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3. PROCESS FACILITY

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3.1 NEW INFRASTRUCTURE

The RAV8 processing facility described in NOI (1999) has been retained but for the crushing and grinding circuits. This NOI covers the reinstatement of the crushing and grinding facilities along with additional carbon in leach and elution circuits to enable processing of gold bearing ores. The existing flotation, thickening, filtration, concentrate storage, reagent mixing and distribution, laboratory, workshop/store, fuel storage area, power generation area and offices will be re-used.

3.2 PROJECT TIMING

Construction of the new processing facilities and refurbishment of existing facilities will commence following receipt of regulatory approvals. Construction is expected to be completed within 9 months of commencement.

3.3 PROCESSING FACILITY

The metallurgical test work carried out on the oxide and primary sulphide ores from the Kundip and Trilogy deposits has confirmed that all ore types are amenable to treatment by standard flotation for copper recovery and CIP processing for gold/silver recovery. The processing facility design for the project therefore incorporates these technologies. The processing facility will be located on the site of the former RAV8 nickel processing facility.

3.4 PLANT DESCRIPTION

The flowsheet proposed for the Phillips River Project follows conventional and proven comminution and leach/CIP processing based on both testwork and industry practices.

The facility has been designed to process oxide ore at a rate of 500 000 tonne per annum and sulphide ore at 300,000 tpa.

The flowsheet can be generally described as follows:

- Run of Mine (ROM) ore is recovered from the ROM pad by front end loader (FEL) and fed to a ROM bin over a static grizzly.
- Ore is recovered from the ROM bin by apron feeder, fed to a jaw crusher and then conveyed directly to a single mill.
- The mill is configured as a SAG mill and operates in closed circuit with hydrocyclones.
- A centrifugal gravity concentrator treats a bleed of the hydrocyclone underflow to recover coarse gold. The concentrate is intensively leached in an In-line Leach Reactor (ILR).
- Leach liquor from the ILR is passed through an electrowinning cell to recover precious metals.
- Cyclone overflow is screened for trash before the slurry passes through a leach/CIP circuit or the flotation circuit.
- The flotation circuit is configured with a carbonaceous pre-float, conventional rougher and scavenger flotation, column cleaner, re-cleaner and cleaner scavenger circuit and concentrate thickening, filtration, storage and dispatch. Flotation tails is thickened and pumped to the leach/CIP circuit.

- Carbon is recovered from the CIP circuit and acid washed in a dedicated acid wash column.
- Activated carbon is then eluted in a dedicated elution column using a Pressure Zadra stripping facility. Eluate is recirculated through two electrowinning cells to recover precious metals.
- Eluted carbon is reactivated in a horizontal kiln prior to reintroduction to the CIP circuit.
- CIP tails are pumped to a tailings holding facility.
- Water is sourced from an existing bore field. Potable quality water is produced by reverse osmosis (RO) and used for domestic supply and elution. A process water circuit provides water to the major plant consumption points.
- Low pressure air (LPA), high pressure air (HPA), instrument air (IA) are generated as required using a combination of compressors and blowers.
- Oxygen is used in both the leach/CIP and ILR circuits to aid leaching. Oxygen is stored in liquid form in a vacuum insulated tank and then vaporised prior to sparging.
- Control and/or equipment monitoring will be via a human-machine interface (HMI) control system.

The facility is described in more detail in the following sections. A site layout of the Plant is provided in Appendix 1.

3.4.1 Crushing

The crushing plant has been designed for a nominal treatment rate of 65 tph on oxide ores with a design maximum of 125 tph. The circuit will be operated on a 24 hours a day basis.

The existing RAV8 plant ROM pad is to be used and is adjacent to the ROM feed bin for storage and reclaim of ore. Ore will be managed by establishing separate stockpiles of various ore grade, handling characteristics and hardness. Ore, nominally minus 600 mm, will be delivered to the ROM pad by dump trucks.

The ROM bin will be a Bisalloy lined steel bin and will be fed by front end loader (FEL). The ROM bin will have a live capacity of 75 tonnes, equivalent to 70 minutes residence time. The ROM bin is to be fitted with an inclined static 600 mm aperture grizzly to prevent oversize material being fed to the crushing plant. Grizzly bars will be inclined toward the ROM pad to permit clearing of oversize material.

Ore is reclaimed from the ROM bin using a 1.0 m wide x 7.0 m long apron feeder driven by an electromechanical drive system. Discharge from the apron feeder reports directly, by discharge chute arrangement, to the primary jaw crusher.

The single toggle jaw crusher has open dimensions of 900 x 1050 mm and will operate with a closed side setting (CSS) of approximately 90 mm. It is envisaged the CSS will be adjusted according to the handling characteristics of the ore being processed. Jaw crusher product, with a nominal 80% passing size of 75 mm, discharges onto the mill feed conveyor CV-02 along with apron feeder fines retained by CV-01.

