CADIA OPERATIONS

NEW SOUTH WALES, AUSTRALIA

NI 43-101 Technical Report

Report Prepared For:

Newcrest Mining Limited.

Qualified Persons:

Mr. Kevin Gleeson, FAusIMM

Mr. Geoffrey Newcombe, FAusIMM

Mr. Paul Griffin, FAusIMM

Mr. Philip Stephenson, FAusIMM.

Report Effective Date:

30 June, 2020.

NEWCREST MINING LIMITED

NEWCREST MINING LIMITED

CERTIFICATE OF QUALIFIED PERSON

I, Kevin Gleeson, FAusIMM, am employed as the Head of Mineral Resource Management with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Road, Melbourne, Victoria, 3004, Australia.

This certificate applies to the technical report titled "Cadia Operations, New South Wales, Australia, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated with a Bachelor of Science (Hons) from the University of Melbourne, Victoria Australia, in 1987.

I have practiced my profession for over 30 years since graduation. I have been directly involved in exploration, interpretation, geological evaluation, development of resource models, ore control, and reconciliation for both open pit and underground mining in Australia, Papua New Guinea, and Indonesia. I have been directly involved in pre-feasibility and feasibility studies for gold and gold–copper deposits, and I currently manage a team of resource modellers and ore deposit knowledge specialists.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I have visited the Cadia Operations on numerous occasions, most recently for the duration of a day on 5 November, 2019.

I am responsible for Sections 1.1 to 1.8, 1.10, 1.11, 1.24; Section 2; Section 3; Section 4; Section 5; Section 6; Section 7; Section 8; Section 9; Section 10; Section 11; Section 12; Section 14; Section 23; Section 24; Sections 25.1 to 25.4, 25.6, Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Cadia Operations since 2012 in my role as the Head of Mineral Resource Management.

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

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

Dated: 13 October, 2020

“Signed”

Kevin Gleeson, FAusIMM.

NEWCREST
MINING LIMITED

CERTIFICATE OF QUALIFIED PERSON

I, Geoffrey Newcombe, FAusIMM, am employed as the PC1-2 Study Manager with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Rd, Melbourne, Victoria, Australia.

This certificate applies to the technical report titled "Cadia Operations, New South Wales, Australia, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the "technical report").

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated from University of Queensland in 1998 with a Bachelor of Engineering Degree specialising in Mining.

I have practiced my profession for 22 years. I have been involved in the engineering, planning, and operations of underground gold and base metal mines in Australia and Fiji. I have been directly involved in managing pre-feasibility and feasibility studies. I have managed underground engineering and geotechnical studies, mining research and development projects; supervision of cost estimation, cost control and economic analyses for mine planning, and project evaluations; supervision of infrastructure, environmental and social studies and their integration with major mining studies; preparation and delivery of underground short-, medium- and long-term mine designs and schedules; and provision of technical support for caving operations.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I am directly employed at the Cadia Operations, and have been since November 2011. This familiarity with the operations serves as my personal inspection for the purposes of the technical report.

I am responsible for Sections 1.1, 1.2, 1.12, 1.13, 1.14, 1.16 to 1.24; Section 2; Section 3; Section 15; Section 16; Section 18; Section 19; Section 20; Section 21; Section 22; Sections 25.1, 25.7, 25.8, 25.10 to 25.17; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Cadia Operations since 2011 as the study manager for various internal feasibility and pre-feasibility studies.

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

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

Dated: 13 October, 2020

"Signed"

Geoffrey Newcombe, FAusIMM.

CERTIFICATE OF QUALIFIED PERSON

I, Paul Griffin, FAusIMM, am employed as the Group Manager – Processing – Governance and Assurance, with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Rd, Melbourne, Victoria, Australia.

This certificate applies to the technical report titled "Cadia Operations, New South Wales, Australia, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated with a Bachelor of Engineering (Chemical) degree from the University of Adelaide in 1988, and a Master of Enterprise (Executive) degree from the University of Melbourne in 2006.

I have practiced my profession for 32 years. I have been directly involved in base metals, gold and iron ore projects and operations in Australia, Papua New Guinea, Indonesia and Africa. I have been involved with operations management, process plant design and commissioning, operational performance reviews, comminution and flotation expansion designs, reviews and implementation, and have provided direction and guidance on geo-metallurgical testwork programs.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

My most recent visit to the Cadia Operations was from 28 October to 1 November 2019, a duration of five days.

I am responsible for Sections 1.1, 1.2, 1.9, 1.15, 1.18, 1.24; Section 2; Section 3; Section 13; Section 17; Section 19; Sections 25.1, 25.5, 25.9, 25.12; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Cadia Operations since 2001 in various roles including Processing Plant Manager (Cadia-based, 2006–2009) and later as Group Manager – Processing – Governance and Assurance.

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

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

Dated: 13 October, 2020

“Signed”

Paul Griffin, FAusIMM.

CERTIFICATE OF QUALIFIED PERSON

I, Philip Stephenson, FAusIMM am employed as the Chief Operating Officer, Australia and Americas, with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Rd, Melbourne, Victoria, Australia.

This certificate applies to the technical report titled “Cadia Operations, New South Wales, Australia, NI 43-101 Technical Report” that has an effective date of 30 June, 2020 (the “technical report”).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM, #112873). I graduated from James Cook University in North Queensland in 1987 with a Bachelor of Science degree, and from LaTrobe University, Victoria, with a Graduate Diploma of Mineral Processing Technology.

I have practiced my profession for 34 years. I have been involved in mine site management in Australia and Papua New Guinea, and have held executive management roles for business units in Australasia, West Africa, Indonesia and Canada. I have also been involved in development roles in corporate health, safety and environment, security, business improvement and project management.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I visited the Cadia Operations most recently from 14–16 January 2020.

I am responsible for Sections 1.1, 1.2, 1.4, 1.17, 1.18,1.22, 1.23, 1.24; Section 2; Section 3; Sections 4.10, 4.12; Section 19; Section 20; Sections 25.1, 25.2, 25.11, 25.12, 25.16, 25.17; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Cadia Operations since September 2014 in my initial role as General Manager, Health, Safety, Environment and Security and later as the Chief Operating Officer, Australia and Americas.

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

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

Dated: 13 October, 2020

“signed”

Philip Stephenson FAusIMM.

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1 SUMMARY

1.1 Introduction

Mr. Kevin Gleeson, Mr. Geoffrey (Geoff) Newcombe, Mr. Paul Griffin and Mr. Philip Stephenson prepared this Technical Report (the Report) for Newcrest Mining Limited (Newcrest) on the Cadia Operations (Cadia Operations or the Project), in New South Wales (NSW), Australia.

The Project is 100% owned by Newcrest through its wholly-owned subsidiary, Cadia Holdings Pty Ltd (CHPL).

The Cadia Operations consist of the operating Cadia East Gold Mine (Cadia East), the mined-out Cadia Hill Gold Mine (Cadia Hill), the Ridgeway Gold Mine (Ridgeway) which is currently on care-and-maintenance, the Blayney dewatering facility which is located in the town of Blayney, and the Cadia dewatering plant east of Blayney on Newbridge Road.

Mineral Resources are estimated for the Cadia East, Ridgeway, Cadia Extended, Big Cadia deposits and the Cadia Hill stockpile. Mineral Reserves are estimated for Cadia East and Ridgeway.

1.2 Terms of Reference

This Report supports disclosure of Mineral Resource and Mineral Reserve estimates in Newcrest's 2020 Annual Information Form.

All measurement units used in this Report are metric unless otherwise noted, and currency is expressed in Australian (A$) dollars unless otherwise identified in the text. The Report uses Australian English.

The term "Project" refers to information and activities that relate to the entire mineral tenure area and not just to the current Cadia East operations and the Ridgeway mine.

The mine plan uses the terms block cave (Ridgeway) and panel cave (Cadia East). A block cave operation produces from the full orebody footprint from the outset of the operation, whilst in panel caving the active caving zone moves across the full footprint with time. Development of a new panel in a panel caving operation is analogous to a pit cutback in an open pit mining operation.

The current Cadia East mine plan is at a minimum of pre-feasibility level of evaluation and outlines the execution of the life of mine plan over a series of three lifts (Lifts 1, 2, and 3). Lift 1 and Lift 2 have an existing panel cave and will, by the end of operations, have four extensions in total each with Lift 3 having one panel extension. The term "Cadia expansion project" refers to a study that was completed at Cadia East to provide additional detail on some aspects of the life-of-mine (LOM) plan to a feasibility level of confidence. The study focused on debottlenecking activities for the processing facility that will modify the plant to better match the production levels from the caving operation, including provision to treat the lower-grade, copper–gold–molybdenum-bearing mineralization that will be exploited over the remaining panel caves. It also brought the next extension of the Lift 2 cave, PC2–3, up to a feasibility level of confidence to commence execution.

Mineral Resources and Mineral Reserves were initially classified using the 2012 edition of the Australasian Joint Ore Reserves Committee (JORC) Code (2012 JORC Code). The confidence categories assigned under the 2012 JORC Code were reconciled to the confidence categories in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards). As the confidence category definitions are the same, no modifications to the confidence categories was required. Mineral Resources and Mineral Reserves in this Report are reported in accordance with the 2014 CIM Definition Standards. Terminology differences were addressed in that the term "Ore Reserves" in the 2012 JORC Code is reported as "Mineral Reserves" using the 2014 CIM Definition Standards.

1.3 Project Setting

The Cadia Operations are located approximately 25 km south–southwest of the town of Orange in NSW, and approximately 200 km west–northwest of Sydney.

The Cadia Operations are accessed by sealed road from Orange. Commuter airlines provide Brisbane to Orange, Sydney to Orange, and Melbourne to Orange services. The Orange airport is about 12 km northeast of the Cadia Operations.

The area experiences the warmest temperatures from November to March and the coolest from May to August. The lowest mean monthly rainfall occurs March and April and the highest mean monthly rainfall occurs in August. The most common wind directions are from the southwest and northeast. Mining and exploration activities are conducted year-round.

Elevations range from approximately 600 m Australian height datum (AHD) to 1,000 m AHD. The region is characterised by gently undulating hills, cleared open grassland and vegetation consisting mainly of scattered paddock trees, with isolated patches of remnant woodland and shelterbelts, and State Forest plantations of Monterey Pine. The dominant land use in the Orange region is agriculture, principally grazing (sheep and cattle), cropping and orchards.

The bushfire season in the Cadia valley area and Central West Region is generally from mid-November to mid-March. Depending on factors such as weather, fuel loads (build-up of leaf litter and broken branches), and drought indices, this season can be extended from early September to late April. There are moderate fuel loads associated with the open forest and woodland areas within the Cadia East subsidence zone and the tailings storage facilities (TSF) expansion areas that may present a fire hazard.

The deposits are located in an area that has been seismically active both prior to and subsequent to the commencement of mining by Newcrest. These events can produce seismic loading, and this risk is taken into account in infrastructure design.

1.4 Mineral Tenure, Surface Rights, Royalties and Agreements

The Cadia Operations consist of six granted Mining Leases and five granted Exploration Licences, with a total approximate area of 215 km^2.

CHPL predominantly owns all land/properties covered by the Mining Leases and a number of properties in the surrounding area. CHPL also holds licences to occupy crown roads within the Mining Leases and a small portion of crown land comprising Lot 7001 in Deposited Land (DP) 1020360 within ML1405. CHPL holds occupation permits for infrastructure within surrounding State forest lands. Some road areas with crown lands are still in the process of purchase.

The concentrate pipeline and return water line from Blayney is subject to leases within public lands under the control of the Blayney and Cabonne local government areas. CHPL owns the land on which the Cadia dewatering plant is located and leases adjoining Lot 102, which contains the rail track spur line used to transport concentrates. Newcrest may be required to acquire additional properties in the vicinity of the mines where mining operations have environmental impacts upon those properties which exceed certain specified limits.

In New South Wales the royalty rate is 4% of the ex-mine value of the bullion and concentrate “recovered” (where recovered consists of sold material and increases in stockpile material), less allowable deductions (treatment, depreciation, realization, and administration costs). Currently, gold, silver, and copper are levied at 4% of the ex-mine value less allowable deductions.

There are no material property agreements currently in place that could affect mining operations or the life-of-mine (LOM) plan. Voluntary Planning Agreements are in place with the councils of Blayney, Cabonne and Orange City. A Softwood Plantation Deed is in place with NSW Forests over specific Newcrest lands and is in effect until July 2032. Mining operations are permitted up until June 2031 with a maximum processing rate of 32 Mt/a (calendar year). An Environmental Protection Licence covers the operations within the six mining leases plus the Blayney and Cadia dewatering facilities, and ancillary infrastructure.

1.5 Geology and Mineralisation

The Cadia East, Cadia Extended, and Ridgeway deposits are considered to be examples of alkalic porphyry gold–copper-style mineralisation. The Big Cadia deposit is a skarn-style occurrence.

The Cadia deposits are located in the eastern Lachlan Fold Belt of NSW and formed within the intra-oceanic Macquarie Arc, a belt of Ordovician to early Silurian mafic to intermediate volcanic, volcaniclastic and intrusive rocks. Post-mineral deformation partially dismembered the district, thereby superposing different porphyry copper–gold systems as well as the host stratigraphy level.

The basement rocks in the Cadia district are Ordovician siltstones and volcanic units of the Weemalla Formation. They are conformably overlain by andesitic to basaltic andesitic lithologies of the Ordovician Forest Reefs Volcanics. Silurian conglomerates, sandstones and siltstones (part of the Waugoola Group) cover large portions of the Ordovician volcanosedimentary succession. Tertiary basalts of the Canobolas Volcanic Complex cover the Palaeozoic rocks to the north and east of the district.

Mineralisation-related Ordovician to Silurian alkalic intrusions young eastwards across the Cadia Valley, with Ridgeway being the oldest deposit in the district and Cadia East the youngest. Three main intrusive complexes were identified. Although currently spatially separated due to the current erosion level, they may be connected at depth.

The Cadia Intrusive Complex (CIC) consists of pyroxene diorite, monzodiorite and occasional pyroxenite in the west to monzonite, quartz monzonite and quartz monzodiorite in the east. The mafic, western portion of the CIC is interpreted to be separated from the eastern, felsic portion of the CIC by a major north–northwest-striking, west–southwest-dipping thrust fault, the Purple Fault.

The Ridgeway Intrusive Complex (RIC) is located 2.5 km northwest of the Cadia Hill portion of the CIC, with the top of the RIC occurring about 500 m below surface. At least three intrusive stages were defined, of which the latter two have a clearly demonstrated temporal relationship with Ridgeway deposit alteration and mineralisation. The RIC comprises a vertically attenuated composite pipe of monzodiorite to quartz monzonite. It has horizontal dimensions of 200 x 100 m, is elongated along a northwest trending axis, and extends subvertically for at least 1 km.

The Cadia East Intrusive Complex (CEIC) comprises a series of west–northwest- to west-striking dykes that dip steeply to the north. The top of the complex averages about 800 m below the surface. Dyke compositions range from monzodiorite and quartz monzodiorite to quartz monzonite.

The major regional structure is the 30 km long Werribee–Cadiangullong Fault Zone. Where the Werribee–Cadiangullong Fault Zone intersects structures related to the west–northwest-oriented Lachlan Transverse Zone, it forms a series of north–northwest- and northeast-trending thrust faults. This structural intersection appears to have controlled the location of the CIC and associated mineralisation. Newcrest identified more than 56 structures during production and development activities that influence the Cadia Valley-wide structural setting, and therefore mine planning and caving operations. Underground mapping demonstrated that fault behaviour at the local scale can be highly complex, particularly for steeply-dipping structures.

The Cadia porphyry deposits record a sequence of alteration and mineralisation events that evolved from early-stage magnetite-stable sodic, potassic and calc-potassic alteration with locally significant gold–copper mineralisation, through a period of transitional stage potassic alteration that introduced most of the gold–copper mineralisation. Propylitic and calc-silicate alteration were developed in the deposit peripheries at this time and a late stage of feldspathic alteration developed irregularly around the deposit margins and locally destroyed mineralisation.

The mineralisation within the Project area occurs within a 6 km-long west–northwest-oriented corridor. Mineralisation in the porphyry deposits occurs as sheeted and stockwork quartz–sulphide veins, and locally as broadly stratabound disseminated mineralisation (Cadia East) and skarn (Big Cadia and Little Cadia).

The Cadia deposit occupies a mineralised zone 2.5 km in strike length, 600 m in width and over 1,900 m in vertical extent. Mineralisation at Cadia East is divided into two broad overlapping zones: an upper, copper-rich disseminated zone and a deeper gold-rich zone associated with sheeted veins. The upper zone forms a relatively small cap to the overall mineralised envelope and has a core of disseminated chalcopyrite (and rare bornite), capped by chalcopyrite–pyrite mineralisation. The deeper zone is localised around a core of steeply-dipping, sheeted, quartz–calcite–bornite–chalcopyrite–molybdenite veins, with the highest gold grades associated with the bornite-bearing veins. Copper and molybdenite form a mineralised blanket above and to the east of the higher-grade gold envelope.

The Ridgeway deposit is a subvertical body of quartz–sulphide vein stockwork mineralisation with an elliptical, pipe-like geometry, elongated along a northwest-striking axis. Stockwork dimensions are approximately 400 m east–west, 250 m north–south and the deposit extends to a depth in excess of 1,000 m. Mineralisation at Ridgeway and Ridgeway Deeps occurs in dense quartz vein stockworks and sheeted arrays localised in and around the small (50–100 m diameter) composite diorite to quartz–monzonite intrusive complex. The most strongly developed quartz stockwork veining and alteration, and the highest copper and gold grades, occur immediately adjacent to the monzonite. Sulphide minerals are zoned from a bornite to chalcopyrite (plus gold) core, outwards and upwards through a chalcopyrite-rich to an outer pyrite-rich domain.

The Cadia Extended deposit has dimensions of about 1,200 x 1,100 m, and extends to about 900 m depth. It is located partly beneath the backfilled Cadia Extended open pit. Cadia Extended contains locally-developed zones of mineralised “pegmatitic” breccia, in addition to late-stage, structurally-focused zones of brecciation with pervasive phyllic alteration. Gold and copper mineralisation are closely associated with sheeted quartz–calcite–sulphide veins that cut obliquely across the host quartz–monzonite porphyry.

The Big Cadia iron–copper–gold skarn deposit is hosted by an intensely-altered, bedded, calcareous volcaniclastic unit. Magnetite skarn mineralisation is localised in a dilatant site at the intersection of the PC40 and Raggatts/Steep Fault. The skarn is zoned around a series of southeasterly-trending steeply-dipping breccia zones. The Big Cadia deposit has dimensions of 1,000 x 200 m, and a drill-tested depth extent of about 400 m. It consists of an oxide lens, and sulphide mineralisation at depth. Chalcopyrite and minor gold are closely associated with bladed hematite, magnetite and epidote (with lesser chlorite–quartz–calcite) replacements.

1.6 History

The discovery of copper and gold in the Cadia area dates back to 1851. The field experienced sporadic production from several deposits within the district until the first half of the 20th century. Extensive copper mining occurred at the Cadia (now called White Engine), Iron Duke (now Big Cadia), West Cadia and Little Cadia mines. From 1918–1929 and 1941–1943, underground and quarrying operations were undertaken at Big Cadia.

Prior to Newcrest’s interest, Pacific Copper Limited (Pacific Copper), and Homestake Australia Limited conducted exploration in the Big Cadia area, including soil sampling, core, reverse circulation (RC), and rotary air blast (RAB) drilling.

Newcrest acquired the property in March 1991 with an initial focus on the small shallow oxide resources at Big Cadia. Since that date, Newcrest has completed rock chip, soil, and stream sediment geochemical sampling, down-hole, ground and airborne geophysical surveys, technical studies, and mining operations.

The production figures that follow are reported using financial years. Cadia East has produced, between 2011 and June 2020, approximately 4.3 Moz of gold and 417,000 t of copper concentrate. Ridgeway produced 3.9 Moz of gold and 487,000 t of copper concentrate between 2002 and 2018. From 1999 to 2018, the Cadia Hill open pit produced 4.3 Moz of gold, and 372,000 t of copper concentrate. No production occurred from either Ridgeway or Cadia Hill in 2019.

1.7 Drilling and Sampling

Drilling completed to 30 June, 2020 comprises a total of 5,656 drill holes (about 1,487,206 m). Drilling was completed primarily for exploration, resource delineation, and geotechnical purposes. A total of 593 drill holes (about 418,123 m) supports resource estimation at Cadia East, and 532 drill holes (about 258,622 m) supports resource estimation at Ridgeway. Mineral Resource estimates at Cadia Extended are supported by 449 drill holes (about 113,391 m) and 558 drill holes (about 71,447 m) support the Big Cadia resource estimate.

Core sizes include NQ3/NQ (47.6 mm core diameter), LTK60 (44.0 mm), HQ3/HQ (63.5 mm), and PQ (85 mm). Most of the drilling is uses triple-tube core tools. RC drilling is used for infill resource definition on occasion; however, geotechnical data are not collected from RC drilling.

Early logging (pre–2000) was typically conducted on 1 m intervals. After 2000, lithology is logged on a variable interval basis with intervals determined from combinations of rock type, alteration, structure, and mineralisation. Logging and data collection include collar, lithology, mineralisation, structure, geotechnical and bulk density information. Lithology is logged based on the geological unit, with subdivisions created based on alteration and mineralisation.

There are only minor zones of lost core or poor core recovery overall. Core recovery is generally excellent Project-wide, with core recoveries in fresh rock of around 99–100%.

All drill hole collars were surveyed by Newcrest or predecessor company survey staff. Survey methods included theodolite surveys and differential global positioning system (DGPS) instruments. A variety of methods were used to measure down-hole deviation (dip and azimuth), including FlexIT, Ranger, Eastman, Maxibor, Multishot, and gyroscopic instruments. Face and wall samples are located using iSITE mapping equipment, with field data processed in Vulcan. Drawpoint samples do not require accurate location and are labelled according to the drawpoint number.

In the opinion of the QP, the quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs conducted are sufficient to support Mineral Resource estimation.

Core is sampled and analysed on intervals determined by the geologist, with the aim of a nominal 2 m sample interval. Minimal RC sampling has been undertaken. Blasthole samples are typically about 5 kg.

Density determinations use the water displacement method. There are 13,664 density determinations in the database for Cadia East at 30 June 2020, averaging 2.76 t/m³. Density is assigned to the resource model by lithology and gold grade. There are 9,421 density determinations for Ridgeway, with a mean of 2.80 t/m³. Bulk density is assigned by domain during estimation. There is a total of 1,030 measurements for Cadia Extended, averaging 2.68 t/m³. Density is assigned by lithology during estimation. There is a total of 539 bulk density measurements at Big Cadia. Density is assigned by lithology type and oxidation state.

Third-party, independent analytical and sample preparation laboratories used during early exploration efforts include Genalysis (Townsville), AAL (Orange), Analabs (Townsville), ALS Chemex (Townsville), and AMDEL (Orange, Perth). There are no accreditation data available in the Project database for these laboratories at the time of use. Other third-party, independent analytical and sample preparation laboratories include ALS Chemex (Orange), and Intertek (Perth), both of which hold ISO170025 accreditations for selected analytical techniques. The Newcrest Services Laboratory, located in Orange (NSLO), has been used as the primary laboratory since June 2010. NSLO holds ISO 17025 accreditations but is not independent.

Sample preparation and analytical methods varied over time. Earlier programs typically crushed to 2 mm and pulverised to 90% passing 75 µm; after 2009 this was amended to crushing to 2 mm and pulverising to 95% passing 75 µm.

The analytical methods used for the majority of the legacy data are not recorded in the Project database. Information recorded typically consists of the element and detection limit. Legacy analyses were primarily for gold and copper, but a multi-element suite could occasionally be completed. Depending on the area, some core may have gaps where no assays were recorded. Samples collected during the Newcrest programs were routinely assayed for gold, copper, and a multi-element suite.

All assays are checked and verified in accordance with the Newcrest Resource Development Quality Assurance Quality Control (QA/QC) and database management procedures. A comprehensive QA/QC program is in place for sample analysis. The process typically involves submission and analysis of standard reference materials (SRMs), blanks, duplicates, replicates, and grind and crush size checks.

Data are stored in a SQL server database using acQuire software. Regular reviews of data quality are conducted by site and corporate teams prior to resource estimation, in addition to external reviews. The database is regularly backed up, and copies are stored in both offsite and in Newcrest facilities.

Sample security at the Cadia Operations has not historically been monitored. Sample collection from drill point to laboratory relies upon the fact that samples are either always attended, or stored in the locked on-site preparation facility, or stored in a secure area prior to laboratory shipment. Chain-of-custody procedures consist of sample submittal forms to be sent to the laboratory with sample shipments to ensure that all samples are received by the laboratory.

In the opinion of the QP, the sample preparation, analysis, and security practices and results are acceptable, meet industry-standard practice, and are sufficient to support Mineral Resource and Mineral Reserve estimation and mine planning purposes at Cadia East and Ridgeway, and for Mineral Resource estimation at Cadia Extended and Big Cadia. Confidence classification restrictions were placed on the Big Cadia data.

1.8 Data Verification

Newcrest includes both internal verification processes and independent third-parties in the data verification steps:

- Internal verification: laboratory inspections; review of geological procedures, resource models and drill plans; sampling protocols, flow sheets and data storage; specific gravity data; logging consistency, down hole survey, collar coordinate and assay QA/QC data; geology and mineralisation interpretation;

- External verification: December 2011 review of the acQuire resource development database by Minffordd Pty Ltd; March 2013 review of resource development and ore control databases by acQuire Technology Solutions (ATS); review of the 2016 Cadia East resource model by SRK Consulting (Australasia) Pty Ltd (SRK); and reviews of the 2015 Cadia Extended and Big Cadia models by SRK in late 2015.

The QP, who relies upon this work, reviewed the reports and is of the opinion that the data verification programs indicate that the data stored in the project database accurately reflect original sources and are adequate to support geological interpretations and Mineral Resource estimation. They can support Mineral Reserve estimation and mine planning at Cadia East and Ridgeway.

A specific verification program was conducted on the Big Cadia data, including performing resource estimation with and without the legacy data included. Newcrest concluded that estimation would benefit from legacy data inclusion, but until check drilling could be undertaken, confidence classifications should be restricted to Inferred Mineral Resources.

Observations made during the QP's site visits, in conjunction with discussions with site-based technical staff also support the QP's conclusion that Newcrest's processes for geological interpretations, and analytical and database quality are being followed.

Newcrest has implemented a steering committee, the Resources & Reserves Steering Committee, to ensure appropriate governance of development and management of resource and reserve estimates, and the public release of those estimates. This is achieved by ensuring regular Resources & Reserves Steering Committee review meetings, internal competent reviews, and independent external competent reviews. The QP's role as the chair of the Resources & Reserves Steering Committee includes review of the estimation processes in place for Mineral Resource and Mineral Reserve estimation, mine planning, and the control procedures in place to ensure the process is being executed as intended.

1.9 Metallurgical Testwork

Metallurgical testwork and mineralogical information supporting the process design and metal recovery estimates included: optical mineralogy; X-ray diffraction (XRD) and mineral laboratory analysis (MLA); comminution tests (drop-weight (DWi), SAG mill comminution (SMC), Bond ball work index (BWi), rod work index (RWi), abrasion (Ai); rougher and cleaner flotation tests, gravity testwork, primary grind and regrind size sensitivity tests; evaluation of alternate reagents; flash flotation testing, fluorine depression batch flotation tests and locked cycle flotation tests.

Laboratories and testwork facilities used during metallurgical evaluation included AMML, ALS Townsville, ALS Brisbane, Metso Minerals Process Technology, JKTech, Metcon, Enviromet, Optimet, Amdel, Normet, and Lakefield Laboratory (Canada).

Overall, samples selected for metallurgical testing during feasibility, development and expansion studies were representative of the various styles of mineralisation within the different mineralised zones. Samples were selected from a range of locations and metal grades within the deposit zones. Sample density is acceptable for forecasting purposes. Cadia East and Ridgeway can be described as "well behaved" porphyry copper deposits where the mineralogical drivers of metallurgical performance are well understood, risks were recognised and appropriate industry standard mitigating actions are identified.

Newcrest operates two adjacent concentrators, Concentrator 1 and Concentrator 2, currently treating ore from the Cadia East mine. Both concentrators have undergone throughput improvement programs.

Overall average LOM recovery forecasts for Cadia East are 80% gold recovery and 85% copper recovery (inclusive of the proposed Cadia plant upgrades). These recovery forecasts include modifying factors to allow for scale-up from the laboratory testwork, recent upgrades to the gravity circuits and the use of Jameson cells and coarse ore flotation using HydroFloat technology. The latter provide a step-change improvement over the standard rougher-cleaner laboratory test. Molybdenum recovery for Cadia East ores is driven by molybdenum grain type, which correlates to increases in head grade. For the new molybdenum plant, it is estimated that the overall recovery of molybdenum to a molybdenum concentrate (relative to plant feed) will be 72%.

Algorithms were developed for Ridgeway copper and gold recoveries based both on plant performance and metallurgical testwork. Recovery forecasts for the overall LOM are 81% for gold, and 87% for copper.

Fluorine is the only known deleterious element identified at Cadia East. Jameson cells were installed in the plant to remove fluorine from the copper concentrate. The first Jameson cell was installed in Concentrator 1 in 2013, followed by Concentrator 2 in 2016. In 2017, two additional Jameson cells were installed into Concentrator 1. Since 2017, all material within the plant has been processed through a Jameson cell giving maximum fluorine rejection, and thereby unlikely that fluorine levels in copper concentrate will exceed the maximum contractual limits over the LOM.

During its operating history, Ridgeway produced a high-quality copper concentrate with high gold grades, payable silver credits and relatively low levels of impurities that did not attract a penalty from smelters. There are expected to be no deleterious elements in any Ridgeway Lift 2 concentrates. This forecast is supported by resource analyses that do not indicate any change in geochemistry which is likely to impact on sales of concentrate derived from the Ridgeway Lift 2 material.

1.10 Mineral Resource Estimation

1.10.1 Cadia East

The database close-out date for the Cadia East Mineral Resource estimate is 21 June, 2016.

Modelling used wireframes of the rock types, structures and a 0.1% Cu grade shell. The resource model is also based on an updated structural model and a new lithological model that uses multi-element geochemistry.

Histograms of all elements were prepared by domain to ensure that domains were valid. Domain boundary contacts were defined as either soft or hard. Sample intervals were not uniformly assayed for all elements. The majority of silver and fluorine assays are 10 m composite intervals that overlap the smaller (typically 2 m) gold and copper sample intervals so 10 m composites were used for all elements. Metal contained in the top 1% and 5% of composites was assessed to determine if top-cuts were required. No top-cuts were applied for any element. Intervals for bulk density determination were selected according to lithology/alteration/mineralisation. Density was assigned to the resource model by lithology and gold grade. The block model was used to flag composite files which included lithology, structural domains, estimation domains and the 0.1% Cu grade shell. Composite intervals did not include missing data or non-sampled intervals. Pairwise experimental variograms were generated for each estimation domain.

Quantitative kriging neighbourhood analysis (QKNA) assessments were focused on the maximum number of samples and search distances to be used in the block estimate. Estimation was undertaken using ordinary kriging (OK) into a block size of 20 m (E) x 20 m (N) x 20 m (elevation). The principal elements estimated were gold and copper. Minor elements estimated included silver, molybdenum, fluorine, and sulphur.

The block model and informing composites were validated using a combination of visual inspection in plan and section, nearest-neighbour model comparison, swath plots, grade–tonnage curves, and direct block simulation.

Classification of the resource model was based on drill hole density, grade and geological continuity using the average weighted distance to data in conjunction with the gold slope of regression. All Mineral Resources are classified as Indicated at Cadia East. No Measured or Inferred Mineral Resources were classified.

The Cadia East Mineral Resource estimate is reported within a potentially economic outline determined by the net smelter return (NSR) values of each block in the resource model. The NSR is the estimated proceeds from the sale of mineral products after the application of metal recoveries and deduction of transport, smelting, refining and marketing charges, as well as royalty payments. The reporting confines were expanded (in places) to fully encompass the panel cave footprints. Because of the lack of selectivity of the panel caving mining method, the entire in-situ contents of the outline were reported. Using the reported resource metal price assumptions and costs aligned with the current and future expected recoveries and charges Mineral Resources are reported above an A$18.71 NSR. Inputs to the NSR include: metallurgical recovery assumption of 80% gold recovery; 85% copper recovery; estimate reported within an NSR constraint of A$18.71/t that includes mine operating cost of A$5.31/t, mine sustaining capital cost of A$0.79/t, mineralisation treatment operating cost of A$8.30/t, mineralisation treatment sustaining capital cost of A$0.89/t, tailings dams sustaining capital cost of A$0.75/t, and general and administration (G&A) cost of A$2.67/t. Metal price assumptions were US$1,300/oz for Au and US$3.40/lb for Cu. The exchange rate for metal price conversion purposes was assumed to be A$1 = US$0.75.

1.10.2 Ridgeway

The database close-out date for the Ridgeway Mineral Resource estimate is 31 March, 2009.

The geological inputs for the Ridgeway resource model were constructed by incorporating all available drill holes (surface and underground) and data collected from the underground mining levels. Six geological domains, seven structural domains, and six grade domains were used in estimation. Some structural domains had hard boundaries.

Composite lengths of 2 m and 4 m were tested to verify the optimum length, and the 4 m length was selected to support estimation of gold and copper. Bulk density was assigned by domain. No grade caps were applied during estimation. Variograms were modelled for gold, copper, silver and sulphur within each estimation domain.

Estimation parameters for the Ridgeway resource model were optimised using QKNA. Blocks were interpolated using OK into a block size of 25 m(E) x 25 m(N) x 25 m(elevation). The principal elements estimated were gold and copper. Minor elements estimated included silver and sulphur.

The Ridgeway models were validated by: filtering the models and checking for any un-estimated blocks; comparing the global statistics of each domain and variable with the corresponding block estimates; comparing the composite and block grades in slices throughout the deposit; locally comparing drill holes and estimated blocks in cross-section and plan; and comparing the models to the previous estimate by area and level. No material issues or biases were identified.

The Ridgeway resource classification was reviewed with relation to sample density, hole spacing, survey method, geological interpretation and confidence in the geological model (especially fault projection) and geologically through slope of regression. Mineral Resources were classified based on the following assumptions within a 0.2 g/t grade shell:

- Indicated Mineral Resources: an average weighted sample distance of <60 m;
- Inferred Mineral Resources: an average weighted sample distance of 60–100 m.

The estimate assumed an underground mass mining method, likely block/ panel caving, and a change in the mining method at 5040m RL, from sub-level caving to block caving.

Mineral Resources were reported using an A$18.71/t NSR cut-off, based on the following input parameters: copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t. These inputs are based on Cadia East as an analogue.

A validation check in 2019 indicated that due to a combination of changes in input price assumptions and mine operating cost assumptions, and the non-selective nature of the block cave process, the shell inputs remain appropriate.

1.10.3 Cadia Extended

The database close-out date for the Cadia Extended Mineral Resource estimate is 16 April, 2015. The estimate uses lithology (monzonite, volcanic rocks, sedimentary rocks and cover), oxidation, and Steep Fault wireframes, and grade shells for gold, copper and molybdenum.

The statistical characteristics of the gold, copper, molybdenum, silver, and sulphur assays were reviewed. The copper grade shell boundary was treated as hard during estimation. Composites were standardised at 10 m. Grade caps were applied to gold, copper and molybdenum data. Bulk density was assigned by lithology. Variograms were modelled for all domains for all elements.

Estimation parameters were optimised using QKNA. Blocks were interpolated using OK into a block size of 20 m (E) x 20 m (N) x 20 m elevation. Copper, gold, silver, sulphur and molybdenum were estimated.

Models were validated using a combination of visual inspection, NN block model and declustered mean analysis, swath plots, and discrete Gaussian change of support models. No material issues or biases were identified.

Blocks that had copper estimates from drill holes that were within a 60 m spacing were classified as Indicated Mineral Resources. All other blocks were classified as Inferred Mineral Resources. No Measured Mineral Resources were classified.

The Mineral Resource estimate is constrained by an outline that approximates the degree of selectivity afforded by a block cave mining method. The block cave conceptual design includes dilution, assumes vertical side stopes between 150–400 m height, 120 m minimum diameter (would require hydro-fracturing for cave propagation), draw scheduling limited to simple coning off top of cave, and no allowance for draw levels. Mineral Resources were reported using an A$18.71/t NSR cut-off, based on the following input parameters: copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t. These inputs are based on Cadia East as an analogue.

1.10.4 Big Cadia

The database close-out date for the Big Cadia Mineral Resource estimate is 27 May, 2015. Models included lithology (limestone, monzonite, volcanic units and sedimentary units), oxidation surfaces (base of complete oxidation, and top of fresh rock), alteration (inner or massive skarn consisting of magnetite/hematite without epidote, and outer or transitional skarn consisting of magnetite/hematite with epidote), and PC40 Fault. No specific mineralisation shells were constructed. The mineralisation is intimately related to the magnetite–epidote alteration.

The statistical characteristics of the gold, copper, molybdenum, silver, and sulphur assays were reviewed. The oxide surface is ‘hard’ for copper and sulphur; therefore, the upper skarn was split into oxide and transitional/fresh domains for estimation. Composites were standardised at 4 m. Grade caps were applied to gold, silver, copper sulphur and molybdenum data. Bulk density was assigned by lithology and oxidation state. Variograms were modelled for all domains for all elements.

Estimation parameters were optimised using QKNA. Block grades were interpolated using OK into a block size of 25 x 25 x 5 m. Copper, gold, silver, sulphur and molybdenum were estimated.

Models were validated using a combination of visual inspection, swath plots, and discrete Gaussian change of support models. No material issues or biases were identified.

Due to data support issues with the inclusion of >50% legacy data, all blocks were classified as Inferred.

Mineralisation crops out on surface. Conventional open pit mining methods were assumed. Mineral Resources are confined within a conceptual open pit shell and reported above an NSR cut-off.

Depletion for historical mining activities was included. Historical drawings of shafts, underground drives and pit slopes were digitised, transferred to current grid references and grades re-set within the model to background values.

1.10.5 Stockpiles

Stockpiles generated from the mining of the former Cadia Hill open pit are estimated as Measured Mineral Resources. The Mineral Resource estimate uses data from grade control protocols during operations with the cut-off based on revenue and costs at the time of production. The grade control evaluation used a combination of blasthole sampling; gold, copper, cyanide-soluble copper and sulphur assays, domains defined by in-pit mapping of structural/thrust truncations and key lithologies, and OK interpolation. Stockpile tonnes and grades are built up from a combination of truck and survey data, and modelled in three dimensions. No allowance for potential degradation in metallurgical recoveries is included.

1.11 Mineral Resource Statement

Mineral Resources are reported with an effective date of 30 June, 2020, and are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

The Qualified Person for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title at Newcrest is Head of Mineral Resource Management. Mr. Gleeson is a Newcrest employee.

Mineral Resources for Cadia East are included as Table 1-1. Mineral Resource estimates for Ridgeway are provided in Table 1-2 and Table 1-3. Table 1-4 presents the Mineral Resource estimate for Cadia Extended, Table 1-5 shows the estimate for Big Cadia, and Table 1-6 summarises the stockpile estimate.

Areas of uncertainty that may materially impact the Mineral Resource estimates include: changes to long-term metal and exchange rate price assumptions; changes in local interpretations of mineralisation geometry, structures, and continuity of mineralised zones; changes to geological and grade shape and geological and grade continuity assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the conceptual underground mass mining methods used to constrain the estimates; changes to the to the input assumptions used in the constraining pit shell for those Mineral Resources amenable to open pit mining methods; changes to the NSR cut-offs applied to the estimates; variations in geotechnical (including seismicity), hydrogeological and mining assumptions; and changes to environmental, permitting and social license assumptions.

Table 1-1: Measured and Indicated Mineral Resource Statement, Cadia East

Resource Classification	Tonnes (Mt)	Grade				Contained Metal			
		Au (g/t)	Cu (%)	Ag (g/t)	Mo (ppm)	Au (Moz)	Cu (Mt)	Ag (Moz)	Mo (Mt)
Measured	—	—	—	—	—	—	—	—	—
Indicated	2,900	0.35	0.26	0.68	64	33	7.4	63	0.19
Total Measured and Indicated	***2,900***	***0.35***	***0.26***	***0.68***	***64***	***33***	***7.4***	***63***	***0.19***

Notes to Accompany Cadia East Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources that have been converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources that are potentially amenable to underground mass mining methods are based on the following assumptions: conceptual panel cave outline; due to the non-selective nature of this mining method, the entire volume within the outline is reported including internal dilution; metallurgical recovery assumption of 80% gold recovery; 85% copper recovery; estimate reported within a net smelter return (NSR) constraint of A$18.71/t that includes mine operating cost of A$5.31/t, mine sustaining capital cost of A$0.79/t, mineralisation treatment operating cost of A$8.30/t, mineralisation treatment sustaining capital cost of A$0.89/t, tailings dams sustaining capital cost of A$0.75/t, and general and administration (G&A) cost of A$2.67/t. Commodity price assumptions are US$1,300/oz gold, US$3.40/lb copper, US$21/oz silver and US$10/lb molybdenum, and exchange rate for metal price conversion of A$:US$ 1:0.80.
4. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper and molybdenum tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 1-2: Measured and Indicated Mineral Resource Statement, Ridgeway

Resource Classification	Tonnes (Mt)	Grade			Contained Metal		
		Au (g/t)	Cu (%)	Ag (g/t)	Au (Moz)	Cu (Mt)	Ag (Moz)
Measured	—	—	—	—	—	—	—
Indicated	110	0.57	0.30	0.74	1.9	0.31	2.5
Total Measured and Indicated	***110***	***0.57***	***0.30***	***0.74***	***1.9***	***0.31***	***2.5***

Table 1-3: Inferred Mineral Resource Statement, Ridgeway

Resource Classification	Tonnes (Mt)	Grade			Contained Metal		
		Au (g/t)	Cu (%)	Ag (g/t)	Au (Moz)	Cu (Mt)	Ag (Moz)
Inferred	41	0.38	0.40	0.43	0.50	0.17	0.56

Notes to Accompany Ridgeway Mineral Resource Tables:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources that have been converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources that are potentially amenable to underground mass mining methods are reported using the following assumptions: an A$18.71/t net smelter return (NSR) cut-off; copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t.
4. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 1-4: Measured and Indicated Mineral Resource Statement, Cadia Extended

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Measured	—	—	—	—	—
Indicated	80	0.35	0.19	0.89	0.15
Total Measured and Indicated	***80***	***0.35***	***0.19***	***0.89***	***0.15***

Notes to Accompany Cadia Extended Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources that are potentially amenable to underground mass mining methods are reported using the following assumptions: A$18.71/t net smelter return (NSR) cut-off; copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 1-5: Inferred Mineral Resource Statement, Big Cadia

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Inferred	11	0.70	0.52	0.25	0.058

Notes to Accompany Big Cadia Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources that are potentially amenable to open pit mining methods are reported using the following assumptions: gold price: US$1,300/oz Au; copper price: US$3.40/lb Cu; exchange rate for metal price conversion of A$1 = US$0.80; transport costs: US$72.95/wmt (consists of two inputs, US$35.70, and $A43.82, converted to US$); royalty: 4%; gold refining costs: A$6.00/oz; copper refining cost: A$0.09/lb; concentrate treatment cost: US$90/dmt; processing cost: A$8.30/t; general and administrative cost: A$2.83/t; metallurgical recoveries that are based on metallurgical recovery algorithms.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 1-6: Measured and Indicated Mineral Resource Statement, Cadia Stockpiles

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Measured	32	0.30	0.13	0.31	0.041
Indicated	—	—	—	—	—
Total Measured and Indicated	***32***	***0.30***	***0.13***	***0.31***	***0.041***

Notes to Accompany Cadia Stockpiles Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources within stockpiles are reported using the following assumptions: copper price of US$3.40/lb, gold price of US$1,300/oz; exchange rate for metal price conversion of A$1 = US$0.75; processing costs of A$9.94/t milled (including rehandling costs), general and administrative (G&A) costs of A$2.87/t milled, metallurgical recoveries of 81% for gold, and 87% for copper.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

1.12 Mineral Reserve Estimation

Mineral Resources were converted to Mineral Reserves at Cadia East and Ridgeway. The Cadia East mine is operating; the Ridgeway mine is currently on care-and-maintenance.

Mine designs supporting the Mineral Reserves were based on the most recently approved pre-feasibility and feasibility studies, and the operating mine life-of-mine plans.

Metal price assumptions consisted of US$1,200/oz Au, US$3.00/lb Cu, US$18.00/oz Ag, and US$8/lb Mo, and an exchange rate of A$1 = US$0.75.

Cost estimates used in the preparation of the Mineral Reserves are based on the most recent studies approved by Newcrest relating to the exploitation of the two deposits. The Mineral Reserves include material that when delivered to the mine portals has a recovered value greater than the cost of all downstream processes, including fixed costs.

Mineral Reserves were estimated assuming bulk underground mining processes:

- Cadia East is a panel caving operation. Panel caving operations have large footprints and it is not necessary to develop all of the drawpoints for caving to occur. After full caving is established, the remaining drawpoints are progressively constructed and the cave is extended over the new drawpoints;
- Ridgeway is a block cave mine. In block caving operations, most of the drawpoints are fully constructed before caving can progress sufficiently to enable the full production rate to be achieved.

1.12.1 Cadia East

The basic methodology employed to complete mine designs included: creation of drawbell footprints; extraction and undercut layouts were designed and access, infrastructure and related ventilation and materials handling development were added to build total mine design; all design was undertaken using mine design and geotechnical parameters; geotechnical modelling was undertaken on mine design to determine stability and highlight problem areas that need modification; and final mine design was completed using geotechnical recommendations.

Other relevant geotechnical mine design parameters included: 20 m minimum undercut extension; 40 m undercut and extraction level perimeter minimum offsets; and 5050 level monitoring drive offsets.

Draw-column heights were limited by an NSR shut-off of A$18.71/t. A breakeven cut-off for ore:waste delineation of A$13.34 was used. Mining footprints were determined using a cost of A$750,000 per drawpoint, or A$1.5 million per drawbell. All drawpoints with a positive net present value (NPV) were considered, with the assumption that all draw columns will be mined to a profitable height after the cost of cave establishment has been sunk. Internal dilution was incorporated into the mine plan.

The Mineral Reserves estimate assumes that the molybdenum plant will commence operations during calendar year 2021. The economic analysis that supports the Mineral Reserves assigns revenue from molybdenum only after 1 July 2021. As a result, the molybdenum tonnage estimate shown in the Mineral Reserves excludes the ore that will be mined prior to the molybdenum plant start-up, as any molybdenum in that material would not be recovered in the current mine plan assumption.

1.12.2 Ridgeway

Mine plans were based on the extraction of caving blocks solely delineated on the basis of Indicated material. Dilution is included within the Probable Mineral Reserve.

The NSR calculation takes into account reserve revenue factors, metallurgical recovery assumptions, transport costs and refining charges and royalty charges. The site operating costs include mining cost, processing cost, relevant site general and administration costs and relevant sustaining capital costs. This cost equates to a break-even NSR cut-off (equivalent to a shut-off value) of approximately A$20/t milled. All drawpoints with a positive NPV were considered, with the assumption that all draw columns will be mined to a profitable height after the cost of cave establishment has been sunk.

Economic footprints were generated in runs of the “Footprint Finder” software and in level by level evaluation using the commercially-available PCBC software. The overall footprint size increases with depth but this is due to a monzonite intrusion piercing the lower mineralisation. The resultant footprint perimeter was finalised based on a layout template using a 32 x 20 m reverse offset herringbone. The block height of 300 m was based on the extraction elevation of Ridgeway Deeps Lift 2 extraction level up to the extraction elevation of the Ridgeway Deeps Lift 1 block cave.

1.13 Mineral Reserve Statement

The Qualified Person for the estimate is Mr. Geoffrey Newcombe, FAusIMM, whose job title at Newcrest is PC1-2 Study Manager. Mr. Newcombe is a Newcrest employee.

Mineral Reserves are reported in Table 1-7 with an effective date of 30 June, 2020.

The Mineral Reserves are forward-looking information and actual results may vary.

Areas of uncertainty that may materially impact the Mineral Reserve estimates include: changes to long-term metal price and exchange rate assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the cave outlines and the mine plan that is based on those cave designs; changes to operating and capital cost assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates; variations in geotechnical, mining, dilution and processing recovery assumptions, including changes to designs as a result of changes to geotechnical, hydrogeological, and engineering data used; changes to the shut-off criteria used to constrain the estimates; ability to source power supplies if the assumption of system intact conditions cannot be met; ability to obtain sufficient water to meet operational needs; changes to the assumed permitting and regulatory environment under which the mine plan was developed; ability to permit additional TSF capacities or facilities; ability to maintain mining permits and/or surface rights; ability to obtain operations certificates in support of mine plans; ability to obtain and maintain social and environmental license to operate.

1.14 Mining Methods

1.14.1 Cadia East

The current operations are planned as a series of three lifts (Lifts 1, 2, and 3). The relative elevation of these lifts and all underground infrastructure is expressed in mine height datum which is 5,000 m above AHD (i.e. 5,900 m mine Relative Level (RL) is equivalent to 900 m AHD). Lifts 1 and 2 are approximately 1,200–1,400 m high with their bases located at approximately 4650 mRL and 4450 mRL. Lift 3 sits below Lift 2 with a block height of 275 m and a base at the 4,175 mRL. Lift 1 refers to the following panel caves: PC1–1, PC1–2, PC1–4, PC5001. Lift 2 refers to the following panel caves: PC2, PC2–3, PC2–4 and PC2–5. Lift 3 refers to the following panel cave: PC 3–1.

Cadia East is accessed via two declines, the main access decline, and the conveyor decline.

The mining method involves inducing caving of the rock mass by undercutting a block of ore. Mining proceeds by progressively advancing an “undercut” level beneath the block of ore. Above the undercut level, the overlying host rocks are pre-conditioned using blasting and/or hydraulic fracturing, resulting in controlled fracturing of the ore block.

Following pre-conditioning of the overlying host rocks, broken ore is removed through an extraction level developed below the undercut level. The extraction level is connected to the undercut level by drawbells, through which the ore gravitates to drawpoints on the extraction level. The ore is removed by a load–haul–dump (LHD) fleet to underground crushing stations.

Table 1-7: Mineral Reserves Statement

Probable Mineral Reserve	Tonnage (Mt)	Grade			Contained Metal		
		Au (g/t Au)	Cu (% Cu)	Ag (g/t Ag)	Au (Moz)	Cu (Mt)	Ag (Moz)
Cadia East Underground	1,400	0.44	0.29	0.78	19	4.0	34
Ridgeway Underground	80	0.54	0.28	0.66	1.4	0.23	1.7
Total	***1,400***	***0.45***	***0.29***	***0.77***	***21***	***4.2***	***36***

Probable Mineral Reserve	Tonnage (Mt)	Grade Mo (ppm)	Contained Metal Mo (Mt)
Cadia East Underground	1,300	88	0.12
Total	***1,300***	***88***	***0.12***

Notes to Accompany Mineral Reserves Table:

1. Mineral Reserves are reported with an effective date of 30 June, 2020, using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Geoffrey Newcombe, FAusIMM, whose job title at Newcrest is PC1-2 Study Manager, and who is a Newcrest employee.
2. Mineral Reserves are reported on a 100% basis.
3. Mineral Reserves for Cadia East are reported using the following assumptions: panel cave mining method; gold price of US$1,200/oz, copper price of US$3.00/lb, silver price of US$18/oz, molybdenum price of US$8/lb; US$A$ exchange rate of 0.75; net smelter return (NSR) cut-off of A$18.71/t. The molybdenum tonnage estimate assumes that the molybdenum plant is not operational until 1 July 2021.
4. Mineral Reserves for Ridgeway are using the following assumptions: block cave mining method; gold price of US$1,200/oz, copper price of US$3.00/lb, US$A$ exchange rate of 0.75; NSR cut-off of A$20.35/t milled.
5. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper and molybdenum tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
6. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content and summation totals. Rounding is to two significant figures.

At each crushing station, ore is tipped into a coarse ore bin, which then feeds the crusher itself which passes material to a surge bin used to regulate the feed from the crushing station onto the collection conveyors. The collection conveyors are in turn used to regulate feed onto the main trunk belt system and to allow for the automated removal of tramp metals.

The main trunk belt transports ore to the surface at a rate of approximately 4,600 t/h (with work underway to upgrade this to 5,150 t/h). The incline conveyor commences at 4,400 mRL (i.e. the base of Lift 2), extends approximately 7,500 m to the surface and is deposited onto the concentrator coarse ore stockpile where it is gravity-fed into the ore processing system.

Waste rock is removed from the underground workings via the decline and is hauled to the South Waste Rock Facility.

Intact rock strength and competency generally increases with depth and to the east of the mine operations at Cadia East. An overall geotechnical block model was created for the Cadia underground mining area, and divided into five areas. Modelling results suggested that some of the known faults could influence cave development, and that effective homogeneous preconditioning could increase the recovery of ore by having more material caved from the flanks, and prevent potential hangs-up in the areas that were not caved due to lower intensity hydraulic fracturing.

Cave initiation will commence adjacent to existing caves for operations on the Lift 1 and Lift 2 levels. Cave 3 will be initiated under the existing Lift 2 caves. Hydraulic fracturing activities will be conducted in two main functional areas, the orebody and infrastructure areas.

Hydrogeological reviews indicated that estimated groundwater inflows to the Cadia East mine show a rising trend in the inflow over time from 0.3 ML/day to about 1.2 ML/day. Discharge of groundwater in the field will occur in two main areas, baseflow into creeks and into mining voids. The mine is currently pump dewatered. There is no discharge of mine dewatering to the environment, with water reused in processing facilities or recycled into the underground operations.

An El Teniente layout will be used for the extraction level. A number of undercutting processes are planned for Cadia East, including post undercut, and W-cut advanced undercut with apex drive. A monitoring and cave engineering horizon was designed for the 5050 mRL. Additional intake and exhaust ventilation requirements are incorporated in the mine design to accommodate an annual production rate of 33–35 Mt/a.

Infrastructure required to support each cave will include primary crushers, four-way tipple arrangements, ROM and crushed ore bins, and conveyor systems.

Equipment requirements include primary development, cave development, and production equipment. A secondary production fleet will support this equipment. These equipment types are conventional to panel cave mining operations.

Maintenance workshop facilities, refuelling station, crib rooms, and offices will support the underground operations. The existing 33 kV and 11 kV electrical distribution systems will be extended to supply power to the operating caves.

1.14.2 Ridgeway

The majority of the Mineral Reserves for Ridgeway are located in the Ridgeway Deeps Lift 2 block cave. This cave is similar in nature to the original Lift 1 cave with a similar downdip extension depth, similar layout and establishment method, and operational targets for 8 Mt/a.

The block cave extraction level for Lift 2 will be located approximately 290 m vertically below the existing Lift 1 extraction level (4500 mRL). There are several mine-scale structures that are likely to affect the geomechanical behaviour of caving, and have an impact on local stability in the undercut and extraction levels of the mine and cave propagation. The geotechnical block model indicates a range of rock mass conditions; generally, the northern region of the footprint is relatively more competent (poor to good quality rock mass), when compared to the southern region (very poor to poor rock mass). Based on previous experience in the Ridgeway Deeps Lift 1 block cave, a significant contrast in drawpoint fragmentation can be expected between the volcanic and sedimentary rocks, and monzonite. The use of post undercut and rock mass preconditioning in Ridgeway Deeps Lift 1 minimised this contrast in drawpoint fragmentation between lithologies.

The design criteria for the pumping system were assumed to be unchanged from Ridgeway Deeps Lift 1 block cave with expected normal flows of 10–30 L/s, and capable of handling emergency flows of 85 L/s. An extension of the existing Ridgeway Mine dewatering watering system is assumed, with the existing pumping infrastructure remaining in use.

Ridgeway is accessed by two declines, the main access and conveyor declines. These would be extended to the Lift 2 workings.

The production rate for the block caving option is based on current expectations for the Ridgeway materials handling system and the relative similarity in footprint dimensions of the Ridgeway Deeps Lift 2 block cave to the Ridgeway Deeps Lift 1 block cave. The mine design for Lift 2 assumes an offset herringbone extraction pattern. A total of 248 draw points will be opened.

Additional intake and exhaust ventilation requirements are incorporated in the mine design to accommodate a base annual production rate of 8 Mt/a.

The Ridgeway Deeps Lift 1 block cave design is assumed to be carried over to Lift 2, with modifications where appropriate. This is also the basis of the mine development plan, essentially replicating the existing ore handling system to accommodate the second block caving lift.

Additional infrastructure required will include new crushing chambers and jaw crushers.

Equipment requirements include primary development, cave development, and production equipment. A secondary production fleet will support this equipment. These equipment types are conventional to block cave mining operations.

New workshop and ablutions facilities will be constructed. The existing Ridgeway Deeps Lift 1 HV ring is an extension of the original ring and is close to capacity. A desktop demand study indicates an additional 4–5 MW electrical power will be required for Ridgeway Deeps Lift 2. The new high voltage ring through the Ridgeway Deeps Lift 2 developments will be of similar configuration to Ridgeway Deeps Lift 1 design, using similar substation layouts and equipment.

The production plan has Cadia East being mined first, followed by Ridgeway Deeps.

1.15 Recovery Methods

There are two operational concentrators. Concentrator 1 was commissioned in 1998 utilising a conventional semi-autogenous grinding (SAG) mill, pebble crush and ball mill (SABC) circuit, and had a design capacity of 17 Mt/a. This circuit was upgraded in 2012 for the processing of Cadia East ore with the addition of a high-pressure grinding rolls (HPGR) circuit and third processing train to achieve a design capacity of 20 Mt/a. Concentrator 1 currently operates at a nominal rate of 23 Mt/a with the improved rate the result of several operational improvements.

Concentrator 2 was commissioned in 2002 using fully autogenous grinding (AG) and had a target capacity of 4 Mt/a. This concentrator has undergone several upgrades since commissioning (including a conversion to SAG milling, the addition of a Vertimill in a tertiary milling duty, additional regrind capacity, the addition of secondary and tertiary crushing ahead of the SAG mill, and flotation circuit debottlenecking), and currently operates at a rate of 7 Mt/a.

Concentrator 1 consists of: a gyratory crusher crushing excess ore stockpiled on the surface; a screening plant; two cone crushers for secondary crushing of screen oversize; a HPGR for further size reduction ahead of SAG milling; a single 20 MW SAG mill in open circuit configuration with oversize pebbles returning to the screening plant; three ball mills in closed circuit with hydrocyclones; flash flotation and gravity concentrator processing of hydrocyclone underflow, gravity concentrator processing of flash flotation concentrate; and rougher and scavenger flotation of the slurry from three ball mill circuits (i.e. flotation trains 1, 2, and 3) with concentrate reporting to regrind mills; a coarse ore flotation circuit using HydroFloat technology on train 3 rougher tailings; cleaner flotation circuits using both conventional and Jameson cell technology; and thickening of rougher tailings before pumping to the tailings storage facilities.

Concentrator 2 consists of: an overland conveyor system transporting ore from the main coarse ore stockpile (COS) to the processing plant; secondary and tertiary crushing using conventional cone crushers; a SAG mill in closed circuit with two pebble crushers; a ball mill and Vertimill (0.93 MW) in closed circuit with hydrocyclones for secondary grinding; another Vertimill (2.2 MW) for tertiary grinding; flash flotation and gravity concentrators processing hydrocylone underflow; additional gravity concentrator treating flash flotation concentrate; and rougher and scavenger flotation (conventional cells) processing grinding circuit product; regrind mill; cleaner flotation stages utilising both conventional and Jameson flotation cells; thickening of rougher tailings before pumping to tailings storage facility; and thickening of final gold/copper concentrate product.

The combined, thickened copper concentrate slurry, with a grade of 23–26% copper, is pumped to Blayney where it is filtered and railed to Port Kembla before export. Approximately 15% of the gold in feed ore is recovered from the gravity concentrator product via shaking tables and then smelted on site to produce gold doré for sale.

Recent studies envisage increasing total combined plant capacity from 30 Mt/a to 33 Mt/a, and up to 35 Mt/a. Higher plant throughput will be achieved through debottlenecking projects such as the installation a third secondary crusher and associated conveyor upgrades for Concentrator 1. In the case of Concentrator 2, debottlenecking is to include upgrades to the secondary and tertiary crushers and associated conveyors, and upgrade to primary cyclone feed pumps and cyclones. Studies have commenced to investigate downstream flotation and dewatering requirements to handle the planned higher throughputs. Additional tertiary milling and rougher flotation capacity will assist in maintaining or improving overall plant recovery.

The Concentrator 1 upgrade is likely to see the further use of a coarse ore flotation circuit treating combined train 1 and 2 rougher tailings with the reground concentrate processed via existing and new flotation cells.

Concentrator 1 uses approximately 60% of the site total power consumption, with Concentrator 2 using a further 15%. The processing plant uses a combination of on-site recycled water (e.g. thickener overflow and TSF return water) and make-up water. Sources have included Cadiangullong Dam, Rodds Creek Water Holding Dam, Belubula

River, Flyers Creek Weir, Cadia Creek Weir, on-site groundwater extraction bores, and site run-off.

Key processing reagents include collectors, frother, lime, and flocculant with other key materials being mill grinding media.

1.16 Project Infrastructure

Existing project infrastructure includes the following: operating panel cave mining operations at Cadia East; block cave operations at Ridgeway (on care and maintenance); Ridgeway and Cadia declines and conveyor incline boxcuts and portals, hardstand areas, contractor area, mine workshops, general stores building, fuel storage facility, and administration and ablution facilities; underground crushing, handling and incline conveyor systems to transfer ore and waste rock mined from Cadia East and Ridgeway to the Cadia Operations processing facilities; ventilation shafts; Concentrator 1 and Concentrator 2, molybdenum plant (under construction); TSFs and associated tailings pipelines, pumps and tailings water return infrastructure; concentrate dewatering facilities; concentrate loading and handling facilities; water management structures; water pipelines and pumping stations; electrical substations and associated electrical infrastructure; support facilities such as truck and vehicle shops, warehouse, offices, clinic and emergency response facilities, and environmental monitoring facilities.

The Cadia expansion will require the debottlenecking equipment discussed in Section 1.15, as well as a new office complex and change house at Cadia East, a high compression thickening facility, new TSF pipelines, and a concentrator load-out shed expansion.

All required road accesses to support the LOM plan are in place. As the Cadia Operations are a drive-in-drive-out site, there are no accommodation requirements.

Power is currently supplied by the state-owned electricity firm, Essential Energy, from Orange via a dedicated high voltage transmission line with a transfer capacity limit of 284 MVA. The site power consumption is approximately 150 MW with 40 MW used for underground mining and 110 MW for the process plants. With a plant throughput increase to 32 Mt/a, the electrical demand will peak at around 190 MVA. Under existing arrangements, the Cadia Operations receive supply at 132 kV from the TransGrid Orange North 132 kV switching station, through an Essential Energy dual-circuit 132 kV transmission line (designated 9 MC and 94G). The combined dual circuit has a technical rating limitation of approximately 300 MVA, and the connection agreement between Essential Energy and Newcrest has a contractual limit of 175 MVA.

Preliminary modelling of the mid-western NSW transmission system identified supply restrictions under various contingent scenarios. Under system intact conditions, the regional transmission system has sufficient capacity to meet the increased power demands of the Cadia expansion project. Capital expenditure is required within the TransGrid transmission system to remove the network constraints under N-1 and N-2 conditions. Formal negotiations are being undertaken with Essential Energy to increase the maximum transfer capacity limits defined within the connection agreement from 175 MVA to 200 MVA. In addition, negotiations are continuing with TransGrid and Essential Energy to identify long-term augmentation works to reduce or eliminate the restrictions within the regional 132 kV transmission network.

1.17 Environmental, Permitting and Social Considerations

Newcrest presently holds a Project Approval for the Cadia East Project (06_0295) under the *Environmental Planning and Assessment Act 1979* (as modified) that provides for mining operations until 30 June, 2031. Newcrest holds an approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that is current until 30 June, 2031.

Detailed baseline studies were completed at each major development stage of the Cadia Operations. It is expected that a number of social, cultural heritage and environmental baseline studies will require updating to support the submission of the proposed Cadia expansion project permitting application. Due to the assumed project start date at the end of the Cadia expansion mine life, no environmental impact assessment or approvals have yet been completed specifically for Ridgeway Lift 2.

1.17.1 Environmental Considerations

Environmental monitoring across the Project includes the following key areas: noise monitoring; air quality monitoring; blast and vibration monitoring; groundwater level and quality monitoring; spring monitoring; surface water flows and quality; aquatic ecosystem monitoring; rehabilitation monitoring; and pollution discharge monitoring.

The Mining Leases require a Mining Operations Plan to be prepared that outlines significant disturbance, rehabilitation plans and mine closure strategies. Development not otherwise covered by existing approvals and Mining Operation Plans will require new authorisations.

1.17.2 Stockpiles

The majority of the surface stockpiles generated from the mining of Cadia Hill and Ridgeway were processed through the concentrator facilities. There are still some stockpiles classified as Mineral Resources at Cadia Hill.

1.17.3 Waste Rock

The current waste rock materials and low-grade ore categories are classified using colour nomenclature that reflects the management approach to that material (yellow, green, blue and pink). Low-grade ore and mineralised waste (yellow and green materials) are placed in accessible parts of the South Waste Rock Facility for reclamation. Blue waste rock can be used as construction material (e.g. for raising of the TSFs). Pink waste material is encapsulated with a combination of a low permeability layer and a cover of blue waste rock over each layer of pink waste material. The cover system is designed to reduce oxygenation and infiltration rates.

1.17.4 Tailings Storage Facilities

There are three tailings storage facilities: the Northern TSF (NTSF), the Southern TSF (STSF), and the mined-out Cadia Hill open pit (Cadia Pit TSF), each of which are located within the Cadia mining lease. Tailings were shown to be non-acid-forming (NAF).

The NTSF design consists of an earth and rock-fill dam, with 10 embankment raises undertaken. All raises since 2005 have involved upstream construction. The STSF is also an earth and rock-fill dam, with, to date, six embankment raises undertaken, also generally using the upstream method.

On March 9, 2018, a mobile slump (the Event) occurred in the southern wall of the NTSF, causing it to lose containment of tailings. The tailings were captured within the basin of the STSF. An Independent Technical Review Board (ITRB) investigation of the Event was completed in April, 2019 and has been publicly released. The ITRB findings were that the dominant factor controlling the location of the Event was the presence of a previously-unidentified lithological unit, the Forest Reef Volcanics (FRV) Unit A, which forms a low-density foundation layer within a variably weathered volcaniclastic succession that has a complex geological history. This material, noted the ITRB, has only been found near the failure zone. The key ITRB recommendations were that Newcrest:

- Continue to work on ensuring that the design and maintenance of the foundations take into account any weak material comparable to that in the area of the NTSF slump, as well as the limited drainage within the body of both the NTSF and STSF and the potential for liquefaction of the tailings;
- Enhance the level and type of monitoring equipment, including monitoring within the foundations of the TSFs, to ensure that the foundation is behaving as intended;
- Approach the design, construction and operation of upstream tailings dams using a more precautionary view.

There has been no other abnormal movement in the NTSF wall, or release of material from the NTSF, as of 31 August, 2020. A prohibition notice issued by the NSW resources regulator on depositing tailings in the NTSF remains in place as at 31 August, 2020.

Newcrest engaged expert engineering firms to confirm that the STSF remained safe to operate. Consistent with recommendations from these experts, in 2018 Newcrest commenced construction of buttresses in two areas of the STSF, which have been completed. In designing this buttressing, Newcrest and its external engineers assumed the potential presence of weak material analogous to that in the area of the NTSF slump, and adopted conservative strength parameters.

Newcrest was granted approval on 20 April 2018 to use the former Cadia Hill open pit as a TSF. Modification 13 was approved in late 2019 to allow tailings disposal to a maximum level of 713 mAHD. The elevation raise provides an additional 177 Mt of storage capacity, equivalent to approximately seven years of additional deposition into the TSF.

A new TSF will be required to support the LOM plan plant production after 2037 when existing capacity will be filled.

1.17.5 Water Supply and Water Management

Water supply is characterised by variable supply sources. Water requirements are proportional to the amount of mineral processing and significant water storage is required to provide consistent supply. The amount of water taken from each source is dependent on the conditions set through agreement or licensing and the physical amount available.

The water supply scheme comprises recycling of water used on-site and make-up water required to compensate for losses in the system. Mine water and excess water in the

TSFs are recycled. Make-up water sources comprise extraction from the Belubula River, Cadiangullong Dam, Rodds Creek Water Holding Dam, Flyers Creek Weir, Cadia Creek Weir, Orange Sewage Treatment Plant treated effluent, on-site groundwater extraction bores, and site run-off. Harvesting of water on-site is licenced at 4,200 ML/a. Newcrest has an annualised 7,205 ML of licensed entitlements on the Belubula River. The City of Orange has commissioned, but not yet finalised, a feasibility study on options for reuse of effluent from the Orange Sewage Treatment Plant for municipal purposes. This may result, in the next 5–10 years, in this water source no longer being available for Cadia Operations purposes.

Newcrest also manages water that accumulates in the Cadia Pit TSF (from tailings supernatant water and rainfall runoff) by recovering (pumping) this water to the water management system for re-use in ore processing.

Droughts have, in the past, resulted in a prolonged period of very low water supply. Drought conditions are a risk to future operations if unduly prolonged. The LOM plan assumes that 65–70% of all water will be recycled. Newcrest continues to pursue further water saving initiatives, both in the plant and by way of optimisation of onsite bores.

Water management structures and facilities include: tailings storage facilities return water system including the Central Pumping Station; process water pond; Cadia Pit TSF, NTSF, and STSF; sediment dams and ponds containing site runoff; WRSF leachate ponds; Cadiangullong Dam; Cadia Creek Weir; Belubula River pumping system; and the Rodds Creek Water Holding Dam.

1.17.6 Closure and Reclamation Planning

The Cadia Mine Closure Plan includes a detailed cost estimate, which is used in determining the closure liability. This closure cost estimate is incorporated in the economic analysis that supports Mineral Reserves. Additionally, the Mining Operations Plan is a requirement of the mining leases and contains Newcrest’s rehabilitation commitments for the period of the plan (usually three years).

Existing rehabilitation areas are regularly monitored, and provide evidence that the vegetation is supporting a stable surface.

1.17.7 Permitting Considerations

Newcrest holds the key permits required to support the current operations. The Cadia expansion will trigger a need to evaluate the proposal under various NSW Government environment and mining legislation and key Commonwealth legislation. Changes to the project will require a new application and reviews conducted under a number of these legislative acts. Due to the long-dated project start date, no permitting assessments were completed specifically for Ridgeway Lift 2. Similar permit processes to those envisaged for the Cadia expansion are likely to be required.

1.17.8 Social Considerations

Community Relations are managed in accordance with the Newcrest Communities Policy and Social Performance Standard. Community relations are undertaken by the Health, Safety, Environment and Social Responsibility Department in line with the Community Relations Strategy. The objective of the Cadia Community Relations Strategy is to provide a strategic and systematic organisational approach to interactions with local communities and stakeholders which facilitate the open exchange of information so that Newcrest can respond to emerging needs at any point of its operations in the Cadia area.

Newcrest holds regular forums with local government authorities and residents and contributes to a Community Partnerships Program (CPP) in which employee volunteers are involved in assessing applications for funding of community projects based on established criteria. In accordance with the requirements of the site's Project Approval, The Cadia Operations have a Community Consultative Committee, which provides a regular forum for discussion of community issues related to operational activities, and for accurate dissemination of material about those activities.

1.18 Markets and Contracts

The copper concentrate currently produced from Cadia East is readily marketable and sold under contract to any of several smelters in Asia, primarily to Japanese and Korean facilities. The concentrate is a high-quality clean copper concentrate with typical copper grade, high gold grades, payable silver credits and relatively low levels of impurities. Any excess concentrate from long-term contract quantities can be sold into the trader/spot market.

The Cadia Operations produce doré that is delivered to a gold refinery in Australia to produce refined gold and silver. Refined gold is sold on the open market. Refined silver is credited to the refiner to offset gold and silver refining cost or sold on the open market.

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

Contracts are in place to support copper concentrate sales and transport and gold refining. Other major contracts cover items such as electricity supply, bulk commodities, operational and technical services, mining and process equipment, earthworks projects, security, transportation and logistics, and administrative support services.

Contracts required to support the future Cadia East and Ridgeway developments are expected to be in line with existing contract terms and norms.

1.19 Capital Cost Estimates

Capital and operating cost estimates are presented at an overall pre-feasibility level of study, which is based on completed feasibility and pre-feasibility studies for the Cadia expansion, pre-feasibility-level determinations for the Ridgeway deposit, and LOM plan determinations for the active Cadia East mining operation.

Newcrest's internal study guidelines require project scope definition for a feasibility study to have an accuracy level of ±15%. Pre-feasibility studies must have a project scope definition accuracy level of ±25%.

Capital cost estimates include consideration of contingency, labour assumptions, mining, process, general and administrative (G&A), Owner, and sustaining capital costs. The overall capital cost estimate, on a Project basis, is provided in Table 1-8.

Table 1-8: Capital Cost Estimate Summary

Description	A$ M
Growth Capital Costs	
Cadia East mine	4,653
Ridgeway mine	587
Processing	504
Infrastructure	619
Capitalised revenue	(345)
Sub-total growth	***6,017***
Sustaining Capital	
Site	4,462
Sub-total sustaining	***4,462***
Total Capital	***10,480***

1.20 Operating Cost Estimates

The operating cost estimates used in the financial model were developed from a variety of sources. The mining costs were derived from a purpose-built, activity-based cost model constructed by the project team, while treatment and G&A costs were based on budgeted numbers.

For mining and milling rates greater than the current Mt/a throughput rate, costs were factored according to estimated fixed/variable components for existing assets and a bottom-up build for new infrastructure.

All operating costs are presented in Australian dollars and reflect 2019 market terms. Inputs in currencies other than Australian dollars were converted at exchange rates as per the Newcrest economic parameters.

Operating costs include consideration of labour, mine, process, power, maintenance and G&A costs. The overall operating cost estimate, on a Project basis, is provided in Table 1-9.

1.21 Economic Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Cadia Operations is supported by a positive cash flow.

Table 1-9: Operating Cost Estimate Summary

Cost Area	Units	Value
Mining	A$/t	5.10
Processing	A$/t	8.41
G&A	A$/t	3.00
Total Operating Costs	***A$/t***	***16.51***

1.22 Risks and Opportunities

As part of Newcrest's Risk Management Process, the risk assessments carried out for the long-term studies are combined with the site risk register to identify material risks for the business. The management of these material risks is based on ensuring that events which are considered to be significant for the business have an elevated level of accountability, management and review.

Newcrest has 31 Material Risks identified for the Cadia Operations in its risk assessment process that include the following areas: mechanical failure of surface fixed assets; mechanical failure of underground fixed assets; underground and surface facilities fires; fall of ground, both underground and surface; failure of cave propagation; delays in cave establishment; people movement/vehicle collisions; large-scale seismic events; failure of tailings embankments; subsidence events; water security; unplanned explosive initiation; and groundwater contamination.

These risks are managed on a day to day basis by the Cadia Operations with regular reviews and audits to ensure compliance with the risk management processes, as well as to ensure risks that have diminished are removed, and new and emerging risks are placed onto the register.

1.23 Interpretation and Conclusions

Under the assumptions in this Report, the Project shows a positive cash flow over the life-of-mine and support the Mineral Reserve estimates. The projected mine plan is achievable under the set of assumptions and parameters used.

1.24 Recommendations

The Cadia Operations have a long operational history. Material engineering studies and exploration programs have largely concluded. As a result, the QPs are not able to provide meaningful recommendations.

2 INTRODUCTION

2.1 Introduction

Mr. Kevin Gleeson, Mr. Geoffrey (Geoff) Newcombe, Mr. Paul Griffin and Mr. Philip Stephenson prepared this Technical Report (the Report) for Newcrest Mining Limited (Newcrest) on the Cadia Operations (Cadia Operations or the Project), in New South Wales (NSW), Australia. The location of the Cadia Operations is shown in Figure 2-1.

The Cadia Operations are 100% owned by Newcrest. The Cadia Operations consist of the operating Cadia East Gold Mine (Cadia East), the mined-out Cadia Hill Gold Mine (Cadia Hill), the Ridgeway Gold Mine (Ridgeway) which is on care-and-maintenance, the Blayney dewatering facility located in the town of Blayney, and the Cadia dewatering plant east of Blayney on Newbridge Road.

Mineral Resources are estimated for the Cadia East, Ridgeway, Cadia Extended, Big Cadia deposits and the Cadia Hill stockpile. Mineral Reserves are estimated for Cadia East and Ridgeway. The major deposits within the Project area are shown in Figure 2-2.

2.2 Terms of Reference

This Report supports disclosure of Mineral Resource and Mineral Reserve estimates in Newcrest's 2020 Annual Information Form.

