HEMERDON MINERAL PROCESSING FACILITY

Best Available Techniques and Operating Techniques

Prepared for: **Drakelands Restoration Ltd**

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Glossary

BAT	Best Available Technique. Regulatory principle for the selection of the methods for environmental protection
EA	Environment Agency
EP	Environmental Permit under Environmental Permitting (England and Wales) (Amendment) Regulations 2013
GLC	Ground Level Concentration
IED	Industrial Emissions Directive 2010/75/EU, 24 November 2010
HIMS	High Intensity Magnetic Separation
LIMS	Low Intensity Magnetic Separation
LPG	Liquefied Petroleum Gas
MPF	Mineral Processing Facility. The process plant installation
MWF	Mining Waste Facility. Facility located within the Hemerdon mine and permitted for the treatment of mine waste. The facility has a tailings separation beach and pond from which water is recycled back to the MPF.
ROM	Run of Mine. Excavated ore for crushing
tpa	tonnes per annum
WTP	Water Treatment Plant. Facility located within and as part of the MPF to optimise recycled process water quality

1.0 Introduction

Drakelands Restoration Ltd (DRL) has instructed SLR Consulting Limited (SLR) to update the Best Available Techniques Assessment previously submitted with the Environmental Permit (EP) application (ref: EPR/AP3203ML/A001) for the Mineral Processing Facility (MPF) at Hemerdon Mine, Crownhill Down, Plympton, Devon under the Environmental Permitting (England and Wales) Regulations 2016 (as amended).

1.1 Schedule 5 Notice

This update has been prepared in response to the Schedule 5 Notice issued on 08/02/2022 by the Environment Agency (EA). Question 2 of the Schedule 5 Notice requested the following;

2) Please update and resubmit your BAT assessment to take account of any modifications proposed under this application, and confirm that any changes will continue to meet the BAT requirements for noise and dust, in accordance with those set out in PGN3.08 below.

Reasoning: The document ' Tungsten West Environmental Permit Application – Section 7 Best Available Techniques and Operating Techniques - TWL-CP-PA-EN-006.2.25' based on the previous application submission by Wolf Minerals in February 2014 , reviewed by TWL as current in April 2021, appears to contradict the current proposals for use of mobile jaw crushers on the ROM pad (without enclosure), rather than the enclosed roll crusher design used previously which was accepted as BAT. Whilst the applicant may wish to modify the previous design for operational reasons, any proposed changes will need to continue to meet the BAT requirements for noise and dust mitigation measures.
This document also refers to an extract from DEFRA Process Guidance Note for quarry processes PGN 3.08 which provides indicative guidance for BAT. The crusher plant complies with PGN 3.08 (para 5.1) in that:" Crushers will be located within a sealed building to prevent dust and noise emission. • Dust generation points in the crusher building will be fitted with dust collection equipment at slight negative pressure to prevent dust emission.• Crushers will be provided with LEV to bag filter to prevent nuisance dust emission." Crushed product from screening will be transported wet.• Screening will be performed as a wet process.• Material will be transported between plant and the process by conveyor enclosed to protect it from the wind (para 5.6), with scrapers and catch plates keep the return belt clean and drop chutes to control drop height.• Crushers & screens will use variable height chutes to reduced drop heights and/or minimise the free fall of materials (para5.2)•Crushers will be sited to minimise windlift;•In normal operation there would be no significant visible emissions.

1.2 Report Context

The Hemerdon mine operations comprise an open pit, MPF, Mining Waste Facility (MWF) and associated infrastructure; this application relates solely to the MPF.

The facility will process ore to produce non-ferrous mineral concentrates. The concentrates will be exported overseas for subsequent processing into non-ferrous metal. The main activities to be undertaken at the Hemerdon MPF comprise the following:

- Primary, secondary and tertiary crushing and screening of mineral ore; and
- Processing of mineral ore to produce non-ferrous mineral concentrates.

Run of Mine (ROM) ore will be crushed and will then enter the MPF main process building.

The MPF is designed with a series of physical processes including dense media separation and froth flotation that reduces and separates the mineral to produce a mineral pre-concentrate. The pre-concentrate will then undergo heat treatment (reduction) to enable the final magnetic separation into the different product streams (concentrate) as below.

The mineral concentrate produced by the facility will include two product streams:

- Tungsten: Wolframite $FeMnWO_4$ – approximately 62-65% WO_3; and
- Tin: Cassiterite SnO_2 – approximately 40-45% Sn.

Wastes from the processing plant will include emissions to air from fuel combustion, mineral drying, heat treatment and flue gas treatment (scrubbing). Solid wastes from mineral separation will be treated, thickened and managed via the MWF. Some small solid waste streams will be disposed of at an appropriate offsite facility.

The process will be a net importer of water that will be recycled within the MPF and via the MWF. At times of low flow, water can be topped up from the Hemerdon mine surface water discharge ponds, Tory Pond or Loughter Mill pumping station. At the MPF a Water Treatment Plant (WTP) will maintain the quality of the process water to prevent the build-up of dissolved and suspended solids.

Activities defined as 'Installations' are required to conform to best available techniques (BAT) requirements. The essence of BAT is that the selection of techniques to protect the environment should achieve an appropriate balance between the environmental benefits they bring and the costs to implement them. In addition, it should be demonstrated that no significant pollution is caused by an assessment of the environmental impact of emissions from the activity as a whole.

This report is an integrated document that describes the operating techniques that will be implemented at the MPF to ensure compliance with the conditions of the EP, and also demonstrates compliance with BAT where applicable. Design options are explained along with the systems of management in place to ensure that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis.

Standards and Regulatory & Technical guidance are discussed in Section 3.3 & Table 3-1.

1.3 Summary of Changes

The Hemerdon MPF was originally designed and constructed by Wolf Minerals to process 550t/h of mineral ore. The facility operated between 2015 and 2018. During that time Wolf Minerals made considerable investment in the MPF and completed a number of substantial modifications to the as-built plant particularly in the concentrator and refinery sections. The MPF ceased operating when Wolf Minerals went into administration in 2018.

Tungsten West plc (TW) (the parent company of DRL) acquired the Hemerdon site in December 2019 and have undertaken a review of the MPF to determine which aspects of the MPF require modification or attention prior to a restart of the operations. The proposed modification and the reasoning for the modifications are summarised as follows:

- **Primary and Secondary Crushing** - as the equipment which had been installed (hybrid rolls crushers) was no longer fit for purpose as the ore became progressively harder. In addition, the design of the as-built circuits was considered sub-optimal in that they resulted in all material being passed through the crushers whether it needed crushing at that stage or not;
- **Introduction of an ore sorting phase** on the basis that studies of the ore indicated that much of the host granite rock was very weakly mineralised or un-mineralised; the tungsten and tin values being predominantly contained withing the introduced sheeted quartz veins. This fact was confirmed by multiple rounds of ore sorting test work undertaken by Wolf Minerals and TW;
- **Removal of the scrubber** which was considered fairly unnecessary even for the 'soft' ore as kaolinite is a non-balling clay type and in future mainly 'hard' ores will be treated, whilst 'mixed' ores will have far lower kaolinite contents than the previous 'soft' ore. This piece of equipment had been proven by Wolf Minerals to have caused considerable destruction (in terms of particle size) of the tungsten minerals

owing to their fragile nature and was therefore responsible for considerable losses through reduction of the wolframite- ferberite to irrecoverable particle sizes (by 'normal' gravity methods);

- **Replacement of the front-end (120 Area) classification screens** which had caused considerable downtime of the process plant through failure (particularly 120-SN-02) and also were also major contributors to the generation of Infrasound and Low Frequency Noise (LFN) and which, because of the introduction of the ore sorting phase, could be replaced with smaller units;
- **Reduction of the infrasound problem (also called LFN – Low Frequency Noise)** through a programme of test work and then modifications or mitigations to be applied to existing and new equipment;
- **Completion of various projects which were not finished under Wolf Mineral's tenure** including the Primary DMS feed stockpile, the upgrade of Primary DMS 1 and recommissioning of the Scavenger DMS circuit including adjustment to the operation of the Primary Mill; and
- **Refurbishment of the parts of the process plant** not impacted by the planned modifications.

1.4 Existing Permissions

The site benefits from existing planning permission to construct and operate a MPF. A Planning Application and detailed Environmental Statement was submitted to the Minerals Planning Authority (Devon County Council) in January 2014, to address the incorporation of a reduction kiln, amongst other planning changes.

An EP application for the adjacent MWF is currently being determined. Aspects of this MPF EP application are associated with the MWF EP. This includes the management of surface water, the recycling of process water and the disposal of inert solids.

Existing Permits for the Impoundment, abstraction and discharge of water include:-

Table 1-1
Schedule of Existing Permits

Description	Permit Reference	Status/date of issue
Smallhanger discharge south tank	EPR/QP3420XX	10/11/2021
Elfords Pond discharge	EPR/DB3290RH	10/11/2021
Loughter Mill Impoundment Licence	SW/047/0002/005	29/12/2021
Loughter Mill Abstraction Licence	SW/047/0002/023	In determination
Tory Pond Reservoir Impoundment Licence	SW/047/0002/003	29/12/2021
Tory Pond Abstraction Licence	SW/047/0002/022	In determination
Dewatering abstraction licence	SW/047/0002/020	In determination
Sewage effluent discharge	EPR/WB3893DT	30/03/2022
Surface water discharge	TBA	Pending

1.5 Site History

The discovery of tungsten at Hemerdon dates back to 1867. However, mining for tungsten at the site only commenced in 1919 following an increase in demand as a result of the First World War. Further mining activities were carried out during the Second World War.

In the 1980s a comprehensive feasibility study was completed by a joint venture company comprising Hemerdon Mining and Smelting Ltd (HMSL) and AMAX, a North American mining company. A pilot plant was constructed and large scale test work was undertaken. Planning consent to establish a mine at Hemerdon was granted in 1986. However due to a fall in the value of tungsten at this time, the mine was not developed.

In late 2007, Wolf Minerals signed an option agreement with the landowners for the mineral rights and the rights to mine the deposit. The option agreement provided for the granting of a 40 year lease to Wolf Minerals. The MPF was constructed by Wolf Minerals and operated between 2015 and 2018. Considerable investment and modifications were made by Wolf Minerals to the MPF. However, in 2018 Wolf Minerals went into administration and operations were ceased in October of that year as a consequence of depressed minerals pricing andissues with the process design linked to the complex geo-metallurgy of the Hemerdon deposit. The project was acquired by TW in December of 2019.

GR Engineering Services Ltd, a Western Australian based engineering group that completed the design and construction of the original Hemerdon concentrator and associated infrastructure, was appointed by TW in March 2020 to complete a feasibility study to undertake preliminary design, equipment selection and operating and capital costs estimate for the work required to be completed to restart operations.

The detail of which was captured in a feasibility study published by TW in 2021. Subsequent macroeconomic factors including inflation driven by increased energy and fuel prices made TW reconsider the proposal. The proposed development and plans presented here is a result of a rigorous optioneering study that identified potential for reduce CAPEX and OPEX, as well the mitigation of any identified areas of environmental risk.

1.6 Site Setting and Sensitivity

The Environmental Risk Assessment (ERA) (Ref; 416.10511.00010/ERA), dated November 2022, assesses the potential impact of the proposed development on nearby receptors. The ERA also includes information on the geology, hydrogeology and hydrological receptors in the vicinity.

The site is located within the boundary of the wider Hemerdon Mine with the northern part of the site extending into the MWF EP boundary. Immediately to the south lies the open face pit. The wider area is characterised by historic and current quarrying and mining operations. The large city of Plymouth is located approximately 10km to the south west of the EP boundary, with the suburban towns of Plympton, Chaddlewood, Woodford, Longbridge and Leigham approximately 2km south west. The National Grid Reference (NGR) for the site is SX 56897 58966.

1.7 Design and Construction Quality Assurance

All relevant elements of the facility are designed in accordance with recognised standards, methodologies and practices. The design process uses a risk based approach and is appropriately documented using drawings, specifications and method statements to provide an adequate audit trail.

Construction Quality Assurance (CQA) plans will govern all construction activities. These CQA plans will be prepared by competent and suitably qualified persons and will detail the assurance and validation process for relevant elements of the facility, which shall include:

- Material selection;

- Handling, storage and installation;
- Conformance and performance testing; and
- Inspection and validation.

A competent and suitably qualified person will supervise the construction activities, and prepare a validation report confirming that the construction activities have been carried out in accordance with the CQA plan.

DRL requires subcontractors to work within acceptable quality and environmental standards.

1.8 Environmental Issues

Environmental issues will be taken into account during the construction phase of the project and where possible, recycled and "environmentally friendly" products will be used.

Details of waste streams, recycling opportunities, disposal routes and responsibilities will be included in a site waste management plan, implemented to cover all construction activities.

1.9 Management Systems

DRL will operate in accordance with an Integrated Management System which is accredited to the following standards:

- BS EN ISO14001:2015, Environmental Management Systems;
- BS EN ISO9001:2000, Quality Management Systems;
- BS ISO 45001:2018, Occupational Health and Safety Management Systems; and
- BS ISO 50001: 2018 Energy Management Systems.

The management system ensures that:

- The risks that the activities pose to the environment are identified;
- The measures that are required to minimise the risks are identified;
- The activities are managed in accordance with the management system;
- Performance against the management system is audited at regular intervals; and
- The EP is complied with.

The management system will be reviewed at least every four years or in response to significant changes to the activities, accidents or non-compliance. The management system will be supplemented by this Best Available Techniques and Operating Techniques (BATOT) document that outlines the operating techniques at the site and demonstrates conformance with the requirements of EA guidance.

1.10 Management Structure & Responsibilities

Appendix BATOT01 provides an indicative management structure for the site.

The Chief Executive Officer (CEO) will have overall responsibility for the establishment of environmental policy, objectives and allocation of resources for the operation of the site.

The CEO will be responsible for ensuring that:

- Operational personnel are trained and familiar with procedures and requirements;
- Operations comply with regulation and EP conditions;

- Activities conform with company policy;
- Procedures, logs and records are followed and maintained, as required; and
- Potential improvements are identified & reported back to the UK Operations Manager.

The CEO will also be responsible for ensuring:

- Awareness of potential environmental consequences of activities and operations;
- Familiarity with site procedures and work instructions;
- Working in compliance with procedures;
- Reporting unsafe conditions and potential or actual release arising from unsafe or insecure operational procedures; and
- Cleaning-up and reporting spillages or releases.

In addition, each aspect of the plant, e.g. crushing/screening/reduction kiln/dryer, will have a designated supervisor responsible for control of operations for that part of the plant.

1.11 Technically Competent Management

The management systems in place will ensure that appropriate technical management is in place at the facility and that technical development and training of staff is provided.

Staff will have clearly defined roles and responsibilities. Senior staff involved in mineral processing will be tertiary qualified metallurgists or process engineers with the necessary experience to manage an operation of the size and complexity of Hemerdon MPF.

Competence will be demonstrated by one or more of the following:

- Academic qualifications;
- Professional qualifications;
- Vocational qualifications;
- External training qualification;
- Attendance at external or in house training courses;
- Training by other trained staff;
- Mentoring as part of on the job training;
- Relevant up to date experience.

1.12 Environmental Policy, Objectives & Targets, Improvement Programmes

Details of environmental targets and objectives and the company's environmental policy and improvement programme will be contained within the environmental management system.

1.13 Management Techniques

1.13.1 Operational Control, Preventative Maintenance and Calibration

Compliance with operating procedures will ensure effective control of site operations.

As part of the environmental management system, procedures will be established covering the following general topics:

- Management and training;
- Environmental protection and risk assessment;
- Equipment registers and calibration;
- Defects, non-conformance and complaints; and
- Operations control and equipment maintenance.

A preventative maintenance programme for all equipment will be implemented at the site. This will follow the inspection and maintenance schedule recommended by the manufacturer. The maintenance programme will be reviewed annually to ensure any necessary changes are implemented.

Also held on site will be any operation and maintenance manuals as provided by the equipment manufacturer covering:

- Machinery associated with the operation of the processing plant;
- Routine maintenance procedures and requirements;
- Environmental protection; and
- Emergency procedures.

Where necessary, all monitoring and process control equipment will be calibrated in accordance with manufacturers' recommendations.

1.13.2 Monitoring, Measuring and Reviewing Environmental Performance

Management will review environmental performance to ensure necessary actions are taken.

The CEO will review the facility's environmental performance on a regular basis to ensure policy commitments are met, that policy remains relevant, and to ensure that actions to improve environmental performance are identified. Records of environmental performance will be maintained within an appropriate filing system at the MPF Manager's allocated office, or on an electronic system.

1.13.3 Staffing Competence and Training

The MPF Manager will be responsible for ensuring that training levels for operational staff are adequate, relevant and up to date.

