



**Chapter 11**  
**Human Health  
and Safety**



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## ABBREVIATIONS

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AS	Australian Standard
CEMP	Construction Environmental Management Plan
DPIR	Department of Primary Industry and Resources
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
NORM	Naturally Occurring Radioactive Material
NT	Northern Territory
OEMP	Operational Environmental Management Plan
PPE	Personal Protective Equipment
RCP	Rehabilitation Closure Plan
RoM	Run of Mine
ToR	Terms of Reference
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedure
WHS	Work Health Safety
WZG	Waste Zoning Guide



# 11 HUMAN HEALTH AND SAFETY

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## 11.1 Introduction

This chapter describes the existing risks to human health and safety within the proposed development footprint and vicinity of the Proposal. The potential hazards and associated risks to human health and safety are assessed and mitigation and management measures are identified to avoid or reduce the potential risks to human health and safety during construction, operation and closure and rehabilitation of the Proposal.

The primary risk to human health and safety would be the handling and storage of hazardous materials. A list of hazardous materials that would be used on-site is provided in Appendix F.

The assessment has been prepared in accordance with the Terms of Reference (refer to Appendix A).

## 11.2 Methodology

A human health and safety hazard and risk assessment was prepared to show that residual risk levels would be acceptable in relation to humans and the surrounding environment, and that potential risks would be appropriately managed. The assessment involved:

- Identifying potential hazards during construction, operation, and closure and rehabilitation of the Proposal through a series of risk workshops.
- Assessing the risks associated with the potential hazards by determining the probability (likelihood) and consequence (effects) of hazardous events for humans, the surrounding land uses and the environment during construction, operation, and closure and rehabilitation of the Proposal.
- Identifying approaches (mitigation and management measures) to avoid or reduce the potential hazards (and associated risks).

The risk assessment determined the Proposal is likely to require notification under the NT *Work Health Safety Act* as a Major Hazard Facility. The NT Work Health and Safety (National Uniform Legislation) Regulations (Work Health Safety (WHS) Regulations) 536, 537 and 547 are triggered because the Proposal may exceed 10 % of the threshold quantities of hazardous chemicals listed within Schedule 15 of the WHS Regulations.

The NT *Work Health Safety Act* and WHS Regulations identify requirements for preparing and executing emergency plans, storage and handling systems, health monitoring during construction and operation.

## 11.3 Existing environment

The proposed Chandler Facility and the Chandler Haul Road would be located within Maryvale Station (NT Portion 810). The proposed Apirnta Facility, Henbury Access Road and a portion of the Chandler Haul Road would be located within Henbury Station (NT Portion 657), to the west of the proposed Chandler Facility (refer to Chapter 1 and Figure 1-1). Land within Maryvale Station and



Henbury Station is pastoral lease land governed under the NT *Pastoral Land Act*. As such, land within Maryvale Station and Henbury Station is used for pastoral activities (specifically for grazing cattle). The use of hazardous materials is primarily limited to diesel that is used to fuel station vehicles.

The Central Australian Railway is located approximately 30 kilometres to the west of the proposed Chandler Facility. The proposed Apirnta Facility would be located adjacent to the Central Australian Railway. The Stuart Highway is located approximately 60 kilometres to the west of the proposed Apirnta Facility and 90 kilometres to the west of the proposed Chandler Facility (refer to Chapter 1 and Figure 1-1). Commercial dangerous goods, including hydrocarbons, are regularly transported by train between Adelaide and Darwin on the Central Australian Railway and by truck along the Stuart Highway.

## **11.4 Assessment of risk during construction, operation and closure and rehabilitation**

This section presents the potential hazards and associated risks to human health and safety during construction, operation and closure and rehabilitation of the Proposal. Mitigation measures to avoid or reduce these impacts are discussed in Section 11.5.

The primary hazardous materials that would be store on-site are listed wastes and include dangerous chemicals and hydrocarbons (refer to Appendix F). The hazardous chemicals that require special storage and handling would be managed at the proposed Apirnta Facility before being transported for permanent isolation at the proposed Chandler Facility.

