**Avonbank Mineral Sands Project**

**Environment Effects Statement**

**Chapter 19 – Wastes and Emissions**

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# Wastes and Emissions

## Introduction

This Chapter provides an overview of the waste and emissions effects for the Avonbank Mineral Sands Project (the Project). It has been prepared to address the Environment Effects Statement (EES) Scoping Requirements (DELWP, 2020) and is supported by a detailed impact assessment prepared by GHD Group Pty Ltd (GHD) (Appendix Q).

The key evaluation objective relating to waste and emissions as defined in the Scoping Requirements is to ‘Protect the health and wellbeing of the community, and minimise effects on air quality, noise, visual and social amenity' in relation to greenhouse gas emissions and wastes produced by the Project. The associated issues and Project Scoping Requirements are detailed in Appendix A of this EES.

This Chapter describes the potential impacts associated with Project related wastes and emissions and details the avoidance and mitigation measures to minimise the residual impacts so far as reasonably practicable.

## Scope and Methods

### Scope

The scope of this Chapter covers the potential impacts identified in the Wastes and Emissions Impact Assessment (WEIA) (Appendix Q) and addresses the relevant Scoping Requirements listed in Appendix A. The impact assessment focused on the mining and mineral processing activities and the associated waste and emissions over the life of the Project. The greenhouse gas assessment included Scope 1, Scope 2 and Scope 3 emissions, as described in Section 19.2.3. Project related aspects that are well understood and considered to be relatively low risk with standard controls in place are addressed in the Project Aspects and Risk Register (Attachment 5).

### Study Area

The WEIA focused on activities within the mining licence (MIN) and WIM Base Area (WBA). The study area extended to the broader region, including the City of Horsham and the settlement of Dooen, as shown in Figure 19‑1. Sensitive receptors that fall within the study area are described in Section  19.5.2.

### Methodology

The WEIA characterised the existing conditions, potential impacts and residual impacts with avoidance and mitigation measures in place. The tasks undertaken are summarised below and detailed in Appendix Q, Section 4, and Section 7.

Existing conditions:

* A review of the relevant impact assessment studies (prepared as part of this EES) was undertaken to establish a broad understanding of the Project.
* Existing conditions were summarised where relevant using the findings from various studies, including Groundwater Impact Assessment (Appendix L), Surface water Impact Assessment (Appendix K) and Radiation Risk Assessment (Appendix I).
* The waste streams associated with each of the Project lifecycle stages (construction, operation and post-mining) were identified and categorised in line with the current EPA guidelines and legislation.
* The existing conditions and surrounding land use were characterised with reference to the relevant impact assessment studies.
* Greenhouse gas (GHG) emission factors were sourced from:
* National Greenhouse and Energy Reporting (Measurement Determination) 2008*.*
* ‘National Greenhouse Accounts Factors’, August 2019 (NGAF, 2019) and October 2020 (NGAF, 2020).

Potential impacts:

* Potential impacts associated with the Project were identified with reference to the relevant studies and risk assessment (refer Appendix Q, Section 4.2).
* The scope of the GHG emissions were identified in line with the *National Greenhouse and Energy Reporting Regulations 2008* and the emission sources from the construction and operation of the Project as follows:
* Scope 1 emissions: The release of GHG into the atmosphere as a direct result of the Project’s activities during construction and operation, including ancillary activities.
* Scope 2 emissions: The release of GHG into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam consumed by the Project that does not form part of the facility.
* Scope 3 emissions: The release of indirect GHG emissions generated by the wider economy because of activities of the Project.
* Groundwater and surface water impacts were assessed and interactions with waste materials were identified.
* Soil impacts were assessed where topsoil, subsoil and overburden impacted by the Project could result in contamination.
* Potential sensitive receptors were identified from relevant studies with consideration to the plausible effects relating to all phases of the Project.
* Key potential impacts were identified where source-pathway-receptor linkages were considered plausible.

Residual impacts:

* Potential measures were identified to avoid and/or minimise impacts to sensitive receptors so far as reasonably practicable.
* The magnitude, extent, and duration of potential impacts on sensitive receptors, as described by relevant impact assessment studies, were considered to understand the effectiveness of the avoidance and mitigation measures.
* Residual impacts were assessed and assigned a significance rating (refer Section 19.5.3).
* A qualitative assessment of the potential cumulative impacts associated with other projects in the region was undertaken.

Key assumptions relating to the impact assessment are detailed in Appendix Q, Section 1.6.

Map

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Figure 19‑1: Study area

## Operational Context

The main waste streams resulting from Project activities will include sand tailings, excavated of regolith (including overburden, subsoil and topsoil), sewage from ablutions, contaminated stormwater run-off, GHG emissions and other general municipal waste. These are described below in Table 19‑1.

The *Environment Protection Act 2017* (EP Act) provides a broad definition of ‘waste’ including, but not limited to, any ‘solid, liquid, gaseous or radioactive matter that is deposited, discharged, emitted or disposed of into the environment in a manner that alters the environment’. Furthermore, waste arising from domestic, commercial, industrial, trade activities or from laboratories are classified as industrial waste.