The primary crusher discharge conveyor will transfer the ore directly to the Grinding circuit.

Blocked chute detectors will be placed in appropriate locations and will trip the feed to that unit of equipment. Standard interlocks will apply and trip preceding equipment in the process flow.

A weightometer will be provided on the primary crusher discharge conveyor and will provide instantaneous and totalised throughput indication of the wet crushing rate.

Dust generated will be controlled by means of sprays at the ROM bin, jaw crusher feed and onto the ore burden on the primary crusher discharge conveyor. The relevant sprays will be activated automatically when the primary apron feeder and conveyor are operating. Electronic detection of FEL access to the ROM bin will activate the ROM bin sprays. Containment of dust will be effected by the use of rubber skirting and skirt box covers at feed points on the conveyors. An insertable bag type dust collector will be mounted on the mill feed conveyor system to ensure a negative pressure is maintained within the crusher discharge conveyor skirt, cover and chute work. Dust collected by the insertable bag collector will discharge onto the mill feed conveyor CV-02.

Provision is made for secondary crushing to be installed at a latter date should the sulphide ores require this additional step of size reduction.

Clean up around the crusher area will be effected using process water for hosing into a sump contained within the concrete floor bunds. The sump pump will discharge clean-up slurry into the mill discharge hopper.

A single, 5 tonne SWL overhead electric hoist mounted on a monorail will be provided over the primary crusher jaw liners for maintenance requirements. Access to chutes and equipment for inspection, cleaning and maintenance requirements will be provided by strategically located doors.

One (1) closed circuit television camera will be installed to view the primary crusher feed arrangement and crushing chamber. A dedicated monitor will be provided in the main plant control room

3.4.2 Grinding, Classification and Gravity Concentration

The grinding circuit will operate 24 hours per day, 7 days per week. The circuit has been designed to achieve an availability of 94.0% which requires a treatment rate of 61 dry tonnes per hour for the processing of oxide ore (500,000 tpa). The actual design rate used has been escalated from the nominal 61 tph up to 65 tph.

The grinding circuit will consist of a single stage steel lined grate discharge SAG mill, hydrocyclone cluster, scats bunker (no scats circuit) and a Knelson centrifugal concentrator. Provision has been made for the future installation of a scats collection conveyor which could ultimately feed a scats crushing circuit.

The primary crushed ore with an 80% passing size of 75 mm is fed directly into the SAG mill feed chute by the mill feed conveyor 330-CV-02. The grate discharge SAG mill will have a diameter of 4.0 m inside the liners and an EGL of 5.6 m. The mill will be fitted with a 1,200 kW fixed speed wound rotor induction motor and LRS.

The SAG mill feed water addition is automated on a ratio basis to the measured mill feed rate. A dual loop arrangement calculates the water addition requirement and a proportional valve and flowmeter adjusts the flow needed. The operator measures discharge pulp density of the mill and then adjusts the input ratio to achieve the required milling density.

The SAG mill is steel lined and is fitted with a discharge grate containing slotted discharge apertures and a number of pebble relief ports. It is anticipated the mill will operate with a ball charge of up to 15% v/v and draw approximately 1,050 kW at the pinion at the 75% of critical mill speed depending on actual ball charge and total charge volume.

The SAG mill will discharge via a trommel fitted with polyurethane panels. Spray water is added to the trommel to aid the screening efficiency and to clean the discharge scats. The clean scats discharge from the trommel spiral via a chute arrangement to the scats bunker. The scats will be reclaimed by FEL for discard if low grade, or recycled if they contain adequate grade. Recycle would be achieved by back-feeding through the ROM bin.

The Rod Mill Work Index (RWI) and Ball Mill Work Index (BWI) ratio suggests there may be times when scats are produced. As there is inadequate testwork reported to establish if the scats production rate will be an issue, no scats handling circuit has been installed. As stated above, the circuit has provision for installation for a future scats reclaim conveyor system which could be configured to feed a scats crusher.

Ball charging of the mill will be facilitated using a dedicated ball charging kibble, monorail and hoist. Balls will be recovered from drums and deposited into a kibble. The kibble is then hoisted into position over the mill feed chute for ball addition to be effected.

The mill trommel undersize is directed into the mill discharge hopper fitted with duty and stand-by centrifugal cyclone feed pumps which are in turn fitted with separate dedicated variable speed drives. The mill discharge hopper is fitted with an ultrasonic level measurement device. The duty mill discharge pump speed is controlled to a set point hopper level. The discharge of the duty and standby cyclone feed pumps combine at a “Tech Taylor” double non-return valve and the pulp is delivered to the cyclone cluster distribution manifold. The cyclone feed line is fitted with a nucleonic density gauge and a magnetic flow meter.

Process water is added automatically to the mill discharge hopper which combines with the mill discharge trommel undersize pulp and the gravity circuit tailings. The automatic water addition is controlled by a flow meter and proportion valve arrangement to obtain either a set point cyclone feed density or a set volumetric flow.

