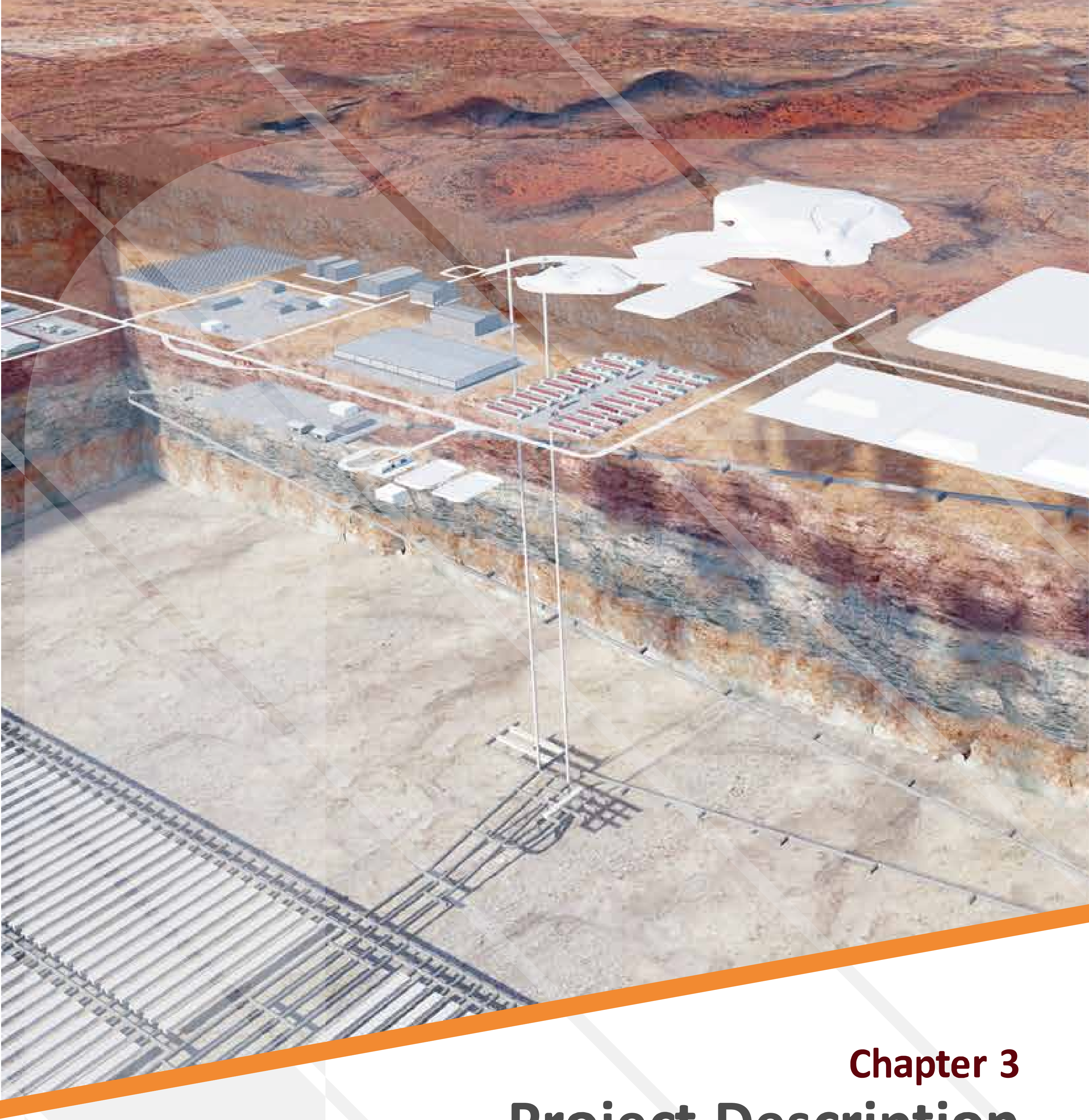

Chapter 3

Project Description

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ABBREVIATIONS

AS	Australian Standard
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration licence
MLA	Mining Lease Area
m^3	cubic metres
mm	millimetres
MW	megawatts
NaCl	Sodium chloride
NT	Northern Territory
PFS	Pre-Feasibility Study
RCP	Rehabilitation and Closure Plan
SEMP	Sediment and Erosion Management Plan
WMP	Waste Management Plan
WIPP	Waste Isolation Pilot Plant

3 PROPOSAL DESCRIPTION

3.1 Proposal overview

3.1.1 Introduction

Tellus propose to construct and operate an underground rock salt mine and storage, recovery and permanent isolation facility (the 'Chandler Facility'). A rail siding and temporary surface storage and transfer facility (the 'Apirnta Facility') is also proposed. A private haul road linking the two facilities (the 'Chandler Haul Road') would be constructed. A private access road (the 'Henbury Access Road'), would be constructed to link the proposed Apirnta Facility with the Stuart Highway. Collectively, the two proposed facilities and the haul and access roads are referred to as 'the Proposal'.

The proposed Chandler Facility and the majority of the Chandler Haul Road would be located within a pastoral lease (Maryvale Station) approximately 120 kilometres south of Alice Springs (refer to Figure 1-1). The proposed Apirnta Facility, Henbury Access Road and a portion of the Chandler Haul Road would be located to the west of the proposed Chandler Facility, also on a pastoral lease (Henbury Station) (refer to Figure 1-1).

Salt mining activities would involve:

- Deep mining of rock salt using a 'room and pillar' system of mining.
- Transport of salt via shaft hoisting to the surface.
- Stockpiling of rock salt for processing and packaging.
- Transport of rock salt to domestic and overseas market:
    - Domestic market (via road and rail) - road transport via truck on federal and state highways. Rail transport via a proposed new railway siding located at the Apirnta Facility.
    - Overseas market (via rail) - rail transport also via the proposed new railway siding located at the Apirnta Facility, predominantly south to a port facility in Adelaide. From there, rock salt would be shipped to overseas markets predominantly in Asia.

Storage, recovery and permanent isolation of materials would involve:

- Transport of materials (equipment, archives, etc.) and waste, predominantly by rail, for receipt and temporary storage at the Apirnta Facility.
- Transfer of materials by truck from the Apirnta Facility to the Chandler Facility via the proposed Chandler Haul Road.
- Transport of packaged materials via mine access decline or via hydraulic backfill into the voids created by the salt mining operation:

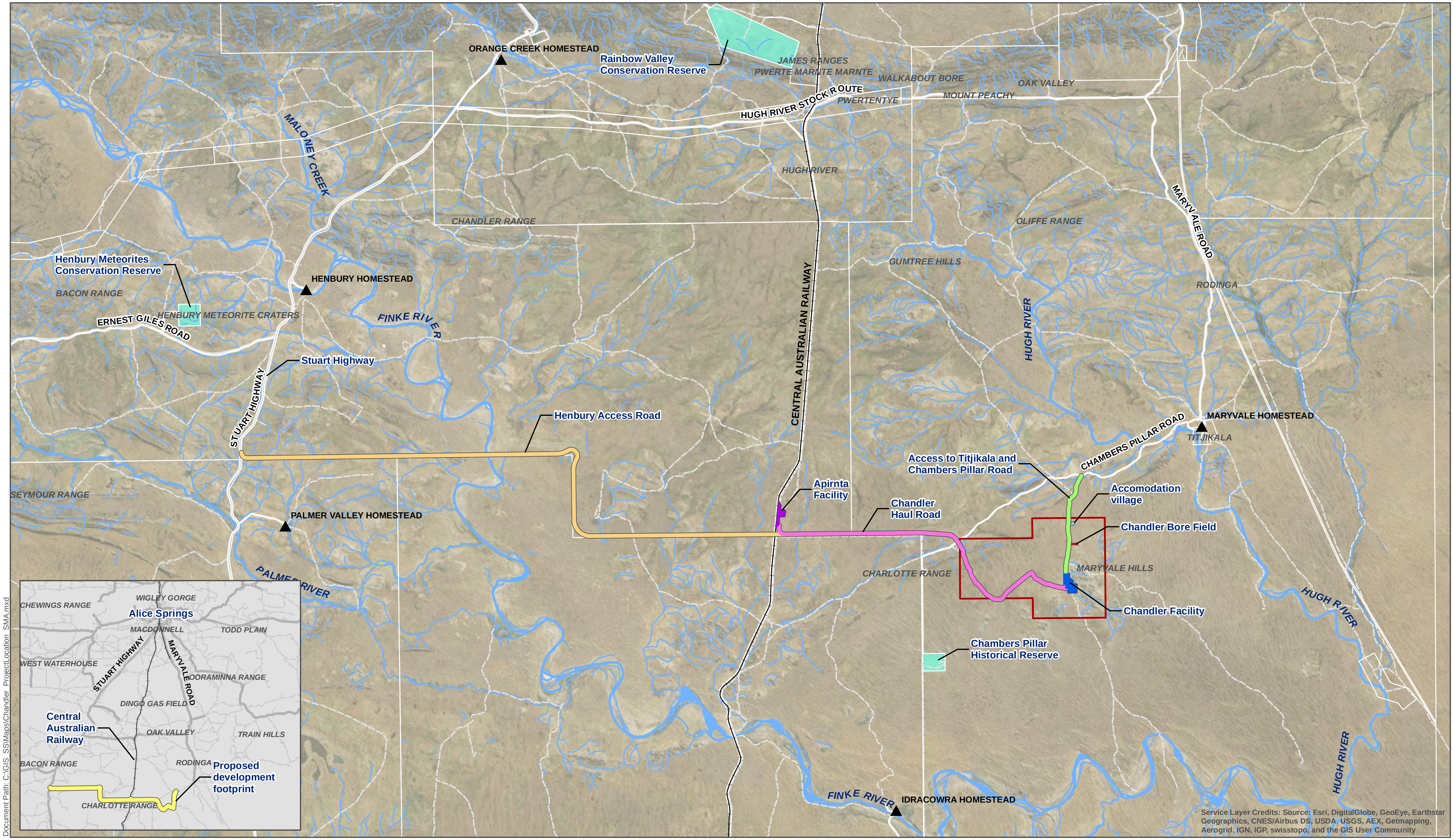
    - Waste would be permanently isolated in line with operational management plans and a strict Waste Acceptance Criteria (WAC).
    - Materials such as equipment and archives would be stored separately for future retrieval.
- Once full, sealing the underground voids permanently with an engineered barrier.

The salt would be mined from the Chandler Salt Bed which is located approximately 850 metres below the surface. Materials stored within the voids left from the mining operation would be situated within a salt bed approximately 200 to 300 metres thick allowing the waste to be permanently removed from the biosphere in a stable and dry environment.

The key components of the Proposal are described in Section 3.1.2 and shown in Figure 3-1.

The overarching concept and dual revenue business model is discussed in Section 3.2. The proposed Chandler Facility is described in Section 3.3, Section 3.4 and Section 3.5. The proposed Apirnta Facility is described in Section 3.6, Section 3.7 and Section 3.8. Logistics are described in Section 3.9. The proposed Henbury Access Road and Chandler Haul Road are discussed in Section 3.10. Closure, decommissioning and rehabilitation of the Proposal is described in Section 3.11, Section 3.12 and Section 3.13, respectively. Post closure is discussed in Section 3.14.

Water, and utilities and services are discussed in Section 3.15 and Section 3.16.



N

5.5 2.75 0 5.5 Kilometers

Coordinate System:
GDA 1994 MGA Zone 53

Legend

- Railways
- Existing road
- Existing track
- Watercourse
- Homestead location
- ML30612
- Henbury Access Road
- Chandler Haul Road
- Access road to Titjikala
- Chandler Facility
- Apirnta Facility
- Accomodation village
- Proposed bore field

Figure 3-1
Key Proposal components

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3.1.2 Key characteristics of the Proposal

The key characteristics of the Proposal are presented in Table 3-1.

Table 3-1 Key characteristics of the Proposal

Characteristic	Description
Property	NT Portion 810 and NT Portion 657
Registered use	Pastoral (cattle grazing)
Planned use	• Salt mining of an average of 750,000 tonnes per annum with salt processing deferred for the first five years of mining operations. • The storage, recovery and permanent isolation of up to 400,000 tonnes of waste per annum (year one 30,000 tonnes, average 340,000 tonnes per annum).
Planned life	Four years of construction plus 25 years of operation
Capital expenditure	$566 million (direct and indirect); $676 million (nominal, including finance and contingency)
Employment	
Construction	270 workers (peak manning)
Operation	150-180 workers
Surface footprint disturbance	
Chandler Facility	113 hectares
Apirnta Facility	30 hectares
Proposed mining area (underground footprint)	361 hectares
Operations	
Salt production (export)	750,000 tonnes per annum (tpa) from year six of mining operations.
Waste storage[1]	400,000 tonnes per annum waste sales (year one 30,000 tonnes, average 340,000 tonnes per annum).

3.1.3 Timing

The overall timing of the Proposal is presented in Figure 3-2. If approved, enabling/construction works would commence in late 2018. The mining of salt is scheduled to commence in late 2021. The emplacement of waste would not occur until enough salt has been mined to allow for the first emplacement of wastes. The emplacement of waste would likely occur in 2022.

[1] *Refer to Appendix F for the proponents proposed listed waste inventory*

Figure 3-2 Key milestones for the Proposal

3.1.4 Land tenure

The proposed Chandler Facility and most of 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) (refer to Figure 1-1). Land within Maryvale Station and Henbury Station is pastoral lease land governed under the NT *Pastoral Land Act.*

The proponent originally applied for and was granted nine mineral exploration licenses covering a total area of approximately 1,432 square kilometres. The proponent subsequently relinquished ground in accordance with the MT Act and currently holds five exploration licences and one mineral lease under application, as listed in Table 3-2.

Table 3-2 The proponent's current tenements within the NT

Tenure	Name	Effective date	Expiry date	Sub blocks	Status
EL 29018	Charlotte North	12-Apr-12	11-Apr-18	41	Grant
EL 27972	Mt Charlotte	20-Oct-10	Renewal pending	25	Renewal pending
EL 27971	Bluebush	20-Oct-10	Renewal pending	20	Renewal pending
EL 27974	Central Railroad	20-Oct-10	Renewal pending	72	Renewal pending
EL 28900	Eastern railroad	05-Mar-12	04-Mar-18	22	Grant
ML30612	Chandler	-	-	9978 ha	Application

The proposed Chandler Facility would be located within ML 30612. All proposed construction, operation, closure and rehabilitation activities associated within ML 30612 would require tenure approval. Detailed discussion of tenure requirements are contained within Chapter 4.

3.2 Proposal concept

3.2.1 Overview

The proposed Chandler Facility would function as an underground rock salt mine and a storage, recovery and permanent isolation facility. The proposed dual revenue business model is shown conceptually in Figure 3-3. The steps depicted in Figure 3-3 are discussed in further detail in Section 3.4.4 and Section 3.4.5.

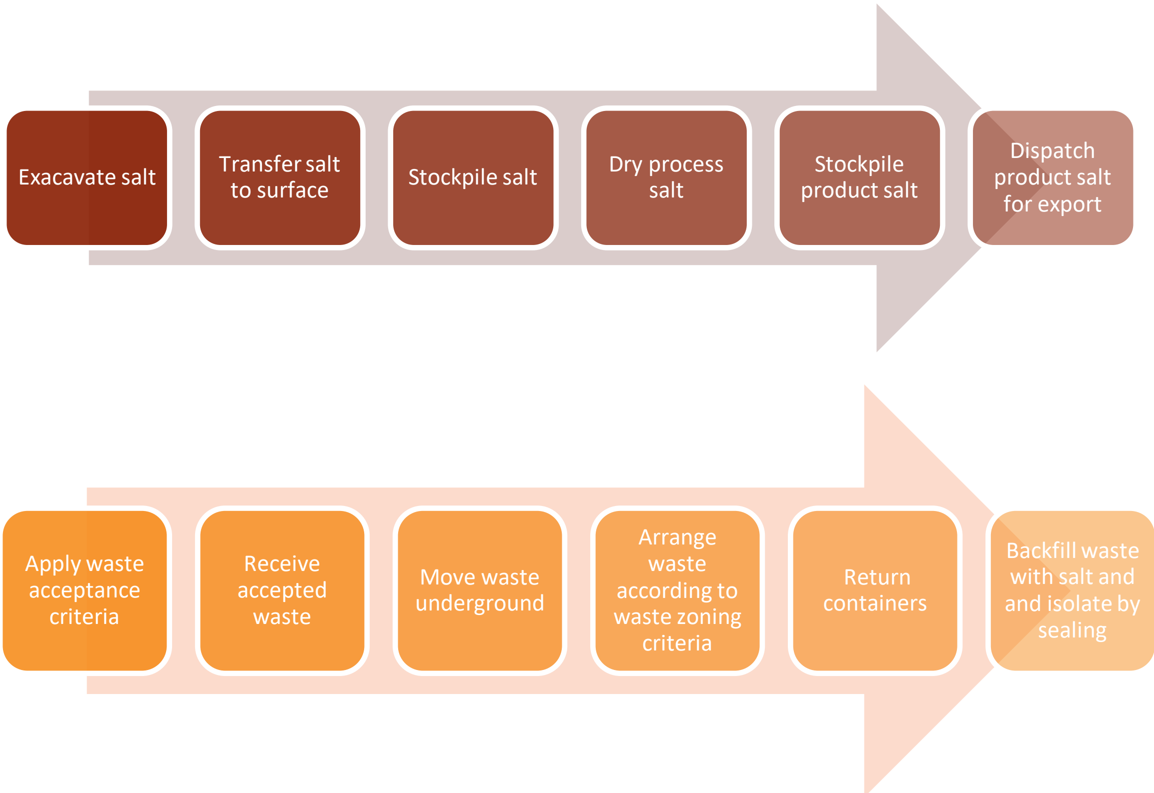


Figure 3-3 Proposal concept

The Proposal represents a major investment and opportunity for long term jobs and business development in a remote and regional part of Australia. If approved, the Chandler Facility would involve a capital investment of around $676 million (nominal, including finance and contingency) and would provide significant long term employment opportunities over its four-year construction and 25-year operation.

