CHAPTER 9- Waste management

9.1 Introduction

The aim of the waste management for the Twin Bonanza mine site is to identify potential waste streams and volumes, potential impacts of waste generation, together with management measures applied to minimise impacts. Waste management for non-mineralised waste will be discussed in this chapter, waste management for mineralised waste from the extraction and processing of ore will be discussed in Chapter 10: Tailings and waste rock management.

The existing waste management system for the project will be upgraded and aligned with the upgraded processing plant and accommodation facilities.

The processes and procedures for managing site-generated wastes are detailed in this chapter. This document also contains management procedures associated with the generation, handling, storage and transport of waste materials.

9.2 Waste management legislation and requirements

The regulatory requirements in the Northern Territory regarding waste management include:

- Waste Management and Pollution Control Act 1998 (NT)
- Waste Management and Pollution Control (Administration) Regulations 2001 (NT)
- Public and Environmental Health Act 2011 (NT)
- Water Supply and Sewerage Services Act 2000 (NT)
- Water Act 2004 (NT)
- Mining Management Act 2009 (NT)
- NT Department of Health - Environmental Health Fact Sheet #700 - Requirements for Mining and Construction Projects
- Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent (1996)
- AS 1940-2004: The storage and handling of flammable and combustible liquids
- Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory (2013)

9.3 Waste management principles

ABM is committed to minimising the impact of waste on the environment and the community by adopting appropriate waste management principles. ABM, in all practicable cases, will endeavour to achieve the best possible environmental outcome by minimising

waste generation, maximising waste re-use, maximising recycling and safely treating and disposing of non-recyclable materials.

Leading practice waste management principals are incorporated into ABM's Waste Management Procedures.

9.4 Waste management strategies

ABM has integrated standard waste management principles and strategies into their waste management practices. Cleaner production, pollution prevention and waste minimisation are important components of the overall waste management strategy.

ABM will segregate wastes that are recyclable and reusable, and will endeavour to recycle wastes in appropriate recycling facilities or use on site if applicable. Availability of recycling facilities is determined largely by the cost of recycling and the market for recycled goods. If additional recycling facilities become available and accessible to ABM, recycling of those waste products will be assessed and, where practicable, implemented.

Re-usable wastes such as oil, scrap metal and timber pallets will be re-used or recycled, while others will be disposed of on-site. Waste planning, such as the separation of components of the waste stream at the generation point, will continue to be implemented during all project phases. This practice allows for the recovery of reusable or recyclable waste materials, such as pallets, which will otherwise be disposed of or destroyed.

ABM's waste management strategy also reduces the level of risk associated with pollution generation, onsite and off-site. ABM's waste management objectives are to:

1. avoid and minimise the production of waste wherever possible
2. prevent wastes from contaminating the surrounding environment
3. manage and control disposal of all wastes
4. recycle waste wherever possible.

The Twin Bonanza mine site will endeavour to:

1. utilise processes/products that produce zero or minimal waste requiring disposal
2. utilise processes/products which minimise contamination of the surrounding environment
3. recycle all wastes that can be recycled.

9.4.1 Waste monitoring

The purpose of monitoring the activities and outcomes related to waste management include:

1. providing baseline data for the progressive development of preventative and mitigation measures for waste management and waste management decisions
2. assessing results against predicted volumes
3. assessing the performance of the mitigation and management measures
4. monitoring for potential environmental impacts.

Monitoring will include the recording of waste types and volumes generated on-site (e.g. general waste, contaminated waste, scrap metal and recyclables) and being transported off-site. Records will be maintained in order to determine where large quantities of certain wastes are being produced. Records will be reviewed on a regular basis and appropriate corrective actions formulated to reduce or eliminate waste generation or impacts associated with waste.

ABM will, where practicable, reduce the total amount of waste and environmental impacts directly associated with waste generated from the project; and will employ principles of avoid, reduce, reuse and recycle wherever possible.

9.4.2 Waste reporting

In addition to the Northern Territory Government's regulatory requirements for waste management, certain projects will be required to comply with relevant National Environmental Protection Measures (NEPM) developed by the National Environmental Protection Council (NEPC). The relevant NEPM for the project is the National Pollutant Inventory (NPI), under which emissions and wastes are reported. ABM, based on current estimates, falls outside of the criteria for reporting; however, if at any stage ABM Resources meets the criteria, the company will estimate and begin reporting mine emissions to the NPI annually, in accordance with the National Pollutant Inventory Guide (SEWPAC, 2010) and associated manuals (e.g. Emission Estimation Technique (EET) Manual for Mining (SEWPAC, 2001)).

