# KPMG
# Independent mineral specialist report – merger of Vulcan Resources and Universal Resources

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| | | Date: | 9 December 2009 |

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9 December 2009 Our Ref: J_1068_G

The Directors
KPMG Corporate Finance (Aust) Pty Ltd
235 St Georges Terrace
PERTH WA 6000

Dear Sirs

## INDEPENDENT MINERAL SPECIALIST REPORT – MERGER OF VULCAN RESOURCES AND UNIVERSAL RESOURCES

At your request, Optiro Pty Limited (Optiro) has prepared an independent mineral specialist report on the mineral assets of Vulcan Resources Limited (Vulcan) and Universal Resources Limited (Universal). Vulcan and Universal are proposing a merger whereby Universal will acquire all of the fully paid ordinary shares in Vulcan for the consideration of 6.85 Universal fully paid shares for each Vulcan fully paid ordinary share currently on issue. Optiro understands that this report will be appended in its entirety to your independent expert report, which will form part of the scheme document to be presented to Vulcan shareholders in advance of a vote on the proposed merger.

The objective of this report is to present a valuation of the mineral assets of both Universal and Vulcan. This valuation encompasses both the technical value and the fair market value of the assets. KPMG has provided a number of commercial parameters to Optiro with respect to the valuation of the assets and Optiro has relied upon that information in its valuation.

The report provides a description of the assets of both companies, covering the Universal development project at Roseby in Queensland, Australia and the Vulcan development project at Kylylahti in Karelia, Finland. Additional Mineral Resources owned by Universal in the Roseby area and by Vulcan in the Outokumpu, Kuhmo-Suomussalmi, Kotalahti and Vammala areas of eastern and southwestern Finland are also described. Details are then presented of the exploration potential of Universal's tenements in the Roseby area, elsewhere in the broader Mt Isa region of northwest Queensland and in New South Wales, and of Vulcan's tenements in the Kylylahti-Outokumpu region, the Kuhmo-Suomussalmi region, and the Kotalahti region. Optiro has based its assessments of Universal's mineral assets upon a visit to the Roseby area in September 2009, discussions with key company personnel, and data provided by Universal. Optiro's assessment of the assets of Vulcan is based upon a visit to Finland in August 2006, discussions with Vulcan personnel in Australia and Finland, and upon Vulcan's library of technical and commercial information.

Optiro has prepared this report with the understanding that the tenements of both Universal and Vulcan are in good standing and that there is no cause to doubt the eventual granting of any current tenement applications. Optiro has not independently verified the legal status of the tenements of either Universal or Vulcan and has relied upon legal advice on the Universal tenements prepared for the Directors of Vulcan and upon a certified copy of the tenement schedule relating to the legal status of Vulcan's Finnish tenements. Both Universal and Vulcan have a number of current agreements with external parties. Optiro has not independently verified the legal status and validity of these agreements and has relied upon assurances provided by Universal and Vulcan in this regard.

Optiro has based its valuation upon information known at the valuation date of 1 November 2009 and has satisfied itself that all material information relating to the assets and their valuation has been made freely available to Optiro. Draft versions of the relevant asset description sections of this report have been passed to the directors of Universal and Vulcan for checking with respect to factual accuracy and omission of material information.

Optiro's valuation of the mineral assets of Universal is presented in the following table, which lists values in Australian dollars:

| Asset | Valuation (AUD Millions) | | |
|---|---|---|---|
| | **Low** | **High** | **Preferred** |
| Roseby Project Ore Reserves | 15.0 | 90.0 | 53.1 |
| Roseby Project additional Mineral Resources | 9.6 | 28.8 | 19.2 |
| Exploration tenements (Roseby, Queensland, New South Wales) | 5.2 | 22.4 | 13.8 |
| **Total** | **29.8** | **141.2** | **86.1** |

Optiro's valuation of the mineral assets of Vulcan is presented in the following table, which lists values in Euros:

| Asset | Valuation (EURM) | | |
|---|---|---|---|
| | **Low** | **High** | **Preferred** |
| Kylylahti Project Ore Reserves | 30.7 | 79.0 | 61.1 |
| Mineral Resources in the Kuhmo, Kylylahti, Outokumpu, Kotalahti and Vammala areas | 1.4 | 9.0 | 6.0 |
| Exploration tenements (Kylylahti, Outokumpu area, Kuhmo and Kotalahti) | 0.7 | 3.4 | 2.0 |
| **Total** | **32.8** | **91.4** | **69.1** |

This report has been prepared by Mr Ian Glacken (Principal Consultant, Optiro), Mr Wayne Ghavalas (Consultant, Optiro) and Mr Karl van Olden (Principal Consultant, Optiro) and was reviewed by Mr Mark Warren (Principal, Optiro). The report has been prepared in accordance with the Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets for Independent Expert Reports (2005) (the VALMIN Code) and the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (2004) (the JORC Code), as well as the Australian Securities and Investment Commission (ASIC) Regulatory Guides 111 and 112. Neither Optiro nor any of its staff involved in the preparation of this report have any material interest in either Universal or Vulcan or in any of the properties described herein. Optiro has charged a fee for the preparation of this report, the magnitude of which is unrelated to the outcome of the merger.

Optiro believes that it has taken all reasonable care to ensure that the information contained within this report is, to the best of its knowledge, based upon facts and stated assumptions and furthermore, that the report contains no omissions likely to affect its value.

Yours faithfully
OPTIRO

Chartered Professional
The Australasian Institute of Mining and Metallurgy
Ian M Glacken
Geology

Ian M Glacken, *MSc, FAusIMM(CP), CEng*
Principal Consultant

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# 1. SUMMARY

Optiro was appointed by KPMG Corporate Finance (Aust) Pty Ltd (KPMG) to carry out a valuation of the mineral assets of Universal Resources Limited (Universal) and of Vulcan Resources Limited (Vulcan). Universal and Vulcan are considering a merger and the directors of Vulcan have appointed KPMG to prepare an independent expert report in relation to the proposed merger. Optiro is acting in the role of independent mineral specialist assisting KPMG.

Universal is a public company listed on the Official List of ASX Limited (ASX). Vulcan is a public company which is also listed on the Official list of ASX and is also listed on the Frankfurt Stock Exchange in Germany and the Norwegian over-the-counter trading system.

The principal mineral asset of Universal is the Roseby Copper Project in northwest Queensland, located approximately 65 km northwest of Cloncurry and 90 km north-northeast of Mt Isa. The Roseby Project sits within the Eastern Fold Belt of the Mt Isa Inlier, which hosts a world class accumulation of copper, copper-gold, lead-zinc-silver, uranium and phosphate deposits.

Universal has defined ten deposits at Roseby for which it has declared Mineral Resources. The deposits comprise two broad types – those in which native copper in the supergene zone predominates (seven deposits) and those in which sulphide copper is the main mineralised species (three deposits). The total declared Mineral Resource at the Roseby Project is 128.5 Mt at a copper grade of 0.68%. Three of the ten deposits – Blackard and Scanlan, in which native copper mineralisation is the major ore type, and Little Eva, which is a sulphide copper orebody – have been the subject of a Definitive Feasibility Study (DFS) which Universal completed in April 2008. Optimal pit shells and pit designs were generated at Blackard, Scanlan and Little Eva and Ore Reserves were subsequently declared, with Universal reporting a total reserve of almost 48 Mt at a copper grade of 0.7%, including 15.5 Mt of copper-gold ore with a gold grade of 0.13 g/t at Little Eva.

Universal revised its DFS in September 2008 to incorporate the feasibility of mining at a steady state rate of 5 Mtpa and producing a blend of 60% oxide (native copper) ore and 40% sulphide ore. The process flowsheet envisioned is a conventional comminution and flotation plant producing a copper-gold concentrate. Universal estimates that the 5 Mtpa mining and processing option would have a start-up capital cost of between \$155M and \$162M. Mining leases over the Roseby Project have yet to be granted; Universal is currently revising its environmental management plan and expects to gain a permit to operate, and subsequently a mining lease, in the second quarter of 2010.

In 2007 Universal entered into a project agreement with Mt Isa Mines Limited (Xstrata). The essence of the agreement is that Xstrata has the right to explore for sulphide copper ore beneath Blackard and Scanlan and near surface elsewhere in the Roseby region. By achieving certain financial hurdles by 30 June 2012 Xstrata can earn the right to 51% of the ore within a defined area below and outside existing resources (known as the Sulphide Extension Exploration Project or SEEP area) and must then purchase 51% of the greater Roseby Project, which includes the currently defined Ore Reserves and Mineral Resources. Xstrata also has an offtake agreement with Universal whereby it has the rights to take up to 100% of the concentrate produced from Roseby.

In addition to the declared resources and reserves at Roseby, Universal has a contiguous tenement holding of 1,407 $km^2$ in the immediate area. Universal also holds a further 754 $km^2$ of tenements in the broader Mt Isa-Cloncurry area which are prospective for base metals and uranium mineralisation, including two exploration joint ventures. In addition to its Queensland projects Universal holds 38 $km^2$ in a single tenement, the Burra Project, which is approximately 30 km south of Canberra.

Vulcan is a Finland focussed explorer whose main mineral asset is the Kylylahti copper-cobalt-zinc-nickel-gold project, situated 22 km northeast of the town of Outokumpu and 380 km northeast of the capital Helsinki. The Outokumpu region has dominated Finnish copper production and the

Kylylahti deposit sits along strike from the main historical producing mines. Vulcan has completed a DFS on Kylylahti which was subject to a phase of optimisation in April 2008. Since this time Vulcan has continued to drill into the orebody and announced a resource upgrade in July 2009, which Optiro has adjusted to 7.5 Mt at a grade of 1.25% copper, 0.24% cobalt, 0.21% nickel, 0.49% zinc and 0.65 g/t gold.

The DFS at Kylylahti envisages an underground mine accessed by a decline from surface. Ore will be mined by a mixture of longitudinal and transverse stoping, with empty stopes filled via a paste plant on the surface. Through the use of paste fill Vulcan expects to achieve a very high conversion of resource to reserve and has reported an Ore Reserve of 6.94 Mt at a grade of 1.17% copper, 0.24% cobalt, 0.2% nickel, 0.49% zinc and 0.7 g/t gold. Processing will be carried out at a concentrator to be built at the mine site; this will be a single-stage crushing, single stage autogenous grinding plant with several differential flotation circuits and a capacity of 0.8 Mtpa. The plant will produce two products; a conventional copper-gold concentrate which Vulcan plans to truck to a railhead 15 km from the mine and thence by rail to smelters at Harjavalta or Pori on the southwest Finnish coast, and a bulk sulphide cobalt-nickel-zinc concentrate. This concentrate is currently planned to be trucked to the recently-commissioned Talvivaara mine, 140 km to the north-northwest, for offtake, although Vulcan has no formal offtake agreement with Talvivaara. The Kylylahti project has full permitting and is well served by infrastructure, with grid power crossing the site and a sealed road 400 m from the plant site. Vulcan has a number of exploration claims (exploration licences) in the Kylylahti region, of which two have declared Mineral Resources relating to remnant ore at the historical Vuonos mine and an unmined deposit at Saramäki.

Vulcan's other main mineral assets in Finland are within the Kuhmo Nickel Project, which covers 180 km of the Kuhmo-Suomussalmi greenstone belt approximately 200 km north of Kylylahti. Vulcan has a total tenement holding within this belt of some 30 $Km^2$, spread over 59 claims in six project areas. The Kuhmo-Suomussalmi greenstone belt has a very similar geologic and structural setting to the Norseman-Wiluna belt of Western Australia (which contains a large nickel sulphide endowment), and Vulcan's leases contain a number of nickel sulphide deposits, of which five have a Mineral Resource declared by Vulcan. The principal deposits are at Vaara, Hietaharju and Peura-aho, with smaller deposits at Sika-aho and Arola. The total declared resource over the five deposits is 11.5 Mt at a nickel grade of 0.4%, with minor copper and cobalt but significant platinum and palladium grades, with up to 1.6 g/t platinum plus palladium at Hietaharju. Vulcan is exploring actively on the Kuhmo Project outside of the defined resources, and the area has good potential for further discoveries.

On 16 November 2009, Vulcan announced that it had purchased a number of assets from the bankrupt estate of Finn Nickel OY, a wholly-owned Finnish subsidiary of Canadian company Belvedere Resources (the Belvedere transaction). The principal asset of this transaction is the Luikonlahti processing plant, 45 km west northwest of Kylylahti. Vulcan's purchase of this processing plant, which requires a relatively small amount of refurbishment, means that the construction of a concentrator at the Kylylahti minesite is no longer required, thus reducing capital expenditure markedly. Vulcan's current strategy is to produce a lower tonnage at a higher grade from Kylylahti than forecast in the optimised DFS, truck this material to Luikonlahti, and then produce three ore concentrates, including a copper-gold concentrate as described above, a low grade zinc concentrate and a nickel-cobalt concentrate somewhat similar to that originally planned in the DFS. A waste sulphide concentrate will be stored at Luikonlahti or disposed in tailings. Vulcan is currently carrying out value engineering to optimise its strategy in line with the new acquisition.

Along with the Luikonlahti processing plant, Vulcan has through the Belvedere transaction acquired a number of mineral properties, including the Hautalampi, Riihilahti, Perttilahti and Kokka deposits in the Outokumpu and Kylylahti regions, a package of nickel-copper-cobalt projects in the Kotalahti region, 100 km southwest of Outokumpu, and a suite of nickel-copper resources in the Vammala area near the southwest coast of Finland, 400 km southwest of Outokumpu. The total additional

Mineral Resources acquired through the Belvedere transaction outside of the Outokumpu as announced by Vulcan comprise 4.0 Mt as both Indicated Resources and Inferred Resources.

Optiro has, wherever possible, attempted to value the various mineral assets of Universal and Vulcan in a similar manner. The main projects at Roseby and Kylylahti were valued using a discounted cashflow (DCF) method resulting in a net present value (NPV). For both projects KPMG has advised Optiro on commodity prices, exchange rates, annual inflation and discount rates, and has provided taxation treatments for the cashflows. Other technical parameters have been selected by Optiro. Optiro has generated a technical valuation for both projects; the market adjustment to reflect fair market values has been applied through the discount rates applied and the use of a range of values as sensitivities, which have been risk-adjusted.

For Roseby Optiro has largely adopted Universal's DFS parameters but has selected slightly lower metallurgical recoveries. Optiro has assumed a greater mining inventory than that scheduled by Universal, on the assumption of the conversion of some current Inferred Resources to Ore Reserves, and also assuming that the SEEP drilling currently being carried out by Xstrata will result in additional reserves. Optiro has not assumed any reserve contribution from the seven Roseby satellite deposits. Optiro has valued the impact of the SEEP JV with Xstrata by assuming two possible options; the first is that Xstrata earns the right to 51% of the SEEP material and thus purchases 51% of the entire Roseby Project; the second option is that Xstrata chooses not to exercise the SEEP option and 100% of the ore at Roseby reverts to Universal. Of note is the fact that the purchase of 51% of Roseby by Xstrata has no impact on the valuation; in contrast, the assumption of a 51% share of the underlying SEEP material by Xstrata has a marked effect on the valuation and results in a negative NPV at the low end of the range of outcomes. Optiro has thus assumed, based upon current knowledge and reasonable forward predictions, that Xstrata would not wish to exercise the SEEP option. If Xstrata was to exercise the SEEP option then certain aspects of the subsequent valuation would no longer be valid.

For the Roseby (and Kylylahti) Project valuations Optiro has carried out a sensitivity analysis around the base case value using a Monte Carlo technique, which has the advantage of simultaneously varying multiple variables, thus providing a much more robust sensitivity than the approach of varying only one parameter at a time. Ranges of variability have been assigned to all major input parameters. Parameters such as commodity prices, exchange rates and mining physicals have a uniform model of variance, which means that any value between the low (generally 15% less than the base assumption) and the high (generally 15% greater than the base assumption) is equally likely. Other variables such as capital and operating costs, smelter returns and working capital ratios have been modelled with a distribution which has a preferred value (the base case value) plus an upper and lower limit. The Monte Carlo technique generates multiple iterations of the financial model, in each case choosing variables at random from the defined ranges. The result is a range of NPV values, from which Optiro has chosen a low case and a high case. The base case (that is, without Monte Carlo analysis) forms the preferred value.

For the valuation of the Kylylahti Project Optiro has, after review, adopted almost all of Vulcan's technical parameters with only minor adjustments, mainly due to the delayed start-up of the project. Optiro has modelled the changed circumstances for mining and milling of the Kylylahti Project ensuing from the Belvedere transaction. Key differences between Optiro's model and Vulcan's in-house modelling are the commodity prices, discount rates and taxation treatments adopted by Optiro under advice from KPMG. In contrast to Roseby, Optiro has assumed no future conversion of resources to reserves at Kylylahti, given the current high 93% conversion rate. As at Roseby, Optiro has carried out Monte Carlo sensitivity analysis around the base case NPV value.

The valuation of the additional resources in the seven satellite deposits at the Roseby Project has been performed using an implied in-ground metal value, based firstly upon recent (post global financial crisis) transactions involving copper resources in the Mt Isa region, and secondly upon a range of project value benchmarks for companies with similar resource assets in the region, where the Enterprise Value (EV) of the company has been calculated as at the valuation date of 1 November 2009. A low, high and preferred value of cents per pound of in situ copper was then applied to the Roseby Inferred Resources. A similar approach was used for all of Vulcan's Mineral Resources outside of the Kylylahti Project. This value was benchmarked against the EV of companies with similar nickel-copper-platinum-palladium assets in Scandinavia or elsewhere.

A valuation option which was considered for Roseby was the scenario under which the DCF analysis of the projects returned a negative post tax NPV at the low end of the range. Under these circumstances the definition of Ore Reserves as per the JORC Code (2004) would no longer hold and the assets would revert to Mineral Resources, which have a less rigorous requirement for profitability. In this option, Optiro has thus valued the Roseby Project on a resource-only basis. Under these circumstances a NPV valuation is inappropriate and an in-ground value, similar to the additional resources valuation described above, has been applied. The concept of fair market value has been built into these valuations by considering recent market transactions. The low value of the valuation of the Roseby Project is the low end of the resource-only valuation.

Exploration assets for both Universal and Vulcan have been valued using the Kilburn approach, which relies upon a range of technical factors applied to the base acquisition cost of a property to derive an implied value per $km^2$ or per ha of exploration tenement. This approach has been used widely in exploration potential valuations. Optiro has benchmarked the Kilburn valuation against recent market transactions both in the Mt Isa region and in Scandinavia in order to provide support for the valuations applied. Fair market value is derived for the Kilburn approach by applying a market related (premium or discount) factor to the technical valuation factors. This fair market value has been benchmarked against a consideration of recent market transactions relating to exploration properties without defined resources.

Optiro has, to the best of its ability, checked and can confirm the arithmetical and logical integrity of the DCF models and the Monte Carlo analysis for Vulcan and Universal.

Optiro's summary valuations for Universal (in AUDM) and for Vulcan (in EURM) are provided in Table 1.1 and Table 1.2 respectively.

**TABLE 1.1 SUMMARY VALUATION OF THE ASSETS OF UNIVERSAL RESOURCES**

| Asset | Valuation (AUD Millions) | | |
|---|---|---|---|
| | Low | High | Preferred |
| Roseby Project Ore Reserves | 15.0 | 90.0 | 53.1 |
| Roseby Project additional Mineral Resources | 9.6 | 28.8 | 19.2 |
| Exploration tenements (Roseby, Queensland, New South Wales) | 5.2 | 22.4 | 13.8 |
| **Total** | **29.8** | **141.2** | **86.1** |

**TABLE 1.2 SUMMARY VALUATION OF THE ASSETS OF VULCAN RESOURCES**

| Asset | Valuation (EURM) | | |
|---|---|---|---|
| | Low | High | Preferred |
| Kylylahti Project Ore Reserves | 30.7 | 79.0 | 61.1 |
| Mineral Resources in the Kuhmo, Kylylahti, Outokumpu, Kotalahti and Vammala areas | 1.4 | 9.0 | 6.0 |
| Exploration tenements (Kylylahti, Outokumpu area, Kuhmo and Kotalahti) | 0.7 | 3.4 | 2.0 |
| **Total** | **32.8** | **91.4** | **69.1** |

# 2. INTRODUCTION

## 2.1. TERMS OF REFERENCE

Optiro was engaged by KPMG which is acting as Independent Expert in the proposed merger of Vulcan and Universal. KPMG has been commissioned by Vulcan to prepare an independent expert report which will be included in a Scheme of Arrangement booklet. The booklet has been prepared to allow Vulcan shareholders to vote on the proposed merger, whereby Universal will acquire all of the fully paid ordinary shares in Vulcan for the consideration of 6.85 Universal fully paid shares for each Vulcan fully paid ordinary share currently on issue.

Optiro's role is as an independent mineral specialist advising KPMG. Specifically, Optiro has been instructed by KPMG to prepare an independent valuation report on the mineral assets of both Universal and Vulcan. Optiro's terms of reference include the Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets for Independent Expert Reports (2005) (the VALMIN Code) and the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (2004) (the JORC Code), as well as the Australian Securities and Investment Commission (ASIC) Regulatory Guides 111 and 112.

Optiro has been requested to provide both a technical valuation and an opinion of the fair market value of the mineral assets of both Universal and Vulcan. The VALMIN Code defines the technical value of an asset as an assessment of the future net economic benefit accruing to the asset at the valuation date under a set of assumptions deemed appropriate by Optiro, excluding any premium or discount to account for market or other strategic considerations.

The fair market value of an asset is the amount of money (as cash or another consideration) as determined by the Expert, who must assume that asset should change hands on the valuation date (1 October 2009 in this case) in an open and unrestricted market between a willing seller and a willing buyer in an arm's length transaction in which each party acts knowledgeably, prudently and without compulsion. Essentially the fair market value comprises the technical value and a market-related premium or discount relating to market conditions at the valuation date.

The assets of both Universal and Vulcan comprise, variably, projects for which there are declared Ore Reserves as defined by the JORC Code, projects which have declared Mineral Resources which have been reported according to the JORC Code and properties which have exploration potential but no defined resources or reserves. Optiro has used a variety of valuation methods in deriving its valuation, each of which is commensurate with the assets being valued.

KPMG has provided Optiro with a number of technical input parameters to use in its valuations. These are forecasts of commodity prices over the lifetime of the major projects, foreign currency exchange rates, inflation rates for Australia, Finland and the USA, taxation assumptions and discount rates. Optiro has assumed values for all other input parameters into the technical valuation, and has justified the choice of these parameters in the text.

In the report, all currencies are Australian Dollars unless otherwise explicitly stated.

## 2.2. STRUCTURE OF REPORT

The report contains a factual description of the assets of Universal and a similar description of the assets of Vulcan. This description covers the main development projects, the other significant resources and brief details of the principal exploration tenements held by both companies. The valuation section which follows describes valuation principles and the methodologies used for each class of asset, namely exploration properties, Mineral Resources and Ore Reserves. The valuation of the various assets of Universal is described in detail, followed by a description of the valuation of the assets of Vulcan. Note that some rounding errors may occur in totals. The appendices include a tenement listing for both companies, sources of information and a glossary of technical terms.

# 3. ASSETS OF UNIVERSAL RESOURCES

## 3.1. OVERVIEW

Universal has exploration and development assets in Queensland and New South Wales, Australia (Figure 3.1). The principal asset of Universal is the Roseby Copper Project (Roseby Project), located approximately 65 km northwest of Cloncurry in Queensland and 90 km north-northeast of Mt Isa. Roseby comprises three separate deposits for which Ore Reserves have been defined, a further seven deposits where only Mineral Resources exist and a significant tenement holding of over 1,407 $km^2$ within the Roseby Project itself. Universal also holds a further 754 $km^2$ of tenements in the broader Mt Isa-Cloncurry area which are prospective for base metals, gold and uranium mineralisation. In addition to the Queensland projects Universal holds 38 $km^2$ in a single tenement, the Burra Project, which is approximately 30 km south of Queanbeyan.

Universal has completed a DFS on the Roseby Project dated April 2008 which examined the scenario of a 4 Mtpa operation treating ore from the three currently defined reserves. This entailed production of a blend of 73% of oxide (native) copper ore and 27% of sulphide copper ore from different open pits and production of a copper concentrate via a conventional comminution and flotation plant. Since the release of the DFS Universal has been examining the feasibility of commencing the Roseby Project with an initial annual mined production of 5 Mtpa of copper ore, at a blend of 60% oxide and 40% sulphide. Universal estimated that this option would have start-up process plant capital costs of between $155M and $162M and a total pre-production capex of $214M. At the valuation date an executive summary of this revised DFS was available.

Universal has an agreement with Xstrata known as the Roseby Project Agreement. This gives Xstrata certain rights, including the right to explore for deeper sulphide copper ore below the existing oxide and supergene copper deposits and an option to earn and/or purchase 51% of the Roseby Project. A fuller description of the terms and significance of the SEEP agreement is provided elsewhere in this report.

## 3.2. THE ROSEBY PROJECT

### 3.2.1. INTRODUCTION AND HISTORY

The Roseby Project is a development project which is the principal asset of Universal Resources. The main native copper deposits comprising Roseby were delineated by CRA Exploration (CRAE), with the bulk of the work being carried out between 1990 and 1996. Little Eva had been identified by CRAE but had not been fully delineated until Universal acquired the property. In 1996 the property was acquired by Pasminco, which undertook further exploration and drilling. Universal acquired the ground from Pasminco in 2001, and due to funding limitations exploration work over part of the area was carried out under a joint venture with Bolnisi Logistics. In 2004 Universal acquired Bolnisi Logistics and thus assumed full ownership and management of the deposits. The location and tenement holding of the Roseby Project, along with the location of Universal's other Queensland regional exploration tenements, is shown in Figure 3.2.

### 3.2.2. SETTING AND GEOLOGY

The Roseby Project sits within the Eastern Fold Belt of the Mt Isa Inlier, which hosts a world class accumulation of base metal, gold, phosphate and uranium mineralisation. This includes some of Australia's largest lead-zinc-silver, copper and copper-gold deposits such as the Mt Isa deposits, Ernest Henry, Century, Dugald River, Cannington and the Selwyn deposits. The regional setting of Roseby within the Mt Isa Inlier and some of the other main deposits is shown in Figure 3.3. Universal's tenements straddle the north-south trending Mt. Rose Bee-Pilgrim Fault and the north-northeast trending Quamby Fault. To the east of the faults lie the Naraku Granite and the quartzites and schists of the Soldier's Cap Group while to the west are the schists and calc-silicates of the Corella Formation and the quartzites, slates and limestones of the overlying Mt. Albert Group. The rocks have been subjected to a number of deformational events and exhibit regional metamorphism of upper greenschist to mid-upper amphibolite grade (Figure 3.4).

**FIGURE 3.1 LOCATION OF UNIVERSAL RESOURCES PROJECTS IN AUSTRALIA**

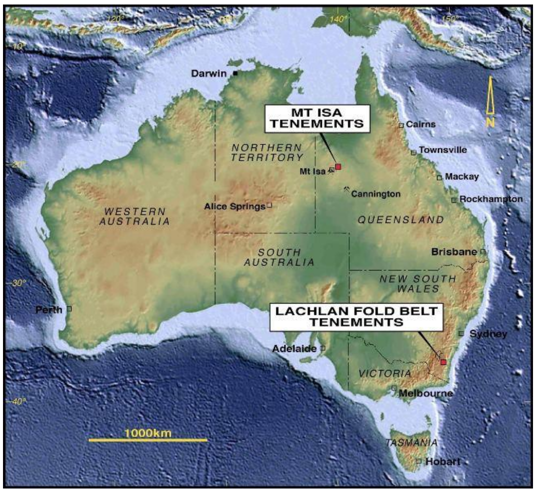



**FIGURE 3.2 LOCATION AND TENEMENT HOLDING OF THE ROSEBY COPPER PROJECT AND OTHER UNIVERSAL TENEMENTS IN QUEENSLAND**

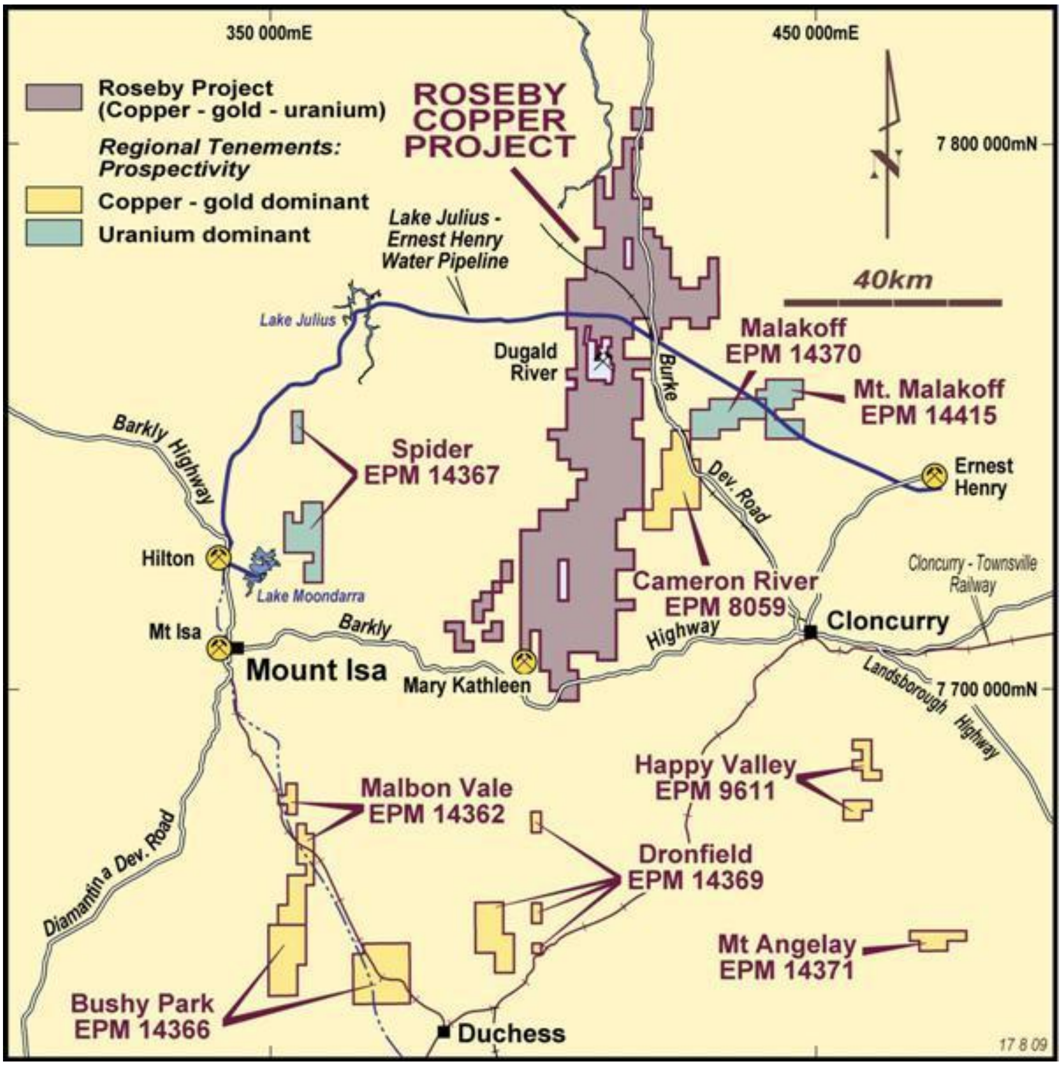
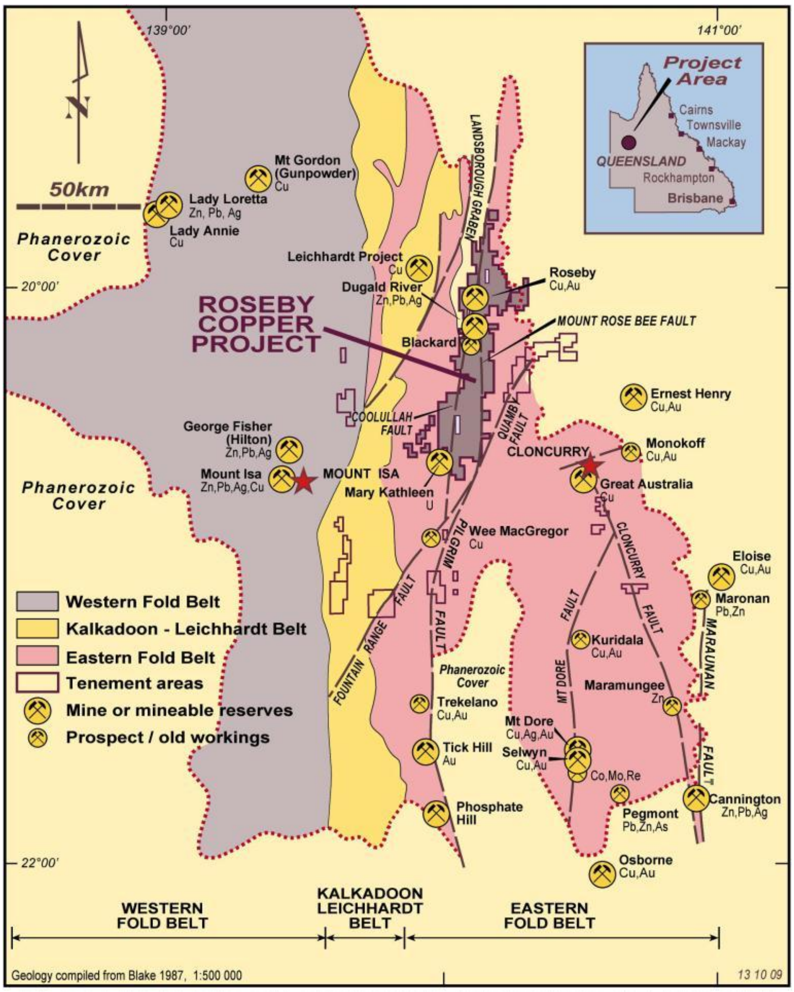


**FIGURE 3.3 OVERVIEW GEOLOGY OF THE MT ISA INLIER SHOWING MAJOR DEPOSITS AND THE LOCATION OF ROSEBY**

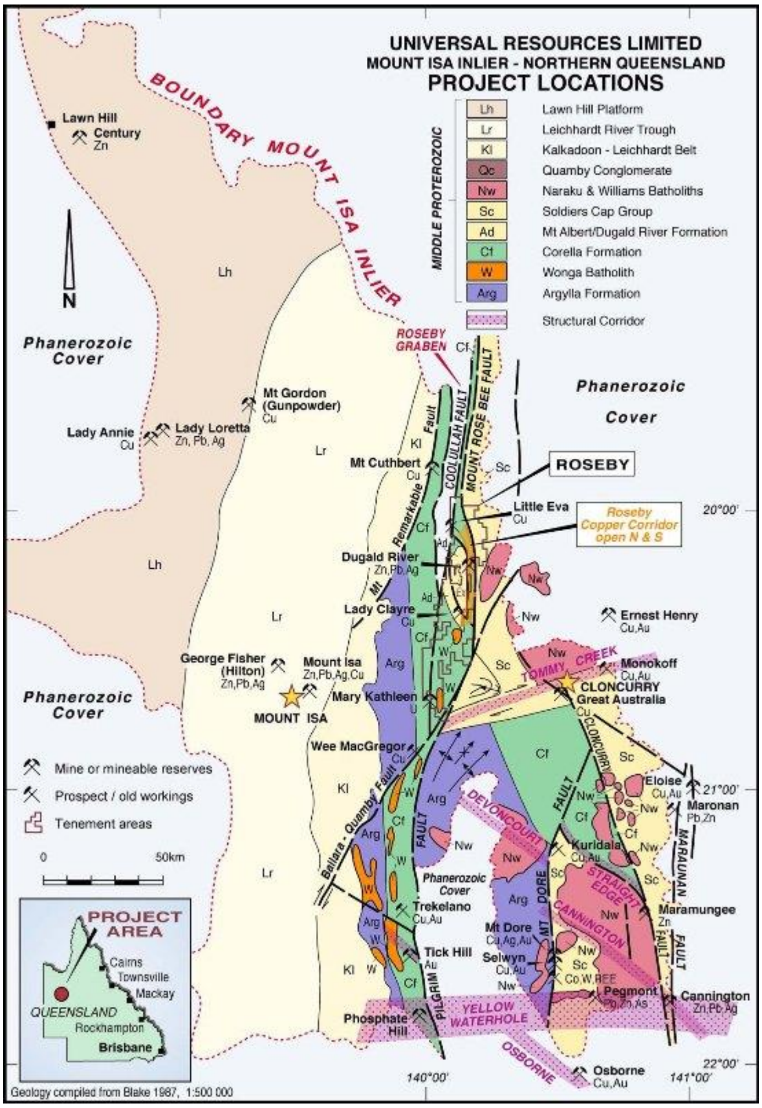



The project area is notable for the presence of a fault-bounded north-south trending structural zone which is termed the Roseby Copper Corridor. The eastern boundary of this corridor is demarcated by the Mount Rose Bee Fault. Rocks to the west of the fault sit within the Corella Formation (Figure 3.4) and host most of the known copper deposits within the project area within a 2 km to 5 km band of schists, calc-silicates, phyllites, marbles and siltstones. An inferred fault, known as the Dugald River Fault, separates these Corella Formation rocks from the Mt Albert Formation on the west. A black slate unit within the Mt Albert Formation hosts the Dugald River lead-zinc deposit which sits immediately to the west of the Roseby Copper Corridor. The Dugald River deposit is currently being assessed for development by the Minerals and Metals Group Australia Limited (MMG) and sits on a group of leases, of which one is wholly surrounded by Universal tenements. The presence of the Dugald River project adjacent to the Roseby Project has potential implications for the sharing of some infrastructure, which is discussed in Section 3.2.8.

The majority of the declared Mineral Resources for the Roseby Project sit within or immediately adjacent to the Roseby Copper Corridor. The only significant deposit which sits to the east of the Mt Rose Bee Fault is the Bedford Deposit. Figure 3.5 shows the location of the main deposits, along with the outlines of the Mining Lease applications and the SEEP project boundary, both of which are discussed in Section 3.2.4.

The defined deposits which form the Roseby Project comprise two types of copper mineralisation – native copper and sulphide. The main native copper deposits are Blackard, Scanlan (which contain Ore Reserves as reported by Universal), Longamundi, Legend, Great Southern, Charlie Brown and Caroline. The principal sulphide copper deposits are Little Eva (which has an Ore Reserve), Lady Clayre and Bedford. It is important to note that the sulphide deposits contain minor amounts of oxide copper near the surface, but that more importantly the native copper deposits can overlie significant amounts of sulphide mineralisation, generally at depth below the supergene zone. This underlying sulphide mineralisation is the target of the SEEP agreement with XStrata, which is described in Section 3.2.4.

**FIGURE 3.4 GEOLOGY OF THE EASTERN FOLD BELT OF THE MT ISA INLIER SHOWING THE ROSEBY PROJECT LOCATION**

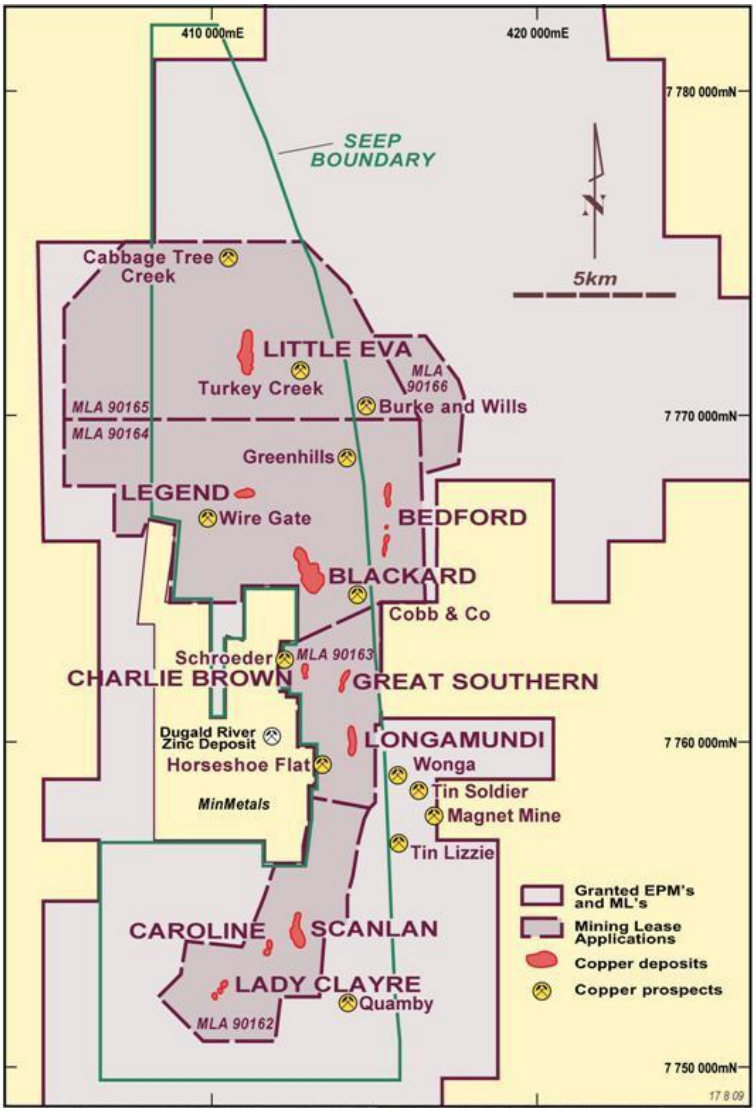



The native copper deposits are hosted within sediments of the Corella Formation, which have been subject to strongly developed tight subvertical to overturned isoclinal folds. Axes are predominantly north-trending, except in the Blackard –Legend area where the fold axes swing to the northwest.

The main native copper deposits are regarded having a primary sedimentary hosted origin. Typically they feature three zones – an oxide zone, a supergene zone and primary zone at depth. The supergene zone generally comprises native copper mineralisation, sometimes with chalcocite. The overlying oxide blanket is thought to be a late-stage weathering event. The main native copper deposits, Blackard and Scanlan, are both characterised by a western trough-like structure and a central anticlinal arch, which are variably mineralised. The mineralisation has been interpreted as having some analogues in the Zambian Copper Belt, but it is clear that there are also strong structural controls on the localisation of the ore along with a hydrothermal overprint or reactivation of primary sulphide copper. The third largest deposit in terms of resource tonnage is Longamundi, which is hosted within a tightly-folded sandstone-siltstone sequence. Smaller oxide deposits occur at Legend, which may eventually prove to be a strike extension of Blackard, and at Great Southern, Charlie Brown and Caroline.

The supergene mineralisation at Roseby is somewhat unusual in that it is predominantly native copper, which is present in two forms; as native platy fine to occasionally coarse copper grains and as copper partly locked up in hydrobiotite crystal lattices. This latter mode of occurrence is effectively non-recoverable through currently proposed processing methods, and contributes to the overall low metallurgical recoveries of 60% - 65% for the native copper ore. The native copper resources at Roseby contain little to no gold.

**FIGURE 3.5 LOCATION OF THE PRINCIPAL DEPOSITS AT ROSEBY, THE MINING LEASE APPLICATIONS AND THE SEEP PROJECT OUTLINE**




The sulphide copper deposits comprise a range of deposit types. The principal deposit, at Little Eva, comprises a sequence of interbedded carbonate-rich metasediments and porphyritic intermediate to mafic volcanic flows and intrusives. The mineralisation is hosted within the feldspar porphyry and the volcanics. Little Eva has been described as a deposit of the Iron Oxide Copper Gold association, prominent examples of which are the mines at Olympic Dam in South Australia and Ernest Henry, some 50 km from Roseby. At the northern end of the Little Eva deposit the mineralisation is quite continuous and corresponds to the boundaries of the feldspar porphyry. Towards the south and southeast of the deposit the mineralisation becomes more diffuse and complex and exists over a width of up to 300 m. Copper is present largely in chalcopyrite within Little Eva, and the deposit also contains gold which has a strong spatial relationship with the copper.

The second largest sulphide copper Mineral Resource is contained within the Lady Clayre deposit, which sits to the south of the proposed plant site. Mineralisation at Lady Clayre is complex and is associated with a folded syncline structure surrounded by dirty dolomitic rocks and black shales. The mineralisation is thought to contain both remobilised stratabound deposits and hydrothermal vein-style deposits and occurs in at least seven distinct areas. Lady Clayre has the highest gold grades (averaging 0.5 g/t gold) of any of the Roseby deposits. Bedford is a modest-size sulphide copper-gold resource located on the eastern side of the Mount Rose Bee fault, some 4 km from the proposed plant site. Mineralisation is hosted within a shear zone in schists and amphibolites. The dominant copper mineral is chalcopyrite. The mixture of sulphide copper and native copper deposits at Roseby has implications on the processing and scheduling options chosen; these are discussed below in more detail.

### 3.2.3. TENURE

Universal's Roseby Project comprises 17 exploration permits for minerals (EPMs) with a total area of 1407 $km^2$. These are shown in Figure 3.2. The details of the tenements are provided in Appendix A, but in summary, the current annual expenditure commitment for the Roseby licence is approximately \$1.8M, comprised of \$0.8M of fixed tenement costs and \$1M of exploration expenditure commitment, along with a small annual ongoing native title cost of about \$20k. Universal is attempting to consolidate 16 of the 17 EPMs into two 'super-EPMs' (without dropping any ground) which would reduce the expenditure commitment by up to \$0.8M in the first year of consolidation, but probably by less after that (assuming that the proposed merged entity does not embark upon a more aggressive exploration programme).

In addition to the EPMs, Universal also has five mining licence applications which cover the defined Mineral Resources and Ore Reserves for the project (Figure 3.5, Appendix A). A substantial amount of the permitting for the project has been completed but the issue of the mining leases is subject to the submission of an acceptable environmental management plan by Universal. Universal expects the mining leases to be granted in the second quarter of 2010.

### 3.2.4. THE ROSEBY FEASIBILITY PROJECT (RFP), SEEP AND CONCENTRATE OFFTAKE AGREEMENTS WITH XSTRATA

Universal and Xstrata signed a Heads of Agreement (HoA) in March 2005. In return for providing funding to Universal by way of a share placement, Xstrata earned certain rights to acquire a 51% interest in the Roseby Project. For the purposes of the agreement the Roseby project was divided into two areas:

- The SEEP area, as depicted in Figure 3.5. This area excludes the major native copper deposits but includes the primary sulphides below the base of the native copper zones at these deposits. The SEEP area in the main part of Little Eva starts from 200 m below the surface and in the southern extension of Little Eva from 150 m below the surface. The intention here was to define the base of likely open pit mining as the upper level of the SEEP zone. Elsewhere outside of the Roseby resources the SEEP zone extends to the surface, allowing Xstrata to explore for primary mineralisation at higher levels.
- The RFP, which includes the balance of the Roseby leases outside of the SEEP area and any resources in the mineralised areas excluded from the SEEP area.

The RFP option provides for Xstrata to acquire a 51% share of the RFP sale interest at any time up to 30 June 2012 at a price to be negotiated or determined by an independent expert valuer acting under the guidelines of the VALMIN Code. If, at the time that the option is exercised, the SEEP JV is still in place, the SEEP area will be excluded from the RFP sale interest.

On 6 June 2007 Xstrata exercised its option to earn a 51% interest in the SEEP area. In order to earn a 51% interest in the SEEP area Xstrata needs to spend before 30 June 2012, by sole funding either:

- \$15M in exploration activities or

- $10M in exploration activities and completion of a detailed feasibility study concerned with the establishment of a mining and processing operation on any defined SEEP material.

The original objective of the SEEP agreement, from Xstrata's viewpoint, was to determine the potential for a major sulphide copper mineralised province below the native copper deposits at Roseby. A second objective was the discovery of new sulphide copper deposits outside of the existing deposits, either of the native copper or the sulphide type.

At the date of the valuation it is estimated that Xstrata had spent approximately $7M on exploration, including geophysical surveys, drilling and general administration.

An important clause in the SEEP agreement is that if Xstrata earns its 51% interest in the SEEP area as described above but has not exercised the RFP option it must buy for cash a 51% share in the RFP area on similar terms to those pursuant to the exercise of the RFP option.

In addition to, and separate from, the SEEP and RFP options is a concentrate offtake agreement with Xstrata whereby, whether it is a 51% owner of the Roseby Project or not, Xstrata has the right to take all concentrate produced from the Roseby tenements. This may either be treated at the Mt Isa smelter of Xstrata, or exported. Xstrata also has the right to be appointed as marketing agent for Universal to market concentrate which is not sold to Xstrata. World parity pricing terms would apply to the concentrate, and Universal and Xstrata would share the freight benefits of transporting the concentrates to Mt Isa rather than a port in Japan.

As a consequence of the agreements described above Universal is not allowed to encumber or dispose of any or all of the Roseby tenements without the consent of Xstrata.

Universal has not carried out any drilling or other exploration to extend its principal resources and reserves at Roseby into the SEEP area since the date on which Xstrata exercised its option in 2007. It may be argued that this lack of extensional drilling activity has not realised the full potential of the main Roseby resources, and thus provides a distinct upside to the Roseby Project. Some Inferred Resources at Scanlan inside the current pit design have not been upgraded to Indicated Resources through drilling (see below) and thus cannot be converted to Ore Reserves. Universal views this lack of infill drilling as both a timing and a cost maximisation issue.

The last assays reported by Universal from SEEP drilling were in January 2009. While many of the SEEP holes are along strike from Blackard one hole (BCD850) drilled below Blackard returned a sulphide copper downhole intersection of 112 m at a grade of 0.89% copper and 2.8 g/t silver immediately below a thick zone of native copper mineralisation (Figure 3.6). During its site visit Optiro had the opportunity to view both BCD850 and some other recent holes drilled underneath Blackard. While no assays were available and Optiro's inspection was not comprehensive or systematic, it is clear that there is significant, but as yet unquantified potential for sulphide mineralisation below Blackard within the SEEP area. Of note is the fact that certain of the SEEP holes drilled by Xstrata below Blackard have been largely barren, so the orientation and extents of the mineralisation are not yet fully understood.