Staff will benefit from training to ensure their professional and technical development. There will be a commitment for staff at all levels to continual improvement, prevention of pollution and compliance with legislation. Training will ensure that staff are aware of:

- The skills and competencies required for each site job;
- Regulatory implications of the EP for the site and their specific work activity;
- Potential environmental effects from operations under normal and abnormal circumstances; and
- Prevention of accidental emissions and action to be taken should emissions occur.

Staff will receive training in:

- Control of point source and fugitive emissions to air;

- Control of odour and noise;
- Monitoring; and
- Health and safety.

Training records maintained by the MPF Manager will be held in the site office.

1.13.4 Communication & Reporting of Actual or Potential Non-Compliance & Complaints

Staff will report non-compliances to the MPF Manager, whose responsibility it will be to ensure that these are rectified and future incidents prevented. The following aspects will be considered:

- Actual or potential non-compliance;
- Suppliers or subcontractors breaking agreed operating rules;
- Incidents, accidents, and emergencies; and
- Other operational system failure.

Remedial actions taken in response to the non-compliance may include:

- Obtaining additional information on the nature and extent of the non-compliance;
- Discussing and testing alternative solutions;
- Modifying procedures and responsibilities;
- Seeking approval for additional resources and training;
- Contacting suppliers and contractors to seek alterations to the way they operate; and
- Informing the EA.

1.13.5 Auditing

A formal internal audit will be carried out by the MPF Manager or suitably qualified nominated personnel to check that all activities are being carried out in conformity with the requirements of the EP. Site audits will ensure that the progress of corrective and preventative actions are regularly monitored and reviewed.

1.13.6 Corrective Action to Analyse Faults and Prevent Recurrence

The MPF Manager will deal with all environmental complaints and other incidents of non-conformance. These include:

- System failure discovered at internal audit;
- Incidents, accidents, and emergencies; and
- Other operational system failures.

Environmental non-compliances, including remedial action taken and any changes to operation made to avoid re-occurrence will be recorded. Complaints will be reported to and investigated by the CEO and remedial measures implemented as required. Changes to avoid future complaints will be proposed and implemented where appropriate. Written records of non-conformances, complaints and other incidents will be maintained in the site log in which the date, time and nature of the event, together with the results of investigations and remedial action taken, will be recorded.

1.13.7 Reviewing and Reporting Environmental Performance

Senior management will review environmental performance annually and ensure that action is taken so that policy commitments are met and the policy remains relevant.

1.13.8 Managing Documentation and Records

The MPF Manager will be responsible for ensuring commitments to site audits and reviews and for ensuring that documents relevant to the EP are issued, revised and maintained in a consistent fashion.

An appropriate filing system will be maintained to ensure that all records relating to environmental monitoring, maintenance, reviews and audits are adequately maintained and updated. All records will be held within the site office and/or a suitable electronic data base.

2.0 Emergency Preparedness and Response Planning

DRL recognises the importance of the prevention of accidents that may have environmental consequences and that it is crucial to limit those consequences. The IMS includes an Internal Emergency Plan and an Emergency Preparedness & Response Plan.

2.1 Action to Minimise the Potential Causes and Consequences of Accidents

An incident management plan will be implemented and maintained to ensure the site staff are fully prepared for such incidents. The accident management plan will be reviewed at least every four years or as soon as practicable after an incident where changes are necessary to minimise the risk of recurrence.

The accident management plan will describe the techniques that will be implemented to minimise the risks posed to the environment. Activities affecting the health and safety (H&S) of operatives, contractors and visitors will be separately managed in compliance with H&S regulation and company H&S policy.

Action will be taken to minimise the potential causes and consequences of accidents. These actions will include:

- A maintained list of substances that could harm the environment if they escape;
- Raw materials and waste will be checked for compatibility with other substances with which they may come into contact;
- Raw materials, products and wastes will be stored so as to prevent their escape into the environment;
- Where appropriate, barriers will be constructed to prevent vehicles from damaging equipment;
- Primary and secondary containment will be provided to prevent the escape of potentially polluting materials;
- Tanks for containing fuels will be fitted with level measurements to prevent overfilling;
- Site security to minimise the risk of unauthorised access;
- A log will be maintained of incidents and near misses;
- Responsibilities for managing accidents will be clearly defined. Clear instructions on the management of accidents will be maintained; and
- Appropriate equipment will be maintained to limit the consequences of an accident.

2.2 Hazard Identification and Mitigation

The following hazards have been identified:

- Plant failure;
- Fire;
- Loss of containment - spillage and leakage;
- Security and vandalism; and
- Flooding.

Mitigation measures for the identified hazards above are presented in the ERA (Ref; 416.10511.00010/ERA), dated November 2022.

3.0 Authorised Activities

3.1 Listed Activities

The following activities, which are listed in Schedule 1 of the EP Regulations, will be carried out at the MPF:

- Section 2.1 Part A (1) (a), Roasting or sintering metal ore, including sulphide ore, or any mixture of iron ore with or without other materials;
- Section 5.4 A (1)(a)(ii), Treatment of non-hazardous waste in a plant with a capacity of more than 50 tonnes per day by physico-chemical treatment;
- Section 3.5 Part B (a), Crushing, grinding or other size reduction of any designated mineral or mineral product.

3.2 Directly Associated Activities

The MPF will also undertake a number of Directly Associated Activities:

- Dense media separation (DMS);
- X-Ray transmission ore sorting
- Grinding, Fines and Floatation separation;
- Pre concentrate dryer;
- Magnetic separation; and
- Ore concentrate separation and final tin concentrate drying.

3.3 Regulatory Guidance

With the adoption of IED into UK regulations there is a period of transition with relevant guidance. Appropriate guidance that covers operation of a Reduction Kiln and associated activities includes the following Sector Guidance Notes and Process Guidance Notes (PGN).

There is little of relevance to concentrate production and reduction kiln, with PGN 3/08 offering the most guidance on general aspects of minerals handling and pre-processing and PGN 3/16(12) offering detailed guidance on mobile crushing and screening.

Table 3-1
Key Technical Standards & Regulatory Guidance Notes

Ref. No	Title	Application
	Develop a management system: environmental permits, Updated 31st August 2022. Control and monitor emissions for your environmental permit: Updated 17th May 2021	Drafting application documents

Ref. No	Title	Application
ERA	Risk Assessments for your environmental permit	Drafting Environmental Risk Assessment – fugitive and point source emissions
H5	Site Condition Report guidance & template, May 2013	Drafting Site Condition Report
EPR 2.03	How to comply with your environmental permit. Additional guidance for: non-ferrous metals and the production of carbon and graphite.	Part A1 – Refining, melting, roasting
PGN 3/08(12)	Statutory guidance for quarry processes. September 2012.	Part B Activities, Emissions to Air as Dust etc. from general quarry and minerals processes.
PGN3/16(12)	Statutory guidance for mobile crushing and screening	Part B Activities, Emissions to Air as Dust etc. from mobile crushing and screening.
PGN 3/18(12)	Statutory guidance for mineral drying and cooling. September 2012.	Part B Activities, Emissions to Air as Dust etc.
EPR 4.03	How to comply with your environmental permit. Additional guidance for: the inorganic chemicals sector.	Part A1 – No direct relevance to ore concentrate processes. Sets Arsenic limit as 1mg/Nm3.
S5.06	Guidance for the Recovery & Disposal of Hazardous and Non-Hazardous Waste	Part A1 – Standards of operation & environmental performance for waste management.
BREF (2017)	Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metal Industries	General guidance on techniques and benchmarks for environmental protection and pollution control.
BREF (2018)	Best Available Techniques (BAT) Reference Document for Management of Waste from Extractive Industries	General guidance on techniques and benchmarks for environmental protection and pollution control.

4.0 Facilities and Process Description

4.1 Overview

The following Drawings provide an overview of the facilities and processes that will be undertaken at the Hemerdon MPF:

- Drawing 002 Environmental Permit boundary
- Drawing 007 Environmental Permit Boundary, Site Layout and Emission Points
- WHP-100-F-000 B Process Flow Schematic
- Figure 1 Outline Process Flow

The MPF is designed to crush and separate mineral ore, which then undergoes a series of physical & chemical processes to remove inert and ferrous contaminants and produce separate tungsten and tin concentrates for export: Wolframite (FeMnWO4) as WO_3 55-60% & Cassiterite (SnO_2) as Sn 50-55%.

The process can be divided into three stages;

- Comminution: Crushing, and Screening to reduce the size of ROM material;
- Coarse Pre-Concentration: Ore Sorting;
- Fine Beneficiation: 2 streams a) DMS & Regrinding, and b) Fines Circuit; and
- Concentrate: Flotation, Reduction Kiln, Magnetic Separation

4.2 Plant Location

The MPF will be located within the wider Hemerdon Mine to the north of the mine pit and to the south of the MWF at the location shown on Drawings 001-005.

The MPF will comprise a number of discrete operational areas:

- Area 115: Primary and Secondary Crushing;
- Area 125: Ore Sorting;
- Area 130: Tertiary Crushing;
- Area 140: Dense Media Separation;
- Area 150: Primary Mill;
- Area 180: Concentrate Milling and Preparation;
- Area 200: Concentrate Dressing; and
- Area 210: Water Treatment.

The layout of the MPF and location of the different operational areas is illustrated on Drawing 007.

4.3 Operating Hours

The MPF will be operational during the following hours:

- Primary and secondary crushers: 07.00 – 22.00 hours 7 days a week;
- MPF processing plant (including ore sorting): 24 hours 7 days a week.

4.4 MPF Building

Drawing 007, shows the main process building. It will comprise a long portal frame building ~125m long, ~20m wide (39m at double width), 23.3m high at the north end and 28.8m high at the south end. Walls and external elevations will be profiled steel cladding.

Plant Building Compliance with BAT

PGN 3.08 (para 5.5) includes a description of techniques to control emissions from buildings. The installation complies with these requirements in that:-

- MPF building will be enclosed to prevent visible emissions.
- Housed plant will be largely sealed on a closed loop system to prevent releases.
- Sealed floors sloping to sumps to collect water spillage & recycle to process.
- Cleaning minimises fugitive emissions and the potential for wind entrainment.
- External plant will be clad with materials that can be cleaned.
- Exhaust ventilation will be ducted to suitable arrestment plant where appropriate.
- Dusty materials will be collected or stored such that dust emissions are minimised.
- Spillages of dusty materials will be cleaned up promptly.

4.5 Process and Plant Description

DRL intends to modify a number of areas of the existing Wolf Minerals process plant identified as being unsuitable or unfit for purpose, and add a new ore sorting section. This section describes each unit process for the new Hemerdon MPF once the envisaged modifications have been completed. Notable changes to the existing process and those operations that will not be modified are highlighted in bold text.

The MPF will, once modified, consist of the following unit operations, (indicated as unchanged - but perhaps with a change of duty - from Wolf Mineral's plant, or modified from Wolf Mineral's plant, or new):

- Run of Mine (ROM) Pad (New);
- Primary crushing (New - modified);
- Secondary crushing (Modified);
- RoM/Primary crushed ore pad and feed section (Modified);
- Classification (Modified);
- Ore sorting (New);
- Tertiary crushing (Unchanged, reduced duty);
- DMS separation (Unchanged, reduced primary DMS duty);
- Deslime and fine gravity separation (Unchanged, reduced deslime and rougher spirals duty);
- Primary milling (Unchanged);
- Pre-concentrate milling (Unchanged);
- Pre-concentrate preparation and flotation (Unchanged);
- Pre-concentrate drying and reduction roasting (Unchanged);

- Low intensity magnetic separation – LIMS (Unchanged);
- High intensity magnetic separation – HIMS (Unchanged);
- Tin circuit (Unchanged);
- Concentrate blending and dispatch (Unchanged);
- Water management & treatment (Unchanged);
- Coarse tailings disposal – 2 types (Unchanged, increased amount);
- Fine tailings thickening and pumping (Unchanged, reduced amount);
- Reagent preparation and dosing (Unchanged, reduced duty);
- Ancillary services (Unchanged); and
- Laboratories (Increased scope).

4.5.1 Run of Mine (ROM) Pad

The new ROM pad will be located to the north of the tertiary crusher building, at the location shown on Drawing 007.

Access to the ROM pad will be directly off the haul road.

The ROM pad will have a capacity of c. 50,000 tonnes.

4.5.2 Primary and Secondary Crushing

The existing primary and secondary hybrid roll crushers within Area 110 cannot reasonably crush hard (or 'Fresh') Hemerdon ore. These roll crushers will be replaced with a semi mobile jaw crusher complete with pre-screen and secondary cone crusher in closed circuit with a screen.

The crusher will be a Metso Outotec's Nordberg C130 semi mobile jaw crusher.

The new crushing circuit will be located to the northeast of the MPF, parallel to the haul road and is to be known as area 115. Area 110/120 of the existing MPF building will be made redundant and no longer operational.

The primary jaw crusher assembly will be mounted on a wheeled frame and include a grizzly screen to remove ore that is already at the correct size for secondary crushing, c.130mm, with the grizzly oversize being crushed through the jaw crusher.

For years 1 and 2, the feed rate to the pre-screen will average c. 600tph based on an operating time of 15 hours per day, from year 3 onwards the throughput is expected to increase to c. 800tph for the same daily operating time. Of the total feed to the crusher, it is estimated that between 50% and 70% will be removed by the pre-screen.

The screen undersize and jaw crusher product will be conveyed to a screen where the -80mm is removed and the +80mm is crushed through a GP300S cone crusher, also supplied by Metso Outotec. The crusher discharge will be conveyed back onto the screen in a closed circuit configuration. As with the jaw crushing configuration, it is expected that screen ahead of the cone crusher will remove a large percentage of the tonnage, estimated at between 60% and 66%.

4.5.3 Secondary Crushed Ore Stockpile

A stockpile of c. 10,000m^3 will be constructed to store -80mm crushed feedstock ahead of ore sorting. This is to allow for suitable redundancy for crusher maintenance without the risk of the plant running out of feed. The stockpile will be located between the new area 115 and the ore sorting area, to the north, northeast of the tertiary crusher building at the location illustrated on Drawing 007.

The stockpile will have 2,000m^3 of "live" capacity with a further 8,000m^3 of "dead" capacity which will require material to be pushed into the feeders with a dozer.

The crushed ore will be reclaimed via 2 feeders located in a tunnel underneath the centre of the stockpile, with the potential for an additional two feeders to be added in the future.

4.5.4 RoM/Primary Crushed Ore Pad and Feed Section

The existing RoM pad will be modified to increase its capacity to 40,000 tonnes, provide better access and allow for the installation of noise abatement measures.

RoM ore will be handled in the RoM area in two ways. The first will be direct tipping, where the haulage trucks will tip their payload directly into the crusher feed hopper without the need for rehandling. The second will involve the haulage trucks tipping their payload onto the RoM Pad in discreet piles or fingers to allow for blending of the crusher feed.

A tracked dozer will push the ore piles so as to be within reasonable reach of the front end loader which will load the RoM ore into the mobile jaw crusher which will in turn discharge the primary crushed ore into the RoM bin with its built- in conveyor.

The RoM bin will be protected by a static grizzly with 115mm openings for the first 2 years, increasing to 150mm in year 3. This crusher assembly is fitted with a rock breaker will be available to break oversize on the grizzly or clear blockages.

The RoM bin will have a live capacity of 90t and will discharge onto an apron feeder with Variable Speed Drive (VSD) which controls the primary crushed ore feed rate into the process plant.

Primary and Secondary Crusher BAT Compliance

It is considered that the appropriate Guidance for mobile crushing and screening is Process Guidance Note 3/16(12) Statutory Guidance for mobile crushing and screening, September 2012.

It is considered that the proposed primary and secondary crushing operations conform to BAT as the crushing, grinding and screening plant have been designed, and will be set up and operated in such a way, that any substances released have the minimum impact on the environment and people. All available techniques have been reviewed and the selection of process equipment and dust control strategies represent BAT.

The overall process design strategy for crushing represents a significant improvement over the previous process operation as there will be a significant reduction in the quantities of material that will need to be crushed. This will be achieved through the use of X-Ray Transmission Ore Sorting, (which rejects barren ore far more coarsely than the existing gravity concentration circuit) and pre-screening.

The crushers have been moved to a location at a greater distance from residential receptors. The nearest residential receptor Galva House is located 996m to the south west. The crushers will be located approximately 4 metres below surrounding ground levels and this will provide protection against the dissemination of noise and dust. There will also be a 2.4m high acoustic barrier on the southern and western boundaries of the crusher area.

All operatives will be appropriately trained to ensure effective supervision of the process.

Further justification that the proposed primary and secondary crushing processes represent BAT in relation to the control of noise and dust is provided in Sections 10.0 and 12.0 respectively.

4.5.5 Ore Sorting – Feed

This section will be a new installation to be located to the south and east of the existing 120 and 130 Areas.