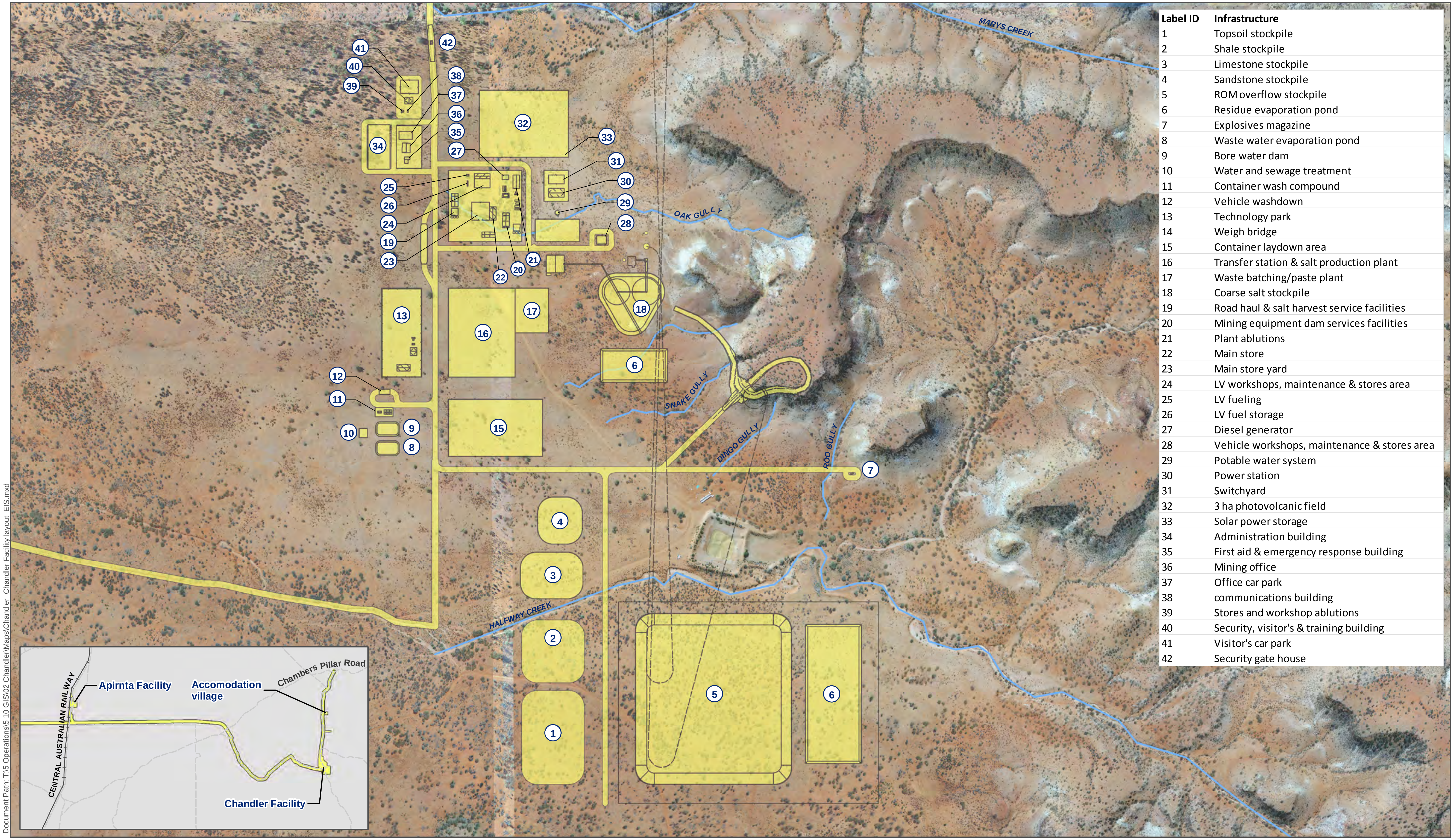
The Proposal would be developed within an isolated and geologically stable site. It would require limited aboveground disturbance to landforms and ecological values. Aquifers with recognised regional value, like the Mereenie Sandstone and the Great Artesian Basin, are not hydro-geologically connected to the Proposal.

Components of the Proposal are listed in Table 3-3 and are illustrated in Figure 3-4 and Figure 3-5.

Table 3-3 Key components of the Proposal

Facility	Primary component	Secondary component
Chandler Facility	*Underground infrastructure*	Underground mine (including room and pillar mining of salt, underground waste rooms, services and workshops)
		Mine access decline (approximately five kilometres long)
		Two vertical shafts (approximately 820 metres and 860 metres long)
Chandler Facility	*Aboveground infrastructure*	Salt processing facilities
		Waste unloading area
		Waste storage warehouse
		Vertical shaft headframe
		Surface hydraulic backfill plant and underground reticulation
		Salt and overburden stockpiles
		Maintenance buildings
		Administration buildings
		Worker accommodation (see below)
		Solar/diesel hybrid power plant
		Clean and raw water dams
		Water and sewage treatment
		Fuel storage facility
		Utility reticulation
		Internal roads
		Compressor building
		Bore field
		Future technology park
Accommodation village	*Above-ground infrastructure*	Accommodation buildings
		Gymnasium
		Leisure centre
		Mess hall/dining room
		Administration buildings
Apirnta Facility	*Aboveground infrastructure*	Rail siding and laydown area
		Open storage yard
		Warehouse
		Liquid storage tank
		Quarantine zone
		Laboratory
		Office
		Maintenance and storage shed
		Internal roads and car parking
		Loading bay, weighbridge and vehicle washdown facility
		Truck driver amenities
		Security gates, fencing, cameras and lighting
		Bunding and stormwater drainage
		Electricity, water and sewerage services

Facility	Primary component	Secondary component
Chandler Haul Road	*Aboveground infrastructure*	Drainage swales
		Check dams
		Light aircraft landing area
		Traffic signs
		Culverts
Henbury Access Road	*Aboveground infrastructure*	Drainage swales
		Check dams
		Traffic signs
		Culverts
		Floodway (Finke River Crossing)
		Controlled intersection at Stuart Highway
Titjikala Access Road	*Aboveground infrastructure*	Drainage swales
		Check dams
		Traffic signs
		Culverts
		Floodway (Hugh River Crossing)



Label ID	Infrastructure
1	Topsoil stockpile
2	Shale stockpile
3	Limestone stockpile
4	Sandstone stockpile
5	ROM overflow stockpile
6	Residue evaporation pond
7	Explosives magazine
8	Waste water evaporation pond
9	Bore water dam
10	Water and sewage treatment
11	Container wash compound
12	Vehicle washdown
13	Technology park
14	Weigh bridge
15	Container laydown area
16	Transfer station & salt production plant
17	Waste batching/paste plant
18	Coarse salt stockpile
19	Road haul & salt harvest service facilities
20	Mining equipment dam services facilities
21	Plant ablutions
22	Main store
23	Main store yard
24	LV workshops, maintenance & stores area
25	LV fueling
26	LV fuel storage
27	Diesel generator
28	Vehicle workshops, maintenance & stores area
29	Potable water system
30	Power station
31	Switchyard
32	3 ha photovolcanic field
33	Solar power storage
34	Administration building
35	First aid & emergency response building
36	Mining office
37	Office car park
38	communications building
39	Stores and workshop ablutions
40	Security, visitor's & training building
41	Visitor's car park
42	Security gate house

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N

100 50 0 100 Meters

Coordinate System:
GDA 1994 MGA Zone 53

Legend

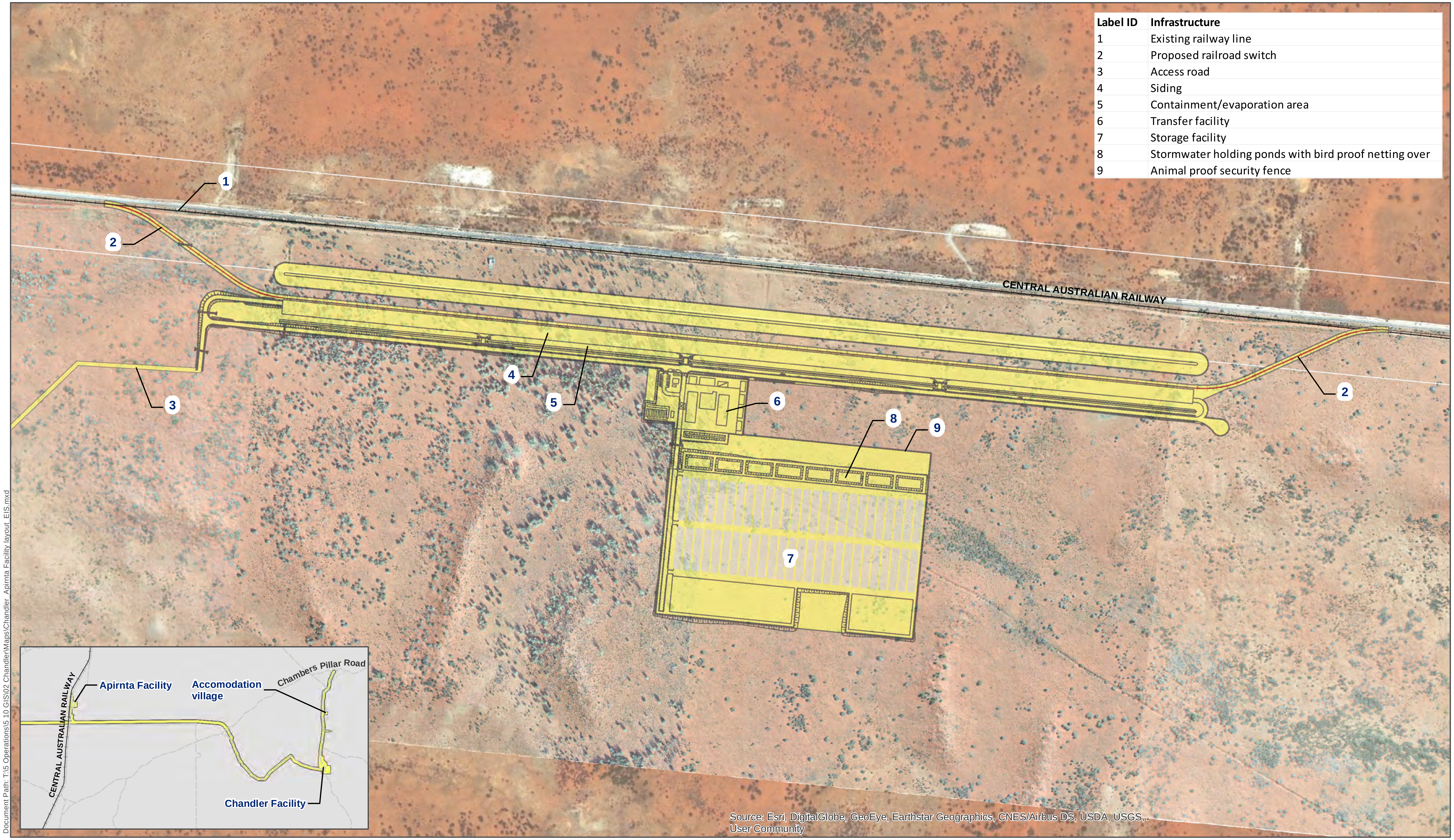
Watercourse

Proposed development footprint

Figure 3-4
Chandler Facility layout

TELLUS

Data source: Geoscience Australia, Topographic base data, 2006;
DLPE NT Government, cadastre, 2016.



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100 50 0 100 Meters

N

Coordinate System:
GDA 1994 MGA Zone 53

Legend

Proposed development footprint

Figure 3-5
Apirnta Facility layout

TELLUS

3.2.2 Proposal lifecycle

The proponent is seeking approval and an operating licence for the Proposal for a 25-year period. Following the cessation of mining and waste disposal, rehabilitation and institutional control would follow for a period of time[2]. The lifecycle of the Proposal has several key milestones, as described below in Table 3-4 and presented in Figure 3-6.

Table 3-4 Lifecycle milestones of the Proposal

Year	Activity
1	At the completion of year one, enabling works would have been completed and the accommodation village established. Preparations for the construction of the Apirnta Facility are underway. At this stage, no salt has been mined.
5	Waste would have arrived at the Apirnta Facility by rail and temporarily stored during the construction of the Chandler Facility. Run of mine salt would be brought to the surface and temporarily stockpiled at the Chandler Facility. Waste would be transferred by road from the Apirnta Facility to the Chandler Facility and emplaced underground for permanent isolation into specially designed waste rooms.
10	Waste storage at the Apirnta Facility decreases but continues to be transported to the Chandler Facility for disposal, recovery or permanent isolation. Salt mining continues at an average rate of 750,000 tonnes per annum. Waste emplacement underground takes place over 25 years at an average of 340 kilo tonnes per annum. Waste arrivals at site take place over 29 years at an average rate of 293,000 tonnes.
29	At the completion of year 29, up to 19,800,000 tonnes of salt would have been mined, and up to 8,500,000 tonnes of hazardous waste would have been permanently isolated over 800 metres underground. Unless the proponent wishes to continue operations and an extension of the approval and licence is granted, mining and waste storage would cease. In accordance with the Mine Closure Plan, the shaft and decline would have been backfilled and sealed. Environmental groundwater monitoring continues.
35	Environmental monitoring is completed.
45	Relinquishment of tenements under the *Mining Management Act*. All mining related infrastructure has been decommissioned and surfaces revegetated in accordance with the Mine Closure Plan and Rehabilitation Plan. Transfer of the management of the Chandler Facility to the NT Government along with financial provision for the management of the Chandler Facility during the institutional control period.
45+	NT Government controls the Chandler Facility for the institutional control period.

[2] *The institutional control period for the Proposal is yet to be agreed with the NT Government.*

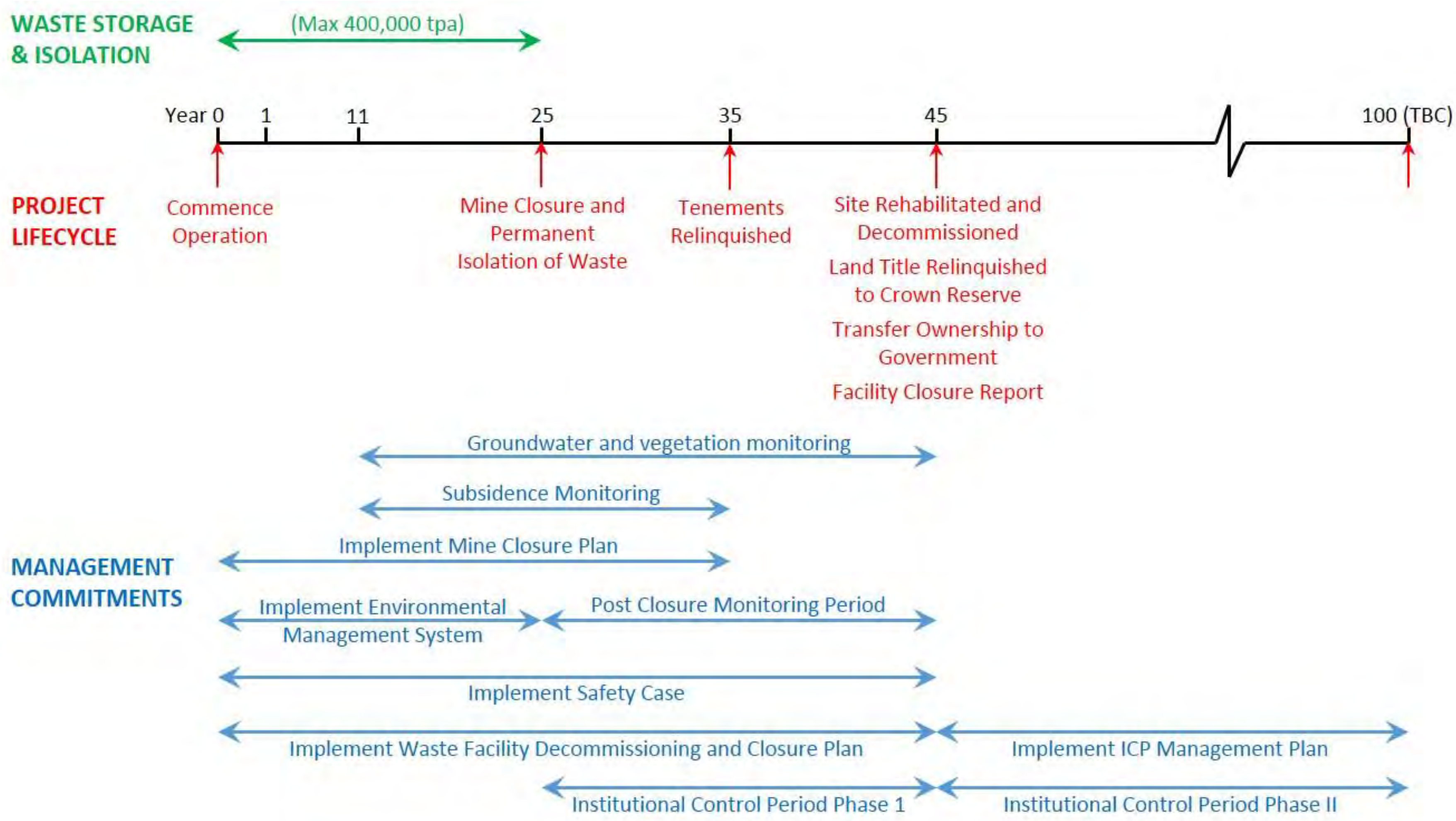


Figure 3-6 Chandler Proposal lifecycle

3.2.1 Regional and local geology

This section describes the regional and local geology at and around the site of the proposed Chandler Facility.

Regional geology

The proponent’s exploration leases are located within the Amadeus Basin in the southern region of the NT. The Amadeus Basin is an asymmetrical, east-west trending depression covering approximately 155,000 square kilometres of central Australia (refer to Figure 3-7).

Regional deposition was terminated in the Late Devonian-Early Carboniferous by the Alice Springs Orogeny. Some earlier structures were reactivated during this period of deformation. Substantial uplift of the basement Arunta block along the current northern margin initiated movement of thrust sheets in the Alice Springs and Altunga regions, and resulted in significant structuring of the basin. North over south thrusting and reverse faulting is typical of Alice Springs orogeny deformation.

The Chandler Formation is located within the Amadeus Basin and is a world class salt deposit. The 500 million-year old Chandler Salt Bed at the sit of the Proposal is approximately eight kilometres wide, 800 metres underground, and 200 to 300 metres thick.

