

Hill End Gold project: Hawkins Hill – reward deposit

by Philip Bruce, FAusIMM, Managing Director, Hill End Gold

Hill End Gold Limited commenced exploration at Hill End in New South Wales in 1994 as a Canadian listed company and started underground mining on the Hawkins Hill – Reward deposit in 2003. The company is now ASX-listed and the Hill End Gold Project includes the three historic goldfields of Hill End, Hargraves and Windeyer, which are located within a radius of 35 km. Most exploration and development is focused on the Hill End and Hargraves areas.

At Hill End the gold mineralisation is in mesothermal gold-quartz veins hosted within folded fine grained graphitic turbidites of Paleozoic age and aligned along the axis of the north-south trending Hill End Anticline. While the quartz-gold veins are generally bedded and laminated in nature the mineralisation can form lenses of sheeted veins up to 20 metres in width. During the late nineteenth century the Hawkins Hill – Reward deposit, which is located to the south of the village of Hill End yielded a reported 400 000 ounces of gold at a grade of 10 ounces per tonne.

The first mining at Hill End during the 1850s focused on the alluvial fields of the Turon River and up the various gullies leading to Hill End and the Tambaroora flats. Hard rock mining started on the Hawkins Hill deposit during the 1860s, however it was the 1870s that saw extremely rich bonanza grade ore being hoisted from about twenty shafts along the 'richest quarter mile.' The early miners worked on moderate returns to a depth of 60 m, where extremely rich gold mineralisation was found in a flat plunging shoot. The gold occurred in a series of closely spaced bedded quartz veins, with late reverse faulting and cross cutting structures localising the very high grade material, such as the Holtermanns 'Nugget,' which contained about 3100 ounces of gold



Hill End 120 tpd gravity plant.

in a piece of rock 1.2 m high that averaged about 30 per cent gold.

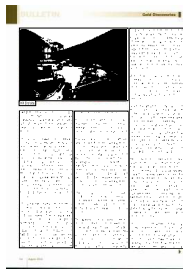
The Hawkins Hill – Reward deposit is part of a continuously mineralised structural corridor following the axis of the Hill End Anticline from 10 km south at Chambers Creek, through the Hill End village and then for a further 10 km to the north. The individual veins are persistent for many kilometres and the line of outcropping gold deposits extends through to Hargraves and beyond for approximately 60 km of strike length. Hill End Gold Limited holds the majority of the tenements that cover these deposits.

The Hawkins Hill – Reward deposit has been reopened by Hill End Gold to do bulk sampling and underground resource drilling along 1000 m of strike to a depth of 350 m below surface. The coarse gold mineralisation required bulk sample testing to determine geological and grade continuity by development and trial mining. During this phase the operations have frequently encountered gold mineralisation

over 10 ounces per tonne and have confirmed the continuity of the high grade zones and the controls of the mineralisation over the accessed strike length of the deposit.

Hawkins Hill – Reward gold mineralisation is on the east limb of an anticline in a north trending structural corridor about 100 m wide, which is the plumbing system for gold enriched fluids that have precipitated gold within the predominantly bedded, 70° east-dipping, quartz veins. The highest gold grades are associated with enrichment derived from fluids channelled by late, transverse, steeply dipping, reverse faults in near-vertical en echelon arrays.

Mineralogy consists of coarse gold with a P80 liberation size of near 0.5 mm hosted in quartz veining within greywacke and turbidite shales as the dominant gangue material, with minor sulfide species such galena, sphalerite, and pyrite also present within the quartz. The coarse nature of the gold provides significant challenges with regard to statistical



back



Hill End site.

sampling of the ore, but also provides an opportunity to economically operate a gravity gold plant at a high recovery without the use of chemicals, and at small scale due to the high grade of the ore.

The June 2009 Hawkins Hill – Reward mineral resources are mostly of the inferred category at 658 000 tonnes at 10.6g/t. Approximately 40 000 tonnes at 10.5 g/t have been mined during the bulk sampling and trial mining phase, which has successfully confirmed continuity of the mineralisation, the controls of the high grade zones and the mining and processing parameters. Mining is currently temporarily halted to allow drilling, mining block definition and mine planning to be completed prior to a productive recommencement of mining.