The ore sorter feed will be reclaimed from the stockpile via two variable controlled vibrating feeders from the crushed ore stockpile and conveyed to the Ore Sorter Sizing Screen at a nominal rate of 351 t/h. Pulping water will be added to the ore before it is presented to the screen deck, where it will be wet screened into 3 size fractions namely, 30-80 mm Cobbles, 10-30 mm Pebbles and -10 mm slurry. The -10 mm slurry will be pumped to the Tertiary Crusher Dewatering Screen and further processed through the coarse and fine preconcentration circuits.

The Cobbles and Pebbles discharging from the Ore Sorter Sizing Screen are conveyed to surge hoppers, with a surge capacity of 20 t each. The hoppers are sized sufficiently to provide a stable feed to each individual ore sorter.

4.5.6 Ore Sorting (125 Area)

A new building will be constructed to house the ore sorters and their ancillary equipment to be denominated the 125 Area.

Ore from the Pebble/Cobble hoppers will be drawn out by a variable speed vibrating pan feeder and conveyed at a controlled rate (by weightometer) to the Ore Sorter Dewatering Screen. The aim of the screen is to act as a final polishing screen to remove any adhering fines prior to ore sorting. The Ore Sorter Dewatering screen ensures the screen overflow material is presented to the ore sorter as a mono layer. The single mono layer aids with the detection of Tungsten and Tin bearing ores from waste rock and prevents unnecessary dilution to the ore sorter accepts.

The screen underflow is pumped via the Ore Sorter Fines Area Floor Pump/s to the Ore Sorter Sizing Screen Undersize Hopper.

The ore entering the machine is conveyed at 3m/s through the ore sorter and passed through X-rays, where a rock particle containing tungsten or tin is detected via fast image processing due to its density. Once detected, the valuable mineral is pneumatically ejected by high air pressure nozzles to the accept chute, or commonly referred to as the eject chute. The ore sorter product is conveyed via a series of two conveyors to the Tertiary Crushing Dewatering Screen where it is mixed with the incoming -10 mm fresh feed slurry being pumped from the Ore Sorter Sizing Screen Undersize Transfer Pump.

For Phase 1, 2 cobble ore sorters will process c. 144tph of material before rising to 256tph in year 3 with the addition of an extra sorter. Pebble sorters will treat 93tph of material through 2 sorters in Phase 1, rising to 135tph in Phase 2, again with the installation of a third sorter.

For phase 1, the ore sorter concentrate mass pull will be 9% when processing Mixed Granite and 20% when processing Fresh Granite.

Process water required for the ore sorter preparation screen sprays will be supplied from the main plant process water manifold via a new pipeline.

Area 125 will have its own Motor Control Centre (MCC) and there will be a common control room shared with the Area 115, as well as feedback to the primary Supervisory, Control and Data Acquisition (SCADA) system, located in the control room on the Plant West side of the MPF Building.

4.5.7 Ore Sorting – Product & Waste Transport

The remaining particles/waste rock will drop through the rejects chute where the waste ore/rejects will be conveyed via a series of conveyors to the Ore Sorter Rejects Stockpile. The Ore Sorter Rejects Stockpile will provide a surge capacity of c.12 hours. Where ore sorter rejects will be loaded onto trucks and hauled to the MWF or alternatively, loaded out for further processing to produce aggregates

Weightometers will be installed on ore sorter product and waste conveyors. An ore sorter waste sampling station will also be installed in the transfer tower between the ore sorter waste conveyors.

4.5.8 Tertiary Crushing (130 Area)

There are no changes planned for the existing 130 Area apart from to extend the tail pulley of the tertiary crush product conveyor so as to protrude beyond the back of the 130 building. This is so it can receive ore sorted product from the 125 Area via the ore sorter product conveyor.

The tertiary crushers will be two Sandvik cone crushers, model CH660, operating in parallel.

The feed to the tertiary crushers will be combined natural -10 +8mm nom. oversize and ore sorter product (-80 +10mm nom.), i.e. overflow from the new tertiary crushing sizing screen. The processing objective of the tertiary crushers will be to maintain the material's particle size distribution (PSD) as coarse as possible whilst having a top size of 8mm nom. The tertiary crusher sizing screen will act as the closing screen for the tertiary crush circuit to achieve this.

The tertiary crush feed conveyor will discharge into a surge bin with two outlets. Vibrating pan feeders will be used to control the feed rate to the crushers via feed chutes. The crushers will discharge via chutes to the tertiary crush discharge conveyor which will transport the crushed material back to the tertiary crusher sizing screen.

The 130 Area will be operated through a SCADA interface from the main plant control room where there will also be the tertiary crusher vendor control panel (Automatic Setting Regulation - ASRI).

There is no water requirement in this area apart from that required for washdown.

4.5.9 Dense Media Separation (DMS)

There will be no changes to the DMS circuits in terms of infrastructure, however following introduction of ore sorting, the primary DMS circuits will process approximately 160 t/h to 170 t/h which is about half of the original design. As there are two primary DMS circuits, each capable of processing up to 200t/h they will be run in future as duty and standby circuits.

Ferberite-wolframite and cassiterite will be recovered from the coarse concentrator feed material (-8+0.8 mm) using three stages of dense media (gravity) separation (DMS).

The primary DMS will be a roughing stage, which operates with a separation density of c2.70 t/m3 to remove the un-mineralised or very weakly mineralised (subeconomic to recover) gangue.

The secondary DMS circuit will act as a cleaner stage to upgrade the primary sinks using a separation density of c3.30 t/m^3 to provide a pre-concentrate assaying approximately 35-45% WO_3 and 4-6% Sn..

The floats from the secondary DMS circuit represent a coarse middlings stream.

Primary DMS

Primary DMS feed will be withdrawn from the DMS feed bin at a controlled rate by one of the two primary DMS feeders onto a conveyor. A weightometer on this conveyor will be used to control the speed of the primary DMS feeders.

The material will then be discharged via a splitter onto the primary DMS preparation screen which will be fitted with 0.8mm slotted media and will act as a wet polishing process. Underflow from this screen will be sent to the fines feed circuit and has been estimated to be about 10% of total DMS feed mass. Overflow from this screen will discharge into one or both of the mixing boxes where the feed material will be combined with medium pumped from the medium sump.

The density of the medium will be automatically controlled by a nucleonic density gauge linked via a PID loop to a make-up water valve and is typically, at normal media composition and rheology, 2.42t/m^3.

From the mixing box(es) the combined feed and medium will gravitate to variable speed DMS cyclone feed pumps. The mixed DMS feed pulp will be fed via a distribution system to a DMS cyclone cluster which will contain 2 x 420mm Ø Multotec DMS cyclones without barrels for Phase 1 and 4 x 420mm Ø Multotec DMS cyclones without barrels for Phase 2. Both of these clusters are pre-existing.

The cyclone overflows (containing floats/rejects) will report to the DMS floats screens via a static drain panel. The cyclone underflows (the sinks or product stream) will report to the DMS sinks screens via a static drain panel. All DMS cyclone product screens will have a drain section and a wash section to provide for efficient media recovery.

Underflow from the drain panel and first section of the floats and sinks screens (drain only) will gravitate to the correct medium sumps. Correct medium pumps will provide media to the mixing boxes from this sump, corrected for density through make-up water addition controlled by the density controllers.

Primary DMS floats (floats/rejects) will be discharged to a floats bin which are taken for transport to waste storage.

Primary DMS sinks will report to the secondary DMS feed bin.

Due to the reduction in feed mass flows for the primary DMS circuit, only one primary DMS circuit will need to be operated at any one time.

Secondary DMS

A second dense medium separation stage will be used on the primary DMS sinks operating at a separation density of c3.3t/m^3 to upgrade the sinks concentrate to the desired pre-concentrate tungsten grade.

The secondary DMS process will be similar to that described for the primary DMS separation but will process a lower tonnage and use a different media type owing to the higher separation density required.

The main secondary DMS circuit will use a two-way distribution system feeding two Multotec 360mm Ø DMS cyclones.

The secondary DMS circuit will have similar process control and ancillary circuits and functions as those described for the primary DMS circuits.

Sinks from the secondary DMS will report to the concentrate regrind circuit while the floats (representing the coarse middlings and comprising binary particles) will be processed further by milling to liberate the values followed by scavenge circuit recovery.

Scavenge DMS

A scavenge DMS circuit will also be commissioned to scavenge values liberated through the milling of secondary DMS floats, using a separation density of c.3.30 t/m^3.

The scavenger DMS operation will be very similar to that described for the secondary DMS circuit.

Scavenger DMS sinks will be combined with secondary DMS sinks for milling within the concentrate mill. Scavenger floats will be returned to the primary grinding mill for further size reduction and liberation.

DMS Compliance with BAT

There is no specific guidance on control techniques or BAT for DMS separation. However, general guidance is contained in PGN 3.08 and includes similar reference to techniques that apply to crushing and screening (Section 4.6).

The plant complies with the general principles of PGN 3.08 (para 5.1) in that material is:

- Transported wet;
- Material is transported between plant and the process by enclosed systems; and
- There are normally no visible emissions.

4.5.10 Fines Circuit Stream

Deslime and Fine Gravity Separation (160 Area)

The deslime and fine gravity circuits were substantially modified under Wolf Mineral's tenure of the process plant and the resultant circuits are considered to be close to optimal. **Consequently, there will be no changes made by DRL to the deslime and fine gravity circuits apart from changes of duty.**

With the introduction of an ore sorting phase between secondary and tertiary crushing, masses reporting to the concentrator circuits will be substantially reduced, by about 65%. This will in turn reduce the deslime and rougher spiral duties by a similar amount. This will be achieved by operating one of the two deslime radials at any one time and reducing the number ofstarts on the rougher spiral banks by 30-40%. Pumps will be replaced by smaller units if necessary. No other changes are considered necessary for the existing circuit.

Deslime

Efficient fine gravity separation relies on deslimed pulps being fed to the gravity separation equipment as excessive amounts of fines result in high pulp viscosities which in turn impede the separation processes.

Fines (-0.8mm nom.) pulp will be delivered to the fines tank by fines transfer pumps. Fines will be derived from a number of processes including DMS fines/effluent cyclone underflow, primary mill screen underflow, basement sump pump and option for spiral middlings. The fines tank has a 2,000m^3 capacity, with c. 2-2.5 hours of retention time.

The combined pulps will be pumped, using a pressure controlled slurry pump to the deslime area and distributed to a hydrocyclone radial.

Overflow from the deslime hydrocyclones will discharge to a launder which routes it to the tailings thickener feed box. The underflow from the Hydrocyclones will gravitate to the primary hydrosizer via a boilbox. However, in Phase 1 due to the low flows, the primary hydrosizer will be bypassed and reintroduced in Phase 2.

Spirals

Phase 1

The single size rougher spirals (-800+37µm), of which the coarse spiral circuit will be used, will be fed directly with diluted deslime cyclone underflow at approximately 32-35% solids across 25 Mineral technologies MG6.3 spiral starts. The rougher spiral concentrate will be pumped to the multi spigot hydrosizer, whilst the middlings are re-pulped and passed over c10 MG 6.3 middlings spirals. The rougher tailings gravity flow to the thickener feed box.

The middlings spirals concentrate join the rougher spiral concentrates and feed the multi-spigot hydrosizer, whilst the middling spirals middlings and tailings gravity feed to a hopper and are pumped to the thickener feed box.

Phase 2

The primary hydrosizer will receive -800+37µm nom. pulp feed from the deslime radial underflow at about 60% solids.

The hydrosizer will work through a process of up-current elutriation which forms a teeter bed within the hydrosizer tank. Density probes will be linked to the discharge valve system and maintain the teeter bed level combined with teeter water flow introduced into the base of the tank through nozzles. Overflow will discharge over a weir at the top of the tank. The nominal D_{50} cut point design for the primary hydrosizer will be 150µm and therefore two fractions will be produced: a -800 +150µm nom. underflow as coarse spirals feed; and a 150 +37µm nom. overflow as fine spirals feed.

The coarse spirals feed will gravitate to the coarse spirals feed hopper from where it will be fed to the coarse rougher spirals feed distributor. Make-up water will be used to provide the ideal spirals feed density of about 35% solids.

The fine spirals feed will gravitate under natural pressure to a mini-hydrocyclone radial where it will be thickened to provide optimal spirals feed density of about 35% solids. The underflow from the mini-radial will gravitate into the fine spirals feed hopper from where it will be fed to the fine rougher spirals feed distributor. Overflow from the mini-radial will be used to dilute the coarse spirals feed.

The coarse rougher spirals will consist of one bank of 11 triple start MG6.3 Mineral Technologies spirals fitted with re-pulpers and concentrate, middlings and waste cutters / discharges.

The fine rougher spirals will consist of two banks of 11 triple start MG6.3 Mineral Technologies spirals fitted with re-pulpers and concentrate, middlings and waste cutters / discharges. Waste from both rougher spirals streams will gravitate via a launder to the thickener.

Middlings from each of the rougher spirals streams will gravitate via launders to their respective middlings spirals feed distributors from where it will be fed to the fine and coarse middlings spirals banks.

The coarse middlings spirals will consist of one bank of 10 triple start MG6.3 Mineral Technologies spirals with re-pulpers and concentrate, middlings and waste cutters / discharges.

The fine middlings spirals will consist of one bank of 12 triple start MG6.3 Mineral Technologies spirals with re-pulpers and concentrate, middlings and waste cutters / discharges.

Middlings from the middlings spiral will be sent for reprocessing in the spirals circuits or to the spiral middlings circuit for processing elsewhere on the plant (mills or fines tank). Tailings from the middlings spirals will gravitate to the spiral tails hopper from where it will be pumped to the spiral tailings launder and then on to the thickener.

Concentrate from the coarse and fine spirals streams, from both rougher and middlings spirals, will gravitate to the feed distributors for the cleaner spirals. The coarse cleaner spirals will comprise 2 x triple start VHG Mineral Technologies spirals and the fine cleaner spirals will comprise 4 x triple start MG6.3 Mineral Technologies spirals. Concentrate from the cleaner spirals will gravitate to the spiral concentrate hopper from where it will be pumped to the multi-spigot Hydrosizer (MSHS). Cleaner spiral tails will be recirculated back to each spiral circuit's feed hoppers for retreatment.

Tables

Cleaned combined spiral concentrates (fine and coarse, rougher and middlings) nominally -800+37µm (lower size for quartz, finer for pay minerals) will be pumped to the multi-spigot hydrosizer (MSHS) for hydraulic sizing prior to feed to the shaking tables.

The MSHS will have 5 compartments, the first for feed reception and then 4 cells with increasing sizes and reducing up-current flows to provide underflows of different sizes. The MSHS, like the primary hydrosizer, will work through an up-current elutriation principle with teeter water introduced through the base of each cell through nozzles. The up-current created will hinder settling of particles beneath a certain hydraulic size forming a teeter bed which will be monitored by a density probe.

Coarser particles will be discharged through spigots at the base of the cell whilst finer particles will overflow to the next cell. Three nominally sized fractions (based on quartz sizes) will be produced, they being nominal -800 +350µm (very coarse table feed), -350 +150µm (coarse table feed), -150 +63µm (medium table feed) and -63+32µm (fine table feed). The -32µm will discharge from the MSHS overflow to the thickener feed box.

The hydraulically sized table feeds will be gravity fed to their respective shaking tables which will be full sized Holman Wilfley 8,000 models fitted with sand (for coarse and medium feeds) or fine sand decks (for fine feeds).

A total of 12 tables are used as detailed below:

- Very Coarse Rougher Table x2;
- Coarse Rougher Table x 2;
- Medium Rougher Table x 2;
- Fine Rougher Table x 2;
- Coarse Middlings (or Cleaner) Table;
- Medium Middlings (or Cleaner) Table;
- Fine Middlings (or Cleaner) Table; and
- Fine Cleaner (or re-Cleaner) Table (160-TB-05).

Table tails will be recirculated back to the spirals circuits. Final table concentrates will be recombined and then pumped to the concentrate milling circuit.

Fines Circuit Stream Compliance with BAT

There is no specific guidance on control techniques or BAT for fines circuit stream. However, general guidance is contained in PGN 3.08 and includes similar reference to techniques that apply to crushing and screening (Section 4.6).

The plant complies with the general principles of PGN 3.08 (para 5.1) in that material is

- Transported wet;
- Material is transported between plant and the process by enclosed systems; and
- There are normally no visible emissions.

4.5.11 Grinding & Regrind

Primary Milling (150 Area)

There are no proposed changes to this operation other than reduced duty.

Secondary DMS floats will report by gravity to the primary mill discharge hopper. The floats will combine with the primary mill discharge pulp before being pumped to the primary mill sizing screen. This screen will be double decked with the purpose of providing a top deck overflow for processing in the scavenge DMS); a lower deck overflow for return to the primary mill (i.e. the mill's closing circuit); and a lower deck underflow (-0.8mm nom.) which will be sent to the fine gravity circuit.