Local geology

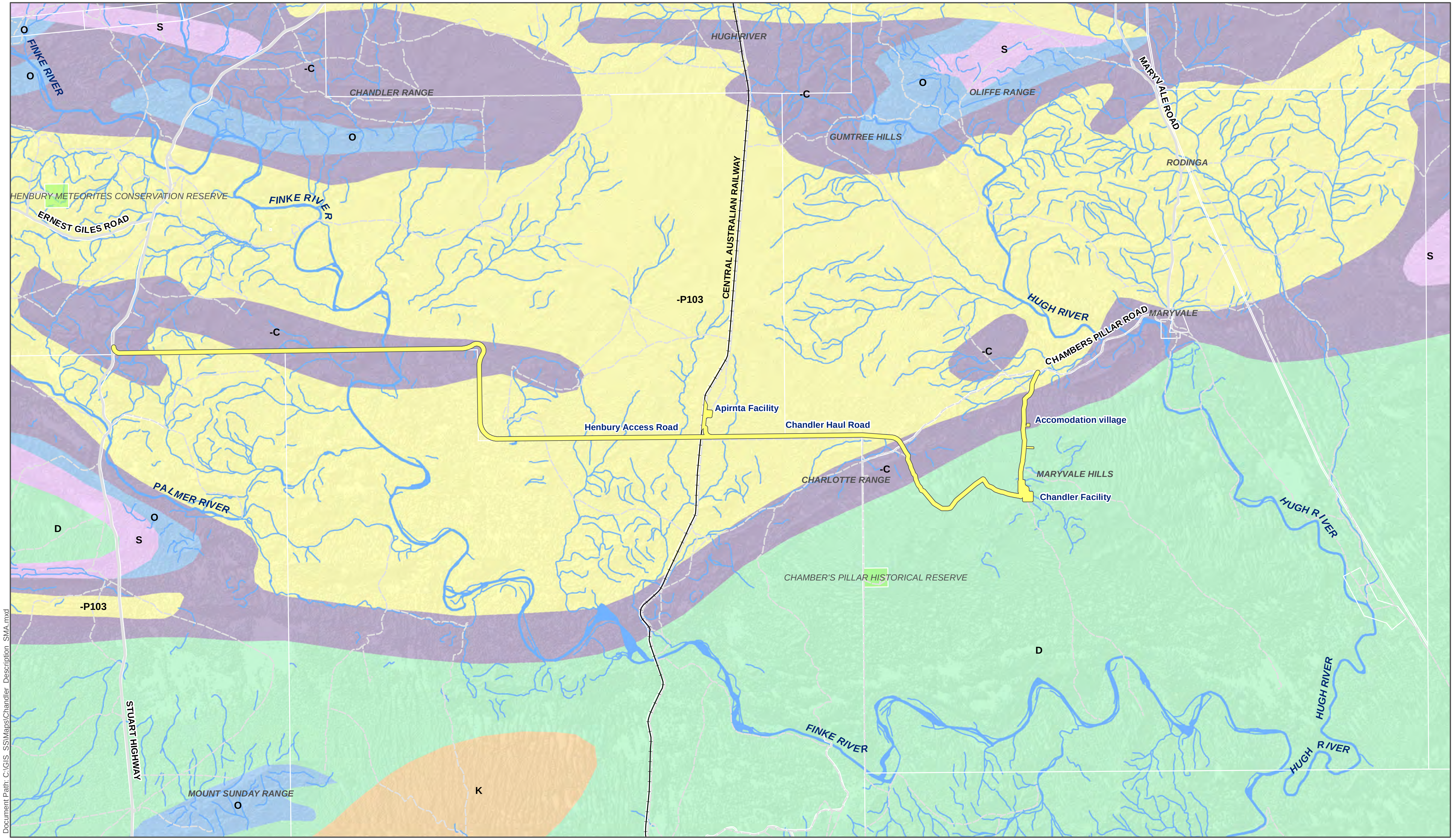
The geology at and around the site of the proposed Chandler Facility is dominated by sandstone and siltstone, before reaching the Chandler Salt Bed at a depth of about 800 metres below ground level. The identified salt resource is a large bed of rock salt (halite) split into an upper 35-metre layer and lower 200-metre layer. The proposed disposal, recovery and permanent isolation horizon would be located in the upper layer.

The Chandler Formation salt has been consistently intersected in all drill holes (historical and recent) within the proponent’s tenements as summarised in Table 3-2.

The subsurface geology at and around the site of the proposed Chandler Facility is understood from exploration activities undertaken in the region for resources including metals, potash, uranium and diamonds by entities including CRA Exploration, Toro Energy, Rum Jungle Resources, Exoil, Finke Oil and Pacific Oil and Gas.

The site location lies within surface outcrop of undifferentiated Quaternary rock cover consisting of quartz sands, with some Tertiary silcrete and Devonian Sandstone outcrops (Santo Sandstone). The site of the proposed Chandler Facility lies towards the south edge of the Central Ridge and is not associated with any major local or regional structural elements.

The stratigraphy within the area of the Chandler Facility has been well defined from historical drilling of the petroleum wells Mt Charlotte 1 and Magee 1, which correlate closely with the drilling completed by the proponent.



Document Path: C:\GIS_SS\Maps\Chandler_Description_SMA.mxd

N

4 2 0 4 Kilometers

Coordinate System:
GDA 1994 MGA Zone 53

Legend

- Proposed development footprint
- Existing road
- Existing track
- Watercourse
- -C: Dolostone, limestone, sandstone, shale, conglomerate
- -P103: Sandstone, dolostone, limestone, diamictite
- D: Sandstone, limestone
- K: Shale, sandstone
- O: Sandstone, shale, dolostone
- S: Sandstone

Figure 3-7
Regional geology

TELLUS

3.2.2 Soils

Soil categories and land units within the proposed development footprint and vicinity have been investigated and mapped over a three year period (2013 to 2016). A detailed soils report is included in Appendix E.

Soil pH

All soils were found to be slight to moderately alkaline with the pH ranging from 7.78 to 8.12 (refer to Figure 3-8 and Figure 2 in Appendix E). This finding is also supported by the calcium carbonate that was found at S08.

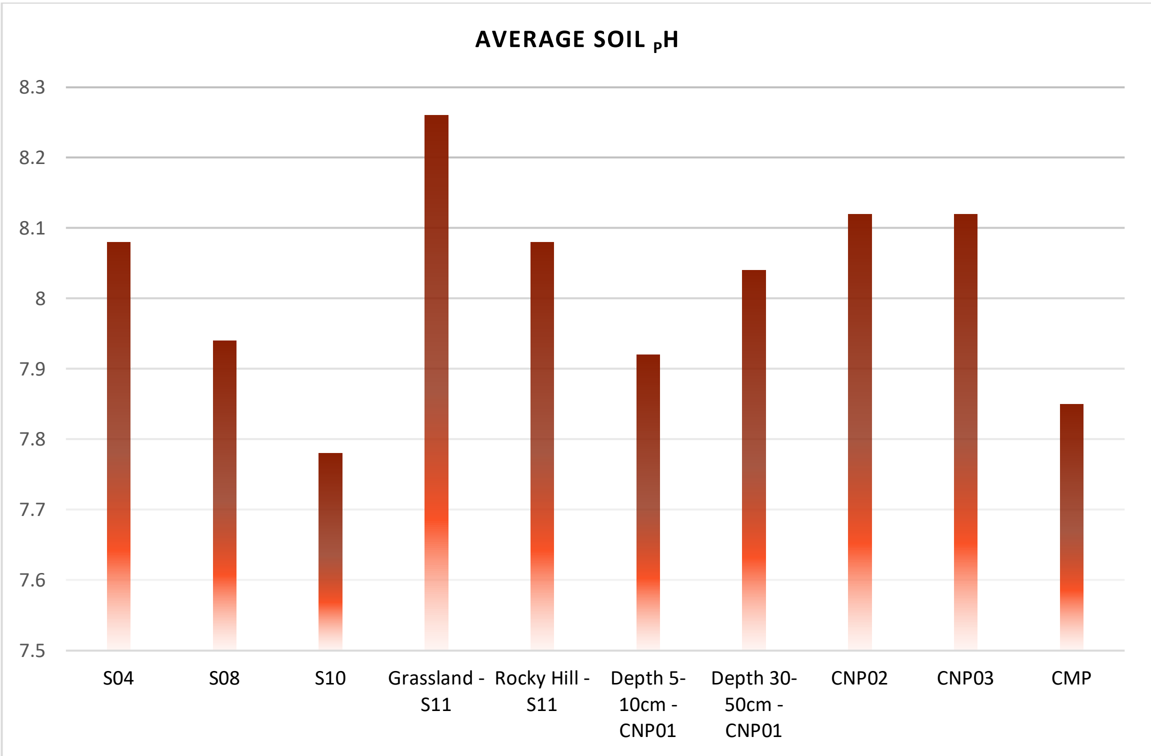


Figure 3-8 Average soil pH by site

Soil salinity

The electrical conductivity of samples ranged from 0.037 to 0.148 ds/m after 15 minutes, from 0.041 to 0.156 ds/m after 3-4 hours and from 0.043 to 0.245 ds/m after 96 hours. While samples from S10, and S04, CNP01-bottom and CNP03 generally remained stable over time. Figure 3-9 illustrates that the salinity increased with time for the remaining samples indicating that, for these samples, increased salt ions were mobilised in solution.

The texture of the soil influences the interpretation of electrical conductivity values. Sandy soils do not hold as much salt as clayey soils and, therefore, tend to give a lower reading. Sandy and loamy soils are considered moderately saline if their $EC_{1:5}$ is greater than 0.3 ds/m while clay soils are considered moderately saline if their $EC_{1:5}$ is greater than 0.6 ds/m (Watling 2007). The rocky ridge slope of S11, CMP01, CNP01-2-top and S08-2 had increased salinity values relative to the other samples; however, no single $EC_{1:5}$ value exceeds 0.3 ds/m. Therefore, there is little evidence that any of the soils evaluated are saline.

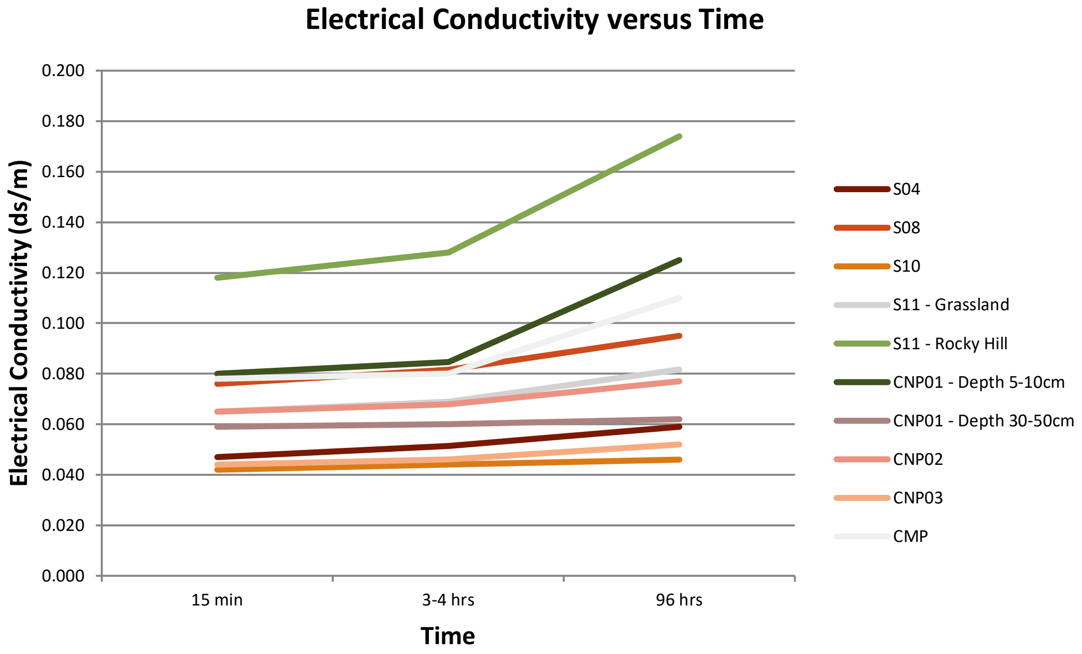


Figure 3-9 Changes in electrical conductivity over time by site

Soil classes, texture and erosion potential

The soil classes across the proposed development footprint and vicinity can be generally categorised as B43 (Rudosols), Nb19 (Sodosols), Nb25 (Sodosols) and LD1 (Calcarosols).

The majority of soils were found to be either loamy sand or sandy loam in texture with very little structure or stability. Erosion modelling was completed in a GIS to rank the sensitivity of soils in terms of low, medium or high risk across the proposed development footprint.

Localised water erosion was evident at sites CNP03, S11-grasslands, S08 indicating a potential for further erosion with disturbance.

Sand dunes and hill slopes are present across the proposed development footprint. Linear structures within the dune will have the potential to cause erosion. Majority of soils have relatively low crust, easily penetrated surfaces and high infiltration rates significantly reducing their erosion potential.

Acidity

There is no potential concern for acid generation. Soils within the proposed development footprint and vicinity are alkaline and do not contain any potential acidic sulfate material such as iron sulfide minerals which when exposed to oxygen, through soil disturbances such as excavation, form acidic soils.

3.2.3 Mineralisation

Historic drilling and local exploration

Historic petroleum exploration over the Amadeus Basin has included numerous seismic surveys and two petroleum wells, namely Mt Charlotte 1 and Magee 1, which were drilled within the area of the proposed Chandler Facility. There is also 145 kilometres of two-dimensional seismic survey information which the proponent has used. Initial exploration in the area targeted diamonds and base metals and this was followed by uranium and most recently potash. No mineral exploration drilling has been recorded in the target mining area of the proposed Chandler Facility.

Resource drilling and surface work

The Amadeus Basin in the NT was short listed as having the best underground salt formation for the dual revenue business and access to markets. The proponent applied for and was granted 1,432 square kilometres in nine EL's, subsequently. It has relinquished two tenements and partially relinquished a further three tenements to the current portfolio size of 816 square kilometres

On 26 March 2012, the proponent announced the completion of a Joint Ore Regional Committee (JORC) compliant exploration target estimate for the Proposal. The initial exploration target estimate covered two potential sites.

- Mt Charlotte site - 4.0 to 4.8 billion tonne exploration target (halite – NaCl).
- Charlotte North site - 0.2 to 0.5 billion tonne exploration target (halite – NaCl) in a substantial halite bed.

The exploration target estimate was prepared by Terra Search Pty Ltd of Townsville, Queensland. Terra Search has extensive experience in resource characterisation and preparation of JORC compliant technical reports. The Chandler Formation salt has been intersected in all drill holes (historical and recent) within the proponent's tenements.

Exploration hole CH003 hit the top of the salt formation at a depth of 772 metres below ground level. Coring and analysis showed two minable layers of high grade salt. The Chandler Formation sits above the deeper (1,800-metre) pre-Cambrian Gillen Salt Formation. Most of Australia's underground salt is from this geological period and is consequently much deeper than the Chandler Formation. A summary of these intersections is presented in Table 3-2.

The study design is based on the mineral resource estimate as at 24th June 2014 (release date 2 July, 2014). The proponent has a JORC compliant measured resource estimate for the Proposal, completed by Ercosplan, Germany (refer to Table 3-5). The measured resource estimate of sodium chloride (NaCl) is 309 million tonnes, indicated resource is 1,128 million tonnes and the inferred resource is 3,103 million tonnes (Ercosplan 2014).

Table 3-5 Mineral resource estimation[3]

Drill hole	Category	Area (km^2)	Thickness (m)	Density (g/cm^3)	NaCl Grade (%)	NaCl Tonnage (Mt)
CH001A	**Measured**	0.64	245.68	2.24	88.56	309.43
CH001A	**Indicated**	1.74	245.68	2.23	88.64	1,128.63
CH003		2.37	60.32			
CH001A	**Inferred**	5.12	245.68	2.23	88.64	3,103.80
CH003		5.12	60.32			

The location of the ore resource in relation to the proposed Chandler Facility is shown in Figure 3-10. More recently, exploration activities have been undertaken by Terra Search on behalf of the proponent. These exploration activities amount to around 30 kilometres of drilling and 145 kilometres of seismic survey lines in and around the site of the Chandler Facility.

The salt resource is estimated at over three billion tonnes in accordance with Australasian JORC *Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves*. The code determines how mineral resources are described in public reports and demands an appropriate level of confidence.

Laboratory testing indicates the salt resource is 80 to 95 % halite with the remainder comprising magnesium rich salts. The salt resource would be selectively mined and selectively processed to produce a product salt exceeding 97 % halite and suitable for a wide range of uses.

[3] *Refer to Mineral Resource compliance statement and Tellus Media Release 02 July 2014*

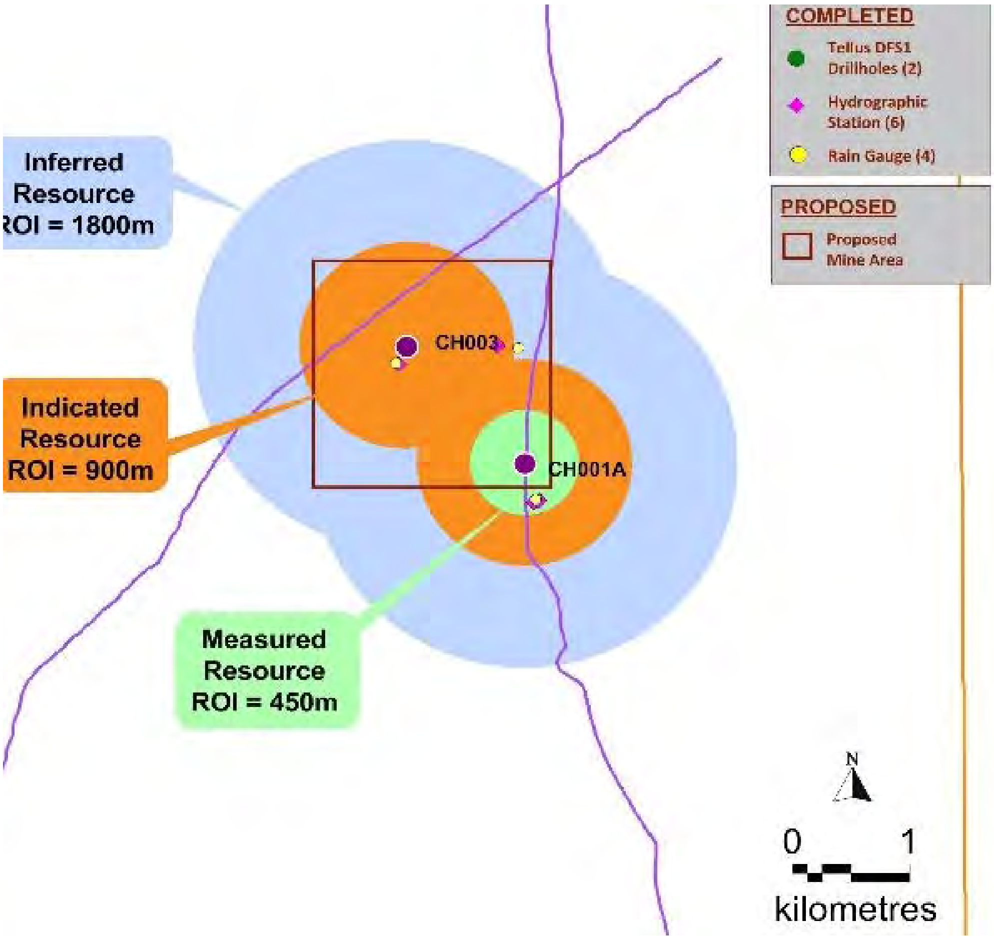


Figure 3-10 Chandler salt resource

Ore characteristics

The rock salt of the Chandler Formation consists mainly of coarse crystalline halite, with minor amounts of anhydrite, calcite, dolomite and quartz.

Laboratory test work

Salt quality analysis has been conducted on drill core samples collected during the exploratory drill campaign (refer to Plate 3-1). Approximately 2,000 metres of core were evaluated across a total of 370 samples. The analysis identified two layers with high quality salt.

Analysis was conducted in two phases: Phase 1 samples were taken from drill hole CH003; and Phase 2 samples were taken from CH001A (refer to Figure 3-9). Quarter core samples were submitted to Nagrom Analytical Laboratory for preparation and analysis. Nagrom was the lead laboratory and coordinated external analysis with Ultratrace Analytical Reference Laboratory and Bureau Veritas. Ercosplan reviewed the proposed analysis methods and confirmed suitability, reviewed assay results and selected samples for independent laboratory cross check analysis; duplicate samples were then sent to Intertek Genalysis.

