50 | - | | - | | - | | - | | - | | - | | - | | 472 | 0.50 |
| -6_509 | 118 | 0.51 | - | | - | | - | | - | | - | | - | | - | | 118 | 0.51 |
| -7_482 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -8_457 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -9_433 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -10_407 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -11_380 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -12_352 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| -13_326 | - | | - | | - | | - | | - | | - | | - | | - | | - | |
| TOTAL | 3,090 | 0.56 | 821 | 0.50 | 161 | 0.61 | 1,470 | 0.53 | 32 | 0.34 | 1,542 | 0.51 | 154 | 0.38 | 45 | 0.41 | 7,316 | 0.53 |

| CLASS | Inferred | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL | AZONE | | | | | | | | | | | | | | | | | |
| | HW | | MAIN | | F1 | | F2 | | HALO | | F3 | | F4 | | F5 | | TOTAL | |
| | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% | Kt | $WO_3$% |
| Sungyeong_805 | 323 | 0.40 | 3 | 0.30 | - | | 132 | 0.51 | - | | 51 | 0.58 | - | | - | | 510 | 0.45 |
| Jangsan_755 | 1,460 | 0.44 | 195 | 0.38 | - | | 335 | 0.41 | - | | 219 | 0.45 | 234 | 0.42 | 4 | 0.34 | 2,446 | 0.43 |
| Baegun_727 | 1,097 | 0.49 | 19 | 0.49 | 0 | 0.48 | 271 | 0.52 | 2 | 0.32 | 297 | 0.38 | 220 | 0.38 | 117 | 0.35 | 2,023 | 0.46 |
| Taebak_685 | 2,167 | 0.49 | 138 | 0.50 | 15 | 0.49 | 405 | 0.55 | - | | 525 | 0.39 | 500 | 0.36 | 251 | 0.42 | 4,001 | 0.46 |
| Sangdong_659 | 2,131 | 0.55 | 81 | 0.47 | 11 | 0.48 | 242 | 0.55 | 2 | 0.32 | 190 | 0.51 | 394 | 0.37 | 298 | 0.42 | 3,350 | 0.51 |
| -1_633 | 2,160 | 0.52 | 174 | 0.52 | 18 | 0.43 | 177 | 0.53 | - | | 256 | 0.53 | 331 | 0.34 | 242 | 0.41 | 3,357 | 0.50 |
| -2_617 | 899 | 0.48 | 217 | 0.50 | 22 | 0.39 | 100 | 0.49 | - | | 210 | 0.50 | 279 | 0.34 | 177 | 0.40 | 1,903 | 0.46 |
| -3_594 | 1,661 | 0.53 | 428 | 0.47 | 56 | 0.34 | 207 | 0.43 | - | | 480 | 0.49 | 263 | 0.36 | 289 | 0.41 | 3,384 | 0.48 |
| -4_566 | 2,275 | 0.51 | 435 | 0.59 | 25 | 0.34 | 418 | 0.43 | - | | 527 | 0.47 | 310 | 0.38 | 44 | 0.42 | 4,033 | 0.49 |
| -5_536 | 2,358 | 0.56 | 676 | 0.65 | - | | 502 | 0.41 | - | | 319 | 0.45 | 302 | 0.43 | - | | 4,157 | 0.54 |
| -6_509 | 1,107 | 0.60 | 363 | 0.66 | - | | 81 | 0.42 | - | | 31 | 0.41 | 276 | 0.45 | - | | 1,859 | 0.58 |
| -7_482 | 240 | 0.65 | 100 | 0.75 | - | | 12 | 0.42 | - | | - | | 64 | 0.43 | - | | 417 | 0.63 |
| -8_457 | 500 | 0.64 | - | | - | | - | | - | | - | | - | | - | | 500 | 0.64 |
| -9_433 | 1,023 | 0.54 | - | | - | | - | | - | | - | | - | | - | | 1,023 | 0.54 |
| -10_407 | 1,676 | 0.56 | 98 | 0.34 | - | | - | | - | | - | | - | | - | | 1,774 | 0.55 |
| -11_380 | 1,014 | 0.62 | 223 | 0.36 | - | | - | | - | | - | | - | | - | | 1,237 | 0.58 |
| -12_352 | 359 | 0.53 | 112 | 0.53 | - | | - | | - | | - | | - | | - | | 471 | 0.53 |
| -13_326 | 6 | 0.42 | 18 | 0.59 | - | | - | | - | | - | | - | | - | | 23 | 0.55 |
| TOTAL | 22,457 | 0.53 | 3,279 | 0.54 | 147 | 0.39 | 2,882 | 0.47 | 3 | 0.32 | 3,104 | 0.46 | 3,173 | 0.38 | 1,422 | 0.41 | 36,466 | 0.50 |

# 15 MINERAL RESERVE ESTIMATES

The Mineral Reserves were derived from the Mineral Resource block model described in Section 14.0. The Mineral Reserves are those Indicated Mineral Resources (there are no Measured Resources in the current estimate) that have been identified as being economically extractable and which incorporate mining losses and the addition of mining dilution. The Mineral Reserves form the basis for the mine plan presented in Section 16.0.

## 15.1 Block Model Preparation

The steps taken in block model (and other data) preparation for stope planning included:

1. Maps of maximum span distances, that had previously been prepared by in a geotechnical study by Turner Mining and Geotechnical Pty Ltd (TMG) in 2014, were used to create perimeters pertaining to maximum span limits of 3, 6 and 10m.

2. These perimeters of maximum span properties were then available to be superimposed onto the block model and areas of potential stope design.

3. Because of the close proximity of the different narrow skarn zones, alternative test block models were created with combinations of an upper bed, the intermediate waste and the underlying bed. These combined models were created, so as to test the feasibility of mining thicker bed systems with lower mining cost. All possible different bed combinations were tested. After this analysis, the only combined set which was selected for subsequent for mine planning was the MAIN-F1 combination.

4. Level strings were created where the base of each modelled skarn zone intersected the relevant level elevation. These strings were used for string construction during stope layout. .

5. For each skarn zone, the resource model blocks were split into separate block models for each zone, and projected so that all grades or other model properties could be viewed and used in a plan projection view.

## 15.2 Stoping Methods

A mine plan was developed, using cut-and-fill (CAF) and mechanised inclined panel (MIP) mining. The planning and development of these methods have evolved from the Up-Dip Panel (UDP) mining, for narrower or poorer ground areas, and Inclined Panel (IP) mining methods proposed in the A-Z Feasibility Study. Details of the currently applied CAF and MIP methods are described in Section 16.

In the A-Z feasibility study, an overall average mining cost of $US33.76/t was applied, according to the overall proportions of mining methods applied of 20% UDP and 80% IP. In the current study, the same processing and G&A unit costs were applied as in the A-Z feasibility study. The mining costs have been revised in the current study, to reflect the updated mining methods and by getting updated mining costs estimates from Korean mining contractors. With respect to cut-off grades, information was also used from the geotechnical study by Turner Mining and Geotechnical Pty Ltd (TMG) in 2014, so as to also consider recommended maximum span ranges.

A summary of the cut-off calculations and parameters is shown in Table 15-1. This shows the parameters used in the A-Z Study, which results in a breakeven cut-off grade of 0.23% $WO_3$. A-Z subsequently applied a cut-off of 0.275% $WO_3$ in their reserve calculations.

Using the updated mining costs, breakeven cut-off grades of 0.20% $WO_3$ for CAF and 0.24% $WO_3$ for MIP were calculated. Based on the overall reserve proportions of 60% CAF and 40% MIP, an overall combined breakeven cut-off of 0.22% was determined. The applied cut-off in the current study was 0.23% $WO_3$ for the majority of stope blocks, where recommended maximum spans were limited by geotechnical recommendations, with elevated cut-offs of 0.28% $WO_3$ for 3-6m, and 0.36% for less than 3m. These elevated cut-offs are only applicable to 26% of the reserve base, and ensure that such blocks would still be profitable, even if substantial additional support costs are required.

As with the A-Z feasibility study, mining factors of 5% losses and 5% additional unplanned dilution have been assumed.

## Table 15-1. Underground Cut-Off Parameters

| Description | | Unit | A_Z June 2015: 20% UDP, 80%IP | Current Study: CAF | Current Study: MIP | Current Study: Mine Average: 60% CAF, 40% MIP |
|---|---|---|---|---|---|---|
| **Prices** | | | | | | |
| | APT Price | *\$/mtu $WO_3$* | | **370** | **370** | **370** |
| | Metal Price - received | *\$/mtu $WO_3$* | | **288** | **288** | **288** |
| | Conc grade | *%WO3* | **65%** | **65%** | **65%** | **65%** |
| | Price per t of concentrate | | **18200** | 18,720 | 18,720 | 18,720 |
| | after transport + smelting | *\$/t $WO_3$* | 28,000 | 28,800 | 28,800 | 28,800 |
| **Costs** | | | | | | |
| | Recovery | *%* | **81.0%** | **81.0%** | **81.0%** | **81.0%** |
| | Processing Cost | *\$/t ore* | **10.95** | **10.95** | **10.95** | **10.95** |
| | G & A | *\$/t ore* | **4.85** | **4.90** | **4.90** | **4.90** |
| | Ore mining | *\$/t ore* | **33.76** | **28.4** | **38.25** | **32.33** |
| | Total Applied Ore Cost (Processing+G&A+OreMining) | *\$/t ore* | 49.56 | 44.25 | 54.1 | 48.18 |
| **Mining Factors** | | | | | | |
| | Production rate | *tpd* | **1,920** | **1,820** | **1,820** | **1,820** |
| | Mining Recovery | | 95% | 95% | 95% | 95% |
| | Dilution | | 5% | 5% | 5% | 5% |
| **Cut-Offs** | | | | | | |
| | Breakeven Economic Cut-Off | *% $WO_3$* | 0.23% | 0.20% | 0.24% | 0.22% |

**Notes**

| Key | |
|---|---|
| **Bold** | **Value supplied** |
| Normal | Derived |

**A-Z Study**

UDP Up-Dip Panel Mining

IP Inclined Panel Mining

**Current Revised FS Study**

CAF Cut-and-fill

MIP Mechanised Inclined Panel Mining

**Applied Cut-Off Grades:**

| **Maximum Span Criteria** | **<=3m** | **>3m <=6m** | **+6m** |
|---|---|---|---|
| **Cut-Offs %$WO_3$** | **0.36%** | **0.28%** | **0.23%** |
| **Proportion of Reserve Base** | **6%** | **20%** | **75%** |

Mining factors of 5% losses and 5% additional unplanned dilution have been assumed.

## 15.3 Stope Layout

Stope blocks were laid out as plan perimeters, bounded by horizontal parts on each level, where the footwall contact of each zone cut through level's reference elevation. In general, most stope blocks were limited to a maximum of 100m along strike. Stope blocks were only laid out in those parts of each zone predominantly demarcated as containing indicated resources. For reference during this planning process, the model blocks were coded with $WO_3$ grade, so as to highlight those blocks above the cut-offs described in Section 15.2. Any inferred resource blocks within stope outlines were treated as planned dilution with mineralised waste, with any grades greater than 0.2% $WO_3$ set to 0.2%.

All stope blocks were automatically assigned block IDs, based on the level interval to which they belong. An example of the stope block layouts of the F2 skarn zone is shown in Figure 15-1. This also shows the maximum span limits for F2, stemming from geotechnical limit maps. The stope block layouts for the updated HW zone are shown in Figure 15-2.

## 15.4 Mineral Reserve Estimation

Stope blocks were overlaid onto the resource block model, and evaluated. At the same time, the tonnages relating to the different span limits within each stope block were also determined, from which an aggregate cut-off grade for the stope block was determined. The stope blocks' average grades were determined, included any waste as planned dilution. The grades were then further decreased with the unplanned dilution factor of 5%. Block contents were only confirmed as reserves if the resultant average stope grades were above the derived block cut-off.

A summary of the resultant reserves is shown in the Table 15-2. A grade-tonnage table of the stope block reserves is shown in Table 15-3.

**Figure 15-1. Stope Block Layout – F2**

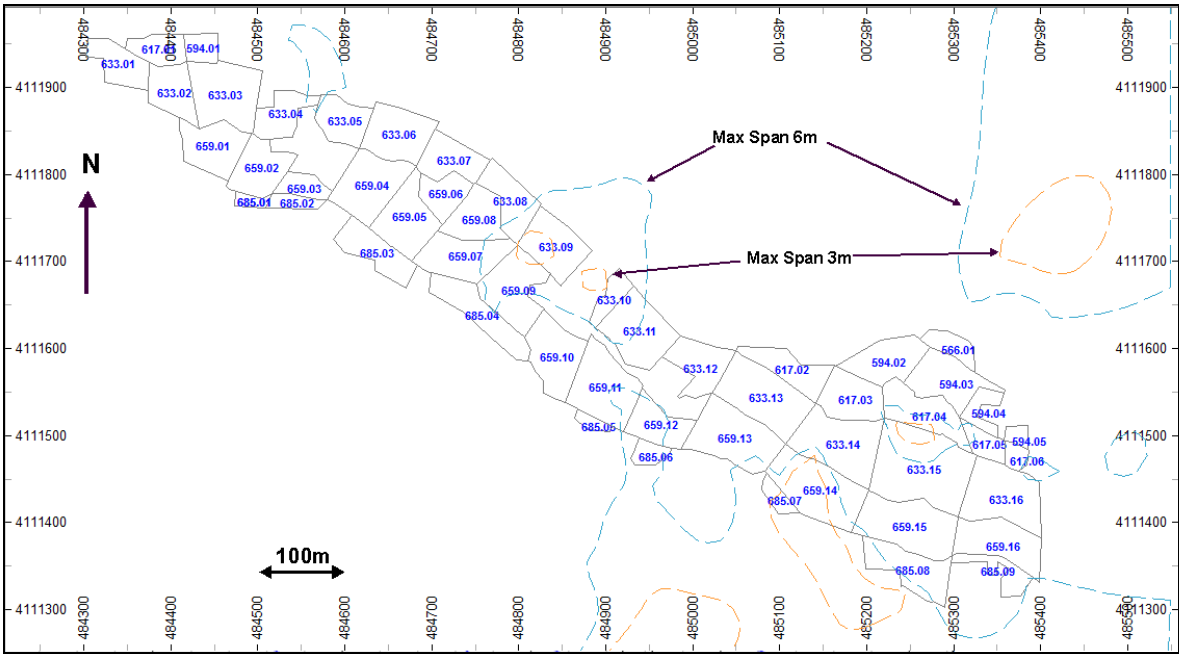
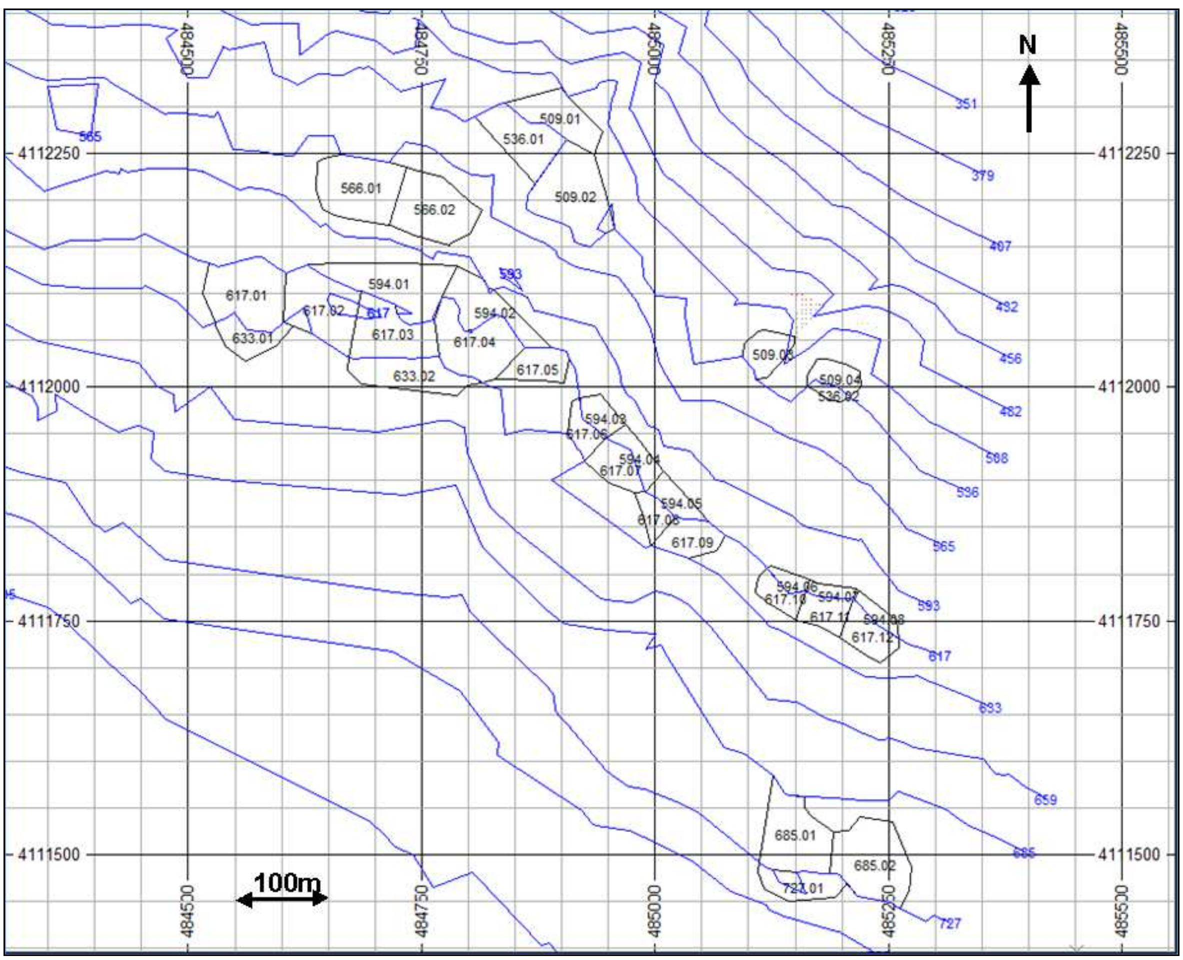



**Figure 15-2. Stope Block Layout – HW**



### Table 15-2. Summary of Mining Reserves

As of July 31st, 2016

| LEVEL_Elevation | HW Tonnes Kt | HW $WO_3$ % | MAINF1 Tonnes Kt | MAINF1 $WO_3$ % | F2 Tonnes Kt | F2 $WO_3$ % | F3 Tonnes Kt | F3 $WO_3$ % | F4 Tonnes Kt | F4 $WO_3$ % | TOTAL Tonnes Kt | TOTAL $WO_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jangsan_755 | - | | - | | - | | - | | 15 | 0.42 | 15 | 0.42 |
| Baegun_727 | 47 | 0.45 | 20 | 0.34 | - | | - | | 10 | 0.35 | 78 | 0.41 |
| Taebak_685 | 320 | 0.37 | 392 | 0.36 | 196 | 0.42 | 66 | 0.38 | - | | 974 | 0.38 |
| Sangdong_659 | | | 518 | 0.32 | 752 | 0.48 | 527 | 0.47 | 2 | 0.26 | 1,800 | 0.43 |
| -1_633 | 266 | 0.49 | 398 | 0.35 | 546 | 0.48 | 656 | 0.46 | 37 | 0.30 | 1,902 | 0.45 |
| -2_617 | 1,061 | 0.52 | - | | - | | - | | - | | 1,061 | 0.52 |
| -3_594 | 755 | 0.53 | | | | | | | | | 755 | 0.53 |
| -4_566 | 506 | 0.45 | | | | | | | | | 506 | 0.45 |
| -5_536 | 173 | 0.46 | | | | | | | | | 173 | 0.46 |
| -6_509 | 632 | 0.40 | | | | | | | | | 632 | 0.40 |
| **TOTAL** | **3,759** | **0.47** | **1,328** | **0.34** | **1,495** | **0.48** | **1,249** | **0.46** | **65** | **0.33** | **7,896** | **0.45** |

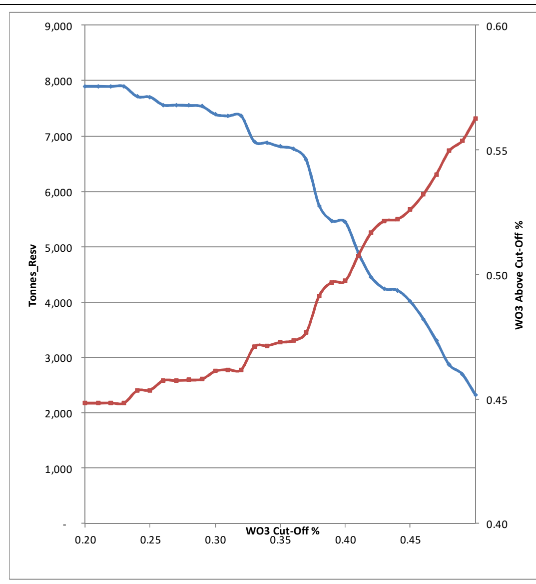
**Notes**

- All reserves have a probable category
- $WO_3$ Cut-offs applied:
  - 0.36% Max Spans <=3m
  - 0.28% Max Spans >3m <=6m
  - 0.23% Max Spans +6m
- Level restrictions:
  - Down to -1 level (633m) for the non-HW zones
- Mining Factors applied
  - Minimum thickness = 2.2m
  - Unplanned dilution = 5%
  - Unplanned losses = 5%

### Table 15-3. Grade-Tonnage Table of Stope Block Reserves

All reserves are of Probable Reserve Category

| WO3 Cut-Off % | Tonnes Kt | WO3 % |
|---|---|---|
| 0.20 | 7,896 | 0.45 |
| 0.21 | 7,896 | 0.45 |
| 0.22 | 7,894 | 0.45 |
| 0.23 | 7,894 | 0.45 |
| 0.24 | 7,711 | 0.45 |
| 0.25 | 7,702 | 0.45 |
| 0.26 | 7,559 | 0.46 |
| 0.27 | 7,557 | 0.46 |
| 0.28 | 7,549 | 0.46 |
| 0.29 | 7,534 | 0.46 |
| 0.30 | 7,389 | 0.46 |
| 0.31 | 7,362 | 0.46 |
| 0.32 | 7,362 | 0.46 |
| 0.33 | 6,899 | 0.47 |
| 0.34 | 6,876 | 0.47 |
| 0.35 | 6,808 | 0.47 |
| 0.36 | 6,769 | 0.47 |
| 0.37 | 6,569 | 0.48 |
| 0.38 | 5,744 | 0.49 |
| 0.39 | 5,467 | 0.50 |
| 0.40 | 5,444 | 0.50 |
| 0.41 | 4,894 | 0.51 |
| 0.42 | 4,455 | 0.52 |
| 0.43 | 4,242 | 0.52 |
| 0.44 | 4,214 | 0.52 |
| 0.45 | 4,011 | 0.53 |
| 0.46 | 3,696 | 0.53 |
| 0.47 | 3,302 | 0.54 |
| 0.48 | 2,866 | 0.55 |
| 0.49 | 2,698 | 0.55 |
| 0.50 | 2,326 | 0.56 |



# 16 MINING METHODS

## 16.1 Existing Mine Infrastructure

Extensive mining has taken place within the Sangdong Mine property and at the time of its closure, the mine had been developed on more than 20 levels, between the elevations of 242 and 755 masl, with a total length of 20 km of development. The mine is flooded to -1 level (633mRL) where a tunnel and trench, situated at the level floor elevation, drains water out to a valley in the mountainside. The level reference system is summarised in Table 16-1.

The mine is located on a mountainside, with two old and one new entry portal situated on the Sangdong level. Old entry portals are also located on the Taebaek, Baegun, Jangsang and Sunyeong levels. A ramp from the Sangdong accesses the -1 level at the eastern end of the level. There are several inclined shafts and vertical shafts that were used to access lower levels. A plan of all levels, overlain with sample data, is shown in Figure 16-1.

Existing verified level development on levels Taebaek, Sangdong and -1 are shown in Figure 16-2, Figure 16-3 and Figure 16-4, respectively. A composite drawing of all levels down to the -1 level is shown in Figure 16-5.

A significant portion of the opening accessing the Mina zone, where it was mined, have caved in but can be rehabilitated if required.

The old ventilation incline located at the west end of mine is in good condition and may be used as the main exhaust air shaft and a secondary egress. Its collar is at 856 mRL.

The existing administration and geology buildings are located on surface on a plateau near the Sangdong portals.

**Table 16-1. Level Reference System**

| Level Name | Elevation (mRL) |
|---|---|
| Ventilation | 856.0 |
| Sungyeong | 804.7 |
| Jangsan | 751.5 |
| Baegun | 724.0 |
| Shaft | 725.0 |
| Taebak | 683.6 |
| Sangdong | 656.8 |
| 2nd Sangdong | 655.8 |
| Woulfe | 656.3 |
| -1 | 632.6 |
| Drainage | 629.0 |
| -2 | 617.5 |
| -3 | 593.8 |
| -4 | 565.8 |
| -5 | 536.3 |
| -6 | 508.6 |
| -7 | 482.1 |
| -8 | 456.8 |
| -9 | 432.6 |
| -10 | 407.4 |
| -11 | 379.7 |
| -12 | 351.8 |
| -13 | 325.5 |
| -14 | 298.2 |
| -15 | 269.5 |
| -16 | 242.6 |
| -17 | 224.0 |