The primary mill will be an Ersel 2,850mmØ x 4,250mm long unit with a discharge grate. There will be a scats trommel fitted withs scats discharging to a removeable bin. 75mm ball grinding media will be introduced into the mill feed chute via a manually operated kibble.

Pre-Concentrate Milling (180 Area)

DRL does not intend to change the concentrate mill circuit on restart of the plant.

The purpose of the concentrate mill will be to liberate minerals from the DMS concentrate and coarser fine gravity concentrate binaries.

Secondary (and in future scavenge) DMS sinks will be conveyed to the DMS concentrate mill feed hopper from which material is drawn with a belt feeder to the concentrate mill feed launder. This will feed the concentrate regrind mill which will be an Ersel 1,500mmØ x 1,540mm long unit configured with an overflow discharge. The grinding medium will be 65mm balls.

The discharge from the mill will be pumped to the concentrate regrind sizing screen which will be a Derrick StackSizer repulping screen fitted with 400µm screening media. Fine gravity final table concentrates will also be pumped to this screen. Underflow (-400µm nom.) from the screen will gravitate to the flotation feed hopper. Overflow from the screen will be returned to the concentrate mill. Scats will be discharged from a trommel and gravitate to a removeable bin.

Grinding and Regrinding Compliance with BAT

PGN 3.08 (Section 3.2) referring to exclusions (para 3.2) notes "Crushing, grinding, screening and grading of wet material is not normally likely to result in the release into air of particulate matter except in a quantity which is trivial." However it does provide indicative guidance for BAT.

The mills complies with PGN 3.08 (para 5.1) in that material is

- Product is processed and transported wet;
- Grinding mills are enclosed; and
- There are normally no significant visible emissions.

SGN 2.03 (para 3.2) indicates filters (and cooling) for dust arrestment (of dry materials) in off-gas. This is not provided as BAT in that the room temperature and wet nature of material handled and that the milling will be enclosed, prevents dust emission.

4.5.12 Pre-Concentrate Preparation and Flotation (180 Area)

Drakelands Restoration does not intend to change the flotation and filtration circuits on restart of the plant.

Milled (-400µm nom.) combined pre-concentrates will be pumped to the flotation dewatering hydrocyclone. Overflow from this cyclone will gravitate to a Constant Density (CD) tank, whilst the cyclone underflow will discharge into the conditioning tank. The CD tank underflow will gravitate to the agitated flotation conditioning tank whilst the overflow will join the flotation froth and will be pumped to tailings.

The flotation process employed will be reverse - designed to float sulphide minerals (such as Arsenopyrite, Iron pyrite and some minor Copper sulphides) from the tungsten and tin preconcentrates which report to float cell underflows. Copper sulphate activator and sodium ethyl xanthate (SEX) collector will be dosed into this tank. The overflow from the conditioning tank will gravitate to the first of 3 flotation cells which will be Outotec 1.5m^3 units with agitators and forced aspiration. Methyl Isobutyl Carbinol (MIBC) frother will be dosed into the first flotation tank.

Underflow from the flotation cells will gravitate to the concentrate filter belt, via an autosampler, which dewaters the concentrate pulp using a vacuum applied to the rear of a moving permeable conveyor belt.

Overflow from the flotation cells (containing the sulphide minerals) will combined with the CD tank overflow and be pumped to the tailings thickener by use of one of the two (duty/standby) flotation rejects pumps.

Flotation Compliance with BAT

None of the guidance (Section 3.2) provides control technologies or suggests BAT for froth flotation except to note that flotation can lead to the generation of tailings – waste slurries that remain after treatment.

Management and treatment of tailings at the MWF to thicken and remove water and manage final disposal will be covered in the EP for the MWF.

4.5.13 Thermal Treatment & Magnetising

Pre-Concentrate Drying and Reduction Roasting

DRL does not intend to change the pre-concentrate drying and reduction roast circuits on restart of the plant. However, initially on re-start of the MPF the reduction kiln will operate in dryer mode only.

Damp filtered pre-concentrate from the 180 Area will discharge via a screw feeder into the pre-dryer which is a Drytech diesel fired indirect rotary dryer with feed spirals and lifters.

Off gas from the pre-dryer (water vapour) will be vented to atmosphere via a dedicated stack.

The pre-dryer will discharge via a screw feeder and then the material will be elevated using a bucket elevator to a hopper ready for feed to the reduction kiln. The major contaminant in the concentrate at this point will be haematite.

The reduction kiln (200-KN-01) will be a Drytech diesel-fired indirect rotary kiln, 1.1m Ø x 13m long with a throughput capacity of 2t/h and which operates at a temperature of up to 700 °C.

The process objective of the kiln is the reduction of the contained hematite ($Fe^{3+}{}_2O_3$) to magnetite (Fe_3O_4 = Fe2+,Fe3+ O), which has a higher magnetic susceptibility than haematite and therefore readily removed by low intensity magnetic separation. This is based on the reaction of a reducing gas (carbon monoxide) with hematite at c650°C converting part of the Fe3+ to Fe2+ per the following reaction:

3Fe2O3 + CO→2Fe3O4 + CO2 (Activation Energy Required (ΔEa) = 48.7 kJ/mol Fe2O3).

Off gas from the kiln will be directed via ducting to a sealed off-gas cyclone circuit for dust removal and then via heat-traced lagged ducting to an incinerator and the off-gas scrubber. The heat traced lagging will maintain the ducting at least 450°C to prevent sublimation of arsenic oxides on the duct walls. Gas exiting from the scrubber will be passed through a baghouse to remove all traces of dust before being vented to atmosphere via a dedicated stack.

Off gas scrubber wash down water and dust from the baghouse will be processed through the waste water treatment plant to remove all traces of arsenic through a stabilisation, precipitation and filtration process. As a first stage this will involve reaction with ferric sulphate in an acid medium, followed by addition of hydrogen peroxide and lime slurry to precipitate the arsenic and neutralise the pulp. WM3 classification has shown that dewatered discharges from the water treatment plant is classified as non-hazardous (or something suitable, reference etc). Subject to EA approval, the dewatered tailings will be reintroduced to the tailings stream and deposited within the MWF.

Reduced concentrate will discharge from the kiln to a quench circuit and will then be lifted with a bucket elevator to the low intensity magnetic separation feed area.

4.5.14 Low Intensity Magnetic Separation – LIMS (200 Area)

DRL does not intend to change the LIMS circuit on restart of the plant.

The reduced concentrate is fed to a dry low intensity magnetic separator which will be an Eriez drum type, operating at a magnetic field strength of 800 Gauss. The objective of this process is to remove iron contamination from the concentrate, possible through low intensity magnetic techniques by the conversion of hematite to magnetite during the reduction roasting process. The LI magnetic fraction (in principle magnetite) will gravitate to bags located in the plant basement. The LI non-magnetic fraction, including the pay minerals ferberite-wolframite and cassiterite, will discharge onto a dry Derrick screen fitted with 150µm screen media for separation into fine and coarse HIMS feeds.

4.5.15 High Intensity Magnetic Separation – HIMS (200 Area)

DRL does not intend to change the HIMS circuits on restart of the plant.

Ferberite-wolframite is paramagnetic and can be separated from the non-magnetic cassiterite and most gangue minerals using high intensity magnetic separation. LIMS non-magnetics will be dry screened at 150µm nom. using a Derrick screen to provide coarse HIMS feed and fine (-150 +0µm nom.) HIMS feed.

The coarse HIMS feed will be distributed 4 ways to four Eriez VOG, model 3.400S, rapid disc high intensity magnetic separators which have 570mm diameter discs and adjustable electromagnetic field strengths of up to 1.8 Tesla over 4 electromagnets on each unit. Each unit will produce a tramp fraction, then 6 products, (the result of increasing magnetic fields through the separator) discharging into drums, and finally a non-magnetic fraction. The products will have differing tungsten grades and as such the product drums will be stockpiled in grade ranges for later blending to provide the desired export grade.

The fine HIMS feed will be distributed 5 ways to 5 Eriez HIMS machines similar to those in the coarse HIMS section and the process will be identical to that described for coarse HIMS separation.

The non-magnetic HIMS fractions (comprising cassiterite and non-magnetic gangue) will be transported using feeders to the fine and coarse tin concentrate hoppers.

Magnetic Separation Compliance with BAT

None of the guidance (Section 3.2) provides control technologies or suggests BAT. The BREF notes that magnetic separation is commonly used in mineral processing.

Thermal Treatment and Magnetising Compliance with BAT

Guidance PGN 3.08 (Section 3.2), general guidance, notes (para 5.20) that stack discharges may achieve an exit velocity of <15m/s provided that there is adequate dispersion.

Guidance PGN 3.18 (Section 3.2) gives guidance on drying and cooling of minerals though generally covers plant of a much greater capacity (up to 50 times larger). However, it is a helpful guide to the control of emissions into the air from small dryers.

Guidance indicates that whilst fluid bed dryers are indicated for higher throughputs (50- 100 tonnes per hour) Rotary Dryers are often preferred for rates below 30 tonne per hour.

Benchmark emission limits for mineral dryers include:-

- Particulate Matter 50mg/m3 – Bag Filters are BAT for arrestment plant (Para 5.3).
- No visible emission across the site boundary.

Guidance specifies that combustion equipment should be maintained to minimise smoke during start up and shall be free of offensive odour. Indicative monitoring (eg differential pressure across bag filters) is suggested, but this is generally for much larger plant.

Control techniques primarily relate to the control of dust before and after drying (eg stockpiles, transfer points, silos, conveyors, wheel washers etc. Whilst not entirely relevant the process does meet BAT criteria for enclosure and extraction to dust arrestment (para 5.11) and elevated discharge (para 5.23 & 5.27).

Concentrate Filtration and Drying Compliance with BAT

None of the guidance (Section 3.2) provides direct control technologies or suggests BAT.

Guidance PGN 3.18 gives guidance on drying and cooling of minerals. Though generally for plant of a much greater capacity (over 100 times larger) guidance notes that Rotary Dryers (the proposed technology) are usually preferred for rates below 30 tonne per hour.

Benchmark emission limits for large mineral dryers include:-

- Particulate Matter 50mg/m^3 – Bag Filters are BAT for arrestment plant (Para 5.3).
- No visible emission beyond the site boundary.

Guidance specifies that combustion equipment should be maintained to minimise smoke during start up and shall be free of offensive odour.

Control techniques primarily relate to the control of dust before and after drying (eg stockpiles, transfer points, silos, conveyors, wheel washers etc. The process meets BAT criteria for enclosure and extraction to dust arrestment (para 5.11) and elevated discharge (para 5.23 & 5.27).

4.5.16 Tin Circuit

DRL does not intend to change the tin circuit on restart of the plant.

Fine and coarse tin concentrates will be fed to the respective tin tables for upgrading. The tables will be full sized Holman Wilfley 8,000 models fitted with a sand deck (for coarse feed) or a fine sand deck (for fine feed).

Concentrate pulps from the tables will be combined and then gravity fed to a vacuum filter belt. The filter belt cake will discharge into a hopper and then a screw feeder will transport the tin concentrate to a dryer which will be a Drytech diesel fired rotary dryer (200-DR-02), 0.6 m Ø x 5.0 m long with a rating of up to 588 kg/h.

Discharge from the dryer will gravitate to an Induced Roll Magnet (IRM) from where the entrained ferberite will be extracted from the cassiterite to provide a tin concentrate of suitable grade for export. The extracted ferberite from the IRM will be added to the stocks produced from the HIMS. Tin table tailings pulp will be returned by pumping to the multi spigot hydrosizer in the 160 Area for scavenging.

4.5.17 Concentrate Blending and Dispatch (200 Area)

DRL does not intend to change the concentrate blending and dispatch operations on restart of the plant.

Tungsten concentrate drums will be selected by WO3 grade and then placed in bins from where the grades will be blended into a final product bin via a tubular feeder to achieve the desired export grades in terms of tungsten content and deleterious (penalty) elements where applicable. The feed into the final product bin will be sampled using an autosampler to provide tungsten shipment samples. The blended concentrates will then be bagged in bulk bags ready for dispatch.

Tin concentrates will be blended with the same system as the tungsten, with the concentrate bins cleaned in between the tin runs.

4.5.18 Fine Tailings Thickening and Pumping (210 Area)

DRL does not intend to change the fine tailings thickening and pumping operations other than a reduction in the total mass generated.

The total mass of tailings generated by the proposed operations will be c50tph, significantly lower than that generated by the original plant design (242t/h for 'Soft Ore' and 179t/h for 'Hard Ore')

The reason for this is the inclusion of ore sorting in the proposed process.

DRL will review the duties for the tailings pumps (210-PP-01 to 04) to see whether the existing pumps are still suitable for the lower flows. If not, they will be replaced with smaller pumps.

The thickener will be an Andritz Delkor HR25/210 high-rate thickener with the main feeds gravitating into it via launders. Polyacrylamide flocculant will be prepared for dosing in the reagent preparation area (Area 360). Underflow will be discharged from the underflow cone at a controlled rate by a pinch valve into the tailings thickener underflow hopper via a two stage autosampler.

The thickened pulp will then be pumped using a two-stage system with duty and standby pumps to the tailings management facility.

Clarified tailings thickener overflow will gravitate to the process water tank for recycling to the process plant. A sump pump located in the tailings area bund will return spillage to the thickener.

4.5.19 Coarse Tailings Disposal

DRL does not intend to change the coarse tailings disposal operation…

Coarse tailings will comprise two types as follows (with estimated masses for the Mixed ore and Fresh ore scenarios):

- Ore sorter Waste (-80 +10mm nom.) - 216t/h Mixed, 321t/h Fresh,
- Primary DMS Floats (-8 +0.8mm nom.) - 82t/h Mixed, 111t/h Fresh.

Primary DMS floats will be discharged from the DMS float bins using actuated gates into haul trucks for disposal in the MWF.

4.5.20 Reagent Preparation and Dosing (360 Area)

DRL does not intend to change the reagent preparation and dosing…

The chemicals will be prepared for dosing in the 360 reagent preparation area.

Details on the ferric sulphate, sulphuric acid and hydrogen peroxide preparation and dosing will be included in Section 4.5.23 Water Management and Treatment.

4.5.21 Electricals & C&I (370 and 375 Areas)

The Hemerdon site will be supplied power from the UK national grid via a dedicated 33kV feeder terminating in a private sub-station which is managed by Western Power. Power will be stepped down to 11kV by a private 33/11kV 8MVA ONAN transformer to supply an 11kV MV distribution system. Each main plant area will have a dedicated 11kV/415V ONAN transformer supplying a containerised Eaton MCC. The MCC's will each have a GE RX3i PLC controller linked together via a network cable which in turn will be linked to the SCADA which is a Proficy HMI/SCADA iFIX, Proficy Historian and Operations Hub.

Power for the Tory Pond and Loughter Mill pumping stations will be supplied from the existing local grid via separate metered supplies feeding local step down transformers.

The process plant will be fitted with a large amount of instrumentation, actuated valves, VSD motor drives and other automation which allows the principal process streams to be mainly operated from SCADA in a single control room.

Appropriate changes will be made to the electrical and control & instrumentation systems to accommodate the proposed changes to the process plant.

4.5.22 Water Management & Treatment (390 and 391 Areas)

DRL does not intend to change the water management and treatment operations.

The process plant has been designed so as to maximise the recirculation and re-use of water modelled to be in the region of 90%.

This will be accomplished by the routing of all waste water flows through the thickener, clarified overflow from which will be returned to the process water tank.

Process water requirement for the as-built Wolf Minerals plant was estimated at 2,087m^3/h for soft ore and 2,123m^3/h for hard ore. DRL estimates that these requirements will reduce by approximately 625m^3/h with the introduction of ore sorting resulting in approximately half duties for the deslime and primary DMS processes, representing reductions of c400m^3/h and 225m^3/h respectively.

Water will be returned to the process water tank from the MWF, tailings storage section, at a rate of 80 to 110m^3/h subject to evaporation and other losses.

Raw water will be required for certain parts of the process and make-up to the raw water tank can be supplied from a number of sources including from pump stations at Tory Pond and at Loughter Mill. The amount of water required from these sources was modelled at 60 to 80m^3/h.

Process Water

Tailings thickener overflow will report by a launder arrangement to the process water tank which is 23.0m in diameter x 8.3 m high, having a live capacity of 2,800 m^3. This will equate to about 2 hours storage capacity with no inflows.

Clarified fine tailings water will be returned to the process water tank by pumping from the MWF settling pond. The level will be topped up by inflow from the raw water tank.

Water will be supplied to the plant process water manifold by 3 x 12" KSB pumps which may be run independently or in parallel subject to water demand. On full operation the volume duty for these pumps is expected to be about 1,400m^3/h. Process water will be used on all processes on the plant which do not require clean water.

Raw Water

The raw water tank will be 4.5m in diameter and 10m high, having a live capacity of 150m^3. It will be fed through return of water from the water treatment plant and topped up by supplies from Tory Pond or Loughter Mill.