Table 19‑1: Key waste streams

| Key Waste Stream | Description |
| --- | --- |
| Sand tailings | Sand tailings will be produced from the Wet Concentrator Plant (WCP) within the WBA. At the WCP, target minerals will be separated from fine and coarse sand tailings by a simple wet gravity circuit. Sand tailings will be returned to the mining void via a pipeline from the WCP. Tailings will be treated with a flocculant and the resultant water released will be recovered via a decant sump and returned to the process water circuit. Around 7.5 ML/day will be lost from the process water circuit and seep to the aquifer. Tailings will be buried at least 3 m below the rehabilitated ground surface. Tailings management for the Project is further described in Chapter 2 (Project Description) and Chapter 17 (Groundwater). |
| Overburden and soils | Prior to mining or the establishment of infrastructure, topsoil and subsoil units will be progressively be stripped and stockpiled for later use in rehabilitation. Overburden will be directly returned to the mining void after excavation except for the two stockpiles which will be established for the starter pits in Block A and Block B (refer Chapter 2). |
| Waste hydrocarbons | Up to 160,000 L (4 x 40,000 L tanks) of diesel will be stored on the WBA/MIN for use by the fleet. Other hydrocarbons, such as oils and lubricants, will also be stored for use by the fleet. Drainage from hydrocarbon management areas such as workshops will be managed so that contaminated water is appropriately contained and treated prior to release to the process water circuit (i.e., via an oil water separator). Waste hydrocarbons will be removed from site to a suitably licenced waste receiver. |
| Sewage | Two sewage management systems will be installed to treat up to 5,000 L/day. This will serve around 200 people. |
| Stormwater run-off | All stormwater from operational areas, including disturbed areas, stockpiles and mine void will drain to sumps for return to the process water circuit or used for dust suppression (where appropriate). There will be no discharge from operational areas and the mine water run-off sumps and process water circuit will have the capacity to hold in excess of a 1% AEP rainfall event. |
| GHG emissions | Scope 1 emissions are defined as the release of GHG into the atmosphere as a direct result of Project activities during construction and operation. Scope 2 emissions are defined as indirect GHG emissions associated with the purchase of electricity by the Project and subsequent consumption of the electricity. Scope 3 emissions are defined as the release of indirect GHG emissions by the wider economy because of activities of the Project.  Plant will operate by sourcing high-voltage power from the site’s distribution network. The in-pit mining unit plant (MUP), the WCP, pump stations and the operation of other pumps and plant will consume energy from this network. In doing so, energy consumption will contribute to GHG emissions.  Through all phases of the Project, a variety of vehicles and machinery will be used and maintained, resulting in the combustion of diesel and fuel (hydrocarbons), contributing to GHG emissions. Ore and overburden will be handled by excavators, D11 dozers, trucks, scrapers, bulldozers, tractor scoops and front-end loaders. B-double articulated vehicles (trucks) will be used for the haulage of HMC to the Port. Light vehicles will also form part of the Project’s fleet, with about 25 to 50 light vehicles per day travelling from the WBA to the active mine area. |

It is noted that the processing of mineral sands does not produce a radioactive waste product. Density gauges that may be used in the WCP will have a radiation source, which will be decommissioned and disposed of in line with the Radiation Management Plan, as described in Chapter 14 (Radiation).

Air emissions, including particulate matter, respirable crystalline silica and depositional dust due to Project activities, are addressed in the Chapter 13 (Air Quality) and Chapter 18 (Human Health Risk Assessment). These matters are not further discussed in this Chapter.

Further operational context is provided in the WEIA (refer Appendix Q, Section 5).

## Existing Conditions

### Surface Water

The proposed mining licence and WBA areas are relatively flat, with surface run-off tending to pool in localised depressions or flow toward Dooen Swamp. Dooen Swamp is a floodplain wetland that connects to the Wimmera River during high-flow events. There are three designated waterways within the vicinity of the Project, which are Yarriambiack Creek, Two Mile Creek and the Wimmera River (refer Chapter 16). No designated waterways are situated within the proposed mining licence or WBA. As described in the Surface Water Impact Assessment (Appendix K), the Project area will not be impacted by riverine flooding or by significant local flooding, even under extreme events.

### Groundwater

The mineral sands ore body is hosted within the Loxton Parilla Sands geological unit on the southern edge of the Murray Basin. The Loxton Parilla Sands forms the watertable aquifer, representing the uppermost saturated geological unit where groundwater is first intersected beneath the Project area.

The depth to groundwater ranges from around 12 to 34 m below ground level (BGL), increasing from the south to north-west across the study area, with an average aquifer saturated thickness of 10 m. The ore body is located, on average, between 16 to 28 mBGL. This means parts of the ore body are located below the watertable, and dewatering will be required during mining (refer Chapter 17).

The existing hydrogeology is characterised by a low recharge, low hydraulic conductivity environment with a gentle hydraulic gradient across the study area. With these characteristics, the Groundwater Impact Assessment (GWIA) identified the primary migration pathway for the transport of Contaminants of Potential Concern was down-hydraulic gradient to the north-west, at a rate of around 100–300 m over 62 years.

Potential groundwater dependent ecosystems (GDEs) were identified in the vicinity of the Project area, including but not limited to Darlot Swamp, Dooen Swamp and Wimmera River. These surface water features were found to be losing systems and were not baseflow dependent, with the exception of the Wimmera River after flood events. Further detail is provided in Chapter 17 (Groundwater).

### Existing Land Use

The site currently consists mostly of privately owned property used primarily for broadacre continuous cropping. The landscape is highly modified and has largely been cleared of native vegetation. The proposed mining licence is mainly zoned for Farming (FZ), and the WBA is largely within a zone for industrial use, Special Use Zone (SUZ9) (refer Chapter 8, Land Use and Planning).

### Existing Waste Management Facilities

The closest landfill to the Project area is the Dooen Landfill, located around 16 km from Horsham. It is operated by the Horsham Rural City Council and accepts asbestos, contaminated soils (Category C waste), tyres (shredded), solid inert waste and putrescible waste. Other nearby waste receival facilities include the Stawell Landfill, located within 100 km of the Project area.

### Greenhouse Gas Emissions

The existing conditions for GHG emissions provide a base case against which the Project can be compared. The Victorian and national GHG emissions for 2019 are presented in

Table 19‑2. The *Climate Change Act 2017* drives the state to achieve net-zero emissions by 2050. Victoria’s total GHG emissions for 2019 was 91.3 Mt CO2-e, which represents a reduction of 25% from 2005 levels.