**Figure 16-1. Plan of All Levels, With Drillhole Data**

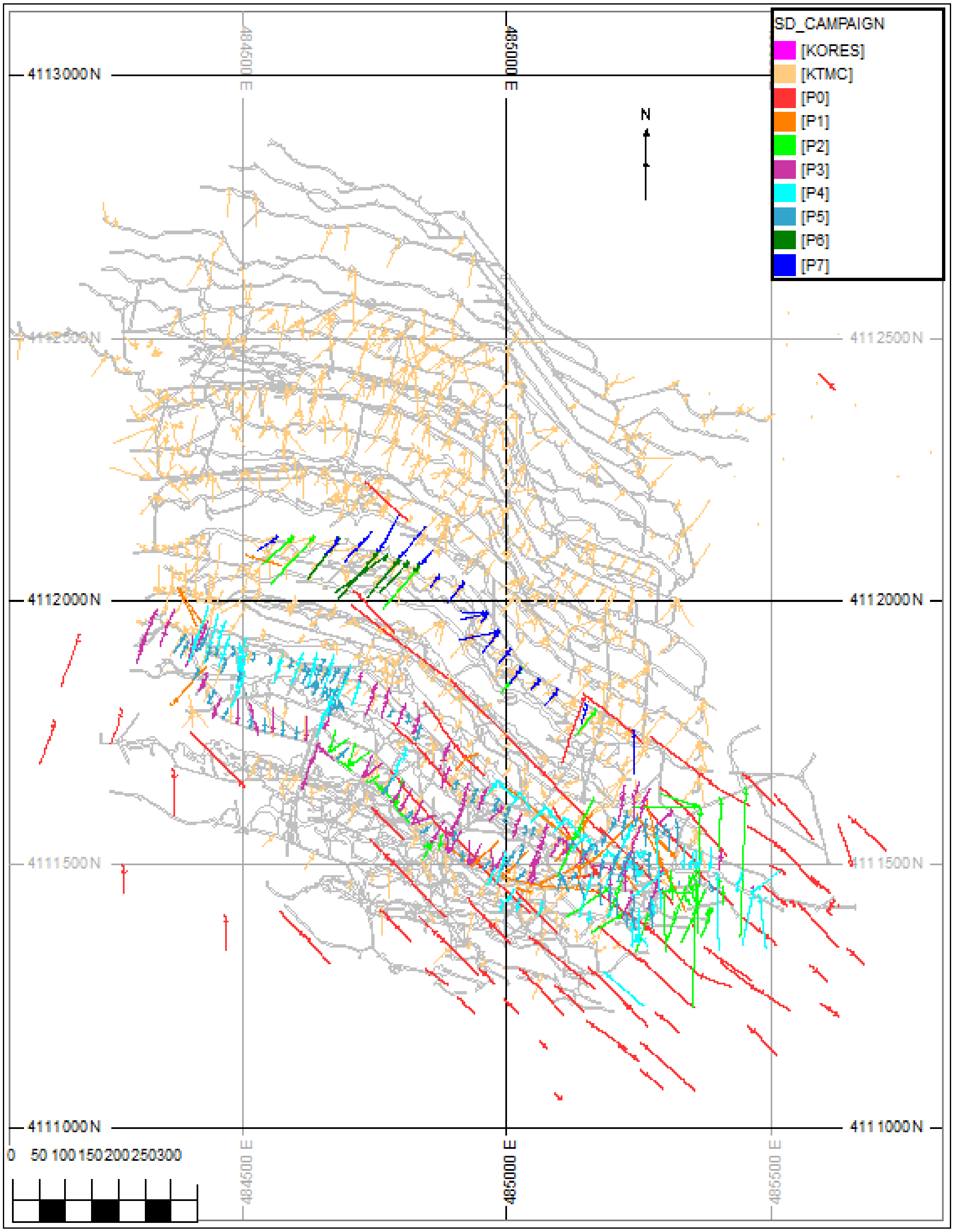


**Figure 16-2. Existing Level Development on Taebaek Level**

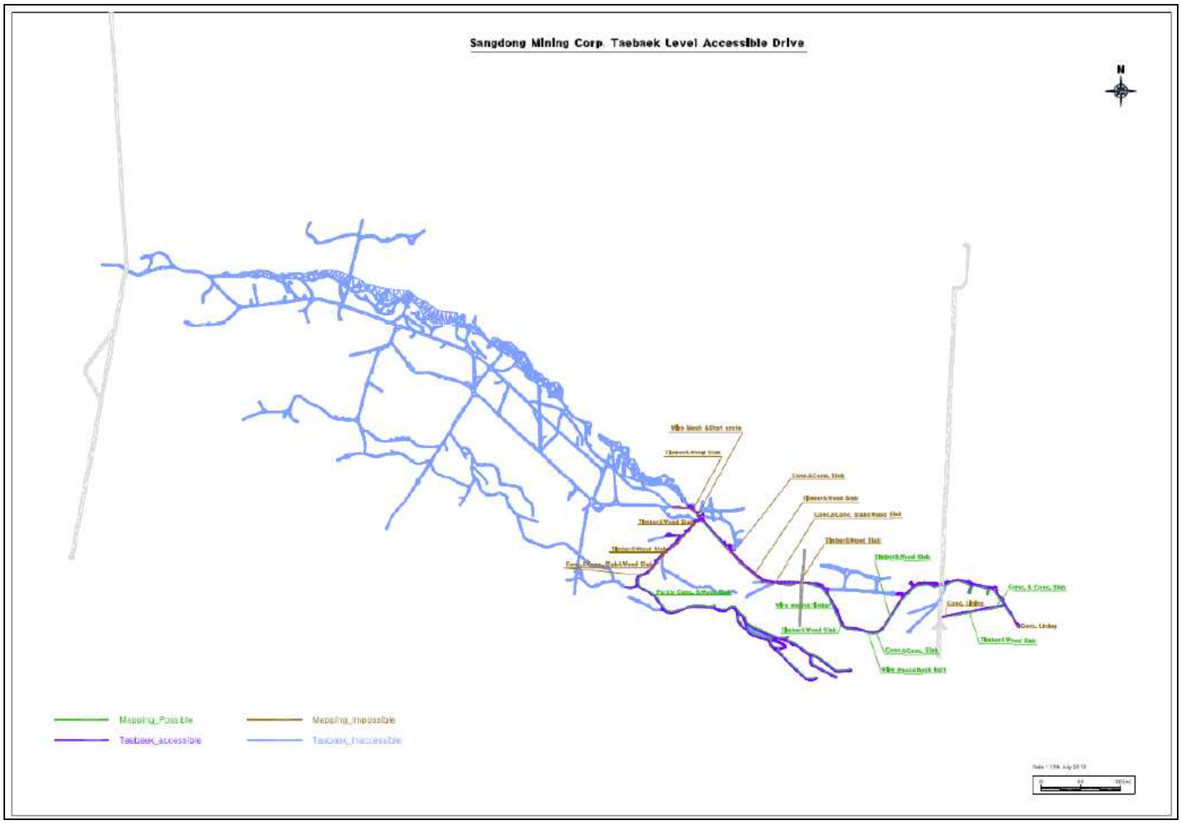



**Figure 16-3. Existing Level Development on Sangdong Level**

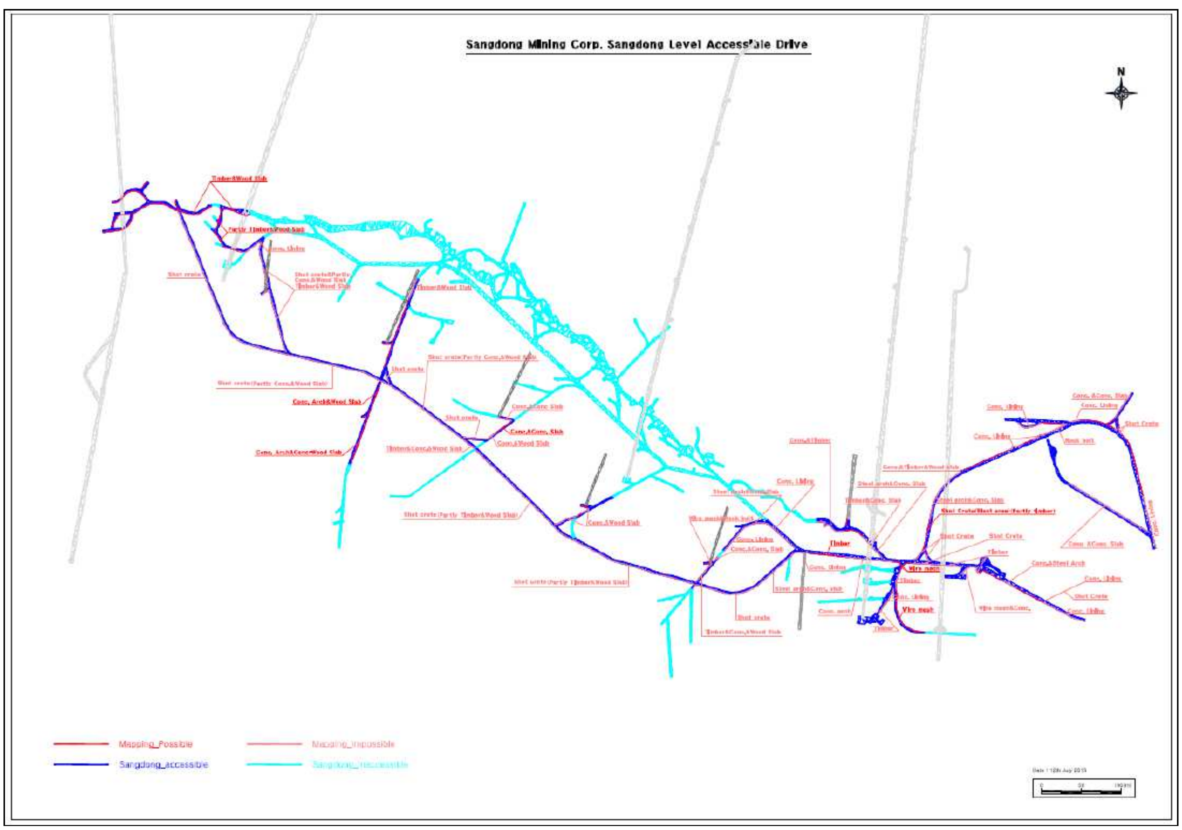


**Figure 16-4. Existing Level Development on the -1 Level**

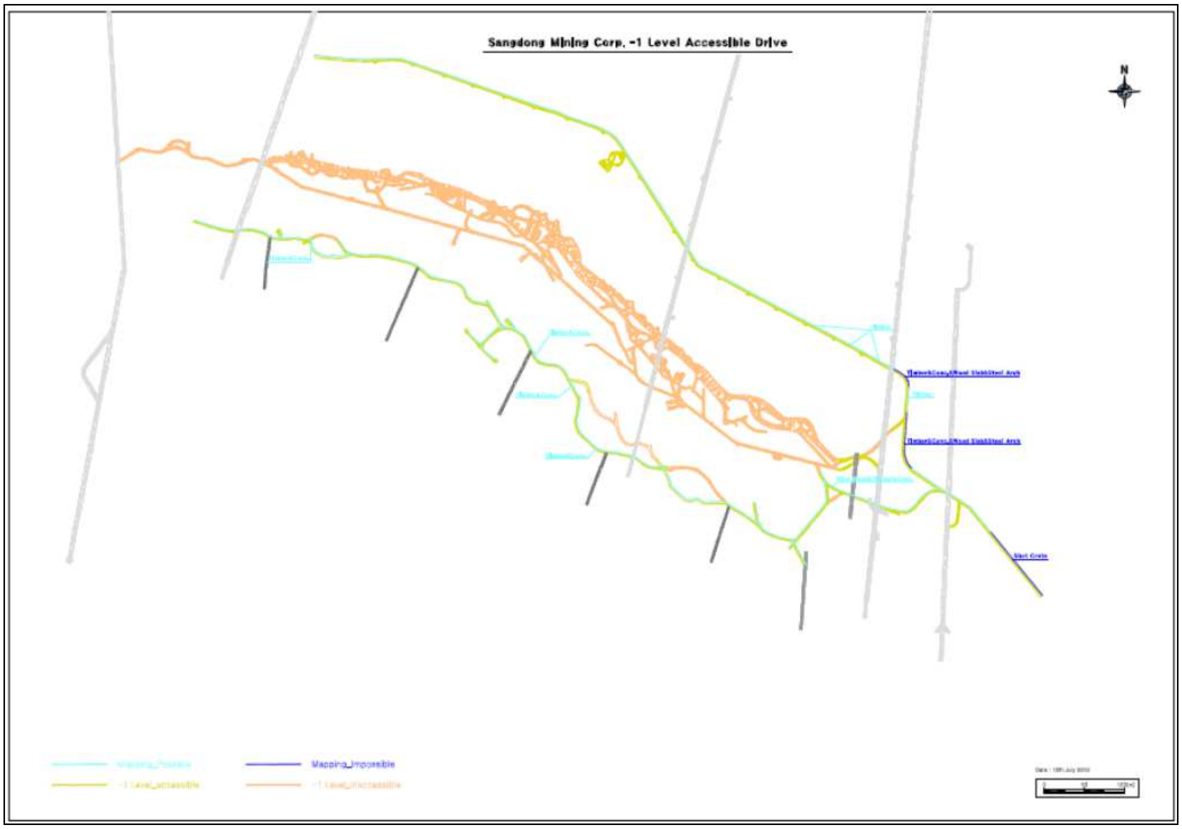
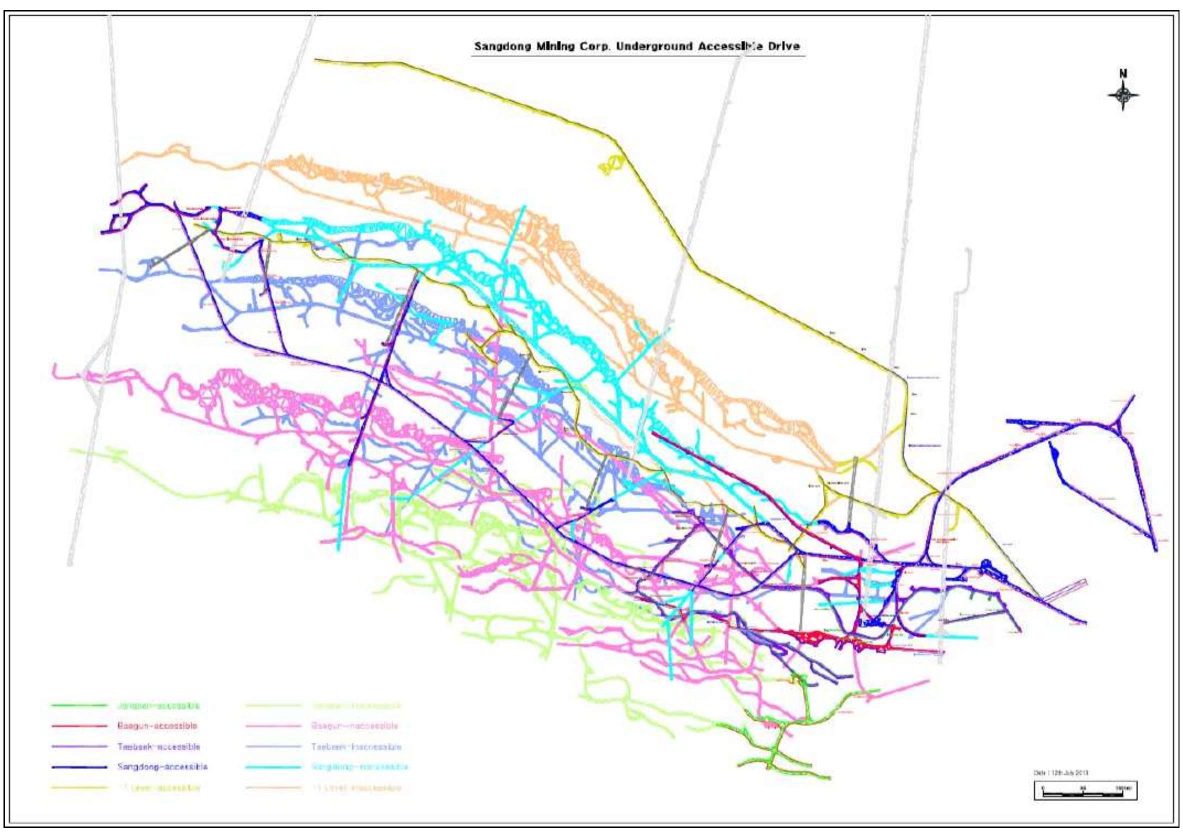



**Figure 16-5. Existing Level Development, Down To -1 Level**



## 16.2 Geotechnical Parameters

### 16.2.1 Rock Quality Assessment

A geotechnical study was completed by Turner Mining and Geotechnical Pty Ltd in 2014, which comprised:

- an appraisal of current underground conditions
- analysis and interpretation of diamond drill core logging data
- analysis of laboratory test results
- analysis of underground mapping
- assessment of suitable mining methods
- generating support designs and standards
- generation of maximum stoping span guidelines.

The current proposed mining area extends from -2 Level to Sangdong and Taebaek Levels on the HW, Main, F1, F2, F3 and F4 Zones. The geotechnical study was focussed on the HW, Main, F2 and F3 zones.

Intact rock tests were undertaken by Geomechanics Co. Ltd., in Kangwon-Do. The results of these tests are summarised in Table 16-2.

**Table 16-2. Laboratory Rock Test Summary**

| Rock Type | Uniaxial Compressive Strength (MPa) | Young's Modulus (GPa) | Poisson's Ratio | Number of tests accepted/rejected |
|---|---|---|---|---|
| Slate | 173 | 63.9 | 0.25 | 18/5 |
| Skarn | 154 | 76.3 | 0.20 | 16/11 |
| Limestone | 116 | 78.3 | 0.31 | 1/1 |
| Halo | 155 | 94.5 (too high) | 0.20 | 1/0 |

There were no records found of stress measurements having been undertaken at Sangdong. The stress regime used for stability analyses has therefore been estimated from the weight of overburden and from visual assessment of conditions relative to other mines. Virgin stress magnitudes vary considerably under hilly terrain and a reasonably conservative depth of 350m has been assumed. The hangingwall stress assumed for the stability analysis has a stress concentration factor of 1.5. The assumptions leading to the representative virgin stress of 10 MPa and hangingwall stoping stress of 15 MPa are shown in Table 16-3.

**Table 16-3. Stress Assumptions**

| | |
|---|---|
| Depth | 350.0 |
| Density | 2900.0 |
| Gravity | 9.81 |
| Virgin Stress (Pa) | 9957150.0 |
| concentration factor | 1.5 |
| Stress (Pa) | 14935725.0 |
| **Stress (MPa)** | **15** |

The Q-system (Barton, Lien and Lunde, 1974) was used to determine the rockmass strength. Q is the preferred method for assessing rock mass strength due to its accepted use in the Stability Graph Method for determining stable stope span limits and for empirical relationships between Q and excavation support requirements. The rockmass strength was calculated for the hangingwall domains of each of the zones, for the zones themselves and for the footwall of the F3 Zone (where permanent access would be located).

Table 16-4 shows the parameters and results for Q′ and Q for the main domains. The results for Q are all in the 'poor' and 'fair' categories (Table 16-5, Barton, 1974).

**Table 16-4. Representative Q Parameters**

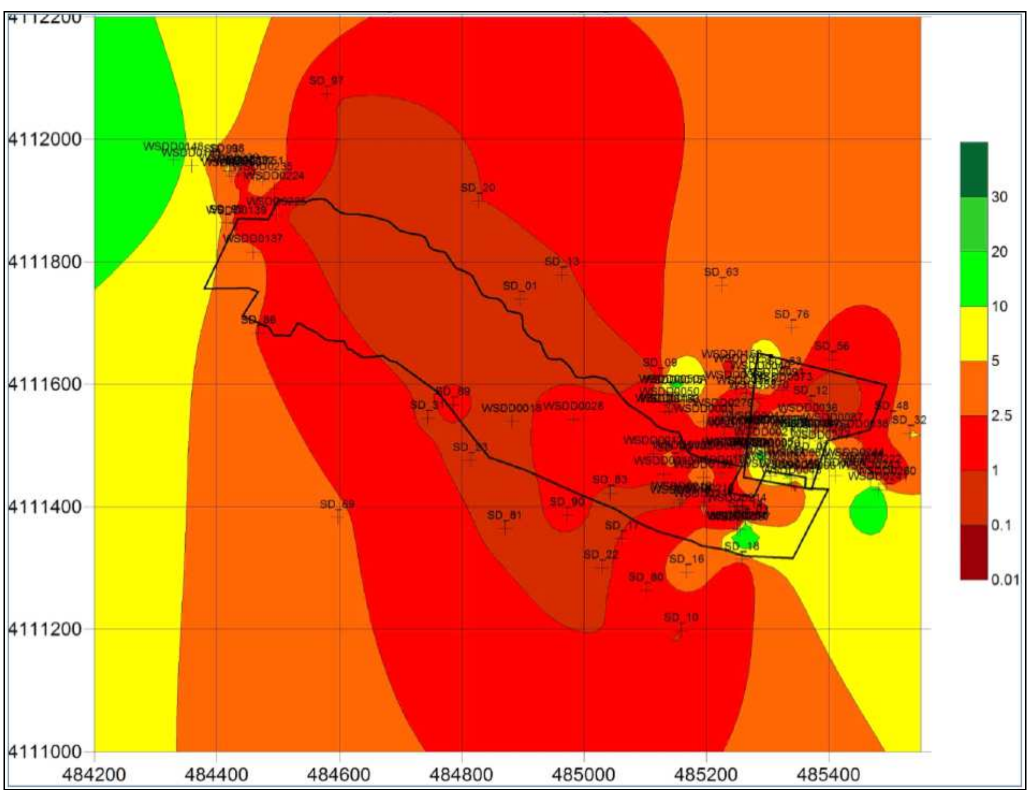
| Domain | Location | RQD | Jn | Jr | Ja | Q′ | Jw | SRF | Q |
|---|---|---|---|---|---|---|---|---|---|
| Hangingwall Lode | Hangingwall | 39 | 10.1 | 2.0 | 2.7 | 2.9 | 1 | 1 | **2.9** |
| | Orebody | 31 | 11 | 1.8 | 2.9 | 1.7 | 1 | 1 | **1.7** |
| Main Lode | Hangingwall | 39 | 10.1 | 1.6 | 2.5 | 2.6 | 1 | 1 | **2.6** |
| | Orebody | 49 | 9.2 | 2.0 | 2.2 | 4.7 | 1 | 1 | **4.7** |
| F2 Lode | Hangingwall | 52 | 9.2 | 1.4 | 2.3 | 3.4 | 1 | 1 | **3.4** |
| | Orebody | 64 | 8.5 | 1.7 | 2.2 | 6.0 | 1 | 1 | **6.0** |
| F3 Lode | Hangingwall | 67 | 7.9 | 1.7 | 2.2 | 6.5 | 1 | 1 | **6.5** |
| | Orebody | 61 | 8.4 | 1.9 | 2.3 | 6.0 | 1 | 1 | **6.0** |
| | Footwall | 59 | 8.8 | 1.4 | 2.3 | 4.2 | 1 | 1 | **4.2** |

**Table 16-5. Rock Quality Parameters (Barton, 1974)**

| Description | Rock Quality (Q) |
|---|---|
| Exceptionally poor | 0.001 to .01 |
| Extremely poor | .01 to .1 |
| Very poor | .1 to 1 |
| **Poor** | **1 to 4** |
| **Fair** | **4 to 10** |
| Good | 10 to 40 |
| Very good | 40 to 100 |
| Extremely good | 100 to 400 |
| Exceptionally good | 400 to 1000 |

RQD and Q values have been contoured using the Surfer software, for each studied zone across the mine, as shown in the example in Figure 16-6.

**Figure 16-6. Plan of Main Lode Hanging Wall Q**



### 16.2.2 Support Recommendations

All non-caving mining methods require the determination of maximum spans to ensure extraction is maximised whilst at the same time minimising the risk of collapse and loss of reserves. Two empirical methods have been used to determine the maximum spans:

- Stability graph method
- Maximum unsupported span (MUS)

Data has been related to the Stability Graph, as shown in Figure 16-7. Data and estimates of the critical hydraulic spans calculated are shown in the last column in Table 16-6. The A, B and C stability factors are based on current mine designs, estimated strengths and stresses, core logging data and calculated joint dips.

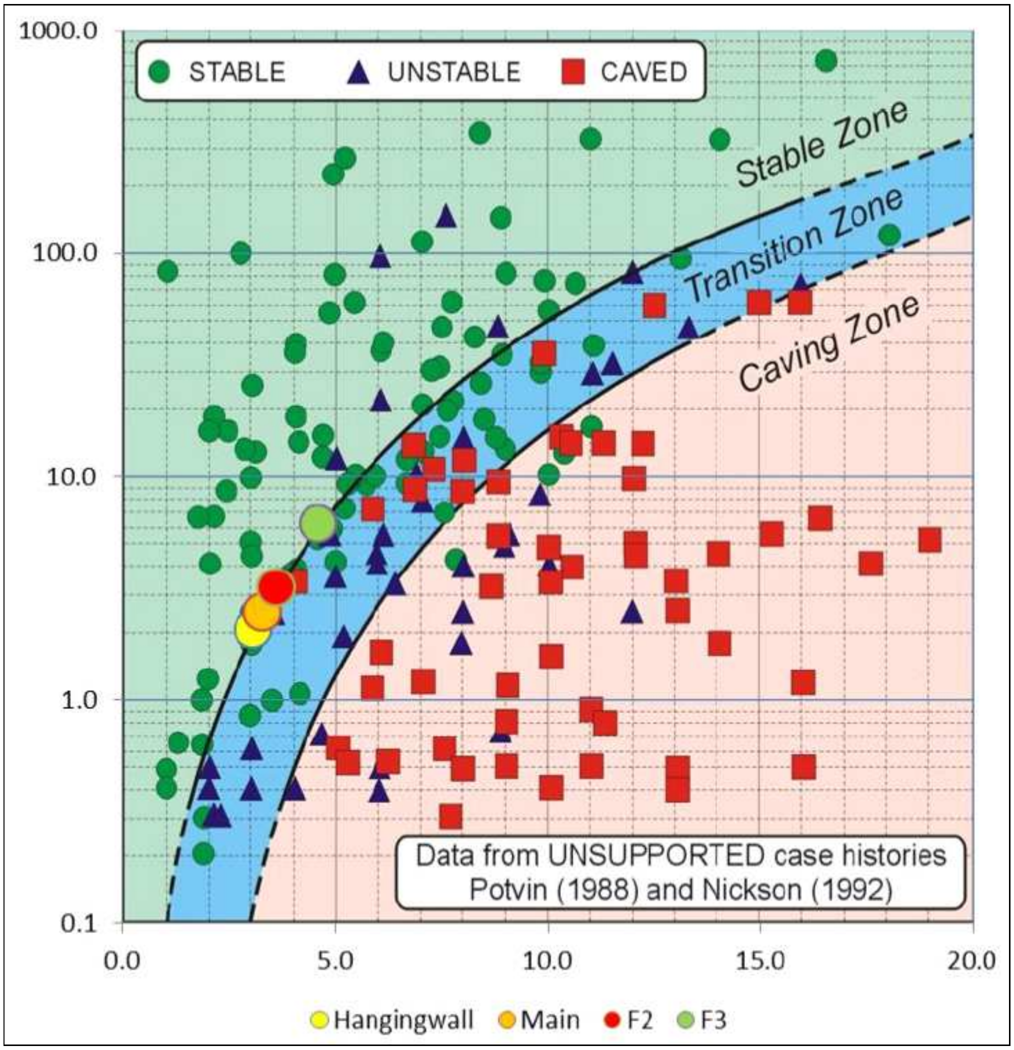
This method does not consider instabilities caused by individual wedges and the rises will still need to be supported with rockbolts.

**Table 16-6. Stability Number Summary**

| Orebody | Factor A | Factor B | Factor C | Q' Rating | N' | HR | Span for 100m length |
|---|---|---|---|---|---|---|---|
| Hangingwall Lode | 0.7 | 0.2 | 4.3 | 2.9 | 2.0 | 3.1 | 6.6 |
| Main Lode | 1 | 0.2 | 4.3 | 2.6 | 2.5 | 3.3 | 7.1 |
| FW2 Lode | 1 | 0.2 | 4.3 | 3.4 | 3.6 | 3.6 | 7.8 |
| FW3 Lode | 1 | 0.2 | 4.3 | 6.5 | 4.6 | 4.6 | 10 |

Maximum unsupported span variations were also determined for each zone, and contoured maps prepared. These were overlain on plans for the reserve blocking-out process in the current study (Section 15.3).

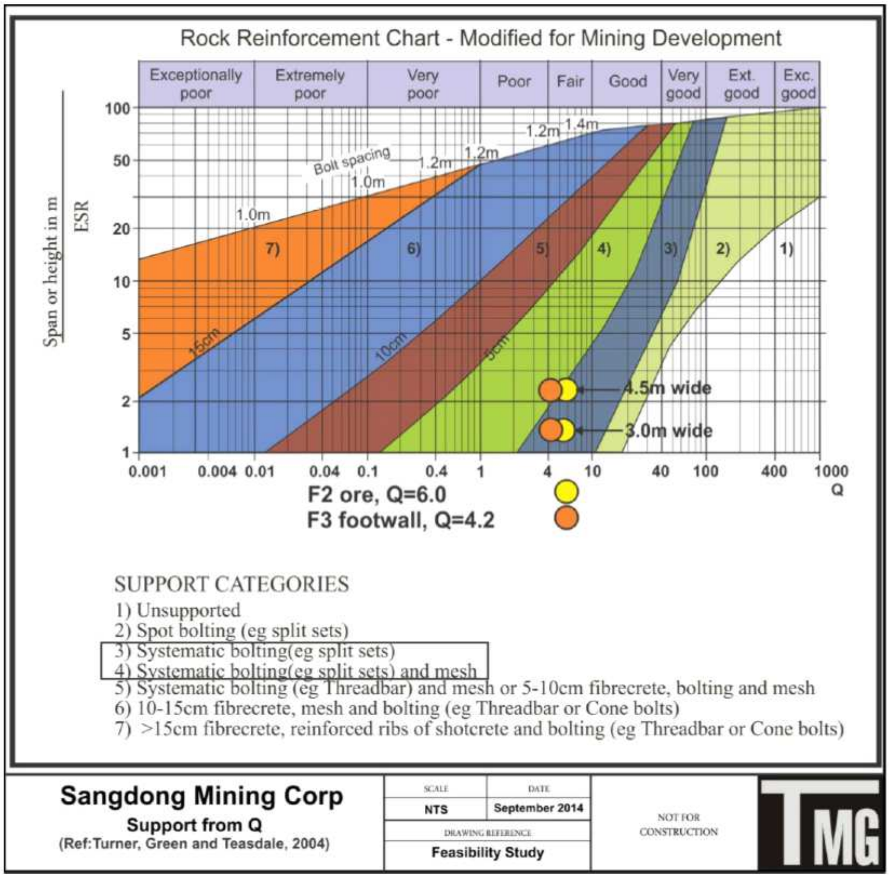
**Figure 16-7. Stability Graph**




Support requirements have been estimated from core logging data using empirical analysis based on RQD, Q and from observations of exposed rock mass. The modified rock reinforcement chart (Turner, Green and Teasdale, 2006), as shown in Figure 16-8, was used for the rockmass quality Q = 6 (SRF=1, 'medium stress, favourable stress conditions' assuming no mining induced stresses).

**Figure 16-8. Modified Rock Reinforcement Chart**

(Turner, Teasdale and Green)




Small-sized development would require Category 3 support, i.e. 'systematic bolting ' and jumbo development would require Category 4 support i.e. 'systematic bolting and mesh'.

In current underground excavations, falls of ground in development and stopes are generally located at the intersection of faults and fault-associated jointing. These sections of poor ground are generally supported with timber sets which have deteriorated and require re-supporting.

Very poor ground towards the hangingwall of the shale unit required concrete arches for permanent stability but this appears to improve towards the far west. Old rockbolts and timber support should be assumed to have lost all load-bearing capacity. Old concrete that has not cracked will generally be stable, as will most steel and concrete sets.

Areas sprayed with old shotcrete appear to have maintained their integrity, with small rocks supported. The old shotcrete was only 5-10mm thick and is not capable of supporting 0.5m thick blocks.

Current development primarily requires check-scaling to remove smaller loose rocks and to determine which areas need supporting. Area requiring rehabilitation would involve the removal of all timber sets and steel sets (where the timber lagging is non-functioning). The most effective support of poor ground sections will be achieved with rockbolting and shotcrete or rockbolting and mesh, using either Swellex-type bolts or resin grouted solid steel bars.

New areas of jumbo development should be supported with mesh or shotcrete plus 2.4m split sets (46mm, galvanised) over the backs and shoulders. Wall support will be required where steep jointing is likely to create slabs, especially in areas close to stoping and in ore drives adjacent to pillars. Mesh should be galvanised weldmesh, 5.6mm wire thickness, 100mm x 100mm apertures, with sheet size chosen to suit drive size and optimise bolting. Bolt spacing will be designed to pin the mesh sheets with 0.2m overlaps.

Where shotcrete is used it should be sprayed after loading, watering down and scaling. Hydraulic scaling is recommended with high-pressure pump attached to the shotcrete sprayer Bolting should be undertaken once the shotcrete has cured sufficiently to prevent fall-off during bolting (1MPa strength at 1 hour required).

Wide spans in stopes will be more susceptible to wedge block failure than in development and the use of split sets is not recommended. Resin grouted bolts or Swellex-type expandable bolts are far more effective in supporting large blocks. Rises should be supported with 2.0m solid steel Threadbar rockbolts installed with resin on a 1.5m pattern or Swellex-type bolts. Shorter bolts would require closer spacings.

Wide excavations and 3-way and 4-way intersections should be supported with cable bolts. The length and spacing would be dependent on dimensions and structures, but could involve fully grouted (cement) 8.5m twin-strand bulbed, 15.2mm cable bolts on a 2.5m pattern. Cables should be tensioned to 50kN and installed with 8-10mm thick plates. The quality of cable bolt installations was extremely good and this should be continued.

### 16.2.3 Earthquakes

The seismic hazard data for the Sangdong area has been assessed from the Global Seismic Hazard Assessment Program data (GSHAP, 1999). The data indicated a 10% probability of exceeding between 0.2 and 0.8 $m/s^2$ peak ground acceleration over 50 years (based on a 475 year return period). This falls in the low-hazard category and increased acceleration has not been considered in any design analysis.

## 16.3 Mining Methods

### 16.3.1 Method Selection

Selection of the mining method requires a flexible design, which is suitable to the geometry of the ore body and typical types of variations. The majority of the ore zones to be mined are relatively shallow dipping, with dips between 20° and 30°, so ore will not naturally flow by gravity on the footwall.

In the A-Z Feasibility Study, the methods proposed were inclined panel (IP) mining, to be applied in thick orebody areas, with panels that would be mined in different sections; and up-dip panel mining (UP), which would be applied in narrow areas with slushers and hand-held drilling equipment.

For this present study, it was decided not to rely on hand-held drilling equipment and slushers. Instead, methods applied would be planned for the use of mechanized mobile diesel powered mining equipment in all areas. Based on this requirement and the latest understanding of the orebody geometry and mining areas, and evaluation of the resources, including in-situ thickness variations, it was decided to apply two proposed mining methods, as summarised below:

- Mechanized Inclined Panel mining (MIP) – areas where the thickness less than 3 metres.
- Cut-and-Fill (CAF) – for areas where the thickness is greater than 3 metres.

Selection of these mining methods was based on plan projections of grades and thicknesses, along with examination of many cross-sections across the whole orebody, as shown in Appendix C. With the requirement for mechanised access in all stopes, the in-situ geological models have all initially been diluted to a minimum thickness of 2.2m. Based on assessment of the relative proportions of these different thickness thresholds for the two mining methods, the approximate split between MIP and CAF mining will be approximately 40%:60%. This ratio will likely change with future Phase 7 drilling and as additional reserves get added from the HW zone.

A plan view of the current reserves, with the different areas split by mining method, is shown in Figure 16-9. The central and western part of the F2 and F3 reserves are generally below 3m true thickness, and so will be mined by MIP. The rest of actual reserves will be exploited by CAF. Within the eastern part of the F2 and F3, certain parts of the Halo zone in-between will also be mineable, allowing a greater overall thickness, which will enable CAF stoping, as depicted in Figure 16-10. A plan and cross-section showing the F2-Halo-F3 relationship are shown in Figure 16-11 and Figure 16-12.

Figure 16-9. Plan - Ore Reserve Zones By Mining Method

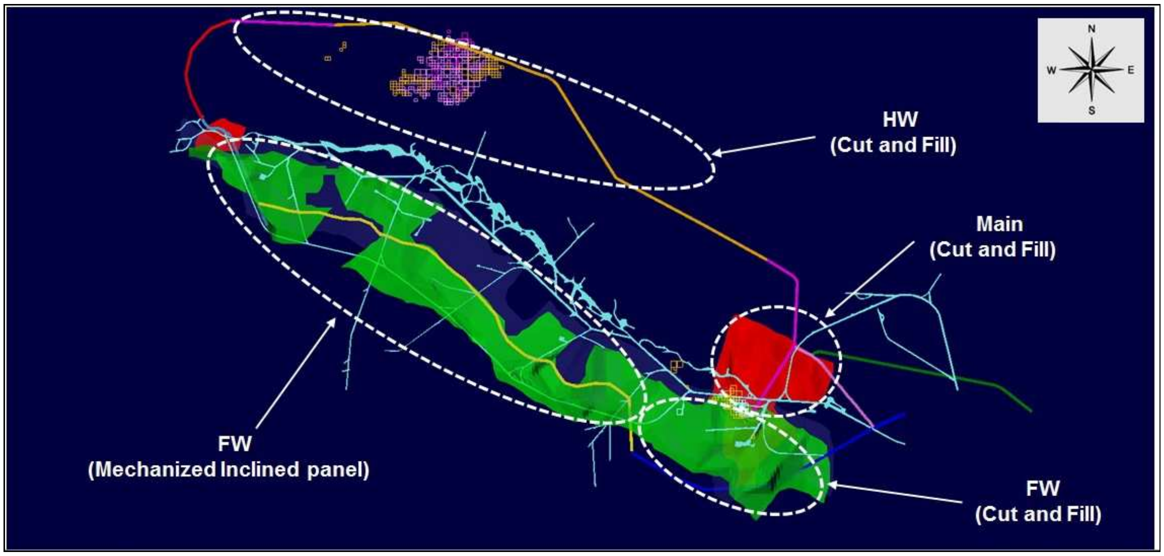



Figure 16-10. Plan- F2 and F3 Reserve Areas

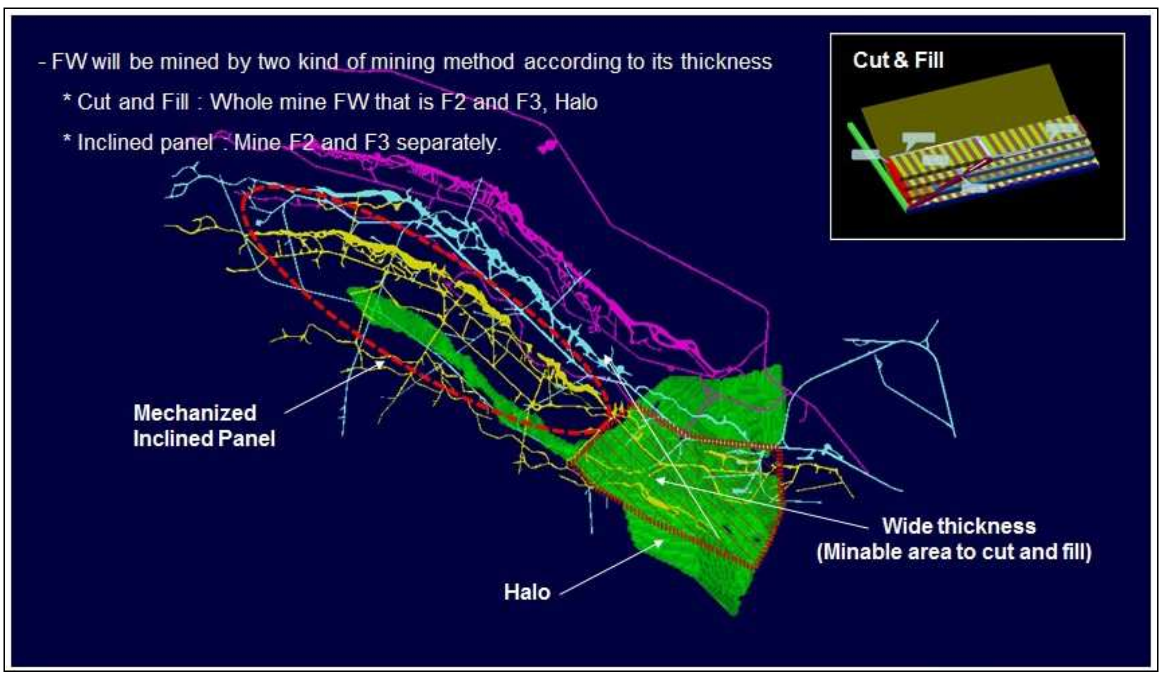


**Figure 16-11. Plan and F2 and F3 Eastern Area**

(Drillholes Also Overlain)

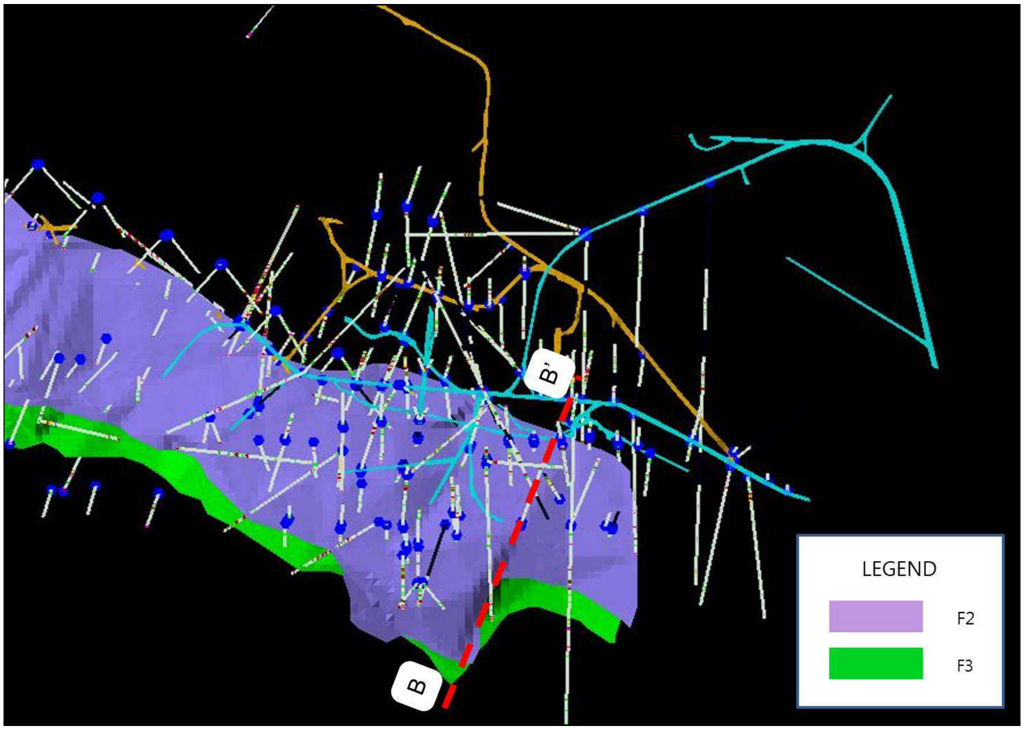
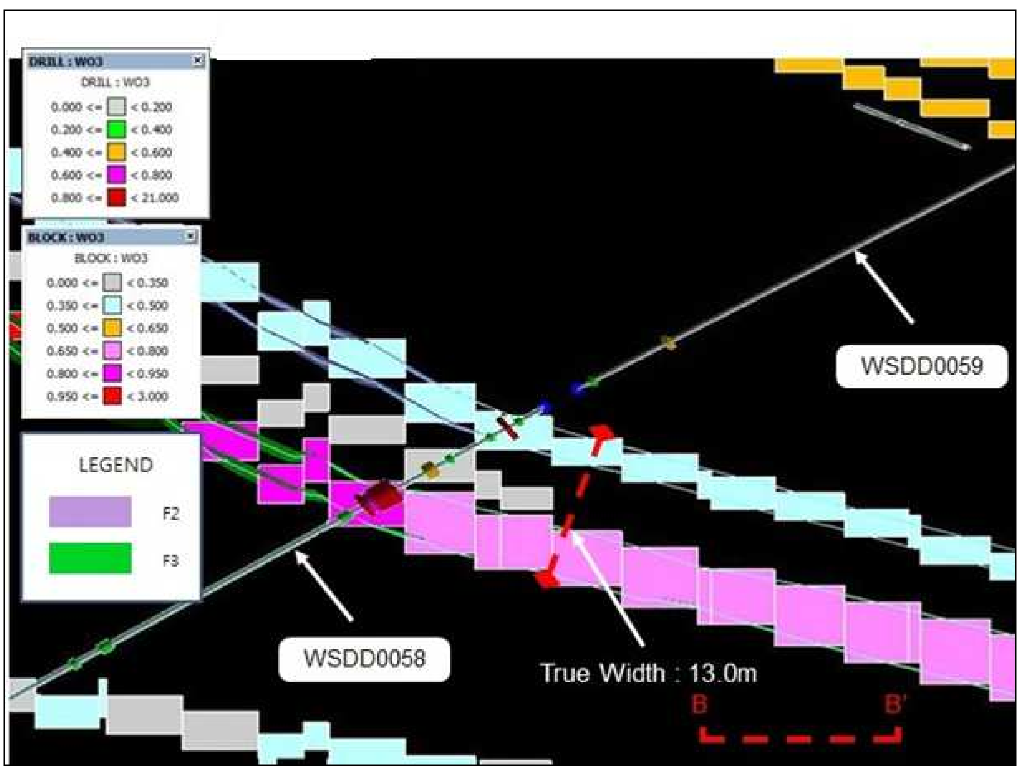
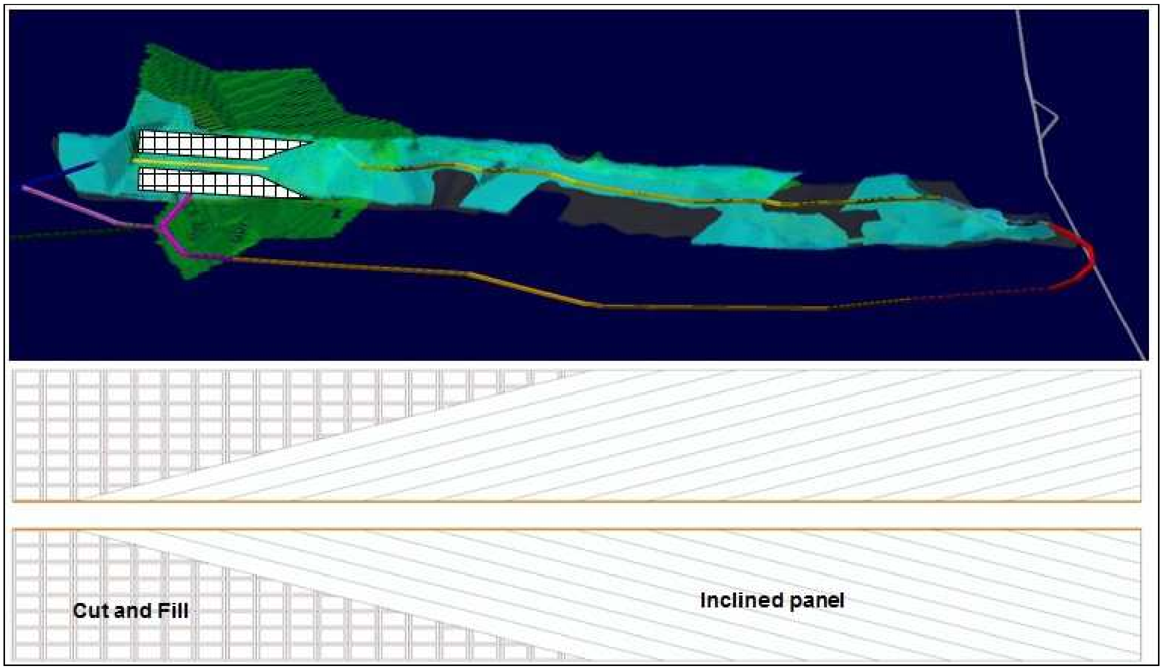



**Figure 16-12. Section B-B Through F2-Halo-F3 Sequence**



Some areas of the F2 and F3 reserves will be represent a transition from thicker (CAF) to thinner (MIP) parts in Figure 16-13.