All NPI information is accessible to the community, industry and government through the NPI website.

Greenhouse gas emissions are discussed in Chapter 8: Air quality and greenhouse gas emissions and Chapter 14: Environmental management plan.

9.4.3 Existing waste facilities

There will either be an upgrade of existing facilities, to encompass the increased wastes generated from the mine or the establishment of new facilities proximal to upgraded infrastructure (Figure 9-1). Existing Infrastructure is outlined below in sections 9.4.3.1 onwards.

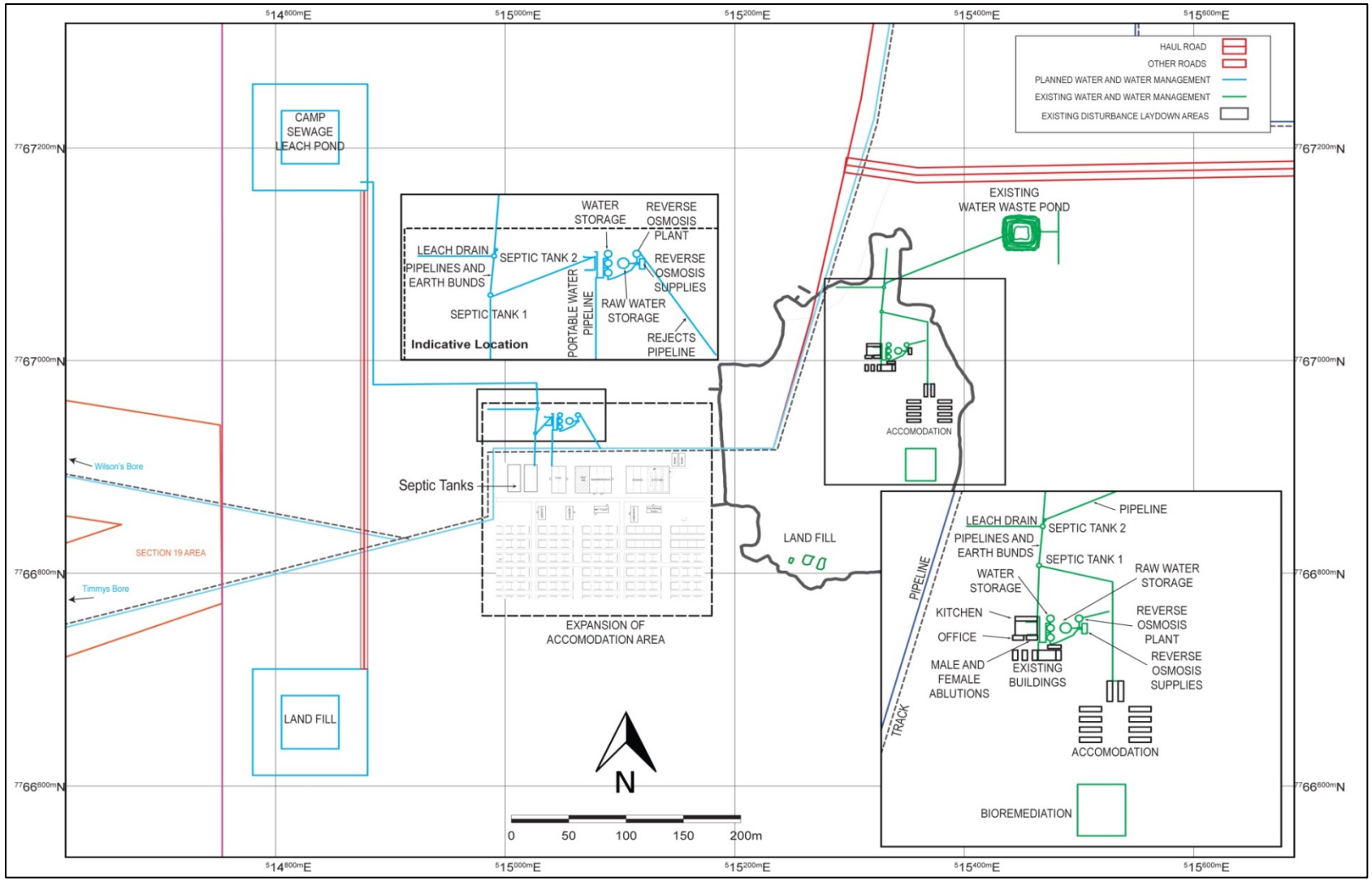

Figure 9-1. Existing and proposed water and waste water management.