The objective of the analysis was to provide sufficient information to:

- Meet JORC resource estimation requirements.
- Identify potential product options.
- Consider processing options.
- Identify what further test work was needed to examine process and product options in further detail.

Plate 3-1 Cores from mining horizon

3.2.4 Salt mining

The proposed Chandler Facility would capitalise a large salt resource that has been subject to a number of exploration activities. The salt resource is situated in the south-east of the Amadeus Basin. This basin is a very old and geological stable depression in about 155,000 square kilometres of central Australia.

The Chandler Facility would produce an average of 750,000 tonnes of run of mine salt each year. The salt would be excavated from an underground mine targeting a large salt resource.

Run of mine salt would be hoisted to surface by shaft from the underground mine where it would be stockpiled. Salt would be temporarily stockpiled during construction of the mine decline and then dry processed to become product salt once the Chandler Facility is operationally ready to accept waste materials.

The product salt would be transported via road to the Apirnta Facility where it would be loaded onto trains for dispatch to customers.

The salt would be marketed nationally and internationally for its various beneficial end uses. These could include industrial use and human consumption. It is possible the salt mine could also support the creation of businesses in nearby centres such as Titjikala or Alice Springs.

Further information on the operations involved in salt mining is described in Section 3.4.4.

3.2.5 Materials storage

A range of materials could be safely and securely stored (either temporarily or permanently) inside the void spaces that are left behind from the salt mining operations at the proposed Chandler Facility. Typical materials that may be stored (and retrieved at a later date) include document archives, film archives, museum artefacts, computer servers, and a host of other valuable documents and equipment.

3.2.6 Waste storage and isolation

Overview

The proposed Chandler Facility would receive waste for storage, recovery and permanent isolation up to a maximum capacity of 10 million tonnes over 25 years. Waste would be sourced from Australia's domestic waste market, and from Australia's Exclusive Economic Zone which extends 200 nautical miles from shore. Approval to import international wastes under the Basel Convention forms part of the Proposal. [4]

Waste accepted (and not accepted) at the proposed Chandler Facility

A range of hazardous wastes could be stored either temporarily (until recovery and treatment is possible) or permanently inside the void spaces left from the salt mining operations at the proposed Chandler Facility. These same waste materials could also be stored temporarily at the Apirnta Facility prior to being transported to the Chandler Facility. A summary of the wastes that would be accepted (and not accepted) at the proposed Chandler Facility is presented in Table 3-7.

An indicative inventory of waste that would be accepted at the proposed Chandler Facility is provided in Appendix F. The waste inventory is indicative, given that the actual quantity of waste would depend on the waste market and agreed waste contracts. This approach ensures planning for the proposed Chandler Facility adequately considers potential risks and impacts on the environment and meets the requirements of the applicable legislation (refer to Chapter 4).

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[4] *Australia is a signatory to the Basel Convention which permits. As a signatory, Australia is permitted to accept and manage wastes from developing nations. Furthermore, under the Convention, Australia has an obligation to adequately manage the production of its own intractable wastes. Refer to Chapter 4 of the EIS for further information.*

Table 3-6 Hazardous waste accepted and not accepted at the proposed Chandler and Apirnta Facility

Type of hazardous chemical wastes	Accepted on-site for surface storage[1]	Accepted in underground voids[1]
Chemical wastes listed under the National Environment Protection Measures (NEPM) (refer to Schedule A List 1: Waste Categories) and under Schedule 2 of the NT Waste Management and Pollution Control (Administration) Regulations	✓	✓
Liquid and sludges	✓	✓[1]
Explosive wastes	×	×
Flammable liquids or solids	×	×
Self-combusting wastes or wastes that can generate a gas-air mixture which is toxic or explosive	×	×
Highly corrosive or oxidizing	×	×
Gases	×	×
Clinical waste (infectious hospital waste and body parts)	×	×
Municipal solid waste (putrescible household and commercial waste)	×	×
Putrescible waste (household rubbish that can rot)	×	×
Uncertified waste (which cannot be identified or has not undergone characterisation testing)	×	×
Reacts with the repository geology (such as dissolving it or producing a gas)	×	×
NORM[2]	✓	✓
Low level radioactive waste (e.g. smoke detectors, exit signs, industrial gauges and medical isotopes)	×	×
Intermediate level radioactive waste (e.g. reprocessed spent nuclear fuel and components with high levels of radioactivity)	×	×
High level radioactive waste (e.g. from power generation and defense use)	×	×

Note: ✓ = accepted, × = not accepted, ✓[1]= normally excluded but could be used in hydraulic backfill processing. 1. Exemption activity levels defined as per *The National Directory for Radiation Protection, February 2014 (RPS 6).*

Waste acceptance documentation

The proponent has developed various waste acceptance documents for the Proposal. These include:

- Waste Acceptance Policy.
- Waste Acceptance Criteria.
- Waste Acceptance Procedures.
- Waste Zoning Guidelines.

These documents are discussed below and are provided in Appendix C.

Waste Acceptance Policy

The proponent has developed a Waste Acceptance Policy for the Proposal. The policy stipulates that before waste could be accepted at the proposed Chandler Facility (and Apirnta Facility) that the proponent must be satisfied that the waste meets the requirements of:

- Environmental approvals and licences issued by regulators.
- The Chandler Waste Acceptance Criteria.
- The Chandler Waste Acceptance Procedure.
- The Chandler Waste Zoning Guide.

Together, these steps form the basis of the proponents Waste Acceptance Policy for the Proposal. The Waste Acceptance Policy is provided in Appendix C.

Waste Acceptance Criteria

The proponent has developed strict Waste Acceptance Criteria (WAC) for the Proposal. The WAC defines:

- The criteria that would be applied for the exclusion of certain types of wastes as listed in Table 3-6.
- The criteria that would be applied for the acceptance of certain types of wastes as listed in Table 3-6.
- The requirement for suitable packaging and the criteria that would be applied for packaging acceptance.

The WAC would ensure that waste is only accepted if it can be stored and isolated in a safe and environmentally sound manner that meet the requirements of the under the *Dangerous Goods Act* and the *Work Health and Safety (National Uniform Legislation) Act*. The WAC is provided in Appendix C.

Waste Acceptance Procedure

The proponent has developed a Waste Acceptance Procedure (WAP) for the Proposal. The WAP outlines a three-stage approach that would be undertaken at the proposed Apirnta Facility to determine if wastes meet the WAC. The three-stage approach to waste characterisation would involve:

- **Level 1: Basic characterisation**. This is a thorough determination, according to standardised analysis and behaviour-testing methods, of the characteristic properties of the waste.
- **Level 2: Compliance testing**. This is periodic testing of regularly arising wastes by simpler standardised analysis methods to determine whether a waste complies with licence conditions and whether a waste with known properties has changed significantly.

- **Level 3: On-site verification**. This constitutes rapid check methods to confirm that a waste is the same as that which has been subjected to compliance testing and that which is described in the accompanying documents.

An overview of the WAP is provided in Figure 3-11. The WAP is provided in Appendix C.

Waste Zoning Guide

Waste that passes the WAC would be arranged aboveground (at the proposed Apirnta Facility) and underground (at the proposed Chandler Facility) according to a strict Waste Zoning Guide (WZG). Waste materials would be grouped into compatible waste type groups that can be stored together safely. Dangerous goods segregation protocols would be adopted in accordance with *Australian/New Zealand Standard AS/NZS 3833 The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers.*

Adopting a zoning approach would also increase the opportunity for potential future recovery of certain materials for beneficial use. The WZG is provided in Appendix C.

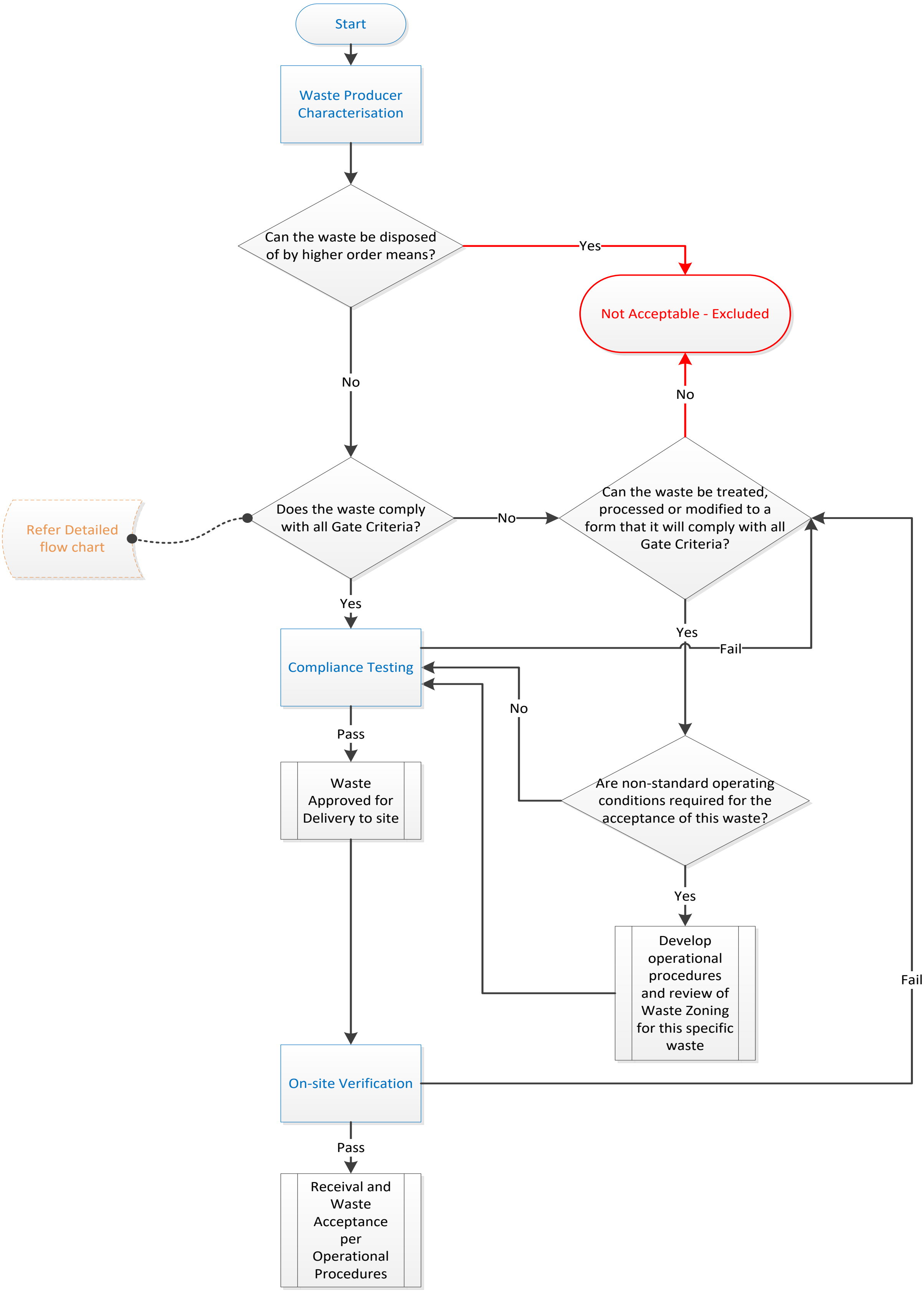

Figure 3-11 Overview of waste acceptance procedure for the Proposal

3.2.7 Multi barrier safety case approach

A multi-barrier safety case approach during transport, storage and disposal operations would be adopted for the Proposal. The multi-barrier approach is summarised below:

- Initially, waste would be placed into specified Dangerous Goods code rated containers, for example a double lined hazardous waste bulk bag, or a heavy duty PVC bag placed into a barrel.
- The smaller containers or waste packages would then be placed into shipping containers during transit operations. The shipping containers are assumed to be mostly transported by train from customers, waste managers or logistic company sites to the proposed Apirnta Facility (although some deliveries may also be made by road).
- The shipping container would be unloaded and taken to the surface storage and transfer station adjacent to the rail sidings at the proposed Apirnta Facility. The waste would undergo waste acceptance verification testing against strict WAC.
- Once the packages have been initially inspected, samples taken and accepted for storage/disposal they would be transferred by road train to the proposed Chandler Facility. Waste would be taken underground via the decline or via the hydraulic backfill system. During the construction phase, the waste packages would be temporarily stored at the Apirnta Facility.
- Waste transferred via the decline would be delivered by truck to designated storage/disposal rooms where it would be unpacked. The empty shipping containers and any pallets would be returned to the surface, cleaned as necessary and returned back into the supply chain.
- Once the waste is in place and confirmation has been received that it cannot be recovered, recycled or reused, any surrounding airspace in the disposal room would be backfilled with fine crushed salt to provide added stability within the room and as a further protective layer.
- Once a room is filled to capacity the entrances would be sealed with an engineered barrier appropriate for the wastes that have been emplaced.
- Ultimately at the end of operations, once the shafts are sealed and backfilled there would be permanent isolation of the material from the biosphere provided by a combination of the engineered barriers and the geological barrier itself (impermeable salt bed and the overburden above the salt bed).

The multi-barrier safety case approach is shown conceptually in Figure 3-12.

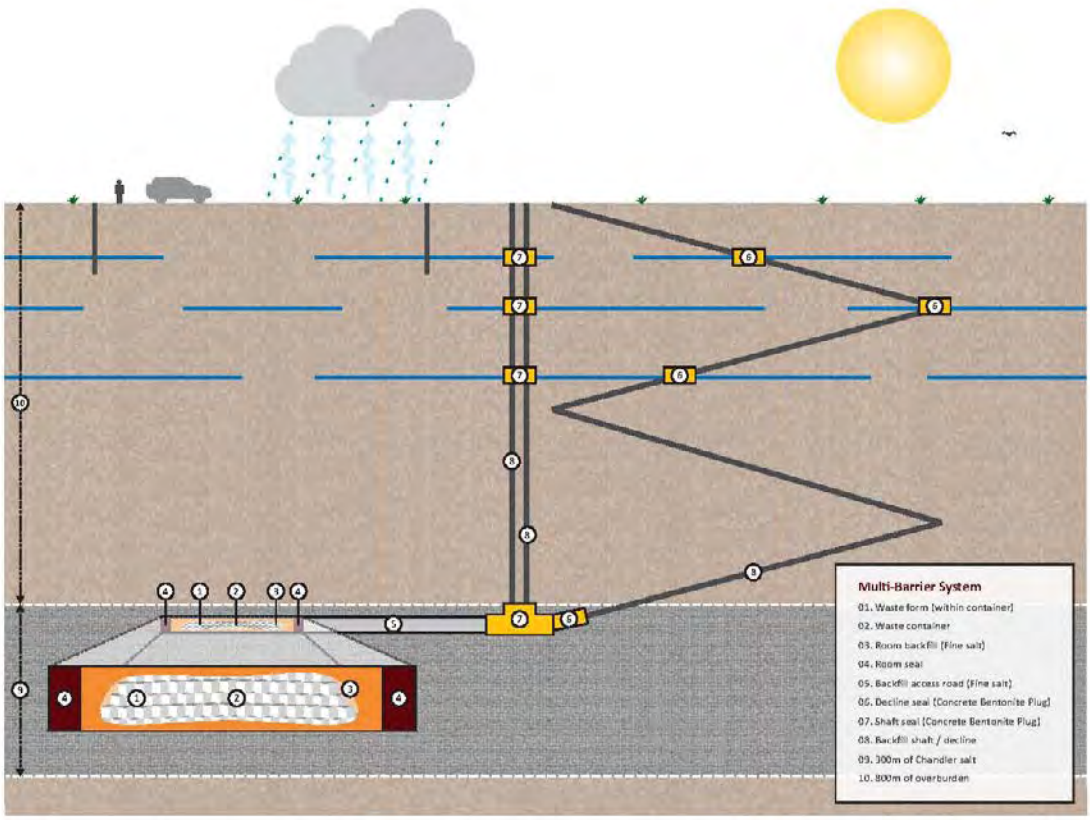

Figure 3-12 Multi-barrier isolation of waste at the Proposed Chandler Facility

3.2.8 Design requirements and criteria of the Chandler Facility

The major requirements that have influenced the design of the Proposal are:

- It shall meet all regulatory requirements.
- It shall be able to safely accept and emplace all forms of intended waste.
- Once closed, including the decline, shaft seals, and the surrounding geosphere, shall passively contain and isolate all waste, so as to protect the environment, and the health and safety of persons.
- The design capacity shall be 400,000 tonnes per annum of assorted wastes.
- It shall be capable of being operated for at least 25 years (including waste emplacement, pre-closure monitoring and decommissioning periods).
- It shall be capable of operating 24 hours per day, seven days per week.
- It shall be located on lands within the Maryvale Station.
- The underground mine design shall balance the needs of stability during the operational phase of the repository and the need to encourage controlled convergence (salt creep) which underpins the post closure safety case.
- If required, the underground waste storage facilities shall maintain a minimum offset of 45 metres from any deep borehole.

Issues that would need to be considered further during planning and detailed design include:

- Site-specific geotechnical issues.
- Salt mining methods.
- Storage material handling techniques.
- Groundwater sealing for the decline and shafts.
- Potential environmental, social and cultural impacts.
- Market conditions and economic criteria.

The principal functional requirements for the proposed Chandler Facility are:

- Provide water tight surface to underground access ways to prevent ingress of water to the underground workings via the access ways.
- Provide efficient personnel access and egress to and from the underground areas of the facility, including during emergency situations which could require evacuation of personnel from below ground.
- Provide for up to 1,200,000 tonnes per annum (maximum) and an average of 750,000 tonnes per annum run of mine salt to be brought to the surface.
- Provide for an average production rate of 120 tonnes per hour mined salt to be brought from underground to the surface.
- Provide for up to 400,000 tonnes per annum of waste storage material input assumed to be transported (predominantly by rail but in some instances by road) in 20 foot ISO freight containers.
- Provide to take equipment from surface to underground including items such as heavy duty continuous miners, supporting equipment for the mining process, storage materials transport and handling equipment.
- Allow for a minimum of 300 cubic metres per second of fresh air to be taken into the underground including the provision for the introduction of cooled air.
- Allow for essential services required underground including process water, high voltage electricity, mine water pumping range and potentially a waste placement reticulation system.

3.2.9 Standards and specifications

The Proposal would be designed, constructed and operated in accordance with relevant industry and regulatory standards and specifications, as summarised in Table 3-8. Sustainability would be a key consideration in the design, construction and operation of the Proposal. This commitment to sustainability would be evidenced by:

- The incorporation of components such as solar power.
- The beneficial reuse of wastewater.
- The use of energy efficient equipment.

Table 3-7 Standards and specifications

Component	Standards and specifications
Sustainability	Infrastructure Sustainability Council of Australia
	Green Building Council of Australia
Building and construction	Construction of all buildings in line with the Australian Building Code.
Flood immunity	1 in 100 year average recurrence interval.
Indoor lighting	*AS 1680.5:2012 Interior and workplace lighting*
Outdoor lighting	*AS 1158.3.1:2005 Lighting for roads and public spaces*
	AS 4282-1997 Control of obtrusive effects of outdoor lighting
Waste handling	*Dangerous Goods Safety Act 2004*
	Radiation Safety Act 1975
	AS 1940-2004 The storage and handling of flammable and combustible liquids
Health, safety and environment	*ISO 9001 Quality management systems*
	ISO 14001 Environmental management systems
	AS 4801 Occupational health and safety management systems
	Australian Drinking Water Guidelines to ensure the health and safety for all construction and operational staff.
	Australian Guidelines for Water Recycling: Managed Aquifer Recharge - For the protection of aquifers and the quality of recovered water during construction and operation of all groundwater bores associated with the Chandler Facility.