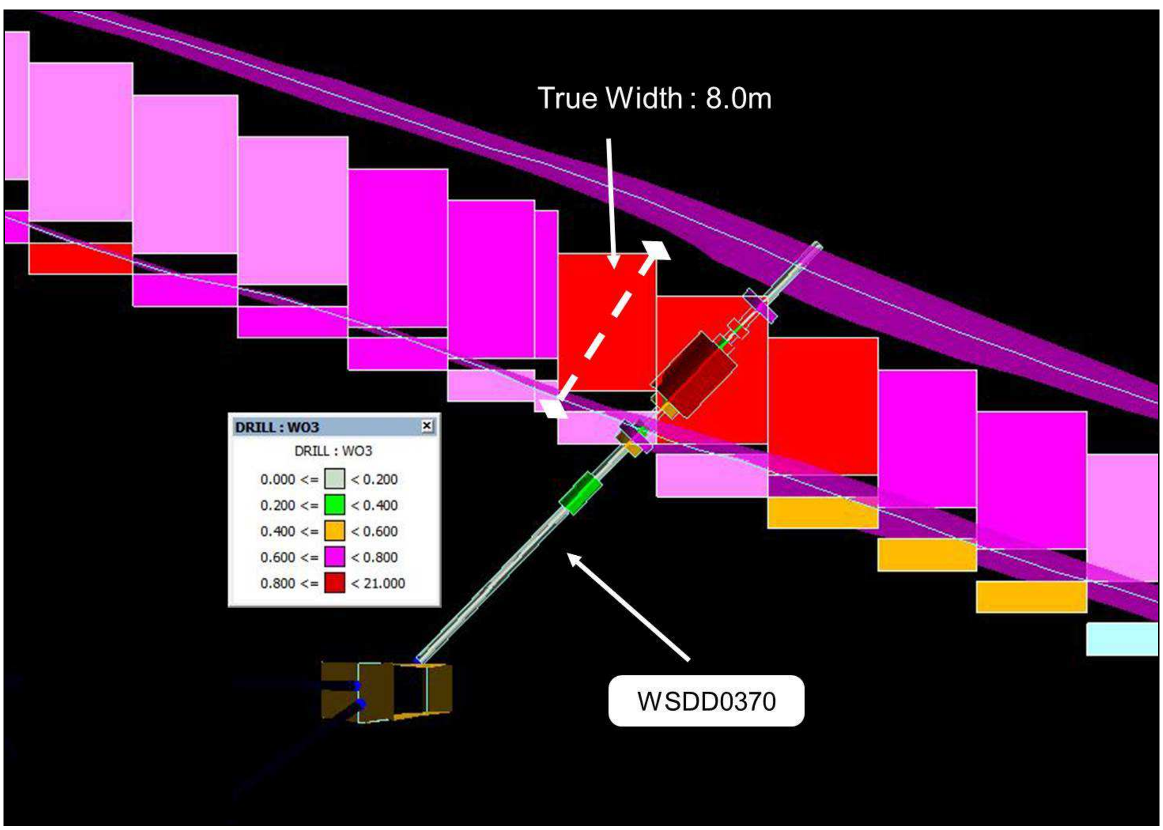
**Figure 16-13. Transition from CAF to MIP Stoping With Thickness Variation**




The eastern part of the Main zone is 8m+ thick, and so amenable to CAF. A plan and cross-section of this zone are shown in Figure 16-14 and Figure 16-15. The cross-section also shows the F1 zone just below the MAIN zone, which will be mined as part of the stope unit.

**Figure 16-14. Plan – Eastern Part of Main Zone Reserve Area**


**Figure 16-15. Section C-C: Eastern Part of Main Zone Reserve Area**



The entire HW zone reserve area on the -1 and Sangdong levels has an appreciable thickness and so can be exploited in Cut-and-fill. A plan and cross-section of this reserve area are shown in Figure 16-16 and Figure 16-17.

**Figure 16-16. Plan – HW Zone Reserve Area off the -1 Level**

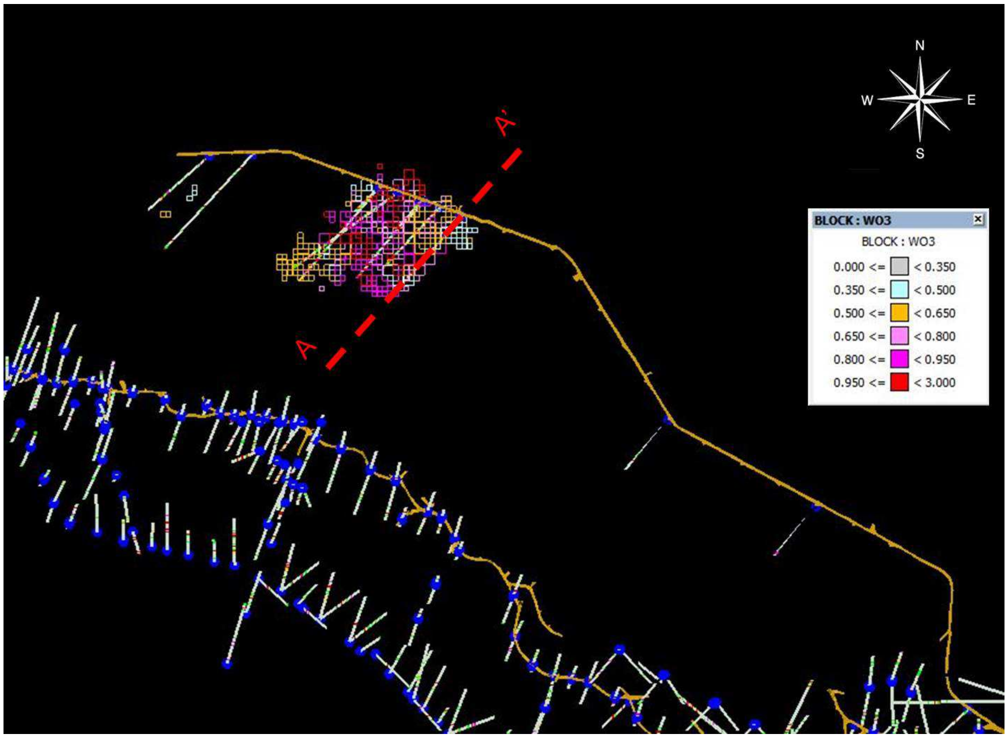
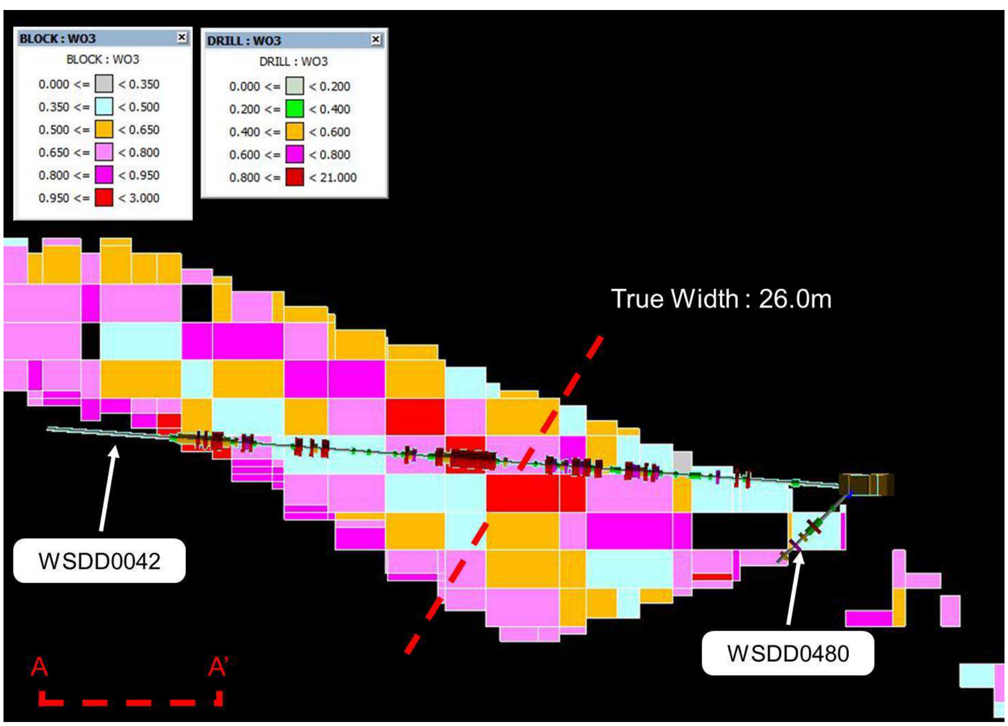
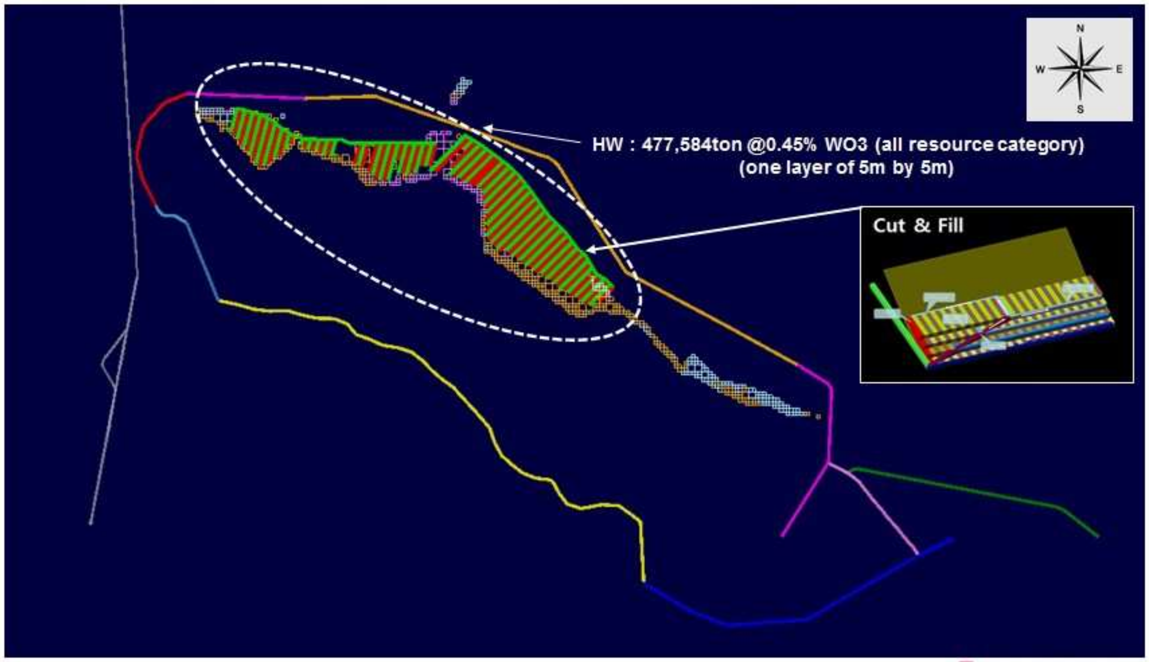



**Figure 16-17. Section A-A: HW Zone Reserve Area**



A plan of the of the western part of the HW reserve area is shown in Figure 16-18.

**Figure 16-18. Plan of Western Part of HW Zone – With CAF Layout**

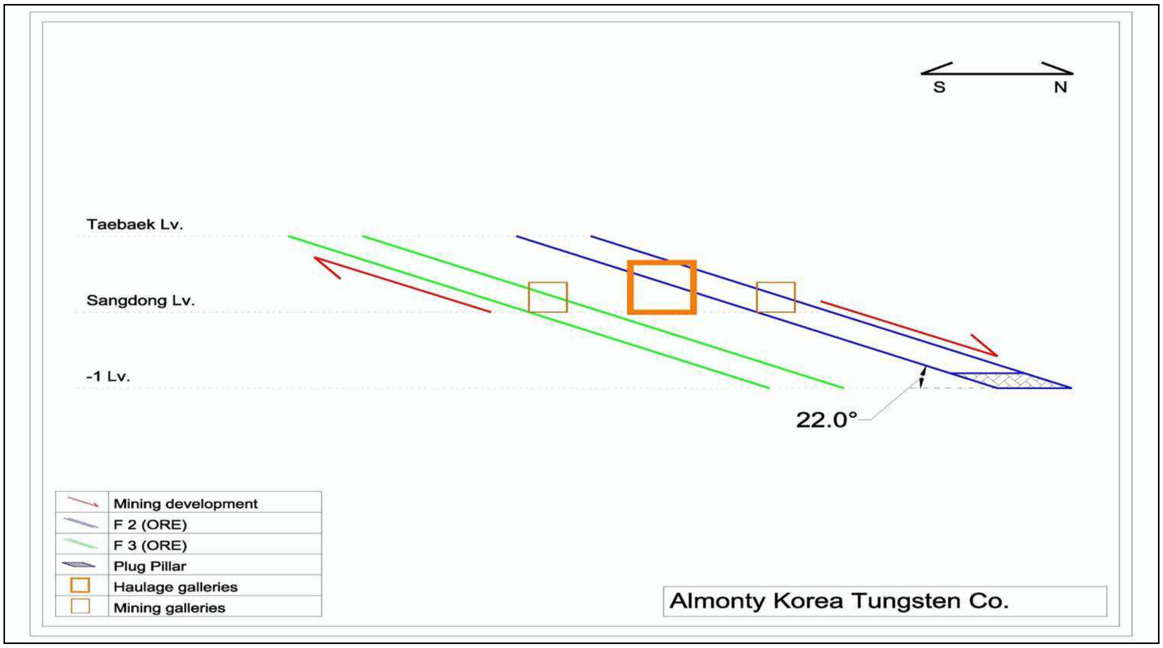



### 16.3.2 Mechanised Inclined Panel (MIP) Method

This method has evolved from Inclined Panel (IP) method described in the A-Z Feasibility Study. This previous method had primary and secondary panels, with slashing from small drives first developed up the centre of each panel.

The envisaged MIP method involves drifting on apparent dip, so as not to exceed a gradient of 15%, and so allow trackless equipment. The stope development is planned to be symmetrical, with panels being extended both up and down from access galleries, as shown in Figure 16-19. This method is also flexible in that it can be easily adapted to room and pillar (as used previously at Sangdong) if local conditions do not favour complete extraction with primary and secondary panels.

**Figure 16-19. Section Depicting Mechanised Inclined Panel Development**




This method is very flexible, in allowing working upwards or downwards, and conversion to cut-and-fill. The development of HW zone can be done in between stope access to F2 and F3, which will save development lengths between the base development and stope access. The F2 can be mined from the Sangdong level to the -1 Level, and at the same time upwards into the F3 between the Sangdong and Taebaek levels. After stoping and backfilling operations have finished in these two zones, the mining direction can be reversed, exploiting F2 upwards and F3 downwards from Sangdong level.

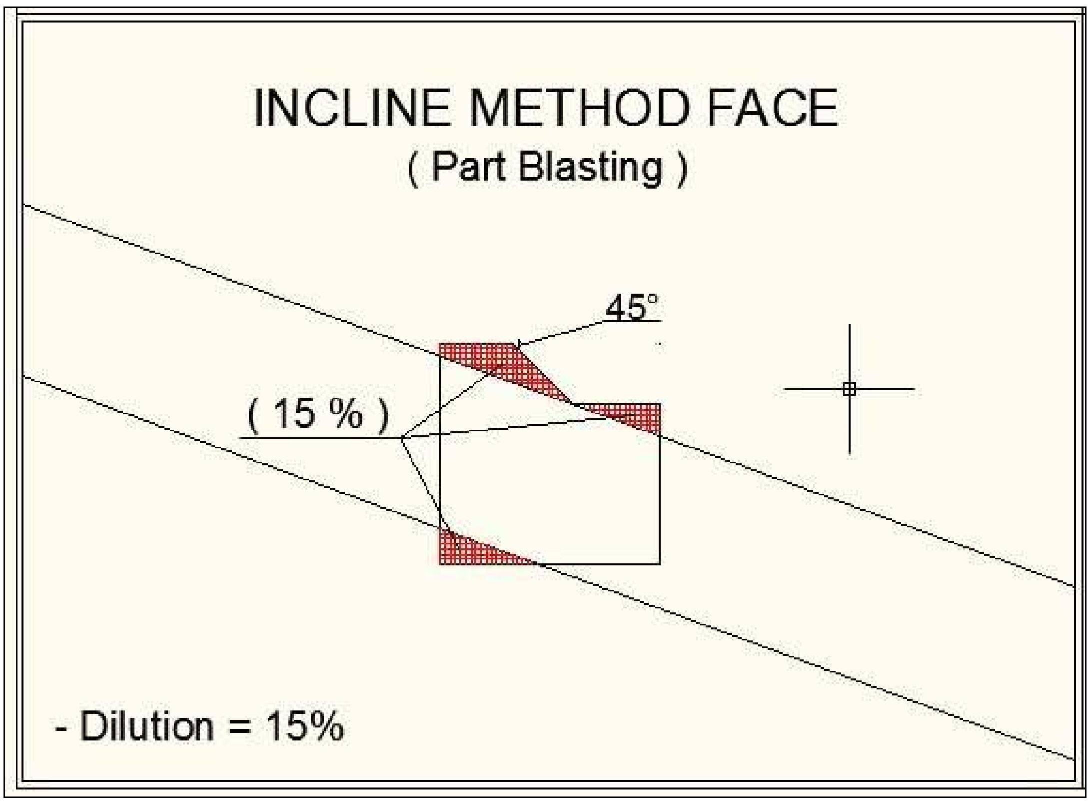
The sequencing of MIP stoping operations will be:

1. Development of level strike drives, the base transport gallery.
2. Ore Drifts will be developed oblique to strike drive, at a maximum gradient of 15%. These drifts will be 3m x 3m, and will spaced 12m apart, to form one side of each primary panel. These drives will be extended to the next upper or lower level, and so will have a strike length of approximately 175m.
3. The ore drives will be slashed out an additional width of 3m, to leave the primary panels 6m wide. For ore regions less than 3m in thickness, the slash height can be limited down to 1.5 m minimum.
4. When the primary panels are complete, fill barricades will be required at the base level of each panel. No barricade will be needed in downwardly developed panels, if they have no connected with the base strike drifts. The barricades can be constructed from waste piles, which are then shotcreted to prevent fill leakage.

5. The primary panel(s) can then be backfilled with paste backfill and cement. As the drifts are inclined this filling should end up tight to the back.
6. After curing the primary panels' backfill, secondary panels can be mined out in the same way as the primaries. The backfilling of secondary stopes can be done with a reduced amount of cement.

To reduce the dilution associated with the development of the primary drives, separate blasts can be made on faces with narrow ore thicknesses, so that some waste can mined separately. This will reduce likely dilution in this phase to approximately 15%, as depicted in Figure 16-20. This primary and secondary blasting has been accounted for in estimating the stoping costs.

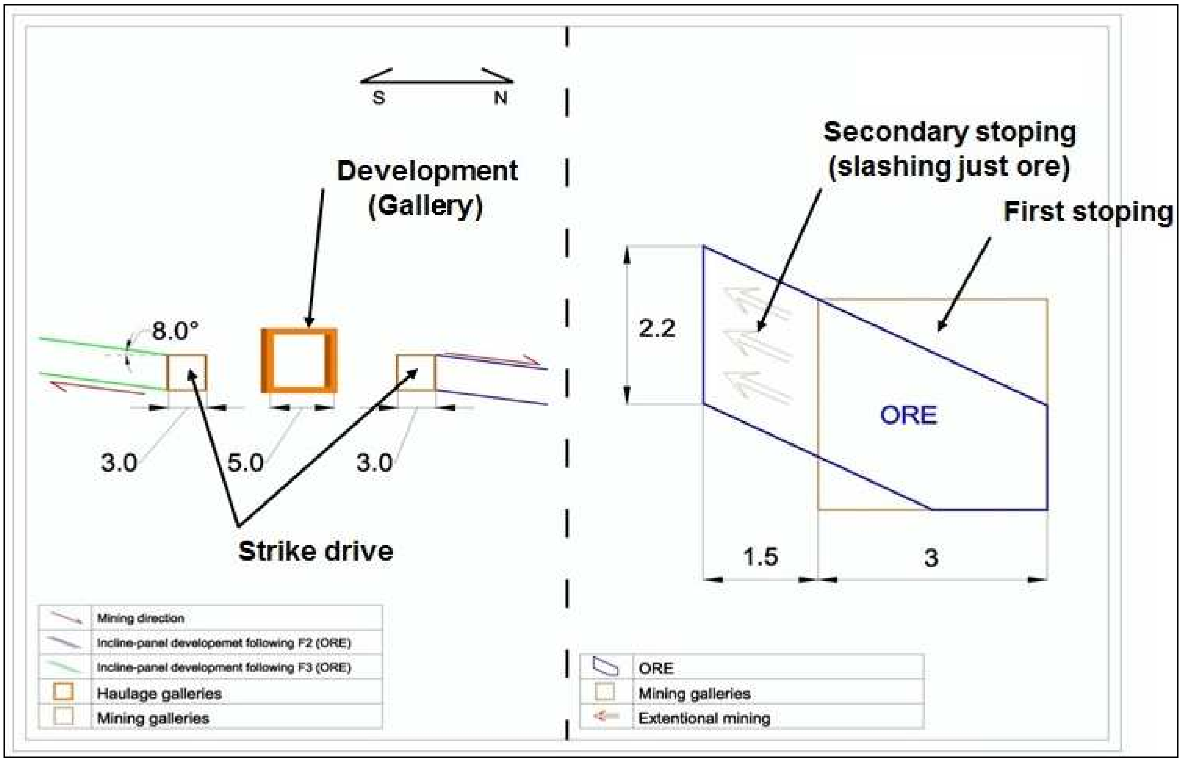
**Figure 16-20. Dilution Associated With Initial Drifting Phase of MIP Mining**




In the slashing operation, dilution can be dramatically reduced, with parallel drilling to the ore structure, as well as a much reduced height, as shown in Figure 16-21. All drilling for these slashes can be inside the mineralized structure, with up to two blasts of 1.5 m width on the up-side. Dilution of 15% (maximum) on drifting and almost no dilution with slashing, should give a combined maximum dilution of 7.5 %, and an average dilution of approximately 5%.

Another important characteristic of scheelite is the visual recognition of that mineral under short wave UV light. With this feature, internal waste dilution can be reduced by blasting and transporting waste to separate neighbouring stope for backfill.

**Figure 16-21. Stoping Phases of MIP Mining**




The ore blasted at the stopes of Mechanized Inclined Panel will be loaded by LHDs to 40t dump trucks, or alternatively smaller 15t Korean trucks, in the main development adjacent to the strike drives.

A mining recovery of 95% has been assumed, based on the stoping method envisaged, and the ability of visual recognition of scheelite using UV light.

### 16.3.3 Cut-and-Fill (CAF) Method

This method will be applied to ore zone areas with a thickness of 3m and higher, up to 20m depending on the local ore thickness. It can be considered a simplification of the previous Inclined Panel Stoping, and in some areas it could also be adapted with uppers for extraction of panels up to 12m in height. One particular advantage of this method is the potential high selectivity, with separate removal of internal waste encountered.

From the base gallery, a cross cut can be opened up, mining though to the footwall of the ore structure, as shown in Figure 16-22. A strike drive can then be developed in ore at the footwall contact, for the length of the stope panel, as shown in Figure 16-23.

From the strike drive, the primary panels are opened in the ore, perpendicular to the strike drive and developed across to the footwall contact, as shown in Figure 16-24. These panels wiil be inclined upwards, to a maximum gradient of 15% to assist with tightfilling during subsequent backfilling operations, and also to create longer stopes. Both primary and secondary panels are nominally planned to be 6m x 6m in cross-section.

An additional footwall drive will facilitate ventilation and backfilling. Some others will need individual barricades. After primary panels have then been backfilled, and time left for curing, secondary stope panels can be opened up. For the excavated secondaries, many panels may be backfilled with just two fill barricades. Some others will need individual barricades, depending on local conditions.

After the backfilling of the entire first 6 m lift, access to the next 6m lift will be from the hanging-wall incline, as shown in Figure 16-26. Access to stope panels behind the incline will need to be done by the footwall strike drift, as shown in Figure 16-26. The backfilling will continue through the footwall strike drive, with multiple barricades in the primary stope panels and with two barricades per sector for secondary stope panels.

A diagram showing the mining of several stope lifts is shown in Figure 16-27. All mining operations will from inside areas of relatively thick ore, so dilution will be minimised. There will be some dilution in secondary panels from primary panels' backfill. The identification of internal waste will be assisted by the use of UV lamps, as shown in Figure 16-29. Overall, a 5% dilution has been assumed for this method, after the application of a 2.2m minimum mining thickness.