9.4.3.1 Landfill

The landfill will receive uncontaminated waste (solid and putrescible) from on-site operation activities, in addition to accommodation activities. To prevent the creation of new habitats for feral animals and manage the potential for windblown rubbish, the landfill will be surrounded by a wire mesh fence with entry via a gate.

Future landfill developed as part of the Twin Bonanza project, when applicable, will be constructed and managed in accordance to the Guidelines for the Siting, Design, and Management of Solid Waste Disposal Sites Northern Territory (2013). This includes:

- The consideration of geological, surface water and ground water factors in determining the location of the landfill.
- The establishment of fencing and a gate around the area.
- The relevant elements related to closure of the landfill.

During operations, the potential to encapsulate large, inert material, which cannot be recycled or reused, within the active waste dump will be investigated. As a minimum, the encapsulation material is to comply with the following requirements.

- Is in adherence to all land holder agreements.
- Is to be located no closer than 5 horizontal metres from the final waste dump outer batters.
- Is to be covered by a minimum of 5 metres of waste rock.
- The location does not compromise the waste dump design or segregation of waste rock within the profile of the waste dump.

9.4.3.2 Reduction, recycling and reuse

To prolong the lifespan of onsite landfills, ABM will segregate wastes that are recyclable and reusable, and will endeavour to recycle wastes in appropriate recycling facilities or re-use on site if applicable. The ability for ABM to recycle depends on the cost of transport and availability of recycling facilities that will take the material. When opportunities become available to transport material offsite, or if recycling merchants are in the region, ABM will assess the potential to recycle and, where practicable, capitalise on opportunities.

ABM will conduct recycling of material where practicable, such as paper, cardboard, glass, aluminium, plastics and steel, and ensure they are segregated and sorted for recycling off-site. In the situation of non-biodegradable waste that is not contaminated with hydrocarbons (such as plastic or aluminium) disposal will occur in the landfill if no recycling options are available or practicable.

Re-usable wastes such as oil, scrap metal and timber pallets will be re-used or recycled, while other inert waste will be disposed of on-site. Waste planning, such as the separation of components of the waste stream at the generation point, will continue to be implemented during all project phases with material stored in designated areas prior to reuse or recycling. This practice allows for the recovery of reusable material such as pallets, that can be used for other purposes across site.

9.4.3.3 Contaminated waste – storage/ handling/containment and emergency management of hazardous materials

Contaminated wastes, including materials that have been in contact with lubricants, greases, hydrocarbons and other hazardous chemicals, will be placed in designated disposal bins for transporting off site and disposal in a licenced facility in either the Northern Territory or Western Australia.

All chemicals on-site have a Materials Safety Data Sheet (MSDS) to provide details of the chemical and safety requirements relevant to use and disposal. The information provided on the MSDS is reviewed prior to handling and disposal of any chemicals.

Hydrocarbon and chemical storage areas are designed, constructed and managed in accordance with AS 1940. All fuel drums / chemical products shall be stored within bunded, lined areas or within portable self bunded pallets. Permanent bunded storage areas are to be located away from the accommodation site and drainage lines. Regular checks of the fuel and chemical storage areas will be undertaken to check for the presence of leaking drums. When leaking drums are identified the drum will be isolated and the liquids transferred into a suitable container for ongoing storage.

In the event of a spillage, spill containment material (e.g. absorbent materials) and spill cleanup kits located at workshops and/or on vehicles will be used to control spills and assist in spill clean-up. Used spill containment material is to be placed in designated disposal bins for offsite disposal with hydrocarbon contaminated soils remediated in an onsite bioremediation facility. Bioremediation, testing and end disposal of the soil will be aligned to the Western Australian guideline titled Bioremediation of hydrocarbon-contaminated soils in Western Australia (October 2004).