Water will be returned to the raw water tank from the water treatment plant at a rate of between 40 and 60m^3/h.

Raw water will be supplied to the process plant using 2 x 3" KSB pumps which may be run independently or in parallel subject to water demand. Raw water will be used in parts of the process that require clean water, including reagent mixing, filtration (cloth washing), off-gas scrubber and cooling water, gland water, and the final rinsing stages on screens where waste products will be produced.

Gland Water

The gland water tank will be 1.85m in diameter and 2.35m high, having a live capacity of 5m3. It will be fed through a bleed off from the raw water delivery line. Gland water will be supplied to the process plant using 2 x 2" KSB pumps and 2 x 1.5" KSB pumps which may be run independently or in parallel subject to water demand. Gland water will be used for sealing the pump shaft glands.

Water Treatment Plant

Wastewater containing arsenate precipitates from the off-gas scrubber will be directed to the Siltbuster water treatment plant (390-WP-01 or Water Treatment Plant - WTP) where the arsenates will be stabilised through the addition of ferric sulphate in an acid environment (addition of sulphuric acid) followed by their oxidisation with hydrogen peroxide solution to provide a stable ferrous arsenate precipitate.

A stream from the process water manifold can be added to the WTP feed so as to conduct continuous cleaning (of arsenic) of the process water.

The precipitate from the WTP will be filtered to a cake using a filter press and subject to EA approval will be reintroduced to the tailings stream and deposited within the MWF.

Potable Water

Potable water supply will be provided by a pipeline from the local water utility company (SW Water) and distributed on the site as required.

Changes to the process flows may result in the need for smaller pumps.

4.5.23 Air Services (420 Area)

Three electric driven 75kW Atlas Copco GA series screw compressors will supply compressed air to the plant air receivers (three in number) via filters and dryers.

Operation of the compressors will be dependent on demand with the third unit acting as a standby unit.

There will be one receiver for each of the plant air manifold (2,000 litres), instrumentation (500 litres) and kiln (2,000 litres) compressed air circuits. One of the two blowers will supply low pressure air to the concentrate flotation circuit.

4.5.24 Ancillary Services (440 Area – Workshops & Stores)

DRL does not intend to change the ancillary services on restart of the plant.

There is an existing workshop and stores area which will be converted into a plant workshop with specialised areas for electricals, control & instrumentation, pumps, component overhaul, machine shop, and welding and fabrication.

4.5.25 Laboratories

DRL intend to increase the use of the laboratory on site on restart of the plant.

The existing site laboratory and sample preparation facility will be refurbished and re-equipped to be operated by Drakelands Restoration and not an external contractor as per the Wolf operations. The laboratory will provide accurate analytical services to the geological, production and metallurgical teams to allow for efficient running of the whole operation.

There will also be an adjoining metallurgical laboratory that will allow the technical team to conduct onsite test work to identify and test process improvements.

5.0 Infrastructure & Equipment Inventory

5.1 Site Identification Board

A site identification board that is easily readable from outside the site entrance during hours of daylight will be provided at or near the site entrance.

The identification board will be inspected at least once per week. In the event of damage or defect that significantly affects the legibility of the board it will be repaired or replaced within a timescale agreed with the EA.

The board will display the following information:

- Site name and address;
- EP holder;
- EP number;
- Emergency contact name and telephone number; and
- EA national telephone numbers.

5.2 Engineered Containment System

5.2.1 Surfacing

The inside of the processing buildings will benefit from an engineered containment system comprising an impermeable concrete flooring with engineered falls towards grated drains or blind sumps that can pump collected water into the process water system.

5.2.2 Sub Surface Structures

The precise locations of subsurface drains, pipework, interceptors and tanks will be established and recorded and relevant documentation maintained in the site office. An inspection and maintenance programme for all subsurface structures will be followed and records will be maintained by the MPF Manager.

Bunds

Bunds and other means of containment will be provided for all tanks containing liquids whose spillage could be harmful to the environment. IBCs typically will be stored internally and/or on spill trays as appropriate. For larger or fixed tanks bund walls will be constructed of suitable materials to prevent harm to the bund (e.g. resin lined for acid storage areas).

5.2.3 Management and Operational Techniques

Containment engineering will prevent the release of potentially polluting liquids to surface water and groundwater. Plant operatives will undergo awareness training to ensure a full understanding of the containment engineering which will minimise the environmental impact of the site. The engineered containment system will be subject to routine visual inspection. Identified breaches in the engineered containment will be remedied to ensure continued integrity of the facility, and to prevent pollution of surface or groundwater.

5.3 Engineered Drainage and Management System

5.3.1 Surface Water Management System

Surface water is described in Section 13.1.

Drawing 006 shows the general arrangement for surface water management at the MPF. No trade drains or discharges are shown as the MPF will not produce an effluent.

Clean surface water run-off (stormwater) in the yard area will fall towards Smallhanger Pond north and thence into Smallhanger Brook. Hemerdon mine surface water management system will be managed under the existing Planning Permission, the EP for the MWF (Section 1.4) and/or under existing consented discharges to surface water.

5.3.2 Engineered Drainage

The MPF building will be constructed on an impermeable surface with appropriate falls to sealed collection drains and sumps. Water collected will be pumped back to the process water system. There will be no provision for off-site disposal of water.

5.3.3 Sewage & Foul Water

Effluent discharge from welfare facilities and offices is outside the scope of this EP application, but will be managed using a standard package treatment plant under a sewage effluent discharge EP.

5.3.4 Process Water

The water management system description is included in Section 4.5.23 above.

5.4 Plant and Equipment

A detailed schedule of plant and equipment is listed in Appendix BATOT02. The list does not include mobile plant used for general transport. All items of plant and equipment will be maintained in accordance with the manufacturer's recommendations.

6.0 Raw Materials

6.1 Inventory of Raw Materials

Table 6-1 lists the main raw materials used, their application, volume used per annum, storage method, maximum quantity stored on site, frequency of delivery and risk characteristics. Additionally, the site will typically retain small amounts of general purpose materials such as wood, aggregate, metal, cement etc. for routine repairs

The processing plant will be supplied by external manufacturers and will have recommended maintenance programmes that dictate the use of replacement parts.

Raw materials will be recorded and assessed for their environmental impact prior to use. A Control of Substances Hazardous to Health (COSHH) assessment will be undertaken prior to the use of chemicals and added to the COSHH inventory, as appropriate.

Table 6-1
Inventory of Raw Materials

Reagent	Use	Volume /year (t)	Storage Method	Maximum Quantity Stored on Site	Frequency of delivery	Risks
Copper Sulphate (20-30% Solution)	Flotation activator	0.67	25kg bags in container / shed	1	3 times per year	Irritant, Ecotoxic
Xanthate (20-30% Solution)	Flotation promoters	1.35	25kg bags in 210L drums. container / shed	1	3 times per year	Combustible, Irritant
Frother (10-30% Solution)	Flotation media	0.07	20l Drums	0.3	1 time per year	Irritant, Ecotoxic
Flocculant (polyacrylamide)	Slimes & Fines Thickener	36.3	700kg bags in container / shed	7	5 times per year	Irritant
Lime Putty	WTP pH Control	35.5	1m^3 bags stillage in container / shed	20	6 times per year	Corrosive
Ferrosilicon	Carrier for ore separation	409.0	1m^3 bags in container / shed	50	Every 3 weeks	Irritant
Magnetite	Carrier for ore separation	136.0	1m^3 bags in container / shed	18	4 times per year	Irritant

Reagent	Use	Volume /year (t)	Storage Method	Maximum Quantity Stored on Site	Frequency of delivery	Risks
Ferric Sulphate (30-60% Solution)	WTP coagulant	163.2	Bulk liquid stored in specialist tanks	21	2 per month	Corrosive, Irritant
Hydrogen Peroxide (~35% Solution)	WTP oxidiser	35.5	1m IBC stored in shed / container	20	4 times per year	Corrosive
Diesel (Therma 35)	Heating oil	511	Self bunded containerised diesel tank	30	2 times a month	Flammable
Diesel	Vehicle Fuel					Flammable
Sulphuric Acid	ASTP pH Control	84.4	Bulk liquid stored in specialist tanks	10	4 times per year	Corrosive
Grinding Media	Primary and Regrind Milling	320	210 l Steel drums, stored externally	20	6 times per year	N/A
Potable Water	Various	500	South West Water (SWW) Mains	2.3	SWW Main Supply	N/A
Raw Water	Top up & process	823090	Flat bottom Steel tank 150m^3	150	Tory Pond Loughter Mill WTP Return	N/A
Process Water	Process		Flat bottom Steel tank 2800m3	2600	Decant Return	N/A
Compressed Air	Flotation Blower	N/A	N/A	N/A	N/A	N/A
LPG		1	86 & 34KG bottles held in the bottle store	0.2	15 times per year	Flammable
Lubricating Oil		3	25Ltr and 205Ltr drums in the Bunded oil store	1.5	12 times per year	Flammable
Hydraulic Oil		2.5	25Ltr and 205Ltr drums in the Bunded oil store	2.5	6 times per year	Flammable
Glycol		0			0	

Reagent	Use	Volume /year (t)	Storage Method	Maximum Quantity Stored on Site	Frequency of delivery	Risks
General Products		1.5	400g cartridge and 400ml Aerosol	0.6	35 times a year	Flammable

Material Safety Data Sheets (MSDS) for potentially hazardous materials or chemicals will be held on site with the COSHH register. The MSDS gives information on how chemicals should be handled, stored and disposed of, and what to do in the event of an accident.

6.2 Raw Materials Selection

Wherever possible, raw materials will be selected to minimise environmental impact. Consideration will be given to such factors as degradability, bioaccumulation potential and toxicity. Reviews will be periodically undertaken to ensure that all raw materials are appropriate for use, that consumption is optimised and that opportunities for reduction and improvements are implemented.

Reviews of alternative raw materials will include assessment of environmental impact. Where there are no quality or commercial requirements, substitution will be given full consideration. The on-going programme of professional and technical development for all site personnel will ensure awareness of new developments in product availability and their implications.

6.2.1 Waste Minimisation (minimising the use of raw materials)

The objective of the MPF is to recover and concentrate the maximum amount of valuable mineral whilst minimising the quantity of waste processed and raw materials used.

To achieve this, naturally-occurring materials extracted with the ore will be removed as early as possible at a coarse size and taken to the MWF by dump truck. This ensures that energy and other raw materials will not be wasted on processing. Fine waste materials will be thickened in order to recover water for reuse and to minimise water loss. This will also prevent particulate entering surface water.

Management of mining and mineral waste at Hemerdon has been the subject of a separate Mining Waste Directive EP.

The nature of the installation facilitates the minimisation of waste and the maximisation of mineral recovery using the minimum quantities of raw material necessary to satisfy this requirement. The potential for further minimisation of materials usage is limited.

Waste minimisation is defined as ‘a systematic approach to the reduction of waste at source, by understanding and changing processes and activities to prevent and reduce waste’. The efficiency of the process at the Hemerdon MPF is dealt with in other sections of this report; where it can be seen that effective methods will be implemented to reduce waste.

Notwithstanding this, the waste generation at the site will be reviewed annually and where necessary an appropriate improvement programme will be implemented.

6.3 Water Use

Section 13.3 provides a detailed description of the process water cycle. Section 5.3.1 provides a general description of surface water management. The primary requirement for water will be for the transport of mineral through the beneficiation process including the separation screens, cyclones, spirals, tables, etc. Other requirements will be for general plant cleaning, washdown and welfare facilities.

There will be a substantial system for the recovery and re-use of water. The small amounts of water that cannot be recovered will be:-

- Water evaporated in the dryers; and
- WTP solids/slurry with water that is not completely removed from discharge.

The process will be a net importer of water effectively imported from stormwater (raw water). During periods of low water storage, the process water system can be topped up with surface water pumped from Hemerdon's Surface Water management system including Tory Brook and Tory Pond at Loughter Mill.

To optimise water use efficiency, the water used in the process will be collected, treated and reused. Effectively there will be three water systems in operation:-

- Potable Water: primarily used for welfare purposes and discharged to on-site foul water system treatment plant. Small amounts of mains water will be used as poly electrolyte (flocculant) reagent make-up water.
- Process Water: used in screening, dense media separation and spirals etc. and will be recycled via the clarifier/ thickener, the MWF and the Process Water system. [Section 13.3 for water cycle description.]
- Raw Water: The WTP will treat process water to maintain the water balance and to provide top up raw water. Surface water will also be managed as part of the adjacent mine complex and may be pumped into the raw water & process water tanks as required.

Water that is not directly recycled within the MPF will be contained within the MWF and managed as part of the MWF operations.

The use of water will be periodically reviewed to ensure maximum efficiency and ensure that any further potential for reduction in consumption and recycling opportunities are identified.

7.0 Waste Handling, Recovery or Disposal

Table 7-1 summarises the wastes produced and the means of treatment. Figure 2 provides a flow diagram of the key waste streams. The relationship with the water cycle is further illustrated in Figure 3.

Table 7-1
Summary of Wastes Generated

Stream	Description	Minimisation & Water Management
Ore sorter rejects (10 – 80 mm)	Physically processed coarse, inert, naturally-occurring material extracted with the ore, removed at the front of the process with XRT Ore Sorters and trucked to MWF	Used as part of the buttress of the fine tailings basin as part of the overall MWF.
Coarse Rejects (0.8-8mm)	Physically processed coarse inert, naturally-occurring, material extracted with the ore. Removed early in the process by DMS and taken by truck to the MWF.	Used to form filter & drainage layers in MWF tailings embankment. Water is recycled to MPF. Minimises water use & prevents particulate entering surface water. Stops waste entering the process in the MPF.
Fines & Slimes (<0.8mm)	Physically processed, fine, inert, naturally-occurring, material extracted with the ore & removed after size reduction & physical processing.	Thickened in the clarifier then pumped to MWF. Water is recycled within the Process Water system. Thickening enables water recovery and minimises water loss.
Water Treatment Solids	Precipitated dissolved/undissolved solids including metal (As) salts and reagents added including solids from kiln flue gas scrubbing & neutralisation.	Improves water quality to enhance recycling and product recovery. Residues including flocculated basic ferric arsenate and iron hydroxides dewatered into a filter cake/slurry for offsite disposal.
General	Maintenance / industrial waste, e.g. wood, gaskets, worn plant, metal, etc.	Segregated into skips/containers/trays in sealed/bund areas for licensed offsite Disposal
Liquids	Maintenance oils and liquids	Small amounts held in contained and/or sealed areas and taken off-site for Recovery.
Packaging waste	Bags/Cardboard/Containers	Held in skips or containers and taken off-site for Recovery.

Table 7-2 shows estimated waste quantities over the approximately 10 year life of the plant. Estimated quantities are 30-40% less than that within the current planning permission.

Around 3 million tonnes per year of mineral will enter the primary crusher. From this the MPF will produce ~5000 tpa tungsten concentrate and ~1000 tpa tin concentrate. A significant percentage of material entering the crusher is unwanted mineral that will largely be disposed of at the MWF and may be associated with differing quantities of water.

DMS rejects (0.5-9mm) will comprise up to 66% of the feed material. Coarse rejects will be trucked to the waste embankments within the MWF [and used to form the filter zone and drainage layer]. Fines from crushing and scrubbing screens will be de-slimed to remove fine waste (<0.5mm) and constitute approximately 16% of the ore.

Tailings from de-sliming, gravity separation, sulphide flotation and magnetic separation will be thickened and clarified to recover water loss for reuse in the MPF. Residual solids (tailings) will be typically discharged at around 100-150 t/h (max 233t/h) and have a density of around 55% solids by weight at an average arsenic content of 0.1%. Tailings will be pumped to the MWF [and discharged via spigots onto the 'beach' behind the coarse embankment to enable water to percolate into the tailings dam for recycling.

Table 7-3 summarises discharges from the WTP including contributions from the kiln scrubber. Kiln scrubber discharges will be forwarded to the WTP and are estimated to total around 2.2t/d (solids 2t/d) at between 0.1 to 5% arsenic [solids 430 t/y]. Solids from the WTP will be dewatered to produce a filter cake/slurry that is largely gypsum with stabilised ferric arsenate and iron hydroxide. A proportion of water will remain with the solids such that the total discharge of solids (plus water) is not expected to exceed 1,800 tonnes per annum.

WM3 classification has shown that dewatered discharges from the water treatment plant are classified as non-hazardous. Subject to EA approval, the dewatered tailings will be reintroduced to the tailings stream and deposited within the MWF.