Other hazardous materials would be used on-site for general construction, operation and closure and rehabilitation activities. Diesel would be required to fuel the mining and vehicle fleet and the generators at the borefield. At a mining rate of approximately 760,000 tonnes per annum, the estimated diesel requirement would be five mega litres per annum. To achieve this, there would be three 10,000 litre deliveries per week by triple carriage semitrailers. Fuel would be stored in self bundled 30,000 litre tanks within a bundled hardstand zone within the mine infrastructure area (refer to Figure 3-3).

Oils and lubricants would be used in the vehicle fleet and within the process plant with small amounts also used to service equipment such as generators and pumps. Oils and lubricants would be delivered by truck. They would be stored within the same location as the self bundled diesel/fuel tanks but separated, where appropriate (refer to Figure 3-3).

Explosives would be used primarily for blasting of the proposed decline portal and tunnel. Explosives use on-site would likely be expected to peak during construction at 2,000 tonnes per annum. It is not expected that explosives would be used during operation or closure and rehabilitation of the Proposal. Explosives would be stored in a separate self bundled area within the mine infrastructure area (refer to Figure 3-3).

Other hazardous materials used on-site (e.g. kerosene, welding gases, battery storages) would be stored appropriately on-site in accordance with industry regulations, codes and standards.

Potential hazards during construction, operation, and closure and rehabilitation of the Proposal are listed in Table 11-1.



**Table 11-1 Potential hazards and associated risks during all phases of the Proposal**

Potential hazard/risk scenario	Cause	Consequence
<b>Exposure from dry waste</b>	Significant volumes of waste, some hazardous, enters work sites and reacts with other materials	Generation of toxic gases
<b>Exposure from wet waste</b>	Significant volumes of waste, some hazardous, enters work sites and reacts with other materials	Generation of toxic gases
<b>Exposure from fuel spills</b>	Accidental spill	Personal health issues
<b>Exposure from waste materials and surface traffic fumes</b>	Waste emplacement and vehicles generates odour and particulates	Personal health issues
<b>Vehicle collision with pedestrians (above and below ground)</b>	Vehicle movements in the vicinity of personnel	Personal injury
<b>Vehicle accidents (above and below ground)</b>	Vehicle movements in the vicinity of other vehicles	Personal injury
<b>Exposure from mine gas extraction</b>	Release of natural underground gases	Personal health issues
<b>Ventilation failure</b>	Power failure	Personal health issues including asphyxiation
<b>Underground vehicle fire</b>	Accident or operator error	A fire develops and personal injury/death results
<b>Underground vehicle exhaust exposure</b>	Operation of plant	Personal health issues
<b>Heat stress (above and below ground)</b>	Natural/seasonal weather conditions	Personal health issues
<b>Construction accidents surface - infrastructure</b>	Failure of machine guarding/working in close proximity to rotating and moving equipment	Personal injury
<b>Construction accidents - underground infrastructure</b>	Failure to observe underground traffic signage	Personal injury
<b>Uncontrolled gas release - underground pressure release</b>	Accident or operator error	Personal health issues
<b>Uncontrolled gas release – underground ignition</b>	Stockpiling of incoming waste material for extended periods of time. Failure of aeration system for other reasons	Anaerobic decomposition takes place producing/releasing dangerous gases
<b>Uncontrolled gas release – underground asphyxiation</b>	Access to mine shafts and decline	Possible asphyxiation due to atmospheric conditions within a confined space
<b>Waste stability with heat</b>	Waste materials could spontaneously combust with elevated air temperatures	Generation of fire and release of toxic gases
<b>Bites and stings</b>	Local insects	Personal health issues
<b>Drugs and alcohol abuse</b>	Breach of drug and alcohol policy	Personal health issues
<b>Strata and ground stability</b>	Spontaneous rock collapse	Personal injury/death results
<b>Mine and drill blast</b>	Use of explosives	Personal injury including loss of hearing
<b>Ignition of flammable materials</b>	Ignition of flammable materials stored on-site e.g. waste paper, cardboard, plastics etc.	A fire develops and personal injury/death
<b>Fall from height</b>	Person working a height falls	Personal injury
<b>Electrical incident</b>	Exposure to damaged electrical equipment or operator error.	Personal injury



Potential hazard/risk scenario	Cause	Consequence
Exposure from radiation	Exposure to NORM	Personal health issues
Windblown materials	Exposure to particulate matter from RoM stockpiles including salt	Personal health issues.