Figure 16-22. CAF – Cross-Cut from Base Development

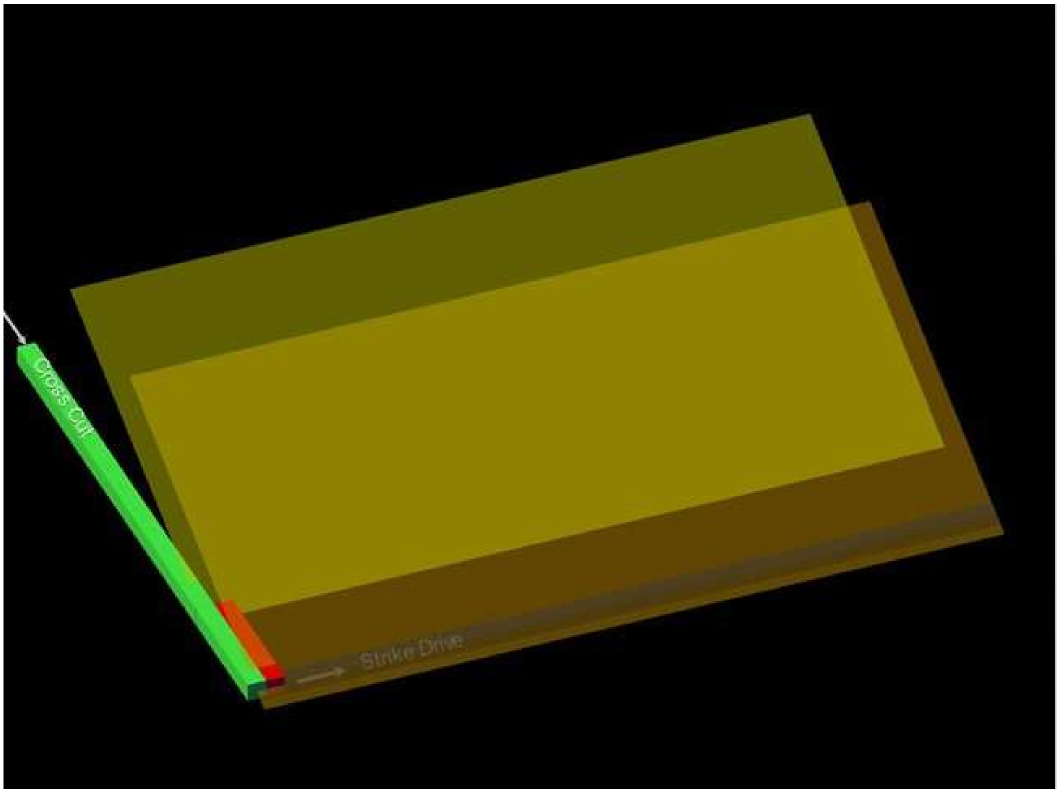



Figure 16-23. CAF- Opening Up of Strike Drive

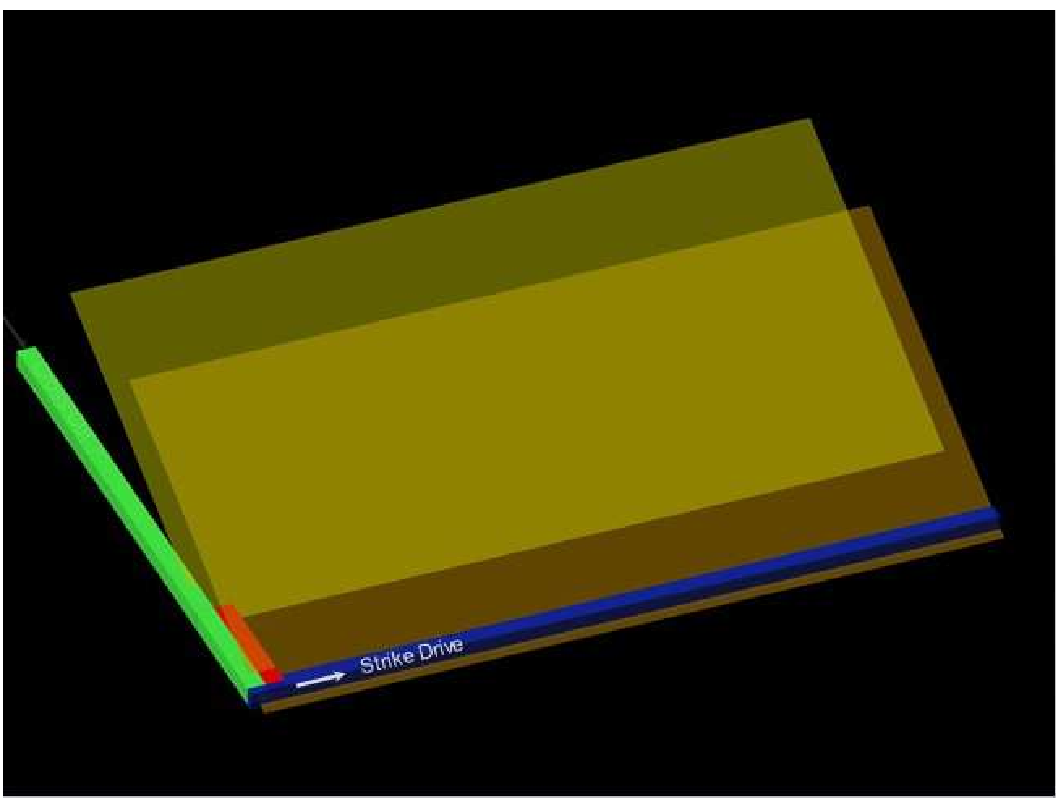


Figure 16-24. CAF – Development of Primary Panels

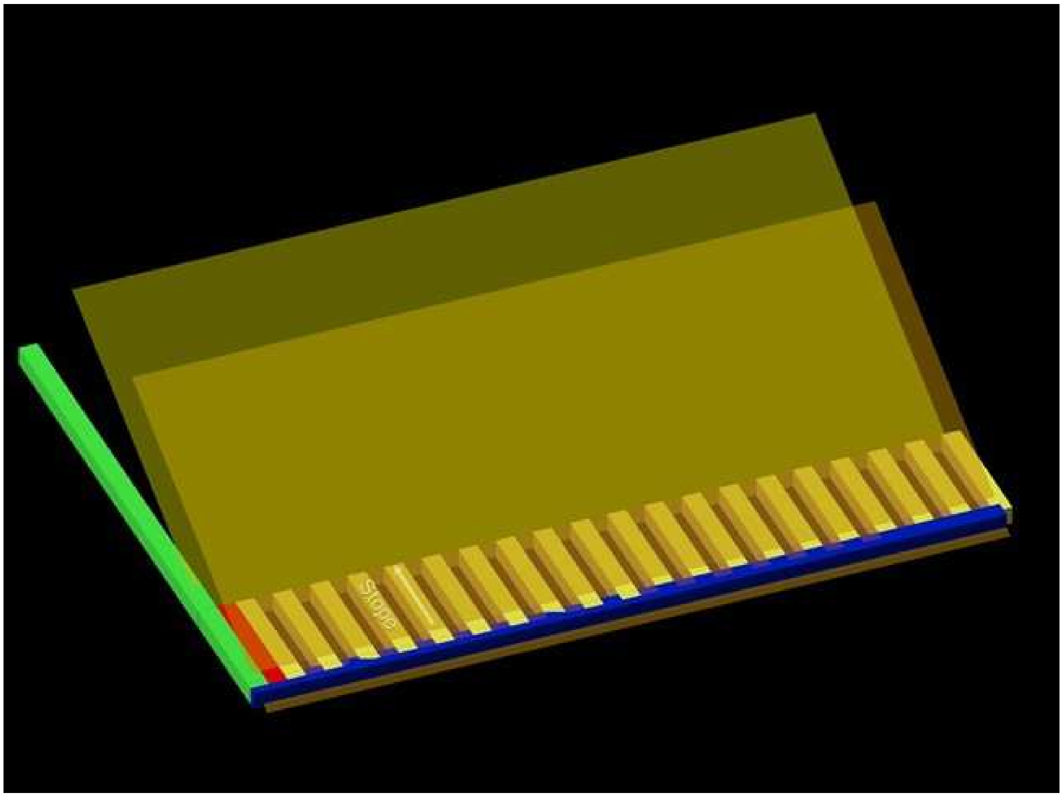



Figure 16-25. CAF – Hanging Wall Incline

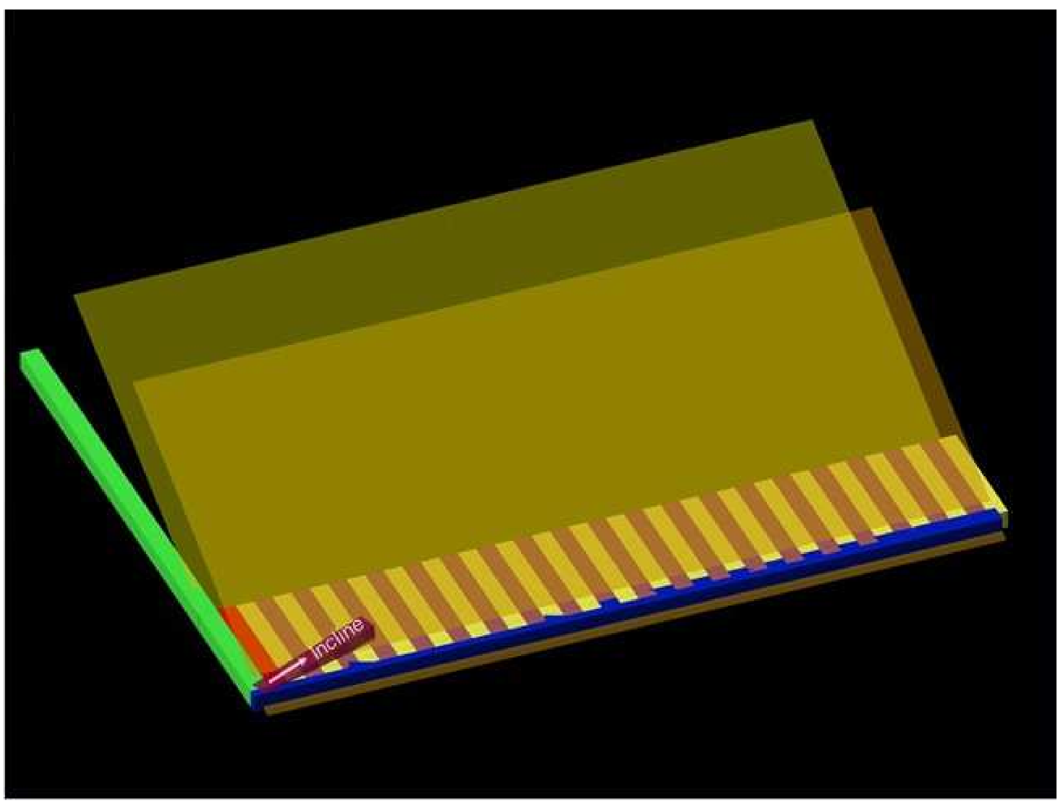


Figure 16-26. CAF – Next Lift By Access from Hanging Wall Incline

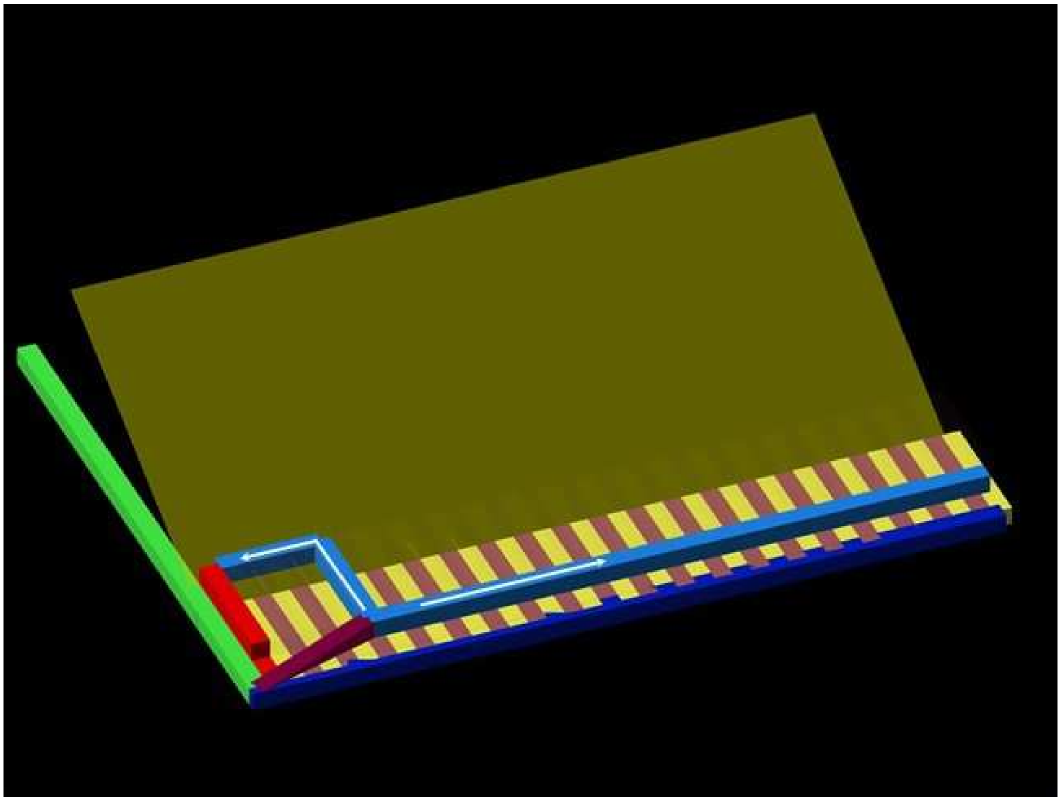


Figure 16-27. CAF – Overall Schematic

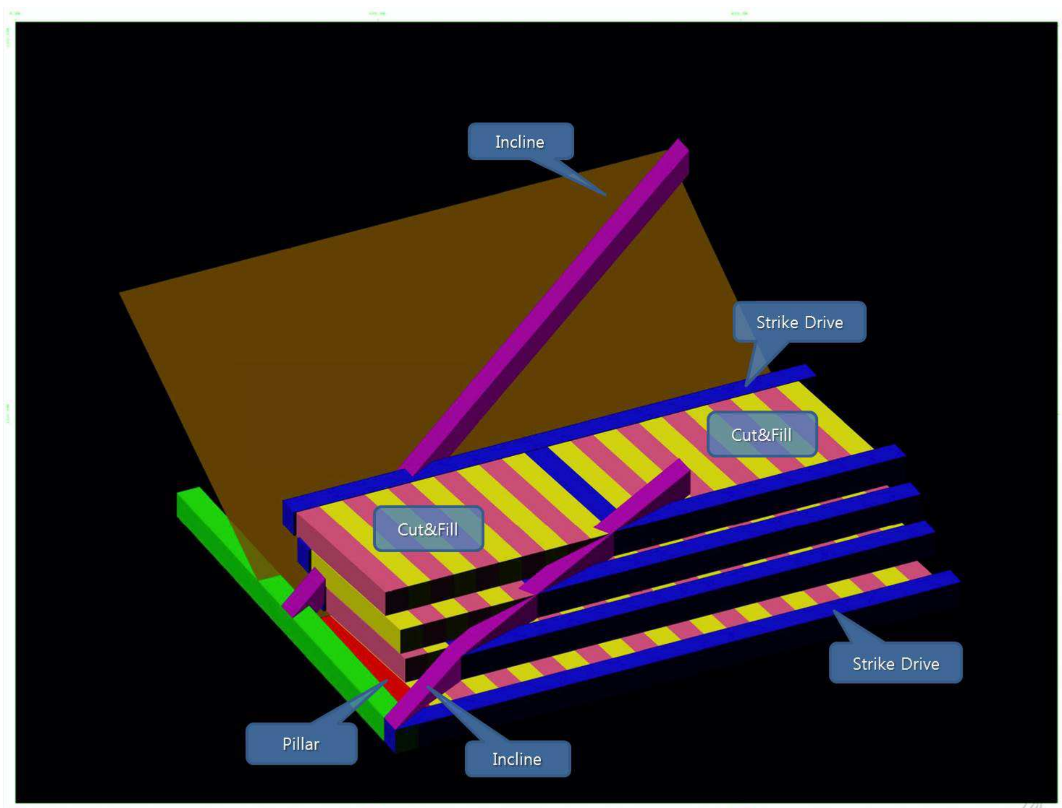
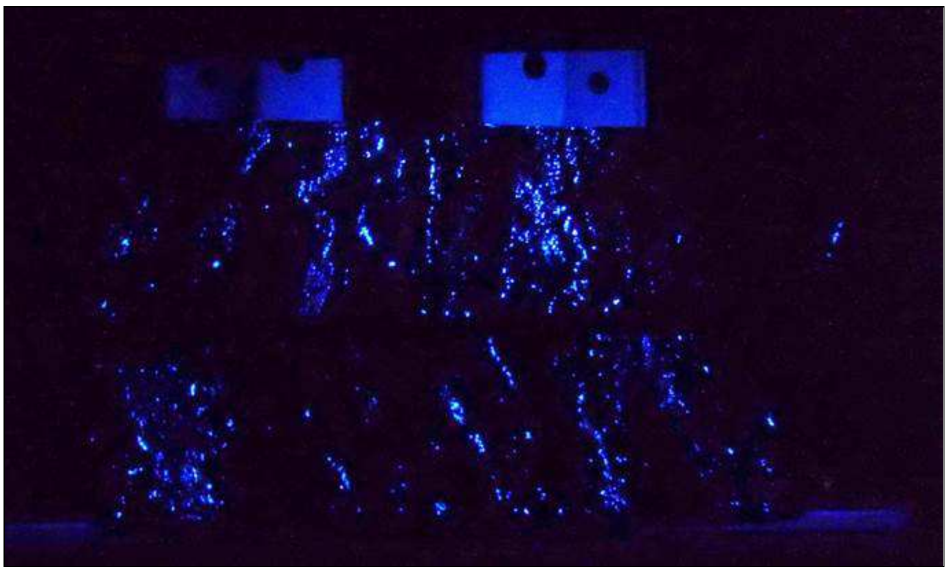


Figure 16-28. Scheelite Ore Under Normal Light

Figure 16-29. Scheelite Ore Under Short Wave UV Light



## 16.4 Stoping Operations

In the MIP mining, drilling will be done with single arm electric/hydraulic jumbos. Drill steels will be 3m, allowing an effective advance/blast of 2.1m in drifting, and 1.5m advance/blast in the slashing. Slashing lengths will be adapted to the local ore exposures ore blending requirements. The drive patterns will typically be a 600mm x 600 mm pattern, with an extra 9 burn-cut holes, 4 of which are reamed. The slash holes will be drilled on a 900 mm by 900 mm pattern. Perimeter holes may be drilled on a similar pattern, depending ground conditions.

In the CAF zones, drilling will be with two arm electric-hydraulic jumbos, that will have 3.6m rods, drilling 44 mm drillholes of 3.1 m length and an effective 2.6 m advance per blast. The burn cuts will have a similar pattern to MIP, and the remaining drillholes will have a pattern of

1m x 1m. Perimeter holes may be drilled on a similar pattern, depending on ground conditions.

All zones to mine will be well drained, production drillholes will be blasted with ANFO. If there are wet zones, drillholes will be blasted with cartridge emulsions. All explosives will be initiated using non-electric caps, initiated by two electric caps connected to a central blasting system.

Mucking and drilling operations will run 2 shifts, with the 3rd shift for blasting and ventilation. As the operation would be using two mining methods with multiple faces scattered along a big area, explosive gases will be quite extensive throughout the mine, so a full shift is warranted for ventilation and safety inspection before the 1st shift of the following day.

Haulage drifts, main access drifts and CAF stope cross-cuts will be supported with swellex and welded wire mesh screen. The majority of MIP panels will not require support, but in some poorer zones, swellex bolts will be installed. All support drilling will be drilled with jumbo and installed from scissor lift trucks in the trackless development headings or from the floor and muckpiles.

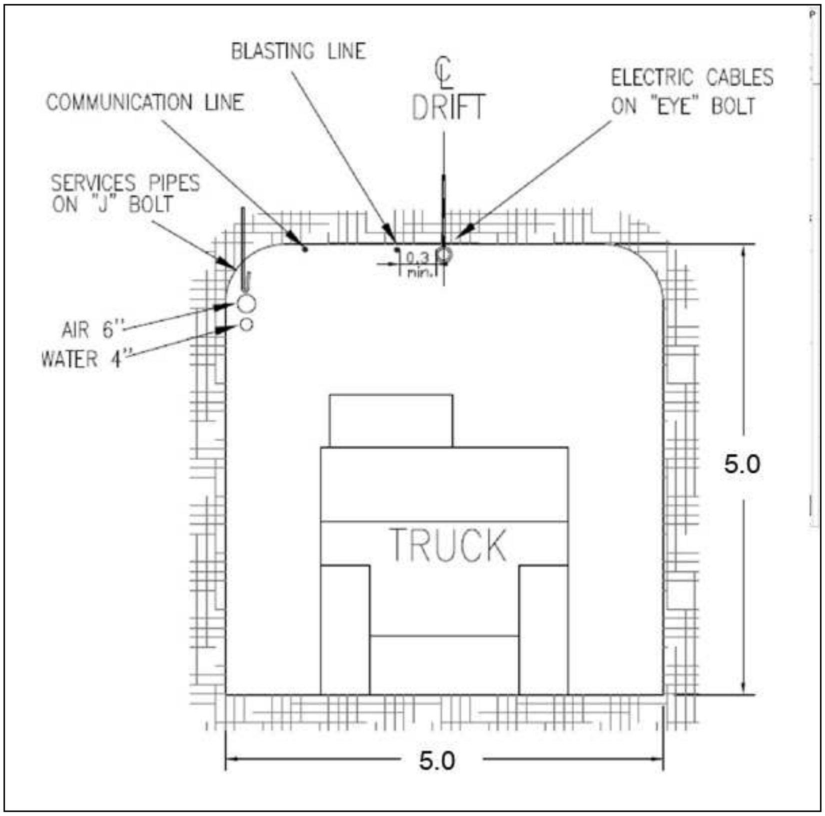
Generally cable bolts will not be required, as both mining methods will be limited to maximum 6m spans. In the zones of worst quality ground identified in the geotechnical study, additional cable-bolting will be required. Cables will generally be bulged twin strand 7-10 metres long and grouted in place. Drilling of holes will utilize a pneumatic long hole drill on a rubber tired rig. Cables will be inserted manually from a scissor lift work platform and grouted using a small grouting pump. Cable support will be designed for the ground conditions and to maximize the span of the stopes that can safely be mined.

Mucking will be done only by LHDs. In the MIP stopes, 2.3m$^3$ LHDs will be used, and in CAF, bigger 5.25 m$^3$ may also be used. The ore will then be loaded onto dump trucks, for direct transportation to the processing plant.

## 16.5 Development

New development headings will be drilled off using 44 mm diameter drill holes, with 4 cut holes reamed. Slashes will be drilled off to the required width and height using 44 mm diameter drill holes as well. Headings will be blasted using a combination of ANFO, stick emulsion for the lifters, perimeter blasting products for the wall and back holes and nonel caps, initiated by electric caps. A typical drift cross-section is shown in Figure 16-30.

**Figure 16-30. Drift Configuration**




Ground support will consist of 1.8 metres long resin grouted rebar, installed on a 1.2 m by 1.2 m pattern, along with welded wire mesh screen on the backs and walls to within 1.5 m of the floor. The ground support will be installed using jumbos and installed from scissor lifts. All services will be installed from scissor lifts.

Services installed in these drifts and ramps will include a 152 mm service waterline, a 152 mm discharge water line, 500 MCM power cable, 1000 volt cable, 48-fibre fibre optic data and communication cable and a central blasting line.

For stope development, the ore haulage drifts will initially be developed with the back of the drifts located at the hanging-wall ore/waste contact, at the end of the access cross-cuts. The drifts will be developed nominally 5m wide x 5 m high, with a shanty back to the up-dip side of the drive. This will accommodate the mining equipment, allow loading of trucks in the cross-cut entrances and coincide with the 6m mining slices planned across much of the ore body. Ore cross-cuts and raises will be developed off these drifts as stope accesses. A 10 m pillar will be left between the ore haulage drift and the stoping panels. The stoping panels will be developed from the ore cross-cuts.

## 16.6 Mining Equipment

The mine development will require two 2 boom electric/hydraulic jumbos, two 5.25 cubic metre bucket LHDs, 2 platforms for explosive chargers, 2 back hoes for scaling, small cleaning works and accessory works, 6 Dump Trucks of 15ton and three light utility vehicles.

Mine production (done by contractors) will require 1 jumbo of 2 arms, 3 jumbos of 1 arm, 2 platforms for explosive charge and accessory services, 1 back hoe of 0.6 $m^3$ and 1 Back hoe of 0.15 $m^3$, 1 LHD of 2.3 $m^3$ and 1 LHD of 5.25 $m^3$. Production works will also require 2 light utility vehicles. The equipment list for the underground mine is shown in Table 16-7.

**Table 16-7. Mine Equipment**

| Equipment | Development | Production | Services | Maintenance | Staff |
|---|---|---|---|---|---|
| Electric/Hydraulic 2 Boom Jumbo | 2 | 1 | | | |
| Electric/Hydraulic 1 Boom Jumbo | | 3 | | | |
| Anfo charger | 2 | 2 | | | |
| LHD 5.25 m3 | 2 | 1 | | | |
| LHD 2.3 m3 | | 1 | | | |
| Excavator 0.6 m3 | 2 | 1 | 1 | | |
| Excavator 0.15 m3 | | | 1 | | |
| Haulage trucks | 6 | 5 | | | |
| Light service vehicle (Van) | 3 | 2 | | | |
| Man carrier | 2 | 2 | | 1 | 2 |
| Shotcrete machine | 1 | 1 | | | |
| Concrete mixer | 3 | 3 | | | |
| High Place Operation Car | 1 | 1 | 1 | | |
| Equipment Carrier | 1 | 1 | | | |
| Light service vehicle | 2 | | 1 | | 2 |

The mine services group will take care of:

- Backfilling.
- Some surface infrastructure maintenance.
- AKT owned fixed equipment (e.g, fans, compressors)

- Underground infrastructure.

The mine services group will also assist the safety department when needed. Services will have 1 lift truck, for the backfill pipes installation and maintenance, and one light truck for the transportation of materials, equipment and backfill pipes.

Maintenance of the mine equipments will be the responsibility of the contractor. For these activities, the contractor will have 1 light vehicle, available at all times during the two production shifts.

Mine staff, engineering and geology will require two light utility vehicles.

Ore and waste haulage to surface will require six 15 tonne trucks. Those trucks are not normal mine trucks, but reinforced road trucks as used in Korea for tunneling and underground limestone quarries, as shown in Figure 16-31.

Underground operations and maintenance personnel will be transported to their working places in personnel carriers. During the shift, workers will travel around the mine in light utility vehicles with bench seats. Service vehicles for materials and parts will consist of flat bed or pickup trucks with boxes for palletized, containerized or individual items.

**Figure 16-31. 15t Mine Truck**

## 16.7 Mining Schedule

Mine production of 640 ktpa is schedule, stemming from approximately 40% of ore from MIP mining and 60% from CAF mining. Development is scheduled to support both mining methods' requirements, on a yearly basis. Mining will take place initially on the -1 Level, both on the Main and F2 structures. Stoping will then proceed onto other mineralized structures and towards higher levels. Zones above the Jangsan and below -1 Levels will be left until later in the mine life.

Development crews in waste headings will generally have multiple headings available. For development scheduling, each crew and equipment is scheduled to advance 2.6 rounds (each of 2.6 metres length) per day, on 4 m by 4m or 5m by 5m headings. This will give a total for the two crews of 270m/month, or 3200 m of advance per year. In addition to this the crew will also develop the necessary safety bays, slashing, cutouts etc.

The division of ore production by type of mining method gives:

- 40% Mechanized Inclined Panel or 731 t/day
- 60% Cut-and-Fill or 1097 t/day

MIP stopes in the drifting phase will produce 60t/blast, so 13 blasts/day would be required if all ore comes from drifting. This would be achievable with 3 jumbos working the 2 production shifts, making a minimum of 2.1 faces/shift. The MIP method has multiple faces were both jumbos and LHDs can go from one face to another with a minimum loss of time, giving a good usage of the equipment; as blasting times are in the 3rd shift. Jumbos and LHDs can also go continuously from 1 face to another, making advance on 3 faces/shift quite realistic. The situation described all drifting is conservative, as half of the production from MIP stopes will come from slashing.

It is assumed for the current study that at any time, two MIP stopes will be in full production, one in the preparation phase and one in the backfilling phase; for a total of 4 active stopes. In reality only 3 active stopes will be required, as strike drives can be developed simultaneously with the stoping phase in the same stopes.

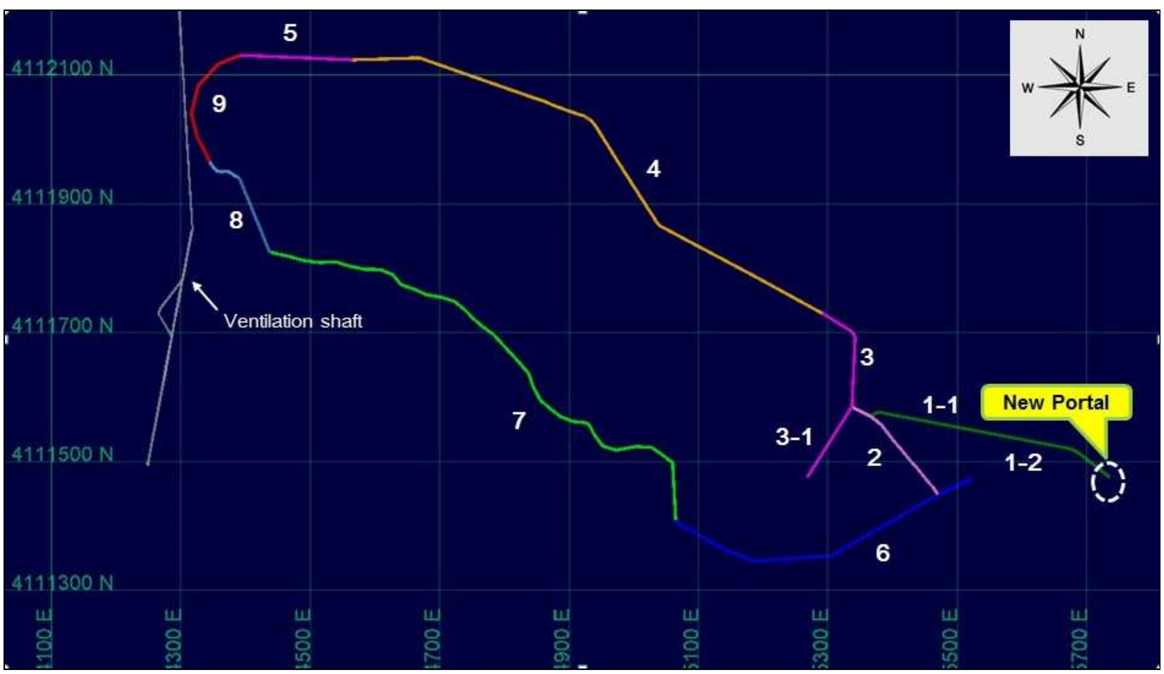
Each face in CAF mining will produce an advance/blast of 2.6m, for 270t of ore. This means that four faces will be required for daily production. One two-boom jumbo can be used for the drilling required in 2 shifts, as the faces will be close together and always available for mucking and drilling.

Prior to multiple faces being available, stope preparation will require execution of an incline up to the upper level for ventilation and backfilling. For a typical CAF stope of 250m length, it could take up to 10 days for backfilling, plus 28 days for curing, meaning that each stope could involve almost 2 months without production over the whole stope cycle. It has therefore been estimated that the mine will require a minimum of 3 CAF stopes active at any time: one in preparation, one in production and the other in backfilling phase. This is readily achievable in the zone accessible via -1 Level gallery into the HW zone, where the HW mineralization is recognized along a minimum length of 600m (as shown in Figure 16-18).

The mine development schedule also includes rehabilitation and enlarging of existing lateral development, as well as new waste and ore development. The development schedule will provide access in place, at least one year before ore zone stope development and mining is required. Table 16-8 shows the schedule for development metres and estimated costs.

This planned development is shown in Figure 16-32. Sectors 1 to 5 are on -1 level and sectors 6 to 8 are on Sangdong Level. Sectors 2 and 9 are ramps connecting both levels. With this development layout, a well-defined ventilation circuit is also created, along with flexibility for the use of equipment among the different zones of the mine, as well as access to escape routes.

**Figure 16-32. Development Plan**




The pre-production development program is based on starting with 2 work faces: one developing the ramp between Sangdong and -1 Levels (sector 2), and another continuing a new gallery (sector 6) through Sangdong Level. After finishing the development of the ramp, the new portal can be started on -1 level from the surface and its connection to -1 Level (sectors 1-1 and 1-2). The location of this new adit is shown in Figure 16-33.

In parallel, sectors 3 (access to the HW zone) and 3-1 (access to Main Zone reserve) can be started. After zone 3, the development can continue through the development of the actual HW gallery off -1 Level (sector 4), and in parallel through the Sangdong Level gallery destined to give access to F2 and F3 (sector 7). The Sangdong Level development can continue through new gallery (sector 8), to link to the ventilation shaft of west sector of the mine. Preparation can then start for the stopes that will be accessed from Sangdong Level. The continuation of the HW gallery on -1 Level will be developed, parallel to the HW mineralized structure (sector 5), for 174 m until reaching a point for the new ramp to be built at the west end of the mine (sector 9). This will link the -1 Level with the Sangdong Level, and will provide ventilation for the entire exploitable areas accessible from -1 Level.

The mine production schedule is based on mining 450 ktpa of ore for Year 1, and thereafter 640 ktpa (1,830 tpd for 350 days per year), as presented in Table 16-9.

**Figure 16-33. New Adit Portal Positon, For -1 Level**

## Table 16-8. Development Schedule

| Gallery No. | Description | Unit Price (KRW/m) | Distance (m) | Cut-Outs (m) | Monthly Development Distance (m) | | | | | | | | | | | | | | | | | | Cost KRW x $10^6$ Excl VAT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th | 14th | 15th | 16th | 17th | 18th | |
| 1-1 | Portal / New / Horizontal | 7,055,380 | 60 | | - | - | 30 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 423 |
| 1-2 | L1 ~ Portal / New / Horizontal | 2,110,425 | 333 | 54 | - | - | - | - | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 26.5 | - | - | - | - | 816 |
| 2 | Ramp / Reaming / Inclined | 1,635,425 | 195 | 18 | 87.5 | 87.5 | 37.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 348 |
| 3 | L1(HW1) / New / Horizontal | 2,110,425 | 173 | 18 | - | - | 40 | 60 | 60 | 30.5 | - | - | - | - | - | - | - | - | - | - | - | - | 402 |
| 3-1 | L1(FW1) / New / Horizontal | 2,110,425 | 127 | | - | - | 40 | 51 | 36 | - | - | - | - | - | - | - | - | - | - | - | - | - | 268 |
| 4 | L1(HW) / Reaming / Horizontal | 1,635,425 | 867 | 118 | - | - | - | - | - | 71 | 120 | 125 | 105 | 105 | 105 | 105 | 105 | 118 | 26 | - | - | - | 1,611 |
| 5 | L1(HW2) / New / Horizontal | 2,110,425 | 174 | 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 119 | 73 | - | - | 405 |
| 6 | SD(FW) / New / Horizontal | 2,110,425 | 443 | 85 | 62.5 | 62.5 | 82 | 89 | 94 | 88 | 50 | - | - | - | - | - | - | - | - | - | - | - | 1,114 |
| 7 | SD(FW) / New / Horizontal | 2,110,425 | 837 | 170 | - | - | - | - | - | - | 40 | 92 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | - | - | - | 2,125 |
| 8 | SD(FW) / Reaming / Horizontal | 1,635,425 | 180 | 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 125 | 73 | - | 324 |
| 9 | New / Inclined | 2,300,425 | 209 | 36 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 125 | 120 | 564 |
| **TOTAL** | | | **3,597** | **535** | **150** | **150** | **230** | **230** | **230** | **230** | **250** | **257** | **270** | **270** | **270** | **270** | **270** | **270** | **270** | **198** | **198** | **120** | **8,400** |

**Table 16-9. Ore Production Schedule**

| LEVEL | | AZONE | Reserves | | Years | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tonnes | WO3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| *mRL* | *Name* | | *Kt* | *%* | | | | | | | | | | | | | |
| 755 | Jangsan | F4 | 15 | 0.42 | - | 15 | - | - | - | - | - | - | - | - | - | - | - |
| 727 | Baegun | HW | 47 | 0.45 | 47 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | MAINF1 | 20 | 0.34 | - | - | - | - | - | - | - | 20 | - | - | - | - | - |
| | | F4 | 10 | 0.35 | - | - | - | - | - | - | - | 10 | - | - | - | - | - |
| 685 | Taebak | HW | 320 | 0.37 | - | - | - | - | - | - | - | 293 | 27 | - | - | - | - |
| | | MAINF1 | 392 | 0.36 | 103 | - | - | - | - | - | - | - | 288 | - | - | - | - |
| | | F2 | 196 | 0.42 | 50 | - | - | - | 78 | - | - | - | - | - | 11 | 57 | - |
| | | F3 | 66 | 0.38 | - | - | - | - | 32 | - | - | - | - | 30 | 1 | 2 | - |
| 659 | Sangdong | MAINF1 | 518 | 0.32 | - | - | - | - | 229 | - | - | 119 | 6 | 137 | 27 | - | - |
| | | F2 | 752 | 0.48 | 231 | 69 | - | - | - | 416 | - | - | 37 | - | - | - | - |
| | | F3 | 527 | 0.47 | 19 | 150 | - | - | - | 150 | 97 | - | - | 20 | 45 | 45 | - |
| | | F4 | 2 | 0.26 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| 633 | -1 | HW | 266 | 0.49 | - | 208 | - | - | - | 58 | - | - | - | - | - | - | - |
| | | MAINF1 | 398 | 0.35 | - | - | - | - | - | - | - | - | 191 | 52 | 155 | - | - |
| | | F2 | 546 | 0.48 | - | 200 | 115 | - | - | - | 58 | 65 | 18 | - | 53 | 38 | - |
| | | F3 | 656 | 0.46 | - | - | 282 | - | - | - | 136 | 28 | - | - | - | 193 | 18 |
| | | F4 | 37 | 0.30 | - | - | - | - | - | - | - | - | - | - | - | 24 | 13 |
| 617 | -2 | HW | 1,061 | 0.52 | - | - | 248 | 316 | - | - | 343 | 106 | 49 | - | - | - | - |
| 594 | -3 | HW | 755 | 0.53 | - | - | - | 327 | 301 | 18 | 7 | - | 17 | 40 | 32 | 12 | - |
| 566 | -4 | HW | 506 | 0.45 | - | - | - | - | - | - | - | - | 11 | 253 | 242 | - | - |
| 536 | -5 | HW | 173 | 0.46 | - | - | - | - | - | - | - | - | - | 110 | 63 | - | - |
| 509 | -6 | HW | 632 | 0.40 | - | - | - | - | - | - | - | - | - | - | 15 | 270 | 347 |
| | | | Tonnes | Kt | **451** | **643** | **644** | **643** | **641** | **641** | **641** | **641** | **644** | **643** | **644** | **643** | **378** |
| | | | WO3 | % | **0.51** | **0.53** | **0.60** | **0.54** | **0.49** | **0.46** | **0.42** | **0.37** | **0.33** | **0.39** | **0.41** | **0.38** | **0.38** |

## 16.8 Backfilling

All stopes will be backfilled with paste backfill, cemented and uncemented, which will also minimize surface tailings management. The paste backfill will consist of classified mill tailings. Paste backfill will be delivered at approximately 70% solids by weight, at a rate of 100 tph.

Paterson & Cooke (P&C) carried out backfill testing for the Sangdong project in 2011 for Tetra Tech. Their report is contained in Appendices of the Tetra Tech Sangdong Feasibility Study. The backfill testing program pertained to paste fill and tested tailings size distribution, rheology, and strength with various binder content. The tailings were found to be medium grained with D80, D50, and D10 sizes of 100, 33, and 10 microns, respectively. They were also found to have rheology characteristics adequate for paste backfill. Strength gains over 7 and 28 days curing time were found to be adequate. Once the processing plant detailed design is complete, a bulk sample of representative tailings product produced by the processing plant will be prepared and tested as paste backfill. The testing will determine the potential fines component to be removed, to allow for adequate backfill drainage and to develop binder recipes for strength. This backfill testing can be performed during the detailed design phase.

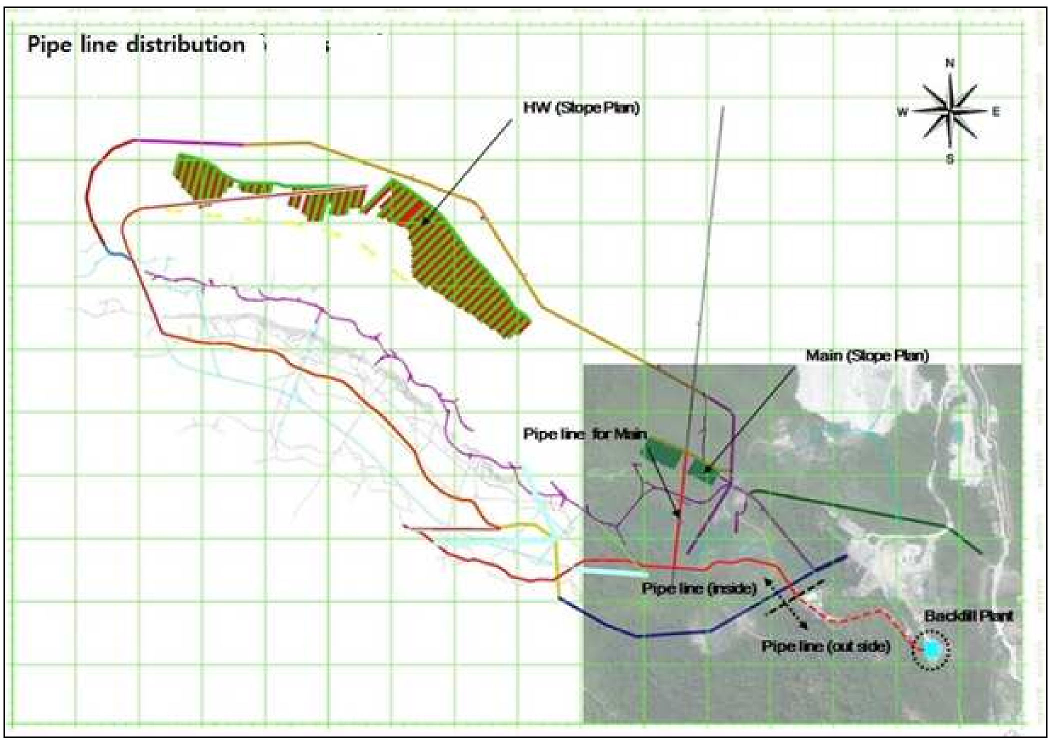
Paste backfilling for Mechanised Inclined Panel and Cut-and-Fill stopes will use approximately 65% of the tailings produced. The paste filling operation envisaged will be almost continuous. To achieve this, several stopes will need to be simultaneously in the process of backfilling, to allow for backfill fences water pressure control and other operational constraints.

The remaining portion of backfill not placed in active mining voids will be backfilled on voids below -1 level or sent to the co-disposal facility, to give consistency and long term stability to the waste rock. It may be possible to transport some of this material to cement factories, receiving some discount on the transportation cost. The old Main Zone mining areas, are also available to store excess tailings. By the time of its closure, the mine had been developed and mined on more than 20 levels, between the elevations of 242 and 755 mRL. Most of the mining was carried out in the Main Zone. The primary mining method used was inclined room-and-pillar. Plans of the old workings indicate that many of the pillars were left intact to support the stope roofs and that extensive voids remain within the Main Zone. The other significant area of voids is in the F2 subzone of the Footwall Zone. This void is estimated to extend from 484500E to 485000E (i.e. approximately 500 m along strike). The backfilling of the Main and FW Zones stopes would ensure that these areas will not cave, as mining in the HW Zones progress.

Paste backfill would be delivered to the top of the stopes by the paste backfill pipelines. The backfill would be pumped from the backfill plant, on the Sangdong level terrace, in a 102 mm Schedule 80 steel pipeline. The main distribution line would be installed in the Taebaek old galleries, that have been recommissioned for that purpose and through Sangdong main drift over the length of the orebody to be mined. This main line would feed backfill lines to the mining levels below, initially the Sangdong and -1 levels.

The backfill distribution system is shown in Figure 16-34. The backfill plant will be close to the old KTMC ore bin, where there is enough space to build the plant and accessory infrastructure. There will be a short pipeline from the backfill plant to the waste storage facility for co-disposal of the tailings and for storage in case of emergency. There is also some storage capacity in the tailings thickener. The site of the backfill plant will also allow the circulation and loading of the trucks that will transport the tailings to co-disposal or cement factories.

**Figure 16-34. General Arrangement of Backfill Distribution System**




The backfill pipeline will enter underground by Taebaek Level, where existing galleries will be used for distribution to the stoping areas, as shown in Figure 16-35. The connection with Sangdong Level will be done through a gallery (2 in Figure 16-36) to access areas below a caved zone on Taebaek Level. From there, the pipes will go through one of the MIP galleries down to base galleries on the Sangdong Level, where it will serve stopes accessed from there.