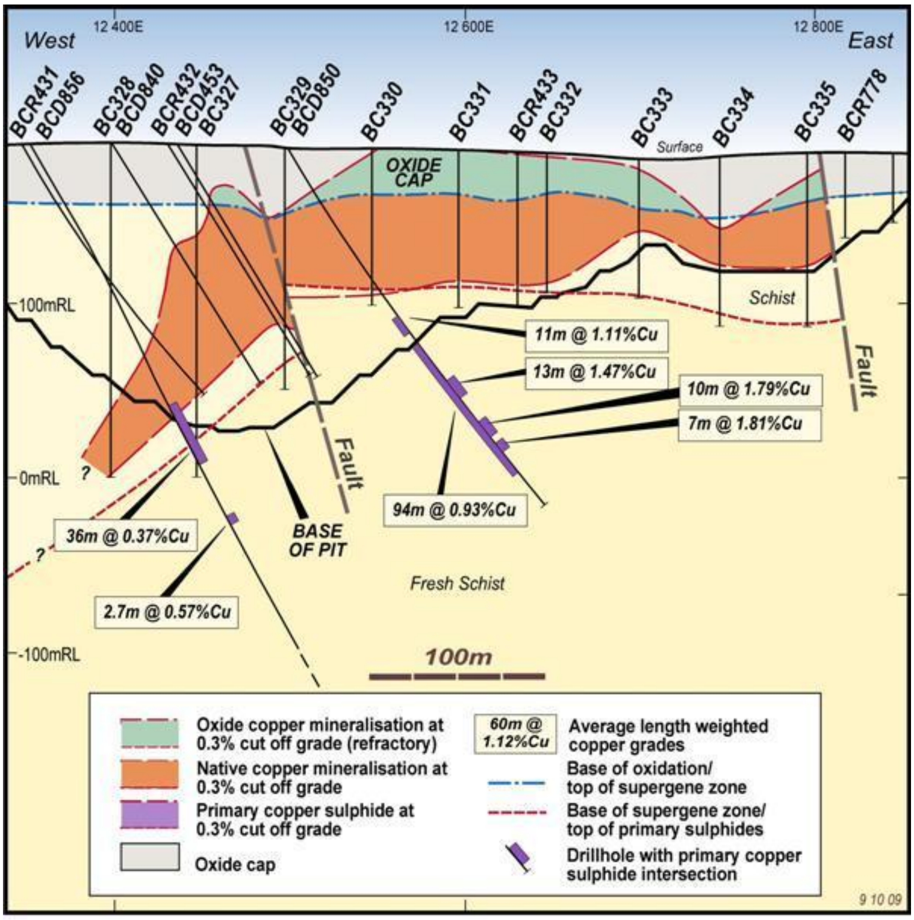
### 3.2.5. MINERAL RESOURCES

#### OVERVIEW

The Mineral Resources at Roseby were last estimated in 2007 by Universal's consultants. Table 3.1 provides a summary. Only Blackard, Scanlan and Little Eva feature any class of resources other than Inferred, although the Indicated and Measured Resources at these deposits does comprise over 67% of the total resource base at Roseby.

In summary the principal Mineral Resources are of low risk for both tonnage and grade estimates, with generally good standards of data collection and QAQC, albeit carried out over a number of years and by a variety of project owners. The geological framework at the main oxide orebodies, Blackard and Scanlan, is robust and reveals more or less consistent native copper mineralisation. The geological framework at Little Eva is more problematic and complex, but structural controls and lithological associations at Little Eva are well known, and the estimation methodology has compensated for the mineralisation complexity. Estimation at Blackard and Scanlan corresponds with good industry practice and resource models reflect the input data. There are opportunities for resource extensions and upgrades at all three deposits, but the greatest potential lies at Scanlan and Blackard.

**FIGURE 3.6 BLACKARD CROSS SECTION 18750 SHOWING A DEEP SEEP HOLE BCD850 DRILLED BY XSTRATA IN 2008**




Descriptions of the main features of the resource estimates for the key deposits at Blackard, Scanlan and Little Eva are provided below. These comments arise from detailed validation of the resource models by Optiro. Many of the issues raised below relate to work carried out by previous owners of the tenements; since Universal (and effectively Xstrata) has assumed control over the deposits standards have increased and now represent good industry practice.

## BLACKARD

The Blackard deposit has good geological continuity and consistent native copper mineralisation. Mineralisation is supported by closely spaced (50 m), angled drill holes, which provide sufficient resolution for defining volumes of mineralisation. There is some extensional opportunity to the mineralisation in areas east of the main lode where drilling coverage is poor.

**TABLE 3.1 ROSEBY MINERAL RESOURCES AT A 0.3% COPPER CUT-OFF**

| Deposit | Measured | | | Indicated | | | Inferred | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tonnes (Mt) | Copper grade | Gold grade | Tonnes (Mt) | Copper grade | Gold grade | Tonnes (Mt) | Copper grade | Gold grade | Tonnes (Mt) | Copper grade | Gold grade |
| **Oxide** | | | | | | | | | | | | |
| Blackard | 26.3 | 0.64 | | 17.9 | 0.63 | | 2.1 | 0.58 | | 46.2 | 0.63 | |
| Scanlan | | | | 15.4 | 0.65 | | 4.2 | 0.8 | | 19.6 | 0.68 | |
| Longamundi | | | | | | | 10.4 | 0.66 | | | | |
| Legend | | | | | | | 6.1 | 0.6 | | | | |
| Great Southern | | | | | | | 6.0 | 0.61 | | | | |
| Charlie Brown | | | | | | | 0.7 | 0.4 | | | | |
| Caroline | | | | | | | 3.6 | 0.53 | | | | |
| **Total oxide** | 26.3 | 0.64 | | 33.2 | 0.63 | | 33.2 | 0.63 | | 92.7 | 0.64 | |
| **Sulphide** | | | | | | | | | | | | |
| Little Eva | 3.8 | 1.04 | 0.13 | 22.8 | 0.75 | 0.13 | 3.7 | 0.73 | 0.15 | 30.4 | 0.8 | 0.14 |
| Lady Clayre | | | | | | | 3.7 | 0.88 | 0.51 | 3.7 | 0.88 | 0.51 |
| Bedford | | | | | | | 1.8 | 0.93 | 0.24 | 1.8 | 0.93 | 0.24 |
| **Total sulphide** | 3.8 | 1.04 | 0.13 | 22.8 | 0.75 | 0.13 | 9.2 | 0.83 | 0.31 | 35.8 | 0.8 | 0.18 |
| **Total** | **30.1** | **0.69** | **0.03** | **56.1** | **0.68** | **0.06** | **42.4** | **0.68** | **0.08** | **128.5** | **0.68** | **0.06** |

### Data collection and data types

Blackard has been drilled out over a number of years, starting with exploratory Aircore (AC) and Rotary Air Blast (RAB) drilling, followed up by more extensive Reverse Circulation (RC) and Diamond Drilling (DD). The drilling methods are appropriate for the style of mineralisation and have adequately defined extents. Drilling before 2000 is not well documented, with a resultant low risk to estimates; however, Optiro notes that the pre 2000 drilling forms less than 20% of the total drilling data. Collar and downhole surveys are acceptable for most of the drill holes with a low risk associated with pre 2000 holes. Sampling practices tend to be consistent within drilling methods, particularly diamond drilling. Sampling of RC chips has been via a variety of methods, which may have introduced some slight bias for pre-2000 drilling. Twinned hole drilling provides some verification of mineralised intersections. In addition there was an acceptable insert rate of field duplicate sampling. Sample recovery of RC drilling does not appear to have been considered during estimation and poses a low to medium risk to the integrity of the more weathered material.

### Data quality

Density measurements have been completed on core samples, along with some downhole geophysical measurements and RC chip measurements. Diamond core results have been carefully analysed and compared with lithology, depth and degree of weathering and oxidation. Accordingly, densities have been assigned to the respective block model domains. Inconsistent measuring methods have limited the number of measurements, particularly for the shallower weathered and waste material. There is a low to moderate risk that densities may not be representative. There are a number of inconsistencies in the geological logging over the various campaigns, which may introduce a risk to the delineation of the various weathered horizons and thus the tonnage estimates. There is acceptable data quality for topography, sampling data, assay data and survey and collar data. Data is stored in a best practice database system with good validation and relational data ability.

### Assay quality

There is evidence of the adoption of reasonable QAQC practice with acceptable rates of inserted standards, repeats and blanks. Optiro notes that QAQC analysis was completed largely at the time of resource estimation, and suggests that future analysis should take place during or immediately after the drilling campaigns. Blank QC samples were only inserted from 2004 onwards; as a result there is a moderate risk of contamination for a large proportion of the database. Standards employed during the Bolnisi drilling programme (50% of the total RC samples) were not certified reference materials, and as a result there is a low to moderate risk to the accuracy of these sample results. There are no umpire or check laboratory sample submissions or analyses prior to 2005; since then an acceptable level of duplicate samples have been sent to an umpire laboratory. In 2005 a large batch (2500) of samples was sent out to a group of laboratories to validate a metallurgical recovery algorithm; these samples were used to correct some of the issues raised with previous analysis of standards. Twin hole drilling, comparing the pre-2000 and post-2000 sampling highlights minor differences in sample values, as may be expected between AC drilling and diamond core. AC samples were not used during resource estimation.

### Database and security

Bolnisi and Universal completed several phases of data validation and cleaning for loading into Maxwell's Datashed system. Accordingly data is consistent, complete, validated, secure and easily interrogated.

### Geological framework

Inconsistent logging codes between various operators pose a low risk to the interpretation of the various surfaces representing oxidation and weathering.

The domain of mineralisation modelled is representative of the geological interpretations and the drillhole logging and assay data. Wireframe volumes are based upon vertical section interpretations of the mineralisation using a nominal 0.3% to 0.5% copper cut-off. The scale and level of detail of available information is reasonable to good. Fault geology has been considered but is currently deemed to have a low impact on the volume estimation; the faults, however, appear to control, at least in part, the localisation of sulphide copper mineralisation below the current pit, which is one of the targets of Xstrata's SEEP drilling.

### Domaining

There is a dominant native copper ore domain which has been used for estimation. There are some zones of chalcocite and chalcopyrite sulphide copper within the broader oxide zone which, when further delineated with infill drilling, offer some upside within the currently defined pit due to better metallurgical recoveries.

### Statistical and geostatistical analysis

The 2 m composite length utilised is appropriate. In terms of geostatistical (variogram) analysis, the Blackard mineralisation displays a distinct sub-vertical and sub-horizontal orientation, suggesting multiple domains.

### Grade estimation and validation

The inverse distance square method used for estimation is believed to be reasonable given the relatively poor variography. There is some opportunity for investigating the character of the mineralisation boundary between ore and waste.

Block sizes for estimation are supported by ore zone dimensions, orientation and drill grid spacing. Estimation parameters were guided by drill grid spacing, indicative variography and the requirement for a reasonable number of samples to inform an estimate. There is a low risk that local block grade estimates are not as robust as a kriged estimate. Block model estimates compare well with input data and are locally representative.

### Classification

Classification criteria for the Blackard Mineral Resource estimate are the data quality, grid spacing and geological continuity. There is a low risk to the assigned categories. It is possible that a kriged estimate would provide additional support for the confidence and robustness of the block model estimates.

### Resource upside

There is low to moderate resource upside within the native copper portion of the Blackard orebody, although there is good potential for orebody extensions. However, some of the 2008 and 2009 SEEP drilling carried out by Xstrata (Section 5.3.3) shows that there is high chance of orebody extensions in the sulphide zone below the supergene.

### SCANLAN

The Scanlan deposit is geologically and mineralogically similar to the Blackard deposit. The estimation at Scanlan used 61% of the data from pre 2000 drilling. This is a moderate risk to the estimation as there is limited documentation for the drilling, sampling, assaying and QAQC procedures employed. Varying drill line spacing across Scanlan poses a moderate risk to the mineralised volume. The mineralisation volumes are adequately defined with 50 m to 100 m line spacing for the southern and northern portions of the deposit. However, the eastern portion has spacings of 200 m, resulting in higher risk to delineation of mineralised volumes which is compounded by the difference in geological continuity across this portion. Inconsistent logging from the various drilling programmes presents a moderate risk to the position of weathering surfaces. Limited density data, particularly for shallow and waste material, is a moderate risk for the resource tonnes.

### Data collection and data types

There have been several drill campaigns to target mineralisation at the Scanlan deposit, utilising both RC and DD holes. The drilling methods are appropriate for the style of mineralisation and have adequately defined the orebody extents, apart from the east of the orebody. The section spacing changes from 50 m in the south to 100 m in the north and the eastern section has a 200 m spacing (Figure 3.7). Drilling pre-2000 is not well documented and constitutes a moderate risk to the estimate, comprising 61% of the total drilling data. Similarly the collar and downhole surveys should be treated with some caution for the pre-2000 holes.

Sampling practices tend to be consistent within the drilling methods. Sampling for RC has been via a number of methods, not all best practice. Practices varied between different programmes from riffle splitting to hand mixing and scooping. Comparisons of RC sample results between pre and post 2000 indicates some possibility of bias, with the pre-2000 data generally reporting lower. There may be upside as pre-2000 sampling constitutes 61% of the data used in the resource estimate. Standard rates of field duplicate sampling were practiced.

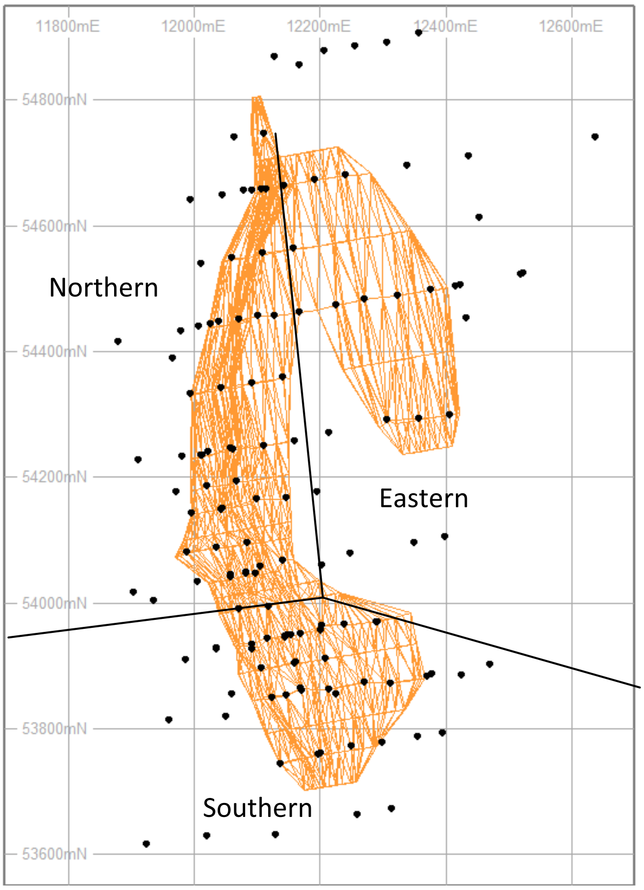
### Data quality

Density measurements were completed mainly on core samples with some downhole geophysical measurements. Results have been carefully analysed and compared with lithology, depth and degree of weathering and oxidation. Accordingly, default densities have been assigned to the respective block model domains. The limited number of density measurements for the respective domains poses a moderate risk for the block model tonnages. Geological logging between the various campaigns is also inconsistent and may affect the delineation of the weathering surfaces.

### Assay quality

There are some issues associated with the abundance of pre-2000 data, for which there is limited QAQC, placing a moderate risk on the estimation process. Post-2000 data has evidence of reasonable QAQC practice with good rates of inserted standards, repeats and blanks. Blanks were only initiated in 2004, and so as a result there is a moderate risk of contamination for a large proportion of the database. Assay quality poses a low to moderate risk to the resource estimates.

**FIGURE 3.7 SCANLAN MINERALISATION WIREFRAME AND DRILLHOLE LOCATIONS (NORTH TO TOP OF FIGURE, GRID SPACING IS 200 M)**




### Database and security

Bolnisi and Universal have completed several phases of data validation and cleaning for loading into Maxwell's Datashed system. Accordingly data is consistent, complete, validated, secure and easily interrogated. The validation and security component of Datashed is a low risk to the resource estimation.

### Geological framework

Regional and local geology models are supported by a wide range of data sources, including geochemical soil sampling, field mapping, aeromagnetic surveys, Induced Potential (IP) surveys, drillhole logging and sampling. Combined with good understanding of regional geology the framework for the resource estimate is sound. However, there has not been as much infill drilling for confidence purposes as there might otherwise have been due to the timing of the Scanlan project in potential production schedules and Universal's desire to maximise drilling effectiveness.

Wireframe volumes are derived from vertical section interpretations of the mineralisation using a nominal 0.3% to 0.5% copper cut-off. The subdivision of the ore into oxide cap, native copper and sulphide domains with appropriate densities, is appropriate. Fault and fold geology has been acknowledged but the impact on the mineralisation is unclear, but probably not significant. The wider spaced drilling does not demonstrate a strong relationship between the geology and mineralisation, and this has accordingly been classified as Inferred. The Inferred material reflects 21% of the Mineral Resource at Scanlan and thus there is considerable upside. There is an opportunity for increased definition of the relationship between geology and mineralisation, with a possible improvement to the mineralised volume.

**Domaining**

The dominant domain is oxide or native copper. There are, however, other styles of mineralisation, including some sulphide areas, which have not been fully delineated. Increased drilling would result in greater definition of these domains and project upside due to increased metallurgical recoveries in sulphide.

**Statistical and geostatistical analysis**

Drillhole data has been composited to 2 m lengths according to the dominant sample length and is appropriate for this deposit. Variography analysis confirms the strike of the copper mineralisation and has a relatively low nugget value. It is possible that improved domaining may enable the utilisation of variogram models and ordinary kriging, which may enhance the quality of the model. Statistical analysis, compositing and geostatistical analysis poses a low risk to resource estimates and classification.

**Grade estimation and validation**

As with Blackard, inverse distance squared estimation was used. Soft boundaries were employed between domains of oxidation and hard boundaries between ore and waste. There is some opportunity for investigating the character of the mineralisation boundary between ore and waste, which is transitional. It should be possible to estimate grades into the waste domain, which would enhance the overall grade recovery and help to more accurately quantify dilution. Ore boundaries will be better defined during pre-development and grade control drilling.

Block sizes used in modelling are supported by the ore zone dimensions, orientation and drill grid spacing. Estimation parameters were guided by drill grid spacing, indicative variography and a requirement for a reasonable number of samples to inform an estimate. There is a slight risk that local block grade estimates are not as robust as a kriged estimate.

Block model results have been statistically compared with the drilling data together with comprehensive visual cross-section validation of block model and input data; the model validates well against the input drilling data. Overall, the estimator's thorough knowledge of the ore body and estimation process has led to a good grade estimate which is deemed to be low risk.

**Classification**

Resource classification criteria are data quality, the drill spacing and geological continuity. Optiro suggests a low to moderate risk to the assigned categories. The Indicated Resources in the eastern portions of the deposit may be optimistic where there is inadequate drill spacing to support continuity (Figure 3.8). Conversely, there is approximately 1 Mt of Inferred material within the optimal pit which could, with drilling, easily be upgraded to Indicated Resources and could thus participate in the Ore Reserve. This lack of definition is a consequence of limited drilling in some areas.

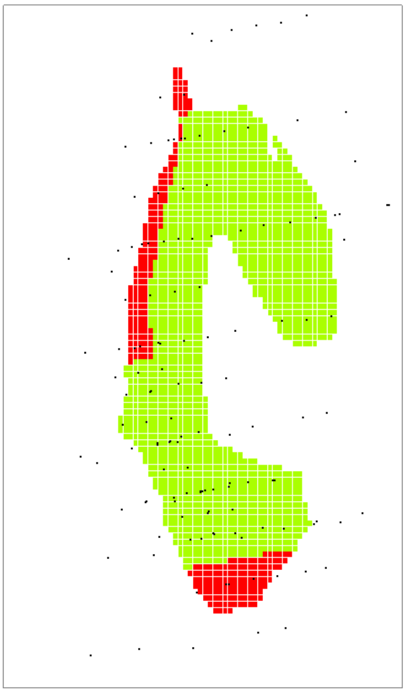
**Resource upside**

As discussed, there is potential both to extend and upgrade the Scanlan orebody with additional and infill drilling. This drilling would also help to better define weathering and lithological boundaries and thus enhance tonnage confidence. With additional drillhole data, a kriging estimation method can be implemented. This will provide additional confidence variables for supporting classification.

## LITTLE EVA

Mineralisation at Little Eva shows good continuity in the north but is highly variable and discontinuous in the South. Accordingly Mineral Resource estimates for Little Eva are exposed to some risk related to the delineation and estimation of the mineralisation. Furthermore, overprints of alteration, weathering and oxidation generate some uncertainty in the logged lithological data supporting mineralised volumes. There is low risk associated with the delineation of weathering/oxidation surfaces. Confidence in density estimates per domain will improve with additional density measurements, particularly for data within the shallow and waste domains. Risk associated with assigned densities and domain surfaces is likely to affect tonnages.

**FIGURE 3.8 SCANLAN BLOCK MODEL IN PLAN VIEW SHOWING DRILLING AND RESOURCE CLASSIFICATION (INDICATED = GREEN, INFERRED = RED), NORTH IS TO THE TOP OF THE FIGURE, FIELD OF VIEW IS 1.2 KM NORTH-SOUTH**



### Data collection and data types

There have been multiple drilling campaigns delineating mineralisation at Little Eva over several years, starting with DD, RAB and then infill RC drilling. Post-2000 RC drilling dominates the data set used for resource estimation. The lack of RC sample recovery data poses a low risk to the estimates. The drilling methods are appropriate for the style of mineralisation and have adequately defined its extents/limits. Optiro notes some opportunity for orebody extensions, with good mineralisation and limited drilling located in the southeast of the deposit and at depth.

The pre-2000 drilling (approximately 18% of the total metres) is not as well documented as the post-2000 drilling and does impose a low risk to these estimates. Collar and downhole surveys are generally good and were checked against repeat surveys and topographic data. There is minimal twin hole drilling data to support significant intersections. Sub standard data was removed from the data set prior to modelling and estimation. This data includes costeans, partially assayed and unassayed drillholes and a hole drilled down the mineralisation to confirm the overall grade of the ore lens.

### Data quality

Data quality is influenced by the variety of drilling campaigns over the last 20 years. Different standards and procedures were employed over time with different owners. As a result Optiro notes a low risk of data inconsistency. At Little Eva this risk is minimised due to a relatively small 18% of the total data being sourced from pre 2000. Overall, data quality is believed to pose a low to moderate risk for delineation of the various geological, alteration and oxidation domains and the estimates.

Density measurements were completed for select drill core, RC samples and through some downhole geophysical measurements. The resulting density values have been analysed and compared to lithology, depth and the degree of weathering and oxidation. There is limited evidence for support of waste rock densities; however, waste densities are likely to be similar to ore densities. There are higher risks of incorrect density determination for the shallower and/or more oxidised portions of mineralisation due to few samples and more variable results. There is the potential for density overestimation in waste and highly weathered material and underestimation in iron-rich rocks.

**Assay quality**

Good industry QAQC practice has been applied, with reasonable rates of inserted standards, repeats and blanks. Twin hole drilling across Little Eva is negligible and verification of significant intersections was not believed valuable by the various owners. Assay quality poses a low to moderate risk for resource estimates and classification.

**Database and security**

As with Blackard and Scanlan, data has been validated and loaded into Maxwell's Datashed system. Accordingly data is consistent, complete, validated, secure and easily interrogated. There is a low risk that database processing, validation, storage and security will affect resource estimates.

**Geological framework**

Regional and local geology is well supported by various data sources, including geochemical bedrock sampling, field mapping, aeromagnetic surveys, IP surveys, drillhole logging and sampling. Combined with a good regional geological understanding the framework supporting the resource estimate is good. The modelled domain of mineralisation is a good representation of the Cu grades and is supported by the drillhole data. Wireframe volumes are based upon vertical section interpretations of the mineralisation using a nominal 0.3% to 0.5% cut-off. Little Eva exhibits considerable variability in the continuity and volume of mineralisation along strike; in particular the geology and mineralisation of the northern portions tends to be far more continuous than the southern broader volumes of mineralisation. Accordingly, the modelling implies a transition between these areas which is likely to be highly subjective and exposes delineation of the mineralised volumes to moderate risk. The Cabbage Tree Creek Fault has been considered and forms a natural abutment for the northern limits of mineralisation. There is potential for offset mineralisation to the north of the deposit along a northeasterly trending fault.

**Domaining**

The key mineralisation domain is the sulphide copper zone. Weathering and associated alteration is complex and has not been considered as a major factor influencing domains. Optiro's site inspection reveals strong mineralisation to the surface, unlike Blackard and Scanlan. The presence of alteration is noted proximal to the mineralised portions of core, but has not been considered for separate domains due to its complex behaviour and the lack of supporting data.

**Statistical and geostatistical analysis**

Drillhole data has been composited to 2 m lengths in order to adequately reflect the grade variability for an inverse distance squared estimate. Classical statistics demonstrate constrained distributions, flat cumulative frequency curves and similar statistics for both the malachite and sulphide domains. Accordingly a single domain (sulphide and malachite) has been estimated with distinctions in the assigned density.

A proprietary 'recovered fraction' method has been used for estimation. In addition to a 2 m composite, a 5 m recovered fraction composite is calculated. This composite method accommodates a considerable amount of the risk associated with the variable and discontinuous nature of the mineralisation for the larger southern volumes. The method removes some of the issues due to the smoothing common to direct estimation using the 2 m composites, and in Optiro's opinion, overcomes some of the risk associated with the uncertain interpretation, particularly in the southern portion of Little Eva. Considerable care has been practiced in the derivation of the recoverable fraction values per 5 m bench with the aid of comparative statistical checks and histogram plots at the various copper cut-off percentages. Statistical analysis, compositing and geostatistical analysis pose a low risk to resource estimates and classification.

**Grade estimation and validation**

The Inverse distance squared method was used to estimate the mineralised blocks. Poor variography limited the application of kriging at Little Eva. However, a dynamic anisotropy method of estimation, which follows folded or flexured domains, was employed, ensuring that appropriate orientations of continuity are employed for local estimates.

The recovered fraction method provides an improved resolution to estimating the proportions of ore and waste per mineable block. The estimation parameters were guided by drill grid spacing, indicative variography and the requirement for a reasonable number of samples to inform an estimate. Treatment of top-cuts or outliers was not believed appropriate as high values were not significantly high enough to influence the estimate. Block sizes are supported by composite length, ore zone dimensions, orientation and drill grid spacing. There is a low risk that the estimation methods employed will dramatically impact the current block estimates. Validations demonstrate reasonable estimates. In Optiro's opinion the recovered fraction approach has largely overcome the issue of the complex distribution of ore and waste at Little Eva. If anything, this method is somewhat conservative for the estimation of 'waste' outside ore zones, which has been allocated zero grade – in practice grades will be between zero and 0.3 % copper.

**Classification**

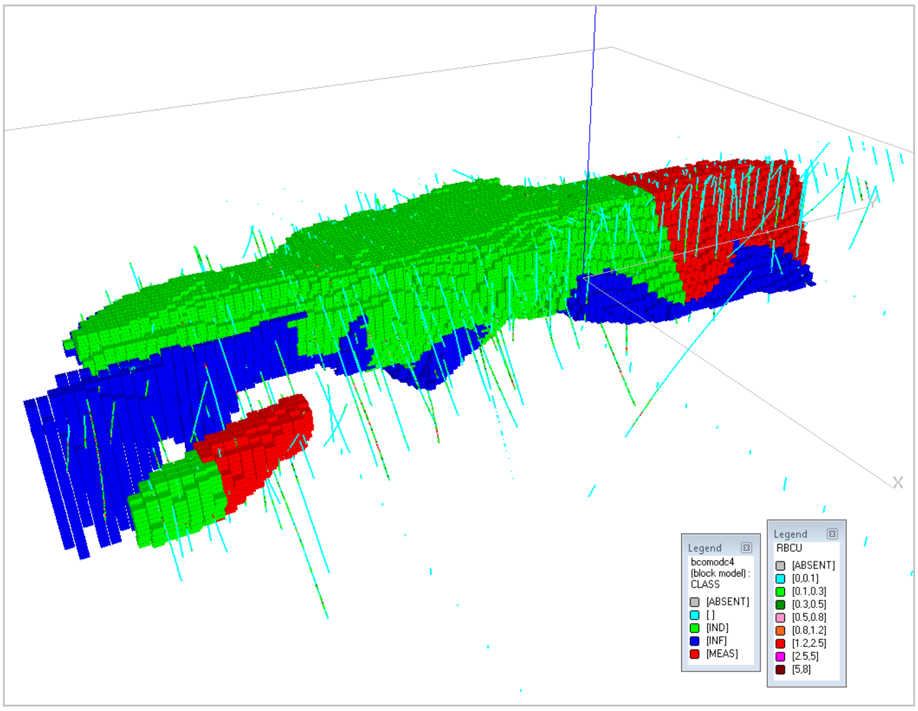
Classification criteria for Little Eva are data quality, grid spacing and geological continuity. Optiro notes a low risk to the assigned categories with the exception for the southwestern most lode which in Optiro's opinion may optimistically be classified as Measured (Figure 3.9). There is some Inferred material included in the pit shell design at the southern extent of the main lode of mineralisation, but this amounts to less than 0.6% of the total tonnage.

**Resource upside**

The current level and spacing of drillhole data certainly suggests some opportunity for orebody extensions, particularly at depth. The complex and discontinuous nature of the southern portion of the Little Eva mineralisation is noted as a low to moderate risk and will benefit from additional infill drilling, allowing for improved delineation of the mineralised volumes and more representative local estimates.

The lack of density data provides real upside for optimising block model tonnages. An extensive density analysis programme across Little Eva will particularly engender increased confidence in the more weathered and waste domains.

**FIGURE 3.9 AN OBLIQUE NORTH EASTERLY 3D VIEW OF THE LITTLE EVA MINERAL RESOURCE CLASSIFICATION, RED IS MEASURED, GREEN IS INDICATED AND BLUE IS INFERRED. THE FIELD OF VIEW IS 1 KM**




## 3.2.6. ORE RESERVES AND MINING SCHEDULE

### ORE RESERVES

Universal has declared Ore Reserves which are compliant with the JORC Code for Blackard, Scanlan and Little Eva. These were estimated at the time of the generation of the Mineral Resources in 2007 and following final pit designs in 2008. The reserve process commenced with the generation of optimal pit shells by Universal's consultants, based upon the resource models described and reported above. The inputs for the optimisation are described below.

### Unit mining costs

Universal's mining consultants derived unit mining costs per tonne or bank cubic metre (bcm) of ore and waste separately for each of the three pits. These costs were derived on the basis of a number of quotes from potential mining contractors. The costs were derived in June 2007. The contractors quoted on the basis of conventional truck and shovel mining in each pit. The overall production rate from the combined operation was assumed to be 4 Mtpa of ore. Different degrees of blasting were assumed for each deposit, with generally less blasting at Blackard and Scanlan and slightly more blasting at Little Eva. The estimates from the contractors were assessed and a median set of unit costs, corresponding to one of the contractors, was adopted as the benchmark.

### Geotechnical parameters

Geotechnical parameters for the pit optimisation were provided by Universal's geotechnical consultants. The investigations were carried out to DFS requirements and included the following studies or data assumptions:

- adequate coverage of the proposed pit walls through exploration drill core and specific diamond drilled oriented core
- geotechnical logging of drill core
- material strength testing
- probabilistic analyses of failure

- structural kinematic analyses
- understanding of geology, structural geology, hydrogeology and the rock mass.

Based upon these studies, the recommended design criteria were:

- Blackard – the overall wall angle for a pit of depth between 150 m and 160 m should not exceed around 43° in order to satisfy West Australian Department of Mines and Energy (DOMEWA) criteria, which are acknowledged as Australian standards.
- Scanlan - the overall wall angle for a pit of depth 130 m should not exceed around 46° in order to satisfy DOMEWA criteria.
- Little Eva - the overall wall angle for a pit of depth 130 m should not exceed around 45° in order to satisfy DOMEWA criteria.

The optimisations carried out by Universal's Consultants used these design criteria, which were also adopted in subsequent pit designs. Optiro's review of these recommended slope angles concluded that whilst the slope designs meet the minimum criteria recommended by DOMEWA (factor of safety = 1.2 and probability of failure = 10%), the rock mass and hydrogeological conditions at the three deposits have been described as complex in the associated documentation. These conditions would normally require a minimum design factor of safety of 1.3 and probability of failure of between 1% and 3% for overall slopes. Thus there is a low to moderate risk attached to the pit slope assumptions used by Universal in its pit designs. Universal believes that it can mitigate geotechnical risk through the adoption of staged pit designs and the monitoring of slope stability over time.

**Metallurgical recovery**

This is discussed in more detail below, but for the purposes of the optimisations and the recovery calculations for royalty and assumed smelting charges the sulphide copper (Little Eva) was assumed to have a recovery to concentrate of 95% and Scanlan (native copper) was assumed to have a recovery of 63%. Blackard was treated in a more complex manner whereby an effective recovery per block was derived using a regression algorithm related to a number of variables. The net result for Blackard was effective recoveries of between 62% and 64%, with some blocks rejected from the Ore Reserve on the grounds of poor recovery.

**Summary optimisation inputs**

In summary, the pit optimisation parameters detailed in Table 3.2 were adopted. In addition to the invariant unit mining costs specific costs for each pit, based upon the consensus contractor quotes, and delineated per each 10 m bench, were applied.

The optimisations by Universal's consultants used the industry standard Lerchs-Grossman algorithms. There were a number of iterations, and when a suitable set of optimal pit shells had been derived these were subject to mine design. The pit shells corresponding to a USD2.0 /lb copper price were used as the basis for full designs, which honoured the geotechnical parameters provided. Although the set of optimal parameters in Table 3.2 indicates a nominal production rate of 8 Mtpa, the DFS resources were predicated on a production rate of 4 Mtpa, and the pit optimisations as such are not sensitive to this parameter. A point of note is that the resource block models at the native copper pits are terminated at a certain elevation to provide a demarcation boundary for the SEEP exploration. This is very relevant at the oxide pits. At Blackard and Scanlan the optimal pits commonly stop short of the SEEP boundary on the basis of the economic parameters adopted, mainly the USD2/lb copper price. Notwithstanding the SEEP terms of agreement it is clear that both Blackard and Scanlan have the potential to be much deeper pits when mining eventually commences.

The final pit designs for Blackard, Scanlan and Little Eva were passed back to Universal's consultants for reserve reporting. The figures which were derived, which are to date the only reserves reported for the Roseby Project, are given in Table 3.3. There has been no regeneration of the optimal pits to reflect current commodity prices and exchange rates.

It is important to note that the Ore Reserves for Blackard and Scanlan do not include an allowance for ore loss and dilution. Optiro's estimate is that dilution at these deposits would not be significant due to the massive nature of the orebodies, but an allowance of 5% tonnage dilution (at a grade of between 0.1% and 0.3% copper) and up to 5% ore loss would be prudent. However, Optiro believes that there is considerable upside in the resource estimates at both Blackard and Scanlan; the Blackard pit includes 100,000 t of Inferred Resource which has been treated as waste and the Scanlan pit similarly includes a million tonnes of Inferred Resources. It would be reasonable to expect that an operator would convert some or all of this material to reserves through judicious infill drilling before production commenced.

The recovered fraction method used at Little Eva largely accounts for ore loss and dilution so no further allowances are required in this case.

**TABLE 3.2 SUMMARY OF OPTIMISATION PARAMETERS USED FOR ROSEBY PITS**

| Parameter | Units | Value |
|---|---|---|
| **Revenue Parameters** | | |
| Exchange rate | USD/AUD | 0.72 |
| Base copper price | USD/lb | 2.00 |
| Base gold price | USD/oz | 500 |
| Effective government royalty for copper | % | 2.07 |
| Effective government royalty for gold | % | 1.80 |
| Effective vendor royalty for copper | % | 1.10 |
| Effective vendor royalty for gold | % | 1.50 |
| Effective Kalkadoon royalty below threshold price | % | 0.15 |
| Effective Kalkadoon royalty above threshold price | % | 0.22 |
| Kalkadoon royalty threshold copper price | USD/tonne | 3300 |
| **Annual Parameters** | | |
| Annual ore production rate | Mtpa | 8.0 |
| Annual administration cost | AUD millions | 9.36 |
| **Recovery Parameters** | | |
| Recovery to concentrate - sulphide copper | % | 95 |
| Recovery to concentrate - native copper * | % | 63 |
| Recovery to concentrate - malachite copper | % | 0 |
| Recovery to concentrate - sulphide gold | % | 90 |
| Recovery to concentrate - native gold | % | 45 |
| Concentrate copper grade - sulphide | % | 30 |
| Concentrate copper grade - oxide | % | 38 |
| Concentrate moisture content | % | 8 |
| **Ore Treatment Parameters** | | |
| Sulphide ore treatment cost | AUD/t | 8.34 |
| Oxide ore treatment cost – first 2 years | AUD/t | 5.42 |
| **Smelting and Refining Terms** | | |
| Concentrate transport cost – first 2 years | USD/t (wet) | 50.25 |
| Copper payment terms – first two years | % | 96.5 |
| Gold payment terms | % | 97.5 |
| Deduction from copper grade | % units | 1.00 |
| Deduction from gold grade | g/t units | 1.00 |
| Smelter charge – first two years | USD/t (dry) | 49.00 |
| Copper refining charge – first 2 years | USD/lb | 0.049 |
| Gold refining charge | USD/oz | 4.50 |
| **Unit Mining Costs (depth invariant)** | | |
| Mining supervision & staff cost | AUD/t | 0.28 |
| Rehabilitation cost | AUD/t | 0.05 |
| ROM handling cost – Blackard | AUD/t | 0.14 |
| ROM handling cost – Scanlan and Little Eva | AUD/t | 0.07 |
| Ore haulage cost - Blackard | AUD/t | 0.00 |
| Ore haulage cost – Scanlan | AUD/t | 1.60 |
| Ore haulage cost – Little Eva | AUD/t | 1.01 |

**TABLE 3.3 ORE RESERVES FOR THE ROSEBY COPPER PROJECT**

| Deposit | Proved | | | Probable | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Tonnes (Mt) | Copper grade (%) | Gold grade | Tonnes (Mt) | Copper grade (%) | Gold grade | Tonnes (Mt) | Copper grade (%) | Gold grade |
| Blackard | 17.0 | 0.67 | | 5.8 | 0.65 | | 22.8 | 0.67 | |
| Scanlan | | | | 9.6 | 0.71 | | 9.6 | 0.71 | |
| Little Eva | 1.8 | 1.03 | 0.11 | 13.7 | 0.69 | 0.13 | 15.5 | 0.73 | 0.13 |
| **Total** | **18.8** | **0.70** | **0.01** | **29.2** | **0.69** | **0.06** | **47.9** | **0.69** | **0.04** |

## Mining schedule

The reserves above are predicated on a 4 Mtpa ore mining rate from all pits. This was to be produced in a ratio of 73% oxide to 27% sulphide for blending into a plant. Universal went through a DFS optimisation phase in 2008, and for the revised DFS a production rate of 5 Mtpa ore was deemed to be more appropriate. This rate matched the capacity of an optimised plant design (see below). Mining schedules were thus revised upwards to reflect the increased production rate, although no economy of scale in terms of reduced unit costs was built into the Ore Reserves, which remain as for the 4 Mtpa case. Universal's consultants produced a 5 Mtpa schedule, which is summarised in Table 3.4. Optiro believes that this schedule is achievable although not necessarily optimal. Of note is that the 5 Mtpa schedule treats ore in a ratio of 60% oxide to 40% sulphide – this has scheduling implications and also means that at least two pits need to be in operation at any one time. At this time insufficient work has been carried out on an 8 Mtpa schedule for it to have any reasonable degree of rigour. Universal has stated that the investigation of a move to 8 Mtpa would be made once production has started, based upon the actual performance capabilities of the plant and the pits.

**TABLE 3.4 LIFE OF MINE SCHEDULE - 5 MTPA**

| | | | Total | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Blackard | Oxide Ore | Mt | 22.9 | 0.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 1.8 | 0.0 | 0.0 |
| | Waste | Mt | 70.0 | 6.1 | 6.0 | 6.7 | 11.6 | 10.5 | 10.0 | 9.2 | 9.0 | 0.9 | 0.0 | 0.0 |
| | **Total** | **Mt** | **92.8** | **6.1** | **9.0** | **9.7** | **14.6** | **13.5** | **13.0** | **12.2** | **12.0** | **2.8** | **0.0** | **0.0** |
| Scanlan | Oxide Ore | Mt | 9.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 5.0 | 2.9 |
| | Waste | Mt | 21.4 | | | | | | | 1.6 | 2.2 | 10.8 | 6.2 | 0.6 |
| | **Total** | **Mt** | **31.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **1.6** | **2.2** | **12.5** | **11.2** | **3.5** |
| Little Eva | Sulphide Ore | Mt | 15.5 | 0.1 | 1.9 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.4 | 0.0 | 0.0 |
| | Waste | Mt | 56.9 | 5.3 | 12.4 | 10.0 | 5.8 | 6.5 | 5.9 | 4.3 | 3.8 | 2.9 | 0.0 | 0.0 |
| | **Total** | **Mt** | **72.4** | **5.4** | **14.4** | **12.0** | **7.8** | **8.5** | **7.9** | **6.3** | **5.8** | **4.4** | **0.0** | **0.0** |
| Total Mined | Ore | Mt | 47.9 | 0.1 | 4.9 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 2.9 |
| | Waste | Mt | 148.3 | 11.4 | 18.5 | 16.7 | 17.4 | 16.9 | 15.9 | 15.1 | 15.1 | 14.7 | 6.2 | 0.6 |
| | **Total** | **Mt** | **196.2** | **11.5** | **23.4** | **21.7** | **22.4** | **21.9** | **20.9** | **20.1** | **20.1** | **19.6** | **11.2** | **3.5** |

## Pre-production schedule and ramp up

The project construction time is likely to be 18 months. Three months of pre strip are required prior to ore production. In order for production to begin in month 19, pre stripping should commence during month 15. As no mining takes place in the first 12 months, they have not been included in the schedule shown in Table 3.4. This is represented graphically in Figure 3.10. From month 19, production ramps up until full production is reached in the following quarter.

### Mining operating costs

A spreadsheet detailing the mining physicals and the costs for the 5 Mtpa version of the Roseby operation is presented in Table 3.5.

These costs are a combination of the operating costs individually applied to each mining bench and each pit over time. The summary of costs appears to be reasonable. It is understood that these costs include the mining, load and haul, owners' costs and mining administration related to mining activities for material delivered to the Run of Mine (ROM) pad at the processing plant. These costs should be applied to all mining scenarios ranging from production rates between 4 Mtpa and 6 Mtpa. The costs are based upon the contractor quotations of 2007 which have been subject to escalation in September 2008 for the 5 Mtpa case. It is prudent, and likely to be required by a financier, that these values be updated to 2010 values or later by obtaining a new set of contractor quotes, and Universal has stated its intention to do this.

The escalation rates used to bring the 2007 costs to 2008 terms appear to be reasonable. The only factor that may be slightly excessive is the escalation rate for diesel. This, if adjusted, may have a reducing effect on the above costs by up to approximately four percent. The values as they stand still reflect a reasonable expectation of the costs likely to be incurred by the Roseby project for the level of work done to date.

### Mining capital costs

The mining specific capital costs are shown in Table 3.6. The prestrip and cutback cost is based on the unit cost of $2.54/t as per Table 3.5. The haul road cost is based on the construction of 17.6 km of haul roads. The cost of any additional exploration should be treated as additional capital expenditure. Of note is that these costs do not include an allowance for construction of a ROM ore pad at the plant; however, Optiro believes that this cost could be absorbed into the overall operation contingency figure provided. Universal has stated that the total pre-production capital costs are $214M; this covers construction of the plant, camp, infrastructure and power line.

**FIGURE 3.10 PROJECT PRE-PPRODUCTION TIMELINE**

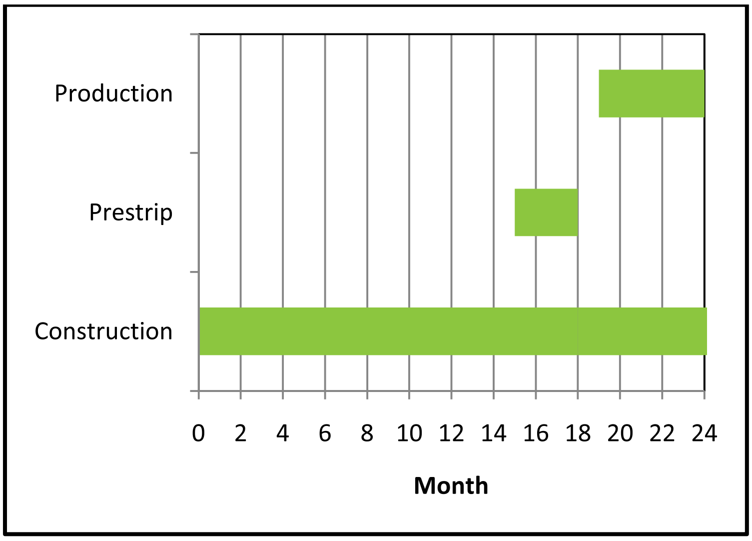


**TABLE 3.5 OPERATING COSTS AND PHYSICALS – 5 MTPA CASE**

| Category | Deposit | $/tonne | $ | tonnes |
|---|---|---|---|---|
| **ORE MINING** | Blackard | $3.29 | $75,198,236 | 22,853,572 |
| | Scanlan | $5.54 | $53,252,346 | 9,617,560 |
| | Little Eva | $4.57 | $70,629,517 | 15,456,057 |
| | **Total Ore** | **$4.15** | **$199,080,099** | **47,927,189** |
| **WASTE MINING** | Blackard | $2.83 | $99,518,678 | 35,187,705 |
| (excl prestrip) | Scanlan | $3.08 | $39,253,416 | 12,763,566 |
| | Little Eva | $2.90 | $141,923,739 | 48,895,259 |
| | **Total Waste (excl PS)** | **$2.90** | **$280,695,833** | **96,846,530** |
| **PRESTRIP MINING** | Blackard | $2.56 | $89,002,194 | 34,763,024 |
| | Scanlan | $2.44 | $21,126,412 | 8,651,005 |
| | Little Eva | $2.59 | $20,830,610 | 8,044,414 |
| | **Total Prestrip** | **$2.54** | **$130,959,217** | **51,458,443** |
| **TOTAL MINING** | Blackard | **$2.84** | **$199,080,099** | **92,804,301** |
| | Scanlan | **$3.66** | **$280,695,833** | **31,032,131** |
| | Little Eva | **$3.22** | **$130,959,217** | **72,395,730** |
| | **Total Mining** | **$3.11** | **$610,735,149** | **196,232,162** |

**TABLE 3.6 LIFE OF MINE CAPITAL COST ESTIMATES**

| Item | $M |
|---|---|
| Mining Contractor mobilisation | 3.60 |
| Mining Contractor demobilisation | 2.00 |
| Pre strip and cutbacks | 131.00 |
| Contractor office and workshop | 1.10 |
| Haul roads | 5.00 |
| **Total** | **142.70** |

### 3.2.7. PROCESSING

#### OVERVIEW

The metallurgy and processing work has been revisited many times over the life of the project and through various owners. URL itself has used a number of metallurgical and engineering consultants. The key issues with respect to metallurgy at Roseby are the recoveries assumed for native copper, sulphide copper (Little Eva) and gold, and the capital costs for the processing plant. The actual flowsheet is relatively straightforward, and comprises a conventional single stage crushing and SAG milling circuit with two stages of flotation (rougher and cleaner) plus a gravity circuit to assist in the concentration of the native copper. The final product is a copper-gold concentrate which can be trucked or railed to a smelter at Mt Isa or railed to Townsville for shipping overseas. The circuit is shown diagrammatically in Figure 3.11.

The original DFS metallurgy work was carried out by a number of consulting groups including Como Engineers, Orway Mineral Consultants, METS and NeoProTec, and considered a 4 Mtpa plant. During the DFS revision phase Universal retained GR Engineering Services (GRES) to optimise the flowsheet and reconfigure the plant to a 5 Mtpa circuit. This work represents the current design. The anticipated feed blend is 60% oxide ore and 40% sulphide ore. The oxide ore is relatively soft (having a bond work index of 5.5 kWhr/t) while the sulphide ore from Little Eva, containing significant quantities of felsic porphyry, is much harder, with a bond work index of 17.6 kWhr/t.

## NATIVE COPPER AND SULPHIDE RECOVERY

One of the key issues throughout the history of development of the Roseby Project has been the measurement of metallurgical recovery, not only for the sulphide copper mineralisation which is deemed to be relatively conventional, but more significantly for the native copper mineralisation which is more exotic. This latter ore has two main modes of occurrence – as small native copper flakes and as copper tied up in the crystal structure of hydrobiotite. This latter mode of copper, which accounts for roughly 30% of the native copper at Blackard and at Scanlan, does not respond to flotation and this is currently not recoverable.

The Roseby flotation knowledge base has developed from the hundreds of batch flotation tests, fifteen locked cycle flotation tests and three pilot plant runs. Definitive locked cycle test results from the most recent set of testing resulted in the recoveries documented in Table 3.7.

**TABLE 3.7 DEFINITIVE LOCKED CYCLE FLOTATION TESTS, ROSEBY ORE**

| Ore type | Concentrate grade (% copper) | Recovery (%) |
|---|---|---|
| Little Eva sulphide ore | 28.1 | 96.4 |
| Blackard oxide ore | 34.7 | 60.7 |

The locked cycle results were subjected to a mass balancing application which seeks to predict more accurately performance in a plant with unmeasurable recycle streams being estimated. This has resulted in the adjusted nominal concentrate grades and recoveries shown in Table 3.8. These represent the headline recoveries which were used in the optimisation and financial modelling.

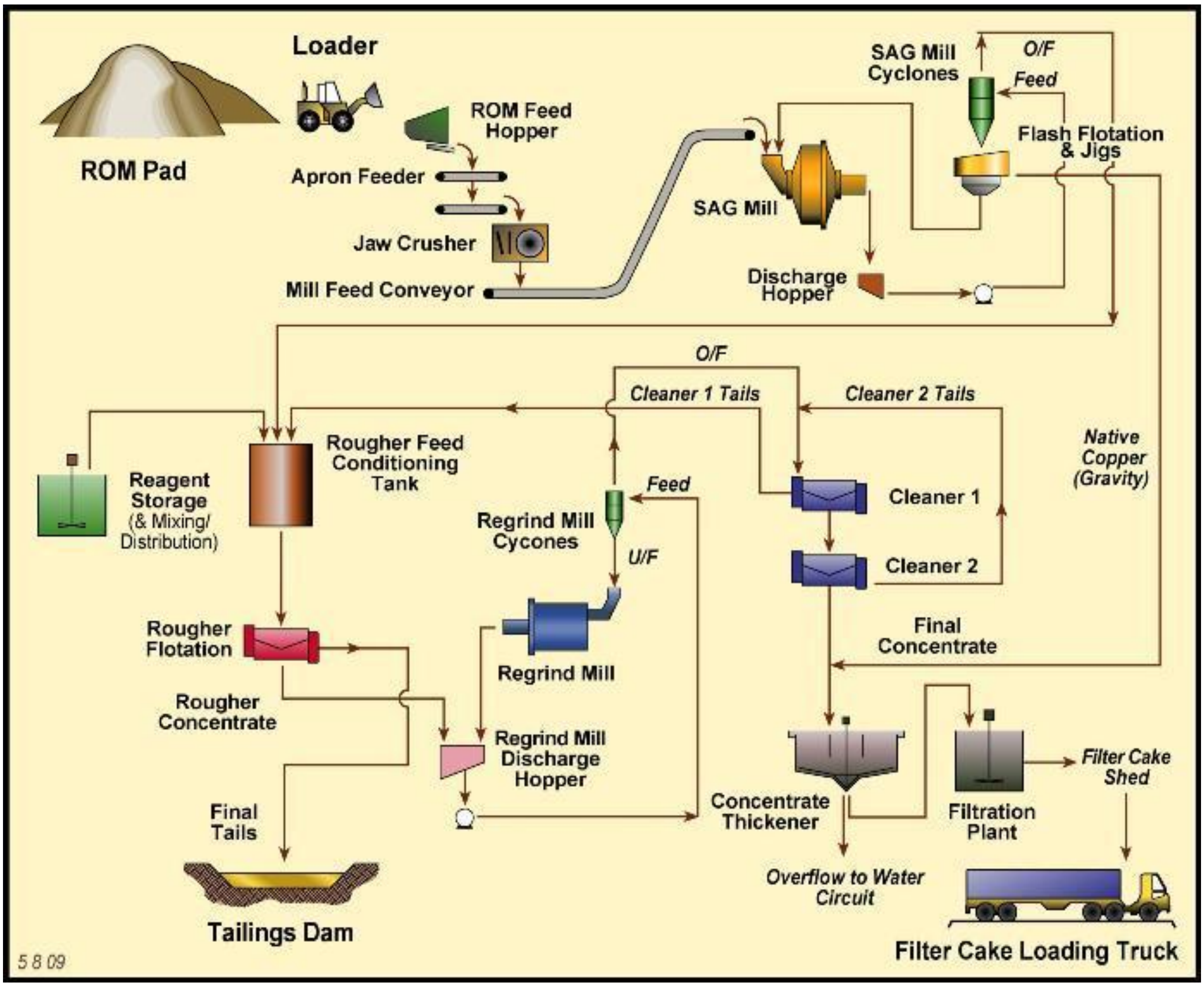
**TABLE 3.8 ADJUSTED MASS BALANCED TESTWORK RECOVERIES, ROSEBY**

| Ore type | Concentrate grade (% copper) | Recovery (%) |
|---|---|---|
| Little Eva sulphide ore | 27.3 | 95.8 |
| Blackard oxide ore | 33.5 | 64.0 |

Due to the complex relationship between native copper, hydrobiotite copper and recovery at Blackard and Scanlan, statistical consultant Geostats was retained to derive a relationship between copper grade and recovery based upon testwork and locked cycle testing. This work was assisted by the development of an assay technique, based upon the use of warm silver nitrate, which more accurately predicts the recoverable native copper. The Geostats algorithm, which is deemed to be applicable only to Blackard (whence the test results came), was used to derive a recovered grade per block in the resource model and thus better inform the pit optimisation and subsequent Ore Reserve estimate. Fixed values of 62% and 94.8%, as per Table 3.8, were used for Scanlan and Little Eva respectively.