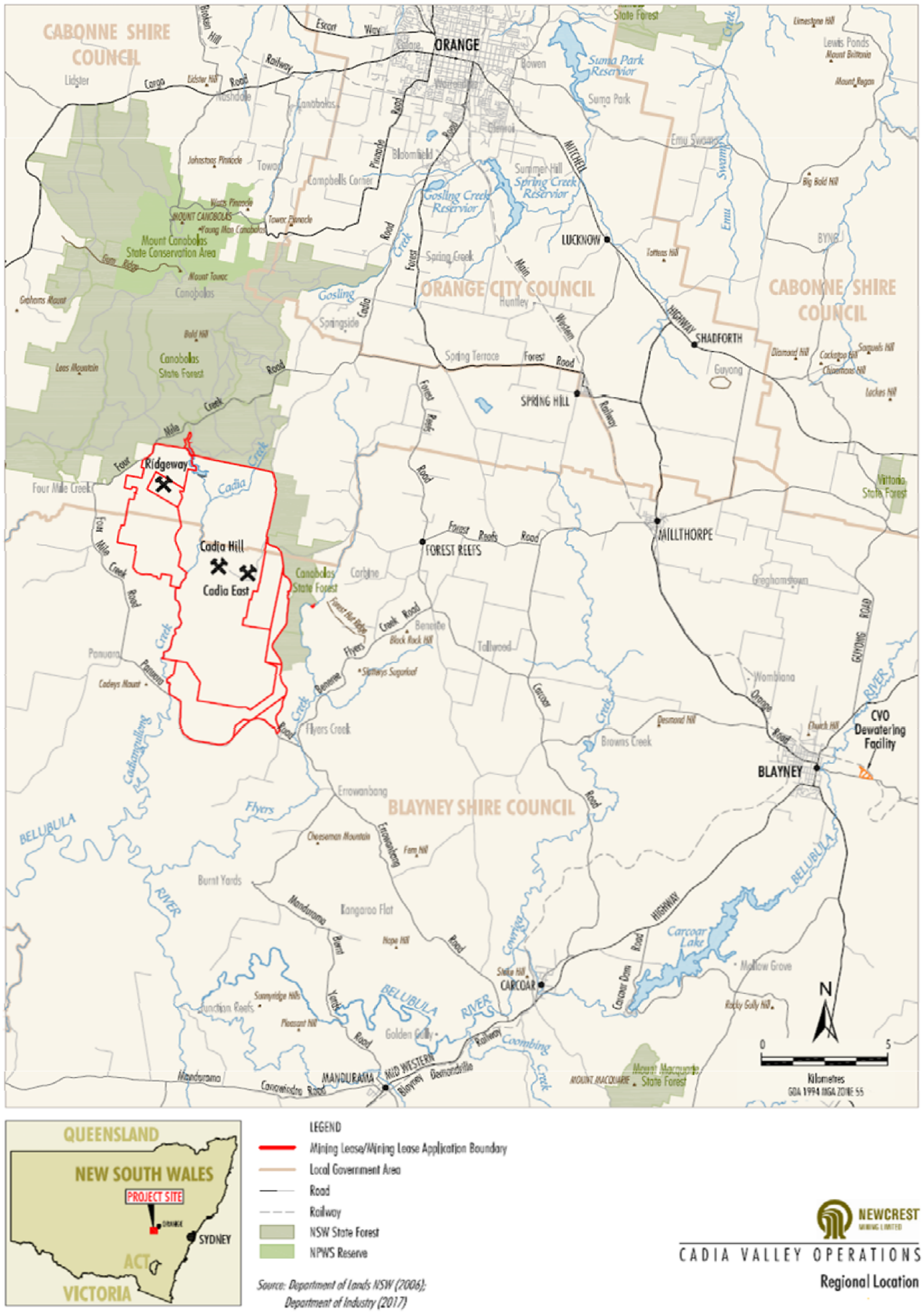
All measurement units used in this Report are metric unless otherwise noted, and currency is expressed in Australian (A$) dollars unless otherwise identified in the text. The Report uses Australian English.

The term "Project" refers to information and activities that relate to the entire mineral tenure area and not just to the current Cadia East operations and the Ridgeway mine.

The mine plan uses the terms block cave (Ridgeway) and panel cave (Cadia East). A block cave operation produces from the full orebody footprint from the outset of the operation, whilst in panel caving the active caving zone moves across the full footprint with time. Development of a new panel in a panel caving operation is analogous to a pit cutback in an open pit mining operation.

The current Cadia East mine plan is at a minimum of pre-feasibility level of evaluation and outlines the execution of the life of mine plan over a series of three lifts (Lifts 1, 2, and 3). Lift 1 and Lift 2 have an existing panel cave and will, by the end of operations, have four extensions in total each with Lift 3 having one panel extension. The term "Cadia expansion project" refers to a study that was completed at Cadia East to provide additional detail on some aspects of the life-of-mine (LOM) plan to a feasibility level of confidence. The study focused on debottlenecking activities for the processing facility that will modify the plant to better match the production levels from the caving operation, including provision to treat the lower-grade, copper–gold–molybdenum-bearing mineralization that will be exploited over the remaining panel caves. It also brought the next extension of the Lift 2 cave, PC2–3, up to a feasibility level of confidence to commence execution.

Figure 2-1: Cadia Operations Location Plan



Note: Figure prepared by Newcrest, 2020.

Figure 2-2: Deposit Locations

Note: Figure prepared by Newcrest, 2020.

Mineral Resources and Mineral Reserves were initially classified using the 2012 edition of the Australasian Joint Ore Reserves Committee (JORC) Code (2012 JORC Code). The confidence categories assigned under the 2012 JORC Code were reconciled to the confidence categories in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards). As the confidence category definitions are the same, no modifications to the confidence categories was required.

Mineral Resources and Mineral Reserves in this Report are reported in accordance with the 2014 CIM Definition Standards. Terminology differences were addressed in that the term "Ore Reserves" in the 2012 JORC Code is reported as "Mineral Reserves" using the 2014 CIM Definition Standards.

The Mineral Reserve estimates are forward-looking information and actual results may vary. The risks regarding Mineral Reserves are summarised in the Report (see Section 15.3 and Section 25). The assumptions used in the Mineral Reserve estimates are summarised in the footnotes of the Mineral Reserve table and outlined in Section 15 and Section 16 of the Report.

2.3 Qualified Persons

This Report has been prepared by the following Newcrest Qualified Persons (QPs):

- Mr. Kevin Gleeson, FAusIMM, Head of Mineral Resource Management;
- Mr. Geoffrey Newcombe, FAusIMM, PC1-2 Study Manager;
- Mr. Paul Griffin, FAusIMM, Group Manager – Processing – Governance and Assurance;
- Mr. Philip Stephenson, FAusIMM, Chief Operating Officer, Australia and Americas.

2.4 Site Visits and Scope of Personal Inspection

Mr. Kevin Gleeson visited the Cadia Operations most recently on 5 November, 2019. He has also visited from 13–14 May 2019, 8–9 April 2019, 21 March 2019, and numerous visits between 2012 and 2019. During site visits Mr. Gleeson inspected the mining operations, reviewed the resource reconciliation performance of the mining operations at the time of the visit, observed collection of ore control samples, visited the off-site laboratory facilities, and viewed drill operations including the sampling methodology from drill collar to laboratory pick-up when drilling operations were occurring. The site visits included discussion of the geological interpretation at both resource and ore control scales.

Mr. Geoff Newcombe has worked for Newcrest since November 2011, and has been based at Cadia Operations since that time to the Report effective date. He has held the role of Manager Mining Studies and PC1-2 Study Manager since 2017, and he has the overall responsibility for the planning of new mining areas including mine development plans, production scheduling, project budgeting and the preparation of execution plans. In his previous role as Technical Services Manager, Mr. Newcombe participated directly in all aspects associated with the execution of annual business plans for the Cadia Operations, performed detailed reviews of operational performance, mining technical designs and financial performance; and led discussions and decision processes associated with long-term strategic planning including annual life-of-mine planning processes.

Mr. Paul Griffin visited the Cadia Operations most recently from 28 October to 1 November 2019. Mr. Griffin was based at the Cadia Operations from 2001 to 2009 where he fulfilled various duties including that of Processing Plant Manager (2006–2009), Production Superintendent, and Grinding Metallurgist. Over the past 11 years, he has visited the Cadia Operations on over 20 occasions in his capacity as Group Manager – Processing – Governance and Assurance. His site visits included independent review of operational performance and metallurgy, process design for comminution and flotation circuit debottlenecking activities, and guidance on geo-metallurgical testwork programs.

Mr. Philip Stephenson has had involvement with the Cadia Operations since joining Newcrest in 2014, and his most recent site visit was from 14–16 January, 2020. During site visits to the Project, he has discussed business management plans, improvement projects, and risk management measures with operations staff. He worked with relevant Cadia Operations personnel reviewing aspects of environmental and social performance, including environmental compliance, permitting status, and stakeholder, community, and government relations. Mr. Stephenson has viewed the operation and associated infrastructure, including the tailings storage facilities (TSFs).

2.5 Effective Dates

There are a number of effective dates pertinent to the Report, as follows:

- Date of the latest information on environmental, permitting, and social considerations: 30 June, 2020;
- Date of the latest information on ongoing drill programs: 30 June, 2020;
- Database close-out date for the Cadia East Mineral Resource estimates: 21 June, 2016;
- Database close-out date for the Ridgeway Mineral Resource estimates: 30 March, 2009;
- Effective date of the Mineral Resource estimates: 30 June, 2020;
- Effective date of the Mineral Reserve estimates: 30 June, 2020;
- Effective date of the Cadia expansion study: 15 October, 2019.

The overall Report effective date is taken to be 30 June, 2020, and is based on the effective date of the Mineral Reserve estimates.

2.6 Information Sources and References

This Report is based, in part, on internal company reports, maps, published government reports and public information, as listed in Section 27 of this Report.

The primary data sources for the Cadia expansion are:

- Newcrest Mining Limited, 2018: Cadia Expansion Pre-Feasibility Study: internal Newcrest report, 8 August, 2018.

- Newcrest Mining Limited, 2019: Cadia Expansion Feasibility Study: internal Newcrest report, 9 September, 2019.

The primary data sources for the Ridgeway mining study are:

- Newcrest Mining Limited, 2007: Ridgeway Deeps Feasibility Study: internal Newcrest report, Vols 1 to 4;
- Newcrest Mining Limited, 2014: Pre-Feasibility Study – Ridgeway Deeps Lift 2: internal Newcrest report.

The following Newcrest employees and consultants retained by Newcrest contributed to various aspects of the Report under the supervision of the QPs:

- Ms. Lisa Bowyer, Manager Land Tenure, 12 years of experience with the Project;
- Mr. Rory Carson, Lead Business Analyst, FP&A, three years of experience with the Project;
- Ms. Jane Chung, Superintendent – Approvals, 2.5 years of experience with the Project;
- Mr. Wayne Jaques, Principal – Electrical Engineer, 19 years of experience with the Project;
- Dr. Graeme Hancock, Consultant, four years of experience with the Project;
- Mr. Charles Lamb, Moly Engineering Manager – Projects and Studies, 10 years of experience with the Project;
- Mr. Fraser MacCorquodale, General Manager, Exploration, 23 years of experience with the Project;
- Mr. Blair Sands, Head of Environment, six years of experience with the Project;
- Ms. Kyoko Sasahara; Manager Marketing and Logistics, nine years of experience with the Project;
- Mr. Vikash Singh, Group Evaluation Geologist, 13 years of experience with the Project.

All figures were prepared by Newcrest personnel for the Report unless otherwise noted.

2.7 Previous Technical Reports

Newcrest initially listed with the Toronto Stock Exchange (TSX) in March 2012, and voluntarily delisted from the TSX effective 4 September, 2013. During its 2012–2013 listing period, Newcrest filed the following technical report on the Cadia Operations:

- Thomas, M., and Moorhead, C., 2011: Technical Report on the Cadia Valley Operations Property in New South Wales Australia: report prepared by AMC Mining Consultants (Canada) Ltd for Newcrest Mining Limited, effective date 31 December, 2011, 136 p.

3 RELIANCE ON OTHER EXPERTS

3.1 Introduction

The QPs have relied upon the following other expert reports, which provided information regarding tailings storage for use in sections of this Report.

3.2 Environmental

The QPs have not independently reviewed the North Tailings Storage Facility stability information. The QPs have fully relied upon, and disclaim responsibility for information derived from experts retained by Newcrest in the following document:

- Jeffries, M., Morgenstern, N.R., Van Zyl, D., and Wates, J., 2019: Report on NTSF Embankment Failure, Cadia Valley Operations, for Ashurst Australia: report prepared by the Independent Technical Review Board, 17 April 2019, 119 p. and appendices.

This information is used in Section 20.6.3 and Section 20.6.6, and in support of the Mineral Reserve estimates in Section 15.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Introduction

The Cadia Operations are located approximately 25 km south–southwest of the town of Orange in NSW, and about 190 km west–northwest of Sydney, at approximately 33°28’25” S latitude, 149°00’00” E longitude.

4.2 Property and Title in New South Wales

Information in this subsection is summarised from Resources and Geoscience NSW (2019), Environmental Defender’s Office (2011), New South Wales Minerals Council (2013), and Resources and Energy NSW (2018).

Key laws that regulate mining activity in New South Wales include the *Mining Act 1992*, Mining Regulations 2016, *Aboriginal Land Rights Act 1983*, *Environmental Planning and Assessment Act 1979*, *Protection of the Environment Operations Act 1997*, and the *Mining and Petroleum Legislation Amendment (Land Access Arbitration) Act 2015*.

4.2.1 Mineral Title

All exploration and mining activity in NSW must be conducted under an exploration, assessment or mining title. Licences are granted for one or more ‘groups’ of minerals. The types of licences are summarised in Table 4-1.

NSW uses a graticular system for granting of Exploration Licences. This system divides the State into a series of ‘blocks’ with dimensions of five minutes of latitude by five minutes of longitude. Each block comprises 25 ‘units’ with dimensions of one minute of latitude by one minute of longitude. Although the area of a unit varies slightly depending on the location within the State, each unit is approximately 3 km^2.

4.2.2 Surface Rights

Mineral rights are separate to surface rights. Land access agreements must be negotiated with surface rights holders for exploration activities. The duration of those agreements will vary depending on the terms agreed to by the various parties.

4.2.3 Environmental Regulations

A development consent under the *Environmental Planning and Assessment Act 1979* (EP&A Act) must be in place before a mining lease can be granted. This act establishes the development assessment and approval framework for exploration and mining activities.

Table 4-1: Mineral Titles

Title Type	Note
Exploration Licence	Gives the holder the exclusive right to explore for specified mineral group(s) within the Exploration Licence area, during the term of the licence. The granting of an Exploration Licence does not give any right to mine, nor does it guarantee a Mining Lease will be granted with the Exploration Licence area. Although Exploration Licences may be granted for periods of up to six years, they are usually granted for a period of five years. They can be renewed for a further term (up to six years but usually five years), with the opportunity for subsequent renewals. Exploration Licences are generally required to be reduced by 50% on each renewal. Applications for Exploration Licences must include a program of activities that the applicant proposes to undertake if the licence is granted.
Assessment Lease	An Assessment Lease is designed to cater for situations between exploration and mining. The lease allows the holder to maintain an authority over a potential project area, without having to commit to further exploration. The holder can, however, continue exploration to further assess the viability of commercial mining. The application area must generally coincide with what would normally be appropriate for a Mining Lease. It must include the mining area outlined in the conceptual mine plan, together with areas for infrastructure and any appropriate buffer zone. Any portions of the original exploration title beyond the application should be relinquished, unless the applicant can justify the retention of these areas. Assessment leases may be granted for up to six years and may be renewed for further periods of up to six years.
Mining Lease	A Mining Lease gives the holder the exclusive right to mine for specified minerals within the Mining Lease area during the term of the lease. In addition to allowing mining, a Mining Lease permits prospecting operations and Ancillary Mining Activities (AMA) to be conducted in association with mining operations. A Mining Lease for mining purposes only may also be applied for. A Mining Lease area may also include any associated infrastructure and must be consistent with the development consent area. Mining Leases may be granted for up to 21 years, and may be renewed for further period of 21 years (or longer with the approval of the Premier).
Ancillary Mining Activities	Titleholders seeking regulation for their AMAs have the option to either apply for a mining lease for Ancillary Mining Activities only, or an Ancillary Mining Activity (AMA) Condition to be imposed on an existing mining lease for minerals.

As part of this approval process, a proponent must prepare an Environmental Impact Statement (EIS). The EIS is a comprehensive document that covers issues such as air quality, noise, transport, flora and fauna, surface and ground water management, mining methods, social impacts, and landscape management and rehabilitation. Extensive public consultation is also required, with community members encouraged to make submissions on the application.

If a project is approved, conditions on approvals are imposed to minimise potential environmental impacts. Rehabilitation and environmental performance conditions are also attached to all authorities (exploration and mining) issued under the *Mining Act 1992*.

4.2.4 Royalties

In New South Wales the royalty rate is 4% of the ex-mine value of the bullion and concentrate “recovered” (recovered being sold material and increases in stockpile material), less allowable deductions (treatment, depreciation, realization, and administration costs). Currently, gold, silver, and copper are levied at 4% of the ex-mine value less allowable deductions.

4.2.5 Fraser Institute Survey

The QP has used the 2019 Fraser Institute Annual Survey of Mining Companies report (the 2019 Fraser Institute Survey) as a credible source for the assessment of the overall political risk facing an exploration or mining project in NSW. Each year, the Fraser Institute sends a questionnaire to selected mining and exploration companies globally. The Fraser Institute survey is an attempt to assess how mineral endowments and public policy factors such as taxation and regulatory uncertainty affect exploration investment.

The QP has relied on the 2019 Fraser Institute survey because it is globally regarded as an independent report-card style assessment to governments on how attractive their policies are from the point of view of an exploration manager or mining company and forms a proxy for the assessment by industry of political risk in specific political jurisdictions from the mining industry's perspective.

Of the 76 jurisdictions surveyed in the 2019 Fraser Institute survey, New South Wales ranks 47th for investment attractiveness, 46th for policy perception and 47th for best practices mineral potential.

4.3 Project Ownership

The Cadia Operations are 100% owned by Newcrest through its wholly-owned subsidiary, Cadia Holdings Pty Ltd (CHPL).

4.4 Mineral Tenure

The Cadia Operations consist of six granted Mining Leases and five granted Exploration Licences, with a total approximate area of 215 km^2.

The current minimum statutory annual expenditure commitment for the Project is $122,000. The commitment changes on an annual basis, depending on approved work programs.

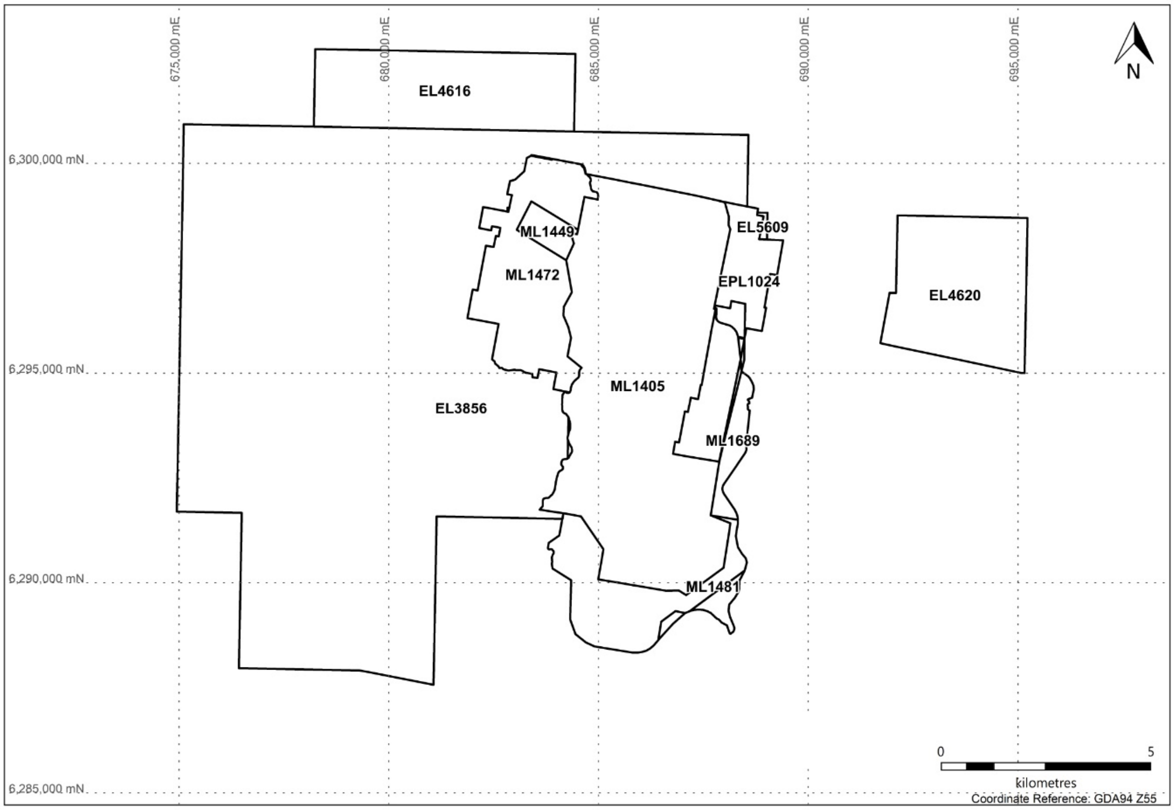
Details of leases and licences are provided in Table 4-2 and Figure 4-1.

Mining Leases do not have statutory annual expenditure requirements. All statutory obligations to retain the Exploration Licences had been met as at 30 June, 2020.

Table 4-2: Land Tenure Details

	Lease Type	Lease Status	Grant Date	Expiry Date	Area (km^2)
E(P)L 1024	Exploration Licence	Granted	21/05/1985	20/05/2019 (renewal pending)	16.8
EL3856	Exploration Licence	Granted	21/05/1991	20/05/2024	117.6
EL4616	Exploration Licence	Granted	8/11/1993	7/11/2021	11.2
EL4620	Exploration Licence	Granted	19/11/1993	18/11/2019 (renewal pending)	14
EL5609	Exploration Licence	Granted	23/08/1999	22/08/2024	2.8
ML1405	Mining Lease	Granted	5/10/1996	4/10/2038	31.16
ML1449	Mining Lease	Granted	1/6/1999	4/10/2038	0.99
ML1472	Mining Lease	Granted	23/10/2000	22/10/2021	12
ML1481	Mining Lease	Granted	8/3/2001	7/3/2022	5.84
ML 1689	Mining Lease	Granted	11/9/2013	11/9/2034	1.54
ML 1690	Mining Lease	Granted	10/9/2013	10/9/2034	0.7
					214.63

Figure 4-1: Exploration and Mining Tenements Location Plan



Note: Figure prepared by Newcrest, 2020.

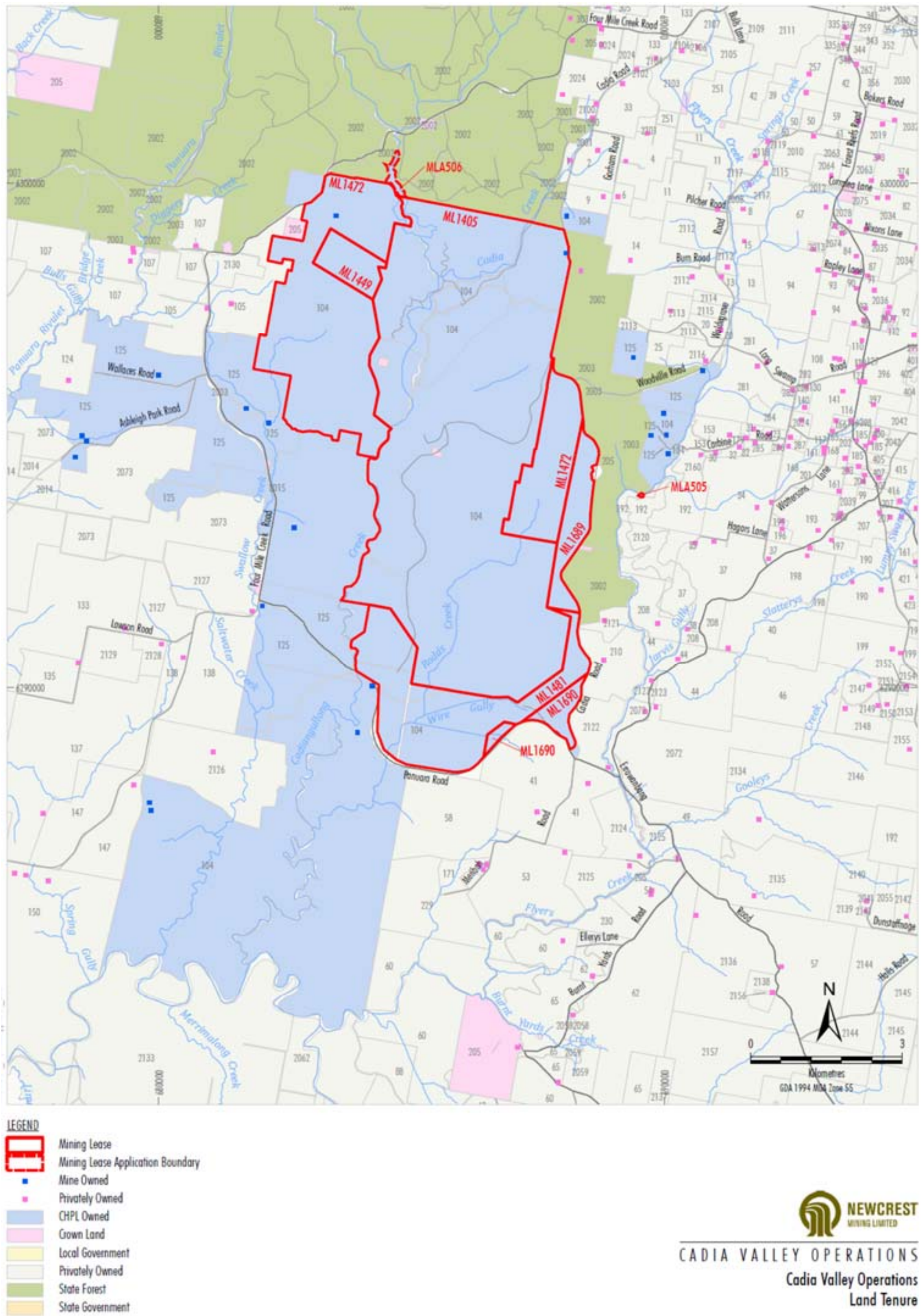
4.5 Surface Rights

Land over which CHPL holds surface rights is shown in Figure 4-2. CHPL predominantly owns all land/properties covered by the six Mining Leases and a number of properties in the surrounding area.

CHPL also holds licences to occupy crown roads within the Mining Leases and a small portion of crown land comprising Lot 7001 in Deposited Land (DP) 1020360 within ML1405. CHPL holds occupation permits for infrastructure within surrounding State forest lands. Some road areas within crown lands are still in the process of purchase.

The concentrate pipeline and return water line from Blayney is subject to leases within public lands under the control of the Blayney and Cabonne local government areas (LGAs or councils).

Figure 4-2: Surface Land Owned by CHPL in the Cadia Operations Area



Note: Figure prepared by Newcrest, 2020.

CHPL owns the land on which the Cadia dewatering plant is located (Lot 106 DP1161062) and leases adjoining Lot 102 which contains the rail track spur line from Mitziya Pty Ltd as owner of the adjoining 'Sea-Link' development site. The rail track spur line connects to the Great Western Railway line, with transport of concentrate ultimately to Port Kembla.

Under the Minister's Condition of Approval issued under the *Environmental Planning and Assessment Act 1979* (EP&A Act), Newcrest may be required to acquire additional properties where mining operations may have environmental impacts that exceed certain specified limits upon those properties.

The surface rights are sufficient to support mining operations, provided that subsidence or other impacts do not occur outside existing approved Mining Leases.

4.6 Water Rights

Newcrest has an annualised 7,205 ML of licensed entitlements on the Belubula River. Of this, 4,080 ML are regulated General Security Entitlements (GSE), and 3,125 ML are held as unregulated supplementary licences. The GSE are subject to the NSW DPI-Water allocation announcements, with the water being released from Carcoar Dam. The supplementary water is taken from unregulated "off allocation" flow that enters the Belubula River downstream of Carcoar Dam. Newcrest is licensed to take this water subject to the conditions of its licence, which include minimum "end-of-system" flow levels at the downstream end of the Belubula River.

Harvesting of water on-site (including Cadiangullong Creek, Flyers Creek, Cadia Creek, Rodds Creek and Copper Gully) is licensed at 4,200 ML/a. Newcrest also holds about 1,588 ML in groundwater licences in the Orange Basalt and Lachlan Fold Belt lithologies. Newcrest must demonstrate through groundwater impact assessments that there is minimal to no impact on surrounding groundwater levels if such extraction is undertaken.

Additional information on water management is provided in Section 20.

4.7 Royalties and Encumbrances

Royalties levied at the State level are outlined in Section 4.2.4. There are no other royalties or similar obligations payable on the Project.

4.8 Property Agreements

There are no major property agreements that will affect mining operations or the LOM plan.

Voluntary Planning Agreements are in place with the councils of Blayney, Cabonne and Orange City.

A Softwood Plantation Deed is in place with NSW Forests over specific Newcrest lands and is in effect until July 2032. The Softwood Plantation Deed provides forestry rights over some land within ML1405, ML1472, ML1481 and ML1489.

Mining operations are permitted up until June 2031 with a maximum processing rate of 32 Mt/a (calendar year).

An Environmental Protection Licence covers the operations within the six mining leases plus the Blayney and Cadia dewatering facilities, and ancillary infrastructure.

4.9 Permitting Considerations

Permitting considerations are discussed in Section 20.

4.10 Environmental Considerations

Environmental considerations are discussed in Section 20.

Current environmental liabilities are in line with those to be expected from a long-life mining operation where mining activities were conducted via open pit and underground mass mining methods.

4.11 Social License Considerations

Social license considerations are discussed in Section 20.

4.12 QP Comments on "Item 4; Property Description and Location"

In the opinion of the QP:

- Information provided by Newcrest's legal and tenure experts on the mining tenure held by Newcrest in the Cadia Operations area supports that the company has valid title that is sufficient to support declaration of Mineral Resources and Mineral Reserves;
- Newcrest holds sufficient surface rights to allow mining activities at Cadia East and Ridgeway. The surface rights are sufficient to support mining operations, provided that subsidence or other impacts do not occur outside existing approved Mining Leases.
- Additional negotiations and permits may be required in support of additional TSF storage (see discussion in Section 20);
- Newcrest holds permits that allow abstraction of groundwater, and surface water, (see discussion in Section 20);
- Royalties are payable to the NSW State. Currently, gold, silver, and copper are levied at 4% of the ex-mine value less allowable deductions;
- Environmental liabilities for the Cadia Operations are typical of those that would be expected to be associated with a long-life mining operation where mining activities were conducted via open pit and underground mass mining methods.

To the extent known to the QP, there are no other significant factors and risks that may affect access, title, or the right or ability to perform work on the Cadia Operations that are not discussed in this Report.

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

5.1 Accessibility

The Cadia Operations are accessed by sealed road from the town of Orange, approximately 25 km to the north–northeast. Orange is connected to Sydney, the largest city in the region, by 265 km of sealed road.

Commuter airlines provide Brisbane to Orange, Sydney to Orange, and Melbourne to Orange services. The Orange airport is about 12 km northeast of the Cadia Operations.

5.2 Climate

The closest Bureau of Meteorology weather station to the Cadia Operations is located approximately 12 km east–northeast, at Orange airport.

The mean annual rainfall recorded at the station is approximately 885 mm. The lowest mean monthly rainfall (approximately 50 mm) occurs in autumn (March and April) and the highest mean monthly rainfall occurs in August (approximately 92 mm). Evaporation rates vary markedly between winter and summer.

The area experiences the warmest temperatures from November to March and the coolest from May to August. Average daily maximum temperatures peak in January, while average daily minimum temperatures are lowest in July.

The most common wind directions are from the southwest and northeast. The bushfire season is typically from mid-November to mid-March.

Mining and exploration activities are currently conducted year-round. It is expected that mining activities associated with the Ridgeway operations will also be year-round.

5.3 Local Resources and Infrastructure

Local shires or local government authorities include Orange (population of approximately 38,000), Blayney (population approximately 7,000) and Cabonne (population approximately 12,000).

The Cadia Operations are located on lands designated under the respective LGA Local Environment Plans (LEP) as Zone 1(a) or general rural; Zone 1(f) or forestry; Zone 1(c) or rural small holdings; Zone 2(v) or urban or village; and Zone 7(a) which is designated for environment protection.

The operations are located within rural zone RU1 Primary Production land in both the Blayney Local Environment Plan (LEP) 2012 and Cabonne LEP 2012. The Cadia East project area falls within the Blayney and Cabonne LGAs. Surrounding land is also zoned RU1 Primary Production except for state forest land to the north and east of Cadia which is zoned RU3 Forestry where located on state forest-owned land. The Cadia dewatering plant is situated on land zoned IN1 General Industrial, while the rail track spur line is within zone SP2 Rail Infrastructure Facilities.

The mining operations are within driving distance of Orange. There is a skilled mining workforce in the region.

Additional information on local resources and infrastructure is provided in Section 18.

5.4 Physiography

The Cadia Operations are located in the Central Tablelands of NSW on the western side of the Great Dividing Range. Elevations range from approximately 600 m Australian Height Datum (AHD) to 1,000 m AHD. Areas of higher elevation in the region include Mount Canobolas (1,396 m AHD) and Mount Towac (1,136 m AHD) located to the north of the Cadia Valley.

The region is characterised by gently-undulating hills, cleared open grassland and vegetation consisting mainly of scattered paddock trees, with isolated patches of remnant woodland and shelterbelts, and State Forest plantations of Monterey Pine. State Forests situated in the area include the Glenwood and Canobolas State Forests to the southwest of Orange, and Mullion Range State Forest to the north of Orange.

The main watercourse through the Cadia valley is Cadiangullong Creek, which flows in a southerly direction to its junction with the Belubula River, some 15 km south. Tributaries of Cadiangullong Creek within the Cadia valley include Rodds Creek, Cadia Creek, Copper Gully and Hoares Creek.

The Cadia Valley is defined by a series of rolling hills which form ridgelines to the east and west of Cadiangullong Creek. To the south, the Cadia Valley opens out to generally gently-undulating land extending to the Belubula River, with occasional steeply sided gullies in the lower portion of the catchment.

The dominant land use in the Orange region is agriculture, principally grazing (sheep and cattle), cropping and orchards. Other agricultural activities include honey production, viticulture and softwood production. Land use in the vicinity of the Cadia Valley Operations is dominated by sheep and cattle grazing in the more gently undulating areas, and private and state forestry operations on poorer soil and steeper slopes such as the Mount Canobolas State Forest.

The bushfire season experienced in the Cadia Valley area and Central West Region is generally from mid-November to mid-March. Depending on factors such as weather, fuel loads (build-up of leaf litter and broken branches) and drought indices, this season can be extended from early September to late April. There are moderate fuel loads associated with the open forest and woodland areas within the Cadia East subsidence zone and the tailings storage facilities expansion areas.

5.5 Seismicity

The deposits are located in an area which has been seismically active both prior to and subsequent to mining by Newcrest. These events can produce seismic loading at the site and this risk is taken into account in infrastructure design.

5.6 QP Comments on "Item 5; Accessibility, Climate, Local Resources, Infrastructure, And Physiography"

In the opinion of the QP:

- The existing local infrastructure, availability of staff, methods whereby goods could be transported to the Project area are well-established and well understood by Newcrest, and can support the declaration of Mineral Resources and Mineral Reserves (see discussion in Section 18);
- All necessary primary infrastructure for the current operations has been built on site and is sufficient for the projected life-of-mine LOM plan; (see discussion in Section 18);
- The Cadia expansion project envisages process plant debottlenecking, and underground mine cave establishment for PC2–3, PC1–2, PC1–4, PC2–4, PC2–5, PC3–1 and PC5001 in Cadia East, and Ridgeway Deeps Lift 1 and Lift 2, at Ridgeway with associated support infrastructure (see Sections 16, 17 and 18);
- There is sufficient suitable land available within the mineral tenure held for installations such as the process plant and related mine infrastructure.
- Surface rights for infrastructure and mining are discussed in Section 4.5.
- Operations are currently conducted year-round. It is expected that mining activities associated with the Ridgeway operations will also be year-round.

6 HISTORY

6.1 Exploration History

6.1.1 Historical Mining

The discovery of copper and gold in the Cadia area dates back to 1851. The field experienced sporadic production from several deposits within the district until the first half of the 20th century. Extensive copper mining occurred at the Cadia (now called White Engine), Iron Duke (now Big Cadia), West Cadia and Little Cadia mines.

From 1918–1929 and 1941–1943, quarrying and underground operations were undertaken at Big Cadia.

6.1.2 Early Modern Exploration

Modern-era exploration in the Cadia district commenced in the mid-1960s with Pacific Copper Limited (Pacific Copper) targeting the Big and Little Cadia deposits, prompted by the proximity of historical mine workings, and in particular, by magnetic anomalies over the skarn at Big Cadia.

In the 1980s Pacific Copper entered into a joint venture with Homestake Australia Limited (Homestake) to explore for gold in the area. Exploration consisted mainly of exploration of the magnetic targets. In 1985 Homestake drilled two reverse circulation (RC) percussion holes to downhole depths of 95m to test magnetic targets, with poor results.

Exploration during this period also included grid-based soil sampling and drilling at Cadia Hill. A total of seven core holes, three RC percussion holes and numerous rotary air blast (RAB) holes were drilled; however, none of this work continued on to the main area of mineralised monzonite, partly due to the presence of post-mineral sediments and residual and transported soil. Consequently, the results of this phase of exploration were not considered encouraging enough to continue.

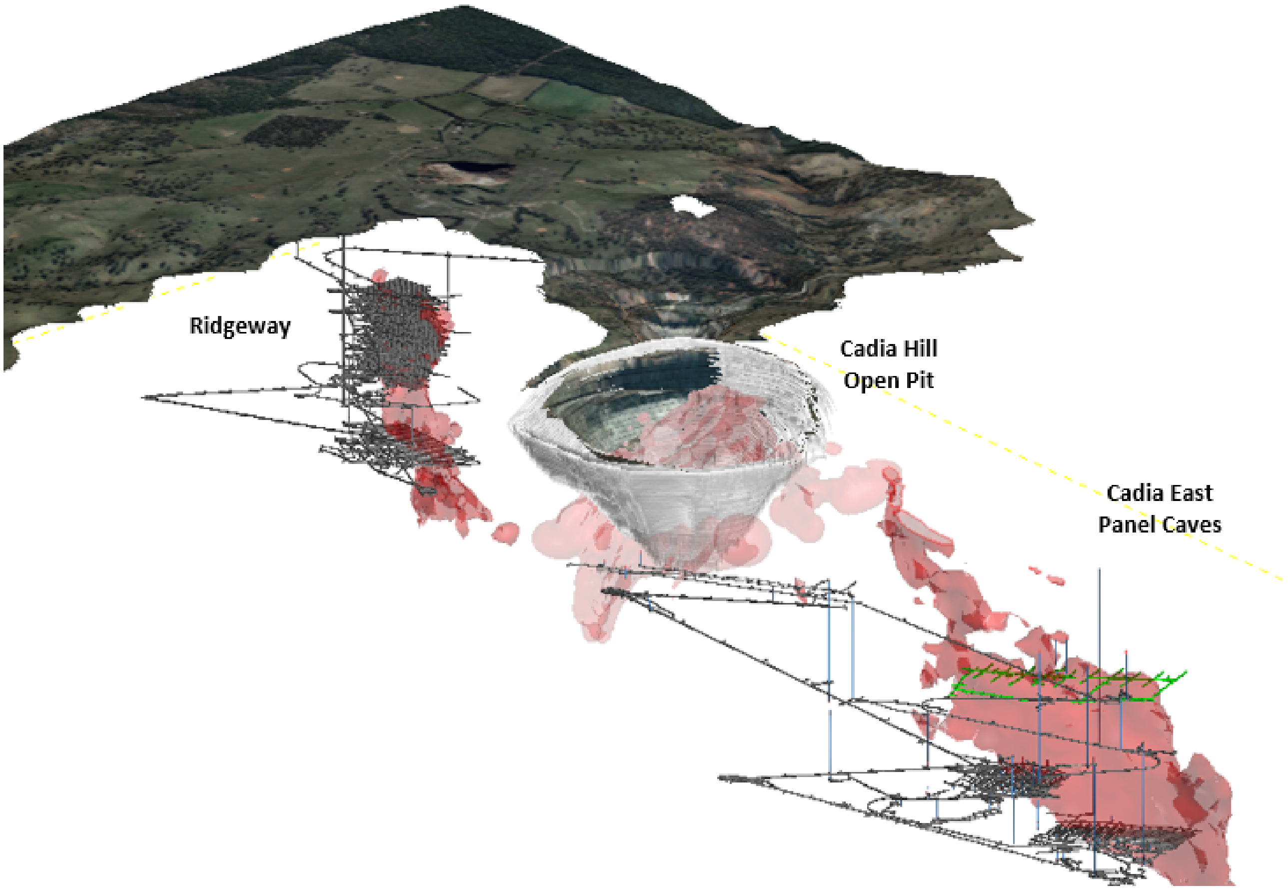
No significant production at any of the mines in the general Cadia area is recorded for this period.

6.1.3 Newcrest Involvement

Figure 6-1 shows the locations of the current and former mines within Newcrest's Cadia Operations as at 30 June, 2020.

Newcrest acquired the property in March 1991 with an initial focus on the small shallow oxide resources at Big Cadia. In 1991, Newcrest drilled seven RC percussion holes to downhole depths of 42–90 m to more comprehensively test the magnetic targets at Big Cadia, also with poor results. All drill holes intersected magnetic volcanic rocks, which were considered to explain the magnetic features.

Figure 6-1: Operations Location Schematic



Note: Figure prepared by Newcrest, 2020. Figure is schematic and not to scale. The layer at the top of the figure represents a topographic slice.

In late 1992, investigations shifted to an area at Cadia Hill which contained anomalous assays in the earlier soil sampling and subsequent rock chip sampling, as well as evidence of oxidised porphyry-style hydrothermal alteration and secondary copper minerals from detailed geological mapping. Drilling during this stage intersected intervals of broad low-grade gold–copper mineralisation which were similar to those intersected by Pacific Copper and Homestake, although over broader intervals. This provided sufficient support for additional drilling, which subsequently intersected economic mineralisation and resulted in the discovery of the Cadia Hill porphyry copper–gold deposit. At the time, Newcrest geologists recognised Cadia Hill as having large-tonnage, low-grade open cut potential.

At the same time as drilling was occurring at Cadia Hill, an extensive halo of low-grade mineralisation was delineated to the northwest of the Cadia Hill deposit at Cadia Quarry (now Cadia Extended). These results appeared to confirm the northwest–southeast alignment of mineralisation at Cadia, so step-out drilling was continued in both directions.

A feasibility study on mining the Cadia Hill open pit was completed in 1996 with project funding approved in September that year. Cadia Hill was a greenfield development requiring construction of a concentrator and all the supporting facilities for a major mining and ore processing operation. Open pit mining commenced at Cadia Hill in 1998, and was completed in 2012, after more than 4 Moz Au and 0.35 Mt Cu were produced over the LOM. Stockpile treatment continued until 2018.

Mining of the Cadia Extended deposit commenced in January 2003, in the form of a small open pit. Mining ceased in 2004, following pit highwall failure, and displacement of the access ramp. As instability of the pit walls prevented mining of the lowest two benches, the pit was permanently closed and backfilled.

As a result of step-out drilling around Cadia Hill in February 1994, additional vein-hosted and disseminated porphyry-style gold–copper mineralisation was intersected in an area east of Cadia Hill, now known as Cadia East. A 1996 drill program encountered high-grade gold–copper mineralisation at depth (formerly referred to as Cadia Far East) beneath previously-outlined mineralisation. Mining operations at Cadia East were approved in 2010, and mining commenced in 2012 as a series of panel caves, across multiple lifts. Commercial production from Panel Cave 1 (PC1) commenced in January 2013. Commercial production from Panel Cave 2 (PC2) commenced in October 2014. The establishment of Panel Cave 2–3 (PC2–3) is in execution.

In conjunction with the development of the Cadia East mine, a program of upgrades and modifications was completed at Concentrator 1 to enable ore from Cadia East to be processed at a design capacity rate of 20 Mt/a. Ore from Cadia East was harder than Cadia Hill ore, and required increased crushing and milling capacity. Flotation residence times were also longer, requiring increased flotation capacity. The concentrator upgrade included provision to produce a separate molybdenum concentrate due to elevated molybdenum grades in some parts of Cadia East.

The Ridgeway deposit was discovered in 1996 beneath 500 m of cover, based on a combination of drill data and geophysical information. The construction of the Ridgeway mine began in 2000 with the first production recorded in 2002. Ore was supplied to a new 4 Mt/a concentrator (Concentrator 2) adjacent to Concentrator 1. Concentrator 2 capacity was increased to about 8 Mt/a. The upper portion of the Ridgeway deposit was mined as a sub-level cave (SLC) operation.

Additional mineralisation was identified in 2003–2004 immediately below the Ridgeway mine (known as Ridgeway Deeps) and was delineated. In 2009, mining extended into the Ridgeway Deeps area below the completed SLC using the lower-cost block cave mining method. Mining operations were completed in 2016. Some stockpile material was treated in 2017–2018.

In late 2010, the Ridgeway Halo Project commenced as an extensional mine project to recover ore on the western side of the Ridgeway Mine SLC levels. The Halo area was part of the original Ridgeway orebody considered for the Ridgeway project in 2002; however, being low grade, was previously deemed uneconomic for mining. Halo operations originally ceased in 2014, but the mine was restarted, and ore mined in 2017.

The Ridgeway mine is currently on care and maintenance.

The process plant is currently undergoing a debottlenecking process, and mine designs have been updated for the Cadia “expansion project”. The Cadia “expansion” title was given to the project at the concept stage when the site was targeting a notional output of 40 Mt/a which represented a 50% increase in output at the time of study commencement (27 Mt/a). As this project was carried out through concept, pre-feasibility and feasibility-level evaluations, the expectations were reduced from 40 Mtpa to 33–35 Mt/a. During the time period in which these studies were conducted, concurrent debottlenecking activities increased plant throughput to a current site capacity of 27–30 Mt/a, and internal guidance is that 31–32 Mt/a rates are achievable using the existing infrastructure. The plant is currently permitted to 32 Mt/a. As a result, while the “expansion” title was not changed in Newcrest’s public disclosures, the actual plant throughput increase envisaged in the Cadia expansion project is from 31–32 Mt/a to 33–35 Mt/a and is not considered by Newcrest or the NSW regulators to be a material expansion.

Newcrest remains actively focused on exploration within the area of the Cadia Operations; see discussion in Section 9.

6.2 Production

Intermittent production by open cut mining that occurred over the Big Cadia deposit during the period 1882 to 1945 yielded approximately 750,000 t of Fe, 5,000 t of Cu and 48 kg of Au at average grades of 50% Fe, 6% Cu and 6 g/t Au respectively (Stevens, 1972).

Table 6-1 summarises production from the Cadia East underground operations.

Table 6-2 summarises production from the Ridgway mine.

Table 6-3 summarises production from the Cadia Hill open pit mine.

Table 6-1: Cadia East Mine Production

Financial Year Ending June	Mine	Mill	Head Grades		Plant Recovery		Concentrate	Metal Production	
	Production	Feed	Au	Cu	Au	Cu	Produced	Au	Cu
	(kt)	(kt)	(g/t)	(%)	(%)	(%)	(kt)	(koz)	(kt)
2011	162	162	0.79	0.23	80.6	84.7	2	3	0
2012	557	601	0.61	0.17	71.6	77.6	4	8	1
2013	3,023	3,001	0.87	0.20	77.6	79.1	23	65	5
2014	8,281	7,935	1.08	0.24	82.3	81.9	85	226	16
2015	14,225	13,794	1.22	0.32	82.4	84.8	189	444	38
2016	18,406	18,015	1.28	0.34	83.3	86.5	228	618	53
2017	18,656	19,011	1.11	0.34	82.7	86.5	233	563	57
2018	21,649	20,227	1.16	0.35	78.9	83.7	242	593	60
2019	28,779	29,302	1.24	0.38	78.4	82.7	367	914	91
2020	30,355	29,347	1.14	0.39	78.6	83.0	379	843	96
Totals	***144,093***	***141,395***	***1.17***	***0.35***	***80.3***	***84.0***	***1,752***	***4,277***	***417***

Prepared from Newcrest quarterly reports. Inputs were rounded.

Table 6-2: Ridgeway Mine Production

Financial Year Ending June	Mine	Mill	Head Grades		Plant Recovery		Concentrate	Metal Production	
	Production	Feed	Au	Cu	Au	Cu	Produced	Au	Cu
	(kt)	(kt)	(g/t)	(%)	(%)	(%)	(kt)	(koz)	(kt)
2002	1,929	1,083	2.43	0.84	84.5	89.6	32	68	9
2003	4,637	4,881	2.76	0.99	87.4	93.5	157	378	45
2004	5,352	5,352	2.93	0.96	86.8	92.6	173	438	47
2005	5,591	5,591	2.55	0.86	83.4	89.4	152	382	43
2006	5,539	5,538	2.4	0.79	86.2	91.1	142	366	40
2007	5,853	5,694	2	0.73	85.7	90.6	137	314	38
2008	5,913	5,775	1.93	0.67	84.7	89.6	131	301	34
2009	6,103	5,860	1.52	0.56	80.9	86.9	114	234	29
2010	5,308	5,172	1.31	0.52	79	86.3	94	172	23
2011	4,969	4,773	1.18	0.47	82.4	88	85	148	20
2012	6,622	6,529	1.31	0.52	81.0	87.8	129	223	30
2013	7,723	7,603	1.31	0.54	81.4	87.3	152	262	36
2014	8,611	8,660	1.47	0.55	84.3	88.3	183	345	42
2015	9,351	9,349	0.92	0.44	81.2	86.8	152	223	36
2016	4,921	4,006	0.51	0.33	77.9	82.0	43	51	11
2017	197	1,147	0.55	0.35	83.2	86.5	12	17	3
2018	453	442	0.34	0.42	80.2	89.6	6	4	2
Totals	***89,072***	***87,455***	***1.67***	***0.62***	***83.9***	***89.2***	***1,894***	***3,928***	***487***

Notes: Only mine production processed through Concentrator 2 is shown. Prior to commissioning the concentrator,1.92 Mt of ore from Ridgeway mine was processed through Concentrator 1. Prepared from Newcrest quarterly reports, and Malone (2011). Inputs were rounded.

Table 6-3: Cadia Hill Open Pit Production

Financial Year Ending June	Mine	Mill	Head Grades		Plant Recovery		Concentrate	Metal production	
	Production	Feed	Gold	Copper	Gold	Copper	Produced	Gold	Copper
	(kt)	(kt)	(g/t)	(%)	(%)	(%)	(kt)	(koz)	(kt)
1999	52,000	14,451	0.76	0.19	71.9	78.7	81	254	22
2000	55,000	15,877	0.85	0.19	75.6	83.5	103	326	26
2001	56,100	16,141	0.8	0.2	72.3	82.5	108	300	27
2002	58,740	16,019	0.68	0.18	73.7	81.8	96	259	23
2003	76150	16,856	0.75	0.17	74.2	80.1	101	299	23
2004	76,600	17,145	0.62	0.26	72	84.5	156	244	37
2005	77,100	16,454	0.75	0.21	78.1	85.7	120	309	29
2006	50,800	15,501	0.65	0.17	76.8	85.1	94	248	22
2007	47,159	16,624	0.58	0.16	79.7	89.3	107	247	23
2008	46,923	16,792	0.94	0.18	82.1	88.8	123	414	26
2009	34,004	17,163	0.71	0.19	75.6	85.2	133	298	28
2010	31,892	17,466	0.71	0.18	81	88.9	151	326	29
2011	16,121	16,970	0.84	0.16	79.1	86.3	121	364	23
2012	7,244	13,715	0.71	0.13	77.2	82.3	75	241	14
2013	—	14,873	0.38	0.12	66.8	73.2	66	119	13
2014	—	3,429	0.36	0.13	53.7	70.4	17	21	3
2015	—	—	—	—	—	—	—	—	—
2016	—	—	—	—	—	—	—	—	—
2017	—	3,868	0.40	0.12	78.1	81.5	17	39	4
2018	—	476	0.28	0.13	55.4	73.0	2	2	0
Total	***685,833***	***249,821***	***0.71***	***0.18***	***76.1***	***83.9***	***1,672***	***4,311***	***372***

Notes: Mine production for each year includes ore and waste. Mill feed in 2000, 2001, and 2002 includes 1.96 Mt of ore from the Ridgeway mine. Production for 2012 is ore-only. Prepared from Newcrest quarterly reports, and Malone (2011). Inputs were rounded.

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The alkalic porphyry gold–copper deposits of the Cadia district are located in the eastern Lachlan Fold Belt of New South Wales. The district comprises four porphyry deposits, Ridgeway, Cadia Extended (Cadia Quarry), Cadia Hill and Cadia East, and two related iron-skarn deposits, Big Cadia and Little Cadia.

The Cadia deposits formed within the intra-oceanic Macquarie Arc (Figure 7-1), a belt of Ordovician to early Silurian mafic to intermediate volcanic, volcaniclastic and intrusive rocks.

As much as 2.5 km of Ordovician stratigraphy is preserved in the Cadia district, including siltstone and sandstones of the Weemalla Formation and andesitic to basaltic andesitic Forest Reefs Volcanics (FRV; Wilson et al., 2003; Harris et al., 2009). Porphyry-style mineralisation is centred on multiphase monzodiorite to quartz monzonite intrusions (Figure 7-2; Wilson et al., 2003) of the Cadia Intrusive Complex (CIC). Silurian conglomerates, sandstones and siltstones (part of the Waugoola Group) cover large portions of the Ordovician volcanosedimentary succession. Tertiary basalts of the Canobolas Volcanic Complex cover the Palaeozoic rocks to the north and east of the district.

Published geochronologic studies show that the mineralisation-related Ordovician to Silurian alkalic intrusions become progressively younger to the east across the Cadia Valley, with Ridgeway being the oldest deposit in the district (ca. 455 Ma) and Cadia East the youngest (ca. 437 Ma; Wilson et al., 2007). Narrow pipe-like stocks and dykes that are associated with gold and copper mineralisation cut the volcano–sedimentary rocks and the large, compositionally zoned (dioritic to monzonitic) intrusive suite that is exposed in the centre of the district.

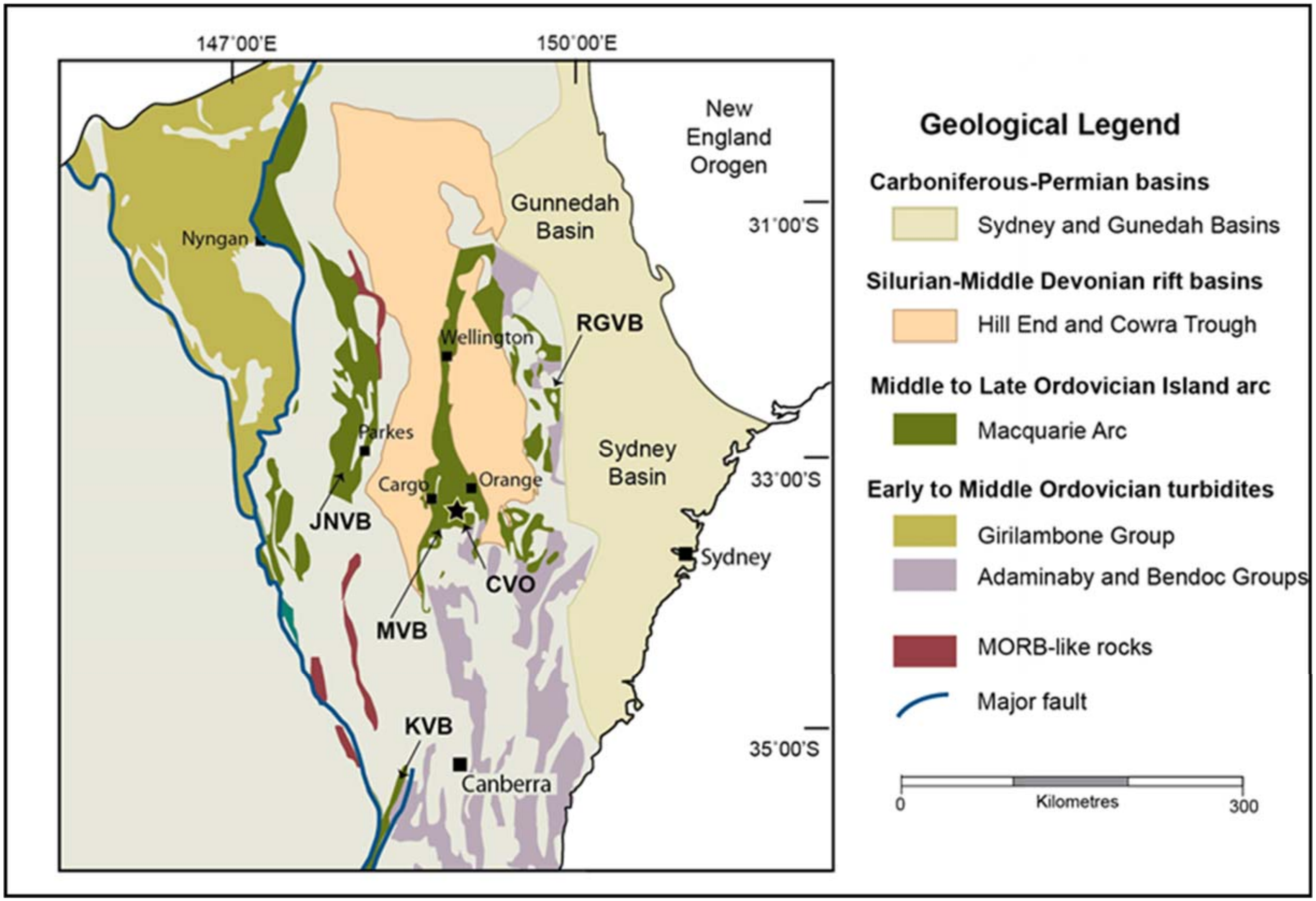
Regional east–west shortening, linked to terrane docking and accretion at the end of the Benambran Orogeny, produced thrust fault systems around the CIC during the early Silurian, including curviplanar, northerly-striking, moderately-dipping basement thrust faults of the Cadiangullong system.

Post-mineral deformation has partially dismembered the district, superposing different porphyry copper–gold systems as well as the host stratigraphy levels (Figure 7-3; Harris et al., 2009).

7.2 Project Geology

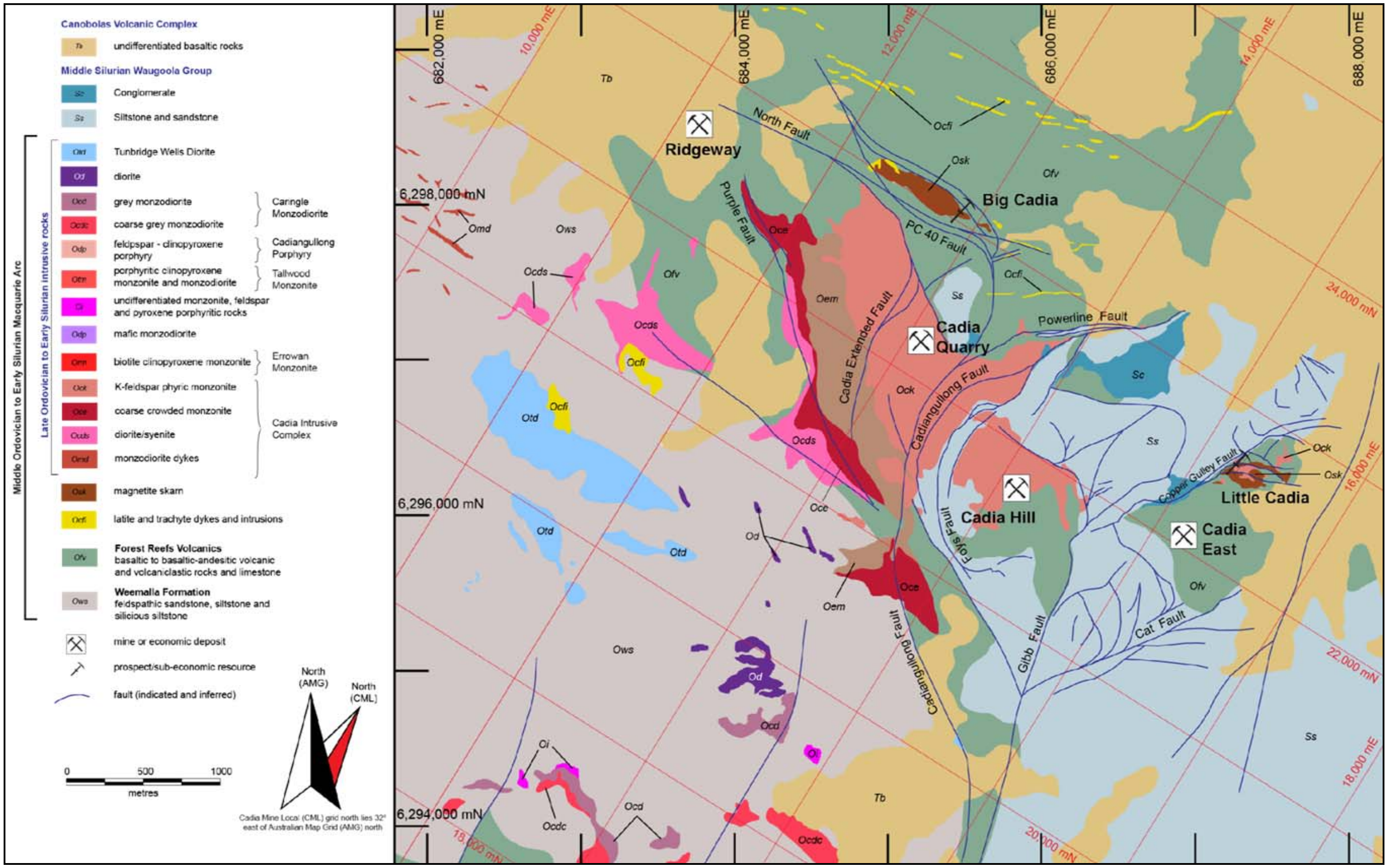
The mineralisation within the Project area occurs within a 6 km-long west–northwest-oriented corridor.

Figure 7-1: Regional Geology of the Ordovician Rocks of New South Wales



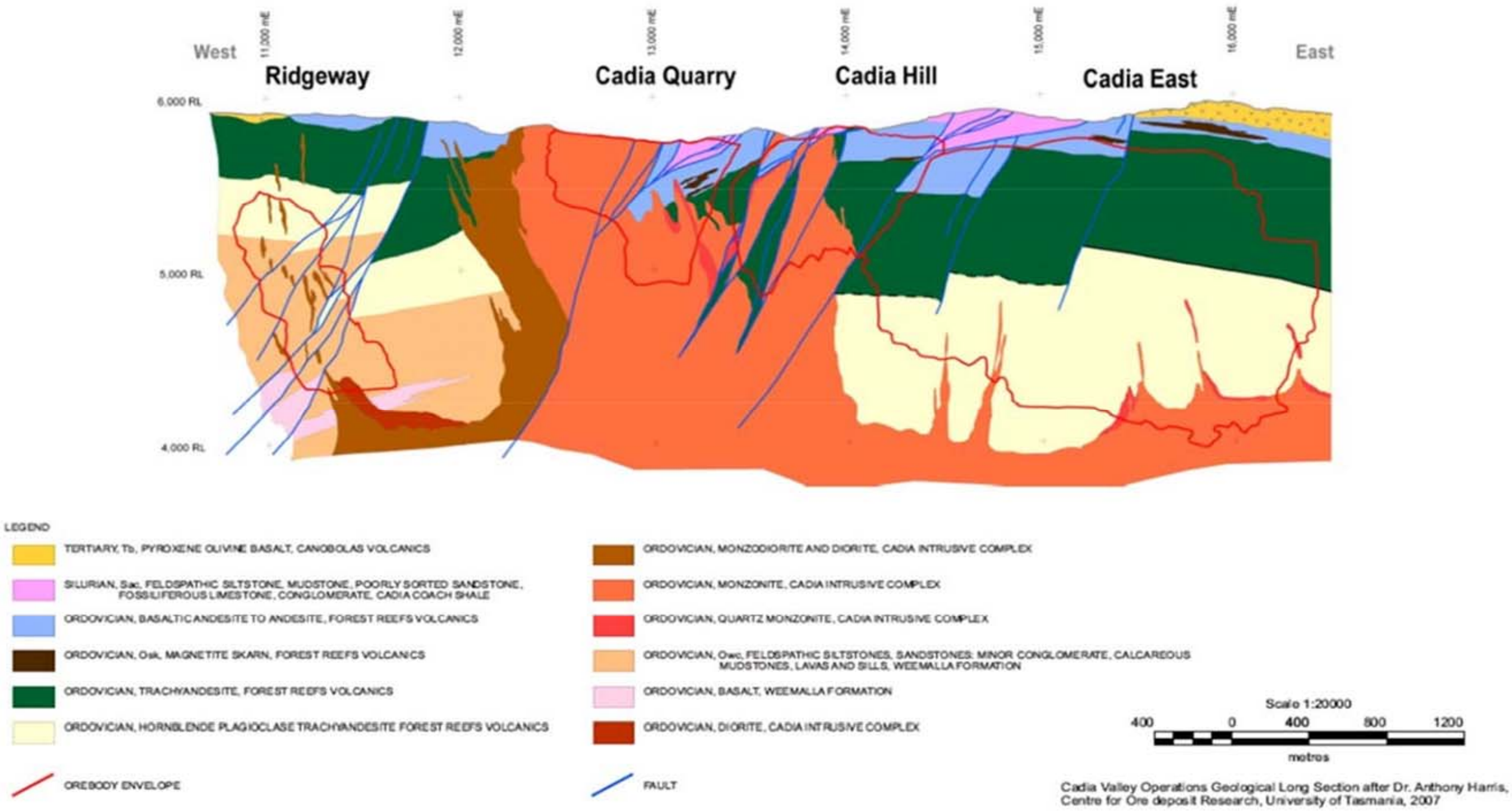
Note: Figure prepared by Newcrest, 2011. RBVB = Rockley–Gulgong Volcanic Belt; JNVB = Junee-Narromine Volcanic Belt; MVB = Molong Volcanic Belt; KVB = Kiandra Volcanic Belt; CVO = Cadia Operations; MORB = mid-ocean ridge basalt.

Figure 7-2: Cadia Valley Geological Plan



Note: Figure prepared by Newcrest, 2011. Note that Cadia Quarry as shown in the figure is now referred to as Cadia Extended.

Figure 7-3: Cadia Valley Geological Cross Section (long-section looking north 22500N)



Note: Figure prepared by Newcrest, 2011.

7.2.1 Lithologies

Figure 7-4 presents a comparative stratigraphy across the Cadia Valley. Figure 7-5 presents a series of geological cross-sections through the deposits.

The basement rocks in the Cadia district are fine-grained, thinly-laminated, carbonaceous to volcanic siltstones, with minor arenaceous volcanic beds of the Weemalla Formation. The Weemalla Formation crops out to the south and southwest of Cadia Hill and to the west of Ridgeway.

It is conformably overlain by the FRV, a sequence of basic to intermediate volcanic and volcano-sedimentary rocks. The FRV is divided into four lithofacies (Wilson, 2003):

- Volcanic lithic conglomerates, breccias and sandstones;
- Planar laminated volcanic siltstone;
- Bedded calcareous volcanic sandstone;
- Clinopyroxene- and plagioclase-phyric lava and subvolcanic intrusions of basaltic to basalt–andesite composition.

Three main Ordovician intrusive complexes were identified in the Cadia district. Although currently spatially separated due to the current erosion level, they may be connected at depth.

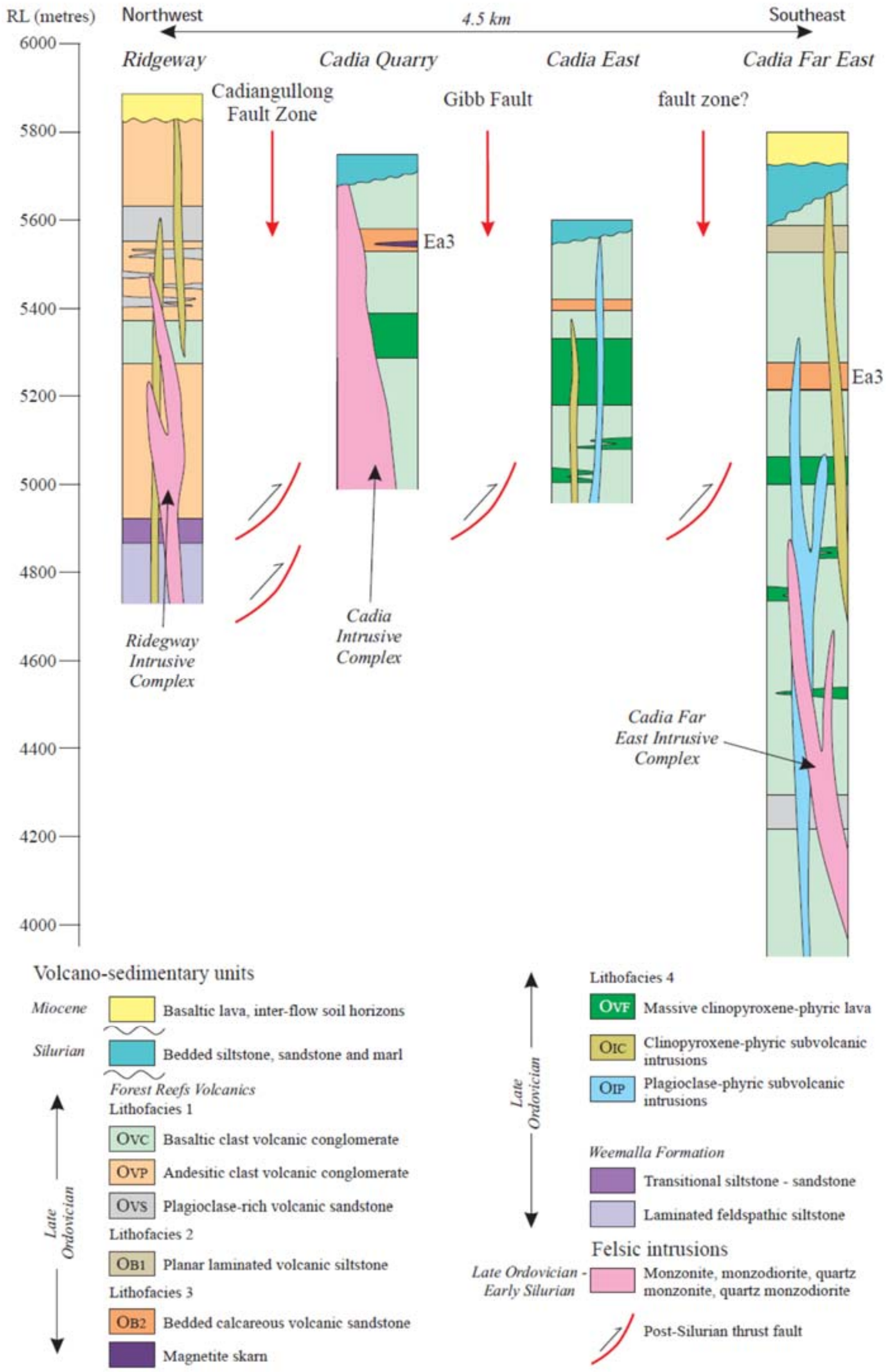
The Cadia Intrusive Complex (CIC) consists of pyroxene diorite, monzodiorite and occasional pyroxenite in the west to monzonite, quartz monzonite and quartz monzodiorite in the east. The mafic, western portion of the CIC is interpreted to be separated from the eastern, felsic portion of the CIC by a major north–northwest-striking, west–southwest-dipping thrust fault, the Purple Fault.

The Ridgeway Intrusive Complex (RIC) is located 2.5 km northwest of the Cadia Hill portion of the CIC, with the top of the RIC occurring about 500 m below surface. At least three intrusive stages were defined, of which the latter two have a clearly demonstrated temporal relationship with Ridgeway deposit alteration and mineralisation. The RIC comprises a vertically attenuated composite pipe of monzodiorite to quartz monzonite. It has horizontal dimensions of 200 x 100 m, is elongated along a northwest trending axis, and extends subvertically for at least 1 km.

The Cadia East Intrusive Complex (CEIC; formerly termed the Cadia Far East Intrusive Complex) comprises a series of west–northwest- to west-striking dykes that dip steeply to the north. The top of the complex averages about 800 m below the surface. Dyke compositions range from monzodiorite and quartz monzodiorite to quartz monzonite.

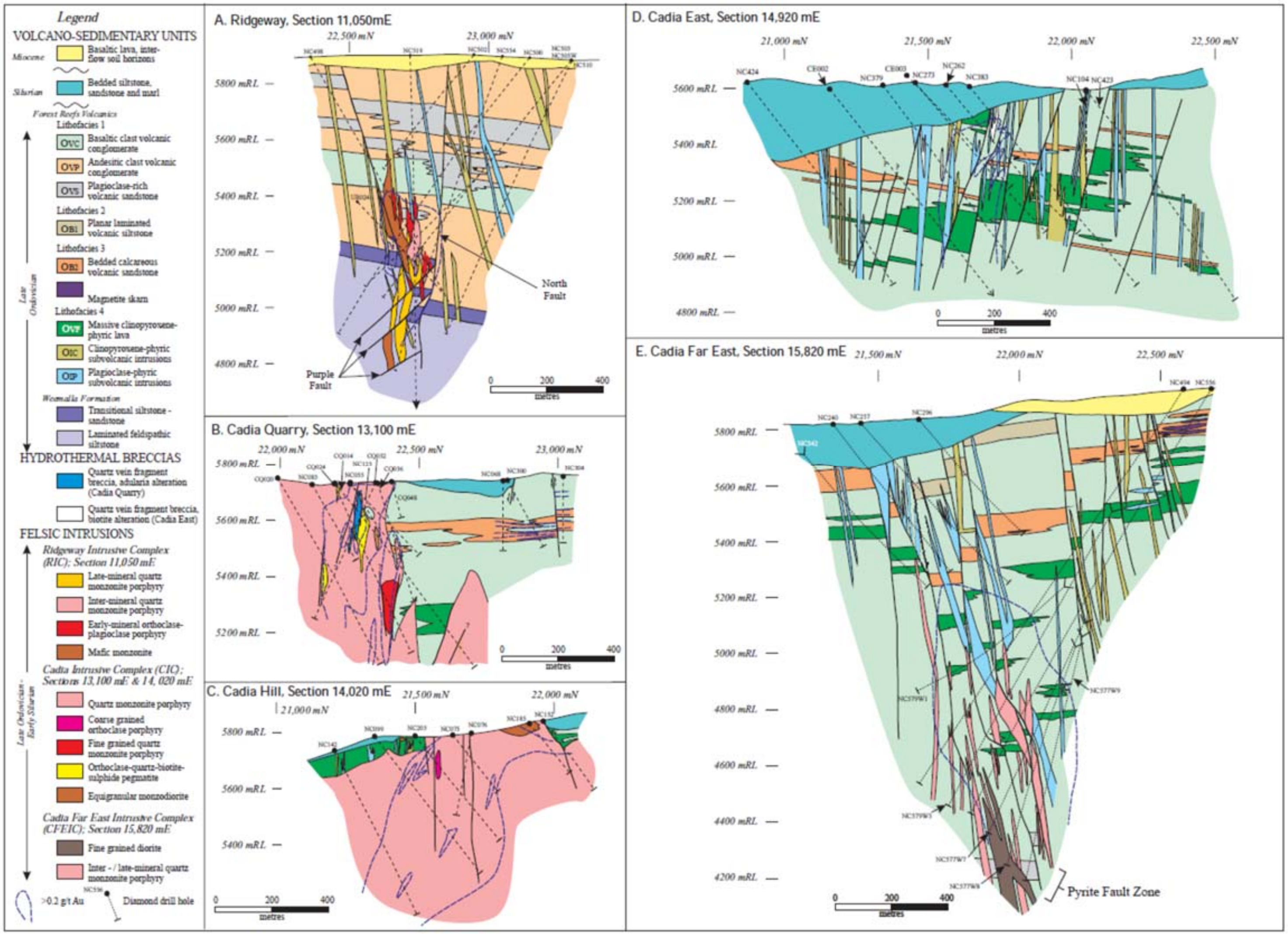
Middle to Late Silurian shale, sandstones and fossiliferous limestone of the Cadia Coach Shale unconformably overlie the eastern part of the district. This unit can reach 200 m in thickness above the Ordovician rocks at Cadia East. Elsewhere in the district, the Cadia Coach Shale infills deep down-faulted basins and can be as much as 1,500 m thick.

Figure 7-4: Comparative Stratigraphy



Note: Figure from Wilson, 2003. The Cadia Far East Intrusive Complex referred to in the figure is currently termed the Cadia East Intrusive Complex.

Figure 7-5: Comparative Geological Cross-Sections



Note: Figure from Wilson, 2003. The Cadia Far East Intrusive Complex referred to in the figure is currently termed the Cadia East Intrusive Complex.

Rafts and inliers of Silurian lithologies are also preserved along part of some major fault structures. A clast to cobble-rich lithology, informally termed the "valley-fill breccia", also of Silurian age, forms a north–south-oriented zone that is preserved on the southern slopes of Sharps Ridge, the highest local topography.

Patchy outcrops of Tertiary olivine basalt to basaltic andesite, related to the Canobolas Volcanic Complex, occur throughout the Cadia district. They totally conceal the Ridgeway deposit and partially overlie the Cadia East and Little Cadia deposits. The basalts are up to 80 m thick at Cadia Far East and comprise at least six lava flows with vesicular tops and local intercalations of peat.

7.2.2 Metamorphism

Regional metamorphism is sub to lower greenschist facies.

7.2.3 Structure

The major regional structure is the 30 km long Werribee–Cadiangullong Fault Zone. Where the Werribee–Cadiangullong Fault Zone intersects structures related to the west–northwest oriented Lachlan Transverse Zone, it forms a series of north–northwest- and northeast-trending thrust faults. This structural intersection appears to have controlled the location of the CIC and associated mineralisation, and has disrupted the Cadia Hill deposit. The Cadia Hill deposit sits in a fault-bounded block within the basement thrust fault system, whereas the Ridgeway deposits lie in the hanging wall and the Cadia East deposit in the footwall.

Three major splays of the Werribee–Cadiangullong Fault Zone were identified in the Cadia district, consisting of the Cadiangullong, Gibb and Purple Faults. The Cadiangullong Fault occurs between Cadia Hill and Cadia Quarry, and the Gibb Fault has placed Cadia Hill in structural contact with the western end of the Cadia East orebody.

Three major west–northwest- to east–west-oriented fault zones occur in the Cadia district:

- The PC40 Fault forms the southern boundary of the outcropping portion of the Big Cadia skarn deposit;
- The North Fault passes through the Ridgeway deposit and may represent a western extension of the PC40 Fault;
- The Pyrite Fault Zone occurs at depth in the Cadia East–Cadia Far East deposit.