**Figure 16-35. Backfill Distribution to Main Zone**

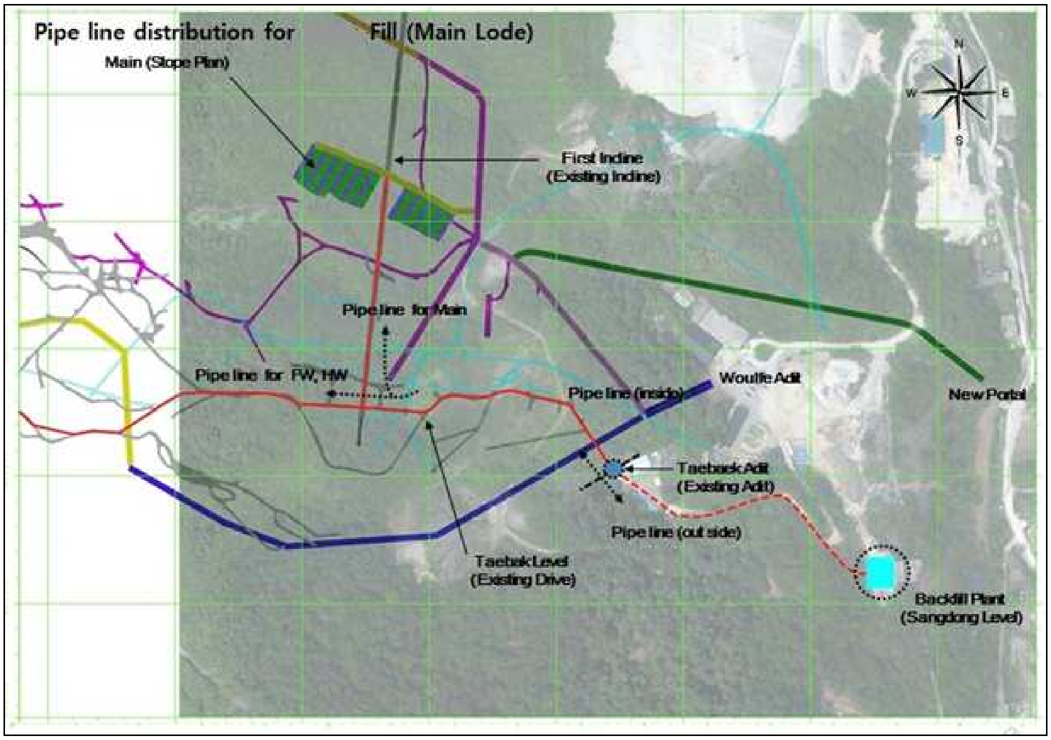
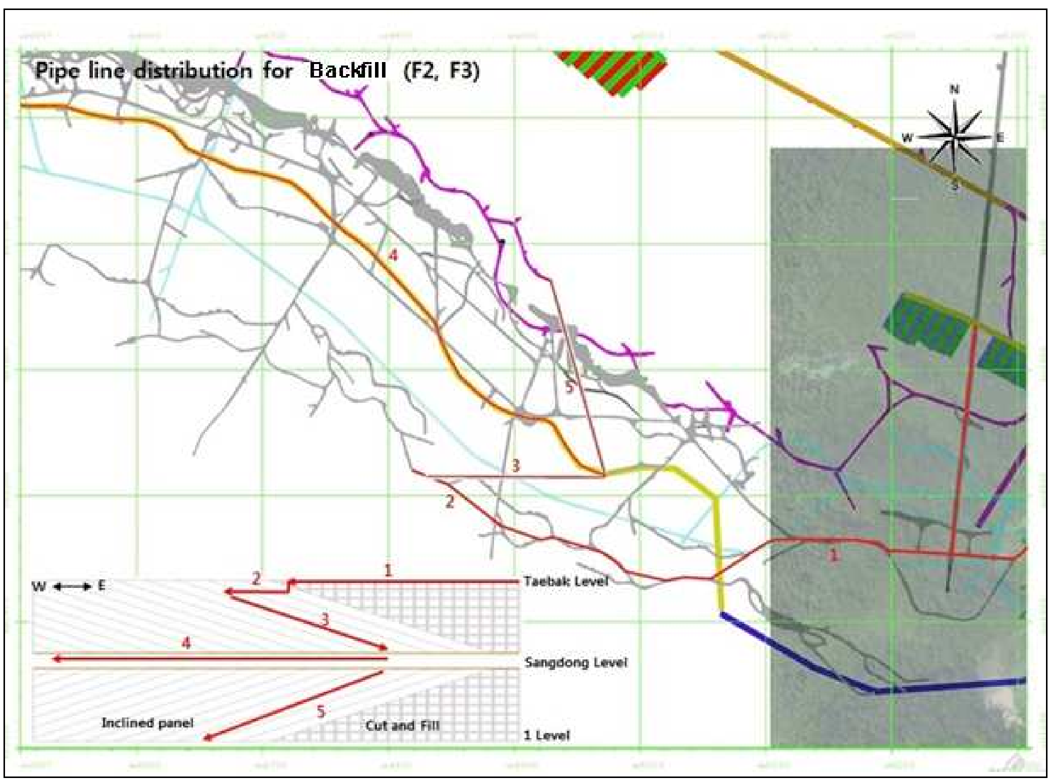



**Figure 16-36. Backfill Distribution to F2 and F3 Zones**



The backfill pipeline that will serve the HW zone will go through the base galleries of Sangdong Level, until connecting with the HW strike drive, from where the backfilling of the HW Cut-and-Fill stopes will be possible .

Future exploitation zones in the upper zones of the Taeabek and Jangsang levels will be backfilled through the ramp which will be developed on the east side of the deposit. The backfilling of lower zones of the deposit will also be done through the east side ramp.

Fill fences, constructed at the stope entrances of CAF stope areas, would consist of a timber frame anchored to the rock at the floor, walls, and back with 25mm dowels, wiremesh, and a synthetic filtering material. Perforated drainage pipes would be installed to collect water from the paste fill and transport it to the other side of the fence lowering the pressure on the fence. Backfill would be delivered to the high point in the stope, via a HDPE pipe hanging at the back of the stope. Water pressure will be monitored and filling would be interrupted if pressure reached a safety limit.

To use excess tailings for backfilling of the old Main zone stopes, these old stopes would require dewatering to their lowest extent. This could mean that the whole mine would require dewatering, to the lowest level before backfilling of oldest past-mined stopes could be completely feasible. Access to the lower levels for this purpose would require dewatering the mine below level -1, rehabilitation of an inclined shaft, and the installation of a hoisting facility for the transportation of workers, materials, and equipment between levels. This option has not been included in the current study. Backfilling of the old past-mined stopes would also require fill fences to be constructed in key areas, to protect existing drifts and inclined shafts for future use. These voids could also be partly filled with development waste and internal waste encountered in stopes.

## 16.9 Ventilation

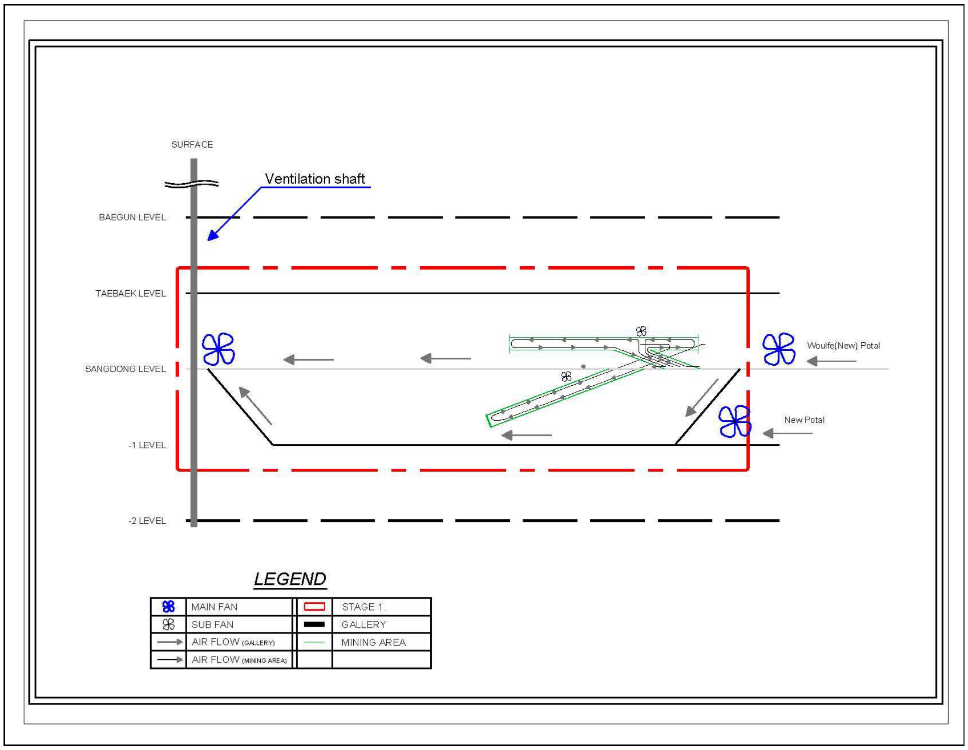
The ventilation system at Sangdong is designed to adequately dilute the exhaust gases produced by diesel equipment. The required air volume was calculated as 0.05 cubic metres per second (100 cubic feet per minute) per brake horsepower of diesel equipment. The horsepower rating of the underground equipment was determined, and utilization factors were applied to estimate the total amount of air required (see Table 16-11). At full production a total air volume of 185 $m^3$/s (390,000 cfm), including losses and miscellaneous usage areas, is required.

Two independent systems are planned; one for the Sangdong level, and one for the -1 level. Figure 16-37 shows a mine ventilation schematic, with main intakes and exhaust air routings. The main high pressure fans will be the exhaust fans installed on each level at the existing inclined ventilation shaft, located at the west end of the mine. Fresh air will be pulled through the portal on each level. Air will travel in the main drifts and through the access cross-cuts to the ore haulage drifts. The air will be distributed to stopes from the haulage drifts. Exhaust air from the stopes will re-enter the haulage drifts and travelways, in the opposite direction to the fresh air flow, to access cross-cuts and out to the main drifts. Air will flow in the main drifts and exhaust to the existing west inclined (shaft) exhaust ventilation raise and up the raise to surface.

**Table 16-10. Ventilation Required for Mine Equipment**

| Diesel Equipment | HP | Air Volume required | Usage | Number of pieces | Total Air Volume required |
|---|---|---|---|---|---|
| | | *cfm* | *%* | | *cfm* |
| Jumbo | 78 | 7,800 | 25% | 6 | 11,700 |
| 1.2 cu. m. LHD | 45 | 4,500 | 50% | 4 | 9,000 |
| 4.6 cu. . m. LHD -D | 270 | 27,000 | 75% | 4 | 81,000 |
| 20 Tonne Truck | 322 | 32,200 | 75% | 6 | 144,900 |
| Scissorlift | 101 | 10,100 | 25% | 2 | 5,050 |
| Anfo Loader | 101 | 10,100 | 25% | 2 | 5,050 |
| Boom Truck | 101 | 10,100 | 25% | 2 | 5,050 |
| Front End Loader | 107 | 10,700 | 25% | 1 | 2,675 |
| Grader | 101 | 10,100 | 25% | 1 | 2,525 |
| Light Service V. | 95 | 9,500 | 50% | 6 | 28,500 |
| Man Carrier | 138 | 13,800 | 25% | 2 | 6,900 |
| **Total** | | | | | **302,350** |

**Figure 16-37. Ventilation Schematic Diagram**




All exhaust fans installations will be located underground (to avoid surface disturbance and noise in a forestry area) at the West Exhaust Ventilation Raise. On the Sangdong and -1 Levels, 2-60-30-1500RPM, type 2000, 250/300 HP fans with a capacity of approximately 80 $m^3/s$ (170,000 cfm) with maximum operating head pressure capacity of approximately 2.5 to 2.9 kPa will be installed, where most of the equipment will initially be operating. As levels below -1 Level are brought into production, 250/300 HP fans of the same capacity as those on the Sangdong and -1 Levels will be installed on the levels (or moved from a level where the main exhaust fan is no longer required). Fans will be variable speed to facilitate adjusting air volume delivery to working areas, as required.

Fresh air delivery to the stopes will be controlled using auxiliary ventilation fans and ducting. Ventilation regulators, doors, and bulkheads will also be used to control the airflow in the mine.

The ramp development will use 150 hp fans. Other lateral development will use a combination of 100 HP and 150 HP fans depending on the heading length. Development headings are sized to accommodate large ducting (107 mm), to reduce head losses.

Auxiliary ventilation delivery to stopes will typically use 75 or 100 hp fans, with 914 mm (36 in) flexible ducting.

# 17 RECOVERY METHODS

The process flowsheet and plant designs rely on the same flowsheet as used in the Tetra Tech 2012 Feasibility Study, and confirmed by pilot plant tests performed on Sangdong ore by the Guangzhou Research Institute of Non-ferrous Metals. The equipment considered in the 2012 Tetra Tech study has now been resized by METSO for the smaller plant capacity now being currently considered.

## 17.1 Process Design

The present report contains a flowsheet developed for the recovery of a scheelite through a flotation process, producing a final concentrate grading approximately 65% $WO_3$. Based on test results, the estimated tungsten overall recovery will be 81% with an average mass yield of 0.86%. The processing plant will have a capacity of 1,920 metric tons per day. The details of the process design criteria are summarised in Table 17-1 below.

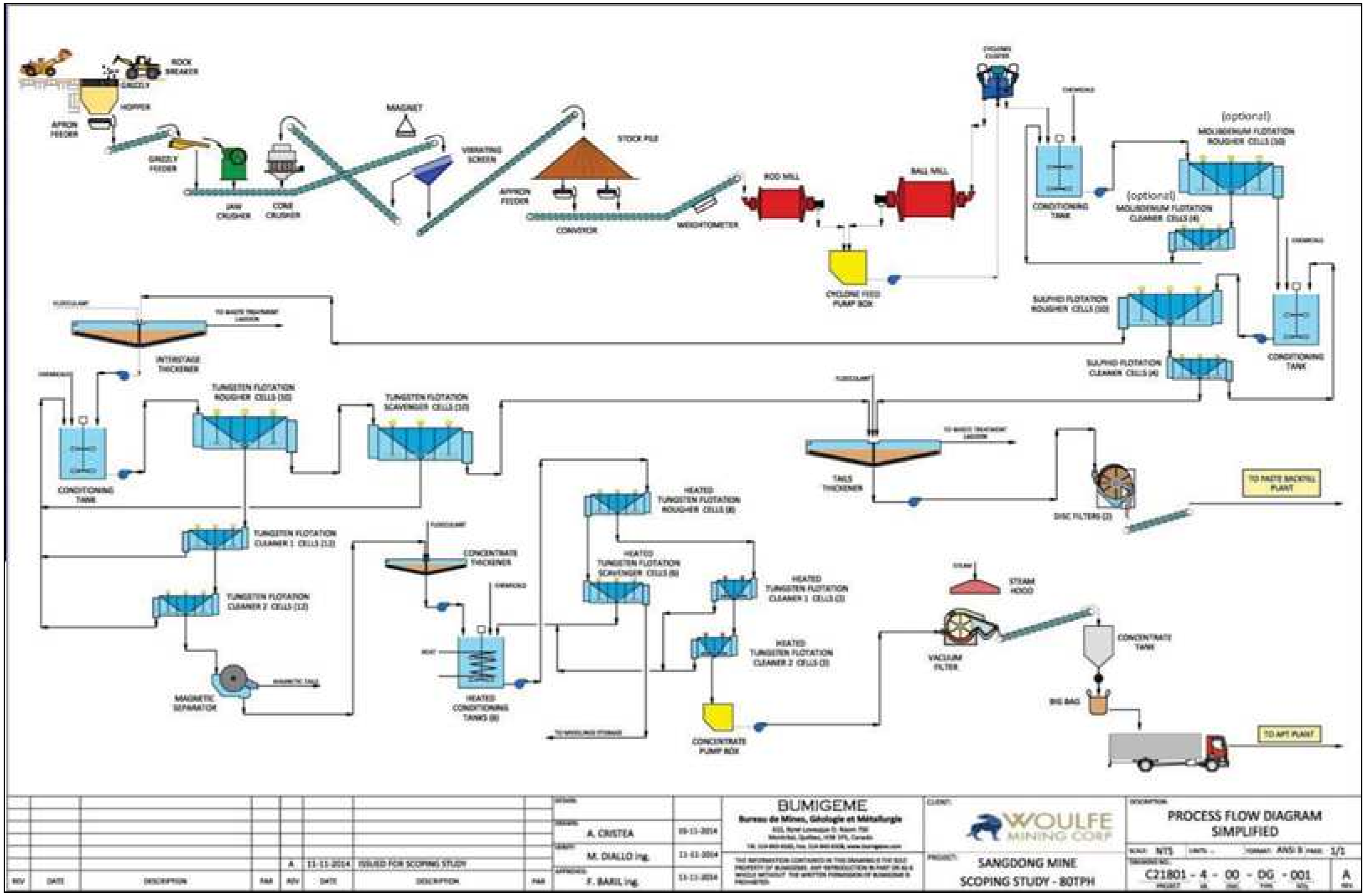
**Table 17-1. Process Design Criteria**

| Designation | Design value | *Unit* |
|---|---|---|
| Scheduled operating days per year | 365 | *Days* |
| Equipment utilisation | | |
| - Crushing | 68.5 | *%* |
| - Others | 92.2 | *%* |
| Plant capacity | 1,920 | *tpd* |
| ***Plant feed analysis*** | | |
| $WO_3$ | 0.69 | *%* |
| Moisture (assumed) | 10 | *%* |
| ***Plant recovery*** | | |
| Tungsten overall recovery | 81 | *%* |
| Final concentrate grade | 65 | *% $WO_3$* |
| ***Annual production*** | | |
| Tungsten final concentrate | 5,519 | *tpy* |

## 17.2 Process Description

The main process steps for treating the Sangdong ore are primary, secondary and tertiary crushing and stockpiling; grinding; flotation divided into two (2) sub-circuits (sulphide flotation and tungsten flotation); thickening; filtration and packaging section; a waste water treatment facility; and services section. Figure 17-1 shows the process flow diagram.

**Figure 17-1. Processing Plant Flowsheet**



### 17.2.1 Crushing and ore stockpiling

The run of mine (ROM) ore from the mine will be received in a feed hopper equipped with an inclined 600 mm square opening grizzly. A rock breaker will be used to bring the grizzly oversize down to 600 mm. The ore will be extracted from the feed hopper by an apron feeder which discharges onto a belt conveyor. The belt conveyor will feed a primary jaw crusher through a static grizzly feeder, which prevents the feeding of the fine fraction to the jaw. The jaw crusher discharge and the fine fraction will be conveyed by a 914 mm transfer belt conveyor. A magnet is located at the head of the transfer belt conveyor to remove steel fragments which might be present in the ore.

The transfer belt conveyor will feed a single deck screen with an aperture of 19 mm. The screen oversize is directed to a surge bin hopper which feeds a secondary standard cone crusher in closed circuit with the single deck screen. The screen undersize (at P100=19 mm) will be carried via a 914 mm belt conveyor to a coarse ore stockpile (approximately 2,000 t).
The crushing facilities will be equipped with a dust collection system consisting of a bag house with a fan to minimize the dust exhausted into the atmosphere.

### 17.2.2 Grinding

The ore will be drawn from the coarse ore stockpile by one or two variable speed apron feeders. The feeders discharge onto a 914 mm belt conveyor carrying the ore to a Rod mill of 3.3 m diameter x 4.9 m long, driven by a variable speed 725 kW WR motor. The feed to the Rod mill will be monitored by a weight scale and controlled by automatic adjustment of the Apron feeders. The grinding water addition will also be controlled to suit the ore feed rate, to maintain the selected pulp density.

The Rod mill discharge will be classified through a cyclone cluster consisting of 10 cyclones of 250 mm diameter (9 in operation and 1 standby). The cyclones underflow will be reground in a ball mill of 4.2 m diameter x 4.6 m long, driven by a synchronous 1,400 kW WR motor. The ball mill discharge is also directed to the cyclones cluster feed pump box. The circulating load is 250%, thus taking into account the high ore hardness.

The cyclone overflow, at a P80 of 75 microns, will be directed by gravity to the sulphide flotation circuit conditioning tank. There is an inline sampler installed in the cyclone overflow line. This sampler delivers a continuous flotation feed sample stream for analysis.

## 17.3 Flotation

### 17.3.1 Sulphide Flotation Circuit

The pulp from the 7-minutes conditioning tank will be pumped to the sulphides rougher flotation bank (2+3 x 15 $m^3$ cells for molybdenum roughing and 2+2 x 15 $m^3$ for other sulphide roughing). The rougher concentrates will be pumped by vertical spindle pumps to the respective cleaner banks, each of 2 x 5 $m^3$ cells. The cleaner concentrate is directed to the final tails pump box. The cleaner tails are combined with the rougher tails and pumped to a 20 m diameter inter-stage thickener. An inline sampler located in the sulphides floatation final tails, delivers a continuous rougher tail sample stream for analysis.

Testwork to simplify this circuit is underway, with the object of having a single bulk sulphide float and single stage cleaning. Elimination of the rougher tails thickener is also considered possible, through modification of the water treatment plant (see Section 18.6.3).

### 17.3.2 Tungsten Primary Flotation Circuit

The use of a thickener before the tungsten primary flotation circuit is intended to reduce the amount of water containing previous flotation reagents which can have a negative effect on the tungsten flotation process, and also allow a more efficient conditioning at high solids density. The thickener underflow at 55% solids is pumped to the 11-minute two (2) conditioning tanks. In the first conditioning tank, the pH will be adjusted with lime and reagents will be added, while in the second conditioning tank (dilution tank), process water is added to adjust the solid density at 35%, suitable for the flotation process. The diluted pulp is pumped to the rougher flotation bank (2+2) x 15 $m^3$ cells.

The rougher tails are directed to the scavenger banks 1 and 2, each (2+2) x 15 $m^3$ cells. The rougher concentrate is pumped by a vertical spindle pump to the 1st cleaner bank 3 x 10 $m^3$ cells. The scavenger concentrate is combined with the 1st cleaner' tails and returned to the conditioning tank ahead of the tungsten flotation circuit. The 1st cleaner concentrate is further cleaned in the 2nd cleaner bank (3 x 5 $m^3$ cells). The 2nd cleaners' tails are returned to the 1st cleaner bank. The scavenger tails are directed to the final tails pump box. An inline sampler is installed on this scavenger' tails line, to deliver a continuous sample stream for analysis.

### 17.3.3 Tungsten Heated Flotation Circuit

The tungsten concentrate obtained after the primary flotation stages has an average assay around 7-8% $WO_3$, and requires to be further upgraded to reach the marketable grade of 65% $WO_3$. A modified Petrov process consisting of a high density heated conditioning at 90°C for 90 min is used to achieve this concentration. The tungsten primary concentrate at 30% solids is thickened in an 8 m diameter thickener. The thickener under flow at 60% solids is pumped to a series of 8 x 1 $m^3$ heated carousel type agitated tank. After the conditioning step, the pulp is diluted at 18% solids and pumped to a rougher and 3 stage scavenger circuit with each stage consisting of 2 x 5 $m^3$ cells.

The scavenger concentrates are returned (countercurrent) to the heated conditioning tank. The rougher concentrate is pumped by a vertical spindle pump to three stages of cleaning cells, respectively 2 x 3 $m^3$ cells, 2 x 0.8 $m^3$ and 2 x 0.8 $m^3$. All of the cleaner tails are returned, countercurrent to the heated conditioning tank.

The scavenger tails which stand as middlings are stocked to be retreated. The tungsten final concentrate is filtered and dried on a 1.2 m diameter x 1.2 m long drum filter. The filter cake is dried in a Holoflite rotary drier and tungsten concentrate with moisture of 3% is conveyed to a 50t capacity silo. A big bag filling equipment with a scale for tungsten concentrate packaging is installed under the silo.

### 17.3.4 Final Tails Management

The concentrator tails are thickened in a 20 m diameter conventional thickener. The thickened tails, at 60% solids, are pumped to the backfill plant situated on the Sangdong terrace. It is estimated that 66% of the tailings produced would immediately be used for backfilling of active stope areas underground. Another 16% of the tailings would also be used for backfilling of old stope voids underground below -1 level. The remaining 16-17% of tailings would be filtered to a cake and then co-disposed with mine waste to assist with long-term stability and tightness of the waste dump. Transport of some filtered tailings to Korean cement plant may also be possible.

### 17.3.5 Fresh Water Quality and Quantity

The process water for the mill will be a combination of mine water (28 $m^3/h$), abstracted river water (30 $m^3/h$ maximum) and treated recycled water. The overall water balance is shown in Figure 18-3.

Mine water is very hard, with calcium ion concentrations of well over 100 ppm and magnesium of 50 ppm. These two ions react with most organic acids, forming calcium and magnesium salts, thus inhibiting their ability to froth. Test results suggest a much higher dosage of frother is required to precipitate the hardness ions.

In the scheelite (tungsten) flotation circuit, calcium and magnesium will be replaced by sodium, which increases the salinity of the water. If this water is recycled, the salinity will increase continuously (if not treated) and result in increased equipment corrosion and a decrease in froth stability (as the salinity decreases the ability of the process to produce foam). Therefore, the sulphide-molybdenum flotation circuit will use recycled water from the process water treatment facility, while the scheelite flotation circuit will use a combination of fresh process water and scheelite flotation circuit recycled water, while maintaining the optimal water salinity for the scheelite flotation circuit operation.

A mix of approximately 1/4 fresh water and 3/4 recycled water has been used in the processing plant design.

### 17.3.6 Waste Water Treatment

The process of flotation of the scheelite requires the addition of several chemicals. Many of which are of organic acid mixture and oils such as pine oil. These chemicals adhere to the minerals to be floated and with the introduction of air produce a froth which contains the mineral values. The froth breaks down when the pulp is not agitated and these chemicals remain mostly in the water. At the end of the flotation cycle the total amount of chemicals introduced, into the conditioning tanks, will be in solution in the waste water exiting the plant.

For environmental reasons the organic chemicals must be removed. The classical method to remove these is by aeration. Several aeration processes exist for a wide scale of industrial wastes. In the current study, prolonged aeration has been selected, using surface mechanical aeration (10 units of 20HP); these aerators should be installed in lagoons 3 metres deep (maximum) and with a total area of 12,640 $m^2$. This is the area equivalent to 5 days of retention. These types of treatment usually give 85-90% reduction of BOD5 in the waste stream, which would allow for direct discharge of water, in most cases. It must be noted that the above process does not remove the salinity in the waste water. It is expected that the sodium ion content in the discharge water will be approximately 100ppm higher than the sodium content in the raw water. This is due to the large quantities of sodium silicate and sodium carbonate used in the plant.

The aeration pond will be installed on Sangdong property, downstream of the area planned for the tailings storage area.

### 17.3.7 Equipment and Energy Consumption

The major equipment to be used in the processing plant is shown in Table 17-2. Minor equipment such as pumps and conveyors have been excluded from this list. The installed power totals 4006 kW, as compared to 5109 kW in the June 2015 Feasibility Study, mainly as the result of the use of larger volume flotation cells. Power costs have been left unchanged, however.

### 17.3.8 Other Services

Two (2) 15 m diameter x 10 m high fresh water tanks, including their pumps, will be installed within the service area. Two compressors are provided one for the plant air supply (150 HP) and the second for the instrumentation air supply (50 HP). An allowance for reagents and flocculants preparation and distribution is included in the main floor of the flotation building. A blower (210 HP) for the flotation cells is provided. The installation of a steam boiler with a water treatment system is planned to provide steam to the heat conditioning of the tungsten flotation and final tungsten concentrate drying.

### 17.3.9 Mill Manpower

Processing plant manpower included in the operating costs totals 36 personnel, of which 28 people are hourly personnel and the remaining 8 personnel are staff.

**Table 17-2. Summary of Major Processing Plant Equipment**

| EQUIPMENT | METSO MODEL NO. or Specification | QTY | CAPACITY or DIMENSION |
|---|---|---|---|
| **Reception, Crushing and Storage** | | | |
| Hopper | Steel Hopper | *1* | *30Ton* |
| Apron Feeder | AF5-1219-6000MM | 1 | 300mm * 300mm |
| Wobbler Feeder | Pitch 292 x 914 | 1 | 5131mm x 1105mm x 648H |
| Rock Breaker | MB293+MH400+MPU1 | 1 | |
| Jaw Crusher(Primare Crusher) | C100 | 1 | 2880mm x 2400mm x 2400H |
| Weightometer #1 | Conveyor부 착 | 1 | *105Ton/HR* |
| Magnet | Suspended | 1 | |
| Magnet | Suspended | 1 | |
| Weightometer #2 | Conveyor부 착 | 1 | *244Ton/HR* |
| Vibrating Screen(Double Deck Elliptical Motion) | ES302 9 371 37 | 1 | 1870mm x 6100mm |
| Silo-Hoppers | Steel Hopper | 2 | *30Ton* |
| Secondary Crusher Feeder | 84Ton | 1 | 630mm x 1000mm |
| Secondary Crusher | HP 100 | 1 | |
| Tertiary Crusher Feeder | 55Ton | 1 | 600mm x 2000mm |
| Tertiary Crusher | HP 100 | 1 | |
| Weightometer #3 | Conveyor부 착 | 1 | *105Ton/HR* |
| Two-Way Gate | *Two-Way Gate* | 1 | *105Ton/HR* |
| Silo-Hopper NO. 3 | Steel Tank | 1 | *30Ton* |
| Apron Feeder | Apron | 1 | 80Ton/HR |
| Weightometer #4 | Conveyor부 착 | 1 | 80Ton/HR |
| **Grinding** | | | |
| Rod Mill(Chute, Screen포 함 ) | | 1 | 3.3DIA x 4.9m |
| Ball Mill(Screen포 함 ) | | 1 | 4.2DIA x 4.6m |
| Crane 20t | Over Crene | 1 | Crane 20t |
| CLASSIFYING CYCLONES CLUSTER | | 1 | $234M^3$/HR |
| **Molybdenum Flotation** | | | |
| Molybdenum Rougher Flotation | RCS 15 | 5 | 15M3 |
| Molybdenum Cleaner Flotation | RCS 5 | 2 | 5M3 |
| **Sulphide Flotation** | | | |
| Sulphide Rougher Flotation | RCS 15 | 4 | 15M3 |
| Sulphide Cleaner Flotation | RCS 5 | 2 | 5M3 |
| Floccuant Feeding System #1 | | 1 | |
| **Scheelite Flotation** | | | |
| Scheelite Rougher Flotation | RCS 15 | 4 | 15M3 |
| Scheelite Scavenger 1 Flotation | RCS 15 | 4 | 15M3 |
| Scheelite Scavenger 2 Flotation | RCS 15 | 4 | 15M3 |
| Scheelite Cleaner 1 Flotation | RCS 10 | 3 | 10M3 |
| Scheelite Cleaner 2 Flotation | RCS 5 | 3 | 5M3 |
| Magnetic Separator | | 1 | 1200DIA. x 600mm x 1810L |
| Flocculant Feeding System #2 | | 1 | |
| **Heated Scheelite Flotation** | | | |
| Electrical Heating System #1 | | 1 | $5M^3$/HR |
| Scheelite Heated Float Rougher Flotation | RCS 15 | 2 | 15M3 |
| Scheelite Heated Float Scavenger 1 Flotation | RCS 5 | 2 | 5M3 |
| Scheelite Heated Float Scavenger 2 Flotation | RCS 5 | 2 | 5M3 |
| Scheelite Heated Float Scavenger 3 Flotation | RCS 5 | 2 | 5M3 |
| Scheelite Heated Float Cleaner 1 Flotation | RCS 3 | 2 | 3M3 |
| Scheelite Heated Float Cleaner 2 Flotation | RCS 0.8 | 2 | 0.8M3 |
| Scheelite Heated Float Cleaner 3 Flotation | RCS 0.8 | 2 | 0.8M3 |
| Scheelite Heated Float Cleaner 4 Flotation | RCS 0.8 | 2 | 0.8M3 |
| **Concentrate Dewatering and Drying** | | | |
| Floccuant Feeding System #3 | | 1 | |
| Disc. Vacuum Filtration | | 1 | $90M^3$/M |
| Weightometer #5 | | 1 | 1Ton/HR |
| Holofilte Dryer | | 1 | 1Ton/HR |
| Electrical Heating System #2 | | 1 | 1Ton/HR |
| Vacuum Filtration | | | |
| **Tailings Thickening** | | | |
| Floccuant Feeding System #4 | | 1 | |
| Disc. Vacuum Filtration | | 1 | 88M3/HR |
| Weightometer #6 | | 1 | 47M3/HR |
| Vacuum Filtration | | | |

# 18 PROJECT INFRASTRUCTURE

## 18.1 Existing Infrastructure

Sangdong, as a past-producing mine, has significant infrastructure on site, which . includes:

- Access road to site
- Site roads
- Powerline and stepdown substation
- Potable water, with a 2 km pipeline connection to the Sangdong town water supply
- Office/changehouse complex
- 63 metre long concrete lined adit
- Townsite within approximately 2 kilometres distance
- Communications and internet service
- Security building

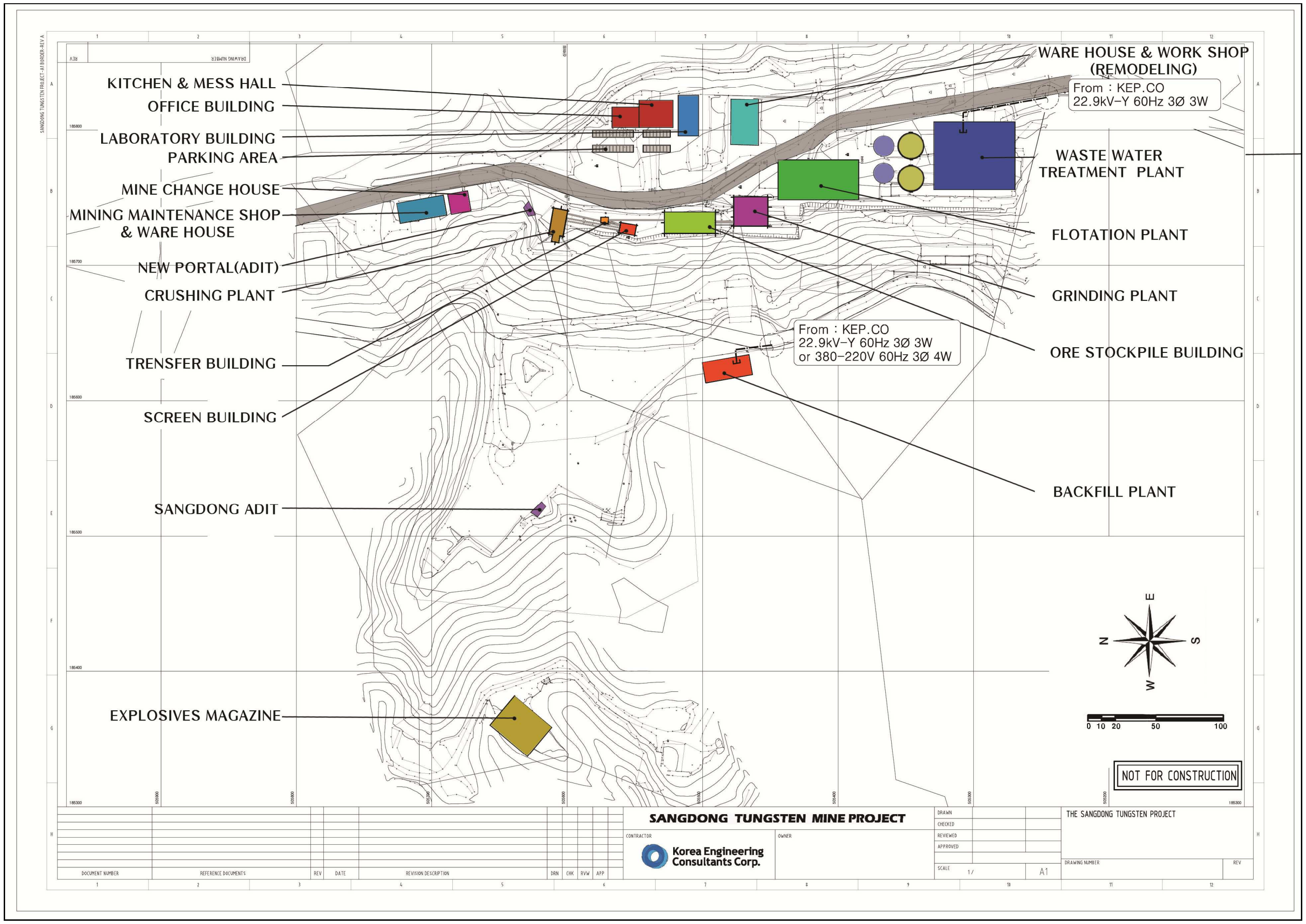
To return to operation, the existing Sangdong infrastructure will be reconfigured and supplemented by new facilities as required.