Recent review of this recovery work has revealed that there will almost certainly be some loss of recovery in the scale-up from the pilot to the plant, and this has been confirmed by Universal's current metallurgical consultant. It is thought that recoveries of about 60% for the native copper and 94% for sulphide are more realistic for financial modelling, and these values have been used in Optiro's project valuation. Some upside to this is that there are zones of sulphide copper within the oxide mineralisation at Blackard and Scanlan which have not yet been quantified as such, in addition to the still unknown tonnage of sulphide mineralisation below Blackard and down dip from Scanlan, the subject of the SEEP drilling by Xstrata.

FIGURE 3.11 DIAGRAMMATIC PLANT FLOWSHEET FOR ROSEBY




Furthermore, there is no suggestion that there is any gain in recovery from processing a blend of oxide and sulphide ore. The gains in throughput appear to be in the comminution area. At the same time there is no evidence that treating an oxide : sulphide blend will reduce the recoveries obtained from individual ores in the locked cycle testing. Optiro believes that the correct blend of material should be the subject of a holistic optimisation study which considers resources through to processing.

As a precursor to mining some of the other oxide and sulphide deposits, such as Lady Clayre, Longamundi or Bedford, extensive and representative metallurgical testing will need to be carried out.

## GOLD RECOVERY

There has been limited locked cycle metallurgical testwork at Little Eva and Lady Clayre on which to base predictions of gold recovery. However, there are a range of concentrate grades reported from the pilot plant testwork that were based on a 37.5% sulphide ore component. The blend had a gold grade of 0.07 g/t which implies a gold recovery range of 70-80%, although Universal's financial modelling appears to imply a 90% metallurgical recovery. A recovery of 80% has been used in Optiro's modelling.

Of note is that the potential life of mine revenue contribution from gold at Little Eva is not insignificant, amounting to (at October 2009 prices) approximately $120 M. It is therefore worthy of further study to get a fix on the expected recoveries.

#### PROCESSING OPERATING COSTS

The operating cost for the 5 Mtpa processing option, derived by GRES and assuming grid power (see below) has been estimated at $8.67 per tonne of ore processed. Optiro believes that this cost is appropriate for the current level of information regarding the project.

### 3.2.8. INFRASTRUCTURE AND PROCESSING CAPITAL

#### OVERVIEW

Planned site access is via the paved Burke Development Road from Cloncurry then by a dirt track travelling west approximately 75 km north of Cloncurry. The dirt track is approximately 9 km in length and contains five creek crossings. The project road will follow this track and will be upgraded to a well-drained gravel road suitable for use by road trains carrying concentrate out and road delivery in of consumables.

The DFS considers a single processing facility at Roseby, to be positioned close to the Blackard orebody (Figure 3.12). This plan envisages a tailings dam or tailings storage facility (TSF) hard up against the scarp of the Knapdale Range, close by the proposed plant site. Water can be supplied from the Lake Julius to Ernest Henry pipeline, which runs within 4 km of the site. However, this water will be expensive and Universal has indicated that it intends to explore for water in the project area, reserving the Lake Julius water for potable purposes only. Universal is very confident, based upon its detailed knowledge of the geology and controlling structures, that it will be able to find water in sufficient quantities to cover plant and tailings usage. In addition, Universal expects to derive a proportion of its process water requirement initially from pit dewatering as well as from a borefield. Figure 3.12 shows the location of a local mine village which would be served by a fly in-fly out workforce which would commute to and from the airport at Cloncurry. Note that the 5 Mtpa option assumes a village in Cloncurry. This option would almost certainly be cheaper than the Roseby on site village proposal.

Power for the plant would be served by a high voltage line to the Chumvale Substation which is on the Barkly Highway west of Cloncurry. This option was chosen over site generated power due to a lower life cycle cost and for the opportunity to share infrastructure and capital with the Dugald River project. The relative timing of the two projects (plus Cudeco's Rocklands project, which is also nearby) is important as there will need to be a capital cost to upgrade the substation to serve the mining projects and the utility company would probably require a commitment from both Universal and MMG before proceeding with the upgrade.

As mentioned above, the recent work on upgrading the plant to 5 Mtpa by GRES has effectively replaced the earlier work carried out by Como Engineers and reported in the DFS. GRES has redesigned the circuit based upon throughput modelling by Orway Mineral Consultants to cater for the expansion to the higher production rate, but achieving the throughput is contingent upon either a blend of oxide and sulphide or the much softer oxide ore only.

#### CAPITAL COST ESTIMATE

Capital costs have been estimated initially by Como Engineers for the DFS and then later by GRES for the 5 Mtpa processing plant option. The basis for the cost estimates was different in each case. GRES provided estimates for a number of items on a provisional cost (PC) basis. The nature of this costing approach is that the owner or client reimburses the Engineer (GRES) the full value of executing the works in addition to a specified margin. The GRES estimate has capped the cost of the process plant which can be quite readily defined, but a substantial number of items that involve risk, without further scope definition, have been converted to PC sums. In summary, the Como Engineers capital cost was estimated at $161.5 M and the GRES cost was estimated at $155.5 M. The basis of the GRES quote is provided in Table 3.9, which covers the plant and associated costs, and in Table 3.10**,** which details the PC items.

**FIGURE 3.12 PROPOSED ROSEBY PLANT AND INFRASTRUCTURE LAYOUT**

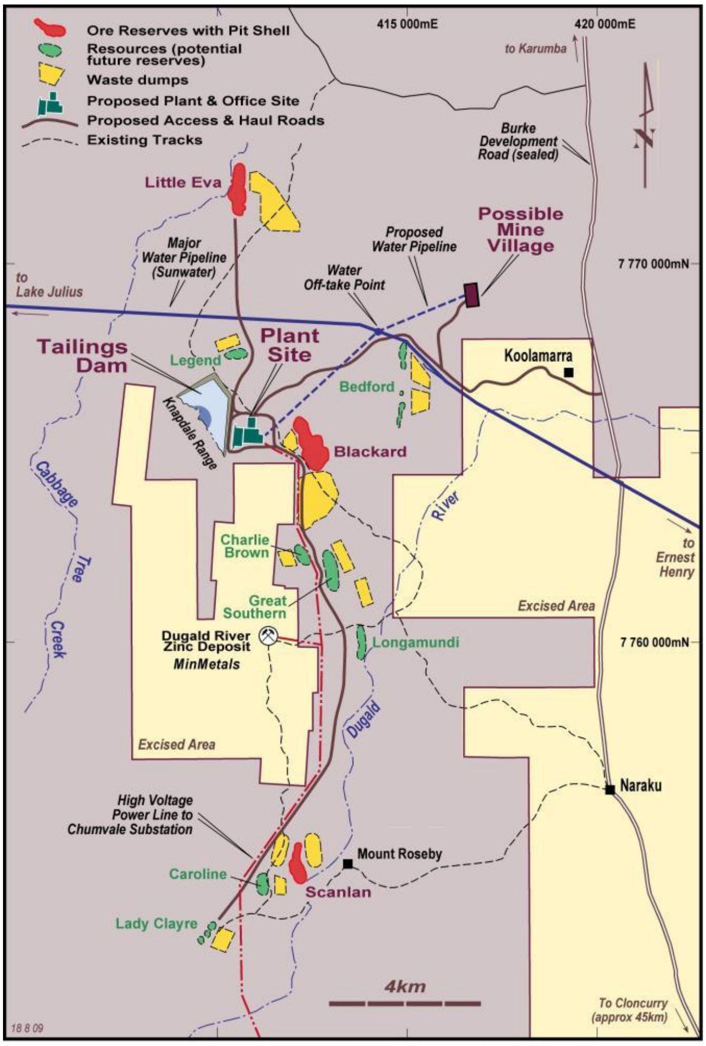



**TABLE 3.9 ROSEBY PROCESSING CAPITAL COST ESTIMATE – FIXED ITEMS**

| Item | Materials | Labour | Freight | Subtotal |
|---|---|---|---|---|
| Site Earthworks | 28,000 | 651,278 | 0 | 679,278 |
| Buildings | 1,297,184 | 259,404 | 228,816 | 1,785,404 |
| Civil engineering | 3,726,875 | 6,971,741 | 15,169 | 10,713,785 |
| Electricals | 8,870,414 | 5,236,037 | 200,480 | 14,306,931 |
| Structural Steelwork | 6,003,023 | 2,377,338 | 679,914 | 9,060,276 |
| Platework | 3,526,559 | 516,678 | 188,580 | 4,231,817 |
| Pipework | 3,522,061 | 4,365,500 | 249,815 | 8,137,376 |
| Equipment supply and installation | 37,002,414 | 3,017,826 | 1,530,124 | 41,550,363 |
| EPCM | 1,009,773 | 17,690,310 | 0 | 18,700,083 |
| Allowances | 6,287,733 | 5,715,644 | 270,480 | 12,273,857 |
| Subtotal | **71,274,036** | **46,801,756** | **3,363,378** | **121,439,171** |
| Contingency | | | | **11,615,983** |
| Total | | | | **133,055,154** |

**TABLE 3.10 SUMMARY OF PROVISIONAL COST ITEMS, ROSEBY PLANT AND INFRASTRUCTURE**

| Item | Cost ($) |
|---|---|
| Plant and accommodation village access road | 2,600,000 |
| Raw water supply system | 1,000,000 |
| Site power distribution and reticulation | 2,000,000 |
| Plant area fuel storage and dispensing facilities | 200,000 |
| Project communications systems | 500,000 |
| Accommodation camp (BOO contract) | 0 |
| Plant site sewerage treatment system | 200,000 |
| Services to mine contractors facilities | 100,000 |
| Raw and process water dams including linings | 400,000 |
| Construction water supply | 200,000 |
| Plant and accommodation village access road | 2,600,000 |
| Temporary construction village establishment | 1,000,000 |
| Construction workforce messing and accommodations | 1,000,000 |
| Site fencing and security | 200,000 |
| First fills | 500,000 |
| Spare parts | 4,000,000 |
| Geotechnical investigation | 100,000 |
| Bulk earthworks | 1,500,000 |
| Metallurgical laboratory | 1,000,000 |
| Vehicle wash-down facility | 450,000 |
| Emergency diesel power generation | 400,000 |
| **Subtotal** | 18,200,000 |
| Contingency (10%) | 1,820,000 |
| PC Margin (12%) | 2,402,000 |
| **Total** | **22,422,400** |

Detailed review of the cost estimates and the reconciliation between the Como Engineers costs and the GRES costs reveal a number of inconsistencies, omissions, and double counting. However, it is believed that these costs are accurate to an order of magnitude of plus or minus $10 M, and thus the range of $150 M - $170 M provides a fair estimate of the Roseby infrastructure capital costs. Note that these costs are additional to the mining-related capital costs in Table 3.6.

### 3.2.9. ENVIRONMENT AND PERMITTING

Universal has applications for five mining leases (MLAs) over the Roseby Project area. One of the conditions for the granting of a mining lease in Queensland is the acceptance of an Environmental Management Plan (EMP). Universal has submitted an Environmental Impact Statement (EIS) and an EMP previously (in April 2007). Nine submissions from various government departments resulted from the draft EIS and a response from URL – the "Roseby Supplementary Report" was submitted in December 2007. Queries were again raised from three government departments regarding the Supplementary Report, and a further report was submitted by URL – "Response to Information Request" - in March 2008. On 2 July 2008 the EIS was approved, with the Assessment Report to follow. Later in July 2008, the EIS Assessment Report was released by the Environmental Protection Authority. This report found the latest version of the EMP of the EIS inadequate and stated that the environmental permit to operate would only be granted after a satisfactory EMP had been submitted. Universal is now in the process of revising the EMP to address a range of items, including:

- water management (surface water, groundwater and drainage, particularly with reference to catastrophic flooding)

- general flora management
- tailings management
- management of waste rock overflow (‘scats’) in the plant
- waste rock characterisation and disposal
- roadworks and creek diversions
- social impact assessment
- treatment of final post mining open pits.

None of these areas are believed by Universal to pose any major obstacles to the successful completion of an EMP. Appropriate baseline studies have been conducted and monitoring of a number of items is ongoing. Waste rock from Little Eva has been shown not to be net acid generating and thus acid groundwater runoff is not a significant problem. There are not believed to be any endangered flora or fauna within the MLA area. The TSF and the plant are both planned for a stable level area. There are many wet season creeks in the area and some creek diversion may be required. The main waterway which could impact mining is Cabbage Tree Creek, which abuts the planned Little Eva pit. Universal is planning to erect a barrier and bund arrangement which will ensure that even severe flooding (such as that experienced in 2009) will not significantly affect the operation.

Universal expects to submit its revised EMP to the EPA by the end of 2009. An optimistic scenario is permitting by the end of the first quarter of 2010, but a more likely outcome is that the MLAs will be granted at some time in the second quarter.

### 3.2.10. PROJECT RISK SUMMARY

Risks to the Roseby Project exist in a number of areas. Geology and mineral resource risks are as follows:

- data quality issues at Scanlan and Blackard may affect the quality and quantity of the resources
- there are probably insufficient density measurements in the oxide zones of all deposits
- the structural controls on the mineralisation at Little Eva are complex and not well understood
- the classification of some portions of the Indicated Resources at Scanlan may be slightly optimistic.

In the mining, reserves and scheduling areas the risks are:

- the pit designs are sub-optimal and more information may impact scheduled tonnages and grades in a negative (but more likely) in a positive sense, providing a possible mismatch between the potential scale of mining and that of processing, which may be allayed with the proposed expansion to 8 Mtpa
- the current pit slope angles may be somewhat optimistic, relying on full depressurisation of the wall rocks for full effectiveness
- dilution and ore loss have not been quantified at Scanlan and Blackard
- costs derived from contractors in 2007 may be out of date and escalation factors may not be accurate.

Risks in the processing area are as follows:

- the recovery of the oxide material may have been overestimated
- the viscosity of the oxide material may impact recovery
- Scanlan has been inadequately tested for metallurgical properties compared to Blackard and may not perform as expected; however, Scanlan only features in the later years of the life of mine and thus is not currently material to the project cashflow in the early years

- the gold recovery has not adequately been quantified
- optimal plant throughput and associated energy costs may depend on the correct blend of material being supplied; deviations from this blend will affect performance and operating cost.

Risks to the infrastructure, cost estimates and engineering aspects of the project are:

- cost changes and their effects on price estimates since the DFS and its revision are difficult to predict
- water management plans are currently being revised and cost increases may ensue as a consequence of the revision
- power charges may escalate as a consequence of emissions trading legislation and demands upon the grid due to multiple projects coming on line
- significant mining activity in the Cloncurry region could escalate the cost of labour and services.

Finally, risks in the permitting area relate entirely to the delay in approval of the revised EMP and the whole project timeline.

In summary, the key risks relating to the Roseby Project are the current lack of permitting and the potential for further delays due to the need to rework the environmental management plan, some uncertainties regarding the correct metallurgical recoveries to be applied, the effects of recent global events on capital and operating cost forecasts and the lack of a firm picture on resource and reserve upside at the three main deposits.

### 3.2.11. ROSEBY PROJECT UPSIDE

In addition to the exploration potential of the region outside of the existing resources, there are a number of opportunities to increase the net present value of the Roseby Project. The most obvious areas of upside are in:

- extending known reserves
- increasing reserves by converting the resources at satellite deposits
- the discovery of new deposits.

The Inferred Resources inside existing pits can be converted partly to reserves and both Blackard and Scanlan have some potential for extensions. Similarly, there is the opportunity to convert some of the Inferred Resource at the other seven deposits to a higher confidence category through additional drilling and thus add to the mining inventory. The recent SEEP drilling by Xstrata, while unquantified, has demonstrated sulphide copper mineralisation below Blackard, which, when converted to a resource, should result in a significantly larger pit.

While there may have been upwards pressure on costs since the 2007 date of the DFS, commodity prices have also increased, and a sustained copper price at or above USD3 /lb would result in a much larger operation. There is an opportunity to optimise the mining and processing operations at Roseby with the delineation of larger deposits.

Optiro's view is that the overall risk profile for Roseby is low to medium.

### 3.2.12. ROSEBY AREA EXPLORATION POTENTIAL

Figure 3.2 shows the tenement holding of Universal in northwest Queensland, and Figure 3.5 shows the SEEP lease boundary. While most of the defined deposits at Roseby are within the SEEP boundary (but defined within the RFP area – see Section 3.2.4) Universal has a large ground holding outside of the SEEP area. One of the Roseby deposits with a defined Inferred Resource – Bedford – sits outside and to the east of the SEEP boundary, which has as its eastern margin the Mt Rose Bee Fault (Figure 3.2). The Bedford deposit is hosted within the Corella formation and is a sulphide copper deposit with a declared Mineral Resource of 1.8 Mt at a grade of 0.93% copper and 0.24 g/t gold. Bedford shows strong structural control and its location suggests that there may be potential for other hydrothermal mineralising systems to the east of the Mt Rose Bee Fault.

One of the most interesting prospects outside of the SEEP area within the Roseby tenement package is the Wonga gold-copper prospect (Figure 3.5). This prospect occurs near the confluence of the Mt Rose Bee Fault and the Ballara-Quamby Fault and is associated with numerous old copper workings including the old Magnet mine, magnetite rich host rocks, strong bedrock copper and gold anomalies, IP anomalies, magnetic anomalies related to both the Rose Bee Fault and the inferred subcrop of the Naraku Batholith and favourable cross faults which help to localise mineralisation within the Roseby Corridor. Universal has drawn parallels between the Wonga prospect and the Salobo copper-gold prospect in Brazil which has a similar combination of structural control, magnetite-rich host rocks and a broad copper-gold anomaly (Figure 3.13). The Wonga prospect has yet to be adequately drill tested by Universal.

Just to the south of the Roseby tenements sits the Mary Kathleen uranium mine. Universal holds ground immediately to the north of the Mary Kathleen mine which is considered to be prospective for similar hydrothermal granite-related uranium deposits, and which features a number of radiometric anomalies. These have been followed up with trenching and limited reconnaissance drilling but have had no systematic exploration.

Optiro is of the opinion that Universal's tenements outside of the immediate Roseby Project area have good potential for copper-gold mineralisation of the Little Eva style and for hydrothermal breccia style granite-related uranium mineralisation.

## 3.3. QUEENSLAND REGIONAL EXPLORATION

### 3.3.1. TENURE

Figure 3.1 shows the location of Universal's regional exploration projects in northwest Queensland. The total area of the tenements is 754 $km^2$, split up between nine separate exploration licences. The full details of the tenements are given in Appendix A. All of the EPMs are 100% owned by Universal, and include two JVs:

- EPM 14369, Dronfield, is a JV with Syndicated Metals whereby Syndicated may earn up to an 80% interest by spending up to $2M in four tranches, leaving Universal with a free carried 20% interest.
- EPM 14367, Spider, which has a JV with Deep Yellow specifically for the uranium prospectivity. As with Dronfield, Deep Yellow can earn up to an 80% interest by spending up to $250k, leaving Universal with a 20% free carried interest.

### 3.3.2. PROJECTS

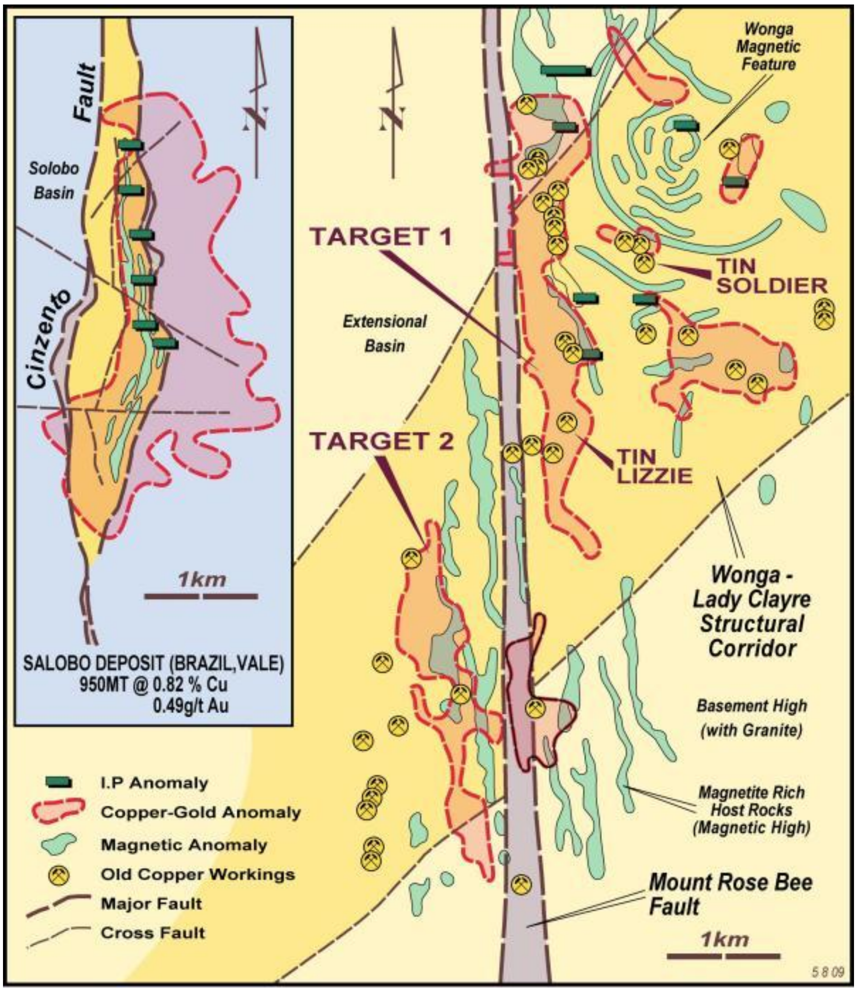
The tenements may be subdivided on the basis of the most prospective commodity, with copper-gold areas and uranium areas.

**COPPER-GOLD**

**Cameron River (EPM 8059)**

The Cameron River tenement has an area of 113 $km^2$ and sits immediately to the east of the Roseby tenements. As such it is underlain by the same Corella Group rocks which host much of the Roseby mineralisation. The Naraku Batholith, a significant regional intrusion, outcrops just off the northwest of the ground. Copper-gold mineralisation has been recorded over a 17 km strike length of this tenement. Mineralisation is associated with ironstones and is adjacent to structural features such as the Quamby Fault Zone. This setting is similar to that at Little Eva. The most significant deposit on the tenement is Ivy Ann, which has an historical resource estimate (not verified by Optiro) of 4 Mt at a grade of 0.7% copper and 0.12 g/t gold.

FIGURE 3.13 WONGA COPPER-GOLD PROSPECT AT ROSEBY – COMPARISON WITH THE SALOBO DEPOSIT IN BRAZIL




## Happy Valley (EPM 9611)

The Happy Valley tenement has an area of 38.5 km$^2$ and sits within the southeastern portion of the Eastern Succession of the Mt Isa Fold Belt, some 25 km south of Cloncurry. The area is underlain by sediments of the Corella Formation, the Mount Norma Quartzite, the Roxmere Quartzite, the Stavely Formation and two small granites. The structural and alteration setting appears to be prospective for copper-gold mineralisation, and there is one significant group of old workings, Mt Michael, within the licence.

## Mount Angelay (EPM 14371)

Mount Angelay is a relatively small tenement (29 km$^2$) 60 km south of Cloncurry. This sits astride the very significant crustal scale Cloncurry Fault. Much of the western portion of the tenement is underlain by the Doherty Formation, an equivalent of the Corella Group. The Mount Angelay Granite also outcrops within the ground. The tenement contains the historic Mt Kalkadoon Mine and is structurally similar to the nearby Eloise copper mine.

## Malbon Vale (EPM 14362)

The Malbon Vale tenement (80 km$^2$) covers the part of the Leichardt Trough, a tectonic unit within the Western Fold Belt of the Mt Isa Inlier. The tenement sits about 50 km south-southeast of Mt Isa. The basement rocks comprise schists and phyllites which have been intruded by the Kalkadoon

Granodiorite. Cover sequence rocks include mixed shallow water sediments and volcanics. The area is transected by a number of north-south structures and contains some historic prospects.

**Bushy Park (EPM 14366)**

The Bushy Park group of tenements (192.1 km$^2$) sit immediately to the south of the Malbon Vale group and also 15 km to the east. As well as rocks of the Leichardt Trough, the tenements include part of the Duchess Fold Belt. A number of copper and copper-gold prospects sit within the licence, with similar prospectivity to the Malbon Vale area.

**Dronfield (EPM 14369)**

Dronfield (83 km$^2$) is a JV with Syndicated Metals and comprises a group of tenements approximately 80 km southeast of Mt Isa and a similar distance southwest of Cloncurry. One of the Tenement blocks is adjacent to the Kalman prospect (Syndicated Metals and Kings Minerals) which has a reported Inferred Resource of 60 Mt of copper-molybdenum-gold mineralisation. This is associated with the dominant regional structure, the Pilgrim Fault Zone, a splay of which passes through the Dronfield tenement group and which hosts numerous off-lease copper occurrences. The structures within the ground have been interpreted by a previous owner as having some parallels with the high grade Tick Hill mine, which sits on a splay off the Pilgrim Fault to the south.

**URANIUM**

**Malakoff – Mt Malakoff (EPM 14370/EPM 14415)**

Probably the most significant of Universal's uranium tenements is at Malakoff and the immediately adjacent Mt Malakoff, some 30 km east-southeast of the proposed Roseby plant location and 40 km north-northwest of Cloncurry (138 km$^2$). A shallow palaeochannel has been identified on the ground which has potentially economic concentrations of uranium of the roll front style. The Quamby Fault Zone transects the western edge of the Malakoff tenement, which is otherwise largely underlain by the Naraku granite and overlain by Cainozoic cover rocks which extend into the Mt Malakoff ground. The potentially mineralised palaeochannel heads off the Malakoff tenement to the northeast but re-enters the Mt Malakoff licence (Figure 3.14). Universal intends to undergo systematic exploration for uranium on this tenement in 2010.

**Spider (EPM14367)**

The Spider tenement (80 km$^2$) is a JV with Deep Yellow and comprises two blocks around 30 km north-northeast of Mt Isa. The basement rocks within the tenement sit within the Leichardt River Fault Trough and are overlain by a cover sequence of shallow water sediments and volcanic. Faulting in the area is complex. Deep Yellow will be exploring for hydrothermal uranium deposits. Universal retains the rights to other minerals but has no immediate plans to explore for these.

## 3.4. NEW SOUTH WALES EXPLORATION

### 3.4.1. TENURE

Universal has a single tenement block within New South Wales – this is the Burra tenement, EL 5692, which has an area of 38 km$^2$. This is 90% held by Universal, with the remaining 10% held by a private individual who has a free carried interest. It is possible that Universal may have to reduce the area of this tenement as a request by Universal to suspend the expenditure commitment was deferred by the Register-General. The location of the project is shown in Figure 3.15.

### 3.4.2. THE BURRA PROJECT

Regional mapping and sampling at the Burra Project has shown it to be prospective for Vulcanogenic Massive Sulphide deposits. The tenement straddles the boundary between Ordovician sediments and a Siluro-Devonian group of felsic flows, sediments, fragmentals and intrusions known as the

Colinton Volcanics. This disconformable contact hosts a number of base metal occurrences within the Universal area including the Burra mine, and the London Bridge prospect. The structural and stratigraphic aspects of the host rocks are believed to be similar to those hosting the Woodlawn Mine and the Captains' Flat massive sulphide deposits, 70 km and 20 km respectively from the tenement area. The London Bridge prospect in particular has had some interesting zinc intercepts in RC and DD holes.

**FIGURE 3.14 MAP OF THE MALAKOFF- MT MALAKOFF TENEMENTS SHOWING POTENTIAL FOR URANIUM MINERALISATION**

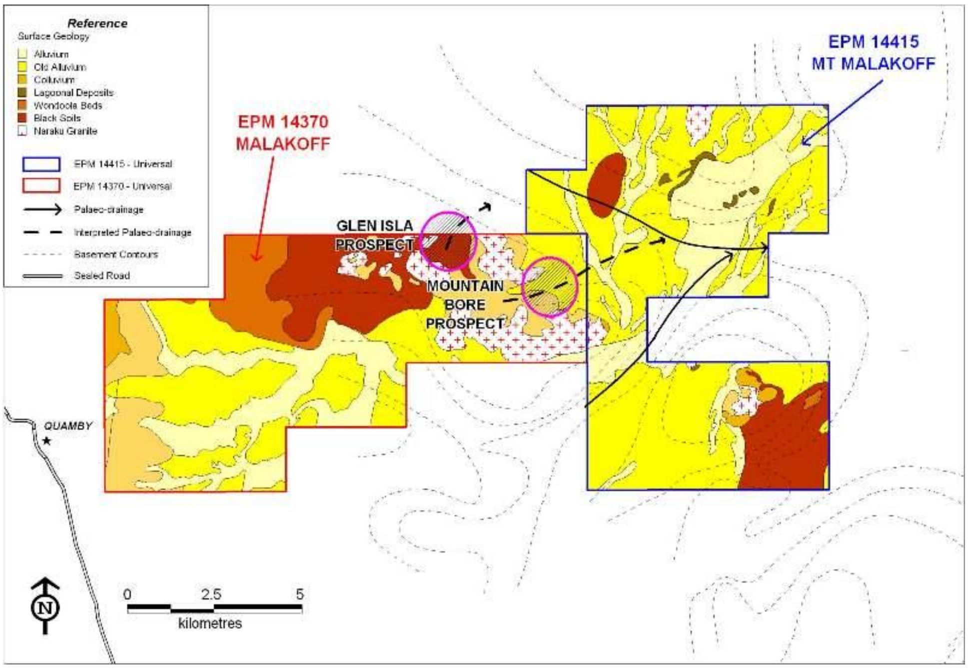
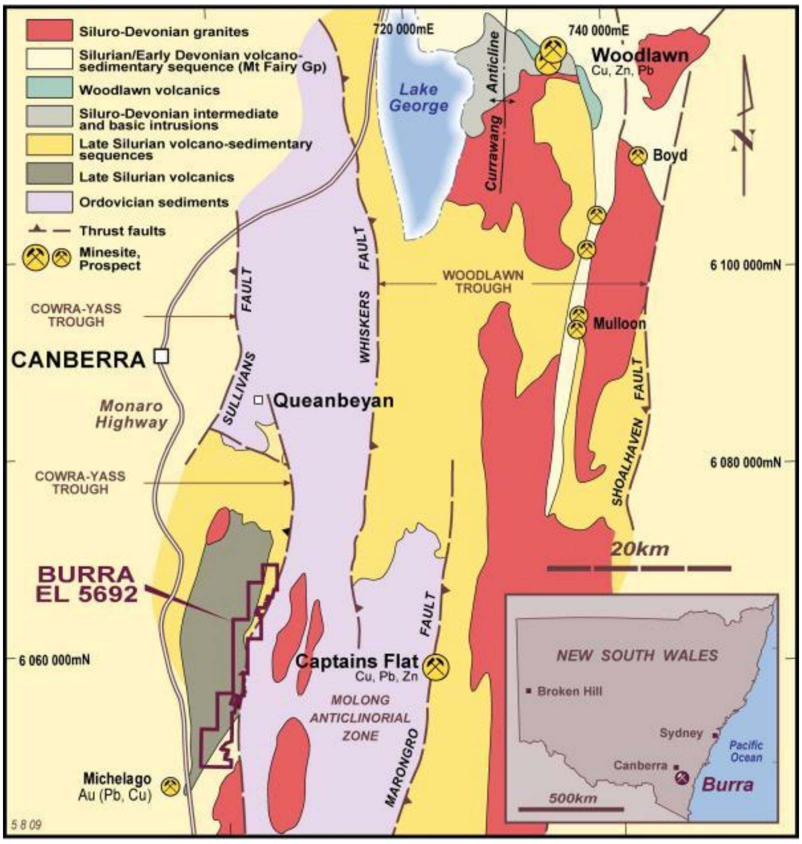



**FIGURE 3.15 LOCATION AND REGIONAL GEOLOGY OF THE BURRA PROJECT**



# 4. ASSETS OF VULCAN RESOURCES

## 4.1. OVERVIEW

The principal asset of Vulcan is the Kylylahti copper-cobalt-nickel-zinc-gold deposit, which is wholly owned by Vulcan and which is situated in central eastern Finland, some 380 km northeast of the capital Helsinki and 22 km northeast of the historic mining centre of Outokumpu. The Kylylahti Project has a declared Mineral Resource of 8.1 Mt at a grade of 1.18% copper, 0.24% cobalt, 0.22% nickel, 0.47% zinc and 0.66 g/t gold, which was released by Vulcan in July 2009. An Ore Reserve, released in 2007, contains 6.9 Mt at a grade of 1.2% copper, 0.24% cobalt, 0.2% nickel, 0.49% zinc and 0.7 g/t gold.

In addition to the Kylylahti project, Vulcan has a 95% share in the Kuhmo Project, which comprises a number of nickel deposits and surrounding exploration leases in the Kuhmo-Suomussalmi greenstone belt of northeastern Finland. Currently defined and reported Mineral Resources for the three major deposits total 9.8 Mt at a grade of 0.38% nickel, 0.1% copper, 0.02% cobalt and 0.4 g/t platinum plus palladium. On 16 November 2009 Vulcan announced that it had been the successful tenderer for the assets of Finn Nickel OY, a wholly owned Finnish subsidiary of Canadian company Belvedere Resources which initiated voluntary bankruptcy proceedings on July 13 2009. The assets of Finn Nickel OY purchased by Vulcan include the following:

- a processing plant at Luikonlahti, 45 km west northwest of Kylylahti
- the Hautalampi and Riihilahti copper-cobalt-nickel deposits in the Outokumpu-Kylylahti region
- two projects for which historical resource exist in the Outokumpu-Kylylahti region, Perttilahti and Kokka
- a portfolio of declared Mineral Resources for four nickel-copper-cobalt deposits in the Kotalahti region, 100 km southwest of Outokumpu, along with a number of exploration tenements
- three nickel-copper projects with Mineral Resources in the Vammala area, near the western coast of Finland.

The Belvedere transaction means that Vulcan can process ore from Kylylahti at Luikonlahti and eliminate the need to build a processing facility at the minesite.

Vulcan has achieved all of the permitting required for the Kylylahti project, and has completed a DFS in 2007, which was further optimised internally in April 2008. The DFS envisages a production rate of 240 ktpa, rising to 800 ktpa by the fourth year of operation, from an underground mine serviced by a decline. Ore will be generated from conventional longhole open stopes with filling of underground voids with paste injected from the surface. As part of Vulcan's new strategy associated with the Luikonlahti purchase a scoping level study on a revised mine schedule has been completed. This envisages a lower tonnage, higher grade operation feeding the plant, which will be configured to up to a 600 ktpa capacity.

The processing plan outlined in the DFS was to crush and concentrate the ore by flotation on site to yield two products – a copper-gold concentrate and a polymetallic bulk sulphide concentrate. The copper-gold concentrate would be trucked to a railhead at Vuonos, some 15 km to the southwest of the minesite, and then railed to a copper smelter at either Pori or Harjavalta, some 400 km to the west of Kylylahti. The current plan for the bulk concentrate is to negotiate an offtake agreement with the recently commissioned Talvivaara mine. Optiro understands that this option is technically feasible and that there is a commitment from both parties to negotiate an agreement; however, Talvivaara is currently ramping up its production and is resolving a number of technical issues, and thus is not prepared to take the bulk concentrate from Vulcan at this time. Vulcan continues to investigate various other offtake possibilities. The revised processing plan featuring the Luikonlahti plant has not yet been finalised, but in addition to the copper-gold concentrate as described above Vulcan believes that it may be more efficient to produce two other saleable products – a low grade zinc concentrate and a nickel-cobalt concentrate. Collectively these will be of lower volume than the previously-envisaged bulk concentrate, and there will be a waste sulphide concentrate which will be stored in the existing Luikonlahti TSF. Offtake for the various concentrate products has not yet been finalised.

Work had commenced on detailed engineering of the Kylylahti project when it was suspended in September 2008 as a consequence of poor markets and falling commodity prices.

## 4.2. MINERAL DEVELOPMENT AND GEOLOGY IN FINLAND

### 4.2.1. OVERVIEW

Finland has a diverse suite of mineral resources, hosting significant deposits of copper, nickel, zinc, cobalt, gold, chromium, iron and vanadium. Mining has in the past provided the raw material base for Finland's metal industry, with significant processing and refining of copper and nickel concentrates at Pori and Harjavalta, zinc and cobalt at Kokkola, stainless steel at Tornio and iron at Raahe. Finnish metallurgical technology and manufacturers of mining equipment are renowned worldwide. Mining accounted for about 1% of Finnish GDP in 2004, and there has been a resurgence in mining activity since then, which has been dampened somewhat by the global financial crisis of 2008-2009. Notwithstanding the lessening of copper and nickel mining in recent times, the total volume of mining in Finland has been increasing continuously since 1995. The main reason for this is the steady growth of mining of industrial minerals.

### 4.2.2. MINERAL TENURE

Finland has a well developed mining act and the government is generally pro mining. Under Finnish mining law, only Finnish citizens or companies with offices registered in any European Union member state can own title to mineral rights in Finland. Notwithstanding this the Ministry of Trade and Industry, at its discretion, can confer these rights to individuals or corporations from outside the European Union. Vulcan holds its rights to the Kylylahti project and associated exploration claims through its wholly owned Finnish incorporated subsidiary, Kylylahti Copper Oy, whereas the Kuhmo nickel prospects are 95% held by another Finnish subsidiary Kuhmo Metals Oy.

The three main types of tenure are reservations, claims, and concessions. Reservations grant to the owner the exclusive right to stake a claim to mineral deposits located in the reservation area for a 12 month period. Drilling or sampling within a reservation requires the landowner's permission. Claims or exploration licences allow the holder to carry out exploration activities without the consent of the landowner. There are no annual expenditure requirements, but claims have a limited tenure and must be converted to mining concessions for the holder to proceed with development activities. Mining concessions will only be granted where a resource which is deemed to be technically and economically exploitable has been defined. Vulcan has claims and mining concessions at the Kylylahti Project, and has both claims and reservations at the Kuhmo Project.

### 4.2.3. GEOLOGY OF FINLAND

The majority of Finland in underlain by the Fennoscandian Shield, which is the largest exposed area of Precambrian rocks in Europe. The Fennoscandian Shield can be subdivided into three broad domains that have shared a common history since about 1.8 Ga, namely the Svecofennian, Karelian and Kola-Lapland domains. These crustal units essentially comprise a Late Archaean cratonic nucleus, (the Karelian Craton) flanked to the northeast and southwest by two early Proterozoic mobile belts (the Kola-Lapland and Svecofennian domains respectively).

The Kola-Lapland domain represents a complex tectonic collage of Archaean and Palaeo-proterozoic terranes, and is more characteristic of collisional tectonic processes. In contrast, the Svecofennian domain is entirely early Proterozoic in age, and indicates relatively rapid formation and accretion of new crust between about 1.97–1.86 Ga. The Outokumpu polymetallic deposits, including the Kylylahti deposit, are hosted within the Svecofennian domain. Locally the Karelian craton underwent numerous rifting events which led to widespread ultramafic to mafic volcanic and subsequent felsic plutonic activity, deformation and metamorphism. Vulcan's nickel projects are located within the Karelian Craton, which is characterised by a series of narrow northerly trending greenstone belts surrounded by extensive granitoids and granite-gneiss terranes. The Kuhmo and Suomussalmi greenstone belts, which host the Kuhmo mineralisation, are the most extensive and well preserved supracrustal units in the Archaean of Finland, and outcrop over a strike length of nearly 200 km and a up to a maximum width of 10 km.

Finland's mineral endowment encompasses a wide variety of mineralisation styles. These include volcanic hosted massive sulphide (VHMS) base metal, nickel-copper associated with Proterozoic mafic-ultramafic complexes, ultramafic-mafic hosted chromite, platinum group elements (PGE), Kiruna-type iron oxide copper-gold, orogenic gold, epithermal gold, alluvial gold and carbonatite-hosted apatite deposits.

For most of the twentieth century the copper industry in Finland has been dominated by production of copper from the Outokumpu polymetallic copper-cobalt-nickel-gold-zinc type deposits, centred on the town of Outokumpu in eastern Finland. When the Outokumpu operations ceased production in 1989, they were credited with having produced some 1Mt copper metal and 20 t gold from some 28.5 Mt of ore at a grade of 3.8% copper, 0.24% cobalt, 0.12% nickel, 1.1% zinc and 0.8 g/t gold.

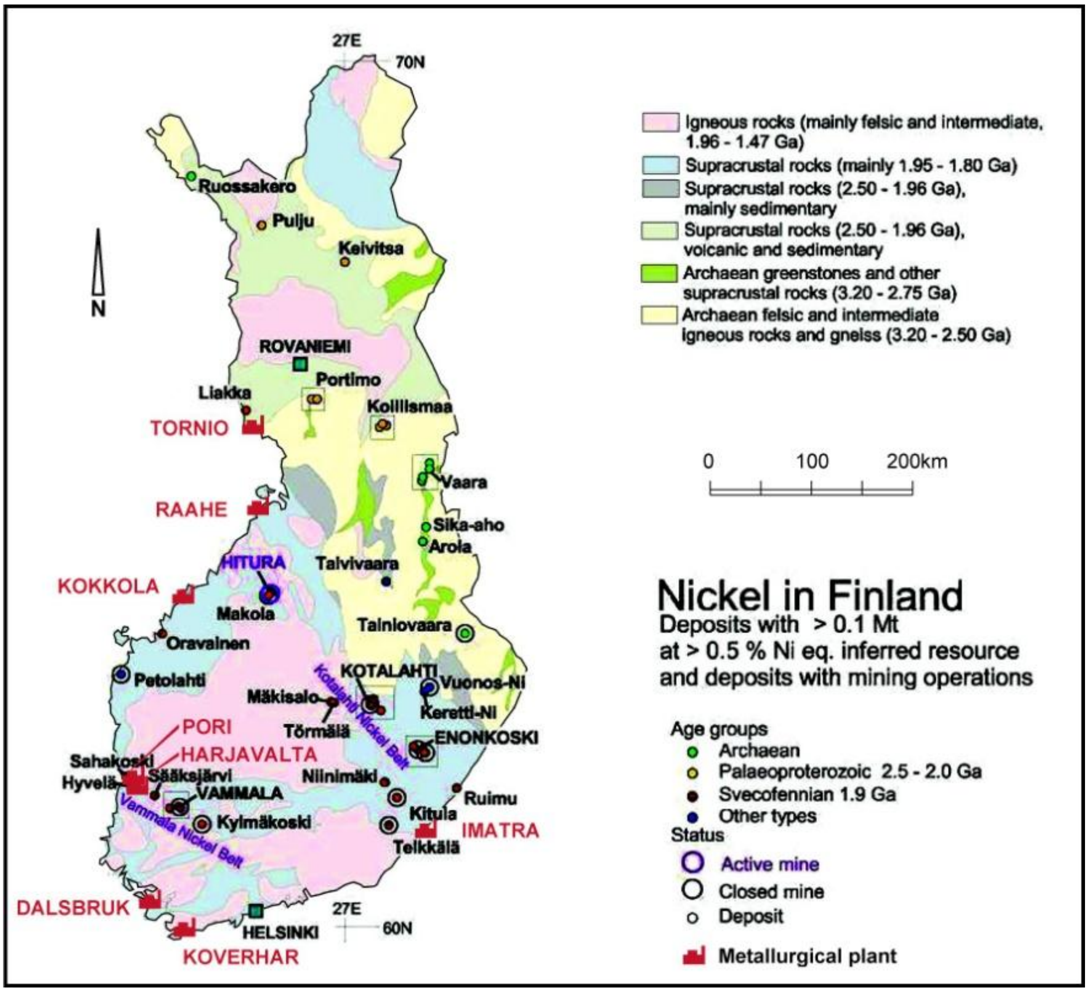
Thirteen nickel mines have been exploited to date in Finland, of which only one mine remains in operation – the Hitura mine in central Finland. The Talvivaara project (Figure 4.1, reproduced from the Geological Survey of Finland) commenced production in 2008 and expects to generate over 30,000 t of nickel from a heap leach when in full production.

## 4.3. THE KYLYLAHTI PROJECT

### 4.3.1. INTRODUCTION AND HISTORY

The Kylylahti Project is 380 km northeast of Helsinki and 40 km northwest of Joensuu which has the closest airport (Figure 4.2). All major roads are sealed. The Kylylahti orebody was discovered by Outokumpu OY in 1984 and sits within the Outokumpu mining district, 22 km northeast of the town of Outokumpu, which hosts the historic Keretti mine.

FIGURE 4.1 GEOLOGY AND NICKEL MINES OF FINLAND SHOWING THE TALVIVAARA PROJECT

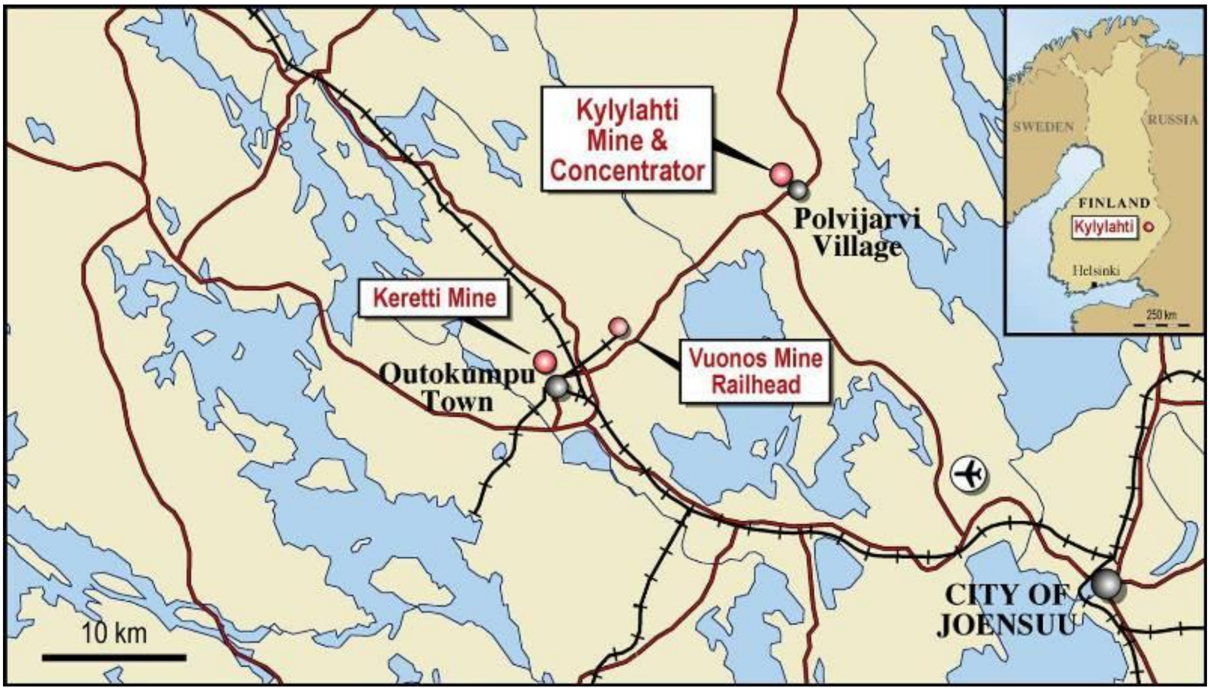



The project was sold to Dragon Mining in 2003 as part of a retreat by Outokumpu from the global mining business. Up until the purchase Outokumpu had carried out four drilling campaigns and had reported an Inferred Resource of 3.45 Mt at a grade of 1.8% copper, 0.3% cobalt, 0.2% nickel, 0.6% zinc and 0.9 g/t gold. The project was purchased from Dragon by Vulcan's subsidiary company Kylylahti Copper OY in December 2004, at which point 90 diamond drill holes had been drilled into the deposit.

### 4.3.2. SETTING AND GEOLOGY

The Kylylahti deposit was discovered by Outokumpu geologists using drilling following the application of geophysical techniques along the Outokumpu trend. The North Karelia Schist Belt, which hosts the orebody, is a structurally-complex package of metasedimentary rocks located at the major crustal boundary between the Proterozoic Svecofennian belt to the southwest and the Archaean Karelian Craton to the northeast. The district is characterised by northeast-southwest striking isoclinal folds with subvertical limbs. The rocks hosting the Kylylahti deposit are serpentinites and talc-carbonate, tremolite-quartz and quartz-sulphide rocks which define the distinctive Outokumpu Association. The serpentinites have been altered to a skarn in the vicinity of the Kylylahti deposit, which sits at the contact of these rocks and black sulphidic shales (Figure 4.3).

**FIGURE 4.2 LOCATION OF THE KYLYLAHTI PROJECT**




A typical cross-section (Figure 4.4) shows the podiform nature of the Kylylahti ore and that there are two main mineralisation types: a coarse grained core containing semi-massive sulphides and a surrounding zone of disseminated sulphides which sits adjacent to the serpentinite-black shale contact. The semi-massive mineralisation comprises 40% to 60% sulphide (predominantly pyrrhotite, pyrite and chalcopyrite, with subordinate local accumulations of cobalt-rich pentlandite, sphalerite, cobaltite and gold), and ranges in thickness from 5 m up to 20 m. The disseminated zone contains medium to coarse grained sulphides (5% to 40% sulphides) and veinlets, with pyrrhotite predominating and lesser amounts of chalcopyrite, pyrite, cobalt-rich pentlandite and sphalerite. The disseminated zone is locally gold-rich, with grades up to 20 g/t gold. The semi-massive zone grades sharply into the disseminated ore over one to two metres, although isolated pods of semi-massive mineralisation may occur entirely within the disseminated zone.

Mineralisation at Kylylahti occurs in an elongated lens which strikes to the northeast, dips near vertically to the northwest and plunges at between 25° and 40° to the southwest. The total length of the mineralised corridor as currently defined is 1.2 km and the orebody is open at depth.