Regional faults can be strike-slip or reverse in movement sense.

Newcrest has identified more than 56 structures during production and development activities that influence the Cadia Valley-wide structural setting, and therefore mine planning and caving operations. Underground mapping has demonstrated that fault behaviour at the local scale can be highly complex, particularly for steeply-dipping structures.

7.2.4 Mineralisation

Six mineralisation styles are known in the district:

- Cadia Hill: Intrusion and volcanic-hosted, sheeted quartz vein mineralisation;
- Cadia East: Volcanic-hosted, disseminated and sheeted quartz vein mineralisation;
- Cadia Far East: Volcanic and intrusion hosted mainly sheeted quartz vein mineralisation;
- Cadia Quarry: intrusion hosted mainly sheeted quartz vein mineralisation;
- Ridgeway: intrusion and volcanic hosted quartz stockwork vein mineralisation;
- Big Cadia, Little Cadia: iron-rich skarns.

7.2.5 Weathering

Weathering is typically restricted to 30–60 m depth. The overlying Silurian sedimentary and Tertiary volcanic rocks have largely protected the mineralisation from weathering effects.

7.3 Local and Deposit Geology

Mineralisation in the porphyry deposits occurs as sheeted and stockwork quartz–sulphide veins, and locally as broadly stratabound disseminated mineralisation (Cadia East) and skarn (Big Cadia and Little Cadia).

The Cadia district porphyry deposits have recorded a sequence of alteration and mineralisation events that evolved from early-stage magnetite-stable sodic, potassic and calc-potassic alteration with locally significant gold–copper mineralisation, through a period of transitional stage potassic alteration that introduced most of the gold–copper mineralisation. Propylitic and calc-silicate alteration were developed in the deposit peripheries at this time and a late stage of feldspathic alteration developed irregularly around the deposit margins and locally destroyed mineralisation.

All of the porphyry deposits show a close spatial association with shoshonitic monzodiorite to quartz monzonite dykes and stocks of the CIC. Gold–copper mineralisation is hosted by these intrusions and also by the enclosing FRV wall rocks. Field evidence (e.g., cross-cutting intrusive and vein relationships, vein dykes, inter-mineral comb quartz layers) strongly supports the hypothesis of deposit formation at the same time as the emplacement of the intrusive rocks that host mineralisation.

Wilson (2003) divided the Cadia porphyry deposits into two types:

- Intrusive wall rock deposits. Monzonitic intrusions in these deposits were interpreted to be country rock, upon which porphyry-style mineralisation was superimposed (e.g., Cadia Quarry and Cadia Hill). These deposits display no field evidence for a temporal relationship between intrusion and mineralisation;
- Intrusive-centred deposits. The intrusions in this deposit class display textural evidence to indicate the existence of a temporal and genetic link between the monzonitic intrusive complexes and hydrothermal alteration and mineralisation (e.g., Ridgeway, Cadia Far East).

The two types have distinctive alteration and mineralisation characteristics, but share a number of paragenetic features.

Early-stage magmatic/hydrothermal events introduced high grade gold–copper mineralisation locally in the intrusive centred deposits; but were not associated with significant mineralisation to the intrusive wall rock deposits. Features of the early event include:

- Emplacement of monzonitic intrusions that are locally associated with high-grade gold–copper mineralisation;
- Selectively pervasive albite–hematite alteration of the plagioclase feldspar component of the quartz monzonite porphyry (QMP) stocks in the intrusive wall rock deposits;
- Local development of fracture and vein controlled, selectively pervasive sodic and sodic–calcic alteration (all deposits). These alteration assemblages are typically associated with magnetite and actinolite, in addition to minor bornite and chalcopyrite;
- Subsequent formation of pervasive calc-potassic and potassic alteration assemblages, associated with multiple generations of quartz–magnetite–actinolite ± sulphide veinlets and veins. High-grade gold–copper mineralisation is developed in some of the intrusive-centred deposits, typically in association with bornite-rich quartz–magnetite veins (e.g. Ridgeway);
- Emplacement of transitional magmatic–hydrothermal aplite vein-dykes synchronous with hydrothermal quartz–magnetite–sulphide veins.

Transitional stage events are associated with most of the gold–copper mineralisation in the intrusive wall rock deposits. Additional gold-copper mineralisation was introduced into the intrusive-centred deposits. Key features of this phase included:

- Emplacement, in the intrusive centred deposits, of QMP stocks and dykes into potassic/calc-potassic-altered early-stage monzonite intrusions and wall rocks;
- Formation of sheeted to randomly oriented quartz–sulphide ± calcite veins, associated with selectively pervasive, magnetite-destructive potassic alteration. In the intrusive centred deposits, vein formation closely followed intrusion emplacement and younger intrusions have progressively lower quartz vein densities;
- Chalcopyrite is the predominant sulphide in transitional stage quartz veins. Bornite is abundant locally in transitional-stage quartz veins at depth in the intrusive-centred deposits. In contrast, bornite occurs in the upper levels of transitional quartz veins in the intrusive wall rock deposits;
- Continued development of transitional magmatic–hydrothermal features. Mineralised aplite vein-dykes and comb quartz layers are associated with intermineral QMP intrusions in the intrusive-centred deposits. Vein-dykes also occur locally throughout the intrusive wall rock deposits;
- Formation of broadly stratabound biotite–chalcopyrite–tourmaline alteration several hundreds of metres above QMP intrusions in the intrusive-centred deposits;
- Propylitic alteration assemblages developed peripheral to the potassic assemblages, associated with prehnite-calcite veining. A subzone of hematite-

bearing propylitic alteration (inner propylitic) formed between the potassic alteration zone and the regional propylitic alteration zone;

- Calc-silicate alteration of chemically reactive units. Alteration assemblages proximal to QMP intrusions are garnet-rich, whereas magnetite-calcite-sulphide assemblages developed several hundreds of metres away from the intrusions.

The late stages of magmatic and hydrothermal activity contributed minor amounts of zinc and lead mineralisation to the porphyry deposits. Gold and copper were locally removed during this stage. The main late-stage events are:

- Formation of pervasive zones of feldspar alteration in the upper levels of the intrusive-centred deposits. This alteration has overprinted and partially destroyed transitional-stage disseminated chalcopyrite mineralisation;
- Development of fault-bounded zones of phyllic alteration, associated with minor quantities of lead–zinc mineralisation. Fracture-controlled to selectively pervasive phyllic alteration has also overprinted late-stage feldspar alteration locally in the intrusive-centred deposits;
- Late-stage potassic alteration occurs at depth in the intrusive-centred deposits, in association with the intrusion of a mafic hornblende-bearing diorite stock.

7.3.1 Cadia East

The Cadia East–Far East deposit occupies a mineralised zone 2.5 km in strike length, 600 m in width and over 1,900 m in vertical extent. It is located below and to the east of the Cadia Hill deposit.

7.3.1.1 Geology

Mineralisation is developed in the FRV, and in a series of subvertical to steeply north-dipping monzodioritic to quartz monzonitic dykes, that are termed the Cadia Far East intrusive complex (CFEIC). The syn-mineral nature of at least some of the intrusions is indicated by the presence of mineralised xenoliths within monzonite porphyry dykes that also host porphyry-style veining and alteration.

The Weemalla Formation has been intersected at depth, and consists of finely-bedded siltstone interbedded with basaltic volcanic rocks. Overlying this unit are five lithofacies of the FRV:

- Upper bedded unit: about 80 m thickness of finely planar-laminated feldspathic siltstone;
- Volcaniclastic unit: approximately 200 m thickness of sandy matrix polymictic conglomerate and volcaniclastic sandstones and locally volcanic breccia;
- Lower bedded unit: around 60 m thickness of bedded calcareous sandstone typically altered to skarn mineral assemblages;
- Massive volcanic rocks: about 150 m thickness of massive pyroxene phyric basalt to andesite lavas;
- Lower sequence: at least 1,100 m thickness of polymictic conglomerates and volcaniclastic sandstones.

Intrusive porphyry dykes and sills are interpreted to be co-eval with the FRV volcanic units. In the Cadia East area, the 5–30 m thick porphyry dykes appear to be stratigraphically controlled by the bedded units, and acted as feeders to overlying sills. The largest dyke has been traced for 1,500 m along strike, are coincident with a change in shape of the orebody on section 15570E, and are cross-cut by mineralised veins. Two large porphyry sills located above the lower bedded unit can be traced along the upper portion of Cadia East. Numerous smaller sills and dykes also exist in this area. The uppermost of the units termed the capping porphyry and is thickest (~70 m) in the middle of the deposit.

Figure 7-6 and Figure 7-7 are sections showing the geology, alteration, mineralisation zoning, and vein distribution in the Cadia East and Cadia Far East zones respectively.

7.3.1.2 Alteration

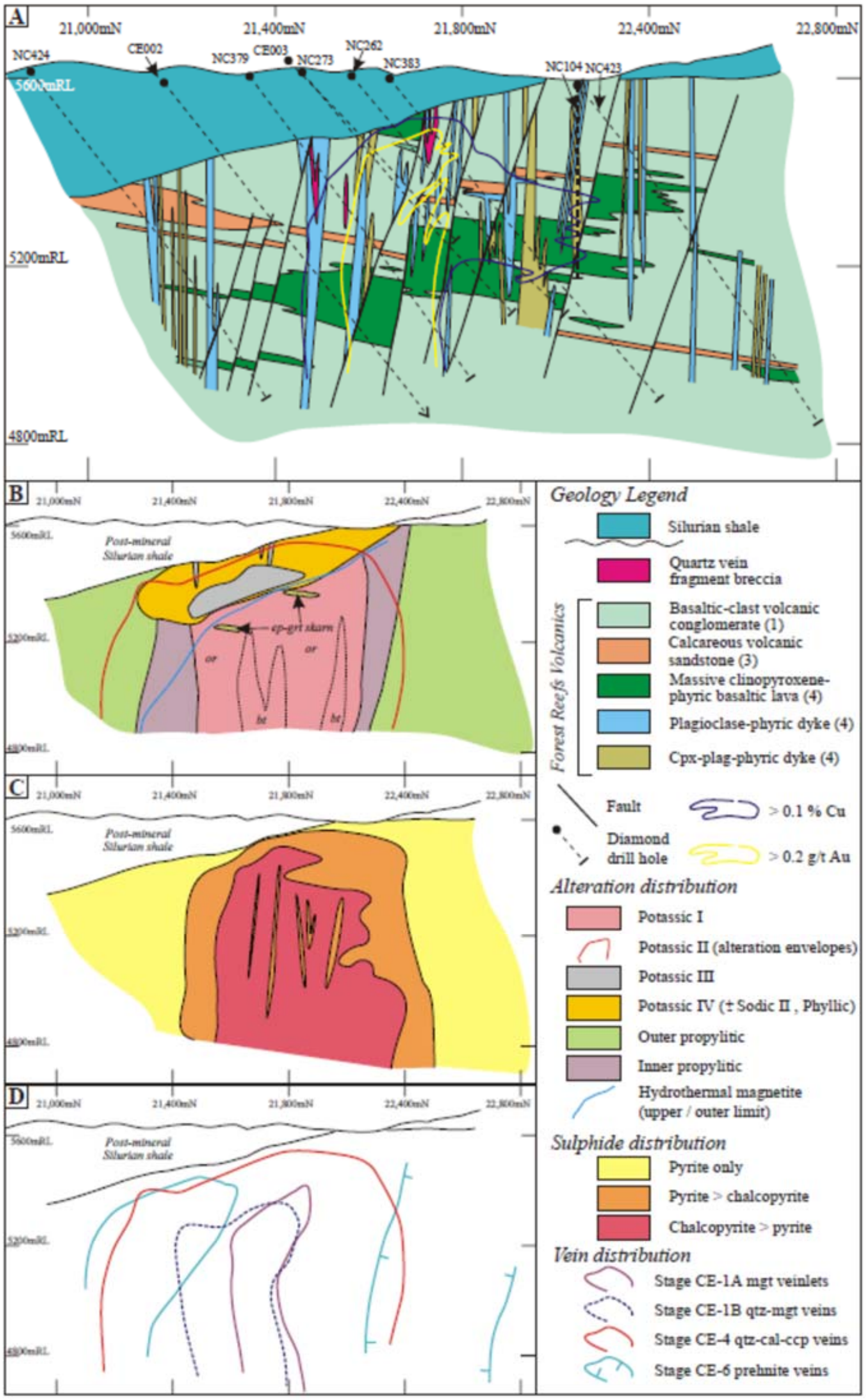
Mineralisation at Cadia East is associated with an alteration system that occurs in roughly concentric zones about the core of the deposit. Within this alteration system both pervasive and selvage styles of alteration are recognised. The pervasive alteration overprints regional propylitic (chlorite–carbonate–epidote) alteration and is characterised by variably intense albite alteration.

The selvage style of alteration is largely made up of three alteration types:

- Hematite/K-feldspar alteration associated with quartz veins (generally mineralised);
- Phyllic alteration associated with faults;
- Iron carbonate–albite alteration associated with faults.

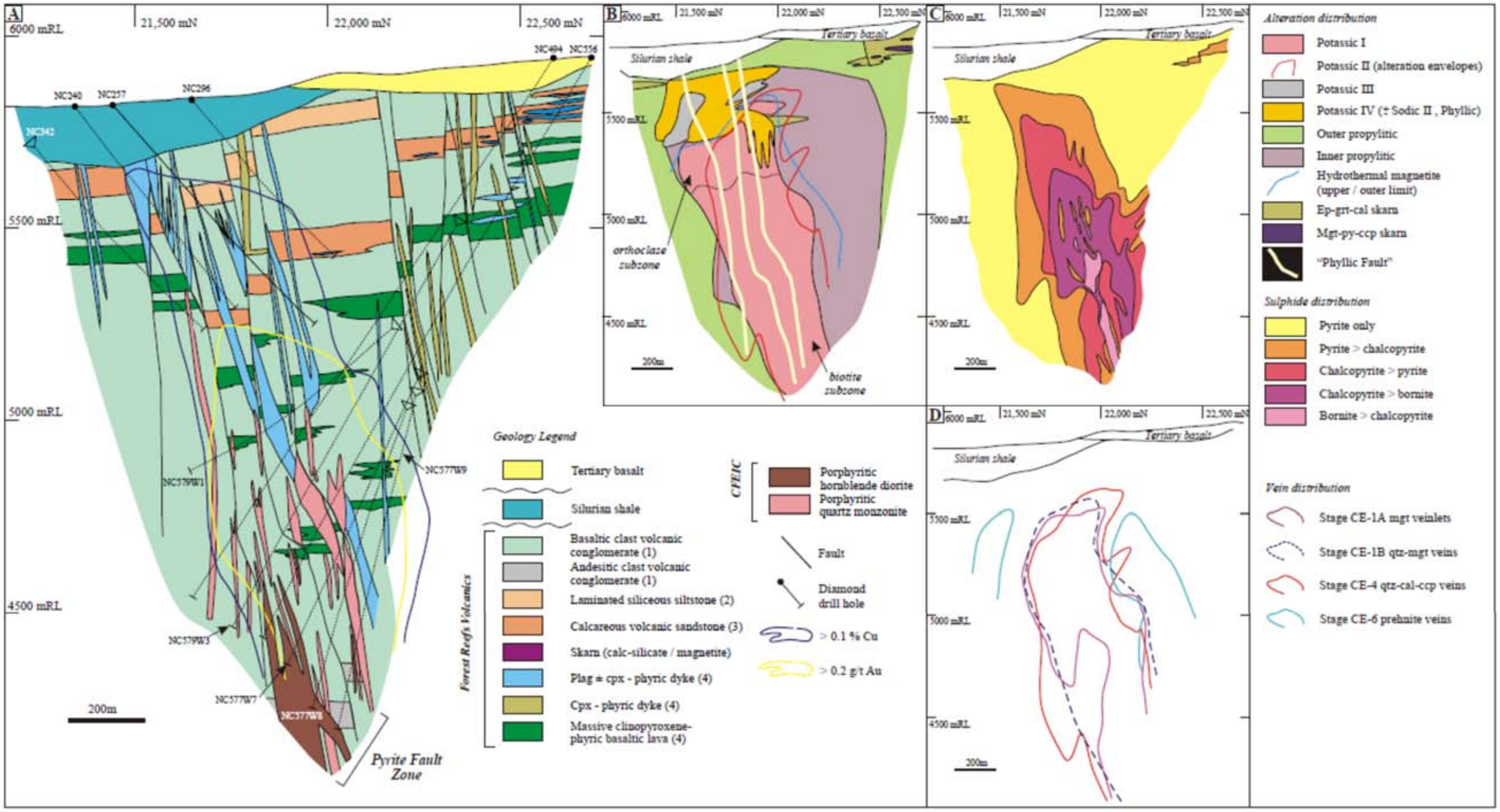
Figure 7-6 and Figure 7-7 include example sections showing alteration zoning.

Figure 7-6: Geology Section, Cadia East (15,820 mE)



Note: Figure from Wilson, 2003.

Figure 7-7: Geology Section, Cadia Far East (Section 15820 mE)



Note: Figure from Wilson, 2003.

7.3.1.3 Structure

Three major groups of faults were identified, including:

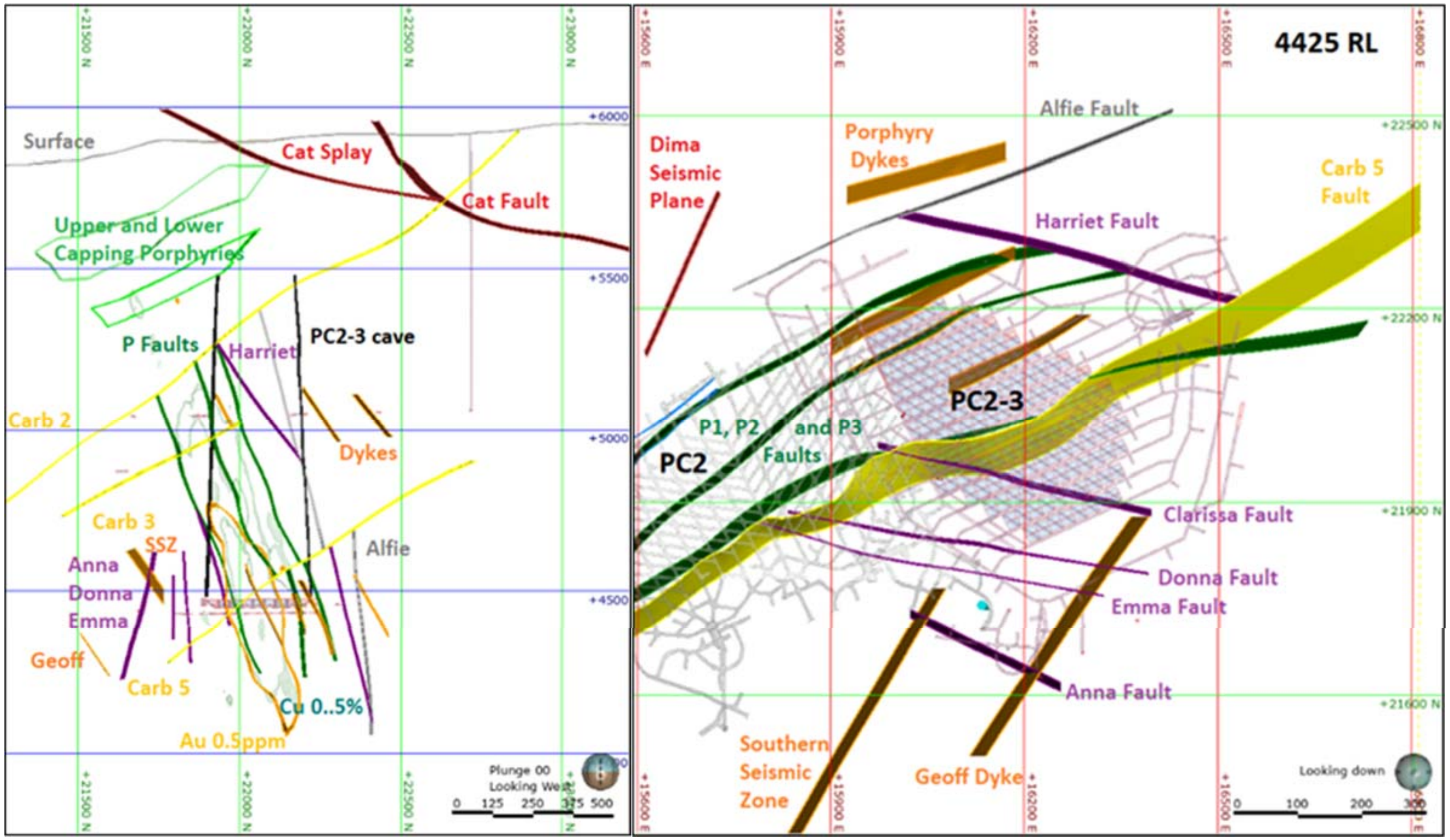
- Sericite–chlorite–clay (SCC) shears: Most common type of fault at Cadia East, and range in scale from millimetres wide to tens of centimetres wide. Infill can vary from friable sericite–chlorite to puggy clay–gouge. Pyrite is common, hence the former term of "pyrite fault", which has been discontinued. The most continuous sub-set, the P Faults (P1, P2 and P3) are east–northeast–west–southwest-striking (parallel to the orebody) and transect the panel cave areas. These faults are anastomosing, and locally discontinuous with splays, and consist of SCC shears that are soft, present deteriorating ground upon exposure, and have a well-developed shear fabric. East–northeast–west–southwest- and east–southeast–west–southwest-striking fault subsets appear to be limited to a 50–100 m strike length and do not have the continuity of the P Faults. The east–southeast-striking shears may be shear fractures that link the tensional fractures within a fault jog, hence their limited (<100 m) continuity along strike;
- Carbonate–laumontite (Ca–La) faults: Highly fractured and veined zones to tens of metres wide. Calcite-laumontite mineralisation is common throughout the Cadia East system, but there are concentrations of calcite–laumontite on the hanging wall (Ca–La North) and footwall (Ca–La Central) sides of the higher-grade orebody (copper and gold), and on the northwest corner of the lower-grade copper zone (Ca–La West). No Ca–La zones were identified in PC2–3. Ca–La Central has not been identified above 5100 RL, and Ca-La North above 5500 RL. The faults are late-stage zones of very poor ground conditions as a consequence of the hydration/dehydration of laumontite;
- Carbonate faults: Related to late low-angle thrusts that are likely splays off the regional Gibb Fault. Characterised by zones of iron-carbonate–albite alteration and chlorite shearing around a zone of calcite veins, or intervals of calcite-rich puggy (sticky) gouge with an iron carbonate selvedge. The main Carbonate Faults interpreted to have an impact on PC2–3 are Carbonate 2 and Carbonate 5. The Cat Fault and Splay overlie PC2–3 near-surface and are zones of well-developed gouge, up to a couple of metres thick. The Cat Fault has been estimated to have at least 80 m of reverse movement. These faults will only be encountered when the PC2–3 cave reaches near surface and will not affect mining recovery.

Figure 7-8 shows the key structures that influence mine planning.

7.3.1.4 Mineralisation

Mineralisation at Cadia East is divided into two broad overlapping zones: an upper, copper-rich disseminated zone and a deeper gold-rich zone associated with sheeted veins. The upper zone forms a relatively small cap to the overall mineralised envelope and has a core of disseminated chalcopyrite (and rare bornite), capped by chalcopyrite–pyrite mineralisation (Fox et al., 2009).

Figure 7-8: Cadia East Key Structures



Note: Figure prepared by Newcrest, 2020.

The deeper zone is localised around a core of steeply-dipping, sheeted, quartz–calcite–bornite–chalcopyrite–molybdenite veins, with the highest gold grades associated with the bornite-bearing veins. Copper and molybdenite form a mineralised blanket above and to the east of the higher-grade gold envelope.

Au:Cu values are vertically zoned. The upper, disseminated zone of volcanic-hosted mineralisation typically has low Au:Cu values (<1), whereas the envelopes of sheeted quartz-calcite-sulphide veins have higher Au:Cu values (typically >2).

Figure 7-6 and Figure 7-7 include examples of mineralisation zoning.

7.3.2 Ridgeway

The deposit is a subvertical body of quartz–sulphide vein stockwork mineralisation with an elliptical, pipe-like geometry, elongated along a northwest-striking axis. Stockwork dimensions are approximately 400 m east–west, 250 m north–south and the deposit extends to a depth in excess of 1,000 m.

7.3.2.1 Geology

Mineralisation is spatially and temporally associated with a composite intrusive plug consisting of multiple mafic monzonite to quartz monzonite phases that intruded the FRV. The earliest phase is a mafic monzonite, which is a northwest striking, subvertical body with horizontal dimensions of 200 x 50 m wide and a vertical extent of at least 500 m. It occurs as a subvertical plug along the southern side of the Ridgeway deposit.

Three phases of porphyritic intrusion (early-mineral monzonite, and inter- and late-mineral quartz monzonite) post-date the mafic monzonite, and form a composite pipe along the northeastern margin of the mafic monzonite. This pipe has a horizontal footprint of about 130 x 40 m, oriented along a west–northwest trending axis. The pipe has been recognised over a vertical interval of >650 m and remains open at depth.

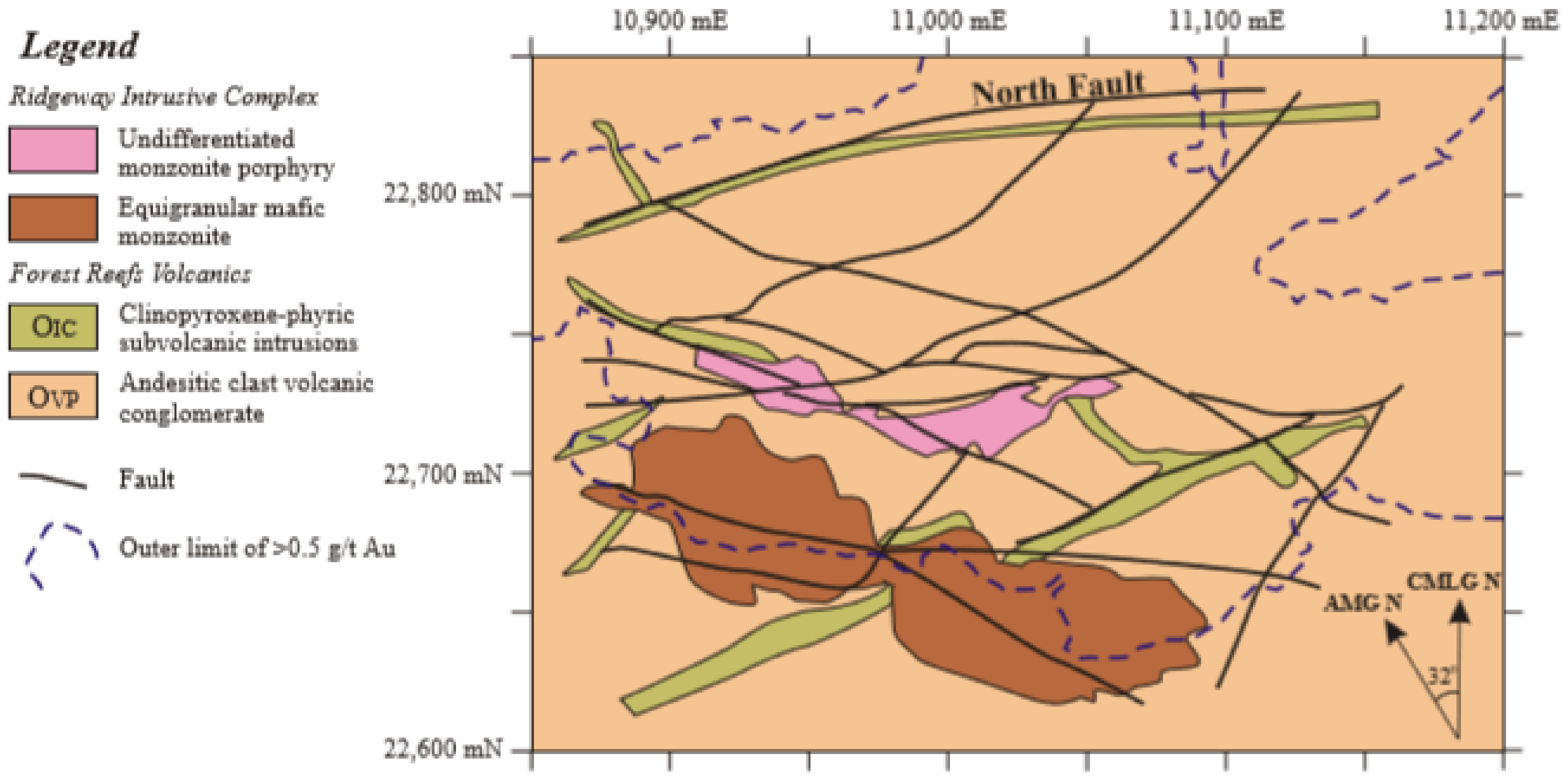
Figure 7-9 is a level plan showing the relationship of the various intrusive phases. Figure 7-10 is a section through the deposit showing the geology in relation to the copper and gold grade shells.

7.3.2.2 Alteration

Hydrothermal alteration is broadly zoned from an inner calc-potassic (actinolite–biotite–orthoclase) and potassic (orthoclase–biotite–quartz) core, outwards through propylitic (chlorite–hematite–magnetite–epidote–albite–pyrite ± calcite) and sodic (albite–pyrite) assemblages (Wilson et al., 2003). The transition to more distal metal-poor propylitic alteration zones has been long recognised by the disappearance of hematite-dusted secondary albite (Holliday et al., 2002).

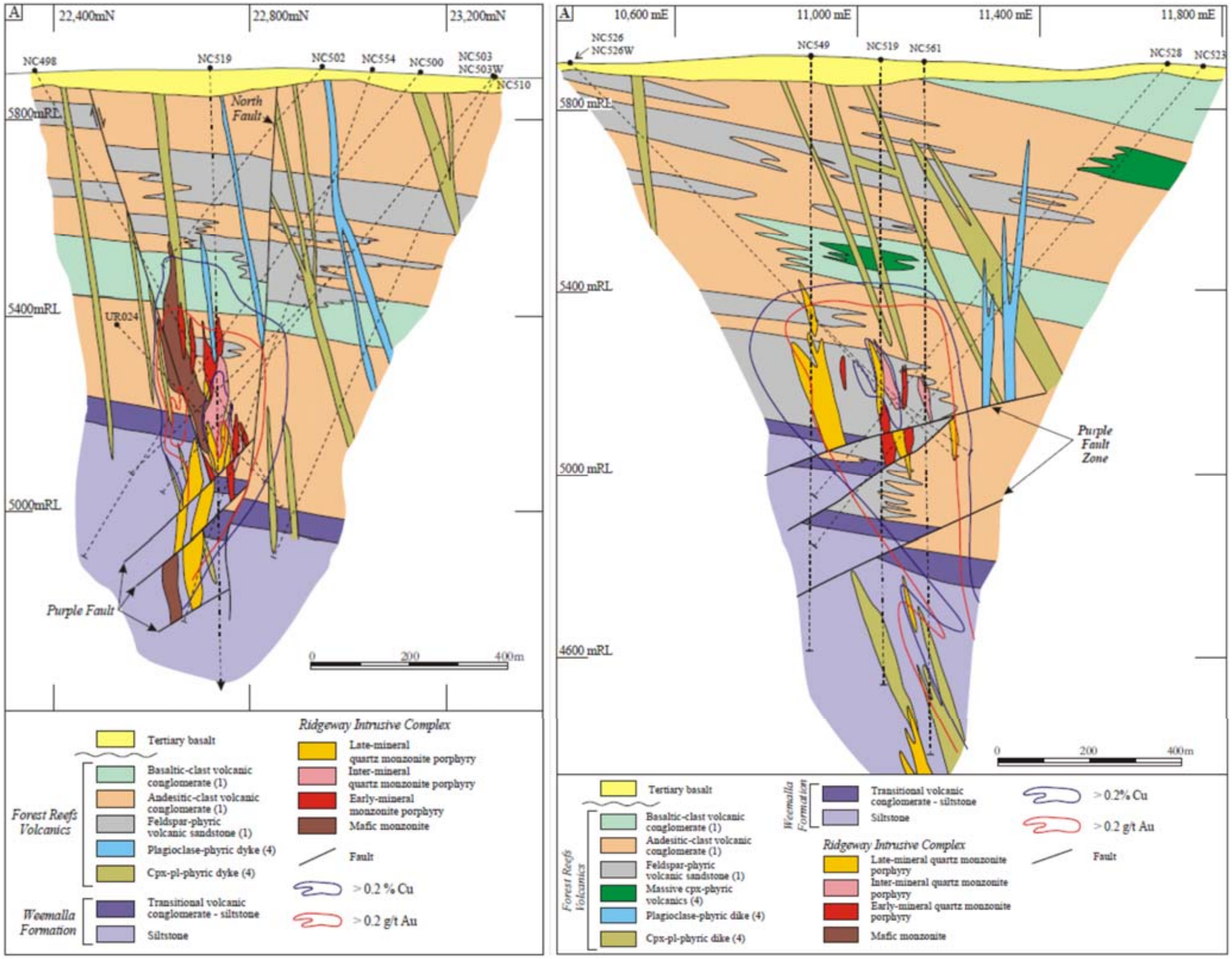
Figure 7-10 includes a cross-section through the deposit showing the alteration zoning.

Figure 7-9: Geology Level Plan, Ridgeway (5280RL level)



Note: Figure from Wilson, 2003.

Figure 7-10: Geological Sections, Ridgeway



Note: Figure from Wilson, 2003. Section on left at 11,050mE; section on right at 22,750mE.

7.3.2.3 Structure

The Ridgeway deposit is centred on multiple steeply-dipping porphyries occurring at the confluence of two gently-dipping structural blocks. To the west of Ridgeway, stratigraphy gently dips east, whereas sedimentary units to the east dip west to west–northwest at 10–20°. These rocks are cut by multiple moderate-dipping reverse faults. A single prominent fault, the Tinnock Fault, occurs with ~500 m of stratigraphic offset (as defined by two stratigraphic pinpoints, including the two lowermost units of the Forest Reefs Volcanics), placing lower parts of the stratigraphy over higher parts. Numerous other moderately-dipping faults splay from this master fault and dismember parts of the Ridgeway deposit. In the deposit, these faults only displace the intrusions by several tens of metres (Harris et al., 2009). Main fault types as summarised by Cuison (2010) are listed in Table 7-1.

Isopach maps combined with 3D modelling show that the ore-related intrusions at Ridgeway occur in the thickest parts of basin-fill successions preserved in both the Forest Reefs Volcanics and the upper parts of the Weemalla Formation. Basin-fill strata laterally vary and broadly thin to the south and west, defining half-graben basin geometries. Tilting (approximately 20° to the west/west–northwest) and structural offset of basin-related sedimentary sequences implies the ongoing dismemberment and expansion of the basins. Well-constrained cross-sections show that the pencil-like intrusions at Ridgeway were probably localised along basin-bounding faults that occur at the margins of the thickest parts of the preserved basin-fill succession.

At Ridgeway, structurally controlled mineralisation is dominated by sub-vertical vein systems:

- North-, west–northwest- and northeast-striking mineralised stockworks and veins most intensely developed in the porphyry intrusions and wall rock;
- East-, northeast- and northwest-striking chalcopyrite-rich sheeted quartz veins.

The vein orientations were generally controlled by pre-existing fractures and the prevailing stress state, and in part by the geometry of the intrusions with which the mineralised veins are associated (Cuison, 2010).

Four deformational events were recognised in the Ridgeway area, and are summarised in Table 7-2.

7.3.2.1 Mineralisation

Mineralisation at Ridgeway and Ridgeway Deeps occurs in dense quartz vein stockworks and sheeted arrays localised in and around the small (50–100 m diameter) composite diorite to quartz–monzonite intrusive complex. The most strongly developed quartz stockwork veining and alteration, and the highest copper and gold grades, occur immediately adjacent to the monzonite (Figure 7-11).

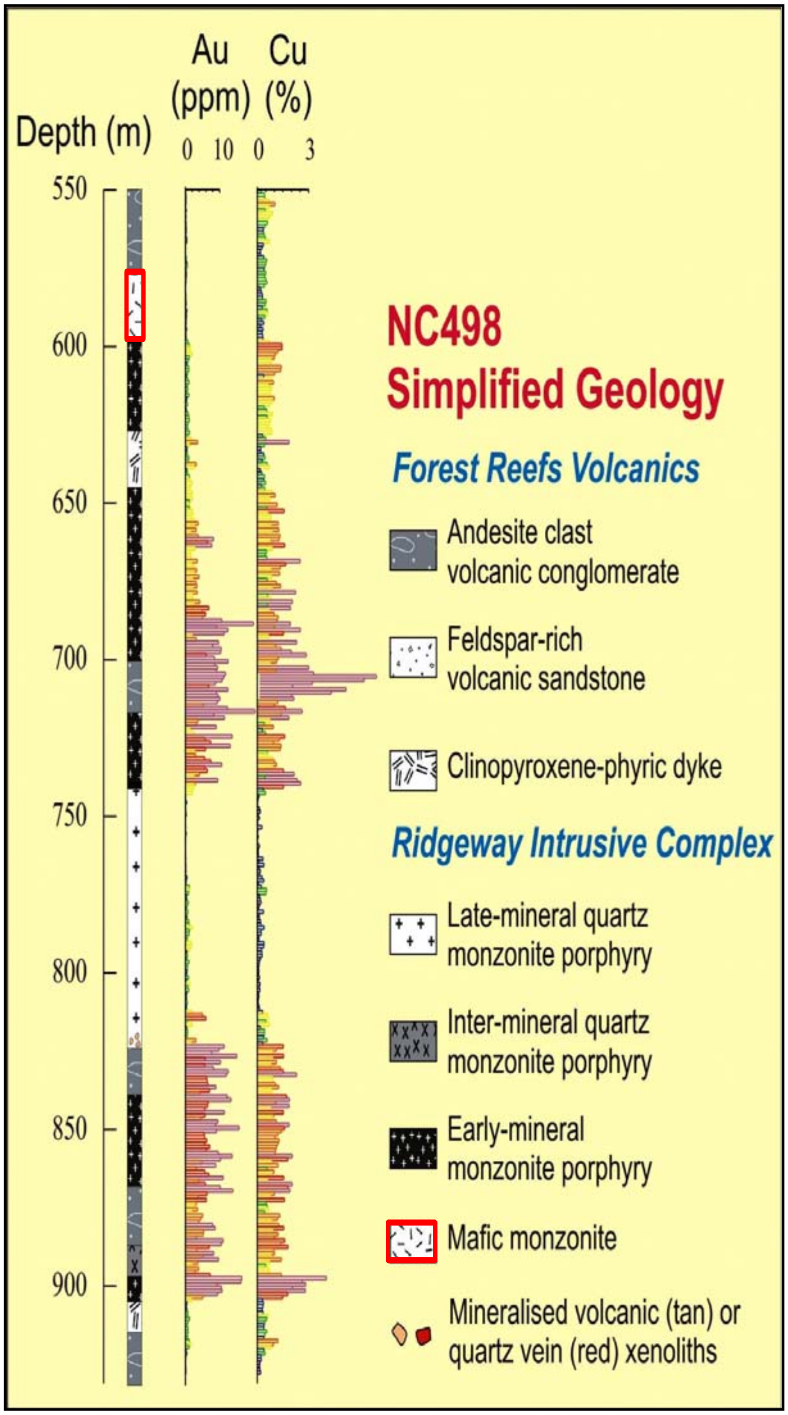
Table 7-1: Ridgeway Fault Types

Fault Set	Fault	Strike	Dip/Dip Direction	Interpretation
Northwest-striking, steeply-dipping	North Fault	Northwest	80º southwest to vertical	Pre-existing faults that are active before, during and after mineralisation; pre-mineralisation pyroxene-phyric dykes occupy these faults
	Merkin Fault	Northwest	Near-vertical	
	Delphin Fault	Northwest	Near-vertical	
	South Fault	Northwest	Approx. 70º to northeast	
North–northwest-striking, southwest-dipping reverse faults	Purple Fault and fault splays	North–northwest	Approx. 50–70º to southwest	Post-mineralisation structures; displaced intrusive complex and mineralisation
	Rimmers Fault	Northeast	Near vertical	Accommodation structure or transfer fault zone to Purple Fault
Low-angle thrust faults	Allana Thrust Fault	Northwest	10–20º northeast	Latest post-mineralisation structures; displaced intrusive complex at depth
	Claudia Thrust Fault	Northwest	Approx. 20–30º northeast	
	Pamela Thrust Fault	Northwest	10–20º northeast	

Table 7-2: Deformation History

Deformation Event	Comment
D1: north–south extension	Resulted in the intrusion of east–west striking, sub-vertical mafic dykes. These dykes appear to have no genetic association to the subsequent mineralisation.
D2: northwest–southeast compression	Resulted in the formation of an east–west orientated dextral strike-slip fault (Ridgeway Fault). It is interpreted that a northwest flexure in this fault became a zone of extension, marked at Ridgeway by a normal fault. The Ridgeway Fault down-throws the FRV–Weemalla Formation contact by 300 m to the northeast. It is interpreted that this fault is now occupied by the Ridgeway deposit.
D3: northeast–southwest compression post mineralisation	Resulted in steep-dipping reverse faults along the margins of the Intrusive Complex. Later movement took place along a 50° southeast dipping thrust fault (Purple Fault) which has displaced the deposit by up to 80 m. The additional movement was accommodated by the steep-dipping reverse faults.
D4: northeast–southwest compression post mineralisation	Resulted in a series of shallow northeast-dipping thrusts.

Figure 7-11: Simplified Geology of Ridgeway Drill Hole NC498 Illustrating the Relationship Between Grade and Monzonite



Note: Figure from Wilson, 2003

The frequency of the veins and intensity of alteration decreases away from the intrusive complex margin (Wilson et al., 2003). Ore minerals include bornite and chalcopyrite with lesser covellite and gold and occur in veins and as disseminations (Wilson et al., 2003).

Sulphide minerals are zoned from a bornite to chalcopyrite (plus gold) core, outwards and upwards through a chalcopyrite-rich to an outer pyrite-rich domain.

Figure 7-12 includes a cross-section through the deposit showing the sulphide mineralisation zoning.

7.3.3 Cadia Hill

Information on Cadia Hill is included in this Report for completeness. The deposit was mined out in 2012 and the open pit is currently being used for tailings backfill.

The Cadia Hill deposit was about 900 m long. Quartz vein-hosted mineralisation extended down dip for over 600 m, although the vein system continued for at least 350 m beyond the base of significant gold and copper mineralisation.

7.3.3.1 Geology

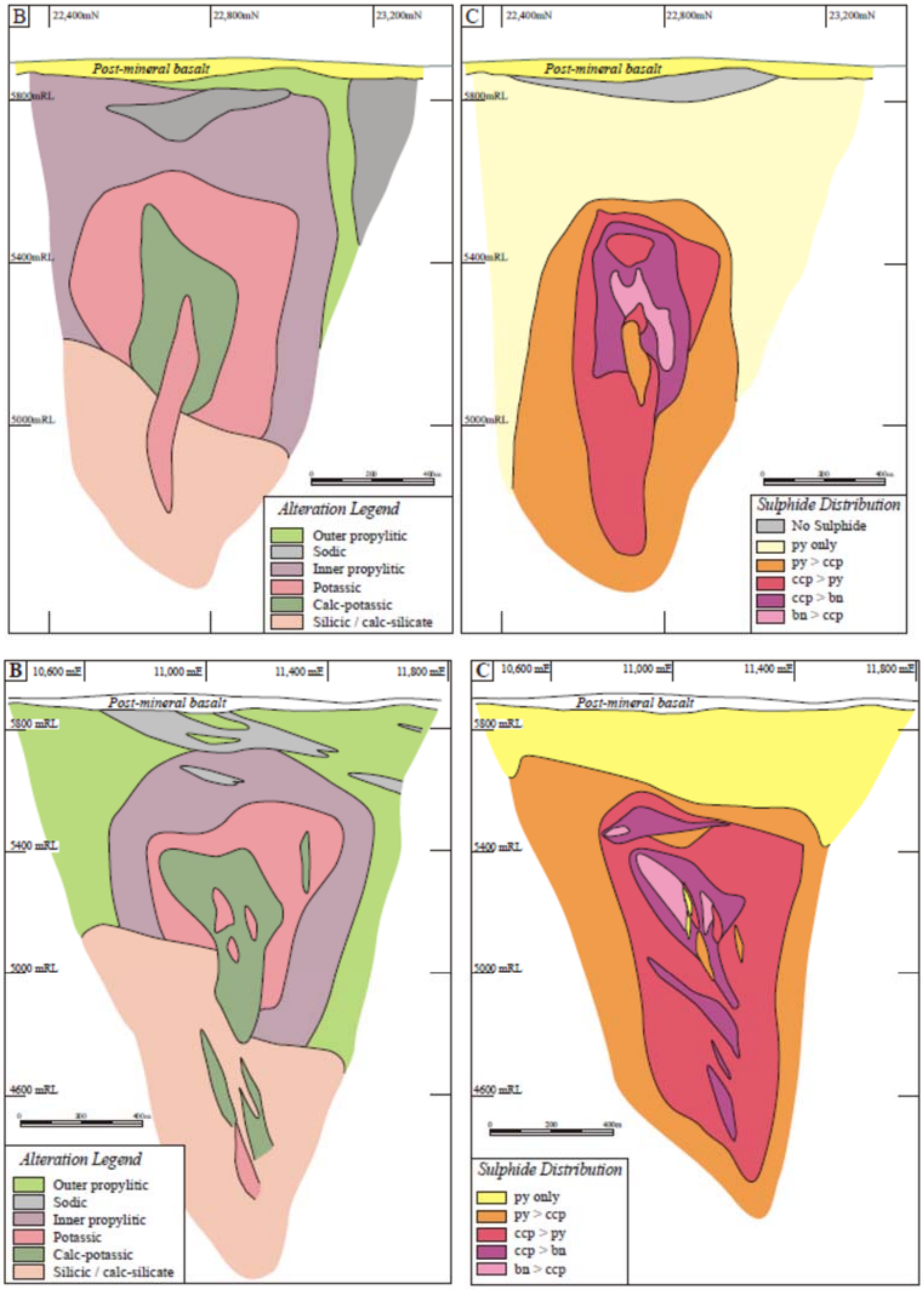
The vein envelope strikes northwest (~340°, AMG grid), and dips to the southwest at between 30º and 60º. Open pit mapping by Newcrest indicated that the northwestern end of the vein envelope was truncated by a series of northeast-striking, northwest-dipping reverse faults that are related to the Cadiangullong Fault Zone.

The intrusions that host mineralisation at Cadia Quarry and Cadia Hill form part of the eastern CIC. The main facies of the eastern CIC is an equigranular to medium to coarse-grained quartz monzonite porphyry. Minor occurrences of equigranular mafic monzonite, and coarse to fine-grained porphyritic monzonites are also present. Intrusive contacts have not been identified between these domains, and no spatial relationship between the domains and mineralisation has been recognised. Emplaced locally within the quartz monzonite porphyry at both Cadia Hill and Cadia Quarry are thin (<2 cm wide) dykes of syenite and quartz syenite, with central seams or selvages of hydrothermal quartz and minor sulphide.

The Cadia Hill deposit is a sheeted quartz vein system. A small roof pendant of volcanic rocks is present on the eastern end of the deposit. Post-Silurian faulting has bounded and internally dismembered the mineralisation; the Cadia Hill system now appears as an imbricate thrust slice with mineralisation truncated by faulting in all directions.

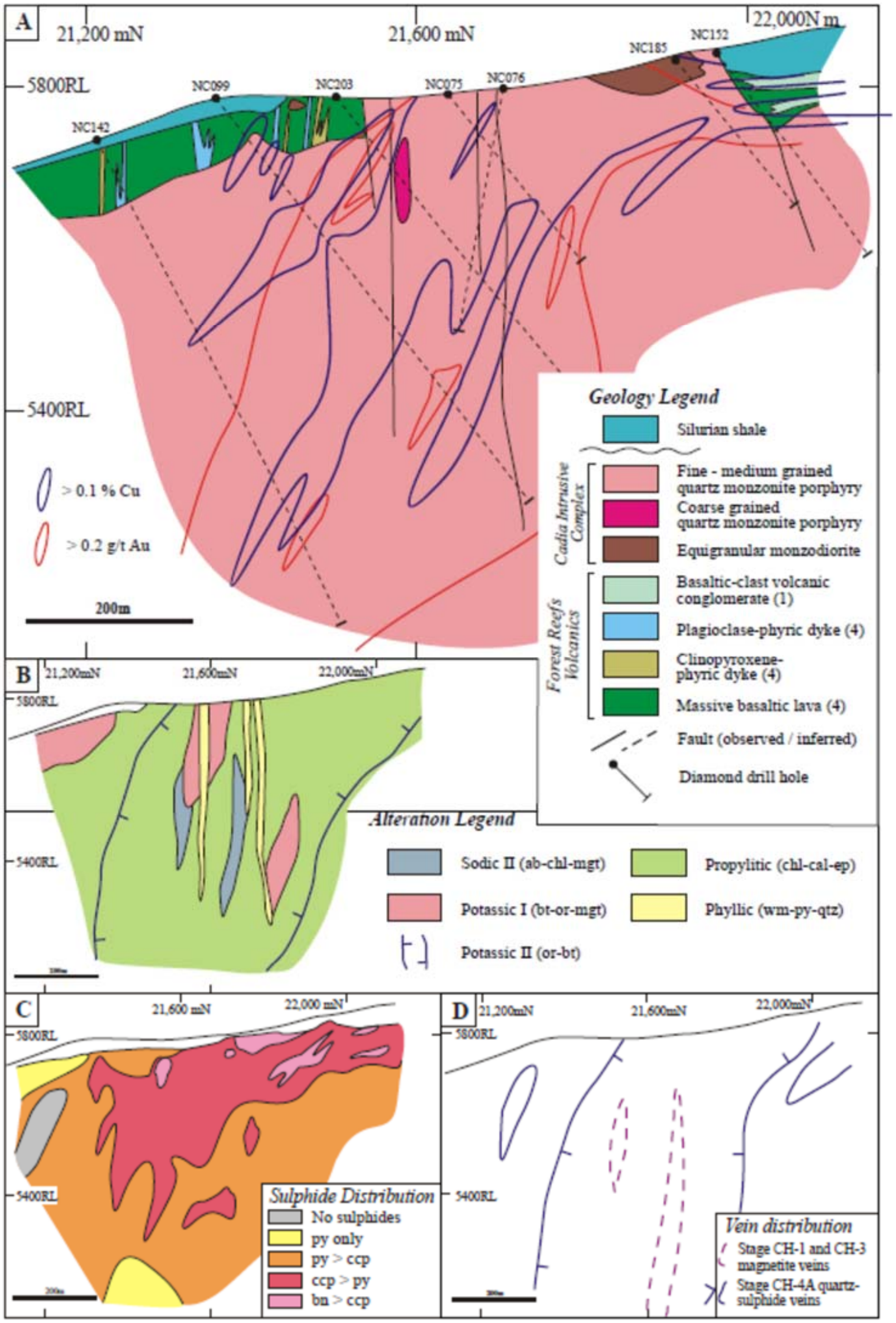
Figure 7-13 is a section showing the geology, alteration, mineralisation zoning, and vein distribution.

Figure 7-12: Alteration and Pyrite Zoning, Ridgeway (section 11050 mE)



Note: Figure from Wilson, 2003. Section at top at 11,050mE; section on bottom at 22,750mE. Bn = bornite, ccp = chalcopyrite, cpx = clinopyroxene, pl = plagioclase, py = pyrite

Figure 7-13: Geology Section, Cadia Hill (section 14020 mE)



Note: Figure from Wilson, 2003.

7.3.3.2 Alteration

The predominant alteration is propylitic (chlorite–epidote) with narrow domains of structurally-controlled phyllic (sericitic) alteration. Mineralisation is in part related to chlorite matrix hydrothermal breccias that cut the deposit. Unusually, compared to the other mineralised systems in the area, potassic alteration is confined to K-feldspar-rich vein haloes and to some quartz veins. Figure 7-13 also shows the alteration zonation.

7.3.3.3 Mineralisation

The vein system forms a broad, 300-m-wide tabular envelope that dips at 60° to the southwest. Chalcopyrite with lesser bornite, pyrite and gold occur in the quartz veins and as disseminations throughout the intrusive wall rock.

Figure 7-13 included an example of the sulphide zonation.

7.3.4 Cadia Extended (Cadia Quarry)

Cadia Extended occurs on the northwestern side of the reverse faults that have truncated mineralisation at Cadia Hill. The deposit has dimensions of about 1,200 x 1,100 m, and extends to about 900 m depth. It is located partly beneath the backfilled Cadia Extended open pit.

7.3.4.1 Geology

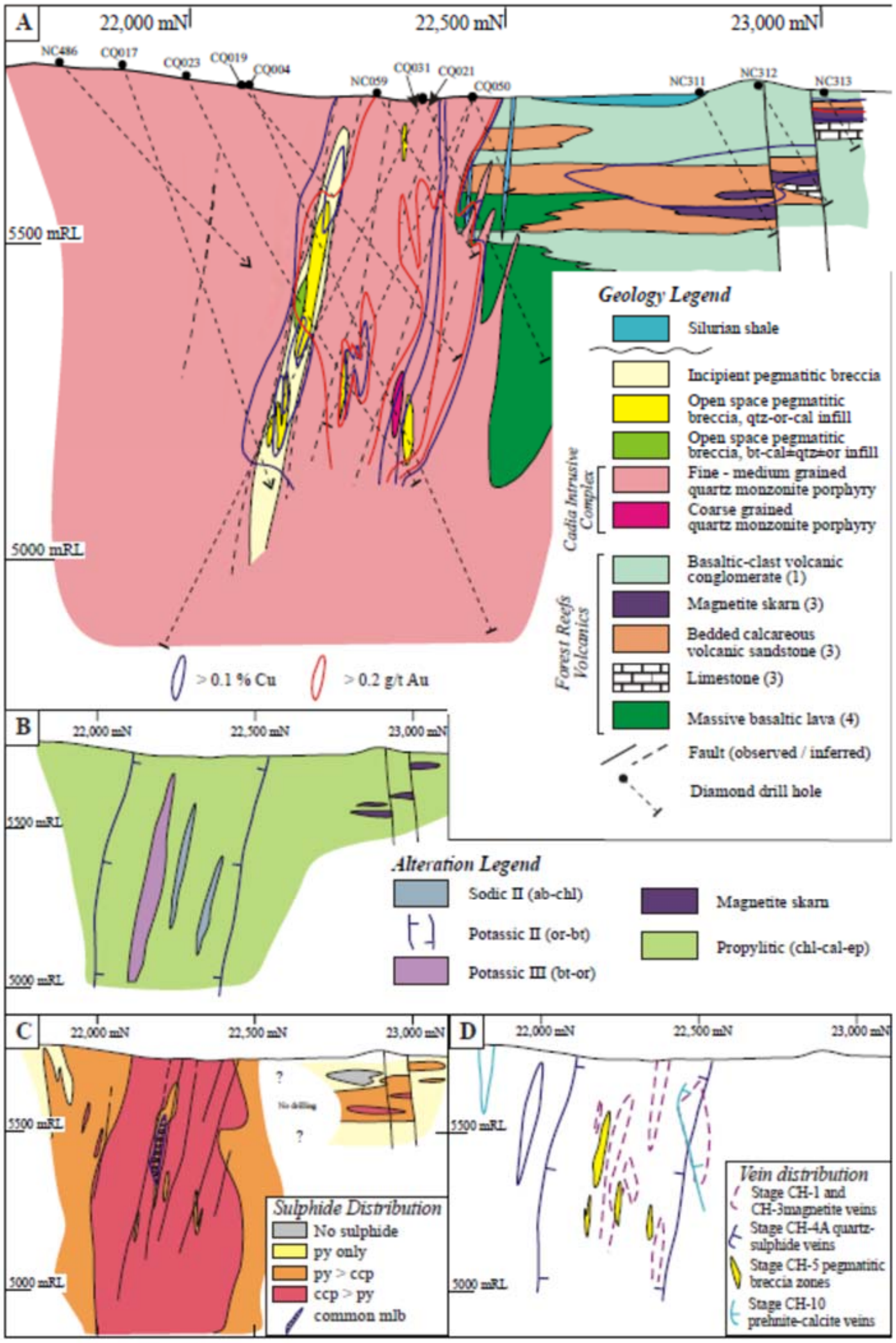
The mineralised zone at Cadia Extended strikes northwest (~330°, AMG grid). Quartz veins within this zone strike at about 300°, and dip to the south at approximately 60°.

The eastern CIC also hosts Cadia Extended. However, Cadia Extended contains locally-developed zones of mineralised “pegmatitic” breccia, in addition to late-stage, structurally-focused zones of brecciation with pervasive phyllic alteration, which do not occur at Cadia Hill. Gold and copper mineralisation are closely associated with sheeted quartz–calcite–sulphide veins that cut obliquely across the host quartz–monzonite porphyry.

The bulk of mineralisation lies adjacent to (approximately 50 m southwest) of a contact with the FRV. This contact is partially intrusive and irregular, but hosts significant mineralised shear zones.

Figure 7-14 is a cross-section through the Cadia Extended deposit showing geology, alteration, vein and sulphide distribution.

Figure 7-14: Geological Section Cadia Extended and Big Cadia (section 13,000 mE)



Note: Figure from Wilson, 2003. Cadia Extended is shown to the left in each figure, with Big Cadia to the right. ab = albite, bt = biotite, cal = calcite, ccp = chalcopyrite, chl = chlorite, ep = epidote, mlb = molybdenite, or = orthoclase, py = pyrite.

7.3.4.2 Alteration

The alteration assemblage is similar to that at Cadia Hill:

- Early-stage: sodic, sodic–calcic, and potassic;

- Transitional: potassic; accompanies main mineralising stage;
- Peripheral: propylitic, calc-silicate;
- Late-stage: phyllic.

Propylitic (chlorite–hematite) alteration is dominant, with localised domains of texturally-destructive phyllic alteration that is associated with breccia and pegmatite style mineralisation.

7.3.4.3 Structure

Faulting both during and after mineralisation emplacement has affected the area. This structural complexity includes east–west-trending trending sub-vertical zones as defined by the copper–gold–molybdenum lodes, as well as flatter, west-dipping thrust faults associated with the Cadiangullong Fault.

7.3.4.4 Mineralisation

Most of the mineralisation-related vein stages at Cadia Hill and Cadia Extended deposits are hosted by quartz monzonitic intrusions. Alteration and mineralisation in the FRV are restricted to locally-developed calc-silicate alteration and minor skarn mineralisation.

Mineralisation consists of sheeted quartz veins containing chalcopyrite–pyrite ± bornite as vein aggregates, and fine disseminations/fracture fill (Wilson, 2003). Mineralisation is in part related to chlorite-matrix hydrothermal breccias that cut the deposit.

Breccia and vein-fill alteration domains that comprise massive chalcopyrite and coarsely (up to centimetre-scale) crystalline molybdenite ± pyrite with gangue minerals including quartz, calcite and K-feldspar also occur. These 'lodes' appear as higher-grade pegmatites associated with porphyry-related mineralisation.

7.3.5 Big Cadia

7.3.5.1 Geology

The Big Cadia iron–copper–gold skarn deposit lies about 600 m north of the Cadia Quarry deposit and is hosted by calcareous volcanic sandstone and limestone units (lithofacies 3) of the FRV. These units occupy a reasonably high stratigraphic position within the FRV. The fault-bounded magnetite (epidote) skarn deposit dips to the southeast, and strikes west–northwest.

Below the skarn, pyroxene-phyric volcanic rocks are dominant, including basaltic lavas, peperites, pillow basalts and monomict porphyritic basalt clast conglomerates.

A polymictic rounded cobble conglomerate overlies the skarn. This unit is mostly restricted to the footwall (southern side) of the PC40 fault.

Skarn mineralisation is hosted in an intensely-altered, bedded, calcareous volcaniclastic unit. It is most conspicuously altered to bladed magnetite after hematite + calcite ± pyrite ± chalcopyrite. Magnetite and sulphides can also be seen replacing fossils. The magnetite rich skarn core varies between massive, banded, and wrigglite-bedded textures. Zones of massive magnetite skarn contain up to 70% magnetite, with the remaining rock being composed of sulphides (mostly pyrite), calcite, and black chlorite. Wrigglite-bedded skarn zones contain 20–50% magnetite, and compositional banding is preserved. Banded texture is intermediate between the massive and wrigglite-bedded skarn in magnetite proportion and appearance. Chlorite-rich, magnetite-poor volcaniclastic sandstone interbeds are present in some intervals within the skarn, and are typically <1 m wide.

The massive magnetite skarn is surrounded by a transitional, or peripheral skarn zone envelope containing typically <5% magnetite. This envelope has higher gold grades than the massive magnetite skarn.

Figure 7-15 also illustrates the geology, alteration, vein and sulphide distribution in the Big Cadia/Cadia Extended area.

7.3.5.2 Alteration

Alteration and mineralisation at Big Cadia occurred in two phases. An early, high-temperature prograde calc-silicate (grossular andradite) phase resulted in carbonate being replaced by bladed hematite and subsequently hematite replaced by hydrothermal magnetite. The later, lower-temperature phase consisted of the remaining carbonate replaced by sulphides (primarily chalcopyrite).

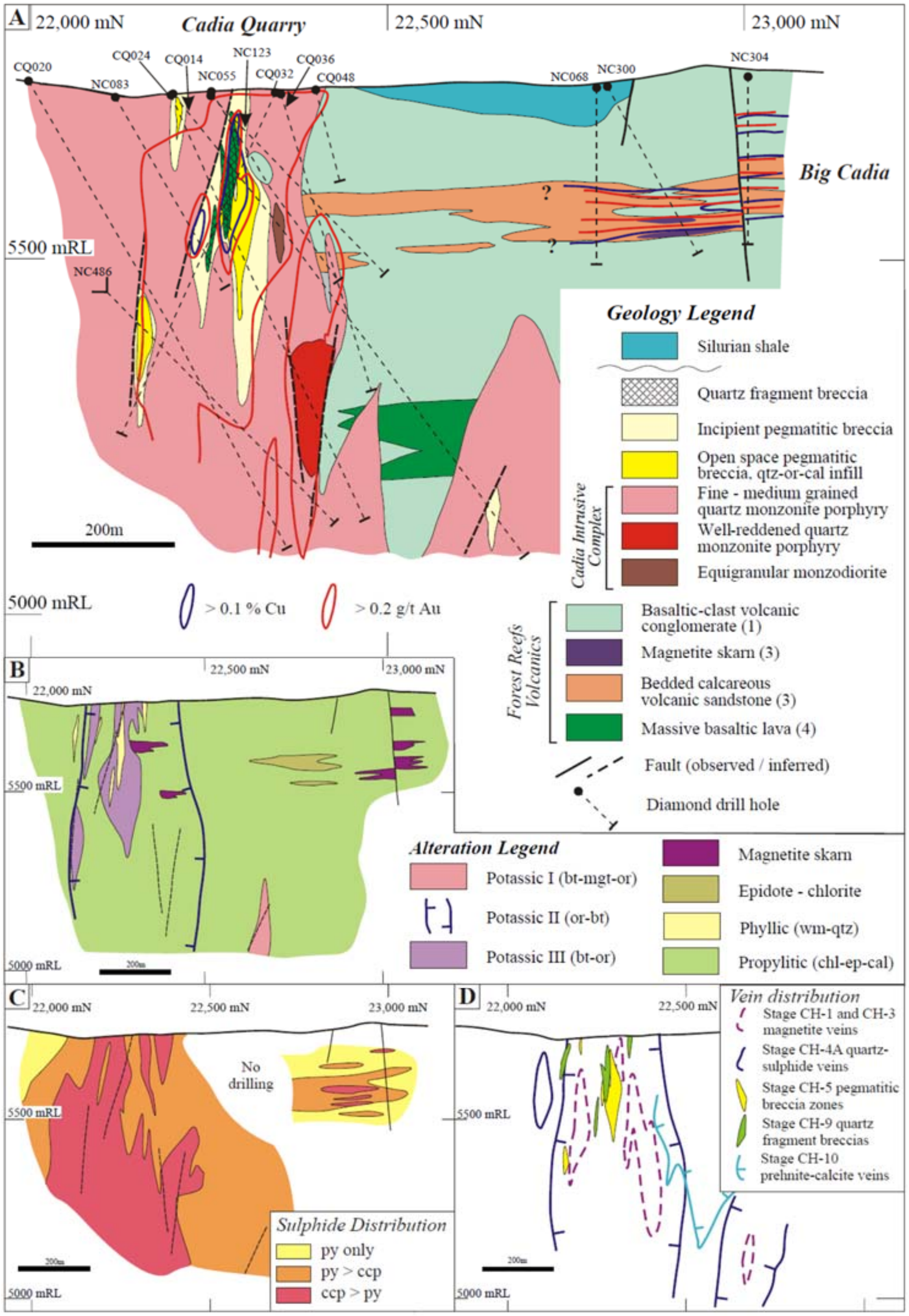
7.3.5.3 Structure

Complex fault and fold relationships are visible in the historical open cut workings. The structural fabric of the Big Cadia deposit is dominated by the east–southeast striking, steeply north-dipping PC40 Fault zone. This fault zone appears to be an early strike-slip structure that separates a southern down-thrown magnetite block from a northern, up-thrown magnetite, partly oxidised block.

The deposit setting may represent an eroded anticlinal fold with the up-thrown block the main dome axis and the down-thrown block one of the sheared-out limbs, with the PC40 Fault representing the sheared-out fold axis.

Magnetite skarn mineralisation is localised in a dilatant site at the intersection of the PC40 and Raggatts/Steep Fault. The skarn is zoned around a series of southeasterly-trending steep breccia zones. The breccia zones vary from a few centimetres to about 2 m thick and have near-vertical dips. The best-developed breccias occur along the southwest margin of the former open pit in the vicinity of the PC40 Fault.

Figure 7-15: Geological Section Cadia Extended and Big Cadia (section 13,100 mE)



Note: Figure from Wilson, 2003. Cadia Extended is shown to the left in each figure, with Big Cadia to the right. bt = biotite, cal = calcite, ccp = chalcopyrite, chl = chlorite, ep = epidote, mgt = magnetite, or = orthoclase, py = pyrite, qtz = quartz, wm = white mica.

However, these breccias are cemented with hydrothermal quartz and or magnetite, unlike the gouge zones which define the PC40 and related structures. The breccias may represent flower faults that formed splays off the PC40 Fault zone.

7.3.5.4 Mineralisation

The Big Cadia deposit has dimensions of 1,000 x 200 m, and a drill-tested depth extent of about 400 m. It consists of an oxide lens, and sulphide mineralisation at depth.

Chalcopyrite and minor gold are closely associated with bladed hematite, magnetite and epidote (with lesser chlorite–quartz–calcite) replacements.

7.3.6 Little Cadia

The Little Cadia deposit has dimensions of 0.8 km x 300 m, and extends to about 150 m depth. The Little Cadia deposit is hosted by bedded, calcareous volcanic-derived sandstones that correlate to the same skarn host at Big Cadia (Packham et al., 1999). Gold and chalcopyrite are associated with epidote ± quartz in the interstices of bladed hematite–magnetite aggregates that have replaced the calcareous sandstone (Forster et al., 2004).

7.4 Prospects/Exploration Targets

Exploration potential is discussed in Section 9.

7.5 Comments on "Item 7: Geological Setting and Mineralisation"

In the opinion of the QP, the understanding of the Cadia East and Ridgeway deposit settings, lithologies, and geological, structural, and alteration controls on mineralisation is sufficient to support estimation of Mineral Resources and Mineral Reserves. There is sufficient understanding of the Cadia Extended and Big Cadia deposits to support estimation of Mineral Resources.

8 DEPOSIT TYPES

8.1 Alkalic Porphyry Gold–Copper Deposits

The major deposits that comprise the Cadia Operations are considered to be examples of alkalic porphyry gold–copper-style mineralisation.

The two major regions that host alkalic porphyry deposits are the Mesozoic arc of British Columbia (Mount Polley, Mount Milligan, Galore Creek) and the Australian Lachlan Fold Belt (Cadia, Ridgeway, North Parkes). Deposits are also known from the Philippines (Dinkidi) and Greece (Skouries).

The following summary of the alkalic sub-class of porphyry deposits is summarised from Pantaleyev (1995), Wilson (2003), Chamberlain et al. (2006), Wilson et al. (2007), and Micko et al. (2014).

Alkaline rocks associated with gold–copper deposition are commonly found in arc environments and areas of extensional tectonics. Host rocks are often subaqueous volcanic-related sequences that were intruded by equigranular to coarsely porphyritic and locally pegmatitic, high-level stocks and dike complexes. Multiple intrusive phases are common, and a wide variety of breccia types can develop. Intrusive rocks can range from (alkalic) gabbro to syenite in composition.

Alkalic deposits are typically locally high-grade, and are associated with small volume, pipe-like alkalic intrusions that may be as small as a few hundred metres. Deposit outlines are highly variable, ranging from small to large, but typically showing significant vertical extents.

Deposits can occur in clusters, with locations influenced by a combination of structural, stratigraphic, breccia and intrusive controls.

Alteration generally has a restricted footprint, but displays complex assemblages and zonation. K-metasomatism leads to the development of a potassic alteration footprint commonly surrounded by a propylitic aureole. The deepest parts of some systems can be associated with a calc-silicate assemblage, commonly accompanied by sodic alteration. Sodic alteration has also been recognised peripheral to potassic zones. Advanced argillic alteration is rarely present, and phyllic zones are usually restricted to fault zones that developed late in the history of the hydrothermal system. Supergene enrichment zones are generally not present.

Wallrock alteration is often represented by a biotite–magnetite–orthoclase assemblage. The abundance of biotite and magnetite is controlled by the iron and magnesium content of the wall rocks. Skarns may occur and can be economically significant. Potassic-style alteration in igneous rocks tends to correlate with calc–potassic assemblages in altered carbonate rocks dominated by andraditic garnets, diopside, epidote, and sometimes biotite.

Breccias in alkalic systems are associated with hydrothermal and phreatomagmatic processes. Magnetite-cemented hydrothermal breccias may host high-grade mineralisation.

Mineralisation can be present in the form of stockworks, veinlets, disseminations and replacements. The major sulphides present can include chalcopyrite, pyrite and magnetite. Other minerals can include bornite, chalcocite, galena, sphalerite, tellurides, and tetrahedrite. Gangue minerals often include K-feldspar, and sericite, with lesser garnet, clinopyroxene (diopsidic) and anhydrite. Hydrothermal magnetite veinlets are generally abundant. Quartz veining is poorly developed to absent in deposits known from British Columbia, but is well developed in the Cadia Valley.

Gold may be present as discrete grains of native gold, tellurides, or auriferous sulphides. Alkalic porphyry deposits may also show elevated tellurium and platinum-group element concentrations. In copper-rich deposits, gold is commonly associated with bornite and high copper concentration. Gold is usually found in stockwork veins of quartz, sulphides, native gold and tellurides.

8.2 Skarn Deposits

The Big Cadia and Little Cadia deposits are slightly different from the majority of the Cadia deposits in that each is a calcic iron–copper–gold skarn. However, the skarn is typical of those found in association with porphyry deposits in volcanic arcs.

Skarn systems can form in diverse settings, and are therefore typically defined by mineralogy, rather than deposit setting.

8.3 QP Comments on “Item 8: Deposit Types”

Features that classify the Cadia and Ridgeway deposits as alkalic porphyry copper–gold-type deposits include:

- Associated with alkalic intrusive rocks;
- Association of gold–copper mineralisation with Ca-, K- and Na-bearing alteration minerals and an absence or comparative lack of phyllic and argillic alteration assemblages;
- Early stage alteration and mineralisation characterised by development of magnetite-rich sodic and sodic-calcic alteration assemblages;
- Lack of pervasive phyllic alteration;
- Mineralisation is spatially, temporally, and genetically associated with hydrothermal alteration of the intrusive bodies and host rocks;
- Large zones of veining and stockwork mineralisation, together with minor disseminated and replacement mineralisation occur throughout large areas of hydrothermally-altered rock, commonly coincident wholly or in part with hydrothermal or intrusion breccias;
- Mineralisation forms that include:
  - Cadia East: Both intrusive-centred and wallrock sheeted vein style plus broad disseminated wall rock;
  - Ridgeway: Intrusive-centred quartz stockwork;
  - Cadia Hill: Wallrock sheeted vein style;

- Cadia Extended: Wall rock sheeted and stockwork quartz–sulphide veins and minor pegmatite and breccia;
- Big Cadia, Little Cadia: Magnetite–garnet skarn, disseminated and veining.

- Zonation of sulphides, typically consisting of a core bornite–chalcopyrite zone, grading into a chalcopyrite zone (that grades outwards through zones of chalcopyrite > bornite, chalcopyrite > pyrite), and an outer pyritic halo.

The QP considers that an alkalic porphyry copper model is a reasonable basis for exploration targeting for copper–gold mineralisation in the Cadia Operations area.

Skarn-style models are also applicable, although economic mineralisation of the tenor of the porphyry deposits has not been identified in the skarn systems to date.

9 EXPLORATION

9.1 Grids and Surveys

The Cadia Operations grid and co-ordinate system is consistent for all deposits and operations. Grid north is aligned at 30º east of true north and 19º east of magnetic north. This grid was used to locate all historical data, including drilling, and is used for all current drilling.

A constant added to the entire Project grid co-ordinates in approximately 1995, to allow for the Ridgeway area, such that 10,000 was added to the easting, 20,000 to the northing, and 5,000 to the elevation for all deposits.

Surface topography across the Cadia East area is based on a combination of theodolite-surveyed ground pickups and air photo photogrammetry. Photogrammetry is levelled by ground-surveyed points. The data are considered accurate to within ±500 mm.

9.2 Geological Mapping

Surface geological mapping was performed by Newcrest geologists and staff of the NSW Department of Primary Industry (Orange 1:100 000 Geological Sheet, 1997).

At the Ridgeway mine, during operations, every development cut, approximately 4 m in length, was mapped in detail at 1:250 scale for rock type, quartz veining and structures. This information was used to update the geological and fault interpretations for the deposit.

9.3 Geochemical Sampling

Geochemical sampling has predominantly been completed in areas of Ordovician basement outcrop. Areas of Silurian sedimentary cover and Tertiary basalt are largely unsampled due to the lack of effectiveness of sampling techniques within these areas.

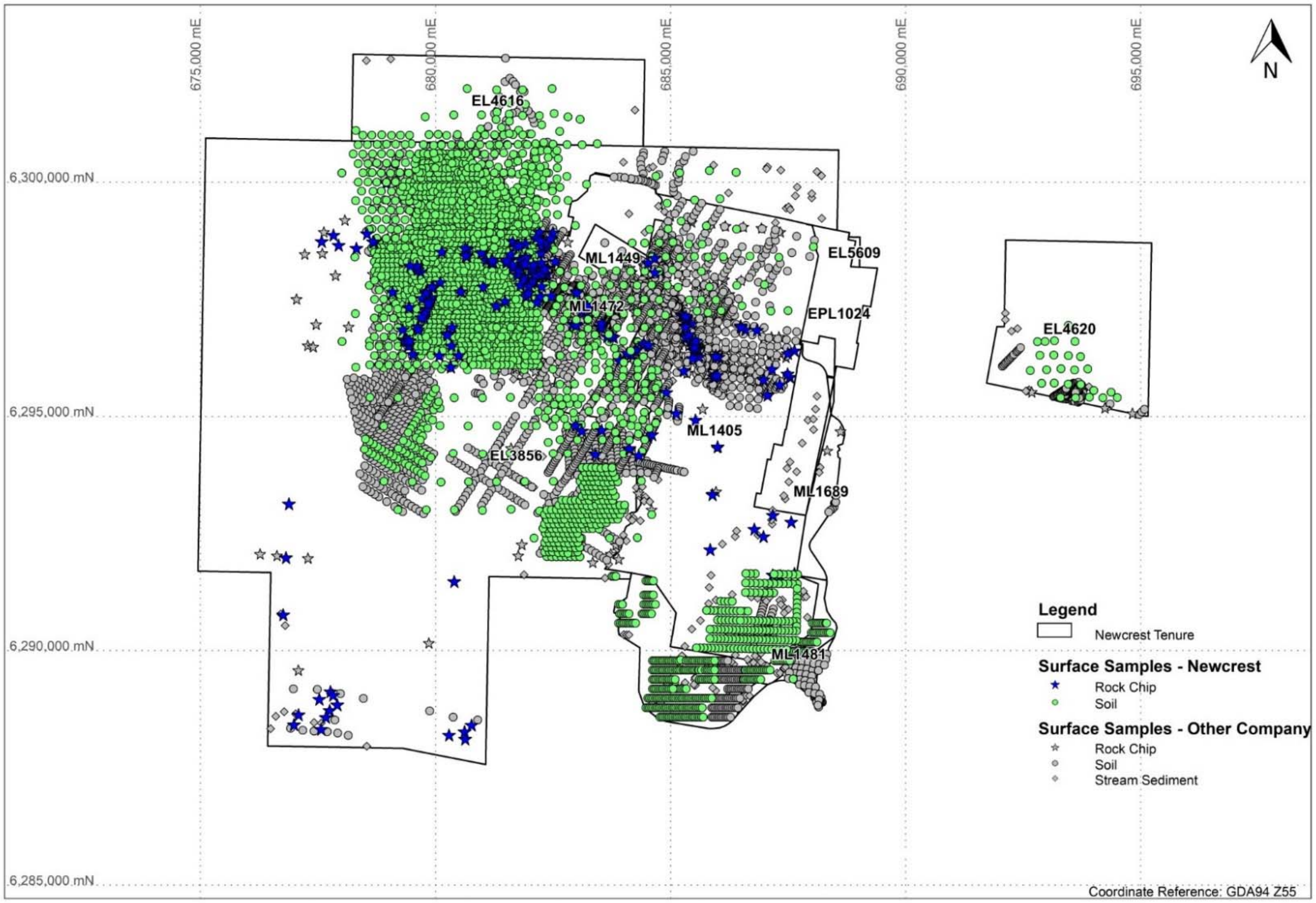
Sampling methods included rock chip (1,094 samples), stream sediment (288) and soil sampling (8,032), for a total of 9,414 samples recorded in the Project database. Sample locations are shown in Figure 9-1.