9.4.3.4 Putrescible and solid waste

If paper, cardboard, and similar inert waste cannot be recycled, when suitable conditions prevail this material is to be incinerated onsite using a turbo-burner. The objective of incineration is to assist in reducing the volumes of material thus prolonging the life of the facility.

Putrescible waste will be disposed in the landfill to prevent both endemic and feral fauna from utilising this material as a potential food source. The landfill will be fenced with regular maintenance inspections of the fence to prevent the entry of fauna.

9.4.3.5 Sewage treatment & waste water

Sewage treatment at the accommodation village will be treated through an installed septic system. The system will be either an upgrade of the existing sewage treatment facility servicing the current Wilsons Camp accommodation or the installation of a new system.

The septics supporting the accommodation and laundry currently include two 5000ltr twin compartments and one 1500ltr twin compartment inline connected concrete septic tanks established for 24 Accommodation rooms with ensuite, and also laundry. The waste water is pumped from the last tank in the system into an evaporation pond. There are also two 4000ltr twin compartment inline connected PVC septic tanks established for two toilets only.

The waste water facility presently on-site services the kitchen, two showers and two washing machines. The system comprises one small evaporation pond, with water from this pond pumped into a second evaporation pond.

The present septic system will not support the increase in numbers and a proposed additional leach / evaporation pond (Chapter 3, Figure 3-11) will be installed in the northwest corner of the extended camp footprint.

The proposed septics servicing the accommodation camp will be have similar twin compartment inline connected PVC septic tanks.

Septic tanks and leach and evaporation systems will be installed in line with the Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations – Regulation 28. As part of this process the Department of Health (DoH) will receive via the prescribed form notice of our intent to expand our waste management system. The waste water treatment system will be installed with signage and fencing as per DoH regulations and also have appropriate DoH and local shire approvals.

9.4.3.6 Water treatment – Reverse osmosis plant

All water for human consumption will be processed through a reverse osmosis (RO) plant. The plant is a SW15 Seawater Reverse Osmosis Desalination Plant supplied by Rotech Hamilton Hill WA and will desalinate the water extracted from the bore fields and make it suitable for human consumption. The plant has a nominal capacity of 15,000 litres per day. RO water will also be used where applicable for certain machinery and operations on site. Additionally, the RO water will be passed through a UV sterilisation system in order to kill any bacteria in the water and system.

Saline water rejected from the plant as a by-product of the reverse osmosis will be recycled and mixed with the water for the processing plant where it will be suitably diluted; the total dissolved salts (TDS) is less than 1500 PPM and will be recycled in the process water for the processing plant. The potable and reject water quality is to be monitored. In the future if the RO reject water is unsuitable for use in the plant it may be directed into the sewage waste water dam.

Permanent raw and potable water tanks will be installed to hold water prior to and after RO treatment. The two tanks, with a capacity of approximately 5000L.

9.5 Potential impacts and mitigation measures

The objective of ABM's waste management procedures will be to minimise the adverse impacts of waste on the environment through management of the mine wastes, ore processing wastes (Chapter 10: Tailings and waste rock management) and general construction and operational wastes.

No new waste streams will be introduced from the current trial mining phase; however waste volumes will increase substantially and will require upgraded waste management facilities.

The potential adverse effects and environmental risks associated with waste management include:

1. Contamination or degradation of surface water and/or groundwater's due to contact with waste products in operational areas
    a. improper Storage and handling of hazardous materials and hydrocarbons
    b. uncontrolled tailings dam seepage - leachates
    c. liberation of sediment from waste dump
    d. liberation of leachates from waste dump
    e. liberation of sediment from processing area
2. Inappropriate management of process water and sewerage dam
3. Build-up of waste material and potential uncontrolled waste disposal
4. Improper disposal of putrescible and general waste
    a. poor waste management leading to incursion of feral animals
    b. introduction of pest fauna species

   c. spread of weed species

5. Loss of aesthetic value
6. Degradation of air quality, including dust and odours
7. Risk of vector-borne diseases from waste disposal sites
8. Land contamination as a result of inappropriate storage and handling of wastes.

9.5.1 Operational wastes

Table 9-1 outlines the type, source and estimated volumes of wastes produced during the project's operational phases and initial construction. Volumes of waste have been estimated based on current waste production at the Twin Bonanza project and are projected forward for stage 3 mining developments.