### 4.3.3. TENURE

Kylylahti sits on four granted mining leases covering 180.75 hectares (1.8 $km^2$) plus four adjacent mineral claims and a further 12 regional claims covering a further 997.23 hectares (9.97 $km^2$). Environmental permitting is complete and all permits required by the project are in place.

### 4.3.4. MINERAL RESOURCES

Vulcan released a Mineral Resource in association with the DFS in June 2007, comprising a total of 7.85 Mt at a grade of 1.17% copper, 0.24% cobalt, 0.22% nickel, 0.49% zinc and 0.7 g/t gold. Since the release of the DFS and the subsequent optimisation study in April 2008 Vulcan has been drilling some additional DD holes into the Kylylahti deposit, culminating in a resource update in July 2009.

**FIGURE 4.3 SURFACE GEOLOGY OF KYLYLAHTI (GRID LINES 1 KM APART, NORTH TO TOP)**

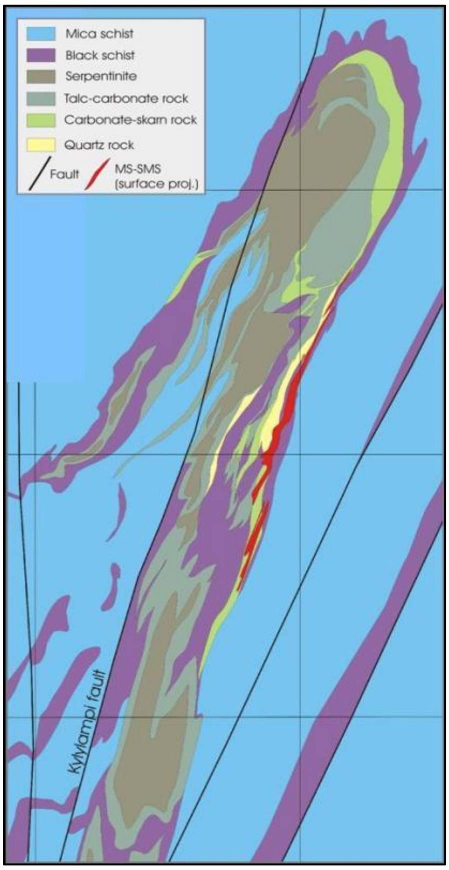
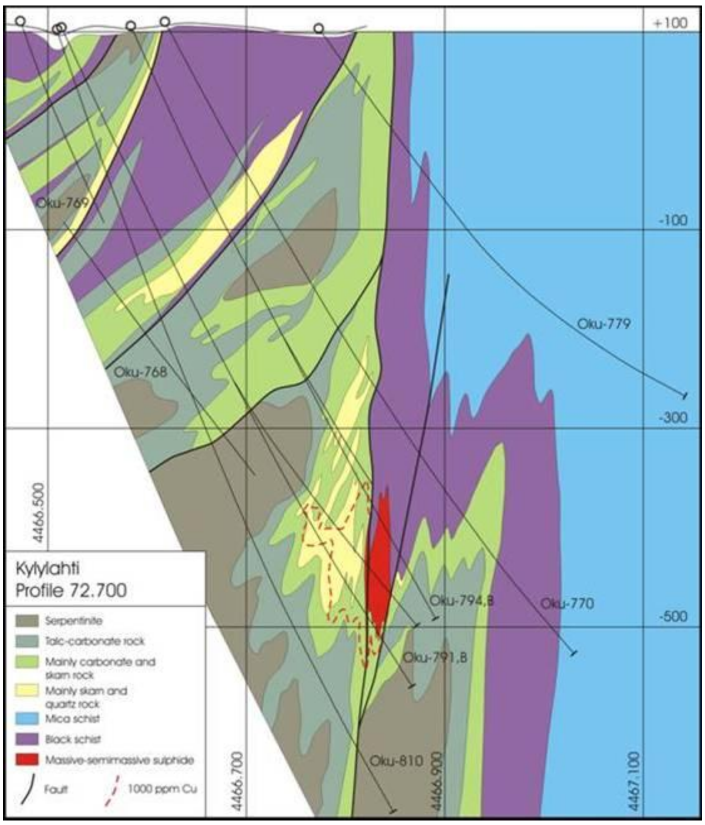



**FIGURE 4.4 SCHEMATIC CROSS SECTION THROUGH KYLYLAHTI (GRID CELLS ARE 200 M)**



Prior to the July 2009 update the orebody was defined as two discrete lenses, termed Wallaby (upper) and Wombat (lower). There was a suggestion that these two lenses may eventually join up and this was confirmed in the post-2007 drilling.

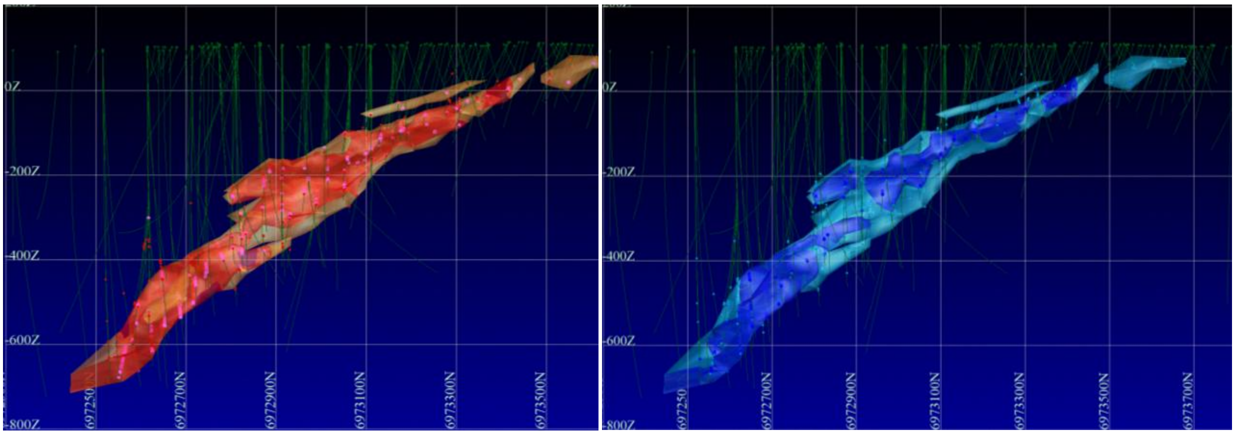
From an estimation domain viewpoint, the semi-massive sulphide and the disseminated zones were treated separately. The semi-massive sulphide domain is defined largely by the increase in sulphide content, but corresponds broadly to a cut-off of 1% copper and 0.3% cobalt. The disseminated domain has a lower cut-off of 0.4% copper and 0.1% cobalt. Because the cobalt is not entirely coincident with the high-grade copper, two separate cobalt domains were defined, partly overlapping the copper-based semi-massive and disseminated domains. These domains are shown in long section in

Figure 4.5 and in perspective view in Figure 4.6. Because of the need to report a common tonnage, the resource estimate has tabulated copper within the cobalt-only areas, which are low in copper (average grade 0.24%). This has resulted in a global downgrade of the copper grade. Optiro therefore recommends exclusion of this material, resulting in the tabulation in Table 4.1. This results in a 7% higher copper grade than that published by Vulcan (1.18% copper).

**TABLE 4.1 KYLYLAHTI JUNE 2009 MINERAL RESOURCE BY JORC CATEGORY (NO CUT-OFF APPLIED)**

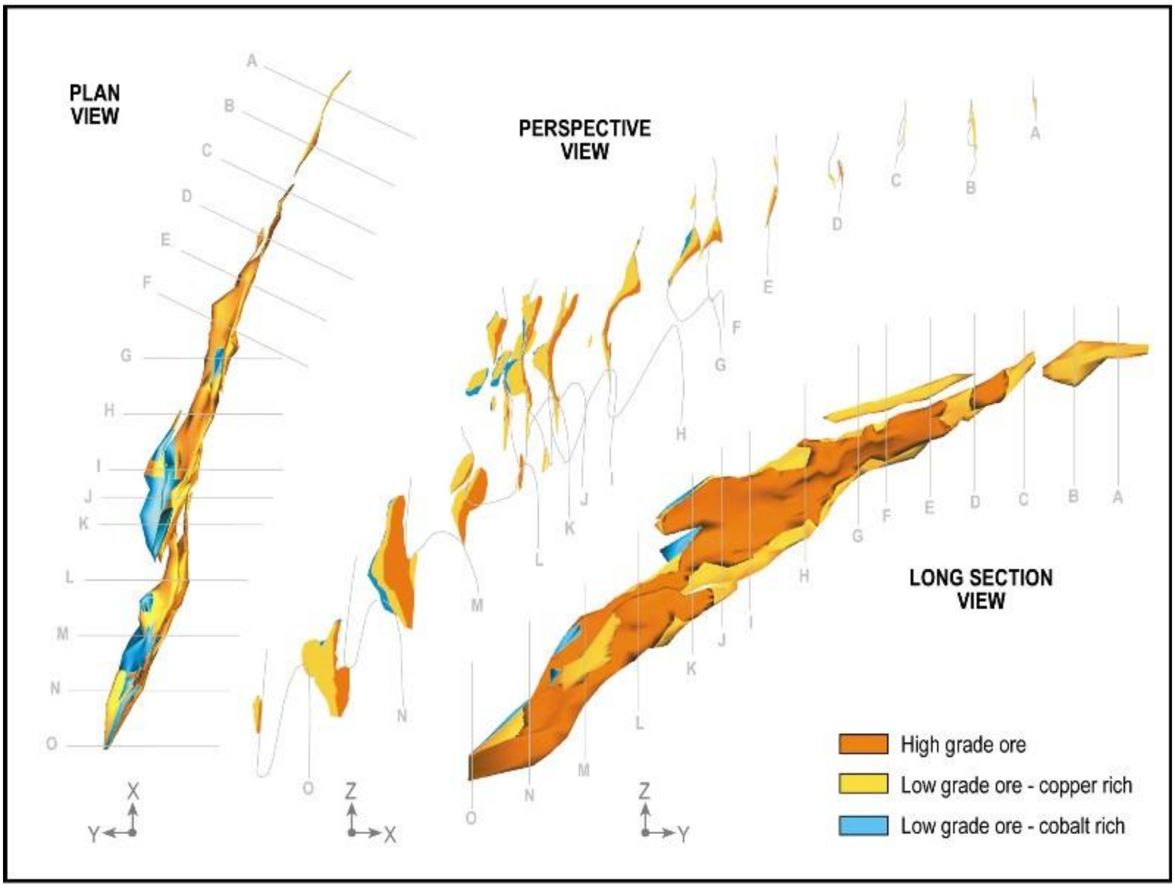
| Category | Tonnes | Copper (%) | Cobalt (%) | Nickel (%) | Zinc (%) | Gold (g/t) |
|---|---|---|---|---|---|---|
| Measured | 590,000 | 1.33 | 0.26 | 0.19 | 0.43 | 0.56 |
| Indicated | 6,600,000 | 1.27 | 0.24 | 0.22 | 0.49 | 0.66 |
| Inferred | 340,000 | 0.89 | 0.23 | 0.23 | 0.47 | 0.64 |
| **Total** | **7,500,000** | **1.25** | **0.24** | **0.21** | **0.49** | **0.65** |

**FIGURE 4.5 LONG SECTION VIEW OF COPPER DOMAINS (LEFT) AND COBALT DOMAINS (RIGHT) AT KYLYLAHTI (GRID IS 200M SPACING)**




Optiro has validated the resource input data, the estimation parameters, the match between drillhole grades and block model grades and the resource classification criteria, which are based upon drill spacing and geological confidence. The wireframes have been well constructed and adequately represent the structural complexity of the area. The estimation parameters, which are largely based upon the previous estimate, are suitable for the data. The resource classification, in which the deposit has largely been classified as Indicated according to the JORC Code, is fair and reasonable. Optiro recommends removing this low copper, moderate cobalt material (585,000 t). It has a cobalt grade of 0.17% and may be recovered in times of high cobalt price, providing some upside.

**FIGURE 4.6 VARIOUS VIEWS OF THE KYLYLAHTI MINERALISATION SHOWING THE COPPER AND COBALT ZONES**




### 4.3.5. SATELLITE RESOURCES IN THE OUTOKUMPU REGION

Vulcan has a number of other exploration claims in the Outokumpu region, and two of these contain deposits for which a Mineral Resource has been declared. These are at Saramäki and at the historic Vuonos mine.

Saramäki is located 15 km northwest of the Kylylahti project and 20 km to the north-northeast of Outokumpu. The Saramäki deposit has an Inferred Resource, declared by Vulcan in 2005 but based upon GTK work, of 3.4 Mt at a grade of 0.71% copper and 0.09% cobalt. It appears to have similar occurrence and genetic characteristics to the larger mined Outokumpu deposits and to Kylylahti.

The Vuonos project was mined between 1973 and 1985 by Outokumpu and produced 5.5 Mt at a grade of 2.13% copper, 0.14% cobalt and 1.32% zinc. There is a remnant resource in mining pillars of 0.76 Mt at a copper grade of 1.76%, a cobalt grade of 0.14% and a zinc grade of 1.33%. Vulcan declared this as an Inferred Resource in 2005 based upon Outokumpu estimations. Optiro has not reviewed these resources in detail but deems it appropriate that they be declared as Inferred. As part of the Belvedere transaction Vulcan has acquired the Hautalampi, Riihilahti, Perttilahti and Kokka deposits. These are all in the broader Outokumpu-Kylylahti region (Figure 4.7). Hautalampi is the largest of these deposits and was the subject of a recent feasibility study by Belvedere Resources. The mineralisation at Hautalampi sits above and in the hangingwall of the historic Keretti mine which transects the town of Outokumpu (Figure 4.8). Belvedere declared a Mineral Resource in May 2009 of 3.2 Mt at a copper grade of 0.36%, a cobalt grade of 0.11%, a nickel grade of 0.43% and a zinc grade of 0.07%. In comparison to Kylylahti (and the underlying Keretti mine) the copper, cobalt and zinc grades are lower but the nickel grade is significantly higher. As part of the feasibility study Belvedere declared a Mineral Reserve in accordance with the Canadian National Instrument 43-101 system of 2.22 Mt at a copper grade of 0.32%, a cobalt grade of 0.1% and a nickel grade of

0.38%. Vulcan has not yet formulated its strategy with respect to Hautalampi but it is clear that Kylylahti will form the initial mill feed to the Luikonlahti plant.

**FIGURE 4.7 LOCATION OF VULCAN'S ASSETS IN THE OUTOKUMPU-KYLYLAHTI REGION**

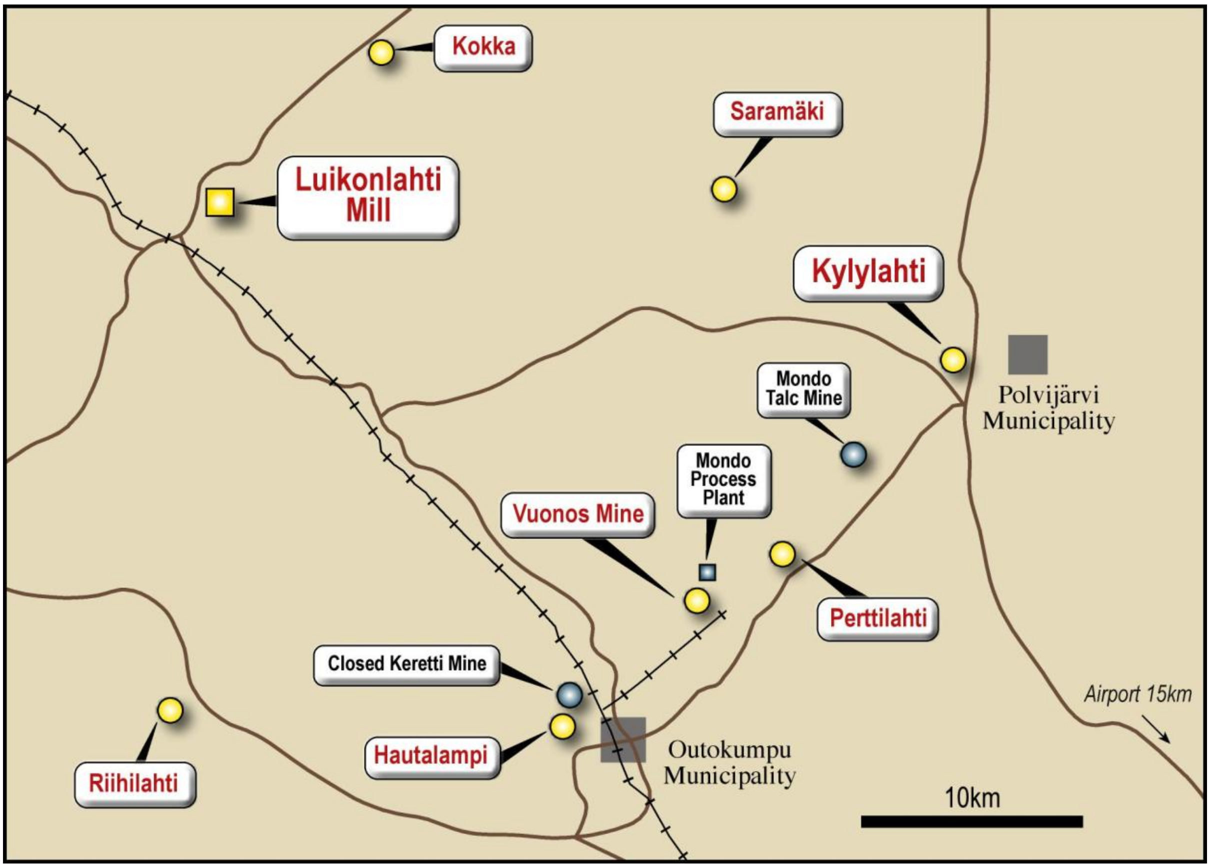
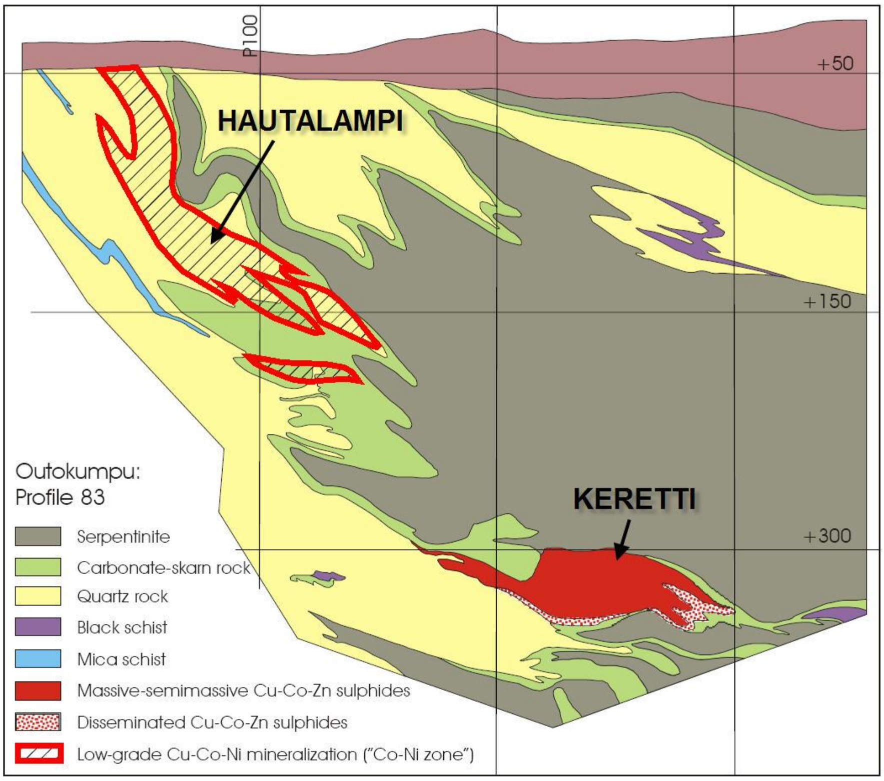



**FIGURE 4.8 CROSS SECTION LOOKING NORTHEAST SHOWING THE KERETTI AND HAUTALAMPI DEPOSITS**



The Riihilahti deposit is a small, relatively high grade copper position to the west of Outokumpu for which Belvedere has declared an Indicated Resource of 140,000t at 1.7% copper, 0.16% nickel and 0.04% cobalt. Perttilahti is interpreted as the down dip extension of the mined Vuonos orebody and has a similar geological setting to Kylylahti. The Kokka deposit is a nickel only position close to the Luikonlahti plant. Belvedere has declared historical resources for both Perttilahti and Kokka based upon work by the GTK.

Optiro has not reviewed any of the resources from the Belvedere transaction in detail.

### 4.3.6. ORE RESERVES AND MINING SCHEDULE

#### MINE PLAN AND ORE RESERVES

The mine plan for Kylylahti is based upon a decline from the surface with a mining of the orebody via conventional longhole stoping. The mining plan is structured around recovering ore in both the semi-massive and the disseminated domains. Geotechnical assessment of ground conditions as part of the DFS revealed that only minimal ground support was required, a finding supported by the general lack of reinforcement applied in the historic Outokumpu area mines. In considering the ground support parameters mine design, a mining method using a mixture of longitudinal (along the orebody) and transverse (across the orebody) stoping was devised. This takes advantage of the wider zones of the deposit. The intention is to sequentially fill the stopes using paste fill technology delivered from a custom-built paste fill plant on the surface using primarily mill tailings. This method is designed to maximise extraction of the orebody. The stope designs were converted to an Ore Reserve through the addition of modifying factors (ore loss and dilution), and individual stopes were assessed economically, resulting in some stopes being removed from the schedule. Table 4.2 details the April 2008 Ore Reserves as reported by Vulcan. Of note is that the July 2009 Mineral Resource update has yet to be converted to an Ore Reserve. When this happens, a higher copper grade than that stated in Table 4.2 will ensue, probably with a slightly reduced tonnage.

**TABLE 4.2 KYLYLAHTI APRIL 2008 ORE RESERVE**

| Category | Tonnes | Copper (%) | Cobalt (%) | Nickel (%) | Zinc (%) | Gold (g/t) |
|---|---|---|---|---|---|---|
| Proved | 604,000 | 1.11 | 0.23 | 0.20 | 0.36 | 0.50 |
| Probable | 6,340,000 | 1.17 | 0.24 | 0.20 | 0.50 | 0.72 |
| **Total** | **6,940,000** | **1.17** | **0.24** | **0.20** | **0.49** | **0.70** |

The conversion of Mineral Resource (all categories) to Ore Reserve is very high at 93% on a tonnage basis. During the DFS optimisation phase the planned production was increased from a maximum of 550 ktpa up to a maximum of approximately 800 ktpa and mining costs were re-worked from first principles.

#### MINE SCHEDULE

Ore production (stoping) commences in the second year of operations. Decline development continues and is completed during the sixth year of operation. Steady state production is achieved in the fourth year of operations. The production schedule from the optimised DFS is detailed in Table 4.3. In its 2008 review of the DFS, made public by Vulcan, Snowden Mining Consultants (Snowden) commented that the mine schedule was based upon reasonable assumptions and presented an achievable project outcome (Snowden, 2008). Snowden did, however, comment that the schedule relied upon critical dependencies for the main constituents of the mining sequence, and that delay in any of the critical activities for mining could throw the schedule out.

Optiro's assessment of the key aspects of the Kylylahti DFS optimisation and subsequent impacts on Optiro's valuation is set out in Section 5.4.3.

In conjunction with the Luikonlahti purchase Vulcan commissioned a conceptual study on a revised mine schedule. This study envisages a higher-grade, lower tonnage mine than the optimised DFS, with all ore from Kylylahti being trucked the 45 km to Luikonlahti. Optiro has adopted this conceptual schedule in its revised financial model for the Kylylahti Project (Section 5.4.3).

### MINE CAPITAL AND OPERATING COSTS

The total mine only capital cost estimate in the optimised DFS was EUR28.7M (excluding EPCM and contingency), of which the principal component, EUR18.8M, was allocated to capitalised mine access development. Other significant items were the cost of owner's equipment and vehicles at EUR4M and capitalised mine maintenance at EUR1.6M. Snowden commented that a high confidence could be placed upon the capital estimate.

The mine operating costs are based upon the concept of using local (Finnish) contractors for all waste development, ground support, loading and hauling of waste and ore. It is planned that Vulcan employees would undertake ore development and drill and blast services. The operating costs as defined in 2007 amounted to EUR20.88 /t, which, when added to a mine capital cost of EUR4.02 /t, gave a total mining cost (excluding fill) of EUR24.90 /t. Snowden commented that this cost may need to be increased to allow for some cable bolting of stope walls. The effect of the global financial crisis on Finnish mine contracting costs is unknown; however, it is a reasonable assumption that these will not have increased significantly from the 2007 estimates. Optiro believes that the demand for mining contractors is much less in Europe than in Australia and thus contractor prices will not have suffered the same inflationary pressure as in Australia.

### PASTE FILL PLANT

Achievement of the very high resource to reserve conversion rate relies upon the construction and successful operation of a paste fill plant. This will use concentrator tailings to fill stopes in a pre-defined sequence to maximise extraction. The capital cost of the paste fill plant and reticulation was estimated at EUR9.7M and the operating cost was estimated at EUR7.6 per tonne of backfill.

The initial paste fill testwork and cost estimation, along with advice for the optimised DFS, was carried out by renowned consulting groups. Optiro has reviewed the work and finds that testwork results and cost estimates are commensurate with industry best practice – thus the design, operation and costing of the paste fill plant is deemed to be a low risk.

As part of the conceptual revised mining plan Vulcan is considering the use of cemented rock fill instead of paste fill. Under this scheme, development waste will be mixed with cement underground and tipped into open stopes. While this approach has yet to be rigorously costed it is believed that there will no longer be a requirement for a paste fill plant and the associated capital cost.

**TABLE 4.3 KYLYLAHTI OPTIMISED DFS PRODUCTION SCHEDULE**

| Item | Development | Ore mined | Copper grade | Cobalt grade | Nickel grade | Zinc grade | Gold grade |
|---|---|---|---|---|---|---|---|
| Units | m | t | % | % | % | % | g/t |
| Year 0 | 2858 | 10000 | 0.64 | 0.16 | 0.26 | 0.3 | 0.44 |
| Year 1 | 5409 | 224000 | 1.27 | 0.26 | 0.2 | 0.5 | 0.7 |
| Year 2 | 3726 | 648000 | 1.14 | 0.26 | 0.21 | 0.51 | 0.66 |
| Year 3 | 4976 | 806000 | 1.29 | 0.25 | 0.18 | 0.49 | 0.61 |
| Year 4 | 2486 | 802000 | 1.42 | 0.25 | 0.16 | 0.51 | 0.7 |
| Year 5 | 1791 | 800000 | 1.36 | 0.24 | 0.2 | 0.61 | 0.92 |
| Year 6 | 987 | 804000 | 1.41 | 0.26 | 0.17 | 0.62 | 0.79 |
| Year 7 | | 802000 | 1.09 | 0.23 | 0.2 | 0.52 | 0.77 |
| Year 8 | | 801000 | 0.94 | 0.21 | 0.23 | 0.39 | 0.64 |
| Year 9 | | 801000 | 0.82 | 0.2 | 0.23 | 0.34 | 0.57 |
| Year 10 | | 447000 | 0.89 | 0.2 | 0.21 | 0.37 | 0.54 |

### 4.3.7. PROCESSING

Processing of the Kylylahti ore on site will be by single stage crushing, single stage autogenous grinding and several differential flotation circuits. The intention is two produce two concentrates – a copper-gold product and a bulk sulphide rich, nickel-cobalt-zinc product. The copper-gold concentrate will contain between 27% and 28% copper and between 10 g/t and 14 g/t gold. Over the life of the mine 90% of the concentrate produced will be the bulk product.

Mineralogy, flotation and comminution testwork has been carried out by consulting groups in Finland and in Perth. The plant as designed (Figure 4.9) envisages a single stage milling and crushing circuit which has a capacity of approximately 800,000 tpa. The Luikonlahti plant, which in the past treated ore which had very similar characteristics to the Kylylahti ore, is expected to be refurbished and designed to have a similar circuit to that depicted in Figure 4.9, except with a proposed throughput of up to 600,000 tpa.

The flotation circuit will incorporate conventional roughing, scavenging and multi-stage cleaning areas, typical of that employed historically to treat Outokumpu-style ores. Following filtration and dewatering concentrates will be stored in a covered shed. The copper-gold concentrate will be delivered by road to the railhead which is within 1.5 km of the Luikonlahti plant (Figure 4.2), and thence moved by rail to a smelter, probably at Harjavalta or Pori on the southwest coast of Finland or elsewhere for shipping to overseas customers.

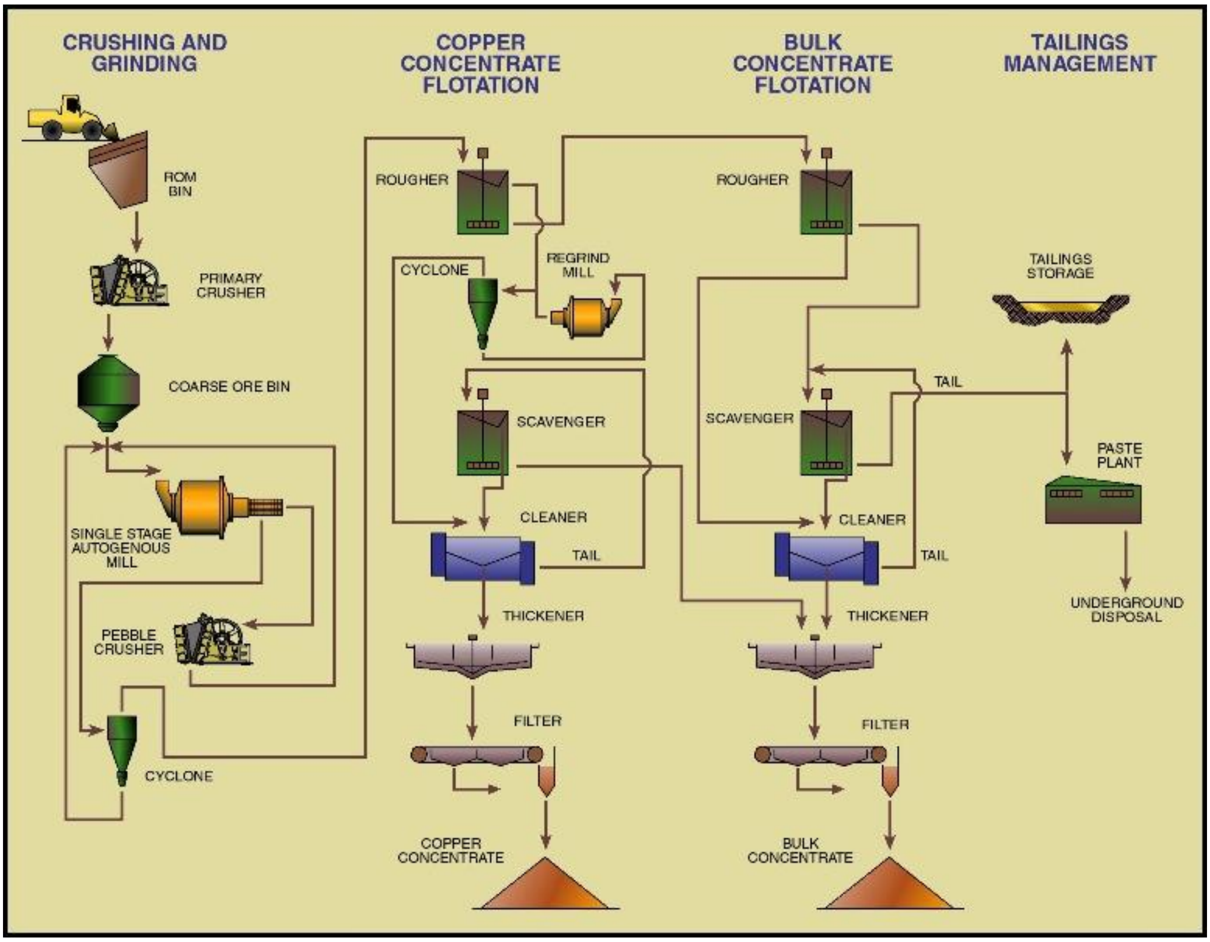
The destination of the bulk sulphide concentrate is not yet fixed; Vulcan has an in-principle offtake agreement to transport this to Talvivaara but the timing of the completion of this agreement is unclear. Vulcan continues to investigate other options for the bulk concentrate, some of which may involve as-yet unquantified capital expenditure. Snowden commented in its review that the DFS processing flowsheet represented industry standard, tried and tested crushing, grinding and flotation components, a view with which Optiro concurs.

### 4.3.8. INFRASTRUCTURE, CAPITAL AND OPERATING COSTS

#### MINESITE AND REGIONAL INFRASTRUCTURE

The regional infrastructure in Finland, and particularly in the region of the proposed operation, is very good. The Luikonlahti plant is adjacent to a sealed highway and 1.5 km from the national rail system. A skilled workforce is available for the mine from the Municipality of Polvijarvi and for the plant from Outokumpu or Polvijarvi. It is not anticipated that snowfall will significantly disrupt operations; notwithstanding this, a small allowance for downtime has been made in the project development and the operational schedules.

**FIGURE 4.9 PROPOSED KYLYLAHTI CONCENTRATOR CIRCUIT**




At the minesite there is provision for administration buildings, temporary waste stockpiles and a mine ore pad. Figure 4.10 shows the planned arrangement of the various site components and shows the proximity of the town of Polvijarvi (to the east of the project) and the local roads. The working and non-working (exploration) portions of the mining leases (ML) are also shown, along with the leases held by Mondo Minerals to the north, where there are talc pits. The concentrator, TSF and paste fill plant locations are no longer valid given the Luikonlahti purchase.

The underground mine will be accessed by a small box cut. Potential tailings material has been analysed for acid-generating material and found to be non-acid generating. The TSF at the Luikonlahti site has a large capacity but will require the bund walls to the west and the south to be built up within the next ten years.

Power for the project will be derived from the Finnish grid system which offers reasonable rates. The power reticulation line crosses the mine lease. Potable water can be derived from the local water supply. Process water will be available from mine dewatering, harvested rainfall and melting snows. An abandoned talc pit adjacent to the mine lease can be used for excess water storage.

### CAPITAL COST ESTIMATE

The uninflated capital costs for the project are summarised in Table 4.4. This excludes a life of mine sustaining capital cost of EUR15.76M, including closure costs.

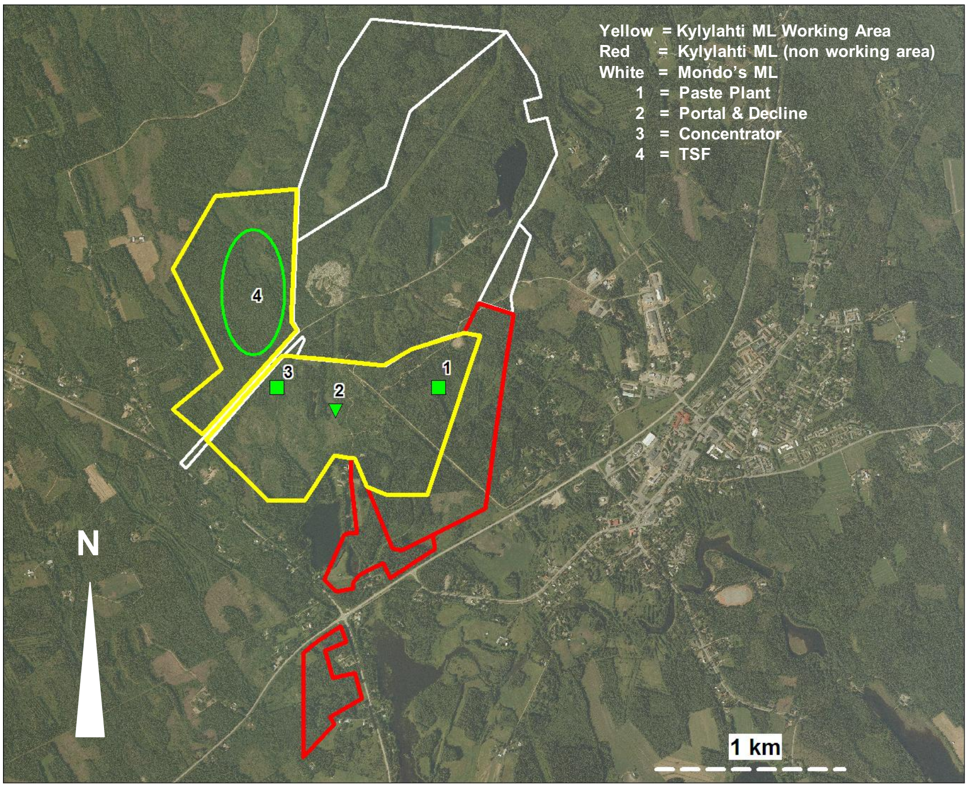
**TABLE 4.4 KYLYLAHTI PROJECT CAPITAL COST ESTIMATE (NOVEMBER 2009)**

| Item | Cost EUR(M) |
|---|---|
| Pre-production and mining costs | 29.72 |
| Concentrator and infrastructure | 16 |
| TSF and paste fill plant | 0.8 |
| Owners costs | 5.12 |
| **Subtotal** | **51.64** |
| EPCM | 1.13 |
| Contingency | 8.11 |
| **Total** | **60.88** |

In its review, Snowden commented that the levels of contingency (14% in this case) were appropriate for projects of this nature. Costs have been estimated to the appropriate degree of accuracy. Net inflation in Finland since April 2008 has been -4.5% and the Finnish market is generally a low-inflation environment, meaning that the cost estimates still have currency or may be slightly high.

Vulcan had entered into contracts with key project engineers and the detailed engineering process was well under way when the project was suspended. It is Optiro's view that the project could recommence relatively quickly and with minimal restart cost apart from hiring of a Vulcan Project Manager and engineering team.

**FIGURE 4.10 PROPOSED SURFACE LAYOUT OF KYLYLAHTI FACILITIES INCLUDING LEASE OUTLINES**




## OPERATING COST ESTIMATE

Table 4.5 is an estimate of the life of mine inflated operating costs for the revised Kylylahti/Luikonlahti operation. The largest single component of the operating cost is the mining cost, which has been developed from first principles and which is believed to have a high level of precision and accuracy. The major component of the processing cost is power, with the second highest being labour. The processing cost estimate is based upon the Hautalampi feasibility study released by Belvedere in May 2009, with a 1 EUR/t contingency added. Since the power options are relatively fixed (exclusive of any unknown future revisions due to emissions trading legislation) and the Finnish labour market is likely to remain very open, this processing cost estimate is deemed to have a low attached risk. Vulcan has quoted an ore transport cost from Kylylahti to Luikonlahti of EUR 2.70/t; this has been used in modelling (Section 5.4.3) and has been built into the overall processing cost. There is an element of uncertainty in the concentrate transport cost, with the destination of the bulk concentrate as yet unknown, but this does form a relatively small component of the total operating cost. The operating costs are higher than the optimised DFS case, which reflects the lower tonnage scenario currently under consideration by Vulcan.

**TABLE 4.5 KYLYLAHTI PROJECT OPERATING COST ESTIMATE**

| Item | Cost EUR per t |
|---|---|
| Mining | 18.67 |
| Processing | 14.38 |
| Overhead and administration | 9.49 |
| Bulk concentrate transport | 4.30 |
| **Total** | **46.84** |

### 4.3.9. ENVIRONMENT AND PERMITTING

#### OVERVIEW

Vulcan has undertaken both an environmental impact assessment process and a community consultation process. The requirements of the Finnish Environmental Impact Assessment Act (1994), the Environmental Protection Act (2000) and the Water Act (1961) have thus been satisfied.

#### PERMIT CONDITIONS

The environmental permit for the commencement of mining was granted in December 2007. The environmental permit had 73 conditions, which relate to environmental contamination (5 conditions), emissions to water and soil (6 conditions), emissions to air (3 conditions), noise and vibration (6 conditions), waste management (13 conditions), chemicals and fuel (8 conditions), incidents and monitoring (15 conditions), fishery monitoring (1 condition) and decommissioning and closure (3 conditions). Vulcan does not consider any of the imposed conditions to be overly onerous, and most would be deemed good operating practice.

#### REHABILITATION COSTS

Rehabilitation costs have been aggregated under sustaining capital, and relate to a mine life of 10 years followed by decommission of infrastructure and rehabilitation for a further 1 to 2 years. The sustaining capital estimate relating to rehabilitation has been estimated at EUR0.156M per year, equating to a total cost of EUR1.72M. Snowden commented that there may be additional costs relating to verification studies and monitoring after mine closure, but that these would not be significant. There is an environmental bond associated with rehabilitation of the Luikonlahti plant which Vulcan expects to be increased to EUR1.1M from its current level of EUR0.75M.

#### COMMUNITY CONSULTATION

Vulcan has undergone community consultation, both in the (local) Polvijarvi Municipality and wider within the region. The area is an historical mining centre with relatively high unemployment, and as such community and local council support for the project is high. There are some issues with the close proximity of residential development to the proposed plant site, relating to noise, dust and on-highway trucks. None of these issues are seen by Vulcan or Optiro as being insurmountable.

#### COMPLIANCE WITH THE EQUATOR PRINCIPLES

As part of its review of the DFS Snowden was asked to comment on Vulcan's compliance with the Equator Principles. These are a set of guidelines which have been adopted by the majority of large financing institutions worldwide. Compliance with the Equator Principles is generally required as a precursor to project finance. Snowden examined compliance with the ten Equator Principles and concluded that 'Vulcan has substantially complied with the Equator Principles with respect to the Kylylahti Project'. Covenants relating to ongoing compliance may be required by financing institutions.

#### 4.3.10. PROJECT RISKS

The Kylylahti Project has been subject to a risk assessment as part of the Snowden review of the DFS which was carried out as a precursor to potential financing in 2008. A summary is provided below, with commentary on any changes since the report was issued in October 2008.

The most significant risk to the project by far is the lack of a firm offtake agreement for the bulk sulphide concentrate. This in turn affects the likelihood of obtaining project finance. While the Talvivaara offtake has been pushed back in time it is currently the firmest option open to Vulcan. Vulcan continues to explore alternative offtake scenarios. The financing risk has diminished since the Belvedere transaction as the total amount of capital required is now much lower, opening up more flexible financing options for Vulcan.

The resource estimate was assigned a low risk. Data collection meets or exceeds industry standards and the geology and mineralisation models are well understood and exist in a well-documented historical mining area. The estimation has been validated and a reporting error has been noted; this has resulted in an approximate 0.6 Mt shortfall in comparison to Vulcan's quoted numbers, but at a 7% higher copper grade.

The reserve estimate, mine planning and schedule and mining cost estimates were assigned a medium risk. Possible schedule critical path constraints have been pointed out, but it is probable that a new schedule, reflecting current metal prices and other production constraints, will be generated prior to production. Costs have been estimated from first principles and are still likely to be largely precise and accurate given the net negative inflation in Finland since the DFS optimisation date. The revised mining schedule for the Luikonlahti processing option, which is still at a scoping level, has an obvious associated risk. This risk has been addressed in Optiro's valuation (Section 5.4.3).

The metallurgy and processing route currently proposed (a copper-gold and a bulk sulphide concentrate) is of low risk and is largely tried and tested both locally in the Outokumpu area and globally. The Luikonlahti plant has previously treated polymetallic ore with very similar characteristics to Kylylahti and thus is fit for purpose. Suitably skilled personnel will available locally to fine-tune and optimise the flotation circuit once production commences.

Environmental and permitting risks are adjudged to be low. A permit to operate has been granted and Vulcan does not see any issues in complying with the conditions of the environmental permit. There is a potential for water discharge to Lake Polvijarvi which needs to be carefully monitored.

Operational risks are seen as low to medium. There is some uncertainty regarding capital costs, but the most recent estimate is at most 18 months old and it is unlikely that there will have been significant escalation given global macroeconomic factors over that time. A local skilled workforce is available and the possibility of Finnish government training and development grants is high.

Infrastructure risks are deemed to be low with the purchase of the Luikonlahti plant. The TSF at Luikonlahti will need to be expanded at some future stage, necessitating building up the bund walls.

Capital and operating cost risks are adjudged to be low with the risk having decreased since the DFS review due to external (macroeconomic) factors. The revised capital cost is significantly lower than that considered in the optimised DFS and is thus of a lower risk. Operating costs per tonne of ore are slightly higher due to the reduced throughput.

Optiro's view is that the overall risk profile of the Kylylahti project is low to medium, largely on the basis of the lack of a bulk concentrate offtake agreement.

### 4.3.11. KYLYLAHTI AREA EXPLORATION POTENTIAL

In addition to the Mining Leases at Kylylahti, Vulcan has a number of surrounding claims in the broader Outokumpu region. These are detailed in Figure 4.11, which shows the regional geology. Figure 4.11 does not show the recently acquired Kylylahti and Outokumpu area leases purchased in the Belvedere transaction, but these are described below.

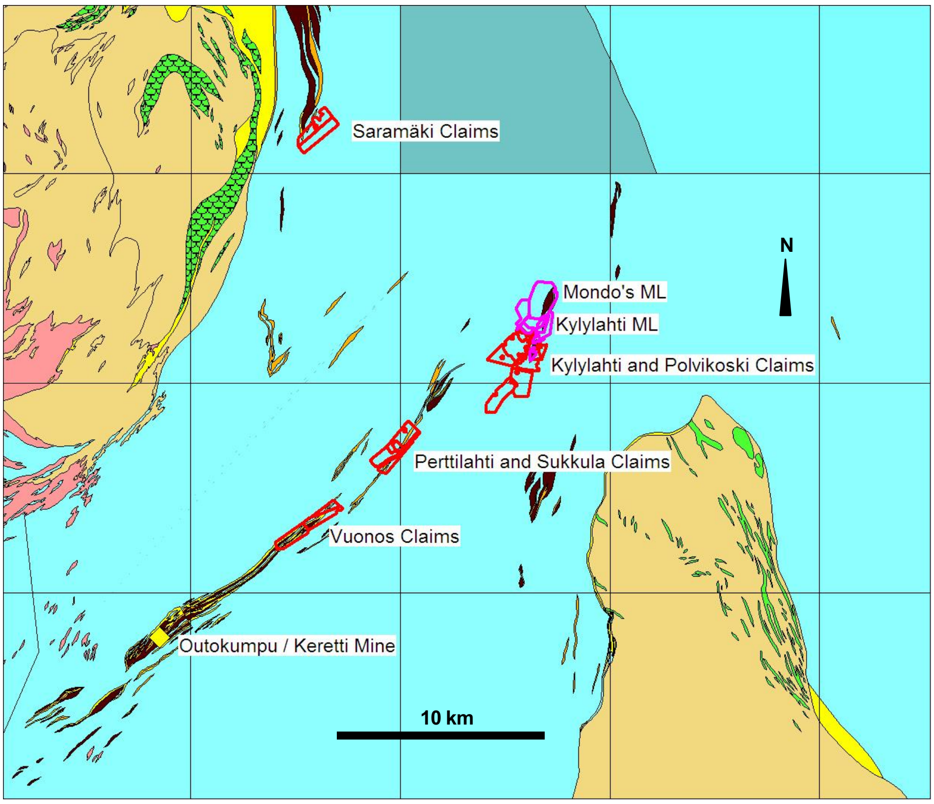
The claims may be split into a number of logical groupings:

- those immediately adjacent to the Kylylahti Project itself
- the claims and mining concessions around the Luikonlahti plant, including the Kokka deposit
- the Hautalampi and Riihilahti mining concessions to the west of the town of Outokumpu
- the Perttilahti and Sukkula claims, including those recently acquired from Belvedere
- the claims in and around the old Vuonos mine, including the Vuonos deposit
- the claims around and including the Saramäki deposit.

In general the tenements purchased in the Belvedere transaction are small and cover only the main deposits for which they were acquired; there is generally little grass roots potential outside of the existing deposits and prospects.

The claims immediately adjacent to the Kylylahti Project itself are to test for the downdip extension of the orebody, bearing in mind that the typical strike length of Outokumpu orebodies is 3 km and that the currently defined strike length of Kylylahti is 1.2 km. The orebody is likely to continue beyond current drilling to the southwest although the increasing depth will ultimately be a factor. To the northeast of the Vulcan Mining Leases Figure 4.11 shows the mining leases held by Mondo Minerals NL.

**FIGURE 4.11 DETAILS OF VULCAN LEASES IN THE KYLYLAHTI REGION (SEE TEXT FOR DETAILS)**



The Perttilahti and Sukkula claims cover a portion of favourable Outokumpu association stratigraphy (altered serpentinites against sulphidic black shales) which has potential for Kylylahti-type deposits, including the Perttilahti deposit (Section 4.3.5).

Vuonos (see Section 4.3.5) is a former producing Outokumpu-style mine for which Vulcan has declared an Inferred Resource.

The Saramäki claim sits off the main Outokumpu trend some township. In addition to the declared Inferred Resource (2005) Vulcan has carried out some recent drilling. During 2008 six holes were drilled for a total length of 926 m and an orientation MMI survey was carried out. Results were encouraging and potential remains for a small to moderate size polymetallic orebody, but at relatively low grades compared to Kylylahti.

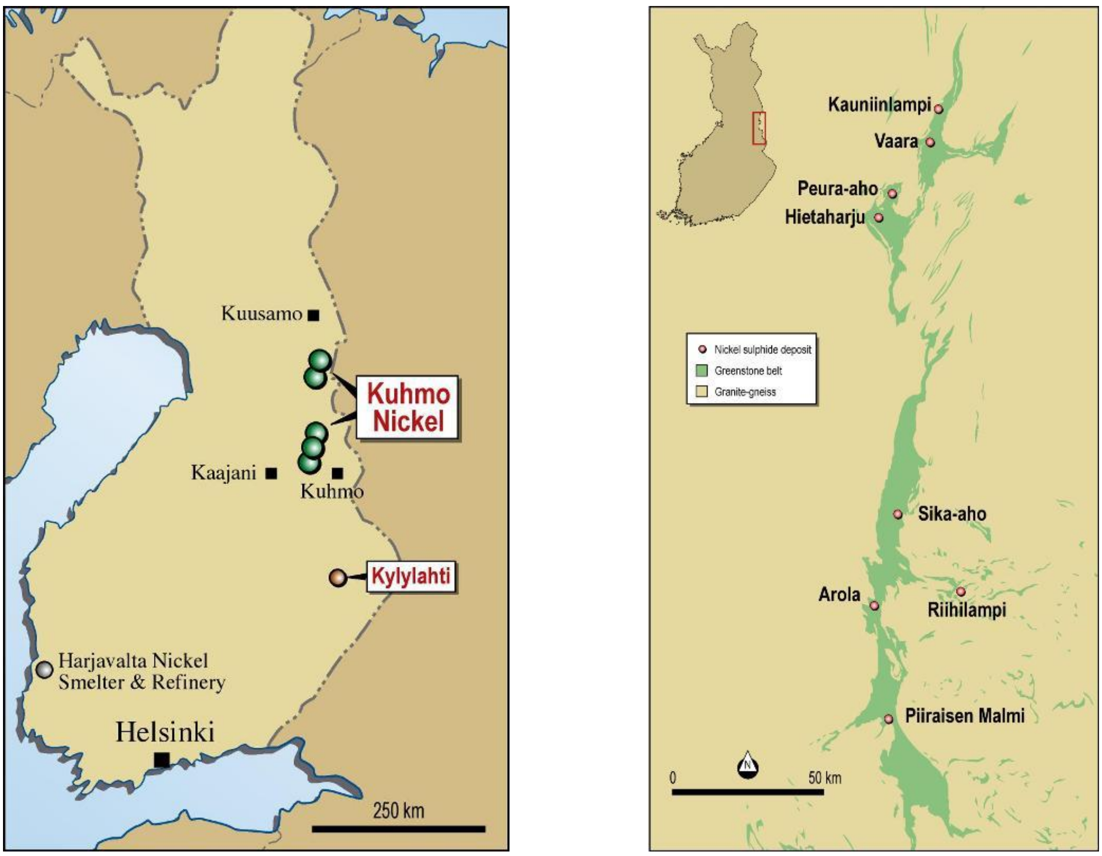
In Optiro's opinion there is moderate potential for the discovery of either new Outokumpu-style polymetallic sulphide deposits or for extensions to known deposits. Clearly there is high potential for down-dip extensions to Kylylahti but these may be at uneconomic depths.