Surface geochemical sampling has principally been used as a mineralisation vectoring tool to prioritise exploration prospects and generate direct drill targets.

9.4 Geophysics

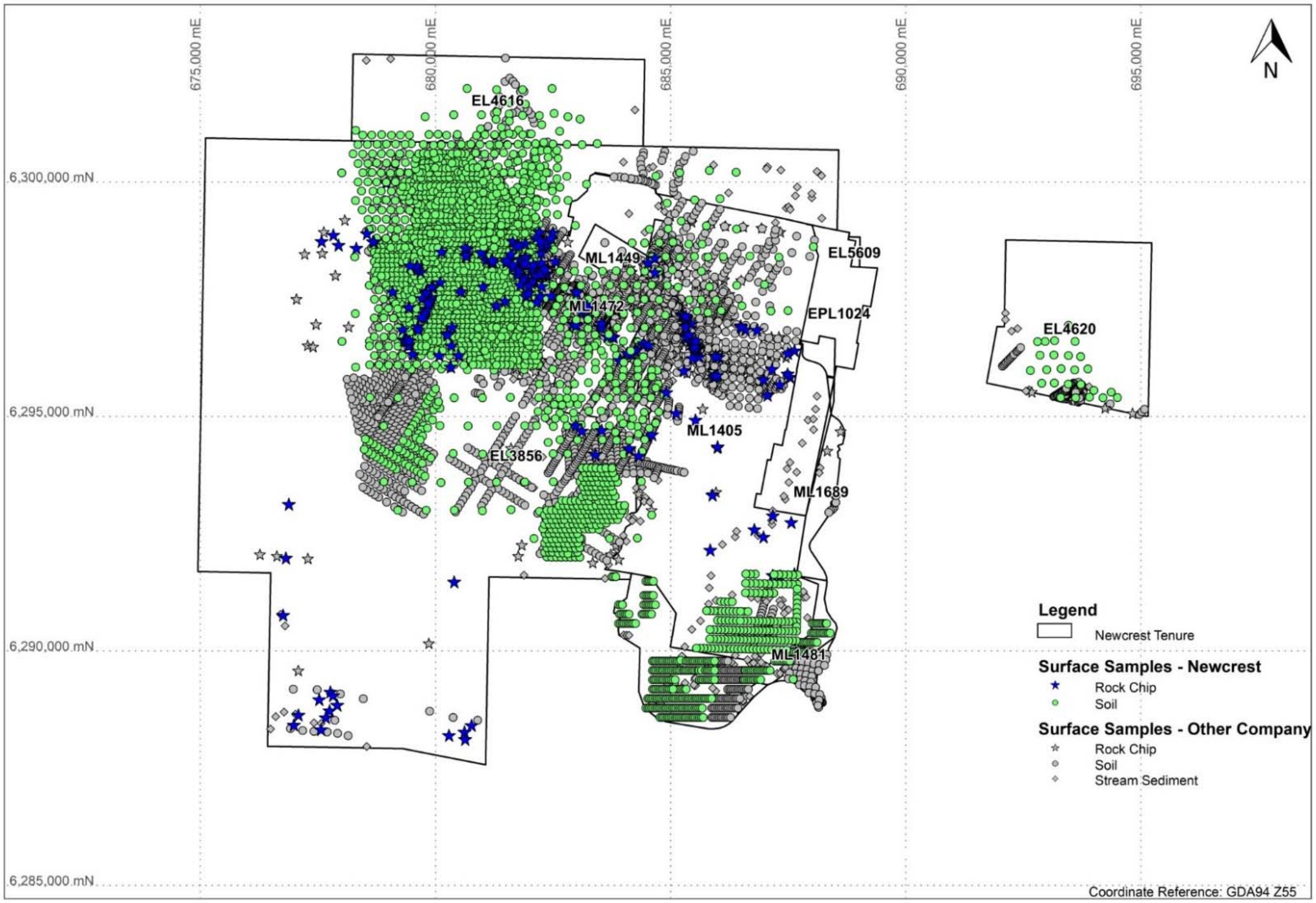
The areas of the completed geophysical surveys are summarised in Figure 9-2.

Figure 9-1: Geochemical Sampling



Note: Figure prepared by Newcrest, 2020.

Figure 9-2: Geophysical Surveys



Note: Figure prepared by Newcrest, 2020.

9.4.1 Airborne Geophysical Surveys

The entire Cadia mineralised system was covered by a heli-magnetic and radiometric survey, acquired by Geoinstruments during 1996. The system used a compensated ‘stinger’ magnetometer mounted on a Bell JetRanger, and a 16 L radiometric crystal pack.

The specifications were 50 m spaced north–south lines, and a 25 m flight height. Magnetic data were acquired at 0.1 s intervals, and radiometric data at 1 s intervals.

The heli-magnetic and radiometric data provide lithological, structural, and alteration information over the area.

Three-dimensional inversion of the total magnetic intensity (TMI) data using UBC MAG3D software was used to create a 3D susceptibility block model. The magnetic response west of Cadia Hill is primarily the result of more mafic phases of the intrusive complex, which average around 0.01 SI susceptibility. The anomalies associated with Ridgeway, Cadia East, and the magnetic rim around part of Cadia Hill are primarily a result of magnetite alteration. The Tertiary basalt can sometimes be observed in the TMI data as remnantly-magnetised ‘lows’.

A heliborne Falcon geophysical survey was completed in June 2010. The survey was conducted on a 200 m traverse line spacing, and 2 km tie-line spacings, with a terrain clearance of 80 m. The survey was designed to gain a better picture of structure and gross lithology not evident in existing helimagnetic data as well as facilitate the investigation of blind felsic intrusive targets, and to assist in optimising future drilling campaigns. Data interpretation indicates the presence of a number of felsic bodies in the survey area.

9.4.2 Ground Geophysical Surveys

9.4.2.1 Magnetics

A ground magnetic survey using Overhauser magnetometers was conducted around the Cadia Hill and Cadia East areas during 1992. Newcrest personnel acquired the data on the local grid at 50 m line spacing, using a hip chain to trigger readings every metre.

These data were used to help optimise the direction of the initial drilling at Cadia Hill during late 1992 and early 1993. The data confirmed north–northwest structural and alteration trends extending outwards from limited exposures of quartz veining. Drill holes were oriented normal to this strike, which proved to be the dominant direction of mineralisation.

In early 1994, 2D and 2.5D inversions were performed on the ground magnetic data at Cadia East, using Geosoft MAGMOD3 software. The models suggested that an earlier 221 m hole drilled by Pacific Copper did not properly test the magnetic ‘high’ anomaly at Cadia East, as seen in the TMI data.

As a result, a vertical core hole was drilled to 404 m depth in early 1994 (NC104). The hole intersected magnetite veins, monzonite dykes, and increasing copper grades at depth. Follow-up drilling discovered the Cadia East mineralisation under Silurian sedimentary cover.

Partly as a result of this magnetite association with mineralisation, the ground magnetic survey work was extended over the entire contiguous Cadia magnetic complex during 1994. This included the Ridgeway area north west of Cadia Hill, where the magnetic complex continued under Tertiary basalt cover.

9.4.2.2 Induced Polarisation

Trial 200 m dipole-dipole induced polarisation (IP) surveys were carried out by Scintrex Pty Ltd at Cadia Hill and Cadia East during 1995, with the dipole spacing selected to provide adequate depth of investigation. A Scintrex IPR-12 receiver was used, measuring apparent chargeability and resistivity.

The Cadia Hill sulphides gave a large response about three times background in the pseudosection. Cadia East, which has a very high pyrite content in an upper disseminated zone (Sulphide Lode), gave a very large response about three times background beneath a minimum of 60 m of cover. Due to the success of these trials, additional lines along strike to the southeast and northwest were acquired.

The stronger IP responses measured within the Cadia East area are due to the pyrite-rich Weemalla Formation sediments. The Ridgeway IP anomaly was drilled by RC drilling during 1995, and the drill hole intersected as much as 5% pyrite, with anomalous copper and gold, below the Tertiary cover. Subsequent deeper drilling discovered the Ridgeway deposit, at depths below 500 m.

9.4.2.3 MIMDAS

During 2018–2019, Geophysical Resources and Services Pty Ltd (GRS) carried out a survey of 2D Mount Isa Mines Distributed Acquisition System (MIMDAS) IP and magneto-tellurics (MT) to survey four prospects in the greater Cadia area, two of which, Cadia NE and Cadia NW, are within the Project area. All lines used 200 m spaced receivers with a dipole-dipole configuration. The transmitter dipole locations, also on 200 m intervals, were spaced equidistantly between the receivers. Data are still undergoing interpretation and evaluation.

9.4.2.4 Gravity

Gravity data were acquired during 1994 and 1995 at nominal 500 m spacing, using digital global positioning system (DGPS) instruments for positioning and levelling.

Significant structural trends are evident in the data, especially a northeast-oriented structure in the vicinity of Cadia Hill, and the west over east Cadiangullong thrust fault.

9.4.2.5 Magneto-Tellurics

An initial magneto-telluric survey was completed in 2017, consisting of two lines, with station spacings at 500 m along lines 1 km apart. Due to the limited nature of the data collected, no evaluations have been done to date. Magneto-telluric survey extensions are planned as part of anticipated MIMDAS IP survey activity.

9.4.3 Drill Hole Geophysical Surveys

9.4.3.1 Downhole Electromagnetics

Downhole transient electromagnetics has been trialled in the Ridgeway area, with data being acquired by Outer Rim using Crone equipment. No off-hole conductors were observed.

9.4.3.2 Physical Property Measurements

A significant quantity of physical property information has been acquired, both from well logs, and measurements on core. The information has been used as constraints in geophysical modelling, as well as to assist density characterisation for resource calculations.

Remnant magnetisation measurements were performed on core from the Big and Little Cadia magnetite-bearing skarns.

9.5 Petrology, Mineralogy, and Research Studies

Numerous research projects and studies were completed on the Cadia district and deposits within the district. These are summarised in Table 9-1.

Regional/academic studies were completed that include:

- Geochemical vectors to mineralisation from hydrothermal alteration minerals such as epidote (green rocks studies);
- Evaluation of the relationship of shoshonitic magmatism to gold–copper porphyry mineralisation;
- Examination of the system architecture of the alkalic porphyry copper deposits in the Cadia area.

Multiple petrological studies were conducted as part of broader research studies and to directly understand the mineralogy of the Cadia deposits. Petrology has been completed on selected core and rock samples from Ridgeway, Cadia East, Cadia Hill and numerous exploration prospects.

Corescan infra-red and near-infra-red hyperspectral analyses were conducted on selected drill core and RC chips from the Cadia deposits. This technique provides accurate mineralogical information through very high-resolution scanning of the sample and use of specific algorithmic processing of the acquired spectra. This technique can be used to accurately identify hydrothermal alteration minerals that are not readily identifiable during geological logging.

Table 9-1: Research Theses

Thesis Type	Year	Author	Title
PhD	2003	Alan Wilson	The Geology, Genesis and Exploration Context of the Cadia Gold–Copper Porphyry Deposits, New South Wales, Australia: unpub. PhD thesis, University of Tasmania.
	2010	Ana Lisa Garcia-Cuison	Geology and Genesis of the Ridgeway Porphyry Au-Cu Deposit, NSW: unpub. PhD thesis, University of Tasmania.
	2012	Nathan Fox	Controls on Alteration and Mineralisation at the Cadia East Alkalic Porphyry Au-Cu Deposit, NSW: unpub. PhD thesis, University of Tasmania.
MSc	2006	Malissa Washburn	Architecture of the Silurian Cover Sequence in the Cadia Porphyry Au-Cu District, NSW, Australia: Implications for Post-Mineral Deformation: unpub. MSc thesis, University of Maine.
BSc Honours	2005	J.C. Kitto	Lithostratigraphy, Alteration and Geochemistry at the Cadia East Au-Cu Porphyry Deposit, NSW: unpub. BSc Hons thesis, University of Tasmania.
	2006	D.J. Finn	Late Stage Phyllic Alteration in the Cadia East Copper–Gold Porphyry Deposit NSW, Implications to Mineralisation: unpub. BSc Hons thesis, University of Tasmania.

As the targeted mineralisation styles are well known to have predictably zoned hydrothermal alteration patterns around mineralised centres, being able to identify the mineralogical assemblages of drilling samples can be a useful tool for improving the understanding of the known orebodies and vectoring towards orebodies in exploration.

Drill core from the Cadia East and Ridgeway deposits, as well as from regional prospects, were analysed to assist in this process.

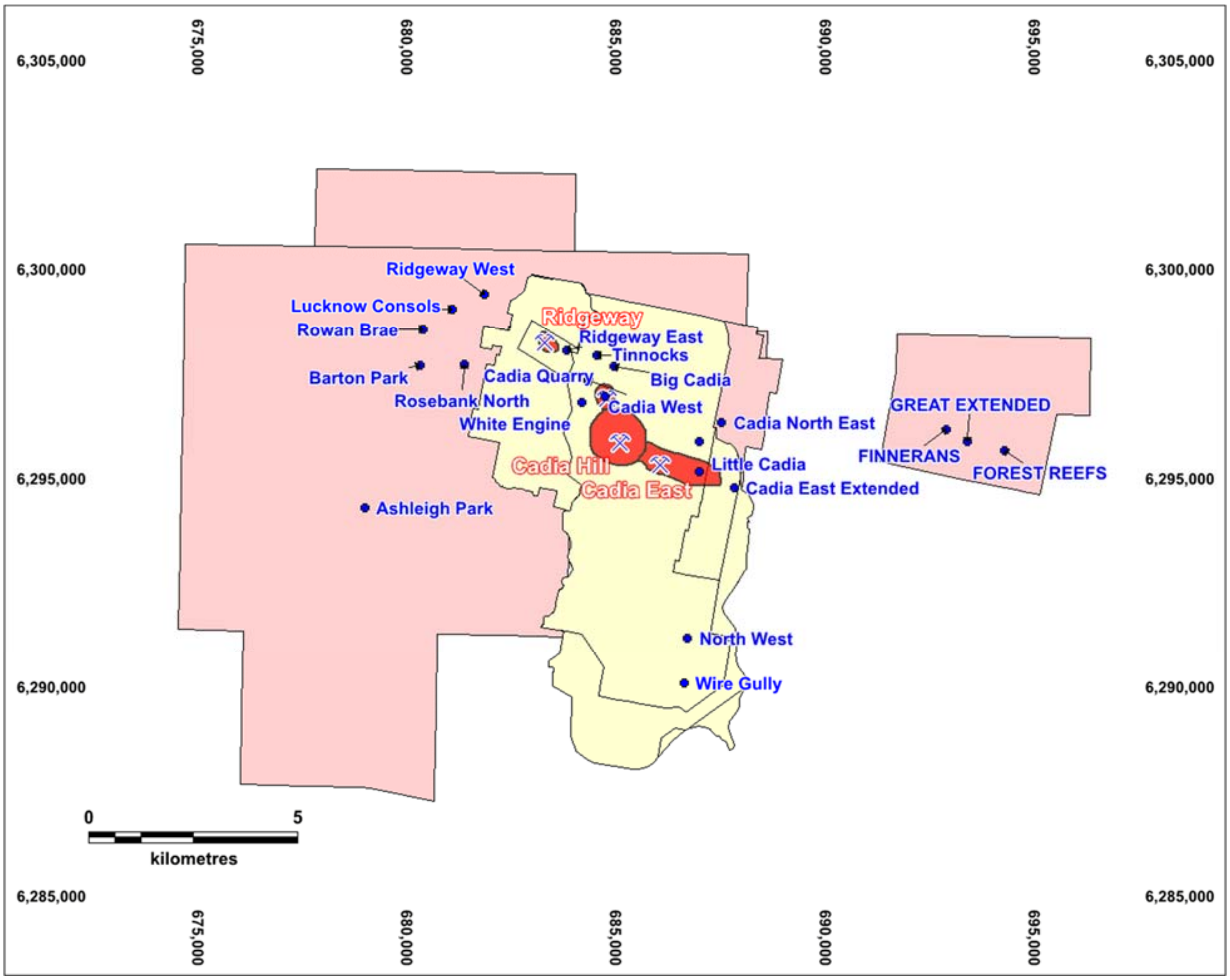
9.6 Exploration Potential

Cadia is a mature district with numerous exploration prospects, as shown in Figure 9-3. As such, the amount of data and geological knowledge that is available is extensive.

Historically these prospects have broadly been divided into the following target styles:

- Porphyry gold–copper, mainly located on northwest–southeast-oriented structural trends extending outwards from the Cadia deposits. Includes associated pegmatite-related sulphide lenses and breccias;
- Gold–base metal quartz–carbonate veins and breccias;
- Gold–copper ‘breccia pipes’;

Figure 9-3: Regional Exploration Targets



Note: Figure prepared by Newcrest, 2019.

- Replacement style magnetite/hematite–copper–gold skarns;
- Distal reduced gold skarns.

Exploration programs typically use one or a combination of methods, which can include mineralogical and geochemical porphyry vectors, prioritising areas in proximity to multiphase intrusive/magnetic complexes, magnetic and IP geophysical targets, favourable host lithologies and strong structural controls.

9.7 QP Comments on "Item 9: Exploration"

In the QP's opinion:

- The exploration programs completed to date are appropriate to the style of the deposits and prospects;

- Exploration potential remains within the Project area, and Newcrest is actively exploring using a number of conceptual geological models to drive the exploration activities.

10 DRILLING

10.1 Introduction

Table 10-1 summarises the drilling to 30 June, 2020 on a Project-wide basis. Across all programs, a total of 5,656 drill holes (about 1,487,206 m), has been completed.

Drilling completed to date includes core, RC, aircore, rotary air blast (RAB), sonic, percussion drill types (Table 10-2). Core drilling is the predominant drill type. Drill holes are typically coded in the database by drill hole purpose, which can include geotechnical, raise bore, resource development (ResDev) and general underground designations; however, the database may not record the drill hole type. Drill holes for which no purpose or drill type were recorded are tabulated as “other”. The database stores trench data as a dummy drill hole type. Aircore, RAB, sonic, and percussion drill types are not used in Mineral Resource estimation.

The drilling that supports the Mineral Resource estimates consists of:

- Cadia East: 593 drill holes (about 418,123 m), Table 10-3;
- Ridgeway: 532 drill holes (about 258,622 m), Table 10-4;

Cadia Extended: 449 drill holes (about 113,391 m),

- Table 10-5;
- Big Cadia: 558 drill holes (about 71,447 m), Table 10-6.

A Project-wide drill location plan is included as Figure 10-1. Drill collar location plans showing the drilling supporting the estimates are provided as Figure 10-2 for Cadia East, Figure 10-3 for Ridgeway, and Figure 10-4 for Cadia Extended and Big Cadia.

Drilling is ongoing at Cadia East in support of operations; current drilling is primarily for geotechnical purposes. The last drill hole in the drill database for Ridgeway was completed in September 2012, for Cadia Extended in October 2008, and for Big Cadia in December 2008. No drilling has been conducted at any of these three deposits since those dates.

10.2 Drill Methods

The drilling of the Cadia East deposit includes drill core of the following sizes, NQ3 (47.6 mm core diameter), HQ3 (63.5 mm) and PQ (85 mm). Drilling at Ridgeway is predominantly LTK60 (44.0 mm), NQ (47.6 mm) or HQ (63.5 mm) core sizes. Most drill holes are collared at PQ or HQ sizes for accurate and safe drilling. The drill hole size is then reduced at the geologist’s discretion as the drill hole advances. Drilling at Cadia Extended included NQ, and HQ core, and RC drill holes. The Cadia Extended RC program was primarily for production purposes in the period the open pit was operational. The Big Cadia deposit drilling consists of PQ, NQ, and HQ core, and RC drill holes.

Table 10-1: Project Drill Summary Table by Company

Operator	Metres	# Holes
BHP Gold Mines	571.0	33
Newcrest	1,414,420.8	4,570
Pacific Copper	31,274.2	357
Unknown	40,939.7	696
Totals	***1,478,959.3***	***5,656***

Table 10-2: Project Drill Summary Table by Area

Deposit/Location	Drill Types	Number of Drill Holes	Metres Drilled
Big Cadia	Core, resource development, RC, percussion, trench, other	500	40,134.3
Cadia Central	Core, resource development	22	9,131.5
Cadia East	Aircore, core, geotechnical, raisebore, resource development, RC, RAB, percussion, sonic, other	1,515	622,987.4
Cadia Hill	Aircore, core, geotechnical, resource development, RC, RAB, percussion, other	1,480	281,398.4
Cadia Quarry	Core, resource development, RC, trench, other	530	118,465.7
Cadia West	Core	6	5,852.9
Forest	Core, RC, other	302	32,594.2
Four Mile Creek	Core, resource development, RC, percussion, other	258	53,606.1
General exploration	Aircore, core, RC, other	64	4,710.0
Nashdale	Core, RC	4	914.2
Paunara	Other	10	2,083.0
Ridgeway	Aircore, core, geotechnical, resource development, underground, RC, percussion, RAB, trench, other	960	311,889.1
Wire Gully	Core, resource development	5	3,439.1
Total		***5,656***	***1,487,205.7***

Note: "Other" is assigned to drill holes in the database for which no drill hole purpose was allocated. General exploration includes some RC holes that were assigned to joint venture purposes in the database, but are within the Project mineral tenure outline. Trenches are included in the drill database as dummy drill holes. There are 29 geotechnical inspection and monitoring drill holes that have no recorded metreage in the database.

Table 10-3: Drill Holes Supporting Cadia East Mineral Resource Estimate

Company	Drill Type	Metres	Holes
Newcrest	Core	118,817.972	201
	ResDev department	294,049.3	336
	RAB	119	5
	Subtotal	*412,986.272*	*542*
Pacific Copper	ResDev department	5,137.21	51
	Subtotal	*5,137.21*	*51*
Total		***418,123.482***	***593***

Table 10-4: Drill Holes Supporting Ridgeway Mineral Resource Estimate

Company	Drill Type	Metres	Holes
Newcrest	Core	25,849.79	71
	Geotech hole	6,500.3	21
	ResDev department	104,108.79	101
	Underground drill hole	121,606.37	324
	Subtotal	*258,065.25*	*517*
Pacific Copper	ResDev department	60.96	1
	Subtotal	*60.96*	*1*
Unknown	Air core	148	5
	Percussion	148	3
	RC	174	2
	RAB	26	4
	Subtotal	*496*	*14*
Total		***258,622.21***	***532***

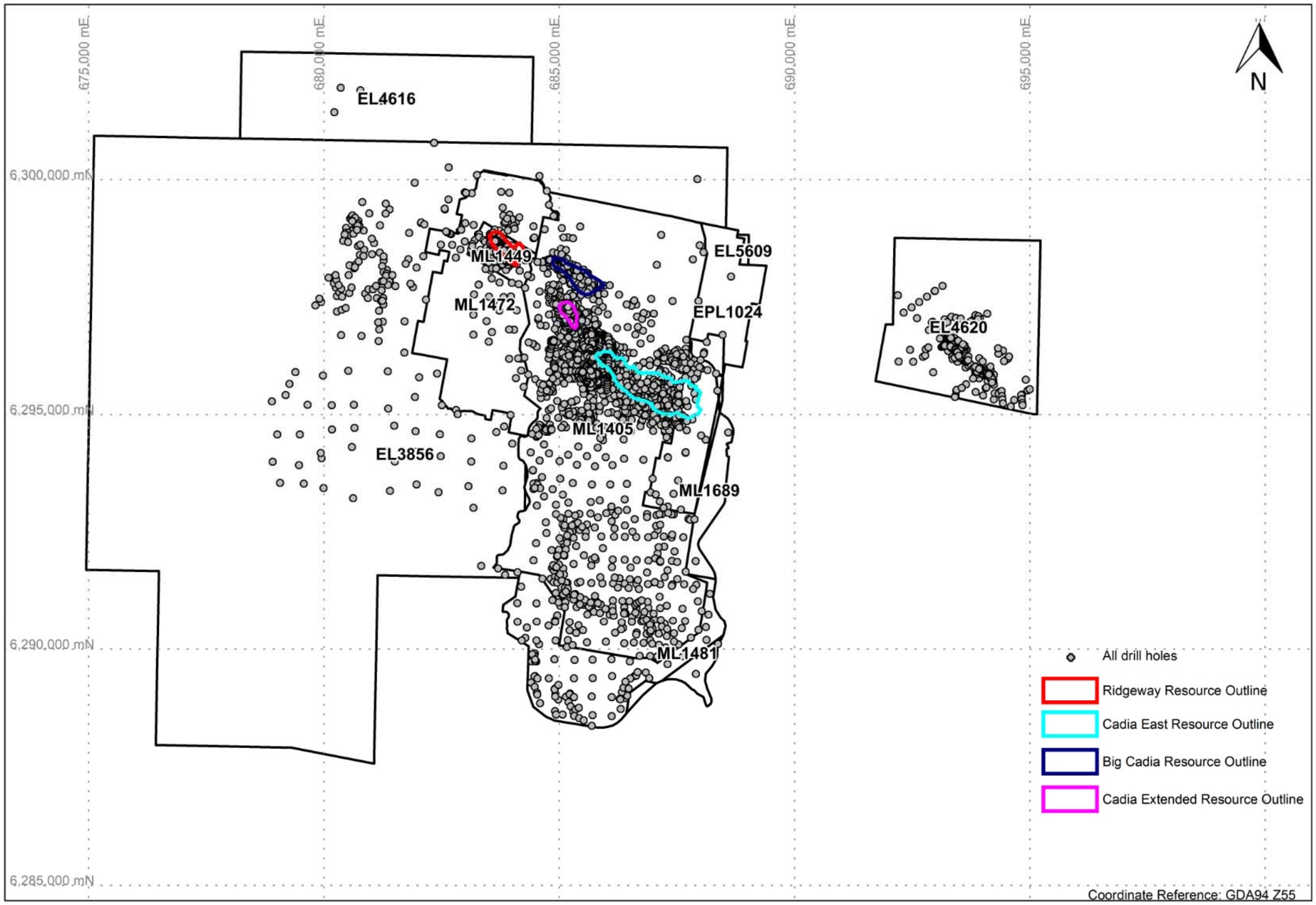
Table 10-5: Drill Holes Supporting Cadia Extended Mineral Resource Estimate

Company	Drill Type	Metres	Holes
Newcrest	Core	25	20,550.93
	Geotech hole	4	726.1
	ResDev department	142	67,040.43
	RC	278	25,073.6
	Total	***449***	***113,391.06***

Table 10-6: Drill Holes Supporting Big Cadia Mineral Resource Estimate

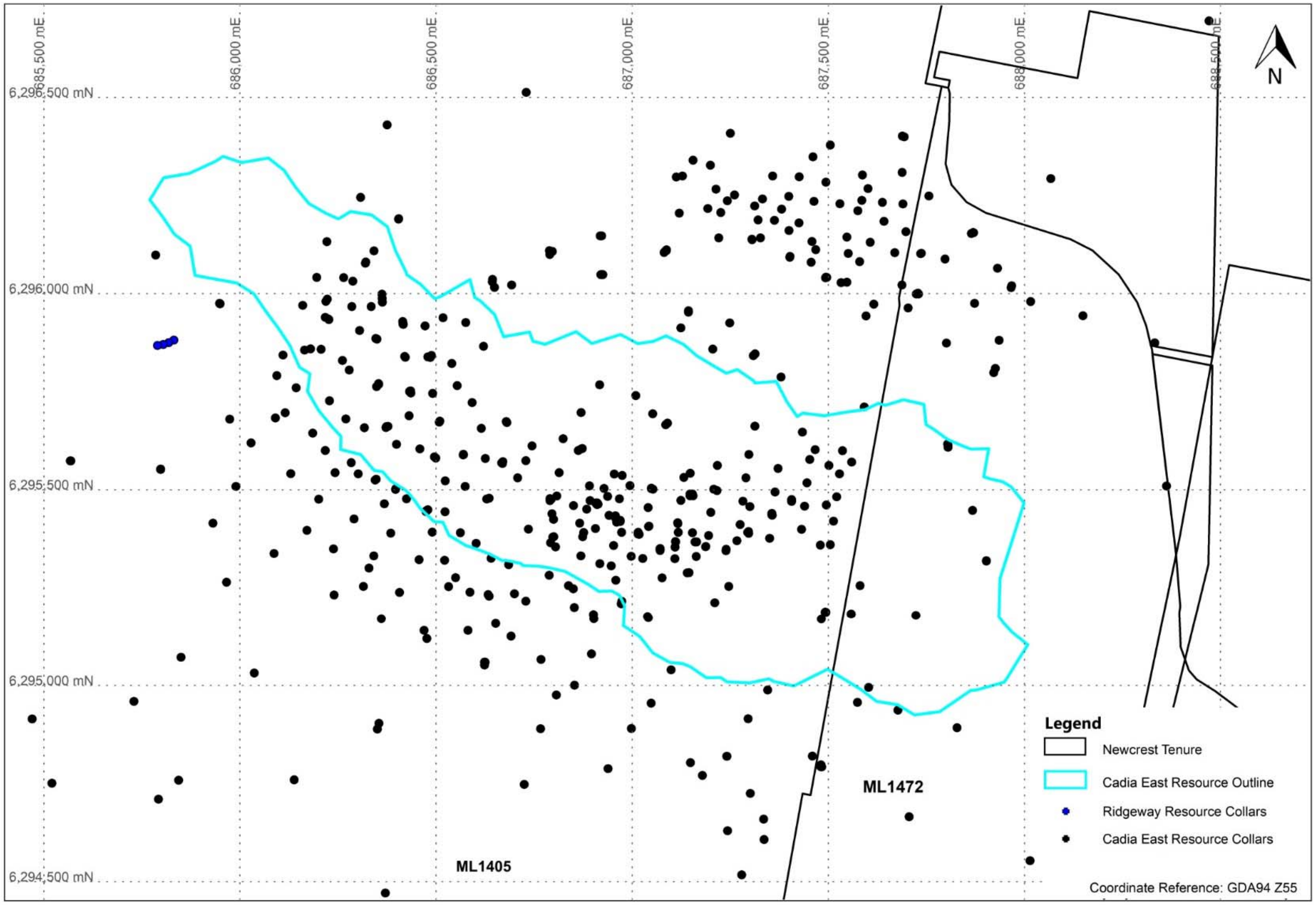
Company	Drill Type	Metres	Holes
Newcrest	Core	84	23,650.21
	Other	17	102
	Percussion	19	348
	ResDev department	78	21,063.73
	RC	54	2,557
	Subtotal	*252*	*47,720.94*
Other	Diamond drill hole	1	100
	Other	29	1,569.09
	Percussion	4	232
	ResDev department	4	155.29
	Reverse Circulation	2	174
	Subtotal	*40*	*2,230.38*
Pacific Copper	Other	101	4,663.8
	ResDev department	165	16,832.17
	Subtotal	*266*	*21,495.97*
Total		***558***	***71,447.29***

Figure 10-1: Project Drill Hole Location Plan



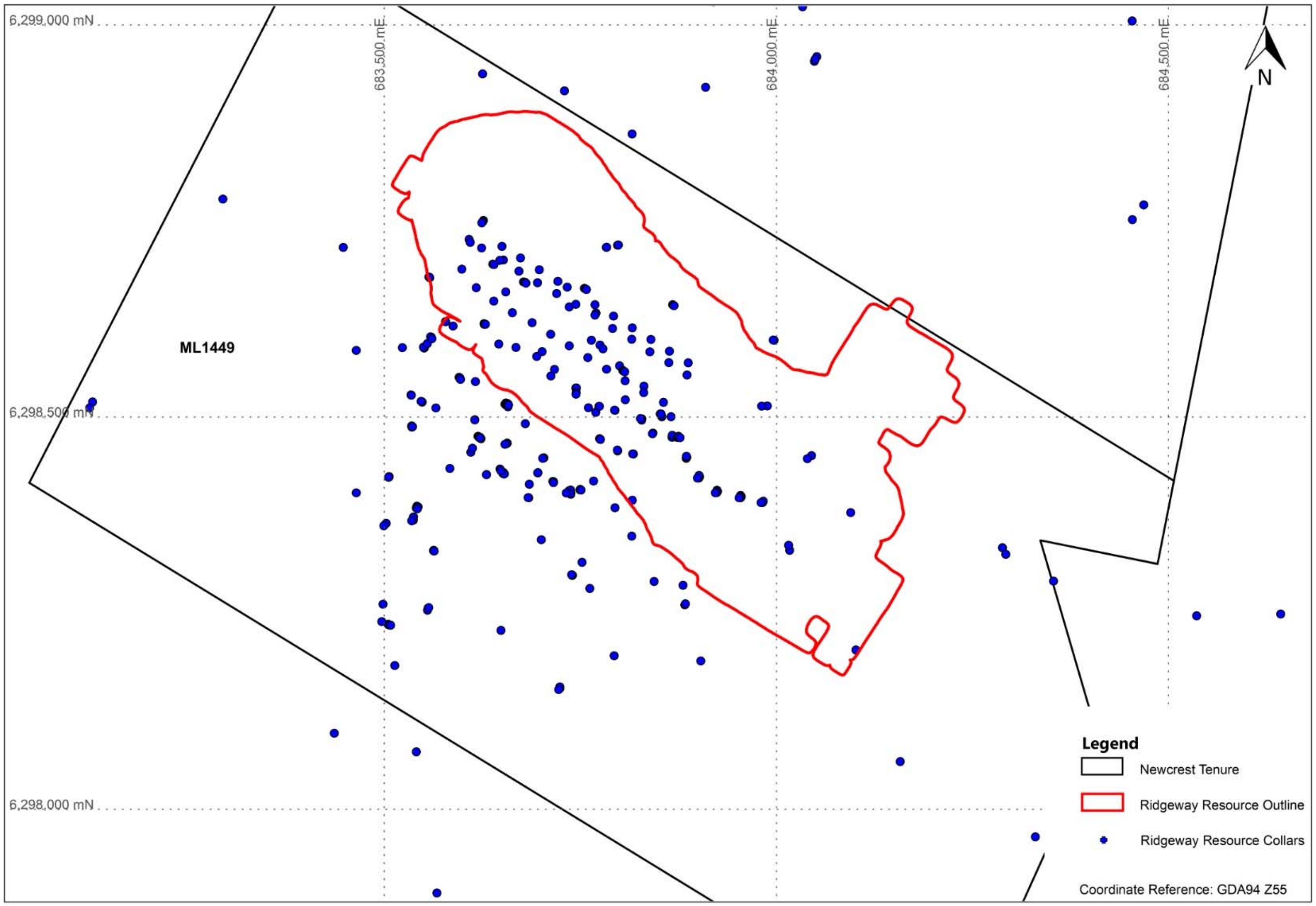
Note: Figure prepared by Newcrest, 2020.

Figure 10-2: Cadia East Drill Hole Location Plan



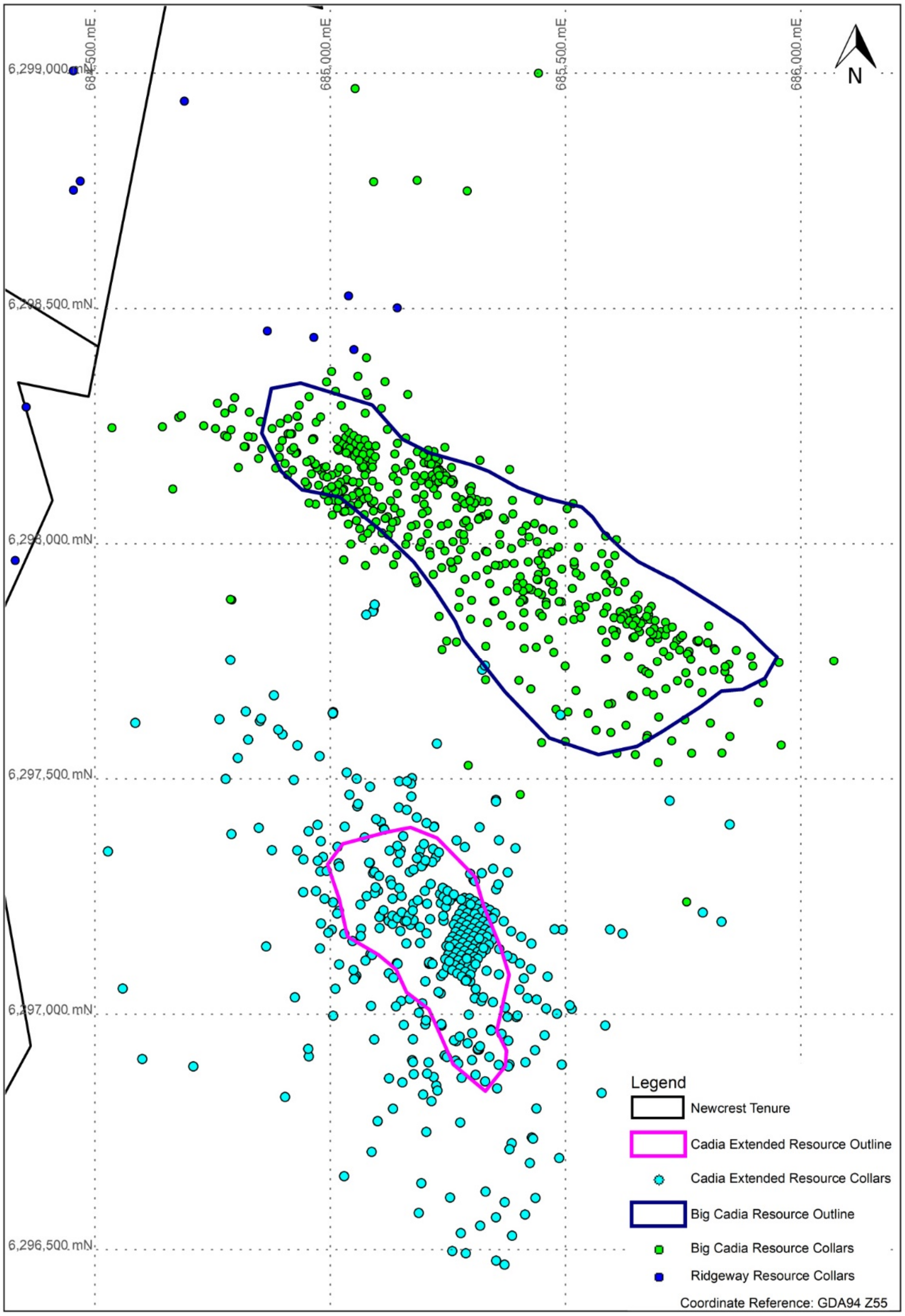
Note: Figure prepared by Newcrest, 2020. Due to the block model extents, some drilling that is used in the Ridgeway model is included in the plan view.

Figure 10-3: Ridgeway Drill Hole Location Plan



Note: Figure prepared by Newcrest, 2020. Due to the block model extents, some drilling that is used in the Cadia East model is included in the plan view.

Figure 10-4: Cadia Extended and Big Cadia Drill Hole Location Plan



Note: Figure prepared by Newcrest, 2020.

All recent drilling is orientated using either the BallMark orientation system developed by Anderson Drilling Pty Ltd (Orange) or the ACE electronic (accelerometer) tool. During logging the length of consistent oriented runs provides a gauge of the reliability of oriented core.

Most of the drilling is core using triple-tube core tools. RC drilling is used for infill resource definition on occasion; however, geotechnical data are not collected from RC drilling.

Core drilling in the 2000s was oriented using the BallMark orientation system; earlier drill holes were oriented using a chinagraph spear on three consecutive runs at defined intervals.

10.3 Logging Procedures

Early logging (pre-2000) was conducted on 1 m intervals. Geological logging style and quality is dependent on the drill program and date. Logging completed prior to 1995 was recorded on paper logs. Only Newcrest drill holes after 1995 are electronically recorded in acQuire.

For Newcrest programs after 2000, lithology is logged on a variable interval basis with intervals determined from combinations of rock type, alteration, structure, and mineralisation. Geological logging is performed using acQuire software to record observations made on core and percussion chips into touch screen and laptop computers. The data are then transferred into various database systems depending on desired end usage of the data. Procedures for geological and geotechnical logging are outlined in Newcrest's logging guides. The exploration drill core logging system consists of six log sheets (windows) into which data are entered.

Log sheets include:

- Collar;
- Lithology;
- Mineralisation;
- Structure;
- Geotechnical;
- Bulk density.

Not all fields are compulsory. However, to ensure compulsory information is collected, compulsory fields are highlighted with a red background when not correctly completed. The individual logger is required to ensure data validation is complete prior to merging new data into the central database.

Lithology is logged based on the geological unit, with subdivision created based on alteration and mineralisation. The lithology intervals form the base cases for all geotechnical domains. Mineralisation is logged on regular 2 m intervals. The intention is that each assay sample has a discrete mineralisation entry, hence it is important that mineralisation intervals match sample intervals. Areas of Tertiary and Silurian cover are logged on broad intervals, based on the presence or absence of sulphides.

The structure log is designed to capture major discontinuities such as shears, faults, intrusive contacts, bedding, and veins. Geotechnical logging includes interpretation and identification of major structures likely to form a discrete failure surface. Unless joints and fractures are related to a larger structure, their logging is recorded as a set.

Detailed geotechnical data collection is not routinely obtained from all core drill holes; however, basic geotechnical parameters such as rock quality designation (RQD), recovery and fracture frequency are collected.

Sample identifiers are generated on site and assays are loaded by direct transfer from laboratory, again validated by a geologist. All assay results are provided with laboratory certification. Logging information is transferred directly from the digital loggers; validation checking tables ensure only valid codes can be entered into specific areas. The acQuire database management software has data entry protocols that ensure the validity of imported data.

All core holes are processed in-house by, in order, orienting, marking-up, and then photographing.

10.4 Recovery

There are only minor zones of lost core or poor core recovery overall. Core recovery is generally excellent Project-wide, with core recoveries in fresh rock of around 99–100%.

At Cadia East, there are small zones of lost core or poor core recovery. The average recovery recorded in the database is 85%, not including recovery figures for core drilled from surface to about 20 m depth. Core loss is largely observed in the surface drilling, with underground drilling returning 99.7% recovery. Poor data entry of surface drilling core recovery figures is likely the major reason behind the lowering of the actual core recovery performance between surface and underground drilling.

At Ridgeway, in general, there are only minor zones of lost core or poor core recovery. For the majority of the completed drill holes, core recovery is 100%.

There is no significant weathering profile or friable material at Cadia Extended, so sample loss is not significant, with core recovery averaging approximately 99%. There is no identified relationship between core loss and grade.

Core loss at Big Cadia is moderate in the weathered zones and where old workings are intersected. For drill programs conducted by Newcrest, core recovery averaged 90% overall, with 86% recovery in oxide and partially oxide material, and 99% in fresh rock. No core recovery information exists for non-Newcrest drill holes within the current database. In the QP’s opinion, the core recovery data are acceptable and will not bias the Mineral Resource estimate for Big Cadia.

10.5 Collar Surveys

All drill hole collars were surveyed by Newcrest or predecessor company survey staff. Survey methods included theodolite surveys and differential global positioning system (DGPS) instruments. The majority of drill hole collars are recorded by mine surveyors, loaded by the database administrator, and validated by supervising geologist. Drill holes that require high accuracy are set up by mine surveyors before commencement of drilling.

Some drill holes in the geological database do not have collar co-ordinates. In these instances, the drill hole identified (ID) can consist of a lengthy alphanumeric code (e.g. GTTSFCDG18123102); this typically indicates a geotechnical inspection point.

10.6 Downhole Surveys

Drill holes are normally surveyed using a combination of electronic and gyroscope survey tools.

Currently, at Cadia East, single-shot surveys using the FlexIT Smart Tool EMS system, Ranger EMS system or Eastman Camera are completed at depths of 25–30 m intervals through the PQ, and 30 m or 50 m intervals thereafter. Multi-shot EMS surveys using the FlexIT Smart Tool EMS system or Ranger EMS system are conducted at end of hole or during a drill bit or core diameter change as the drill hole is drilled.

All recent holes are gyroscope surveyed as close to the end of hole as possible. Where gyroscope surveys were not taken due to poor access or unavailability, Multishot surveys were performed with a measurement taken every 3 m.

Face and wall samples are located using iSite mapping equipment, with field data processed in Vulcan.

Drawpoint samples do not require accurate location and are labelled according to the drawpoint number.

Down-hole surveys at Ridgeway were collected using a variety of instrumentation, including Eastman Camera, EMS, ESS, Maxibor, north-seeking gyro, and standard gyro. The majority of underground drill holes were surveyed using the Maxibor optical tool. Gyro surveys were completed by Downhole Surveys Pty Ltd at the end-of-hole at intervals of 5 m. Surveys were completed to as close to total hole depth as possible.

The Cadia Extended down-hole surveys used borehole camera, electronic single shot and gyroscopic methods, with single-shot methods predominating. Generally, single-shot electronic surveys were completed at an initial depth of 50 m and thereafter every 50 m down hole.

The legacy downhole surveying techniques at Big Cadia are unknown. Newcrest's downhole surveying was completed using Eastman single-shot instruments outside the magnetic skarn units. Post-2004, downhole drill surveys were conducted using gyroscopic instruments at nominal 30 m intervals down hole.

10.7 Geotechnical and Hydrological Drilling

10.7.1 Cadia East Geotechnical Drilling

At Cadia East, geotechnical data from 485 drill holes distributed across the site, totalling 252,935 m of core, were used for geotechnical characterisation for the purposes of the Cadia East feasibility study. In addition to the logged geological parameters, geotechnical logs include:

- Intact rock strength;
- RQD (the percentage of intact core pieces longer than 100 mm in the total length of core);

- Fracture spacing and number of fractures;
- Fracture condition (shape, roughness, structure infill);
- Microfractures.

A set of guidelines for the geotechnical logging system (GLS) was adopted by Newcrest for the Ridgeway and Cadia East operations. The purpose of the GLS is to collect the necessary geotechnical information to:

- Describe the physical characteristics of the rock mass and major structures;
- Classify the rock mass and major structures using industry standards including Laubscher's $MRMR^{L90}$ and Barton's Q' systems (Laubscher, 1990, Barton et al, 1974).

This information is used for empirical analysis of caveability, fragmentation assessment, ground support selection, subsidence and numerical modelling. Geotechnical logging uses a maximum interval length of 4 m. Smaller intervals may be required in areas of disruption. As far as possible, geotechnical interval boundaries match lithological boundaries. As a result, geological logging of the drill holes is completed prior to geotechnical logging.

10.7.2 Cadia East Hydrogeology Drilling

Hydrogeological parameters are based on information derived from a system of water bores around the Cadia Operations.

10.8 Drilling Completed Since Close-out Date for Database Supporting Cadia East Mineral Resource Estimate

Six geotechnical drill holes have been completed since the Mineral Resource estimate database close-out date. These drill holes are included in the totals in Table 10-1, and have not been assayed. The structural information from the drilling will have a local effect on the structural interpretations, but will not have a material effect on the Mineral Resource estimate.

10.9 Sample Length/True Thickness

Drill spacing in Cadia East ranges from approximately 20 x 20 m in the better drilled deposit areas to about 200 m spacing on the less well drilled portions of the deposit. Ridgeway Deeps drill spacing ranges from approximately 30 x 30 m to about 100 x 100 m. Drilling at Cadia Extended ranges from approximately 50 x 75 m on the deposit edges, to, over a 150 m strike extent, 50 x 50 m spacing in the centre of the deposit. The drill spacing at Big Cadia varies from 25 x 25 m in the upper elevations to 50 x 50 m spacing at depth.

The term "true thickness" is not generally applicable to porphyry-style deposits as the entire rock mass is potentially mineralised and there is often no preferred orientation to the mineralisation. In areas that display porphyry-style mineralisation, in general, most drill holes intersect mineralised zones at an angle, and the drill hole intercept widths reported for those drill holes are typically greater than the true widths of the mineralisation at the drill intercept point.

The Big Cadia deposit is essentially flat-lying. Drilling is typically near-vertical. This drill orientation is acceptable for the majority of the mineralisation orientation, and results in drilled widths that approximate true widths.

10.10 QP Comments on "Item 10: Drilling"

In the opinion of the QP, the quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs are sufficient to support Mineral Resource (Ridgeway, Cadia Extended and Big Cadia) or Mineral Reserve (Cadia East, Ridgeway) estimation as follows:

- Core logging meets industry standards for gold, copper, silver and molybdenum exploration (Cadia East) and gold and copper exploration (Ridgeway, Cadia Extended and Big Cadia);
- Collar surveys were performed using industry standard instrumentation at the time the drill program was conducted;
- Downhole surveys were performed using industry standard instrumentation at the time the drill program was conducted;
- Recovery data from core drill programs are acceptable;
- Geotechnical logging of drill core meets industry standards for planned mass mining operations;
- Geotechnical data available for Big Cadia is sufficient to support an assumed open pit mining method;
- Drilling practices, logging, collar surveys and downhole surveys were periodically reviewed by Newcrest personnel and independent auditors (refer to Section 12) and indicate no material issues with the data practices or collection methodologies;
- The drilling pattern provides adequate sampling of the gold, copper, silver and molybdenum (Cadia East) and gold and copper (Ridgeway, Cadia Extended and Big Cadia) mineralisation for the purpose of estimating Mineral Resources and Mineral Reserves;
- Sampling is representative of the gold, copper, silver and molybdenum grades in the Cadia East deposit area, and the gold and copper grades in the Ridgeway, Cadia Extended and Big Cadia deposit areas, reflecting areas of higher and lower grades;
- Confidence classifications were restricted for Big Cadia based on the factors discussed in Section 12.3.4, and Section 14.4.10.

In the QP's opinion, no material factors were identified with the data collection from the drill programs that could significantly affect Mineral Resource (Ridgeway, Cadia Extended and Big Cadia) or Mineral Reserve (Cadia East, Ridgeway) estimation other than outlined for Big Cadia.

11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 Core Sampling

Actual sampling as recorded in the database is:

- Ridgeway: minimum 0.10 m, maximum 9.40 m, average 1.5 m. Core is sampled and analysed on intervals determined by the geologist, with the aim of a nominal 2 m sample interval.
- Cadia East: minimum 0.10 m, maximum 10.60 m, average 1.72 m. Core is sampled and analysed on intervals determined by the geologist, with the aim of a nominal 2 m sample interval.
- Cadia Extended: Half core saw cut to metre marks and sampled on 1 m or 2 m intervals;
- Big Cadia: RC samples were riffle split on 1 m intervals; NQ and HQ core sampled on 1 m sample intervals. PQ core was sampled on 0.5 m sample intervals within mineralisation and 1 m sample intervals in visually un-mineralised zones.

Intact and competent drill core is cut in half along the cut-line using a diamond saw. Where the core is too soft to be cut with a diamond saw, a knife is used to cut the core in the core tray. Where the core is too broken or brittle to be cut by the saw, the fragments are manually sampled. The left-hand half of the core is placed in a calico bag marked with the appropriate sample number, and sent to the laboratory for sample preparation and assaying.

After core logging is complete, a cut-line is drawn on the core and the core is photographed.

11.1.2 RC Sampling

At Cadia Extended, RC holes were sampled on 2 m intervals with rig-mounted cyclone splitters.

RC drilling at Big Cadia included 1 m intervals in pre-2000 drill programs. Splits were retained in calico bags and placed on spoil piles on the ground. Scoop samples were taken from the spoil piles for 4 m composites. If anomalous grades were returned, the 1 m splits were submitted and analysed. Post 2000, resource definition samples were collected through a 1:8 riffle splitter attached to the rig cyclone. The splitter produced a bulk reject that was bagged (numbered) and temporarily stored for reference and logging. A primary split of 2 to 5 kg was achieved through the 1:8 chute.

11.1.3 Grade Control Sampling

Cadia East drawpoint samples are typically collected in 5 kg calico bags from the buckets of the load–haul–dump (LHD or bogger) vehicles. A nominal 45 mm screen is used to exclude large particles.

The face sampling procedure is:

- Take samples from one side of the muck pile moving across to the other side of the muck pile, sampling at a minimum of three different locations (if there is no muck pile sample either side of the drive on the base of the side walls);
- Collect a handful of rock sample, and ensure that no individual rock is greater than fist size.

During operations at Ridgeway, an approximate 30 kg grab sample was collected from every 4 m development cut, and assayed for gold and copper. Results were used for grade control purposes.

11.2 Density Determinations

Intervals for bulk density determination are selected according to lithology, alteration and mineralisation considerations. Density determinations are performed on site by geologists or geological assistants as part of the logging process. Depending on the deposit and the geotechnical conditions encountered, measurements are generally taken at 20–50 m or 20–30 m intervals down hole. Bulk density is calculated using the formula:

- Bulk density (g/cm³ or t/m³) = dry weight (g)/(dry weight – wet weight) (g).

There are 13,664 density determinations in the database for Cadia East as at 30 June, 2020. These range from 1.00–to 5.26 t/m³, with a mean of 2.76 t/m³, and median of 2.76 t/m³.

There are 9,421 density determinations in the database for Ridgeway as at 30 June, 2020. These range from 0.76–7.90 t/m³, with a mean of 2.80 t/m³, and median of 2.79 t/m³.

Core from Cadia Extended was subject to density determinations using the water immersion method. There is a total of 1,030 measurements. These range from 2.26–4.29 t/m³, with an average of 2.68 t/m³. Density values were assigned by lithology to the block model, as follows: monzonite, 2.73 t/m³; volcanic units, 2.80 t/m³; sedimentary units, 2.60 t/m³; and oxide, 2.40 t/m³. As there were insufficient measurements for the oxide and sediments domains, the values were assigned using data from Cadia East.

A total of 539 density measurements are in the Big Cadia database. Density was assigned by lithology type, using different density values for fresh, transition and oxide materials as follows:

- Skarn: 3.5 t/m³ (fresh), 3.2 t/m³ (transition), 3 t/m³ (oxide);
- Transition skarn: 3.3 t/m³ (fresh), 2.7 t/m³ (transition), 2.4 t/m³ (oxide);
- Limestone: 2.7 t/m³ (fresh), 2.4 t/m³ (transition), 2.1 t/m³ (oxide);
- Volcanics: 2.8 t/m³ (fresh), 2.5 t/m³ (transition), 2.2 t/m³ (oxide);
- CIC: 2.7 t/m³ (fresh), 2.4 t/m³ (transition), 2.1 t/m³ (oxide);
- Sediment: 2.6 t/m³ (fresh), 2.3 t/m³ (transition), 2 t/m³ (oxide).

A density of 2.2 t/m³ was assigned to underground workings to allow for some backfill material.

11.3 Analytical and Test Laboratories

A number of laboratories were used during the exploration and operational history:

- Analabs, located in Townsville (Analabs): used as the primary laboratory in early campaigns from 1998–2000; independent. Accreditations during the time used are not recorded in the Project database;
- AMDEL, located in Orange (AMDEL Orange): used as the primary laboratory for assaying until May 2004; independent. Accreditations during the time used are not recorded in the Project database;
- AMDEL, located in Perth (AMDEL Perth): noted to have been used for primary assay of two drill holes from Ridgeway in 2005–2006; independent. Accreditations during the time used are not recorded in the Project database. There is no information as to sample preparation or analytical protocols used;
- ALS Chemex, located in Orange (ALS Orange): used from May 2004 until May 2010 as a primary laboratory; independent. ALS Orange was ISO 17025-2005 for specific methods and ISO 9001-2008 accredited at the time. ALS Orange is currently used as a secondary laboratory, and is ISO 17025-2005 accredited for specific analytical methods and ISO 9001-2015 accredited;
- Newcrest Services Laboratory, located in Orange (NSLO): used as the primary laboratory from June 2010 to date; not independent. NSLO holds ISO 17025 accreditations;
- Intertek Laboratory, located in Perth, Western Australia (Intertek Perth): used as check laboratory from 2018 to date, independent; ISO 17025 accredited for specific analytical methods.

Earlier in the Project history, check assays were completed at Genalysis in Townsville, AAL in Orange, Analabs in Townsville, and ALS Chemex in Townsville. Genalysis is now owned by the Intertek Group. Laboratory accreditations at the time used are not recorded in the Project database. All of these laboratories were independent.

11.4 Sample Preparation and Analysis

Sample preparation and analytical methods have some variations over time.

For sample preparation prior to April 2009, where known, the overall sample preparation procedure typically included:

- Weighing and oven-drying;
- Crushing to 2 mm;
- Pulverising to 90% passing 75 µm;

Prior to 2016, samples were generally assayed, where known, as follows:

- Gold determined using fire assay and atomic absorption spectroscopy (AAS);
- Copper in the Ridgeway deposit area was initially determined by multi-acid digest with AAS finish;

- Copper determined by inductively coupled plasma–optical emission spectrometry (ICP–OES). Ore grade (>1%) mixed acid digest for Cu ≥1% with flame AAS finish;
- Sulphur, iron, molybdenum, lead, zinc grades determined by ICP–OES;
- Cyanide-soluble copper (CuCN) determined by flame AAS.

Results were recorded electronically and uploaded to the resource database for checking and validation.

After April 2009, and to date, the sample preparation procedure has typically been:

- Weighing and oven-drying;
- Crushing to 2 mm;
- Pulverising to 95% passing 106 µm.

Analytical methods from 2016 onward include:

- Fire assay using a nominal 30 g or 50 g sample charge, four-acid digest/AAS read;
- Copper determined by ICP–OES after four-acid digest;
- Ag, As, Bi, Co, Fe, Ni, Pb, Sn, Zn and S determined by ICP–OES after four-acid digest;
- S >10% by Eltra (furnace and infra-red absorption);
- CuCN (solution strength 0.4% CN/sample weight 0.2 g and time four-hour leach).

Where known, the laboratories, analytical methods, elements analysed, and detection limits are provided in Table 11-1.

Table 11-1: Elements Analysed and Detection Limits

Laboratory	Method	Element and Detection Limit
AAL		As (1 ppm); Au (1 ppm); Mo (1 ppm)
ALS Chemex	OG46	Ag (1 ppm)
	OG49	Ag (1 ppm); Cu (0.01%); Zn (0.01%)
	IC581	Ag (1 ppm); As (2 ppm); Bi (5 ppm); Co (5 ppm); Cu (1, 5 ppm); Mo (5 ppm); Pb (5 ppm); S (1, 10 ppm); Zn (1, 5 ppm)
	MEICP41	Ag (0.1, 0.2 ppm); As (1, 2 ppm); Bi (1, 2 ppm); Co (1 ppm); Cu (1 ppm); Fe (0.01%); Hg (1 ppm); Mo (1 ppm); Ni (1 ppm); Pb (1, 2 ppm); S (0.01%); Sb (1, 2 ppm); Sn (10 ppm); Te (10 ppm); W (10 ppm); Zn (1, 2 ppm)
	MEICP42	Ag (1 ppm); As (2 ppm); Cu (1 ppm); Fe (0.01%); Mo (5 ppm); Pb (5 ppm); S (0.001%, 10 ppm); Sb (5 ppm); Zn (5 ppm);
	MEICP49	Ag (0.1, 0.2 ppm); As (1, 2 ppm); Bi (0.1, 5 ppm); Cu (1, 2 ppm); Fe (0.01%); Mo (1 ppm); Pb (1, 2 ppm); S (0.01%); Zn (1 ppm)
	MEMS61	Ag (0.01%, 0.1 ppm); As (0.2 ppm); Ba (10 ppm); Be (0.05 ppm); Ca (0.01 ppm) Cd (0.02 ppm); Ce (0.01 ppm); Cr (1 ppm); Cs (0.05 ppm), Cu (2 ppm); Fe (0.01%); Ge (0.05 ppm); Hf (0.1 ppm); In (0.005 ppm); K (0.01%); La (0.5 ppm); Li (0.2 ppm); Mg (0.1%); Mn 5 ppm; Mo (0.05 ppm); Na (0.05 ppm); Nb (0.1 ppm); Ni (0.2 pm); P (10 ppm); Pb (0.5 ppm); Rb (0.1 ppm); Re (0.002 ppm); S (0.01%); Sb (0.05 ppm); Sc (0.1, 1 ppm); Sn (0.2 ppm); Ta (0.05 ppm); Te (0.05 ppm); Th (0.2 ppm); Ti (0.005 %); Tl (0.02 ppm); U (0.1 ppm); V (0.1 ppm); W (0.1 ppm); Y (0.1 ppm); Zn (2 ppm); Zr (0.5 ppm)
	MEAD4OES	Ce (1 ppm)
	AA22	Au (0.001 ppm)
	AA25	Au (0.01 ppm)
	AA26	Au (0.01 ppm)
	AAFA	Au (0.001 ppm)
	PM209	Au (0.01 ppm)
	Cu19	CuCN (2 ppm)
	FA_FUS04	Au (1 ppm)
	ELE81a	F (20 ppm)
AMDEL	Unknown	Ag (1 ppm); As (5 ppm); Cu (1 ppm); Fe (1 ppm); Mo (1 ppm); Pb (3 ppm); S (1 ppm); Zn (1 ppm)
	IC2L	As (5 ppm); Cu (5 ppm); Mo (1 ppm); Pb (20 ppm); S (100 ppm); Zn (5 ppm)
	FA	Au (0.01 ppm)
Analabs	A102	Ag (1, 50 ppm); Cu (2 ppm); Mo (5 ppm); Pb (3 ppm); Zn (2 ppm)
	H102	As (1, 10 ppm)
	IC2L	As (5 ppm); Cu (2, 5 ppm); Mo (1 ppm); Pb (3, 20 ppm); S (10, 100 ppm); Sr (10 ppm); Zn (1, 5 ppm)
	F650	Au (0.01 ppm)
	FA1	Au (0.01 ppm)
	I104	Ca (50 ppm); Cu (5 ppm); Fe (100 ppm); Mo (10 ppm); Pb (20 ppm); S (10 ppm)
	V821	S (0.005%)

Laboratory	Method	Element and Detection Limit
Intertek	4AMS	Ag (0.05 ppm); Ag (0.005%); As (0.2 ppm); Ba (0.1 ppm); Be (0.05 ppm); Bi (0.01 ppm); Ca (0.005, 0.05%); Cd (0.02 ppm); Ce (0.01 ppm); Co (0.1 ppm); Cr (1 ppm); Cs (0.05 ppm); Cu (0.5 ppm); Fe (0.01%); Ga (0.1 ppm); Ge (0.1 ppm); Hf (0.05 ppm); In (0.01 ppm); K (0.002%); La (0.01 ppm); Li (0.1 ppm); Mg (0.002%); Mn (1 ppm); Mo (0.1 ppm); Na (0.01%); Nb (0.05 ppm); Ni (0.5 ppm); P (0.005%); Pb (0.5 ppm); Rb (0.05 ppm); Re (0.002 ppm); S (0.05%); Sb (0.05 ppm); Sc (0.1 ppm); Se (0.5 ppm); Sn (0.1 ppm); Sr (0.05 ppm); Ta (0.01 ppm); Te (0.2 ppm); Th (0.01 ppm); Ti (0.005%); Tl (0.02 ppm); U (0.01 ppm); V (2 ppm); W (0.1 ppm); Y (0.05 ppm); Zn (1 ppm); Zr (0.1 ppm)
	FA50MS	Au (1 ppb)
	4AHOE	Ba (20 ppm); Cu (10 ppm); Ti (50 ppm)
	CSA	S (0.01 ppm)
NSLO	ICP2AO	Ag (0.2 ppm); Al (10 ppm); As (3 ppm); Ca (0.01, 10 ppm, 0.01%); Co (5 ppm); Cu (5 ppm); Fe (100 ppm; 0.01%); K (20 ppm); Mg (0.01, 10 ppm, 0.1%); Mn (5 ppm); Mo (1 ppm); Na (50 ppm); Ni (5 ppm); P (10 ppm); Pb (5 ppm); S (100 ppm; 0.01%); Ti (10 ppm); Zn (2 ppm)
	ICP3AO	Cu (0.01%); Fe (0.01 ppm, 0.01%); Mn (0.01%); Zn (0.001, 0.1%)
	ME2ADOES	Ag (0.2, 0.5 ppm); Cu (1, 2 ppm); Fe (0.01%); Hg (0.05 ppm); Mo (2, 3 ppm); Pb (2, 5, 10 ppm); S (0.01%); Zn (0.5, 2 ppm)
	MEAD4MS	Ag (0.05, 0.1 ppm); As (1 ppm); Ba (0.05, 1 ppm); Be (0.01, 0.2 ppm); Cd (0.02, 0.05 ppm); C4 (0.5 ppm); Ga (0.02, 0.2 ppm); Ge (0.05, 0.2 ppm); Hf (0.01, 0.1 ppm); In (0.005, 0.5 ppm); La (0.01, 0.1 ppm); Li (0.02, 0.1 ppm); Mo (0.02, 0.1 ppm); Na (0.01, 0.1 ppm); Rb (0.02, 0.1 ppm); Re (0.005, 0.5 ppm); Sb (0.05, 0.1 ppm); Sc (0.05, 1 ppm); Se (0.1, 2 ppm); Sn (0.1 ppm); Sr (0.05, 0.5 ppm); Ta (0.01, 1 ppm); Te (0.01, 0.1 ppm); Th (0.005, 0.05 ppm); Tl (0.01, 0.02 ppm); U (0.05, 0.5 ppm); W (0.05 ppm); Y (0.01, 0.1 ppm); Zr (0.05, 0.5 ppm)
	MEAD4OES	Ag (0.2 ppm); Al (100 ppm, 0.01%); As (2, 5 ppm); B (5 ppm); Ba (0.5 ppm); Bi (0.005, 0.05 ppm); Ca (100 pm, 0.01%); Cd (0.05, 0.01 ppm); Co (0.5, 3 ppm); Cr (1, 2 ppm); Cs (0.005 ppm); Cu (2 ppm); Fe (0.01 ppm, 0.01%); K (100 ppm; 0.01%); La (1 ppm); Mg (100 ppm, 0.01%); Mn (0.05, 0.1 ppm); Mo (2 ppm); Nb (100 ppm, 0.01%); Ni (1, 2 ppm); P (5, 10 ppm); Pb (2, 15 ppm); S (0.01 ppm, 0.01%); Sr (10 ppm); Ti (100 ppm, 0.01%); V (1, 2, 5 ppm); W (1, 2, 5 ppm); Zn (0.5, 2 ppm)
	XRFOR2	Al2O3 (0.05%); Ca (0.05%); MgO (0.01%)
	ICPMS1	As (0.1 ppm); B (0.1 ppm); Ba (1 ppm); Be (0.1 ppm); Bi (0.1 ppm); Cd (0.05 ppm); Cr (0.05 ppm); Ga (0.2 ppm); Hg (0.05 ppm); La (0.05 ppm); Mo (0.2 ppm); Sb (0.1 ppm); Sc (2 ppm); Sr (0.1 ppm); Th (20 ppm); Tl (0.02 ppm); U (0.05 ppm); V (0.05 ppm); W (0.05 ppm)
	FA301	Au (0.01 ppm)
	FA501	Au (0.005, 0.1 ppm)
	PGM505	Au (0.001 ppm)
	XRFOR1	Ca (0.05%); Fe (0.01%); S (0.01%)
	AAS3A	Cu (0.01%)
	CN19	CuCN (0.05, 5 ppm)
	CUCN1	CuCN (5 ppm)
	ELE81a	F (20 ppm)
	MECIC1	F (10 ppm)

11.5 Quality Assurance and Quality Control

All assays are checked and verified in accordance with the Newcrest Resource Development Quality Assurance Quality Control (QA/QC) and database management procedures.

Sample identifiers are generated on site and assays are loaded by direct transfer from one of the laboratories, then validated by a geologist. All assay results are also provided with laboratory certification. Logging information is transferred directly from the digital loggers. A validation checking table ensures only valid codes can be entered to specific areas. The acQuire database management software has data entry protocols that ensure the validity of imported data.

A comprehensive QA/QC program is in place for sample analysis. Metallurgy and waste characterisation are generally determined once assays have been received, validated, and interpreted.

The laboratory QA/QC procedures currently involve some or all of the following:

- Received sample weights;
- Standard reference material (SRMs);
- Duplicates from the crusher coarse splits;
- Duplicates from the pulveriser pulp;
- Checks on grind and crush size from the sample preparation steps;
- Replicate submissions of pulps to an alternative laboratory for analysis;
- Replicate submissions of pulps to the same laboratory for analysis;
- Random insertion of blank samples.

The procedures also include visits to the laboratory for confirmation of actual procedures applied, and monthly QA/QC meetings with laboratory personnel.

A monthly report is prepared for the site Mineral Resource Manager detailing QA/QC performance and an annual report is prepared to support the documentation of the Mineral Resource estimate.

11.5.1 Cadia East

The available QA/QC is divided into two periods, pre-June 2016, and June 2016–30 June, 2020.

11.5.1.1 Pre-June 2016

A review of the available QA/QC data from 2010 to June 2016 was completed. Data were exclusively from NSLO analyses.

Blanks

Several different blank materials were used in Cadia East analytical campaigns after it was found that a purchased blank, which had started to return patchy gold grades, was being locally sourced, rather than sourced from outside the Cadia Operations area. No locally-sourced material was found to be completely suitable; however, the blank principally used during the review period was obtained from within the mine lease. This blank material returns acceptable gold results; however, copper can report a higher concentration (60–80 ppm) than is optimal for an analytical blank.

Interpretation of blank data is complicated due to the changes to the blank material, but there appears to be no indication of severe or ongoing contamination with respect to either copper or gold.

Pulp Grind Size

Pulp grind size analyses, where conducted, indicated generally-acceptable results.

Standard (Certified) Reference Materials

All SRMs were prepared and certified by Ore Research and Exploration Pty Ltd and were matrix-matched to Cadia Operations materials: 10 to Cadia Hill (then in operation) and six to Cadia East.

The median gold bias from the analytical results available was +1.6%. Copper results showed a median bias of +0.2%. Both results were considered acceptable as the SRMs did not indicate any extreme or sustained periods of analytical bias.

Gold Duplicates and Replicates

Gold coarse duplicate precision was 20%, dropping to 11.4% when outliers and pairs with gold assay results of <0.1 g/t Au were removed.

Pulp duplicate precision was found to be no better than coarse duplicate precision, suggesting that pulverising does not lead to any improvement in homogeneity. If this precision figure is not a laboratory artefact (e.g. by poor sampling of the pulverising mill) then it would usually be taken as an indication of the presence of relatively coarse, non-comminutable gold.

Laboratory replicates (two aliquots from the same sample envelope) showed an average precision of 18%, dropping to 10.5% when outliers and pairs with gold assay results of <0.1 g/t Au were removed. This suggests that the central 95% of laboratory replicates are a little more precise than the central 95% of pulp duplicates.

It was concluded that the gold coarse subsamples were representative of the crushed core; however, neither the pulp samples from the pulveriser nor pulp aliquots from the sample envelope can be assumed to be representative, at the nominated target levels, of the pulp lot from which they were taken.

Copper Duplicates and Replicates

Copper coarse duplicates returned 6.6% precision for the total data set, which is well inside the target range for laboratory replicates. Removing outlier samples and lower-grade values improved the precision to 4.6%.

There were no copper pulp duplicates to evaluate during the review period.

Laboratory replicate analyses showed an average precision of 7.0%, which was reduced to 3.4% after outlier removal. These values are considered acceptable.

Laboratory Resubmissions

No secondary laboratory checks were undertaken in the review period.

A total of 230 gold blind resubmissions from Cadia East material were undertaken. The median bias was between original and resubmission is zero and the total set precision was 21%. Removal of low-grade pairs and outliers reduced the precision to 12.7%, which is under the resubmission target of 15%. There is no systematic bias between jobs and that between-job precision is within the target range but worse than within job precision, as expected.

Copper resubmissions totalled 163 samples, which have a 1% median bias (original high) relative to the pair average. Precision is 14.4% for the full set, dropping to 5.0% after removal of low-grade pairs and outliers; this latter value is below the target for copper in resubmissions of 12%.

11.5.1.2 June 2016 to June 2020

A review of the available QA/QC data for Cadia East was conducted as of 30 June, 2020. The data are separated into two categories, “Ore Control” and “Resource Definition”, and include grade control, resource definition drilling, and near mine exploration sampling.

Blanks

The blank samples are granite or local volcanic rocks, and typically inserted at a rate of 1:40 in the resource definition sampling campaigns. The coding for resource definition blanks includes both fine and coarse blanks. Ore control blanks were inserted at a rate of approximately 1:20.

The NSLO laboratory uses a barren flush of feldspar (not assayed) at the start of every batch. A similar process is followed at Intertek Perth.

Blanks were only assayed for gold and copper. There were no assay batch reassays required due to instances of gold or copper contamination in blanks at either of the laboratories during the period 1 June 2016 to 30 June, 2020. Instances of blank failures are interpreted to be due to background gold and copper grades in the source material and it is planned to change the material used as a blank to mitigate this issue.

Field Duplicates

Field duplicate precision was calculated for values greater than 10 times the detection limit, applied in the case where at least one of the pairs was greater than that value.

The following formula is used:

$$\text{Precision \%} = \sqrt{\frac{2}{n} * \text{Sum} \frac{(\text{original-check})^2}{(\text{original+check})^2}} * 100$$

For drawpoint sampling, the gold precision (29.1%) compares well to the corporate guidelines (MIN GL-33) of <35%. Copper precision for drawpoints (15.3%) is also well within guidelines (<30%).

Newcrest does not have guidelines for precision for face sampling (P) for gold and copper due to the nature of duplicating another sample channel at the heading. The increase in copper imprecision (15.3% in draw point sampling to 41.6% in face sampling) points to a need to understand the mineralogical sampling practices (e.g. chalcopyrite veining) compared to elemental distribution e.g. gold.

Standard (Certified) Reference Materials

SRMs were inserted at a nominal frequency of 1:20 with all batches. Resource definition drilling used 10 different SRMs across a grade range from approximately 0.5–2.5 g/t Au. Ore Control sampling used 13 SRMs, with a grade range from 0.2–2.5 g/t Au. Results from the NSLO and Intertek Perth laboratories were evaluated using ‘z-score’ criteria.

Evaluation of the SRM results did not indicate any material issues with the analytical programs.

Crush Duplicates

Primary crushing for drill core has been undertaken with a primary jaw crusher, with a Boyd crusher employed as of about 2010 onwards. Splitting processes evolved from riffle splitting at the beginning of the project to the use of mechanical dividers built as part of the Boyd crushers.

Routine screen testing is undertaken at a rate of 1:20 samples to maintain compliance to the planned crush sizing. A split of the crushed sample is taken to achieve a nominal 2.5 kg pulveriser feed.

At NSLO, duplicate samples are collected at the crusher and assigned the same sample number with the suffix “A”. At Intertek Perth, the duplicate crush sample has the same sample ID as the original and is tracked by the internal laboratory system.

Overall, crush duplicate precision is better than the internal limits set by Newcrest for gold (<25%) and copper (<20%).

Pulp Duplicates

Pulverising was completed using bowl and puck pulverisers. Routine screen testing was undertaken at a rate of 1:20 samples to maintain compliance with the planned crush sizing.

Duplicate samples are collected at NSLO at the pulveriser and assigned the same sample number with the suffix “B”. At Intertek Perth, the duplicate crush sample has the same sample ID as the original and is tracked by the internal laboratory system.

Pulp duplicate precision is outside corporate guidelines for gold (<12%) and copper (<8%). Added to this, it is regularly observed in monthly reports that the pulp duplicate precision shows little improvement over crush duplicate precision. Crushed duplicates have a reported precision of 16.0% compared to pulp duplicate precision of 16.8%, which is not materially different. Replicate sampling (same pulp packet, second assay) has a precision on 18.4%, once again reinforcing there is no improvement in precision despite sampling from the same packet. The issue is specifically related to gold, as the copper does show the expected precision improvement.

Pulp Replicates

Laboratory duplicates represent two pulp packets collected from the crusher or the pulveriser, a replicate is a repeat analysis from the one pulp packet. Pulp replicate assays are provided by the laboratory as evidence of internal QA/QC. These data can be used as a quantitative measure of precision for comparison to the pulp duplicates.

Evaluation of results from both NSLO and Intertek Perth show that gold replicates have a higher imprecision than corporate standards (<10%); however, copper results are generally sufficiently close to corporate standards (6%) to be acceptable.

11.5.2 Ridgeway

No drilling has been conducted at Ridgeway since September 2012. The QA/QC reviews discussed in the following subsections were completed between 2002–2009. The database closeout date for resource estimation was in 2009.

11.5.2.1 Standard (Certified) Reference Materials

At least 47 SRMs were used during the Ridgeway drilling programs; 17 of which appear to have been control samples without third-party certification. Where known, certified materials were sourced from Geostats, and OREAS. A number of the early SRMs were not certified for copper. All SRMs were certified for gold.

During the early exploration programs, Analabs returned a consistent negative bias for gold (-6.5%) and copper (-3.2%). Negative biases were returned from the AMDEL programs for gold (-1.2%) and copper (-4.2%).

Review of the resource definition drilling SRM data indicate the following:

- Analabs (1999): gold bias of -4.9%; however, results are acceptably precise, and copper bias of 3.2%;
- ALS Orange (2000–2001): With the removal of results for one SRM, the overall gold bias was -2%, and copper -1.5%. A three-month period in early 2001 saw a significant bias for gold and copper, which disappeared after the SRM used in that period was discontinued;
- AMDEL Orange (2001–2004): The median bias was +0.8% for gold, and -0.5% for copper. The gold data are to some extent cyclic, particularly early in the analytical period;
- ALS Orange (2004–2009): The gold bias (-0.7%) was not a problem; however, precision of gold analyses tended to be poor. The data are to some extent cyclic. ALS Orange used two slightly different methods to analyse copper in the Ridgeway resource development programs. Method MEICP42 has poor precision, strong cyclicity and substantial periods of significant local bias. The median bias of MEICP42 is +2.3% however there are local extremes of about 6% bias. MEICP49 does not demonstrate the same inconsistent bias and, apart from a period shortly after the method was introduced, has superior precision. The median bias of MEICP49 is +0.6%.

11.5.2.2 Blanks

Blanks were not included with Ridgeway analytical jobs until late in 2006. ALS Orange was the only laboratory to have received blanks for analysis. One example of a swapped sample was noted during evaluation of gold results, and about 10 samples were suggestive of contamination. Copper values also suggest instances of contamination.