Table 19‑2 Victorian and national GHG emissions

| **Sector** | **State** | | **National** | |
| --- | --- | --- | --- | --- |
| **GHG Emissions  (Mt CO2-e)** | **Contribution to State Emissions (%)** | **GHG Emissions (Mt CO2-e)** | **Contribution to National Emissions (%)** |
| Energy | 87.0 | 95.3% | 434.0 | 82.0% |
| Industrial processes  (Mineral industry) | 3.3  (0.1) | 3.6%  (0.1%) | 31.8  (5.6) | 6.0%  (1.1%) |
| Agriculture | 15.6 | 17.1% | 74.8 | 14.1% |
| Waste | 2.8 | 3.1% | 13.8 | 2.6% |
| Land use, land use change and forestry | -17.4 | -19% | -25.1 | -4.7% |
| **Total** | **91.3** | **100%** | **529.3** | **100%** |

## Potential Impacts

### Identified Potential Impacts

Potential impacts are identified in the WEIA with consideration to the Project activities, risk assessment outcomes, and the location of sensitive receptors (refer Section 19.5.2). Where a source-pathway-receptor relationship was considered plausible, further investigation was undertaken to assess the residual impacts with avoidance and mitigation measures in place (refer Section 19.7). The potential impacts are listed in Table 19‑3.

Table 19‑3 Potential impacts

|  |  |  |
| --- | --- | --- |
| Item | Potential Impacts | Phase[[1]](#footnote-2) |
| IP-01 | Placement of tailings resulting in changes to groundwater quality. | O, D |
| IP-02 | Excavation and placement of overburden, topsoil and subsoils resulting in groundwater or land contamination. | C, O, D |
| IP-03 | Spills and leaks from hydrocarbons or other chemicals resulting in groundwater or land contamination. | C, O, D |
| IP-04 | Sewage systems inappropriately managed resulting in groundwater or land contamination. | C, O, D |
| IP-05 | The release of contaminated stormwater resulting in surface water contamination. | C, O, D |
| IP-06 | Generation of GHG emissions resulting in contributions to global GHG emissions. | C, O, D |
| IP-07 | Uncontrolled disturbance of existing contaminated sites resulting in groundwater or land contamination. | C, O |

### Sensitive Receptors

Potential sensitive receptors identified in the WEIA are listed in Table 19‑4 and are shown in Figure 19‑2. These receptors are situated within the worst-case plausible extent of potential impacts.

Table 19‑4: Sensitive receptors

|  |  |
| --- | --- |
| Receptor Type | Sensitive Receptors |
| Residential dwellings and educational facilities | Dwellings in Dooen, Jung, isolated residences, as well as the Longerenong College residences. |
| Industrial and commercial facilities | Receptors located within the Wimmera Intermodal Freight Terminal (WIFT) Precinct and elsewhere in the study area. |
| Community | Community venues in the vicinity of Dooen and Jung. |
| Natural waterways/habitat | Darlot Swamp, Yarriambiack Creek, Two Mile Creek, Dooen Swamp. |
| Groundwater bores | Two groundwater bores identified: public stock groundwater bore 68431 and unknown bore 60526. |

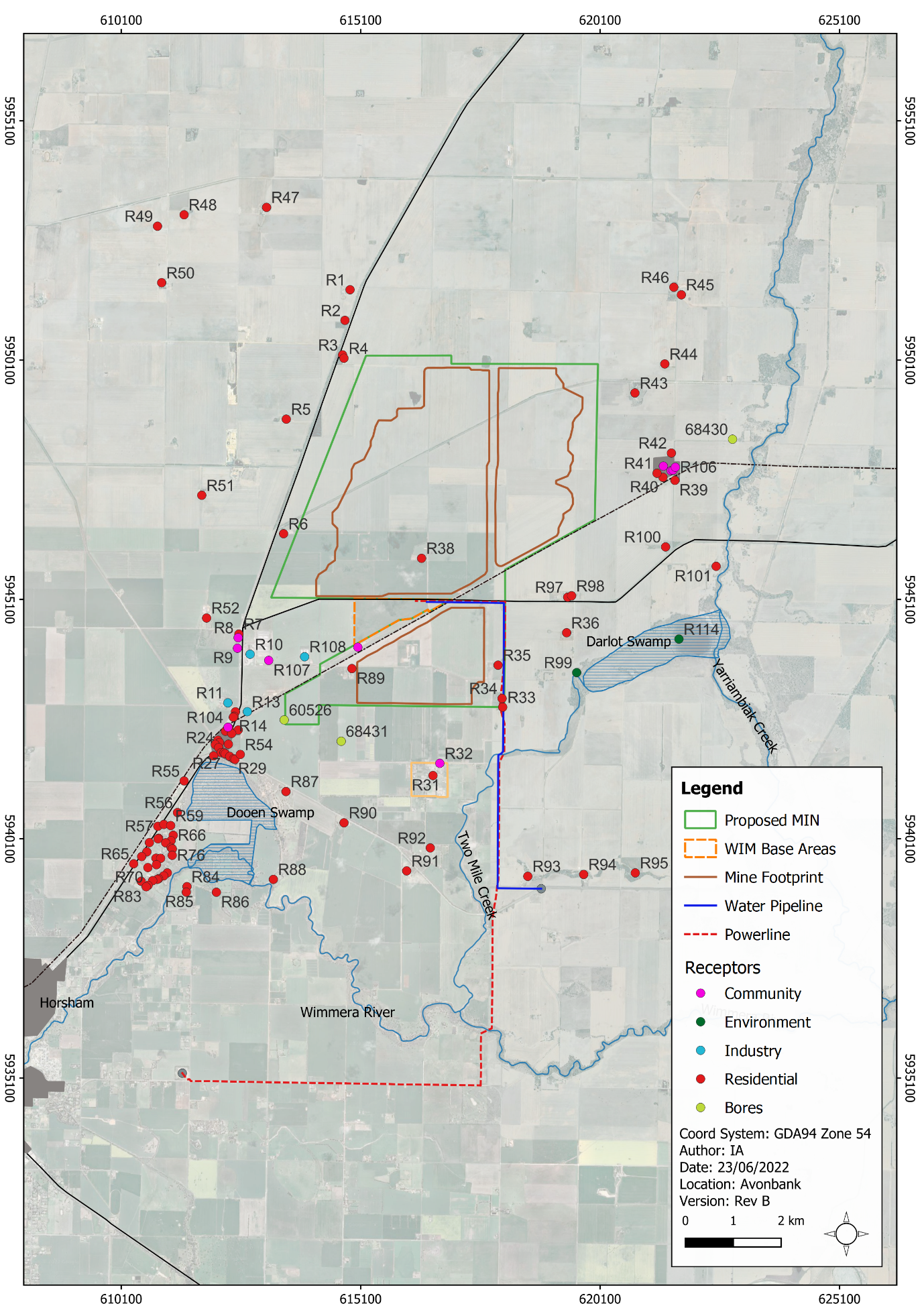


Figure 19‑2: Sensitive receptors

### Impact Characterisation

The impact assessment summarised in Section 19.7 considers the magnitude, spatial extent, and duration of the residual impacts where relevant, as described in Chapter 6 (Impact Assessment Framework). In assessing the residual impacts, consideration was given to the findings from relevant studies relating to groundwater, surface water and radiation and the relevant benchmarks summarised in Table 19‑5.