## 11.5 Mitigation and monitoring

Mitigation and management measures proposed to minimise the potential impacts on human health during construction, operation, and closure and rehabilitation of the Proposal are listed in Table 11-2. These measures would be incorporated into the CEMP, OEMP and/or RCP for the Proposal. A draft Emergency Response Management Plan has been prepared and is included in Appendix T.

As discussed in Chapter 3, the proposed Chandler Facility qualifies as a major hazard facility under the Work Health and Safety (National Uniform Legislation) Regulations. As such, the facility requires the preparation of a Safety Case to demonstrate that it can be operated safely and within the requirements of the Work Health and Safety (National Uniform Legislation) Regulations. An outline Safety Case is included in Appendix X.

The proponent currently maintains and continuously improves an Environmental Management System that complies with the requirements of the International Standard *ISO 14001:2015 Environmental Management Systems*, International Standard *ISO 9001:2015 Quality Management Systems*, and Australian and New Zealand Standard *AS/NZS 4801:2001 Occupational Health and Safety Management System*. Once all necessary approvals have been obtained for the Proposal, the proponent would update the Environmental Management System with management plans and procedures relevant to the construction, operation and closure and rehabilitation of the Proposal.

**Table 11-2 Mitigation and management measures (human health and safety)**

ID	Outcome	Mitigation/management measure	Timing
HS.1	Minimisation of potential impacts on human health and the environment through responsible storage and handling of hazardous materials.	Finalise Safety Case for a Major Hazard Facility in accordance with the NT <i>Work Health Safety Act</i> and the NT WHS Regulations 536, 537 and 547 administered by NT WorkSafe and the Australian Dangerous Goods Code 2007.	Detailed design
HS.2	Minimisation of potential impacts on human health and the environment.	Finalise Emergency Response Management Plan.	Pre-construction
HS.3	Minimisation of potential impacts on human health and the environment.	Update Environmental Management System with management plans and procedures relevant to the construction, operation and closure and rehabilitation of the Proposal.	Pre-construction, construction, operation, closure and rehabilitation
HS.4	Minimisation of potential impacts on human health and the environment through responsible transportation, storage and handling of hazardous materials.	<ul style="list-style-type: none"> <li>Transport, store and handle hazardous materials in accordance with industry regulations, codes and standards (e.g. <i>Work Health and Safety (National Uniform Legislation) Act</i> and the NT WHS Regulations</li> <li>Adhere to Chandler Safety Case.</li> </ul>	Construction, operation, closure and rehabilitation