Mitigation and management measures will be further detailed in Chapter 14: Environmental management plan (EMP). The EMP will assess management options by applying guidelines for waste management on the mine site.

Table 9-1. Waste management: Twin Bonanza project – Estimated quantity of waste projected forward for operational mine site.

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
MINING WASTES				
Waste rock	Waste rock-material surrounding the economic ore and below the topsoil and growth medium.	Refer to Chapter 10: Tailings and waste rock Management	Mining	Any overburden material that is found to have elevated elements with the potential to leach are encapsulated within the waste dumps. Material that has the potential to generated small volumes of acid will be contained within non-acid forming material (NAF) material to reduce any negative effects on the environment through leaching. The final landforms will be physically stable, safe, non-polluting and suitable for the agreed post mining land use so as not to affect the receiving environment. Specific measures to promote the stability of the waste dump are included in Chapter 11: Mine closure and rehabilitation and Chapter 10: Tailings and waste rock management.
MINING AND METALLURGICAL WASTES				
Tailings	Tailings will be produced by the processing of the ore	Refer to Chapter 10- Tailings and waste rock management	Processing plant	Tailings are removed from the processing plant as slurry and pumped to the tailings dams for disposal. Testing of the tailings water is to be conducted monthly. To date tailings material has been shown to exhibit NAF characterisations (refer Appendix L). Ongoing tailings characterisation will occur during the project. Surface and groundwater, monitoring and sampling will also continue to be conducted to determine if leaching from the tailings is occurring The tailings storage facility will be monitored to ensure the facility

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
				will be stable; adequate freeboard is available, seepage is controlled and storage capacity of tailings waste is sufficient during operations.
OTHER WASTES – operational				
Blasting waste (detonating cord)	Blasting is generally undertaken using ammonium nitrate/fuel oil (ANFO) and initiated with boosters and detonators. The main waste product from blasting is fragments of expired detonating cord.	Minimal	Blasting	No specialist management is proposed as most detonating cord is transported to the waste rock dump as part of mining and is buried during the overburden dumping.
Timber/wooden pallets	The majority of materials are transported to the mine site on timber pallets, which are re-used until they are no longer safe, at which time they become waste.	Up to 5 pallets per fortnight	Operations and accommodation village	Majority of timber/wooden pallets are re-used on-site or used to transport material from site or returned to suppliers. Those contaminated with hydrocarbons will be disposed appropriately in the designated waste bins.
Tyres	Tyres from trucks, earthmoving equipment and associated mining vehicles	2 per week	Workshops	Earthmoving machinery and vehicle tyres will be segregated, stored and stacked in a designated tyre storage area and will be regularly disposed of off-site in at an appropriate tyre disposal facility. Other options for recycling will be investigated as they arise
Liquid hazardous waste	Tails concentrate leaching and assaying residuals of tailings concentrates and sample analysis	Up to 3 to 4 cubic metres a day	Processing plant – designated area for leach and assay	The tailings concentrates are leached in an Acacia Reactor that is a close system to the environment. Within the Acacia process a recycling and detoxification module using sodium hypochlorite destroys cyanide. Once detoxified, the cyanide free waste solution

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
			laboratory	will be discharged to the lined Concentrate Residual Dam (CRD). Sample assaying material will be neutralised in a 20L container once denaturing and destruction of cyanide is completed with sodium hypochlorite disposal is via the CRD. The total destruction of cyanide and subsequent disposal in the CRD renders the concentrates harmless to the surrounding environment
Waste oil, grease and lubricants	Used hydrocarbons are collected as part of regular maintenance of equipment	Up to 1 tonne per week	Processing plant and workshops	All chemicals on-site have a Material Safety Data Sheet (MSDS) to provide details of the chemical and safety requirements relevant to use and disposal. Segregation of waste (e.g. separation of grease, waste oils, jet fuel and lubricants etc.) All hydrocarbon and chemical storage areas are designed and constructed in accordance with AS1940. Waste oil will be stored in waste oil tanks/containers prior to offsite disposal. Waste oil is removed off-site for disposal at an appropriately licensed facility. In the event of a spillage, spill containment material (e.g. absorbent materials) and spill cleanup kits located at workshops and/or on vehicles are used to control spills and assist in spill clean-up
Contaminated materials	All material that has been contaminated by hydrocarbons, including oily rags, oil filters and contaminated soils must be	1 skip bin per fortnight	Processing plant and workshops	Hydrocarbon contaminated material including rags, hydraulic hoses, absorbent materials, empty plastic or steel containers, grease cartridges and miscellaneous oily waste will be disposed in designated waste bins for offsite disposal.