Table 19‑5 Benchmark criteria

|  |  |
| --- | --- |
| Reference | Commentary |
| Environment Reference Standards (ERS, 2021) | The ERS defines a range of protected environmental values for defined segments of the groundwater environment. Environmental values for GDEs, groundwater bores (irrigation, stock, potable) are identified with reference to water quality (salinity) objectives. The ERS provides for the use of background levels in the first instance and other published criteria as a secondary consideration.  The ERS also defines indicator criteria for surface water environments. This applies to the Wimmera River, Yarriambiack Creek and other waterbodies (to which groundwater may ultimately discharge).  The ERS refers to the ANZG ‘Guidelines for Ecosystem Protection’ which have been adopted as GDE objectives (ANZG, 2018) and ANZECC and ARMCANZ ‘Guidelines for Primary Industries’ (including water for irrigation) (ANZECC AND ARMCANZ, 2000a). |
| Environment Protection Authority, Waste disposal categories – characteristics and threshold (EPA, 2021c) | The publication lists criteria against which certain wastes are intended to be assessed to determine which waste disposal category applies. Where soil contains known or is reasonably expected to contain contaminants exceeding the upper limits for fill material in Table 3 of EPA Publication 1828.2 (EPA, 2021c), these will be classified accordingly as wastes. |
| National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 1999) | The NEPM provides a national risk-based framework for the assessment of site contamination in Australia. The NEPM ensures there is adequate protection of human health and the environment. The most stringent level of health-based soil contamination in the NEPM are the HIL-A investigation levels which are typically applied to residential properties with gardens and/or accessible soils. |

In addition to the detailed characterisation of the impacts described above, the relative significance of each residual impact was summarised on a scale ranging from negligible to severe (Table 19‑6).

Table 19‑6 Significance ratings

| Rating | Waste Assessment Rating | GHG Assessment Rating |
| --- | --- | --- |
| Negligible | No detectable impact on identified receptor/s, values or use. | Construction or operation GHG emissions per annum are insignificant; that is, the Project is near to, or on par with the ‘no project’ scenario. |
| Minor | Impact on identified receptor/s within natural variability and/or no tangible change to environmental values or use, that is, no impact to current or future on-site and off-site environmental values or uses from waste generated and potentially discharged to land, surface water, air or groundwater. | Construction or operation incremental GHG emissions per annum triggers, or are over, the NGER Scheme reporting requirements. |
| Moderate | Impact on identified receptor/s with a tangible change to environmental values or use. Impacts extend outside the Project area and may persist over the medium (> 5 years) to long-term (> 30 years), that is, the waste associated with the Project is inappropriately stored, transported, reused or disposed of, either on-site or off-site, resulting in an impact to receiving environments. | Construction or operation Scope 1 and Scope 2 GHG emissions per annum represent a non-negligible proportion of Victoria’s total GHG emissions (>1%). |
| Major | Impacts on identified receptor/s with a significant change to environmental values or use. Impacts extend locally or regionally and may persist over the medium (>5 years) to long-term (>30 years). Receptors of state significance permanently impacted. | Construction or operation Scope 1 and Scope 2 GHG emissions per annum represent a non-negligible proportion of Victoria’s total GHG emissions (>10%). |
| Severe | Impacts on identified receptor/s with a significant change to environmental values or use. Impacts may extend locally, regionally or state-wide and may persist over the long-term (>30 years) or be irreversible. | Construction or operation Scope 1 and Scope 2 GHG emissions per annum represent a non-negligible proportion of Australia’s total GHG emissions (>10%). |

## Avoidance and Mitigation Measures

This Section outlines the measures identified to avoid and minimise residual impacts. It is noted that in line with the requirements of the proposed environmental management system (EMS) and relevant legislation, additional measures may be required during Project implementation to ensure risks and potential impacts have been minimised so far as reasonably practicable.

### Avoidance

#### WE-01: Off-site water discharge

The process water storage, transfer areas and sumps will be designed with a capacity to contain a significant rainfall event of at least 1% AEP, such that there will be no discharge of surface water from operational areas. It is anticipated that process water capacity will be maintained at between 350% to 500% of a 1% annual exceedance probability (AEP) event.

### Minimisation

#### WE-02: Tailings strategy

The fine tailings produced at the desliming cyclone will be dosed with a polymer flocculant to promote water recovery. A large diameter thickener and a flocculant dosing system will be used in the primary stage of dewatering to allow the fines to be thickened.

Fines will report to the thickener underflow and will be combined with sand tailings and pumped back to the mine void. Clean water overflow from the thickener will be transferred to a process water dam or recirculated to the WCP.

Secondary dewatering will occur at the mine void tails discharge outlet. This will involve adding further polymer flocculant to the slurry exiting the pipe head. The clean water will separate from the tailings beach and will report to a decant sump. The recovered water will be recycled to the process water circuit. This process results in water recovery of around 62% and will effectively maximise water recovery so far as reasonably practicable.

It is expected that up to 30% of the tailings water will infiltrate to the groundwater aquifer. A portion of this water may be recovered as seepage in adjacent mining cells. This water will contribute to offsetting the predicted drawdown. Process water monitoring will be undertaken at the WCP. Real-time monitoring of key parameters will be undertaken as a set of leading indicators prior to groundwater discharge. Further detail on the groundwater management and monitoring program is provided in Chapter 17 (Groundwater).