ID	Outcome	Mitigation/management measure	Timing
		<ul style="list-style-type: none"> <li>Adhere to Chandler Waste Acceptance Procedure (WAP), Waste Acceptance Criteria (WAC) and Waste Zoning Guide (WZG).</li> <li>Adhere to Emergency Response Management Plan.</li> </ul>	
HS.5	Minimisation of potential impacts on human health and the environment through responsible transportation of hazardous materials.	<ul style="list-style-type: none"> <li>Transport hydrocarbons in compliance with the Australian Dangerous Goods Code 2007.</li> <li>Ensure all vehicles are registered and carry appropriate equipment to respond to a spill, including personal protective equipment (PPE).</li> </ul>	Construction, operation, closure and rehabilitation
HS.6	Minimisation of potential impacts on human health and the environment through responsible handling of hazardous materials.	Ensure personnel are trained in the appropriate handling of hazardous materials and in clean-up procedures in the event of a spill.	Construction, operation, closure and rehabilitation
HS.7	Minimisation of potential impacts on human health and the environment through responsible storage of hazardous materials.	Store diesel in 30,000 litre self-bunded tanks manufactured in compliance with Australian Standard (AS)1692 (Steel Tanks for Flammable and Combustible Liquids) and installed in compliance with AS1940 (The Storage and Handling of Flammable and Combustible Liquids).	Construction, operation
HS.8	Minimisation of potential impacts on human health and the environment through responsible storage of hazardous materials.	<ul style="list-style-type: none"> <li>Store lubricating oil in bulk containers inside a bunded area with spill protection and recovery kits.</li> <li>Ensure waste hydrocarbons are stored in tanks inside a bunded area and held for collection by an appropriately licensed contractor for reprocessing and recycling.</li> </ul>	Construction, operation
HS.9	Minimisation of potential impacts on human health and the environment through responsible storage and handling of hazardous materials.	Store ammonium nitrate in a dedicated building and in accordance applicable regulations, codes and standards. Ensure that ammonium nitrate is handled by appropriately trained personnel.	Construction, operation
HS.10	Minimisation of potential impacts on human health and the environment through appropriate clean-up of spills in accordance with Emergency Response Management Plan.	<p>In the event of a spill of hazardous material, implement the strategies outlined in the Emergency Response Management Plan. These strategies would include (but would not be limited to):</p> <ul style="list-style-type: none"> <li>Isolating and containing spill using spill kit.</li> <li>Evacuating area if potential danger exists.</li> <li>Notifying Environmental Manager. Provide location, extent, substance type, quantity, environments impacted (e.g. soils, surface watercourses, groundwater) and spill kit contents used.</li> <li>Using spill kit to remove the contamination source or, where relevant, excavate and appropriately dispose of contaminated sediments.</li> </ul>	Construction, operation, closure and rehabilitation



ID	Outcome	Mitigation/management measure	Timing
		<ul style="list-style-type: none"> <li>Commencing investigation into soil, surface and/or groundwater impacts from the spill. Detail spill quantity, determine extent and significance of impact to human health and/or environment (including upstream/control samples, as required).</li> <li>Providing DPIP with Section 29 Notification and NT EPA with Section 14 Incident Report Form within 24 hours of incident occurring if the incident caused or is threatening or may threaten to cause pollution resulting in minor or serious environmental harm.</li> <li>Ensuring spill kits are located at all hazardous material storage locations. Spill kits would be available to be relocated to specific areas in accordance with scopes of work.</li> </ul>	
HS.11	Minimisation of potential impacts on human health and safety (general)	Establish emergency medical safety points containing eye flush/body flush stations and first aid kits at easily identifiable key locations above and underground.	Construction, operation, closure and rehabilitation
HS.12	Minimisation of potential impacts on human health and safety (exposure from fuel spills)	<ul style="list-style-type: none"> <li>Adhere to WAP and WAC.</li> <li>Wear appropriate PPE.</li> </ul>	Construction, operation, closure and rehabilitation
HS.13	Minimisation of potential impacts on human health and safety (pedestrian and vehicle interactions)	<ul style="list-style-type: none"> <li>Develop Traffic Management Plan. The plan would include standard traffic rules, signage etc. It would also include collision avoidance system (refer to Chapter 15)</li> <li>Mark designated pedestrian areas.</li> <li>Promote driver competency through training programs, as necessary.</li> </ul>	Construction, operation, closure and rehabilitation
HS.14	Minimisation of potential impacts on human health and safety (exposure from mine gas extraction)	<ul style="list-style-type: none"> <li>Wear and maintain correct PPE (including breathing apparatus).</li> <li>Aerate decline and shafts.</li> <li>Undertake gas monitoring.</li> </ul>	Construction and operation
HS.15	Minimisation of potential impacts on human health and safety (ventilation failure)	<ul style="list-style-type: none"> <li>Ensure there is a back-up supply of power.</li> <li>Wear and maintain correct PPE (including breathing apparatus).</li> </ul>	Construction, operation, closure and rehabilitation
HS.16	Minimisation of potential impacts on human health and safety (underground vehicle fire)	<ul style="list-style-type: none"> <li>Establish underground escape routes and isolation zones.</li> <li>Ensure fire extinguishers and suppression systems are installed.</li> </ul>	Construction, operation, closure and rehabilitation
HS.17	Minimisation of potential impacts on human health and safety (underground vehicle exhaust exposure)	<ul style="list-style-type: none"> <li>Consider use of electrical vehicles underground.</li> <li>Wear and maintain correct PPE (including breathing apparatus, as appropriate).</li> <li>Aerate decline and shafts.</li> <li>Undertake gas monitoring.</li> </ul>	Construction, operation, closure and rehabilitation