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
	treated as a contaminated waste			Hydrocarbon contaminated soils are placed within the dedicated bioremediation area. Once remediated, soil will be disposed on site or off site depending on the nature of the residual contamination.
Fuel contaminated water	Fuels and hydrocarbons are stored within bunded areas to contain any minor spills and prevent contamination of land or waterways. Bunds also collect rainfall which needs to be drained out for the stored materials to be accessed. This collected rainfall contains small proportions of the stored materials and cannot be released directly to the land or waterways	1 tonne per year	Refuelling operations at the refuelling bay and fuel storage areas	Removal off-site for disposal at an appropriately licensed facility for all fuel contaminated water. In the event of a spillage, spill containment material (e.g. absorbent materials) and spill clean-up kits located at workshops and/or on vehicles are used to control spills and assist in spill clean-up
AvGas	AvGas fuel is generated from the test samples when refuelling the daily regional link charter flight	Up to 200L per month	Fuel storage facility / airstrip	The small samples produced during fuel testing will be stored in accordance to the MSDS and disposed of to a licenced facility.
OTHER WASTES – Administration/offices and Accommodation				
Recyclables – cardboard,	Cardboard and paper from packaging. Aluminium and tin	1 tonne per month	Offices, kitchens,	Where practicable cardboard and paper is to be transported off-site for recycling at appropriate recycling facilities. If this cannot be

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
paper, glass, tin and aluminium cans	cans, and glass which are generated from staff		administration area, workshop and accommodation areas	achieved when suitable conditions prevail this material is to be incinerated onsite using a turbo burner. Aluminium and tin cans, glass and beverage containers will be collected in designated containers and transported for recycling to approved recycling depots.
General waste	Kitchen (putrescible) waste	1 m^3 per week	Offices, kitchens, administration area, workshop and accommodation areas	Labelled bins for general wastes will be placed in all appropriate locations on-site Putrescible wastes will be burnt via a turbo burner or disposed in the designated fenced landfill.
Vehicle batteries	Batteries that are no longer viable for their allocated use are classified as a contaminated waste. Recycling of the batteries will occur	1 per week	Workshops and power generators	Collected and stored in designated areas and contained within bunded pallets. Transported off-site to a licenced receiver for recycling.
Scrap metal	Any metal-based equipment or scraps that meet the quality requirements for recycling	1 tonne per month	Processing plant, and workshops	Minimise waste by producing/procuring only the amount necessary Segregation and collection on-site Transportation off-site for recycling or reused around site where possible
OTHER WASTES – Liquids / water				
Process water	Any water that has been used	Refer to	Processing plant	Where practicable, runoff water (i.e. 'clean water') is diverted away

TYPE	WASTE DESCRIPTION	ESTIMATED QUANTITY OF WASTE	SOURCE(S)	MANAGEMENT
	or contaminated by mining operations, including mine runoff water or water that has been used at the processing plant	Chapter 6- Water Management		from mining operations and re-directed back into existing drainages. Runoff that cannot be diverted away from mining operations (i.e. 'dirty water') is collected in sediment ponds or sumps and where practicable, re-used for operational purposes (e.g. at the processing plant, for dust suppression on haul roads). Excess water is released into the environment once sediment is liberated. The consumption of raw water is kept to a minimum by the implementation of water recycling where possible. Decanted water from the tailings dam is re-used in the processing plant to reduce water consumption and assist in the consolidation of tailings.
Sewage	Sewage wastes	200L per day per person.	Accommodation village and mine, including showers, toilets and facilities	Treated on-site by a sewage treatment plant through a process of intermittent aeration and settlement The treated effluent water is disposed of on-site by irrigation to nearby designated land

9.5.2 Mine closure wastes

Chapter 11: Mine closure and rehabilitation describes the waste generated from the decommissioning of the project, including the mine infrastructure area such as offices and the processing facilities. More detail is also provided in Appendix O: Conceptual Mine Closure Plan.

Amounts of decommissioning waste may change depending on the amount of salvageable material and legislation applicable at the time. Some infrastructure areas may remain after decommissioning with agreement from the post mine landowner.