#### WE-03: Mine planning and site drainage

Prior to opening new mining cells or constructing new infrastructure, a drainage plan will be prepared by the Mine Planning Engineer with consideration to the existing topography, detailed mine design, surrounding infrastructure and the location of sensitive receptors.

All infrastructure, including but not limited to buildings, stockpiles, sumps, pipelines and booster pumps, will be located in areas to minimise the risk of ponding and adverse effects to surface water flow paths. Rehabilitation areas will be contoured to reflect the pre-mining landform and surface drainage will be re-established commensurate with undisturbed areas.

Appropriately sized sediment retention basins will be established as part of the drainage plan to capture mine contact water and prevent discharge outside operational areas. Stormwater drains will be designed and constructed to minimise the risks posed to infrastructure and sensitive receptors.

A Surface Water Management Plan (refer Chapter 16) will be developed and implemented to monitor water quality within operational areas and in established rehabilitation areas.

Stormwater collected within hydrocarbon management areas such as workshops will be managed so that it is appropriately contained and treated prior to release to the process water circuit (i.e. via an oil water separator).

#### WE-04: Contaminated land

Prior to mining each land parcel, a contaminated site investigation will be undertaken in accordance with the ‘National Environment Protection (Assessment of Site Contamination) Measure’ (NEPM) (NEPC,1999). The investigation will be undertaken at the earliest opportunity once the relevant consent to access land parcels has been granted by the landholder.

The NEPM outlines a staged approach to the investigation and assessment of existing contamination that proceed in stages, in proportion to the risks of environmental harm. A preliminary site investigation (PSI) will be completed for the relevant land parcels (refer Chapter 15). As detailed in Section 2 of the NEPM, further work may be required pending the outcomes of the site investigation, which may involve a detailed site investigation. If areas of contamination are confirmed, a remediation plan will be developed to address all relevant requirements of the NEPM.

Any management plan in the first instance will determine whether it is possible to avoid disturbing pre-existing contaminated land. Where disturbance cannot be avoided, it will describe options to mitigate or remediate environmental harm from existing contamination.

#### WE-05: GHG emissions and energy efficiency program

An energy efficiency program will be prepared to minimise GHG emissions. The program will be developed using the ‘Protocol for Environmental Management (PEM): Greenhouse Gas Emissions and Energy Efficiency in Industry’ (PEM, 2001) and the EPA’s ‘Guideline for minimising GHG emissions’ (EPA, 2022).

The program will identify energy efficiency targets and measures to achieve these targets. The program will set out the monitoring requirements required to evaluate the effectiveness of the management measures and will establish a mechanism to identify improvements. In setting targets, consideration will be given to Victoria’s Climate Change Framework, as this sets out Victoria’s long-term plan to achieve net zero emissions by 2050.

#### WE-06: Waste Management Plan

A Waste Management Plan (WMP) will be prepared prior to Project commencement which will provide a management framework to avoid and minimise risks so far as reasonably practicable.

The WMP will address aspects relating to Project related waste, emissions and associated potential impacts on sensitive receptors.

The WMP will be reviewed and updated at an appropriate frequency as established in the overarching environmental management system, with consideration to the level of risk, statutory requirements, monitoring results, community complaints and in response to audit findings. It will be developed in consultation with stakeholders, including the EPA, and will be subject to approval by the relevant Authority.

The WMP will:

* Summarise the baseline data and existing environment.
* Explain the relevant statutory requirements and context (including any relevant approvals).
* Describe the mitigation measures to be implemented to minimise residual risks/impacts so far as reasonably practicable.
* Identify specific environmental objectives and performance standards to be achieved with avoidance and mitigation measures in place.
* Detail monitoring is to be undertaken to verify the effectiveness of the avoidance and mitigation measures.
* Describe mechanisms to determine when/if corrective actions and contingency measures are required.
* Detail a program to investigate and implement ways to improve the environmental performance of the Project over time.
* Detail appropriate review periods and/or triggers to ensure the plan remains fit for purpose.
* Establish procedures to manage:
* incidents and any non-compliance.
* stakeholder and community complaints.
* failure to comply with statutory requirements and/or environmental performance standards.
* roles and responsibilities for implementing the plan.
* a protocol for periodic review of the plan.
* Include a community engagement strategy which will include a complaints handling system.

In addition to the above requirements and the avoidance and mitigation measures in this Chapter, the WMP will include specific requirements to:

* Ensure all dangerous goods on-site (including waste hydrocarbons and chemicals) are stored in accordance with AS 1940-2004 ‘The storage and Handling of Flammable and Combustible Liquids’, AS 1692 ‘Tank Storage of Fuels’, and EPA Publication 1698 (EPA, 2018).
* Develop a recycling program that will include investigating options for waste material re-use on-site.
* Track waste transport through the EPA Waste Tracker and maintain records and receipts.
* Ensure onsite sewage systems are designed and installed in compliance with EPA Publication 891 (EPA, 2016a) for systems <5,000 L/day.
* Review waste volumes disposed of, recycled and reused to assess the effectiveness of waste minimisation and management measures.
* Evaluate and consider alternative, carbon friendly fuels, electricity sources, energy efficient equipment and other measures to minimise GHG and carbon emissions.
* Participate in GHG reporting and audits, as required by current regulations and legislation.
* Include an unexpected finds protocol for the discovery of unexpected, historical waste during excavation on-site.
* Provide a framework and procedure outlining the requirements for demolition and removal of Project infrastructure at the end of Project life, which will include the identification and categorisation of waste types and disposal options adopting the waste hierarchy.

### Rehabilitation

#### WE-07: Rehabilitation plan

A Rehabilitation Plan will be established for the Project that will address matters relating to progressive rehabilitation and closure. It will cover all work areas within the proposed mining licence and within the broader development extent and the Port of Portland.