The cyclone cluster contains four (4) off installed 250 mm cyclones off a common radial distribution manifold. The cluster is configured as 3 duty and 1 standby. The underflow pan directs flow to a distribution box which is divided into a split compartment arrangement. One compartment services the gravity circuit. The other returns the remaining underflow to the feed chute of the SAG mill. The total cyclone overflow reports to the common overflow launder and flows by gravity feed pipe to the trash screen feed box and on to the CIL circuit.

Testwork indicates that a proportion of the gold (and silver) in the feed is gravity recoverable. The cyclone underflow gravity circuit feed portion, flows by gravity to the gravity circuit feed screen. The box incorporates an adjustable gate and overflow arrangement to allow the gravity circuit feed rate to be controlled. Feed rate to the gravity circuit will be a nominal 45 tph with any excess overflowing the distribution box weir and returning to the mill feed stream.

The gravity circuit screen is a horizontal vibrating type screen 1.2 m wide by 2.4 m long fitted with modular polyurethane panels with 3.2 mm cross flow aperture slots. Process water can be added to the feed box or screen surface for pulp dilution and/or improving the screening efficiency. The screen oversize is directed by chute to the SAG mill feed chute. Screen undersize is directed to a 30 inch Knelson centrifugal concentrator.

The Knelson concentrator will discharge concentrate automatically via gravity flow to the intensive cyanidation circuit located at the base of the cyclone tower structure. The frequency of this discharge will be selected by the operator from the HMI plant control system. Selected fluidising and flush water flowrates will be automatically controlled by the HMI system. The diluted centrifugal concentrator tails will combine and flow by gravity to the mill discharge hopper. For added security, the Knelson concentrator will be housed in a lockable security meshed enclosure with heavy duty doors to facilitate maintenance and will incorporate camera surveillance. An electric chain hoist is provided to service the concentrator.

Cylcone overflow flows by gravity to the trash screen feed box. The trash screen is a horizontal vibrating type screen 1.2 m wide by 2.4 m long fitted with modular poly-urethane panels with 0.63mm cross flow aperture slots. The screened trash is directed to the tailings hopper by way of gravity.

The trash screen undersize is discharged to the leach feed/flotation feed hopper. A duty only feed pump delivers slurry to the CIL tank, or to the flotation circuit, at a pulp density of approximately 42% solids w/w. The hopper is fitted with an ultrasonic level sensor which provides an input to a speed control loop on the pump. The pump, fitted with a variable speed drive, accelerates and decelerates to maintain a hopper level set-point. The pump discharge pipeline branches to facilitate tank bypass if required, or redirection of the feed to the flotation circuit.

Grinding circuit spillage will be contained by a concrete bunded area with generously sloped floor to direct slurry to one of two sumps located within the bund and equipped with vertical spindle sump pumps. A separate gravity area sump pump will similarly be provided.

3.4.3 Flotation

The flotation circuit is the former RAV8 circuit and will not be described in this NOI.

The reagents added vary from the RAV8 circuit. Reagents will be added by using variable speed dosing pumps controlled via the HMI system. In the case of lime for pH control, addition valves will be through full flow on-off control valves on piping run off a ring main.

Provision will be made to add reagents at the following points:

<u>Frother MIBC</u>

- Pre-float column
- Conditioning tank
- Rougher/scavenger bank 2 feed box

<u>Collector PAX</u>

- Conditioning tank
- Rougher/scavenger bank 2 feed box
- Column cleaner pump hopper
- Re-cleaner feed box
- Cleaner scavenger feed box

<u>Promoter/Collector A3894/DSP-009</u>

- Conditioning tank
- Rougher/scavenger bank 2 feed box
- Column cleaner pump hopper

- Re-cleaner feed box
- Cleaner scavenger feed box

Tanigan PR (Carbonaceous depressant)

- Conditioning tank
- Rougher/scavenger bank 2 feed box
- Column cleaner pump hopper

NaHS Activator (Sulphidisation reagent)

- Conditioning tank
- Cleaner feed box
- Re-cleaner feed box

Sodium Silicate (Dispersion/pH modification)

- Conditioning tank
- Rougher/scavenger bank 2 feed box
- Column cleaner pump hopper

SMBS (Depressant)

- Conditioning tank
- Rougher/scavenger bank 2 feed box
- Column cleaner pump hopper

A Courier online analysis system will be installed to analyse the following streams for copper, iron and solids concentrations.

- Flotation circuit feed
- Combined cleaner feed
- Flotation tails
- Final concentrate
- Cleaner scavenger tails
- Carbonaceous concentrate

Each stream will be sampled using appropriate stream samplers and transferred to the Courier OSA. OSA rejects will be returned to the appropriate streams.