Table 7-2
Wastes Generated by Mineral Processing in 10 years

Description	Typical Source	Description	Treatment	Million Tonnes
Coarse rejects	Ore Sorter	10 – 80 mm coarse inert material	Carried by mine trucks to tailings dam embankment.	21.73
Coarse rejects	DMS	Crushed washed coarse granite 0.8 to 8mm Slurry thickened	Carried by mine trucks to tailings dam embankment.	7.26
Slurried & tailings	Thickener & Clarifier	Slimes & flotation waste. Polyacrylamide thickener	Pumped in a pipe via MWF & spigot(s) to tailings pond beach to dewater and enable water recovery.	2.95*

Description	Typical Source	Description	Treatment	Million Tonnes
Dewatered solids (cake & slurry)	Water Treatment Plant	Stable & neutral flocculate, pH arsenic & iron hydroxides	Offsite treatment and/or disposal. Monitored for long term disposal via tailings.	0.01
Other	General Industry & Maintenance	Metals & replaced plant, seals, broken items, etc.	Segregated for appropriate offsite disposal or recycling (e.g. metals/plastics	0.01
*Assumes 1.5mt of spiral tailings sold, otherwise 4.45mt				

Table 7-3
Water Treatment Plant – Solid Waste Contributions

Name	Chemical Formula	Mass Dry (t/d)	Mass Dry[Note 1] (t/y)
Scrubber Neutralisation			
Calcium Sulphate (gypsum)	CaSO4	1.75	510
Ferric Arsenate	FeAsO4	0.28	82
Iron Hydroxide	Fe(OH)3	0.15	44
Water Treatment Plant			
Solids (Dewatered)		1.2	350
Slurry		2.6	758
		TOTAL 5.98	1,744

Note 1: Based on 7,000 hours per year

Solid waste will be managed and disposed of in accordance with the Duty of Care and where applicable the EP Regulations. All waste recovered or generated during the process will either be managed on site in compliance with the MWF EP or removed from site to a suitable licensed processing or disposal site.

Wastes stored on site will be protected from vandalism by fencing around the site. Gates will be locked other than at shift change times.

Waste Generation Compliance with BAT

The installation complies with sector guidance, EPR 2.03 (para 2.5), that includes sections on refractory metals and tungsten, that notes that indicative BAT should minimise solid waste production by ore pre-treatment. Waste and tailings will be treated to thicken and remove water and manage final disposal.

8.0 Energy

8.1 Uses of Energy

The MPF will use electrical and heat energy to process the mineral and to transfer materials between equipment. Plant design optimises energy use (Section 8.3).

Electrical power from the grid will largely be used to drive motors, pumps, feeders, fans etc. for the transfer of product, water, conveyors, cyclones, screens etc. Equipment to be provided with uninterruptable supply includes the drive motor for the rotary Reduction Kiln to allow continued operation to prevent sag in the event of power failure.

Fossil fuels use will include diesel to provide heat energy for use in the Rotary Dryer, the Reduction Kiln and the off-gas Oxidiser. The plant is initially expected to operate on diesel (light fuel oil) but will later transfer to cleaner LPG. Coal may also be used as a reductant in the reduction kiln.

There will be a planned plant shutdowns to enable routine or planned maintenance to take place. Equipment will be shutdown during this period. Plant will be protected against unexpected electrical blackouts with uninterruptable supplies as appropriate.

Plant will be provided with appropriate interlocks and supported by staff training such that relevant equipment can be shutdown in the event of power or plant failure.

8.2 Energy Generation & Consumption

Table 8-1 shows typical energy use by the site. Power requirements reduce by almost 10% when processing soft granite compared to hard granite.

Table 8-1
Energy Use

Energy Source	Process Activity	Annual MWh/y	Release	Estimated CO2
Electricity from Public Supply	Pumps, Fans, Motors, Drives	36,916	Indirect	14,707
Diesel (Therma 35)	Pre-Dryer, tin-dryer	2088	Direct	31

When DRL enters into full production, it is anticipated that the business will fall within scope of the Streamlined Energy Carbon Reporting (SERC) and Energy Saving Opportunity Scheme (ESOS) Legislation. These pieces of legislation require business to report on both their carbon emissions and energy usage with the overall aim of reducing carbon emissions from business and industry.

8.2.1 Greenhouse Gas Emissions

Table 8-1 shows greenhouse gas emissions from the conversion of carbon in fuel as carbon dioxide equivalents (CO2e).

8.3 Energy Management Measures

The MPF is designed to optimising the recovery and reuse of energy. Key aspects of energy use and energy management at the facility are:-

- Unsuitable material will be removed as early as possible in the process, through the introduction of x-ray transmission ore sorting, preventing energy (and raw materials) being used in treatment of such material;
- Equipment will be gravity driven where possible including spirals, screens and water reception sumps & ponds to minimise energy used for pumps and motors;
- Heat energy from fuel burnt in the kiln & offgas oxidiser will be recovered from the flue gas to provide heat energy to the pre-dryer;
- Pumps, motors and drives will be selected to include equipment with variable speed drives and a low energy use footprint;
- Equipment not in use will be turned off or put onto reduced duty;
- Low energy light fittings will be used, with the need for lighting being minimised by the inclusion of translucent roof and wall panels in the main buildings; and
- Equipment will be regularly serviced and maintained to keep it in good condition – this will include a weekly maintenance programme. Regular maintenance ensures equipment continues to operate at optimum energy efficiency and that energy consumption does not increase due to inefficient performance.

8.3.1 Management Measures

- Energy use will be monitored, recorded and periodically reviewed to identify areas of improvement and to ensure that inefficiency is investigated and improvement actions are implemented;
- DRL have an ISO50001 Energy Management System which provides a framework for the management of energy consumption on site and aims to promote continual improvement. The review process identifies energy use by source for the different site operations. Results will be used to identify potential measures for improving energy efficiency; and
- Staff will undergo awareness training in energy efficient practices.

Due to the nature of the activities opportunities for further energy efficiency measures are limited. However, DRL recognises the importance of minimising energy consumption and so future consideration may be given to further energy saving techniques.

Energy Efficiency Compliance with BAT

Operations comply with BAT guidance for energy efficiency as described in SGN2.03 (para 1.2) is not relevant in that it relates to waste heat boilers or reactors to generate heat energy – neither of which are present. However, the general need to recover energy from hot exhaust gases is identified as BAT for some metal processes (para 2.4).

Basic Energy requirements that have been adopted into the plant design and can be summarised as follows:

- Monitor energy flow and target areas for reduction which should be updated annually.
- Operate and maintain plant so as to optimise the use and minimise energy loss.
- Use containment methods, (seals and self-closing doors) to minimise energy loss. Other energy efficiency techniques:
- Recover heat energy.
- Minimise water use.
- Design plant to reduce pumping (and transfer) distances.

9.0 In-Process Controls

9.1 Mineral Extraction

Feedstock for the MPF will be extracted from the adjacent Hemerdon mine. The installation will not receive mineral feedstock from other sites.

Feedstock will be delivered by dump truck to the crushers and thence by conveyor to the Process Buildings and thence by a combination of conveyors, screw conveyors, bucket lines, hoppers, pipes, channels, spirals etc. between process equipment.

Rejects will be transported to the MWF by dump truck and finer particles as tailings by pipeline to the MWF.

9.2 Material storage and Handling

Arrangements for the storage of raw materials are detailed in Section 6.0, and waste storage arrangements are detailed in Section 7.0 of this report.

The storage procedures that will be implemented on site are considered to be best practice for the following reasons:

- All storage tanks & containers will be designed to be fit for purpose, taking into account the nature of the material to be stored and the required design life;
- Tanks will be quality assured and tested for leakage prior to commissioning;
- Storage areas will be clearly marked;
- Procedures will be in place for the regular inspection and maintenance of storage areas with any repairs being undertaken as soon as is practicable;
- Levels within storage tanks will be monitored to alert the operator to high levels and operate interlocks.
- Bulking and mixing will only take place under instruction from appropriately trained personnel; and
- Written records will be kept, detailing:
    - Capacity;
    - Construction including materials;
    - Maintenance schedules and inspection results;
    - Fittings; and
    - Materials stored.

9.3 Operational Monitoring & Control

The installation will benefit from a number of process control features that will ensure adequate process control and prevent the development of abnormal operating conditions. These are described below.

9.3.1 Process Monitoring System

Operations will be controlled and monitored by a Supervisory SCADA system that interfaces to Programmable Logic Controllers (PLC's). The system will provide a range of control and monitoring functions that automate and monitor actions throughout the plant. The process operators will interface with the system via the SCADA PC. This will include interface panels situated in the Control Room.

9.3.2 Level Control

Levels within storage tanks will be monitored to ensure all material is contained.

9.3.3 Interlocks

Interlocks will be incorporated into the design to prevent abnormal operation. The system will shut down or inhibit start-up of various aspects of the plant in the event that set-point conditions are not met.

Manual switches allow for certain interlocks to be overridden when circumstances require, such as during maintenance.

9.4 Inspection, Maintenance and Monitoring

Infrastructure and equipment will be inspected on a regular basis and maintained and repaired as recommended by the relevant manufacturer. The operator will undertake visual checks on all plant and equipment at least once a week and, if deemed necessary, bring forward any planned maintenance or undertakes remedial works.

There will be a weekly plant shutdown to enable routine or planned maintenance to take place. The majority of equipment is expected to be shutdown during this period.

Records of all visual and scheduled inspections and details and certificates (where appropriate) of any maintenance work will be regularly updated and maintained. Maintenance schedules for equipment will be regularly reviewed and updated.

All maintenance work will be carried out in conformance with DRL’s Health and Safety Policy.

10.0 Control of Noise & Vibration

DRL recognises that the site must be operated in a manner that minimises or prevents noise and vibration nuisance.

The potential risk from Noise and Vibration at the Hemerdon site has been assessed in detail within the following documents:

- Low Frequency Noise (LFN) & Infrasound: Noise and Vibration Impact Assessment. Tungsten West Document: TWL-CP-PA-EN-006.2.23, 18th August 2021
- Audible Noise: Hemerdon Mineral Processing Plant: Noise Impact Assessment, SLR Ref: 403.064510.00001 November 2022.

These assessments should be read in conjunction with this BATOT.

10.1 Low Frequency Noise & Infrasound

The Noise and Vibration Impact Assessment (NVIA) provides a summary of the assessment methodology used to inform the design and implementation of BAT, and an understanding of their potential effectiveness with respect to the management of Low Frequency Noise (sound with a frequency below about 200Hz) and Infrasound (sound with a frequency of 20Hz or lower).

The source of Infrasound has been identified as the mineral sizing screens at the MPF. Consequently, DRL developed a method to determine the characteristic sound pressure being emitted by a sizing screen and field tested several infrasound and LFN mitigations to provide confidence in the mitigations developed. The assessment methodology involved the development of an environmental model capable of assessing various screening configurations and mitigations.

10.1.1 Noise Mitigation and Control

The NVIA proposes a range of noise mitigation and control measures that will be implemented at the Hemerdon MPF.

Proposed noise mitigation and control measures include the following:

- Introduction of ore sorting to reduce screening requirements within the MPF;
- Selection of screens with operating frequency away from 16Hz;
- Removal of problematic screens;
- Reduction in screening area;
- Reduce screening area within the MPF;
- Screening configuration & screen placement within the MPF;
- Improve scheduled maintenance to reduce tolerances within screening machinery;
- Screen selection and equipment;
- Reduce efficiency of noise generation;
- Under Pan Venting;
- Cancelling Noise at source; and
- Isolating noise.

10.1.2 Noise Management Plan

Based on the foregoing noise control and mitigation measures, DRL's Noise Management Plan includes the following:

- The introduction of ore sorting technology to reduce screening requirements;
- The introduction of ore sorting technology to increases particle size and decreases material bed thicknesses;
- Removal of the most problematic screens from within the MPF;
- Replacement of other problematic screens within the MPF with smaller contemporary equipment;
- Selection of screens with a lower operating speed;
- Introduction of deck venting to all screens within the MPF;
- Implementation of an improved maintenance schedule to reduce mechanical tolerances in the operation of the screens; and
- Implementation of a noise monitoring and management scheme, subject to agreement with the regulator.

10.2 Noise Impact Assessment

The Noise Impact Assessment was carried out in accordance with the guidance contained in British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* as required by the EA Guidance *Noise and vibration management: environmental permits*. British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, the NPPF, the NPSE and World Health Organisation (WHO) 2018 *Environmental Noise Guidelines for the European Region* were also referred to.

The assessment was based on the results of a baseline sound survey undertaken at nearby noise-sensitive receptors during periods of appropriate weather.

Cumulative sound rating sound levels were predicted at nearest sensitive receptors using noise modelling techniques. The assessment tended towards a worst-case, based on conservative assumptions and following industry standards.

The numerical assessment predicted that the worst-case rating levels would be 6dB above the representative background sound levels, during the weekday night-time period; however, predicted operational noise impacts have been supported as low when considering the context of the site.

It was established that sound from the proposed development would have no effect at distant noise sensitive receptors. In the worst-case and closest receptors, it would be largely unnoticeable, or just perceptible. If it is possible for the sound to be audible, it is not expected to cause any change in behaviour or attitude. The proposed development could marginally affect the acoustic character of the area but not to the extent that there is a perceived change in quality of life.

It was concluded that the range of noise impacts for the proposed development were acceptable with respect to overarching and local requirements for planning and noise.

10.2.1 Noise Mitigation and Management Measures

A full assessment of the engineering and management options for the design of the plant has taken place. Mitigation to reduce the impact to receptors that may be affected by the noise emissions from the site are detailed below.

Delivery of Mineral Ore

Noise emissions associated with the delivery of mineral ore will be minimised due to the following factors:

- The primary and secondary crusher will be located immediately adjacent to the haul road thereby minimising distance travelled by delivery vehicles;
- There will be no movement on the public highway;
- Vehicles will be maintained to minimise noise;
- Site roads will be maintained to minimise noise;
- Speed limits will be imposed for vehicles travelling on site; and
- Traffic management measures will be implemented to enforce speed limits.

Processing of mineral Ore – Primary and Secondary Crushing

Noise emissions associated with the processing of mineral ore will be minimised due to the following factors:

- The revised operational layout will move the primary and secondary crushing equipment to the north east of the existing mineral processing building, further away from the nearest noise sensitive receptors;
- The primary and secondary crushing equipment will be located at a distance of 996m from the nearest noise sensitive receptor (Galva House, located to the south west);
- The primary and secondary crushing equipment will be located approximately 4 metres below surrounding ground level in an engineered excavation, which will result in the attenuation of noise emissions;
- The jaws will be located within an enclosure below surrounding ground level;
- A 2.4m high acoustic barrier will be installed on the southern and western boundaries of the crusher area;
- The ROM pad will be located adjacent to the primary and secondary crushers which will minimise material transport and handling;
- Primary and secondary crushing will be undertaken between the hours of 07.00 – 22.00. During night-time hours there will be no primary and secondary crushing operations;
- X-Ray transmission ore sorting will ensure that only metalliferous ore is crushed, and barren ore is rejected therefore reducing the total tonnage being crushed;
- The primary and secondary crusher will include a pre-crushing screen so that only material which is of a particular size is crushed. This will avoid crushing material that is already of a suitable size and will further reduce the total tonnage being crushed;
- The quantities of ore that will be crushed represent a 70% reduction during the night-time and a 37% reduction during the day-time compared to the previous operation;
- The plant has been designed to minimise screening requirements and remove problematic screens;
- Conveyors will be covered and conveyor entries have been designed to mitigate noise;
- The crushers will be fitted with rubber lined feed hoppers and rock boxes to mitigate noise generation;
- The site will be managed to minimise start up and shut down as much as possible;
- A schedule of planned preventative maintenance will be in place to ensure that the plant operates as designed; and

- Site personnel will be trained in the need to minimise site noise and will be responsible for monitoring and reporting excessive noise when carrying out their everyday duties.

Operations within the processing buildings

Noise emissions associated with the operations within the processing buildings will be minimised due to the following factors:

- The buildings will benefit from existing and new cladding;
- Roller shutter doors will be fitted to mitigate the release of noise;
- Building apertures and conveyor openings will be designed to mitigate noise emissions;
- Low noise generating plant have been selected for use in the processing buildings;
- Plant will be turned down/off when not in use;
- Plant and equipment will be maintained regularly to minimise noise resulting from deterioration and inefficient operation;
- If items of plant are found to give rise to unacceptable noise levels, consideration will be given to their replacement with quieter designs; and
- If equipment continues to generate unacceptable noise levels, consideration will be given to modification to incorporate noise suppression equipment or replacement components.

Management Measures

- The MPF Manager will be responsible for ensuring that nuisance from site noise is minimised. Site personnel will be trained in the need to minimise site noise and will be responsible for monitoring and reporting excessive noise when carrying out their everyday duties; and
- Opening of doors will be kept to a minimum.

Noise Action Plan

- In the event that noise is found to be causing a problem, action will be taken to determine the source and to take remedial actions as follows: shut down, replace, service or repair equipment to reduce noise levels; and modify plant to incorporate noise suppression equipment; and
- Records relating to the management and monitoring of noise will be maintained and include: inspections undertaken; noise problems (date, time, duration, weather conditions and cause of the problem); complaints received; and corrective action taken to prevent future occurrences.