The Rehabilitation Plan will include a schedule of progressive rehabilitation and will describe the strategy to establish a safe, stable, sustainable landform capable of supporting the proposed end land use. It is expected that land will be stabilised as soon as reasonably practicable after mining, typically within 4 years.

The Rehabilitation Plan will define the end land use with consideration to the views of the landholders and the broader community where appropriate.

A preliminary Rehabilitation Plan for the Project has been developed to meet the intent of the Scoping Requirements and is included with this EES as Attachment 3. This plan will be refined prior to commencement with consideration to the detailed operating plans, stakeholder and community feedback and the Minister's assessment of the EES.

## Residual Impacts

This Section describes the likely residual impacts with avoidance and mitigation measures in place. The residual impacts have been characterised, as described in Section 19.5.3 and Chapter 6 (Impact Assessment Framework).

### Tailings and Process Water

There is one potential impact (IP-01) listed in Section 19.5.1 that relates to changes to groundwater hydrochemistry due to process water discharged to the mining void. This potential impact is primarily investigated in the GWIA (Appendix L), the results of which have been summarised below.

The GWIA assessed the environmental values associated with the protection of groundwater dependent ecosystems and bore use, noting that all relevant environmental values will be maintained through the protection of these two values. The focus of this Section is on the potential impacts on GDEs and stock water use.

During the operational phase, sand tailings and process water will be discharged to the tails cells within the mine void. Process water will drain to decant sumps for re-use in the process, with around 62% recovered and up to 30% expected to infiltrate to the aquifer as described in Section 19.6.1.1 and Chapter 2 (Project Description).

The process water will be less saline than the groundwater, as it will be sourced primarily from the Wimmera-Mallee pipeline, with smaller amounts of groundwater extracted during dewatering and ore removal. As such, the groundwater will become less saline within the immediate vicinity of the mining pit, due to the discharge of process water.

Process water is expected to migrate slowly away from the pit to the north-west at a rate of around   
100–300 m over 62 years. It is expected that process water will mix with the groundwater over time, increasing salinity levels toward the natural background levels.

The nearest point of potential groundwater discharge, where the groundwater dependent ecosystems and species environmental objectives may apply, is the Wimmera River, down hydraulic gradient of the mine footprint, approximately 20 km to the north-west.

Process water will migrate down hydraulic gradient towards this receptor and is not expected to result in detectable concentrations of metals above the natural background. It is expected that the considerable transport distance and slow groundwater flow velocity will facilitate sufficient attenuation through advection and dispersion processes. The residual impacts on the GDEs at the Wimmera River were assessed to be negligible.

Groundwater extraction for stock watering purposes within the study area is currently limited, however, there is the potential for new bores to intersect the affected area in the future, resulting in a possible complete transport linkage (during and/or after mining).

The GWIA explains that during the Avonbank Demonstration Trial, process water remained within the stock water guideline. While it was noted that there is the potential for hydrogeochemical conditions to become more conducive to the formation of hexavalent chromium, a review of the leachability tests indicated there were insufficient amounts of chromium to generate dissolved concentrations above the stock water criteria.

Flocculants/polyacrylamides were considered unlikely to pose a risk to the stock water environmental value, as they are predicted to be present in low concentrations and will have limited mobility. There is expected to be no change to the environmental value associated with stock water bore use, and the residual impacts were assessed to be minor (refer Chapter 17).

The avoidance and mitigation measures and the associated monitoring requirements relating to the discharge of process water are described in Chapter 17 (Groundwater).

It is anticipated that an A18 Permit will be required under Section 46 of the EP Act to discharge waste to the groundwater aquifer. Permissions granted by EPA typically include conditions that are largely standard across an industry sector and designed to ensure that environment protection standards are met.

The General Environmental Duty (GED) will apply concurrently such that the risks of harm to human health or the environment from pollution or waste will need to be minimised so far as reasonably practicable. Other approvals will also be required, including but not limited to the *Mineral Resources (Sustainable Development) Act 1990*. These approvals are further explored in Chapter 4 (Regulatory Framework).

### Stockpiles and Backfilled Soils

There is one potential impact (IP-02) listed in Section 19.5.1 that relates to the potential contamination of land or groundwater through the placement and stockpiling of mined minerals.

As described in the Soils and Landform Impact Assessment (Appendix J), the concentration of metals in the mined materials were consistently reported below the upper thresholds for Category D Industrial Waste (EPA publication 1828) (EPA, 2021). Topsoil and subsoil material were also below the relevant investigation levels in the National Environment Protection Measure Assessment of Site Contamination (NEPM) (NEPC, 1999).

The salinity of the Shepparton Formation and mixed overburden was assessed to be moderately to highly saline. Salinity in the ore body and non-mineralised sandy overburden was moderate. Overburden will be directly returned to the mining void after excavation, except for the two stockpiles, which will be established for the starter pits in Block A and Block B (refer Chapter 2).

Overburden material will be stockpiled on like material (overburden on overburden) to avoid mixing different materials. Surface water will be drained and recovered into the process water circuit, where it will be mixed with large volumes of fresh pipeline water and re-used.

The rehabilitation strategy aims to place overburden below the effective rooting zone, which will comprise subsoil units stripped prior to mining. As described in Chapter 22 (Land rehabilitation), it is expected the soil profile capability of the rehabilitated landform will be commensurate with surrounding unmined areas.

With avoidance and mitigation measures in place, the likely residual impacts were assessed to be minor to negligible.

### Inappropriate Waste Management, Spills and Leaks

There is one potential impact (IP-03) identified in Section 19.5.1 that relates to the inappropriate management of wastes and potential spills/leaks of hydrocarbons that may cause soil contamination and/or seep into groundwater.

Municipal waste will be stored appropriately to reduce the risk of litter, odour, scavenging by pest animals and direct impacts on land. Wastes will be classified, segregated on-site and sent to an appropriate landfill licensed to accept the specific type of waste for disposal. A suitably qualified and licensed contractor will be engaged to collect and transport the waste to a licensed landfill.