A cross stream sampler will be provided to take metallurgical samples from all of the streams at the Courier unit. Assay values will be displayed on a dedicated VDU in the control room and the HMI screen.

Flotation pulp level in each bank will be measured by a ball float – angle transmitter arrangement and an air actuated pinch valve will adjust the pulp level using a PID feedback loop controller.

Airflow to each bank of cells will be controlled by proportional type valves controlled via the HMI control system, where applicable. The smaller re-cleaner and cleaner cells have manual air adjustments for fine tuning.

3.4.4 Concentrate Thickening

Final concentrate will be pumped to a 4.0 metre high rate concentrate thickener, where it will be thickened to nominally 65% solids prior to being transferred to the concentrate filter. The thickener will be capable of treating up to 4 tph, with the design duty ranging from 1 tph for High Copper Oxides to 3 tph for Trilogy Sulphide. Sufficient flexibility has been incorporated to cope with the expected variability in flotation circuit performance.

Water sprays will be provided over the surface of the thickener to assist in the break down of froth. Foam fitted poly pipe followers attached to long rake arms will continuously present froth to the sprays and a froth retaining ring will be provided to help control froth. Thickener overflow water will be recycled to the process water tank for re-use.

The thickener will be fitted with standard process control instrumentation including bed level measurement for flocculant control and bed pressure measurement for discharge density control. Both control variables will be automatically controlled via the HMI.

Two variable speed peristaltic hose pumps (one duty and one stand by) will be provided to transfer the thickened concentrate to the concentrate storage tank. A recycle facility will be provided to recycle the underflow when required or during plant shutdowns.

Operating parameters, equipment status and alarm annunciation will be displayed on the HMI screen.

Sloping floors within the thickener bunded area will direct spillage into a sump. The sump pump will pump clean up into the concentrate thickener feed well.

3.4.5 Concentrate Filtering/Storage

The existing RAV8 concentrate storage, concentrate filter and concentrate storage shed will be utilised for the Phillips River Project.

A weighbridge will be installed to monitor the removal of concentrate from site. Concentrate production will vary due to a variation in throughput and ore sources processed but will average a nominal 5,000tpa.

The filter cake will be washed with fresh water to reduce the chloride present in the filter cake from the use of saline water in the process plant. In washing out the chlorides the excess flotation reagents will also be washed out, minimising the possibility of evolution of gases from the filtered concentrate.

The oxide concentrate minerals are malachite and azurite and will not reduce further. The sulphide concentrate primarily contains chalcopyrite which is relatively stable and would not oxidise during storage or transport.

The concentrate will be transported from site to Esperance Port in bulk by road trains. The road trains will be monitored and measures taken to ensure that spillage is kept to a minimum during transport.

3.4.6 Flotation Tailings/Leach Feed Thickener

Flotation tailings will report to the leach feed thickener at a nominal pulp density of 31% solids. The pulp will be thickened to approximately 60% solids to maximise recovery of flotation process water and minimise the carryover of flotation reagents into the CIL circuit. Thickener underflow will be re-diluted with CIL water to 42% solids prior to being pumped to the CIL feed box.

Leach feed thickener underflow will discharge to the leach feed hopper via a control valve and be pumped to the leach feed box via two variable speed (duty/standby) peristaltic hose pumps. A branch line will be provided to allow transfer of the thickened tailings to the final tailings hopper when treating Trilogy Sulphide ores.

Thickener overflow will report via a gravity overflow launder to the process water tank.

The thickener will be fitted with standard process control instrumentation including bed level measurement for flocculant control and bed pressure measurement for discharge density control. Both control variables will be automatically controlled via the HMI.

3.4.7 Leach and CIP Circuit

The leaching and adsorption circuit is configured to have two leach tanks at 450 m3, one large adsorption tank of 450 m3 followed by six smaller adsorption tanks at 200 m3 each. This provides some 2,550 m3 affective volume in total or a nominal 21 hours oxide slurry residence time at design conditions.

Feed to the leach circuit is from either the trash screen undersize and pumped to the leach tanks, or pumped from the flotation circuit leach feed thinckener. Cyanide solution at 30% strength by weight will be added to the leach tanks through a flowmeter and automatic control valve. Future provision to dose the first five adsorption tanks will be made.

Intertank flow will be via launders in the new tanks and via existing plug boxes in the smaller reused tanks. The facility to by-pass individual tanks using isolating gates and plugs is provided.

Interstage screening will be achieved using vertically mounted, cylindrical, mechanically wiped screens. Individual manually operated pillar jib type hoist structures will facilitate removal of the interstage screens for maintenance. Maintenance to the agitator gearboxes and wet ends and the carbon recovery pumps will be carried out using a mobile crane.

Carbon transfer between adsorption tanks will generally be carried out by airlifting. Loaded carbon removal and transfer from the first two absorption tanks will be achieved with a vertical spindle recessed impeller pump mounted in each tank.