In view of the foregoing measures that will be adopted at the Hemerdon MPF, and the conclusions of the Noise Impact Assessment and the NVIA, it is considered that the operations at the proposed MPF comply with BAT for noise control.

11.0 Control of Odour

11.1 Odour Sources

Table 11-1 summarises the relatively few activities that may generate odour at the Hemerdon MPF.

Table 11-1
Potential Odour Emissions

Process		
Froth Flotation. Xanthates and other agents displaced into air by bubbling.	Operational hours	Contained within building fitted with air ventilation vents
Reduction Kiln: Fired on diesel or liquid petroleum gas with reduced oxygen generating typical combustion pollutants associated with the fuel source and odorous off gases from heating ore in a reducing atmosphere.	Operational hours	Flotation removes sulphur compounds beforehand. Off-gas oxidised, cooled and passes acid gas scrubbing system before discharge.
General Processing: Ores & pre-concentrates contain small amounts of sulphur that can be released from milling & tailings streams and slurries.	Operational hours	Stabilised as ferro-sulphates prior to release to thickener. Standing slurries that may give rise to odour are minimised by forwarding to MWF.

11.2 Mitigation Measures

11.2.1 General Principles

Process plant will be designed to mitigate or contain potential odour. The operating philosophy is to prevent or contain odour when possible and treat before discharge, where practicable.

Key aspects are:-

- The majority of the pre-concentration process and the ore itself are generally considered to be of low/no odour;
- Any operations that may be odourous will normally be enclosed within buildings to prevent the potential for fugitive odour releases; and
- The site will not normally store significant quantities of odorous materials. Potentially odorous raw materials will be stored internally or within enclosed equipment.

11.2.2 Reduction Kiln

The Reduction Kiln will be potentially the largest odour source due to quantity of reducing off- gases produced.

Flue gases from the reduction kiln will pass through a thermal oxidiser. Dilution air will be added and the flue gas re-heated by diesel/LPG to convert potentially odorous and harmful products in the flue gas to less odorous and less harmful releases. For example reduced sulphur compounds (H2S), volatile organic compounds (VOC) and carbon monoxide into less odorous and less harmful acid gases, sulphur oxides and carbon dioxide.

The resulting acid gas will then be cooled and passed through an alkaline scrubber to remove acid gases such as sulphur oxides (and other products such as As2O3) before being discharged to air.

11.2.3 Flotation

Quantities of flotation reagents will be relatively small and used in very low concentrations within the process. It is considered that the use of these reagents will not give rise to significant odour emissions.

11.3 Management and Operational Techniques

If appropriate an Odour Management Plan (OMP) will be prepared in accordance with EA guidance.

The MPF Manager is responsible for odour control. This includes ensuring that suitable checks are in place for system integrity, ensuring that ventilation systems are fully operational and, where appropriate, carrying out olfactory monitoring. Records will be maintained of odour emissions, odour complaints and remedial action taken.

In the event that odour is found to be causing a problem, as determined by off-site complaints or during routine on-site monitoring, the following actions will be taken:

- Investigations by the MPF Manager to establish the cause of the problem;
- Appropriate actions to mitigate the problem; and
- The EA will be informed.

12.0 Control of Emissions to Air

An updated Air Emissions Risk Assessment (AERA) has been prepared in support of this application and should be read in conjunction with this BATOT. It includes detailed air quality modelling and the comparison of potential effects against relevant Environmental Assessment Levels (EAL).

12.1 Point Source Emissions

The AERA has considered all point source emissions to air from the MPF, namely:

- Pre-concentrate dryer (A2 point source release);
- Reduction Kiln (A3 point source release); and
- Tin concentrate dryer (A4 point source release).

The locations of the point source emissions are illustrated on Drawing 007.

The AERA included an assessment of potential cumulative (or in-combination) impacts with the MWF and other emissions from mine activities.

The objective of the study was to assess the impact of emissions against the relevant Air Quality Standards for the protection of human health and where necessary, deposition for the protection of amenity, soils, and relevant Critical Levels (C_{Le}) and Critical Loads (C_{Lo}) for the protection of designated ecological receptors.

Detailed atmospheric dispersion modelling using the AERMOD model was undertaken using the following staged approach:

- Review of emission to air and derivation of source term;
- Identification of sensitive receptors;
- Compilation of the existing air quality baseline and review of Local Air Quality Management status;
- Dispersion modelling; and
- Calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for both human and ecological receptors.

The conclusions of the assessment were:

- There are no predicted exceedances of Air Quality Assessment Levels for NO_2, SO_2, PM_{10}, $PM_{2.5}$ or arsenic at any of the receptor locations;
- The process contribution to arsenic deposition is predicted to be less than 1% of the benchmark levels for the protection of soils at all receptor locations and impacts can be considered insignificant; and
- The process contribution of nitrogen oxides, sulphur dioxide and arsenic are less than 1% of the relevant Critical Levels and Critical Loads at all sites (including European Sites (SPA's and SAC's)) and their impacts can be considered insignificant.

12.2 Fugitive Dust

The potential risk from dust at the Hemerdon MPF has also been assessed in the AERA.

The scope of the AERA included an assessment of the potential cumulative (or in-combination) impacts of dust emissions from the primary and secondary crushing activities and the ROM pad with potential dust from the MWF and other emissions from mine activities.

The assessment adopted a hypothetical worst-case scenario for the generation of the dust emissions source term. The hypothetical scenario assumed that each dust emission source was emitting at the maximum simultaneously, specifically:

- The MWF was assumed to be operating with the largest working area with only minimal restoration;
- The full extent of the tailings storage area was assumed to be in place; and
- Mine activity (i.e. truck movements on haul roads, blasting, material handlings) were based upon the MPF operating at capacity after ramp-up, i.e. +3 years from start.

The following dust sources were assessed:

- MPF emissions - Point sources, crushing, stockpiles and material unloading; and
- Other mine and MWF sources – vehicle entrainment of dust from unpaved haul roads, wind erosion, drilling and blasting and materials handling.

The conclusions of the assessment in relation to fugitive dust were:

- There are no predicted exceedances of dust deposition benchmarks for the protection of amenity at any receptor locations.

12.3 Mitigation Measures

12.3.1 Point Source Emissions

Mitigation measures for the point source pollutants are ‘designed in’ to the source. General measures such as keeping equipment free of excess dust build up (cleaning) and brushing and scraping surfaces to remove accumulated material will be undertaken. Specific measures include the following:-

- Pre-Concentrate Dryer:
    - Heat energy recovered from other parts of the process will be used to supplement and reduce the fuel required to dry the pre-concentrate;
    - Burners will be designed to be low NOx with significant secondary air to provide a mixed drying atmosphere with full combustion and low NOx generation;
    - A bag-house filter system will be used to prevent particulate emission; and
    - Emissions will be released via elevated exhaust stack (~25m).
- Reduction Kiln:
    - Burners will be low NOx being in a reducing atmosphere;
    - Cyclone will recover product dust to optimise recovery and prevent impacts on subsequent abatement plant;
    - Thermal oxidiser will treat off-gases that may contain reduced nitrogen and sulphur compounds, metals & unburnt hydrocarbon to produce a ‘cleaner’ acid gas stream;
    - Aqueous alkaline scrubber system will remove acid gases and residual metal oxides (including As_2O_3) from the flue gases. The treatment liquor will be pH balanced and metal oxides stabilised by use of ferric sulphate, sulphuric acid and hydrated lime; and
    - Emissions will be released via a 30m stack.
- Tin Concentrate Dryer

  - Small unit for final product drying only;
  - Burners low NOx with significant secondary air to provide a mixed drying atmosphere with full combustion and low NOx generation; and
  - Emissions will be released via elevated external exhaust stack (~25m).

12.3.2 Fugitive Dust Emissions

Mitigation and control measures that will ensure BAT is employed for the control of fugitive dust are outlined below.

Design of Quarry Blasting

Quarry blasting will be specifically designed to achieve optimum rock fragmentation and therefore reduce the percentage of rock requiring crushing.

Dust from Delivery and Transport of Mineral Ore

- There will be no vehicle movements on public highway;
- Speed limits will be imposed for vehicles on site;
- Dust suppression measures will be implemented on internal roads;
- Roads will be maintained to minimise fugitive emissions from road surfaces which will be graded and compacted rock fill and maintained free of pot-holes;
- Wheel washing equipment will be provided on the haul road;
- The ROM pad will be located in close proximity to the crushers and haul road and this will reduce material handling and transport; and
- Vehicle exhausts will not be configured downwards.

Dust From Primary and Secondary Crushing

- The moisture content of the ore to be crushed will consistently be at levels above 3%, and as such is not expected to give rise to significant dust emissions;
- Moisture content will be monitored regularly by site personnel and continuous water suppression will be provided when required;
- Multi atomising nozzles will be mounted over the crusher aperture, product conveyor feed and discharge points;
- Fixed water sprays will be installed on the ROM pad;
- X-ray transmission ore sorting & screening prior to crushing will minimise the quantity of ore being crushed;
- Chutes will be fitted at belt conveyor transfer points;
- The primary and secondary crushers will be located at least 996m from potentially sensitive receptors;
- The primary and secondary crushers will be located approximately 4m below surrounding ground level within an engineered excavation and will therefore be protected from wind whipping;
- Due to revised site design there will be reduced drop heights for vehicle unloading;
- Conveyors will be of sufficient capacity to handle maximum loads without spillage;

- Covered conveyors will reduce dust emissions;
- Site personnel will be trained in the need to minimise dust and will be responsible for monitoring and reporting excessive dust when carrying out their everyday duties;
- Operatives will be trained to ensure they are aware of responsibilities under the EP, to minimise emissions during shutdown and start up and during abnormal conditions;
- Visual assessment of emissions shall be made at least 3 times a day. The time location and results will be recorded;
- Corrective action relating to dust control shall be recorded; and
- There will be a preventative maintenance programme for pollution control equipment.

Dust From Operations within the Process Buildings

- Tertiary crushing will be carried out in an enclosed building, processed wet in sealed plant;
- Concentrate processing, Milling Screening, etc. will be carried out in enclosed building, processed wet in sealed plant;
- Particulates from Dryer Exhaust will be discharged through 25m stack, & Baghouse;
- Reduction Kiln, As2O3 & metals, NMVOC, acid gas, particulate -Cyclone will remove & recover product (dust). Oxidiser will reduce CO & VOC. Scrubber will remove acid gas, metals, As2O3 etc. via 30m stack; and
- Fugitive dust and particulates from floors and tailings areas – operations will be carried out in closed building and floors will be regularly cleaned.

Management and Monitoring Techniques

- The MPF Manager will be responsible for ensuring that nuisance from site dust is minimised. Site personnel will be trained to minimise site dust and will be responsible for monitoring and reporting excessive dust from site duties;
- There will be restricted operational hours for the primary and secondary crushers. They will only operate between 07.00 and 22.00 hours;
- Regular inspections and maintenance will be carried out;
- Operatives will be trained to ensure they are aware of responsibilities under the EP, to minimise emissions during shutdown and start up and during abnormal conditions;
- The moisture content of ore will be monitored to allow proactive measures to be taken if moisture content falls to below 3%;
- Visual assessment of emissions shall be made at least 3 times a day. The time, location and results will be recorded;
- Corrective action relating to dust control shall be recorded; and
- There will be a preventative maintenance programme for pollution control equipment.

Dust Action Plan

- In the event that dust is found to be causing a problem, action will be taken to determine the source and to take remedial actions; as follows:
    - Inspect equipment;

    - Give consideration to wind speed and direction; and
    - Damp down dusty working areas;
- Records relating to the management and monitoring of dust will be maintained and include:
    - Inspections undertaken;
    - Dust problems (date, time, duration, weather conditions and cause of the problem);
    - Complaints received; and
    - Corrective action taken to prevent future occurrences.

The conservative AERA concluded there were no predicted exceedances of either Air Quality Assessment Levels or dust deposition benchmarks for the protection of amenity at any receptor locations. In view of this and the extensive management and monitoring measures for dust, as outlined above, it is considered that the proposed operation of the Hemerdon MPF represents BAT for the control of both point source emissions to air and fugitive dust as outlined in Process Guidance Note 3/16 (12) – Statutory guidance for mobile crushing and screening.

13.0 Control of Emissions to Groundwater, Surface Water & Sewer

Sections 5.2 and 5.3 describe the general arrangement for the prevention of releases and the control of emissions to groundwater, surface water and sewer.

In summary the principal aspects are:-

- The inside of the MPF buildings will benefit from an engineered containment system comprising an impermeable surfaced flooring with engineered falls towards grated drains or blind sumps that can pump collected water into the process water system;
- Appropriately engineered bunds and other means of containment will be provided for all tanks or vessels containing liquids that could be harmful to the environment;
- There will be no trade or effluent discharges from the process;
- Stormwater will collect in the Hemerdon mine surface water management system; and
- Land adjacent to the MPF falls to surface water drainage ditches or culverts that pass along the perimeter of the MPF 'yard' area and into the catchment ponds or the general Hemerdon mine surface water management system.

The process will be a net importer of water and the MPF and adjacent MWF manages a substantial system for the recovery, optimisation and re-use of water.

The primary requirement for water will be for the transport of mineral through the beneficiation process including crushers, trommel, separation screens, cyclones, spirals, tables, etc. Other requirements will be for general plant cleaning & washdown and welfare facilities.

Water that cannot be recovered includes:-

- Water evaporated in the dryers; and
- Water retained with solids/slurry discharged to MWF or offsite and not recycled.

The use of water will be periodically reviewed to ensure maximum efficiency and ensure that any further potential for reduction in consumption and recycling opportunities are identified.

13.1 Surface Water Management System

Drawing 006 shows the general drainage layout for the capture and management of surface water around and adjacent to the MPF.

Clean surface water run-off (stormwater) in the yard area will fall towards Smallhanger Pond north and thence into Smallhanger Brook.. Hemerdon mine surface water management system will be managed under the existing Planning Permission, the EP for the MWF and/or under existing consented discharges to surface water.

The following is provided for information.

Surface water from roofs, car parking areas and areas adjacent to the MPF will be collected and held in catchment pond(s) at the MPF to feed into the raw water system as required.

Elsewhere and on land immediately adjacent to the MPF, the land falls to surface water drainage ditches or culverts that pass along the perimeter of the MPF 'yard' area. Depending on exactly where stormwater enters the ditch it may be managed as above or as clean water as part of the wider Hemerdon mine surface water management system.

Hemerdon's surface water management system will comprise a series of catchment ponds located mainly around the perimeter of the site. These will collect water and drain via an interception system and sediment ponds to a final discharge pond in compliance with the Water Framework Directive.[1]. To the west of the MPF, surface water will drain via an interception system and sediment ponds to the 'Tory Pond'.

In the vicinity of the MPF, stormwater from roofs, canopies and clean surface areas will flow via an interception system to the Smallhanger (North) Ponds. The Smallhanger Ponds will provide flow regulation and attenuation for surface water from the surrounding catchment including the MPF and pit.

The existing consented arrangement for an impoundment across Smallhanger Brook has been improved and replaced by the provision of 4 offline ponds.

- Smallhanger North Ponds (settlement & discharge ponds) will receive the majority of clean surface water from the MPF and surrounding catchment area..
- Smallhanger South Ponds (settlement & discharge ponds) will receive the majority of clean surface water from the pit catchment area including the crushers.

13.2 Direct & Fugitive Emissions

There will be no significant or direct discharges to surface water, groundwater or sewer.

The MPF building will be constructed on an impermeable surface with a sealed drainage system [Section 5.3]. Process water collected in tank(s) will be held on-site prior to reuse in the process or recycled via the MWF.

Other potentially contaminated water that may occur will be contained and tested prior to disposal off site to a suitable licensed facility.

13.2.1 Point Source & Fugitive Emissions to Groundwater

Containment measures in place [Section 5.3] will ensure there are no point source or fugitive emissions to groundwater. Accordingly, there will be no direct or indirect discharges of contaminating materials into groundwater from the site.

13.2.2 Point Source & Fugitive Emissions to Surface Water

There will be no point source or fugitive emissions of potentially polluting substances to surface water from the MPF.

13.2.3 Point Source & Fugitive Emissions to Sewer

Effluent discharges from welfare facilities and offices are outside the scope of this EP application. Foul waste water will be managed by a package treatment plant.

As detailed in Section 5.3 there will be no discharge to sewer.

13.3 Process Water Management

The MPF is designed to maximise the recycling of water and to minimise water loss.

[1] SLR Consulting. Hemerdon Mine, Activities in the catchment of the Smallhanger Brook, Water Framework Directive Compliance Assessment.

Figure 3 shows that Raw Water will be sourced from surface water run-off and/or made-up by water from the surface water managements system including licensed abstraction from Tory Pond and Tory Brook at Loughter Mill.