## 4.4. THE KUHMO NICKEL JV

### 4.4.1. INTRODUCTION

Vulcan's other significant project in Finland is the Kuhmo Nickel Joint Venture, of which Vulcan holds a 95% interest in the non-gold rights. Vulcan's JV partner in both cases is Polar Mining Oy, a Finnish subsidiary of Dragon Mining NL, which holds a 5% free carried interest in the non-gold rights and a 100% interest in the gold rights. Figure 4.12 (left) shows the location of the Kuhmo assets in relation to Kylylahti and a likely destination for any concentrate produced, the Harjavalta smelter and refinery. The right side of Figure 4.12 shows the detail of the Kuhmo-Suomussalmi greenstone belt, which hosts all of the claims, and the location of the individual project areas.

FIGURE 4.12 LOCATION OF THE KUHMO NICKEL JV PROJECTS OF VULCAN



### 4.4.2. SETTING AND GEOLOGY

Vulcan's defined Mineral Resources and nickel sulphide prospects sit within the Kuhmo-Suomussalmi greenstone belt within the Karelian Craton (Figure 4.1). This may be divided into two zones, the Kuhmo greenstone belt to the south and the Suomussalmi greenstone belt to the north. The Karelian Craton is a typical granite-greenstone terrain comprising extensive areas of gneissic and tonalitic to granitic rocks within which are preserved isolated keels of greenstone comprised of ultramafic, mafic and felsic volcanic rocks and minor sedimentary rocks, and as such it is geologically similar to many major nickel sulphide provinces such as the Norseman-Wiluna belt in Western Australia.

The Kuhmo and the Suomussalmi areas comprise two semi-contiguous, north-south trending belts of greenstone extending over distances of 100 km and 50 km respectively. The belts range between 2 km and 12 km in width, averaging between 5 km and 6 km wide. The belts display the typical curvilinear geometry of greenstone-granite terrains, with linear segments that splay and terminate against lobate granitoid bodies. Isolated remnants of greenstone are commonly preserved outside the main greenstone belts surrounded by granitoid, such as in the Riihilampi area. The Kuhmo-Suomussalmi greenstone belt has been well studied and a basic stratigraphy has been erected. This stratigraphy comprises a lower unit of felsic sedimentary and volcanic rocks, an overlying sequence of komatiite to high MgO basalts, a relatively thick sequence of tholeiitic basalt including high-chromium lavas, and an upper sequence of felsic to intermediate volcanic and volcaniclastic rocks and sediments, including graphitic shale and minor banded iron formation. Most elements of this stratigraphy are seen in other granite-greenstone belts such as the Norseman-Wiluna and Forrestania belts of Western Australia. As with these regions, it is the komatiitic and high MgO basalts which are generally the most important in localising nickel sulphide deposits.

### 4.4.3. TENURE

Vulcan's claims may be split into six project areas as detailed in Table 4.6, with the names corresponding to the areas shown on the right of Figure 4.12. These claims have various expiry dates, ranging from November 2010 through to April 2014.

**TABLE 4.6 DETAILS OF VULCAN'S CLAIM HOLDING IN THE KUHMO-SUOMUSSALMI BELT**

| Project/belt | Number of claims | Total area (Ha) |
|---|---|---|
| Saarikylä (Vaara - Kauniinlampi) | 8 | 586.3 |
| Kiannanniemi (Peura-aho/Hietaharju) | 8 | 223.64 |
| Huutoniemi (Kiannanniemi east) | 4 | 242.71 |
| Moisiovaara (Sika-Aho) | 20 | 1145.63 |
| Arola-Harma North | 16 | 762.25 |
| Kuhmo area (Riihilampi) | 3 | 72.05 |

### 4.4.4. MINERAL RESOURCES

#### SUMMARY

Vulcan has advanced drilling at three projects in the Suomussalmi belt to the stage that Mineral Resources, reported according to the JORC Code (2004), have been declared. These resources sit in the Saarikylä area (Vaara) and in the Kiannanniemi area (Peura-aho and Hietaharju) Figure 4.13 shows the geological setting of the three projects and reveals them all to be associated with the combination of ultramafic rocks, felsic to intermediate volcanics, metasediments and granitoids.

The most recent tabulation of resources was in 2009 following extensive drilling in 2008. The resource tabulations for the three deposits are given in Table 4.7. The resources have been declared either within mineralised domains (such as massive sulphide mineralisation) or more generally above a 0.2% or 0.3% nickel cut-off.

Vulcan has drilled sufficient holes at two other deposits – Sika-aho and Arola – to be able to estimate an updated Mineral Resource, but these had not been completed at the date of the valuation.

### VAARA

At Vaara in the Saarikylä area, large olivine meso- to adcumulates, representing the channel facies of komatiite lava flows, host low grade disseminated nickel mineralisation consistent in style with examples such as the Perseverance and Mt Keith mines in Australia (Figure 4.14). GTK (the Finnish Geological Survey) and Outokumpu completed a total of 6,158 metres of diamond drilling in 58 holes at Vaara between 1994 and 2001, revealing that mineralisation is persistent at depth.

Vulcan completed infill drilling programmes comprising 43 holes, totalling 4,608 metres, on the Vaara deposit. Resource modelling and estimation was completed in July 2009. This was the first resource update since 2006. The domaining includes a wide disseminated zone of sulphides within serpentinite which includes a number of smaller zones of more consistent higher grade mineralisation. The sum of these more consistent zones is 2.8 Mt at a nickel grade of 0.5%, and represents a potential higher grade target for an open pit. Of note is that the claim hosting the Vaara deposit (7789) has expired, and Vulcan has applied for an extension. Vulcan believes that granting of the extension is a formality and Optiro endorses this view.

**TABLE 4.7 2009 MINERAL RESOURCE ESTIMATES FOR VULCAN'S KUHMO PROJECT**

| Deposit | Classification | Tonnes | Nickel (%) | Copper (%) | Cobalt (%) | Palladium (g/t) | Platinum (g/t) |
|---|---|---|---|---|---|---|---|
| Vaara | Indicated | 7,500,000 | 0.32 | 0.02 | 0.01 | 0.15 | 0.07 |
| | Inferred | 740,000 | 0.27 | 0.02 | 0.01 | 0.11 | 0.07 |
| | ***Total*** | ***8,240,000*** | ***0.32*** | ***0.02*** | ***0.01*** | ***0.14*** | ***0.07*** |
| Hietaharju | Indicated | 850,000 | 0.85 | 0.44 | 0.06 | 1.25 | 0.53 |
| | Inferred | 235,000 | 0.59 | 0.27 | 0.04 | 0.89 | 0.34 |
| | ***Total*** | ***1,085,000*** | ***0.80*** | ***0.40*** | ***0.05*** | ***1.17*** | ***0.49*** |
| Peura-aho | Indicated | 405,000 | 0.63 | 0.29 | 0.04 | 0.62 | 0.28 |
| | Inferred | 90,000 | 0.48 | 0.23 | 0.03 | 0.42 | 0.21 |
| | ***Total*** | ***495,000*** | ***0.60*** | ***0.27*** | ***0.04*** | ***0.58*** | ***0.27*** |
| TOTAL | Indicated | 8,760,000 | 0.39 | 0.08 | 0.02 | 0.27 | 0.13 |
| | Inferred | 1,060,000 | 0.36 | 0.09 | 0.02 | 0.31 | 0.14 |
| | **Grand Total** | **9,820,000** | **0.38** | **0.08** | **0.02** | **0.28** | **0.13** |

### HIETAHARJU AND PEURA-AHO

The orebodies of Hietaharju and Peura-aho sit to the south of the Vaara project in the Kiannanniemi project area (Figure 4.13) and both have a similar deposit style, containing lenses of massive sulphide with a nickel tenor of 2% - 5% and less important disseminated nickel sulphide in ultramafic. They feature higher nickel grades than Vaara and additionally carry reasonable palladium and platinum grades. Vulcan believes that these deposits have a similar style to Xstrata's Raglan deposits in Quebec, Canada. The sulphide bodies are associated with the contact of former olivine cumulates and high MgO basalts, similar to the Kambalda nickel orebodies of Western Australia, except with higher copper and PGE.

Vulcan has carried out multiple drilling programmes at Hietaharju and Peura-aho since the last resource estimate in 2006, where 63 drill holes for 5,738 metres have been drilled. Resource modelling and estimates for both prospects at a nickel cut-off of 0.3% was completed in 2008. At Hietaharju (Figure 4.15) disseminated and massive sulphide lenses were defined above the 0.3% nickel cut-off, and in some cases elevated copper or PGE grades were also used to discriminate the ore zones. At Peura-aho (Figure 4.16) there is one economically-significant lens of massive sulphide and a large number of smaller lenses of massive sulphide, disseminated sulphide in ultramafic and sulphide on an ultramafic-basalt contact. Vulcan has carried commissioned some metallurgical testing on selected core from Hietaharju and has applied for a mining lease.

**FIGURE 4.13 LOCATION AND GEOLOGICAL SETTING OF KUHMO MINERAL RESOURCES (NORTH TO TOP OF FIGURE)**

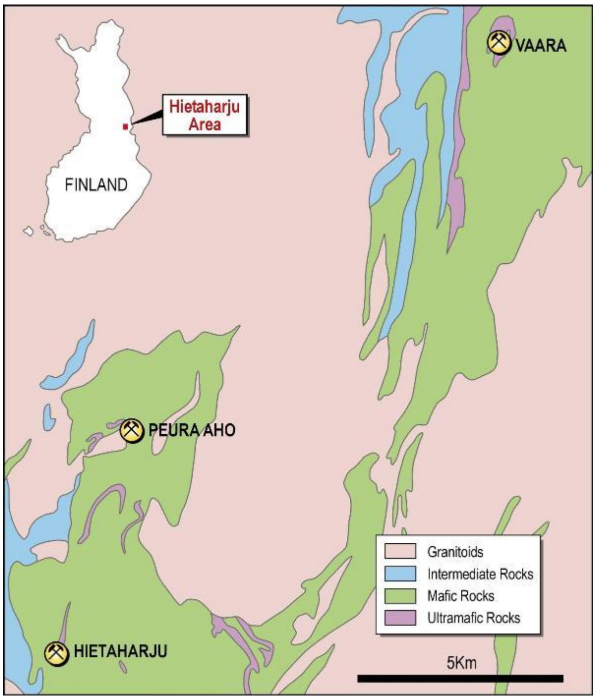
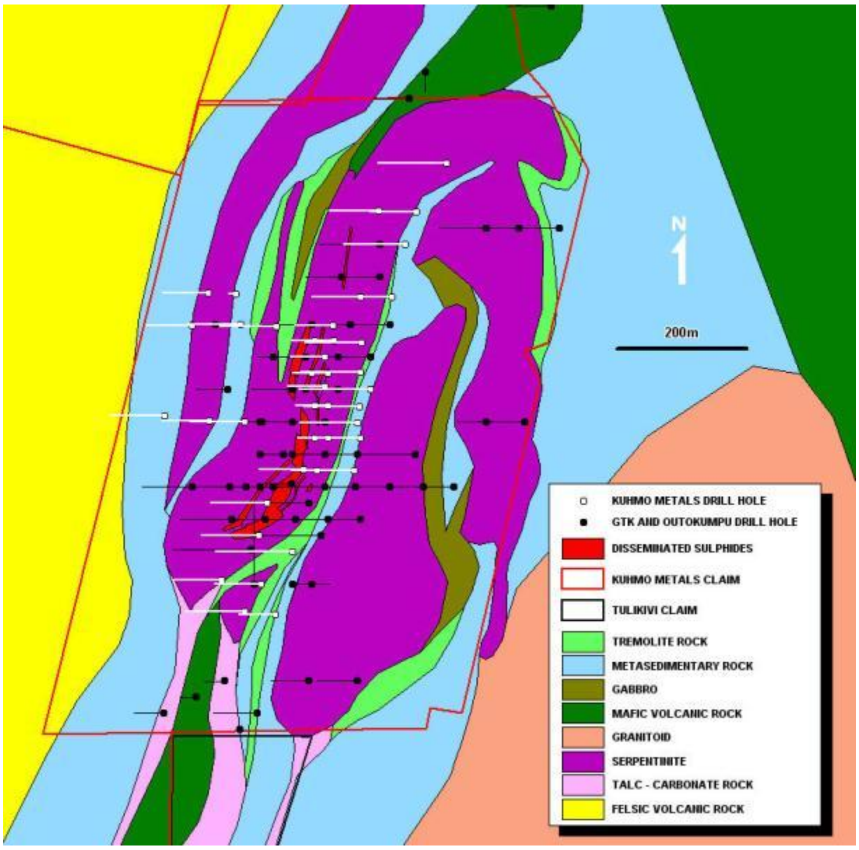


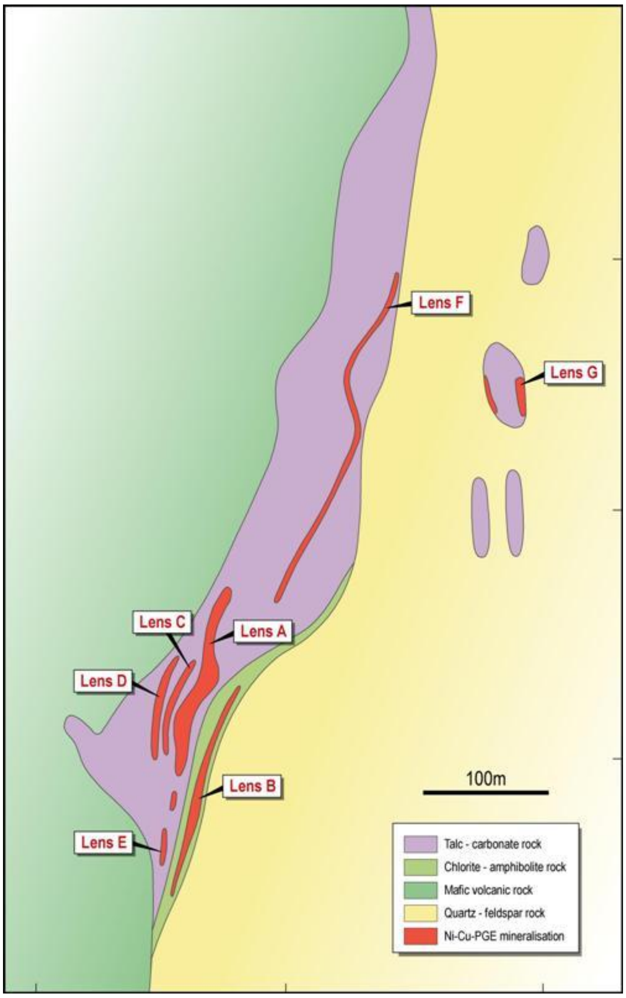

**FIGURE 4.14 PLAN VIEW OF VAARA SHOWING MINERALISATION**



## OTHER RESOURCES

Vulcan has defined two significant nickel sulphide prospects in the Hyrynsalmi region of the Kuhmo greenstone belt (Figure 4.12, right). The Sika-aho nickel deposit is hosted by sheared felsic, mafic, ultramafic rocks and minor graphitic schist within the western edge of the north-northeast trending Tammasuo Shear Zone. The orebody is located a few metres west of talc-carbonate altered komatiitic cumulates in sheared chloritic schists, and comprises a one to nine metre wide zone of massive sulphides developed over approximately 80 metres of strike length; it has been interpreted as a possible structurally remobilised Kambalda-style deposit. Vulcan completed a 17 hole DD programme for 1044 m core in 2007. The best intercept was 17.8 m downhole at 0.76% nickel. The Sika-aho deposit is thought to have been largely closed off by drilling.

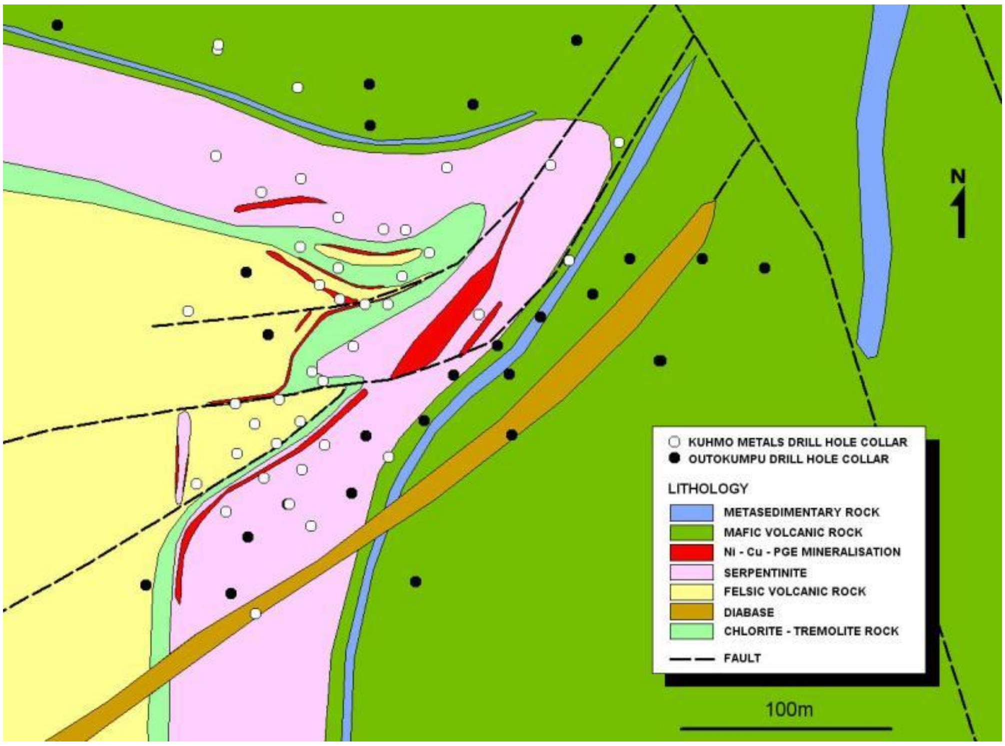
FIGURE 4.15 HIETAHARJU PLAN VIEW SHOWING MINERALISED LENSES (NORTH TO TOP OF FIGURE)




The Arola deposit is located within a north-south trending greenstone belt dominated by mafic volcanic rocks and ultramafic units. The belt is less than two kilometres wide in this area; however, it widens to five to eight kilometres in the north and south. The local geology comprises a sequence of amphibolite, schistose sedimentary rocks including graphitic schist, serpentinite and talc-carbonate altered ultramafic rocks. The mineralisation comprises three lenses over 400 m of strike, hosted in sheared, chloritic basalts but thought to be remobilised from distal komatiites. Vulcan completed a 10 hole diamond drilling programme totalling 1075 metres in 2007. All holes intersected nickel mineralisation, with the longest intercept being 18 m downhole at 0.46% nickel. Although the Arola deposit has been closed off along strike, potential for extensions exist down dip and within the local area.

There are historical estimates for both Sika-aho and Arola, which Vulcan has classified according to the JORC Code. Sika-aho has a polygonal resource, estimated by the GTK in 1990, of 180,000t at a nickel grade of 0.66%. Outokumpu NL reported a polygonal resource for Arola of 1.5 Mt at a nickel grade of 0.46%. These estimates do not incorporate Vulcan's recent drilling.

FIGURE 4.16 PEURA-AHO PLAN VIEW SHOWING MINERALISED LENSES




### 4.4.5. KUHMO AREA EXPLORATION POTENTIAL

#### VAARA REGION

The Vaara region is located within the northern end of the Suomussalmi greenstone belt and consists of a north to north-northeast striking sequence of mafic, ultramafic and felsic rocks. It contains five large (up to three kilometres x 0.5 kilometres) serpentinite (ex-olivine cumulate) lenses referred to as the Saarikylä komatiite cumulate complex. In addition to the Vaara deposit nickel mineralisation, associated with the serpentinites, has been located at a number of locations within the region. The largest of these (apart from Vaara) is the Kauniinlampi deposit itself. Vulcan has been active in the Vaara-Kauniinlampi region, carrying out MMI surveys, which are believed to be useful in locating ultramafic bodies below glacial till, and two types of geophysical surveys – moving loop electromagnetic and airborne versatile time-domain electromagnetic (VTEM). Collectively, the surveys identified twelve priority targets for follow-up drilling.

#### KIANNANNIEMI REGION

The Kiannanniemi region is located within the southern portion of the Suomussalmi greenstone belt and consists of a north-west to north-east striking wide zone of mafic and felsic extrusive rocks hosting thinner units of black schist and ultramafic rocks. The region hosts the Hietaharju and Peura-aho nickel occurrences described above. In the last few years Vulcan has undertaken MMI sampling programmes and a helicopter-borne VTEM survey as well as the resource drilling at Hietaharju and Peura-aho. In 2007 the GTK conducted a mise-a-la-masse survey in the Hietaharju and Peura-aho districts, in addition to a moving loop EM survey at Hietaharju.

There is another advanced prospect in the Kiannanniemi region – this is the ultramafic-hosted Huutoniemi deposit at which Vulcan has a number of priority drill targets. Elsewhere in the region Vulcan has carried out a till sampling programme and considers that the Kiannanniemi area is very prospective for further nickel sulphide discoveries.

### HYRYNSALMI REGION

The Hyrynsalmi Region is located at the centre of the Kuhmo greenstone belt and hosts the two advanced prospects of Sika-aho and Arola. These two deposits have been the main focus of exploration in this area, with drilling, MMI surveys and a VTEM survey being carried out in recent years. These surveys have highlighted a number of regional follow-up targets, including 40 targets alone in the Hyrynsalmi area.

### RIIHILAMPI REGION

The Riihilampi area is located 20 km to the east of the main greenstone belt (Figure 4.12, right) and comprises a number of mafic-ultramafic remnants within granitoids, one of which hosts a low grade nickel occurrence. Vulcan drilled two holes at Riihilampi in 2008; both returned nickel sulphides averaging about 0.35% nickel, with the best intercept being 5.25 m downhole. In the Riihilampi area the potential for massive high-tenor nickel sulphides remains along the southern contact of the serpentinite with gneiss-granitoid basement, and this contact zone requires further drilling. A secondary drilling target is along the northern contact where weak indications of mineralisation have been encountered.

### REGIONAL EXPLORATION

Vulcan has an active regional exploration programme over its claims within the six previously-mentioned areas within the Suomussalmi and Kuhmo greenstone belts. Exploration methods include the aforementioned VTEM surveys, MMI sampling, till sampling, bedrock sampling below till and boulder tracing. Vulcan has collected a significant amount of data relating to the regional geology, favourable rock types, geochemical and geophysical follow-up targets. This has led to the identification of a number of areas for further exploration, including the Luokkivaara, Kelosuo, Lehdonmaa, Selkäjärvi and Yhteisenaho prospects within the Kuhmo greenstone belt and a number of targets around the main identified orebodies within the Suomussalmi greenstone belt. While there has been exploration by the GTK and some private companies for almost 50 years in this area, the Suomussalmi-Kuhmo greenstone belt is still relatively underexplored in relation to other global analogues, and it would be fair to say that Vulcan has a prime landholding in this prospective area.

## 4.5. ASSETS IN THE KOTALAHTI AND VAMMALA REGIONS

As part of the Belvedere transaction Vulcan has acquired two portfolios of mineral deposits and leases outside of the Outokumpu region. These are in the Kotalahti area, 100 km southwest of Outokumpu, and around the municipality of Vammala, close to the western coast of Finland (Figure 4.17).

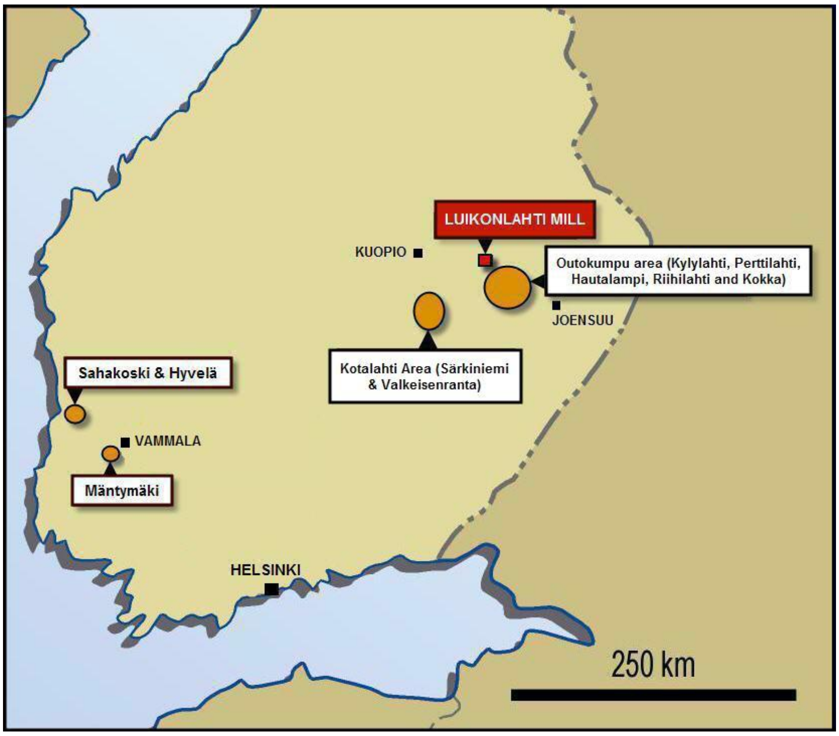
In the Kotalahti area Vulcan's properties are a suite of four nickel-copper-cobalt deposits including a mine at Särkiniemi from which Belvedere produced a small amount of ore in 2007. The other resources are at Valkeisenranta, where Belvedere has defined an Indicated Resource of some 1.5 Mt at a nickel grade of 0.7% and a copper grade of 0.3%, at Sarkalahti and at Niinimäki, both of which contain small resources. The total resource endowment of Vulcan's properties in the Kotalahti region is almost 2 Mt at a nickel grade of 0.8%, a copper grade of 0.32% and a cobalt grade of 0.03%. In addition to the defined deposits for which Mineral Resources exist Vulcan has a number of claims (exploration tenements) which are generally centred on known prospects or deposits.

Deposits in the Kotalahti Nickel Belt are classed as magmatic nickel-copper sulphide deposits and are generally associated with segregations of sulphide minerals from mafic or ultramafic magmas. The Kotalahti Nickel Belt has been the main production source of nickel in Finland, with over 41 Mt of historical production.

Vulcan's other nickel assets outside of Kotalahti and Kuhmo surround the municipality of Vammala and the town of Pori, near the west coast of Finland (Figure 4.17). The Vammala area tenements comprise three granted mining concessions surrounding the deposits of Mäntymäki, Hyvelä and

Sahakoski, which have a total declared Mineral Resource of 2.1 Mt at a nickel grade of 0.7%, a copper grade of 0.2% and a cobalt grade of 0.03%. The Vammala or Kylmäkoski Nickel Belt, which contains the three deposits, contains a large number of mafic-ultramafic cumulate bodies which sit within highly deformed metamorphic gneisses. As with the Kotalahti deposits, mineralisation within the Vammala area orebodies is associated with segregations of immiscible sulphide liquids from mafic and ultramafic magmas.

**FIGURE 4.17 PROPERTIES AND TENEMENTS ACQUIRED FROM FINN NICKEL OY**



# 5. PROJECT VALUATIONS

## 5.1. VALUATION CONSIDERATIONS

### 5.1.1. INTRODUCTION

**CATEGORIES OF MINERAL ASSET**

The VALMIN Code defines mineral assets in five categories:

- **Exploration Areas** – these are properties where mineralisation may or may not have been identified, but where no Mineral Resource (defined as in the JORC Code) has been defined.
- **Advanced Exploration Areas** – properties where considerable exploration has been undertaken and specific targets have been identified. These targets warrant further detailed evaluation, usually involving some form of geological sampling. There is no requirement for a resource estimate to have been carried out but there is an understanding that there will be sufficient encouragement that further work will elevate one or more prospects to the resource category.
- **Pre-Development Projects** – these are properties where Mineral Resources have been defined, but also where a decision to proceed with development has not been made.
- **Development Projects** – properties for which a decision has been made to proceed with construction and/or production, but which are not yet commissioned or which are not yet operating at design levels.
- **Operating Mines** – properties which have been commissioned and which are in production.

The various properties held by Universal and Vulcan can be divided into these categories as detailed in Table 5.1.

**TABLE 5.1 SUBIVISION OF UNIVERSAL AND VULCAN ASSETS INTO VALMIN CATEGORIES**

| VALMIN category | Universal assets | Vulcan assets |
|---|---|---|
| Exploration Areas | • Roseby Project tenements (in part)<br>• Queensland regional tenements (in part) | • Kuhmo Project tenements (in part)<br>• Kylylahti and Outokumpu area tenements (in part)<br>• Kotalahti area tenements (in part) |
| Advanced Exploration Areas | • Roseby Project tenements (in part)<br>• Queensland regional tenements (in part)<br>• NSW tenement | • Kuhmo Project tenements (in part)<br>• Kylylahti and Outokumpu area tenements (in part)<br>• Perttilahti and Kokka deposits (Outokumpu area) |
| Pre-Development Projects | • Roseby Project Inferred Resources | • Kuhmo Project Inferred Resources<br>• Outokumpu area Mineral Resources<br>• Kotalahti area Mineral Resources<br>• Vammala area Mineral Resources |
| Development Projects | • Roseby Project Ore Reserves | • Kylylahti Project Ore Reserves |
| Operating Mines | • None | • None |

In carrying out the valuations of the various components of the assets of Universal and Vulcan Optiro has assessed both the technical value and the fair market value. The technical value of an asset is an assessment of the future net economic benefit accruing to the asset at the valuation date under a set of assumptions deemed appropriate by Optiro, excluding any premium or discount to account for market or other strategic considerations.

According to the VALMIN Code the fair market value of an asset is the amount of money (as cash or another consideration) as determined by the Expert, who must assume that asset should change hands on the valuation date (1 November 2009 in this case) in an open and unrestricted market between a willing seller and a willing buyer in an arm's length transaction in which each party acts knowledgeably, prudently and without compulsion. Essentially the fair market value comprises the technical value and a market-related premium or discount relating to market conditions at the valuation date.

Many of the valuation methodologies discussed below introduce the concept of fair market value by the consideration of the implied value of current or recent transactions which are deemed to be arm's length. For instance, in the valuation of exploration potential the consideration of the value per $km^2$ or ha of exploration ground from recent market transactions can be derived – this imparts the perspective of current and fair market value on the valuation. In other cases, for instance the DCF valuation of Ore Reserves, the notion of fair market value is implicitly built into the valuation via the discount rate, which has been adjusted to cater for risk. Thus the outcome of the DCF is deemed to be a fair market value.

A final point of note is that Optiro's valuation is of the assets of the company, not of the company itself. Thus any positive or negative implications to the valuations which arise as a consequence of the corporate structure of either Vulcan or Universal have not been considered.

## 5.2. VALUATION METHODOLOGIES

### 5.2.1. VALUATION OF EXPLORATION POTENTIAL

Optiro has chosen to value the both the Exploration Areas and the Advanced Exploration Areas of both Universal and Vulcan using similar methodologies to ensure consistency and transparency. The prime methodology utilised by Optiro is the Kilburn method. This has been used to value tenements either on which there are no resources or the additional exploration potential of those tenements which do contain resources. The method takes cognisance of the stage of exploration (i.e. initial or advanced) and so all exploration tenements can be valued using this approach. The defined Mineral Resources themselves have been valued separately to the exploration potential (see Section 5.2.2 for further details).

The Kilburn method was developed by a Canadian mining engineer who wished to introduce a more systematic and defendable way of valuing exploration properties. The method considers four key technical aspects of the valuation process and derives a rank or score for the property under consideration under each of these headings according to stated criteria. The four technical aspects are:

- Off property factor – this relates to physical indications of favourable mining conditions in nearby properties, which may or may not be owned by the company being valued. Such indications are old workings through to world-class mines.
- On property factor – this is similar to the off property factor but relates to favourable indications actually on the property itself, such as mines with significant production. It is worth noting that the mines will be valued by another method; the Kilburn approach attempts to value the additional potential for further mining operations.
- Anomaly factor – the anomaly factor relates to the degree of exploration which has been carried out and the level and/or number of the targets which have been generated as a consequence of that exploration. Properties which have been subject to extensive exploration without the generation of sufficient or quality anomalies are marked down under the Kilburn approach.
- Geological factor – this refers to the amount and exposure of favourable lithology and/or structure (if this is related to the mineralisation being valued) on the property. Thus

properties which have a high coverage of favourable lithology and throughgoing structures will score most highly.

The Kilburn approach works by deriving a score for each of these factors for each tenement. The score can be greater than or less than one. These scores are multiplied together and then further multiplied by the Base Acquisition Cost (BAC). The BAC is deemed to be the average cost to acquire a unit of exploration tenement (generally one km$^2$ or one ha) and maintain it for one year, including statutory fees and minimum expenditure commitments. Details of the calculation of the BAC for each of Universal and Vulcan are provided in the Section 5.3.1 and Section 5.4.1 respectively.

Details of the derivation of the scores for the various factors are given in Table 5.2. These descriptions have been derived from Snowden (2007) after Kilburn and have been slightly modified by Optiro. The final part of the determination of value is the application of a Market Factor, which allows a premium or discount to be applied to the valuation based upon perception of current market conditions.

**TABLE 5.2 DETAILS OF KILBURN VALUATION – AFTER SNOWDEN (2007)**

| Rating | Off property factor | On property factor | Anomaly factor | Geological Factor | Market Factor |
|---|---|---|---|---|---|
| 0.1 | | | | Unfavourable lithology | |
| 0.2 | | | | Unfavourable lithology with structures | |
| 0.3 | | | | | Market severely undervalues tenements of this type |
| 0.4 | | | | Favourable lithology (10%-20%) | |
| 0.5 | | | Extensive previous exploration with poor results | Covered by overburden, Generally favourable lithology (50%) | Market undervalues tenements of this type |
| 0.6 | | | | | |
| 0.7 | | | | | |
| 0.8 | | | | Generally favourable lithology (50%) | |
| 0.9 | | | | | |
| 1 | No known mineralisation | No known mineralisation | No targets outlined | Generally favourable lithology (70%) | Market value equates to technical value |
| 1.5 | Minor workings | Minor workings | | Generally favourable lithology (>70%) | Market applies a premium to tenements of this type |
| 2 | Several old workings | Several old workings | Several well-defined targets | Generally favourable lithology (>70%) with structural control | Market applies a significant premium to tenements of this type |
| 2.5 | Abundant workings | Abundant workings | | | |
| 3 | | | Several significant subeconomic intersections | Generally favourable lithology (>70%) with structural control along strike or proximal to a major deposit | |
| 3.5 | Abundant workings/mines with significant historical production | Abundant workings/mines with significant historical production | | | |
| 4 | | | | | |
| 4.5 | | | | | |
| 5 | Along strike from major mines | Major mine with significant historical production | Several significant ore grade intersections which can be correlated | | |
| 10 | Along strike from world class mines | | | | |

The attraction of the Kilburn method for valuation is that it is transparent and defendable, and while it does require a subjective assessment of the various multipliers, supporting information for these judgments is readily available.

As a reality check and as supporting evidence for the Kilburn valuation, Optiro has derived a range of purchase, acquisition or JV values for exploration tenements from recent worldwide market transactions. Since the advent of the global financial crisis in mid-2008 it may be argued that there has been a fundamental shift in the values obtained for exploration leases; thus Optiro has elected (in general) not to consider transactions from before this period. This has served to diminish the database of transactions available for consideration, but in Optiro's opinion provides a more realistic range of values.

#### 5.2.2. VALUATION OF MINERAL RESOURCES

Both parties in the proposed merger have a number of projects which contain Mineral Resources which have not yet been converted into Ore Reserves.

In the case of Universal these are discrete projects, i.e.

- Legend
- Longamundi
- Great Southern
- Charlie Brown
- Caroline
- Lady Clayre
- Bedford North
- Bedford South.

The location of these projects is shown in Figure 3.5. In addition, the three principal projects at Roseby, Blackard, Little Eva and Scanlan, all contain some Inferred Resources inside the current optimised pit shells in addition to resources of all categories which sit outside of the pit shells. The valuation of these resources is discussed in Section 5.3.2.

Vulcan has declared Mineral Resources according to the JORC Code in the Inferred and Indicated categories at its Kuhmo Project. These comprise the following deposits:

- Vaara
- Hietaharju
- Peura-aho.

The location of these projects is shown in Figure 4.12. Vulcan has also declared historical resources at two more projects, Sika-aho and Arola. There are also some Mineral Resources and some historical resources at the Kylylahti Project and in the broader Outokumpu region which have not been converted into Ore Reserves. The valuation of these is discussed in Section 5.4.2.

As part of the recently acquired Belvedere assets, Vulcan has a number of Mineral Resources in the Kotalahti and Vammala areas (Section 4.5). At the Kotalahti area the deposits are:

- Särkiniemi
- Valkeisenranta
- Sarkalahti
- Niinimäki.

In the Vammala area Vulcan has acquired the following resources:

- Sahakoski

- Hyvelä
- Mäntymäki.

The valuation of Mineral Resources, and in some cases historical resources, which have not been converted into Ore Reserves has been carried out by assuming a value per unit of contained metal (in the case of the Universal assets and some of the Vulcan assets, which are predominantly copper assets) or a value per tonne in the case of the Vulcan assets, which are essentially polymetallic. This value per unit has been derived by considering Mineral Resources in a similar geologic environment or a similar regional setting, and by examining recent transactions where a resource was purchased in an arms-length transaction. In addition to this metric Optiro has examined the implied value of resources owned by companies operating in similar commodities, geologic or regional environments by estimating the Enterprise Value (EV) of the organisation per unit of metal or of in situ ore. The EV is defined as the share price on the valuation date times the number of shares on issue, minus the cash on hand plus the debt. These two sources of comparable values have been used to arrive at a fair market value of the metal or ore in the ground. In general terms this provides a benchmark for the total asset value of similar size and profile companies.

### 5.2.3. VALUATION OF ORE RESERVES

Both Universal and Vulcan have assets which have been reported as Ore Reserves according to the JORC Code – in other words, the Measured and Indicated Mineral Resources have been subject to a series of modifying factors (mining, metallurgical, economic, marketing, legal, environmental, social and governmental) and the economically mineable portion reported as an Ore Reserve. The assessments – in this case the respective DFS studies carried out by Universal and Vulcan on their projects – should demonstrate at the time of reporting that extraction could reasonably be justified.

At the valuation date of 1 November 2009 a number of the assumptions used by Universal and Vulcan in their DFS studies could not reasonably be justified. Certain of these are discussed in the respective Sections 5.3.3 and 5.4.3, but in general terms assumptions which have been re-defined for this valuation comprise the following factors:

- commodity prices
- exchange rates
- discount rates
- inflation rates.

KPMG has advised Optiro as to the nominal values of these parameters to be used for both the Roseby and the Kylylahti Projects. The parameters adopted are detailed in Table 5.3 and Table 5.4.

The accepted method of valuation of Ore Reserves is by means of a Net Present Value (NPV) arising from a Discounted Cashflow (DCF) analysis. This method has been applied in the valuation of the Ore Reserves for Universal and for Vulcan.

KPMG provided further input advice regarding taxation and working capital ratios. The overall project risk, leading to the definition of the fair market value, has been incorporated in the nominal, ungeared after tax weighted average cost of capital values that have been used and through the use of sensitivity analysis. The discount rate range for each project is given in Table 5.5. For the base case valuation the upper value in each range was used.

One exception to the use of the DCF valuation method for Ore Reserves is if the application of reasonably assumed modifying factors and other cashflow assumptions results in a negative NPV. Under these circumstances of 'failed reserves', it is appropriate to reclassify the material as a Mineral Resource, which has less rigorous assumptions regarding profitability, namely 'reasonable prospects of eventual economic extraction' according to Paragraph 19 of the JORC Code. Once all or part of an Ore Reserve has been reclassified as a Mineral Resource it is appropriate to value it using the methodology described in Section 5.2.2, that is by assuming a reasonable unit metal or tonnage value based upon recent related transactions and in-ground EV/t or EV/lb. Thus the lower limit of some valuations will not be zero but the 'resource value'.

**TABLE 5.3 COMMODITY PRICES USED FOR ORE RESERVE VALUATIONS**

| Year | Copper | Gold | Nickel | Zinc | Cobalt | Sulphur |
|---|---|---|---|---|---|---|
| | US$/lb | US$/oz | US$/lb | US$/lb | US$/lb | US$/t |
| 2010 | 3.00 | 1,070 | 7.90 | 0.95 | 18.50 | 45.00 |
| 2011 | 3.10 | 1,070 | 7.90 | 1.00 | 18.50 | 45.00 |
| 2012 | 3.00 | 1,070 | 7.90 | 1.00 | 18.50 | 45.00 |
| 2013 | 2.90 | 1,070 | 7.50 | 0.95 | 18.50 | 45.00 |
| 2014 | 2.96 | 1,094 | 7.67 | 0.97 | 18.91 | 45.99 |
| 2015 | 3.03 | 1,118 | 7.83 | 0.99 | 19.32 | 47.00 |
| 2016 | 3.10 | 1,142 | 8.01 | 1.01 | 19.75 | 48.04 |
| 2017 | 3.16 | 1,167 | 8.18 | 1.04 | 20.18 | 49.09 |
| 2018 | 3.23 | 1,193 | 8.36 | 1.06 | 20.63 | 50.17 |
| 2019 | 3.30 | 1,219 | 8.55 | 1.08 | 21.08 | 51.28 |
| 2020 | 3.38 | 1,246 | 8.73 | 1.11 | 21.54 | 52.40 |
| 2021 | 3.45 | 1,274 | 8.93 | 1.13 | 22.02 | 53.56 |
| 2022 | 3.53 | 1,302 | 9.12 | 1.16 | 22.50 | 54.74 |
| 2023 | 3.61 | 1,330 | 9.32 | 1.18 | 23.00 | 55.94 |
| 2024 | 3.68 | 1,359 | 9.53 | 1.21 | 23.50 | 57.17 |

**TABLE 5.4 INFLATION AND EXCHANGE RATES USED IN ORE RESERVE VALUATIONS**

| Year | Inflation | | | Exchange rates | |
|---|---|---|---|---|---|
| | Australia | United States | Finland | AUD:USD | EUR:USD |
| 2010 | 2.2% | 2.0% | 1.2% | 0.89 | 1.47 |
| 2011 | 2.3% | 2.2% | 1.6% | 0.87 | 1.46 |
| 2012 | 2.4% | 2.2% | 1.9% | 0.83 | 1.47 |
| 2013 | 2.5% | 2.2% | 1.9% | 0.80 | 1.44 |
| 2014 | 2.5% | 2.2% | 1.9% | 0.80 | 1.43 |
| 2015 | 2.5% | 2.2% | 1.9% | 0.80 | 1.43 |
| 2016 | 2.5% | 2.2% | 1.9% | 0.79 | 1.42 |
| 2017 | 2.5% | 2.2% | 1.9% | 0.79 | 1.42 |
| 2018 | 2.5% | 2.2% | 1.9% | 0.79 | 1.41 |
| 2019 | 2.5% | 2.2% | 1.9% | 0.79 | 1.41 |
| 2020 | 2.5% | 2.2% | 1.9% | 0.78 | 1.40 |
| 2021 | 2.5% | 2.2% | 1.9% | 0.78 | 1.40 |
| 2022 | 2.5% | 2.2% | 1.9% | 0.78 | 1.39 |
| 2023 | 2.5% | 2.2% | 1.9% | 0.78 | 1.38 |
| 2024 | 2.5% | 2.2% | 1.9% | 0.77 | 1.38 |

**TABLE 5.5 NOMINAL, UNGEARED, AFTER-TAX WEIGHTED AVERAGE COST OF CAPITAL VALUES USED FOR DCF VALUATIONS, ROSEBY AND KYLYLAHTI**

| Project | Applicable currency | Range | |
|---|---|---|---|
| Roseby | AUD cash flows | 12.8% | 13.8% |
| Kylylahti | Euro cash flows | 9.9% | 10.9% |

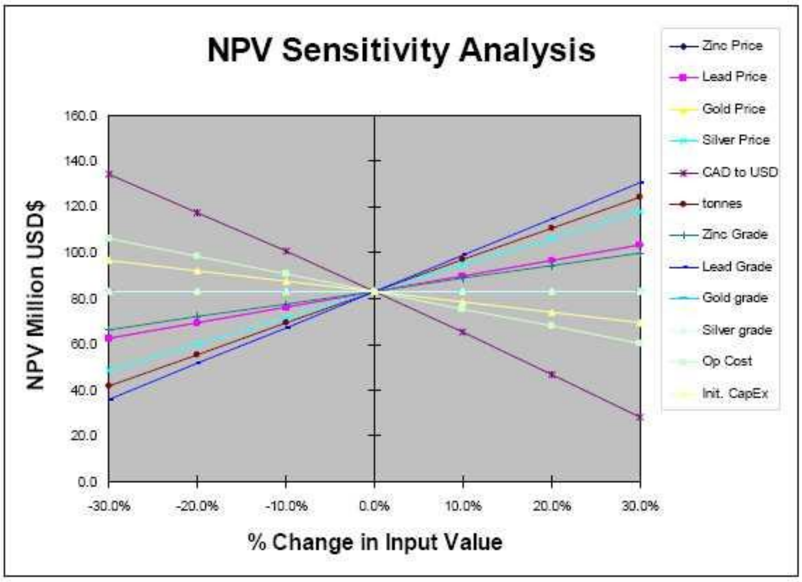
It must be emphasised that the valuation is only current at the valuation date, in this case 1

November 2009. While the independent specialist has provided its best estimate of key commercial and technical parameters, other potential investors may take an alternative view as to future values.

## SENSITIVITY ANALYSIS OF FINANCIAL MODELS

Optiro has elected to use a Monte Carlo approach for determining the upside and downside of the preferred DCF value. This method is becoming more common in modelling the uncertainty associated with projects which comprise a large number of variables. Each of these variables has an associated uncertainty, and the variables can and do interact, resulting in a large number of potential outcomes. The Monte Carlo approach has the significant benefit of simultaneously assessing the effect of uncertainty in all of the key variables, rather than the traditional 'spider diagram' approach to sensitivity analysis (Figure 5.1, which does not relate to either of the projects under consideration in this report) in which a single key variable is changed by a fixed amount and the resultant change on a key outcome (usually the NPV) is plotted. This method of determining sensitivity keeps all variables other than the one under investigation constant and looks at the project outcome. In reality there will be interaction between the variables, and there may be some possible scenarios in which key variables will interact to provide a 'worst case' outcome, some scenarios in which a best case outcome results and others in which the effects of uncertainty in key variables may cancel each other out.

FIGURE 5.1 EXAMPLE OF SPIDER DIAGRAM FOR PROJECT SENSITIVITY




The Monte Carlo sensitivity analysis method works by firstly defining a potential or likely range of values or outcomes for each key variable in the financial model. This range of values is defined as a distribution or range of outcomes.

For some variables, any value within a given range may be assumed to be equally likely to occur. Variables which conform to this model are commodity prices and exchange rates, where there is no likely or preferred value. For instance, in the analysis for Roseby the copper price in 2010 has been allowed to vary between USD 2.55 /lb and USD 3.45 /lb, which represents 15% either side of the base case value advised by KPMG of USD 3.00 /lb.

For other variables which have been determined to a feasibility study level of accuracy there will be a likely or preferred value – this will be the estimated or calculated value which is used in the base case valuation. The uncertainty around this value in the Monte Carlo analysis has been represented with a triangular distribution – in other words, the most likely or preferred value of the variable is the peak of the triangle and the upper and lower limits for the sensitivity represent the ends of the triangle.

These distributions are illustrated in Figure 5.2, which shows the uniform distribution assumed for copper price in 2010 on the left and the triangular distribution assumed for the Kylylahti infrastructure capital expenditure on the right. Note that the values are a percentage of the base case value; thus 0.85, which is the minimum value on the left hand side of Figure 5.2, represents 85% of the base case, or USD 2.55 /lb, and the 1.15 maximum value represents 115% of the base case, or USD 3.45 /lb. The triangular distribution on the right hand side of Figure 5.2 is asymmetric with a minimum value of 0.9, or 90% of the base case value, and a maximum value of 1.20, or 120% of the base case value. Thus the ranges of sensitivity for the Kylylahti infrastructure Capex of EUR9M (Table 5.33) are EUR8.1M (90% of the base case) through to EUR10.8M (120% of the base case). Note that there is no requirement for the ranges to be symmetrical around the base value, and in this case Optiro has judged that there was more potential for cost overruns in the capital than underruns, as demonstrated by numerous mining projects.

Optiro has modelled approximately 50 variables in the DCF model using either uniform or triangular distributions.

The Monte Carlo analysis works by choosing a value from the distribution specified for each of the 50 variables at random and then calculates a key project parameter – in this case the NPV. This is repeated a large number of times using specialised software – 10,000 in the case of Optiro's analysis – with a different value being chosen at random from within the entire range encapsulated by the distributions for each of the 50 or so variables every time. The 10,000 resultant values of NPV are then stored for further analysis. Over the 10,000 iterations for any one variable the range of values chosen almost exactly matches the input distribution specified. For example, if the 10,000 randomly chosen values of the copper price for 2010 are plotted from the Roseby sensitivity analysis (Figure 5.3, left hand side) , it can be seen that they reflect almost exactly the input distribution in Figure 5.2. Similarly, the output histogram of 10,000 random values drawn from the input Kylylahti infrastructure capex (Figure 5.2, right hand side) can be seen to exactly reflect the input distribution (Figure 5.3, right hand side). Similarly, over 10,000 iterations the triangular and uniform distributions of each of the 50 variables specified as input are almost exactly replicated.

There are many ways of representing the range and distribution of each variable using different shaped distributions; however, in Optiro's experience the difference between using, say, a triangular distribution and a normal distribution (the classic 'bell-curve') is less important than the limits of the distribution. Clearly there is a significant difference between a uniform distribution (in which each value is equally likely to occur) and a triangular distribution (which has a preferred or a most likely value) and this distinction is important to the modelling.