ID	Outcome	Mitigation/management measure	Timing
HS.18	Minimisation of potential impacts on human health and safety (heat stress - above and below ground)	<ul style="list-style-type: none"> <li>Remain hydrated and have a sufficient supply of water.</li> <li>Wear and maintain correct PPE.</li> </ul>	Construction, operation, closure and rehabilitation
HS.19	Minimisation of potential impacts on human health and safety (construction accidents)	<ul style="list-style-type: none"> <li>Install machine guarding.</li> <li>Adhere to operational and maintenance procedures.</li> <li>Ensure operator competency through training, as necessary.</li> </ul>	Construction
HS.20	Minimisation of potential impacts on human health and the environment (underground ignition).	<ul style="list-style-type: none"> <li>Adhere to Chandler WZG.</li> <li>Undertake weekly gas monitoring in storage areas.</li> <li>Ensure fire extinguishers and suppression systems are installed.</li> <li>Install aeration system to maintain ventilation and restrict temperature rise.</li> </ul>	Operation
HS.21	Minimisation of potential impacts on human health and safety (bites and stings)	<ul style="list-style-type: none"> <li>Wear appropriate PPE.</li> <li>Use insect repellent.</li> </ul>	Construction, operation, closure and rehabilitation
HS.22	Minimisation of potential impacts on human health and safety (drugs and alcohol abuse)	<ul style="list-style-type: none"> <li>Develop Drug and Alcohol Management Plan.</li> <li>Implement daily testing for drugs and blood alcohol levels.</li> </ul>	Construction, operation, closure and rehabilitation
HS.23	Minimisation of potential impacts on human health and safety (strata and ground stability)	<ul style="list-style-type: none"> <li>Correct design of room and pillar in the salt formation.</li> <li>Wear and maintain correct PPE (including two-way radio).</li> </ul>	Construction, operation, closure and rehabilitation
HS.24	Minimisation of potential impacts on human health and safety (mine and drill blasting)	<ul style="list-style-type: none"> <li>Ensure there is an adequate separation zone whilst blasting occurs.</li> <li>Wear hearing protection.</li> <li>Wear and maintain correct PPE.</li> </ul>	Construction and operation
HS.25	Minimisation of potential impacts on human health and the environment (ignition of flammable materials).	<ul style="list-style-type: none"> <li>Adhere to Chandler WZG and Dangerous Goods Regulations.</li> <li>Ensure fire extinguishers and suppression systems are installed.</li> </ul>	Construction, operation, closure and rehabilitation
HS.26	Minimisation of potential impacts on human health and safety (fall from height)	<ul style="list-style-type: none"> <li>Ensure operator competency for working at heights.</li> <li>Implement work at heights procedures.</li> <li>Use suitable work at heights equipment e.g. fall protection.</li> </ul>	Construction, operation, closure and rehabilitation
HS.27	Minimisation of potential impacts on human health and safety (electrical incident)	<ul style="list-style-type: none"> <li>Design and maintain all electrical systems as per legislative requirements.</li> <li>Install physical protection (cabinets, bollards etc.) around high risk electrical installations.</li> </ul>	Construction, operation, closure and rehabilitation



ID	Outcome	Mitigation/management measure	Timing
HS.28	Minimisation of potential impacts on human health and safety (exposure from radiation)	<ul style="list-style-type: none"> <li>Adhere to WAP and WAC.</li> <li>Wear and maintain correct PPE.</li> </ul>	Operation
HS.29	Minimisation of potential impacts on human health and safety (windblown materials)	<ul style="list-style-type: none"> <li>Factor local wind directions during placement of stockpiles.</li> <li>Consider vegetation cover for long term stockpiles.</li> </ul>	Construction and operation
HS.30	Minimisation of potential impacts on human health and safety (confined space)	<ul style="list-style-type: none"> <li>Ensure operational procedures are adhered to including those listed in the Air Quality Management Plan.</li> <li>Ensure workers obtain confined space permits. Ensure operator competency in confined space entry.</li> <li>Use breathing apparatus, where necessary.</li> <li>Aerate decline and shafts.</li> <li>Undertake gas monitoring.</li> </ul>	Construction, operation, closure and rehabilitation

## 11.6 Summary of risk assessment

A summary of the risk assessment undertaken for human health and safety during construction, operation and closure and rehabilitation of the Proposal is provided in Table 11-3.