Slimes, fines and flotation discharges will be treated in a thickener and clarifier. The overflow as clean water will be recycled back to the Process Water tank. The underflow will be pumped as a slurry to the MWF where water will be filtered off and returned to the MPF Process Water tank.

Dissolved solids within the basic scrubber liquor will be stabilised and neutralised to fix arsenic as ferric arsenate. The discharge is forwarded to the Water Treatment Plant for the recovery of water.

13.3.1 Quantity of Water Used

The process is designed to recycle water through the process at around 0.6m^3/s (2,200m^3/h) but almost all of this 2,100m^3/h, will be recovered within the MPF via the tailings thickener overflow. This gives an overall recovery rate of 95%.

Around 100m^3/hr will be lost from the system with the losses attributed to water tied up with the tailings in the MWF and in evaporation from the dryers.

13.4 Water Treatment Plant (WTP)

The Water Treatment Plant (WTP) is designed to maintain the quality of the Process Water stream. There will be no discharges of effluent though dewatered solids that are removed for disposal.

The WTP will be a stand-alone equipment item located in its own area adjacent to the MPF building. The plant will consist of a reagent storage area, mix tanks, coagulation/flocculation tanks, clarifier, water balance and sludge balance tanks, filter press and control cabin.

The WTP will continually capture a significant proportion of the process water stream to remove dissolved and undissolved impurities. These will be removed by chemical and physical processing including oxidation, coagulation, flocculation and filtering. In particular the plant is designed to remove and fix arsenic as a stabilised ferric arsenate. This will ensure that arsenic does not build-up in the water.

The influent will contain:-

Determinants	pH	TSS mg/l	Metals (mg/l)				Organics	Salts (mg/l)	
			As	Cu	Fe	Zn		Calcium	Sulphates
Influent	7.0	<300	0.5	Trace	Trace	Trace	Trace	500	500

This will include traces of processing reagents such as Copper Sulphate, Sodium Ethyl Xanthate, Frother (Methyl Isobutyl Carbinol), Flocculant (SNF's AN910SH), Ferrosilicon, Sulphuric Acid, Lime, Ferric Sulphate.

The treatment plant is estimated to treat process water at an average rate of 80m^3/h but is designed with a capacity for treating up to 120m^3/hr.

The plant will comprise:

- Containerised and sealed dosing plant containing hydrogen peroxide, ferric sulphate, lime and flocculant dosing systems;
- Peroxide in 1m^3 IBCs on spill trays;
- Flocculant poly anionic 700kg bags in container with mains water make-up;
- Lime putty 1m^3 bags in container;
- Ferric sulphate in external free standing self bunded ~8m^3 tank;

- Sulphuric acid in external free standing self bunded tank;
- 1No ~40m^3 arsenic oxidation tank;
- 1No ~40m^3 coagulation and flocculation tank;
- 1No lamella clarifier;
- 1No ~30m^3 sludge tank with vertical mixers providing up to 3 days sludge storage capacity (to avoid the need to press sludge over weekends);
- 1No ~30m^3 treated water balance tank;
- 600 litre manually discharged filter press discharging into a hooklift skip; and
- Pumps, hydraulic power pack, pipework, frames, walkways, safety shower & control centre to provide a self-contained, stand-alone plant.

The best available technology for the removal of arsenic is co-precipitation with iron to form a basic ferric arsenate ($FeAsO_4.xFe(OH)_3$). The process is robust and is capable of producing low residual arsenic concentrations in the treated effluent (<0.05mg/l). Provided the Fe to As ratio is maintained greater than 3, the sludge generated will be stable over a wide pH range, which reduces the risk of arsenic remobilisation. Stability will be further enhanced by the co-precipitation of other metals such as copper and zinc.

Tests indicate that over 99.5% of the arsenic will be precipitated by this technique.

The process will normally be operated with an Fe:As ratio of 5:1 (ranges of 3 & 8:1 are effective) to provide a robust process that is not overly sensitive to pH variations. Calcium (lime addition) reduces leachability but has to be controlled to avoid the formation of a sludge rich in calcium arsenate ($Ca_3(AsO_4)_2$).

13.4.1 Mix Tank

Removal is most effective when arsenic is present in the form of arsenate (As^{5+}) rather than arsenite (As^{3+}). Before being mixed with iron the influent will be dosed with hydrogen peroxide to ensure the arsenic is fully oxidised (to arsenate). Hydrogen peroxide is preferred as the oxidation rate achieved using air is too slow.

Lime will maintain the pH to the optimum value for coagulation and flocculation.

Ferric sulphate is added to provide iron co-precipitation (coagulation). This results in the formation of a fluffy voluminous hydroxide sludge. Ferrous chloride with appropriate pH adjustment also removes other parameters such as suspended solids.

- 35% peroxide solution at 5 litres/hr to treat 80m3/hr
- 30-60% Ferric sulphate at 23 litres/hr to treat 80m3/hr (iron:arsenic ratio of 8:1)
- Lime at 5kg/hr to hold pH 7 – 8.
- Sulphuric acid at 11.9kg/hr to control pH

Flow metering of water delivered to the treatment stream will be used to control flow proportional dosing of the hydrogen peroxide, ferrous chloride and flocculant solutions. Impellor mixers will maintain the Total Suspended Solids (TSS) in suspension.

Depending on flowrate the retention time in the tank will be between 20 and 30 minutes.

13.4.2 Thickening Tank

Water will flow by gravity into the tanks that provide additional retention time to ensure complete arsenic oxidation/co-precipitation and allow the controlled addition of flocculant for floc formation.

The tank will be divided into two compartments. The first will ensure the complete oxidation and precipitation of the arsenic. Flocculant (0.1% solution) will be dosed into the second compartment. The flocculant will be an anionic polymer emulsion (consistency of wallpaper paste) that binds and flocculates the precipitate to settle at around 5% w/w.

- Anionic polymer makeup solution at 40g/tonne to treat 80m3/hr
- Potable water makeup ~1m3/hr

Flocculant will be dosed on a proportional basis via a control loop from the influent flow meter. Mixers will maintain the floc in suspension. Depending on flowrate the retention time in the tank will be between 20 & 30 minutes.

13.4.3 Clarifier

The floc will pass by gravity to the lamella clarifier, which through an effective clarification area of $100m^2$ promotes the separation of the flocculant from the treated and balanced water stream. Addition of further flocculant at 0.6 kg/hr and a sludge thickening rake will assist the sludge thickening. Overflow from the clarifier will pass to the treated water balance tank. The underflow (settled solids) will be pumped into the sludge tank. The underflow will typically be around 10% w/v with a flow rate of up to 400l/hr.

13.4.4 Water Balance Tank

Water quality will be monitored on the clarifier outlet for pH, conductivity and turbidity. The treated water will then be stored in the balance tank and forwarded into the raw water system. An ultrasonic level probe will provide feedback to vary the speed of the forwarding pump.

13.4.5 Sludge Tank

The sludge tank will continually be stirred and can contain up to 3 days of clarifier output at the highest treatment rate to avoid pressing over weekends/holidays.

13.4.6 Filter press

The hydraulic plate press can dewater up to 3 days sludge during a normal shift. Dewatering increases solids content from 10% solids to around 25% to 30%. The press can treat 600 litres per cycle and typically operates on ~4 cycles per day up to 2 hours per cycle. Further flocculant will be added at 1.5kg/hr to aid thickening. The filtrate is returned to the thickening tank. The sludge will be dropped into a closed skip.

WM3 classification has shown that dewatered discharges from the water treatment plant is classified as non-hazardous. Subject to EA approval, the dewatered sludge will be reintroduced to the tailings stream and deposited within the MWF.

13.4.7 Containerised Dosing System

The chemical dosing equipment and control system will be pre-installed into a 12m container.

The container will be subdivided into two compartments, one housing the dosing equipment and the second housing the control system. Each compartment will be accessed by man-door and a roller shutter door to allow IBCs of reagents (e.g. flocculant and peroxide) to be forklifted onto spill stands within the dosing container.

14.0 CONTROL OF LITTER, MUD & PESTS

14.1 Litter

The nature of the material for processing (mineral ore) and the nature of the activity will not to give rise to litter.

14.2 Mud and Debris

The site will not use public highways for the delivery of mineral ore.

Notwithstanding the above, in order to prevent the deposition or tracking of mud or debris from the site onto public areas and highways the following measures will be in place:

- Areas of hard standing will be maintained free of significant mud and debris;
- A wheel wash facility will be located on the mine access road and used as appropriate by HGVs and 4-wheel-drive site vehicles exiting the site;
- Operational areas will be subject to monitoring by staff throughout the working day to identify accumulations of mud requiring remedial action; and
- Where necessary road cleaning equipment will be deployed to prevent the tracking of mud and debris onto the highway.

In the event that mud or debris arising from the site is deposited onto public areas outside the site, the following remedial measures will be implemented:

- The affected public areas outside the site will be cleaned; and,
- Traffic will be isolated from sources of mud and debris within the site to prevent further tracking of mud and debris, and measures will be taken to clear any such sources as soon as practicable.

14.3 Pests

The nature of the material for processing (mineral ore) and the nature of the activity will not give rise to pests.

15.0 Monitoring

The Hemerdon MPF will be subject to a comprehensive programme of monitoring to ensure the site operates to the specified design standards, and does not give rise to unacceptable environmental impact.

Monitoring will comprise the following:

- General observations;
- Monitoring of infrastructure and equipment;
- Monitoring of process variables; and
- Emissions monitoring.

15.1 General Observations

As part of the day to day operations routine observations and monitoring will be undertaken by site staff to ensure the site operates without causing unacceptable environmental impact.

15.2 Monitoring of Infrastructure & Equipment

Infrastructure and equipment will be subject to regular visual inspection. In the event of deterioration or damage, appropriate remedial action will be taken to restore the infrastructure and equipment to a satisfactory condition.

15.3 Monitoring of Process Variables

Monitoring of process conditions and variables is discussed in Section 9.0.

15.4 Emissions Monitoring

15.4.1 Monitoring Emissions to Surface Water

As detailed in Section 13.2 emissions to surface water will be only clean run off from non- operational areas of the site. Monitoring will including periodic observation of ponds and discharges to ensure releases do not contain unacceptably high levels of debris, discolouration, sheens or high turbidity.

Design and containment measures of the facility will ensure that there are no point source emissions of potentially polluting substances to surface water. Monitoring will be carried out on a regular basis and comprise visual inspection for oil and grease.

15.4.2 Monitoring Emissions to Sewer

There will be no emissions to sewer from the MPF.

15.4.3 Monitoring Emissions to Air

Exhaust emissions to air will be subject to a routine measurement programme Monitoring Standards & Techniques

Monitoring will be undertaken in compliance with recognised techniques or using ‘standard methods’. Monitoring equipment will be calibrated, serviced and maintained in line with manufacturer recommendations.

Monitoring Stack Emissions

Prior to undertaking stack emissions monitoring a site specific protocol (SSP) will be prepared. This will ensure that monitoring is carried out in accordance with EA Technical Guidance Note M1, Sampling Requirements for Stack Emissions Monitoring and TGN M2 Monitoring of Stack Emissions to Air. The SSP will ensure that a representative sample is obtained from the stack.

Specifically the SSP will consider the following aspects: The sampling approach, technique, method and equipment that are chosen will ensure:

- A safe means of access to the sampling position;
- Space for equipment & personnel & provision of essential services such as electricity;
- Selection of the sampling points; and
- Sampling plan.

15.5 Monitoring Action Plan

In the event that the monitoring programme identifies a potentially significant release the following actions will be undertaken:

- The MPF Manager will be informed immediately;
- Actions to isolate and contain the source of release will be undertaken; and
- The causes of the release will be evaluated, and where possible, procedures put in place to prevent a recurrence.

In the event that abnormal monitoring results are identified, the operations staff will inform the MPF Manager and appropriate action will be taken to reduce the process to normal operating conditions. An inspection of the treatment facility will be undertaken to identify the cause and necessary remedial action will be taken.

15.6 Management, Reporting and Training

All monitoring results will be recorded and stored electronically. The MPF Manager or his nominated deputy will inspect the monitoring records monthly to ensure monitoring is being undertaken in accordance with procedures. Annually results will be examined as part of the site's management review.

Staff involved in sampling and monitoring will be trained sufficiently to carry out the set procedures.

16.0 Closure of Installation

16.1 Operations Prior to Closure

The MPF operations at the site should not lead to deterioration of the land by the introduction of any polluting substances due to the containment and control measures that will be implemented to ensure the processes are contained within the appropriate structure / containers.

In the unlikely event of a potentially polluting incident, which impacts the site, the MPF Manager will record the details of the incident together with any further investigation or remediation work carried out. This will ensure that there is a coherent record of the state of the site throughout the period of the EP.

16.2 Design of Site

Records will be maintained of the location of facilities, services, and sub-surface structures. During any modifications or alterations on site, care will be taken to update these records to ensure easy closure of the site.

Designs will ensure that:

- Underground tanks for the containment of potentially polluting liquids are avoided where possible (unless protected by secondary containment or other suitable programme);
- There is provision for the draining and clean out of vessels and pipe work prior to dismantling; and
- Materials used are recyclable, if practicable (having regard for operational and other environmental protection objectives).

16.3 Site Closure Plan

Closure will occur when the Hemerdon MPF stops accepting mineral ore. Actions that will be taken at this point to avoid pollution risk and return the site to a satisfactory condition are set out below.

16.3.1 Communication

The EA will be informed in writing of the date of cessation of mineral processing. This will enable the EA to inspect the site, approve the closure, and to agree the actions that will need to occur following closure.

16.3.2 Access & Security

Security provision will be audited to ensure that the site is in a secure condition and that unauthorised access is avoided. Site security will be maintained through the use of perimeter fencing and lockable gates. Regular inspections of the fencing and gates will be carried out, and damage will be repaired as soon as practicable. If necessary temporary repairs will be implemented until permanent repairs can be carried out.

16.3.3 Restoration

Storage and treatment vessels and drainage systems will be drained and cleaned prior to dismantling, with all effluent and solid residues being contained and taken to an appropriate treatment or disposal facility. Substances will be removed in such a way as to protect land and groundwater from potentially harmful contents. Containers and other structures will be dismantled in such a way as to prevent pollution risk to the surrounding environment.

Assessment will be undertaken of the site to record its condition relative to the initial site report. If operations at the site have resulted in deterioration of the land, these areas will be re-examined and returned to their original state as defined by the initial site report. A final assessment report will be submitted to the EA with an EP surrender application.

17.0 Environmental Impact

17.1 Impact Assessments

A number of impact assessments have been undertaken in support of this application to demonstrate that the operation of the Hemerdon MPF will not give rise to unacceptable impact on the environment.

The assessments carried out in line with current EA guidance are as follows:

- Environmental Risk Assessment;
- Air Emissions Risk Assessment;
- Noise and Vibration Impact Assessment; and
- Noise Impact Assessment.

In addition, an Environmental Statement was prepared as part of the Planning Application for the facility which included the following chapters:-

- 1.0 Introduction
- 2.0 Site Description
- 3.0 Development Proposals
- 4.0 Planning Policy
- 5.0 Alternatives
- 6.0 Air Quality
- 7.0 Landscape and Visual Impact
- 8.0 Highways & Transportation
- 9.0 Noise
- 10.0 Geology, Hydrology and Hydrogeology
- 11.0 Ecology
- 12.0 Cultural Heritage
- 13.0 Cumulative Impacts

The assessments concluded that, with the planned mitigation measures described for the Hemerdon MPF operations, environmental impacts will not be significant.

18.0 Information

18.1 Reporting and Notifications

All relevant notifications and submissions to the EA regarding the site will be made in writing and will quote the EP reference number and the name of the EP holder.

Records will be maintained for at least six years, however in the case of offsite environmental effects, and matters which affect the condition of land and groundwater the records will be kept until EP surrender.

18.1.1 Changes in Technically Competent Persons

The EA will be informed in writing of any changes in the technically competent management of the site and the name of any incoming person together with evidence that such person has the required technical competence.

18.1.2 Relevant Convictions

The EA will be notified of the following events:

- The operator being convicted of any relevant offence; and,
- Any appeal against a conviction for a relevant offence and the results of such an appeal.

18.1.3 Notification of Change of Operator’s or Holder’s Details

The EA will be notified of the following:

- Any change in the operator’s trading name, registered name or registered office address; and
- Any steps taken with a view to the company going into administration, entering into a company voluntary arrangement or being wound up.

18.1.4 Adverse Effects

The EA will be notified without delay following the detection of any event that may cause significant adverse environmental impact / health effects including:

- Any malfunction, breakdown or failure of equipment or techniques;
- Any accident; and
- Emissions;

19.0 Basis of Report

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APPENDIX BATOT 01

Indicative Organogram

APPENDIX BATOT 02

Plant & Equipment List

FIGURES

DRAWINGS

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