**FIGURE 5.2 EXAMPLES OF INPUT DISTRIBUTIONS – UNIFORM (LEFT) AND TRIANGULAR (RIGHT)**

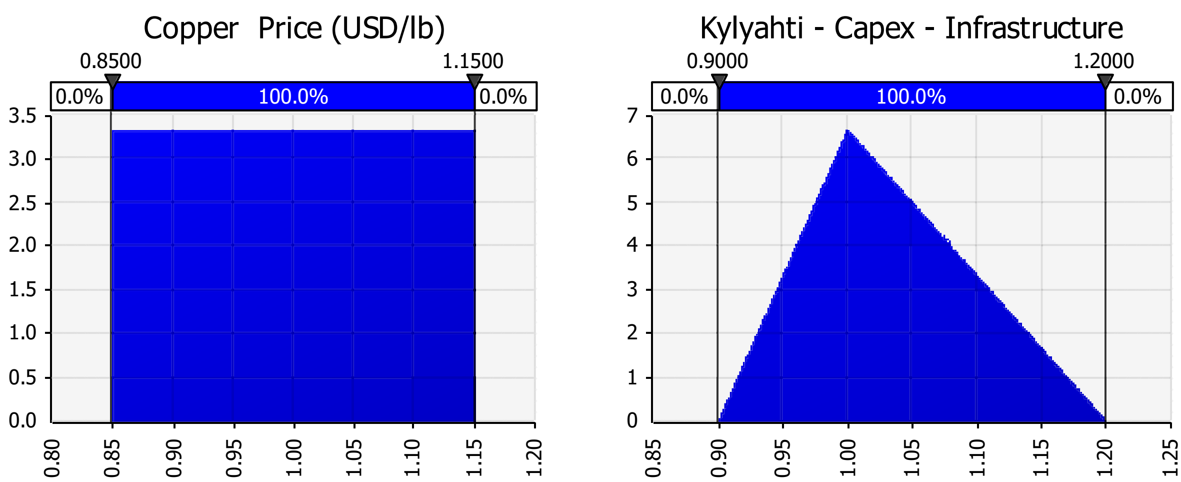
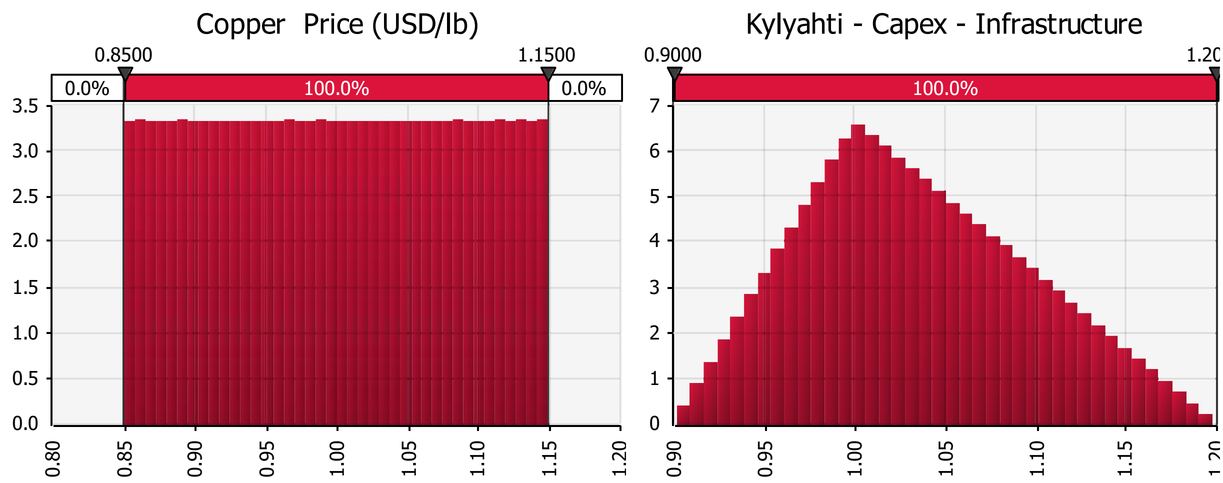


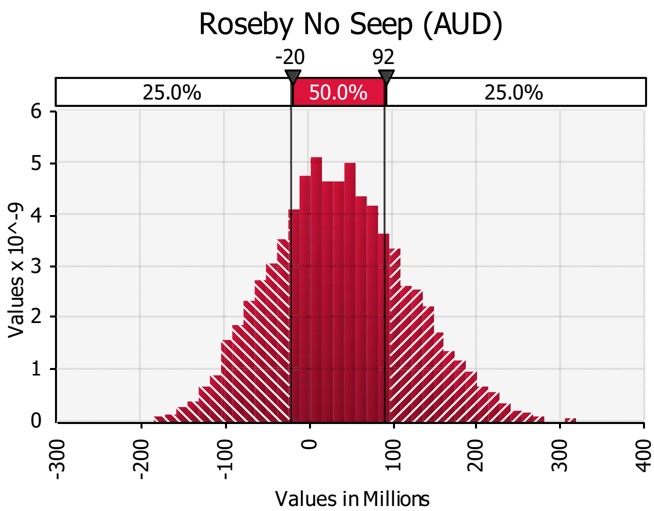
**FIGURE 5.3 OUTPUT DISTRIBUTIONS OF 10,000 RANDOMLY SELECTED VALUES FOR TWO VARIABLES**




A few common sense rules need to be applied in specifying the distributions – for instance in defining the range of uncertainty of metallurgical recovery, a sensible upper limit (i.e. recoveries no greater than 100%) needs to be applied, resulting in a distribution which has the shape of a truncated triangle, or a trapezoid.

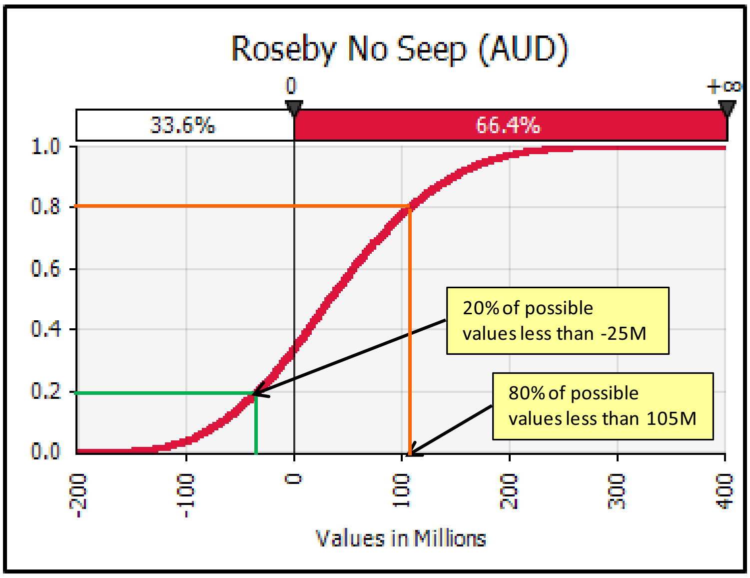
The result of the Monte Carlo modelling – in this case 10,000 values of possible NPVs – can be viewed in various ways. One of the most common ways is as a histogram of values (Figure 5.4). The horizontal axis of this chart is the magnitude of the NPV for Roseby (in AUDM) and the vertical axis represents the number of values for each increment of NPV. The extreme negative values (greater than $150M) will occur only in a very few instances (out of the 10,000) – these represent the 'perfect storm' where all of the variables interact to provide a very poor outcome. Clearly this outcome is possible but highly unlikely, as is a very high NPV result (greater than $250M). As may be expected, most of the values cluster around the average or base case value, which in Figure 5.4 is around $50M. Figure 5.4 also features two vertical lines, at $-20M and $92M. 25% of the values (or 2,500 Monte Carlo outcomes) have an NPV of less than $-20M; similarly, 25% (or 2,500) of the values have an NPV of greater than $92M. Thus it can be seen that half of the 10,000 possible outcomes lie within this range, and half of the values will be outside of the range (either higher or lower).

**FIGURE 5.4 EXAMPLE OF MONTE CARLO ANALYSIS OUTPUT – 10,000 POSSIBLE NPV VALUES FOR ROSEBY**



Another way of presenting the results of the Monte Carlo analysis is as a cumulative distribution of values. This is shown in Figure 5.5, which presents exactly the same data as shown in Figure 5.4. As with Figure 5.4, the horizontal axis depicts the NPV in $M. The vertical axis represents the cumulative probability of the NPV values being below a certain level. Thus it can be seen that at a probability of 0.2 on the vertical axis, 20% of the 10,000 values are less than $-25M; alternatively there is a 20% chance of the project NPV being less than $-25M; alternatively there is an 80% chance of a value greater than $-25M. Similarly, the orange line on Figure 5.5 shows that there is an 80% chance that the project NPV will be less than $105M and therefore a 20% chance that the NPV will be greater than $105M. The central vertical line on Figure 5.5 shows that there is a 34% likelihood of the project having a negative NPV – alternatively, 3,360 of the 10,000 possible NPV values were less than zero.

**FIGURE 5.5 EXAMPLE OF CUMULATIVE DISTRIBUTION OF 10,000 PROJECT VALUES, ROSEBY**




In both the Roseby and the Kylylahti valuations the sensitivity ranges and distribution types as detailed in Table 5.6 were used. The ranges in each case are a percentage of the base case value.

**TABLE 5.6 MONTE CARLO SENSITIVITY PARAMETERS USED FOR ROSEBY AND KYLYLAHTI ANALYSIS**

| Variable | Statistical Distribution | Range | |
|---|---|---|---|
| Metal price | Uniform | -15% | +15% |
| Exchange rate | Uniform | -15% | +15% |
| Working capital ratios | Triangular | -20% | +20% |
| Mining Physicals (Roseby) | Uniform | -10% | +10% |
| Mining Physicals (Kylylahti) | Uniform | -20% | +20% |
| Metallurgical recovery | Triangular | -10% | +10% to max of 99.9% |
| Metal paid | Triangular | -5% | +5% to max of 99.9% |
| Capital costs | Triangular | -10% | +20% |
| Operating costs | Triangular | -10% | +20% |

Metal prices and exchange rates are difficult to forecast to a high level of accuracy over time. There is considered to be an equal likelihood that the forecast will be above or below the actual outcome, and for this reason a uniform distribution having a range of +15% to -15%, within which all values are equally probable, has been chosen.

Similarly, a +10% to -10% uniform range has been applied to the mining physicals for Roseby. This range allows for scheduling (timing) and material property changes. This distribution is not as wide as for metal prices and exchange rates as these physicals have been estimated to a high degree of accuracy and/or are based upon firm quotes. At Kylylahti the mining schedule is largely conceptual (Section 5.4.3) and thus the uncertainty is larger; this has been reflected in a range for the uniform distribution of -20% to +20% of the base values.

Metallurgical recoveries and metal paid have been given triangular distributions, where the base case values or the values applied in the various DFS level studies are the most likely outcome. An equal positive and negative range caters for any uncertainties. The maximum outcome has been restricted to 99.9% of the contained metal.

A skewed triangular distribution with limits of -10% and +20% of the base value has been applied to the cost aspects of the model; this is to cater for price and timing changes. Since cost and time overruns in projects are more common than early finishes and under budget outcomes, the range potential outcomes has been skewed to reflect this; however the most likely outcome (the apex of the triangle) is closer to the base case values used in the various studies.

It is important to note that the values chosen for the upper and lower limits of the distributions are entirely consistent with the levels of precision for the data available; that is, a DFS for Roseby (which is generally accepted to have been executed to an accuracy of plus or minus 10-15%) and a DFS for some of the parameters at Kylylahti (reflected by the narrow range) and conceptual studies for others (reflected in a wider range).

At the request of KPMG, Optiro has included the discount rate as a variable in the sensitivity analysis. The values used for the upper and lower limits are as detailed in Table 5.5. These were varied by means of a uniform distribution – that is, for each iteration of the Monte Carlo analysis any value between the lower and upper limits was able to be chosen with equal probability.

## 5.3. ASSETS OF UNIVERSAL RESOURCES

### 5.3.1. VALUATION OF EXPLORATION POTENTIAL

As discussed in Section 5.2.1, Optiro has applied the Kilburn approach to valuing the exploration assets of Universal. On those tenements where there are existing defined Mineral Resources, Optiro has valued the tenement net of the resource, which has been valued separately using an implied in-ground value per unit, as described in Section 5.4.2.

In Queensland the rental per EPM sub-block (approximately 3.23 km$^2$) is \$132.30 pa, and the expenditure commitment is around \$750 per sub-block per annum. In New South Wales there is no annual rental but there is an expenditure commitment of \$30,000 per exploration licence plus about \$1,000 per sub-block. Thus the BAC values can easily be calculated for each of Universal's licences. In reflection of the demand by the market for copper, uranium and phosphate exploration licences in the Mt Isa region, and to reflect the maturity of the Roseby package and that it represents a contiguous group of claims, a market premium of 50% (Market Factor) has been allocated to the valuation. This effectively values the entire Universal portfolio at approximately \$6,300 per km$^2$, with a low value of \$2,400 per km$^2$ and a high value of \$10,200 per km$^2$.

The workings of the Kilburn valuation are shown in Table 5.8. Note that derived values for the Burra tenement have been revised downwards by 10% to reflect Universal's ownership.

The low value for the Universal tenements is \$5.2M, the high value is \$22.4M and the preferred value is \$13.8M.

In order to provide a benchmark for the value of the exploration tenements, Optiro has examined the implied value per square kilometre of tenements in the same area and with the same broad geology and mineral potential, based upon recent transactions. This information is tabulated in Table 5.7.

Implied values for early stage tenements vary between \$350 and \$77,000 per km$^2$ (and between \$1,800 and \$4,000 with the highest and lowest values removed), and for advanced stage tenements the implied values vary between \$13,310 and \$19,800 per km$^2$. Of interest is that two of the recent JV deals were carried out by Universal, with Syndicated and with Deep Yellow respectively (Section 3.3.2). The Syndicated Metals JV covers a tenement which is adjacent to the Kalman South project and has good potential, whereas the JV with Deep Yellow covers early stage uranium exploration.

The Universal tenements include both early stage areas and advanced exploration areas. Many of the tenements in the Roseby Project may be classified as advanced exploration areas, and some of the regional tenements are at an advanced stage of investigation following work by a number of owners, including Universal. The Burra licence in NSW may certainly be considered as being at an advanced stage. Based upon detailed discussions with Universal staff and upon Optiro's assessment of the levels of exploration and targeting carried out over Universal's tenements, a reasonable assumption is that 60% (1,320 km$^2$) may be classified as advanced.

After due consideration, Optiro believes that on the basis of recent JV and other transactions, and considering the balance of Universal's tenements between early stage and advanced exploration, that a range of \$6,000/ km$^2$ to \$12,000/ km$^2$ seems reasonable. The value obtained by the Kilburn approach, which is \$6,300/ km$^2$, sits towards the lower end of this range, and thus is deemed to be reasonable.

**TABLE 5.7 RECENT RELATED EXPLORATION TRANSACTIONS, MT ISA AND NORTH QUEENSLAND AREA**

| Company | Commodity | Exploration status | Comments | Implied dollar value per km$^2$ |
|---|---|---|---|---|
| De Grey Mining | Copper | Early stage | 100% of tenements for \$2M expenditure, 26 km$^2$ | 77,600 |
| Cape Lambert | Base metals/uranium | Early stage | 100% for \$1.75M in scrip, 5000 km$^2$ | 350 |
| Deep Yellow | Uranium | Early stage | Uranium rights only to two Matrix Minerals areas from receivers, total of 765 km$^2$ | 1,830 |
| Deep Yellow | Uranium | Advanced stage | 100% of uranium rights for \$10M, total of 504 km$^2$ | 19,800 |
| GBM Resources | Copper | Early stage | 100% for \$2.6M expenditure, 1458 km$^2$ | 1,780 |
| Goldsearch – China Yunnan | Copper, uranium | Advanced stage | 70% for \$1.5M expenditure, 161 km$^2$ | 13,310 |
| Universal – Syndicated | Copper, gold | Advanced stage | 70% for \$1M expenditure, 83 km$^2$ | 17,200 |
| Universal – Deep Yellow | Uranium | Early stage | 80% for \$0.25M expenditure, 81 km$^2$ | 3,900 |

## 5.3.2. VALUATION OF MINERAL RESOURCES

### VALUATION OF INFERRED RESOURCES

In valuing the satellite Mineral Resources at the Roseby Project outside of Blackard, Scanlan and Little Eva Optiro has elected to assume an in-ground value of the metal on the basis of both recent related transactions and the implied value of relevant copper resources. These transactions have been chosen since the start of the global commodity downturn and thus are believed to be relevant to the situation at the valuation date. Table 5.9 details a number of relevant transactions. Table

5.10 provides details of a number of copper projects which are in the Mt Isa – Cloncurry area. In this case the implied in-ground value per pound of copper has been calculated by dividing the number of pounds of copper in resources by the adjusted enterprise value of the company, i.e. after corrections for cash in hand and debt. Where the company has significant non-copper resources, the implied cost per pound has been scaled back by the proportion of the total resources which are copper; for instance, in the case of Exco Resources, only 79% of the total in-ground metal value (calculated using commodity prices at the valuation date and excluding any allowance for mining and processing recovery) is based upon copper, and thus the total calculated in-ground value has been reduced by 21%.

The range is between 2.4 c/lb and 13.2 c/lb of in situ Mineral Resource copper. This range of values relates to projects which have all Inferred material up to those which have 94% Indicated. The project which has the most similar geology, grades and spatial location to the Roseby Project is the Exco Resources Cloncurry Copper Project, which has 55% of its resource base in the Indicated category.

After due consideration of the benchmark values in Table 5.9 and Table 5.10, and considering that the resources at the Roseby projects are all Inferred, Optiro believes that an implied fair market value of the Roseby projects is between 2 c/lb and 6 c/lb, with a preferred value of 4 c/lb. Note that at copper prices as of the valuation date this preferred value equates to approximately 1.2% of the Australian Dollar price with a range of 0.6% to 1.8% based upon the high and low values. Optiro believes that the range is slightly lower than ranges observed in similar valuations. Accordingly, Optiro believes this to be a reasonable and slightly conservative valuation for Inferred Resources in the prospective Mt Isa Inlier. In addition to the copper value, some of the Inferred Resources at the Roseby satellite projects contain gold. This contained gold (some 73,000 oz in situ) has been valued by considering an in-ground value which is 1% of the gold price at the valuation date.

**TABLE 5.8 KILBURN VALUATION OF THE EXPLORATION POTENTIAL OF UNIVERSAL RESOURCES**

| | | | | Equity | Off property | | On property | | Anomaly | | Geology | | Market Factor | | Valuation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tenement | Name | Area Km$^2$ | BAC | Share | Low | High | Low | High | Low | High | Low | High | Low | High | Low | High | Preferred |
| EPM 8506 | Mt Roseby | 112.8 | $ 30,823 | 100% | 2.0 | 2.5 | 2.0 | 2.5 | 3.0 | 3.5 | 1.5 | 2.5 | 1.50 | 1.50 | $ 832,000 | $ 2,528,000 | $ 1,680,000 |
| EPM 9056 | Pinnacle | 12.9 | $ 3,525 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.0 | 1.50 | 1.50 | $ 12,000 | $ 40,000 | $ 26,000 |
| EPM 10266 | Highway | 258 | $ 70,499 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.5 | 1.50 | 1.50 | $ 238,000 | $ 1,190,000 | $ 714,000 |
| EPM 10833 | Cameron | 292.7 | $ 79,980 | 100% | 2.5 | 3.5 | 2.0 | 2.5 | 1.0 | 2.0 | 0.8 | 2.0 | 1.50 | 1.50 | $ 450,000 | $ 4,199,000 | $ 2,324,500 |
| EPM 11004 | Ogorilla | 80.4 | $ 21,969 | 100% | 2.5 | 3.0 | 1.5 | 2.0 | 1.0 | 2.0 | 0.8 | 2.0 | 1.50 | 1.50 | $ 93,000 | $ 791,000 | $ 442,000 |
| EPM 13249 | Lilliput | 32.2 | $ 8,799 | 100% | 2.0 | 2.5 | 2.5 | 3.0 | 2.5 | 3.0 | 1.5 | 2.5 | 1.50 | 1.50 | $ 247,000 | $ 742,000 | $ 494,500 |
| EPM 14535 | Roseby infill | 138.3 | $ 37,791 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.5 | 1.50 | 1.50 | $ 128,000 | $ 638,000 | $ 383,000 |
| EPM 14363 | Bannockburn | 61.3 | $ 16,750 | 100% | 2.5 | 2.0 | 1.5 | 2.0 | 1.0 | 1.5 | 0.5 | 1.5 | 1.50 | 1.50 | $ 47,000 | $ 226,000 | $ 136,500 |
| EPM 14365 | Corella | 147.8 | $ 40,386 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 1.0 | 2.0 | 1.50 | 1.50 | $ 182,000 | $ 909,000 | $ 545,500 |
| EPM 14545 | Murrumba | 48.2 | $ 13,171 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.5 | 1.50 | 1.50 | $ 47,000 | $ 222,000 | $ 134,500 |
| EPM 14556 | Coolullah | 61.4 | $ 16,778 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.5 | 1.50 | 1.50 | $ 57,000 | $ 283,000 | $ 170,000 |
| EPM 11611 | Gulliver | 29 | $ 7,924 | 100% | 2.0 | 2.5 | 1.0 | 1.5 | 1.0 | 2.0 | 0.8 | 2.0 | 1.50 | 1.50 | $ 19,000 | $ 178,000 | $ 98,500 |
| EPM 12121 | Gulliver East | 9.7 | $ 2,651 | 100% | 2.0 | 2.5 | 1.0 | 1.5 | 1.0 | 2.0 | 0.8 | 2.0 | 1.50 | 1.50 | $ 6,000 | $ 60,000 | $ 33,000 |
| EPM 12492 | Queen Sally | 41.9 | $ 11,449 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.0 | 1.5 | 0.8 | 1.5 | 1.50 | 1.50 | $ 39,000 | $ 193,000 | $ 116,000 |
| EPM 12493 | Quamby | 19.3 | $ 5,274 | 100% | 1.5 | 2.0 | 1.5 | 2.0 | 1.0 | 1.5 | 0.5 | 1.5 | 1.50 | 1.50 | $ 9,000 | $ 71,000 | $ 40,000 |
| EPM 12529 | Cabbage Tree | 25.8 | $ 7,050 | 100% | 2.0 | 2.5 | 2.0 | 2.5 | 1.0 | 1.5 | 0.8 | 2.0 | 1.50 | 1.50 | $ 32,000 | $ 198,000 | $ 115,000 |
| EPM 14822 | River Gum | 35.5 | $ 9,700 | 100% | 2.0 | 2.5 | 2.0 | 2.5 | 1.0 | 1.5 | 0.8 | 2.0 | 1.50 | 1.50 | $ 44,000 | $ 273,000 | $ 158,500 |
| **SUB-TOTAL** | | | | | | | | | | | | | | | **$ 2,482,000** | **$ 12,741,000** | **$ 7,611,500** |
| EPM 8059 | Cameron River | 112.6 | $ 30,768 | 100% | 2.0 | 2.5 | 2.5 | 3.0 | 2.0 | 2.5 | 1.0 | 2.0 | 1.50 | 1.50 | $ 462,000 | $ 1,731,000 | $ 1,096,500 |
| EPM 9611 | Happy Valley | 38.5 | $ 10,520 | 100% | 2.0 | 2.5 | 1.5 | 2.0 | 1.5 | 2.0 | 1.0 | 2.0 | 1.50 | 1.50 | $ 71,000 | $ 316,000 | $ 193,500 |
| EPM 14371 | Mt Angelay | 28.9 | $ 7,897 | 100% | 1.5 | 2.0 | 1.5 | 2.0 | 1.5 | 2.0 | 1.0 | 2.0 | 1.50 | 1.50 | $ 40,000 | $ 190,000 | $ 115,000 |
| EPM 14362 | Malbon Vale | 80.2 | $ 21,915 | 100% | 1.5 | 2.0 | 1.0 | 1.5 | 1.0 | 2.0 | 1.0 | 1.5 | 1.50 | 1.50 | $ 49,000 | $ 296,000 | $ 172,500 |
| EPM 14415 | Mt Malakoff | 67.2 | $ 18,362 | 100% | 2.0 | 2.5 | 2.0 | 2.5 | 2.0 | 2.5 | 2.0 | 2.5 | 1.50 | 1.50 | $ 441,000 | $ 1,076,000 | $ 758,500 |
| EPM 14367 | Spider | 80.5 | $ 21,997 | 100% | 1.0 | 1.5 | 1.0 | 1.0 | 1.0 | 2.0 | 1.0 | 2.0 | 1.50 | 1.50 | $ 33,000 | $ 198,000 | $ 115,500 |
| EPM 14370 | Malakoff | 70.8 | $ 19,346 | 100% | 2.0 | 2.5 | 1.5 | 2.5 | 2.0 | 2.5 | 2.0 | 2.5 | 1.50 | 1.50 | $ 348,000 | $ 1,134,000 | $ 741,000 |
| EPM 14366 | Bushy Park | 192.1 | $ 52,491 | 100% | 2.0 | 2.5 | 1.0 | 1.5 | 1.0 | 2.0 | 1.0 | 1.5 | 1.50 | 1.50 | $ 157,000 | $ 886,000 | $ 521,500 |
| EPM 14369 | Dronfield | 83.2 | $ 22,734 | 100% | 2.5 | 3.0 | 1.5 | 2.5 | 1.0 | 2.0 | 1.0 | 2.0 | 1.50 | 1.50 | $ 128,000 | $ 1,023,000 | $ 575,500 |
| **SUB-TOTAL** | | | | | | | | | | | | | | | **$ 1,729,000** | **$ 6,850,000** | **$ 4,289,500** |
| EL 5692 | Burra | 38 | $ 46,000 | 90% | 2.0 | 2.5 | 2.5 | 3.0 | 2.5 | 3.0 | 2.0 | 3.0 | 1.00 | 1.00 | $ 1,035,000 | $ 2,795,000 | $ 1,915,000 |
| **GRAND TOTAL** | | | | | | | | | | | | | | | **$ 5,246,000** | **$ 22,386,000** | **$ 13,816,000** |

**TABLE 5.9 RECENT TRANSACTIONS RELATING TO COPPER RESOURCES IN THE NORTH QUEENSLAND AREA**

| Project | Transaction details | Asset details | Project value per pound of copper ($) |
|---|---|---|---|
| Mount Oxide | Chalice agreed to purchase Perilya's Mount Oxide project north of Mt Isa for $25M in September 2008. Deal was terminated due to falling copper prices | 15.5 Mt of Inferred and Indicated resource (63% Indicated) at a grade of 1.3% copper and 0.05% cobalt, containing 203,000t contained copper (in-ground) | 5.6c, includes some credits for cobalt |
| Mount Oxide | As part of an investment in Perilya by Zhonjin Lingyan in January 2009, Ernst and Young (EY) valued Mt Oxide at $15M. No other details were provided | As above | 3.4c, no allowance for cobalt credits |
| Maitland deposit | Kagara purchased the Maitand Deposit and associated tenements from Glengarry resources in September 2008. These are near Balcooma in N Queensland | Indicated plus Inferred resource (94% Indicated) of 1.5Mt at 1.5% copper and 0.02% molybdenum. The acquisition includes 3 EPMs | 13.2c, no allowance for exploration licence value or molybdenum value |

**TABLE 5.10 IMPLIED VALUE PER POUND OF COPPER FOR SELECTED MT ISA AREA PROJECTS**

| Company and project | Asset detail | Enterprise value | Project value per pound of copper ($) |
|---|---|---|---|
| Redbank Copper, Redbank copper project | Oxide and sulphide copper resources, 5.21 Mt at 1.3% copper, 33% Indicated | $8.1M | 5.0c, no value assigned to exploration properties |
| Syndicated Metals, Kalman project, Barbara project | Kalman project – 112,000t copper, all Inferred, plus 173,000 oz gold; Barbara project – 38,000t copper, 12,000 oz gold, almost all Inferred | $9.7M | 2.4c, allowing for 17% of total potential revenue from gold |
| Exco Resources, Cloncurry copper project | 57 Mt at 0.87% copper plus 107,000 oz gold, 52% Indicated | $54.7M | 4.0c, allowing for 21% of potential revenue from gold |

Applying this range of valuations to the Roseby Inferred Resource projects, the values derived are summarised in Table 5.11.

**TABLE 5.11 VALUATION OF INFERRED RESOURCES, ROSEBY**

| Tonnage and grade | lbs copper in situ | Low value (2 c/lb) | High value (6 c/lb) | Preferred value (4 c/lb) |
|---|---|---|---|---|
| 32.3 Mt at 0.66% copper plus 73,000 oz gold | 470M | $9.6M | $28.8M | $19.2M |

## VALUATION OF MEASURED AND INDICATED RESOURCES AT ROSEBY

The lower limit of value of the Roseby Ore Reserves would in theory not be zero or negative, but their implied value as a Mineral Resource. This resource-only valuation should be assigned when the reasonable assumptions regarding the modifying factors for Ore Reserves do not result in a profitable project. In Optiro's view it would not be correct to assign an in-ground value to all of the Mineral Resources at Blackard, Scanlan, and Little Eva. A reasonable approach (based upon existing Roseby resource to reserve conversion rates, as discussed further in Section 5.3.3) would be to re-classify the existing Ore Reserves as Mineral Resources and assume a 60% conversion of the in-pit Inferred Resources.

Thus the total 'failed reserve' plus additional reasonably assumed Inferred Resources would be:

- Blackard: 22.9 Mt at 0.66% copper
- Scanlan: 10.2 Mt at 0.71% copper
- Little Eva: 15.7 Mt at 0.70% copper.

Optiro has elected to use a range of in-ground values which has 2 c/lb as the low value, 6 c/lb as the high value and 5 c/lb as the preferred value. This preferred value is higher than that assumed for the satellite Inferred Resources (4 c/lb) and reflects the greater certainty in the Measured and Indicated Resources at Blackard, Scanlan and Little Eva. Given this range, a resource-only valuation for the Roseby reserves is as presented in Table 5.12.

**TABLE 5.12 VALUATION OF FAILED RESERVES (MEASURED PLUS INDICATED RESOURCES), ROSEBY**

| Tonnage and grade | lbs copper in situ | Low value (2 c/lb) | High value (6 c/lb) | Preferred value (5 c/lb) |
|---|---|---|---|---|
| 48.9 Mt at 0.70% copper | 752M | \$15.0M | \$45.2M | \$37.7M |

### 5.3.3. VALUATION OF ORE RESERVES

#### DCF MODELLING OF THE ROSEBY PROJECT

Optiro has built a life of mine discounted cashflow model for the Roseby Project. In generating this model, Optiro has relied upon a number of sources. As described in Section 3, Universal's DFS was completed in April 2008 with 2007 costs, but was revised to incorporate a production upgrade to 5 Mtpa ore and updated unit mining costs in September 2008.

A summary of the key components of Optiro's DCF model and their derivation is provided in Table 5.13.

**TABLE 5.13 SUMMARY OF THE DERIVATION OF COMPONENTS OF THE ROSEBY DCF MODEL**

| Model component | Source of data |
|---|---|
| Mine production physicals | Universal DFS, 5 Mtpa schedule |
| Processing physicals | Universal DFS, 5 Mtps schedule |
| Metallurgical recoveries | Universal DFS, figures discounted by Optiro following review |
| Mine operating costs | Universal DFS, 5 Mtpa schedule, adjustments for constant inflation |
| Processing operating costs | Universal DFS, slightly amended by Optiro, adjustments for constant inflation |
| Pre-production capital | Universal revised DFS, figures subject to inflation by Optiro |
| Total (life of mine) capital | Universal revised DFS, figures subject to inflation by Optiro |
| General and administration cost | Cost assumed by Optiro, no cost provided by Universal |
| Commodity prices, exchange rates, discount rates, inflation rates | As advised by KPMG |
| Taxation treatment | As advised by KPMG |

Optiro has reviewed the input parameters to the Roseby DFS as supplied by Universal's employees and consultants, and has adopted certain of these on the basis that they are believed to be appropriate. Optiro has amended other input parameters following review; the details are presented below.

Table 5.14 shows the adjusted mining schedule that has been input into Optiro's DCF valuation. It can be seen that mining is expected to commence in 2012. The Base Case 5 Mtpa schedule that was used in the DFS has been modified by Optiro as follows:

- delayed start to allow for mining to commence after the termination of the SEEP option, financing, additional study work and construction
- updated mining inventory to include additional material that is likely to be mined as a result of the modified economic criteria and exploration activities.

### Conversion of Inferred Resources and additional resources

The Universal DCF model as described in Section 4 schedules out the total Ore Reserve as reported to the market, which is 47.93 Mt at a copper grade of 0.7% and a gold grade of 0.04 g/t. Optiro notes that during the life of mine Universal has assumed $8M for exploration; it is therefore reasonable to assume that this exploration could be used to upgrade current Inferred Resources contained within pit designs to a higher category of resource and thus a reserve. This assumption excludes extensional resources, which are subject to the SEEP option (see below).

The conversion rates from Measured plus Indicated Mineral Resources to Ore Reserve achieved at Roseby, calculated on an in situ contained copper basis, are

- Blackard: 54%
- Scanlan: 68%
- Little Eva: 54%

An unweighted average of these values gives a 59% Measured plus Indicated Resource conversion. Based upon this benchmark, Optiro's operational experience and consideration of the nature of the mineralisation at Roseby, that the current Inferred Resources within the designed pits at Blackard, Scanlan and Little Eva will be upgraded to reserves with a 60% conversion rate at the overall ore reserve grade. Thus the quantities of Inferred Resource converted to reserves from each pit are:

- Blackard – 73,000 t at 0.66% copper
- Scanlan – 600,000 t at 0.59% copper
- Little Eva – 265,000 t at 0.73% copper.

Note that as this ore is recovered from the existing pits there will be no additional waste mining required – in fact the quantity of waste mined will drop slightly as Inferred Resources are currently viewed as waste. This additional reserve has been added to the end of the mine life, which is strictly not accurate but a fair approximation.

**TABLE 5.14 PRODUCTION SCHEDULE USED IN ROSEBY VALUATION**

| | | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Blackard** | | | | | | | | | | | | | | | | |
| Prestrip | Mt | 0.0 | 0.0 | 3.0 | 5.3 | 4.5 | 6.7 | 6.2 | 3.8 | 3.7 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste | Mt | 0.0 | 0.0 | 0.0 | 0.7 | 1.8 | 2.4 | 4.9 | 6.4 | 5.9 | 7.6 | 5.0 | 2.5 | 2.0 | 2.0 | 1.0 |
| Oxide Ore | Mt | 0.0 | 0.0 | 0.0 | 1.5 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 2.4 | 1.0 | 0.0 | 0.0 | 0.0 |
| Cu (oxide ore) | % | 0.00 | 0.00 | 0.51 | 0.66 | 0.68 | 0.64 | 0.55 | 0.54 | 0.60 | 0.65 | 0.70 | 0.76 | 0.00 | 0.00 | 0.00 |
| Sulphide Ore | t | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 2.3 |
| Cu (Sulphide ore) | % | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.80 | 0.80 |
| **Little Eva** | | | | | | | | | | | | | | | | |
| Prestrip | t | 0.0 | 0.0 | 1.5 | 2.5 | 2.1 | 1.3 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste | t | 0.0 | 0.0 | 1.2 | 6.4 | 9.1 | 6.6 | 5.7 | 6.0 | 5.1 | 4.1 | 3.4 | 1.5 | 0.0 | 0.0 | 0.0 |
| Sulphide Ore | t | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.2 | 0.0 | 0.0 | 0.0 |
| Cu | % | 0.00 | 0.00 | 0.72 | 0.86 | 0.83 | 0.81 | 0.81 | 0.72 | 0.63 | 0.63 | 0.73 | 0.73 | 0.00 | 0.00 | 0.00 |
| Au | g/t | 0.00 | 0.00 | 0.13 | 0.11 | 0.12 | 0.13 | 0.14 | 0.14 | 0.14 | 0.13 | 0.12 | 0.12 | 0.00 | 0.00 | 0.00 |
| **Scanlan** | | | | | | | | | | | | | | | | |
| Prestrip | t | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 1.9 | 3.5 | 2.4 | 0.0 | 0.0 | 0.0 |
| Waste | t | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 6.1 | 3.4 | 0.8 | 0.0 |
| Oxide Ore | t | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.9 | 3.0 | 3.0 | 2.7 |
| Cu | % | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.65 | 0.70 | 0.71 | 0.71 |

## TREATMENT OF THE SEEP OPTION

One of the terms of the SEEP agreement with Xstrata (Section 3.2.4) is that Xstrata can earn a 51% share of the SEEP area by either a $15M exploration spend or by a $10M exploration spend and the completion of a feasibility study before 30 June 2012. Optiro is not willing to predict Xstrata's strategy with respect to the SEEP earn-in and has thus assumed three options.

- **Option 1** is that between the valuation date and 30 June 2012 Xstrata terminates the SEEP agreement – thus all ore defined within the SEEP area remains with Universal.
- **Option 2** is that Xstrata earns a 51% share of the SEEP area by fulfilling the terms of the agreement by 30 June 2012. Xstrata would thus earn the rights to 51% of the ore defined within the SEEP area. The purchase of the 51% of the RFP by Xstrata, which is a consequence of this earn in, would mean that Xstrata would incur 51% of the total cost and gain 51% of any revenue. Universal has stated that there is an intention between the parties that if the RFP option is exercised, Xstrata will reimburse to Universal 51% of all capital costs relating to plant, equipment and infrastructure at the RFP incurred by Universal prior to the RFP option being exercised. Optiro's modelling reflects this intention.
- **Option 3** is the scenario whereby Xstrata terminates the SEEP agreement before 30 June 2012 but still elects to exercise the RFP option. Since the objective of the agreement with Xstrata is for Xstrata to explore for and develop large sulphide copper orebodies, and having regard to the profile of the RFP cashflows developed for Option 1, Optiro considers it unlikely that this option will eventuate, and as such has not separately modelled it.

Currently there is no Mineral Resource or Ore Reserve defined within the SEEP area; however, based upon Optiro's viewing of SEEP core and reasonable extrapolation, it is fair to assume that there will be an Ore Reserve resulting from the SEEP drilling. By examination of the current models and knowledge of the existing SEEP holes and likely future holes, Optiro believes that the following additional Ore Reserve may conservatively be available under reasonably assumed continuity:

- Blackard – 8 Mt at 0.8% copper sulphide ore
- Scanlan – 1 Mt at 0.71% copper oxide ore, no copper sulphide ore
- Little Eva – 1.5 Mt at 0.73% copper sulphide ore.

Optiro has assumed that this ore will be mined at the end of the currently scheduled mine life.

Since this ore is largely below existing designed pits, Optiro has assumed that there will be an incremental stripping ratio of 1:1 ore to waste; in other words, for every tonne of additional ore there will be a corresponding tonne of waste mined. Optiro's DCF model reflects a 51%: 49% split of the waste mining cost and a similar split of the revenue from the ore.

### Commentary on differences between Universal and Optiro DCF assumptions

The cost inputs that were used in the Universal DFS were reviewed and modified as required based on Optiro's judgement and other work completed subsequent to the DFS. The modified input costs are shown in Table 5.15. Table 5.16 details the metallurgical recoveries that have been used in Optiro's DCF calculation for each metal and ore type. These recoveries differ slightly from those used in the DFS, but conform to recommendations made by various metallurgical consultants following a review of the DFS.

A comparison between Optiro's DCF model and the one generated by Universal was completed. The major differences are due to the following factors:

- the Universal model is a pre tax real $DCF_{8.5\%}$ compared to Optiro's post tax nominal $DCF_{13.8\%}$
- operating costs are similar, although annual cost escalations vary
- additional mining inventory has been included in the Optiro model, as discussed above

- the Optiro model includes an allowance (up to a maximum of $2M pa) for general site and administration costs
- even though Optiro's model uses lower metallurgical recoveries due to metal price differences, the total revenue remains about the same.

**TABLE 5.15 KEY COST INPUTS TO THE ROSEBY DCF MODEL**

| Capital Costs | | |
|---|---|---|
| Pre Strip | | |
| Blackard | 2.56 | $/t |
| Little Eva | 2.59 | $/t |
| Scanlan | 2.44 | $/t |
| Other Pre Production Capex | 205.0 | M$ |
| Exploration | 8.1 | M$ |
| **Operating Costs** | | |
| Waste Mining | | |
| Blackard | 2.83 | $/t |
| Little Eva | 2.90 | $/t |
| Scanlan | 3.08 | $/t |
| Ore Mining | | |
| Blackard | 3.29 | $/t |
| Little Eva | 4.57 | $/t |
| Scanlan | 5.54 | $/t |
| Processing Cost | 8.67 | $/t |
| G&A | 2.0 | $Mpa |
| Concentrate Freight | 58.22 | $/t conc |
| Copper Treatment Charges | 50.00 | USD/t conc |
| Copper Refining Charges | 0.05 | USD/lb |
| Gold Refining Charges | 4.50 | USD/oz |

**TABLE 5.16 METALLURGICAL RECOVERIES USED IN OPTIRO DCF MODELLING - ROSEBY**

| Metal | Ore Type | Recovery |
|---|---|---|
| Copper | Sulphide | 94.0% |
| Copper | Oxide | 63.0% |
| Gold | Sulphide | 80.0% |

## SUMMARY OF DCF MODELLING – PREFERRED VALUES

The results of Optiro's financial modelling of the Roseby life of mine for production from the Blackard, Scanlan and Little Eva pits are presented in Table 5.17 for the two options detailed above.

**TABLE 5.17 SUMMARY OF PREFERRED VALUES – UNIVERSAL ORE RESERVES VALUATION**

| Scenario | NPV ($M) |
|---|---|
| Option 1 – SEEP earn-in not realised; Universal accrues all value of SEEP Ore Reserves | 53.1 |
| Option 2 – Xstrata achieves SEEP earn-in; Universal accrues 49% of value of SEEP Ore Reserves and 49% of additional waste mining cost | 23.7 |

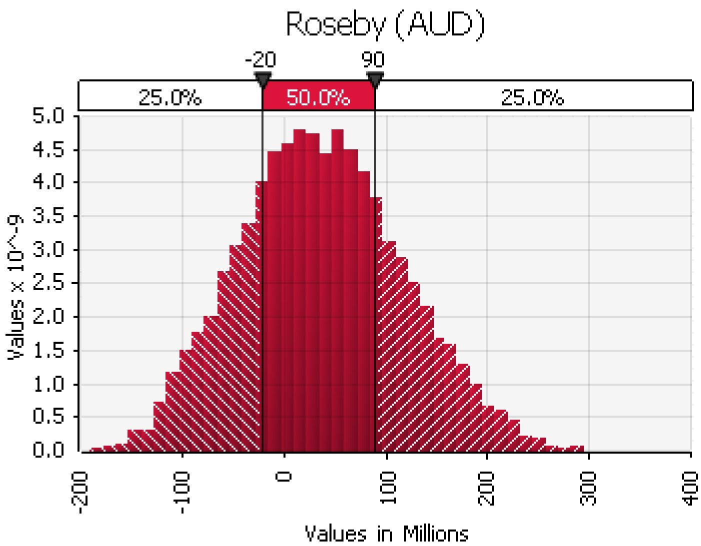
Both options provide a positive outcome for the preferred case and both options were subject to sensitivity analysis as described below.

## SENSITIVITY ANALYSIS

As described in Section 5.2.3, the Monte Carlo approach was used to provide sensitivity analysis around the preferred NPV figures of $53.1M (Option 1) and $23.7M (Option 2) for Roseby. The parameters were varied according to Table 5.6 and were the same for both Option 1 and Option 2. The range of likely values for the NPV from the Monte Carlo modelling for Option 1 is depicted in Figure 5.6. The interquartile range of these values – that is, the range of values from the bottom quarter of the distribution to the top quarter of the distribution, or the range within which half of the 10,000 possible NPV values sit – lies between $-20.1M and $90.0M. For Option 2 the corresponding range is $-13.3M to $42M. Optiro has selected the option which provides the greatest value to Universal, which is Option 1.

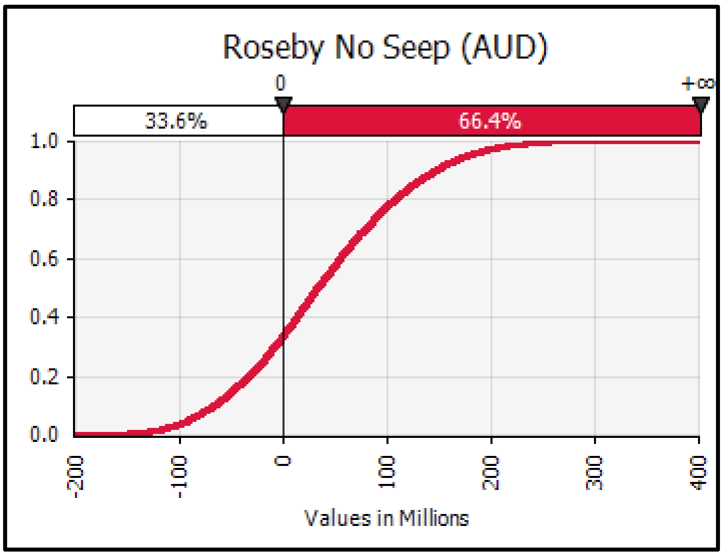
For both Options the lower range is negative, and under these circumstances the valuation reverts to that of the Roseby assets as 'failed reserves' or Mineral Resources only (Table 5.12). For the Ore Reserve valuation Optiro has thus adopted a low value of $15.0M, which is the low value of the Roseby project as a Mineral Resource. Optiro recommends the 75th percentile from the sensitivity analysis from Option 1 as the high value of the valuation – this is shown as $90.0M.

**FIGURE 5.6 RANGE OF POSSIBLE NPV VALUES, ROSEBY SENSITIVITY ANALYSIS**




The sensitivity analysis output is presented as a cumulative distribution in Figure 5.7. This format is described in Section 5.2.3 and displays the percentage of the 10,000 possible outcomes of NPV which sit below various values. It can be seen that there is a 33.6% probability that the Roseby project will have a negative NPV under the assumptions stated and input parameters as described.

**FIGURE 5.7 CUMULATIVE DISTRIBUTION OF VALUES, ROSEBY SENSITIVITY ANALYSIS**




One of the outputs from the Monte Carlo analysis provides details of which parameters the NPV calculation is most sensitive to. This information is depicted in Figure 5.8 in the form of a 'tornado' diagram. This shows which parameters have the greatest influence on the calculation of the NPV, in a positive sense (bars to the right) and in a negative sense (bars to the left). The length of the bar relates to the degree of correlation between the overall NPV and the variance due to that specific parameter. The results show that, unsurprisingly, the assumed copper price has the greatest effect on the NPV of the Roseby project, followed by the AUD:USD exchange rate. All other parameters are relatively less important, and therefore sensitivity in the main technical parameters has relatively little effect on the range of output NPV values, which are driven by the +/- 15% sensitivity in the copper price and the +/- 15% sensitivity in the exchange rate. If less sensitivity was allowed in these parameters both the low sensitivity value and the high sensitivity value would be much closer to the preferred value. Notwithstanding this, it is important to note that the sensitivity range in the copper price and exchange rate, at +/- 15%, is slightly higher than some other variables. If this sensitivity range was reduced to +/- 10%, in line with most of the other variables, the impact of the commodity price and exchange rate variables on the overall range of NPV values is virtually unchanged, as illustrated in Figure 5.9.

### SUMMARY – ROSEBY ORE RESERVE VALUATION

The Roseby valuation is summarised in Table 5.18, with the low value being obtained from the low value of the preferred value resource-only valuation (Table 5.12), the high value being the 75$^{th}$ percentile of the Monte Carlo sensitivity analysis for Option 1 and the preferred value being the base case NPV of the DCF valuation.

**FIGURE 5.8 ROSEBY VALUATION – SENSITIVITY ANALYSIS SUMMARY**

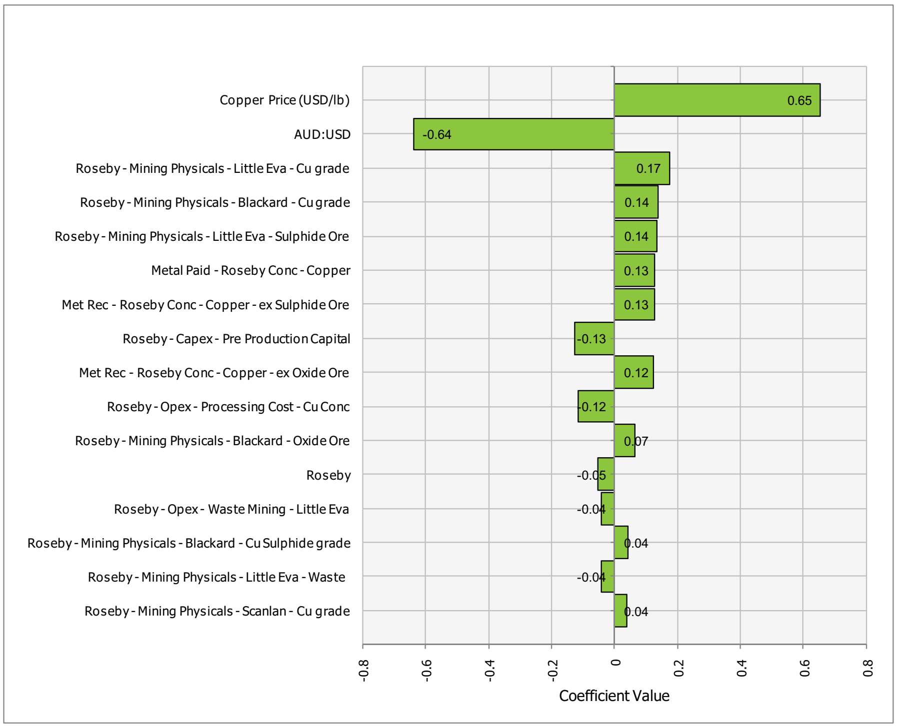



**FIGURE 5.9 ROSEBY VALUATION – SENSITIVITY ANALYSIS WITH REDUCED METAL PRICE AND EXCHANGE RATE LIMITS**

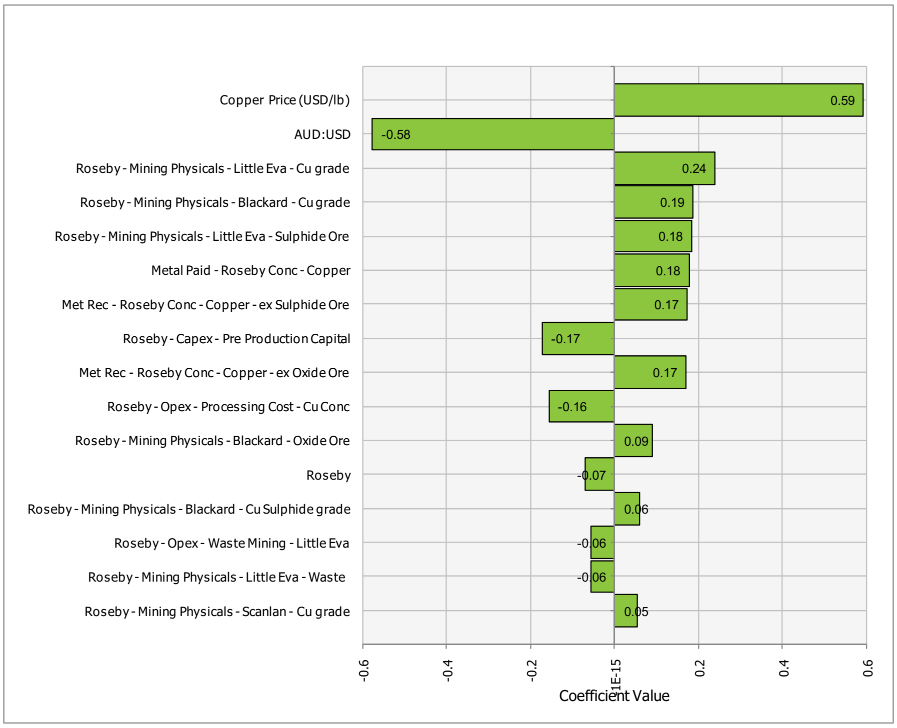



**TABLE 5.18 VALUATION OF THE ROSEBY PROJECT**

| Low value ($M) | High value ($M) | Preferred value ($M) |
|---|---|---|
| 15.0 | 90.0 | 53.1 |

#### 5.3.4. SUMMARY OF VALUATION OF THE ASSETS OF UNIVERSAL RESOURCES

In summary, the assets of Universal may be valued as shown in Table 5.19.