Table 11-3 Summary of risk assessment (human health and safety)

Hazard	Pre-mitigated risk			Post-mitigated risks			Risk outcome
	Likelihood	Consequence	Risk ranking	Likelihood	Consequence	Risk ranking	
Exposure from dry waste	Unlikely	Moderate	Medium	Remote	Moderate	Low	Risk reduced
Exposure from wet waste	Unlikely	Moderate	Medium	Remote	Moderate	Low	Risk reduced
Exposure from fuel spills	Remote	Minor	Low	Remote	Minor	Low	Risk same
Exposure from surface traffic fumes	Remote	Minor	Low	Remote	Minor	Low	Risk same
Vehicle collision with pedestrians (above and below ground)	Likely	Catastrophic	Extreme	Unlikely	Catastrophic	High	Risk reduced
Vehicle accidents (above and below ground)	Likely	Catastrophic	Extreme	Unlikely	Catastrophic	High	Risk reduced
Exposure from mine gas extraction	Almost certain	Minor	High	Unlikely	Minor	Low	Risk reduced
Ventilation failure	Likely	Moderate	High	Unlikely	Moderate	Medium	Risk reduced
Underground vehicle fire	Likely	Major	High	Unlikely	Major	Medium	Risk reduced
Underground vehicle exhaust exposure	Almost certain	Major	Extreme	Remote	Major	Medium	Risk reduced



Hazard	Pre-mitigated risk			Post-mitigated risks			Risk outcome
	Likelihood	Consequence	Risk ranking	Likelihood	Consequence	Risk ranking	
Heat stress above and below ground	Almost certain	Moderate	High	Unlikely	Moderate	Medium	Risk reduced
Construction accidents - surface infrastructure	Possible	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Construction accidents - underground infrastructure	Possible	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Uncontrolled gas release - underground pressure release	Unlikely	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Uncontrolled gas release - underground ignition	Unlikely	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Uncontrolled gas release - underground asphyxiation	Unlikely	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Waste stability with heat	Unlikely	Major	Medium	Eliminated	Major	Eliminated	Risk reduced
Bites / stings	Almost certain	Catastrophic	Extreme	Unlikely	Moderate	Medium	Risk reduced
Drugs and alcohol abuse	Almost certain	Major	Extreme	Remote	Major	Medium	Risk reduced
Strata / ground stability	Unlikely	Catastrophic	High	Remote	Catastrophic	Medium	Risk reduced
Mine drill and blasting	Eliminated	Insignificant	Eliminated	Eliminated	Insignificant	Eliminated	Risk same
Ignition of flammable materials	Possible	Major	High	Unlikely	Major	Medium	Risk reduced
Fall from height	Possible	Catastrophic	High	Unlikely	Catastrophic	High	Risk reduced
Electrical incident	Possible	Major	High	Unlikely	Major	Medium	Risk reduced
Exposure from Naturally Occurring Radioactive Material (NORM)	Unlikely	Major	Medium	Eliminated	Major	Eliminated	Risk reduced

## 11.7 Conclusion

The assessment of hazards and risks on human health and safety was undertaken through the mechanism of risk workshops. The outcome of the risk workshops was the identification of potential hazards and risks during the construction, operation, and closure and rehabilitation of the Proposal.

They key risks on human health and safety without mitigation or management measures in place were identified as being the transport, handling and storage of hazardous wastes, fire and working underground. By following the procedures outlined in the various applicable industry regulations, codes and standards, as well implementing the mitigation and monitoring measures outlined Table



11-2, the residual risks on human health and safety are reduced and considered manageable through each phase of the Proposal.