Loaded carbon will be recovered to the acid wash and elution circuits by a vertical spindle recessed impeller pump. The pump will be sized to achieve a transfer of 5 tonnes of carbon in approximately 4 to 6 hours depending on carbon population in the first adsorption tank. The carbon will be recovered from the slurry by the loaded carbon screen. This screen is a horizontal vibrating type screen 1.2 m wide by 2.4 m long fitted with modular polyurethane panels with 0.8mm cross flow aperture slots. The screen will be mounted above adsorption tank 2. The screen undersize will return to either tank 2 or 3 primarily due to height difference existing between tanks 1 and 2.

Loaded carbon (screen oversize) will gravitate to a pressure transfer vessel. The carbon will then be transferred, by a recessed impeller pump, to the 5 tonne capacity rubber lined acid wash column in readiness for acid washing. Pulp undersize from the loaded carbon screen will flow by gravity back to either of the last two adsorption tanks.

Carbon concentration in each of the adsorption tanks will average approximately 15 g/L to ensure adequate carbon is present to process 5 tonne batches. The carbon concentration in the first adsorption tank would be allowed to increase to greater than 15 g/L immediately prior to a transfer to speed up the process and reduce dilution from the loaded carbon screen sprays.

Each tank will be fitted with agitators having dual open impellers. The agitator shafts have not been configured to permit down shaft addition of oxygen to the tanks. Oxygen injection will be achieved by lances installed at the shear point of the agitators or via diffusers located under the bottom agitator impeller. The two leach and first three adsorption tanks will have this oxygen injection facility.

The CIL area will be bunded with floors sloped towards a strategically located sump to collect spills from the circuit. The sump will be fitted with vertical spindle centrifugal sump pump to return spillage back to the process.

3.4.8 Intensive Cyanidation

Gravity concentrate recovered from the Knelson Concentrator is directed to a feed cone on the vendor supplied In-Line Leach Reactor (ILR). Concentrate is stored and then batch processed via the ILR.

The ILR comprises drum which rotates at low speed to agitate the concentrate contained within. Sodium cyanide and caustic soda are dosed to provide intensive cyanidation conditions. Oxygen is sparged to maintain dissolved oxygen levels. Leach accelerant and flocculant additions may be required when processing some ore types.

After batch leaching the solid and liquid phases are separated in the tails settling cone and clarifier arrangement and the pregnant liquor is direct to the ILR electrolyte tank. The electrolyte is dosed with additional caustic soda and re-circulated through a dedicated ILR electrowinning cell fitted with a 1,500 Amp rectifier. The electrowinning cell is fitted with 0.8 m x 0.8 m cathodes and uses steel wool as the cathode material onto which the precious metals are plated.

ILR tails are directed back into the grinding circuit and the barren electrolyte sent to the CIL for scavenging of precious metal values and residual reagents.

3.4.9 Tailings Disposal

Slurry from the last adsorption tank will flow by gravity to the feed box of the carbon safety screen. The carbon safety screen will be a horizontal vibrating type screen 1.2m wide and 2.4m long fitted with modular polyurethane panels with 1.0mm cross flow aperture slots. Underflow from the carbon safety screen will discharge into the tailings pump hopper which will be fitted with duty and standby tailings disposal pumps. The pumps will have dedicated variable speed drives and will be controlled by an ultrasonic level sensing element measuring the slurry level in the tailings pump hopper. Bypass of the safety screen for maintenance is facilitated by a valved pipe linking the screen feed box to the underflow hopper.

The tailings will be pumped through a polyethylene pipeline to the tailings storage facilities (TSF). Victaulic couplings will be installed at convenient intervals between the tailings pumps and the TSF to allow the line to be drained and de-sanded if required.

Pressure in the line at the process plant end is monitored via the HMI control system to detect high pressures due to line obstructions or sanding and low pressure due to pipe failures. Protection against spillage due to a ruptured pipeline will be provided by a vee trench drain into which the disposal pipe is laid en route to the TSF.

3.4.10 Elution and Acid Wash

Acid washing and elution will be conducted in separate 5t capacity columns. The acid wash column will be of rubber lined steel construction and the elution column will be of stainless steel construction. Elution will be achieved using pressure Zadra.

Loaded carbon will be transferred from the loaded carbon screen into the acid wash column. The ambient temperature acid wash cycle time will be 30 minutes at 3% hydrochloric acid solution. Following the acid wash cycle carbon will be educted to the elution column.

The pressure Zadra elution process will operate at a nominal temperature of 110ºC. Heating of the solution and water will be affected using a 800kW LPG fired boiler. The pregnant electrolyte solution will be pumped through the 2 by (18 cathode) electrowinning cells that will operate in parallel. The cells will be 800mm by 800mm in cross section and constructed from polypropylene. Barren electrolyte will then be pumped to the leach feed box.

Following completion of the elution cycle the carbon will then be transferred to the regeneration kiln by eduction water.