3.3 Land requirements

A summary of the land requirements for the Proposal is presented in Table 3-8.

Table 3-8 Summary of land take requirements

Facility	Key dimensions (indicative only)	Land requirement (ha)
Chandler Facility (underground infrastructure)		
Surface conveyors for run of mine salt	300 metre length	1
Underground room and pillar excavation	3.1 kilometres x 1.48 km	360
Vertical shafts	5 metre wide diameter 866 metre depth (max)	2
Reclaimer system	150 metre by 150 metre	2.5
Sub total		***365.5***
Chandler Facility (aboveground infrastructure)		
Mine infrastructure	600 metres by 600 metres	36
Accommodation village	70 metres by 70 metres	0.5
Run of mine salt stockpile[5]	500 metres by 500 metres by 20 metres	25
Power generation (Diesel/gas/solar field)	200 metres by 200 metres	4
Spoil storage piles	500 metres by 100 metres	5
Firebreak	To be confirmed	15[6]
Sub total		***85.5***
Apirnta Facility		
Rail siding	1,800 metres by 50 metres	9
Storage and transfer facility	600 metres by 500 metres	30
Sub total		***39***
Road infrastructure		
Henbury Access Road	60,000 metres by 30 metres	180
Chandler Haul Road	31,000 metres by 30 metres	93
Sub total		***273***
Total land requirement (above and below)		**763**

3.4 Overview of the Chandler Facility

This section presents an overview of the proposed Chandler Facility. Details regarding the construction of the Chandler Facility are presented in Section 3.4 and details regarding operation of the Chandler Facility are presented in Section 3.5.

3.4.1 Site access

During the initial years of construction and operation, the site would be accessed via an existing public road, Maryvale Road. When mining operations begin and revenue is generated, a proposed

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[5] *This is based on a worst case scenario of 3,500,000 tonnes of run of mine salt. The footprint would be larger if salt were not stockpiled to this height capacity.*

[6] *This is a nominal amount which will be confirmed during detailed design.*

private access road would be constructed which would be accessed from the Stuart Highway (the proposed Henbury Access Road).

The proposed Henbury Access Road would cross the Central Australian Railway and join a private haul road (the proposed Chandler Haul Road) that would lead to the Chandler Facility. The total distance of the proposed Henbury Access Road and Chandler Haul Road is approximately 90 kilometres. The proposed Henbury Access Road and Chandler Haul Road are located on the Henbury Station and Maryvale Station, respectively.

3.4.2 Underground infrastructure

The key underground infrastructure at the proposed Chandler Facility would include:

- Underground mine.
- Mine access decline.
- Two vertical shafts (one allowing for salt hoisting and personnel riding as well as downcast ventilation, and one for upcast ventilation).

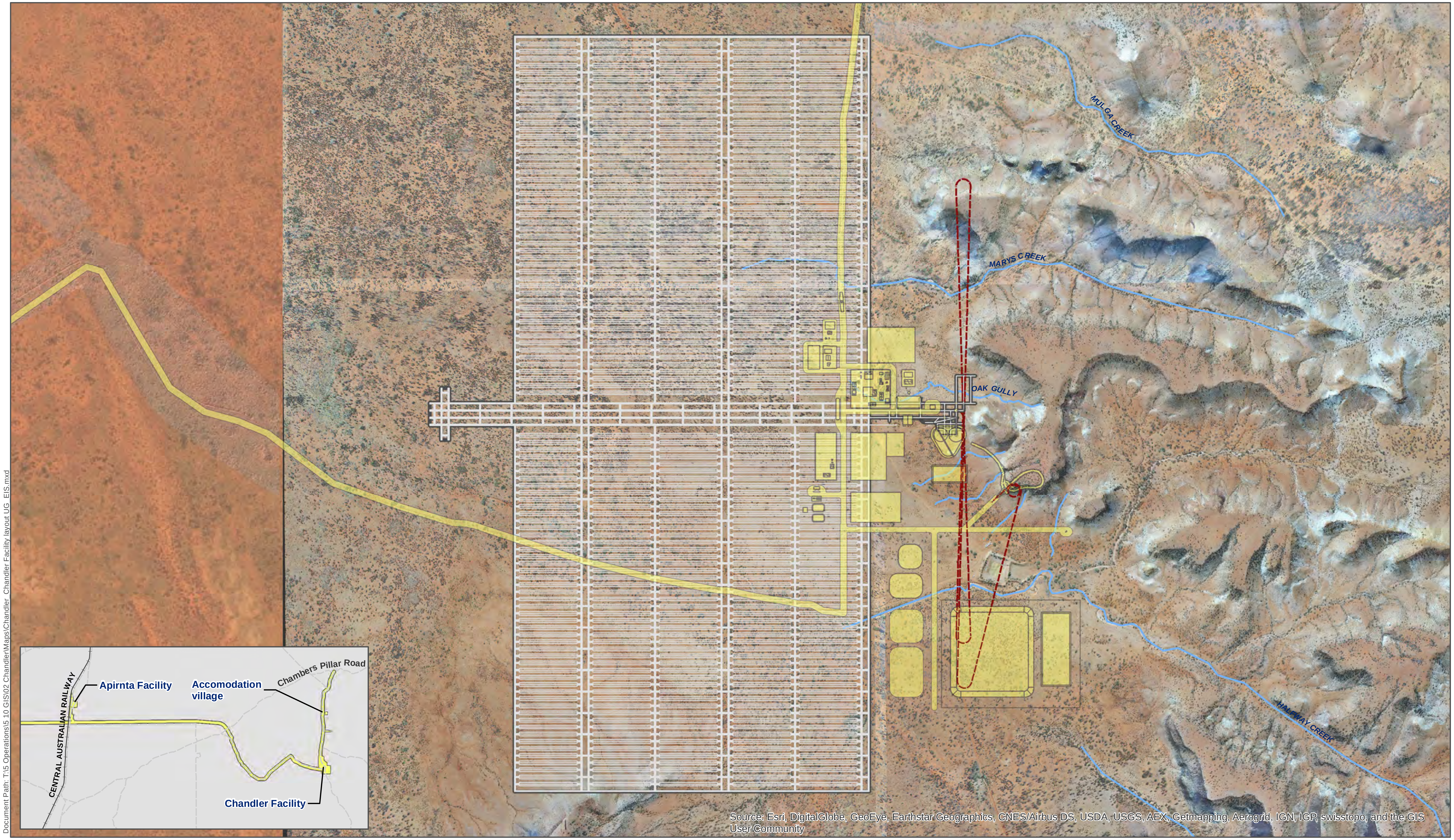
The underground infrastructure is described below and is shown conceptually in Figure 3-13.

Underground mine

The underground mine would be located between about 842 and 848 metres below ground level (this is a current planning assumption based on borehole intersection of the salt bed and may vary over the wider mine infrastructure area). It would be approximately 361 hectares in size.

Salt would be mined using a room and pillar system of mining. The underground mine would, therefore, be composed of multiple lengthy passages (or rooms) running in parallel along a horizontal plane, separated by pillars of unmined material. Each room would be approximately 250 metres long, 15 metres wide and six metres high. Each room would be allocated to a waste type which would allow separation of waste according to the WZG. The indicative layout of these rooms is shown in Figure 3-13.

The underground mine would be fitted with a conveyor system to transfer run of mine salt from the continuous miners to the surface. A dedicated underground workshop and services area would also be established near the bottom of the downcast shaft. The services provided in this area would include personnel amenities, a lunch room, maintenance services and storage areas including a 5.5-kilolitre fuel storage bay.



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200 100 0 200 Meters

Coordinate System:
GDA 1994 MGA Zone 53

Legend

Watercourse

Proposed development footprint

Underground infrastructure

Portal and decline

Indicative layout

Figure 3-13

Underground layout of the proposed Chandler Facility

TELLUS

Data source: Geoscience Australia, Topographic base data, 2006; AUSURV, Aerial imagery, 2016.

Mine access decline

Construction of the mine access decline would commence by drill and blasting using a box cut into an existing rock outcrop on Maryvale Hills. This technique would create a portal entrance from where the decline would commence.

The mine access decline would comprise a sloped, zig-zag, tunnel approximately five kilometres in length that would connect the surface to the underground mine. The mine access decline would be the main transport route for waste containers entering the underground mine and waste rock leaving the underground mine during construction.

A schematic of the mine access decline in context of the existing environment is provided in Figure 3-14.

Vertical shafts

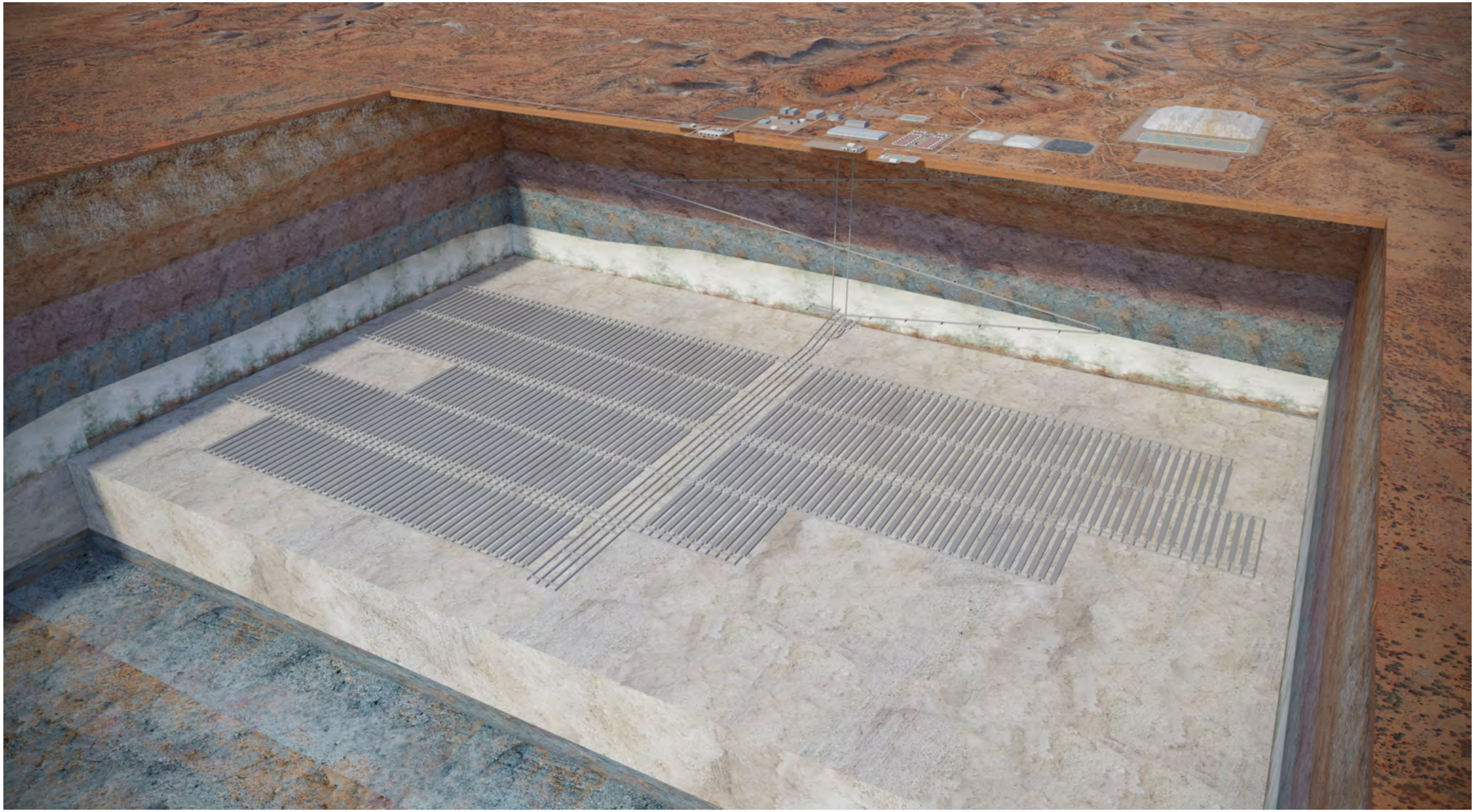
Two vertical shafts would be installed – a main shaft allowing for salt hoisting and personnel riding as well as downcast ventilation, and a secondary shaft for upcast (exhaust) ventilation. The main shaft would be approximately 820 metres long and the secondary ventilation shaft approximately 860 metres long. The shafts would intersect the mine access decline and terminate at the underground mine (refer to Figure 3-14).

The main shaft would be compartmentalised. The main compartment would hold a container or "skip" used to convey run of mine salt, while the counterweight compartment would regulate its movement. An auxiliary compartment would be used to transport workers to the underground mine. The auxiliary compartment would split into two floors that could transport up to six workers per floor.

The main shaft would also reticulate some utilities and services such as raw water, power and communications and would provide fresh air to the underground mine. The main shaft would also be used to run the hydraulic backfill pipeline underground.

The secondary shaft would draw exhaust air from the underground mine to the surface.

Figure 3-14 Proposed mine access decline



3.4.3 Aboveground infrastructure

The key aboveground infrastructure at the proposed Chandler Facility would include:

- Salt processing facilities.
- Waste unloading area.
- Waste storage warehouse.
- Vertical shaft headframe.
- Surface hydraulic backfill plant and underground reticulation.
- Salt and overburden stockpiles.
- Maintenance buildings.
- Administration building.
- Worker accommodation.
- Solar/diesel hybrid power plant.
- Clean and raw water dams.
- Water and sewage treatment.
- Fuel storage facility.
- Utility reticulation.
- Internal roads.
- Compressor building.
- Bore field.
- A future technology recovery park.

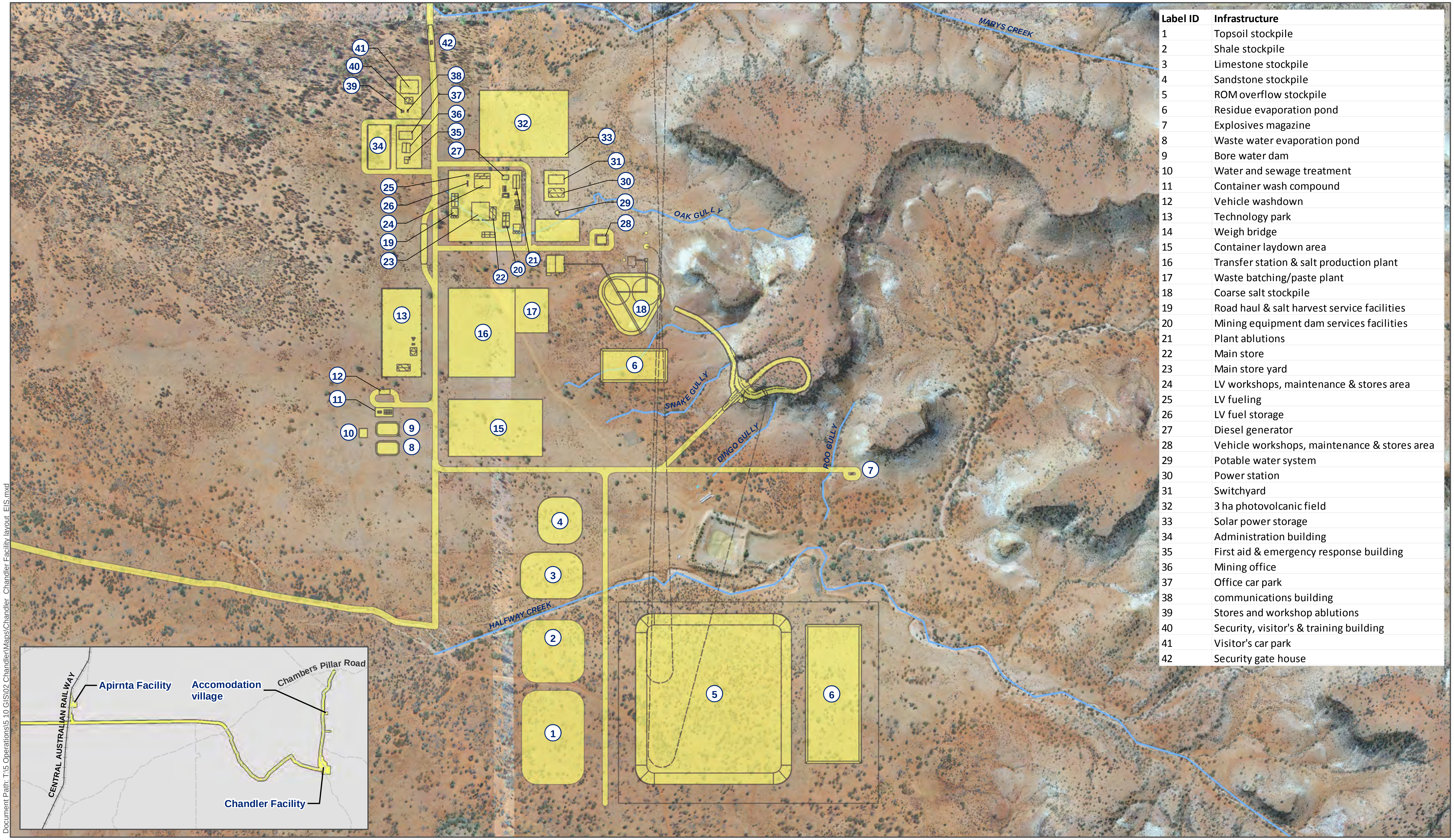
The aboveground infrastructure is described below and is shown conceptually in Figure 3-15.

Salt processing facilities

Dry optical sorting facilities are likely to be located within the mine infrastructure area in the vicinity of the run of mine salt stockpile. The final location of these facilities would be determined during detailed design of the Proposal.

Waste unloading area

The waste unloading area would be an engineered hard stand. The area would temporarily hold waste before it is transferred underground. The area would also hold empty containers returned from the underground operations before being transferred back to the proposed Apirnta Facility.



Label ID	Infrastructure
1	Topsoil stockpile
2	Shale stockpile
3	Limestone stockpile
4	Sandstone stockpile
5	ROM overflow stockpile
6	Residue evaporation pond
7	Explosives magazine
8	Waste water evaporation pond
9	Bore water dam
10	Water and sewage treatment
11	Container wash compound
12	Vehicle washdown
13	Technology park
14	Weigh bridge
15	Container laydown area
16	Transfer station & salt production plant
17	Waste batching/paste plant
18	Coarse salt stockpile
19	Road haul & salt harvest service facilities
20	Mining equipment dam services facilities
21	Plant ablutions
22	Main store
23	Main store yard
24	LV workshops, maintenance & stores area
25	LV fueling
26	LV fuel storage
27	Diesel generator
28	Vehicle workshops, maintenance & stores area
29	Potable water system
30	Power station
31	Switchyard
32	3 ha photovolcanic field
33	Solar power storage
34	Administration building
35	First aid & emergency response building
36	Mining office
37	Office car park
38	communications building
39	Stores and workshop ablutions
40	Security, visitor's & training building
41	Visitor's car park
42	Security gate house

Figure 3-15
Proposed aboveground layout of the Chandler Facility

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Data source: Geoscience Australia, Topographic base data, 2006; DLPE NT Government, cadastre, 2016.