11.5.2.3 Duplicates

Duplicate assay data are available from an unknown laboratory or laboratories (name(s) not recorded in the database), Analabs, AMDEL Orange, and ALS Orange. Data are split between exploration and resource development campaigns, and between coarse and pulp duplicates. The exploration data are discussed in Table 11-2 and Table 11-3. Resource definition data are reviewed in Table 11-4 and Table 11-5.

11.5.2.4 Repeat Assays

Repeat assays are regularly sampled from the Boyd crusher and analysed for gold, copper and sulphur.

The repeat assay results for the 2002–2003 and 2004–2005 drilling also show good repeatability, with results similar to the 2005–2006 drilling.

11.5.2.5 Check Assays

A total of 35 check pulp samples from the 2002–2003 Phase 3 drilling were submitted to ALS Orange. Results for gold and copper indicate that they are well correlated with the original assays, and show there is minimal positive bias. However, precision for gold is poor. In contrast, 99% of the copper population had a relative paired difference of 10%.

No check assays were submitted for the 2002–2003 and 2005–2006 drilling programs.

11.5.2.6 Comment

The quality of the QA/QC procedures used on Ridgeway exploration and resource definition drilling has varied over time as has the method of handling QA/QC exceptions.

The failed SRMs and short-duration issues tend to have averaged out. Bias as measured from SRM determinations varied from laboratory to laboratory.

Precision was determined from up to three types of duplicate. Most calculated precision values fell within Newcrest's target ranges. The two that failed to meet target show evidence of at least two different data types, one of which appears to be a check rather than a duplicate. The various duplicate types are acceptably representative of the material from which the sample was taken.

No persistent large departures from preferred values were found and, despite the large number of individual errors, the QA/QC sampling has not revealed any evidence of material errors. It is reasonable to conclude that the data, considered as a whole, can be used in Mineral Resource estimation.

Table 11-2: Coarse Duplicate Data, Exploration

Laboratory	Element	Note
Unknown laboratory	Au	Returned total dataset precision of 62% and trimmed data set precision (removing all pairs with an average less than 0.1 g/t) of 69%. There were 915 pairs with relative difference worse than 60%. Removing the worst 180 of those (5% of total data) gave 59% precision. There were two distinct groups of data, one with minimal bias and good precision, the other with a large bias (duplicate high relative to the pair average) and poorer precision. It is probable that the biased data includes resubmissions or second laboratory checks.
	Cu	Precision was calculated to be 2.6% for both the total data set and the trimmed set. There were no outliers.
Analabs	Au	Overall precision was 54% which worsened to 60% when pairs with an average below 10 x detection were removed. Eliminating the 180 worst pairs with relative difference greater than 60% gave 45% precision. There were another 365 pairs with relative difference greater than 60% that were retained. The Analabs data has a pronounced bias similar to that of the unknown laboratory, but there is no high precision second population.
	Cu	Full data set precision was 6.5%, improving to 5.6% when pairs with an average grade below 20 ppm Cu were removed. There were three outliers and their removal resulted in 2.5% precision.
ALS Orange	Au	Precision figures of 27% for all data, 10.9% with low grade removed and 7.5% when the one outlier was removed. These figures appear too good for coarse duplicates and they could represent some form of pulp duplicate.
	Cu	Precision was excellent with figures of 3.3% (full data set) and 2.8% (low grade removed). There were no outliers so 2.8% is the underlying precision.
AMDEL Orange	Au	Small number of pairs. Precision figures of 41% for the full set, 26% for the trimmed set and 10.7% when the three outliers were removed.
	Cu	Small dataset, no outliers.

Table 11-3: Pulp Duplicate Data, Exploration

Laboratory	Element	Note
Unknown laboratory	Au	Total set precision is 11.5%, improving to 9.0% when pairs with an average less than 10 x detection are removed, and to 7.0% when the 12 pairs with a relative difference greater than 60% are ignored. There is no evidence of a second population within the data.
Analabs	Au	Precision is 34% which improves to 26% when low grade samples are removed. Discarding the 78 outliers with worse than 60% relative difference gives 7.8% precision.
ALS Orange	Au	Precision figures of 24% for the entire set, 16% for the set without low grade samples and 7.6% when the five outliers are removed.

Table 11-4: Coarse Duplicate Data, Resource Definition

Laboratory	Element	Note
Analabs	Au	Labsplit samples. Precision was calculated to be 24% for the total data set, 18% for the set once pairs with an average less than ten times detection had been eliminated and 9.0% when the three outliers were removed. All values inside the 35% target level for coarse gold duplicates.
	Cu	Labsplit samples. 4.5% precision for the entire set, 4.4% when the single low-grade pair was removed. There were no outliers so 4.4% is the underlying precision, not only inside the coarse duplicate target but inside the target for pulp duplicates.
ALS Orange	Au	Labsplit samples; 2 analytical methods. Total data set precision was 31%, trimmed data set precision 22% and cleaned data set, after removing 23 outliers, was 14.5%. All gold precision figures are inside the target level for gold in coarse duplicates of 35%.
	Cu	Labsplit samples; same digest method but three different analytical finishes. All copper precision results, including the total data set results, are inside the copper coarse duplicate target of 25% and all of the underlying precision figures (after removing low grade and outliers likely to be the result of human error) are inside the target for copper in laboratory pulp replicates (8.0%).
AMDEL Orange	Au	Precision figures of 34% for the full data set, 24% for the trimmed set and 12.8% after deleting the 50 pairs with a relative difference worse than 60%. These results are all inside the coarse duplicate gold target level of 35% leading to the conclusion that there is no reason to believe that the coarse duplicates are not representative of the material crushed.
	Cu	Precision results of 11.6%, 10.6% and 5.6% for total, trimmed and cleaned data sets respectively. Once again, all results are inside the target level for copper and the data indicates that assays are likely to be acceptably representative.

Table 11-5: Pulp Duplicate Data, Resource Definition

Laboratory	Element	Note
ALS Orange	Au	Pulp duplicates, two analytical methods. Both cleaned data set precisions are inside the target limit of 12% and there is no reason to doubt that pulp samples are representative of the material pulverised.
	Cu	Pulp duplicates; same digest method but three different analytical finishes. All precision figures are inside the target level of 10% and thus pulp samples can be considered to be representative of the pulverised material.
AMDEL Orange	Au	Pulp duplicates. Calculated precision figures for gold were 38% for the full set, 14.1% for the set with pair average less than 10 x detection removed and 9.5% after removal of three outliers. Pulp replicates. 23% precision for the full data set, 11.4% for the trimmed data set and 9.9% when the four outliers were removed. The cleaned data precision is just inside the pulp replicate target of 10%.
	Cu	Pulp duplicates. Copper returned figures of 9.1% precision for the full set, 9.3% for the trimmed set and 2.3% after removing the only outlier. Pulp replicates. precision figures of 11.8%, 10.4% and 3.8% for the full set, trimmed set and cleaned data set respectively.

11.5.3 Cadia Extended

11.5.3.1 Standard (Certified) Reference Materials

The Cadia East database has records for 24 matrix-matched SRMs. A number of these are control samples that do not have third-party certification. The remainder of the SRMs were purchased from Ore Research and Exploration Pty Ltd.

Review of ALS Orange data from 2000–2001 indicates good accuracy and fair precision for gold, and acceptable accuracy and very good precision for copper. Some SRM sample swaps were noted.

SRM data from AMDEL Orange that span the period 2001–2004 indicate that for gold, overall accuracy was good and precision fair to good. Copper accuracy is considered to be fair, and precision good. Some SRM sample swaps were noted.

ALS Orange SRM data from 2004–2009 showed an accuracy that can be assessed as fair, but the precision is fair to poor. Copper data indicate that accuracy and precision are both good.

While there are many individual poor results, these appear to result from random rather than systematic causes. SRM data do not reveal any significant or sustained bias.

11.5.3.2 Blanks

Blanks were not introduced into the Cadia Extended QC program until March 2007, and consequently have only been analysed by ALS Orange and NLSO. NLSO reported only 12 gold blanks, all with below detection limit results. ALS Orange had a maximum reported gold result of 0.6 g/t Au, which could be either a swapped sample or contamination. There were no significant clusters of failed results. The 12 NLSO copper blank results were all below 30 ppm Cu. In the ALS Orange copper blank data there were seven points above the 160 ppm Cu acceptance limit, the maximum being 3,660 ppm Cu. The distribution of the failures appears to be random.

11.5.3.3 Duplicates

ALS Orange in the period 2000–2001 analysed 579 coarse duplicates, 495 pulp duplicates; and 299 pulp replicates (although the two fields that define sample type are incompatible in this last set, so they may be a different sample type). The results were considered acceptable.

AMDEL Orange duplicate data consisted of 570 coarse duplicates, 681 pulp duplicates and 566 pulp replicates/repeats. Evaluation also indicated acceptable results.

ALS Orange either did not report laboratory replicates/repeats or they were stored as pulp duplicates in the 2004–2009 period. Duplicates reported comprised 383 coarse duplicates and 283 pulp duplicates. The results were considered acceptable.

Overall, none of the precision calculations indicate a significant problem and almost all underlying precision figures are within the target limits. From this it can be inferred that there is no evidence suggesting that samples are not representative of the bulk material from which the sample was taken.

11.5.3.4 Check Assays

A total of 287 AMDEL Orange gold resubmissions and 47 ALS Orange gold resubmissions (all from ALS's first period as principal laboratory) are recorded in the database. Twenty-three of the AMDEL resubmissions were described as coarse resubmissions. There were also 314 copper resubmissions, consisting of 267 AMDEL Orange checks and 47 ALS Orange resubmissions from their first period as principal laboratory.

There was no bias between original and checks sets for gold. In three of the nine outliers the original and duplicate results did not appear to be from the same sample, suggesting there had been some form of sample swap. There were no low-grade copper results and the only outlier has what appears to be a gold result loaded as the copper resubmission. There was no bias between the two sets of copper results.

11.5.3.5 Comment

About 20% of drill holes, predominantly if not entirely from early programs, have no QA/QC sampling in the database. While it is likely that some of the earliest drill holes had no control samples, there are possibly other drill holes for which control samples are likely to have been analysed but could not be located. Similarly, it is likely that some QC sample types, particularly second laboratory checks, exist but have not been loaded.

11.5.4 Big Cadia

11.5.4.1 Standard (Certified) Reference Materials

The earliest drill holes with SRM results in the database are from late 2001. A number of earlier drill holes are believed to have had SRMs included in analytical jobs, but no results could be found in the database.

Eleven SRMs were used, all were matrix-matched to either Cadia Hill or Cadia East. Of these SRMs, five were control samples that do not have third-party certification; the remainder were purchased from Ore Research and Exploration Pty Ltd.

Review of AMDEL Orange data from 2001–2004 indicated that both copper and gold data are both accurate and precise.

Review of ALS Orange data, collected between 2004–2009, showed that gold accuracy was acceptable but precision was poor. Copper results were both accurate and precise.

Z-score charts and bias and precision figures for gold and copper at both laboratories revealed no long-standing or significant issues.

11.5.4.2 Blanks

Blanks were not introduced to the QA/QC protocols until April 2007, and thus have been analysed only at ALS during 2007–2009. Gold results are generally good. Two results are very high (0.5 ppm Au or above) and probably represent swapped samples although they are close to each other and another lower-grade failure. There are another seven results that could indicate some contamination. These are spread randomly through the blanks, rather than forming clusters (except for the one previously mentioned) of poor results. The maximum copper result is over 1,700 ppm, and another at 1,000 ppm is the same sample as one of the gold blanks interpreted as a swapped sample. Seven blanks exceed the error limit.

Blank data show no evidence of any systematic mishandling.

11.5.4.3 Duplicates

There are 656 gold results that are considered to be from coarse duplicates (i.e. split before pulverising and the duplicate pulverised separately from the original). AMDEL Orange were responsible for 78 of the analyses and ALS Orange for 578. The results were considered acceptable.

AMDEL Orange assayed 86 pulp duplicate pairs for gold. No AMDEL copper pulp duplicates could be located. ALS Orange assayed 495 gold pulp duplicate pairs (87 from the 2000–2001 period and the remainder from 2004–2009), and 888 copper pulp duplicate pairs for copper (54 in the 2000–2001 program, the remainder from 2004–2009). The results were considered acceptable.

Analabs produced 35 gold pair samples that were recorded in the database as laboratory repeats or replicates (no distinction has been drawn between these two). AMDEL Orange reported 96 gold laboratory replicate/repeat pairs. The high percentage of low-grade pairs suggests that much of this set was selected at random and the majority are likely to be true replicates. ALS Orange reported five repeat pairs (all relatively high-grade) from the 2000–2001 program, and four pairs, also high-grade, from the 2004–2009 period. There were only a handful of replicate/repeat copper pairs. AMDEL Orange reported 13 such assays, and ALS Orange had one. The results were considered acceptable.

11.5.4.4 Comments

While it is likely that some of the earliest drill holes had no control samples, there are many other drill holes for which control samples are known to have been included but could not be located.

There is no evidence of any sustained or material issues arising from the available QA/QC data.

11.6 Databases

11.6.1 Cadia East

Cadia East data are stored in a SQL server database using acQuire software. Assay data and geological data are electronically loaded into acQuire and the database is replicated to Newcrest's centralised database server. The geological team on-site currently manages all data. Data are collected from geotechnical logging, geological logging and drilling data (collar, survey) and imported/logged directly into the acQuire database. Regular reviews of data quality are conducted by site and corporate teams prior to resource estimation, in addition to external reviews.

Exclusive control over the checking and entry of analyses from the laboratory is restricted to database administrator(s) and designated geologists at Cadia East. Login and access permissions are limited to control access to the database and to maintain the integrity of the resource data. Data access is generally limited to project geologists and the database administrators.

The database is regularly backed up, and copies are stored in both offsite and in Newcrest facilities.

11.6.2 Ridgeway

Drill data for Ridgeway are stored in an acQuire database. Data from underground development (production sampling and development grab samples) are maintained in the Ridgeway Ore Control acQuire database.

All drill collars were recorded by mine surveyors, loaded by the database administrator and validated by supervising geologist. Sample identifiers were generated on site and assays were loaded by direct transfer from laboratory, again validated by a geologist. All assay results were provided with laboratory certification. Logging information was transferred directly from the digital loggers. Validation checking tables ensured that only valid codes could be entered into specific areas.

The database is regularly backed up, and copies are stored in both offsite and in Newcrest facilities.

11.6.3 Cadia Extended and Big Cadia

Data are stored in a SQL server database using acQuire. Assay data and geological data are electronically loaded into acQuire and the database is replicated in Newcrest's centralised database system. Regular reviews of data quality are conducted by site and corporate teams prior to resource estimation, in addition to external reviews.

11.7 Sample Security

Sample security at the Cadia Operations has not historically been monitored. Sample collection from drill point to laboratory relies upon the fact that samples are either always attended to, or stored in the locked on-site preparation facility, or stored in a secure area prior to laboratory shipment.

Chain-of-custody procedures consist of sample submittal forms to be sent to the laboratory with sample shipments to ensure that all samples are received by the laboratory.

11.8 Sample Storage

Three core yards are currently in use:

- Mine site processing yard: secure facility used for core processing (logging, sampling);
- Mine site yard: approximately 2 km north of the mine site processing yard; designated yard used to store core following processing at the mine site facility;
- Exploration yard: about 5 km northeast of the mine site processing yard; used for exploration core processing and storage.

Core is stacked on pallets so that a forklift can be used to order and retrieve core. Site personnel have a system of ordering the archival core. The location of the exploration core trays is stored within Newcrest's computer network.

Pulps and coarse rejects are delivered to the core yard in shrink wrapped (plastic wrapping) pallets for outdoor storage. This usually means an effective life of less than two years, such that these sample types are generally discarded after two years.

11.9 QP Comments on "Item 11: Sample Preparation, Analyses, and Security"

In the opinion of the QP, the sample methods, including preparation, analysis, and security practices and results are acceptable, are in line with industry-accepted practices, and are adequate to support Mineral Resource and Mineral Reserve estimation and mine planning purposes at Cadia East and Ridgeway, and Mineral Resource estimates at Cadia Extended and Big Cadia based on the following:

- Drill sampling was adequately spaced to first define, then infill, gold, copper, silver and molybdenum (Cadia East) and gold and copper (Ridgeway, Cadia Extended and Big Cadia) anomalies to produce prospect-scale and deposit-scale drill data;
- Sample preparation for core samples has followed a similar procedure since Newcrest's Project involvement. The preparation procedure is in line with industry-standard methods;
- Analytical methods for core samples used similar procedures for the core drill programs. The analytical procedure is in line with industry-standard methods;
- Newcrest has used a QA/QC program comprising blank, SRM and duplicate samples. QA/QC submission rates are typical for the program at the time the data were collected. Evaluations of the QA/QC data do not indicate any material problems with the analytical programs; therefore, the gold, copper, silver and molybdenum (Cadia East) and gold and copper (Ridgeway, Cadia Extended and Big Cadia) analyses from the core drilling are suitable for inclusion in Mineral Resource estimation;
- Confidence classifications were restricted for Big Cadia based on the factors discussed in Section 12.3.4, and Section 14.4.10;
- Data collected prior to the introduction of digital logging were subject to validation, using inbuilt program triggers that automatically checked data on upload to the database;
- Verification is performed on all digitally-collected data on upload to the main database, and includes checks on surveys, collar co-ordinates, lithology, and assay data. The checks are appropriate, and consistent with industry standards;
- Sample security has relied upon the fact that the samples were always attended or locked in the on-site sample preparation facility. Chain-of-custody procedures consist of filling out sample submittal forms that are sent to the laboratory with sample shipments to make certain that all samples are received by the laboratory;
- Current sample storage procedures and storage areas are consistent with industry norms.

12 DATA VERIFICATION

12.1 Laboratory Visits

Laboratory inspections were regularly carried out, although older inspection records are no longer available. Inspection periods have varied between monthly and six-monthly intervals.

Additional measures include laboratory visits performed by the Newcrest Operations Chemist. Visits included:

- Intertek Perth: 2013, 2017.

Laboratory visits have also been undertaken on Newcrest's behalf by consultant sampling specialists such as Agoratek International.

12.2 Laboratory Checks

Round-robin programs are run by Geostats Pty Ltd, an independent third-party organisation that undertakes world-wide assay programs. Each program is run quarterly and routinely involves more than 200 laboratories each time. The NSLO participates in Geostats programs on a six-monthly basis, and has performed within expected industry standards. The most recent program participation report was dated April 2019.

Laboratory performance details are reviewed by the Newcrest Operational Chemist and improvement plans put in place if required.

12.3 Internal Data Verification

All data and interpretative inputs to Mineral Resource models are checked and verified in accordance with a range of standard operating procedures.

12.3.1 Current QA/QC Reviews

12.3.1.1 Short Term Control Measures and Reporting

Weekly monitoring of key metrics including CRMs and blanks have been recorded by the sites on the corporate server since November 2011 and that process was in place as at 30 June, 2020.

A log of non-compliant laboratory batches with associated actions has been filed on the corporate server since December 2013. This monitoring continued as at 30 June, 2020.

12.3.1.2 Longer Term Control Measures and Reporting

From November 2010 to June 2017, the corporate QA/QC specialist prepared monthly consolidated assay reviews that highlighted improvements and issues needing attention. This reporting was accompanied by individual QA/QC reviews of assays used for resource modelling. These reports are filed on the corporate server and were reviewed by the QA/QC specialist to investigate any issues requiring improvement actions.

From June 2017 to July 2019, the procedure was modified such that all reporting was done by the mine site on a monthly basis. A corporate review of the monitoring was conducted in July 2019.

From July 2019 onward, monthly site-based reporting has been undertaken, and all reports are filed on the corporate server and reviewed by the corporate QA/QC specialist.

12.3.2 Analytical QA/QC Review

All Resource Development data are checked as the batch is loaded and any errors are corrected if possible. If there is any indication of a systematic error that could have an effect on either the geological interpretation or the resource model, then all or part of the analytical job is likely to be reassayed.

12.3.3 Database Review

Newcrest employs an in-house resource drill hole database team to check, verify and validate new data and to ensure the integrity of the total resource database, including the following general activities:

- Ensuring compatibility of total hole depth in the collar, survey, assay and geology database files;
- Checking of drill hole survey data for unusual or suspect down hole deviations; ensuring sequential down hole depth and interval data in the survey, assay and geology files;
- Checking of lithology and alteration codes.

Day-to-day management of the resource data is undertaken by the database administrator on site using the acQuire database system.

12.3.4 Model Input Review

The following detailed data review was carried out for the current resource models:

- Validation of collar surveys against the DTM;
- Downhole surveys consistency of hole path;
- Missing or overlapping intervals;
- Negative values;
- Depth of the assayed holes compared to the hole depth stored with the collar details;
- Silver assay values and detection limits;
- Removal and correction of duplicate assays stored in database as primary assays.

All corrections were completed before final data extraction for input into the Mineral Resource estimation.

12.3.5 Big Cadia

About 58% of the data in the database was collected prior to Newcrest's Project interest. Legacy data reviews noted:

- Legacy data were not subject to the same QA/QC as Newcrest-collected data. Most of this legacy data is over 25 years old;
- The distribution of copper when remobilised in the weathered zones results in leached and enriched horizons that are spatially poorly understood or constrained;
- The volumes of alluvial and fill (mine dumps, excavations and not in-situ material) are poorly estimated and unverified;
- Not all legacy drill holes were analysed for copper and gold; this has resulted in grade uncertainties for the missing intervals.

A sensitivity model was run to assess the impact of excluding the legacy data from estimation support whereby the legacy data were removed, and the grades re-estimated using the same variogram and search parameters as the original model.

The exclusion of the legacy data did not have a significant impact on the gold grade, with only 3% total difference between the two models. There was, however, a 15% drop in total copper grade when the legacy data were removed. The copper grade was markedly lower in the oxide and lower skarn areas, but negligibly lower in the upper skarn area, indicating that the bias is not consistent between skarn zones. Visual inspection suggested the variance may be partly due to poor representation of Newcrest drilling within the transitional skarn volumes (i.e. within the oxide and lower skarn areas). During estimation, the transitional and massive skarn volumes were combined into a single estimation domain, based on gradational contact analysis. Copper grades are higher within the transitional skarn than in the massive skarn, but gold grades remain similar in the two skarn types. The difference in the grades between the skarn types may explain the bias seen in the legacy data. There are more Newcrest drill holes in the upper skarn area, which is likely mitigating the impact of exclusion of legacy data in this zone.

Newcrest concluded that estimation would benefit from legacy data inclusion, but until check drilling could be undertaken, confidence classifications should be restricted to Inferred.

12.4 Resources and Reserves Steering Committee

Newcrest has implemented a steering committee, termed the Resources & Reserves Steering Committee, to ensure appropriate governance of development and management of resource and reserve estimates, and the public release of those estimates. This is achieved by ensuring regular Resources & Reserves Steering Committee review meetings, internal competent reviews, and independent external competent reviews.

In particular, the Resources & Reserves Steering Committee is responsible for monitoring performance of Mineral Resource and Mineral Reserve models, ensuring governance over changes to estimation, and reporting of resources and reserves including critical input parameters of costs base assumptions, metallurgical recovery algorithms and mining dilution. The Resources & Reserves Steering Committee also monitors reconciliation of extracted metal to the resource and provides governance to resolving reconciliation variance. The committee ensures that independent external reviews of Mineral Resources and Mineral Reserve estimates for each deposit are conducted at a minimum of every three years or more frequently when a material change has occurred.

The Resources & Reserves Steering Committee has permanent committee members that represent the following areas: operations, resource management, commercial, mining, and metallurgy.

The QP is a member of the Resources & Reserves Steering Committee and the current committee chair.

12.5 External Data Verification

12.5.1 2011

An external review was conducted in December 2011 of the acQuire resource development database by N. Fordyce of Minffordd Pty Ltd. No material issues were identified following the review.

12.5.2 2013

A database "health check" was undertaken by acQuire Technology Solutions (ATS) in March 2013 that covered both the resource development and ore control databases. No material issues were noted with either database.

12.5.3 2015

SRK reviewed the Cadia Extended and Big Cadia resource estimates in 2015. No material issues were identified following the reviews.

12.5.4 2016

The 2016 Cadia East resource model was reviewed by Mr. Daniel Guibal, Corporate Consultant – Geostatistics & Resource, of SRK Consulting (SRK). No material issues were identified with the gold, copper, molybdenum or silver estimates following the review.

12.6 QP Comments on "Item 12: Data Verification"

The process of data verification for the Cadia Operations was performed by Newcrest personnel and external consultancies contracted by Newcrest.

The QP, who relies upon this work, reviewed the reports and is of the opinion that the data verification programs indicate that the data stored in the project database accurately reflect original sources and are adequate to support geological interpretations and Mineral Resource estimation. The data support Mineral Reserve estimation and mine planning for the Cadia East and Ridgeway deposits.

Until check drilling can be undertaken, confidence classifications should be restricted to Inferred for Big Cadia.

The QP has performed numerous site visits, most recently in November 2019 (refer to Section 2.4). Observations made during the visits, in conjunction with discussions with site-based technical staff also support the geological interpretations, and analytical and database quality.

The QP's role as the chair of the Resources & Reserves Steering Committee includes review of the estimation processes in place for Mineral Resource and Mineral Reserve estimation, mine planning, and the control procedures in place to ensure the process is being executed as intended.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

Newcrest operates two adjacent concentrators, Concentrator 1 and Concentrator 2, currently treating ore from Cadia East mine. Both concentrators have undergone throughput upgrades, including operational improvements, over the years.

Metallurgical testing programs have been conducted since the 1990s to test the amenability of the mineralisation to conventional separation processes for gold, copper, and molybdenum. Based on these tests, two concentrators were constructed using conventional flotation and gravity separation methods and have subsequently treated the Cadia Hill, Ridgeway, and Cadia East mineralisation.

Testing programs have also included extensive comminution testing with results informing past and future throughput upgrades and debottlenecking of the two concentrator plants.

Laboratories and testwork facilities used during metallurgical evaluation included AMML, ALS Townsville, ALS Brisbane, Metso Minerals Process Technology, JKTech, Metcon, Enviromet, Optimet, Amdel, Normet, and Lakefield Laboratory (Canada). These facilities are independent of Newcrest. Metallurgical testwork facilities are typically not accredited for metallurgical testwork techniques.

13.2 Metallurgical Testwork

Metallurgical testwork and mineralogical analysis completed on the deposits has included:

- Cadia East: optical mineralogy, X-ray diffraction (XRD) and mineral laboratory analysis (MLA); comminution tests (drop-weight (DWi), SAG mill comminution (SMC) tests, Bond ball work index (BWi), rod work index (RWi) and abrasion (Ai)); gravity testwork; rougher and cleaner flotation tests, primary grind and regrind size sensitivity tests; evaluation of alternate reagents; flash flotation testing, fluorine depression batch flotation tests, and locked cycle flotation tests.
- Ridgeway: BWi, DWi, SMC tests; comparison to the original feasibility data; gravity and flotation testing; primary grind and regrind sensitivity flotation tests; and locked cycle confirmatory tests;
- Cadia Extended: flotation tests;
- Big Cadia: BWi and abrasion tests; sulphide and oxide flotation tests; primary grind sensitivity, gravity and magnetics separation tests; and cyanide and acid leach tests.

13.2.1 Cadia East

Initial testwork programs focused on determining the response of Cadia East ores types to the original Concentrator 1 flowsheet designed for processing Cadia Hill open pit ore. Subsequent metallurgical investigation efforts were directed towards improving the understanding of the specific processing needs of the Cadia East mineralisation, particularly in regard to maximising gold recovery and reducing fluorine content in copper concentrate product. A total of 12 campaigns (stages) of bench-scale laboratory testwork were completed between 1995 and 2011. Confirmatory testing of bulk ore samples in a laboratory pilot plant, and also in a plant trial with Cadia East underground ore, was completed in 2008.

Testwork conducted from 2015 to 2019 focused on revising the models used to forecast copper and gold recoveries based on information gathered from further drill sampling, face samples and the metallurgical response in the process plants from ore provided from the PC1 and PC2 caves. These data were used to update all areas of the orebody to provide a realistic representation of the of the expected processing performance, and were incorporated into a LOM plan which will have the concentrator throughput increase to 33–35 Mt/a.

13.2.1.1 Sample Selection

The mine plan presented in the Cadia East feasibility study recommended two initial panel caves (PC) PC1-Stg1 and PC2-Stg1, to be followed by two larger panel caves, PC1-Stg2 and PC2-Stg2. Samples used in the early testwork (Stages 1 to 8) were core samples mostly sourced relatively high in the PC1-Stg2 cave, consistent with the initial open pit mining concept. Later program stages (Stages 9 to 12) selected material from PC1-Stg1, PC1-Stg2 and an area east of the mine; samples based on lithology and grade, categorised as volcanic, breccia, monzonite, conglomerate or porphyry; composites with similar grades and expected mineralogy, but not lying within any one particular mining block; and a composite sample sourced from a drill hole intersecting the lower-central, and upper-central portion of the PC2-Stg1 mining block.

The 2015–2019 tests included material from panel caves designated as PC1–2 (East and West), PC2–3, PC3–1 and PC2 to reflect updated mine plans.

13.2.1.2 Testwork Summary

Testwork and results from the early feasibility-stage evaluations are summarised in Table 13-1.

The key implications from all the metallurgical testwork results for processing of Cadia East ore in Concentrator 1 are that:

- Additional comminution energy was required to maintain high throughput;
- Additional flotation capacity was required to suit the higher copper grade and slower kinetics of Cadia East ore;
- A finer concentrate regrind size was required to control fluorine to acceptable levels.

Table 13-2 provides a summary of the 2015–2019 testwork results that support the LOM plan designs.

Table 13-1: Cadia East Testwork Summary (1995–2011)

Test	Notes
Optical mineralogy, X-ray diffraction and mineral laboratory analysis	Identified two geometallurgical domains: a finer grained, disseminated chalcopyrite domain, predominantly near surface; and sheeted veining, containing bornite, predominantly at depth. Both chalcopyrite and bornite were observed to be relatively coarse grained. Pyrite content is variable but tends to be higher at the periphery of the ore body. Gold occurs as either fine grained free gold or attached to the copper minerals. Gangue minerals present include fluorine containing minerals sericite and fluorite, as well as minor apatite and biotite. The mineralogy of the fluorine containing minerals is important with regards to meeting concentrate fluorine specifications.
DWi; SAG mill competency	The 75th percentile value for the DWi results was calculated to be 10.0, and was used in flowsheet design. This represented approximately 20% increased energy demand when compared with Cadia Hill ore with a typical value of 8.1.
BWi	BWi average for all tests was 20.6 kWh/t, which is higher than the typical values of 17.5 kWh/t for Cadia Hill ores and 18.7 kWh/t for Ridgeway ores. The 75th percentile value of 21.5 kWh/t was used for plant design.
Rod work index (RWi)	RWi average of all tests was 29.1 kWh/t and is therefore over 40% harder than the typical values of 20 kWh/t for Cadia Hill ores, and 21 kWh/t for Ridgeway ores. The 75th percentile value of 31.1 kWh/t was used for plant design.
Abrasion index (Ai)	The average from all tests was 0.193, which is lower than typical values for Cadia Hill and Ridgeway, indicating that the Cadia East underground ore is less abrasive. A value of 0.21 was used in design.
High pressure grinding rolls (HPGR)	Tests were encouraging. Design parameters were determined for inclusion of a HGPR circuit to reduce ore sizing ahead of the semi-autogenous grind (SAG) mill.
Gravity recoverable gold	Recovery increases with increasing gold head grade; recovery increases at finer grind sizes. Based on a primary grind size of P_{80} = 150 µm the following relationship was proposed: For gold head grade < 0.5 g/t: gravity gold recovery (%) = 22.9 x Au + 0.54; For gold head grade > 0.5 g/t: gravity gold recovery (%) = 5.0365 x Au + 10.94.
Flotation testing	Design primary grind size of P_{80} = 150 µm selected. Regrinding testwork indicated a requirement for rougher and scavenger concentrates to be reground to a particle size of P_{80} = 38 µm for optimum copper recovery. Concentrate regrinding at a size of P_{80} = 38 µm results in concentrate with fluorine content near to, or above, the rejection limit in most samples. A nominal regrind size of 25 µm was shown to reduce fluorine to more acceptable levels, but at the expense of copper and gold recovery. Other elements of potential concern in final concentrate quality as determined in batch tests were chlorine, mercury and molybdenum. However, mercury levels from both piloting and a plant trial were satisfactory, and molybdenum can be recovered from concentrate as a by-product, leaving fluorine and chlorine as the principal elements to be managed. The Cadia East ore types are composed of a finer mineral grain structure than the Cadia Hill and Ridgeway ores, resulting in slower flotation kinetics. Flotation recovery models for gold and copper were developed based on batch tests, but it was noted that variability within the models was high. The major driver for higher gold recovery was found to be gold grade of feed, and likewise copper head grade was found to be the major driver for higher copper recovery. Flotation piloting of four ore types resulted in copper recoveries varying between 85% and 94%, at concentrate grades of 19.9% to 25.5% Cu. A plant trial with underground ore resulted in recoveries of 80.1% for gold and 83.6% for copper. Evaluation of alternative reagent schemes resulted in the standard Cadia Hill flotation reagent suite, consisting of Cytec 8761 collector and MIBC frother, being used as the basis of flotation design.

Table 13-2: Cadia East Testwork Summary (2015–2019)

Test	Notes
Mineralogy	Both the PC1–2E and PC1–2W sample sets exhibit variability in their mineralogy, whereas the mineralogy of the PC2–3 sample set is much more homogeneous. Pyrite varies in the PC1–2W composites and the pyrite/copper sulphide ratio in this sample set is the highest of all of datasets. PC2–3 ores contain higher average levels of pyrite but have a lower pyrite/copper sulphide ratio than PC1–2W due to the higher copper sulphide grades in PC2–3. All three sample sets reported here contain less bornite than the average level in the current Concentrator 1 recalculated feed. All three of the new datasets exhibit higher pyrite/copper sulphide ratios than either the PC3–1 ore composites or the current Concentrator 1 feed as well as more white mica, and biotite. PC1–2E (PC1–2E (MB12)) has six samples where a significant proportion of copper is contained in bornite, while the other six samples are chalcopyrite dominant/chalcopyrite only. PC2–3 (PC2–3 (MB23)) as a whole is chalcopyrite–dominant, with only one sample (UE293B) containing >7% of its copper in bornite. PC1–2W (HB12–W) has variable copper deportment, with three samples having between 12–29% Cu in chalcocite. These samples also have bornite and would generate a high theoretical maximum concentrate grade. Copper deportment in other PC1–2W (HB12–W) samples range from approximately equal amounts of copper in bornite and chalcopyrite through to all copper in chalcopyrite. Grain size distributions show that for each of these three sulphides (grouped copper sulphide, pyrite and molybdenite), the distributions for PC2–3 (MB23) are more consistent, relative to more variable distributions in the samples which comprise the PC1–2E (MB12) and PC1–2W (HB12–W) sample sets.
Comminution	All ores are generally categorised as 'hard'. Ores that have previously been processed are represented by PC1 and PC2 belt cut data. The only ore that responds similarly to these ores is PC1-2W. The remaining ores in PC1–2E, PC2–3 and PC3–1 are all harder than any ore processed to date and are considered to be harder than the Stage 9 CE feasibility testwork samples that were used as the basis for the existing plant design. The updated hardness values were incorporated into the LOM plan.
Recoveries	The average gold head grade for ores tested from PC2–3 is 0.32 g/t, ranging from 0.09–0.87 g/t. The average copper head grade for ores tested from PC2–3 is 0.46%, ranging from 0.24–0.69%. Gold diagnostic performed at a grind P80 of 150 µm indicates the proportion of gold reported as cyanide soluble averages 58.9%, with 24.1% being locked in sulphides which does not specifically limit their capacity for flotation recovery. The 3.4% of gold reported as gangue-locked can be considered essentially unrecoverable. The balance is considered to be 'free' or liberated Au. Copper diagnostic leaching performed at a grind P80 of 150 µm indicates the proportion of copper reported as being locked in gangue averages of 7.7%. This indicates that a proportion of copper has a mineralogical association with potentially non-floating gangue which is reflected by the average copper recovery for a 20-minute rougher flotation test being 91.8%. The average Au recovery of PC2–3 ores is 84.6% Au recovery over the total flotation time. In general, PC2–3 ores are performing consistently in terms of their gold recovery. The copper recovery performance of PC2–3 ores can be considered high, averaging 91.8% over the total flotation time, which is the highest copper recoveries of all ores tested. The average gold head grade for ores tested from PC1–2E was 0.72 g/t, ranging from 0.13–2.47 g/t. The average copper head grade of ores tested from PC1–2E was 0.30%, ranging from 0.10–0.69%. Gold diagnostic performed at a grind P80 of 150 µm indicates the proportion of gold reported as cyanide soluble averages 44%, with 20.9% being locked in sulphides, which does not specifically limit their capacity for flotation recovery. The 1.8% of Au reported as gangue-locked can be considered essentially unrecoverable. The balance is considered to be 'free' or liberated gold. Copper diagnostic leaching performed at a grind P80 of 150 µm indicates the proportion of copper reported as being locked in gangue averages 9.1%, indicative that a proportion of copper has a mineralogical association with potentially non-floating gangue. This is reflected by the average copper recovery for a 20-minute flotation test being 90.4%. The gold recovery performance of PC1–2E ores have the highest recoveries from all ores tested, averaging 89.4% over the total flotation time. The copper recovery performance of PC1-2E ores can be considered high, averaging 90.4% Cu recovery over the total flotation time.

Test	Notes
	The average gold head grade for ores tested from PC1–2W was 0.45 g/t, ranging from 0.10 to 0.83 g/t. The average copper head grade of ores tested from PC1–2W was 0.22%, ranging from 0.13 to 0.39%. Gold diagnostic performed at a grind P80 of 150 µm indicates the proportion of gold reported as 'free' averages 21.5%. Gold reported as cyanide soluble averages 51.8%, with 25.3% being locked in sulphides, which does not specifically limit their capacity for flotation recovery. The 1.5% of gold reported as gangue-locked can be considered essentially unrecoverable. Copper diagnostic leaching performed at a grind P80 of 150 µm indicates the proportion of copper reported as being locked in gangue averages 4.8%, indicative that a proportion of copper has a mineralogical association with potentially non-floating gangue, this is reflected by the average copper recovery over a 20-minute flotation test being 90.1%. The average gold recovery of PC1–2W ores tested was 84.3% over the total flotation time. The copper recovery performance of PC1–2W ores can be considered high, averaging 90.1% over the total flotation time of 20 minutes. The average gold head grade of ores tested from PC3–1 is 0.72 g/t, ranging from 0.18–2.98 g/t. The average copper head grade of ores tested from PC3–1 is 0.40%, ranging from 0.18–0.73%. Gold diagnostic performed at a grind P80 of 150 µm indicates the proportion of gold reported as cyanide soluble averages 64.7%, with 21.9% being locked in sulphides, which does not specifically limit their capacity for flotation recovery. The 3.1% of gold reported as gangue-locked can be considered essentially unrecoverable. The balance is considered to be 'free' or liberated gold. Copper diagnostic leaching performed at a grind P80 of 150 µm indicates the proportion of copper reported as being locked in gangue averages 6.7%, indicative that a proportion of copper has a mineralogical association with potentially non-floating gangue. This is reflected by the average copper recovery over a 20-minute flotation test being 90.0%. The average gold recovery of PC3–1 ores was 82.7% over the total flotation time, which is the lowest of the ores tested. The average copper recovery of PC3–1 ores tested was 90.0% which is consistent with the recoveries reported for PC2, and the average recovery to the first flotation concentrate of 56.1% is also consistent with PC2 performance, showing slower flotation kinetics than PC1–2. The average gold head grade of ore samples tested from PC2 was 1.11 g/t, ranging from 0.12–5.11 g/t. The average copper head grade of ores tested from PC2 was 0.45%, ranging from 0.12–0.93%. Gold diagnostic performed at a grind P80 of 150 µm indicates the proportion of gold reported as 'free' is on average 23.6%, while cyanide soluble gold averages 40.6%, with 34.1% being locked in sulphides, which does not specifically limit their capacity for flotation recovery. The 1.7% of gold reported as gangue-locked can be considered essentially unrecoverable. Copper diagnostic leaching performed at a grind P80 of 150 µm indicates the proportion of copper reported as being locked in gangue averages 4.2%, indicative that a proportion of copper has a mineralogical association with potentially non-floating gangue. This is reflected by the average copper recovery for a 20-minute flotation test being 90.2%. The average gold recovery of PC2 ores was 82.9% over the total flotation time. The average copper recovery of PC2 ores was 91.8% over the total flotation time.

13.2.2 Ridgeway

Concentrator 2 was designed to treat a throughput rate of 4 Mt/a from the Ridgeway underground mine. Testwork was undertaken as part of initial feasibility studies, and the concentrator was commissioned in 2002. The flowsheet included autogenous (AG) grinding, pebble crushing, ball milling, flash float and gravity concentration, rougher flotation, and cleaner flotation to produce gold doré, and a marketable gold-rich copper sulphide concentrate. The circuit capacity was progressively increased to 5.6 Mt/a through the conversion of the AG mill to a SAG mill. A regrind mill was installed to improve copper concentrate grades.

In 2007, additional phases of metallurgical testwork were undertaken to investigate the predicted metallurgical performance of deeper ore below the 5065 mRL crusher, and to support changes that would result from moving from sub-level caving (SLC) to block caving (Ridgeway Deeps).

13.2.2.1 Sample Selection

Drill core intervals from a wide range of spatial locations across the deposit were selected and sorted by lithology to prepare five variability lithology composites. The lithology composites were subjected to grind sensitivity flotation testing and locked cycle flotation tests.

A master composite sample was used in comminution testing, grind sensitivity flotation tests, gravity/flotation testing and locked cycle confirmatory tests. The master composite consisted of 33% sediment, 30% volcanic, 21% monzonite, 11% porphyry and 6% monzodiorite lithologies.

Other selected variability intercepts were used for comminution parameter testing and flotation recovery variability testing.

13.2.2.2 Testwork Summary

Testwork and results are summarised in Table 13-3.

The higher hardness with increasing depth and the change from SLC mining to block cave mining, resulted in a requirement to install more energy in the Concentrator 2 comminution circuit. Comminution modelling showed that installation of a secondary crusher would be required to maintain target throughput. Based on an analysis of all results, the required changes to Concentrator 2 for processing of the deeper ore were determined to be:

- Installation of a secondary crusher to allow the mill to maintain 5.6 Mt/a;
- Installation of additional grinding capacity to achieve a finer primary grind;
- An upgrade of the concentrate regrind circuit to target a concentrate P_{80} of 38 µm.

13.2.3 Cadia Extended

The Cadia Extended Resource is the underground extension of what was referred to as the Cadia Extended open pit that was mined and processed during 2003 and 2004.

There were no significant issues experienced during the processing of the Cadia Extended open pit, with reconciliation of the mill performance generally in line with the predictive models based on the Cadia Hill pit.

Average gold and copper recoveries were 74% and 84% for 2003–2004, respectively.

13.2.4 Big Cadia

Flotation testwork on the Big Cadia deposit was carried out by BMI Mining Pty Ltd in 1982. A range of samples of varying mineralization types (magnetite skarn or andesite skarn) and degree of weathering (fresh, moderate or intensely weathered) were tested. The results were highly variable, with copper recovery ranging between 35–90%, and gold recovery ranging from 45–70%. Highly weathered skarn materials had a recovery of about 20% for both copper and gold, and were concluded to be uneconomic to recover by flotation methods.

Table 13-3: Ridgeway Deeps Testwork Summary

Test	Notes
Bond work index (BWi)	The average BWi for Ridgeway Deeps ore was 18.9 kWh/t, compared with 17.2 kWh/t achieved in previous Ridgeway ore testing. Sediment material was shown to be the hardest ore type with an average BWi of 20.1 kWh/t.
Drop weight (DWi); SAG mill competency	Impact to breakage resistance was higher for Ridgeway Deeps ore than previous ore mined. The average breakage hardness as defined by a standard comminution parameter (A*b) for Ridgeway Deeps was 40.1, compared to an equivalent average of 45.5 for previous ore mined at Ridgeway (the lower the A*b result, the higher the hardness).
Flotation grind	Conducted at sizes between 53–150 µm. Flotation performance of Ridgeway Deeps ore is grind-dependent. Gold recovery is very grind dependent while copper recovery was less dependent. A finer grind in the regrind of rougher flotation concentrate was considered necessary to realise optimum recovery. Grind sensitivity with individual rock types showed differences in sensitivity to grind, with monzonite as the least sensitive whilst porphyry was the most sensitive.
Gravity gold	Variable between rock types with mean gravity recovery values ranging between 17% and 26%.
Locked cycle; rougher flotation copper recovery	Locked cycle tests at simulated plant conditions resulted in final concentrate grades ranging from 18–26% copper and copper recoveries ranging between 89–96%.
Concentrate	Concentrate generally had low levels of penalty elements, but the levels of fluorine and Al_2O_3+MgO in some samples were of concern.

Further testwork was carried out in 1991 and 1992 by Envriomet, Optimet, Amdel and Normet. Both flotation testwork and cyanide leaching was completed, as well as diagnostic assays and mineralogical analysis on select composites. Heap leach testing was conducted on two samples. Copper and gold rougher recovery results from these tests ranged between 11–94 and 38–95%, respectively. Cyanide recovery of gold ranged between 45–100%, with highly variable and erratic cyanide consumption rates due to the varying amount of cyanide-soluble copper minerals present, making cyanide leaching potentially uneconomic and high risk. No metallurgical recovery models were developed from the 1991 and 1992 program results.

Eacham Metallurgy conducted mineralogical analysis and flotation optimisation programs in 2008. The response to varying pH, grind size, blending, collector type and addition and cleaning options were all tested. No additional model improvements resulted from this work.

Eighteen variability samples, composited from 127 quarter core samples, were tested by Metcon in 2011 for amenability to magnetite recovery, gravity gold recovery from non-magnetic material, and copper flotation of gravity tailings. The samples were taken from two zones, designated Upper Block and Lower Block. Sample head grades were assayed at ALS Ammtec, Perth. Testwork is summarized in Table 13-4.

Table 13-4: Big Cadia 2011 Testwork Summary

Composite	Test Type	Note
Massive Magnetite' composite comprising eight Upper Block samples with average head grades of 0.58% Cu, 0.32g/t Au and 53.1% Fe.	Magnetic separation efficiency versus grind sizes ranging from 2 mm to 75 µm	Iron recovery was 81% at the 1200 µm grind reducing to 73% at 75 µm which a corresponding grade increase from 59.7% Fe to 65.4%.
	Silica recovery to magnetics	Silica grade needs to be low for concentrate saleability and the effect with grind size showed the magnetics silica content was reduced from 8% to 4.2%
18 samples, Upper and Lower Blocks	Variability	All variability samples gave >60% Fe grade in the magnetite concentrate with the exception of: MS010 (Upper Block, Lower Transitional) which gave a magnetics mass recovery of only 0.3% indicating very low magnetite in the feed, and MS011 (Upper Block, Lower Transitional) which produced a concentrate of 56.9% Fe but had the highest silica content of 9.47% SiO_2. Each variability sample was tested individually for gold recovery at 75 µm grind.
	Grind size–gold	Gold recovery to the non-magnetics of the grind series tests increased by grinding to 80% passing 500 µm with little benefit to grinding finer. Tests on the composite non-magnetics (further ground to 80% passing 106 µm) recovered 12% of the gold to a gravity concentrate and 42% by flotation of the gravity tails. This totalled 53% recovery however when adjusted to reflect gold in the mill feed before removing the magnetite, recovery was 47%.
	Grind size–copper	The grind size tests on the massive magnetite composite showed the copper reporting to the non-magnetics and thus available for flotation recovery was increased from 63% to 85% by grinding to 75 µm. Subsequent tests on the composite non-magnetics (further ground to 80% passing 106 µm) recovered only 23% to the flotation recleaner concentrate (of the non-magnetics copper content) and concentrate copper grade was 16%. The low concentrate copper grade can be largely attributed to high pyrite content

13.3 Recovery Estimates

13.3.1 Cadia East

The 2015–2019 testwork resulted in four mine block-specific gold recovery models being developed for the purpose of forecasting the expected gold recovery on the basis of gold head grade:

- PC3–1 and PC2–L (lower):
  - Gold recovery (%) = 76.68 + 2.25 x Ln (Au);
- PC2–M (middle) and PC2–U (upper):
  - Gold recovery (%) = 79.76 + 3.52 x Ln (Au);
- PC1 group:

  - Gold recovery (%) = 80.65 + 2.88 x Ln (Au);
- PC2–3:
  - Low Fe:S Group (the majority of ore): Gold recovery (%) = (9.022 – 0.000417 x Y + 0.000210 x Z + 0.0560 x Ln (Au)) x 100;
  - High Fe:S Group (a small subset of the ore): Gold recovery (%) = (0.855+0.133 x Ln (Au)) x 100.

Where Au is the gold feed grade in g/t, Y is the spatial location in the north/south direction and Z is the spatial location with vertical height.

Comparison with the 2012 gold recovery model highlighted that this model was likely to under-predict gold recoveries at feed grades of less than 0.6 g/t Au and over-predict recovery as gold feed grade increased. For this reason, it was recommended that the customised models developed in 2017–2019 in both the expansion pre-feasibility and feasibility studies be applied to the specific mine blocks they were developed for, as a replacement for the current site model. The recommendation was adopted.

Gold recovery is expected to be lowest for PC3-1 and the lower part of PC2–1. The middle and upper parts of PC2 are expected to have lower gold recoveries than those of the PC1 group ores.

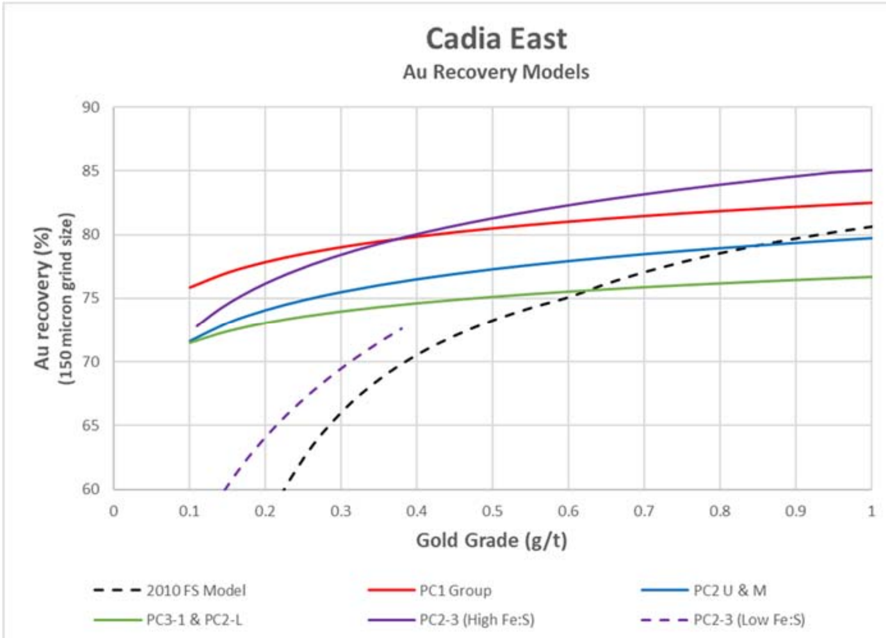
Figure 13-1 summarises the predicted LOM gold recoveries against existing data.

Five mine block-specific copper recovery models were developed for the purpose of forecasting the expected copper recovery on the basis of copper head grade:

- PC2–L
  - Copper recovery (%) = 90.92 +7.30 x Ln (Cu);
- PC1–2E and PC1–2W:
  - Copper recovery (%) = 91.06 + 2.02 x Ln (Cu);
- PC3–1:
  - Copper recovery (%) = 88.49 + 4.45 x Ln (Cu);
- PC2–3:
  - Copper recovery (%) = (1.126 + 0.170 x Ln (Cu) – 0.234 x Cu) x 100;
- PC1, PC2–M, PC2–U:
  - Copper recovery (%) = ((Cu) – 0.067 x (Cu) + 0.0127)) ÷ (Cu) x 100 – 3.

Where Cu is the feed grade as a copper percentage.

Figure 13-1: Cadia East Future and Current Gold Recovery Predictions



Note: Figure prepared by Newcrest, 2020.

Copper recoveries for PC1–2E and PC1–2W are expected to be higher than those experienced for PC1–1 ores (baseline). Current experience of lower plant recoveries while treating PC2 lower ores is indicated to be limited to those ores, and copper recoveries are expected to improve as ores from the middle and upper parts of PC2 begin to be processed.

PC3–1 is expected to have lower copper recoveries than the PC1–1 ores currently treated.

Figure 13-2 summarises the predicted LOM copper recoveries against existing data.

Overall average LOM recovery forecasts are 80% gold recovery, and 85% copper recovery.

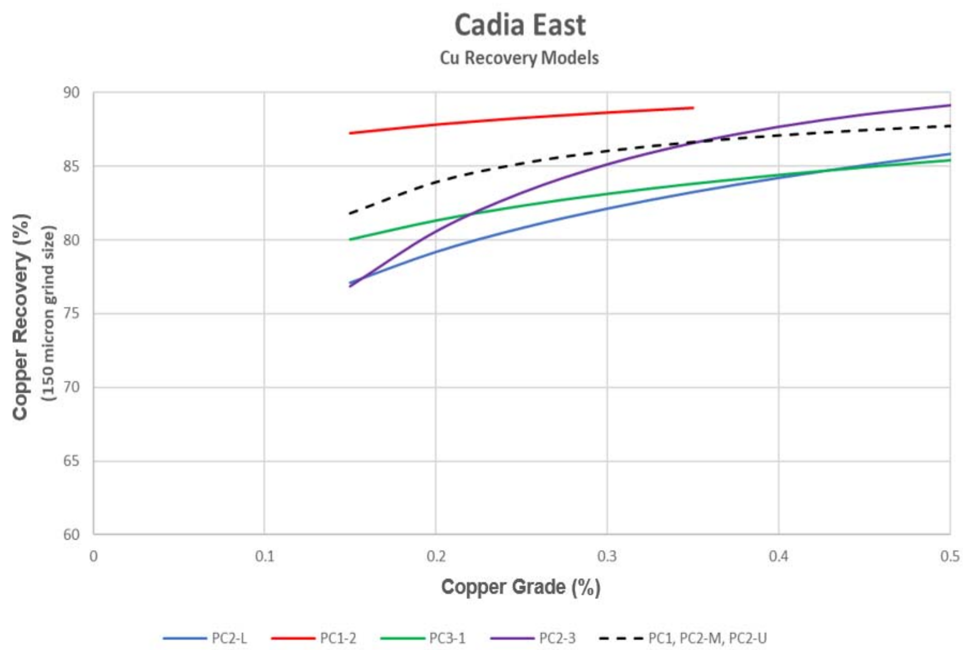
Molybdenum recovery is driven by molybdenite morphology, which is related to increases in head grade. Molybdenite flotation response is observed to have data inflection points at head grades of 70 and 300 ppm in feed.

Three models were developed based on these inflection points for molybdenum recovery to copper concentrate:

- Mo in feed >70 ppm, recovery (%) = 56.40 + 5.811 x Ln (Mo in ppm);
- Mo in feed ≤70 ppm, recovery (%) = 21.047 + 13.788 x Ln (Mo in ppm);
- Mo in feed >300 ppm, recovery (%) = 89.5.

An optimisation testwork program, including both locked cycle tests and piloting was conducted to evaluate whether a saleable molybdenum concentrate could be produced from copper concentrate. The outcomes of this testwork included:

Figure 13-2: Cadia East Future and Current Copper Recovery Predictions



Note: Figure prepared by Newcrest, 2020.

- High concentrate grades of >52% Mo were achieved at high recoveries up to 96% Mo recovery;
- The use of diesel as a molybdenum collector was required to give high molybdenum recoveries;
- The inclusion of a Jameson cell in the roughing duty, followed by mechanical rougher scavenger cells, enabled higher concentrate grades in pilot plant test work. A Jameson cell has been included in the plant flowsheet;
- Regrinding was shown to be beneficial for both grade and recovery.

The gold and copper recovery equations are based on standardised laboratory results. For final anticipated recovery performance, a number of modifying factors are applied in order to account for plant performance. These modifying factors take the form of an adjustment of +2–3% for the current concentrators and +1–3% for proposed Cadia debottlenecking configurations.

Gold recovery improvements resulting from the plant debottlenecking are expected to realise LOM gold recovery rates of approximately 80%, copper recovery rates of approximately 85% and molybdenum recovery rates (relative to plant feed) of approximately 72%.

13.3.2 Ridgeway

The overall copper recovery algorithm for Ridgeway Deeps mineralisation is:

- Copper recovery (%) = 83.5447 + 8.2837 * Copper head grade (%Cu) + 1.5007 * Cu:S ratio in feed.

The overall gold recovery model for Ridgeway Deeps ore is:

- Gold recovery (%) = 4.0445 x Gold head grade (g/t) + 77.406.

Gold recovery forecasts for the overall LOM are 81% for gold, and 87% for copper.

13.3.3 Cadia Extended

The average mineral assemblage recoveries for Cadia Hill developed during the Cadia Hill feasibility study are summarised in Table 13-5. These recovery models were initially applied to the Cadia Extended resource estimate for the mineralisation considered amenable to underground mining.

In 2008, the recovery assumptions for Cadia Hill were revised based on mill actual performance from July 1998 to December 2008 and on-going laboratory testwork of Cadia Operations materials. The revised models were tails grade models based on the dominant sulphide species present (set by Au/Cu, CuCN/S and Cu/S ratios) with maximum and minimum recovery 'bookends' applied.

From May 2008, the Cadia Extended resource estimate 'value' function was assigned using the Ridgeway metallurgical recovery parameters reflecting the long-term mine schedule for Cadia Operations where a Cadia Extended underground mine would supply a high-grade plant, rather than the low-grade facility used for mineralisation amenable to open pit mining.

Upon review in 2011, the 'value' calculation for the Mineral Resource estimate for Cadia Extended was replaced with that of the Cadia East value calculation as the long-term grade profile for Cadia Extended is similar to Cadia East (0.3–0.4 g/t Au). The Cadia East value calculations at the time were those of the Cadia East 2010 Feasibility Study and are still currently applied during Mineral Resource estimation for Cadia Extended.

The recovery functions were:

- Cu recovery (%) = (Cu feed (%) – (0.067 x Cu feed (%) + 0.0127)) ÷ Cu feed (%) x 100 – 3
- Au recovery (%) <0.6 g/t Au feed = Au feed (g/t) – (0.1294 x Au feed (g/t) + 0.0541 ÷ Au feed (g/t) x 100 – 3.
- Au recovery (%) >0.6 g/t Au feed = Au feed (g/t) – (0.091 x Au feed (g/t) + 0.083 ÷ Au feed (g/t) x 100 – 2.

These recovery functions are consistent with the recoveries noted during the 2003–2004 processing of the Cadia Extended open pit ore and provide an adjustment for feed grade.

13.3.4 Big Cadia

Recommended metallurgical recovery values for the purposes of Mineral Resource estimation were derived from the 1982 testwork program (Table 13-6).

Table 13-5: Cadia Hill Flotation Recovery Characteristics

Mineralisation Type	Percentage (%)	Copper Concentrate Grade (%)	Overall Float Recovery (%)	
			Gold	Copper
Bornite	3%	34	64.1	79.4
Pyrite/Chalcopyrite	59%	25	77.3	84.0
Chalcopyrite/Pyrite	21%	25	75.1	89.1
Chalcopyrite/Bornite	11%	32	57.4	77.0
Pyrite/Bornite	6%	25	61.5	78.4

Table 13-6: Big Cadia Forecast Metallurgical Recovery Parameters

	Unit	Grade	Fresh Rock Recovery (%)			Slightly Weathered Rock Recovery (%)			Moderately Weathered Rock Recovery (%)		
			Cu	Au	Ag	Cu	Au	Ag	Cu	Au	Ag
Metallurgical recovery	Andesite	>0.5% Cu	90	70	70	85	65	65	40	60	40
		<0.5% Cu	85	60	60	80	55	55	35	50	35
	Magnetite	>0.5% Cu	85	60	50	80	50	65			
		<0.5% Cu	80	55	45	75	45	30			

13.4 Metallurgical Variability

Samples selected for metallurgical testing during feasibility and development studies for Cadia East and Ridgeway were representative of the various styles of mineralisation within the different deposits. Samples were selected from a range of locations within the deposits. Sufficient samples were taken, and tests were performed using sufficient sample mass for the respective tests undertaken.

Variability assessments are supported by mill production and extensive underground exposures.

Cadia East and Ridgeway are “well-behaved” porphyry copper deposits where the mineralogical drivers of metallurgical performance are well understood, risks have been recognised and appropriate industry standard mitigating actions are identified.

There is limited variability testwork completed specifically for Cadia Extended. Available data should be reviewed for spatial representivity prior to any mining operations that include this mineralization.

The Big Cadia mineralization is atypical of mineralization from the remainder of the Cadia deposits, as much of the material is strongly to weakly weathered with a leached and enriched profile resulting in common secondary copper minerals especially chalcocite and pseudo-malachite. Additional testwork will be required to fully establish the metallurgical variability across the deposit.

13.5 Deleterious Elements

13.5.1 Cadia East

Fluorine is the only known deleterious element identified.

A campaign of fluorine assaying on existing pulp samples took place between October and November 2009, and the additional fluorine data allowed estimation of a fluorine model using ordinary kriging (OK). This model has been used to improve understanding of fluorine distribution to assist with mine planning. Based on this work, the average fluorine head grade in the mill feed material is predicted to be 1,500 ppm F, and in the range of 1,200–1,900 ppm F over the LOM. The majority of fluorine is present as fluorite (about 50%) and as biotite-dominant and sericite micas (also about 50%). Minor amounts are present as fluoro-apatite, tourmaline and other minerals. The relationship between copper concentrate quality and deleterious fluorine is dependent on the type and quantity of fluorine bearing minerals.

Fluorine-bearing minerals may end up in the concentrate through either of two processes:

- Fluorine minerals attached to, or locked within, sulphide or other floating minerals, and recovered into concentrate;
- Fluorine minerals recovered into concentrate by entrainment, physically “dragged” in to concentrate by high mass recovery and poor froth washing.

Jameson cells were installed in the plant to remove fluorine from the concentrate. The first Jameson cell was installed in Concentrator 1 in 2013, followed by Concentrator 2 in 2016. In 2017, two additional Jameson cells were installed into Concentrator 1. Since 2017, all material within the plant has been processed through a Jameson cell, giving maximum fluorine rejection, particularly of the entrained fluorine-bearing minerals, and therefore unlikely that fluorine levels in copper concentrate will exceed the maximum contractual limits over the LOM.

13.5.2 Ridgeway

During its operating history, Ridgeway produced a high-quality copper concentrate with high gold grades, payable silver credits and relatively low levels of impurities that did not attract a penalty from smelters.

There are expected to be no deleterious elements in any Ridgeway Lift 2 concentrates. This forecast is supported by resource analyses that do not indicate any change in geochemistry which is likely to impact on concentrate sales for the Ridgeway Lift 2 material.

13.5.3 Cadia Extended

No formal deleterious element assessment has been undertaken for the Cadia Extended mineralization.

13.5.4 Big Cadia

No formal deleterious element assessment has been undertaken for the Big Cadia mineralization.

13.6 QP Comments on “Item 13: Mineral Processing and Metallurgical Testwork”

The QP notes:

- The testwork undertaken is of an adequate level to ensure an appropriate representation of metallurgical characterisation and the derivation of corresponding metallurgical recovery factors for Cadia East and Ridgeway. Initial metallurgical assumptions are supported by multiple years of production data;
- More recent testwork data were used to update all areas of the Cadia East to provide a realistic representation of the performance and were incorporated into a LOM plan for 33 Mt/a;
- Four mine block-specific gold recovery models were developed for Cadia East for the purpose of forecasting the expected gold recovery on the basis of head grade. Customised models generated during pre-feasibility and feasibility studies will be applied to the specific Cadia East mine blocks the models were developed for, as a replacement for the current site model;
- Five mine block-specific copper recovery models were developed for Cadia East for the purpose of forecasting the expected copper recovery on the basis of copper head grade;
- Molybdenum recovery at Cadia East is driven by molybdenite morphology, which corresponds to increases in head grade. Molybdenum flotation response is observed to be aligned with changes in grain type and consequently, head assay with inflection points observed at 70 and 300 ppm in feed;
- Recovery improvements resulting from Cadia plant debottlenecking activities are expected to achieve LOM gold recovery rates of approximately 80% and copper recovery rates of around 85%;
- Gold and copper recoveries for Ridgeway are based on algorithms; gold recovery forecasts for the overall LOM are 81% for gold, and 87% for copper;
- Fluorine is the only known deleterious element identified in the Cadia East concentrates. Since 2017, all material within Concentrator 1 has been processed through a Jameson cell giving maximum fluorine rejection of fluorine-bearing entrained minerals, and therefore it is considered unlikely that any penalties due to excess fluorine in concentrate will be incurred at the smelter;
- The Ridgeway concentrate was historically clean, very marketable, and had high copper grades. There are expected to be no deleterious elements in future concentrates from Ridgeway Lift 2;
- Testwork results from the Big Cadia deposit indicate that there is risk associated with metallurgical performance if the material is sent to the current processing plants. Development of a Big Cadia materials process flowsheet will be required.

14 MINERAL RESOURCE ESTIMATES

14.1 Cadia East

14.1.1 Introduction

The database close-out date for estimation purposes was 21 June, 2016.

14.1.2 Modelling Approach

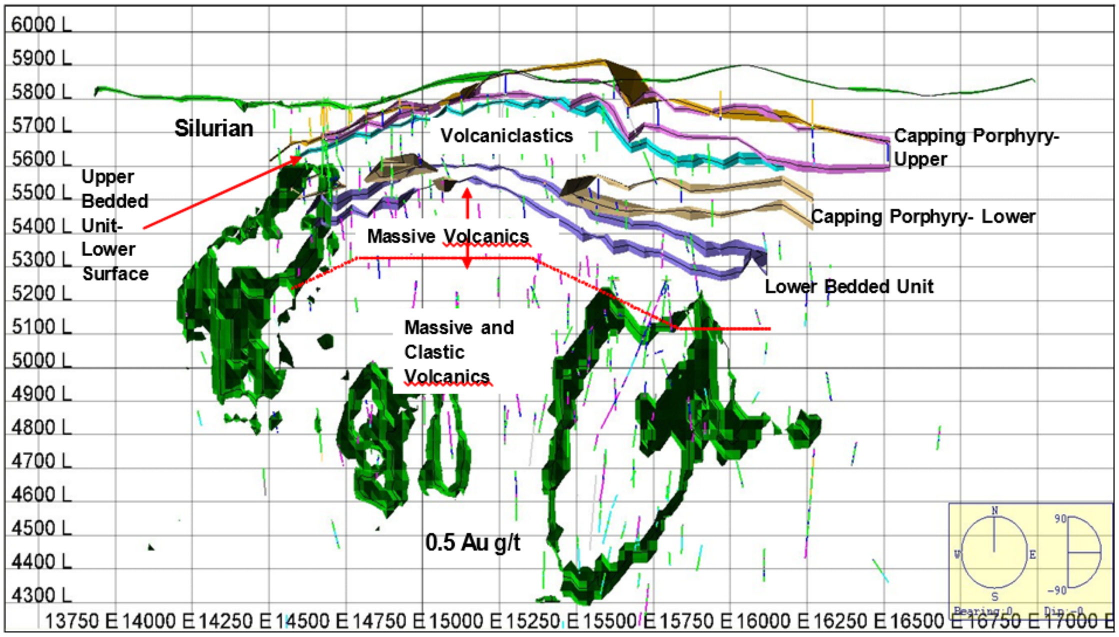
The block modelling process used to generate the Cadia East model consisted of:

- Create block model via block construction file (.bdf) in Vulcan software;
  - Define model extents, block size, variables;
  - Domain flagging via wireframes (rock type, structures and a 0.1% Cu grade shell);
  - Block construction file (bcf) scripts used to flag estimation domains and density;
- 10 m composited databases for each element generated in Vulcan;
  - Validate assay data (overlapping intervals, downhole surveys etc.);
  - Recode below detection limit values and unsampled intervals;
  - Domain fields are flagged within the composite file from the block model;
  - Export flagged composited datasets from Vulcan for upload into Snowden Supervisor software;
  - Export as *.csv files from Isatis software;
- Exploratory data analysis and variogram modelling completed in Snowden Supervisor;
- Cell declustering, domain testing, swath plots and grade estimation completed in Vulcan;
- Estimation completed in Vulcan;
- Block model validation completed in Vulcan and Isatis;
- Direct block simulation of PC1 (Isatis);
- Swath plots (Vulcan).

In 2016, a major re-interpretation of the Cadia East grade estimation domains was completed. Grade shells were constructed using a 0.1% Cu threshold.

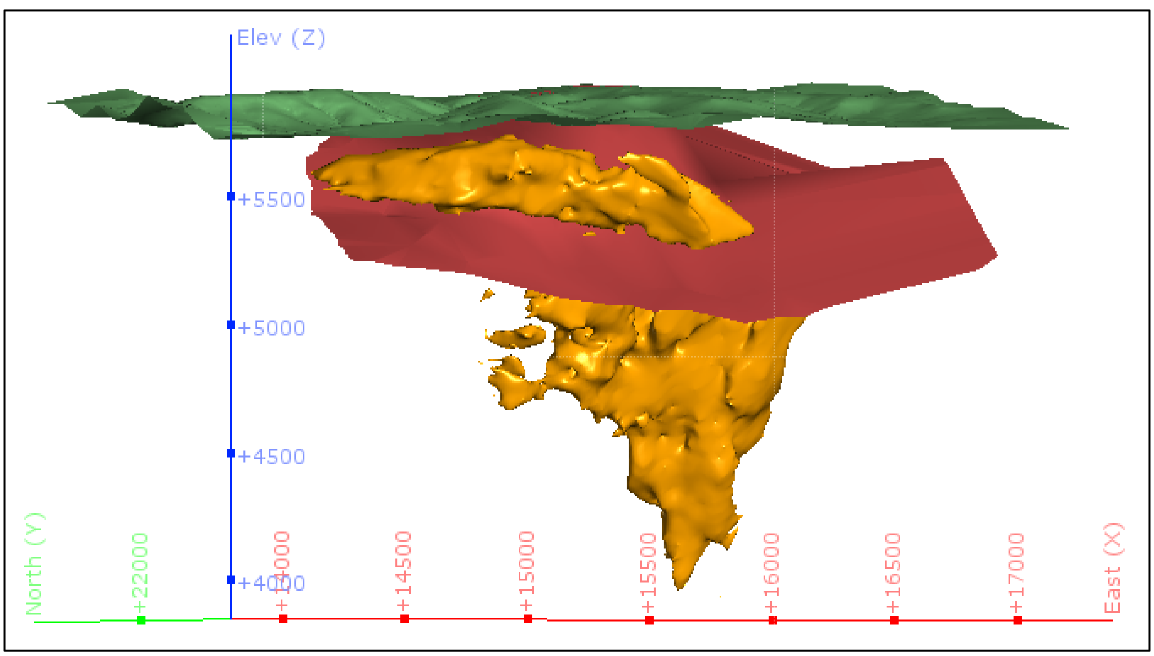
The resource model is also based on an updated structural model and a new lithological model that uses multi-element geochemistry. A long-section showing the interpolated geological domains is provided in Figure 14-1. An example mineralisation cross-section is included as Figure 14-2. A total of seven domains were constructed (Table 14-1).

Figure 14-1: Long Section at 21850N



Note: Figure prepared by Newcrest, 2016.

Figure 14-2: Mineralisation Cross-Section (



Note: Figure prepared by Newcrest, 2016. Orange = 0.4% Cu grade shell, green = topographic surface; brown = 5280 thrust fault/SF3_Lower_Porp surface.

Table 14-1: Domains Used in Estimation

Domain	Description
100	Above 5250 thrust and West of Ca-La North
200	Above 5250 thrust. East of Ca-La North and West of the Ca-La Central
300	Above 5250 thrust and East of Ca-La Central
400	Below 5250 thrust and West of Ca-La North
500	Below 5250 thrust. East of Ca-La North and West of the Ca-La Central
600	Below 5250 thrust and East of Ca-La Central
700	Silurian sediments – not estimated

Fluorine domains are different to the other estimated elements, and include the combined basalt lithology, which was identified and constructed from multi-element geochemistry, the SF3_Lower_Porp surface, and the Ca-La North fault.

14.1.3 Exploratory Data Analysis

Histograms of all elements were prepared by domain to ensure that domains were valid.

Leapfrog software was used to evaluate contacts between domains where composite co-ordinates were defined as inside or outside domain wireframes/'interpolant' surfaces and the orthogonal distance from the interpolant shell calculated. Based on the histogram data and correlation matrices, domain contacts were assigned as hard or soft boundaries.

14.1.4 Composites

Sample intervals were not uniformly assayed for all elements, and as a result, multiple composite files were generated for gold, copper, silver, fluorine and sulphur. Due to the large-scale bulk mining method in use at Cadia East, composites were generated prior to flagging with wireframes; i.e. composites are not constrained by wireframes.

The majority of silver and fluorine assays are 10 m composite intervals which overlap the smaller (typically 2 m) gold and copper sample intervals so 10 m composites were used for all elements.

Missing assay values were set to -9007 and ignored during compositing.

Cell and OK declustering were conducted in Vulcan. All elements (gold, copper, silver, molybdenum, sulphur and fluorine) were analysed by domain to determine the appropriate the cell size. The cell size for the declustering was nominally selected as two to three times the average composite spacing.

14.1.5 Grade Capping/Outlier Restrictions

Metal contained in the top 1% and 5% of composites was assessed to determine if top-cuts were required. No top-cuts were applied for any element.

14.1.6 Density (Specific Gravity) Assignment

Intervals for density determination are selected according to lithology/ alteration/mineralisation. Density is assigned in sequence to the resource model by lithology and gold grade (Table 14-2 and Table 14-3).

The block model was used to flag composite files which included lithology, structural domains, estimation domains and the 0.1% Cu grade shell. Composite intervals did not include missing data or non-sampled intervals.

14.1.7 Variography

Variography was completed using Snowden Supervisor software. In 2015 an external review of the 2012 resource model suggested that a Gaussian semi-variogram could be more accurate than the pairwise semi-variogram used in the 2012 model. Both methods were tested using the cross-validation technique, in which the original intervals of drill holes are back estimated and compared to the original assay for accuracy. This validation process indicated that the pairwise semi-variogram overall had less error and was therefore used in the current estimate.

Variograms were generated in the horizontal plane, across strike and in the plane of maximum continuity. The nugget component was derived from downhole variograms using a lag spacing of 10 m. Pairwise experimental variograms were generated for each estimation domain and as a form of validation, Gaussian variograms were generated to confirm continuity directions.

Review indicated that directions of continuity for gold and copper derived from the fitted variogram models were consistent with the geological understanding of mineralisation in addition to 3D interpretations.

14.1.8 Estimation/Interpolation Methods

Quantitative kriging neighbourhood assessments (QKNA) focused on the minimum and maximum number of samples and search distances to be used in the block estimate that would optimise the sum of negative weights generated, followed by the quality parameters e.g. slope of regression and kriging efficiency. Based on the review of these QKNA parameters, and visual examination of the resulting grade estimation, the final search parameters used were compiled. A discretisation size of 4 x 4 x 4 was used for all estimates.

The model was constructed from 20 x 20 x 20 m cells, with no sub-celling. Estimation was undertaken using OK. Minor elements estimated in addition to gold and copper were silver, molybdenum, fluorine and sulphur.

14.1.9 Block Model Validation

The 2016 Cadia East resource model was validated using a number of methods.

The bulk domain estimates were checked visually by viewing the estimates and sample grades in 3D and in 2D sections. In all cases, the estimates were seen to be satisfactorily honouring the data.

Table 14-2: Cadia East Density Assignments by Lithology

Lithology	Mean Bulk Density
Silurian	2.16
Upper Volcanics	2.75
Lower Volcanics	2.78
Monzonite	2.71

Table 14-3: Cadia East Density Assignments by Gold Grade

Grade Bin	Mean Bulk Density
Gold > 2.5	2.71
0.5 > Gold < 2.5	2.74
Gold < 0.5	2.77

A mean grade comparison was conducted between the OK estimates and the kriging and cell declustered composite means. A statistical validation, consisting of ensuring that the OK estimates (at 0 g/t cut-off) were not significantly different to or higher than the kriging and cell declustered composite means, was completed.

Swath plots were generated in Vulcan to display grade trends. The current mining blocks of PC1, PC2 and a conceptual PC3 were analysed to determine if there was any change from the current resource estimate to the previous resource estimate in an RL direction.

A direct block simulation (DBSIM) study was undertaken for PC1 to evaluate gold and copper grade variability within the resource model performance in the context of the expected range of outcomes in terms of the inherent variability, and mill performance.

14.1.10 Classification of Mineral Resources

There are no Measured or Inferred Mineral Resources estimated at Cadia East. All Mineral Resources are classified as Indicated Mineral Resources. The Indicated classification extends to the 3800 RL.

Classification of the resource model was based on drill hole density, grade and geological continuity using the average weighted distance to data in conjunction with the gold slope of regression. Blocks that had an average weighted distance of <120 m and/or a gold slope of regression of >0.75 were classified as Indicated Mineral Resources. This represents the delineation between the estimate including sufficient data to verify, and a limited data set where confidence is reduced.

In locations where the slope of regression criteria were fulfilled, but the average distance exceeded 120 m, blocks were removed from the Indicated classification.

14.1.11 Reasonable Prospects for Eventual Economic Extraction

Metal price assumptions used in Mineral Resource estimation are summarised in Table 14-4.

Table 14-4: Metal Price and Exchange Rate Assumptions

Metal Price Assumptions	Units	Value
Gold price	US$/oz	1,300
Copper price	US$/lb	3.40
Exchange rate	US$:A$	0.80

The Cadia East Mineral Resource estimate was reported within an outline determined by net smelter return (NSR) cut-offs for each block in the resource model. The NSR was the estimated proceeds from the sale of mineral products after the application of metal recoveries and deduction of transport, smelting, refining and marketing charges, as well as royalty payments.