## 18.2 Mine Surface Infrastructure

To accommodate the new waste disposal facility, the existing buildings at the Sangdong portal level will be demolished to allow for reconfiguration of the space. New site infrastructure will include a new mine/administration building, assay laboratory, warehouse, maintenance shop, laboratory and recreational facilities for employees, fuel storage, process water supply and water and sewage treatment facilities.

Surface facilities will generally be located outside of the -1 Portal in the footprint of old KTMC installations, as shown in Figure 18-1. Exceptions will be the backfilling plant (on the Sangdong Terrace) and surface explosives magazine, that will be located at Baegun portal level, in order to meet the Korean distance requirements to the remaining areas.

**Figure 18-1. General Arrangement of Surface Installations**



### 18.2.1 Explosives and Detonators Magazines

Due to the consumption of explosives and to the eventuality of explosive interruption due to traffic constrains, or interruptions due to meteorological reasons, the project shall have surface explosive and detonators magazines with capacity to supply production during 4 working days. The explosives and detonators storage area for the mine would be located at surface at Baegum Level and constructed in accordance with Korean regulations.

### 18.2.2 Surface Offices

A new surface mine/administration office complex will be integrated into the new industrial complex. This will comprise:

- Mine department management offices
- Laboratory
- Shift foreman offices
- Crew lineup area including 1 meeting room
- Change house for mining, processing and surface services employees
- Engineering and geology offices and bullpen
- Processing plant department offices
- Mine general management offices
- Administration staff offices
- 1 conference room
- Communications / IT room
- First aid room
- Reception area
- Kitchen area
- Washrooms

There will be 6 mine offices and a crew lineup area comprising 6 wickets for informing miners of their daily lineup. The engineering and geology departments will require 6 offices and an area divided into 6 to 8 workstations. The administration personnel will require 10 offices, including a couple of spare offices for visitors/consultants to use. The offices will be located mainly on the outside walls of the office complex and look into the open areas for engineering, geology and other personnel located at workstations.

### 18.2.3 Maintenance Shop/Warehouse

The surface maintenance shop will be constructed, in a new regular building, next to the old APT plant. The building will be a steel framed or brick structure clad with roof and wall sheeting.

The main shop area will be 20 metres long and 15 metres wide, with offices and storage areas inside. This facility will perform major and preventative maintenance servicing on all, surface mobile and small equipment (such as pumps, etc.). It will also be available, for necessary maintenance of underground mobile trackless equipment. The shop will be divided into sections for mobile equipment maintenance, and the electrical and instrumentation group.

The maintenance shop will be equipped with an overhead bridge crane. Shielded bays will allow welding to be carried out without affecting activities in the main shop area. Offices for the maintenance staff will be located off of the main shop area and include a conference room, lunchroom, washrooms and small parts storage areas.

Attached to the maintenance shop will be a drill repair shop, along with bit sharpening facilities. Additional facilities will include a small electrical shop, as well as a self-contained area for mine rescue facilities.

The warehouse will have attached a fenced yard area for storage of large bulky items that do not require weather protection or secure storage. The building will be a steel framed or brick structure clad with roof and wall sheeting.

The interior of the warehouse building will be equipped with pallet shelving shelves and racking. Separate small stores will be provided for oxygen and acetylene bottle storage, paints, solvents and rubber lining, a cool store and a safe storage area for small tools and valuables. An office area will be provided for purchasing and stores administration functions.

The warehouse for mine items only would be a combination of pallet (large or bulk items) and shelved (smaller items) storage. Valuable items would be placed in a locked storage area.

The warehouse for the mine will be built at the expense of the contractor, who will be doing development and mining works. Small items concerning backfilling and others from AKT will be stored at the main warehouse at the refurbished APT KTMC plant.

### 18.2.4 Assay Laboratory

A purpose-built laboratory (inside the processing plant building will provide analytical, investigational and quality assurance services to the production operation.

### 18.2.5 Other Facilities

All underground mine water would be sent to the water treatment facility and reused or discharged.

A fully equipped mine rescue station will be installed on the property. The mine rescue station will be equipped with all necessary equipment, including self-contained breathing apparatus, flame lamps, gas testing equipment, rescue equipment, etc. and supplies and chemicals required to operate the station. There will be enough emergency equipment to have 3 five person mine rescue teams operating or on standby at any one time.

Sewage will be connected to the local Sangdong sewage treatment distribution system and be treated in the Sangdong waste water treatment facility. Sewerage piping to the town Sangdong Sewage Treatment Plant will be installed parallel to the access road. This will require 2 kilometres of 203 mm HDPE Sewerage heat traced piping.

Garbage disposal will be off-site disposal at the Sangdong landfill facility.

Fire water will be provided by electric and diesel driven fire water pumps from the town water supply.

Staff and visitors to the mine will be housed in village apartments to rent. Employees and contractors (totaling approximately 170 people) will be housed in the local communities. All hourly employees will be provided with a meal in mid shift from the catering facilities. A catering facility providing meals for all employees on the 3 shifts would include refrigerated foods storage. non-perishable food storage, kitchen, food serving, eating, and dish washing areas. Recreational facilities would include common lounging areas with comfortable chairs and couches, large screen TV rooms indoor games such as darts, ping pong, etc. and outdoor facilities for basketball soccer, etc.

## 18.3 Site Access

The mine site has existing road access from the village of Sangdong. The main road that runs up the valley to the site is a public road (National Road No. 31) recently repaved. The Taebaek to Naedeok Road runs adjacent to the Sangdong mine site. This two lane bitumen road can accommodate trucks carrying heavy equipment and road haulage transport trucks. The present route for this road will go through the proposed plant area. An allowance of 1.5 kilometres for site roads connecting surface support facilities has been included in cost estimation. The roads will be built from waste rock, gravel top covered and wide enough to accommodate 2-way transport truck traffic.

## 18.4 Power Supply and Distribution

The project will be powered by one (1) overhead line, which is scheduled to be installed by KEPCO in October 2016, and which will supply 2 main substations installed in the immediate vicinity of the plant. The substations will mainly be composed of step-down transformers of 10MVA (22.9/3.3 kV). One substation will supply power to the mine and non-processing plant facilities while the second will be dedicated to providing power to the processing plant.

### 18.4.1 High Voltage Equipment

Planned High Voltage Equipment for the project is summarised in Table 18-1.

**Table 18-1. High Voltage Equipment**

| Description | Specification | Unit | Quantity |
|---|---|---|---|
| Main Site Substations complete with Step-down Transformers and Switchgear | 4kV | | 2 |
| Standby Generators complete with Interlocking Switch Panel | 2 MVA | | 3 |
| Step-down Transformers (per final design equipment) | 4000/1000/380 | | 4 |
| Step-down Dry Type Skid Mounted Transformers (per final design of underground equipment) | 4000/380/220 | - | 6 |
| ASTM-AAAC or Equivalent Overhead Line Conductor | 100 $mm^2$ | m | 1,800 |
| ASTM-AAAC or Equivalent Overhead Line Conductor | 40 $mm^2$ | m | 7,200 |
| Poles and Associated Hardware for Overhead Line Conductor | 12 m | | 70 |
| XLPE Cable | 250 MCM x 3c (150 mm) 4.16 kV rated | m | 500 |
| XLPE Cable | 2 AWG x 3c (35 mm) 1000/600 V rated | m | 400 |
| XLPE Cable | 250 MCM x 3c (150 mm) 4.16 kV rated | m | 2,000 |

Note: All Cables to be to ICEA S57-381/ NEC Code - Article 400 or equal or equivalent

### 18.4.2 Medium Voltage Network

The Medium Voltage (MV) network will be designed in such a way that each main substation can power the entire load normally fed by the other main-substation in case of outage of the other main-substation. Such as configuration will avoid the installation of an expensive, diesel generator based, emergency power supply.

As much as possible, all the MV switchgear will be installed in the same MV-Substation within the process plant. Dry step-down transformers will be used to feed the LV-Switchgears and MCCs. Inside the mine, transportable skids mounted substations and switchgear will be used. All the Medium voltage cables will be preferably trenched cables.
Figure 18-2 indicates the location of the underground transformers.

### 18.4.3 Low Voltage Network

As much as possible, all the LV-Switchgears and MCCs will be installed in a dedicated LV-Substation within the process plant. The low voltage network will be 440V/220V-60Hz. Given the existing plant and the other components' foot-print, the trenches will be developed for the LV cables routing.

### 18.4.4 Connected Load

The following table shows the connected loads of the Main-Substations, based on a production rate of 80 tonnes of ore/hour:

**Table 18-2. Summary of Connected Load**

| | Load | *kW* |
|---|---|---|
| ***Main-Substation-1*** | Mining | 2,000 |
| | Backfill | 1,000 |
| | ***Total 1*** | ***3 000*** |
| ***Main-Substation-2*** | Process plant | 2,212 |
| | Crushing | 480 |
| | Grinding | 2,172 |
| | Camp | 400 |
| | ***Total 2*** | ***5,264*** |

### 18.4.5 Energy Consumption

The estimate for energy consumption for the project was calculated according to the design criteria associated with the planned plant capacity, as summarised in Table 18-3. The costs were derived from a local electricity cost of 76.56 Won/kW.

**Table 18-3. Energy Consumption Summary**

| Designation | Energy Consumption | Electricity Unit Cost |
|---|---|---|
| | *MWh* | *$US/t ore* |
| ***Plant*** | 26,313.3 | $3.74 |
| ***Mine*** (2000 kW) | 11,226.8 | $2.00 |
| ***Backfill*** (1000 kW) | 5,613.4 | $1.00 |
| ***Camp*** (400 kW) | 2,452.8 | $0.44 |

### 18.4.6 Standby Power

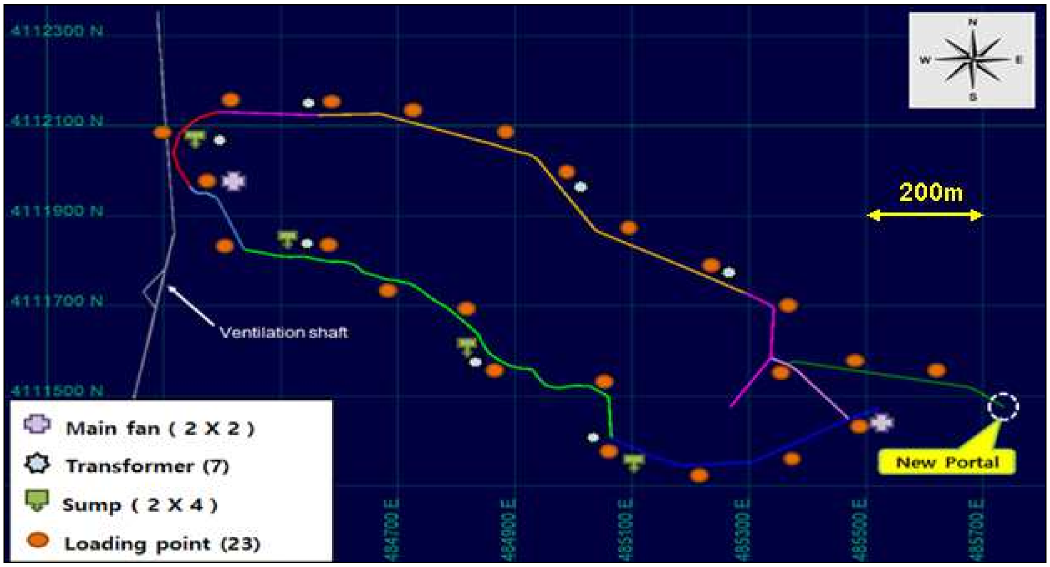
In the event of a power interruption in the KEPCO power supply the plant will shut down. For operational and safety reasons, emergency power will be supplied to essential services, which include the backfill plant agitators, thickener rakes, and underground mine main ventilation fans.

The emergency power supply will be supplied by two, 2 MVA generator sets located near and terminating in the KEPCO HV Substation South. An alternative to the standby power generators, which will be evaluated in the future, will be to analyse a possible switched interconnection between the two 10MVA incomers.

## 18.5 Underground Services and Infrastructure

The majority of underground infrastructure will be located in existing excavations on the Sangdong or -1 levels, as shown in Figure 18-2.

**Figure 18-2. Underground Infrastructures Location**




### 18.5.1 Rock Handling

In all stoping areas, trucks will be loaded with ore directly from the stopes by LHDs. Primary stope entrances have been configured to allow loading of trucks. The trucks will haul ore out of the ore zones directly to surface.

On surface, the underground haul trucks will haul ore to a crusher dump located at the processing plant. The dump will be equipped with a grizzly and rockbreaker, to size underground ore to minus 0.6 metres before crushing. Low grade ore (mineralization which must be mined as part of a stope, but is below the mining cut-off grade, but above the grade where revenue equals processing and general and administration costs) will be trucked on surface to a low grade stockpile for processing at the end of mine life, or when excess milling capacity is available.

Waste rock will be placed in mined out stopes or trucked to a surface waste rock stockpile for sale to construction companies.

### 18.5.2 Electrical Distribution

It is proposed to supply power from the-1 Level substation into the underground mine using a total of 2,000 m of HV cable(s), via the new -1 Level mine portal. The cable(s) will be buried in outdoor areas up to the mine entrance, and then supported on hangers along the mine drifts and ramps. Underground cables and substations fixed in mined "cubbies" will be protected, as required by mining law.

The main sub-station will comprise two 2.5 MVa unit substations, which step the power down from 15kV to 5000 volts. One 5000 V bus will feed the mine exhaust fans and crusher, while the other feeds the underground mine power requirements. Local distribution will be carried out using mine load centres of 1000 kVA capacity, which will step voltage down from 5000V to 1000V/240V, as required for use with pumps, fans or other items.

Lighting panels and welding plugs will be serviced via low-capacity, local transformers and panels, feeding work areas as required. The mine load centres will be completely transportable, allowing them to be re-used in new working areas, rather than being replaced as the work advances

### 18.5.3 Compressed Air

Compressed air will be supplied by individual mobile compressors, placed where necessary for shotcreting, ANFO charging or other necessary purposes.

### 18.5.4 Service Water

Service water consumption for drilling and other purposes (not including backfill water) in the mine is estimated to be 673,000 cubic metres per year. Water will be delivered in 102 mm HDPE pipes in the haulage drifts and 50 mm HDPE pipes in access drifts to stopes.

### 18.5.5 Mine Dewatering

Water flows out of the mine by gravity at the -1 level, via a tunnel/trench excavated from the Main zone old stopes floor elevation. This drain is located near the bottom of the access ramp out to the mountainside, and can be seen in Figure 16-33.

Initially, very little pumping will be required to keep the mining operations dewatered. During development of the ore haulage drifts, some pumping may be required to dewater the advancing faces. Water will be directed to sumps, and drainage holes will be drilled to the level below. All water will be collected on the -1 level.

There is significant water flow in current excavations during the rainy season. Water inflow will be directed to the flooded portion of the mine, while dewatering of the flooded workings is taking place, and then diverted as much as possible when all workings have been dewatered.

It is planned to utilize the existing water within the mine for process water for the underground mine and surface processing plant. The water will be treated where necessary. Mine water will be pumped to the storage areas on the Sangdong level (for the underground stoping water), and to a surface process water pond for the processing plant. All water will need to be pumped out of the mine once working areas progress below the -1 level elevation.

Pumping out of the flooded mine workings water will take place from -1 Level using the Vertical Shaft to the Baegun Level. A submersible pump on a pontoon will be placed in the shaft and water pumped out to the processing plant process water pond. As the pump descends during pumping, the pipeline in the shaft will be extended downwards. A total of approximately 400 metres of pipeline will be required to reach the bottom developed level, -8 Level.

#### 18.5.6 Maintenance Shop

The maintenance shop will be the responsibility of the mine contracting company. Enough space for this purpose will be left in the surface infrastructure arrangement in front of the -1 Level Portal.

It will contain a wash bay and will be built at a 2% slope, with an integrated centre grated trench, to facilitate water flow towards a sump at the back of the wash bay.

#### 18.5.7 Meeting Rooms

After the development phase, the most convenient underground loading points will be adapted into meeting points.

The meeting rooms will be equipped with wooden benches and tables and those informal mine offices will be equipped with 4 workstations connected to the mine information management system.

#### 18.5.8 Fuel Station

Fuel stations will be located on surface near the -1 Level portal. The fuel station on the -1 level will consist of one 50,000 litres tank with an integrated catch basin.

### 18.5.9 Refuge Stations

Refuge stations will be located initially on the Sangdong, and -1 Levels of the mine. As the mine progresses, they will be transferred to the main operating levels. The refuge stations will be constructed in old excavations at suitable areas, or in loading points transformed for that purpose. The refuge stations walls and backs will be supported with 1.8 metre resin rebar installed on a 1.2 metre by 1.2 metre pattern.

The stations will have a door in a concrete wall at one end. A 1% sloped concrete floor (towards the entrance) will be poured in the refuge station to allow gravity drainage of water to a sump outside the refuge station. The refuge station will include a main area for the mine workers, containing wooden benches and tables for the crew, hand washing station and other equipment and supplies. The refuge station will be equipped with safety and rescue equipment such as a fire extinguisher, eyewash station, first aid kit, emergency food and drink rations and stretcher. Compressed air and water lines will be connected from the mines supply system to the inside of the refuge station. The refuge station will also be fitted with an electric heater unit and will be vented through intake and exhaust ventilation ducts to the outside.

### 18.5.10 Underground Explosives Magazines

Explosives and detonators will be stored in underground magazines, constructed in existing excavations on the Sangdong and -1 levels. They will be stored in accordance with Korean regulations. Only holders of South Korean blasting licenses will supervise the transportation and initiation of explosives.

The magazines' ground support will consist of 1.8 metre resin rebars (on a 1.2 metre by 1.2 metre pattern), with welded wire mesh screen. The floor will be graded with a 3% slope using crushed gravel. The magazine entrance will include a concrete wall, with a roll-up door, to allow access for mobile equipment, and a man door for people traffic. Both will remain closed, except when explosives are being placed into or removed from the magazine.

One side of the magazine will be fitted with a low 1.5 metre wide wooden shelf, onto which bulk explosives bags can be placed, holding approximately five 1,000 kg bags. Above this shelf will be a wall mounted 1.5 tonne jib crane, to pick up the bags and move them around. The opposite side of the magazine will have a series of shelves to store stick powder off the ground. Boxes of explosives will be transferred to the shelves and removed by hand.

### 18.5.11 Underground Detonator Magazines

Detonator magazines will also be located on the Sangdong and -1 Levels. The magazine will include a concrete wall with a prefabricated lockable steel access door, providing for the inside length of the magazine to be 4 metres.

The magazine will be equipped with suitable wooden shelving to allow stacking of detonator boxes on each side. Access controls and sign out documentation will be placed inside the magazine. The magazine will also be equipped with ventilation slots to allow some air circulation through the magazine. An explosion proof red light will be installed outside the magazine to indicate its location.

Explosives and detonators will be transported directly to magazines. An explosion proof red light will be installed outside the magazine to indicate its location. The detonator magazines will also be equipped with sufficient auxiliary ventilation to remove any chemical fumes.

### 18.5.12 Mine Communications and Controls System

An 802.11 (WiFi) voice and data transmission network will connect the mine and the surface operations. The system will comprise access points (transmits data to and from clients - computers, tags, PLC's etc.) installed in the mine drifts, which facilitate communication between clients and transfers data to a database server and control system on surface. Wired telephones will be located at key infrastructure locations, such as the refuge stations. Key personnel (such as mobile mechanics, crew leaders and shift supervisors) and mobile equipment operators (such as loader, truck and utility vehicle operators) will be supplied with handheld mobile telephones, suitable for use underground, for contacting over the 802.11 network.

### 18.5.13 Backfill Distribution

The paste backfill plant will be located on surface at the Sangdong elevation. All stopes will be backfilled. Paste fill will be originally delivered to the mining areas through a 102 mm pipeline in the main access drifts on Taebaek level and on Sangdong level. The Sangdong level pipeline will be fed from a pipe installed in the service raise from Taebaek level. The pipeline will consist of 102 mm diameter schedule 80 steel pipes suspended to the back of the main haulage drifts.

## 18.6 Water Supply

### 18.6.1 Potable Water

The Project will require approximately 40,000 $m^3$ per year of potable water which will be supplied from the local town water supply. The site is already connected to the Sangdong town water supply.

### 18.6.2 Process Water

The process water supply will utilize water pumped out of the underground mine as part of the mine dewatering programme below the -1 Level, until this source is depleted. The processing plant requires approximately 2 million cubic metres per year of process water. Of this process water volume approximately 75% will be recycled, requiring 500,000 cubic metres of fresh process water per year for the processing plant. The flooded underground mine has an estimated volume of 6.7 million cubic metres of water which if utilised, would provide processing plant requirements for approximately 13 years. However, a proportion of this volume will serve as a reservoir to allow for seasonal and annual fluctuations. Water inflows to the mine are estimated at 245,000 cubic metres per year. The combination of water in the flooded mine and inflow water meets project process water requirements for the life of mine forecast in this study. Water captured during rainfall events in sedimentation ponds will also be reused.

Clean service water for uses such as gland water for pumps, fire-fighting, cooling circuits, etc. will be supplied from town water and recycled water. The main losses of water will occur from water which is not recycled, dust suppression on site roads and evaporation.

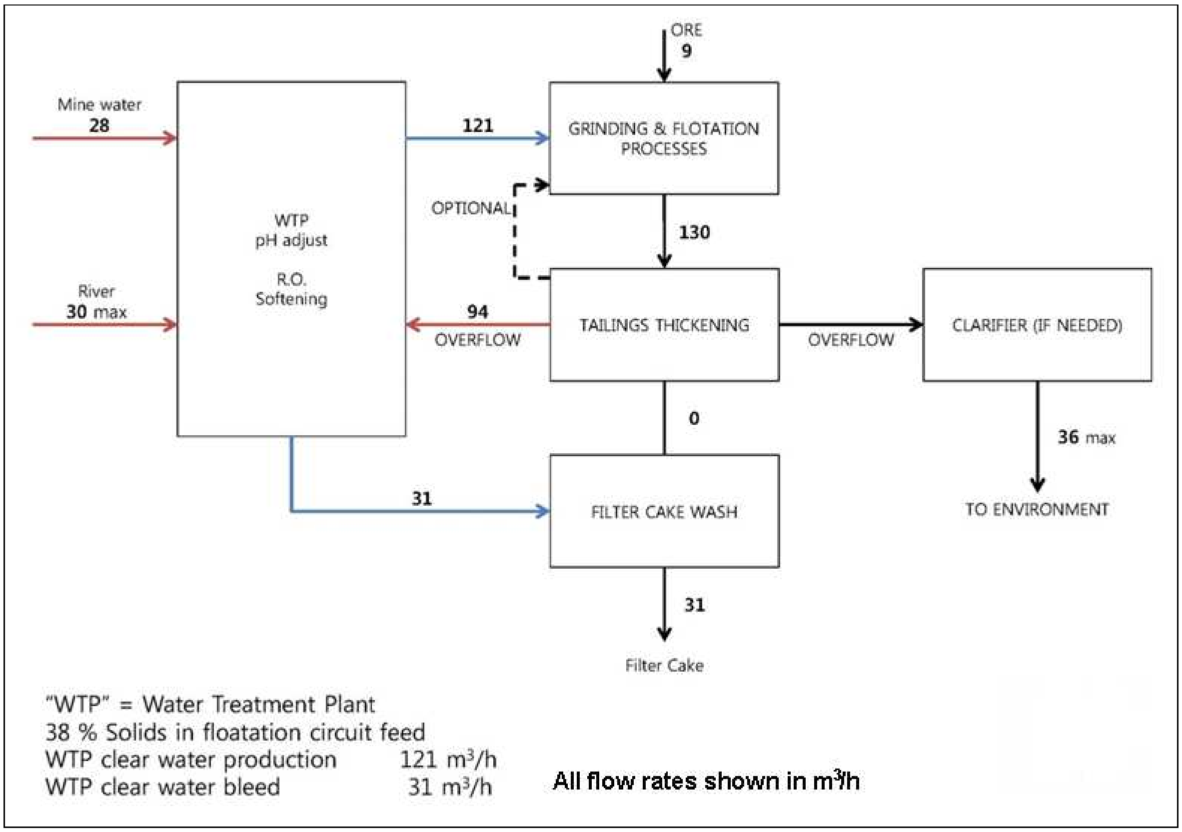
### 18.6.3 Water Treatment

The underground water run-off has been tested and found to be very hard. The mine water was tested to approximately 70 to 80 metres depth and found to contain acceptable levels of arsenic and potentially deleterious constituents. Water hardness has been assumed to continue in mine water at depth, in the flooded mine. The water in deeper flooded areas cannot be easily tested without pumping out the whole mine, but past operations did not have major water treatment issues. This suggests that mine water at depth will not contain major contaminants harmful to the operation or the environment. However, over time, and with seasonal fluctuations in water level within the lower levels of the mine, this will most likely result in a decrease in pH, as the result of in-situ sulphide mineral oxidation.

To ensure the mine water can be used in the processing plant, all water pumped from the mine will be sent to an aeration pond for removal of the calcium and other water hardness components using biological ingredients and aeration. Should the mine water contain other undesirable components, these will be removed at the same treatment site pond or an adjacent facility. The overall conceptual water balance is shown in Figure 18-3.

It is estimated that more than 75% of processing plant water is to be recycled from backfill and tailings placement operations, for reuse in the processing plant. To facilitate this, the water will need re-treating to remove salts and other deleterious chemicals. This will be performed using a reverse osmosis plant.

**Figure 18-3. Overall Conceptual Water Balance**




Water storage at the site will be designed for either waters which are potentially chemically contaminated (e.g. process water) or waters which have a low potential of containing chemical contaminants (e.g. surface runoff).

Water collected on site will comprise runoff water from rainfall and snow, process water from the processing plant and contaminated potable water. The site water collection systems are designed to minimize the contact of runoff water with water used in mining, processing and associated activities. All water, except for diverted runoff water will be treated in a water treatment plant prior to re-use or release to the local environment.

Storm and snow melt runoff water will be diverted around the site where possible and directed to sediment ponds where suspended solids will settle out, before water is released. The sediment ponds and dams will be located downstream of all infrastructure. Each sediment pond will comprise a small embankment with a water decant system to drain water after the water sediment load has achieved acceptable standards. Each sediment pond will also have an overflow spillway to safely pass large storms that exceed the capacity of the reservoir.

Adjacent to the processing plant will be the process water pond which will store return water pumped from the tailings management area, the underground mine dewatering programme, ROM rock storage pad pond(s) and other minor water sumps around the site. This pond will be lined with a single 1.0mm HDPE liner. This pond will also supply firefighting water for the processing plant.

# 19 MARKET STUDIES AND CONTRACTS

Sales of 65% $WO_3$ concentrate would be directly to IMC, of Israel under an existing off-take agreement with IMC, based on Asian Metal China Pricing.

The price levels used in this study represent the current long term expectations of $370 $/MTU $WO_3$.

# 20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL IMPACT

In 2011 Woulfe initiated environmental baseline studies for the project including water sources and quality, climate, flora and fauna, air quality, noise, heritage, land use and water quality.

As well as providing information for the Feasibility Study the studies provided the comprehensive environmental information required in preparing the Environmental Impact Assessment (EIA) Report.

The proposed operations (i.e. preferred alternatives) were selected based on technical and economic viability, as well as minimisation of potential environmental and social impacts.

## 20.1 Environmental Baseline Studies

### 20.1.1 Surface Water

Several permanent streams run thought the site. These streams drain to Okdong Creek, which flows through the town of Sangdong. The water is generally of good quality, based on the analytical results for “Living Environment” items (pH, biochemical oxygen demand, suspended solids, dissolved oxygen). Water quality is classified as first grade at all sampling points except at one site where results for pH and suspended solids exceed the standards.

However, analytical results for total coliforms (an indicator of potential human and animal waste present in water) were high 10-22,000 total coliforms/100ml. In accordance with these results, water quality is classified as fourth grade for the “Living Environment” standards. It is assumed that slash-and-burn-fields around the stream contribute substantially to total coliforms concentrations.

Strategies to prevent degradation of the surface waters of the Project site include:

- sediment settling dams to reduce the volume of sediment, derived from mined and disturbed land, from entering the natural river systems of the area;
- storm water will be diverted around mining operations as much as practicable, and where contact occurs with disturbed areas, water will be collected, monitored, and treated as appropriate;
- all spills of chemicals or fuels will be cleaned up immediately and contaminated areas remediated in accordance with the relevant guidelines and standards;
- any potentially acid forming material will be blended or encapsulated in the waste rock storage facility to prevent possible contamination.

### 20.1.2 Groundwater

Groundwater is expressed as springs where there is contact between the limestone and either skarn or shale. For example, there are three springs, near the old mine buildings where there is a limestone outcrop with a strike of approximately 300° and a dip of 80° north. Elsewhere to the west of the site, springs occur where there is contact between limestone and shale. Flows from the springs are in the order of 2 to 20l/s.

Ground water varied in quality. Total coliforms were above the established quality criteria. Nitrates were also found in concentrations above the Korean drinking water standards. Exhaustive testing for arsenic in water during 2014 was performed and concentrations were found to be well within those for Korean drinking water standards. Elevated nitrate concentrations are likely to be a result of the application of nitrogenous fertilisers both for forestry and agriculture, while the heavily mineralised region around Sangdong will lead to elevated concentrations of arsenic in ground waters.

Potential groundwater quality impacts from Project activities may include contamination of groundwater by process water spillage and chemical spills on site. Based upon a review of the water quality of the existing tailings dams, leachate from tails is expected to be of good quality. It should be noted that Sangdong does not own or have any liability for the old tailings dams.

Mitigation strategies to minimise impacts on groundwater include:

- monitoring of groundwater levels and quality at springs/established bores around infrastructure areas and the waste rock storage facility to determine background water quality and any change in quality that may be due to the Project operations;
- clean-up of any process water or chemical spills immediately;
- all areas will be bunded to prevent any spills within the plant.

### 20.1.3 Flora and Fauna

Two flora and fauna surveys were completed in the spring and summer of 2007. One hundred and eighty three species of fauna were identified. No endangered or endemic species were found.

A total of 73 families, 165 genus, 183 species, 30 varieties, and 3 forma were identified from the site investigation in the project area and surrounding area. No endangered species and endemic species designated by Ministry of Environment (MOE) or protection species were found.

Eleven mammal species were identified including mice, rats, and wild cats. A total of 5 orders, 10 families, and 11 species of mammals were confirmed through direct field investigation and the survey questionnaire. Footprints and excrement of elk were found in several spots in the investigation area. The presence of elk in the project area was also confirmed through the survey questionnaire.

The Serbian weasel and the racoon dog in addition to two species of deer were identified. Feral goats, mice and cats were also present. Wild boar, the Serbian chipmunk and the red squirrel were found across the site and surrounds.

No mammals of conservation significance or precious natural treasure as designated by the Ministry of Environment were observed on the Project Site during the survey periods. A combined total of 41 bird species and 218 individuals were recorded on the Project Site during the two surveys. The most frequently observed species of birds identified on site were the Vinous-throated Parrot Bill, a small granivorous (seed eating) bird which occurs from northern Vietnam to southern Manchuria, and occupies a wide range of habitats across its range. The Spot-billed Duck (Anas poecilorhyncha) was recorded in large numbers. Large numbers of magpies and egrets were also sighted across the site.

Three birds of conservation significance were recorded across the site. They were the Kestrel, Chinese Sparrow Hawk and the Common Buzzard. These species have become vulnerable as a result of habitat disturbance from changes in land use. As the footprint of the proposed development requires very little additional clearing or habitat disturbance it is not expected that the development will have any impacts on these regional species.

A total of 5 families, 6 genus and 11 species of amphibians were found. Bombina orientalis (toad) was the most frequently observed species. No amphibians of conservation significance or precious natural treasure as designated by the Ministry of Environment were observed on the Project Site during the survey periods.

A total of 4 families, 6 genus, and 10 species of reptiles were recorded. Eight species were confirmed from site investigation and two species were confirmed by use of a questionnaire survey. No reptiles of conservation significance and precious natural treasures as designated by the Ministry of Environment were observed on the Project Site during the surveys.

A total of 301 fish of 11 different species were collected during the first round of sampling. In the second round of sampling, 279 fish of 9 different species were collected. Nine species of fish were caught at a one site and 11 species were caught at the second site, none are protected. One hundred and forty two insect species were found, with one dead insect classified as an endangered species.

Based on this review, the flora and fauna are common in Korea. There were two natural monument and two endangered species found; however it is considered that mining impacts would not be significant on these species because of the underground nature of the mine and small surface disturbance.

A number of levels of conservation zones are designated in South Korea. A review of these conservation zones showed that these areas are a substantial distance from the mining tenure areas and will be not be impacted by the mining activities.

The land affected by the Project is not likely to become part of a protected area estate or subject to any treaty. In making this statement, consideration has been given to national parks, conservation parks, fish habitat areas, wilderness areas, aquatic reserves, national estates, world heritage listings and sites covered by international treaties or agreements (e.g. RAMSAR, KAMBA), and scientific reserves.

The Ecological Nature Maps for Korea were developed by the Ministry of Environment. Grade one areas are set aside for conservation and restoration of the natural environment whilst Grade two basically restricts development with small scale development approved for exceptional cases.

The different Grades are:

| | |
|---|---|
| **1st grade** | Development is not permitted as a prior conservation area. |
| **2nd grade** | Basically restricts development, small scale development approved for exceptional case. |
| **3rd grade** | Conditional approval through the environmental review process. |
| **4th grade** | Environmental friendly development based on the demands for development. |
| **5th grade** | Planned usage with full consideration for environment. |

These areas have been identified to the west of the mine site (Figure 20.1). The mine will have no impact on these or any other conservation areas.