Waste storage warehouse

Wastes that are generated during operation would be stored within a designated waste storage warehouse. The warehouse would be located within the vicinity of the stores areas as shown in Figure 3-3.

Vertical shaft headframe

The vertical shaft headframe would be approximately 40 metres high with a plan area of approximately 225 square metres (15 metres by 15 metres). The headframe contains a tower mounted 4.50 metres in diameter. The auxiliary friction hoists, would be approximately 1.4 metres in diameter.

The headframe would contain four metre diameter deflection sheaves for the main hoist head ropes, arresting gear for retarding the conveyances in the event of overwind and overhead crane beams for maintaining and installing the conveyances. Stairs and intermediate floors and platforms would be provided for access and maintenance requirements. An elevator would be installed to service the various floors in the headframe and to provide access to the hoist room.

The main shaft hoist room would be located at the top of the main shaft headframe and has nominal external dimensions of approximately 15 metres by 22 metres with a height of 12.5 metres. The hoist room would have a seven metre overhang to facilitate hoisting of major components for the main hoist from ground surface to the hoist level.

A 50 tonne-rated overhead travelling crane mounted in the hoist room would be used to hoist the equipment and maintenance supplies to the top of the headframe. This hoist room would house all the controls and electrical equipment necessary to operate the hoist along with a local operating station.

The secondary ventilation shaft headframe would be a 40-metre high, insulated and clad steel structure. The headframe would be designed so that the structure would not require major refurbishments during the 100-year design life.

Hydraulic backfill plant and underground reticulation

The hydraulic backfill plant would house equipment for the receiving and processing of solid and liquid wastes. The backfill would be transported underground via a pipeline fitted within the downcast shaft where it would then be reticulated to an excavated room for disposal.

Salt and overburden stockpiles

Salt and overburden (soil and rock) stockpiles would be established within the mine infrastructure area at the proposed Chandler Facility. There would be one stockpile for run of mine salt and product salt generated during operation. There would also be stockpiles for topsoil, sandstone, siltstone and claystone.

The size of the salt stockpile may fluctuate during operation according to supply and demand but would have a volume of approximately 3.5 million cubic metres and a height of about 20 metres. The soil and rock stockpiles would be smaller ranging in volumes from approximately 58,000 cubic metres to 478,000 cubic metres and a height of approximately 12 metres.

Maintenance buildings

Maintenance buildings and a storage area would be located adjacent to the mine infrastructure area and would be used for minor repairs and preventative maintenance tasks for the shaft components and the equipment used within the mine infrastructure area.

Administration buildings (offices, main control room and amenities building)

The offices, main control room and amenities building would consist of a steel framed, insulated and clad structure. The approximate size of the building would be approximately 25 metres by 25 metres and two-storeys high. The main control room would be equipped with computing, control, and monitoring equipment to marshal all signals and data transmitted from the both aboveground and underground.

The amenities area would be equipped a with change room/locker facilities, lunch room and a training or visitors room. First aid and emergency response would be provided in this area.

Radiological badging for NORM waste and work control would also be managed in the amenities building. A car parking area would be provided to receive staff and visitors. Other facilities that would be provided include a lamp room, mechanical areas and storage.

Worker accommodation

An accommodation village would be established approximately two kilometres north-east of the proposed Chandler Facility. The accommodation village would likely include semi-detached dwellings; ablutions; laundry facilities; car parking; dry mess, wet mess, kitchen and cold room; games room; tennis court and gymnasium; sewage treatment plant; fire water protection; and administration offices.

Worker accommodation would be provided for both the construction and operation workforce. Worker accommodation would be temporarily expanded by utilising modular temporary buildings during relatively short workforce peaks during construction.

Further information on the proposed accommodation village is provided in Section 3.5.10.

Solar/diesel hybrid power plant

A solar/diesel hybrid power plant would be installed to provide baseload power to the proposed Chandler Facility. The hybrid power plant would consist of an array of photovoltaic panels producing approximately two megawatts of power output. The diesel component would supplement the two megawatts of solar power with three megawatts of diesel power plus two megawatt standby.

The hybrid power plant would include fuel storage vessels for consumption during power generation, including an adequate emergency reserve to provide 48 hours power at 35% load. The fuel would be stored within a bunded area within the mine infrastructure area and fuel volumes would not exceed NT WorkSafe Guidelines.

Clean and raw water dams

Dams would be constructed to separate clean and raw water. Water would be drained to these areas where it is expected to evaporate.

Water and sewage treatment

Infrastructure would be constructed to treat raw water for potable supply as well as sewage generated on-site. The location of this infrastructure is shown in Figure 3-3.

Fuel storage facility

A dedicated fuel storage facility would be constructed to manage the acceptance of regular (weekly) fuel deliveries. The storage of fuel in this area would meet the necessary requirements under the NT Dangerous Goods Act. Fuel demand is discussed in Section 3.17.5.

Utility reticulation

The reticulation of process water, particularly for hydraulic backfill, is required during operation of the Proposal. Volumes of reticulated water during operation are discussed in Chapter 8.

Internal roads

A network of internal roads would be constructed within the mine infrastructure area at the proposed Chandler Facility. The roads would be used by personnel and visitors and for the movement of waste materials and salt. The internal roads would be unsealed. The proposed road infrastructure is discussed further in Section 3.10.

Borefield

Up to 54 mega litres of raw water per annum would be required during construction. During operation, 104 mega litres would be required. A borefield would be utilised for water supply and would comprise approximately 15 bores located to the north of the proposed Chandler Facility.

Groundwater research undertaken to date indicates water could be drawn from the Upper Langra Formation which lies at approximately 140 metres below ground level. A water treatment plant would be necessary to treat water for consumption or domestic use by the workforce. Treatment processes may include reverse osmosis, ultraviolet sterilisation, chlorination, or others as required.

Compressor building

A compressor building located close to the main vertical shaft would house two compressors that would provide compressed air for surface and underground maintenance. In the event of an underground emergency, refuge would likely have bottled supply and or rely on large volume of oxygen present in a room.

The steel framed metal clad compressor would have a footprint of approximately nine metres by 10 metres. The building would be designed to act as an acoustic enclosure. Each compressor would be capable of providing compressed air of 30 cubic metres per minute at 830 kilopascals.

Future technology park

The site layout would allow for a technology park for research and development activities throughout the life of the Proposal. The technology park would be designed to enhance the quality of research and development in salt processing and waste recovery as well as other fields such as geophysics and particle physics.

It is expected that the technology park could support members of a research and development community working independently or in joint venture with the proponent.

3.5 Construction of the Chandler Facility

This section provides details regarding the construction of the proposed Chandler Facility. An indicative construction schedule is provided along with the proposed workforce and working hours. Information regarding the typical equipment, machinery and vehicles that would be used during construction is provided along with a description of the different phases of construction (enabling works, construction of aboveground infrastructure, construction of underground infrastructure, and testing and commissioning). Traffic and transportation, utilities, and waste generated during construction are also discussed.

3.5.1 Construction schedule

Subject to obtaining approval, it is anticipated that construction would commence in late 2018. The majority of construction works would occur over a three-year period, ending in late 2021. An additional year would be required for testing and commissioning, ending in late 2022. An indicative construction schedule is provided in Table 3-9.

The proposed Apirnta Facility would likely be commissioned earlier in the construction schedule to provide for early receipt and interim storage of waste in preparation for the commissioning of the proposed Chandler Facility (refer to Section 3.7.1).

Table 3-9 Indicative construction schedule (Chandler Facility)

Activity	Indicative construction period	
	Start	Finish
Planning approval and environmental licences obtained	February 2017	February 2018
Enabling works	March 2018	June 2018
Construction of aboveground infrastructure	October 2018	December 2021
Testing and commissioning	January 2022	December 2022

The construction of the proposed Chandler Facility (including the Henbury Access Road and Chandler Haul Road) would be broken down into five key construction stages, as discussed below and shown in Figure 3-16.

Figure 3-16 Summary of key construction stages (Chandler Facility including Henbury Access Road and Chandler Haul Road)

Stage 1: Site preparation (Month 1 to 6)

- Clearing and grubbing – 100 % complete.
- Construction of accommodation village – 75 % complete.
- Henbury Access Road – 50% complete.
- Chandler Haul Road – 50 % complete.
- Main shaft platform and laydown areas earthworks completed.
- Construct drainage attenuation basins and sediment and erosion control measures.
- Construct groundwater bore field.

Stage 2: Accommodation village and road construction (Month 7 to 19)

- Accommodation village – 100 % complete.
- Commence construction of shaft head frame chambers, intake and exhaust ventilation shaft and decline box cut.
- Henbury Access Road and Chandler Haul Road – 100 % complete.
- Topsoil stockpiled for re-use.

Stage 3: Aboveground infrastructure construction (Month 20 to 32)

- Continuation of decline development.
- Quantity of extractive material retained on-site within stockpiles and re-used in road maintenance, where appropriate.
- Begin construction on vertical shafts.

Stage 4: Underground mine access construction (Month 33 to 45)

- Continuation of decline and vertical shaft development.
- Early commissioning testing commences.

Stage 5: Underground mine development (Month 46 to 48)

- Decline and vertical shafts – 100 % complete.

- Final commissioning testing.

3.5.2 Construction workforce and working hours

At the peak of construction, it is estimated that there would be 270 personnel working on-site. Construction would require workers with a range of skills including labourers, equipment operators, tradesmen (such as plumbers, welders and electricians), surveyors, field engineers (civil, mechanical or process), health and safety staff, administrative staff and cleaners. An indicative profile of the workforce for the duration of construction of the proposed Chandler Facility is provided in Table 3-10.

Hours of construction would be 12 hour shifts, seven days per week (alternating crews working two weeks on and one week off). Night shift work would be necessary for underground development activities and as a contingency to critical aboveground activities. All exceptions to standard working hours would be in compliance with relevant legislation with shift patterns designed accordingly.

The proponent or its contractors would (where suitable) aim to source employees (construction staff) locally either from the community of Titjikala or from Alice Springs or other communities within the NT. Construction workers sourced from further afield than Titjikala would be housed within the accommodation village located to the north of the proposed Chandler Facility.

Table 3-10 Construction workforce profile (Chandler Facility including Henbury Access Road and Chandler Haul Road)

Construction stage	Time (months)	Approximate construction workforce (per month)
Stage 1	1	15
	2	20
	3	40
	4	60
	5	75
	6	80
Stage 2	7 to 12	90
	13 to 19	150
Stage 3	20 to 32	200
Stage 4	33 to 45	270
Stage 5	46	100
	47	75
	48	50

3.5.3 Construction equipment, machinery and vehicles

Enabling and construction works would likely require the following equipment, machinery and vehicles:

- Light vehicles.
- Mini buses to transport employees from the airstrip to site.
- Excavators.
- Dump trucks.
- Fuel truck.
- Front end loaders.
- Vibrating rollers.
- Cranes.
- Water trucks.
- Dozers.
- Graders.
- Prime movers and trailer sets.
- Low loaders.
- Drills.
- Scraper.
- Roller
- Haul trucks.
- Shotcreter.
- Cherry pickers and elevated work platforms.
- Blasting equipment.
- Water trucks.
- Forklifts.
- Underground pumps.
- Temporary construction ventilation fans and ducting.
- Raise boring machine and support equipment
- Temporary services and utilities

3.5.4 Enabling works

Prior to commencement of construction works, the following enabling works would be required:

- Clearing and grubbing.
- Earthworks and grading.
- Utilities and services.
- Temporary fly camp.
- Temporary site offices, crib facilities and buildings.
- Explosives storage.
- Site security.

The enabling works are described below.

Clearing and grubbing

Clearing and grubbing of the site would be necessary to carry out further site preparation activities. Clearing and grubbing would be undertaken progressively over the site in parallel with other site preparation activities to minimise the area of exposed ground and to reduce the potential for erosion.

Where possible, trees above five metres would be retained. This is a decision the proponent has made following consultation with Traditional Owners. Where vegetation is removed, it would be stockpiled, and sometimes chipped, for use in erosion control. Larger woody vegetation that cannot be chipped would be deposited in or around the site as habitat for terrestrial fauna. Subsurface vegetation would be grubbed to a depth suitable to facilitate construction of the proposed Chandler Facility.

Earthworks and grading

Earthworks and grading of the site would be necessary to provide a flat and stable surface for construction and to provide adequate drainage. It is predicted that around one million cubic metres of soil and rock material would be stockpiled and managed at the site of the proposed Chandler Facility.

Topsoil and subsoil would be stripped and stockpiled separately. Topsoil would be stockpiled and maintained for redistribution at the surface. Subsoil would be stockpiled for use as road sub-base or backfill at the site of the Chandler Facility.

Utilities and services

Utilities and services would be established progressively during site preparation and into construction (extending to facility components as they are established). These services would include air, water, power, communications, personal amenities, waste collection, water management, and lighting. Utilities and services are discussed further in Section 3.4.6 and Section 3.16.

Temporary fly camp

A fly camp would be established to allow for enabling works. It would accommodate 50 people. The fly camp would consist of air conditioned rooms, kitchen, laundry units, and an office. Following the completion of the enabling works, a permanent accommodation village would be constructed to provide housing for the construction workforce.

Temporary site offices, crib facilities and buildings

A number of temporary buildings would be required to support the enabling works. These buildings would include site offices and personal amenities. Temporary buildings would typically be transportable and demountable structures and would be removed once no longer needed.

Temporary construction compounds would also be established within construction sites for the storage of equipment and materials during the enabling works. These compounds would be disestablished as construction progresses and permanent facilities are constructed.

Explosives storage

An explosives storage would be established in line with the NT *Dangerous Goods Act* and Dangerous Goods Regulations to store explosives needed for the construction of the mine access decline and box cut. The explosives storage would be situated a safe distance from commonly inhabited parts of the site and access would be strictly controlled. The explosives storage would remain during construction, but removed during operation of the proposed Chandler Facility.

Site security

Installation of security during enabling works would be necessary to secure the sites and comply with biosecurity regulations. Security controls installed at the proposed Chandler Facility would include:

- Perimeter fencing.
- Lighting and surveillance.
- Security gating at access points.
- Internal fencing at key infrastructure.
- Check points and identification protocols.

Personnel accessing the Chandler Facility would do so via the proposed Henbury Access Road via the Apirnta Facility. Personnel would be subject to security controls at the Apirnta Facility.

3.5.5 Construction of underground infrastructure

Construction of the underground infrastructure would involve:

- Construction of the underground mine.
- Construction of the mine access decline.
- Construction of the vertical shafts.

A description of the activities associated with the construction of the underground infrastructure is provided below.

Underground mine

The underground mine would essentially be constructed through mining during the operation of the proposed Chandler Facility, as described in Section 3.5.4.

The underground mine would be connected to the underground services area. The mine access decline and vertical shafts would be connected to the underground mine by drilling and blasting. Waste rock generated by drilling and blasting would be hoisted to the surface via the main shaft and stockpiled.

Mine access decline

Construction of the mine access decline would involve excavation of a box cut followed by the progressive excavation of the decline. The box cut would be excavated using bulldozers, rock breakers and excavators – along with drill and blast methods if necessary. The mine access decline would be excavated by conventional drill and blast.

Vertical shafts

The vertical shafts would be developed using a conventional raise bore drilling method. This method involves the drilling of a pilot hole to intersect with an underground opening, before attaching a cutting head and reaming the shaft opening back to the raise bore machine. The shafts would then be appropriately sealed and supported.

The two shafts would be developed in a staged manner from the surface and two underground galleries. The underground galleries would be developed off the mine access decline allowing vertical development to occur in parallel to the decline development.

Once completed, the main shaft would be fitted out for personnel riding and salt hoisting. Services and utilities would also utilise the main shaft including the backfill pipeline. A refrigeration plant would also be fitted at the surface to ensure a suitable air temperature underground.

The secondary shaft would be fitted with exhaust fans mounted on an engineered concrete monolith.

3.5.6 Construction of aboveground infrastructure

Construction of the aboveground infrastructure would involve:

- Construction of surface structures.
- Construction of the vertical shaft headframe and shaft collars.
- Establishment of salt stockpiles.
- Construction of internal roads.
- Construction of the borefield.
- Installation of utilities and services.

A description of the activities associated with the construction of the aboveground infrastructure is provided below. Materials used during construction and the management of construction waste is also discussed.

Surface structures

Surface structures (including the salt processing facilities, waste unloading area, waste storage warehouse, surface hydraulic backfill plant, maintenance buildings, administration buildings, worker accommodation, solar/diesel hybrid power plant, fuel storage facility, and future technology recovery park) would be constructed in accordance with the relevant industry and regulatory standards including the NT *Building Act*, NT Building Regulations and *Building Code of Australia*. In addition, an architect would be engaged to provide services in relation to the design of the buildings.

The permanent accommodation village would be constructed early to provide accommodation for the construction workforce and would also include supplementary accommodation units to manage construction peak manning.

Vertical shaft headframe

Once the collar areas have been prepared and headframe foundations completed, headframe construction would begin at the main shaft. The electrical room and compressor building that adjoin the main shaft headframe would also be constructed.

The main shaft headframe structure would be constructed in its permanent configuration and would look similar to that shown in Figure 3-17. Construction would be completed using conventional steel structure construction practices.