The NSR calculation does not include any site costs and its application within the resource estimate is used to determine an outline consistent with the cost structure of the proposed panel caving underground mining method.

The reporting shell (potentially economic outline) was expanded (in places) to fully encompass the panel cave footprints.

Using the reported resource metal price assumptions and costs aligned to the current and future expected recoveries and costs, the classification of material at Cadia East was constrained within an A$18.71 NSR cut-off, and was considered to be the boundary at which the material had reasonable prospects for eventual economic extraction. Input values to the NSR are provided in Table 14-5.

Metal price assumptions were US$1,300/oz for Au and US$3.40/lb for Cu. The exchange rate was assumed to be A$1 = US$0.80.

14.2 Ridgeway

14.2.1 Introduction

The database close-out date for estimation purposes was 31 March, 2009.

The model was estimated using Datamine software. Modelling used a block size of 25 x 25 x 25 m with subcelling to 5 x 5 x 5 m.

14.2.2 Modelling Approach

The geological inputs for the Ridgeway resource model were constructed by incorporating all available drill holes (surface and underground) and data collected from the underground mining levels.

The geological interpretation was undertaken in four steps:

- Plan interpretation of lithology and structure;
- Plan interpretation of quartz veining;
- Three-dimensional (on-screen) interpretation of sulphide species;
- Three-dimensional (on-screen) interpretation of grade.

Table 14-5: NSR Inputs

Activity	Units	Value
Mine operating cost	A$/t	5.31
Mine sustaining capital cost	A$	0.79
Ore treatment operating cost	A$	8.30
Ore treatment sustaining capital cost	A$	0.89
Tailings dams sustaining capital cost	A$	0.75
General & administration cost	A$	2.67
Total Cost Applied	***A$***	***18.71***

The interpretations were conducted on mining level plans between 5330RL and 4980RL. Level plans were generated in MapInfo and included all "backs" mapping and drill hole data. Major structures and lithologies were interpreted and then digitised for loading into Datamine.

Wireframes of the major structures were generated in Datamine from three 'points' files

- Mapping points (from level plan interpretations);
- Drill hole points (from logging data and core photos);
- Interpretation points (from level plan interpretations between 5330 and 4980 RL, and extrapolations below 4980 RL).

Wireframes of the major lithologies were generated in Datamine from string files from level plan interpretations and 3D extrapolations. The wireframes were "snapped" to drill hole intersections.

Estimation domains were based on lithology and structure inside a mineralised envelope. Individual domains were created for gold, copper, sulphur and silver. Interpretation features were classified into five primary categories:

- Lithologies: Forest Reef Volcanics/Weemalla sediment contact, and monzodiorite, monzonite and pyroxene porphyries;
- Structures: major thrusts and faults, including North, Purple and Rimmers Faults;
- Grade domains;
- Quartz veining;
- Sulphide species.

These features were used to build a set of broad domains. Data were separated into six geological domains, seven structural domains, and six grade domains:

- Geology domain: monzodiorite, monzonite, internal barren monzonite, pyroxene porphyries, Forest Reef Volcanics and Weemalla sediments;
- Structural domains: north of North Fault; east of Rimmers Fault and above Purple Fault; east of Rimmers Fault and below Purple Fault; west of Rimmers Fault and below Purple Fault; west of Rimmers Fault above Purple Fault and north of Merkin

Fault; west of Rimmers Fault above Purple Fault and between Delphin and Merkin Faults; and west of Rimmers Fault above Purple Fault and south of Delphin Fault;

- Grade domains: 0.2 g/t Au, 1.0 g/t Au, 2.0 g/t Au, 4.0g /t Au, 0.2% Cu and 1.0% Cu.

The Claudia Fault shows a 150 m offset, and was interpreted to be a hard domain boundary. To accommodate the fault influence, two sub-faults were interpolated, the Deep Purple and Deep Red faults, which had the same relationships and orientations of the faults of the same names above the Claudia Fault. The Deep Red fault was not used to domain grade; however, the Deep Purple fault was a major hard boundary for both mineralisation and grade.

14.2.3 Exploratory Data Analysis

The statistical characteristics of the gold, copper and sulphur domains were reviewed in 25 m horizontal, east–west and north–south slices through the mineralised system.

14.2.4 Composites

Composite lengths of 2 m and 4 m were tested to verify the optimum length, and the 4 m length was selected to support resource estimation of gold and copper.

The global statistics and stationarity of all of the domains were assessed using Isatis software. Subsequently, some of the original domains were re-combined due to similar geostatistical characteristics and some were discarded.

The quartz veining and sulphide species domains, and the majority of the grade domains were not used. However, the 0.2 g/t Au and 0.2% Cu domains were retained as they separate background metal values from the Ridgeway mineralisation. The resulting domains were a combination of the geological and structural domains within a 0.2 g/t Au and/or 0.2% Cu grade domain.

14.2.5 Density (Specific Gravity) Assignment

Density is assigned by domain as shown in Table 14-6.

14.2.6 Grade Capping/Outlier Restrictions

No grade caps were applied during estimation.

14.2.7 Variography

Variograms were modelled for gold, copper, silver and sulphur within each estimation domain. All models are spherical, typically with two structures, and were developed over raw experimental variograms.

The main orientation of the Ridgeway mineralisation is west–northwest to east–southeast, dipping sub-vertically. This is the plane of maximum continuity.

Drilling at Ridgeway is predominantly from south to north at various dips. Downhole variograms orientated in this direction (with tolerances ± slicing width applied) were generated to provide information on the nugget and short-range structures, and in the wider domains to provide insight into longer-range structures.

Table 14-6: Ridgeway Density Values for Grade Domains Applied to the Resource Model

Density Domains	Description of Domain	Assigned Density (t/m^3)
Au Dom1, StDom2	Monzonite below Purple Fault	2.78
Au Dom1, StDom4	Monzonite west of Rimmers Fault	2.81
Au Dom1-2, StDom3	Monzonite and Monzodiorite east of Rimmers Fault	2.81
Au Dom1-5, StDom1	All lithologies north of North Fault	2.84
Au Dom2, StDom4	Monzodiorite west of Rimmers Fault	2.85
Au Dom3, StDom2	Barren Monzonite below Purple Fault	2.76
Au Dom4	Weemalla Sediments	2.80
Au Dom5	Forest Reef Volcanics	2.85
Au Dom0	Background	2.80

14.2.8 Estimation/Interpolation Methods

Estimation parameters for the Ridgeway resource model were optimised using QKNA. This process involved estimating individual blocks using OK to test the slope of regression between the true and estimated grade, estimate value, variance and percentage of negative kriging weights.

Each block was simple kriged to record the weight-of-the-mean, which was used as an indicator of estimation quality. Blocks on the margins of domains, in the centre of domains, of higher than average grade, average grade and lower than average grade were tested.

The results of analysis indicate that the estimation parameters are not sensitive to changes in search neighbourhood. The most sensitive estimation parameter was found to be the number of samples used to estimate each block.

The following estimation parameters were used for the Ridgeway Mineral Resource estimate:

- Block size of 25 m (E) x 25 m (N) x 25 m (elevation);
- Minimum of eight samples and maximum of 48 samples;
- OK interpolation.

14.2.9 Block Model Validation

The Ridgeway models were validated by:

- Filtering the models and checking for any un-estimated blocks;
- Comparing the global statistics of each domain and variable with the corresponding block estimates;
- Comparing the composite and block grades in slices throughout the deposit;
- Locally comparing drill holes and estimated blocks in cross-section and plan;

- Comparing the models to the previous estimate by area and level.

No material issues or biases were identified. In general, the global comparisons between composite and block grades were within 5% for most domains and variables.

14.2.10 Classification of Mineral Resources

The Ridgeway resource classification was reviewed with relation to sample density, hole spacing, survey method, geological interpretation and confidence in the geological model (especially fault projection) and geologically through slope of regression. Mineral Resources were classified within a 0.2 g/t Au grade shell based on the following assumptions (Table 14-7):

- Indicated Mineral Resources: an average weighted sample distance of <60 m;
- Inferred Mineral Resources: an average weighted sample distance of 60–100 m.

14.2.11 Reasonable Prospects for Eventual Economic Extraction

The estimate was reported assuming an underground mass mining method, likely block/panel caving. There was an assumption of a change in the mining method at 5040m RL, from sub-level caving to block caving.

The conceptual cave was constructed by assigning an NSR value to all blocks in the resource block model, determining a cave footprint string, and projecting directly to the top of the cave column. The cave was not allowed to expand beyond the extraction level footprint but could be reduced in diameter as a draw bell can be shut-off at cut-off grade before the entire column was extracted. Column heights ranged from 150–400 m with minimum diameters of 120 m.

Metallurgical formulae were used on the Ridgeway grade model to estimate recoverable metal, regardless of sulphide species as input to the estimated block value. The formulae estimate the metal deportment to gravity, tail and concentrate (refer to discussion in Section 13.3.2). The recoveries were grind-size dependent.

There was no direct input of geotechnical parameters to the resource model.

Mineral Resources were reported inclusive of internal zones of non-mineralised diluting material. These zones can include low-grade-barren monzonite zones and late stage pyroxene porphyry dykes.

Mineral Resources were reported using an A$18.71/t NSR cut-off, based on the following input parameters: copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t. These inputs are based on Cadia East as an analogue.

Table 14-7: Mineral Resource Confidence Classification Parameters, Ridgeway

Resource Category	Area	Mineralisation Constraint
Indicated	Between 5000 and 4750 mRL and west of 11400 mE Also, below Claudia to 4475 mRL	Inside the mineralised shell (the greater of either 0.2% Cu or 0.2 g/t Au)
Inferred	Between 4750 & 4500 mRL and west of 11400 mE	Inside the mineralised shell (the greater of either 0.2% Cu or 0.2 g/t Au)
Inferred	West of 11400 mE	Inside the mineralised shell (the greater of either 0.2% Cu or 0.2 g/t Au)

14.3 Cadia Extended

14.3.1 Introduction

The database close-out date for estimation purposes was 16 April, 2015.

Modelling used a block size of 20 x 20 x 20 m with subcelling to 10 x 10 x 10 m. Estimation was conducted using Vulcan software.

14.3.2 Modelling Approach

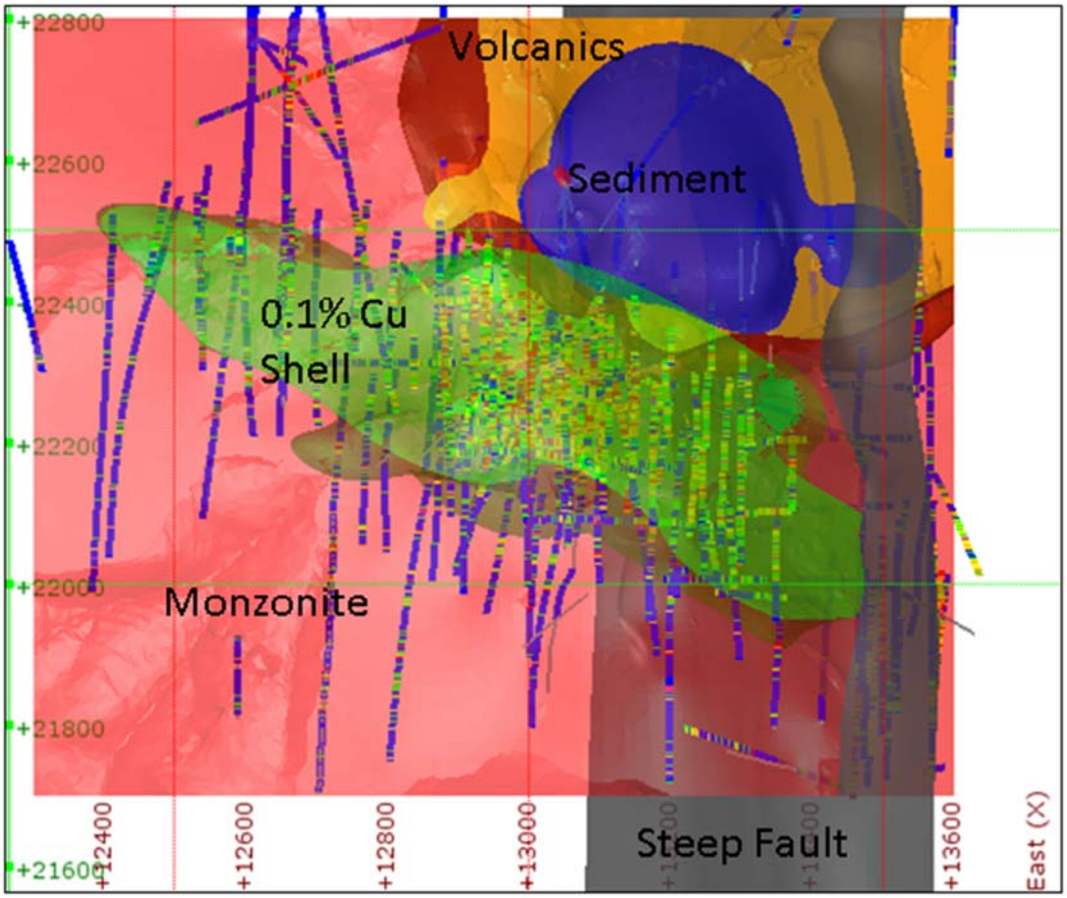
All wireframes were constructed in Leapfrog software using implicit modelling interpolations from primary logging codes extracted from the acQuire database. Models constructed included lithology (monzonite, volcanic rocks, sedimentary rocks and cover), oxidation, Steep Fault, and grade shells for gold, copper and molybdenum (Figure 14-3).

Mineralisation at Cadia Extended is elongated southeast to northwest within the monzonite unit. Attempts were made to build alteration, quartz veining and sulphide wireframes for potential use in defining the mineralisation limits. Although grade is clearly associated with quartz veining, sulphides and potassic alteration, wireframes produced did not quite emulate the grade shells. The 0.1% Cu shell proved to be the most robust in defining the limits to mineralisation. Molybdenum grades do not correlate well with gold or copper, and appear loosely related to phyllic alteration. Three individual high grades zones > 40 ppm Mo were defined in Leapfrog.

14.3.3 Exploratory Data Analysis

The statistical characteristics of the gold, copper, molybdenum, silver, and sulphur assays were reviewed. The copper grade shell boundary was treated as hard during estimation.

Figure 14-3: Cadia Extended Estimation Domains



Note: Figure prepared by Newcrest, 2015.

14.3.4 Composites

Approximately 85% of sample lengths within the 0.1% Cu shell are 2 m long, while the remaining 15 % are mostly 1 m in length. A composite length of 10 m was selected to normalise the dataset, assuming selective mining unit sizes that would support mass mining methods.

14.3.5 Density (Specific Gravity) Assignment

Density values used in estimation were discussed in Section 11.2.

14.3.6 Grade Capping/Outlier Restrictions

Top-cuts were determined by review of the histograms and percentage of metal contributed from the highest-grade samples (both raw and declustered) in each domain. Final top-cuts was based on ensuring the OK model was not exceeding the maximum theoretical metal in the NN evaluation model. Top-cuts were applied to gold, copper and molybdenum data.

14.3.7 Variography

Variograms were modelled for all domains for all elements. Directions of continuity for gold and copper derived from the fitted variogram models were consistent with the geological understanding of mineralisation in addition to 3D interpretations.

14.3.8 Estimation/Interpolation Methods

QKNA was used to establish model search parameters and maximum search distances. Although the QKNA suggested the maximum number of samples could extend up to 30 before generating negative weights, a maximum of 24 samples for gold and copper were selected to keep the estimation more local and not looking too far across the drift in the porphyry system. As only 50% of the samples were assayed for sulphur and molybdenum, the maximum number of samples for the resource estimate was lowered to 18.

OK interpolation was used for copper, gold, silver, sulphur and molybdenum. The primary model recorded estimated grade, density, estimation parameters (e.g. number of samples used, average distance of informing samples) and estimation quality parameters (e.g. kriging efficiency, slope of regression).

14.3.9 Block Model Validation

Validation was performed using a combination of the following:

- Visual inspection;
- NN block model and declustered mean analysis. Any domains where the OK model had a higher average grade than the NN model were reviewed again in detail for applied top-cuts and high yielding to ensure the OK model grades were lower than the maximum theoretical metal estimated by the NN model;
- Swath plots;
- Discrete Gaussian change of support model.

No material issues or biases were identified.

14.3.10 Classification of Mineral Resources

Mineral Resources were classified based on an extension variance examination. The extension variance was based on the normal-score back-transformed variogram model and sampling grids representing drill spacing, with a conceptual annual production volume and domain density used to calculate number of samples at each grid spacing.

Blocks that had copper estimates, within drill holes that were within a 60 m spacing were classified as Indicated. No Measured or Inferred Mineral Resources were classified.

14.3.11 Reasonable Prospects for Eventual Economic Extraction

The Mineral Resource is constrained by an outline that approximates the degree of selectivity afforded by a block cave mining method. The block cave conceptual design includes dilution, and assumes vertical side stopes between 150–400 m height, 120 m minimum diameter, (would require hydro-fracturing for cave propagation), draw scheduling limited to simple coning off top of cave, and no allowance for draw levels.

The estimate assumes an NSR cut-off of A$18.71/t. The value calculation reflects the generally low grades within the deposit, and cost assumptions benchmarked to Cadia East. Metal price assumptions were US$1,300/oz for Au and US$3.40/lb for Cu. The exchange rate for metal price conversion was assumed to be A$1 = US$0.80. Other parameters included: mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t.

14.4 Big Cadia

14.4.1 Introduction

The database close-out date for estimation purposes was 27 May, 2015.

The model was estimated using Vulcan software. Modelling used a block size of 25 x 25 x 5 m with subcelling to 6.25 x 6.25 x 2.5 m.

14.4.2 Modelling Approach

Wireframes were constructed in Leapfrog software using implicit modelling interpolations from primary logging codes extracted from the acQuire database and historical drill logs. The logging data from historical drilling were incorporated into the interpretation.

Models included lithology (limestone, monzonite, volcanic units and sedimentary units), oxidation surfaces (base of complete oxidation, and top of fresh rock), alteration (inner or massive skarn consisting of magnetite/hematite without epidote, and outer or transitional skarn consisting of magnetite/hematite with epidote), and PC40 Fault. Figure 14-4 and Figure 14-5 provide examples of the model shapes.

No specific mineralisation shells were constructed. The mineralisation is intimately related to the magnetite–epidote alteration.

14.4.3 Exploratory Data Analysis

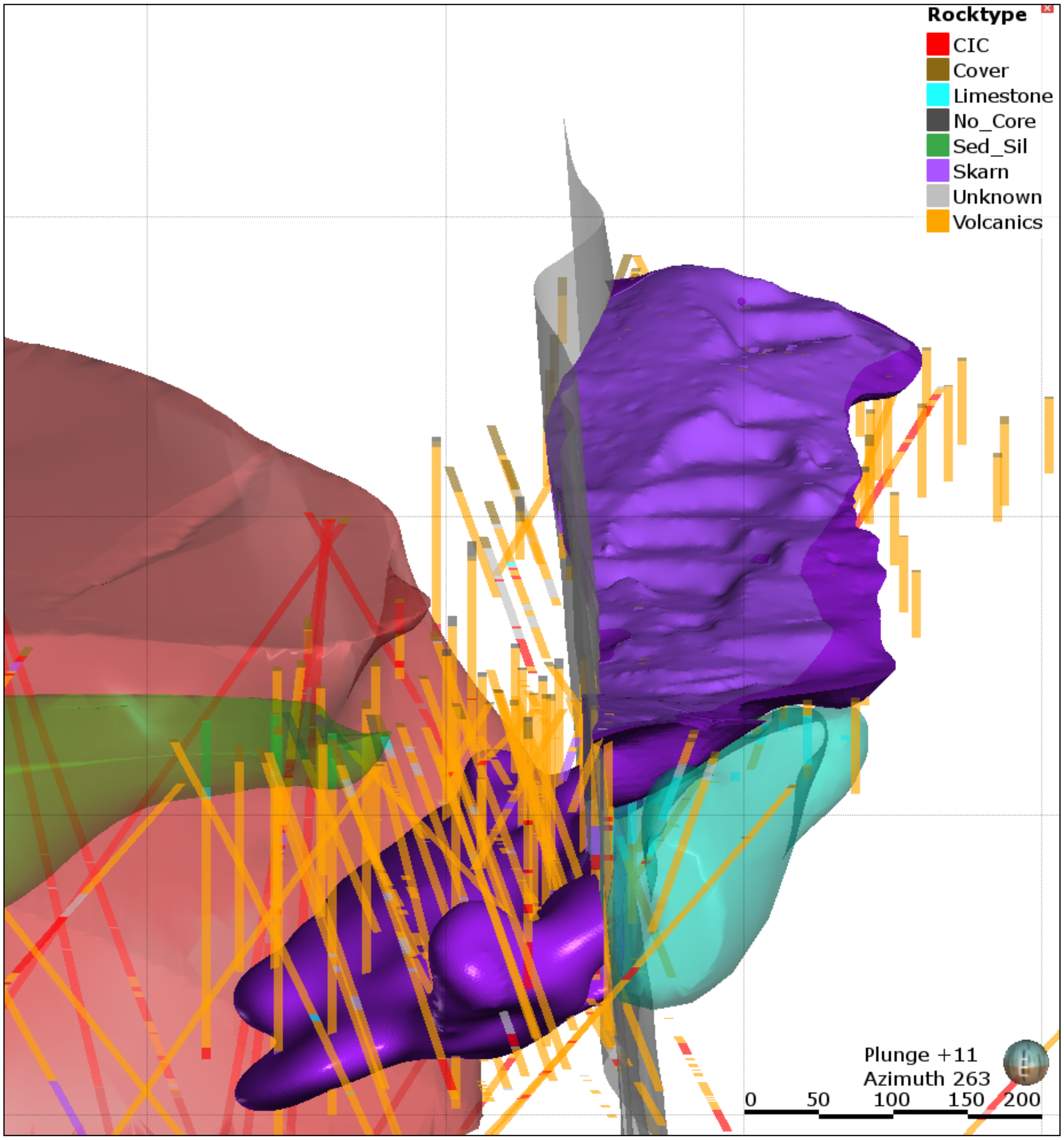
A significant portion of the dataset available for estimation at Big Cadia is legacy data. A review of these data was completed prior to the 2015 resource estimate.

Approximately 70% of the drilling is core drilling with the remaining 30% of the drilling completed using RC methods. A comparison indicated no significant bias between the different sample types.

Quantile–quantile (QQ) plots were produced comparing historical drilling and Newcrest drilling and comparing core to RC. Gold is biased towards Newcrest drilling in the upper skarn but there is no bias in the lower skarn domain. The risk of the inclusion of legacy gold samples is low, as gold appears biased towards Newcrest drilling. Copper is, however, biased towards legacy drilling in both the upper and lower skarn domains. This risk has been taken into account in the Mineral Resource classification.

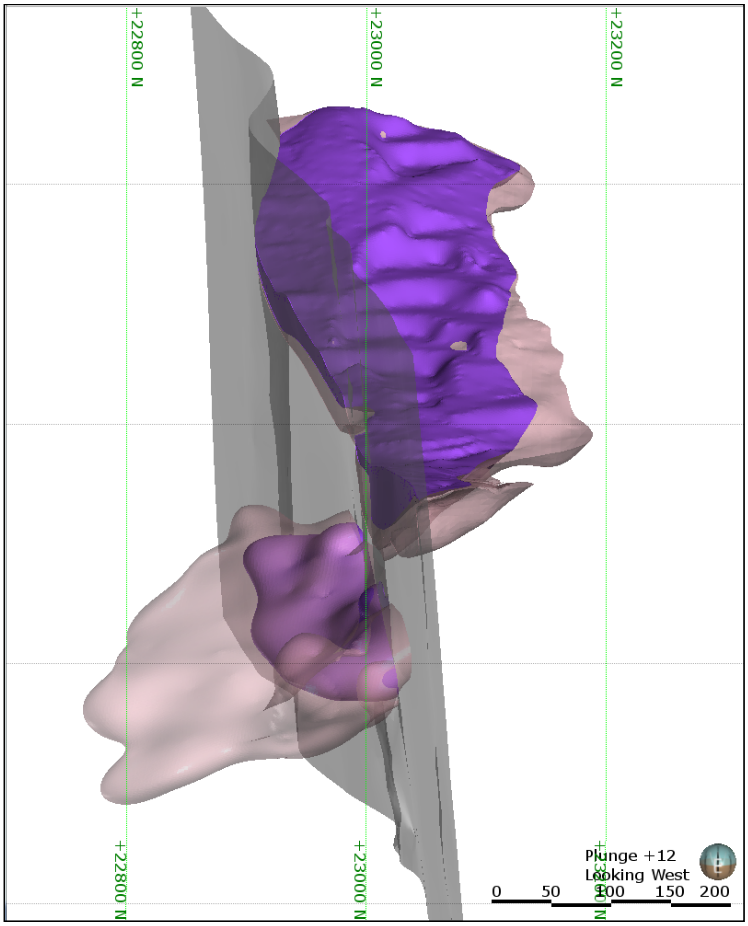
The statistical characteristics of the gold, copper, molybdenum, silver, and sulphur assays were reviewed.

Figure 14-4: Big Cadia Lithology Models



Note: Figure prepared by Newcrest, 2015.

Figure 14-5: Big Cadia Alteration and Structural Zones



Note: Figure prepared by Newcrest, 2015. Purple = Inner/massive in purple, Pink = outer/transitional in pink, grey = PC40 Fault

The contact analysis plots show gold and copper grade is highest at the transitional/massive skarn boundary, grading away from the contact on both sides. The upper and lower massive and transitional domains were combined into single upper and lower skarn domains for estimation. The transitional skarn outside boundary defines the limits to mineralisation sufficiently for gold and copper. As expected, the oxide surface is 'hard' for copper and sulphur; therefore, the upper skarn was split into oxide and transitional/fresh domains for estimation.

This resulted in three mineralisation domains being defined:

- Combined transitional and massive skarn;
- Upper skarn is above the oxide boundary;
- Lower skarn below the oxide boundary.

14.4.4 Composites

Average raw sample lengths are dominantly 1 m or 2 m intervals with some ~1.5 m (5 foot) intervals from legacy samples. Composite intervals were standardised at 4 m.

14.4.5 Density (Specific Gravity) Assignment

Density values used in estimation are discussed in Section 11.2.

14.4.6 Grade Capping/Outlier Restrictions

Top-cuts were determined by review of the histograms and percentage of declustered metal contributed from the highest-grade samples. Top-cuts were used for all estimated elements.

14.4.7 Variography

All experimental variograms were generated in Supervisor software; variograms were modelled for all domains for all elements. Directions of continuity for Au and Cu derived from the fitted variogram models were consistent with the geological understanding of mineralisation in addition to 3D interpretations.

14.4.8 Estimation/Interpolation Methods

QKNA was used to establish model search parameters and maximum search distances. A discretisation size of 4 x 4 x 4 was used for all estimates.

The grade model was estimated with OK using back-transformed normal-score variograms on 4 m composites for gold, copper, silver, molybdenum and sulphur. The estimation used the domain composites as informing samples, back-transformed normal score variogram models for composite weighting, and ellipsoidal search neighbourhoods for composite selection.

14.4.9 Block Model Validation

Model validation included:

- Visual inspection;
- Discrete Gaussian change of support model;
- Swath plots.

No material issues or biases were identified.

14.4.10 Classification of Mineral Resources

The model was reviewed for:

- Slope of regression;
- Average weighted distance from informing samples;
- Geological continuity/confidence.

The average weighted distance for the mineralised skarn domains is approximately 30 m, the slope of regression averages about 0.9 in the oxide skarn domain and around

0.7 in both the lower and upper skarn domains. Apart for a small portion of the lower skarn down dip of the last mineralised drill holes, the parameters support the classification of an Indicated Mineral Resource. The average weighted distance within the mineralised skarn domains is primarily within 70% of the variogram ranges.

However, as over 50% of the estimation samples were derived from legacy data that cannot be demonstrated to have been collected in accordance with the current Newcrest resource estimation quality assurance standards, the classification was downgraded to Inferred (refer to discussion in Section 12.3.4). The sensitivity model and QQ plots suggest a risk of copper bias towards the legacy drilling. This result is likely due to the lack of Newcrest drilling within the transitional (high copper) skarn areas rather than a true bias. Follow-up drilling within the transitional skarn zones is required to verify the copper grades in these areas to provide confidence for any future assignment of Indicated Mineral Resources.

14.4.11 Reasonable Prospects for Eventual Economic Extraction

Mineralisation crops out on surface. Conventional open pit mining methods have been assumed. The estimate is confined within a conceptual pit shell that used the following input parameters:

- Royalty: 4% of the ex-mine value less allowable deductions;
- Geotechnical slope parameters: assumed at 28º for cover material, and 45º in basement;
- Gold price: US$1,400/oz;
- Copper price: US$4.00/lb;
- Exchange rate for metal price conversion: A$1 = US$0.80;
- Mining costs: A$3.93/t mined;
- Processing costs: A$8.30/t milled;
- G&A costs: A$2.83/t milled;
- Metallurgical recoveries as outlined in Table 13-6.

Mineral Resources are reported above a conceptual NSR value that used the following parameter inputs:

- Gold price: US$1,300/oz Au;
- Copper price: US$3.40/lb Cu;
- Exchange rate for metal price conversion: A$1 = US$0.80;
- Transport costs: US$72.95/wmt (consists of two inputs, US$35.70, and $A43.82, converted to US$);
- Royalty: 4%;
- Gold refining costs: A$6.00/oz;
- Copper refining cost: A$0.09/lb;

- Concentrate treatment cost: US$90/dmt;
- Processing cost: A$8.30/t;
- General and administrative cost: A$2.83/t;
- Metallurgical recoveries that are based on metallurgical recovery algorithms, which have maxima of 95% for gold and 91% for copper (refer to Table 13-6).

Depletion for historical mining activities was included. Historical drawings of shafts, underground drives and pit slopes were digitised, transferred to current grid references and grades re-set within the model to background values.

14.5 Stockpiles

Stockpiles generated from the mining of the former Cadia Hill open pit are estimated as Measured Mineral Resources using the cost assumptions for Cadia Hill at the time the stockpile material was deposited. The estimates use data from grade control protocols during operations with the cut-off based on revenue and costs at the time of production. The grade control evaluation used a combination of blasthole sampling; gold, copper, cyanide-soluble copper and sulphur assays, domains defined by in-pit mapping of structural/thrust truncations and key lithologies, and OK interpolation.

Stockpile tonnes and grades are built up from a combination of truck and survey data, and modelled in three dimensions. No allowance for degradation in recoveries due to stockpiling is included.

14.6 Mineral Resource Statement

Mineral Resource estimates are reported with an effective date of 30 June, 2020, and are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

Mineral Resources for Cadia East are tabulated in Table 14-8. Mineral Resources for Ridgeway are provided in Table 14-9 and Table 14-10. The estimate for Cadia Extended is included in Table 14-11, and the estimate for Big Cadia in Table 14-12. Mineral Resources contained in stockpiles are tabulated in Table 14-13.

The Qualified Person for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title at Newcrest is Head of Mineral Resource Management. Mr. Gleeson is a Newcrest employee.

Table 14-8: Measured and Indicated Mineral Resource Statement, Cadia East

Resource Classification	Tonnes (Mt)	Grade				Contained Metal			
		Au (g/t)	Cu (%)	Ag (g/t)	Mo (ppm)	Au (Moz)	Cu (Mt)	Ag (Moz)	Mo (Mt)
Measured	—	—	—	—	—	—	—	—	—
Indicated	2,900	0.35	0.26	0.68	64	33	7.4	63	0.19
Total Measured and Indicated	***2,900***	***0.35***	***0.26***	***0.68***	***64***	***33***	***7.4***	***63***	***0.19***

Notes to Accompany Cadia East Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources that have been converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources that are potentially amenable to underground mass mining methods are based on the following assumptions: conceptual panel cave outline; due to the non-selective nature of this mining method, the entire volume within the outline is reported including internal dilution; metallurgical recovery assumption of 80% gold recovery; 85% copper recovery; estimate reported within a net smelter return (NSR) constraint of A$18.71/t that includes mine operating cost of A$5.31/t, mine sustaining capital cost of A$0.79/t, mineralisation treatment operating cost of A$8.30/t, mineralisation treatment sustaining capital cost of A$0.89/t, tailings dams sustaining capital cost of A$0.75/t, and general and administration (G&A) cost of A$2.67/t. Commodity price assumptions are US$1,300/oz gold, US$3.40/lb copper, US$21/oz silver and US$10/lb molybdenum, and exchange rate for metal price conversion of A$:US$ 1:0.80.
4. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper and molybdenum tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 14-9: Measured and Indicated Mineral Resource Statement, Ridgeway

Resource Classification	Tonnes (Mt)	Grade			Contained Metal		
		Au (g/t)	Cu (%)	Ag (g/t)	Au (Moz)	Cu (Mt)	Ag (Moz)
Measured	—	—	—	—	—	—	—
Indicated	110	0.57	0.30	0.74	1.9	0.31	2.5
Total Measured and Indicated	***110***	***0.57***	***0.30***	***0.74***	***1.9***	***0.31***	***2.5***

Table 14-10: Inferred Mineral Resource Statement, Ridgeway

Resource Classification	Tonnes (Mt)	Grade			Contained Metal		
		Au (g/t)	Cu (%)	Ag (g/t)	Au (Moz)	Cu (Mt)	Ag (Moz)
Inferred	41	0.38	0.40	0.43	0.50	0.17	0.56

Notes to Accompany Ridgeway Mineral Resource Tables:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources that have been converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources that are potentially amenable to underground mass mining methods are reported using the following assumptions: an A$18.71/t net smelter return (NSR) cut-off; copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t.
4. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 14-11: Measured and Indicated Mineral Resource Statement, Cadia Extended

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Measured	—	—	—	—	—
Indicated	80	0.35	0.19	0.89	0.15
Total Measured and Indicated	***80***	***0.35***	***0.19***	***0.89***	***0.15***

Notes to Accompany Cadia Extended Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources that are potentially amenable to underground mass mining methods are reported using the following assumptions: an A$18.71/t net smelter return (NSR) cut-off; copper price of US$3.40/lb, gold price of US$1,300/oz, exchange rate for metal price conversion of A$:US$ 1:0.80; mine operating cost of A$5.31/t; mine sustaining capital cost of A$0.79/t; mineralisation treatment operating cost of A$8.30/t; mineralisation treatment sustaining capital cost of A$0.89/t; tailings dams sustaining capital cost of A$0.75/t; and G&A cost of A$2.67/t.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 14-12: Inferred Mineral Resource Statement, Big Cadia

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Inferred	11	0.70	0.52	0.25	0.058

Notes to Accompany Big Cadia Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources that are potentially amenable to open pit mining methods are reported using the following assumptions: gold price: US$1,300/oz Au; copper price: US$3.40/lb Cu; exchange rate for metal price conversion of A$1 = US$0.80; transport costs: US$72.95/wmt (consists of two inputs, US$35.70, and $A43.82, converted to US$); royalty: 4%; gold refining costs: A$6.00/oz; copper refining cost: A$0.09/lb; concentrate treatment cost: US$90/dmt; processing cost: A$8.30/t; general and administrative cost: A$2.83/t; metallurgical recoveries that are based on metallurgical recovery algorithms.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Table 14-13: Measured and Indicated Mineral Resource Statement, Cadia Stockpiles

Resource Classification	Tonnes (Mt)	Grade		Contained Metal	
		Au (g/t)	Cu (%)	Au (Moz)	Cu (Mt)
Measured	32	0.30	0.13	0.31	0.041
Indicated	—	—	—	—	—
Total Measured and Indicated	***32***	***0.30***	***0.13***	***0.31***	***0.041***

Notes to Accompany Cadia Stockpiles Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, Head of Mineral Resource Management, a Newcrest employee.
2. Mineral Resources within stockpiles are reported using the following assumptions: copper price of US$3.40/lb, gold price of US$1,300/oz; exchange rate for metal price conversion of A$1 = US$0.75; processing costs of A$9.94/t milled (including rehandling costs), general and administrative (G&A) costs of A$2.87/t milled, metallurgical recoveries of 81% for gold, and 87% for copper.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

14.7 Factors That May Affect the Mineral Resource Estimate

Areas of uncertainty that may materially impact the Mineral Resource estimates include:

- Changes to long-term metal price and exchange rate assumptions;
- Changes in local interpretations of mineralisation geometry, structures, and continuity of mineralised zones;
- Changes to geological and grade shape and geological and grade continuity assumptions;
- Changes to metallurgical recovery assumptions;
- Changes to the input assumptions used to derive the conceptual underground mass mining methods used to constrain the estimates;
- Changes to the to the input assumptions used in the constraining pit shell for those Mineral Resources amenable to open pit mining methods;
- Changes to the NSR cut-offs applied to the estimates;
- Variations in geotechnical (including seismicity), hydrogeological and mining assumptions;
- Forecast dilution;
- Changes to environmental, permitting and social license assumptions.

14.8 QP Comments on "Item 14: Mineral Resource Estimates"

The QP is of the opinion that Mineral Resources have been performed using industry-accepted practices and conform to the 2014 CIM Definition Standards. Mineral Resources are based on underground mass mining assumptions at Cadia East, Ridgeway, and Cadia Extended, and assume open pit methods at Big Cadia.

There are no other environmental, legal, title, taxation, socioeconomic, marketing, political or other relevant factors known to the QP that would materially affect the estimation of Mineral Resources that are not discussed in this Report.

15 MINERAL RESERVE ESTIMATES

15.1 Introduction

Mineral Reserves are reported for Cadia East and Ridgeway. The Cadia East mine is operating; Ridgeway is currently on care-and-maintenance.

Mine designs supporting the Mineral Reserves were based on the most recently approved pre-feasibility and feasibility studies, and the operating mine life-of-mine plans.

Metal price and exchange rate assumptions used in Mineral Reserve estimation are provided in Table 15-1. Cost estimates used in the preparation of the Mineral Reserves are based on the most recent studies approved by Newcrest relating to the exploitation of the two deposits. The Mineral Reserves include material that, when delivered to the mine portals, has a recovered value greater than the cost of all downstream processes, including fixed costs.

Mineral Reserves are estimated assuming bulk underground mining processes:

- Ridgeway is a block cave mine. In block caving operations, most of the drawpoints are fully constructed before caving can progress sufficiently to enable the full production rate to be achieved;
- Cadia East is a panel caving operation. Panel caving operations have large footprints and it is not necessary to develop all of the drawpoints for caving to occur. After full caving is established, the remaining drawpoints are progressively constructed and the cave is extended over the new drawpoints.

15.2 Cadia East

The planned mine layout is provided in Figure 15-1.

15.2.1 Development of Mining Case

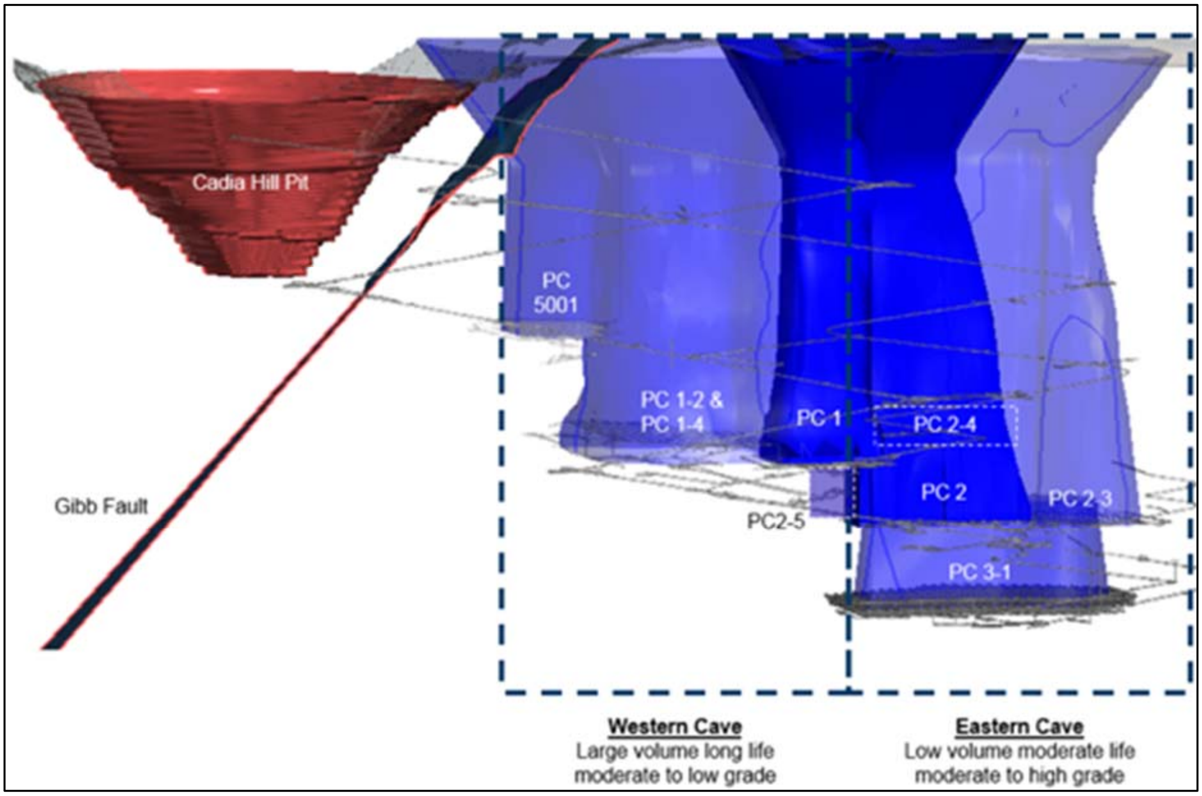
The basic methodology employed to complete mine designs included:

- Creation of drawbell footprints;
- Extraction and undercut layouts were designed and access, infrastructure and related ventilation and materials handling development were added to build total mine design;
- All design was undertaken using mine design and geotechnical parameters;
- Geotechnical modelling was undertaken on mine design to determine stability and highlight problem areas that need modification;
- Final mine design was completed using geotechnical recommendations.

Table 15-1: Metal Price and Exchange Rate Assumptions

Item	Units	Price
Gold price	US$/oz	1,200
Copper price	US$/lb	3
Silver price	US$/oz	18
Long-term exchange rate	A$:US$	0.75

Figure 15-1: Planned Mine Layout Schematic, Cadia East



Note: Figure prepared by Newcrest, 2020.

15.2.2 Ore Versus Waste Determinations

15.2.2.1 Net Smelter Return

The panel cave outline was prepared by analysing the cost of constructing and establishing drawpoints, and mining and processing ore. These cost estimates were then compared to the estimated NSR generated by mining the material from the draw-column overlying the drawpoint. NSR values are calculated on a payable metal basis taking metal prices, metallurgical recoveries, and realisation costs (transportation, smelting, royalties, etc.) into account.

Only draw-columns generating a positive NSR value (economic draw-columns) are included in the reserve, except where it is necessary to include an uneconomic draw-column to ensure a practical mining shape. Draw-column heights were limited by a shut-off NSR value of A$18.71/t.

15.2.2.2 Development Ore Selection

All development material is planned to be hauled to the surface portal dump. From the portal, dump ore is then screened and cleaned of any remnant ground support steel and then hauled to the mill for processing. Waste is hauled to the waste rock storage facility (WRSF) using surface equipment. The costs involved are:

- Site processing cost A$8.30/t;
- Surface haulage cost waste to WRSF: A$2.05/t;
- Surface haulage cost to plant (includes A$3/t for cleaning/screening): A$7.54/t.

A breakeven cut-off value has been used for ore waste delineation of A$13.34/t.

15.2.2.3 Panel Cave Ore Selection

Mining footprints were determined using a cost of A$750,000 per drawpoint, or A$1.5 million per drawbell. No other capital costs are included in the evaluations as the remaining costs are sunk as part of footprint establishment. All drawpoints with a positive net present value (NPV) are considered, with the assumption that all draw columns will be mined to a profitable height after the cost of cave establishment has been sunk.

15.2.2.4 Shut-off Values

Shut-off value inputs are provided in Table 15-2.

15.2.2.1 Dilution

Internal dilution is incorporated into the mine plan. All development has mining factors for dilution and recovery applied to accurately represent the expected mined tonnes.

Table 15-2: Reserve Shut-off Value

Activity	Units	Value
Mine operating cost	A$/t	5.31
Mine sustaining capital cost	A$/t	0.79
Ore treatment operating cost	A$/t	8.30
Ore treatment sustaining capital cost	A$/t	0.89
Tailings dams sustaining capital cost	A$/t	0.75
General & administration cost	A$/t	2.67
Total Cost Applied	***A$/t***	***18.71***

15.2.3 Metallurgical Recoveries

The following recovery ranges are anticipated over the LOM:

Gold: 70–85%;

Copper: 80–87%;

Molybdenum: 65–75%.

15.2.4 Molybdenum Plant

The Mineral Reserves estimate assumes that the molybdenum plant will commence operations during calendar year 2021. The economic analysis that supports the Mineral Reserves assigns revenue from molybdenum only after 1 July 2021. As a result, the molybdenum tonnage estimate shown in the Mineral Reserves excludes the ore that will be mined prior to the molybdenum plant start-up, as any molybdenum in that material would not be recovered under the current mine plan assumptions and would be sent to the TSF.

15.3 Ridgeway

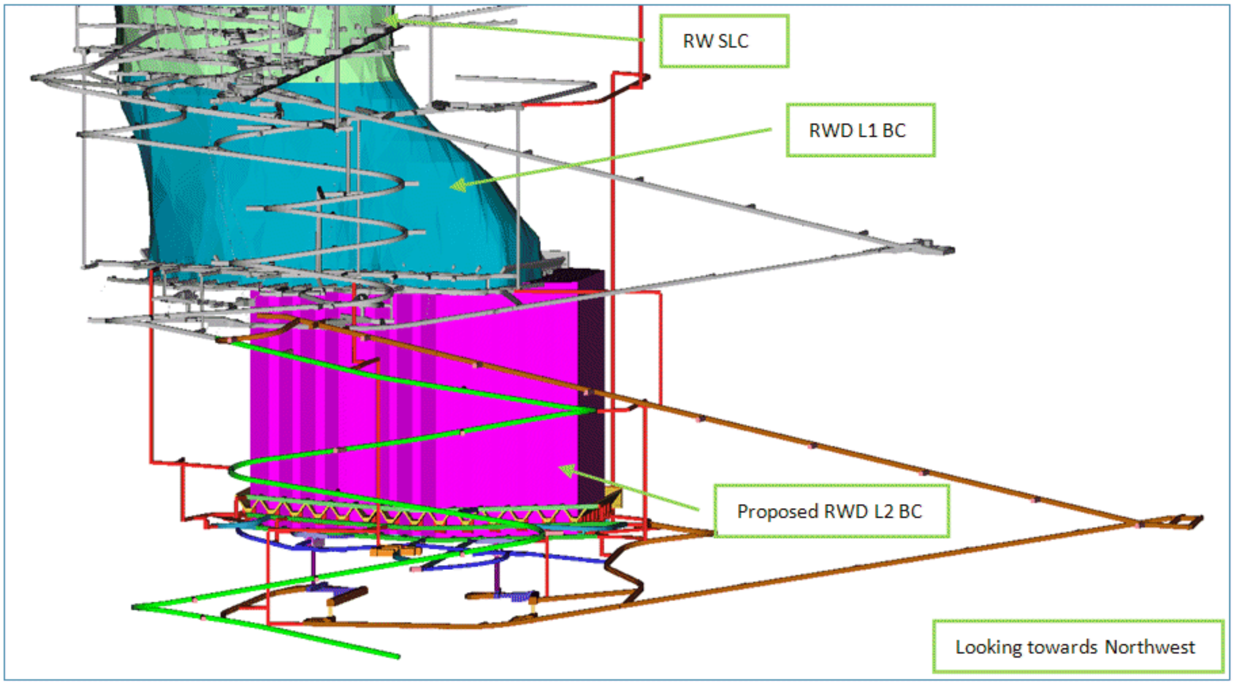
A schematic showing the relationships of the mined-out SLC and Ridgeway Deeps Lift 1 operations to the planned Ridgeway Deeps Lift 2 is provided in Figure 15-2.

Ridgeway Deeps Lift 2 is overlain by caved waste material drawn down by the previous SLC operation. Underground cave mining activities at Ridgeway Deeps Lift 1 support the appropriateness of the selected mining methods for Ridgeway Deeps Lift 2 as the basis of the estimate.

15.3.1 Development of Mining Case

Estimation of the Mineral Reserves involved standard steps of mine optimisation, mine design, production scheduling and financial modelling. Factors and assumptions were based on operating experience and performance in gained in the Cadia Operations. The basis the analysis is considered at pre-feasibility study level or higher.

Figure 15-2: Ridgeway Mine Layout Schematic



Note: Figure prepared by Newcrest, 2014.

Mine plans are based on the extraction of caving blocks solely delineated on the basis of Indicated material. Dilution is included within the Probable Mineral Reserve.

Due to the nature of block caving (where all material that caves must be included) and the placement of the footprint of the Ridgeway Deeps Lift 2 block cave underneath the Ridgeway Deeps Lift 1 block cave to take advantage of infrastructure, the material must be included within the material movement schedules and therefore where the material is above cut-off parameters it has been included in the milling schedule.

15.3.2 Metallurgical Recovery

Recovery assumptions are based on testwork completed during the Ridgeway SLC and Ridgeway Deeps Lift 1 feasibility studies. These assumptions were validated as representative by reconciliation of production to date of Ridgeway SLC and Ridgeway Deeps Lift 1 ore through the processing plant. Recoveries for gold are anticipated to range from approximately 78–82% and recoveries of copper are expected to range from approximately 85–87% through the life of the project.

Testwork analysis of resultant concentrates shows the presence of a variety of elements/minerals in the Ridgeway Deeps concentrate. None of the contaminant elements/minerals are at sufficient concentrations to classify them as deleterious elements.

Transport and refining charges were developed from first principles consistent with the application and input assumptions for these costs used by the current operation.

15.3.3 Royalties

Royalties are calculated as 4% of block revenue less all off site realisation costs (treatment and refining charges), less ore treatments costs and less one third of site general and administrative costs. The royalty payments equate to approximately 3% of total revenue on average.

15.3.4 Net Smelter Return

Estimation uses a value-based cut-off by determining the NSR value equal to the relevant site operating cost. The NSR calculation takes into account reserve revenue factors, metallurgical recovery assumptions, transport costs and refining charges and royalty charges. The site operating costs include mining cost, processing cost, relevant site general and administration costs and relevant sustaining capital costs. This cost equates to a break-even cut-off value (equivalent to a shut-off value) of approximately A$20/t milled (Table 15-3).

15.3.4.1 Development Ore Selection

All development material is planned to be hauled to the surface portal dump. From the portal, dump ore will be screened and cleaned of any remnant ground support steel and hauled to the mill for processing. Waste will be hauled to the waste dump using surface equipment.

15.3.4.2 Block Cave Ore Selection

All drawpoints with a positive net present value (NPV) are considered, with the assumption that all draw columns will be mined to a profitable height after the cost of cave establishment has been sunk.

15.3.5 Ore Versus Waste Determinations

The ore/waste determination is made within the mining software on the basis of material value using the modelled VALUE field, allowing for site operating costs. The VALUE field is calculated using a value macro run over the geological resource model essentially as an NSR-type calculation. Each mining method and/or milling scenario uses the same basis for ore selection.

The outline of economic columns based on the undercut horizon designates the footprint in conjunction with preferred geotechnical parameters required for successful caving of the lift. As such, uneconomic columns are included on the edges of the footprint and design if it is necessary, from a geotechnical perspective, to support the extraction of economic blocks inside the footprint. The outline is essentially a cost per tonne outline for the panel caving footprint using a cut-off value taking into account economic column height for each draw point.

Economic footprints were generated in runs of the “Footprint Finder” software and in level by level evaluation using the commercially-available PCBC software. The overall footprint size increases with depth, but this is due to a monzonite intrusion piercing the lower mineralisation.

Table 15-3: Ridgeway Deeps Lift 2 Cut-Off Values

Activity	Unit	Break Even NSR
Mine operating cost	A$/t mined	6.72
Mining sustaining capital cost	A$/t mined	1.02
Ore treatment operating cost	A$/t milled	8.30
Ore treatment sustaining capital cost	A$/t milled	0.89
Tailings dams sustaining capital cost	A$/t milled	0.75
General & administration cost	A$/t milled	2.67
Total Cost	***A$/t milled***	***20.35***

At depths below the 4500 mRL horizon, the economic footprints start to decrease in size with grades falling and columns dropping off (losing the benefit of the higher grades just below the Ridgeway Deeps Lift 1 block cave footprint as a result of mixing). The resultant footprint perimeter is finalised based on a layout template using a 32 x 20 m reverse offset herringbone, which essentially smooths the southern and northern perimeters into a footprint more amenable to development mining.

Dilution is simulated in the mixing algorithm used to deliver the secondary block models for each lift. A 60% dilution entry point has been assumed for the mixing algorithms. Ore recovery is assumed to be 100% of the mixed/diluted block model. Scheduling inclusive of ore dilution is estimated in the mixing and draw schedule outputs of the PCBC software.

The block height of 300 m is based on the extraction elevation of Ridgeway Deeps Lift 2 extraction level up to the extraction elevation of the Ridgeway Deeps Lift 1 block cave. The mining height (mining surface) of the Ridgeway Deeps Lift 2 block cave will depend on the economics of the draw columns and the remnant value in the cave material above as well as the influence of the hang-up surface as currently known above Ridgeway Deeps Lift 1 block cave in terms of rilling and caving extent. The hang-up surface has been interpreted for coverage over the Ridgeway Deeps Lift 2 block cave footprint ahead of any geotechnical evaluation of a resultant Ridgeway Deeps Lift 1/Ridgeway Deeps Lift 2 hang-up surface.

Higher metal prices will drive greater acceptance of diluted material as ore. The drawing of clay material is the primary issue that may result in loss of ore from the draw columns ahead of losing draw points through geotechnical and mining concerns. The early ingress of clay was noted for the Ridgeway Deeps Lift 1 block cave but as yet has not posed a significant issue with regards to ore dilution and ore recovery. Drawing of clay material will be addressed at the cessation of the care-and-maintenance phase, and the resumption of mining operations.

15.4 Mineral Reserves Statement

Mineral Reserves are reported in Table 15-4 with an effective date of 30 June, 2020. The Qualified Person for the estimate is Mr. Geoffrey Newcombe, FAusIMM, whose job title with Newcrest is PC1-2 Study Manager, and who is a Newcrest employee.

Table 15-4: Mineral Reserves Statement

Probable Mineral Reserve	Tonnage (Mt)	Grade			Contained Metal		
		Gold (g/t Au)	Copper (% Cu)	Silver (g/t Ag)	Gold (Moz)	Copper (Mt)	Silver (Moz)
Cadia East Underground	1,400	0.44	0.29	0.78	19	4.0	34
Ridgeway Underground	80	0.54	0.28	0.66	1.4	0.23	1.7
Total	***1,400***	***0.45***	***0.29***	***0.77***	***21***	***4.2***	***36***

Probable Mineral Reserve	Tonnage (Mt)	Grade Molybdenum (ppm Mo)	Contained Metal Molybdenum (Mt)
Cadia East Underground	1,300	88	0.12
Total	***1,300***	***88***	***0.12***

Notes to Accompany Mineral Reserves Table:

1. Mineral Reserves are reported with an effective date of 30 June, 2020, using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Geoffrey Newcombe, FAusIMM, whose job title with Newcrest is PC1-2 Study Manager, and who is a Newcrest employee.
2. Mineral Reserves are reported on a 100% basis.
3. Mineral Reserves for Cadia East are reported using the following assumptions: panel cave mining method; gold price of US$1,200/oz, copper price of US$3.00/lb, silver price of US$18/oz, and molybdenum price of US8/lb; US$:A$ exchange rate of 0.75; net smelter return (NSR) cut-off of A$18.71/t. The molybdenum tonnage estimate assumes that the molybdenum plant is not operational until 1 July 2021.
4. Mineral Reserves for Ridgeway are using the following assumptions: block cave mining method; gold price of US$1,200/oz, copper price of US$3.00/lb, US$A$ exchange rate of 0.75; NSR cut-off of A$20.35/t milled.
5. Tonnages are metric tonnes. Gold and silver ounces are estimates of metal contained in tonnages and do not include allowances for processing losses. Copper and molybdenum tonnes are estimates of metal contained in tonnages and do not include allowances for processing losses.
6. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content and summation totals. Rounding is to two significant figures.

15.5 Factors that May Affect the Mineral Reserves

Areas of uncertainty that may materially impact the Mineral Reserve estimates include:

- Changes to long-term metal price and exchange rate assumptions;
- Changes to metallurgical recovery assumptions;
- Changes to the input assumptions used to derive the cave outlines and the mine plan that is based on those cave designs;
- Changes to the shut-off criteria used to constrain the estimates;

- Changes to operating and capital cost assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates;
- Variations in geotechnical, mining, dilution and processing recovery assumptions, including changes to designs as a result of changes to geotechnical, hydrogeological, and engineering data used;
- Ability to source power supplies if the assumption of system intact conditions cannot be met;
- Ability to obtain sufficient water to meet operational needs;
- Changes to the assumed permitting and regulatory environment under which the mine plan was developed;
- Ability to permit additional TSF capacities or facilities;
- Ability to maintain mining permits and/or surface rights;
- Ability to obtain operations certificates in support of mine plans;
- Ability to obtain and maintain social and environmental license to operate.

15.6 QP Comments on “Item 15: Mineral Reserve Estimates”

The QP is of the opinion that Mineral Reserves were estimated using industry-accepted practices, and conform to the 2014 CIM Definition Standards. Mineral Reserves are based on underground mass mining assumptions.

The Mineral Reserves are acceptable to support mine planning.

There are no other environmental, legal, title, taxation, socioeconomic, marketing, political or other relevant factors known to the QP that would materially affect the estimation of Mineral Reserves that are not discussed in this Report.

16 MINING METHODS

16.1 Cadia East Operations

16.1.1 Overview

The current operations are planned as a series of three lifts (Lifts 1, 2, and 3). The relative elevation of these lifts and all underground infrastructure is expressed in mine height datum which is 5,000 m above AHD (i.e. 5,900 m mine Relative Level (RL) is equivalent to 900 m AHD). Lifts 1 and 2 are approximately 1,200–1,400 m high with their bases located at approximately 4650 mRL and 4450 mRL. Lift 3 sits below Lift 2 with a block height of 275 m and a base at the 4,175 mRL. Lift 1 refers to the following panel caves: PC1–1, PC1–2, PC1–4, PC5001. Lift 2 refers to the following panel caves: PC2, PC2–3, PC2–4 and PC2–5. Lift 3 refers to the following panel cave: PC 3–1.

Cadia East is accessed via two declines, the main access decline, and the conveyor decline.

The mining method involves inducing caving of the rock mass by undercutting a block of ore. Mining proceeds by progressively advancing an “undercut” level beneath the block of ore. Above the undercut level, the overlying host rocks are pre-conditioned using blasting and/or hydraulic fracturing, resulting in controlled fracturing of the ore block (Figure 16-1).

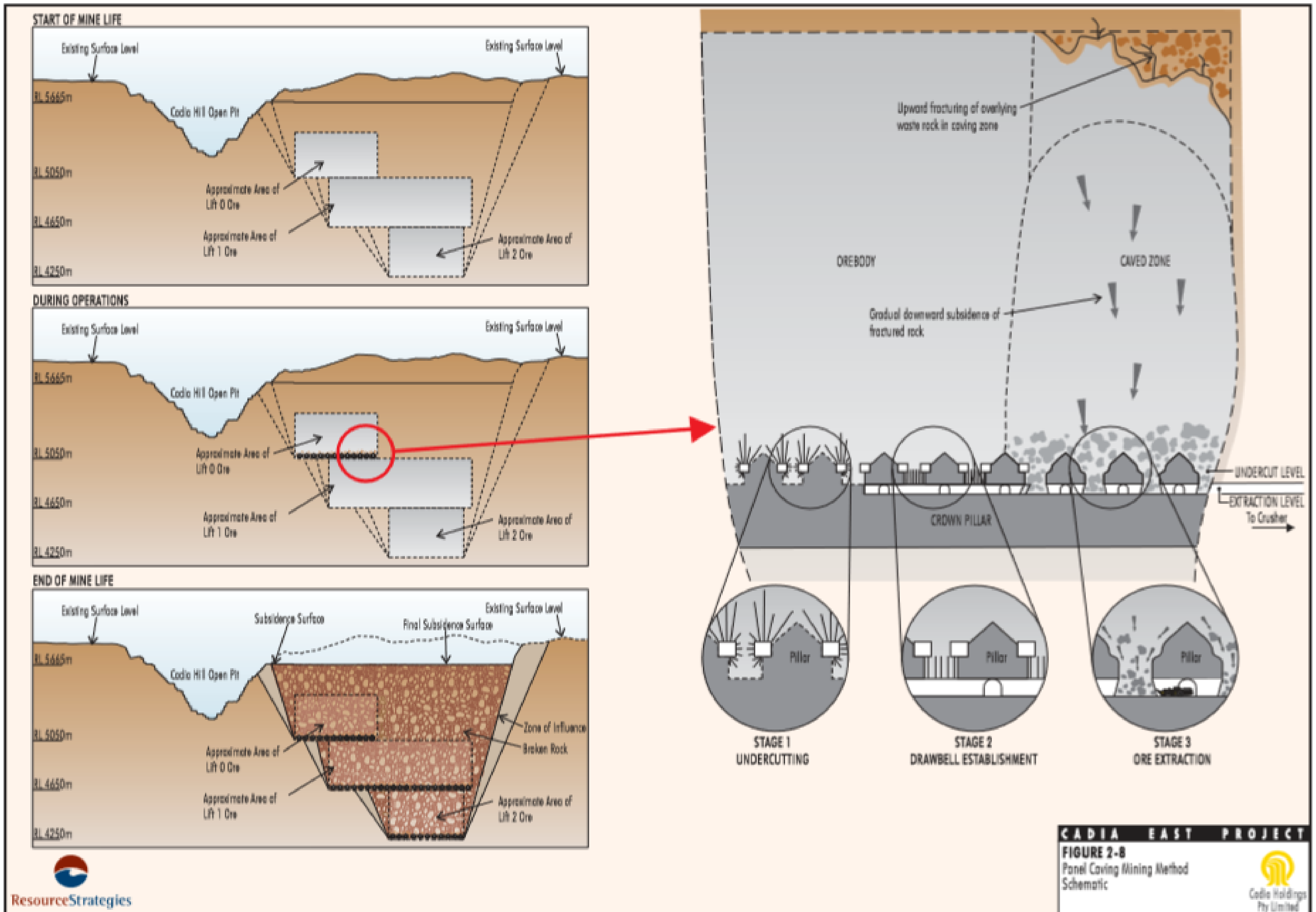
Following pre-conditioning of the overlying host rocks, broken ore is removed through an extraction level developed below the undercut level. The extraction level is connected to the undercut level by drawbells, through which the ore gravitates to drawpoints on the extraction level. The ore is removed by a load–haul–dump (LHD) fleet to underground crushing stations.

At each crushing station, ore is tipped into a coarse ore bin, which then feeds the crusher itself which passes material to a surge bin used to regulate the feed from the crushing station onto the collection conveyors. The collection conveyors are in turn used to regulate feed onto the main trunk belt system and to allow for the automated removal of tramp metals.

The main trunk belt is used to transport ore to the surface at a rate of approximately 4,600 t/h (with work underway to upgrade this to 5,150 t/h). The incline conveyor commences at 4,400 mRL (i.e. the base of Lift 2), extends approximately 7,500 m to the surface and is deposited onto the concentrator coarse ore stockpile where it is gravity fed into the ore processing system.

Waste rock is removed from the underground workings via the decline and is hauled to the South Waste Rock Facility. Fresh air enters the underground workings via the main and conveyor declines and six ventilation intake shafts (VR4, VR6, VR10, VR12 with plans to construct a further system, VR14) A total flow intake of approximately 1,500 m^3/s is installed with plans during expansion to raise this to 2,200 m^3/s of fresh air to maintain underground air quality.

Figure 16-1: Schematic Showing Mining Operations



Note: Figure prepared by Resource Strategies, 2012.

Air is expelled from the workings via four vertical shafts and exhaust fan installations (VR3A, VR5, VR7, VR8, with plans to construct VR11 and VR15 during the Cadia expansion project).

Blasting consists of development blasting and production blasting to precondition the ore. Emulsion explosives are typically used for blasting purposes. Ammonium nitrate fuel oil (ANFO) may be used on occasions if emulsion charging is not available. Hydraulic fracturing is used to augment the caving process, and is conducted from the 5050 mRL level.

Groundwater that accumulates in the underground mine workings is collected, and then pumped to the surface at a maximum rate of about 160 L/s.

Underground facilities include workshops, wash bays, fuel bays, offices, and crib rooms. Underground workshops are used to maintain the development and production fleet.

The Cadia East mine is supplied by a dedicated 132 kV transmission line feed which in turn feeds into the site switchyard. Two 33 kV feeders run from the surface substation to provide a ring main to the underground workings.

16.1.2 Geotechnical Considerations

16.1.2.1 Rock Quality and Geotechnical Domains

Geotechnical data collection included:

- Rock mass rating (RMR_{90});
- Q and Q' (Q prime) values.

In an effort to provide additional insight into the potential for veining or small defects within intact rock to affect the overall strength and behaviour of the rock mass, where possible the data was used to calculate in-situ rock mass rating (IRMR) classification values.

Intact rock strength and competency generally increases with depth and to the east of the mine at Cadia East. Laboratory strength testing has confirmed these rock mass findings. Monzonite is the main intrusive at Cadia East with varying levels found within the host volcanic unit.

An overall geotechnical block model was created for the Cadia underground mining area, and divided into five areas:

- Far West (including PC5001, PC1–2 and PC1–4);
- Centre West (including PC1–2, PC1–4, and part of PC1);
- Centre East (including PC2, part of PC1 and the western part of PC3–1);
- Middle East (including PC2-3 and the eastern half of PC3–1);
- Far East (including some access development).

A schematic section through the model is provided as Figure 16-2. This model allows for a detailed understanding of the rock mass and its likely response to the cave mining process.

16.1.2.2 Design Considerations

Modelling results suggest that the Church Splay Fault could influence the western flank, while the P Fault would influence vertical cave development on the east. The sub-horizontal Carbonate 2 Fault appears to temporarily arrest the cave development, as also shown by micro-seismic events in the field.

Modelling also indicate that effective homogeneous preconditioning could increase the recovery of ore by having more material caved from the flanks, and prevent potential hangs-up in the areas that are not caved due to lower intensity hydraulic fracturing. The increased mobilisation of the cave flanks would appear to reduce cave necking.

The planned preconditioning design for cave growth is one that implements a regular and tightly-spaced hydraulic fracturing geometry of between 1.5–2 m fracture spacing with a draw sequence that is initiated adjacent to the existing cave, to mitigate any potential pendant effect.

16.1.2.3 Cave Initiation

Cave initiation will commence adjacent to existing caves for operations on the Lift 1 and Lift 2 levels. This cave initiation position aligns with Newcrest's caving rules to prevent the formation of a low-mobility cave-flow area (pendant). The Lift 3 level will be initiated under the existing Lift 2 caves as a virgin cave and the breakthrough to the lift above will be managed via a combination of fracturing, draw control and personnel exclusion from high-risk zones.

16.1.2.4 Hydraulic Fracturing

Hydraulic fracturing activities will be conducted in two main functional areas, the orebody and infrastructure areas with two separate intents. As discussed above the orebody will be fractured at a minimum of 1.5–2 m vertical spacings for all areas below the 5050 mRL to enhance cave propagation. Pre-conditioning is expected to provide caving angles of 80–90°.

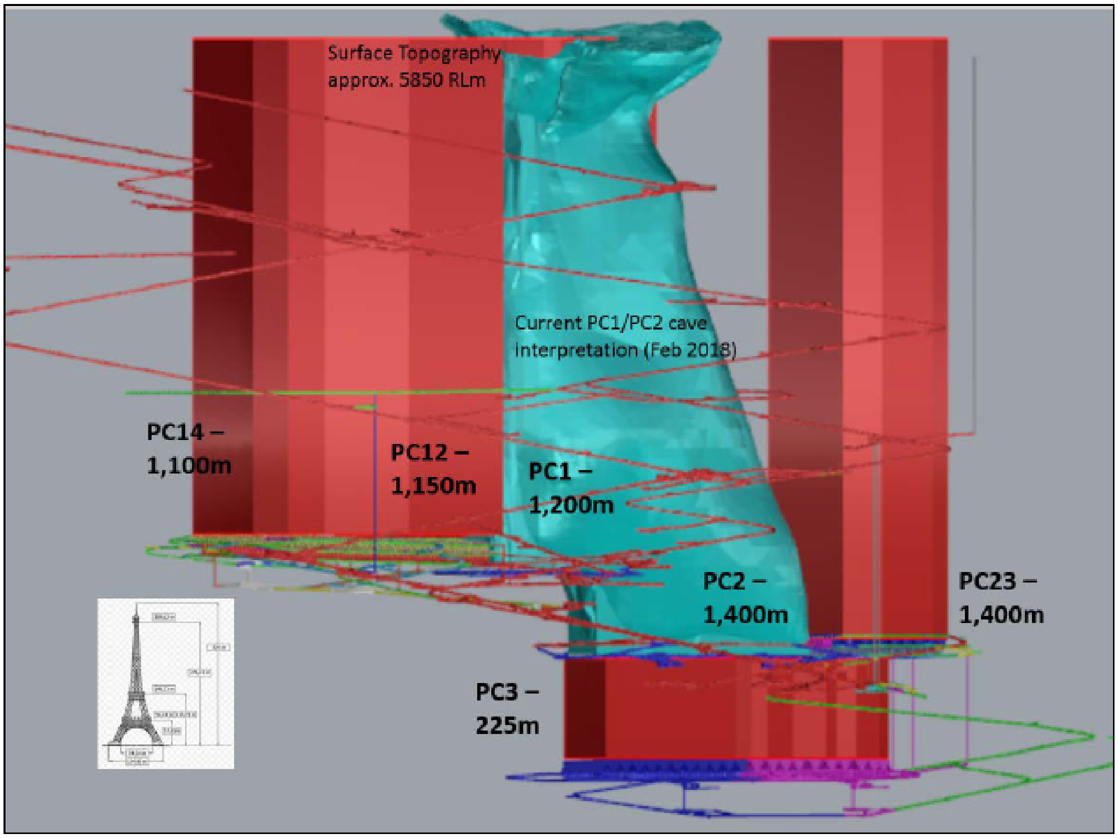
Infrastructure areas will be fractured at a minimum of 4 m vertical spacings to reduce the seismic hazard. Areas within the infrastructure that require fracturing are defined by excavations that are within 30 m of areas where there is significant potential for strain-bursting (based on numerical models), or excavations within 30 m of a major structure with the potential to produce local slippage events on discontinuities.

16.1.2.5 Caveability, Fragmentation, and Flow

Findings from fragmentation studies, which included analysis of over 500 drawpoint photos and the results from cave markers and cave tracker beacons supports the current extraction level spacing, drawbell and drawpoint designs being used as optimum for recovery of the fragmented ore.

Draw behaviour results derived from the current cave marker and cave tracker beacons show that disturbed flow mechanisms are occurring in the cave material during cave draw.

Figure 16-2: Geotechnical Block Model Schematic



Note: Figure prepared by Newcrest, 2020.

Pre-conditioning was applied to the rock mass in Cadia East PC1 and PC2, and the results of this, combined with the rock mass properties, have shown that the mine is capable of caving to surface without significant risk of stall. Future caves have similarly been planned with pre-conditioning, and rock mass conditions are anticipated to be similar to current site experience.

The implementation of preconditioning reduces drawpoint hang-ups, oversize rocks and provides an improvement in caveability by placing regular fractures in the caving block. This preconditioning is specifically designed to address the first 50 m of draw where the largest and most inefficient production draw exists.

Future mining blocks at Cadia will adopt new technologies in cave monitoring, using magnetic cave beacons that can actively monitor the cave propagation and material flow and can be combined with expert systems and software packages that simulate the whole caving process.

16.1.2.6 Cave Subsidence

A mine-scale numerical model using FLAC3d was completed and used to assess the potential underground and surface subsidence. The average break angle for the

Ordovician volcaniclastic rock and the Silurian sediments at Cadia East are 70º and 55°, respectively. At the end of the Cadia East mine life, the surface subsidence area would be approximately 255 ha and would resemble a dish-shaped depression surrounded by steep slopes on the margin.

16.1.2.7 Ground Support

Primary support will consist of fibre-reinforced shotcrete, mesh and rock bolts. In addition, each cut will have face meshing, and an additional ring of rock bolts to join mesh with the previous cut. Secondary support will consist of Osro straps and cables. In-cycle cables will be required through zones of high deformation such as strain burst-prone areas.

16.1.3 Hydrogeological Considerations

16.1.3.1 Hydrogeology

The hydrogeology of the Cadia East deposit area can be described as following:

- The Tertiary basalt forms a productive aquifer with yields that vary from low to high and produces consistently good water quality suitable for potable use;
- The underlying Silurian sequence is more variable but can form low yield aquifer from sandstone and siltstones, with locally high yields where fractured limestones are present;
- The Ordovician volcaniclastic basement rocks have widely spaced and poorly interconnected fracture networks beyond the major fault zones and form an aquitard with very low yields and slightly brackish water quality.

Surface water flow is confined to periods of precipitation, with no creeks in the subsidence area. Any surface runoff from the within the subsidence crater and the upslope areas will drain into the cave, eventually flowing to the lowest point in in the cave column. Some of the water will be held as entrained moisture in the cave material.

16.1.3.2 Inflows

The estimated groundwater inflows to the Cadia East mine, based on the mine water balance spreadsheet, shows a rising trend in the inflow over time from 0.3 ML/day to about 1.2 ML/day.

Simulations were run in the hydrogeological numerical model representing the period from 2016 through to 2050. The commencement of PC2 has the largest influence with the model predicting seepage to increase from about 0.5 ML/day to average about 1.5 ML/day when both PC1 and PC2 are actively mined. It is expected that similar volumes and changes will occur in the hydrogeological field with the commencement of PC2–3.

Recharge of the groundwater levels is noted to occur following substantial rainfall events across the region. The actual recharge amount varies substantially across the entire field, due in part to the variable rock storage, permeability parameters, and topographic features. Discharge of groundwater in the field will occur in two main areas, baseflow into creeks and into mining voids.

16.1.3.3 Dewatering

Mine dewatering is currently achieved with a vertical dam and Geho positive displacement pump system placing water into thickener TH2003 for reuse in the ore treatment facility. The dewatering facilities are designed to accommodate groundwater and surface catchment area water inflows for a one-in-100-year rainfall event.

There is no discharge of water from the mine dewatering activities to the environment, with water reused in processing facilities or recycled into the underground operations.

16.1.4 Design Considerations

Key assumptions in the design process are included as Table 16-1. The default density for caved material is 2.2. The range for neighbouring drawpoints is 28 m. In each case, this allows for rilling and toppling interaction between neighbouring drawpoints within the specified radius. The draw cone used has a maximum radius of 14 m and a maximum height of 1,350 m.

Development profile assumptions are provided in Table 16-2.

16.1.4.1 Extraction Levels

Future extraction level development (inclusive of PC2–3) will consist of:

- 1,119 drawbells, with total footprint dimensions of 700,000 m^2 across seven panel areas;
- Crushers located adjacent to the footprint, connected to the level via development drives for LHD operation and situated with a 110–130 m standoff from the edge outer edge of the nearest drawbells;
- The standard extraction level layout used in mine planning is an El Teniente layout with spacing of 32 x 20 m, a 60° turn out angle and 5.4 m wide x 4.6 m high drive, as per PC1 and PC2. This spacing is considered to meet the needs of extraction level stability and ore recovery under Cadia East conditions.
- Extraction level perimeter drives are located at least 50 m from the edge of the undercut.
- Crushing stations have a four-tipple dump arrangement;
- Extraction level drainage are designed so that water flows away from the crusher.

16.1.4.2 Undercut Levels

A number of undercutting processes are planned for Cadia East. These are summarised as:

- Post undercutting: PC2–3; 20 m high post undercut;
- Advanced undercut: PC1–2, PC1–4, PC5001, PC2–4, PC2–5 and PC3–1; W-cut advanced undercut with apex drive.

Table 16-1: Cadia East Key Design Parameters

Development Area	Gradient
Access declines (max)	1 in 6
Conveyor declines (max)	1 in 5.3
Level development (max)	1 in 6
Level development (min)	1 in 50
Minimum development radius	25 m
Excavation Sizes: Vertical	**Diameter**
Ore passes	4.5 m
Ventilation rises	3.0–6.0 m
Geotechnical	**Distance**
Drawbell spacing	32 x 20 m
Major apex pillar	44 m
Minor apex pillar	22.5 m
Crusher cave footprint standoff	110 m
Minimum pillar distance (XY or Z)	17 m
Min angle BTW drives	59°

Table 16-2: Future Development Profiles

Profile	Width (m)	Height (m)	Arch radius (m)	Type
A	5.5	6.0	5.7	Decline, access, ventilation
B	5.0	5.7	3.7	Turning bays
P	5.7	6.3	3.6	Conveyor decline
T	5.0	4.6	5.8	Drawpoints, perimeter drives, undercut drill drives
U	5.4	4.6	6.5	Extraction drive, tipple approaches
H	4.7	4.6	3.5	Sumps
Mass excavation	6–12	8–15	65% of width	Workshops, conveyor transfers, crushing station

16.1.4.3 Monitoring and Cave Engineering Horizon

A monitoring and cave engineering horizon was designed for the 5050 mRL for Lifts 1 and 2. A perimeter drive was designed 150 m from the undercut edge to ensure adequate monitoring access post cave breakthrough. The development will be used for infrastructure hydro-fracturing, orebody hydrofracturing, geotechnical instrumentation, and ventilation.

16.1.4.4 Waste

Waste material from development activities will be trucked to the surface by underground trucks to a stockpile near the portal, and then be rehandled to the surface South Waste Rock Facility by surface equipment.