The refuelling and maintenance of vehicles and equipment have the potential to result in onsite spillage of hydrocarbons to land. In line with industry standard practice, refueling activities for light vehicles will be conducted on hardstands, with appropriate bunding and stormwater treatment facilities to minimise environmental risks.

To reduce the risk of significant spills, self-bunded fuel storage will be established at designated areas for refuelling. It is considered that the avoidance and mitigation measures outlined in Section 19.6 will be effective at reducing the possible frequency and size of spills, and the likely residual impact was assessed to be negligible.

### Sewage Waste

There is one potential impact (IP-04) identified in Section 19.5.1 that relates to the potential contamination of land and groundwater from sewage systems.

On-site sewage management systems will be required for the workforce within the WBA and mining licence areas. It is anticipated that there will be two systems, one located on the mining licence and one in the WBA. Each will have the capacity of less than 5,000 L/day to cater for around 200 people each.

For a sewage treatment system with a design or actual flow rate of sewage not more than 5,000 L on any day, compliance with EPA Publication 891.4 (EPA, 2016) and an A20 permit from council is generally required to construct, install, or alter a system.

The sewage management systems will be constructed to ensure the design and installation will be undertaken in accordance with the requirements of EPA Publication 891 (EPA, 2016a) and are fit for purpose. The systems will be maintained and operated in line with the design specifications. The residual impact was assessed to be negligible, with all design and maintenance controls in place.

### Stormwater Runoff

There is one potential impact (IP-05) listed in Section 19.5.1 that relates to the release of contaminated stormwater run-off, resulting in impacts to sensitive receptors.

Stormwater run-off may become contaminated if it comes in contact with spilt hydrocarbons from fuel bunds, workshops, service areas, plant or machinery. Stormwater drainage from hydrocarbon management areas, such as workshops will be managed so that contaminated water is appropriately contained and treated prior to release to the process water circuit via an oil water separator. Such measures are standard practice and can be effectively implemented to prevent the release of contaminated waters to the environment.

Run-off from overburden stockpiles or disturbed areas may become turbid or saline due to entrained sediment. All stormwater from operational areas, including disturbed areas, stockpiles and the mine void, will drain to sumps. This water will be used where practicable for dust suppression if it is of a suitable quality or will be returned to the process water circuit.

Stormwater with elevated salinity levels will be significantly diluted once incorporated into the process water circuit, which pumps large volumes of relatively fresh water. Turbidity will be managed with drop-out sumps and will ultimately be treated with a flocculant, once it returns to the process water circuit. A process water monitoring program is further described in Chapter 17 (Groundwater).

Similarly, run-off from the HMC stockpiles will be returned to the process water circuit. The HMC stockpile area will have a small catchment area and contribute an exceedingly small volume to the total process water volume circulating at any one point in time. The solubility of uranium and thorium is naturally very low, and the solubility of radium is likely to be commensurate with the in situ ore. The risk of mobilising radionuclides from the HMC stockpile in material volumes is considered to be low.

With the above measures in place and the implementation of the Surface Water Management Plan and the Waste Management Plan, the residual impacts were assessed to be negligible.

### Greenhouse Gas Emissions

There is one potential impact (IP-06) listed in Section 19.5.1 that relates to GHG emissions resulting from the activities associated with the Project.

GHG emissions are expected to increase in the local atmosphere from the associated loss of carbon due to vegetation clearing, embodied GHG emissions in the consumption of materials, emissions from fuel use for offsite and onsite transportation and the energy consumption from grid electricity.

GHG emissions are categorised as either Scope 1, Scope 2 or Scope 3 emissions, all of which are relevant to the Project.

Scope 1 emissions are defined as the release of GHG into the atmosphere as a direct result of Project activities during construction and operation. Scope 1 emissions from Project construction are estimated to be 68,033 t CO2-e. This would include GHG emissions from the construction of the WBA, other Project infrastructure, fuel consumption and vegetation removal.

During operation, Scope 1 emissions are estimated to be 74,493 t CO2-e. The largest contribution to Scope 1 emissions is from fuel consumption by stationary equipment and vehicles over the duration of the operational phase (36 years).

Scope 2 emissions are defined as indirect GHG emissions associated with the purchase of electricity by the Project and subsequent consumption of the electricity. Scope 2 emissions from the Project are estimated to be negligible for construction and 112,516 t CO2-e for the operational phase. The majority of operational GHG emissions are attributed to electricity use from the grid for processing activities.

Whilst the use of electricity is unavoidable, emissions will be reduced where practicable by optimising pumping distances and through the development of an energy efficiency program for the Project.

Scope 3 emissions are defined as the release of indirect GHG emissions by the wider economy because of activities of the Project. Scope 3 emissions from the Project during construction are 9,751 t CO2-e, mainly as a result of embodied emissions of construction materials and fuel consumption by stationary equipment.

During the operational phase, Scope 3 emissions are estimated to be 69,440 t CO2-e. Emissions associated with the transport of raw materials to site, HMC from site and shipping of HMC accounts for a significant portion of the overall Scope 3 GHG emission. The consumption of grid electricity is the next largest contributor to Scope 3 emissions, followed by embodied emissions in raw materials used by the Project.

Overall, the Project’s contribution to GHG emissions is comparatively minor. For the construction phase, the Project’s contribution is 0.075% of Victoria’s total, and for operation, the annual contribution is 0.205% of Victoria’s total. The Project’s proportional contribution to Australia’s total is an order of magnitude less.

It is anticipated that the Project will be required to report greenhouse GHG emissions and energy consumption in line with the *National Greenhouse and Energy Reporting Act* *2007* scheme. This scheme is administered by the Clean Energy Regulator (CER), which registers and deregisters corporations for reporting and enforces compliance with the Act.

With consideration to the Project’s contribution to GHG emissions, the residual impact was assessed to be minor. A GHG and Energy Efficiency Program will be maintained to minimise GHG emissions so far as reasonably practicable (refer Section 19.6.2.4)

### Uncontrolled Disturbance of Contaminated Sites

There is one potential impact (IP-07) identified in Section 19.5.1 that relates to the potential uncontrolled disturbance of contaminated sites associated with the pre-mining land use.