3.4.11 Carbon Regeneration

The regeneration kiln will be a horizontal rotary gas fired type with a steam injection system, capable of a nominal 500kg/h throughput. The carbon will be reactivated at a temperature of between 650 to 750ºC. The carbon will then be discharged over a screen and quenched with water in a carbon conditioning tank.

New and barren carbon will be conditioned in the agitated carbon conditioning tank to remove fines and sharp edges from the carbon particles. Once conditioned, the new or barren carbon will be transferred to the barren carbon screen and loaded into the last adsorption tank.

3.4.12 Gold Recovery

Doré will be produced from the electrowinning steel wool and from the electrowinning cell sludges. The gold laden cathodes will be removed from the cells, placed on trays and put into the calcining oven for approximately 8 hours prior to smelting. The calcining oven will be equipped with a mercury recovery system.

The calcine and/or cake will be mixed with fluxes and smelted in a gas fired titling bullion furnace. A safe will be provided in the gold room to store the valuable products.

Gravity gold concentrate will be treated by a separate ILR. The gravity circuit pregnant solution from the ILR will be processed by electrowinning in a single, dedicated 18 cathode electrowinning cell, with the cathodes then calcined to obtain a cake suitable for smelting. Gravity bullion will be prepared separately for metallurgical reconciliation purposes.

Tailings solids from the ILR will be returned to the ball mill discharge hopper.

3.4.13 Reagents Mixing, Storage and Distribution

The reagents used in the process plant consist of:

- Slaked quicklime pH modifier – up to 1,500tpa
- PAX collector – up to 120tpa
- Frother (MIBC) – up to 18tpa
- Sodium Metabisulphite (depressant) – up to 750tpa
- Sodium Silicate (pH modifier / dispersant) – up to 300tpa
- Tanigan PR (Carbonaceous Depressant) – up to 45tpa
- Sodium Hydrosulphide (NaHS) sulpidisation reagent – up to 375tpa
- DSP009 collector – up to 18tpa
- Flocculant – up to 13tpa
- Sodium Cyanide (leach reagent) – up to 750tpa
- Hydrochloric Acid (leach reagent) – up to 190tpa
- Sodium Hydroxide (caustic solution, elution reagent) – up to 30tpa
- Oxygen (via PSA plant) – up to 875tpa

The reagent consumptions indicated above are maximum values and the actual consumption will depend on the ore types processed each year. Reagent additions will be automated where possible with dosing of other reagents controlled by the HMI system.

The existing RAV8 reagent mixing and distribution facilities will be used for PAX, fother, flocculant, sodium metabisulphite and Tanigan PR. The facilities for all other reagents will be new.

The new reagent storage and mixing areas will be bunded in accordance with the dangerous goods storage regulations. Any reagent spillage will be cleaned up as per the MSDS and dangerous goods guidelines.

<u>Lime</u>

Control of the leach pulp Ph will be maintained by addition of hydrated lime as a slurry to the milling circuit. The addition point will be at the SAG Mill feed chute, regulated through a metering station controlled by feedback from the leach feed Ph probe. The silos will provide approximately 20 days of storage on site when treating the oxide ore types respectively, based on a consumption rate of 3.4 kg/t.

Hydrated lime will be delivered in bulk by road train. The lime will be pneumatically transferred into the storage silos. The two storage silos will present dry product to an agitated mixing tank via a variable speed rotary valve and screw feeder arrangement. The hydrated lime will be mixed with water and pumped around a recirculating ring main returning to the mixing tank.

<u>Collector PAX</u>

Collector will be delivered in 110 kg drums. Mixing will be carried out manually. Five drums of PAX in pellet or flake form will be added to the mechanically agitated mixing tank and the tank made up to 2.8 m3 to obtain a 20% w/v solution. After mixing the solution will be transferred to a 1.0 m3 PAX header tank. Collector distribution will be by variable speed peristaltic pumps controlled via the HMI operating system. Collector will be dosed into funnels and will gravitate to the relevant distribution points. This will allow easy measurement of the addition rate.

<u>Frother</u>

MIBC frother will be delivered to site in bulk boxes (1,000 litre). An electric pump will be provided to pump the frother to a 0.5m³ header tank located in the flotation building. Header tank overflow will return to the bulk box. A low level alarm will be provided for the header tank and annunciation on the HMI VDU.

Frother distribution will be by variable speed peristaltic pump controlled via the HMI system. Frother will be dosed into funnels and gravitate to the relevant distribution points. This will allow easy measurement of the addition rate.

Depressant - Sodium Metabisulphite (SMBS)

Sodium metabisulphite will be delivered to site in 1,100 kg bulk bags. Mixing will be carried out manually. Two bags of flake or powder SMBS will be added to a mechanically agitated mixing tank and the tank made up to 12 m3 to obtain a 20% w/v solution. After mixing, the solution will be transferred to a 48 m^3 storage tank. The solution will be transferred from the storage tank to a 1.0 m^3 header tank equivalent to 1.6 hours operating capacity.