16.1.5 Declines

The Cadia East deposit is accessed via two declines:

- Main access decline: approximately 10 km long; dimensions of 6.0 mW x 6.5 mH; gradient of 1:7 to 1:8. Functions as an air intake, and is the general mine access for heavy vehicles, light vehicles and personnel;
- Conveyor decline: about 7 km long; dimensions of 6.0 mW x 6.5 mH; gradient of 1:5. Functions as an air intake, and is the main trunk conveyor system and secondary access for light vehicles and personnel.

16.1.6 Ventilation

The ventilation and cooling requirements for a base annual production rate of 33 Mt were examined. The airflow requirement was determined and a general allowance for fixed infrastructure and system leakage was included in the ventilation calculations. It was assumed a development rate of up to 1,000 m per month would be achieved during peak development.

An allowance of 5% of mine ventilation requirements was added for ventilation system leakage to determine the total exhaust capacity requirements. To match the required airflow, the current intake and exhaust airway capacities need to be increased. The following are proposed:

- VR12 (eastern intake) system: designed to supply fresh air to: PC2–3 development and production area; PC3–1 development and production; conveyor system from Lift 2 down to Lift 3;
- VR7-2 to VR8–2 connection: required to distribute exhaust air between VR80 and VR70;
- VR6-3–2: required to increase the fresh air supply capacity to PC1–2; and increase the overall utilisation of VR6;
- Upgrade of VR30, VR50 and VR70 fans;
- VR11 (western) exhaust system: support exhaust for PC1–2 and PC1–4 during peak production; support exhaust for PC5001;
- VR14 system to replace the VR10 airway;
- VR15 system to link the PC2–3 mine with the VR 8 system.

16.1.7 Materials Handling System

Infrastructure required to support each cave will include:

- Primary crusher (2 x in the case of PC1–2);
- Four-way tipple arrangement;

- ROM bin (450 t capacity);
- Crushed ore bin (1,000 t capacity);
- Extension of an existing conveyor to transfer station 20 for PC2–3 and transfer station 30 for PC3–1; other caves will use the existing transfer stations on the trunk belt;
- Each crushing station will require the installation of lateral conveyors at a rate of up to 3,000 t/h (5,150 t/h in the case of PC1–2).

The infrastructure required is illustrated in Figure 16-3. In that figure, PC1 and PC1–2 are shown in the uppermost image, and the remaining caves in the lowermost image.

16.1.8 Equipment

Equipment forecasts are included in Table 16-3 and Table 16-4.

16.1.9 Facilities

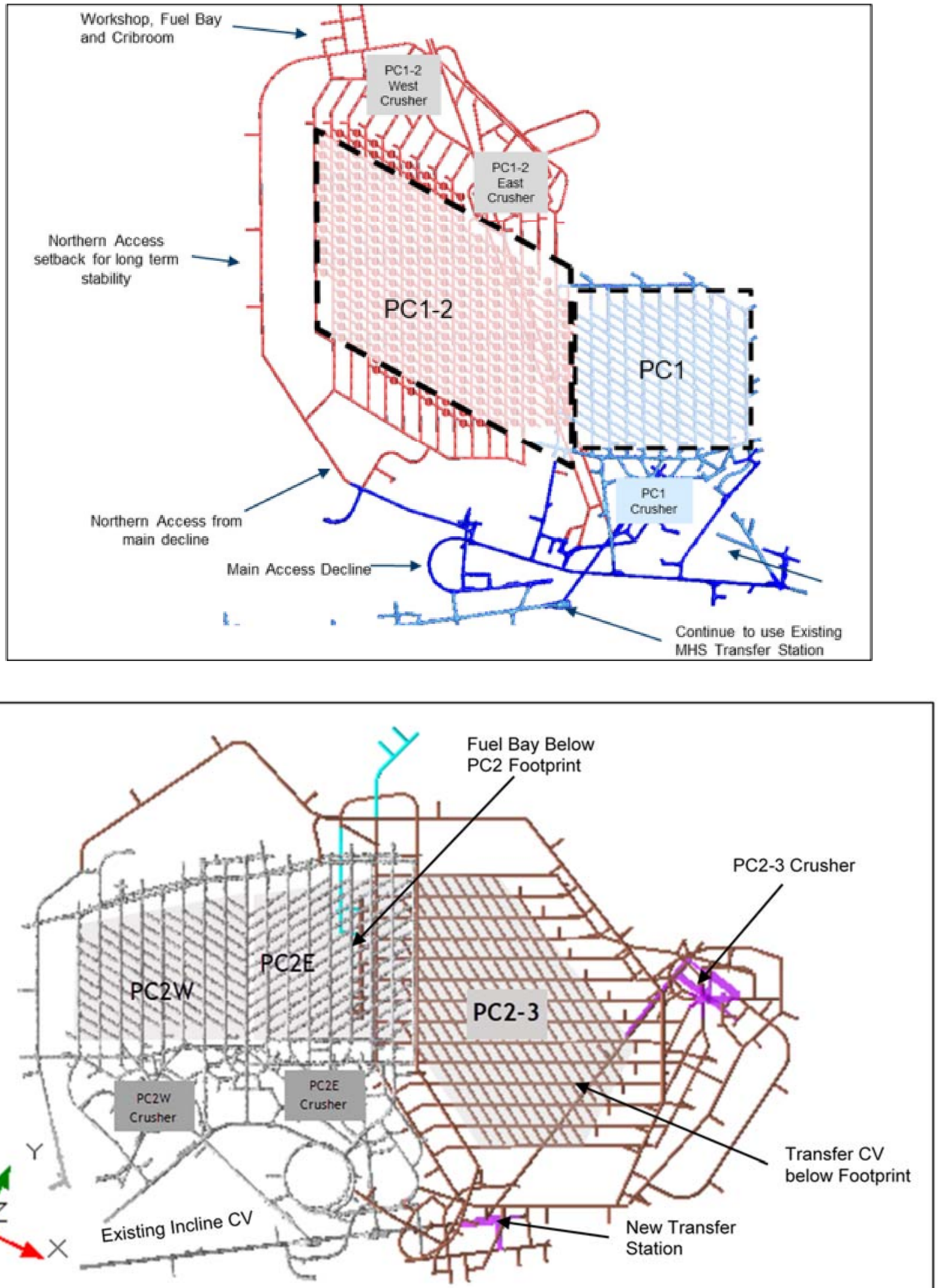
No changes are expected to the types of facilities that are used in support of current underground operations such as maintenance workshop facilities, refuelling station, crib rooms, and offices. In addition to these facilities, the following will be required during the expansion:

- Crib room and workshops setup on the western side of PC1–2, PC2–3 and the southern side of PC3–1 to support the operations on Lift 1, lift 2 and Lift 3 respectively;
- Substations and pumping facilities;
- Further dewatering surface connection for dewatering as the mine progresses;
- Additional ventilation fans for the VR8 and VR11 systems.

The existing 33 kV and 11 kV electrical distribution systems will be extended to supply power to the operating caves.

The current operational philosophy for the existing dewatering system has three pump types to remove water from underground to the surface. This includes two separate rising mains/pipelines which service the independent pumping systems. The primary dewatering system is a single lift GEHO system that discharges water from the PC1 pump station to the thickeners and/or site run off pond. The second system is a scamont plunger system which is a staged pumping system using three intermediate pump stations at PS5 (4435 mRL), 4730 mRL and 5250 mRL, with a separate rising main. The third system comprises stage mono pump stations up the main access decline. Water from the extraction level and infrastructure sumps is transported to the main pump stations through the use of transportable, submersible pumps, pipe and boreholes. Mine water on the mining levels will be collected by sumps at low points on the extraction level(s), workshops and conveyor(s), and pumped to a collection sump near the PC2–3 extraction level access at RL 4427. From this collection sump, it will be transferred to the existing pump station 5 at RL 4492.

Figure 16-3: Planned Infrastructure



Note: Figure prepared by Newcrest, 2018.

Table 16-3: Primary Equipment Summary

	Equipment Description	Equipment Type	Number at Peak
Primary development equipment	Face drilling jumbo	Atlas Copco E2C30	1
	Rock bolting jumbo	Atlas Copco M2D18	6
	Cable bolting jumbo	Sandvik DS422	6
	Development loader	Sandvik LH621	3
	Truck 60 t	Sandvik TH663	10
	Tool carrier	Volvo L120F/ L90F	6
	Shotcrete rig	Jacon Maxijet X3	3
	Development charge up rig	Normet Charmec 1610B	2
Primary cave preparation equipment	Production drill	Atlas Copco E7C	4
	Charge-up Unit	Explosives Supplier Emulsion Truck	2
	Development loader	Sandvik LH621	3
Primary production equipment	Production loader	Caterpillar R3000H	26
	Secondary break hammer	Maclean Engineering RB3 Mobile Rockbreaker	2
	Secondary break drill & blast	Maclean Engineering BH3 Blockholer	2
	Water cannon	Jacon Maxijet X3	2
	High hangup removal	Maclean Engineering High Hang-up Removal Unit	2

Table 16-4: Secondary Production Equipment Summary

Equipment Description	Equipment Type	Number at Peak
Services small lift	Manitou	2
Flat-bed truck	Isuzu 10 t flatbed tilt tray with crane	4
Grader	Caterpillar 12H	2
Water truck	Caterpillar 730C converted to water truck	1
Roller	Caterpillar CS78B	1
Light vehicle	Toyota Landcruiser 70	50–100

Raw water will be supplied from the surface raw and fire water tank, and distributed underground via the conveyor decline. The existing system was designed on a nominal flowrate basis of 82 L/s. Potable water is delivered underground in the form of water bottles.

The underground network system includes two fibre optic cable systems: one multi-mode fibre optic network, which connects protection relays to the site-wide load monitoring and control system; and one single-mode fibre optic network, which handles the plant control system and general communications.

16.1.10 Blasting

No changes are anticipated to the current blasting methods or explosives types.

Drawbells will be drilled using 76 mm blastholes and blasted using smooth blasting techniques to minimise pillar damage. Each drawbell will require approximately 1,600 m of drilling.

Undercuts will be drilled with 102 mm diameter blastholes. Minor bogging will be conducted from the undercut level which will be conducted for advanced undercutting and clean up any swell reporting into the drill drive for post undercutting areas.

Intensive blast preconditioning will be undertaken as part of the PC2–3 undercutting process. The design consists of 102 mm diameter blastholes to heavily fragment the ore.

16.1.11 Production Schedule

The production schedule is outlined in Table 16-5 and shown in Figure 16-4. During construction of the caves, an additional 20 Mt of development ore will be extracted and processed. The cave locations are indicated in Figure 16-5 and Figure 16-6 in schematic plan and section view respectively.

16.2 Ridgeway

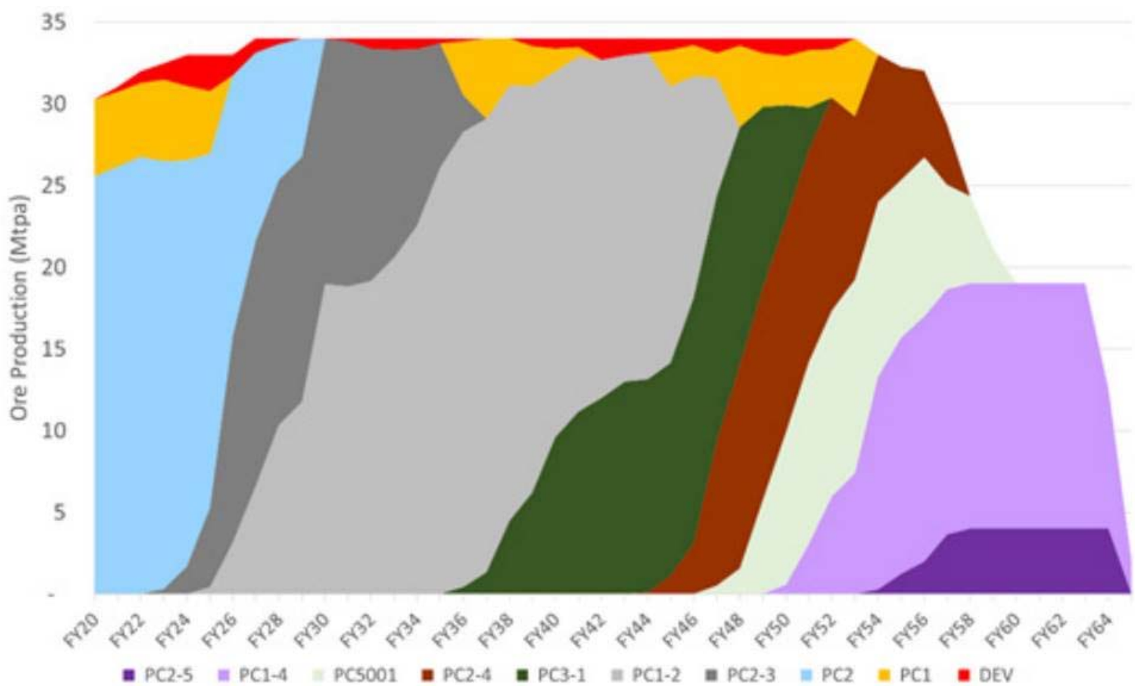
16.2.1 Introduction

Ridgeway is a vertical porphyry copper/gold deposit located within the Cadia Valley and approximately 5 km from the ore treatment facility and adjacent to the Cadia Hill deposit. The upper portion of the deposit down to 5040 Level (approximately 800 m below surface) has been mined using SLC methods, resulting in a column of caved material that extends to the surface to form a subsidence zone. An underground crusher was installed at the base of the SLC area and crushed ore was conveyed out of the mine via an inclined conveyor system. SLC mining is now complete.

Table 16-5: Forecast Production Schedule

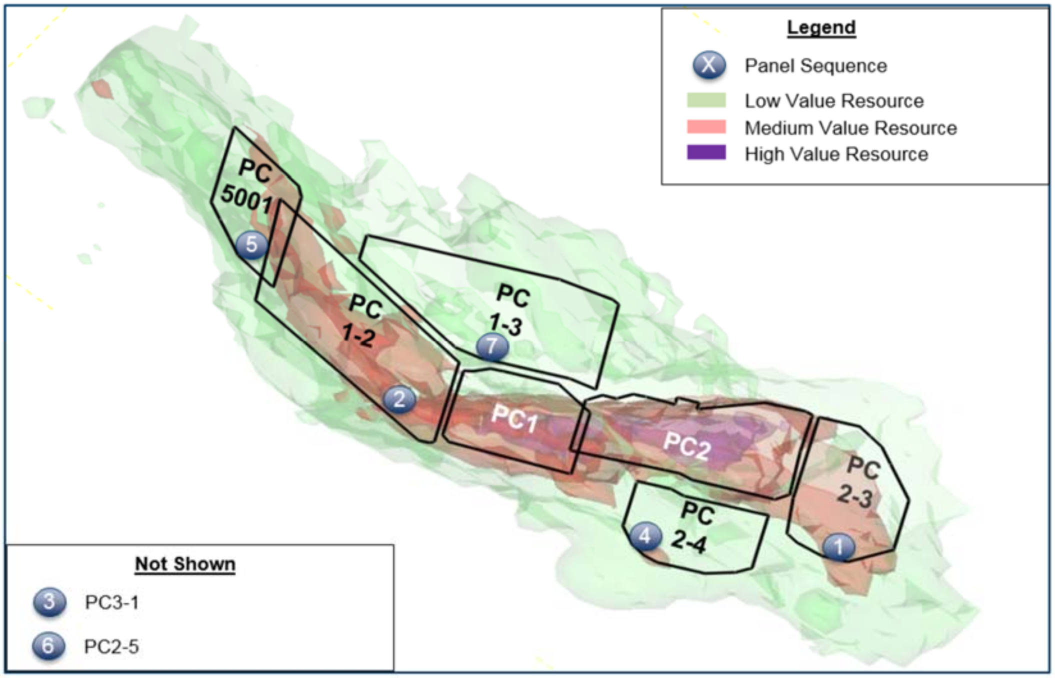
Panel Cave ID	Start of Construction	Year of First Production	Anticipated Ore (Mt)
PC2–3	FY19	FY23	142
PC1–2	FY22	FY25	408
PC3–1	FY36	FY36	149
PC2–4	FY42	FY44	113
PC5001	FY44	FY47	96
PC1–4	FY48	FY50	175
PC2–5	FY51	FY54	35

Figure 16-4: Forecast Production Schedule



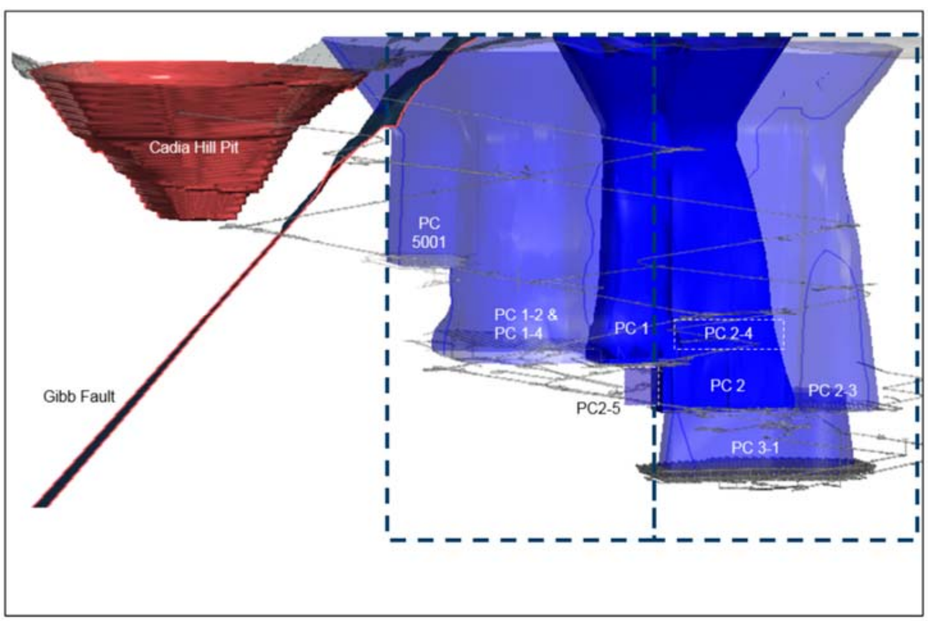
Note: Figure prepared by Newcrest, 2020.

Figure 16-5: Location of Planned Caves in Schematic Plan View



Note: Figure prepared by Newcrest, 2018. Numbers in blue circles denote the caving order.

Figure 16-6: Location of Planned Caves in Schematic Section View



Note: Figure prepared by Newcrest, 2020.

The Ridgeway Deeps Lift 1 block cave operation was mined between 2007 and 2015 and was Newcrest's first block cave operation. The change to block caving was introduced after the identification that the grade profile for Ridgeway was declining to the point where subsequent SLC levels below the 5040 mRL were uneconomic. It was also recognised that experience with techniques and methods of cave establishment were required for the then future Cadia East operations which were significantly larger in scale. As a result of extensive reviews and study it was proposed that a 5.6 Mt/a block cave mine be established 250 m downdip of the base of the SLC at the 4786 mRL. Subsequent to establishment and ramp-up, the mine was debottlenecked to the point of achieving a total of 9.6 Mt/a. A total of 17 Mt grading 0.57g/t Au and 0.29% Cu remains in the Lift 1 level.

A schematic showing the layout of the Ridgeway mine was included as Figure 15-2.

The majority of the Mineral Reserves for Ridgeway are located in the Ridgeway Deeps Lift 2 block cave. This cave is similar in nature to the original Lift 1 cave with a similar downdip extension depth, similar layout and establishment method, and operational targets for 8 Mt/a.

16.2.2 Geotechnical Considerations

The block cave extraction level for Lift 2 will be located approximately 290 m vertically below the existing Lift 1 extraction level (4500 mRL). The undercut hydraulic radius will be approximately 70 m, while the minimum and maximum span will be 230 m and 420 m respectively. The current planned mining sequence is an advanced undercut, with undercutting direction from the northeast to southwest. Relative to Lift 1, the geotechnical environment for Lift 2 is expected to be in a higher stress regime with a lower rock mass quality.

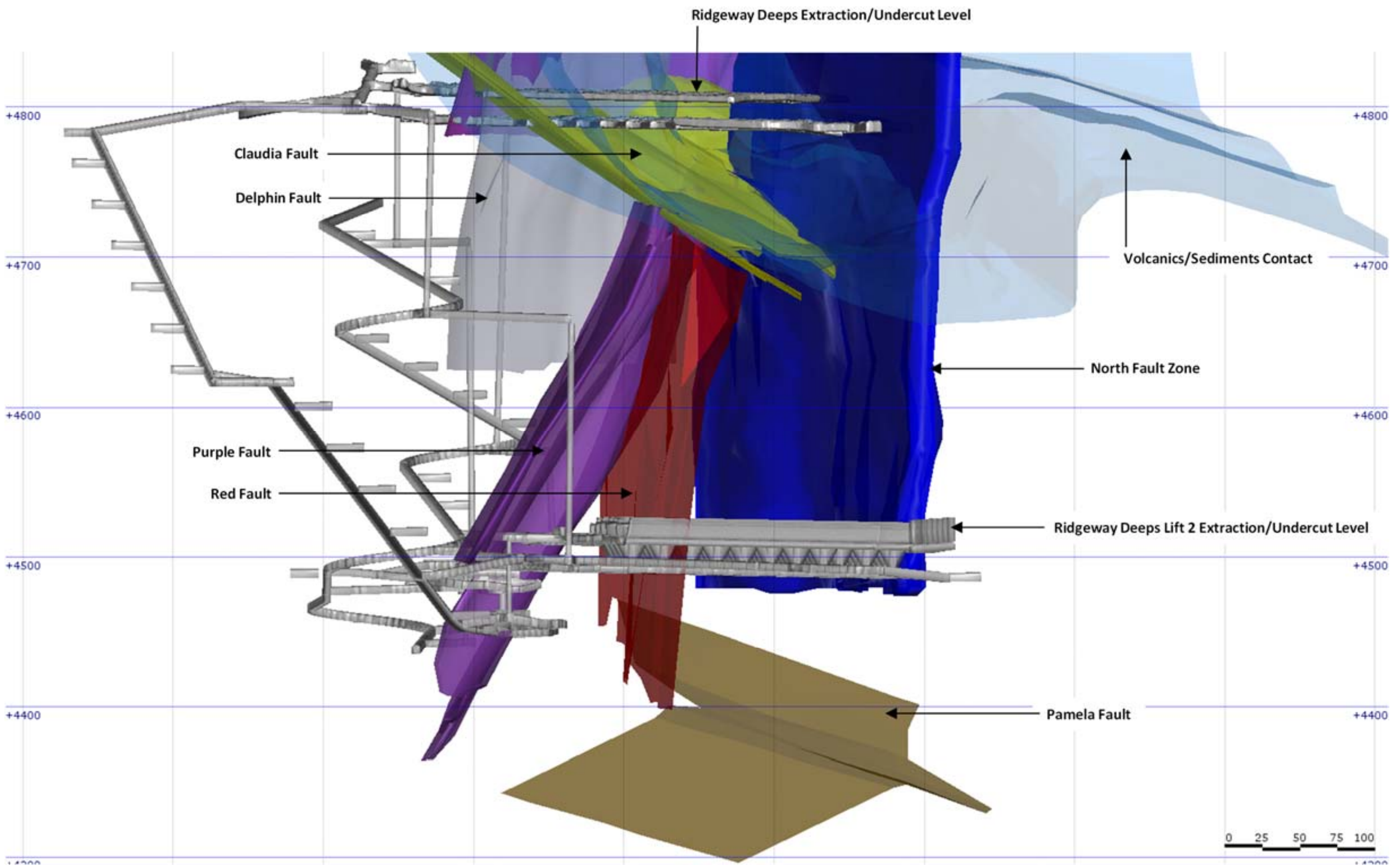
There are several mine-scale structures that are likely to affect the geomechanical behaviour of caving (Figure 16-7). These structures will also have an impact on local stability in the undercut and extraction levels of the mine and cave propagation.

Domains were classified for the Ridgeway Deeps (Lett, 2009), based on qualitative and quantitative data, and extrapolated to the Ridgeway Deeps Lift 2 block volume. Drill core logging data was supplemented by underground heading mapping when specific parameters were required that core logging could not provide. The main geotechnical parameters used for consideration of domains include lithology, alteration, discontinuities, planarity, joint infill, microfracturing and major structural zones.

The Ridgeway geotechnical block model was developed to provide data to highlight rock mass condition variability for the various geotechnical domains from the 4500 mRL to surface (Lett, 2009). Geotechnical domains representing regions of similar rock mass conditions were based on lithology, fracture frequency, location of faults, and rock strength. Two classification schemes were used to represent the rock mass parameters for each domain, these were the rock tunnelling quality index, Q (Barton et al., 1974) and the rock mass rating, RMR_{L90} (Laubscher, 1990).

Based on Q values, the block model indicates a range of rock mass conditions varying from extremely poor (associated with the North Fault Zone) to good within the Lift 2 block volume. The block model generally indicates that the rock mass is relatively more competent (fair to good quality rock mass) on the western side of the block volume, when compared to the eastern side (very poor to poor quality rock mass).

Figure 16-7: Major Mine Scale Structures within Ridgeway Deeps Lift 2 Block



Note: Figure prepared by Newcrest, 2014.

With respect to the Lift 2 undercut/extraction level, the block model indicates a range of rock mass conditions varying from extremely poor (associated with the North Fault Zone) to good. Generally, the northern region of the footprint is relatively more competent (poor to good quality rock mass), when compared to the southern region (very poor to poor rock mass). The extremely poor to very poor rock mass conditions in the northwest corner of the footprint are associated with the North Fault Zone.

The rock mass in the southern footprint region can generally be considered weaker than those encountered on the Ridgeway Deeps Lift 1 undercut/extraction level.

A coupled discontinuum finite element–Newtonian cellular automata (DFE–NCA) model was completed to simulate cave draw, cave flow, cave growth, rock mass damage and movements on faults as a coupled system (Beck, 2013). Model outputs were used to mine scale geotechnical risks, which included: undercut and extraction level stability, cave propagation geometry and impact on infrastructure and resource recovery, and seismicity. Primary and secondary fragmentation analysis has not been undertaken to date; however, conditions are not expected to differ significantly from Lift 1. Based on previous experience in the Ridgeway Deeps Lift 1 block cave, a significant contrast in drawpoint fragmentation can be expected between the volcanic and sedimentary rocks, and monzonite.

16.2.3 Hydrogeological Considerations

16.2.3.1 Inflows

Two key hydrological risks are associated with the Ridgeway Deeps Lift 2 block cave:

- Increased surface catchment area caused by an increase in the surface subsidence crater;
- Possible structural linkage of the underground workings to Cadiangullong Dam.

A study was undertaken by hydrologists Kalf & Associates in 2002 to assess the implications of a direct connection between the surface crater and the underground workings. The findings of this study proposed a simple model having a direct hydraulic connection between rain falling in the catchment formed by the crater and being directly transmitted to the workings. Pumping capacity was found to be adequate to deal with inflows generated by a one-in-100-year rainfall event. The relationship between area of the subsidence crater, potential rainfall and pumping/sump capacity requires constant review.

Hydrogeologists from Aquaterra Consulting (Pfitzner, 2007) assessed the potential of hydraulic connection via a large-scale structure from Cadiangullong Dam to the Ridgeway Deeps underground workings. The study found that it is unlikely that there are any faults able to provide a conduit from the dam to the mine and that the only possible structure that might provide a connection was the North Fault, which is interpreted as not being able to transmit significant quantities of water into the mine. It was however, recommended that any future exploration drilling to the east of the underground workings is reviewed for structural conduits with the permeability sufficient for transmission from the dam to the cave.

16.2.3.2 Dewatering

The design criteria for the pumping system were assumed to be unchanged from Ridgeway Deeps Lift 1 block cave with expected normal flows of 10–30 L/s, and capable of handling emergency flows of 85 L/s. An extension of the existing Ridgeway Mine dewatering watering system is assumed, with the existing pumping infrastructure remaining in use. A new pumping station would be located at 4475 RL horizon, reporting to the existing 4812 RL horizontal dam. An additional horizontal dam is proposed as the 4500 RL horizon to supply the 4475 RL pumping station.

16.2.4 Design Considerations

16.2.4.1 Declines

The Ridgeway deposit is accessed via two declines;

- Main access decline: approximately 10 km long; dimensions of 6.0mW x 6.0mH; and a gradient of 1:10 to 1:6. Functions as an air intake, and is the general mine access for heavy vehicles, light vehicles and personnel;
- Conveyor decline: about 7 km long, dimensions of 6.0mW x 6.0mH; and a gradient of 1:6 to 1:5.3. Functions as an air intake, and contains the main trunk conveyor system and secondary access for light vehicles and personnel.

16.2.4.2 Cave Establishment

The program of works for Ridgeway Deeps Lift 2 calls for the construction of two declines down from the existing Lift 1 workings. This will be followed by establishment of 80,000 m^2 of economic footprint and the associated infrastructure to support the planned extraction rate. The cave establishment process will be conducted as an advanced undercut with a three-level design including an apex drive (W-cut design). This design was deemed most suitable for Ridgeway based on review of practices at Ridgeway Deeps Lift 1 and geotechnical considerations.

Following preliminary geotechnical advice, the Ridgeway Deeps Lift 2 block cave undercut and draw bell opening schedule will be progressed from the northwestern corner diagonally towards the southeastern corner of the footprint, which binds production start-up to the completion of development of the extraction level (except for the later draw point and draw bell development requirements). It is anticipated that it will take approximately 21 months to complete cave establishment from the first firing.

Cave draw will commence once the undercut has reached critical hydraulic radius (approximately five months into the drawbell establishment program). As was the case in Lift 1, it is anticipated that the cave will initially draw slowly as the caving process commences with draw rates at the lower end of the 95–225 mm/day range. Initial cave draw is programmed to target full cave connection with cave growth anticipated to reach the Lift 1 footprint in the second year after draw commencement. This program will be followed by full cave ramp-up production as it was in Lift 1, with full production rates not anticipated until the fifth year after development commences and three years after first cave draw.

The production rate for the block caving option is based on current expectations for the Ridgeway materials handling system and the relative similarity in footprint dimensions of the Ridgeway Deeps Lift 2 block cave to the Ridgeway Deeps Lift 1 block cave.

There will be three years of development and a ramp-up to reach 8 Mt/a. Production rates are based on an undercutting rate of 6,000 m^2/month and a draw rate ranging from 95–225 mm/day.

16.2.4.3 Design Parameters

The mine design for Lift 2 assumes an offset herringbone extraction pattern (Figure 16-8). The offset herringbone layout is used at Ridgeway Deeps Lift 1, Northparkes E26 Lifts 1 and 2, Cullinan (formerly Premier) mine in South Africa, the Finsch mine in South Africa, and the Palabora mine in South Africa.

Design considerations include:

- 8 Mt/a feeding Concentrator 2;
- Two 4 Mt/a jaw crushers (east and west locations);
- 32 m extraction drive spacing x 20 m draw point spacing layout;
- Extended loading chute and ore bins at the juncture of transfer points to the main conveyor, providing surge capacity following crushing;
- Reverse offset herringbone layout facilitating lower cycle times and higher productivity as well as less delays during operations using either tethered electric loaders or conventional diesel loaders;
- All production from the footprint delivered to the materials handling system as ore;
- Development material trucked to the existing conveyor system on Lift 1 prior to construction of the Lift 2 extension to the system.

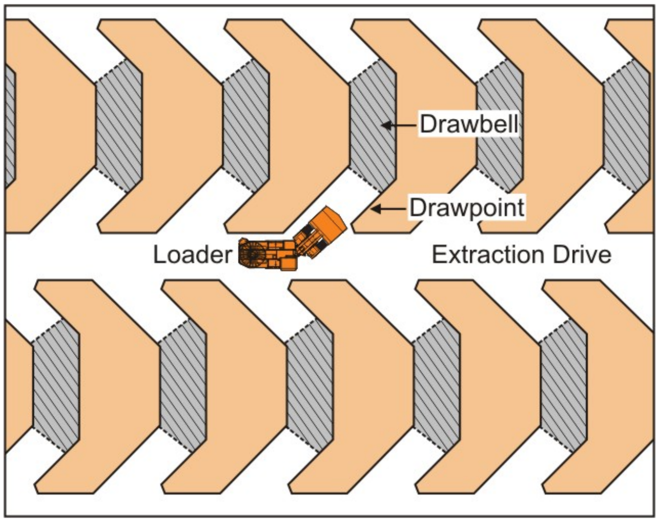
The number of draw points opened per quarter will be limited by the development scheduling for the extraction and undercut levels. A total of 248 draw points will be opened over a 21-month period from the commencement of draw point firing. The opening sequence will be based on a single front sweeping across the footprint. The commencement of several cross cuts of undercut firing will precede the commencement of the first extraction drive and draw points being developed.

Figure 16-9 is a schematic level layout plan for the proposed operation.

16.2.5 Ventilation

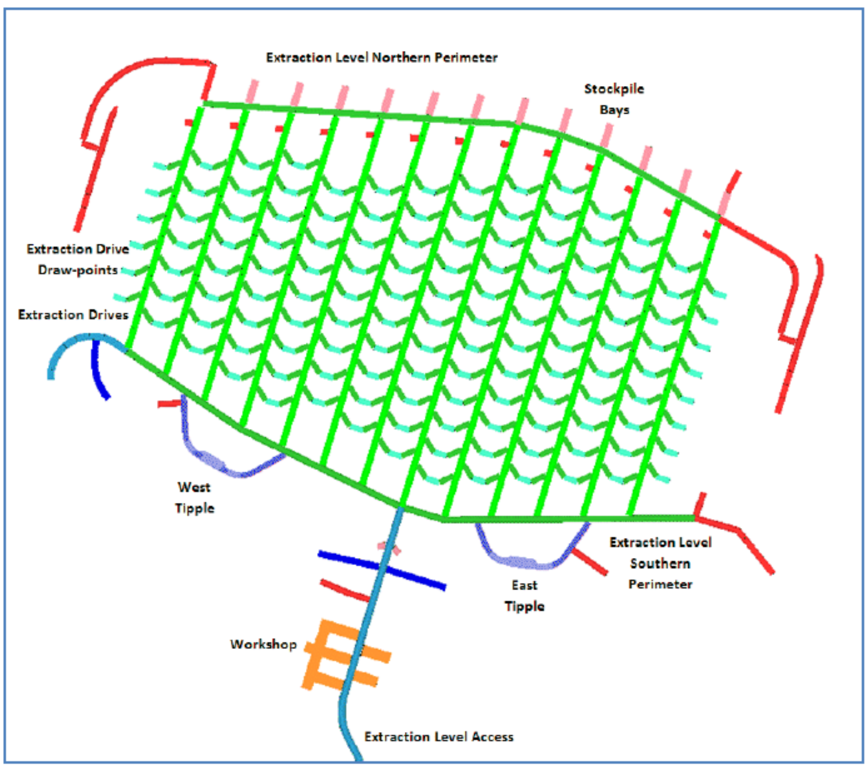
The proposed ventilation capacity for the Ridgeway Deeps Lift 2 project is designed to meet internal Newcrest ventilation standards as well as satisfying the NSW regulatory framework with respect to ventilation, airborne contaminants (gases, dust and particulates) for the health and safety of all underground employees. Drilling to date has not indicated the presence of any significant levels of gas nor resulted in any defining of gas regimes.

Figure 16-8: Offset Herringbone Layout Schematic



Note: Figure prepared by Newcrest, 2014.

Figure 16-9: Schematic Layout, Ridgeway Deeps Lift 2



Note: Figure prepared by Newcrest, 2014.

The ventilation review for the Ridgeway Deeps Lift 2 block cave indicated that the designed ventilation infrastructure inclusive of the VR2 raise as an intake airway, and the upgrade of the existing VR40 and VR60 fans will be sufficient for the proposed 8 Mt/a production rate.

All the extraction drives will be segregated from each other and also from the general access perimeter on the northern end of the extraction level. The ventilation system entails the supply of fresh air to each extraction drive to flow from north to south. This will be achieved by using small axial flow fans that can be remotely turned on and off as required, as well as the use of pneumatic panel lift doors situated between the intake air source and the access perimeter on the northern end. This will ensure air flows from north to south to the ventilation return airway. It will also provide unrestricted roadways between the draw bells and the ore passes.

An exhaust ventilation raise will be located so as to exhaust each crushers tipple level, access drive to each crushing chamber and the transfer and collection conveyor infrastructure. The crushing and materials handling exhaust raises will exhaust to the under-cut level using a single fan per raise.

The primary ventilation rate will be 890 kg/s.

16.2.6 Materials Handling System

Materials handling must be capable of delivering the required 8 Mt/a to Concentrator 2, and attention must be paid to the reliability of the conveyor system and availabilities of both the conveying system and the proposed crushers.

No detailed design of this infrastructure has been completed. It is assumed that the Ridgeway Deeps Lift 1 block cave design will be carried over to Ridgeway Deeps Lift 2 with modifications where appropriate. This is also the basis of the mine development plan, essentially replicating the existing ore handling system to accommodate the second block caving lift.

Two new crushing chambers will be located on the crusher horizon adjacent to the extraction level. The production loaders on the 4775 RL extraction level will tip directly to the crusher tipples. Jaw crushers will be used, with crushed ore storage bins provided below the crushers. Tramp removal will be at collection and picking conveyors, with two self-cleaning magnets and a manual picking station per crusher. Ore will then be hoisted to the existing trunk conveyor system via two new trunk conveyors coupled by two short transfer conveyors.

Jaw crushers were selected for commonality with the existing Ridgeway Deeps Lift 1 jaw crushers. A static rock-breaker will be installed at each crusher to precondition oversize ore presenting to the crushers.

16.2.7 Facilities

16.2.7.1 Workshops

New workshop and ablutions facilities will be constructed at the new extraction level. Existing workshop and ablutions facilities at 4786 RL horizon will be decommissioned.

16.2.7.2 Communications

The mine communications backbone and associated infrastructure will be extended to cover the new workings. This includes the existing leaky feeder radio and telephonic systems. The fibre optic backbone extension for Ridgeway Deeps Lift 2 will be to same specification as used for Ridgeway Deeps Lift 1.

16.2.7.3 Power

The existing Ridgeway Deeps Lift 1 HV ring is an extension of the original ring and is close to capacity. A desktop demand study indicates an additional 4–5 MW electrical power will be required for Ridgeway Deeps Lift 2. The new high voltage ring through the Ridgeway Deeps Lift 2 developments will be of similar configuration to Ridgeway Deeps Lift 1 design, using similar substation layouts and equipment.

16.2.7.4 Raw Water

The raw water system will build onto the established “break tank” philosophy utilised to regulate pressure within the Ridgeway raw water system. Two separate raw water supply systems will be provided, comprising north and south systems.

16.2.8 Equipment

Equipment requirements are provided by year in Table 16-6. An additional 19 pieces of ancillary equipment were estimated for the project development phase. A total of 12 units would be needed during the project operations phase. These totals include integrated tool-carriers, spraymec units, roller, grader, water truck, fuel truck, stores trucks, skid steers and crew buses.

16.2.9 Production Schedule

The total material movements and total ore production were scheduled using both Mine2-4D/EPS and Gemcom GEMS/PCBC software, using the draw point opening sequence and development schedule for the extraction layout and undercut.

The development schedule is outlined in Figure 16-10, and the production schedule in Figure 16-11.

The schedule uses a maximum rate of undercut development of 80 m/month. The draw bells do not begin development until the undercut provides a stress shadow. The maximum undercut rate in the schedule is 6,000 m^2/month and the maximum number of draw bells fired per month is nine.

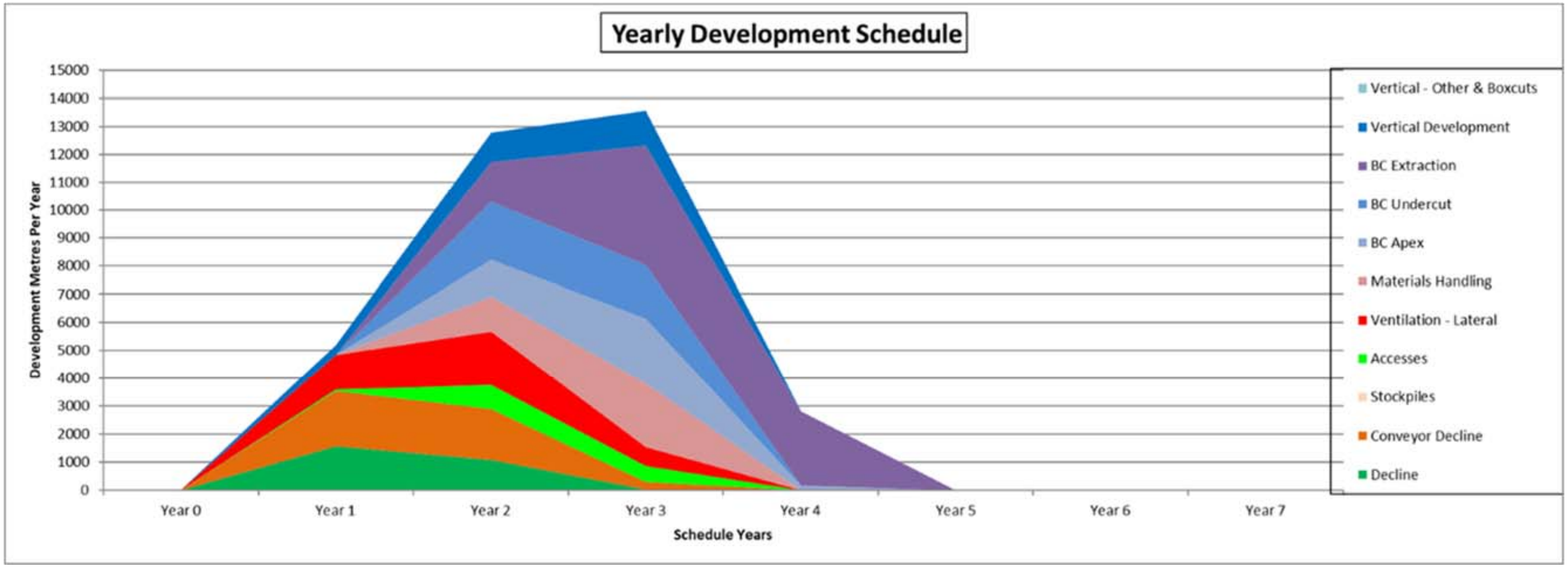
The cave tonnes coming post mining of draw bells, is estimated from flow parameters in PCBC. A hang-up surface estimated by geotechnical review is used to cap the extraction of ore that will not cave.

Table 16-6: Equipment Requirements, LOM Plan

Year	Dev. Jumbos	Bolting Jumbos	Diesel Dev. Loader	Diesel Dump Truck	Diesel Prod. Loader	Electric Prod. Loader	Prod. Drill	Charge Machine	Hang-up/Sec. Break
Year 0	—	—	—	—	—	—	—	—	—
Year 1	1	4	1	1	—	—	—	1	—
Year 2	2	9	2	3	1	—	1	2	—
Year 3	2	9	2	6	3	—	4	2	3
Year 4	1	3	1	—	7	—	3	1	7
Year 5	—	2	1	—	7	—	—	—	4
Year 6	—	2	1	—	7	—	—	—	4
Year 7	—	2	1	—	7	—	—	—	3
Year 8	—	2	1	—	7	—	—	—	3
Year 9	—	2	1	—	7	—	—	—	3
Year 10	—	2	1	—	7	—	—	—	3
Year 11	—	2	1	—	7	—	—	—	3
Year 12	—	2	1	—	7	—	—	—	3
Year 13	—	—	—	—	—	—	—	—	—
Year 14	—	—	—	—	—	—	—	—	—

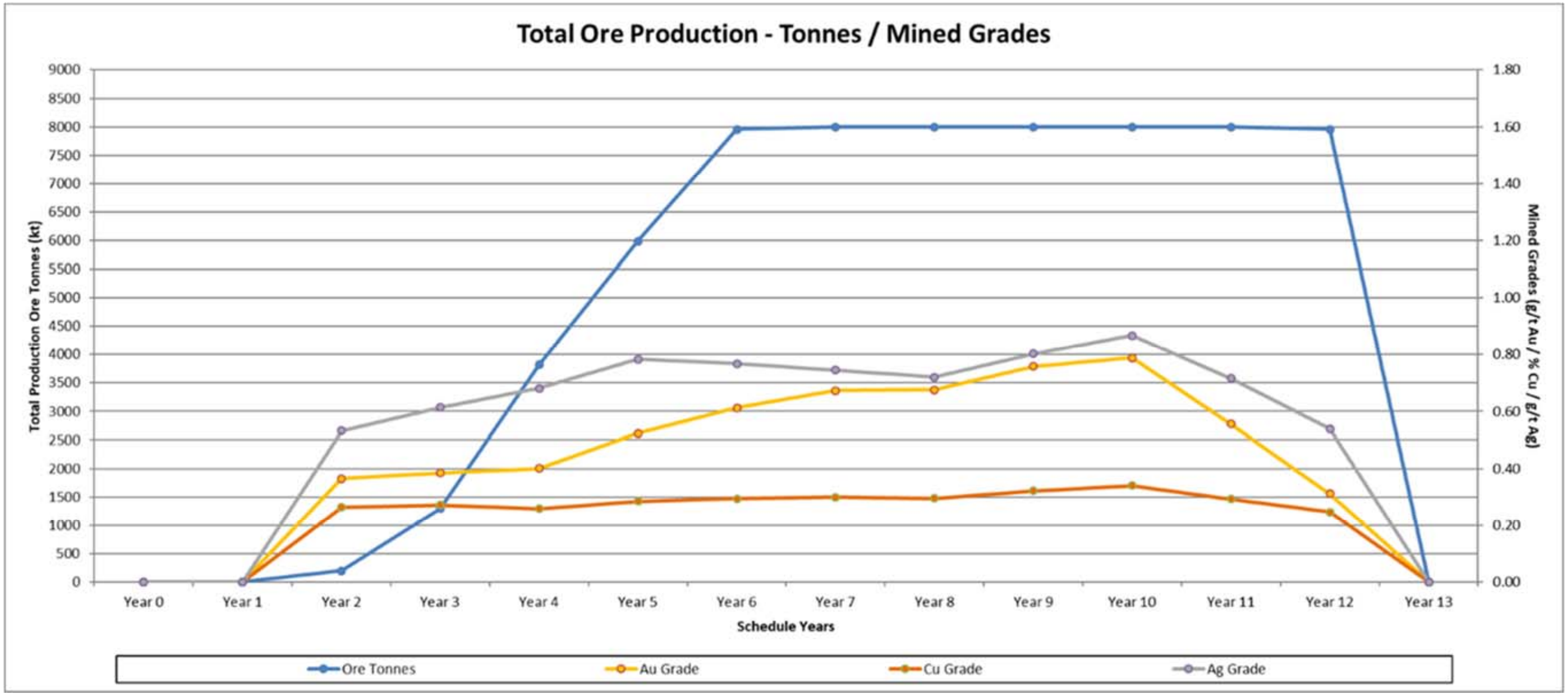
Note: years are assumed as financial years, reported from July 1 to June 30, not as calendar years.

Figure 16-10: Development Schedule



Note: Figure prepared by Newcrest, 2020.

Figure 16-11: Production Schedule



Note: Figure prepared by Newcrest, 2020.

16.3 QP Comments on "Item 16: Mining Methods"

The QP notes:

- Current and planned operations use or will use mass mining methods;
- The current Cadia East operations are planned as a series of three lifts (Lifts 1, 2 and 3), and are accessed by two declines;
- New panel caves are planned adjacent to the current Cadia East operation;
- Cave initiation will commence adjacent to existing caves for operations on the Lift 1 and Lift 2 levels (PC–2, PC1–4, PC5001, PC2–3, PC2–4 and PC2–5). Lift 3 (PC3–1) will be initiated under the existing Lift 2 caves;
- The Ridgeway mine is accessed by two declines. Lift 2 of the caving operation is scheduled for the end of the proposed mine plan and is directly below the current Lift 1 cave;
- Mine designs incorporate underground infrastructure and ventilation requirements;
- The planned supporting fleet and equipment requirements are conventional for block caving operations;
- The combined Cadia East and Ridgeway projected mine life is 45 years (2020–2065);
- The mine plan assumes that additional tailings storage can be permitted once the existing facilities have been filled. Planning for this work is currently ongoing with a number of locations and deposition options under consideration. Once a plan has been confirmed it will require regulatory approval from statutory authorities.

17 RECOVERY METHODS

17.1 Introduction

Concentrator 1 was commissioned in 1998, designed for Cadia Hill ore and had a design capacity of 17 Mt/a. In 2012, Concentrator 1 was upgraded for the processing of harder Cadia East ore which included the addition of a HPGR circuit, ahead of the SAG Mill, and a third ball mill and third flotation train. Concentrator 1 has a current throughput of about 23 Mt/a.

Concentrator 2 was commissioned in 2002, and had a target rate of 4 Mt/a, and currently treats approximately 7 Mt/a. In mid-2008, the facilities were upgraded to suit predictions of harder and fines-deficient ore from Ridgeway Deeps block cave mine. The upgrade included installation of a secondary crushing circuit and additional regrind mill power. A 2.24 MW Vertimill was installed in 2011 to reduce flotation feed size and improve metal recoveries.

Concentrator 1 has historically been referred to as the low-grade process facility, or the Cadia concentrator. Concentrator 2 has historically been referred to as the high-grade process facility, or the Ridgeway concentrator.

17.2 Process Flow Sheet

A simplified flow diagram for the concentrators is included as Figure 17-1. The figure shows the existing major equipment and the debottlenecking steps discussed in Section 17.5.

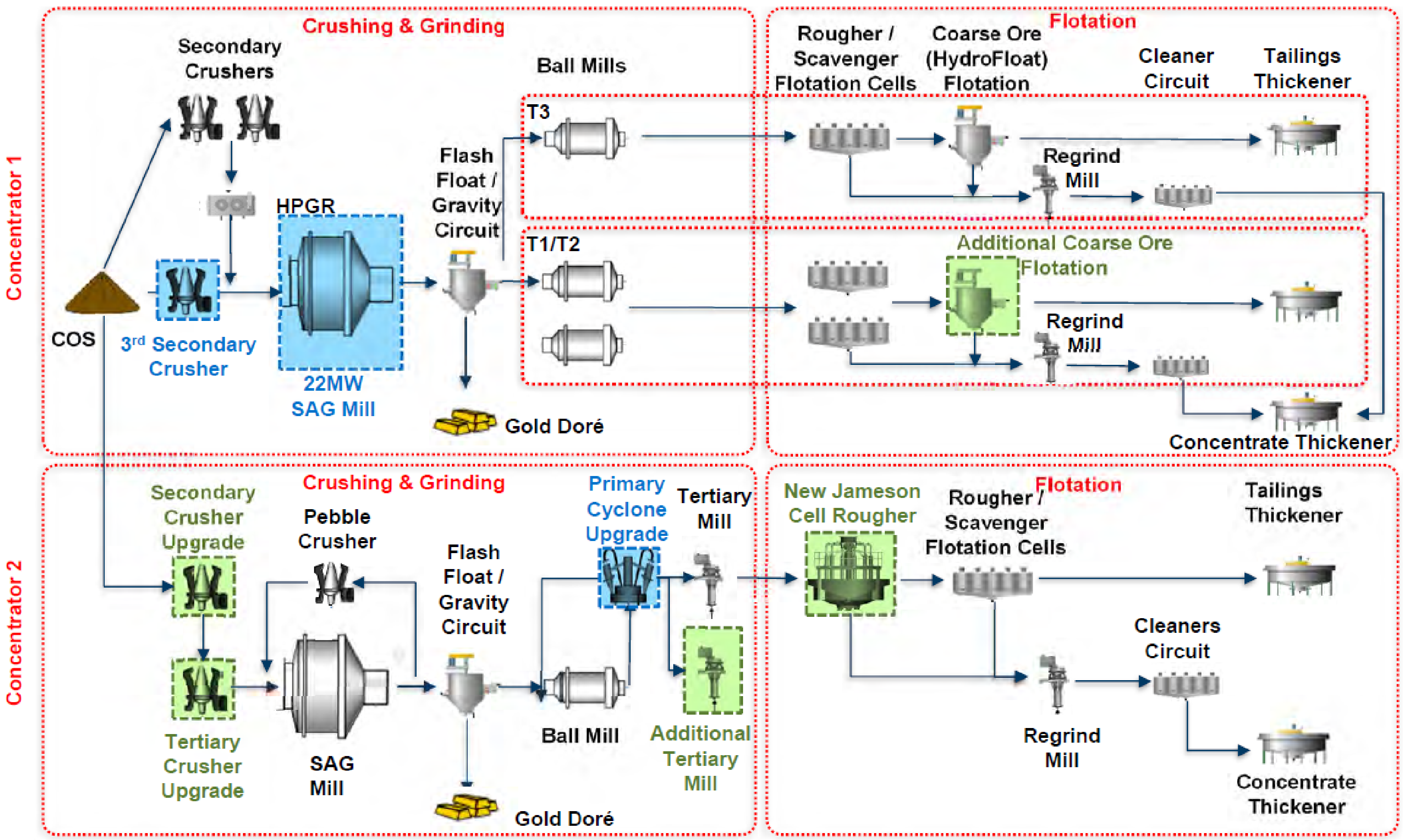
An equipment list for the plants is provided in Table 17-1.

17.3 Concentrator 1 Design

The key unit operations in the processing plant are:

- Primary crushing in a 60-inch x 113-inch gyratory crusher. This was the main primary crusher for the original Cadia concentrator and now primarily used for surface stockpile reclaim;
- Coarse ore stockpile (COS) to a live capacity of 40,000 t and subsequent reclaim facilities;
- Distribution bin and double-deck vibrating screens for feed size preparation;
- Secondary crushing, treating screen oversize, using MP1000 cone crushers;
- High pressure grinding rolls (HPGR) unit treating screen undersize prior to the SAG mill;

Figure 17-1: Simplified Process Flow Diagram



Note: Figure prepared by Newcrest, 2020.

Table 17-1: Process Equipment

Plant Area	Description	Manufacturer	Model/Size	Quantity	Note
Underground	Jaw-gyratory crusher	Thyssen-Krupp	BK 63-75	3	
Concentrator 1	HPGR	Thyssen-Krupp (Polysius)	PM 8-24 / 17 M	1	
	Secondary crusher	Metso (Nordberg)	MP1000	2	
	SAG mill	Mill – Metso (Svedala), gearless motor drive – Siemens	40 ft	1	Gearless drive
	Ball mill	Metso (Svedala)	22 ft x 36 ft 6 in	2	
	Ball mill	Metso	26 ft x 42 ft	1	
	Flash flotation cell	Outotec	SK1200	3	
	Rougher/scavenger flotation cells	Outotec	OK150	14	
	Rougher/scavenger flotation cells	Outotec	OK300	5	
	Cleaner/cleaner scavenger flotation cells	Outotec	OK30	10	
	Recleaner flotation cells	Outotec	OK8	3	
	Cleaner/cleaner scavenger flotation cells	Outotec	e50	10	
	Vertimill	Metso	VTM1250	1	
	Vertimill	Metso (Svedala)	VTM650	1	Although the body is that of a VTM650, the motor and gear box were modified effectively to a VTM800
	Jameson cell	Glencore Technology	B6500/24	1	(Formerly Xstrata Technology)
	Jameson cell	Glencore Technology	B5400/18	1	(Formerly Xstrata Technology)
	Jameson cell	Glencore Technology	E2532/6	1	(Formerly Xstrata Technology)
	Tailings thickener	EIMCO	53 m	1	
	Tailings thickener	FLSmidth	40 m	1	
	Concentrate thickener	Outokumpu Supaflo	12 m	1	
	Cross flow classifier	Eriez	XF-3050	4	

Plant Area	Description	Manufacturer	Model/Size	Quantity	Note
	HydroFloat cell	Eriez	HF-3350	2	
Concentrator 2	Secondary crusher	Metso	MP800	1	
	Tertiary crusher	Metso	MP800	1	
	Pebble recycle crusher	Kawasaki	1500Z	2	
	AG mill	Metso (Svedala)	32' x 16'	1	Conventional pinion drive
	Ball mill	Metso (Svedala)	6,706 mm x 8,534 mm	1	
	Flash flotation cell	Outotec	SK1200	1	
	Rougher/scavenger flotation cells	Outotec	OK100	7	
	Cleaner/cleaner scavenger flotation cells	Outotec	OK30	9	
	Recleaner flotation cells	Outotec	OK20	1	
	Recleaner flotation cells	Outotec	OK8	3	
	Vertimill	Metso	VTM1250	2	1 x secondary grinding application, 1 x flotation regrind application
	Vertimill	Metso	VTM3000	1	
	Jameson cell	Glencore Technology	E3432/8	1	(Formerly Xstrata Technology)
	Tailings thickener	Outokumpu Supaflo	29 m	1	
	Concentrate thickener	Outokumpu Supaflo	20 m	1	
Concentrate handling	GEHO pump	Weir Minerals	TZPM500	1	
	Dewatering filter press	Jord	C-3811	2	

- Primary open circuit milling in a single 40-ft SAG mill fitted with a 20 MW motor. The motor will be upgraded to 22 MW. Oversize pebbles from the SAG mill are returned to the distribution bin;
- Secondary milling in three ball mills, with the two original mills fitted with 8.7 MW motors, and a more recently installed third ball mill with a 16 MW motor. The mills are in closed circuit with cyclone classification for a target grind size of P80 of 150–190 µm;
- Flash flotation and gravity processing of flash flotation concentrate to produce a gravity gold concentrate for smelting;
- Rougher and scavenger flotation of the slurry from the milling circuit with concentrate reporting to regrind circuits utilising Vertimills;
- Cleaner and cleaner-scavenger flotation;
- Recleaner flotation utilising both conventional and Jameson cell technology. The Jameson cells assist in fluorine rejection;
- Two HydroFloat cells processing train 3 scavenger tailings for coarse composite mineral recovery;
- Thickening of rougher/scavenger tailings before pumping to a TSF.

17.4 Concentrator 2 Design

Concentrator 2 includes the following processes:

- Reclaim and conveying system to transfer ore from Concentrator 1 COS to Concentrator 2 facilities;
- Secondary and tertiary crushing using MP800 cone crushers and open circuit pre-screening;
- Dedicated coarse (crushed) ore stockpile (COS) and apron feeder reclaim facilities;
- Primary open circuit milling in a single SAG mill fitted with a 7.5 MW motor;
- Secondary milling using a 7.5 MW ball mill and parallel Vertimill VTM1250, in closed circuit with classifying cyclones.
- Tertiary milling using a Vertimill VTM 3000;
- Gravity concentration of ground slurry in a centrifugal concentrator to produce a gravity gold concentrate for further upgrade and smelting;
- Flash flotation in the milling circuit to recover an additional concentrate suitable for further gravity gold recovery, with the remaining copper concentrate reporting to the flotation cleaning circuit;
- Rougher and scavenger flotation in tank flotation cells. Rougher and scavenger concentrates report to cleaning flotation via a regrind circuit using a Vertimill VTM 1250;
- Thickening of rougher/scavenger tailings before pumping to a TSF;

- Cleaner and cleaner–scavenger flotation;
- Recleaner flotation using both conventional and Jameson cells and subsequent thickening of final gold–copper concentrate;

The final copper concentrate slurry with a grade of around 25% copper is pumped to the town of Blayney where it is filtered and exported using the same filtration facilities as used by Concentrator 1.

Approximately 15% of the gold in feed ore is recovered as gravity concentrate and then smelted on site to produce gold doré for sale.

17.5 Plant Debottlenecking

Engineering options were brought evaluated from earlier pre-feasibility and trade-off studies on the comminution circuits during 2019, to increase total plant capacity from approximately 30–32 Mt/a to 33 Mt/a, and potentially up to 35 Mt/a.

Higher plant throughput will be achieved by the following debottlenecking sub-projects on Concentrator 1 and Concentrator 2:

- Concentrator 1 (to increase throughput from 23 Mt/a to a nominal 26 Mt/a):
  - Existing conveyor upgrades and some new conveyors;
  - New secondary crusher circuit to process material currently bypassing high-pressure grinding rolls (HPGR) circuit;
  - SAG mill motor upgrade to 22 megawatts (MW) from current 20 MW;
- Concentrator 2 (to increase throughput from 7 Mt/a to a nominal 9 Mt/a):
  - Upgrades to primary cyclones and cyclone feed pumps;
  - Secondary and tertiary crusher upgrades from MP800 to MP1000 units.

Studies have commenced to investigate downstream flotation and dewatering requirements to handle the planned higher throughputs.

The Concentrator 1 flotation upgrade envisages the installation of a second coarse ore flotation circuit. The primary grinding circuit is expected to produce a coarser grind around 220 µm (flotation feed) at the highest throughput (nominal 26 Mt/a), compared to 180 µm used in current operations. The additional throughput, up to 3 Mt/a, will be processed through train 1/train 2 only. Train 3 is to be left unchanged. The coarse concentrate to be reground in a new Vertimill and upgraded via a Jameson cell before returning the upgraded concentrate into the existing regrind and train 1/train 2 cleaner circuit.

The Concentrator 2 upgrade is likely to involve the addition of additional grinding circuit power and rougher flotation capacity to maintain and/or improve overall plant recovery.

17.6 Energy, Water, and Process Materials Requirements

17.6.1 Energy

Concentrator 1 uses approximately 60% of the site total power consumption, with Concentrator 2 using a further 15%. This means that the site processing areas including water reticulation and tailings storage account for 75% of site power demand (refer to Section 18.9). This power is delivered via a distribution network fed by the site link to the state electricity grid.

17.6.2 Water

The processing plant uses the general site supply water which is a combination of water recovered from site reclamation areas and dewatering facilities, as well as water supplied from the site (refer also to discussion in Section 20.7 and Section 20.8).

17.6.3 Process Consumables

Key processing reagents include collectors, frother, lime, and flocculant with other key materials being mill grinding media.

The site has suitable reagent handling and storage facilities for these items, with all materials transported to site via road transport

17.7 QP Comments on "Item 17: Recovery Methods"

The QP notes:

- Concentrator 1 and Concentrator 2 use conventional equipment;
- The technology associated with the ore processing is an industry standard for porphyry copper deposits, with the exception of the coarse ore flotation processing that uses HydroFloat technology, which has been successfully proven on train 3;
- Both plants have undergone a number of modifications and upgrades. The LOM plan assumes that additional debottlenecking will be required;
- Saleable products include a copper concentrate and doré bars;
- The site processing areas including water reticulation and tailings storage account for 75% of site power demand;
- The processing plant uses the general site supply water which is a combination of water recovered from site reclamation areas and dewatering facilities, as well as water supplied from the site. Processing can be affected by drought periods (see Section 20.8). Newcrest has developed and implemented a water conservation strategy to support operations during low rainfall periods;
- Additional water supplies and or storages will be required if the processing rate exceeds 35 Mt per calendar year. A revised water balance will be required in this eventuality, and if the City of Orange resumes the water supply from the Orange Sewage Treatment Plant (refer to discussion in Section 20.8).

18 PROJECT INFRASTRUCTURE

18.1 Introduction

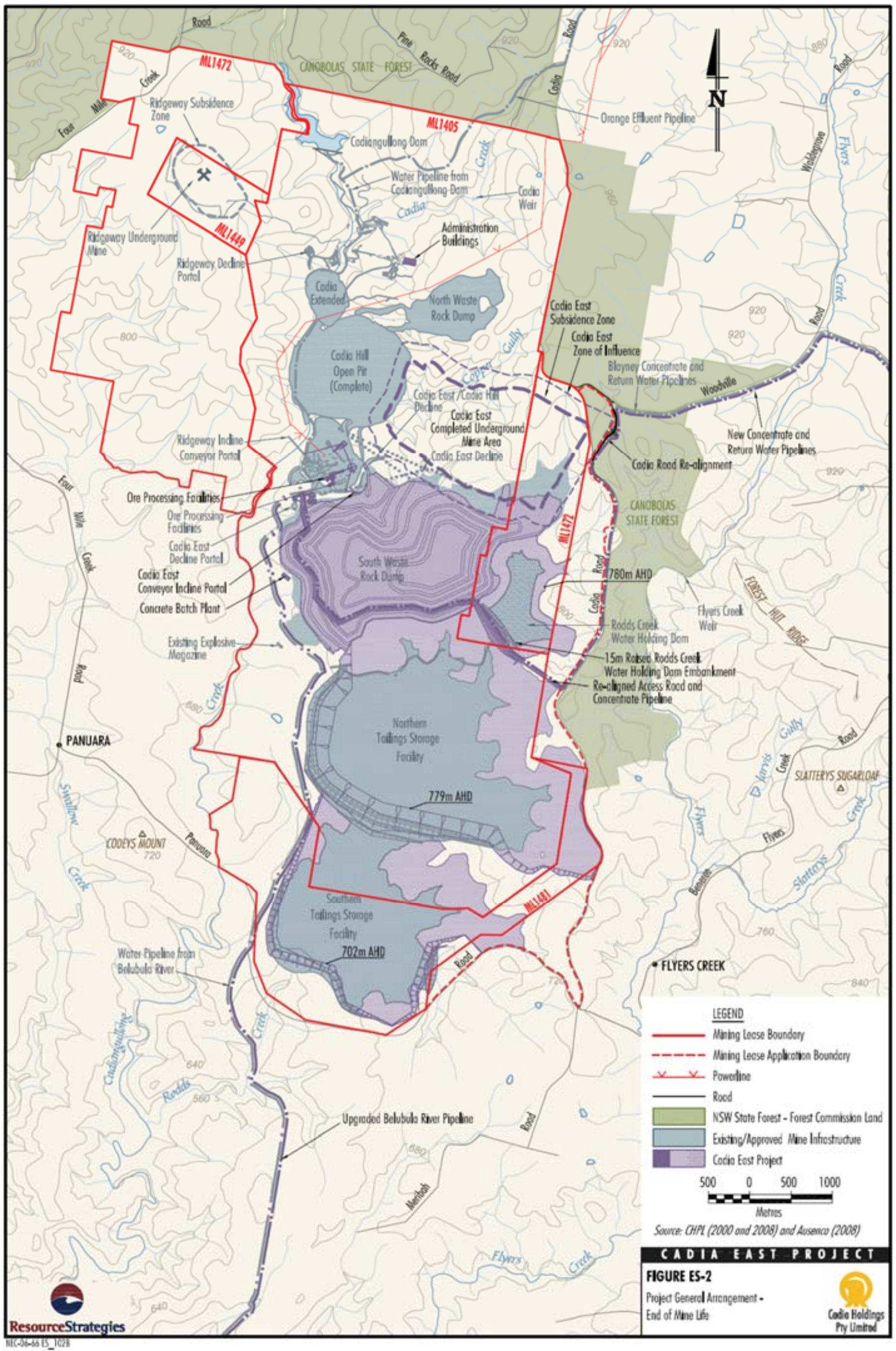
Key infrastructure supporting the Cadia Operations includes:

- Operating panel cave mining operations at Cadia East;
- Block cave operations at Ridgeway (on care and maintenance);
- Ridgeway and Cadia decline and conveyor incline boxcuts and portals, hardstand areas, contractor's area, mine workshops, general stores building, fuel storage facility, and administration and ablution facilities;
- Underground crushing, handling and incline conveyor systems to transfer ore and waste rock mined from Cadia East and Ridgeway to the Cadia Operations ore processing facilities;
- Ventilation shafts at both Cadia East and Ridgeway;
- South Waste Rock Facility;
- Cadia Operations ore treatment facilities consisting of Concentrator 1 and Concentrator 2;
- Molybdenum recovery plant (currently in construction execution);
- Northern tailings storage facility (NTSF), southern tailings storage facility (STSF) and Cadia Pit TSF and associated tailings pipelines, pumps and tailings water return infrastructure. This infrastructure has a serviceable life until 2037. Planning for the expansion of these facilities to facilitate production beyond 2037 is currently underway;
- Water management structures (Cadiangullong Dam, Copper Gully Dam, Hoares Creek Dam, Cadia Creek Weir, process water pond, site runoff pond, sediment ponds, waste rock dump leachate ponds, tailings drainage collection ponds);
- Water pipelines and pumping stations;
- Electricity substation, powerlines, communication towers, and switching stations;
- Helipad;
- Blayney and Cadia dewatering facilities;
- Various support facilities including truck and vehicle shops, warehouse, administration, contractor and temporary offices, fuel storage, core processing facilities, clinic and emergency response facilities, gatehouse, mess facilities, change rooms, personnel training facilities, information technology (IT) communications setups and towers, environmental monitoring facilities, water treatment plants, sewage treatment plants, reagents shed, and plant nurseries;
- Concentrate loading and handling facilities.

The railway facilities are leased.

The infrastructure layout for the operations is shown in Figure 18-1.

Figure 18-1: Infrastructure Layout for LOM Plan



Note: Figure prepared by Resource Strategies, 2012.

The proposed Cadia expansion project will require the following:

- Process plant debottlenecking enabling 33–35 Mt/a throughput rates, involving:
  - Concentrator 1 secondary crushing expansion;
  - Concentrator 1 SAG mill motor upgrade to 22 MW;
  - Concentrator 1 expansion of coarse ore flotation technology;
  - Concentrator 2 upgrades to crushers, and additional tertiary grinding and flotation capacity;
- Underground mine cave establishment for PC2–3, PC1–2, PC1–4, PC2–4, PC2–5, PC3–1, and PC5001 in Cadia East and Ridgeway Deeps Lift 1 and Lift 2 at Ridgeway with associated support infrastructure.

The final infrastructure layout that supports the LOM plan is provided in Figure 18-2.

18.2 Road and Logistics

18.2.1 Roads

The Mid Western Highway (State Highway 6) connects Bathurst to Hay in western NSW, via Blayney, and the Mitchell Highway (State Highway 7) connects Bathurst to Bourke in northwestern NSW, via Orange. The Great Western Highway (State Highway 5) which connects Bathurst to Sydney provides access to Sydney.

Main Roads 245 and 559 provide a link between Orange and Blayney (refer to Figure 2-1).

The principal route used to access the Cadia Operations is from Orange via Forest Road and Cadia Road.

Gravel haul roads provide access to the processing facilities, TSFs, and WRSFs. Gravel roads are used to access areas such as water supply dams, and ventilation shafts. Use of these internal access roads is restricted to mine personnel.

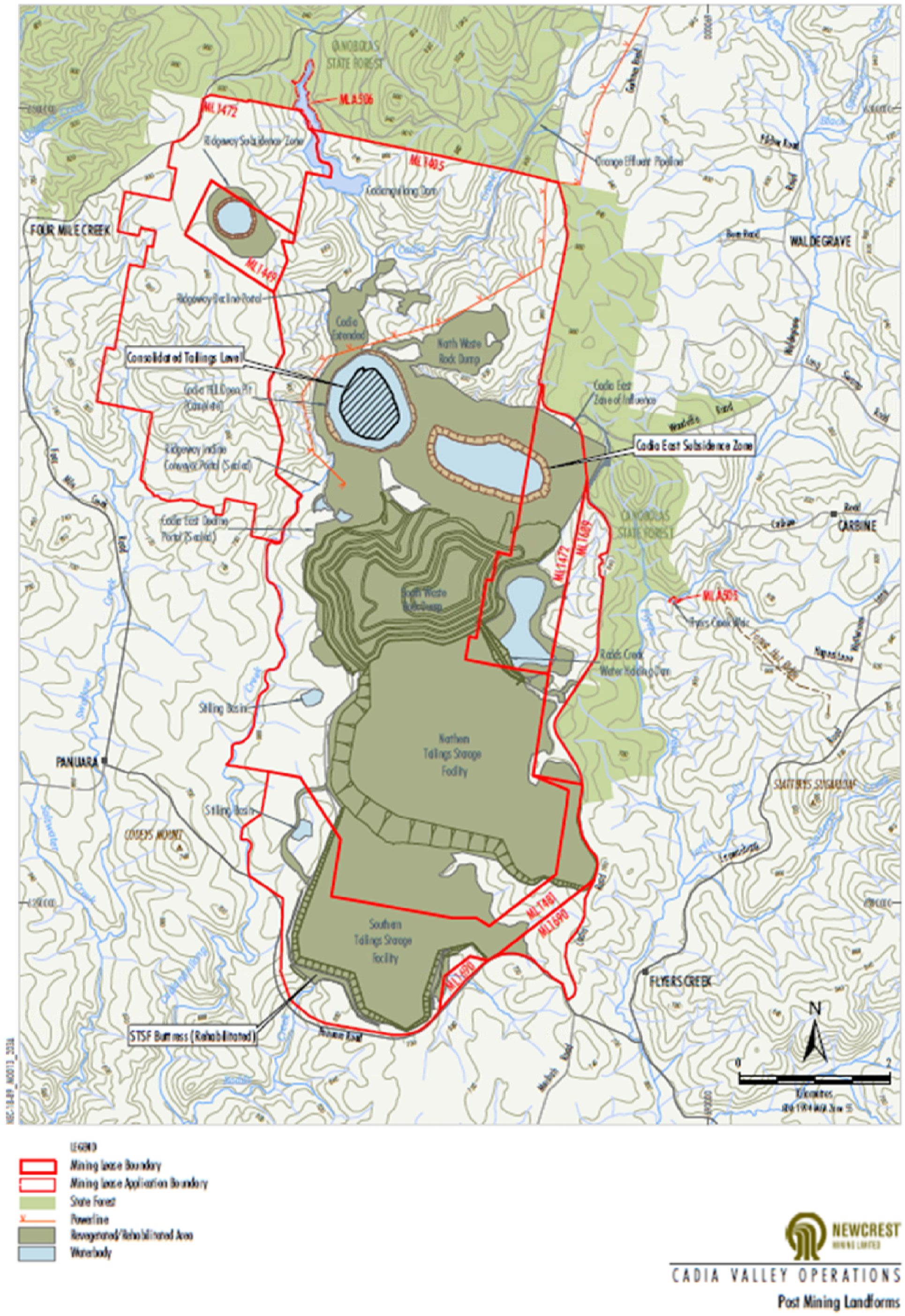
The Cadia Operations Dewatering Facility is accessed from Newbridge Road, which connects to the Mid-Western Highway in Blayney via Burns Street.

18.2.2 Concentrate Dewatering and Handling

Copper concentrates are pumped to the Cadia dewatering facility at Blayney for final dewatering and railing to the Port Kembla Gateway for shipping to customer smelters. Design capacity is based on a concentrator copper metal production of up to 115 kt/a with a copper concentrate grade of 20.8% copper and 9% moisture content. The design of the Cadia Operations dewatering facility includes an additional allowance for concentrate volume variations on a daily, weekly, and monthly basis, and maximum design capacity is 622,000 dt/a.

Concentrate is loaded into containers using a mobile loader and forklift. The current rail contract with Qube allows for trains of 44 wagons (88 containers) based on about 5.5 rail services per week.

Figure 18-2: Final Project Layout



Note: Figure prepared by Newcrest, 2018.

Port Kembla Gateway currently loads between two and three ships per month at an annual rate of between 300,000–400,000 dt/a, and has the potential capacity to handle between 600,000–700,000 dt/a. Newcrest has a Services Agreement in place with Port Kembla Gateway for the receival of concentrate by rail, unloading of trains, storage of concentrate prior to shiploading, stevedoring of concentrate and loading by bulk conveyor and spout onto export vessels. Port Kembla Gateway has a lease in place with NSW Ports to 2022; and is currently in negotiations for lease extension. Newcrest's Services Agreement with Port Kembla Gateway is tied to the port lease, and could be extended if the lease is extended.

18.3 Stockpiles

Stockpiles are discussed in Section 20.4.

18.4 Waste Storage Facilities

The WRSFs are discussed in Section 20.5.

18.5 Tailings Storage Facilities

The TSFs are discussed in Section 20.6.

18.6 Water Management

The water management strategy and supporting infrastructure are discussed in Section 20.7.

18.7 Built Infrastructure

As noted in Section 18.1, much of the mine infrastructure is constructed and operational. However, additional infrastructure will be required to support the LOM plan:

- New office complex and change house at Cadia East;
- High compression thickening facility;
- New TSF pipelines;
- Concentrator load-out shed expansion;

18.8 Camps and Accommodation

As the Project is drive-in-drive-out of Orange and other nearby communities, there are no accommodation requirements.

18.9 Power and Electrical

Power is currently supplied by the state-owned electricity firm, Essential Energy, from Orange via a dedicated high voltage transmission line with a transfer capacity limit of 175 MVA. The site power consumption is approximately 150 MW with 40 MW used for underground mining and 110 MW for the process plants.

When the plant is expanded to 33–35 Mt/a, the electrical demand will peak at around 187 MVA.

Under existing arrangements, the Cadia Operations receive supply at 132 kV from the TransGrid Orange North 132 kV switching station, through an Essential Energy dual-circuit 132 kV transmission line (designated 9 MC and 94G). The combined dual circuit has a technical rating limitation of approximately 300 MVA whilst the connection agreement between Essential Energy and Newcrest has a contractual limit of 175 MVA.

The preliminary modelling of the mid-western NSW transmission system has identified supply restrictions under various contingent scenarios.

- Under system intact conditions, the regional transmission system has sufficient capacity to meet the increased power demands of the Cadia expansion project;
- Under N-1 system constraint conditions, the regional transmission system has insufficient capacity to meet the increased power demands of the Cadia expansion project at 0.95 power factor, which would require a reduction in site production. It is noted that due to regular maintenance activities within the TransGrid transmission system, the regional transmission system is regularly operating within N-1 system constraints;
- Under N-2 system constraint conditions, the regional transmission system has insufficient capacity to meet the increased power demands of the Cadia expansion project and would require a reduction in site production down to an instantaneous rate of approximately 29 Mt/a.

Capital expenditure is required within the TransGrid transmission system to remove the network constraints under N-1 and N-2 conditions. Apart from minor maintenance works within the network, TransGrid has advised that their network planning is currently based on forced load shedding under network constraint conditions and that additional capital expenditure to remove system constraints is not being considered. Formal negotiations are being undertaken with Essential Energy to increase the maximum transfer capacity limits defined within the connection agreement from 175 MVA to 200 MVA. In addition, negotiations are continuing with TransGrid and Essential Energy to identify long-term augmentation works to reduce or eliminate the restrictions within the regional 132 kV transmission network.