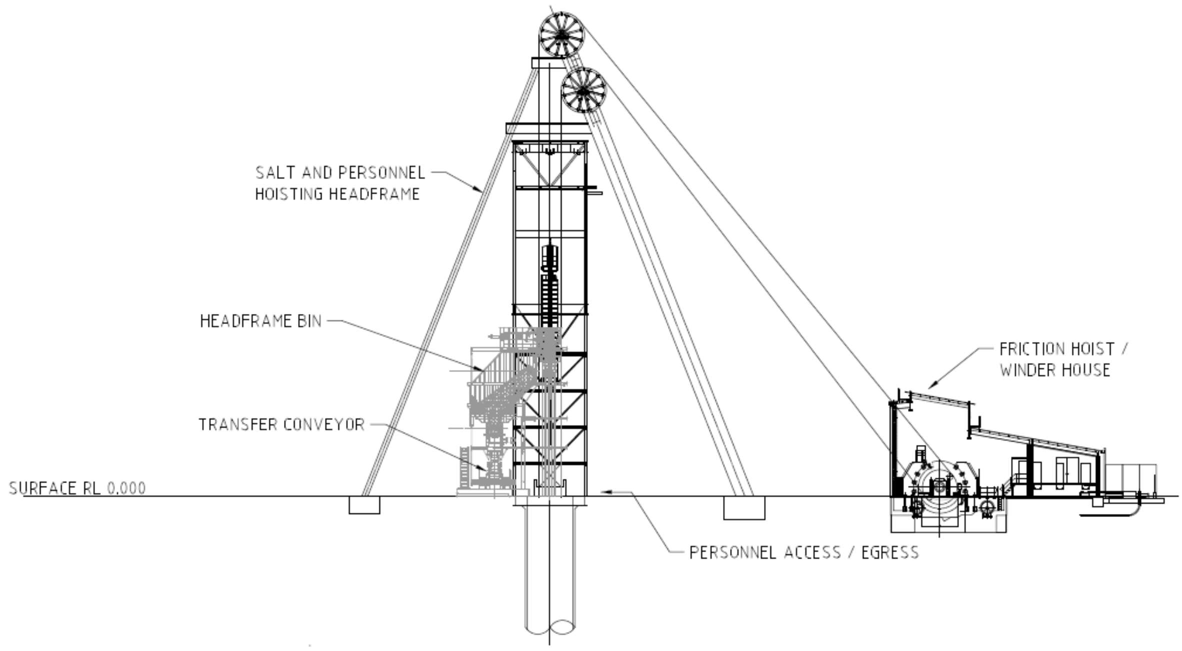


Figure 3-17 Example of main shaft headframe structure (Chandler Facility)

Salt and overburden stockpiles

Salt stockpiles would include run of mine salt and product salt generated during operation. The indicative salt stockpile volumes and dimensions are provided in Table 3-11 and are shown in Figure 3-18. The size of these stockpiles may fluctuate during operation according to supply and demand but, for the purposes of the environmental risk assessment, a worst case run of mine volume scenario has been adopted.

Salt stockpiles would be established on an impervious clay base to block saline leachate from draining into groundwater. Clay would be sourced from excavation of the mine access decline. During rainfall, the surface of the salt stockpiles would naturally form a crust that would protect the surrounding environment from saline runoff. As such, sheltering structures or sheeting are not proposed. Dish drains would be constructed around the perimeter of the run of mine stock piles to control any runoff.

Overburden (soil and rock) would also be stockpiled within the mine infrastructure area at the proposed Chandler Facility. The soil and rock stockpiles would be constructed with 3:1 slopes to ensure stability. In order to prevent ponding of water on the top of the stockpiles, the top of the stockpiles would be graded. Further information regarding the soil and rock stockpiles is provided in Section 3.4.10.

Table 3-11 Indicative salt stockpile volume and height (Chandler Facility)

Salt material	Stockpile volume (m^3)	Stockpile height
Run of mine salt	3,500,000	20 metres

Internal roads

The network of internal roads within the mine infrastructure area would be established toward the end of the construction.

The alignment of the internal roads would be cleared, graded and compacted. The roads would then be constructed on top of the compacted surface with the following layers.

- Road sub-base.
- Road base.
- Road surface.

Construction materials would be sourced from excavations associated with the mine access decline and vertical shafts or from borrow pits located along Maryvale Road.

Document Path: C:\GIS_SS\Maps\Chandler_Stockpiles_SMA.mxd

N

100 50 0 100 Meters

Coordinate System:
GDA 1994 MGA Zone 53

Legend

- Proposed development footprint
- Existing track
- Watercourse

Stockpile material

- Limestone
- Salt
- Sandstone
- Shale
- Topsoil

Figure 3-18
Stockpiles including run of mine salt

TELLUS

Borefield

The borefield and water storage would be constructed early to provide raw water for construction. The reverse osmosis water treatment plant would also be constructed early to provide water for consumption or domestic use by the workforce.

Utilities and services

As discussed above, utilities and services would be established progressively during site preparation and into construction (extending to facility components as they are established). These services would include air, water, power, communications, personal amenities, waste collection, water management, and lighting. Annual demands for water, power and fuel during construction of the proposed Chandler Facility are listed in Table 3-12. Utilities and services are also discussed further in Section 3.16.

Table 3-12 Annual demand for utilities and services during construction of the Chandler Facility

Utilities and services	Annual demand	Primary uses
Raw water	54 ML	Dust suppression and industrial cooling
Potable water	16 ML	Consumption and domestic use
Power	34,000 MWh	Temporary buildings and salt processing
Fuel	8 ML to 10 ML	Equipment and services and underground vehicle transport via mine decline

Construction materials

The most significant material required for construction would be fill comprising soil and rock material. The proponent would aim to source the majority of this material on-site for the construction of the proposed Chandler Facility.

The proponent would also aim to source fill material for construction of the proposed Chandler Haul Road and Henbury Access Road from a series of borrow pits along the alignments of Chandler Haul Road and Henbury Access Road. The location of the borrow pits would be subject to the final alignment of the roads and geotechnical assessment and, thereafter, a site selection protocol to avoid environmental impacts.

A range of other general construction materials such as wood, steel, glass and concrete would be required for the construction of the proposed Chandler Facility. Wood, steel, glass and so on would be ordered and delivered to the site of the proposed Chandler Facility (as needed).

A concrete batch plant would be established at the site and would produce concrete for use during construction. Quantities and providers of these materials would be determined during detailed design and procurement.

Construction waste

Waste generated during enabling and construction works would include construction waste, domestic waste and waste water. Construction waste and domestic waste would be managed by collecting, separating and storing waste according to its potential for reuse, recycling, recovery, treatment and/or disposal. Waste would be stored in appropriate containers such as industrial bins or drums in dedicated waste collection areas for collection by appropriately licensed waste contractors. Waste is discussed further in Section 3.4.10 and Section 3.4.12. The management of waste water is discussed further in Section 3.16.

3.5.7 Testing and commissioning

Testing and commissioning of underground and aboveground infrastructure would be staged progressively during construction and would involve the various facility components as they are established.

Commissioning would include a range of activities including:

- Configuration of systems for operation.
- Mobilisation and assembly of operating equipment.
- Fitout and equipping of buildings including offices and workshops.
- Stocking of storage areas with materials for ongoing maintenance activities.

3.5.8 Traffic and transportation

The movement of the workforce, equipment, materials, waste, utilities and services would generate a number of heavy and light vehicle movements during enabling and construction works at the proposed Chandler Facility. The main routes for these vehicle movements would be Maryvale Road during construction and when operational, along the Stuart Highway and proposed Henbury Access Road and Chandler Haul Road.

Workers who fly-in-fly-out from Alice Springs would utilise commercial services to Alice Springs Airport from the proposed Chandler Facility. It is anticipated that workers would be transported by coach on a weekly basis, staying the proposed accommodation village located to the north of the Chandler Facility.

Equipment required for enabling and construction would be moved to and from the proposed Chandler Facility at the start of the enabling works and at the end of construction. This would generate two short peaks in vehicle movements rather than ongoing vehicle movements.

Materials required for enabling and construction would be delivered, as required, via the Maryvale Road. Vehicle movements would not be significant given that the proponent is aiming to source the majority of fill material from on-site.

Waste generated during enabling and construction would require periodic collection by appropriately licensed waste contractors. Vehicle movements associated with waste collection would not be significant and would likely occur on a weekly basis.

Traffic and transportation impacts and mitigation (including the implementation of a Traffic Management Plan) are discussed further in Chapter 18.

3.5.9 Utilities

Electrical supply and emergency power would be supplied via a stand-alone two megawatt solar/diesel hybrid power plant to the proposed Chandler Facility.

The main vertical shaft hoist, ventilation fans and continuous miners would constitute the major load on electric power during construction of the proposed Chandler Facility. Power would be required for:

- Exhaust fans.
- Refrigeration unit.
- Air compressors.
- Maintenance and storage area, office and amenities building.

Small power distribution transformers would be required for lighting, receptacles, and other facility service loads. The total connected load for the facility is outlined in Table 3-12.

An emergency power system using diesel generators, complete with load bank, would be installed to assure safety in the event of a power failure. An emergency generation capacity of approximately 1,750 kilowatts (that would consist of multiple generators providing the required load with additional capacity) would be required to serve the site loads that are essential for personnel safety.

The emergency power system would be located at the proposed solar/diesel hybrid power plant and would feed equipment through the cables and switchgear used for normal operations. The emergency power system would automatically supply power to critical components within 30 seconds of a power failure. Specialised controls and switchgear would be used to initiate the start-up of the generators and shed non-critical loads following a power outage, as well as allow an uninterrupted switchover when the supply grid is re-energised. Inspection and maintenance programs would be implemented to ensure the reliability of the emergency power system.

3.5.10 Construction waste

Approximately 986,000 cubic metres of overburden (soil and rock) would be excavated during construction of the mine access decline and vertical shafts at the proposed Chandler Facility. The soil and rock would be stockpiled and managed in accordance with a Waste Management Plan (refer to Appendix G). The indicative stockpile volumes and dimensions are provided in Table 3-13 and are shown in Figure 3-18.

It is expected that the waste rock would be used on-site in the construction of roadways and in the build-up of the mine infrastructure area. The soil and waste rock would also be used during closure and rehabilitation of the Proposal. The material has been tested and is not expected to have problematic characteristics such as acid or metalliferous drainage.

Table 3-13 Indicative overburden stockpile volume and height (Chandler Facility)

Soil and rock material	Stockpile volume (m^3)	Stockpile height (m)
Topsoil	120,000	12
Sandstone	478,000	12
Siltstone	330,000	12
Claystone	58,000	12
TOTAL	**986,000**	-

Other waste generated during construction would likely include:

- Cleared vegetation.
- Concrete.
- Scrap metal.
- Wood.
- Paint and resin.
- Used oils and greases.
- General waste.
- Sewage sludge.

Waste would be managed by collecting, separating and storing waste according to its potential for reuse, recycling, recovery, treatment and/or disposal. Waste would be stored in appropriate containers such as industrial bins or drums in dedicated waste collection areas for collection by appropriately licensed waste contractors. Sewage sludge would be removed from site and disposed of at a suitably licensed disposal facility.

3.5.11 Health, safety and environment

Management systems

Construction of the proposed Chandler Facility would be undertaken by one or multiple construction contractors. These contractors would operate their own health, safety and environment management systems.

The proponent would manage risks subject to the control of construction contractors through the contractor selection and negotiation of contract terms. These processes would be formalised in the proponent's health, safety and environment management systems.

Environmental management

The effect of the construction of the Chandler Facility on the environment would be controlled by the implementation of a series of measures collated in a Construction Environmental Management Plan (CEMP). The CEMP would reflect the measures committed to in this EIS and conditions attached to statutory approvals. The CEMP would also contain additional details such as the delegation of responsibility for the implementation of measures and requirements to periodically review the plan for the purpose of adaptive management.

3.6 Operation of the Chandler Facility

This section provides details regarding the operation of the proposed Chandler Facility. An indicative operational schedule is provided along with the proposed workforce and working hours. Information regarding the typical equipment, machinery and vehicles that would be used during operation is provided along with a detailed description of the proposed salt mining and waste storage and isolation operations. Traffic and transportation, communications, utilities, fuel storage, and worker accommodation are discussed along with the expected waste generated during operation of the proposed Chandler Facility.

3.6.1 Operational schedule

The operational schedule for the proposed Chandler Facility is 25 years. However, waste would be received on the surface beginning in the first year of construction. Therefore, the life of the Proposal would be 29 years. About one tonne of waste would be accepted for every 2.3 tonnes of salt mined at the proposed Chandler Facility (refer to Table 3-14).

Table 3-14 Indicative schedule

Year	Salt mined (approximate tonnes / year)	Waste accepted (approximate tonnes / year)
1		30,000
2		90,000
3		90,000
4	957,645	90,000
5	1,221,090	200,000
6	540,895	200,000
7	509,639	200,000
8	524,479	220,000
9	568,600	240,000
10	612,128	260,000
11	655,063	280,000
12	697,405	300,000
13	713,745	309,000
14	730,438	318,270
15	747,490	327,818
16	853,360	337,653
17	869,152	347,782
18	796,032	358,216
19	814,587	368,962
20	822,926	380,031
21	842,254	391,432
22	838,438	392,000
23	954,476	393,000
24	717,533	394,000
25	750,134	395,000
26	751,924	396,000
27	753,713	397,000
28	751,248	398,000
29	795,114	399,003
AVERAGE	**682,396**	**293,203**

3.6.2 Operational workforce and working hours

Operation of the proposed Chandler Facility would directly employ around 150 to 180 full time equivalent workers. Two environment managers would be employed to manage and monitor environmental performance during construction and operation of the Proposal. The environment managers would (at a minimum) hold a Bachelor of Environmental Science degree (or similar) and would have at least five years' experience in managing large mining operations (or similar large infrastructure operations). An indicative profile of the workforce for the duration of operation of the proposed Chandler Facility is provided in Table 3-15.

Hours of operation would be 24 hours per day, seven days per week (alternating crews working two weeks on and one week off).

Initially, the majority of workers would fly-in-and fly-out via Alice Springs Airport. The proponent plans to progressively upskill and employ workers in the local region to increase their presence in the workforce. A range of job training initiatives including on-site training and apprenticeships, internal training courses and external training courses (such as TAFE) would be implemented.

Table 3-15 Operational workforce profile (Chandler Facility)

Description	Direct	%	Roster
Management	12	6	9 on 5 off
Mining – Staff	10	5	9 on 5 off
Mining – Crews	48	22	14 on 7 off
Mining - Maintenance	24	11	14 on 7 off
Processing – Staff	2	1	9 on 5 off
Processing – Crews	10	5	14 on 7 off
Processing – Maintenance	7	3	14 on 7 off
Waste staff and crews	52	24	Mix
Site administration staff	3.5	2	9 on 5 off
Contractors on-site	46	21	Mix
Total full time equivalent workers	216	-	-

3.6.3 Operational equipment, machinery, vehicles and other materials

Operation would likely require the following equipment, machinery and vehicles:

- Backhoes.
- Cherry pickers.
- Continuous miners.
- Salt haul trucks.
- Conveyors.
- Drill gophers.
- Forklifts.
- Front end loaders.
- Graders.
- Feeder breaker.
- Haul trucks (waste)
- Haul trucks (salt).
- Jumbos.
- Light vehicles.
- Rock breakers.
- Roll crushers.
- Salt backfill sprayer (snow blower).
- Telehandlers.
- Transformers.
- Ventilation fans.

A range of other materials would also be required during operation, including:

- Mixing agents for use at the hydraulic backfill facility.
- Food and domestic supplies for worker accommodation.
- Maintenance fluids and parts for equipment maintenance.
- Office supplies for control rooms and administration buildings.
- Soil and rock material for maintenance of proposed internal roads and Chandler Haul Road and Henbury Access Road.

The most significant volume of material required for the operation of the Chandler Facility would be mixing agents for use at the hydraulic backfill facility. The primary mixing agent used in hydraulic backfill would be groundwater sourced from the borefield.

Another potential significant material that would be required would be soil and rock for the maintenance of internal roads and the proposed Chandler Haul Road and Henbury Access Road. These materials would be sourced from borrow pits established during construction. The quantities of other materials are not expected to be significant and would be determined along with providers during detailed design and procurement.

3.6.4 Salt mining operations

The proposed salt mining operations would involve:

- Excavating salt.
- Transferring salt to the surface.
- Stockpiling salt.
- Stockpiling product salt.
- Processing salt.
- Clay lining for salt stockpiles.
- Dispatching product salt.

The steps involved in the proposed salt mining operation are described below.

Excavation of salt

The rooms of the underground salt mine would be excavated using continuous miners (refer Plate 3-2). Continuous miners employ a drum shaped head with numerous short picks that cut the salt as the head rotates.

Plate 3-2 Example of continuous miner excavating rooms in a salt mine

On average, approximately 12 rooms in the underground salt mine would be excavated each year (maximum of 15 rooms per year) to meet the operating schedule described in Section 3.4.1. Once an entire room is excavated, the entrance to the room would be barricaded until waste storage and isolation commences, as described in Section 3.5.5.

Transfer of salt to surface

Excavated salt would be transferred by haul truck through the underground mine via conveyor and then hoisted to the surface via the main vertical shaft. The excavated salt may require some initial crushing underground to improve its sizing for the conveyor system.

Salt stockpile

The operational schedule estimates the total run of mine salt (mined salt) at 19.8 million tonnes (over the 25-year life of the Proposal). This tonnage would be driven by the waste emplacement schedule (that is, salt would not be selectively mined). Because of this, salt processing is anticipated to be variable. To manage this, the proponent would defer processing for the first five years of mining resulting in approximately 3.5 million tonnes of salt being stockpiled on the surface. The stockpile would be located to the south of the mine infrastructure area at the proposed Chandler Facility (refer to Figure 3-1). The run of mine salt stockpile could reach a height of approximately 20 metres.

Salt processing would commence in year six of the mining operations and would be undertaken for the remainder of the operational phase (i.e. 20 years of salt processing). The proponent would target a maximum of 750, 000 tonnes per annum of exported salt product giving a total exported volume of approximately 15 million tonnes over the life of the Proposal. The final exported volumes would depend on the quality of the mined salt, feed stock on surface and product specification to be agreed with the customer(s).

Any rejected salt from processing would be returned underground and used to backfill development drives within the salt formation. Fine salt would also be screened prior to processing and used to backfill around the waste packages within the mined rooms. The proponent estimates that approximately 76 % of the salt mined would ultimately be exported leaving approximately 24 % utilised underground as backfill. These volumes would be refined during detailed design of the Proposal.

Product salt stockpile

Run of mine salt that is dry optical sorted and processed to a marketable grade would also be stockpiled as product salt. As noted above, salt processing and export would be deferred until year six (when the first wastes would be emplaced underground).

Dry salt processing

Salt processing would be undertaken, as follows:

- The rock salt extracted by continuous miner would be hauled to a feeder breaker located underground (the position of the feeder breaker would be confirmed subject to geotechnical stability confirmation during detailed design of the Proposal).
- Salt screened out at less than two millimetres would be stockpiled underground and used as room backfill material.

- Salt greater than two millimetres in size and any surplus two-millimetre salt not required for room backfill would be hoisted to the surface and transferred to the run of mine salt stockpile.
- Salt from the run of mine stockpile would be fed by loader to a hopper and reduced in size to less than 10 millimetres and then screened to produce +4 millimetres, +2 millimetres and <2 millimetre fines.
- The +4 millimetre and +2 millimetre fines would be colour sorted via dry process optical sorting machines to remove the high insoluble ore particles. Up to five optical sorting machines would be used to extract industrial grade salt.
- Salt less than specification would be rejected and stockpiled for future use as backfill underground.
- Industrial grade salt or product salt of 98.4 % NaCl quality would be containerised and loaded onto rail for export.

Dry process optical sorting is commonly used for rock salt refining throughout the world. Initial technology selection trials using bulk samples recovered from the proponent's drilling programs at Chandler have been undertaken at TOMRA's facilities in Sydney and Germany.

Clay lining for salt stockpiles

There is estimated to be a suitable quantity of rock available from the mine access decline and vertical shaft excavations to construct rock pads upon which the salt stockpiles could be constructed. The same material could also be used for the construction of water containment structures at the proposed Chandler Facility. The total volume of rock to be excavated during the mine development phase would be approximately 0.9 million cubic meters.

Rock characterisation and design of the pads and water containment structures would be completed during detailed design of the Proposal. However, a three metre high rock pad constructed using the excavated rock would allow the construction of a pad of approximately 29 hectares. In comparison, the 3.5 million tonne run of mine salt stockpile at the proposed 20 metre finished height would take up less than half that area (approximately 12.5 hectares).