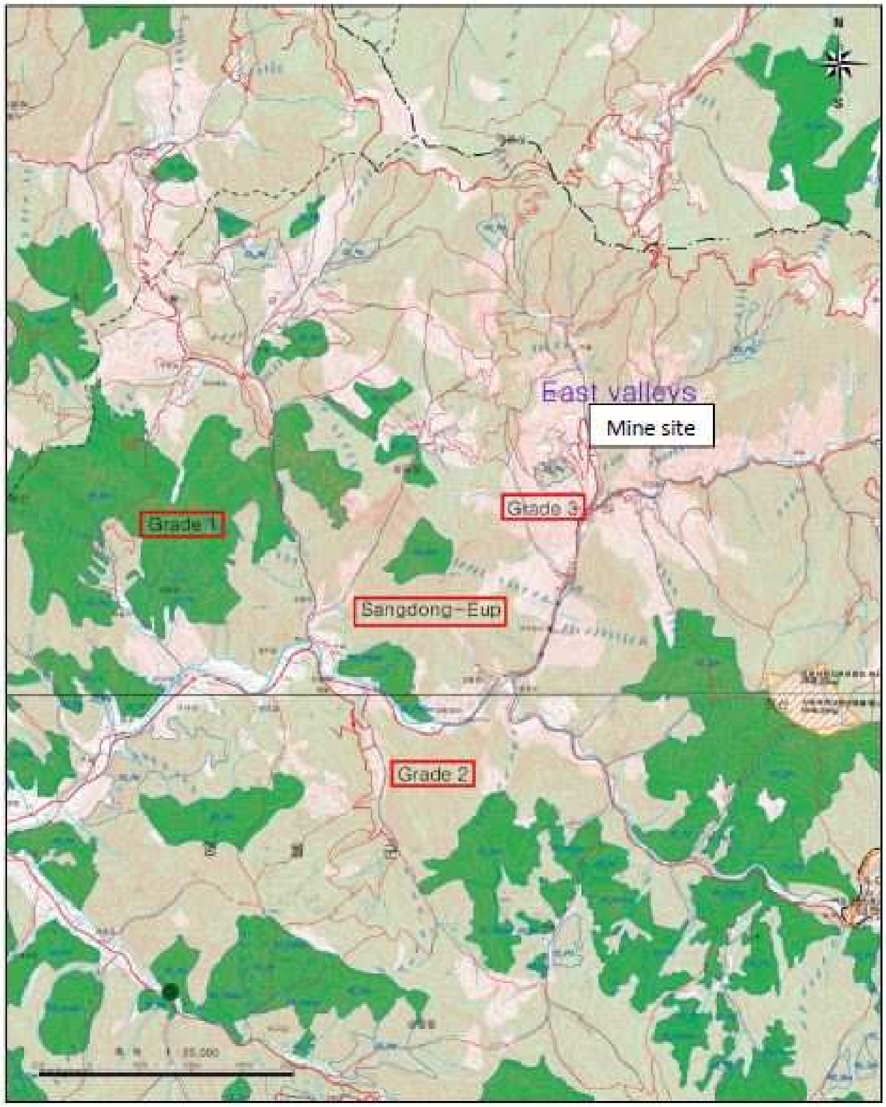



**Figure 20.1; Ecological Nature Map of the Area West of Sangdong Mine**

A number of levels of conservation zones are designated in South Korea. A review of these conservation zones showed that these areas were a substantial distance from the mining tenure areas and will not be impacted by the mining activities.

The nearest designated wildlife protection zone is located on Hwaam-Riin Dongmyun, Jeonseon-Gun,Kangwon-Dow which is more than 15kms from the project site. No impacts on these sites from the project are expected.

There are 30 designated ecosystem conservation areas in Korea. Among these are ten sites designated by the Ministry of Environment (MOE) and four sites designated by the Ministry of Marine Affairs and Fisheries. The remaining sixteen sites are designated by provincial and county entities. Keumdaebong in Daeduck Mountain, is designated as a rare wildlife habitat, and is located approximately 8 km from the project area. No impacts on these sites from the project are expected.

There is no protection zone for ecology and scenery in the project area.

There are no wetland protection areas in the vicinity of the Project.

Natural parks are classified either as national, provincial, or county natural parks. As of 2007 there were 20 national, 23 provincial, and 33 county natural parks in Korea. Taebaek Provincial Park is situated 8km from the Project site. No impacts on these sites are expected from the Project.

In summary, there are no areas requiring special protection or significant natural environmental resources or wildlife habitats in the area surrounding the Project site.

## 20.2 Air Quality

The area surrounding the proposed mine is predominantly forestry and agricultural land. The main sources of ambient dust in the region are likely to be due to grass seeds, pollens and wind erosion of exposed soil surfaces particular during tree harvesting.

Modelling of dust from the site originating from the waste rock storage facility, processing, and truck movements showed that dust increases were minimal in the community and will meet Korean air quality standards.

Air quality issues associated with this Project include:

- dust emissions associated with clearing vegetation, extracting and transporting small quantities of waste rock and ore, blasting and stockpiles;
- dust emissions associated with the transport of ore via conveyor and stockpiling;
- dust emissions associated with the crushing and milling processes at the ore processing plant;
- windblown dust from erosion of disturbed and cleared areas on the Project site.

Mitigation strategies to minimise impacts of air emissions include:

- truck watering operations;
- minimisation of vegetation disturbance;
- covers over conveyors and dust control as required.

## 20.3 Noise

Several households at Sangdong are considered to be sensitive receptors that may be impacted upon by mine operations. Households located adjacent to the road network had noise readings 12 to 15dBa higher than rural areas during the day and 6dBa higher at night.

Noise modelling of truck movements and the milling and processing activities showed a small increase in noise at the nearest community receptors, while still meeting Korean noise standards. The mountainous terrain surrounding the mine acts as a significant barrier to noise propagation, assisting in noise reduction from the site.

The following mitigation strategies will be adopted by the Project to minimise noise from operations:

- purchase mining equipment which favours noise reduction in the design;
- mine vehicles to be maintained in good condition to prevent unnecessary noise;
- maintain diesel generators, lights, and other equipment in proper working order to prevent unnecessary noise being emitted.

The following mitigation strategies will be adopted to minimise impacts from blasting on the Project:

- blasting will be underground;
- a blasting strategy will be maintained to meet vibration regulatory requirements.

## 20.4 Waste

The major sources of waste generation from the Project are:

- waste rock;
- tailings;
- process/storm water;
- solid and liquid wastes (e.g. waste oil, tyres, batteries and plastics).

A waste management plan will be developed prior to the commencement of mining. The waste management strategy of the Project will follow a four tiered waste management strategy according to practicalities and available markets, in preferential order:

- waste minimisation;
- waste reuse and/or recycling;
- waste treatments, and
- waste disposal.

## 20.5 Waste Rock

Waste rock material will be stacked in a single waste rock stockpile at the site. Over a eight-year period, 750,000 t of waste rock will be produced, the majority of which will be accumulated in the early phase of mining. There may be the opportunity to backfill waste in the historic underground workings and it is expected that some may be used locally as a building material. The remaining waste rock will be stored on-site in a single waste rock storage facility at Sangdong Portal.

Some waste material from internal dilution control with UV lamp can be stored inside the mine in neighbouring active stopes and mixed with backfill. The pre-production amount of waste will be approximately 500,000 t, that will be stored in a secondary valley, shown in according to Figure 20-1. This zone has a reduced thickness of topsoil and will require the transportation of topsoil from other zones in the final restoration of this area. The final waste dump planned at Sangdong Terrace is shown diagrammatically in Figure 20-2.

Sixty-eight waste rock samples were collected to determine the potential for acid rock drainage. The samples were sourced from core samples across the ore body and are representative of all profiles of all geological units encountered in the deposit.

Acid-base and net acid generation testing indicated that 61 samples were classified as non-acid forming and 7 of the samples were potentially acid forming.

The results of the waste rock assessment indicate the proportion of material which will be potentially acid forming is relatively small at approximately 10% of the total waste volume.

Historically, there has been no acid rock drainage from the existing well vegetated waste rock storage facility on site, or from the existing tailings dams. This trend is expected to continue. However, during operations continuing assessment of all waste rock will be conducted to confirm if any potentially acid forming material is present and if required, this material will be encapsulated to reduce the likelihood of acid rock drainage.

**Figure 20-1. Waste Dump Planned for Pre-Production Development Waste**

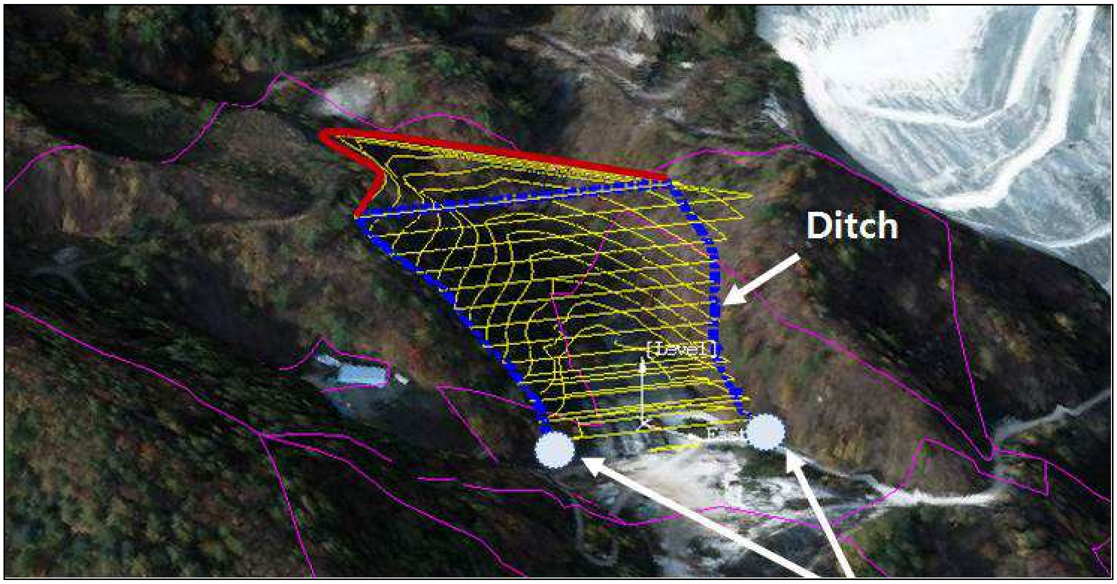



**Figure 20-2. Final Waste Dump**

## 20.6 Cultural Resources

A cultural property survey was conducted during July 2007 by ERM.

According to previous investigations undertaken for a cultural property survey, no state designated cultural properties exist in Sangdong-eup area.

Five historical sites were reviewed according to the Cultural Asset Map Book. Of these sites, two were natural caves, one is a historical temple ruin, one is a significant fossil discovery, and one is a Monument of Loyalty and Filial Piety. All are described below:

- Geukgol Cave – shut to public a few years earlier and not accessible;
- Beophwasa Temple Site – now used as a cabbage patch, remains have been excavated here including some pottery;
- Bat Cave – close to the mining site, no products come from this cave and it was inaccessible due to overgrowth and high water levels. It is said bats are found in the cave;
- Palaeozoic Cephalopod – fossil found 35km from the mine site;
- Monument of Loyalty and Filial Piety – 5 km southwest of the mine site.

## 20.7 Environmental Management and Monitoring

Project operations will be in accordance with an International Organization for Standardisation (ISO) 14001 compliant environmental management system.

Environmental monitoring of various aspects of the Project including rehabilitation success, surface water quality, groundwater quality, dust deposition, and noise will occur in accordance with the Korean Environmental Authority requirements. Requirements and plans for waste and tailings disposal, site monitoring, and water management both during operations and post mine closure will also be specified and implemented.

Environmental management plans will be developed to address the environmental requirements for monitoring the management of wastes both during operations and post mine closure including:

- solid waste from the site; and
- potential acid rock material and storage in the waste rock storage facility and tailings disposal underground with particular emphasis on leachate water quality monitoring and management.

Water quality monitoring will be undertaken to meet relevant statutory guidelines for ecological and drinking water quality. Water quality monitoring will include:

- surface water quality at established baseline sites upstream and downstream of the mine site;
- ground water quality and depth at established baseline sites upstream and downstream of the mine site; and
- surface water flows at selected springs adjacent to the mine site at established baseline sites.

Monitoring of noise and dust will be undertaken at baseline sites within the community on a regular basis.

## 20.8 Social Environment

The town of Sangdong is located 2km from the mine site. The population of the town is approximately 500 people. Sangdong was once a regional centre for the district's agricultural and mining industries, when the mine was operable, with mining supporting 40,000 inhabitants (thereby acquiring the title Sangdong-eup).

Sangdong has a hospital, schools, supermarkets, shops, service stations, road and transport links. It is planned to house the 95 AKT full time employees in the town and the surrounding region, except for staff who will live in a camp on site.

A community consultation programme was undertaken and included discussions with landholders, government departments, and other stakeholders. There is overwhelming favourable support for the mine from the community.

## 20.9 Economic Environment

The economic flow-on benefits to Sangdong and the towns and cities of the county include increases in the following service industries:

- fuel supply and transport;
- supply and transport services for mining supplies, reagents, and machinery;
- light vehicle servicing;
- bus and air services;
- training and personnel management services;
- plant maintenance and fabrication services;
- hospitality, accommodation, and domestic supplies.

The Project is expected to directly employ up to a maximum of 400 people during the construction phase, reducing to approximately 200 people during operations.

The flow-on benefits in terms of employment vary between three to four people for each permanent employee, so the direct employment benefits are in the order of another 800 - 1,000 people.

The mine concentrate product will be transported by road to the APT plant located some distance from the mine.

The local county and Sangdong regions have predominantly elderly populations, which in general are declining. The re-opening of the mine will provide a number of employment opportunities for both unskilled and skilled trades, with resulting economic benefits locally, regionally and nationally.

## 20.10 Relevant Legislation and Policy Requirements

Legislation identified as affecting the Sangdong project is summarised below:

### 20.10.1 Clean Air Conservation Act No.8976, March 21,2008

The purpose of the Act is to prevent air pollution which causes harm to people and the environment and manage and preserve the atmospheric environment in a proper and sustainable manner, thereby enabling all people to live in a healthy and comfortable environment. The dust emissions from the mine operations comply with guidelines established under this Act for a rural area and will not have any significant detrimental effects on surrounding air quality.

### 20.10.2 Water Quality and Ecosystem Conservation Act, No. 8976, March 21, 2008

The purpose of the Act is to prevent people's health and environment from being exposed to harm and danger caused by water pollution and to properly manage and preserve water quality and aquatic ecosystems of the public waters, including rivers, lakes and marshes, etc. in order to enable people to enjoy benefits accruing from measures, and hand down such benefits to future generations. The mine project is consistent with this purpose in that there will be no waste water discharged to the natural environment, best practice storm water management techniques will be used and water recycling will take where possible.

### 20.10.3 Noise and Vibration Control Act No. 8976, Mar. 21, 2008

The purpose of the Act is to enable all citizens to live in a calm and tranquil environment by preventing any damage due to noises and vibrations generated in factories, construction work fields, roads, railroads, etc. and by controlling and regulating such noises and vibrations properly. Analysis of the noise impacts of the mine operation on the rural community has shown it will comply with the guidelines developed under the Act.

### 20.10.4 Wastes Control Act No. 8789, December 21, 2007

The purpose of the Act is to contribute to environmental conservation and the enhancement of the quality of life for the people by minimising the production of wastes and proper disposal of wastes generated. It does so by establishing a preferred waste management hierarchy and various principles as the basis for waste management. The waste control hierarchy moves from the most preferred – waste avoidance, to re-use, recycling and energy receiver, through to waste disposal, the least preferred. The mine generates a significant waste tailings stream which is to be disposed of in underground voids. All other wastes are generally of much smaller nature and will be recycled where possible.

### 20.10.5 Soil Environment Conservation Act No. 8469, May 17, 2007

The purpose of this Act is to enable all citizens of the nation to live in a healthy and comfortable environment, by preventing potential hazards or injury to public health and environment due to soil contamination and by conserving the soil ecosystem by properly maintaining and preserving soil, including purifying contaminated soil, etc. The mine will capture all contaminated material and restore as per the Act. Rehabilitation as part of the mine closure plan will also focus on restoring any contaminated land.

### 20.10.6 Natural Environment Conservation Act, No.9037, March 28,2008

The purpose of the Act is to seek sustainable utilisation of the natural environment and to allow people to lead a leisurely and healthy life in a comfortable natural environment by systematically conserving and managing the natural environment, such as protection of the natural environment from artificial damage, conservation of the ecosystem, natural scenery, etc. The mine plan has recognised these values and will be managed to meet the purpose of the Act.

Other relevant acts are:

- Act on the Promotion of Saving and Recycling of Resources, Act No. 8957, March 21, 2008;

- Act on Special Measures for the Control of Environmental Offences Act No. 9313, Dec. 31, 2008;
- Framework Act on Environmental Policy, Act No. 9037,March 28,2008;
- Management of Drinking Water Act No. 8952, March 21, 2008;
- Natural Environment Conservation Act No. 9037, March 28, 2008.

## 20.11 Project Permitting Requirements and Status of Permit Applications

A number of permits have been granted. These include approvals for:

- Exclusive use of a mountain area (Temporary use of forest land) for an application of a mining plan has been extended on Dec. 18 2013 for another 2 years (Jan. 1 2014 to Dec. 31-2015). *Note: Yeongwol County Land lease has been extended for 3 years (Jan. 1 2016 to Dec. 31 2018). AKTC is preparing for the temporary use of forest land for an application of a mining plan and the period will be extended for another 3 years. (Jan. 1 2016 to Dec. 31 2018).*

- The term of SMC's mining plan is related to the Temporary use period of a mountain area. SMC has been extended the Temporary use of a mountain area to Dec. 31 2015 and will keep extending the term of the Temporary use of a mountain area as required.

- Approval for construction of an installation for a mining facility, to build the Sangdong adit, on July 09 2011, by the Eastern Mining Safety Office.

- Approval for construction of an installation for a mining facility, to build the Woulfe adit, on Nov. 13 2012, by the Eastern Mining Safety Office.

- Approval for construction of and installation for a mining facility, to build Taebaek and Baegun adits, on Sep. 29 2014, by the Eastern Mining Safety Office.

The following permits/approvals will be required for construction:

- long term land lease or land purchase
- approval of the building construction of the processing plant
- approval of the measures to protect the national heritage in the manufacturing site
- approval of construction of a manufacturing facility.
- approval of the development activities
- approval of an temporary use of a mountain area
- approval of riverside road occupancy

- preliminary research on the impact of potential disaster
- deliberation by urban planning committee
- approval/report of discharging facilities installation (air, water, noise)
- prior report on specified construction works

When these approvals have been granted, additional information will also be sought on environmental controls during construction.

## 20.12 Sangdong Community Relations

The relationship between Almonty Korea and the Sangdong community is excellent. AKT have been an active member of the Sangdong community since 2009. The workforce at the mine is approximately 15 people. Because of these strong local connections, public consultation has been undertaken both informally and formally, particularly with the local Sangdong Township and Yeongwol County. Again because many members of the workforce are locally based, there is a high degree of awareness and anticipation of the project coming to fruition.

The site manager has excellent contacts within the Sangdong community and site visits are encouraged for local people. There is widespread support for the project to date with no major environmental issues being raised by the public or government department. There has been good local consultation with government staff related to day to day issues with the exploration programme at the AKT tungsten project. When the integration of the project into the Almonty group was completed, it was warmly welcomed by the display of over 30 different banners (Figure 20-3) from the representative community associations in Sangdong supporting the proposed mine development. The relationship with the surrounding land holders is good.

Discussions between AKT and the Town are extremely positive, particularly in view of the fact, that the operation will be community based and the mine can help support and improve local services. This strategy by AKT allows the Town and Yeongwol County to develop longer term planning strategies for the town with an emphasis on affordable housing, increased employment opportunities and appropriate support services.

AKT intends to hold further public information days in Sangdong during the development of the mine plan. This is to assist local people further with their understanding of the project. There have been numerous activities held with the community of Sangdong and to foster long-term relationships, a memorandum of understanding has been signed with the local high school to provide employment opportunities for graduating students.

**Figure 20-3. Example of Banner from Local Community**


## 20.13 Closure Plan

The following rehabilitation procedures will be implemented for each disturbance area.

### 20.13.1 Contouring

The preparation of disturbed areas prior to the establishment of vegetation will involve surface contouring to minimise erosion and maximise beneficial land use.

### 20.13.2 Ripping

Following surface contouring, ripping of the surface is required. The design criteria for ripping operations are detailed in Table 20-1. The spacing between rip lines which acts to reduce soil erosion and increase plant establishment rates, is determined by the slope of the land. Where soils are particularly compacted, a more suitable ripping depth of 300mm would be employed.

**Table 20-1 Design of Ripping Operations for Post-disturbance Surface Preparation**

| Slope | Ripping Depth* | Rip Line Spacing |
|---|---|---|
| **>10%** | 200mm | <1.5m |
| **5-10%** | 200mm | <2.5m |
| **<5%** | 200mm | <5.0m |

**Soils which are severely compacted are to be ripped to a depth of 300mm.*

### 20.13.3 Topsoil Management

All clearing will be conducted in accordance with AKT's Permit to Clear procedure. Construction activities will be limited to designated construction areas unless approved by AKT's General Manager. The total area to be cleared will be restricted to the minimal area required. Prior to clearing, the boundary of the area authorised to be cleared will be identified and clearly marked to ensure construction vehicles do not impact on adjacent undisturbed areas. Prior to clearing, a clearing pattern will be determined that will allow fauna adequate opportunity for dispersal into adjacent habitats.

Cleared vegetation will be pushed into a series of windrows within the disturbed areas and generally chipped for reuse. Vegetation identified as potentially valuable habitat e.g. hollow logs may be stockpiled for use in erosion and sediment control works or on site rehabilitation.

Topsoil clearing up to 300mm (terrain allowing) is encouraged. The top 50-100mm of soil contains the seed bank and is generally higher in organic matter, microbial activity and nutrient content. The subsoil located below the topsoil is a source of bulk growth material; whilst not as biologically active as topsoil, combined with seeding it is suitable as a topsoil alternative.

The topsoil stockpiles will be no higher than 1.5 - 2m; clearly signposted in the field identified on a site plan. These soils low in organic matter, <1.5%, when stockpiled will need to be managed so that the loss of organic carbon is minimised.

### 20.13.4 Topsoil Spreading

Spreading of topsoil will be to an average depth of 0.2 – 0.3m. Erosion control measures will be implemented where required.

### 20.13.5 Re-vegetation Procedures

After appropriate surface preparation has occurred as outlined above, disturbed land will be revegetated as follows:

- Prepare area with fertilisers and other ameliorates, if required, based upon soil testing;
- Re-vegetation undertaken using a combination of direct and hand seeding;
- Species to be used in the re-vegetation program will be a mixture of endemic woody, herbaceous and grassy species in a ratio that reflects the existing natural species density;

- A weed management plan created to identify local weed species and control methods for implementation until wanted species re-vegetation is well established.

### 20.13.6 Rehabilitation Management of Individual Disturbance Areas

The final landform design and method of rehabilitation for each type of disturbance associated with the Project is described below.

#### *20.13.6.1 Waste Rock Dump*

The waste rock dump will be rehabilitated by leaving a berm of at least 10m between each lift once the dump faces have been dozed down to act as a water control structure preventing erosion of the lower waste dump face. Waste rock dumps will be progressively rehabilitated throughout the life of mine, as areas become available. The berm between the two lifts of the dump will be graded to slope back towards the dump to act as a water control structure for any storm water flowing off the lift above. The top of the waste rock dump will be graded towards the centre and a drain or bund installed back from the edge to prevent any overtopping of water from the top of the dump over the face of the dump. The slopes and top of the waste rock dumps will be covered with topsoil where possible and deep ripped. Native local grass and tree species, and an appropriate fertiliser if required, will be directly seeded on to the topsoil cover of the dump.

#### *20.13.6.2 Water Dams and Sediment Ponds*

Dams and sediment ponds across the site may be left for future use by the landholder.

#### *20.13.6.3 Buildings and Infrastructure*

The rehabilitation of building and infrastructure across the site will involve:

- Landholder discussions with regard to leaving structures to be left on-site including liability issues;
- Removal of buildings and building materials from site and disposal of waste materials in an appropriate licensed landfill; and
- Ripping, covering with topsoil, contouring and re-vegetation of these disturbed areas.

#### *20.13.6.4 Roads*

Roads will only remain at the request of the community. After decommissioning the haul roads will be deep-ripped to 0.3m, overlaid with topsoil, if available then seeded.

#### *20.13.6.5 Waste Storage Areas*

All recyclable/reusable materials (machinery, scrap metal, used drums, etc.) will be removed from the site by the recycling contractors or removed to the local landfill. The landfill areas on site will be covered, contoured and revegetated.

#### *20.13.6.6 Exploration Areas*

Dependent on site condition and surrounding landscape, it may be necessary to conduct earthworks to stabilise and reshape the site. The site should be rehabilitated to as near original condition after completion of drilling operations. Ground which has become compacted by the use of heavy machinery and traffic should be ripped along contour to loosen soil to aid revegetation and minimise erosion. As much as is possible of the earth and overburden that was excavated from the pads and benches should be pushed, raked or pulled back over. The stockpiled topsoil and vegetation should be re-spread over the site.

All sample bags and waste materials will be removed from site and disposed of in an appropriate manner.

The drill cuttings should be dispersed around the site or returned to the drill hole or sump.

Drill sumps should be backfilled with the excavated material and covered with stored topsoil. Tracks constructed to access the drill site should be rehabilitated as per haul roads.

### 20.13.7 Rehabilitation Schedule

All areas disturbed on the Project site will be subject to rehabilitation works that will, at the completion of the project, result in a stable vegetated landscape, supporting the preferred land use where possible and having minimal impact on the surrounding environment. Rehabilitation of the project site will be on a progressive basis as disturbed areas become available. Exploration areas will be rehabilitated on an ongoing basis if not part of the main mine activity.

### 20.13.8 Monitoring of Rehabilitation

#### *20.13.8.1 Monitoring Standards*

Monitoring for performance of rehabilitation of land resources and attainment of post-mining land suitability targets includes monitoring of the following:

- Compatibility with agreed post mining land use e.g. monitoring of trends of vegetation structure, richness and cover;
- Low risk to biota e.g. surface water quality meets water quality standards or appropriate mitigation in place to minimise risk;
- Contaminated areas to be removed or remediated;
- Revegetation monitoring will be conducted annually after commencement of rehabilitation. Should monitoring reveal that successful rehabilitation is not being achieved then maintenance will be performed to promote acceptable cover or to repair failed areas. If rehabilitation targets have been met for an agreed number of consecutive years, rehabilitation will be considered successful.

*20.13.8.2 Monitoring Procedures*

Monitoring of rehabilitation will be conducted in the following manner:

- A stable landform will be characterised by the lack erosion and presence of vegetation cover to be measured by visual interpretation and ground data;
- Monitoring of vegetation structure, richness and cover *via* aerial photographic data and fieldwork; and
- Existing drainage supports the post mining land use.

#### 20.13.9 Final Rehabilitation Report

Prior to the surrender of the mining leases, a Final Rehabilitation Report will be compiled which involves a site investigation, risk assessment and a site management plan, as well as details regarding the rehabilitation status of all disturbed areas.

## 20.14 Requirements to Post Reclamation Bonds

Should forestry land be used, which is currently not the case, the use of forest land for the Project, would require the lodgement of surety bonds for asset retirement liability.

## 20.15 Remediation and Reclamation Requirements and Costs

The following rehabilitation principles will support mine closure at Sangdong. These include:

- the preparation of a decommissioning and rehabilitation plan within 12 months following the commencement of operations, with 3 yearly reviews;
- progressively rehabilitating the site as much as practicable in accordance with operational plans;
- preventing the introduction of noxious weeds and pests;

- reshaping disturbed land so that it is stable, adequately drained, and suitable for the desired long-term land use;
- minimising the long-term visual impacts where feasible and appropriate by creating landforms that are compatible with the surrounding landscape;
- minimising the potential for erosion by wind and water;
- re-vegetating the area with plant species consistent with the approved post operational land use;
- meeting all statutory, state, and county requirements;
- making the area safe by removal of all plant, machinery, structures, facilities and equipment from the site unless agreed otherwise with key stakeholders;
- environmentally sound waste disposal at the site including any radioactive material;
- monitoring and managing rehabilitated areas until the vegetation is self- sustaining and meets the requirements of the landowner or land manager, or until their management can be integrated into the management of the surrounding area.

A consultation and communication strategy will include:

- providing copies of a closure and rehabilitation plan to, and discussing it with key stakeholders;
- maintaining a line of communication with the key stakeholders by providing annual updates of Almonty Korea's environmental and business plans, including rehabilitation plans and progress through the company website and annual reports;
- providing opportunities to comment on and provide input to the decommissioning and rehabilitation plan to be provided to relevant parties at least 12 months prior to closure of the operation.

The mine closure plan will focus on the following major environmental aspects:

- AMD minimisation
- portal and underground mine disestablishment
- groundwater contamination
- surface water management
- surface subsidence expression
- long term management and stability of the tailings dam
- effective environmental management or removal of all facilities
- recycling or reuse of usable assets
- identification and remediation of contaminated soils
- decontamination and rehabilitation of all utilised areas
- maintenance of site security for on-going term during rehabilitation
- maintenance of the site's weeds free status during the rehabilitation and validation periods
- consideration given to the local community for public access to farming and social activities in the region.

The costs of rehabilitation of the additional equipment, plant, and facilities associated with the SMP including the portal, underground workings, crushing, processing plant and associated facilities and miscellaneous site re-vegetation based on estimates of labour, plants seeds, etc., has been estimated at US$2,000,000.

## 20.16 Summary

All baseline environmental studies have been completed and no endangered species of flora or fauna identified, which could adversely affect development of the project.

All environmental approvals for project construction and operation have been successfully completed. Overall construction permits have already been granted. Permits and approvals as required to construct specific facilities will be applied for and received as a routine part of ongoing construction activities.

# 21 CAPITAL AND OPERATING COSTS

The cost estimates in the current study include:

- Mine development and rehabilitation, mining equipment mobile and fixed and associated consumables and maintenance parts for development and infrastructure.
- Direct costs of new equipment for the processing facilities.
- Project infrastructure equipment and materials.
- Construction materials
- Labour.
- Temporary buildings and services.
- Construction support services.
- Spare parts.
- Initial fills (inventory).
- Freight.
- Vendor Supervision.
- Owner’s cost.
- Engineering, Procurement and Construction Management.
- Commissioning and start up.
- Contingency.

## 21.1 Direct Costs

Direct costs have been allocated as all costs associated with permanent facilities. These includes mine development openings, equipment and material costs, as well as construction and installation costs.

Mine infrastructure costs are those associated with maintenance shops, mine dewatering, refuge stations, etc. Wherever possible, equipment and materials’ quotes and contractor installation costs have been used.

Other major equipment expenditure estimates are based on quotes obtained from suppliers and installation costs estimated as part of this study.

During the pre-production and sustaining development periods, all materials and equipment pricing are based on quotes obtained from local Republic of Korea suppliers or European and international suppliers, where Republic of Korea suppliers do not exist. Processing plant equipment pricing is based on the equipment list, specifications and process flow diagrams. Budgetary prices were obtained from Vendors of major equipment and in-house data was used from similar projects for items not quoted. Estimated costs for plate work were based on local data, associated with remaining equipment: tanks, bins and chutes. Costs for installation of equipment are based on unit man-hour requirements.

All major equipment expenditures include freight only. Applicable taxes and duties have not been included in the capital expenditure estimates.

Other direct costs are based on actual local costs:

- Earthwork / site work
- Concrete
- Structural steel
- Buildings and architectural
- Electrical
- Instrumentation and controls
- Piping.

Commodity pricing for earthwork, concrete, steel, architectural and piping were provided by local contractors based in The Republic of Korea. Labour rates and equipment usage rates used throughout the estimate were provided by the same source as the commodity prices. It was assumed that rock required for site preparation and the tailings will be provided at no cost during the preproduction stage. Only costs for placement have been allowed for in estimates.

Labour rates generally reflect industry-wide Republic of Korea and international levels for the types of work performed, and in some cases adjusted for locally applied rates. The mine labour costs are based on three types of estimates:

- Quoted contractor prices for undertaking the tasks associated with constructing a specific installation;
- Average industry rates a contractor would be expected to charge for performing specific tasks;
- Lateral and raise development rates, developed and based on expected productivity and labour, materials and equipment costs for such an underground development program.

All labour costs include local Republic of Korea government mandated contributions and the costs for company provided benefits.

## 21.2 Indirect Costs

The indirect costs cover all the costs associated with temporary construction facilities and services, construction support, freight, Vendor representatives, spare parts, initial fills and inventory, Owner's costs, EPCM, commissioning and start-up assistance.

The costs for construction facilities include all temporary facilities, services and operation, site office operations, security buildings and services, construction warehousing and material management, construction power and utilities, site transportation, medical facilities and services, garbage collection and disposal, and surveying.

The costs for spare parts have been factored in, based on equipment costs where Vendors did not provide cost for spares needed for the first year of operations.

The estimated cost for initial fills of reagents is based on 3 months of operating requirements. Budget quotations were obtained for reagent pricing.

The freight costs were either provided by Vendors or estimated based on weights and typically include for containerised and break-bulk shipping, and each are respectively divided into ocean freight and inland freight. For imported equipment, the cost of freight and export packing, ex- works to a local port, is included with the cost of the equipment. Freight insurance is included in the Owner's cost.

The requirement for Vendor representatives to supervise the installation of equipment or to conduct a checkout of the equipment prior to start-up of the equipment as deemed necessary for equipment guarantees or warranties has been included in the estimate. Typically, the cost for this item is inclusive of salary and travel.

Taxes and duties have been excluded.

Engineering, Procurement and Construction Management (EPCM) costs have been calculated based on AKT Project managing development and construction, using consultants for processing plant and some aspects of mining and infrastructure design.

## 21.3 Capital Exclusions

Capital expenditures estimates exclude:

- Sunk costs
- Taxes and Duties
- Deferred capital
- Financing and interest during construction
- Additional exploration drilling
- Escalation
- Corporate withholding taxes
- Legal costs
- Metallurgical testing costs
- Condemnation testing.

## 21.4 Capital Costs

The cost estimates are to Feasibility Study level accuracy. All expenditure estimates are in 2015 constant US Dollars. Costs derived from Republic of Korea Won figures have been converted at a rate of $US 1 = Won 1180.

### 21.4.1 Mining

All construction work will be executed by local contractors. Mine capital expenditures are based on Almonty Korea hiring a mine contractor for developing and operating the mine. Mine capital expenditures are primarily related to underground infrastructure, stope development and mine services. As existing development can be extensively utilized, the underground development costs are relatively low.

Mine capital expenditures do not include closure expenses, as it is not expected the project to be restricted to the actual reserves. They also do not include the value(s) of existing assets.

The total mine pre-production expenditures (including design engineering) are expected to be approximately $US12.16M (including 5% contingency). The summary capital expenditures breakdown for the mine is shown In Table 21-1. The mine development capital expenditures and infrastructure capital expenditure estimates are shown in Tables 21-2 and 21-3, respectively.