**TABLE 5.19 SUMMARY VALUATION OF THE ASSETS OF UNIVERSAL RESOURCES**

| Asset | Valuation | | |
|---|---|---|---|
| | Low ($M) | High ($M) | Preferred ($M) |
| Roseby Project Ore Reserves | 15.0 | 90.0 | 53.1 |
| Roseby Project additional Mineral Resources | 9.6 | 28.8 | 19.2 |
| Exploration tenements (Roseby, Queensland, New South Wales) | 5.2 | 22.4 | 13.8 |
| **Total** | **29.8** | **141.2** | **86.1** |

### 5.4. ASSETS OF VULCAN RESOURCES

#### 5.4.1. VALUATION OF EXPLORATION POTENTIAL

As with the Universal exploration areas Optiro has elected to use the Kilburn method to value Vulcan's exploration properties. As described in Section 4, Vulcan has mineral claims, which impart similar privileges to the owner as exploration licences in Australia, in the Kylylahti area (690 ha) and in the Kuhmo-Suomussalmi greenstone belt in central eastern Finland (2950 ha). The Kylylahti/Outokumpu area tenements cover either historically mined or unmined deposits of the Kylylahti/Keretti type, such as Vuonos, Hautalampi, Perttilahti and Saramäki, other deposits such as Kokka and Riihilahti, favourable serpentinite/black shale stratigraphy (Sukkula) or possible extensions of the Kylylahti deposit. As such, all of the claims may be defined as advanced exploration areas.

Vulcan's claims in the Kuhmo-Suomussalmi belt are described in Section 4.4.5 and centre around the known deposits for which Vulcan has declared resources – that is Vaara, Hietaharju, Peura-aho, Sika-aho and Arola - plus other known deposits which do not yet have a declared resource and ground along strike from the known deposits. Vulcan also has claims over areas of favourable mafic and ultramafic stratigraphy. Vulcan has been pursuing an active exploration programme over these areas and the vast majority of the claims may be termed advanced exploration areas.

As part of the Belvedere transaction Vulcan has acquired a number of mining concessions and claims in the Kotalahti and Vammala areas (Section 4.5). Almost all of these contain either existing Mineral Resources or historical resources and have thus been valued as such (Section 5.4.2). Only those tenements which are either sufficiently large to contain potential extensions to existing resources or which contain mineralisation which has not been valued elsewhere have been considered in this section.

The details of the Kilburn valuation for these claims are provided in Table 5.20. Optiro has elected not to place a value on Vulcan's reservations as these represent an early stage of exploration. The annual rental for an existing claim in Finland is EUR16.75 per ha, plus a stamp duty fee of EUR400 per claim. There is no minimum expenditure requirement for claims in Finland; thus the BAC can easily be calculated. The Kuhmo claims have been grouped into project area for ease of valuation.

The low value for the Kilburn valuation is EUR0.72M, the high value is EUR3.4M, and the preferred value is EUR2.0M. Note that this preferred valuation amounts to EUR548 per ha of claim.

In order to benchmark this number, Optiro carried out a search for related transactions. There have been few transactions executed since the start of the global downturn in Finland but one of interest features Nortec. Nortec has earned a 74% stake in the claims (2800 ha) surrounding the Kaukua property in central northeastern Finland, by spending about EUR1.9M on exploration. This is a PGE-copper-nickel rich area without a defined resource which may be termed an advanced exploration project. The implied in-ground value of the Kaukua earn-in by Nortec is EUR680 per ha of claim, which matches Optiro's estimate of Vulcan's potential quite closely, given that some of the Vulcan claims could not be termed as advanced exploration areas.

Optiro is therefore confident that the range of values for Vulcan's claims represents both a technical value and a fair market value.

**TABLE 5.20 KILBURN VALUATION FOR THE EXPLORATION POTENTIAL OF VULCAN RESOURCES**

| | | | | Equity | Off property | | On property | | Anomaly | | Geology | | Market Factor | | Valuation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Claim | Name | Area Ha | BAC | Share | Low | High | Low | High | Low | High | Low | High | Low | High | Low | High | Preferred |
| 7914/1 | Saramäki 1 | 93.68 | 1,969 € | 100% | 1.5 | 2.0 | 2.0 | 2.5 | 3.0 | 4.0 | 2.0 | 2.5 | 1.00 | 1.00 | 35,000 € | 98,000 € | 66,500 € |
| 8394/1 | Saramäki 2 | 12.9 | 616 € | 100% | 1.5 | 2.0 | 2.0 | 2.5 | 3.0 | 4.0 | 2.0 | 2.5 | 1.00 | 1.00 | 11,000 € | 31,000 € | 21,000 € |
| 7906/1 | Perttilahti 1 | 70.64 | 1,583 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 12,000 € | 47,000 € | 29,500 € |
| 7906/2 | Perttilahti 2 | 34.45 | 977 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 7,000 € | 29,000 € | 18,000 € |
| 7906/3 | Vuonos 1 | 85.5 | 1,832 € | 100% | 4.0 | 5.0 | 3.0 | 3.5 | 2.0 | 2.5 | 2.5 | 3.0 | 1.00 | 1.00 | 110,000 € | 240,000 € | 175,000 € |
| 7906/4 | Vuonos 2 | 65.2 | 1,492 € | 100% | 4.0 | 5.0 | 3.0 | 3.5 | 2.0 | 2.5 | 2.5 | 3.0 | 1.00 | 1.00 | 90,000 € | 196,000 € | 143,000 € |
| 7906/5 | Vuonos 3 | 30.1 | 904 € | 100% | 4.0 | 5.0 | 3.0 | 3.5 | 2.0 | 2.5 | 2.5 | 3.0 | 1.00 | 1.00 | 54,000 € | 119,000 € | 86,500 € |
| 8393/1 | Polvikoski 1 | 97.7 | 2,036 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.0 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 10,000 € | 61,000 € | 35,500 € |
| 8393/2 | Polvikoski 2 | 94.2 | 1,978 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.0 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 10,000 € | 59,000 € | 34,500 € |
| 8393/3 | Kylylahti 6 | 16.9 | 683 € | 100% | 3.0 | 3.5 | 1.0 | 1.5 | 2.0 | 2.5 | 2.5 | 3.0 | 1.00 | 1.00 | 10,000 € | 27,000 € | 18,500 € |
| 8525/1 | Sukkula 1 | 84.2 | 1,810 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 14,000 € | 54,000 € | 34,000 € |
| 8525/2 | Sukkula 2 | 6.75 | 513 € | 100% | 4.0 | 5.0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 1.00 | 1.00 | 4,000 € | 15,000 € | 9,500 € |
| **SUB-TOTAL** | | | | | | | | | | | | | | | **367,000 €** | **976,000 €** | **671,500 €** |
| - | Saarikylä | 586.3 | 10,221 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 5.0 | 2.0 | 2.5 | 1.00 | 1.00 | 58,000 € | 485,000 € | 271,500 € |
| - | Kiannannaiemi | 223.64 | 4,146 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 5.0 | 2.0 | 2.5 | 1.00 | 1.00 | 24,000 € | 197,000 € | 110,500 € |
| - | Huutoniemi | 242.7 | 4,465 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 4.0 | 2.0 | 2.5 | 1.00 | 1.00 | 25,000 € | 170,000 € | 97,500 € |
| - | Moisovaara | 1145.63 | 19,589 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 4.0 | 2.0 | 2.5 | 1.00 | 1.00 | 112,000 € | 744,000 € | 428,000 € |
| - | Arola-Harma N | 762.25 | 13,168 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 4.0 | 2.0 | 2.5 | 1.00 | 1.00 | 75,000 € | 500,000 € | 287,500 € |
| - | Kuhmo area | 72.05 | 1,607 € | 95% | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 3.5 | 2.0 | 2.5 | 1.00 | 1.00 | 9,000 € | 53,000 € | 31,000 € |
| **SUB-TOTAL** | | | | | | | | | | | | | | | **303,000 €** | **2,149,000 €** | **1,226,000 €** |
| 7773/1 | Vehmasjärvi | 24.2 | 805 € | 100% | 1.0 | 2.0 | 1.5 | 2.0 | 2.0 | 3.0 | 1.0 | 2.0 | 1.00 | 1.00 | 2,000 € | 19,000 € | 10,500 € |
| 7770/1 | Pihlajasalo | 25 | 819 € | 100% | 1.0 | 2.0 | 3.0 | 4.0 | 2.0 | 3.0 | 2.0 | 2.5 | 1.00 | 1.00 | 10,000 € | 49,000 € | 29,500 € |
| 7771/1 | Heiskalanmäki | 17.5 | 693 € | 100% | 1.0 | 2.0 | 3.0 | 4.0 | 2.0 | 3.0 | 2.0 | 2.5 | 1.00 | 1.00 | 8,000 € | 42,000 € | 25,000 € |
| 7739/1 | Valkeisenranta | 81.2 | 1,760 € | 100% | 4.0 | 5.0 | 1.0 | 2.0 | 2.0 | 3.0 | 2.0 | 2.5 | 1.00 | 1.00 | 28,000 € | 132,000 € | 80,000 € |
| **SUB-TOTAL** | | | | | | | | | | | | | | | **48,000 €** | **242,000 €** | **145,000 €** |
| **GRAND TOTAL** | | | | | | | | | | | | | | | **718,000 €** | **3,367,000 €** | **2,042,500 €** |

### 5.4.2. VALUATION OF MINERAL RESOURCES

#### KUHMO PROJECT

Vulcan has not formally declared any additional Mineral Resources at the Kylylahti Project outside of the main deposit itself. However, Vulcan does have a large tenement package in the Kuhmo-Suomussalmi greenstone belt (Section 4.4) for which Mineral Resources have been declared over five deposits. These comprise resources estimated by Vulcan and classified according to the JORC Code at Vaara, Hietaharju and Peura-aho and additional, historical resources at Sika-aho and Arola which Vulcan has classified according to the JORC Code. These resources are summarised in Table 5.21. The total Mineral Resource within the Kuhmo area is 11.5 Mt at 0.4% nickel, with varying quantities of the other elements. Of note is that 76% of the resources have been classified (by Vulcan) as Indicated according to the JORC Code.

**TABLE 5.21 SUMMARY OF VULCAN'S KUHMO MINERAL RESOURCES**

| Deposits | Classification | Tonnes | Nickel (%) | Copper (%) | Cobalt (%) | Palladium (g/t) | Platinum (g/t) |
|---|---|---|---|---|---|---|---|
| Vaara, Hietaharju, Peura-aho | Indicated (JORC) | 8,760,000 | 0.39 | 0.08 | 0.02 | 0.27 | 0.13 |
| | Inferred (JORC) | 1,060,000 | 0.36 | 0.09 | 0.02 | 0.31 | 0.14 |
| Sika-aho | Inferred (JORC) | 170,000 | 0.66 | 0.01 | - | - | - |
| Arola | Inferred (JORC) | 1,500,000 | 0.46 | - | - | - | - |

As with the Inferred Resources of Universal outside of the three main Roseby projects, Optiro has elected to value the above resources on the basis of an implied in-ground value per unit. One of the issues with such a valuation method is the paucity of transactions which are similar in geologic environment, mineralisation style or geographic area. Nickel sulphide deposits were one of the hardest-hit casualties of the global financial crisis and there have not been many transactions in the 18 months preceding the valuation date.

However, one transaction which is of importance is the sale of Vulcan's Haukiaho tenement to Nortec Ventures. This was a consideration for shares in Nortec, which, around the time of the valuation date, ascribed a EUR0.9M value to the project. The Haukiaho project has an historical resource of 27 Mt at a nickel grade of 0.24%, a copper grade of 0.36%, and a platinum plus palladium plus gold grade of 0.98 g/t. While the deposit's grade profile does not exactly match that of the Kuhmo deposits, which have higher nickel grades, lower copper grades and lower platinum plus palladium grades, it may be argued that the current market appetite for platinum group elements is, if anything, lower than that for nickel sulphide, and thus Haukiaho may be viewed as a reasonable benchmark for a base metal plus PGE transaction in Finland in recent times. The transaction values each tonne of in situ ore (i.e. with no allowance for recovery or conversion to reserves) at EUR3.3c.

Another company with nickel-copper-cobalt resources in Scandinavia is Blackstone Ventures, which has defined Mineral Resources in both Sweden and Norway. Blackstone has announced resource updates for most of its projects during 2009 and has a total of 22 Mt of Indicated plus Inferred Resources (21% Indicated) with grades which are broadly similar to Vulcan's Kuhmo deposits, minus the PGE credits. A calculation of the EV of the company (EUR14M at the valuation date) per in situ resource tonne reveals a value of EUR0.64. Blackstone has a large resource base and thus this valuation may be higher due to perceived operational synergies.

After consideration of these benchmark values, which relate to similar deposits in a similar geographic area and geologic environment, Optiro has formed the view that on balance, the value of Vulcan's Kuhmo assets will be between EUR6c per in situ tonne and EUR45c per in situ tonne, with a preferred value of EUR30c, due to the generally high resource confidence. This ascribes a range of values to the resources at Vulcan's Kuhmo project which are detailed in Table 5.27. It is not appropriate to convert this to a percentage of the valuation date nickel price as there is some value from the other elements, in particular the PGE.

**TABLE 5.22 VALUATION OF MINERAL RESOURCES, KUHMO REGION**

| Asset | Low value (EUR6 c/t) | High value (EUR45 c/t) | Preferred value (EUR30 c/t) |
|---|---|---|---|
| Kuhmo area Mineral Resources | EUR0.66M | EUR4.9M | EUR3.3M |

The Kuhmo values have been reduced by 5% to reflect Vulcan's 95% ownership of these assets.

## MINERAL RESOURCES IN THE KOTALATHI AND VAMMALA AREAS

As part of the Belvedere transaction Vulcan has acquired two portfolios of properties, in the Kotalahti and Vammala areas of eastern and southwestern Finland respectively (Figure 4.17). These comprise a number of declared Mineral Resources, which are summarised in Table 5.23. Optiro has elected to value these resources in a similar manner to the Kuhmo area properties, using a related transaction value. Since the relative proportions of Indicated and Inferred at Kotalahti is quite similar to the proportions at Kuhmo, Optiro has elected to use the same low, high, and preferred values per tonne as Kuhmo, that is EUR6 c/t, EUR45 c/t and EUR30 c/t respectively. The resultant range of values is shown in Table 5.24. The resources at Vammala have a much lower degree of certainty, comprising 88% Inferred, and so Optiro does not deem it appropriate to use the same range of in situ values. After due consideration, a range of values of EUR6 c/t, EUR30 c/t and EUR15 c/t have been used for the low, high and preferred values respectively (Table 5.27).

**TABLE 5.23 SUMMARY OF VULCAN'S KOTALAHTI AND VAMMALA AREA MINERAL RESOURCES**

| Region | Classification | Tonnes | Copper (%) | Nickel (%) | Cobalt (%) |
|---|---|---|---|---|---|
| Kotalahti area | Indicated (JORC) 89%<br>Inferred (JORC) 11% | 1,910,000 | 0.32 | 0.79 | 0.03 |
| Vammala area | Indicated (JORC) 12%<br>Inferred (JORC) 88% | 2,090,000 | 0.21 | 0.67 | 0.03 |

**TABLE 5.24 VALUATION OF MINERAL RESOURCES, KOTALAHTI REGION**

| Asset | Low value (EUR6 c/t) | High value (EUR45 c/t) | Preferred value (EUR30 c/t) |
|---|---|---|---|
| Kotalahti area Mineral Resources | EUR0.12M | EUR0.89M | EUR0.6M |

**TABLE 5.25 VALUATION OF MINERAL RESOURCES, VAMMALA REGION**

| Asset | Low value (EUR6 c/t) | High value (EUR30 c/t) | Preferred value (EUR15 c/t) |
|---|---|---|---|
| Vammala area Mineral Resources | EUR0.13M | EUR0.63M | EUR0.31M |

## SATELLITE DEPOSITS IN THE KYLYLAHTI AND OUTOKUMPU REGIONS

In addition to the nickel resources at Kuhmo, Vulcan has some satellite resources in the Kylylahti area, including some recently acquired via the Belvedere transaction. These are the old Vuonos deposit, which contains a resource in remnant pillars, the Hautalampi deposit, which sits up-dip of the historic Keretti mine and the unmined Riihilahti and Saramäki deposits (Section 4.3.5). Vulcan has declared a total Mineral Resource at these four deposits of 7.5 Mt at a grade of 0.7% copper, 0.1% cobalt and 0.2% Nickel (Table 5.26). Belvedere carried out a feasibility study on the Hautalampi project which resulted in the declaration of Ore Reserves. However, since Belvedere's strategy for the treatment of Hautalampi (which was for it to be the primary feed for the Luikonlahti plant) is no longer valid, many of the feasibility study assumptions are no longer valid and the parameters which led to the declaration of Ore Reserves are arguably no longer appropriate. Optiro has thus elected to value the Hautalampi deposit as a Mineral Resource, on the understanding that at some stage in the future it may provide incremental mill feed for the Luikonlahti plant.

The Kylylahti and Outokumpu area resources have an overall Measured component of 14% of the total, an Indicated component of 18% and an Inferred component of 68%, calculated on a tonnage basis.

**TABLE 5.26 SUMMARY OF VULCAN'S OUTOKUMPU AREA MINERAL RESOURCES (EXCLUDING KYLYLAHTI)**

| Deposit | Classification | Tonnes | Copper (%) | Cobalt (%) | Nickel (%) | Zinc (%) |
|---|---|---|---|---|---|---|
| | Measured (JORC) | 1,030,000 | 0.47 | 0.13 | 0.47 | - |
| Hautalampi | Indicated(JORC) | 1,230,000 | 0.30 | 0.12 | 0.42 | - |
| | Inferred (JORC) | 900,000 | 0.30 | 0.10 | 0.40 | - |
| Saramaki | Inferred (JORC) | 3,400,000 | 0.71 | 0.09 | 0.05 | 0.63 |
| Vuonos | Inferred (JORC) | 760,000 | 1.76 | 0.14 | - | 1.33 |
| Riihilahti | Indicated (JORC) | 140,000 | 1.69 | 0.04 | 0.16 | |

Optiro does not deem it appropriate to value this package using the same in situ rates as the Kuhmo resource due to the generally lower confidence material (68% Inferred versus 24% at Kuhmo). Therefore, after consideration Optiro is of the view that a range of EUR6c to EUR30c, with a preferred value of EUR20c, would be appropriate. The values derived from this range are presented in Table 5.27.

**TABLE 5.27 VALUATION OF MINERAL RESOURCES, KYLYLAHTI AND OUTOKUMPU REGION**

| Asset | Low value (EUR6 c/t) | High value (EUR30 c/t) | Preferred value (EUR20 c/t) |
|---|---|---|---|
| Kylylahti and Outokumpu area Mineral Resources | EUR0.45M | EUR2.2M | EUR1.5M |

## VALUATION OF HISTORICAL RESOURCES, KYLYLAHTI AND OUTOKUMPU REGION

In addition to the resources declared according to the JORC Code, Vulcan has, through the Belvedere transaction, acquired two deposits for which Belvedere declared historical resources. These are the Perttilahti deposit, which has been interpreted as the along strike extension of the Vuonos mine, and the Kokka deposit, which sits some 10 km northeast of the Luikonlahti plant. The Perttilahti deposit has a wide drill spacing of up to 500 m, although the quality of the data is deemed to be high by Vulcan. The Kokka deposit has been intersected by a relatively large number of drillholes (97), but these are up to 50 years old and QAQC for this data has not been sighted. Vulcan has thus declared both deposits as Exploration Targets in its market release of 16 November and has provided a range of values. The original historical resources as quoted by Belvedere are detailed in Table 5.28. Note that the Historical resources reported by Belvedere for Kokka sit outside of the range stated by Vulcan; Optiro has adopted the historical resources as originally reported.

**TABLE 5.28 HISTORICAL RESOURCES AT PERTTILAHTI AND KOKA (NOT TO JORC STANDARD)**

| Deposit | Classification | Tonnes | Copper (%) | Cobalt (%) | Nickel (%) | Zinc (%) |
|---|---|---|---|---|---|---|
| Perttilahti | Historical | 1,320,000 | 2.2 | 0.15 | 0.15 | 1.9 |
| Kokka | Historical | 2,500,000 | - | - | 0.38 | - |

Rather than introduce a range of values in addition to the high, preferred and low values, Optiro has elected to base its valuation on the original historical resources and to handle the lack of confidence through the use of discounted in situ value per tonne figures. It is important to note that these are not being reported in accordance with the JORC Code, but are being used as the basis for valuation in the absence of more rigorous figures. Optiro believes that this approach provides a more realistic outcome than a valuation on exploration potential alone.

After due consideration of the uncertainty associated with these resources, Optiro has elected to adapt the in-ground values per tonne used for Kuhmo, with a low value of EUR3 c/t, a high value of EUR10 c/t and a preferred value of EUR7 c/t. The values derived from these rates are shown in Table 5.29.

**TABLE 5.29 VALUATION OF HISTORICAL RESOURCES AT PERTTILAHTI AND KOKA**

| Asset | Low value (EUR3 c/t) | High value (EUR10 c/t) | Preferred value (EUR7 c/t) |
|---|---|---|---|
| Perttilahti and Kokka historical resources | EUR0.11M | EUR0.38M | EUR0.27M |

The valuation for the Mineral Resources and selected historical resources of Vulcan is presented in summary form in Table 5.30.

**TABLE 5.30 SUMMARY VALUATION OF MINERAL RESOURCES AND SELECTED HISTORICAL RESOURCES OF VULCAN**

| Asset | Low value (EURM) | High value (EURM) | Preferred value (EURM) |
|---|---|---|---|
| Kuhmo area Mineral Resources | 0.66 | 4.9 | 3.3 |
| Kotalahti and Vammala area Mineral Resources | 0.24 | 1.52 | 0.91 |
| Kylylahti and Outokumpu area Mineral Resources | 0.45 | 2.2 | 1.5 |
| Perttilahti and Kokka historical resources | 0.11 | 0.38 | 0.27 |
| **TOTAL** | **1.45** | **9.0** | **5.98** |

### 5.4.3. VALUATION OF ORE RESERVES

As with Universal, Optiro has valued the Ore Reserves at the Kylylahti Project by constructing a DCF model and deriving a NPV based upon reasonably justified assumptions. The most recent firm source of information was Vulcan's internal DFS review and optimisation report, published in April 2008. Since this time Vulcan has been exploring alternative processing and offtake options but none of these have been defined to a sufficiently firm level that costs can be assumed. Optiro has reviewed the input parameters to the optimised DFS and has considered the review carried out by Snowden in 2008, and has adopted certain of these on the basis that they are believed to be appropriate. Optiro has amended other input parameters following review; the details are presented below. Parameters have also been amended to suit Vulcan's new strategy, which was announced to the market on 16 November; this is to mine a high grade product from Kylylahti, truck the ore 45 km to the refurbished Luikonlahti facility which will treat between 0.5 Mtpa and 0.6 Mtpa, and generate two or three products. The products are expected to be a conventional copper-gold concentrate as per the DFS, a nickel-cobalt concentrate and a low grade zinc concentrate. However, Vulcan has announced that it is undergoing a phase of value engineering and revision of the Kylylahti DFS to incorporate the new acquisitions, which is expected to be complete early in the second quarter of 2010. There is thus a degree of uncertainty in some of Optiro's assumptions as they are no longer based upon firm DFS-level estimates. This uncertainty has been addressed by increasing the error range in the sensitivity analysis (Section 5.2.3, Section 5.4.3).

Optiro has based its technical valuation upon an amendment of Vulcan's optimised DFS case to cater for treatment at Luikonlahti. Table 5.31 summarises the key aspects of the financial model and the source of the inputs.

The model has been based on the production and sale of two concentrates, a copper gold concentrate and a bulk concentrate as detailed in Section 4.1. Although Vulcan has discussed production of three concentrates from Luikonlahti, there is little or no testwork to support firm recovery assumptions, and thus Optiro has reverted to the two concentrate scenario – a copper-gold and a bulk concentrate – which has firm recovery figures available.

**TABLE 5.31 SUMMARY OF THE DERIVATION OF COMPONENTS OF THE KYLYLAHTI DCF MODEL**

| Model component | Source of data |
|---|---|
| Mine production physicals | Revised by Optiro based upon an internal report to Vulcan to represent a high grade, lower tonnage option |
| Processing physicals | Revised processing cost to represent treatment at Luikonlahti plant and transport from Kylylahti |
| Metallurgical recoveries | Vulcan optimised DFS |
| Mine operating costs | Vulcan optimised DFS – amended based on SRK and Snowden reviews |
| Processing operating costs | Revised by Optiro to reflect Luikonlahti option |
| Copper-gold concentrate | Vulcan optimised DFS – truck and rail to Finnish smelter |
| Bulk sulphide concentrate | As per Vulcan optimised DFS |
| Pre-production capital | Reduced to exclude cost of a plant at Kylylahti and a paste fill plant |
| Total (life of mine) capital | Vulcan optimised DFS – amended for new processing scenario |
| General and administration cost | Vulcan figures, amended by Optiro |
| Commodity prices, exchange rates, discount rates, inflation rates | As advised by KPMG |
| Taxation treatment | As advised by KPMG |

One of the key assumptions which is different from Vulcan's optimised DFS case is that Optiro has assumed that the Talvivaara operation will not be ready to take concentrate for at least another 18 months to 24 months. Inherent in this assumption is that without this offtake agreement for the bulk concentrate in place project finance cannot be obtained and pre-production activities (primarily plant construction and decline advancement) cannot begin. In essence, the start of the project has been delayed for 18 to 24 months from the valuation date. This scenario may be affected by the Luikonlahti purchase, which significantly reduces the finance required by Vulcan, but in the absence of firm estimates Optiro has assumed that the delayed start-up will still be in place.

The mining physicals that form the base of the DCF model are shown in Table 5.32, which compares the schedule after the Belvedere transaction with that set out in Vulcan's optimised DFS. Essentially the new schedule represents a lower tonnage, higher grade scenario, and thus a shorter mine life. Capital and operating costs used in the model are detailed in Table 5.32.

The changes which accrue as part of the Belvedere transaction are:

- the infrastructure capital expenditure has been halved from the optimised DFS case
- the concentrator capital expenditure has been set at EUR7M, which represents Vulcan's current estimate of the refurbishment and upgrade of the Luikonlahti plant
- the TSF cost has been reduced to reflect the fact that there is a current, partly filled tailings facility next to the Luikonlahti plant which will require (at some stage in the future) an increase to the bund wall height
- all capital costs associated with the paste fill plant have been removed as Vulcan is now contemplating cemented rock fill
- the stope filling costs have been reduced by 20% to allow for the supply and placement of cemented rock fill
- the unit processing cost has been derived from Belvedere's Hautalampi feasibility study, and includes an allowance for EUR2.70/t to cover transport to Luikonlahti.

**TABLE 5.32 MINING PHYSICAL SCHEDULE, KYLYLAHTI DCF MODEL**

| | | Total | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Updated mining physicals** | | | | | | | | | | | | | | | |
| Vertical development | m | 1,500 | 125 | 300 | 300 | 300 | 300 | 150 | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| Horizontal development | m | 16,200 | 1950 | 3400 | 3275 | 3275 | 2625 | 1275 | 150 | 100 | 100 | 50 | 0 | 0 | 0 |
| Ore mined | kt | 4,268 | 90 | 340 | 525 | 550 | 565 | 555 | 520 | 495 | 434 | 194 | 0 | 0 | 0 |
| Copper grade | % | 1.6 | 1.3 | 1.4 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.5 | 1.5 | 1.6 | 0 | 0 | 0 |
| **Original (optimised DFS) mining physicals** | | | | | | | | | | | | | | | |
| Vertical development | m | 1,630 | | | 0 | 808 | 822 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Horizontal development | m | 20,611 | | | 2,450 | 2,312 | 2,667 | 2,751 | 2,745 | 2,669 | 1,247 | 1,245 | 1,245 | 1,020 | 260 |
| Ore mined | kt | 6,946 | | | 66 | 330 | 687 | 805 | 802 | 801 | 803 | 802 | 801 | 713 | 335 |
| Copper grade | % | 1.2 | | | 1.2 | 1.2 | 1.2 | 1.3 | 1.4 | 1.4 | 1.3 | 1.1 | 0.9 | 0.8 | 0.9 |

Table 5.34 and Table 5.35 detail, respectively, assumed recovery, payability, treatment charges and refining charges for the copper-gold concentrate and the bulk concentrate. These have not been changed following the Belvedere transaction; however, the bulk (nickel/zinc/cobalt) concentrate production has been delayed until the second year of operation.

It should be noted that no government royalties apply in Finland. Other aspects of the valuation that are different from Vulcan's assumptions are commodity prices, exchange rates and discount rates. Optiro's valuation is post tax and assumes a Finnish withholding tax – further details of this are provided in the document by KPMG to which this is appended.

### COMMENTARY ON DIFFERENCES BETWEEN VULCAN AND OPTIRO DCF ASSUMPTIONS

In general many of the technical parameters as described above assumed by Optiro are very similar to those adopted by Vulcan in the DFS optimisation study, apart from the introduction of the Luikonlahti plant, the absence of a paste fill plant at the mine, and the adoption of a reduced tonnage, elevated grade mining schedule. Other key differences between the valuation presented here and the Vulcan valuation relate to:

- commodity prices and in particular the price assumptions in the first few years of the project
- discount rates
- the application of taxation.

**TABLE 5.33 CAPITAL AND OPERATING COSTS USED IN KYLYLAHTI DCF MODEL**

| Capital Costs | | |
|---|---|---|
| Mobilisation / Demobilisation | 0.8 | EURM |
| Infrastructure | 9.0 | EURM |
| Concentrator | 7.0 | EURM |
| TSF | 0.8 | EURM |
| Paste Fill Plant | - | EURM |
| Mining Plant and Equipment | 6.3 | EURM |
| Boxcut | 0.5 | EURM |
| Capitalised Mining Maintenance | 1.1 | EURM |
| Vertical Development | 2,283 | EUR/m |
| Horizontal Development | 2,487 | EUR/m |
| Owners Cost | 1.2 | EUR/t |
| Contingency | 1.9 | EUR/t |
| **Operating Costs** | | |
| G&A | 4.5 | M€pa |
| Development | 2,487 | €/m |
| Stoping Cost | 11.00 | €/t ore |
| Filling Cost | 2.60 | €/t ore |
| Processing Cost - Copper Concentrate | 14.38 | €/t ore |
| Processing Cost - Bulk Concentrate | 4.30 | €/t ore |
| Freight - Copper Concentrate | 55.00 | USD/wmt |
| Secondary Processing Costs - Bulk Concentrate | 28.55 | €/t conc |
| Freight - Bulk Concentrate | 8.25 | €/t conc |

**TABLE 5.34 DETAILS OF COPPER-GOLD CONCENTRATE, KYLYLAHTI DCF MODEL**

| | Metallurgical Recovery | Payable Metal | Treatment Charge | | Refining Charges | |
|---|---|---|---|---|---|---|
| Copper | 82% | 97% | 55.00 | USD/t conc | 0.055 | USD/lb |
| Gold | 63% | 97% | 0.00 | USD/t conc | 6.00 | USD/oz |

**TABLE 5.35 DETAILS OF BULK CONCENTRATE, KYLYLAHTI DCF MODEL**

| | Initial Metallurgical Recovery | Secondary Processing Recovery | Payable Metal | Refining Charges | |
|---|---|---|---|---|---|
| Cobalt | 96% | 92% | 59% | 0.75 | USD/lb |
| Nickel | 92% | 87% | 77% | 2.4 | USD/lb |
| Zinc | 89% | 91% | 60% | 35 | % of revenue |
| Copper | 15% | 88% | 65% | 35 | % of revenue |
| Sulphur | 90% | 95% | 100% | 0 | % of revenue |
| Iron | 89% | 99% | 0% | 0 | % of revenue |

## CONVERSION OF ADDITIONAL RESOURCES AT KYLYLAHTI

As described in Section 4.3.5, the conversion of Mineral Resource to Ore Reserve at Kylylahti is very high at 93% - this is a function of the mining method and the use of stope paste fill to enable very high extraction rates. As a consequence of this Optiro believes that it is not prudent to allow for any future conversion of Mineral Resources to Ore Reserves. In its Kylylahti DFS Vulcan has not made any allowance for ongoing exploration at the project. While it is certain that the Kylylahti orebody is open at depth, the mineability, width and grade of this depth extension has yet to be determined; thus Optiro has conservatively assumed that the current Ore Reserve defines the life of mine.

In addition to the Kylylahti deposit Vulcan has recently acquired the Hautalampi deposit as part of the Belvedere transaction. While Belvedere carried out a feasibility study at Hautalampi and declared an Ore Reserve, as described in Section 5.4.2 Vulcan's options for mining and processing Hautalampi ore are wider than those of Belvedere and the ultimate production schedule and capital and operating cost framework will almost certainly be quite different to those described in the Hautalampi feasibility study. Given this uncertainty, Optiro has not elected to schedule Ore Reserves from Hautalampi and has valued the Hautalampi project as a Mineral Resource.

## SENSITIVITY ANALYSIS ON PREFERRED VALUE

As described above Monte Carlo analysis was performed on the financial model in order to give a range of values for sensitivity. The ranges and distributions of the key variables are described in Table 5.6. Figure 5.10 is a 'tornado' diagram showing the sensitivity of the Kylylahti valuation to various factors. The results show that the EUR:USD exchange rate has the greatest influence on the project, followed by mining physicals and the copper price. The effect of the uncertainty in the mining physicals reflects the fact that these values are largely conceptual until the completion of Vulcan's value engineering to suit its new mining and processing strategy in the second quarter of 2010. The uncertainty in the exchange rate and commodity price assumptions still has a strong influence on the overall project range of NPV values. To investigate the effects of uncertainty in the commercial assumptions the range of variability in these specific parameters has been reduced from +/- 15% to +/- 10%, as shown in Figure 5.11. It is clear that the sensitivity in the technical parameters (apart from the mining physicals, with their inherent uncertainty) has relatively little impact on the possible range of NPV values.

The range of possible NPV values is shown in Figure 5.12. As with Roseby, Optiro recommends the use of the upper quartile (the 75th percentile) as the high value for the valuation – in this case it is EUR79.0M. The cumulative distribution of the 10,000 NPV values from the Monte Carlo analysis is shown in Figure 5.13, which presents exactly the same data as Figure 5.12, but in a different format.

**FIGURE 5.10 KYLYLAHTI VALUATION – SENSITIVITY ANALYSIS SUMMARY**

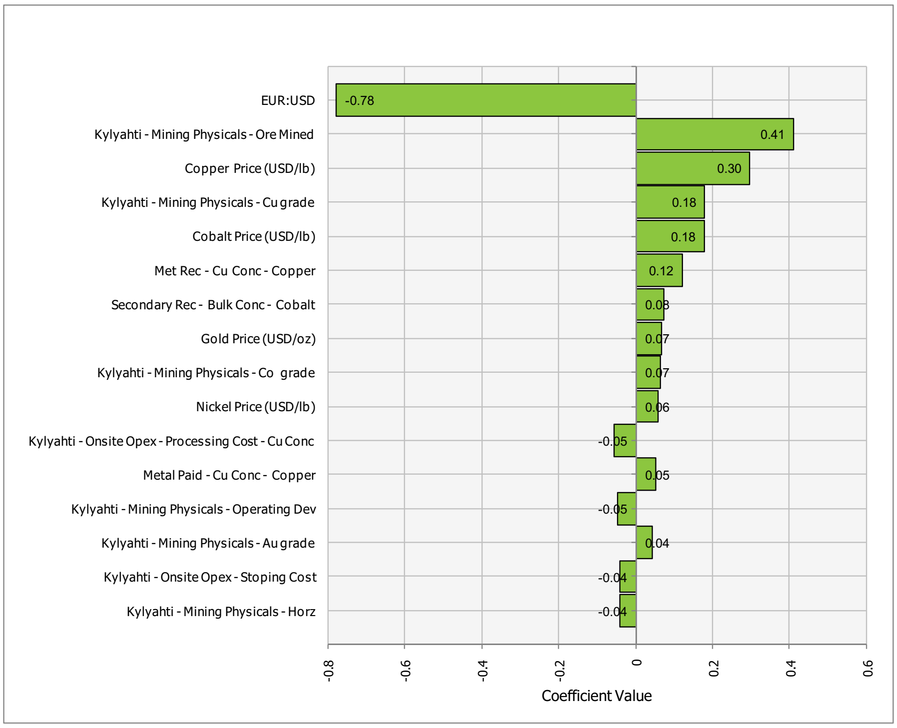


**FIGURE 5.11 KYLYLAHTI VALUATION – SENSITIVITY ANALYSIS WITH REDUCED METAL PRICE AND EXCHANGE RATE LIMITS**

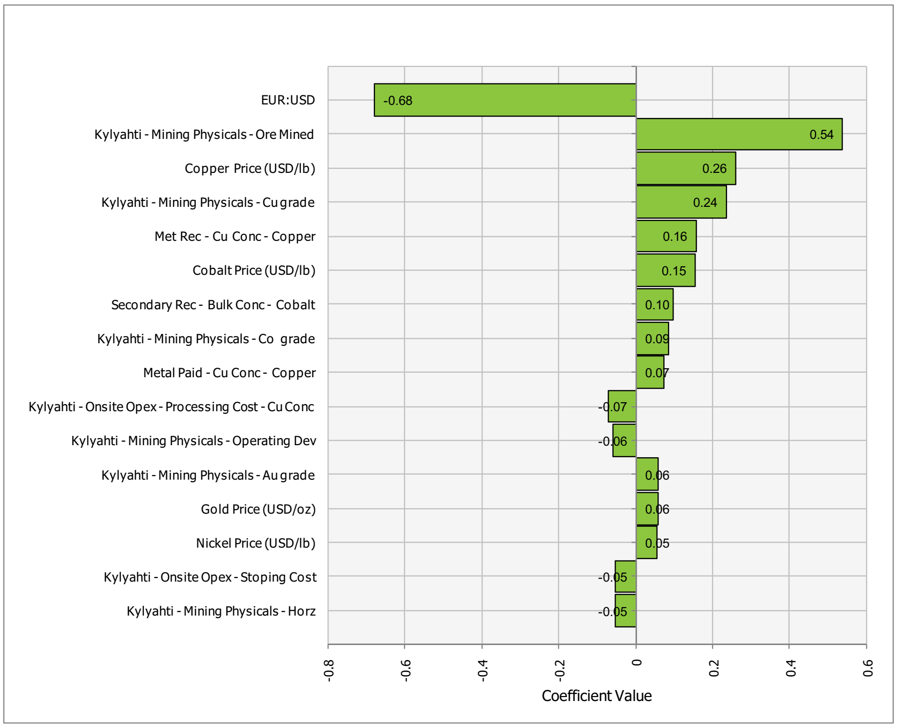



**FIGURE 5.12 RANGE OF POSSIBLE NPV VALUES, KYLYLAHTI SENSITIVITY ANALYSIS**

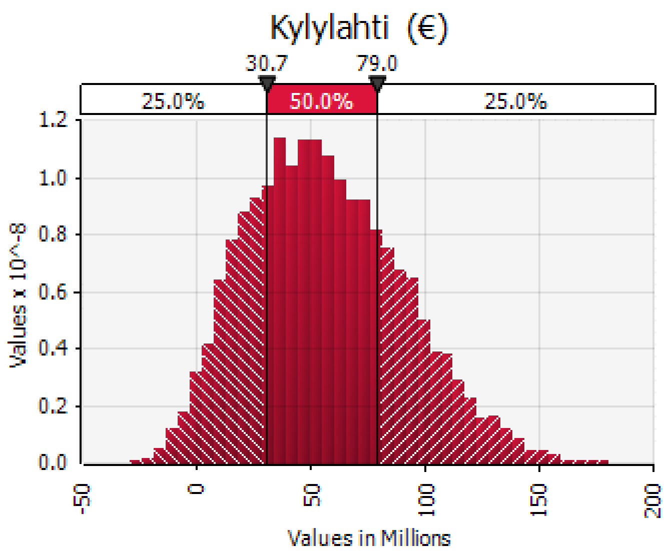
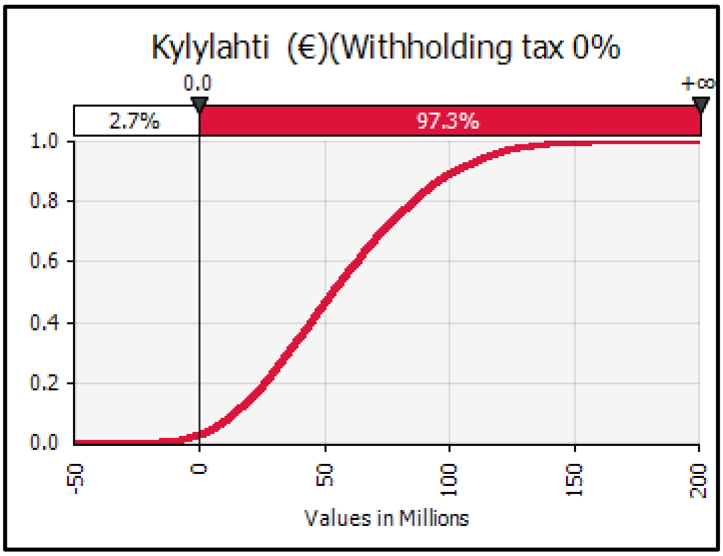


**FIGURE 5.13 CUMULATIVE DISTRIBUTION OF KYLYLAHTI NPV OUTCOMES FROM MONTE CARLO ANALYSIS**




## SUMMARY – KYLYLAHTI ORE RESERVE VALUATION

The net result of DCF modelling using the parameters described above is a base case NPV of EUR61.1M. This reflects a number of factors, namely:

- the significant reduction in capital compared to the Vulcan optimised DFS with the purchase of the Luikonlahti plant
- the absence of a paste fill plant under a new mining plan
- the inherent uncertainty built into the valuation through the use of a risk-adjusted discount rate
- the Vulcan DFS study attributed a large value to the sulphur in the bulk concentrate; this value has diminished significantly with the falling sulphur price
- lower nickel, cobalt and sulphur prices since the Vulcan DFS optimisation study.

Optiro has elected to use the base case NPV from the DCF analysis for the preferred value of the Kylylahti reserve valuation, namely EUR61.1M. The low case of the sensitivity analysis (the 25$^{th}$ percentile of the possible distribution of NPV results) is EUR30.7M and Optiro has used this value as its low value. The high case of the sensitivity analysis is the 75$^{th}$ percentile of the sensitivity analysis (EUR79.0M). These results are summarised in Table 5.36.

**TABLE 5.36 VALUATION OF THE KYLYLAHTI PROJECT**

| Low value (EURM) | High value (EURM) | Preferred value (EURM) |
|---|---|---|
| 30.7 | 79.0 | 61.1 |

## TREATMENT OF WITHHOLDING TAX IN SENSITIVITY ANALYSIS

Optiro's valuation of the Kylylahti project as set out in Table 5.36 represents a post-tax valuation at a project level and includes the benefit of current carry forward tax losses. For the purpose of KPMG's analysis of Vulcan as a corporate entity, Optiro has, at the request of KPMG, included various scenarios in relation to Finnish withholding tax and existing carry forward tax losses in its Monte Carlo sensitivity analysis. These scenarios comprised:

- inclusion of both Finnish withholding tax on repatriated funds at a rate of 28% and existing tax losses – Scenario 1
- exclusion of both withholding tax and carry forward tax losses. – Scenario 2.

The outcome of this analysis is shown in Table 5.37.

**TABLE 5.37 TREATMENT OF WITHHOLDING TAX AND EXISTING TAX LOSSES**

| Withholding tax rate | Low (25th percentile) | | High (75th percentile) | |
|---|---|---|---|---|
| | Before tax NPV – Scenario 2 (EURM) | After tax NPV – Scenario 1 (EURM) | Before tax NPV – Scenario 2 (EURM) | After tax NPV – Scenario 1 (EURM) |
| 28% | 27.7 | 13.3 | 76.2 | 50.4 |

### 5.4.4. SUMMARY OF VALUATION OF THE ASSETS OF VULCAN RESOURCES

Table 5.38 is a summary of the various components of the valuation of the assets of Vulcan. As discussed above, Optiro's valuation of Kylylahti does include Finnish taxation but does not include the effects of Finnish withholding tax.

**TABLE 5.38 SUMMARY VALUATION OF THE ASSETS OF VULCAN RESOURCES**

| Asset | Valuation | | |
|---|---|---|---|
| | Low (EURM) | High (EURM) | Preferred (EURM) |
| Kylylahti Project Ore Reserves | 30.7 | 79.0 | 61.1 |
| Mineral Resources in the Kuhmo, Kylylahti, Outokumpu, Kotalahti and Vammala areas | 1.4 | 9.0 | 6.0 |
| Exploration tenements (Kylylahti, Outokumpu area, Kuhmo and Kotalahti) | 0.7 | 3.4 | 2.0 |
| **Total** | **32.8** | **91.4** | **69.1** |

# 6. DECLARATIONS BY OPTIRO PTY LTD

## 6.1. INDEPENDENCE

Optiro Pty Ltd is a consulting organisation which provides specialist technical and financial services to clients within the minerals industry. Optiro operates out of its head office in Perth, Western Australia. Its services include resource estimation mining engineering, technical audits, due diligence reviews, independent valuation, optimisation and simulation studies and a wide range of transaction related services.

This report has been prepared in accordance with the VALMIN and JORC Codes of the AusIMM. The authors declare that they do not hold any interest in Vulcan Resources Limited or Universal Resources Limited, its associated parties or any of the mineral properties described in this report. Optiro declares that it has not provided strategic planning advice either to Vulcan Resources Limited or Universal Resources Limited nor specifically provided advice in relation to the terms of the proposed merger between Vulcan and Universal. Optiro is aware that KPMG will rely upon its independent mineral specialist report (this document) in the preparation of its independent expert's report and consents to the attachment of this report to that document.

Optiro is receiving a fee for this work, the magnitude of which is unrelated to the outcome of the proposed merger.

## 6.2. QUALIFICATIONS

The principal authors of this report are Mr Ian Glacken, Mr Wayne Ghavalas and Mr Karl van Olden.

Mr Ian Glacken (BSc (Hons), MSc Mining Geology, MSc Geostatistics, Grad. Dip. Computing, FAusIMM(CP), CEng, MIMMM, DIC) is a geologist with over 28 years experience in the international mining industry since graduation. He has worked for WMC Resources for 16 years, the Snowden Group for 10 years, and Optiro since its inception in September 2008.

Mr Wayne Ghavalas (BSc (Eng, Mining), Graduate Diploma in Applied Finance and Investment, MAusIMM) is a Mining Engineer with 15 years experience. He has worked in mining operations in South Africa and Australia, as Mine Planning Superintendent at Broken Hill, as a Senior Consultant for the Snowden Group and is currently a Consultant at Optiro.

Mr Karl van Olden (BSc (Eng, Mining), Graduate Diploma in Engineering, MBA, MAusIMM) is a Mining Engineer with 16 years worldwide experience in the mining industry. He has worked in operations and in mine planning, as Manager Mine Planning at the South Deep Gold Mine in South Africa, as Mine Planning Superintendent at Nickel West for BHP Billiton and as a Principal Consultant for the Snowden Group. He is currently Principal Mining Consultant at Optiro.

The principal reviewer for this report was Mr Mark Warren, who is Principal at Optiro.

## 6.3. LEGAL STATUS OF TENEMENTS

Optiro has not independently verified the legal status of the tenements of either Universal Resources Ltd or Vulcan Resources Ltd, but has rather relied upon legal due diligence of the Universal tenements commissioned by Vulcan and upon a certificate of tenement status produced by the Finnish Department of Mines in regard to the tenements of Vulcan.

## 6.4. PREVIOUS WORK

Optiro was not involved in setting the terms of the proposed transaction with Universal nor has it provided advice of a strategic nature to either Vulcan or Universal in relation to the proposed transaction.

### 6.4.1. PREVIOUS WORK CARRIED OUT FOR VULCAN RESOURCES

Optiro has carried out a number of assignments for Vulcan since inception. Most of these relate to brief technical reviews of potential asset acquisitions by Vulcan, none of which proceeded. The only work which Optiro has carried out for Vulcan in respect to Universal is a technical due diligence of the assets of Universal which immediately preceded the agreement with Vulcan to pursue a potential merger. Optiro also carried out a brief assignment for Vulcan on the Kylylahti project which involved a review of the existing mining schedule. Optiro has carried out no strategic work for Vulcan in respect to either Universal or the assets of Vulcan Individual authors of this report have in the last two years carried out work for Vulcan while employees of other companies. This work was an independent technical review of the Kylylahti Feasibility Study which was issued by Snowden Mining Industry Consultants Pty Ltd in October 2008, for which Mr Ian Glacken and Mr Karl van Olden were contributing authors.

Optiro has received fees from Vulcan over the last two years of approximately $100,000, which is not material to Optiro’s business.

### 6.4.2. PREVIOUS WORK CARRIED OUT FOR UNIVERSAL RESOURCES

Optiro has carried out no previous work for Universal.

# 7. SOURCES OF INFORMATION

## 7.1. UNIVERSAL RESOURCES

An overview of Universal Resources and the Roseby Copper Project, internal Universal document, August 2009.

McCullough Robertson, Legal opinion – tenement report, report prepared for Vulcan Resources, September 2009.

Queensland Environmental Protection Agency – Assessment report on the Environmental Impact Statement for the Roseby Copper Project proposed by Universal Resources Limited, July 2008.

Roseby Copper Project – Technical Due Diligence, Optiro report for Vulcan, September 2009.

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## 7.2. VULCAN RESOURCES

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Hautalampi Ni-Co-Cu Project, Feasibility Study, Finn Nickel Oy, May 2009.

Kuhmo Nickel Status Report, internal Vulcan document, September 2009.

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Kylylahti Copper Project Mining Feasibility Study, SRK Consulting, March 2008.

Management discussion and analysis for the year ending 31/12/2008, Belvedere Resources.

Perttilahti copper-zinc-cobalt deposit, Kontinen et al, GEOMEX final report, 25 January 2006.

Project Close-out Report, Kylylahti Copper Oy, October 2008.

Property portfolio of Suomen Nikkeli Oy, NI43-101 Technical Report produced for Belvedere Resources, October 2006.

Redesign of the Kylylahti Copper Project underground mine, internal report from Piran Mining for Vulcan, November 2009.

Review of Kylyahti Feasibility Study, Snowden report for Vulcan, October 2008.

Various Vulcan market presentations.

NI43-101 Technical Report for the Hautalampi deposit, revised December 15 2008.

## 7.3. VALUATION REFERENCE

Independent Valuation of the Mineral Assets of Territory Resources Limited, Snowden public report, July 2007.