Mining has been by hand held methods in 3 m x 3 m development drives and declines and narrow vein ladder rising and sub-levels. The Amalgamated portal and the old adit development were stripped out from the original dimensions and new development advanced for a total of 1200 m of flat development and approximately 600 m of inclined development. The new development has opened the deposit for an additional 500 m north

along strike of the old workings.

An excellent safety record was maintained in the arduous hand-held mining conditions, particularly in ladder rising and decline development.

A 2.44 m x 250 m deep shaft was raise bored from the Amalgamated level to surface and equipped with a semi automatic Alimak lift and ladderway. Ten stations were cut at 12 m intervals from beneath the old workings at 100 m below surface to the Amalgamated level. On seven of the sub-levels there were scraper drives advanced on the dominant veins and ladder rises were developed every 50 m from the Amalgamated level for extraction of broken material.

The mining equipment included hand-held rock drills, a variety of compressed air scrapers and air fans and the haulage equipment included 10 t Bird dump trucks and Toro 150/1 loaders.

The gravity gold recovery plant for the development of the Hawkins Hill – Reward deposit was constructed in 2008 to process approximately 20 tonnes per day on a batch basis to reconcile gold output against underground blocks. The purpose of the original plant was to enable full

gold reconciliation in the treatment of complete sample lots of mined ore, to gain an improved understanding of the geology and gold distribution within the Hawkins Hill – Reward deposit. For this reason, the plant was designed to be easy to clean, such as the use of hammer mills for fine size reduction, as any trapped gold would have an effect on resource grade reconciliation.

When trial mining commenced and increased development provided additional material, the tertiary crushers were replaced with a small ball mill and the plant operated continuously at up to 2500 tonnes per month.

Given the graphitic, slaty nature of the ore, with variable hard and soft material at a coarse slurry size and at a low production rate there were significant materials handling and processing challenges. Plant personnel undauntingly tested modifications and persisted in improving materials flow and equipment design and reliability, and significant improvements were made in process productivity with gold recovery increasing from 75 per cent in 2008 to 95 per cent in 2010.

The slaty material tended to paste when crushed so a number of crusher types and designs were tested to overcome feed and discharge issues. Impact crushers were chosen for secondary and tertiary duty to enhance material flow and to provide a high reduction ratio. Major modifications were made to the impact crusher high wear items in material type, and hammer and feed distribution design, which reduced wear by 40 per cent and increased availability significantly. Water flushing the crusher discharge material eradicated pasting up of crusher discharge.

The normal difficulties of handling coarse material slurry flow through small pumps and piping were exacerbated due to a large proportion of high aspect shaped particles causing non-uniform flow and rapid settling rates, particularly in low pulp



back

density slurries such as the 50 mm tailings line to the dam some 2 km distant.

Upgrading the plant for continuous production included the installation of a ball mill in closed circuit with a 1 mm DSM tailings screen, a slimes removal and handling system, and material handling modifications throughout the plant. A 30" Knelson concentrator is the primary gold recovery unit. Due to the low throughput of the plant, the Knelson concentrator bowl has been modified by filling approximately 50 per cent of the riffles to avoid excessive concentrate make and subsequent downstream gold concentrate dressing time. Two sets of twin start HG spirals provide scavenging of liberated and near-liberated fine gold and tailings are classified over a 1 mm aperture DSM sieve bend in closed circuit with the ball mill. The plant water is a closed system with the tailings dam with the majority of the recycled water being harvested at the plant.



Hill End dore bar.

Plant concentrates are upgraded in the goldroom using tabling, and smelting to dore bars is done on site.

In addition to the Hawkins Hill – Reward deposit, the Company's other main projects in the Hill End area are the Red Hill project with an inferred resource of 849 000 tonnes at 3.3 g/t, and the Hargraves project which is located 35 km north of Hill End. Both have similar iconic historical production profile and geological setting to Hill End. Hargraves was discovered with a 50 kg piece of gold found in outcrop on the Big Nugget Hill structure, which was then only mined to 50 m below surface. Recent diamond drilling has confirmed the continuity of gold mineralisation from surface to 400 m in a 40 m wide structure with intersections of up to 4.2 g/t over 75 m from near surface. The project is being drilled to outline an initial resource target for mine development and numerous zones of previously mined, though unexplored, mineralised structures are located adjacent to the Big Nugget Hill deposit within a ten kilometre radius. ■