**Table 21-1. Overall Mine Capital Costs**

| Component | Total Expenditures $US x $10^6$ |
|---|---|
| Mine Development & Definition Drilling | 7.63 |
| Mine Infrastructure | 4.53 |
| **Total Pre-Production Mine Capital** | **12.16** |

**Table 21-2. Mine Development Capital Costs**

| | | | Costs $US x $10^6$ | | |
|---|---|---|---|---|---|
| | | | Year | | Total |
| **Component** | **Quantity** | **Units** | **-2** | **-1** | **Cost** |
| New development (5m x 5m) | 2,736 | *m* | 2.14 | 1.92 | 4.06 |
| Slashing (=> 5m x 5m) | 1,396 | *m* | 0.61 | 0.74 | 1.35 |
| Ground Support | 4,132 | *m* | 0.81 | 0.90 | 1.71 |
| Contingency (5%) | | | 0.18 | 0.18 | 0.36 |
| **Total** | | | **3.74** | **3.73** | **7.47** |

## Table 21-3. Pre-Production Mine Infrastructure Capital

| Component | Qty | Units | Costs $US x 1000 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Cost | Q1 | Q2 | Q3 | Q4 | Total Year -2 | Q1 | Q2 | Q3 | Q4 | Total Year -1 |
| **MINE INFRASTRUCTURE** | | | | | | | | | | | | | |
| Intake Vent Fan (200HP, Incl.Installation) | 2 | EA | **92** | - | 46 | - | - | **46** | - | 46 | - | - | **46** |
| Exhaust Vent Fans (100HP, Incl.Installation) | 2 | EA | **64** | - | 32 | - | - | **32** | - | 32 | - | - | **32** |
| Ventilation Pipe Line (Φ1,000 / Tarpaulin, YDC install for nothing) | 4,132 | m | **60** | - | 8 | 10 | 11 | **29** | 12 | 12 | 7 | - | **31** |
| Ventilation Branching Point (Two way, YDC install for nothing) | 3 | EA | **10** | - | 3 | 3 | - | **7** | - | - | 3 | - | **3** |
| Underground Service Water Storage Pond (Incl. Pump) | 3 | SET | **18** | - | 6 | - | 6 | **12** | 6 | - | - | - | **6** |
| Explosives Magazines (Surface explosive storage facility) | 1 | EA | **50** | - | - | - | - | **-** | - | - | 50 | - | **50** |
| Surface Mine Maintenance Shop : Mine Subcontractor Charge | - | EA | **-** | - | - | - | - | **-** | - | - | - | - | **-** |
| Hydraulic Backfill Plant | 1 | EA | **2,537** | - | - | - | - | **-** | - | 2,537 | - | - | **2,537** |
| Mine Rescue Equipment | 1 | EA | **100** | - | 20 | 20 | 20 | **60** | 20 | 20 | - | - | **40** |
| | | | | - | - | - | - | **-** | - | - | - | - | **-** |
| **UNDERGROUND SUPPORT SERVICES FACILITIES** | | | | - | - | - | - | **-** | - | - | - | - | **-** |
| Fuel Bay | 1 | EA | **41** | - | 41 | - | - | **41** | - | - | - | - | **-** |
| Explosives & Detonators Magazines Construction & Equipping | 2 | EA | **14** | 14 | - | - | - | **14** | - | - | - | - | **-** |
| Water Pumps for plant water | 2 | EA | **72** | - | - | - | - | **-** | 72 | - | - | - | **72** |
| Refuge Station Construction & Equipping | 3 | EA | **22** | - | 7 | - | 7 | **14** | 7 | - | - | - | **7** |
| Portable Toilets | 5 | EA | **6** | 1 | 1 | 1 | 1 | **5** | 1 | - | - | - | **1** |
| | | | | - | - | - | - | **-** | - | - | - | - | **-** |
| **MINE SERVICES** | | | | - | - | - | - | **-** | - | - | - | - | **-** |
| Portable Substations (Transformers(200KVA+400KVA), Cables) | 7 | EA | **677** | - | 230 | - | 224 | **454** | 224 | - | - | - | **224** |
| Mine Communications (Telecommunication Repeater) | 1 | EA | **50** | 10 | 10 | 10 | 10 | **40** | 10 | - | - | - | **10** |
| Computers, Peripherals & Software | 1 | EA | **50** | 50 | - | - | - | **50** | - | - | - | - | **-** |
| Engineering & Geology Equipment | 1 | EA | **44** | 44 | - | - | - | **44** | - | - | - | - | **-** |
| Backfill Distribution System | 1 | EA | **275** | - | - | - | - | **-** | 138 | 138 | - | - | **275** |
| Underground Booster Fans & Auxilliary Ventilation | 10 | EA | **100** | - | - | - | - | **-** | - | 100 | - | - | **100** |
| Mine Lamps | 70 | EA | **13** | 13.35 | - | - | - | **13** | - | - | - | - | **-** |
| Safety & Protection Equipment | 1 | EA | **20** | 20.00 | - | - | - | **20** | - | - | - | - | **-** |
| | | | | - | - | - | - | **-** | - | - | - | - | **-** |
| **Contingency (5%)** | | | **216** | 8 | 20 | 2 | 14 | **44** | 24 | 144 | 3 | - | **172** |
| **Total Pre-Production Infrastructure Capital** | | | **4,530** | **160** | **425** | **47** | **293** | **925** | **513** | **3,028** | **64** | **-** | **3,606** |

### 21.4.2 Processing Plant

The processing plant capital expenditures are based on equipment costs from METSO (a major processing equipment supplier), who would provide all major processing equipment except for conveyors and thickeners from Korean Engineering Consultants Corporation (KECC) a major Korean engineering firm. These capital estimates cover all remaining aspects of the processing plant building and installations. Table 21-4 shows the processing plant capital expenditures breakdown, for a total of $US32.807 million (including 5% contingency).

### 21.4.3 Infrastructure and Support

Total pre-production capital expenditures for project infrastructure and surface department are estimated to be approximately $US13.9M, including a 5% contingency. The breakdown of expenditures is presented in Table 21-5. Infrastructure expenditure estimates were primarily provided by Korea Engineering Consultants Corporation (KECC). Major expenditure components are for power distribution, an office/shop/warehouse complex, camp and catering facilities and water supply and treatment.

### 21.4.4 Project Indirect and Owners' Costs

Project indirect procurement and construction management and owners' costs are estimated at $US 6.69M over the 20 month pre-production period. A breakdown of these Owner's costs is presented in Table 21-6. Owner's costs also include manpower recruitment and training during the pre-production period and all equivalent General and Administration costs which would be incurred during the construction phase.

## Table 21-4. Processing Plant Capital Costs

| Component | Total Cost ($US M) | Year -2 Q1 ($US M) | Year -2 Q2 ($US M) | Year -2 Q3 ($US M) | Year -2 Q4 ($US M) | Total Year -2 | Year -1 Q1 ($US M) | Year -1 Q2 ($US M) | Year -1 Q3 ($US M) | Year -1 Q4 ($US M) | Total Year -1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Processing Plant Equipment & Machinery** | **19.94** | - | 3.66 | 0.28 | 3.94 | **7.88** | 8.54 | 3.52 | - | - | **12.06** |
| **Crushing Building** | **0.27** | - | 0.11 | 0.05 | 0.05 | **0.21** | 0.05 | - | - | - | **0.05** |
| **Grinding Building** | **0.58** | - | 0.23 | 0.12 | 0.12 | **0.46** | 0.12 | - | - | - | **0.12** |
| **Flotation Building** | **1.31** | - | 0.52 | 0.26 | 0.26 | **1.05** | 0.26 | - | - | - | **0.26** |
| **Water Treatment Facility : FS 2015 Jun** | **2.70** | - | - | - | 0.54 | **0.54** | 0.54 | 1.62 | - | - | **2.16** |
| **Laboratory Equipment** | **0.22** | - | - | - | - | **-** | 0.22 | - | - | - | **0.22** |
| **General Overhead Expenses** | **7.55** | - | 0.75 | 0.64 | 0.97 | **2.37** | 2.26 | 2.92 | - | - | **5.18** |
| **Contingency (5%)** | **0.24** | - | 0.04 | 0.02 | 0.05 | **0.11** | 0.05 | 0.08 | - | - | **0.13** |
| **TOTAL PROCESSING PLANT CAPITAL EXPENDITURES** | **32.81** | **-** | **5.32** | **1.38** | **5.93** | **12.63** | **12.04** | **8.14** | **-** | **-** | **20.18** |

**Notes**

**. Capital estimates exclude VAT**

### Table 21-5. Surface Infrastructure Capital Costs

| | | Year -2 | | | | | Year -1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Total Cost ($US M) | Q1 ($US M) | Q2 ($US M) | Q3 ($US M) | Q4 ($US M) | Total Year -2 | Q1 ($US M) | Q2 ($US M) | Q3 ($US M) | Q4 ($US M) | Total Year -1 |
| Civil Engineering Construction | **3.71** | - | 0.60 | 1.20 | 1.06 | **2.86** | 0.58 | 0.27 | - | - | **0.85** |
| Architecture & Building Facility | **1.67** | - | - | 0.75 | 0.75 | **1.50** | 0.16 | - | - | - | **0.16** |
| Electric Facility | **4.19** | - | 0.53 | 0.80 | 1.90 | **3.23** | 0.87 | 0.09 | - | - | **0.96** |
| Information & Communication | **0.15** | - | - | - | - | **-** | - | 0.15 | - | - | **0.15** |
| Instrumentation & Control | **2.32** | - | - | 0.02 | 0.02 | **0.03** | 1.14 | 1.15 | - | - | **2.29** |
| Offices Fittings and Furnishings | **0.05** | - | - | - | - | **-** | 0.05 | - | - | - | **0.05** |
| First Aid Supplies & Equipment | **0.06** | - | - | - | - | **-** | - | 0.06 | - | - | **0.06** |
| Maintenance Shop Equipping | **0.15** | - | - | - | - | **-** | 0.15 | - | - | - | **0.15** |
| Warehouse Equipping | **0.10** | - | - | - | - | **-** | 0.10 | - | - | - | **0.10** |
| Catering Facilities Building and Equipping | **0.05** | - | - | - | - | **-** | 0.05 | - | - | - | **0.05** |
| Process Water Supply (Natural - settling chamber) | **0.40** | - | - | 0.28 | 0.12 | **0.40** | - | - | - | - | **-** |
| Fuel Storage Facility (Surface, Incl. Installation) | **0.04** | - | - | 0.04 | - | **0.04** | - | - | - | - | **-** |
| Site Lighting | **0.04** | - | - | - | 0.02 | **0.02** | 0.02 | - | - | - | **0.02** |
| Used Oil Storage | **0.02** | - | - | - | - | **-** | - | 0.02 | - | - | **0.02** |
| Telecommunications Upgrade (Site Wide) | **0.12** | - | - | - | - | **-** | - | 0.12 | - | - | **0.12** |
| Surface Mobile Equipment | **0.10** | - | - | - | - | **-** | - | 0.10 | - | - | **0.10** |
| Miscellaneous Small Equipment | **0.05** | - | - | - | - | **-** | - | 0.05 | - | - | **0.05** |
| Contingency (5%) | **0.66** | - | 0.06 | 0.15 | 0.19 | **0.40** | 0.16 | 0.10 | - | - | **0.26** |
| **TOTAL INFRASTRUCTURE CAPITAL EXPENDITUR** | **13.90** | **-** | **1.19** | **3.25** | **4.06** | **8.50** | **3.27** | **2.13** | **-** | **-** | **5.40** |

**Notes**

**. Capital estimates exclude VAT**

**Table 21-6. Indirect and Owners' Capital Costs**

| Description | Total Cost ($US M) | Year -2 Q1 ($US M) | Year -2 Q2 ($US M) | Year -2 Q3 ($US M) | Year -2 Q4 ($US M) | Total Year -2 | Year -1 Q1 ($US M) | Year -1 Q2 ($US M) | Year -1 Q3 ($US M) | Year -1 Q4 ($US M) | Total Year -1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Geology Modelling : FS 2015 June | 0.110 | 0.110 | - | - | - | 0.110 | - | - | - | - | - |
| Mine Design Engineering : FS 2015 June | 0.050 | 0.035 | 0.015 | - | - | 0.050 | - | - | - | - | - |
| Detail Engineering (Plant & Subsidiary Facility) | 2.509 | 0.564 | 0.943 | 0.223 | 0.260 | 1.989 | 0.283 | 0.237 | - | - | 0.520 |
| Mine & Processing Plant Training : FS 2015 June | 0.180 | - | - | - | - | - | 0.090 | 0.090 | - | - | 0.180 |
| Business Travel Expenses | 0.200 | 0.020 | 0.020 | 0.040 | 0.040 | 0.120 | 0.040 | 0.040 | - | - | 0.080 |
| Environmental Impact Assessment | 0.012 | 0.012 | - | - | - | 0.012 | - | - | - | - | - |
| Water Quality Monitoring Tests | 0.024 | 0.005 | 0.005 | 0.005 | 0.005 | 0.019 | 0.005 | - | - | - | 0.005 |
| Land Use (Long Term Land Lease) | 0.045 | - | 0.045 | - | - | 0.045 | - | - | - | - | - |
| Survey Cost for Temporary Land Use Permission | 0.021 | 0.021 | - | - | - | 0.021 | - | - | - | - | - |
| Removal of Trees on the Waste Storage Space | 0.013 | - | 0.013 | - | - | 0.013 | - | - | - | - | - |
| Removal of Existing Building and Other Cleaning Works | 0.270 | - | 0.270 | - | - | 0.270 | - | - | - | - | - |
| Operating Expenditures | 3.315 | 0.276 | 1.332 | 0.252 | 0.326 | 2.185 | 0.415 | 0.498 | 0.217 | - | 1.130 |
| **TOTAL OWNERS COSTS** | **6.749** | **1.042** | **2.642** | **0.520** | **0.631** | **4.835** | **0.833** | **0.865** | **0.217** | **-** | **1.914** |

**Notes**

**. Capital estimates exclude VAT**

### 21.4.5 Total Pre-Production Capital Expenditures

The estimated total project pre-production capital expenditure, inclusive of contingencies and excluding working capital, is approximately $US65.62M. The total expenditures include EPCM, contractor overheads and a 5% contingency on all estimated expenditures. A summary of all project pre-production capital expenditures is presented in Table 21-7.

**Table 21-7. Project Pre-Production Capital Expenditure**

| Component | Total Expenditures |
|---|---|
| | ***$US x 10$^6$*** |
| Mine Development & Infrastructure | 12.16 |
| Processing Plant (Incl. Contingencies) | 32.8 |
| Surface Infrastructure & Mobile Equipment | 13.9 |
| Owner's Costs | 6.75 |
| **Total Pre-Production Capital** | **65.62** |

### 21.4.6 Working Capital

A working capital allowance, in addition to capital expenditures, of $US1.94M has been included in the cashflow model. This represents 1 to 2 months of operating costs which would be incurred before the first revenue is realized. The working capital requirement is less than would normally be expected, as payment for the mine product is expected immediately after concentrate has been shipped.

### 21.4.7 Sustaining Capital

Additional sustaining capital has also been allowed for in the overall cashflow model, of $US2.99M. This is for ongoing primary development and continuation of the Sangdong gallery, from years 1 to 5 of the mine life.

## 21.5 Operating Costs

### 21.5.1 Basis for Cost Estimation

Project operating costs are based on efficiencies and productivities generally achievable in The Republic of Korea. The overall performance objectives are conservative by European standards.

Project departmental operating costs were divided into two components - consumables/maintenance parts and labour. The consumables component includes all materials and parts needed for mining, processing and surface facilities and the operation and maintenance of equipment for these areas. Costs for consumables were obtained from a mining contractor and Republic of Korea, European and international suppliers. Maintenance parts and consumables are based on Republic of Korea based and international equipment suppliers. The total mine labour force complement and salaries were calculated on a total yearly basis. The labour component was combined with the materials component, to produce the yearly departmental operating cost estimates.

The General and Administration (G&A) cost components include the materials and supplies used by the administration and surface services groups. These costs comprise office supplies, computer supplies and computer and software upgrades, light vehicle and surface equipment operating and maintenance consumables, camp accommodation operational costs, business travel inside Republic of Korea and internationally, fees for consultants and communications costs.

Labour costs and salaries for all services labour and mine staff have been estimated on a yearly total cost basis.

Critical operating cost components are based on the following costs:

- The diesel fuel price is assumed to be $US 1.61 / litre.
- The electrical power cost is assumed to be $US 0.08 per kWh.

Labour costs for the operating period are based on the manpower schedules presented for each department and the associated labour costs. The costs include a burden component of approximately 35 percent. Labour rates are based on local rates where available and/or contractor costs in the region and country, for similar types of work. Where costs were not available, costs from other similar projects were used. The rates used include all cost and profit components payable to contractors. All costs are quoted in constant 2015 US Dollars.

### 21.5.2 Mining

Individual costs for mining have been estimated for manpower, equipment operating, maintenance and materials consumptions, based on a mining contractor developing and operating the mine. The total mining unit cost has been estimated as $US32.33 per tonne of ore, as summarised in Table 21-8.

**Table 21-8. Mine Operating Costs**

| Area | Unit Cost |
|---|---:|
| | *$US/t ore* |
| Stope preparation | 3.10 |
| Stoping | 18.13 |
| Backfill | 4.30 |
| Support | 2.05 |
| Power | 1.90 |
| Technical Services | 2.04 |
| U/g Supervision | 0.81 |
| **TOTAL MINING OPERATING COSTS** | **$32.33** |

**Notes**

**. Average stoping cost above is derived from:**

| | $US/t | Ore Prop'n. |
|---|---:|---:|
| **CAF** | **14.20** | **60%** |
| **MIP** | **24.05** | **40%** |
| **Average** | **18.13** | **(Weighted by proportion)** |

Mines services and overheads costs include all other non-direct stoping costs for the mine. Mine services operating costs are associated with maintaining underground facilities and services (power, water supply, etc.), operating and maintaining ventilations fans, supplies for safety and training including personal protective equipment and mine rescue and operating and maintaining all support mobile and track haulage equipment used in the mine.

The total estimated unit mining cost shown above is $32.33 per tonne of ore, using the 2 proposed mining methods. The Mechanised Inclined Panel stoping mining cost is $US 24.05 and for Cut-and-Fill is $US 14.2 per tonne. The direct stoping costs above are a blended cost, assuming relative proportions of 60% Cut-and-Fill and 40% Mechanised Inclined Panel mining. Table 21-9 shows a breakdown of the mining costs.

## Table 21-9. Breakdown of Mining Operating Costs

| Area | | $ US/t ore | |
|---|---|---|---|
| **Stope preparation** | | | |
| | Labour | 0.79 | |
| | Materials | 2.31 | |
| | Sub-total | | 3.10 |
| **Stoping** | | | |
| | Materials | 7.43 | |
| | Wages | 6.16 | |
| | Other Expenses | 4.53 | |
| | Sub-total | | 18.13 |
| **Backfill** | | | |
| | Labour | 0.52 | |
| | Binder Material | 3.44 | |
| | Materials | 0.34 | |
| | Sub-total | | 4.30 |
| **Support** | | | |
| | Labour | 0.31 | |
| | Materials | 1.74 | |
| | Sub-total | | 2.05 |
| **Power** | | | |
| | Electricity | 1.90 | |
| | Sub-total | | 1.90 |
| **Technical Services** | | | |
| | External consultancy | 0.31 | |
| | Engineering expenses | 0.41 | |
| | Geology expenses | 0.51 | |
| | Samples annalisis | 0.82 | |
| | Sub-total | | 2.04 |
| **Underground Supervision** | | | |
| | Labour | 0.75 | |
| | Materials | 0.06 | |
| | Sub-total | | 0.81 |
| | **Total** | **32.33** | **32.33** |
| | | | |
| **Notes** | | | |
| | **. Stoping costs from contractor** | | |
| | **. All other costs outside of contractor** | | |

### 21.5.3 Processing

The total processing plant operating cost is estimated to be approximately $US 10.95 per tonne of ore, as shown in Table 21-10.

**Table 21-10. Processing Plant Operating Costs**

| Area | Unit Cost *$US/t ore* |
|---|---|
| Consumable Parts | 1.93 |
| Reagents | 4.52 |
| Maintenance Parts | 0.19 |
| Power | 2.22 |
| Manpower | 2.10 |
| **TOTAL PROCESSING OPERATING COST** | **10.95** |

### 21.5.4 General & Administration Costs

The estimates for G&A costs encompass all operating costs associated with operating the offices and providing materials and supplies for staff functions. Administration operating costs include costs and taxes for maintaining the property in good standing, land taxes, and resource usage fees (water, etc.).

The total yearly G&A costs are estimated to be approximately $US 3.2M, as summarised in Table 21-11. Employee burdens account for approximately 35% of the total salary for each employee. Camp operating costs are the other large G&A expenditure estimate with a total cost of approximately $US 1.1M per year.

Annualized site G&A costs, at an annual production rate of 640,000 tonnes per year of ore, are estimated at $US 4.9 per tonne (including environmental costs) of ore.

The mine management and administration component of G&A correspond with the employment of 27 people in this area, most of which would be staff positions. They would be responsible for the management, administration, personnel, accounting, purchasing needs, and distribution of material to the operation, site security, health and safety, and environmental issues.

**Table 21-11. Breakdown of G&A Costs**

| Component | Annual Cost ($US) |
|---|---|
| Salaries & Overhead | 1,046,960 |
| Camp Costs | 1,040,000 |
| Light Vehicles Operation | 38,000 |
| Service/Garbage Truck | 34,000 |
| Surface ITC | 109,000 |
| Roads and Yards Maintenance | 5,000 |
| Admin/Warehouse Buildings Maint'ce | 28,000 |
| Camp Buildings Maintenance | 42,000 |
| Electrical Distribution Repair | 15,000 |
| Water Supply & Water Treatment | 50,000 |
| Power | 173,000 |
| Training | 25,000 |
| Human Resources | 15,000 |
| Safety Equipment | 6,000 |
| Medical, Health & Safety | 15,000 |
| Security Supplies | 5,000 |
| Office Supplies | 10,000 |
| Computer Supplies | 10,000 |
| Shipping, Courier and light freight | 20,000 |
| Communications | 25,000 |
| Dues & Subscriptions | 5,000 |
| Travel & Accommodations | 40,000 |
| Government Relations | 15,000 |
| Community Relations | 50,000 |
| Legal and Accounting | 10,000 |
| Consultants | 50,000 |
| Insurance | 250,000 |
| Bank Costs | 10,000 |
| **Total G&A costs** | **3,141,960** |

| | |
|---|---|
| **Overall G&A unit cost** | **4.90 $US/t ore** |

### 21.5.5 Total Operating Costs

The estimated total average operating cost, over the life of mine, to produce a 65% $WO_3$ concentrate from the mine is approximately $US48.18 per tonne of ore, as summarised in Table 21-12.

**Table 21-12. Project Operating Cost Summary**

| Area | Unit Cost *$US/t ore* |
|---|---|
| Mining | 32.33 |
| Processing & Tailings | 10.95 |
| Management Surface Dept. and G&A | 4.90 |
| **TOTAL OPERATING COST** | **48.18** |

For the purpose of this study, value added taxes and other taxes, along with import duty costs, have not been included. Exploration costs and all costs associated with areas beyond the property limits have also not been included.

# 22 ECONOMIC ANALYSIS

The base case APT price used was $370/MTU, which is forecast to be a reliable scenario for the period 2018-2025.

The discounted cashflow analysis has been based on 2015 Constant US Dollar values. The mine production schedule is based on mining at 450 kt for Year 1 and at the steady state rate of 640 ktpa from Year 2 onwards. The economic model results for the base scenario are shown in Table 22-2.

Financial results for prices of $US 300 /MTU and $US 440/ MTU are also presented.

The discounted cashflow analysis has been based on 2015 Constant US Dollar values.

A summary of the expected parameters used for the financial analysis is presented in Table 22-2. The tax rate used was 24.2%: the same as in the A-Z Feasibility Study. Sensitivities on the derived project NPV values, for different $WO_3$ prices, is shown in Table 22-1.

**Table 22-1. Sensitivities - NPVs Calculated at Different $WO_3$ Prices**

| | Discount Rate | WO3 Price $US/MTU 370 | 300 | 440 |
|---|---|---|---|---|
| Pre-Tax Net Present Value | 5% | 234.3 | 128.9 | 339.6 |
| | 8% | 181.9 | 97.0 | 266.9 |
| | 15% | 103.4 | 49.1 | 157.7 |
| After-Tax Net Present Value | 5% | 178.1 | 93.1 | 263.1 |
| | 8% | 137.6 | 68.5 | 206.6 |
| | 15% | 76.5 | 31.7 | 121.4 |

**Notes**

. **All NPVs shown in $US M**

## Table 22-2. Economic Analysis – Base Case Price $370/MTU $WO_3$

| | | Unit | Total | Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | -2 | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| **Production** | Ore Tonnes | *t* | **7,896** | | 0 | 451 | 643 | 644 | 643 | 641 | 641 | 641 | 641 | 644 | 643 | 644 | 643 | 378 |
| | WO3 | *%* | **0.45** | | 0 | 0.51 | 0.53 | 0.60 | 0.54 | 0.49 | 0.46 | 0.42 | 0.37 | 0.33 | 0.39 | 0.41 | 0.38 | 0.38 |
| | Contained t WO3 | *t WO3* | **35,397** | | | 2,303 | 3,433 | 3,835 | 3,460 | 3,160 | 2,972 | 2,678 | 2,402 | 2,154 | 2,523 | 2,613 | 2,418 | 1,445 |
| | Plant recovery | | | | | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% | 81% |
| | Recovered t WO3 | *t WO3* | **28,672** | | | 1,866 | 2,781 | 3,106 | 2,803 | 2,560 | 2,408 | 2,169 | 1,946 | 1,744 | 2,044 | 2,116 | 1,959 | 1,170 |
| | Recovered MTUs | | **2,867,168** | | | 186,582 | 278,112 | 310,639 | 280,270 | 255,977 | 240,762 | 216,937 | 194,556 | 174,445 | 204,372 | 211,616 | 195,877 | 117,023 |
| | Concentrate grade | *%* | | | | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% | 65% |
| | T of concentrate / year | *t/year* | | | | 2,870 | 4,279 | 4,779 | 4,312 | 3,938 | 3,704 | 3,337 | 2,993 | 2,684 | 3,144 | 3,256 | 3,013 | 1,800 |
| | T of concentrate / month | *t/month* | | | | 239 | 357 | 398 | 359 | 328 | 309 | 278 | 249 | 224 | 262 | 271 | 251 | 150 |
| | Containers / month | | | | | 12 | 18 | 20 | 18 | 16 | 15 | 14 | 12 | 11 | 13 | 14 | 13 | 8 |
| **Revenue** | **Revenue** | *$US M* | **827** | | | **53.85** | **80.26** | **89.65** | **80.89** | **73.87** | **69.48** | **62.61** | **56.15** | **50.34** | **58.98** | **61.07** | **56.53** | **33.77** |
| **Costs** | Mine | *$US M* | **255** | | | 14.58 | 20.78 | 20.82 | 20.79 | 20.72 | 20.73 | 20.71 | 20.72 | 20.81 | 20.78 | 20.82 | 20.80 | 12.22 |
| | Plant | *$US M* | **86** | | | 4.94 | 7.04 | 7.05 | 7.04 | 7.02 | 7.02 | 7.02 | 7.02 | 7.05 | 7.04 | 7.05 | 7.04 | 4.14 |
| | G&A | *$US M* | **39** | | | 2.21 | 3.15 | 3.16 | 3.15 | 3.14 | 3.14 | 3.14 | 3.14 | 3.15 | 3.15 | 3.16 | 3.15 | 1.85 |
| | **Total OPEX** | *$US M* | **380** | | | **21.72** | **30.96** | **31.02** | **30.98** | **30.87** | **30.90** | **30.87** | **30.88** | **31.01** | **30.97** | **31.02** | **30.99** | **18.21** |
| **Capital** | Mine development and definition drilling | *$US M* | **9.72** | 3.77 | 3.86 | | | 1.25 | | | 0.42 | 0.42 | | | | | | |
| | Additional HW development | *$US M* | **11.48** | | | 0.54 | 2.72 | 2.92 | 0.42 | 0.42 | | | | 4.47 | | | | |
| | Sangdong Gallery Continuation | *$US M* | **0.90** | | | 0.90 | | | | | | | | | | | | |
| | Mine infraestruture & Services Cap. Exp. | *$US M* | **4.53** | 0.92 | 3.61 | | | | | | | | | | | | | |
| | Processing plant capex | *$US M* | **32.81** | 12.63 | 20.18 | | | | | | | | | | | | | |
| | Surface infraestruture & mobile equipment | *$US M* | **13.90** | 8.50 | 5.40 | | | | | | | | | | | | | |
| | Owners costs | *$US M* | **6.75** | 4.83 | 1.91 | | | | | | | | | | | | | |
| | Working capital | *$US M* | **1.94** | | | 1.94 | | | | | | | | | | | | |
| | Mine Closure | *$US M* | **-** | | | | | | | | | | | | | | | |
| | **Total capex** | *$US M* | **82.03** | **30.65** | **34.96** | **3.39** | **2.72** | **4.17** | **0.42** | **0.42** | **0.42** | **0.42** | **-** | **4.47** | **-** | **-** | **-** | **-** |
| **Cash flow** | Project Pre-tax Cash flow | *$US M* | **365.02** | - 30.65 | - 34.96 | 28.74 | 46.58 | 54.46 | 49.49 | 42.59 | 38.16 | 31.32 | 25.27 | 14.86 | 28.01 | 30.05 | 25.54 | 15.57 |
| | Project Cumulative cash flow | *$US M* | | - 30.65 | - 65.62 | - 36.88 | 9.70 | 64.16 | 113.65 | 156.24 | 194.40 | 225.72 | 250.99 | 265.86 | 293.87 | 323.92 | 349.46 | 365.02 |
| | Tax (calculated using 24.25%) | *$US M* | **85.99** | | | | | 13.18 | 11.98 | 10.31 | 9.24 | 7.58 | 6.12 | 3.60 | 6.78 | 7.27 | 6.18 | 3.77 |
| | Project After-tax Cash flow | *$US M* | **279.03** | - 30.65 | - 34.96 | 28.74 | 46.58 | 41.28 | 37.51 | 32.28 | 28.93 | 23.74 | 19.16 | 11.27 | 21.23 | 22.78 | 19.36 | 11.80 |
| | Project Cumulative after tax cash flow | *$US M* | | - 30.65 | - 65.62 | - 36.88 | 9.70 | 50.98 | 88.49 | 120.78 | 149.70 | 173.44 | 192.60 | 203.87 | 225.10 | 247.88 | 267.23 | 279.03 |

| | | |
|---|---|---|
| **Pre-Tax Net Present Value** | 5% | 234.3 |
| | 8% | 181.9 |
| | 15% | 103.4 |
| **After-Tax Net Present Value** | 5% | 178.1 |
| | 8% | 137.6 |
| | 15% | 76.5 |

# 23 ADJACENT PROPERTIES

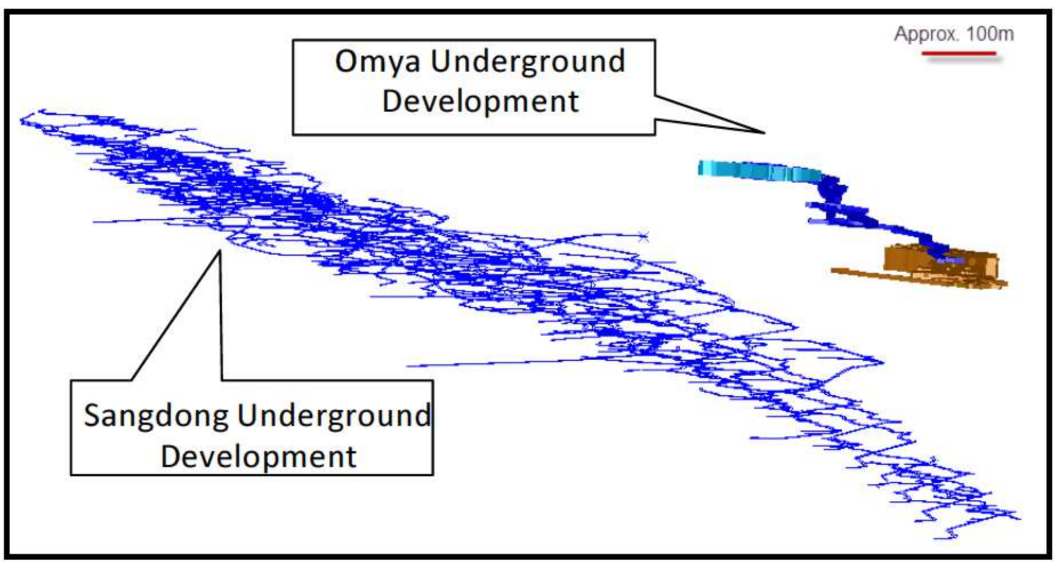
The South Korean mining company Omya holds the mining rights for limestone on part of the Property (coincident with the Se Woo Mining Right 71875) and are currently extracting the Pungchon limestone by underground mining. This horizon sits approximately 200 m above the Sangdong deposit which is hosted within the Myobong slate.

The Omya limestone mine adit entrance is approximately 260 m northeast of the Sangdong adit and the workings are in the Hangingwall Pungchon Limestone situated above the northeast corner of the Sangdong Mine old Main orebodies mine workings. Omya's closest mine workings are approximately 250 m away from the Sangdong Hangingwall orebody (Figure 23.1).

Current Omya mining is taking place between 600 and 663 masl using the room and pillar mining method. Omya's future plans are to continue mining down dip in the Pungchon Limestone at a rate of 150,000 t/a.

At the moment there is no protocol between the two mines regarding safety precautions to be taken during blasting times. This is a situation that should be addressed and it is recommended that both mines clear at blasting time

**Figure 23-1. View of Omya Mine Limestone Workings Relative to Sangdong Old Mine.**



# 24 OTHER RELEVANT INFORMATION

The mine will be technically supported by geology and engineering departments. The geology department will be responsible for mapping and interpretation, sampling of production drill holes, grade control and ore reserve estimations. There will be a separate exploration group to undertake exploration work on the property and to prove up new mineral resources for potential mining. The engineering department will be responsible for mine planning, production scheduling, surveying, geotechnical design, collecting and reporting performance statistics for the mine and any other technical requirements that support the operation.

# 25 INTERPRETATION AND CONCLUSIONS

The evaluation work was carried out and prepared in compliance with Canadian National Instrument 43-101, and the mineral resources in this estimate were calculated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May, 2014. The updated resource estimation is shown in Table 25-1, for 3 different cut-off grades.

**Table 25-1. Mineral Resources**
**As of End July 31st, 2016**

| $WO_3$ Cut-Off | Resource Class | Tonnes Kt | $WO_3$ % | $MoS_2$ % |
|---|---|---|---|---|
| 0.15% | Indicated | 8,029 | 0.51 | 0.06 |
| | Inferred | 50,686 | 0.43 | 0.05 |
| 0.20% | Indicated | 7,864 | 0.51 | 0.06 |
| | Inferred | 47,630 | 0.44 | 0.05 |
| 0.30% | Indicated | 7,316 | 0.53 | 0.06 |
| | Inferred | 36,466 | 0.50 | 0.06 |

**Notes**

**. Bed models diluted to a minimum thickness of 2.2m**
**. Resources shown are inclusive of reserves**
**. 50m surface pillar material removed**
**. Indicated HW material based on all samples, with a maximum search of 35m x 50m (along-strike x down-dip)**
**. Indicated material in all other beds are based on only PO-P6 samples, with a maximum search of 50m, and sample grid required**
**. Inferred material based on all samples, up to a maximum search of :**
**105m x 150m in HW**
**100m x 100m in all other beds**

This Technical Report has identified a Proven and Probable Reserve of 7,896 Mt grading 0.45% $WO_3$. This Reserve will sustain a mining operation for approximately 12 years, at an annual capacity of 640 kt of ore.

Based on the forecast operating parameters and capital and operating costs estimates, for the Sangdong project, the returns from the project are very positive and project economics are extremely robust to potential reasonably expected variances from the base case assumptions.

# 26 RECOMMENDATIONS

In order to enhance the resource and reserve base, the following steps are recommended:

- Based on this updated Technical Study's results, it is recommended that Almonty Korea and its partners progress the Sangdong project to detailed engineering and construction budgeting. This would be immediately followed by construction, according to the approximate 20 month schedule presented as part of this Feasibility Study. The budget for proceeding is the capital expenditures estimate total presented in this study, of $US65.62M over 20 months.

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# 28 QUALIFIED PERSONS CERTIFICATES

## Certificate Of Author

Adam Wheeler, Mining Consultant,

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As the author of this report on the Sangdong Project, I, A. Wheeler do hereby certify that:-

1. I am an independent mining consultant, based at, Cambrose Farm, Redruth, Cornwall, TR16 4HT, England.

2. I hold the following academic qualifications:-
   B.Sc. (Mining) Camborne School of Mines 1981
   M.Sc. (Mining Engineering) Queen's University (Canada) 1982

3. I am a registered Chartered Engineer (C. Eng and Eur. Ing) with the Engineering Council (UK). Reg. no. 371572.

4. I am a professional fellow (FIMMM) in good standing of the Institute of Materials, Minerals and Mining.

5. I have worked as a mining engineer in the minerals industry for over 30 years. I have experience with a wide variety of mineral deposits and reserve estimation techniques.

6. I have read NI 43-101 and the technical report, which is the subject of this certificate, has been prepared in compliance with NI 43-101. By reason of my education, experience and professional registration, I fulfil the requirements of a "qualified person" as defined by NI 43-101. My work experience includes 5 years at an underground gold mine, 7 years as a mining engineer in the development and application of mining and geological software, and 19 years as an independent mining consultant, involved with evaluation and planning projects for both open pit and underground mines.

7. I am responsible for the preparation of the technical report titled "Technical Report on the Mineral Resource and Reserves of the Sangdong Project" and dated July 31st, 2016. I visited the mine site on August 24th – 26th, 2015.

8. As of the date hereof, to the best of my knowledge, information and belief, the technical report, which is the subject of this certificate, contains all scientific and technical information that is required to be disclosed to make such technical report not misleading.

9. I am independent of Almonty Industries Inc., pursuant to section 1.5 of the Instrument.

10. I have read the National Instrument and Form 43-101F1 (the "Form") and the Technical Report has been prepared in compliance with the Instrument and the Form.

11. I consent to the filing of the report with any Canadian stock exchange or securities regulatory authority, and any publication by them of the report.

Dated this 31st of July, 2016

A. Wheeler, C.Eng.