# APPENDIX A TENEMENT SCHEDULE - UNIVERSAL

| Project | Tenement Name | Tenement ID | Date granted | Expiry date | Area (km2) | Annual rent (AUD) | Expenditure commitment | Universal interest |
|---|---|---|---|---|---|---|---|---|
| Roseby Copper Project | Mt Roseby | EPM 8506 | 26/11/2008 | 25/11/2010 | 112.8 | 6,833.69 | 150,000.00 | 100% |
| Roseby Copper Project | Pinnacle | EPM 9056 | 29/10/2006 | 28/10/2008 | 12.9 | 6,729.29 | 55,000.00 | 100% |
| Roseby Copper Project | Highway | EPM 10266 | 1/01/2008 | 31/12/2009 | 258.0 | 11,621.83 | 60,000.00 | 100% |
| Roseby Copper Project | Cameron | EPM 10833 | 1/01/2008 | 31/12/2009 | 292.7 | 13,078.23 | 30,000.00 | 100% |
| Roseby Copper Project | Ogorilla | EPM 11004 | 1/01/2008 | 31/12/2009 | 80.4 | 8,339.83 | 40,000.00 | 100% |
| Roseby Copper Project | Lilliput | EPM 13249 | 20/03/2009 | 19/03/2011 | 32.2 | 7,445.69 | 10,000.00 | 100% |
| Roseby Copper Project | Roseby Infill | EPM 14535 | 28/02/2005 | 27/02/2010 | 138.3 | 10,387.63 | 70,000.00 | 100% |
| Roseby Copper Project | Bannockburn | EPM 14363 | 20/04/2005 | 19/04/2010 | 61.3 | 8,204.45 | 15,000.00 | 100% |
| Roseby Copper Project | Corella | EPM 14365 | 21/04/2005 | 20/04/2010 | 147.8 | 11,157.28 | 80,000.00 | 100% |
| Roseby Copper Project | Murrumba | EPM 14545 | 21/07/2005 | 20/07/2010 | 48.2 | 7,052.88 | 15,000.00 | 100% |
| Roseby Copper Project | Coolullah | EPM 14556 | 22/09/2005 | 21/09/2010 | 61.4 | 7,582.48 | 90,000.00 | 100% |
| Roseby Copper Project | Gulliver | EPM 11611 | 9/03/2006 | 8/03/2011 | 29.0 | 6,258.48 | 58,340.00 | 100% |
| Roseby Copper Project | Guilliver East | EPM 12121 | 9/03/2006 | 8/03/2011 | 9.7 | 5,464.08 | 10,000.00 | 100% |
| Roseby Copper Project | Queen Sally | EPM 12492 | 9/03/2006 | 8/03/2011 | 41.9 | 6,788.08 | 58,340.00 | 100% |
| Roseby Copper Project | Quamby | EPM 12493 | 13/03/2006 | 12/03/2011 | 19.3 | 5,861.28 | 58,340.00 | 100% |
| Roseby Copper Project | Cabbage Tree | EPM 12529 | 13/03/2006 | 12/03/2011 | 25.8 | 2,126.08 | 156,666.00 | 100% |
| Roseby Copper Project | River Gum | EPM 14822 | 10/04/2006 | 9/04/2011 | 35.5 | 2,486.23 | 55,000.00 | 100% |
| | | | | | | | | |
| Queensland Regional | Cameron River | EPM 8059 | 14/10/2008 | 13/10/2010 | 112.6 | 10,728.88 | 70,000.00 | 100% |
| Queensland Regional | Happy Valley | EPM 9611 | 26/08/2006 | 25/08/2008 | 38.5 | 4,561.60 | 30,000.00 | 100% |
| Queensland Regional | Mt Angelay | EPM 14371 | 27/06/2005 | 26/06/2010 | 28.9 | 8,164.40 | 18,000.00 | 100% |
| Queensland Regional | Malbon Vale | EPM 14362 | 5/07/2005 | 4/07/2010 | 80.2 | 8,376.88 | 100,000.00 | 100% |
| Queensland Regional | Mt Malakoff | EPM 14415 | 2/08/2008 | 1/08/2010 | 67.2 | 7,991.75 | 20,000.00 | 100% |
| Queensland Regional | Spider | EPM 14367 | 21/07/2005 | 20/07/2010 | 80.5 | 8,376.88 | 20,000.00 | 100% |
| Queensland Regional | Malakoff | EPM 14370 | 21/07/2005 | 20/07/2010 | 70.8 | 7,979.68 | 20,000.00 | 100% |
| Queensland Regional | Bushy Park | EPM 14366 | 21/07/2005 | 20/07/2010 | 192.1 | 13,010.88 | 40,000.00 | 100% |
| Queensland Regional | Dronfield | EPM 14369 | 22/09/2005 | 21/09/2010 | 83.2 | 14,380.78 | 72,000.00 | 100% |
| | | | | | | | | |
| NSW | Burra | EL 5692 | 9/04/2008 | 6/02/2010 | 38.0 | - | 46,000.00 | 90% |

# APPENDIX B TENEMENT SCHEDULE – VULCAN

| Project | Tenement Name | Tenement ID | Holder | Date granted | Expiry date | Area (km2) | Vulcan interest |
|---|---|---|---|---|---|---|---|
| **Kylylahti** | Kylylahti | 3593/1a | Kylylahti Copper Oy | 1993 | | 0.9196 | 100% |
| | Kylylahti | 3593/1b | Kylylahti Copper Oy | 2003 | | 0.1222 | 100% |
| | Kylylahti 2 | 3593/2a | Kylylahti Copper Oy | 2003 | | 0.0992 | 100% |
| | Kylylahti ML extension | 3593/1c | Kylylahti Copper Oy | 5/09/2007 | | 0.6662 | 100% |
| | Saramäki 1 | 7914/1 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.9368 | 100% |
| | Perttilahti 1 | 7906/1 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.7064 | 100% |
| | Perttilahti 2 | 7906/2 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.3445 | 100% |
| | Vuonos 2 | 7906/4 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.6524 | 100% |
| | Vuonos 3 | 7906/5 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.301 | 100% |
| | Vuonos 1 | 7906/3 | Kylylahti Copper Oy | 10/02/2005 | 31/12/2009 | 0.8547 | 100% |
| | Polvikoski 1 | 8393/1 | Kylylahti Copper Oy | 26/11/2008 | 26/11/2013 | 0.977 | 100% |
| | Polvikoski 2 | 8393/2 | Kylylahti Copper Oy | 26/11/2008 | 26/11/2013 | 0.942 | 100% |
| | Kylylahti 6 | 8393/3 | Kylylahti Copper Oy | 26/11/2008 | 26/11/2013 | 0.169 | 100% |
| | Saramäki 2 | 8394/1 | Kylylahti Copper Oy | 20/11/2008 | 20/11/2013 | 0.801 | 100% |
| | Sukkula 1 | 8525/1 | Kylylahti Copper Oy | 26/02/2009 | 26/02/2014 | 0.8419 | 100% |
| | Sukkula 2 | 8525/2 | Kylylahti Copper Oy | 26/02/2009 | 26/02/2014 | 0.0675 | 100% |
| | | | | | | | |
| **Luikonlahti** | Kaavi, Luikonlahti | 553/1 | Kylylahti Copper Oy | | 18/04/2011 | 0.0817 | 100% |
| | Kaavi, Petkel I, II | 1281/1 | Kylylahti Copper Oy | | 18/04/2011 | 0.017 | 100% |
| | Kaavi, Petkellahti | 2061/1 | Kylylahti Copper Oy | | 18/04/2011 | 0.0615 | 100% |
| | Kaavi, Kokka | 8131/1 | Kylylahti Copper Oy | | 20/10/2011 | 0.039 | 100% |
| | | | | | | | |
| **Outokumpu** | Hautalampi | Various | Vulcan Hautalampi Oy | | 31/12/2009 | 0.287 | 100% |
| | Riihilahti | 7975/1a | Kylylahti Copper Oy | | 3/05/2012 | 0.041 | 100% |
| | KokonVaara | 7976/1 | Kylylahti Copper Oy | | 27/07/2010 | 0.043 | 100% |
| | Perttilahti | 7976/2 | Kylylahti Copper Oy | | 27/07/2010 | 0.0779 | 100% |
| | | | | | | | |
| **Kuhmo Joint Venture** | ***Saarikylä belt*** | | | | | | 95% |
| | Kotisuo | 8049/1 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.2505 | 95% |
| | Kauniinlampi | 8049/2 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.8894 | 95% |
| | Hoikkalampi | 8049/3 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.8402 | 95% |
| | Rytys | 8049/4 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.9105 | 95% |
| | Vaara North | 8049/5 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.3768 | 95% |
| | Hoikka | 8396/1 | Kuhmo Metals Oy | 25/11/2008 | 25/11/2013 | 0.833 | 95% |

| Project | Tenement Name | Tenement ID | Holder | Date granted | Expiry date | Area (km2) | Vulcan interest |
|---|---|---|---|---|---|---|---|
| | Hakovaara | 8618/1 | Kuhmo Metals Oy | 6/04/2009 | 6/04/2014 | 0.933 | 95% |
| | Vaara West | 8602/1 | Kuhmo Metals Oy | 26/02/2009 | 26/02/2014 | 0.8295 | 95% |
| **Kuhmo Joint Venture** | ***Kiannanniemi*** | | | | | | 95% |
| | Peura-aho | 7922/1 | Kuhmo Metals Oy | 16/03/2005 | 16/03/2010 | 0.6429 | 95% |
| | Peura-aho North | 8033/3 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.1233 | 95% |
| | Peura-aho East | 8033/1 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.0703 | 95% |
| | Peura-aho NE | 8033/2 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.1015 | 95% |
| | Peura-aho SW | 8033/5 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.0834 | 95% |
| | Peura-aho South | 8033/4 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.188 | 95% |
| | Myllyaho 1 | 8618/3 | Kuhmo Metals Oy | 6/04/2009 | 6/04/2014 | 0.944 | 95% |
| | Myllyaho 2 | 8618/4 | Kuhmo Metals Oy | 6/04/2009 | 6/04/2014 | 0.083 | 95% |
| **Kuhmo Joint Venture** | ***Huutoniemi*** | | | | | | 95% |
| | Huutoniemi 1 | 8476/1 | Kuhmo Metals Oy | 24/02/2009 | 24/02/2014 | 0.2051 | 95% |
| | Huutoniemi 2 | 8476/2 | Kuhmo Metals Oy | 24/02/2009 | 24/02/2014 | 0.9044 | 95% |
| | Huutoniemi 3 | 8476/3 | Kuhmo Metals Oy | 24/02/2009 | 24/02/2014 | 0.9579 | 95% |
| | Huutoniemi 4 | 8476/4 | Kuhmo Metals Oy | 24/02/2009 | 24/02/2014 | 0.3597 | 95% |
| **Kuhmo Joint Venture** | ***Moisiovaara*** | | | | | | 95% |
| | Luokkivaara | 8047/4 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 1 | 95% |
| | Luokkipuro | 8055/1 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.7388 | 95% |
| | Hyyrylainen | 8055/2 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.1304 | 95% |
| | Sika-aho | 8049/7 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.9245 | 95% |
| | Paatola | 8049/8 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.3698 | 95% |
| | Likosuo | 8049/9 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.9998 | 95% |
| | Karsikkosuo | 8049/10 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.6045 | 95% |
| | Lehdonmaa | 8049/11 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.2692 | 95% |
| | Harju | 8049/12 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.1911 | 95% |
| | Yhteisenaho | 8049/13 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.3374 | 95% |
| | Selkajarvi | 8049/14 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.9744 | 95% |
| | Kaartilanvaara | 8049/15 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.6481 | 95% |
| | Kaivolampi | 8049/16 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.1303 | 95% |
| | Paatolaislampi | 8049/17 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.345 | 95% |
| | Kinnula | 8233/1 | Kuhmo Metals Oy | 5/07/2007 | 5/07/2012 | 0.401 | 95% |
| | Kupusenkangas | 8233/2 | Kuhmo Metals Oy | 5/07/2007 | 5/07/2012 | 0.6 | 95% |
| | Metsälä | 8242/6 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.365 | 95% |
| | Viima-aho | 8242/4 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.515 | 95% |
| | Rinneaho | 8242/5 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.946 | 95% |

| Project | Tenement Name | Tenement ID | Holder | Date granted | Expiry date | Area (km2) | Vulcan interest |
|---|---|---|---|---|---|---|---|
| | Kemppaanlehto | 8242/3 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.967 | 95% |
| **Kuhmo Joint Venture** | ***Arola - Harma North*** | | | | | | 95% |
| | Hautalehto 1 | 7457/1 | Kuhmo Metals Oy | 12/11/2008 | 14/10/2010 | 0.216 | 95% |
| | Korkea-aho | 7457/4 | Kuhmo Metals Oy | 12/11/2008 | 14/10/2010 | 0.5211 | 95% |
| | Arola | 7923/1 | Kuhmo Metals Oy | 16/03/2005 | 16/03/2010 | 0.542 | 95% |
| | Arola South | 8047/1 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.47 | 95% |
| | Palovaara South | 8047/2 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.129 | 95% |
| | Tiikkaja-aho | 8047/3 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.204 | 95% |
| | Kelosuo South | 8043/1 | Kuhmo Metals Oy | 7/11/2005 | 7/11/2010 | 0.41 | 95% |
| | Karhujarvi | 8049/18 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.996 | 95% |
| | Palovaara | 8049/19 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.9252 | 95% |
| | Putkisuo | 8049/20 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.8309 | 95% |
| | Kelosuo | 8049/21 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.4733 | 95% |
| | Pitkaaho | 8049/22 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.755 | 95% |
| | Antinaho | 8242/2 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.481 | 95% |
| | Nyberginlehto | 8242/1 | Kuhmo Metals Oy | 9/07/2007 | 9/07/2012 | 0.453 | 95% |
| | Korkea-aho 2 | 8500/1 | Kuhmo Metals Oy | 23/02/2009 | 23/02/2014 | 0.1198 | 95% |
| | Korkea-aho 3 | 8500/2 | Kuhmo Metals Oy | 23/02/2009 | 23/02/2014 | 0.0962 | 95% |
| **Kuhmo Joint Venture** | ***Kuhmo Area*** | | | | | | 95% |
| | Siivikkovaara | 8055/3 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.1472 | 95% |
| | Niemenkyla | 8055/4 | Kuhmo Metals Oy | 2/11/2005 | 2/11/2010 | 0.3356 | 95% |
| | Riihilampi | 8049/24 | Kuhmo Metals Oy | 3/11/2005 | 3/11/2010 | 0.2377 | 95% |
| **Kuhmo Joint Venture** | ***Tulikivi Oyj*** | | | | | | |
| | Savelahti | 7871/1 | Tulikivi Oyj | 8/11/2004 | 8/11/2009 | 0.037 | 95% |
| **Vammala area** | Mäntymäki | 4099/1a | Vulcan SW Finland Oy | | 16/9/2009 | 0.00802 | 100% |
| | Hyvelä | 2891/1a | Vulcan SW Finland Oy | | 30/03/2010 | 0.00935 | 100% |
| | Sahakoski | 2928/1a | Vulcan SW Finland Oy | | 30/3/2010 | 0.00934 | 100% |
| **Kotalahti area** | Särkiniemi | 6977/1a | Vulcan Kotalahti Oy | | 25/04/2015 | 0.04749 | 100% |
| | Niinimäki | 7801/1 | Vulcan Kotalahti Oy | | 18/06/2009 | 0.0087 | 100% |
| | Phlajasalo | 7770/0 | Vulcan Kotalahti Oy | | 25/3/2009 | 0.01121 | 100% |
| | Heiskalanmäki | 7771/1 | Vulcan Kotalahti Oy | | 25/3/2009 | 0.025 | 100% |
| | Vehmasjärvi | 7773/1 | Vulcan Kotalahti Oy | | 25/3/2009 | 0.0175 | 100% |
| | Valkeisenranta | 7739/1 | Vulcan Kotalahti Oy | | 31/12/2009 | 0.0812 | 100% |

| Project | Tenement Name | Tenement ID | Holder | Date granted | Expiry date | Area (km2) | Vulcan interest |
|---|---|---|---|---|---|---|---|
| | Sarkalahti | 8167/1 | Vulcan Kotalahti Oy | | 30/10/2011 | 0.012 | |

# APPENDIX C GLOSSARY OF TECHNICAL TERMS

# GLOSSARY OF TECHNICAL TERMS

| Term | Explanation |
| --- | --- |
| Abbreviations and acronyms | % - Percentage |
| | 3D – three dimensional |
| | AC – Aircore drilling |
| | AUDM – Millions of Australian Dollars |
| | BAC – Base Acquisition Cost |
| | Capex – capital expenditure |
| | DCF – Discounted cashflow |
| | DD – Diamond drilling |
| | DFS – Definitive Feasibility Study |
| | dmt – dry metric tonnes |
| | EM – electromagnetic |
| | EPCM – Engineer, procure, contract and maintain |
| | EPM – an exploration licence in Queensland, Australia |
| | EUR – Euro |
| | EURM – Millions of Euros |
| | EV – Enterprise Value |
| | FY – Financial year |
| | G&A – General and administration costs |
| | Ga – 1 billion years (109 years) |
| | GDP – Gross Domestic Product |
| | GNP – Gross National Product |
| | GPS – Global Positioning System |
| | GTK – Finnish Geological Survey |
| | ha - hectare |
| | IP – induced polarisation |
| | JV – joint venture |
| | km – kilometre |
| | $km^2$ – square kilometres |
| | kt – kilotonnes |
| | ktpa – kilotonnes per annum |
| | kW – kilowatts |
| | kWh – kilowatt hours |
| | kWh/t – kilowatt hours per tonne |
| | lb – pound |
| | LOM – life of mine |
| | m – metre |
| | M – million |
| | $m^3$ – cubic metres |
| | Mbcm – million bank cubic metres |
| | ML – megalitres or mining lease |
| | MLA – a mining licence application in Queensland, Australia |
| | mm – millimetres |
| | MMI – mobile metal ion |
| | mRL – metres reduced level |
| | Mt – million tonnes |
| | Mtpa – million tonnes per annum |
| | MW – megawatts |
| | NPV – Net Present Value |
| | ppm – parts per million |
| | RAB – Rotary Air Blast drilling |
| | RC – Reverse Circulation drilling |
| | ROM – Run of mine |
| | RQD – rock quality designation |
| | SAG – semi-autogenous grinding |
| | t – tonnes |
| | tpa – tonnes per annum |
| | tph – tonnes per hour |
| | TSF – Tailings Storage Facility |
| | USD – United States Dollar |

| Term | Explanation |
|---|---|
| | VTEM – (Airborne) Virtual Time Domain Electromagnetic (see below) |
| acid heap leach | Metallurgical process using sulphuric acid to extract metal from ore. |
| Acquire | Geological database. |
| actinolite | A metamorphic ferromagnesian mineral. |
| aeromagnetic | An airborne magnetic survey. |
| airborne magnetic survey | A measurement of the magnetic susceptibility of rocks, measured from a plane in flight. |
| Airborne Versatile Time-Domain Electromagnetic | An airborne geophysical method for measuring the change in electric potential of rocks on the ground. |
| albite | An alkali feldspar mineral. It is the sodium end member of the plagioclase solid solution series. |
| alluvial gold | An accumulation of alluvium (sediment), sometimes containing gold in the bed or former bed of a river. |
| alteration | A change in mineralogical composition of a rock through reactions with hydrothermal fluids, temperature or pressure changes. |
| amphibolite | A rock composed largely of amphibole and other similar minerals |
| amphibolite facies | Moderate to high temperature and low pressure regional metamorphic facies. Characterized by the presence of amphibole. |
| anisotropy | The property of having different values in differing directions. |
| anticline | A fold shaped like an arch. |
| apatite | A group of phosphate minerals, usually referring to hydroxylapatite, fluorapatite, and chlorapatite. |
| Archaean | Era of the geological time scale within the Precambrian aeon containing rocks greater than 2500 million years old. |
| argillite | A compact rock, derived from either mudstone or shale that has undergone a higher degree of induration but is less clearly laminated than slate. |
| arsenopyrite | Most common arsenic mineral and principal ore of arsenic. |
| artisanal mining | Surface and sometimes underground mining carried out by unlicensed, generally illegal, local inhabitants, generally with minimal technology. |
| autoclave | A strong closed vessel for carrying out chemical reactions under high pressure and/or temperature. |
| autogenous grinding | Rock comminution without the use of an external grinding medium such as a ball or a rod. |
| backfill | Waste rock, gravel, sand or tailings used as a support in stopes after the removal of ore. |
| ball mill | A rotating horizontal steel cylinder loaded with steel balls which grind the ore to a fine powder. |
| banded iron formation | Iron formation that shows banding, generally of iron-rich minerals and chert or fine-grained quartz. |
| bar | A unit of pressure (1 bar = 0.1 Mega Pascal) |
| basalt | A fine grained igneous rock consisting mostly of plagioclase feldspar and pyroxene. |
| base metals | Copper, lead, zinc or tin, in general terms. |
| basement | In general terms, older or Archean rocks which are often covered by younger rocks. |
| batholith | A large intrusive granite body. |
| black shale | Variety of shale that contains abundant organic matter, pyrite, and sometimes carbonate nodules or layers. |
| blanks | Samples whose grade is (practically) zero. |
| block model | A model comprised of rectangular blocks, each with attributes such as grades, rock types, codes that represents a given mineral deposit. |
| boxcut | The excavation at the top of a decline; a small open pit with a ramp at the bottom. |
| breccia | A detrital sedimentary rock composed of poorly sorted fragments which are all angular to sub-angular in shape, and have a particle size of greater than 2 mm. |
| brecciated siltstone | A siltstone containing small fragments of breccia. |
| brecciation | Converted into or resembling a breccia. |
| brittle deformation | The cracking and fracturing of rocks subjected to stress. |
| bulk concentrate | A high-volume, sulphide rich concentrate containing one or more metals. |
| bulk density | A property of particulate materials. It is the mass of many particles of the material divided by the volume they occupy. The volume includes the space between particles as well as the space inside the pores of individual particles. |
| calc-silicate | A group of minerals comprised of calcium and silicate compounds, or a rock comprised of these minerals. |
| carbonaceous | A rock or sediment that is rich in carbon or containing organic matter. |
| carbonate | A class of sedimentary rocks composed primarily of carbonate minerals. The two major types are limestone and dolomite. |
| cemented paste backfill | A substance used to fill voids underground, comprised of mine or mill tailings, water, |

| Term | Explanation |
|---|---|
| | and powdered cement. It is injected underground as a liquid or a slurry |
| Cenozoic | The most recent of the three classic geological eras. |
| certified reference material | A certified standard. |
| certified standard | An analytical reference material of known true value used for quality control of laboratory assays. |
| chalcocite | A copper ore ($Cu_2S$). |
| chalcopyrite | A copper ore ($CuFeS_2$). |
| chert | A very fine grained sedimentary rock composed of silica. |
| chlorite | A group of mostly green minerals of varying composition often found as alteration products of ferromagnesian minerals. |
| classification | A system for reporting Mineral Resources and Ore Reserves according to a number of accepted Codes. |
| clasts | A grain or fragment of a sediment or rock, produced by the mechanical weathering of a larger rock. |
| cleaner cell | The second stage of a flotation circuit which prepares copper concentrate for sale. |
| cobaltite | A sulphide mineral comprised of cobalt and iron (Co, Fe) AsS). |
| collector | Chemical used in the froth flotation process that reacts with the ore to make the ore surface hydrophobic (sodium ethyl xanthate). |
| colluvium | Weathered material transported by gravity. |
| comminution | The crushing and grinding of ore in order to reduce the particle size for further processing. |
| composite | A sample comprised of a number of smaller samples. |
| compositing | The process of combining drillhole assay grades into even sample intervals to provide an even representation of sample grades and eliminate bias due to sample length. |
| concentrate | End product of the flotation process. |
| conglomerate | A detrital sedimentary rock composed of rounded to sub-rounded shaped fragments, which have a particle size of greater than 2mm. |
| contractor mining | Mining method where the mining equipment and fleet are owned and run by a company which is contracted to mine on behalf of the mines owner. |
| core | See diamond drilling |
| costean | A surface trench, usually for sampling. |
| covenant | A bond posted with an organisation, usually in respect to a rehabilitation obligation. |
| craton | A stable area of continental crust that has not undergone much plate tectonic or orogenic activity for a long period |
| crosscut | An underground tunnel excavated generally at right angles to the orebody. |
| crown pillar | Material at the top of a stope or underground mine deliberately left behind for the purpose of ground support. |
| crustiform | When minerals grow within a vein, they often grow inwards form the vein wall. |
| cuboid | An individual block that comprises the block model |
| cut and fill stoping | Underground mining method involving excavation of ore and replacement of cemented material into the void. |
| cutback | Term used to describe the staged mining of an open pit. |
| cut-off grade | The grade that differentiates between mineralised material that is economic to mine and material that is not. |
| Datashed | Geological database. |
| decline | Access ramp to underground workings. |
| declustering | A mathematical technique for reducing bias in drillhole data. |
| Definitive Feasibility Study | A study carried out to justify financing for a project. |
| deformation | Term used to describe changes in rocks after their formation, usually caused by tectonic forces. |
| depletion | Ore reserve material which has been mined out. |
| development | Any tunnelling work carried out in an underground mine. |
| diabase | A mafic, holocrystalline, igneous rock equivalent to volcanic basalt or plutonic gabbro. |
| diamond drilling | Drilling method which produces a cylindrical core of rock by drilling with a diamond tipped bit. |
| dilution | Waste mined as ore. |
| dip | Geological measurement – the angle at which bedding or a structure is inclined from the horizontal. |
| disconformity | A rock which sits above an older rock with a period of time and missing units |

| Term | Explanation |
|---|---|
| | intervening. |
| disseminated | An ore deposit consisting of fine particles of the ore mineral dispersed through the enclosing rock. |
| dolerite | Basaltic rocks which are comparatively coarse grained. |
| dolomite | A carbonate rock consisting of calcium magnesium carbonate. |
| domain | A homogenous zone within a mineral deposit consisting of a single grade population, orientation of mineralisation and geological texture. |
| downhole EM data | Electromagnetic data collected from down a drill hole. |
| drillhole data | Data collected from the drilling, sampling and assaying of drill holes. |
| drive | Underground mining horizontal development. |
| duplicates | A set of two samples taken at the same time and in the same way. |
| dykes | A tabular igneous intrusive rock that cuts across the bedding or foliation of the country rock. |
| early Proterozoic | The oldest period of the Proterozoic Era of the geological time scale within the Precambrian aeon containing rocks of approximately 2500 million years old. |
| electromagnetic (EM) geophysical surveys | Survey over an area involving the measurement of alternating magnetic fields associated with currents artificially or naturally maintained in the ground. |
| electron microscopy | Determining and identifying the structure of substances using an electron microscope. |
| eluvial | An incoherent ore deposit resulting from decomposition or disintegration of rock in place. |
| epithermal gold | Epithermal gold deposits form in hydrothermal systems close to the earth's surface, and are related to volcanic activity |
| factor of safety | A geomechanical measure which is related to the multiple of a safe rock slope. |
| fault | A fracture in rock along which displacement has occurred. |
| fault breccia | Breccia produced by movement along a fault. |
| feasibility study | A mining and or processing study into the economic development of a project for which the inputs have an accuracy of 5% to 10%. |
| feldspar | An important group of rock-forming minerals which make approximately 60% of the Earth's crust. Feldspars crystallize from magma in both intrusive and extrusive rocks. |
| felsic | Silicate minerals, magmas, and rocks which are enriched in the lighter elements such as silica, oxygen, aluminium, sodium, and potassium. |
| flotation circuit | Process for concentrating metal sulphide minerals. Ore is crushed and ground, mixed with water, frothing and collecting reagents and the mixture is aerated and agitated. The hydrophilic sulphide minerals attach to the bubbles which rise to the surface as the waste material falls to the bottom. The froth is skimmed off, and the water and chemicals removed, leaving a clean concentrate. |
| flowsheet | The arrangement of processes designed to turn ore from mining into a concentrate or other semi-finished or metallic product. |
| fold (folded) | A flexure in rocks. |
| foliation | Parallel orientation of platy minerals or mineral banding in rocks. |
| footwall | The underlying side of a fault, orebody or mine workings. |
| fracture | A break in a rock due to mechanical failure by stress. |
| fragmental | A rock composed of fragments of older rocks, generally of volcanic origin. |
| frother | Surfactant used to create froth in the froth flotation process (methyl isobutyl carbinol (MIBC)) |
| gabbro | A dark, coarse-grained, intrusive igneous rock chemically equivalent to basalt. |
| gabbro-anorthosite | An intrusive igneous rock, characterised by predominance of potassium feldspar. |
| geological contact | Boundary between rock types. |
| geological domains | Spatial domains created to represent areas with similar geological characteristics. |
| geophysical survey | A survey that measures the physical properties of rock formations, commonly magnetism, specific gravity, electrical conductivity and radioactivity. |
| geotechnical analysis | Analysis of the factors affecting the stability of a rock mass. |
| geotechnical core logging data | Data collected on the geotechnical properties of rock mass by examining diamond drill core. |
| glacial till | An unsorted glacial sediment. Glacial drift is a general term for the coarsely graded and extremely heterogeneous sediments of glacial origin |
| gneiss | A common and widely distributed type of rock formed by high-grade regional metamorphic processes from pre-existing formations that were originally either igneous or sedimentary rocks. Gneissic rocks are coarsely foliated and largely recrystallised. |
| grade control | The process of collecting geological, sample and assay information for the delineation of mineable ore boundaries; the minimization of dilution and ore loss, and the reconciliation of the predicted grade and tonnage to the grade and tonnage mined and milled. |

| Term | Explanation |
|---|---|
| granite | A coarse grained intrusive felsic igneous rock. |
| granite-gneiss | Metamorphosed igneous rocks or their equivalent |
| granitic intrusion | Granite rock which has been emplaced into the earth's crust. |
| granitoid | A common and widely-occurring type of intrusive, felsic, igneous rock. |
| granophyre | A textural term to describe an igneous rock that contains quartz and alkali feldspar in characteristic angular intergrowths. |
| graphite | A mineralised form of carbon. |
| gravity circuit | Part of a concentrator or processing plant in which minerals or metals are separated by the action of gravity and differential density. |
| greenfields | Is a type of exploration within geological terrains which are not in close proximity to known ore deposits. |
| greenschist facies | Assemblage of minerals formed during regional metamorphism. |
| greenstone belt | Greenstone belts are zones of variably metamorphosed mafic to ultramafic volcanic sequences with associated sedimentary rocks that occur within Archaean and Proterozoic cratons between granite and gneiss bodies. |
| greywacke | A variety of sandstone generally characterized by its hardness, dark color, and poorly-sorted, angular grains of quartz, feldspar, and small rock fragments set in a compact, clay-fine matrix. |
| grit | Sand or sandstone made up of angular grains that may be coarse or fine. |
| ground support | Strengthening of the rock in underground mines with bolts, mesh or by other means, in order to prevent collapse. |
| haematite | An iron oxide mineral. |
| hangingwall | The overlying side of a fault, orebody or mine workings. |
| high resolution airborne survey | A survey carried out with a high sampling density from an instrument mounted on a plane – usually magnetic, but may be electrical. |
| hydrobiotite | A hydrated form of biotite, a micaceous mineral. |
| hydrogeology | The science of the interaction of groundwater and geological features. |
| hydrothermal | The actions of hot water or the products produced by the action of hot water. |
| hypogene | A geological process, and its resultant features occurring within and below the crust of the Earth. |
| in situ | Material found in its original position of formation. Latin for 'in place'. |
| Indicated Mineral Resource | 'An 'Indicated Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed.'<br>(JORC 2004) |
| induced polarisation (IP) geophysical survey | Survey over an area involving the application of an electric or magnetic field and measurement of the decay of voltage in the earth when the field is switched off. |
| Inductively Coupled Plasma Mass Spectrometry | A type of mass spectrometry that is highly sensitive and capable of analysis of a range of metals and several non-metals at below one part in 1012. |
| Inferred Mineral Resource | 'An 'Inferred Mineral Resource' is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be limited or of uncertain quality and reliability.'<br>(JORC 2004) |
| inverse distance squared | A grade estimation method in which blocks are informed by samples whose weighting function is proportional to the inverse power of their distance from the block to be estimated. |
| iron oxide copper gold | A class of deposit characterised by copper and gold mineralisation in iron-rich, often acidic rocks. |
| ironstone | An iron rich rock. |
| isoclinal | A fold in which the limbs are parallel or near-parallel. |
| jointing | Fractures in rocks where there has been no displacement. |
| JORC Code | The JORC Code provides minimum standards for public reporting to ensure that investors and their advisers have all the information they would reasonably require for forming a reliable opinion on the results and estimates being reported. The current version is dated 2004. |
| kinematic | An indicator in a rock as to the direction of movement which a fault or shear has |

| Term | Explanation |
|---|---|
| | undergone. |
| komatiite | Ultramafic mantle-derived volcanic rocks. They have low SiO2, low K2O, low Al2O3, and high to extremely high MgO. Komatiites occur with other ultramafic and high-magnesian mafic volcanic rocks in Archean greenstone belts. |
| kriging | A geostatistical estimation method using a distance weighting technique which is based upon the relative spatial continuity of the samples. |
| land satellite magnetic survey | A survey taken on foot or in a vehicle where the location of points are obtained from a Global Positioning System. |
| leach pad | Area set aside for heaps of un-leached ore where leaching can take place and the leached solution can be collected. |
| Lerchs-Grossman | The most popular pit optimisation algorithm. |
| level | Extraction horizons in an underground mine at approximately the same horizontal height. |
| limestone | A rock composed mainly of calcium carbonate or magnesium carbonate or combinations thereof. |
| lineament | A straight topographic feature of regional extent which is thought to represent crustal structure. |
| lithology | The study and description of rocks, including their mineral composition and texture. |
| locked cycle | A type of metallurgical bench scale test which closely simulates conditions in a full-scale plant. |
| lode | Ore zone. |
| longhole open stoping (LHOS) | Underground mining method comprising the extraction of ore from stopes which are charged up from drillholes put in from one or more elevations within the stope. |
| longhole stoping | See longhole open stoping. |
| longitudinal stoping | Stopes organised along the strike of an orebody |
| mafic | Silicate minerals, magmas, and volcanic and intrusive igneous rocks that have relatively high concentrations of the heavier and darker minerals. |
| magnetic anomaly (high / low) | Magnetic signatures different from the background, made up of a high and a low (dipole) compared to the average field. |
| magnetic geophysical survey | Survey over an area involving measurements of magnetic intensity of rocks in response to the earth's magnetic field. Different rock compositions show varying degrees of magnetic intensity, which can be used to infer changes in geology. |
| magnetite | An iron oxide mineral, $Fe_3O_4$. |
| malachite | Copper carbonate. |
| marble | A metamorphic rock formed by the action of pressure on limestone. |
| Measured Mineral Resource | 'A 'Measured Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm geological and grade continuity.'<br>JORC 2004. |
| median | The middle in a range of values. |
| mesocumulate | Igneous rocks with between 93-85% accumulated minerals in a groundmass. |
| mesothermal | A hydrothermal mineral deposit formed at considerable depth. |
| metallogenic province | geographic area characterized by a particular assemblage of mineral deposits, or by a distinctive style of mineralization. |
| metallurgy | Study of the physical properties of metals as affected by composition, mechanical working and heat treatment. |
| metamorphic | The process of metamorphism or its results. |
| metamorphism | Alteration of the minerals, texture and composition of a rock caused by exposure to heat, pressure and chemical actions. |
| metasedimentary | A sediment or sedimentary rock that shows evidence of having being subjected to metamorphism. |
| metasomatism | The process by which rocks are altered when volatiles exchange ions. |
| mica schist | A group of medium-grade metamorphic rock, chiefly notable for the preponderance of lamellar minerals such as micas, chlorite, talc, hornblende, graphite, and others. |
| mill feed | Ore processed through the mill. |
| millerite | A nickel sulphide mineral (NiS). |
| mineral inventory | A quantity of mineralisation, expressed as tonnage and grade, which has not been classified according to the JORC Code. |
| Mineral Resource | 'A 'Mineral Resource' is a concentration or occurrence of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are |

| Term | Explanation |
|---|---|
| | reasonable prospects for eventual economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.'<br>JORC 2004. |
| mineralisation | The process by which a mineral or minerals are introduced into a rock, resulting in a valuable deposit. |
| mineralogical | The study of minerals: formation, occurrence, properties, composition and classification. |
| mining licence | A right to operate a mine |
| mise-a-la-masse | A drillhole-based induced polarisation geophysical exploration technique capable of penetrating to significant depth. |
| mobile belt | An elongated zone of the Earth's crust subjected to relatively great structural deformation. |
| mobile metal ion | A geochemical prospecting technique. |
| modifying factors | Factors affecting extraction which are taken into consideration and applied to Indicated and Measured Mineral Resources to produce Ore Reserves. The factors include mining, metallurgical, economic, marketing, legal, environmental, social and governmental considerations. |
| Monte Carlo analysis | A technique for determining sensitivity analysis based upon multiple iterations of random number generation from defined distributions. |
| moving loop EM | A geophysical technique which uses an inductive loop on the earth's surface to measure electrical potential. |
| moving window trend graph | Geostatistical method for testing local estimation of mean within narrow slices through domain. |
| mudstone | A detrital sedimentary rock composed of clay minerals similar to shale but lacking the well developed bedding planes. |
| native copper | Copper present in elemental form. |
| nodules | A mineral mass that has a different composition or is more weathering resistant than its surrounding rock. |
| nominal | Before tax. |
| nugget | Average difference of pairs of data at very small distances. |
| offtake | The process of selling a metallic concentrate to a downstream customer. |
| olivine | A magnesium iron silicate, common in ultramafic and mafic rocks. |
| open stoping | Underground mining method. |
| optimal pit shell | An open pit defined by a cashflow optimisation algorithm, usually the Lerchs-Grossman algorithm or similar. |
| Ordinary Kriging | A geostatistical estimation method which relies upon a model of spatial continuity as defined in a variogram. |
| Ordovician | A geological period, after the Cambrian era and before the Silurian era. |
| ore | Mineralised material which is economically mineable at the time of extraction and processing. |
| ore loss | Ore left as waste after the mining process. |
| Ore Reserve | 'An 'Ore Reserve' is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proved Ore Reserves.' (JORC, 2004) |
| ore zone | Zone of mineralised material. |
| orebody | Usually refers to the deposit as a whole. |
| orogeny | The process of mountain building, and may be studied as a tectonic structural event, as a geographical event and a chronological event, in that orogenic events cause distinctive structural phenomena and related tectonic activity, affect certain regions of rocks and crust and happen within a time frame. |
| owner mining | Mining method where the mining equipment and fleet are owned and run by the company that also owns the mine. |
| oxidation, oxidized | The addition of oxygen to the metal ion, generally as a result of weathering. |
| palaeochannel | An old river channel, now filled in and perhaps covered with later rocks. |

| Term | Explanation |
|---|---|
| Palaeoproterozoic | The first of the three sub-divisions (eras) of the Proterozoic occurring between 2500 Ma and 1600 Ma (million years ago). |
| paste fill | Cemented material used to fill voids of worked stopes in underground mining. |
| pentlandite | An iron-nickel sulphide, $(Fe,Ni)_9S_8$ |
| peridotite | a dense, coarse-grained ultramafic rock, consisting mostly of the minerals olivine and pyroxene. |
| petrographic | The study of rocks. |
| pH | measure on a scale from 0 to 14 of the acidity or alkalinity of a solution (where 7 is neutral and greater than 7 is more basic and less than 7 is more acidic |
| Phanerozoic | Geologic time where rocks have abundant evidence of life. |
| phyllite | A type of foliated metamorphic rock primarily composed of quartz, sericite mica, and chlorite. |
| pit optimisation | A mathematical process whereby an open cut volume is optimised according to certain financial criteria. |
| plunge | The inclination of a fold axis or other linear structure measured in the vertical plane. |
| pluton | An intrusive igneous rock body which crystallized from a magma below the surface of the Earth. Plutons include batholiths, dikes, sills, laccoliths, lopoliths, and other igneous bodies. |
| polymetallic | Co-existence of 2 or more metals within an ore deposit. |
| polyphase folding | A term used when there are multiple episodes of folding |
| porphyritic | A rock containing a porphyry texture. |
| porphyry | A variety of igneous rock consisting of large-grained crystals, such as feldspar or quartz, dispersed in a fine-grained feldspathic matrix or groundmass. |
| portal | The surface entrance to an underground mine. |
| Precambrian | Rocks older than the Cambrian age. |
| pressure acid leach | An extraction process involves leaching at high temperatures and generally high pressures using sulphuric acid in an autoclave in order to liberate one or more elements. |
| pressure oxidation | Conversion of metal species to oxides and hydroxides, usually at considerable temperature and pressure, inside an autoclave. |
| pre-strip | The amount of waste material to be removed before the first exposure of ore in an open pit. |
| primary | A zone in an orebody below the effects of surficial weathering; unweathered. |
| probability of failure | The chance that a rock slope of a given angle will undergo a failure. |
| Probable Ore Reserve | A 'Probable Ore Reserve' is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors These assessments demonstrate at the time of reporting that extraction could reasonably be justified.<br>(JORC, 2004) |
| production schedule | Planned and timed order of areas, tonnes and grade for mining. |
| Prospecting Licence | Authorization granted by a government to an individual permitting the person to prospect for minerals. |
| Proterozoic | Era of the geological time scale within the Precambrian eon containing rocks of approximately 1000 – 2500 million years old |
| Proved Ore Reserve | A 'Proved Ore Reserve' is the economically mineable part of a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified.<br>(JORC, 2004) |
| pulp | A pulverised laboratory sample. |
| pyrite | Iron disulphide, $(FeS_2)$. |
| pyritized | Introduction of or replacement by pyrite. |
| pyroclastic | A rock formed when small particles of magma are blown from the vent of a volcano by escaping gas. |
| pyroxenite | An ultramafic igneous rock consisting essentially of minerals of the pyroxene group. |
| pyrrhotite | An iron sulphide mineral (FeS) |
| QAQC | Quality assurance and quality control. |
| quartz | crystalline silica $(SiO_2)$. |

| Term | Explanation |
|---|---|
| quartzite | Metamorphosed sandstone. |
| radiometric survey | A survey pertaining to the measurement of geologic time by the study of parent and/or daughter isotopic abundances and known disintegration rates of the radioactive parent isotopes. |
| range | The distance at which the model reaches its maximum value. |
| reconciliation | Measured assessment of the forecast and review of its correctness. |
| recovery | Metallurgical: The percentage of metal that can be recovered given the limitations of the processing equipment.<br>Mining: The percentage of ore material that can be recovered once ore loss is taken into account due to the sampling or mining resolution. |
| re-crystallisation | The process where the crystals in a rock become solution and then solid again with a new set of crystals. |
| refining | The process of purification of copper metal. |
| refractory | Of ore – unable to be processed to liberate the metals or minerals of interest. |
| remnant ore | Ore left underground in pillars that may or may not be recoverable at a later stage in a mine's life. |
| remote sensing | A branch of geophysics that acquires and interprets airborne or satellite images of the surface using infrared and visible wavelengths of light. |
| resistivity survey | An electrical exploration survey in which current is introduced into the ground by two contact electrodes and potential differences are measured between two or more other electrodes. |
| reverse circulation drilling (RC) | Drilling method that uses compressed air and a hammer bit to produce rock chips. |
| rib pillars | Vertical slices of rock left between stopes in an orebody for the purposes of stability. |
| riffle splitter | A device to provide a statistically correct separation of particulate sample material into two or more equal portions. |
| rift | In geology, a rift is a place where the Earth's crust and lithosphere are being pulled apart. |
| rock quality designation (RQD) | The cumulative length of core pieces longer than 10cm in a run divided by the total length of the core run. |
| rock stress | Internal forces within a rock mass that occur because of an external force acting to change its shape or volume. |
| Rotary Air Blast (RAB) drilling | A cheap and quick drilling method using a rotating bit together with air pressure to produce rock chips for sampling. It is used at the exploration stage of project evaluation. |
| rougher cell | The first stage of a flotation circuit. |
| sandstone | A sedimentary rock of sand size particles. |
| saprolite | A soft, typically clay-rich, thoroughly decomposed rock, formed in place by chemical weathering of igneous, sedimentary and metamorphic rocks. |
| scavenger cell | The third stage of a flotation circuit where copper concentrate is extracted from tailings. |
| schist | A group of medium-grade metamorphic rocks, chiefly notable for the preponderance of lamellar minerals such as micas, chlorite, talc, hornblende, graphite, and others. |
| schist | A group of medium-grade metamorphic rocks, chiefly notable for the preponderance of lamellar minerals such as micas, chlorite, talc, hornblende, graphite, and others. |
| schistosity | A metamorphic rock comprised of large grains aligned in parallel layers. |
| schistosity | A metamorphic rock comprised of large grains aligned in parallel layers. |
| scoping study | a preliminary study into the development of a mining project generally with a low degree of accuracy. |
| search pass | A process used in grade estimation to find samples from a given point. |
| sedimentary | Rock forming process where material is derived from pre-existing rocks by weathering and erosion. |
| sediments | Loose, unconsolidated deposit of debris that accumulates on the Earth's surface. |
| selective mining unit (SMU) | Is the smallest block on which selection as ore or waste is commonly made. |
| semi-autogenous grinding mill (SAG) | a mill for the grinding of rock with the addition of grinding media. |
| serpentinite | A metamorphic rock comprised of an admixture of serpentine minerals. |
| shale | A detrital sedimentary rock composed of clay minerals with a well marked bedding plane usually due to the alignment of the clay minerals. |
| shear | Fault. |
| shear | Fault. |
| shotcrete | A cement mixture sprayed onto the surfaces of mine openings with a pressure gun to provide ground support, prevent erosion by air and moisture, and provide a smooth surface for airflow. |

| Term | Explanation |
|---|---|
| silica | Most commonly quartz ($SiO_2$). |
| silicification | The process of bringing in silica into a non-siliceous rock. |
| silicified | The introduction of, or replacement by silica, generally resulting in the formation of fine-grained quartz. |
| siltstone | A detrital sedimentary rock composed of clay minerals similar to mudstone but with mostly silt-grade material (1/16-1/256) mm. |
| Siluro-Devonian | A geological period, after the Ordovician and before the Carboniferous. |
| skarn | Skarns form at the contact between an intrusive rock and a carbonate rock or a clastic sediment rich in carbonate and have a characteristic mineral composition – calcium, magnesium and iron silicates. |
| skewed | Non-symmetrical |
| slate | A hard platy rock, formed by the action of pressure on shales. |
| slope of regression | Estimates the slope of the regression equation between the estimated and true block grades. Often used as a measure of the precise estimation of a block in a block model. |
| sludge holes | Underground drilling technique utilising a percussive hammer; samples are returned as a sludge or slurry with drilling water. |
| slurry | Liquid containing suspended solids. |
| smelting (smelter) | Heating and melting ore then separating the molten copper metal from other elements. |
| sphalerite | The main ore mineral of zinc, (Zn, Fe)S. |
| splay | A minor fault at the extremity of a major fault |
| SQL | Is a database computer language (Structured Query Language) |
| stacked | Material placed onto pads for heap leaching. |
| standards | See certified standards. |
| stockpile | Heap of mined ore waiting to be milled. |
| stockwork | A network of veins. |
| stope, primary / secondary / tertiary / quaternary | Timing of stoping operations. |
| stoping operations | The process of underground mining. |
| strata | Multiple beds or layers of rock. |
| stratigraphy | The study of stratified rocks, their timing, characteristics and correlations in different locations. |
| stream sediment sampling | Soil sampling of sediments from stream beds. |
| strike | Geological measurement – the direction of bearing of bedding or structure in the horizontal plane. |
| stringer | An irregular filament or a narrow vein of one or more minerals traversing a rock mass. |
| stripping | Open pit mining term relating to the removal of uneconomic waste material to expose ore. Metallurgical term relating to the removal of copper from the organic phase in the solvent extraction process. |
| subcell | A cell that comprises a larger cuboid. Subcelling increases the resolution of the block model to better reflect domain margins and provide a more reliable volume representation. |
| sublevels | Levels in between the main levels in underground workings. |
| sulphide | Minerals consisting of a chemical combination of sulphur with a metal. Also refers to fresh or unoxidised material. |
| sulphide copper | Copper present as part of sulphide minerals, generally chalcopyrite, chalcocite or bornite. |
| supergene | A mineral deposit or enrichment formed near the surface. |
| supracrustal zone | Rocks that overlie basement rocks. |
| surface heap leaching | Leaching of ore by staking un-leached ore on the surface in heaps and passing reacting solutions through it. |
| Svecofennian Orogeny | A period of the Proterozoic characterised by orogenic activity and associated geological processes |
| syncline | A fold shaped like a basin. |
| tailings | Waste left over after removing the gangue from ore, usually finely ground rock materials left after milling is complete. |
| tailings storage facility (TSF) | A dam constructed to contain milled waste from a process plant. |
| talc | A hydrated magnesium silicate. |
| talc-carbonate | A mineral assemblage that is commonly associated with ultramafic intrusions. |
| tectonics | The study of processes that move and deform the Earth's crust. |
| tenement | A generic term for an exploration or mining licence or lease. |
| tenor | Weight percent (wt%) of a metal sulphide in 100 wt% sulphide. |
| terrain | A rock or group of rocks or an area in which they crop out. |

| Term | Explanation |
|---|---|
| thickener | Are substances which, when added to a mixture, increase its viscosity without substantially modifying its other properties |
| tholeiite | A quartz rich basalt. |
| threshold | The point at which a process or effect commences. |
| tonalite | A quartz rich plutonic rock. |
| top cut | A process that reduces the effect of isolated (and possible unrepresentative) outlier assay values on the estimation. |
| transitional | The partially oxidised zone between oxidized and fresh material. |
| transverse open stoping | Stopes arranged perpendicular to the strike of an orebody. |
| tremolite-quartz-sulphide | A mineral assemblage that is commonly associated with skarn deposits. |
| tuffs | A rock composed of pyroclastic material ejected from a volcano. |
| ultramafic | Igneous rocks with very low silica content (less than 45%), generally >18% MgO, high FeO, low potassium and are composed of usually greater than 90% mafic minerals. |
| ultramafic to mafic layered intrusions | Ultramafic to mafic layered intrusions are found in typically ancient cratons. The intrusive complexes exhibit evidence of fractional crystallization and crystal segregation by settling or floating of minerals from a melt. |
| umpire laboratory | In QAQC – a laboratory used to check the performance of the primary laboratory. |
| unconformity | A structural break in the geological profile representing unrecorded time. |
| uphole bench retreat | A method of open stoping characterised by drilling holes for blasting upwards and by mining away from a pre-excavated opening. |
| VALMIN Code | The Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets for Independent Expert Reports (2005), sponsored by the AusIMM, the ASX, the AIG and MICA among others. |
| vanadiferous magnetite | A mineral association that is commonly associated with layered intrusions. |
| variogram | A graphical representation of how the grade varies over increasing distances in different direction within a given domain. |
| variography | The process of fitting a semivariogram model while capturing the spatial relationships. |
| veinlet | A small or secondary vein. |
| ventilation shaft (rise) | Shaft for intake of fresh air or expelling exhaust from underground workings. |
| volcaniclastic | All volcanic particles regardless of their origin |
| volcanosedimentary sequence | A stratigraphic sequence comprised of volcanic and sedimentary units in vertical succession, usually formed in tectonic rift environments. |
| waste | Material which is not mineralised or mineralised material which is not economically mineable. |
| waste dump | Heap of either non-mineralised material excavated to expose ore, or mineralised material below economic cut-off grade. |
| water table | The depth below which the ground is saturated with water (the surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric pressure). |
| weathering | The process by which rocks are broken down and decomposed by the action of wind, rain, changes in temperature, plants and bacteria. |
| wireframe | A surface or 3D volume formed by linking points together to form triangles.  Wireframes are used in the construction of block models. |