The Cadia Operations are supplied by a dedicated 132 kV transmission line feed which in turn feeds into site switchyards. Onsite distribution is via the 132/33 kV substation. The substation contains three 110 kVA ONAF transformers. The switchyard is adjacent to Concentrator 2, and distributes power to the various substations. Two 33 kV feeders currently run from the surface substation to provide a ring main to the underground workings.

18.10 Fuel

The Cadia Operations maintain a month's fuel supplies on site to service the light and heavy vehicle fleet requirements.

18.11 Workforce

Mining operations are conducted on a 24-hour day, seven day a week basis.

The total operational workforce at the Cadia Operations (including mining contractor's personnel and personnel at the Blayney dewatering facility) currently averages about 1,200 persons.

The proposed Cadia expansion would see an increase in workforce numbers to approximately 1,700 at peak, before returning to about 1,200 persons after capital works have been completed.

18.12 QP Comments on "Item 18: Project Infrastructure"

The QP notes:

- Infrastructure required for current mining operations has been constructed and is operational;
- Some additional facilities will be required to support the planned Cadia expansion and Ridgeway operations;
- The preliminary modelling of the mid-western NSW transmission system has identified supply restrictions under various contingent scenarios, although under system intact conditions, the regional transmission system has sufficient capacity to meet the power demands of the Cadia expansion project.

19 MARKET STUDIES AND CONTRACTS

19.1 Market Studies

19.1.1 Existing Markets

Cadia produces a high-quality clean copper concentrate with typical copper grade, high gold grades, payable silver credits and relatively low levels of impurities. Because of its quality and the continuing strong global demand for concentrate, the current Cadia concentrate is readily marketable to any of several smelters in Australasia.

Cadia produces doré which is delivered to a gold refinery in Australia to produce refined gold and silver. Refined gold is sold on the open market. Refined silver is credited to the refiner to offset gold and silver refining cost or sold on the open market. As at 30 June, 2020, the Western Australia Mint in Perth was Newcrest's preferred refiner.

19.1.2 Cadia East

The majority of the world's copper concentrate (concentrate) production is processed through pyrometallurgical processes in copper smelters and refineries throughout the world. Primary smelting technologies may be further broken down to Outokumpu, Mitsubishi, Teniente, Noranda, Isasmelt and Vanyukov processes. Recent technological advances have seen the introduction of double flash and bottom blown furnaces (BBFs), with both technologies being advanced significantly in China. The BBFs are said to be able to treat lower concentrate grades with higher impurities whilst maintaining high metal recoveries.

Copper market demand is driven by electrical network demand and underpinned by construction (including nonelectrical applications) which primarily reflects the nature of continued Chinese consumption.

Mines producing concentrate and smelters smelting and refining concentrate can be categorised as either integrated or custom. Integrated mines/smelters produce concentrate from their own mines for feed to their own smelters. Custom producers buy or sell concentrate on the open market. Some integrated producers cross the arbitrary definition by buying or selling concentrate on the market from time to time to supplement smelter feed or to offload excess mine production. The custom market accounts for ~63% of global copper concentrate and has grown markedly over the last 20 years. In contrast, the integrated share of the market has diminished over time.

Growth in demand for refined copper has been dominated by China over recent years, and global refined copper marginal demand is virtually completely dependent on Chinese demand.

Demand for custom concentrate is manifested through demand by custom smelters. In terms of demand for copper concentrate, this market is also China-centric. China has emerged as the largest buyer of copper concentrate on a global basis. Consequently, whereas Japanese and European smelters once led the market in establishing commercial terms which were often followed by others in the market, the Chinese smelters now share that role. Some 80% of custom concentrate purchasers are located in the Asian region.

Cadia's natural market for concentrate is Asia, and Cadia has a comparative advantage in selling to nearby smelters in Asia when compared with mines in the Americas and Africa. As additional tonnage at Cadia is produced, it will either be added to existing contracts (those contracts will be expanded) or sold to new smelter customers in Asia with whom direct communication already takes place. No premiums payable to the smelters are expected to be incurred.

Although most smelters once sought to feed concentrate at 28–33% Cu on a blended basis, declining grades from major mines have forced them to feed at about 25–28% Cu. At a grade of around 25% Cu, Cadia concentrate will continue to be purchased for blending with higher-grade material. Provided that the concentrate maintains acceptable levels of copper and low levels of impurities, the potential for scalability in Cadia concentrate sales contracts is good.

The forecast average concentrate volume of 390,000 dmt per annum is expected to be able to be sold into the market on a forward (contracted) basis. Any excess concentrate from long-term contract quantities would be expected to be sold into the trader/spot market

The current typical copper payable by a smelter is 96.5%, subject to a 1.0 unit deduction for a copper content of 20–30%. At levels exceeding 30–33%, smelters may agree to a higher copper payable rate. However, some smelters have also sought a higher unit deduction for concentrate where the copper grade is below 24%. For standard grade for copper concentrates (25–35% Cu), direct mine-smelter treatment charges over the past 10 years have varied from US$42–US$110 per dry metric tonne of concentrate, and refining charges from US¢4.2–US¢11.0 per pound payable copper.

The gold payable scale in a sales contract may vary from smelter to smelter. Typically, an Asian smelter will have payabilities at the average LOM Cadia Extension gold-in-concentrate grade of 36 g/t Au of about 97.5%. However, over the projected annual gold-in-concentrate grade range of 28–66 g/t Au, payabilities could range from 97.5–98.25%.

In Asian markets, silver is paid at 90% of the analytical silver content subject to such content being higher than 30 g/t Ag. No payment is made below 30 g/t Ag.

19.1.3 Ridgeway

Marketing for any future production from Ridgeway would use similar approaches to those outlined in Section 19.1.2. for Cadia East.

19.2 Commodity Price Projections

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

Metal price assumptions used for the 2019 Mineral Resource and Mineral Reserve estimates are provided in Table 19-1.

Pricing and exchange rate assumptions used in the financial modelling that supports the Mineral Reserves are provided in Table 19-2.

Table 19-1: Mineral Resource and Mineral Reserve Metal Price Assumptions

Area	Parameter	Unit	Value
Mineral Resources	Gold price	US$/oz	1,300
	Copper price	US$/lb	3.40
	Silver price	US$/oz	21
	Molybdenum price	US$/lb	10
Mineral Reserves	Gold price	US$/oz	1,200
	Copper price	US$/lb	3
	Silver price	US$/oz	18
	Molybdenum price	US$/lb	8
	A$ exchange rate	A$/US$	0.75

Table 19-2: Cadia East Metal Price Assumptions

Parameter	Unit	FY19	FY20	FY21	FY22	FY23+
Gold price	US$/oz	1,250	1,250	1,250	1,250	1,250
Copper price	US$/lb	3	3	3	3	3
Silver price	US$/oz	17	17	17	17	17
Molybdenum price	US$/lb	8	8	8	8	8
A$ exchange rate	A$/US$	0.75	0.75	0.75	0.75	0.75

Note: FY = financial year; runs from 1 July to 30 June.

19.3 Contracts

There are 11 contracts currently in place to support copper concentrate sales/transport including five concentrate sales contracts, two long-term bulk shipping contracts, ship-loading service contract, rail contract, load/port agency contract, and a data management/invoicing contract. A contract is also in place for doré refining.

Other major contracts cover items such as electricity supply, bulk commodities, operational and technical services, mining and process equipment, earthworks projects, security, transportation and logistics, and administrative support services. Contracts are typically reviewed and negotiated on a frequent basis. Contract awarding is in accordance to the procurement standard and a delegation of authority process. Based on Newcrest's knowledge, the contract terms are typical of similar contracts both regionally and nationally.

Contracts required to support the future Cadia East and Ridgeway developments are expected to be in line with existing contract terms and norms.

19.4 QP Comments on "Item 19: Market Studies and Contracts"

The QP notes:

- Cadia East currently produces a high-quality copper concentrate with high gold grades, payable silver credits and relatively low levels of impurities that do not attract a penalty from smelters;
- The current Cadia East operation has concentrate sales contracts in place;
- The terms contained within the refining agreement and sales contracts are, in Newcrest's experience, typical of and consistent with Australian standard industry practice, and are similar to contracts for the supply of copper concentrate elsewhere in Australia;
- Future concentrate production from Cadia East and Ridgeway is expected to be marketed to Asian smelters;
- As additional concentrate tonnage at Cadia is produced, it will likely either be added to existing contracts (those contracts will be expanded) or sold to new smelter customers in Asia with whom direct communication already takes place. No premiums payable to the smelters are expected to be incurred. The terms contained within any new contracts would be expected to remain in line with industry norms;
- Forecast payability and deduction assumptions appear reasonable;
- Contracts are currently in place in support of project operations. These contracts are negotiated and renewed as needed. Contract terms are within industry norms, and typical of similar contracts in Australia that Newcrest is familiar with;
- Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

The QP is of the opinion that the marketing and commodity price information is suitable to be used in the project-level cash flow evaluations supporting Mineral Reserve estimates.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Introduction

The main New South Wales legislation of relevance is the EP&A Act.

Newcrest presently holds a Project Approval for the Cadia East Project (06_0295) under the EP&A Act (as modified) that provides for mining operations until 30 June 2031.

Other NSW State legislation of particular relevance to the proposed Cadia expansion include the following Acts and subordinate regulations:

- *Mining Act, 1992*;
- *Protection of the Environment Operations Act, 1997*;
- *Water Management Act, 2000*;
- *Biodiversity Conservation Act, 2016*;
- *National Parks and Wildlife Act, 1974*.

The key Commonwealth act of potential relevance to the Cadia expansion is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Newcrest holds an approval under the EPBC Act for the Cadia East Project (2006/3196). The EPBC Act approval (2006/3196) also has effect until 30 June 2031.

20.2 Baseline and Supporting Studies

20.2.1 Completed Studies

Detailed baseline studies were completed at each major stage of the development at Cadia, including:

- Cadia Hill Environmental Impact Statement (CHPL, Cadia Hill Environmental Impact Statement, 1995);
- Ridgeway Environmental Impact Statement (CHPL, 2000);
- Cadia East Environmental Assessment (CHPL, 2009).

Environmental monitoring is documented in the following reports:

- Cadia Water Management Plan (2014);
- Cadia Land & Biodiversity Management Plan (2016)
- Cadia Air Quality Monitoring Program (2014);
- Cadia Noise Monitoring Program (2014);
- Cadia Vibration Monitoring Program, incorporating Blast Monitoring Program, (2014).

Social community related baseline studies include:

- Cadia Community Impact Review (Gillespie Economics; 2009);

- Cadia Socio-Economic Study (Western Research Institute; 2013);
- Community Sentiment Survey (2010);
- Community Sentiment Survey (2016).

20.2.2 Cadia East Extension

It is expected that a number of social, cultural heritage and environmental baseline studies will require updating to support the submission of the proposed project permitting application. These studies would also serve a basis for the community risk assessment and an update of the stakeholder engagement plans.

The Cadia expansion would require a Statement of Environmental Effects to comply with NSW regulatory planning approval requirements.

20.2.3 Ridgeway

Environmental baseline studies were completed in support of the original mining operation at Ridgeway, and included aspects such as:

- Waste disposal;
- Surface and ground water;
- Flora and fauna;
- Noise;
- Visual;
- Heritage;
- Traffic.

The proposed Ridgeway Lift 2 operation will be a brownfields mining project extending a previously mined open pit and underground mining operation. Due to the long-dated project start date, no environmental impact assessment or approvals have yet been completed specifically for Ridgeway Lift 2.

The proposed process pathway for approval of Ridgeway Lift 2 is likely to require a new development application for a major project to NSW Department of Planning which then may require an assessment by the Planning Assessment Commission (PAC). This process would include consultation with NSW Planning Department, other NSW government departments and extensive community consultation.

The process will likely require a variety of environmental studies e.g. ground water, surface water, noise, dust, tailings, socio-economics and waste management and could take several years to complete.

20.3 Environmental Considerations/Monitoring Programs

Monitoring undertaken across the Project includes:

- Noise monitoring;
- Air quality monitoring;

- Blast and vibration monitoring;
- Groundwater level and quality monitoring;
- Spring monitoring;
- Surface water flows and quality;
- Aquatic ecosystem monitoring;
- Rehabilitation monitoring;
- Pollution discharge monitoring.

Conditions in the Project Approvals, EPL 5590, and Mining Leases, require annual reporting to various organisations, and local and State government departments on Newcrest's environmental performance.

The Mining Leases further require a Mining Operations Plan to be prepared that outlines significant disturbance, rehabilitation plans and mine closure strategies.

Development not otherwise covered by the project approvals and Mining Operation Plans require new authorisations.

In line with ISO 14001 and the Newcrest Environmental Standard, the Cadia Operations have developed an Environmental Management Strategy that incorporates the Newcrest environmental policy, Newcrest environmental standards, identified impacts and risks and legal requirements. The strategy describes the way the Cadia Operations manages the identified environmental issues through objectives and targets and the use of management plans, programs, procedures and other documents. These documents form part of an overarching Environmental Management System (EMS).

Each of the management plans and programs were developed in consultation with relevant community groups, government agencies and departments, and are updated as required. Table 20-1 summarises the key documents and the monitoring regime in place.

Reports and results are regularly posted to the Cadia Operations website (http://www.cadiavalley.com.au/site/environmental-monitoring).

Potential noise (especially blast noise) and dust impacts were modelled using well-accepted methods, and appropriate mitigation programs developed. Real-time dust and noise monitors are located in sensitive areas, thus allowing prompt and effective response to complaints, and clear demonstration of compliance with national and NSW guidelines and regulations.

Table 20-1: Environmental Management and Monitoring Regime

Aspect	Management/Monitoring Plan or Program	Monitoring Type/ Parameters	Frequency of Sampling or Monitoring	Monitoring Locations
Vibration and overpressure	Cadia vibration (blast) monitoring program	Blast monitoring units (measure ground vibration (mm/sec) & air overpressure dB (Lin Peak))	24 hours continual (12:00 – 12:00)	Coorabin Meribah; Chimney; Chesterfield; Rosebank; Mayburies; Warrengong
Air quality	Cadia air quality monitoring program	Dust deposition (g/m^2/month)	Monthly	DG5A: Bundella; DG15A: Bundarra; DG17: Ashleigh Park; DG18: Wire Gully; DG19: Oakey Creek; DG29A: Meribah; DG12A: Flyers Creek Weir; DG9A: Exploration; GL6: Somervaille; DGL8: CDWF; DGL9 – Hollwood
		TEOM (PM10)	24 hours continual (12:00 – 12:00)	TEOM 1: Bundarra; TEOM 2: Flyers Creek Weir; TEOM 3: Triangle Flat; TEOM 4: Meribah
Noise	Cadia noise monitoring program	Directional unattended (7-day period) dBA and attended	Biannually on a rotation basis	Chesterfield; Warrengong; Willow Creek; South Log; Bonnie Glen; Rosebank; Northwest; Somervaille; Hollwood; 247 Newbridge Road; Athol
		attended	Biannually on a rotation basis	Blayney L1; Blayney L2; Blayney L3; Blayney L4 (if exceeding at L2); Blayney L5
		Traffic (directional unattended)	Biannually on a progressive basis	Cadia Road; Woodville Road; Orchard Road
Pests and weeds	Land and biodiversity (landscape) management plan	Vertebrate pests, noxious weeds, environmental weeds	Continuous	Site wide CDF's and neighbouring farms
Meteorology	N/A	Temperature; Barometric pressure; Wind direction; Wind Speed; Sigma-theta; Relative humidity; Solar radiation; Evaporation; Rainfall	Continuous	Weather Stations Ridgeway; Southern Lease Boundary Pluviometers (Rainfall only) PVDC; PVLO; 412147; USFC; SPR03; PV3; PV6; MB74; CWRR; 412167; 412702
Rehabilitation	Land and biodiversity (landscape) management plan	Ecology monitoring	Annually* *Pending climatic conditions, reference site monitoring may be extended to biannual	Woodland Reference Sites* RfWood01: Bundarra; RfWood02: Ashleigh Park; RfWood04: CVO Access Rd; RWood05 (RfBush01); RfPast01; RfPast03; RrRip02 (Bakers Shaft); RrRip03 (CVO Cadiang Ck) Monitoring Sites Ashleigh Park; South Dump 01; South Dump 02; South Dump 03; South Dump 04; South Dump 05; South Dump 06; South Dump 07; South Dump 08; South Dump 09; South Dump 10; North Dump 01; North Dump 02; North Dump 03; Willunga DS01; Willunga DS02; Cadiangullong Creek; Creek Diversion

Aspect	Management/Monitoring Plan or Program	Monitoring Type/ Parameters	Frequency of Sampling or Monitoring	Monitoring Locations
Cover system performance (including acid rock drainage)	Land and biodiversity (landscape) management plan	Thermal conductivity water; content sensor net; radiometer water levels; interflow monitoring; rain gauge	Continuous	North Waste Rock Dump P1; P2; P3; P4; P5; P6; S1; S2 Natural Site South Waste Rock Dump P1; P2; P3, P4; P5; P6
Aquatic ecosystem monitoring	Land and biodiversity (landscape) management plan	Macroinvertebrate, fish populations and aquatic habitat condition	Biannually (autumn and spring)	Cadiangullong Creek CC1; CC2; CC3; CC4; CC5 Flyers Creek FC1; FC2 Swallow Creek SC1 Panuara Rivulet PR1; PR2 Rodd's Creek RC1 Diggers Creek DG1
Historical heritage	Historical heritage management plan	Monitoring for structural damage of Cornish engine house, crusher and chimney & historic surrounds in SHR779	Monthly (internal); annual (external independent)	SHR 779
Sediment dams	Water management plan	Water level and maintenance / pump out requirements	Following 10 mm rainfall	1:100 ARI Design Dams SROP; Northern leachate (NLD); Southern leachate (SLD); ST14; R2 1:20 ARI Design Dams CS; AR1; AR4-5 combined; CD GL; CD HT; SB4A; SB10; SB12; SB14; SB15; CD15; CP1A*; CP2; CP3; CP4; CD11' CD13; CD14; Molybdenum Plant Area; RCD (1); H18-H19 combined; T6; T7-T8 combined (1)

The Cadia Operations operate under Newcrest's Health, Safety and Environment Management System. In addition to established site standards and procedures, the Cadia Operations maintain a Major Hazard Register and a Risk Register.

20.4 Stockpiles

The majority of the surface stockpiles generated from the mining of Cadia Hill and Ridgeway were processed through the concentrator facilities. Mineral Resources in stockpiled materials were estimated at Cadia Hill.

20.5 Waste Rock Storage Facilities

The current waste rock materials and low-grade ore categories are classified using colour nomenclature (Table 20-2).

Low-grade ore and mineralised waste (i.e. yellow and green materials) are placed in accessible parts of the South Waste Rock Facility for reclamation. Blue waste rock can be used as construction material (e.g. for raising of the TSFs). Pink waste is encapsulated with a combination of a low permeability layer and a cover of blue waste material over each layer of pink waste material. The cover system is designed to reduce oxygenation and infiltration rates.

The approved South Waste Rock Facility has a surface disturbance area of approximately 450 ha and extends to about 100 m above the natural surface level. The facility is partially rehabilitated in accordance with Newcrest's commitment for progressive rehabilitation over the life of the mine. In-line with this strategy, additional rehabilitation is planned to be completed prior to operational closure.

Mine waste and tailings were subject to rigorous geochemical testwork, using best-practice methods to assess risks of acid generation from oxidation of sulphides. While some waste is potentially acid forming (PAF), kinetic testwork (regular leaching of columns of material) has shown that sulphide oxidation is slow, so that PAF waste is unlikely to produce acid drainage while stored at surface prior to being encapsulated with non-acid forming (NAF) and/or acid-consuming waste.

Prior to encapsulation, PAF material is stored in a designated compartment within the waste stockpile, to manage risks of acidic and metal-enriched (particularly copper-enriched) drainage escaping to the broader environment. As much as 50% of the open-pit mine waste was PAF, as is almost all underground waste.

20.6 Tailings Storage Facility

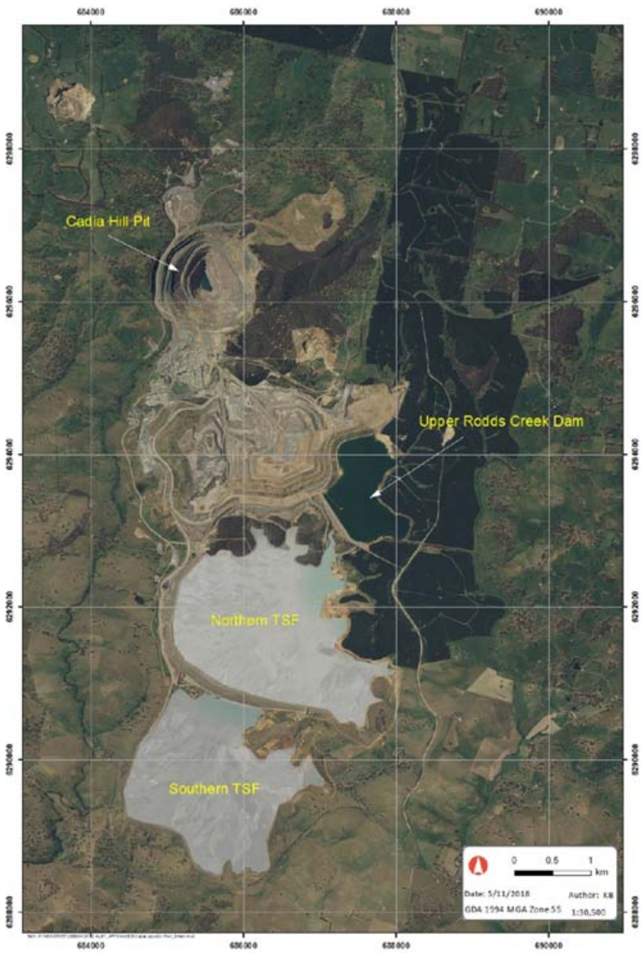
20.6.1 Overview

There are three tailings storage facilities: the NTSF, the STSF, and the mined-out Cadia Hill open pit (Cadia Pit TSF), each of which are located within the Cadia mining lease (Figure 20-1).

Table 20-2: Waste Management

Waste Type	Comment
Blue waste	Managed as non-acid forming (NAF); identified by ore control as having a modelled total sulphur content that is less than 0.5%.
Pink waste	Managed as potentially acid-forming (PAF); identified by ore control as having modelled total sulphur content that is greater than or equal to 0.5%.
Yellow waste	Stockpiled, low-grade mineralised ore.
Green waste	Stockpiled mineralised waste rock with current sub-economic gold/copper content. This material may or may not be reclaimed for processing before the end of the mine life; is mineralised and managed as PAF.

Figure 20-1: Tailings Storage Facility Location Plan



Note: Figure prepared by Newcrest, 2018.

The NTSF, in operation since 1998, is located approximately 3 km south of the processing plant site, and the STSF, in operation since 2002, is downstream of the NTSF. Both TSF embankments were constructed across the former Rodds Creek; the NTSF being at the upstream location and the STSF at the downstream location.

The NTSF design consists of an earth and rock-fill dam, with 10 embankment raises undertaken. All raises since 2005 have involved upstream construction. The STSF is also an earth and rock-fill dam, with, to date, six embankment raises undertaken, also generally using the upstream method.

Tailings were shown to be NAF, which significantly reduces potential costs of closure and rehabilitation of TSFs.

20.6.2 NTSF Embankment Failure

On March 9, 2018, a mobile slump (the Event) occurred in the southern wall of the NTSF, causing the NTSF to lose containment of tailings. The tailings were captured within the basin of the STSF. There has been no abnormal movement in the NTSF wall, or release of material from the NTSF since the Event to the Report effective date.

An Independent Technical Review Board (ITRB) investigation of the Event was completed in April, 2019 and has been publicly released. Key ITRB findings included (Jefferies et al., 2019):

- The Event occurred because of deformation in the foundations during the last months of Stage 10 construction, led to the removal of support for the tailings thus triggering liquefaction of the loose saturated tailings;
- The dominant factor controlling the location of the Event was the presence of a previously-unidentified lithological unit, the Forest Reef Volcanics (FRV) Unit A, which forms a low-density foundation layer within a variably weathered volcaniclastic succession that has a complex geological history. This material has only been found near the failure zone. The FRV Unit A is relatively weak, highly compressible, and strain-weakening (brittle) when subjected to load.
- Event-contributing factors included the local height of the dam, prevailing phreatic conditions, and additional excavation at the toe of the structure;
- The timing of the Event was controlled by the deformations accumulated through the construction history which were sufficient to trigger static liquefaction in the loose saturated tailings stored in the NTSF;
- The occurrence of two small earthquakes on the day prior to the Event had no role in the Event.

The ITRB recommended that to avoid the type of failure experienced in the Event, Newcrest should (Jefferies et al., 2019; Newcrest, 2019):

- Continue to work on ensuring that the design and maintenance of the foundations take into account any weak material comparable to that in the area of the NTSF slump, as well as the limited drainage within the body of both the NTSF and STSF and the potential for liquefaction of the tailings;
- Enhance the level and type of monitoring equipment, including monitoring within the foundations of the TSFs, to ensure that the foundation is behaving as intended;

- Approach the design, construction and operation of upstream tailings dams using a more precautionary view.

Newcrest engaged expert engineering firms to confirm that the STSF remained safe to operate (Newcrest, 2019). Investigations and stability assessments were conducted. Remedial stabilisation was required for part of the STSF embankment to deal with deficiencies identified. Additional stabilisation measures may be required when detailed design of future raises is done. Consistent with recommendations from these experts, in 2018 Newcrest commenced construction of buttresses in two areas of the STSF, which have now been completed (Newcrest, 2019). In designing this buttressing, Newcrest and its external engineers have assumed the potential presence of weak material analogous to that in the area of the NTSF slump and adopted conservative strength parameters.

Newcrest is evaluating the prospect of restoring the NTSF to service. The methodology of construction is still under review. For the purposes of the LOM plan, the approved upstream lift technique has been used, and the STSF operations are assumed to be maintained in a similar manner. The findings of the ITRB will be factored into the study for the repair of the NTSF.

A prohibition notice issued by the NSW resources regulator on depositing tailings in the NTSF remains in place as at 31 August, 2020.

20.6.3 Cadia Pit Tailings Facility

Newcrest was granted approval on 20 April 2018 to use the former Cadia Hill open pit as a TSF. Cadia Valley Operations Modification 11 – Cadia Hill Tailings (Modification 11) allows in-pit deposition up to a final consolidated elevation of 420 mAHD. Pit deposition commenced on 5 May, 2018.

On 24 September 2018, approval of the Cadia Hill Tailings Continuation Modification (Modification 12) was granted to increase the consolidated tailings level to 560 mAHD. Modifications 11 and 12 provide capacity for approximately four years of tailings deposition into the Cadia Hill open pit (for that facility) at permitted annual ore processing rates. Modification 13 allows for tailings disposal to a maximum level of 713 mAHD.

20.6.4 LOM Requirements

LOM plan requirements for tailings storage were reviewed during 2019. The available storage capacity of the NTSF was estimated at 304 Mt from 1 July 2019 to the final approved design height. Storage capacity of the STSF was estimated at 105 Mt from 1 July 2019 to the currently-approved design height.

Newcrest identified the opportunity to deposit tailings within the completed Cadia Hill open pit. The total deposition storage for the Cadia Pit TSF would be 295 Mt from 1 July 2019. The elevation raise that has been granted provides for an additional 177 Mt of storage capacity.

The deposition plan for operations would therefore consist of the three TSFs, with the Cadia Pit TSF receiving tailings from trains 1 and 2 from Concentrator 1, the NTSF receiving tailings from train 3 from Concentrator 1 and the STSF receiving tailings from Concentrator 2. In this scenario, the current tailings facilities will be filled after 2037.

A new TSF will be required later in the mine plan life to support the LOM plan plant production envisaged in this Report. Planning for this work is currently ongoing with a number of locations and deposition options under consideration. Once a plan has been confirmed it will require regulatory approval from statutory authorities. Newcrest considers that there is sufficient time for finalisation of the plan and for this approval to be obtained. The capital and operating cost estimates include provision for the new TSF. These costs were included in the economic analysis that supports the Mineral Reserves.

20.6.5 Deposition Methods

The tailings delivery infrastructure currently delivers tailings from Concentrator 1 (trains 1 and 2) and train 3 to the NTSF, and tailings from Concentrator 2 to the STSF. Tailings in the above-ground TSFs are managed by perimeter spigot discharge and tailings are deposited sub-aerially.

20.7 Water Management

20.7.1 Management Strategy

The Cadia Operations water management system includes the components in Table 20-3. The majority of water on-site is recycled. The water management strategy is outlined in

Table 20-4.

The objectives of the erosion and sediment control system are to control soil erosion and sediment generation from areas disturbed by construction activities; and to maintain water quality (particularly in terms of suspended solids content) in local watercourses to acceptable standards for downstream use.

The water management strategy incorporates the following components:

- Sequencing to reduce to minimum practicable levels the potential for sediment generation;
- Upslope clean water diversions to limit run-on to disturbed areas;
- Use of small-scale runoff controls comprising silt fences and rockfill filter bunds;
- Rapid stabilisation and/or revegetation of disturbed areas.

20.7.2 Cadia Pit TSF

A review was conducted of the impact of using the mined-out Cadia Hill open pit as a TSF.

The geotechnical investigation, based on ongoing recalibration of geotechnical models, indicated that the Cadia Hill open pit and the Cadia East subsidence zone would not intersect. Instead of a single pit lake, there would be a lake on each of the two mining areas.

Table 20-3: Water Management System Elements

Item	Item
Tailings storage facilities return water system including the Central Pumping Station	Return water from the Blayney and Cadia dewatering facilities
Process water pond	Cadia Hill open pit (dewatering)
NTSF and STSF	Ridgeway/Ridgeway Deeps underground mine (dewatering)
Sediment dams and ponds containing site runoff	Cadia East and Cadia Hill Deeps exploration declines (dewatering)
Waste rock dump leachate ponds	Orange Sewage Treatment Plant treated effluent (delivered to site via a pipeline owned by Orange City Council
Cadiangullong Dam, which has a capacity of approximately 4,200 ML	On-site groundwater extraction bores (potable water, and process water under exceptional circumstances)
Cadia Creek Weir (gravity fed to Cadiangullong Dam)	Flyers Creek Weir. Allows extraction of water from Flyers Creek when flows in the creek are above 3.5 ML/day
Belubula River pumping system	Cadia Extended open pit acts as a water storage reservoir
Rodds Creek Water Holding Dam, which holds water pumped from the Belubula River (maximum annual licensed quantity of 7,205 ML) and other sources as required (see Table 20-4)	

Table 20-4: Water Management Strategy

Area	Comment
Processing plant and ore stockpile areas	Runoff from the ore processing facilities site is intercepted and conveyed to the process water pond via a system of bunded collection drains constructed around the perimeter of the plant area. The design basis is containment of all runoff from a one-in-100 year average recurrence interval (ARI), 48 hour rainfall event.
Mining operations	A system of sediment dams, clean water diversions, internal runoff drains and culverts are in place.
Mine dewatering system	Water collected from Ridgeway and Cadia Hill is sent to the process water pond or the Rodds Creek Water Holding Dam. Water from Cadia East is sent to TH2003 or the process water pond.
Tailings	Seepage from the NTSF reports to the STSF and decant pool. Seepage from the STSF reports to a seepage collection pond below the STSF. A float controlled electric pump located at the seepage collection pond returns collected seepage water to the STSF. Water recycling from the NTSF and STSF is maximised through the use of floating decant structures, a runoff/drainage collection pond and return water system.
Rodds Creek Water Holding Dam	Collects and holds the following: licensed water extractions from the Belubula River; water transferred from Cadiangullong Dam; excess water in the site water management system, including but not limited to excess water in the tailings storage facilities, water from on-site sediment dams, and water from underground dewatering activities; and treated effluent from Orange.
Internal runoff collection	Project area runoff is collected by a series of bunds and collection ponds, the majority of which are existing and approved. Runoff from the administration/laydown areas and other disturbed areas is collected during rainfall events and transferred to the process water pond or Rodds Creek Water Holding Dam for inclusion in the water supply system.

The groundwater assessment considered the potential groundwater implications of the proposed deposition of approximately an additional 177 Mt of tailings in the Cadia Hill open pit. Tailings slurry, initially deposited to 713 mAHD, will settle to about 563 mAHD in the middle of the former Cadia Hill open pit. Within a 6–7-year period, it is anticipated that the level of the tailings will fall below 700 mAHD and a lake will form over the settling tailings. post-closure, as the pit water level falls and equilibrates, the potential for direct seepage to Cadiangullong Creek will reduce to zero.

A post-mining groundwater elevation between 700–710 mAHD in the vicinity of Cadiangullong Creek indicates there will be an inward hydraulic gradient established southwest of the pit wall resulting in the pit forming a long-term ‘sink’. The groundwater quality would remain unchanged, as the water quality will remain subject to the long term evapo-concentration of salts and also acidic drainage of potentially acid-forming Ordovician host rock affecting pH and dissolved metal concentrations. Additional monitoring bores were installed to monitor the impact of tailings deposition in the Cadia Hill open pit, with further bores planned adjacent to the southwestern corner of the Cadia Pit TSF.

Surface water monitoring suggests that the in-pit water is currently significantly less saline than long term water quality predicted for the approved final void. From a surface water perspective, it was concluded that there would be minimal surface water impacts from the proposed continued tailings deposition into the Cadia Pit TSF.

Newcrest manages water that accumulates in the Cadia Pit TSF (from tailings supernatant water and rainfall runoff) by recovering (pumping) this water to the water management system for re-use in ore processing. Pumping rates would approximately match the tailings deposition rate and anticipated rainfall runoff. Reclaim from the Cadia Pit TSF would be given the same use priority as the other operational tailings storages.

20.8 Water Supply

20.8.1 Overview

Water supply for mining and processing purposes is characterised by variable supply sources. Water requirements are proportional to the amount of mineral processing and significant water storage is required to provide consistent supply. The amount of water taken from each source is dependent on the conditions set through agreement or licensing and the physical amount available.

The water supply scheme consists of recycling of water used on-site and make-up water required to compensate for losses in the system. Mine water and excess water in the TSFs are recycled. Make-up water sources comprise extraction from the Belubula River, Cadiangullong Dam, Rodds Creek Water Holding Dam, Flyers Creek Weir, Cadia Creek Weir, Orange Sewage Treatment Plant treated effluent, on-site groundwater extraction bores, and site run-off (see also water management discussion in Section 20.7).

Harvesting of water on-site (including Cadiangullong Creek, Flyers Creek, Cadia Creek, Rodds Creek and Copper Gully) is licenced at 4,200 ML/a.

In addition to ensuring adequate water supply, the water system also plays a critical role in managing water accumulation during prolonged periods of above average rainfall, as occurs during La Nina events. This is achieved by reserving airspace in the Rodds Creek

Water Holding Dam to allow transfer of water from the TSF, leachate collection dams and sediment control dams.

Treated sewage effluent is sourced from Orange under an agreement between the Orange City Council and Newcrest. The agreement has an upper limit on the amount that can be supplied per annum, but varies depending on the rainfall. Extraction of water from surface water systems (creeks and river) and groundwater is governed by water licences issued by the NSW State Government. The conditions imposed on those licences limit the rate of extraction, the times at which water can be extracted and the total amount of water that can be extracted per year.

The City of Orange has commissioned, but not yet finalised, a feasibility study on options for reuse of effluent from the Orange Sewage Treatment Plant for municipal purposes. This may result, in the next 5–10 years, in this water source no longer being available for Cadia Operations' purposes.

A water balance review in support of 33 Mt/a operations was completed, assuming deposition of highly-thickened tailings, 65% w/w solids, from Concentrator 1 into the Cadia open pit at a rate of 14 Mt/a. The remaining tailings from Concentrator 1 were assumed to continue to go to the NTSF at a rate of around 10 Mt/a, while Concentrator 2 tailings would report to the STSF at approximately 8 Mt/a. Models showed that there is a very low risk of water shortage in the short-term (five years). Over the longer term, there is a small risk of around 10% in any given year of a small short-fall of approximately 1,000 ML which equates to around 2 Mt/a of production rate. Installation of a high compression thickening facility to improve the overall recovery of water from tailings at the higher throughput rates and the installation of 150 L/s of dewatering capacity to return rainfall back to the process plant will be required to ensure acceptable water reliability for the Cadia Operations. No further external water sources or supplies are considered necessary for the proposed project.

Additional water supplies and or storages will be required if the processing rate exceeds 35 Mt per calendar year. A revised water balance will be required in this eventuality, and if the City of Orange resumes the water supply from the Orange Sewage Treatment Plant.

Droughts have, in the past, resulted in a prolonged period of very low water supply. Drought conditions are a risk to future operations if unduly prolonged. Based on the Aqueduct Water Risk Atlas, which assesses water risk on a five-tiered scale against a series of indicators (including physical quantity, quality, and regulatory and reputational risk) at Newcrest sites, water risk ranges from medium to high at the Cadia Operations. This rating is the median of the risk ratings assigned in the atlas.

20.8.2 Water Recycling

The LOM plan assumes that 65–70% of all water will be recycled.

Newcrest has continued to implement water saving efficiency measures which has resulted in net water recycling rates increasing from approximately 65–70% to approximately 85%. This higher rate of water recycling has been driven by improving the level of water recycle from the tailings thickeners in the process plant and by exceptionally high water recycle rates being delivered from the Cadia Pit TSF.

Newcrest continues to pursue further water saving initiatives, both in the plant and by way of optimisation of onsite bores.

20.9 Closure Plan

The overarching rehabilitation goals, final land uses and mine closure benchmarks are detailed in the Cadia Valley Operations Rehabilitation Strategy (CHPL, 2016). The details of rehabilitation work for all mine landforms are documented in the Cadia Mine Closure Plan (CHPL, 2018).

At the completion of mining, the key final landforms/features, as currently approved, will include the following:

- Landscaped pasture and woodlands over the South Waste Rock Facility and North Waste Rock Facility, and waste rock backfilled Cadia Extended open pit including selective encapsulation of potentially acid-forming waste rock, with a non-acid forming material and topsoil cover;
- Woodlands over the NTSF and STSF;
- Secured subsidence zones created by Ridgeway and Cadia East;
- Secured Cadia Hill open pit void;
- Decommissioning and rehabilitation of mine infrastructure, e.g. ore processing facilities and workshops;
- Retaining Rodds Creek Water Holding Dam, Cadiangullong Dam and associated pipelines for potential future regional water infrastructure demands;
- Vegetation corridor enhancement areas across Newcrest-owned land.

The key element of the Cadia expansion project that would require revision of the currently-approved Cadia East project rehabilitation commitments is the development and closure of the Cadia Hill open pit TSF that would largely be backfilled with tailings with a supernatant final void lake.

The Cadia Mine Closure Plan includes a detailed cost estimate, which is used in determining the closure liability. Additionally, the Mining Operations Plan is a requirement of the mining leases and contains Newcrest's rehabilitation commitments for the period of the plan (usually three years).

Considerable rehabilitation of WRSFs has already been completed, with success evidenced by the absence of significant erosion and by well-established vegetation.

Newcrest's closure planning includes provision for retention of infrastructure of potential use to other parties, and extensive monitoring, especially of water quality and landform stability.

The closure provision in the financial analysis supporting the Mineral Reserves, which includes the Cadia expansion mine plan, is estimated at A$122 M.

20.10 Permitting

20.10.1 Statutory Environmental Approvals and Compliance

The umbrella environmental approval for the Cadia Operations is the Environmental Assessment (EA) process operated through the *NSW Planning and Environment Act*. The January 2010 EA approval of the Cadia East operation incorporated all pre-existing approvals into a single instrument – this greatly facilitates co-ordination of compliance assessment and reporting.

Commonwealth (Federal) approval under the EPBC Act was required for Cadia East Project Approval because of potential impacts on a Federally-Listed Endangered Ecological Community. The Commonwealth agreed, as is usual, that Federal requirements could be addressed through the NSW EA process, so that no separate approvals process was required.

Subsidiary approvals (authorities to construct, licences to operate and to abstract groundwater and surface water, etc.) were obtained as required, beneath the umbrella of the EA and EPBC approvals.

These approvals have led to the development of sophisticated and well-integrated environmental management plans designed to satisfy the operational performance indicators and thresholds that form part of the approvals.

Compliance is at a high standard, facilitated by various monitoring and reporting programs that are stipulated as conditions of environmental approval. Minor exceedances and breaches predictably occur, but none is considered likely to significantly constrain the Cadia Operations.

Compliance is primarily reported via an Annual Environmental Management Report to the NSW government, as required by the umbrella EA process. Other reports are produced to meet conditions of subsidiary licences, as required by relevant legislation.

20.10.2 Operating Permits

Newcrest holds the key permits required to support the current operations. Key permits are summarised in Table 20-5.

20.10.3 Cadia Expansion

Newcrest presently holds a major Project Approval for the Cadia East project. The Cadia expansion project will trigger a need to evaluate the proposal under various NSW Government environment and mining legislations, and key Commonwealth legislations.

Changes to the Cadia expansion project are expected to require a new application and reviews conducted under a number of these legislative acts.

20.10.4 Ridgeway

Due to the long-dated project start date, no permitting assessments were completed specifically for Ridgeway Lift 2. It is assumed that similar processes to those envisaged for the Cadia expansion will be required. There is an expectation that a new EIS will be requested by the regulatory authorities, rather than a project approval modification.

Table 20-5: Key Permits

Permit/Permit Area	Note
Cadia East Project Approval	PA06_0295 and subsequent modifications
Granted mining leases	ML1405; ML1449; ML1472; ML1481; ML1689; ML1690
Local development consents	Black Rock Range Subdivision (Development Consent No. 16/2010)
Environmental protection licence	Approval No. 5590, and subsequent variations and revisions
Heritage approvals and permits	General monitoring/archival recording; conservation of Cadia (Cornish) engine house crusher room and chimney; development consent for a rural cemetery, garden of remembrance and interpretive centre; excavation permits for Little and Big Cadia; retention of existing strengthening of engine house, crusher room and chimney.
Prescribed dams (*Dams Safety Act 1978*)	Cadiangullong Dam; Cadia Tailings Dam (Northern TSF); Cadia Southern Tailings Dam (Southern TSF); Rodds Creek Water Holding Dam; North Waste Rock Dump Detention Basin (Hoares Creek Dam)
Enclosure permit	No. 20364
Work Cover	Hazardous chemicals at premises; licence to store explosives
Environmental Protection Authority	Resource recovery order and resource recovery exemption – Orange treated sewage biosolids.

20.11 Considerations of Social and Community Impacts

Community relations are managed in accordance with the Newcrest Communities Policy and Social Performance Standard. Community relations are undertaken by the Environment and Community Relations Department in line with the Community Relations Strategy.

The objective of the Cadia community relations strategy is to provide a strategic and systematic organisational approach to interactions with local communities and stakeholders which facilitate the open exchange of information so that Newcrest can respond to emerging needs at any point of its operations in the Cadia area.

The primary target group for Cadia's community relations strategy is members of the Cadia district. The Cadia district is defined as the local community directly surrounding the mine site in approximately a 10 km radius. The Cadia district also includes community representatives who are actively involved in consultation with Newcrest. Secondary focus groups include members of Orange, Blayney and Cabonne Shire Council areas, as well as the overall Cadia workforce.

Newcrest holds regular forums with local government authorities and residents and contributes to a Community Partnerships Program (CPP) in which employee volunteers are involved in assessing applications for funding of community projects based on established criteria.

Newcrest is also a member of a Community Consultative Committee, which includes representatives of the three local government authorities and the community. This provides a regular forum for discussion of community issues related to Cadia Operations' activities, and for accurate dissemination of material about those activities.

20.12 QP Comments on "Item 20: Environmental Studies, Permitting, and Social or Community Impacts"

The QP notes:

- Detailed baseline studies were completed at each major development stage of the Cadia Operations. It is expected that a number of social, cultural heritage and environmental baseline studies will require updating to support the submission of the proposed Cadia expansion project permitting application. Due to the assumed project start date at the end of the Cadia expansion mine life, no environmental impact assessment or approvals have yet been completed specifically for Ridgeway Lift 2;
- Monitoring is undertaken across the Project;
- The current waste rock materials and low-grade ore categories are classified using colour nomenclature that reflects the management approach to that material;
- Three TSFs support the mine plan, and have capacity to 2037. These consist of two earth and rock-fill dams, and an in-pit disposal facility;
- An Event occurred in the southern wall of the NTSF, causing it to lose containment of tailings. As of 31 August, 2020, there has been no other abnormal movement in the NTSF wall, or release of material from the NTSF. A prohibition notice issued by the NSW resources regulator on depositing tailings in the NTSF remains in place as at 31 August, 2020;
- Newcrest engaged expert engineering firms to confirm that the STSF remained safe to operate. Consistent with recommendations from these experts, in 2018 Newcrest commenced construction of buttresses in two areas of the STSF, which have been completed;
- The Cadia Pit TSF is in operation, and permitted to deposit to a maximum level of 713 mAHD;
- Additional tailings storage will be required to support the LOM plan envisaged in this Report. Newcrest is still evaluating tailings disposal plans. There is potential that a new EIS will be required for a new facility, depending on studies outcomes and finalisation of intended plans;
- Water requirements are proportional to the amount of mineral processing and significant water storage is required to provide consistent supply. The amount of water taken from each source is dependent on the conditions set through agreement or licensing and the physical amount available;
- Droughts have, in the past, resulted in a prolonged period of very low water supply. Drought conditions are a risk to future operations if unduly prolonged. Newcrest had noted that if rainfall remained at historic 1-in-100 year lows (with 2018 and 2019 being at this level) there was potential that production could be impacted by the end of calendar year 2020. However, rainfall in the region during February–March 2020 and the purchase of water licences on the water trading market has resulted in

improved levels of water being captured in on site storage facilities. Newcrest's latest internal modelling indicates that Cadia should have enough water to avoid any water-related production interruption for at least the next two years;

- There is provision for closure in the financial analysis supporting the Mineral Reserves;
- Newcrest holds the key permits required to support the current operations. The Cadia expansion will trigger a need to evaluate the proposal under various NSW Government environment and mining legislation and key Commonwealth legislation. Changes to the project will require a new application and reviews conducted under a number of these legislative acts. Due to the long-dated project start date, no permitting assessments have been completed specifically for Ridgeway Lift 2. It is assumed that similar processes to those envisaged for the Cadia expansion are likely to be required;
- Community Relations are managed in accordance with the Newcrest Communities Policy and Social Performance Standard. Newcrest holds regular forums with local government authorities and residents. Newcrest notes that there has been some negative community feedback as a result of the Event, and due to dust generation from the NTSF and STSF as they are no longer actively receiving tailings.

21 CAPITAL AND OPERATING COSTS

21.1 Introduction

Capital and operating costs are presented at an overall pre-feasibility level of study, which is based on a completed feasibility study and pre-feasibility study for the Cadia expansion, pre-feasibility-level determinations for the Ridgeway deposit, and LOM plan determinations for the active Cadia East mining operation.

Newcrest's internal study guidelines require project scope definition for a feasibility study to have an accuracy level of ±15%. Pre-feasibility studies must have a project scope definition accuracy level of ±25%.

21.2 Capital Cost Estimates

21.2.1 Basis of Estimate

The capital cost estimate for Cadia East was developed in accordance with the following Newcrest standards and guidelines:

- IM GL-04 Feasibility Study Guideline
- IM GL-03 Pre-Feasibility Study Guideline
- PRJ-340-05-A Preparation and Review of Estimates
- PRJ-340-05-B Preparing a Project Estimate Guide
- PRJ-340-05-C Estimating Standards and Guidelines

The estimate was developed to achieve an expected accuracy of -15% to +25% at 80% confidence. The estimate is based on the following parameters:

- Mining: detailed estimate;
- Underground material handling and infrastructure: detailed estimate for direct costs, indirect costs factored;
- Coarse ore stockpile: semi-detailed quantities; unit rates derived from recent studies including underground material handling;
- Concentrator: detailed estimate for direct costs with capacity factoring applied to equipment for sizing, indirect costs factored;
- C1 concentrator debottlenecking – detailed estimate for direct costs, indirect costs factored;
- Cadia Pit TSF: semi-detailed quantities; unit rates derived from recent studies including underground material handling, indirect costs factored;
- Adit plug, closure costs, pit modifications feasibility study costs: allowance.

The estimate was broken down into:

- Direct costs: Permanent plant equipment supply; bulk materials supply; direct labour; contractors' distributable costs; construction equipment for mass earthworks; freight, construction indirect costs;

- Indirect costs: EPCM costs including field construction management services, project office and home office costs for engineering, procurement, project services and sub-consultant EPCM costs; Owner's team costs; and contingency.

The capital cost estimate for Ridgeway was developed in accordance with the following Newmont guideline:

- IM GL-03 Pre-Feasibility Study Guideline

This estimate was developed to achieve an expected accuracy of -15% to +25% at 80% confidence. The estimate was based on the following parameters:

- Mining: detailed estimate;
- Underground material handling and infrastructure: factored estimate for direct costs, indirect costs factored.

Ridgeway costs were inflated from 2015 pre-feasibility study estimates to 2019 terms.

21.2.2 Contingency

Contingency/risk was included in the Cadia East portion of the capital cost estimate as a factored allowance of up to 25% based on the level of inputs (scope/rates) and was assessed on a deterministic basis using typical industry percentage norms associated with the level of project definition. Contingency was intended to produce an estimate with equal chance of under-run/over-run.

Contingency/risk was included in the Ridgeway portion of the capital cost estimate as a factored allowance of up to 25% based on the level of inputs (scope/rates) and was assessed on a deterministic basis using typical industry percentage norms associated with the level of project definition. Contingency was intended to produce an estimate with equal chance of under-run/over-run.

21.2.3 Labour Assumptions

Labour estimates for underground mining at Cadia East were calculated using project underground mine development and operating schedules consistent with site experience in execution of similar activities and utilising industry standard practices. Operator and maintenance labour rates were taken from Newcrest standard pay scales and benchmarked against the eastern seaboard hard rock mining cost base in the McDonald Gold & General Mining Industries Remuneration Report (McDonald's remuneration survey). Labour estimates for construction activities were calculated using detailed project construction estimates. Labour rates were based on historical and current site project rates. The operating assumption for underground activities is a 12-hour shift with 24/7 continuous work arrangements. For surface construction activities, the assumption was for a day-shift only, with a six-day, 56-hour working week.

Labour estimates for underground mining at Ridgeway were calculated using project underground mine development and operating schedules consistent with site experience at Ridgeway Deeps Lift 1 and using industry standard practices. Operator and maintenance labour rates were taken from Newcrest standard pay scales at the time of study and benchmarked against the eastern seaboard hard rock mining cost base in the MacDonald's remuneration survey. Labour estimates for construction activities were included in the factored estimate for construction activities.

21.2.4 Mining Costs

Mine capital costs were based on modelling, using mine plans and schedules, engineering take-off of development quantities, equipment data, consumable estimates and labour schedules.

21.2.5 Process and Infrastructure Costs

Mine infrastructure and services capital, and mill debottlenecking and supporting infrastructure capital were based on equipment lists and material take-offs from engineering drawings.

21.2.6 Owner (Corporate) Capital Costs

Owner's costs were factored from all direct costs, and based on benchmarking against costs from similar projects and historical precedence at site.

21.2.7 Sustaining Capital

Sustaining capital costs were taken from current operational practice and adjusted using mine plans and schedules, engineering designs and equipment recapitalisations strategies. These costs included estimates for mining, ore processing and tailings deposition

21.2.8 Capital Cost Summary

The overall capital cost estimate for the combined Cadia East and Ridgeway operations as envisaged in the financial analysis is outlined in Table 21-1.

21.3 Operating Cost Estimates

21.3.1 Basis of Estimate

The operating costs used in the financial model were derived from a variety of sources.

Mining costs were derived from a purpose-built, activity-based cost model constructed for the Cadia expansion study estimates, while ore treatment and G&A costs were based on budgeted numbers.

For mining and milling rates greater than 30 Mt/a, costs were factored according to estimated fixed/variable components for existing assets and a bottom-up build for new infrastructure.

Ridgeway costs were inflated from 2015 pre-feasibility study estimates to 2019 terms.

All operating costs are presented in Australian dollars and reflect 2019 market terms. Inputs in currencies other than Australian dollars were converted at exchange rates as per the Newcrest economic parameters.

Table 21-1: Capital Cost Estimate Summary

Description	A$ M
Growth Capital Costs	
Cadia East mine	4,653
Ridgeway mine	587
Processing	504
Infrastructure	619
Capitalised revenue	(345)
Sub-total growth	***6,017***
Sustaining Capital	
Site	4,462
Sub-total sustaining	***4,462***
Total Capital	***10,480***

21.3.2 Labour Costs

Labour costs included both operating and supervision. Operator manning requirements were based on current levels of automation in the process plant and the introduction of limited levels of automation in the underground operations. Maintenance manning requirements were accounted for in the maintenance costings under an activity-based variable rate.

21.3.3 Mine Operating Costs

Mining costs were derived from a purpose-built, activity-based cost model. Overall average mining costs were estimated at A$5.10/t mined.

21.3.4 Process Operating Costs

The costs for the existing plant are based on FY19 actual costs from the fourth quarter 2019 financial year (FY19 Q4F) at a throughput rate of 30 Mt/a. To determine individual concentrator costs, the cost breakdown for this period was split by cost area across Concentrator 1, Concentrator 2 and common costs, with an adjustment made for the long-term power price.

SAG media consumption rates were calculated using historical plant performance data of the treatment of Cadia East ore through Concentrator 2. Scaling was then applied based on expected ball charge and SAG power draw.

Ball mill media consumptions were based on long-term forecasting estimates in kg/kWh and checked against actual site performance.

SAG and ball mill liner wear rates were derived using a five-year average cost per tonne processing rate, and scaled with modelled power draws.

The cost associated with flotation reagent consumptions were based on long-term forecasting estimates and checked against actual site performance

A unit rate of A$0.45/t milled was applied in periods where the copper–molybdenum separation plant is forecast to operate.

Process costs were estimated at an average A$8.41/t milled over the LOM.

21.3.5 Power Costs

Power costs were derived using two categories: major equipment power and minor equipment power.

Major equipment power was calculated using a combination of JKSimMet as well as the tertiary grinding considerations using power-based methodologies.

The minor equipment power includes items such as pumps, conveyors, agitators, thickeners, and blowers. Adjustments were made to the installed power to account for annual operating times and design factors.

21.3.6 Maintenance Costs

Maintenance costs were derived using historical information from similar equipment at Cadia and other Newcrest operations, and adjusted for tonnage variance.

21.3.7 General and Administrative Operating Costs

A review of historical expenditure found that of the key cost elements that make up site-based G&A costs, the majority of the cost base could be considered fixed and would not have a material change with an increase in throughput rates. Consequently, the budget costs for the FY20 year were adopted as an annual rate, with no adjustment for changes in throughput rate.

General and administrative costs were estimated at A$95 M/a, comprising A$79 M/a of site G&A costs and A$17 M/a of corporate G&A costs. These costs are maintained for LOM planning purposes. The costs as presented do not include minor cost savings that may arise due to the ramp-down when Concentrator 2 shuts down at the end of the mine life.

General and administrative costs were applied on a per tonne basis of A$2.93/t.

21.3.8 Operating Cost Summary

The operating cost estimate is summarised in Table 21-2.

21.4 QP Comments on "Item 21: Capital and Operating Costs"

The QP notes:

- Capital costs based on a combined Cadia East/Ridgeway operation are estimated at A$10,480 M, over the LOM envisaged;
- Operating cost estimates include A$5.10/t mining costs, A$8.41 processing costs, and G&A costs of A$2.93, for an overall average LOM estimate of A$16.51/t;
- The capital and operating cost estimates include provision for the new TSF facility that will be required by 2037.

Table 21-2: Operating Cost Estimate Summary

Cost Area	Units	Value
Mining	A$/t	5.10
Processing	A$/t	8.41
G&A	A$/t	3.00
Total Operating Costs	***A$/t***	***16.51***

22 ECONOMIC ANALYSIS

22.1 Cash Flow Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Cadia Operations is supported by a positive cash flow.

22.2 Comments on Section 22

An economic analysis was performed in support of estimation of Mineral Reserves; this indicated a positive cash flow using the assumptions and parameters detailed in this Report.

23 ADJACENT PROPERTIES

This section is not relevant to this Report, as there are no adjacent properties that must be considered for the Project presented.

24 OTHER RELEVANT DATA AND INFORMATION

This section is not relevant to this Report as there are no other relevant data or information on the Cadia Operations that have not been summarised and presented in the Report.

25 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

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

Information from legal experts and Newcrest's in-house experts supports that the tenure held is valid and sufficient to support a declaration of Mineral Resources and Mineral Reserves.

The Cadia Operations are 100% owned by Newcrest.

Newcrest holds sufficient surface rights to allow mining activities at Cadia East and Ridgeway. The surface rights are sufficient to support mining operations, provided that subsidence or other impacts do not occur outside existing approved Mining Leases.

Additional negotiations and permits may be required in support of additional TSF storage to accommodate the mine plan envisaged in this Report.

Newcrest holds permits that allow abstraction of groundwater, and surface water in support of the Cadia Operations.

Royalties are payable to the NSW State. Currently, gold, silver, and copper are levied at 4% ex-mine value (value less allowable deductions).

Environmental liabilities for the Cadia Operations are typical of those that would be expected to be associated with a long-life mining operation where mining activities were conducted via open pit and underground mass mining methods.

To the extent known to the QP, there are no other significant factors and risks that may affect access, title, or the right or ability to perform work on the Project that are not discussed in this Report.

25.3 Geology and Mineralisation

The Cadia East, Cadia Extended and Ridgeway deposits are considered to be examples of alkalic porphyry gold–copper-style mineralisation. The Big Cadia deposit is interpreted as a skarn.

The understanding of the Cadia East and Ridgeway deposit settings, lithologies, mineralisation, and the geological, structural, and alteration controls on mineralisation is sufficient to support estimation of Mineral Resources and Mineral Reserves. Mineral Resources can be estimated for Cadia Extended and Big Cadia.

Exploration potential remains within the Project area, and Newcrest is actively exploring using a number of conceptual geological models to drive the exploration activities.

25.4 Exploration, Drilling and Analytical Data Collection in Support of Mineral Resource Estimation

The exploration programs completed to date are appropriate for the style of the deposits in the Project area.

Sampling methods are acceptable for Mineral Resource estimation.

Sample preparation, analysis and security are generally performed in accordance with industry-accepted practices.

The quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs are sufficient to support Mineral Resource and Mineral Reserve estimation.

No material factors were identified with the data collection from the drill programs that could significantly affect Mineral Resource estimation.

The sample preparation, analysis, and security practices and are acceptable, meet industry-standard practice, and are sufficient to support Mineral Resource estimation. The collected sample data adequately reflect deposit dimensions, true widths of mineralisation, and the style of the deposits. Sampling is representative of the gold, copper, silver and molybdenum grades in the Cadia East deposit; the gold, copper, and silver grades in the Ridgeway deposit; the gold and copper grades in the Cadia Extended deposit, and the gold grades within the Big Cadia deposit. There is a bias noted with legacy copper data in the Big Cadia deposit; as a result, the confidence classification for Big Cadia was restricted to Inferred.

The QA/QC programs for the Newcrest campaigns adequately address issues of precision, accuracy and contamination. Drilling programs typically included blanks, duplicates and SRM samples. QA/QC submission rates meet industry-accepted standards at the time of the campaign. The QA/QC programs did not detect any material sample biases in the data reviewed that supports Mineral Resource estimation.

The data verification programs concluded that the data collected from the Project adequately support the geological interpretations and constitute a database of sufficient quality to support the use of the data in Mineral Resource estimation.

25.5 Metallurgical Testwork

Metallurgical testwork and associated analytical procedures were appropriate to the mineralisation type, appropriate to establish the optimal processing routes, and were performed using samples that are typical of the mineralisation styles found within the Cadia East and Ridgeway deposits.

Samples selected for testing were representative of the various types and styles of mineralisation. Samples were selected from a range of depths within the deposits. Sufficient samples were taken so that tests were performed on sufficient sample mass.

Recovery factors estimated are based on appropriate metallurgical testwork, and are appropriate to the mineralisation types and the selected process routes. Gold recovery improvements resulting from the Cadia plant debottlenecking process are expected to achieve LOM gold recovery rates of approximately 80% and copper recovery rates of around 85%. Gold and copper recoveries for Ridgeway are based on algorithms; gold recovery forecasts for the overall LOM are 81% for gold, and 87% for copper.

Fluorine is the only known deleterious element identified in the Cadia East concentrates. Since 2017, all material within the plant has been processed through a Jameson cell giving maximum fluorine rejection, and thereby unlikely that fluorine levels in copper concentrate will exceed the maximum contractual limits over the LOM.

The Ridgeway concentrate was historically clean, very marketable, and had high copper grades. There are expected to be no deleterious elements in future concentrates from Ridgeway Lift 2.

25.6 Mineral Resource Estimates

The Mineral Resource estimation for the Project conforms to industry-accepted practices, and is reported using the 2014 CIM Definition Standards.

Areas of uncertainty that may materially impact the Mineral Resource estimates include: changes to long-term metal price and exchange rate assumptions; changes in local interpretations of mineralisation geometry, structures, and continuity of mineralised zones; changes to geological and grade shape and geological and grade continuity assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the conceptual underground mass mining methods used to constrain the estimates; changes to the to the input assumptions used in the constraining pit shell for those Mineral Resources amenable to open pit mining methods; changes to the NSR cut-offs applied to the estimates; variations in geotechnical (including seismicity), hydrogeological and mining assumptions; and changes to environmental, permitting and social license assumptions.

There is upside potential for the estimates if mineralisation that is currently classified as Inferred can be upgraded to higher-confidence Mineral Resource categories.

25.7 Mineral Reserve Estimates

The Mineral Reserve estimation for the Project incorporates industry-accepted practices and meets the requirements of the 2014 CIM Definition Standards.

Mineral Reserves at Cadia East and Ridgeway were estimated assuming conventional block caving methods. Mineral Resources were converted to Mineral Reserves using a detailed mine plan, an engineering analysis, and consideration of appropriate modifying factors. Modifying factors include the consideration of dilution and ore losses, underground mining methods, geotechnical and hydrological considerations, metallurgical recoveries, permitting and infrastructure requirements.

Areas of uncertainty that may materially impact the Mineral Reserve estimates include: changes to long-term metal price and exchange rate assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the cave outlines and the mine plan that is based on those cave designs; changes to operating and capital cost assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates; variations in geotechnical, mining, dilution and processing recovery assumptions, including changes to designs as a result of changes to geotechnical, hydrogeological, and engineering data used; changes to the shut-off criteria used to constrain the estimates; ability to source power supplies if the assumption of system intact conditions cannot be met; ability to obtain sufficient water to meet operational needs; changes to the assumed permitting and regulatory environment under which the mine plan was developed; ability to permit additional TSF capacities or facilities; ability to maintain mining permits and/or surface rights; ability to obtain operations certificates in support of mine plans; ability to obtain and maintain social and environmental license to operate.

25.8 Mine Plan

Mining operations are conducted year-round. It is expected that mining activities associated with the Ridgeway mine will also be year-round.

The mine plans are based on the current knowledge of geotechnical, hydrological, mining and processing information. Mine designs incorporate underground infrastructure and ventilation requirements.

Underground operations use and will continue to use conventional block or panel cave underground mining methods and equipment fleets.

The projected combined Cadia East and Ridgeway mine life is 45 years (2020–2065).

25.9 Recovery Plan

The process methods are generally conventional to the industry. The comminution and recovery processes are widely used with no significant elements of technological innovation. The use of coarse ore flotation using HydroFloat technology has been proven at the plant scale.

The process plant flowsheet designs were based on testwork results, previous study designs and industry-standard practices.

The process plants will produce variations in recovery due to the day-to-day changes in ore type or combinations of ore type being processed. These variations are expected to trend to the forecast recovery value for monthly or longer reporting periods.

25.10 Infrastructure

Infrastructure required for operations is constructed and operational. Some additional facilities will be required to support the operations as envisaged in the LOM plan.

The preliminary modelling of the mid-western NSW transmission system has identified supply restrictions under various contingent scenarios, although under system intact conditions, the regional transmission system has sufficient capacity to meet the power demands of the Cadia expansion project.

25.11 Environmental, Permitting and Social Considerations

Baseline studies were completed in support of current and former operations. Environmental monitoring is undertaken across the Project, and in the vicinity of the Cadia Operations. The mining leases further require a Mining Operations Plan to be prepared that outlines significant disturbance, rehabilitation plans and mine closure strategies. Development not otherwise covered by existing approvals and Mining Operation Plans will require new authorisations.

The current waste rock materials and low-grade ore categories are classified using colour nomenclature that reflects the management approach to that material.

Tailings were shown to be NAF. The NTSF design consists of an earth and rock-fill dam, with 10 embankment raises undertaken. All raises since 2005 have involved upstream construction. The STSF is also an earth and rock-fill dam, with, to date, six embankment raises undertaken, also generally using the upstream method. The Cadia Pit TSF is a pit-fill TSF, and operations are currently permitted to deposit to 713 mAHD. A new TSF facility will be required to support the LOM plan plant production envisaged in this Report. The capital and operating cost estimates include provision for the new TSF. These costs were included in the economic analysis that supports the Mineral Reserves.

Water supply is characterised by variable supply sources. Droughts have, in the past, resulted in a prolonged period of very low water supply. Drought conditions are a risk to future operations if unduly prolonged.

Newcrest holds the key permits required to support the current operations. The Cadia expansion will trigger a need to evaluate the proposal under various NSW Government environment and mining legislation and key Commonwealth legislation. Due to the long-dated project start date, no permitting assessments were completed specifically for Ridgeway Lift 2. It is assumed that similar processes to those envisaged for the Cadia expansion are likely to be required.

Community relations are managed in accordance with the Newcrest Communities Policy and Social Performance Standard.

25.12 Markets and Contracts

Cadia East currently produces a high-quality copper concentrate with high gold grades, payable silver credits and relatively low levels of impurities that do not attract a penalty from smelters. Smelter contracts for the concentrate produced from the current operations are in place.

As additional concentrate tonnage at Cadia East is produced, it will likely either be added to existing contracts (those contracts will be expanded) or sold to new smelter customers in Asia with whom direct communication already takes place. No premiums payable to the smelters are expected to be incurred. The terms contained within any new contracts would be expected to remain in line with industry norms.

Contracts are currently in place in support of project operations. These contracts are negotiated and renewed as needed. Contract terms are within industry norms, and typical of similar contracts in Australia that Newcrest is familiar with.

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

25.13 Capital Cost Estimates

Capital and operating cost estimates are based on a combination of operating LOM plans, feasibility and pre-feasibility studies. Newcrest's internal study guidelines require project scope definition for a feasibility study to have an accuracy level of ±15%. Pre-feasibility studies must have a project scope definition accuracy level of ±25%.

Contingency allowances were applied, as applicable, and were based on evaluations of all major cost categories.

Capital costs on a project basis are estimated at A$10,480 M, which includes growth capital allocations of A$6,017 M, and sustaining capital costs of A$4,462 M.

25.14 Operating Cost Estimates

Estimated operating costs include $5.10/t mining costs, A$8.41 processing costs, and G&A costs of A$2.93, for an overall average LOM estimate of A$16.51/t.

25.15 Economic Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Cadia Operations is supported by a positive cash flow.

25.16 Risks and Opportunities

As part of Newcrest's Risk Management Process, the risk assessments carried out for the long-term studies are combined with the site risk register to identify material risks for the business. The management of these material risks is based on ensuring that events which are considered to be significant for the business have an elevated level of accountability, management and review. The areas of risk are based on evaluations of:

- People (Health and Safety);
- Environment;
- Social and cultural;
- Reputation;
- Legal;
- Sovereign, legislation, regulatory;
- Financial.

Newcrest has 31 Material Risks identified for the Cadia Operations in its risk assessment process, including the following key areas:

- Loss of key tenements;
- Mechanical failure of surface fixed assets;

- Mechanical failure of underground fixed assets;
- Underground and surface facilities fires;
- Fall of ground underground and surface;
- Failure of cave propagation;
- Delays in cave establishment;
- People movement/vehicle collision;
- Large-scale seismic events;
- Failure of tailings embankments;
- Water security;
- Unplanned explosive initiation;
- Groundwater contamination.

These risks are managed on a day to day basis by the Cadia site with regular reviews and audits to ensure compliance to the process risk management protocols, as well as to ensure risks that have diminished are removed, and new and emerging risks are placed onto the register.

25.17 Conclusions

Under the assumptions in this Report, the Project shows a positive cash flow over the life-of-mine and support the Mineral Reserve estimates. The projected mine plan is achievable under the set of assumptions and parameters used.

26 RECOMMENDATIONS

The Cadia Operations have a long operational history. Material engineering studies and exploration programs have largely concluded. As a result, the QPs are not able to provide meaningful recommendations.

27 REFERENCES

Barton, N., Lien, R., and Lunde, J., 1974: Engineering Classification of Rock Masses for the Design of Tunnel Support: Rock Mechanics vol 6, pp. 189–236.

Beck, D, 2013: Ridgeway Deeps Lift 2 Coupled Simulation of Footprint Deformation: Beck Engineering.

Cadia Holdings Pty Ltd, 2016: 2016–2019 Mining Operations Plan: internal CHPL report.

Cadia Holdings Pty Ltd, 2018: Rehabilitation Strategy: internal CHPL report.

Canadian Institute of Mining, Metallurgy and Petroleum (CIM), 2014: CIM Standards for Mineral Resources and Mineral Reserves, Definitions and Guidelines: Canadian Institute of Mining, Metallurgy and Petroleum, May 2014.

Canadian Securities Administrators (CSA), 2011: National Instrument 43-101, Standards of Disclosure for Mineral Projects: Canadian Securities Administrators.

Chamberlain, C.M., Jackson, M., Jago, C.P., Pass, H.E., Simpson, K.A., Cooke, D.R., and Tosdal, R.M., 2006: Toward an Integrated Model for Alkalic Porphyry Copper Deposits in British Columbia (NTS 093A, N; 104G): BC Ministry of Energy, Mines and Petroleum Resources, Geological Field work 2006, Paper 2007-1259.

Cuison, A.L., 2010: Geology and Genesis of the Ridgeway Porphyry Au-Cu Deposit, NSW: PhD thesis, University of Tasmania.

Finn, D., 2015a: Mineral Resource Report, Big Cadia: internal Newcrest report, July 2015, 109 p.

Finn, D., 2015b: Mineral Resource Report, Cadia Extended: internal Newcrest report, December 2015, 71 p.

Flores G., and Karzulovic, A., 2003: Geotechnical Guideline for a Transition from Open Pit to Underground Mining: Geotechnical Characterization: Report to International Caving Study II, Brisbane, Julius Kruttschnitt Mineral Research Centre.

Fluor, 2010: Cadia East Project Feasibility Study Report. April 2010.

Forster D.B., Seccombe P.K., and Phillips D., 2004: Controls on Skarn Mineralisation and Alteration at the Cadia Deposits, New South Wales, Australia: Economic Geology and the Bulletin of the Society of Economic Geologists 99, pp. 761–788.

Fox, N., Harris, A., Cooke, D., and Collett, D., 2009: Controls on the Formation of the Cadia East Alkalic Porphyry Au-Cu Deposit, NSW: Potential Reactivation of Early Basin Structures: Macquarie Arc Conference, Orange.

Fraser Institute, 2019: Survey of Mining Companies, 2019: Fraserinstitute.org, 80 p.

Glen R.A., Walshe J.L., Barron L.M., and Watkins J.J., 1998: Ordovician Convergent-Margin Volcanism and Tectonism in the Lachlan Sector of East Gondwana: Geology 26, pp. 751–754.

Glen R.A., Hancock P.L., and Whittaker A., 2005: Basin Inversion by Distributed Deformation; the Southern Margin of the Bristol Channel Basin, England. Journal of Structural Geology 27, pp. 2,113–2,134.

Glen R.A., Crawford A.J., and Cooke D.R., 2007: Tectonic Setting of Porphyry Cu-Au Mineralisation in the Ordovician-Early Silurian Macquarie Arc, Eastern Lachlan Orogen, New South Wales; Geological Evolution and Metallogenesis of the Ordovician Macquarie Arc, Lachlan Orogen, New South Wales: Australian Journal of Earth Sciences 54, pp. 465–479.

Harris, A.C., Percival, I.G., Allen, C.M., Cooke, D.R., Tosdal, R.M., McMillan, C., Dunham, P.D., and Collett, D., 2009: Inverted Submarine Basins Hosting the Cadia Valley Porphyry Ore Deposits, New South Wales: Fundamental Controls on System Architecture: Macquarie Arc Conference, Orange.

Holliday J.R., Wilson A.J., Blevin P.L., Tedder I.J., Dunham P.D., and Pfitzner M., 2002: Porphyry Gold-Copper Mineralisation in the Cadia District, Eastern Lachlan Fold Belt, New South Wales, and its Relationship to Shoshonitic Magmatism: Mineralium Deposita 37, pp. 100–116.

Holliday J.R. and Cooke D.R., 2007: Advances in Geological Models and Exploration Methods for Copper ± Gold Porphyry Deposits: *in* Milkereit B. ed. Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration: Toronto, Canada, pp. 791–809.

Jeffries, M., Morgenstern, N.R., Van Zyl, D., and Wates, J., 2019: Report on NTSF Embankment Failure, Cadia Valley Operations, for Ashurst Australia: report prepared by the Independent Technical Review Board, 17 April 2019, 119 p. and appendices.

Jones, R., 2015a: Cadia Extended QAQC Summary to April 2015: internal Newcrest report, 30 September, 2015, 25 p.

Jones, R., 2015b: Big Cadia QAQC Summary to May 2015: internal Newcrest report, 18 October, 2015, 18 p.

Laubscher, D.H., 1990: A Geomechanics Classification System for the Rating of Rock Mass in Mine Design. Trans S Afr Inst Min Metal 9(10).

Micko, J., Tosdal, R.M., Bissig, T., Chamberlain, C.M. and Simpson, K.A., 2014: Hydrothermal Alteration and Mineralisation of the Galore Creek Alkalic Cu-Au Porphyry Deposit, Northwestern British Columbia, Canada: Economic Geology, v. 109, pp. 891–914.

Newcrest Mining Limited, 2007: Ridgeway Deeps Feasibility Study: internal Newcrest report, Vols 1 to 4.

Newcrest Mining Limited, 2014: Pre-Feasibility Study- Ridgeway Deeps Lift 2: internal Newcrest report.

Newcrest Mining Limited, 2018: Cadia Expansion Pre-Feasibility Study: internal Newcrest report, 8 August, 2018.

Newcrest Mining Limited, 2019a: Expert Review of Cadia Tailings Facility Completed: news release, 30 April 2019, 3 p.

Newcrest Mining Limited, 2019b: Cadia Valley Operations Cadia Hill Tailings Completion Modification – Modification Report: draft report prepared for NSW Department of Planning & Environment.

Newcrest Mining Limited, 2019c: Cadia Expansion Feasibility Study: internal Newcrest report, 9 September, 2019.

Packham G., Percival I., and Bischoff G., 1999: Age Constraints on Strata Enclosing the Cadia and Junction Reefs Ore Deposits of Central New South Wales, and Tectonic Implications: Quarterly Notes - Geological Survey of New South Wales 110, pp. 1–12.

Panteleyev, A., 1995: Porphyry Cu±Mo±Au: *in* Selected British Columbia Mineral Deposit Profiles, Volume 1, D.V. Lefebure and G.E. Ray, eds, British Columbia Ministry of Energy, Mines, and Petroleum Resources, pp. 87–91.

Pfitzner, M, 2007: Ridgeway Deeps Feasibility Study Volume 4.3: Technical Geotechnical, 8 August 2007.

Seedorff, E. Dilles, J.H., Proffett, J.M., Jr., Einaudi, M., Zurcher, L., Stavast, W.J.A., Johnson, D.A., and Barton, M.D., 2005: Porphyry Deposits: Characteristics and Origin of Hypogene Features: Economic Geology 100th Anniversary Volume, pp. 251–298.

Sillitoe, R.H., 2000: Role of Gold-Rich Porphyry Models in Exploration, in S.G. Hagerman and P.H. Brown, eds., Gold in 2000, Reviews in Economic Geology, v. 13, pp. 311–346.

Sillitoe, R.H., 2010: Porphyry Copper Systems: Economic Geology, v. 105, pp. 3–41.

Sinclair, W.D., 2006: Consolidation and Synthesis of Mineral Deposits Knowledge - Porphyry Deposits: report posted to Natural Resources Canada website 30 January 2006, 14 p., <http://gsc.nrcan.gc.ca/mindep/synth_dep/porph/index_e.php>, accessed 28 August, 2010.

Singer, D.A., Berger, V.I., and Moring, B.C., 2008: Porphyry Copper Deposits of the World: Database and Grade and Tonnage Models: U.S. Geological Survey Open-File Report 2008-1155, version 1.0 (http://pubs.usgs.gov/of/2008/1155/).

Stevens, B.P.J., 1972: Mine Data Sheets to Accompany Metallogenic Map Bathurst 1:250,000 sheet: *cited in* Bajwah, Z.U., Seccombe, P.K., and Offier, R., 1987: Trace Element Distribution, Co:Ni Ratios and Genesis of the Big Cadia Iron-Copper Deposit, New South Wales, Australia: Mineralium Deposita, vol. 22, pp. 292–300.

Washburn, M., 2008: Architecture of the Silurian Sedimentary Cover Sequence in the Cadia Porphyry Au-Cu District, NSW, Australia: Implications for Post-Mineral Deformation: M.Sc. thesis, University of British Columbia.

Wilson A.J., 2003: The Geology, Genesis and Exploration Context of the Cadia Gold-Copper Porphyry Deposits, New South Wales, Australia: PhD thesis, University of Tasmania, Hobart, Tasmania, Australia.

Wilson A.J., Cooke D.R., and Harper B.L., 2003: The Ridgeway Gold-Copper Deposit; a High-Grade Alkalic Porphyry Deposit in the Lachlan Fold Belt, New South Wales, Australia: Economic Geology 98, pp. 1,637–1,666.

Wilson A.J., Cooke D.R., Stein H.J., Fanning C.M., Holliday J.R., and Tedder I.J., 2007: U-Pb and Re-Os Geochronologic Evidence for Two Alkalic Porphyry Ore-Forming Events in the Cadia District, New South Wales, Australia: Economic Geology 102, pp. 3–26.