Variable speed peristaltic pumps controlled by the HMI system will distribute sodium metabisulphite solution. Sodium metabisulphite solution will be dosed into funnels and gravitate to the relevant distribution point to allow easy measurement of addition rate.

Sodium Silicate (Dispersant / pH modifier)

Sodium Silicate will be delivered to site as a liquid by isotainer. The liquid sodium silicate will be stored in a 50 m3 tank. Solution will be pumped from the storage tank to a 1m3 header tank, and dosed by peristaltic dosing pumps controlled via the HMI system.

Tanigan PR (Carbonaceous Depressant)

Tanigan PR will be used as a carbonaceous depressant. The reagent will be supplied in 25kg bags and mixed in the existing RAV 8 Copper Sulphate Tank. Twenty bags will be added to a mechanically agitated mixing tank and the tank made up to 2.5m³ to obtain a 20% w/v solution. The mixed solution will be pump to a 1m³ header tank for distribution to the flotation circuit.

Sodium Hydrosulphide (NaHS)

Sodium Hydrosulphide will be used as the flotation sulphidisation reagent for the copper oxide ore types. The reagent will be supplied in 800kg bulky bags or commercial equivalent. Mixing will be done manually. Two bags of powder sodium hydrosulphide will be added to a mechanically agitated mixing tank and the tank made up to 10m³ to obtain a 20% w/v solution. After mixing, the solution will be transferred to a 20m³ storage tank. The solution will be pumped from the storage tank to a 1m³ header tank for distribution.

Variable speed peristaltic pumps controlled by the HMI system will distribute sodium hydrogen sulphide solution. Sodium hydrosulphide solution will be dosed at a rate controlled by an ES probe to ensure sufficient reagent is added.

DSP009 Collector

DSP009 will be supplied to site in as a liquid in bulk boxes and will be pumped to a 0.5m³ header tank for distribution. Variable speed peristaltic pumps controlled by the HMI system will distribute promoter solution. Promoter solution will be dosed into funnels and gravitate to the relevant distribution point to allow easy measurement of additional rate.

Flocculant

Flocculant will be delivered to site in 25kg bags. An automatic mixing system utilising the existing RAV 8 equipment will be supplied with a dedicated PLC. Mixed flocculant will be automatically transferred to a 14m³ storage tank. The storage tank will be provided with ultrasonic level indication and will be displayed on the HMI display screen.

Flocculant will be dosed to each thickener by dedicated variable speed dosing pumps. The dose rate will be controlled by the thickener bed level or manually by the operator via the HMI system.

Sodium Cyanide (leach reagent)

Sodium cyanide is delivered to site as liquid at 30.5% w/w by 21.5 tonne road tankers. The liquid is transferred to the supplier provided storage tank of 110 m3 capacity. Distribution pumps from this storage tank re-circulate the liquid cyanide to the CIL tanks, elution and intensive cyanidation areas via a ring main system. The storage capacity of the tank is nominally 18 days for the oxide ore type.

A concrete bund and sump will be provided in this storage tank area to collect any spillage. A sump pump is provided for removing spillages and accumulated rain water. The tank is also fitted with an ultrasonic measurement device which provides remote indication of the storage tank contents to the main control room. A mechanical type sight gauge is also fitted to the tank for local indication of content level.

Hydrochloric Acid (elution reagent)

Hydrochloric acid will be used to wash the loaded carbon prior to elution. Hydrochloric acid at a strength of 32% will be delivered to site in 16 m3 iso-tankers and pumped into a 30 m3 site storage tank.

Hydrochloric acid will then be transferred by a transfer pump to the acid wash and mixed with potable water to a concentration of 3.0% w/v. A concrete bund and sump will be provided in this storage tank area to collect any spillage. A sump pump is provided for removing spillages and accumulated rain water. Any spillage is pumped direct to the tails hopper. A mechanical type sight gauge is also fitted to the tank for local indication of content level.

Sodium Hydroxide (elution reagent)

Sodium Hydroxide at a strength of 50% will be delivered in bulk using 16 m3 iso-tankers. A storage tank of 34 m3 capacity will be provided. A concrete bund and sump will be provided in this storage tank area to collect any spillage. A sump pump is provided for removing spillages and accumulated rain water.

Sodium Hydroxide will be used for strip solution preparation and intensive cyanidation requirements and will be reticulated to the process via a ring main piping system. The storage tank capacity is approximately 50 days at the design usage rates. A mechanical type sight gauge is also fitted to the tank for local indication of content level.

Oxygen (leach reagent)

Oxygen is to be supplied to the leach and adsorption circuit by a vendor supplied vacuum insulated storage vessel and vaporiser. Oxygen is distributed to the leach and adsorption tankage by the vendor supplied rotameters which will measure individual flows. Sparging is effected by lances located adjacent to shear zones generated by the in-tank agitators.