Areas of contaminated land associated with the existing land use may be present within the Project area. Given the current and historical agricultural land use, the potential for contamination is considered to be relatively low.

There are various sources of potential contamination within the disturbance footprint, including one dwelling, farm sheds, silos, sealed and unsealed roads and farm dams. It is plausible that areas of contamination, including but not limited to hydrocarbons, sewage, asbestos and pesticides/herbicides, could be associated with these potential sources.

As described in Section 19.6.2.3, a contaminated sites investigation will be undertaken in accordance with the NEPM prior to mining for each land parcel. If areas of contamination are confirmed, a remediation plan will be developed to address all relevant requirements of the NEPM.

It is anticipated that the Project will be able to manage contaminated land in line with industry standard practice and the NEPM. The progressive and high-precision nature of the stripping activities will minimise the risk of impacting an unexpected contaminated site in an uncontrolled manner.

The likely residual impacts relating to pollution events associated with the disturbance of contaminated sites are expected to be minor, assuming the NEPM is implemented as described in 19.6.2.3.

## Management Framework

An AS/NZS 14001:2016 EMS will be established for the Project, as detailed in Chapter 24. The EMS will address matters relating to planning, operational control, monitoring and continuous improvement over the life of the Project. Relevant matters relating to waste and emissions monitoring, auditing and corrective actions/contingencies are summarised below.

### Environmental Objectives

Environmental objectives will be established as part of the EMS to articulate the outcomes to be achieved during Project implementation. These reflect the expected and achievable outcomes based on the studies undertaken as part of this EES.

The key environmental objectives relevant to the Project during implementation are listed below:

* Storage, transport, use and disposal of chemicals and fuels associated with the Project will have no material impact on the surrounding environmental values.
* Targets and stretch targets for reducing GHG will be set and reviewed annually.

Performance standards will be established to measure/assess if the environmental objectives have been achieved during operations, as discussed in Section 19.8.2.

### Monitoring and Management

A monitoring program will be incorporated into the EMS to measure, analyse and evaluate the effectiveness of the avoidance and mitigation measures and overall environmental performance. Monitoring will be undertaken over the life of the Project at sensitive receptors to confirm the avoidance and mitigation measures have minimised residual impacts so far as reasonably practicable.

Monitoring and management programs are proposed for groundwater (Chapter 17), surface water (Chapter 16) and soils and landforms (Chapter 15). In addition, the volume and characteristics of all waste streams removed from site will be recorded and routine site inspections will be undertaken to ensure procedures are effectively implemented. Performance will be monitored against established environmental objectives.

### Audits

Periodic internal and independent audits will be undertaken to assess the effectiveness of the EMS. An internal audit program will be maintained, which details the frequency, methods, responsibilities and reporting requirements.

Audits will be undertaken by a suitably qualified person to assess the effectiveness of the EMS and associated management plans to minimise or avoid waste and emissions impacts so far as reasonably practicable. Any non-conformity identified in the audit will be investigated and corrective actions implemented.

The outcomes of audits will be communicated to the Project’s Management team and records of the audit finding will be retained in the records management system. Significant findings will be reported to relevant regulators and stakeholders, where appropriate to do so.

## Cumulative Impacts

The WEIA considered the cumulative impacts of other proposed projects, which may interact and have the potential to contribute to cumulative waste management impacts. This includes the Western Highway Duplication, Western Renewables Link, Wimmera Mineral Sands, WIM 150 Mineral Sands, Donald Mineral Sands, Murra Warra Wind Farm and Jung Renewable Energy Project. Each of these projects may generate wastes that will require management, transport and recycling or disposal.

Despite the multiple projects operating and proposed in the region, cumulative waste impacts on regional waste management facilities and transport networks were assessed to be minor when considered over the 36-year lifetime of the Project. It is expected that each project will have a waste management strategy to minimise the production of waste and the cumulative impacts so far as reasonably practicable. Further details of cumulative impacts are provided in Appendix Q, Section 11.

## Conclusions

This Chapter provides an overview of the Wastes and Emissions Impact Assessment prepared to address the EES Scoping Requirements for the Avonbank Mineral Sands Project.

The potential impacts on sensitive receptors associated with the Project activities were assessed as part of the GHD impact assessment. Consideration was given to potential impacts associated with changes to groundwater quality from tails placement, stormwater contamination, GHG emissions, hydrocarbon spills and the uncontrolled disturbance of existing contaminated sites.

Avoidance and mitigation measures were identified during the impact assessment to reduce the residual impacts so far as reasonably practicable. Listed below are the key measures identified:

* Process water storage, transfer areas and sumps will be designed with a capacity to contain a significant rainfall event of at least 1% AEP, such that there is no discharge of contact water from operational areas.
* Process water will be recovered and reused to minimise discharge.
* Potentially contaminated materials and sites will be assessed in accordance with the NEPM prior to mining.
* A drainage plan will be prepared prior to the disturbance of each new mining cell with consideration to the existing topography, detailed mine design and surrounding infrastructure.
* A Waste Management Plan will be maintained to avoid and minimise waste and emissions so far as reasonably practicable.
* Hydrocarbons and other chemicals will be stored and managed in line with relevant guidelines and industry best practice.
* An energy efficiency program will be established to minimise GHG emissions over the life of the Project.

The proposed tailings strategy will result in minor or negligible impacts on sensitive receptors, and there is expected to be no change to the existing environmental values that would limit the current use of the groundwater resource.

Residual impacts associated with the uncontrolled disturbance of contaminated sites, chemical spills and stormwater run-off were assessed to be minor or negligible.

Increased GHG emissions due to construction and operational activities, including energy consumption, were assessed to result in a minor residual impact.

The above residual impacts are all considered to be minor or negligible. Overall, the proposed Project work/activity is unlikely to result in significant effects as a result of waste generation or emissions. It is anticipated that the associated impacts can be managed with avoidance and mitigation measures in place to achieve the evaluation objectives.

1. Construction (C); Operations and rehabilitation (O); Decommissioning and closure (D) [↑](#footnote-ref-2)