All reagents added to the process will report either to the flotation concentrate (minimal distribution due to fresh water washing) or to the plant tailings.

3.4.14 Water Services

Raw Water

Raw water is provided from the RAV8 water dam or existing RAV8 borefield. Raw water is pumped from the existing RAV8 raw water tank using one of the two raw water distribution pumps. Gland seal water is pumped from the tank by dedicated gland water pumps.

Reverse Osmosis Water

Potable water is produced from raw water using reverse osmosis (RO) treatment technology. Approximately 285 m3/day of water is bled from the raw water supply header under pressure to the RO treatment facility. RO product water, at approximately 100 m3/day, flows to the potable water tank and the RO reject water is disposed of directly to the processing plant tailings hopper. The potable water tank has a capacity of 300 cubic metres and is fitted with a level transmitter to provide both remote and local level indication.

Potable water is pumped from the potable water tank for use in the process plant area using one of two duty and stand-by distribution pumps. Potable water is used for the concentrate filter for cake and cloth wash cycles, strip solution preparation, intensive cyanidation process, carbon rinsing and transfer, the regeneration kiln sprays and the safety shower circuit.

Part of the RO product water is also used for domestic supply. Secondary treatment equipment is located in a branch from the potable water pump discharge and provides sterilised water for distribution to the existing infrastructure facilities including office and workshop buildings and ablutions, and to drinking fountains located in the processing plant.

Leach/CIP Water

The use of froth flotation prior to leach/CIP requires separation of water circuits for the unit processes either side of the leach feed thickener. Flotation water contains residual flotation reagents that can foul activated carbon, whilst leach/CIP water may contain copper and cyanide species that can depress sulphide flotation and lead to poor copper recoveries to concentrate.

The Flotation plant requires installation of a leach/CIP water circuit. The leach/CIP process water circuit will provide for the crushing, grinding and flotation duties. A leach/CIP water circuit will provide for leach feed dilution and general process water requirements downstream of the leach feed thickener underflow.

Leach/CIP water will be supplied from the Raw water tank and detoxified tailings decant water if necessary.

Process Water

Process water requirements are met by thickener overflow and raw water flows. Both the concentrate and leach feed thickeners provide overflow water to the process water tank located in the process plant area. Additional top up water to the process water tank is supplied via the raw water pump. Process water will be pumped by one of two process water pumps (one duty, one standby) throughout the plant. A high and low level alarm will be provided for the process water tank.

3.4.15 Air Services

High Pressure Air

One rotary screw compressor will be provided to supply the main plant air receiver. Air is subsequently distributed throughout the plant via a ringmain system. Instrument air will be bled of the main high pressure air system and passed through an instrument air dryer.

Low Pressure Air

Low pressure air is provided by duty and standby “Rootes” type blowers to service the air lifts in the adsorption circuit. A relatively high volume of low pressure air is required for the flotation cells.

3.5 TAILINGS STORAGE FACILITY

Tailings will be pumped through a polyethylene pipeline to the tailings storage facility (Ex-RAV 8 open pit). A vee trench drain into which the disposal pipe will be laid en route to the TSF will prevent spreading of spillage into the surrounding area due to a ruptured pipeline. Thickened material from the leach feed / flotation tailing thickener will be diluted with leach/CIP water and pumped to tailings or to leach feed. Leach tailings will be directly pumped without a thickening stage at 40% solids.

3.6 POWER SUPPLY AND DISTRIBUTION

The power station will have two new diesel fuelled skid mounted generators in acoustic enclosures installed along side the existing power station. Two generator sets each rated at 1,200 Kw are proposed to compliment the two existing Caterpillar generator sets. The new generator sets exhibit higher fuel efficiency and longer service life between engine rebuilds when compared to the existing Caterpillar sets. The site will not exceed the trigger fuel usage levels that require licensing as a Category 87 – Schedule 1 Premises.

Power generation and fuel storage approvals were part of the RAV8 NOI.

The new plant and infrastructure electrical systems will be designed and installed to provide compliance with all relevant standards and statutory requirements, high reliability, ease of maintenance and in accordance with the best industry practice.

The total average electrical load for the process facility is estimated to be 2.4 MW.

3.7 NOISE

Noise was covered in the RAV8 NOI.

Mining noise levels will be monitored, to ensure compliance with Part 7, Division 1 of the *MSIR (1995)*.

3.8 DUST CONTROL

Dust Control would be covered in the RAV8 NOI.

Dust suppression programmes and resources to comply with DOIR regulations and Shire requirements will be provided to ensure that the safe site operating conditions prevail at the processing site and during travel on shire and mine roads.

3.9 FIRE CONTROL

Fire Control would be covered in the RAV8 NOI.

The processing plant is located in pastoral lands and appropriate resources and strict fire control procedures will be maintained for the site.