The proponent has not yet undertaken any construction-focused surface geotechnical investigations but is confident that in-situ clay materials exist throughout the site. Halfway Dam is a large, existing agricultural dam which the proponent proposes to decommission as part of the Proposal. The dam has been formed using in-situ materials of high clay content suitable for building water retaining structures. This material could be incorporated in layers with the mine development rock to create low permeability structures.

Dispatch of product salt

Product salt would be either filled into bulk bags or bulk filled into lined shipping containers before being transported by road train to the proposed Apirnta Facility via the Chandler Haul Road. The containers would be unloaded and temporarily held at the Apirnta Facility before being loaded onto trains for transport to Adelaide via the Central Australian Railway. Product salt stored in bulk bags prior to being loaded into a shipping container is shown in Plate 3-3

Plate 3-3 Product salt stored in bulk bags

3.6.5 Waste storage and isolation operations

The proposed waste storage and isolation operation would involve:

- Application of the WAC.
- Receiving accepted waste.
- Moving waste underground (dry packaged waste backfill or hydraulic backfill).
- Arranging waste into compatible zones within emplacement rooms.
- Backfilling and room closure.
- Returning containers to surface

The steps involved in waste storage and isolation operation are described below. The waste storage and isolation operation is visually summarised in Figure 3-19. The long term safety case of the proposed operation is visually summarised in Figure 3-20.

Figure 3-19

REV	BY	DATE	DESCRIPTION	CKD	DESIGN	ENG APPR	PROJ APPR
A	DS?	29.07.16	ISSUED FOR INFORMATION	JDA			

REFERENCE DRAWING — No / TITLE

CLOUGH

APPROVALS: DRAWN / CHECKED / DESIGNED / ENG APPR. / PROJ APPR. / CLIENT APPR.

CLIENT: TELLUS

TITLE: CHANDLER SALT MINE PROJECT
WASTE MATERIALS SCHEMATIC
CHANDLER MINE SITE

A1

SCALE

DRAWING No. 40870-SK-00-P-0004

REV. A

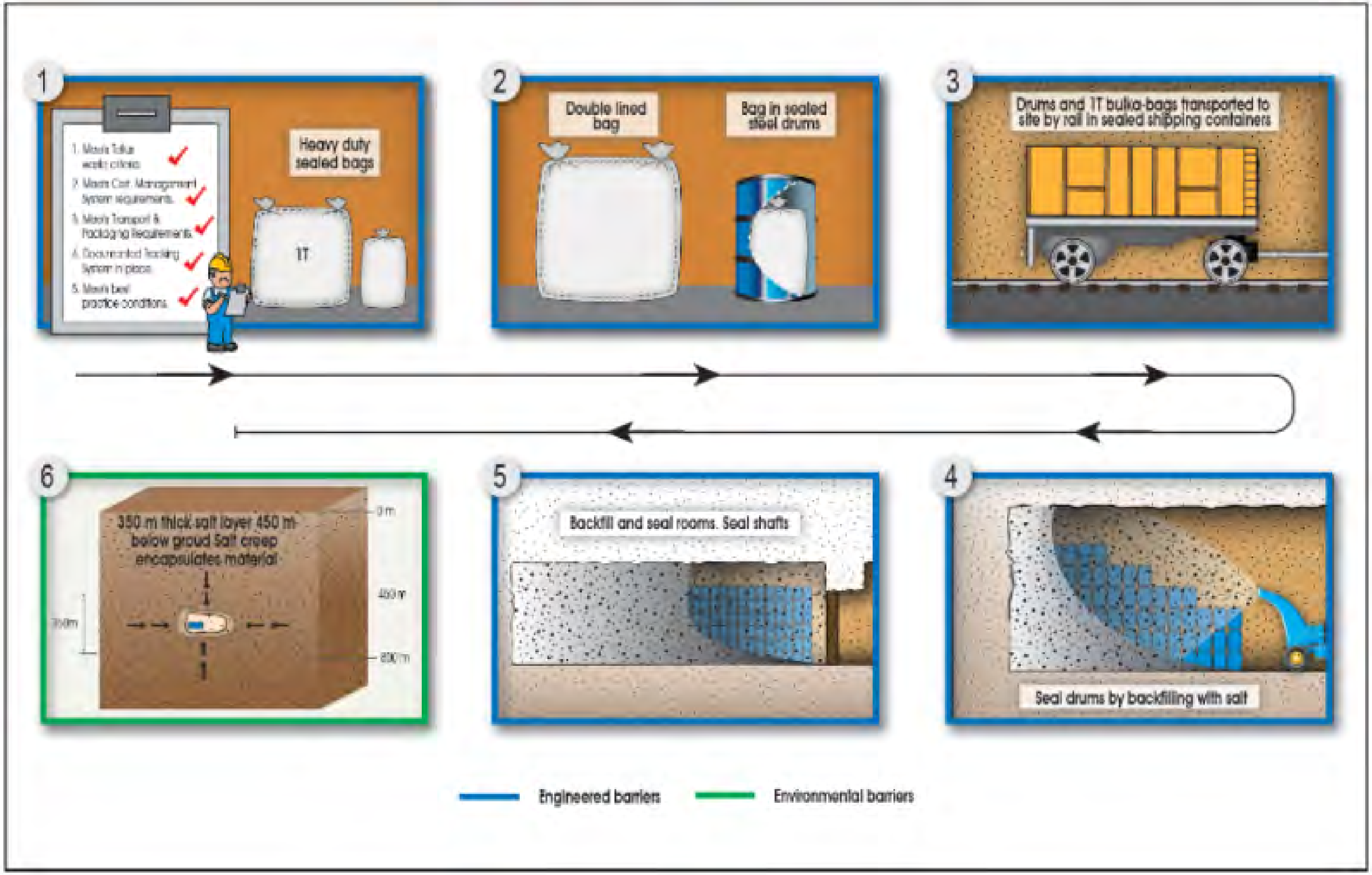


Figure 3-20 Illustration of waste emplacement and long term safety case for packaged waste

Apply waste acceptance criteria

Waste delivered to the proposed Chandler Facility would be subject to strict WAC developed in reference to relevant legislation and guidelines and the specific characteristics of the Chandler site. The WAC would ensure that waste is only accepted if it can be stored in a safe and environmentally sound manner.

In the development of the WAC, the proponent has drawn on the European Union COUNCIL DECISION of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC. Appendix A of that document provides the legislative framework against which underground storage operations in Europe operate. This document has also informed the Operational and Post Closure and Integrated Assessment / Environmental Performance Assessments undertaken for the Proposal (refer to Appendix H).

The WAC is provided in Appendix C, while an indicative waste inventory following the implementation of the WAC is provided in Appendix C.

Receive accepted waste

Accepted waste would usually be transported via the Central Australian Railway to the proposed Apirnta Facility and then via the Chandler Haul Road to the Chandler Facility. The Chandler Facility would receive on average 300,000 tonnes of waste each year while a maximum of 400,000 tonnes would be temporarily stored at Apirnta Facility at any given time. It is anticipated for current planning purposes that approximately 75 % of all wastes would be solid waste and 25 % would be liquid wastes.

Waste would be transported to the Apirnta Facility and the Chandler Facility within primary and secondary containment (refer to Plate 3-4). The primary containers would include appropriately labelled double-barrier containers such as double-lined bulk bags or PVC bags stored within barrels. The containers would be selected to meet Dangerous Goods requirements, as necessary. These primary containers would be stored and transported within ISO 20-foot shipping containers.

The waste would be inspected at the Apirnta Facility to confirm acceptability and compliance with the WAC. Inspection routines would include visual inspection of waste packaging and material safety data sheets, weighing of waste loads, sampling and testing at a laboratory building and measurement of radioactivity. Inspection could occur at the Apirnta Facility and/or the Chandler Facility but would generally occur at the Apirnta Facility.

Received waste that does not meet the WAC, is inappropriately packaged, or is otherwise deemed unacceptable, would be quarantined and returned to the waste generator. If the waste cannot be safely or legally returned, the relevant regulatory authority would be contacted.

Plate 3-4 Container types that would be used for storage, disposal and isolation at the Chandler Facility

Move waste underground

Waste received at the proposed Chandler Facility would be moved underground via the mine access decline or by hydraulic backfill. It is planned that solid waste would be moved underground via the decline in ISO 20-foot shipping containers. The containers would be transported by truck through the underground area to the designated storage or disposal room. Waste would also be transported by hydraulic backfill directly to designated storage or disposal rooms.

Dry packaged waste backfill

Underground storage and disposal rooms would be constructed in accordance with the safety case requirements and to optimize their value for geological storage and disposal, which would involve creating access roads leading to engineered storage/disposal rooms. Each storage room is currently assumed to be approximately 240 metres long, 10 metres wide and six metres high, with disposal rooms of similar design but currently assumed to be 15 metres wide.

Plate 3-5 Pyramid stacking of waste packages

After the ISO 20-foot shopping container has been placed on the floor of the storage room, the individual waste packages would be unpacked from the container and placed in their storage or disposal location. This operation would be undertaken by fork lift trucks or telehandlers. The maximum available height in a storage room would be used with pyramid stacking of packages as illustrated in Plate 3-5. The underground layout would be designed to allow 'like for like' wastes to be stored together to ensure compatibility during the storage and disposal period.

During the surface storage period, after waste acceptance procedures have been carried out, containers would be monitored to ensure no leakage of material from containers. After transfer of waste underground and placement in storage and disposal rooms, active inspection and monitoring systems would be deployed. The monitoring system would involve monitoring the facility atmosphere in the vicinity of the storage operations and in the main ventilation roadways downwind of storage operations to confirm that the stored materials are not emitting any gasses or particulate matter in harmful concentrations.

Once a decision has been taken to permanently dispose of waste, fine salt would be placed around the waste packages using a salt backfill sprayer to fill any voids present (refer to Plate 3-6). This fine salt would re-constitute around the waste packages over time, due to the self-healing nature of rock salt and the surrounding strata, converging back in a controlled manner into the opening created by mining. This process is known as 'salt creep'.

Plate 3-6 Salt backfill sprayer placing fine salt around waste packages

After loose salt backfilling has been completed, an engineered seal or wall would be constructed at the entrance to the disposal room to permanently isolate the wastes. An example of a simple wall structure is shown in Plate 3-7. The appropriate room seal designs for the Chandler Facility would be undertaken during detailed design of the Proposal.

Plate 3-7 Example of simple single-skin wall seal in

Hydraulic backfill

The proponent commissioned a preliminary study during the pre-feasibility stage of the Proposal to examine the feasibility of using hydraulic backfill at the proposed Chandler Facility (refer to Appendix I). The report presents a high-level analysis of the potential wastes that would be received at the proposed Chandler Facility, which were then screened to determine which wastes would, and would not, be suitable for incorporation in hydraulic backfill. The report discusses options for different types of hydraulic backfill systems that could be used at the proposed Chandler Facility. It also presents key safety and operational issues associated with hydraulic backfill at the Chandler Facility.

The application of hydraulic backfilling is a feasible option to dispose of suitable and compatible wastes in excavated rooms of salt mines. These wastes can be liquid or solid but need a grain size small enough to achieve appropriate hydraulic properties. There are fundamentally two types of hydraulic backfill, firstly *flushing backfill* which exhibits low viscosity and is transported by gravity and uses a saturated brine as the transport medium, and secondly *viscous slurry backfill* which exhibits high viscosity and needs a pump to be transported through a pipe system.

There are a number of advantages in adopting hydraulic backfilling where the waste types make this possible. The main advantages include:

- Reduced vehicle movements in the mine access decline and underground reduces some of the health and safety issues associated with running large diesel vehicle fleets.
- Increased void utilisation of the underground space by removing the spaces between packages and when placed in specifically designed rooms there is no void space at roof level.

- The improved use of the void further improves the overall geotechnical control of the underground workings by providing support to the excavation sooner.

Strict recipe development underpinned by waste acceptance procedures would ensure that only compatible wastes are introduced into the hydraulic backfill mixing plant. During the mixing process there could be occasional "gassing off", typically of hydrogen gas, which would be controlled through monitoring before being emitted to the atmosphere.

Hydraulic mixtures would also be designed to ensure that there would be no adverse interaction or dissolution of the host salt rock (saturated brines are generally used in the mixtures). A hydraulic mixing plant which would include safety systems that are used to safeguard correct mixtures are manufactured before being placed in the underground (refer to Plate 3-8).

Plate 3-8 Control room of typical hydraulic backfill plant

The underground storage rooms would be specifically designed to accept hydraulic backfill. Currently the planning assumption is that the lower end of the room would be closed with an engineered dam wall following construction. A typical dam wall to contain hydraulically placed waste is shown in Plate 3-9.

Plate 3-9 Typical underground hydraulic backfill

The mixtures would also be designed to set in situ in a matter of days, normally this is achieved by including binding materials within the waste recipe. It is normal to be able to walk on emplaced wastes within a few days of emplacement.

The type, volume and location of all waste accepted and stored underground would be recorded in a database for the purpose of compliance auditing and potential future retrieval.

Details of the hydraulic backfilling method proposed

As discussed above, there are two types of hydraulic backfill , i.e. flushing backfill and viscous backfill, the main difference being the percentage of fluid contained in the backfill mixture transported underground through pipelines. At this stage, a definite choice for one of the two types cannot, and should not, be made as insufficient information on the exact available wastes materials is unavailable. Even with more detailed information on the available waste materials, designating certain wastes to one or both backfill types is only possible based on laboratory testing and subsequent classification. The proponent has assumed the viscous backfill method in their pre-feasibility study and EIS and accepts that this is a reasonable planning assumption subject to further analysis when more information becomes available on the types of wastes to be backfilled.

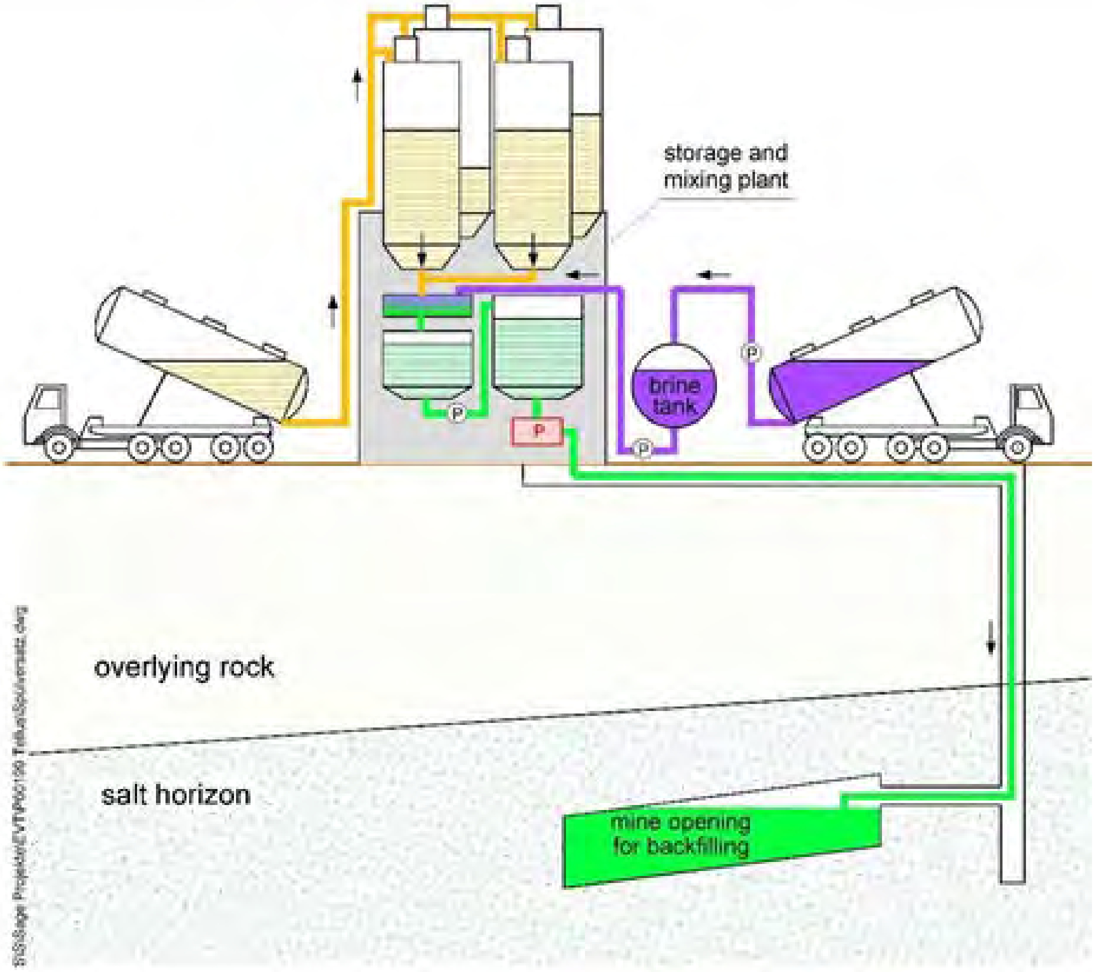
As hydraulic backfill can be emplaced more efficiently than packaged waste backfill due the absence of vehicle transportation and a very high filling rate (utilisation) of the mined rooms, it might be beneficial to maximise the use of hydraulic backfill as a waste emplacement method. An opportunity presents itself to enable the production and emplacement of both flushing and viscous backfill to maximise the range of waste types emplaced hydraulically.

Viscous backfill (current assumption)

Characteristics for the viscous backfill is that the mixture composition contains just enough fluid as to produce a pumpable and flowable backfill suspension. The fluid should be saturated (with salt) for a geological repository in a salt host rock either by itself or through the presence of salts within the waste inventory to avoid any dissolution of the host rock.

It is common for binding agents to be added to viscous backfill in order to bind the major part of the fluid contained in the mixture. When certain waste materials have sufficient binding properties, such as fly ash from waste incineration, no additional binding agents are needed. It is conceivable that such a mixture, without additional binding agents, could be developed for the Chandler Facility due to the expected availability of fly ashes (NEPM code N150, see Table 2 in Appendix I). The experiences in Europe with such combustion residues show good binding properties for viscous backfill recipes and thereby minimise or even eliminate the need for additional binding agents from primary resources, i.e. cement (K-UTECH 2017). An overview of the viscous backfilling process is presented in Figure 3-21.

Although Figure 3-21 shows no fluid being drained from the emplaced backfill mixture, i.e. all fluid is bound within the backfill by the wastes with fluid binding properties, in practice some excess fluid can be expected on top of the backfill. This fluid might appear due to the minor settlement of solids within the backfill mixture after emplacement in the room. The excess fluid can be managed by simply letting it “dry out”, i.e. the fluid evaporates due to the constant mine ventilation air being led through the backfill storage rooms and the expected high temperatures of the Chandler Facility. As only water contained in the fluid evaporates, this process does not spread any contaminants in the mine’s ventilation system nor in the aboveground environment. Further details on the backfill preparation process, plant and related infrastructure is given in paragraph 2.1.3 in Appendix I.



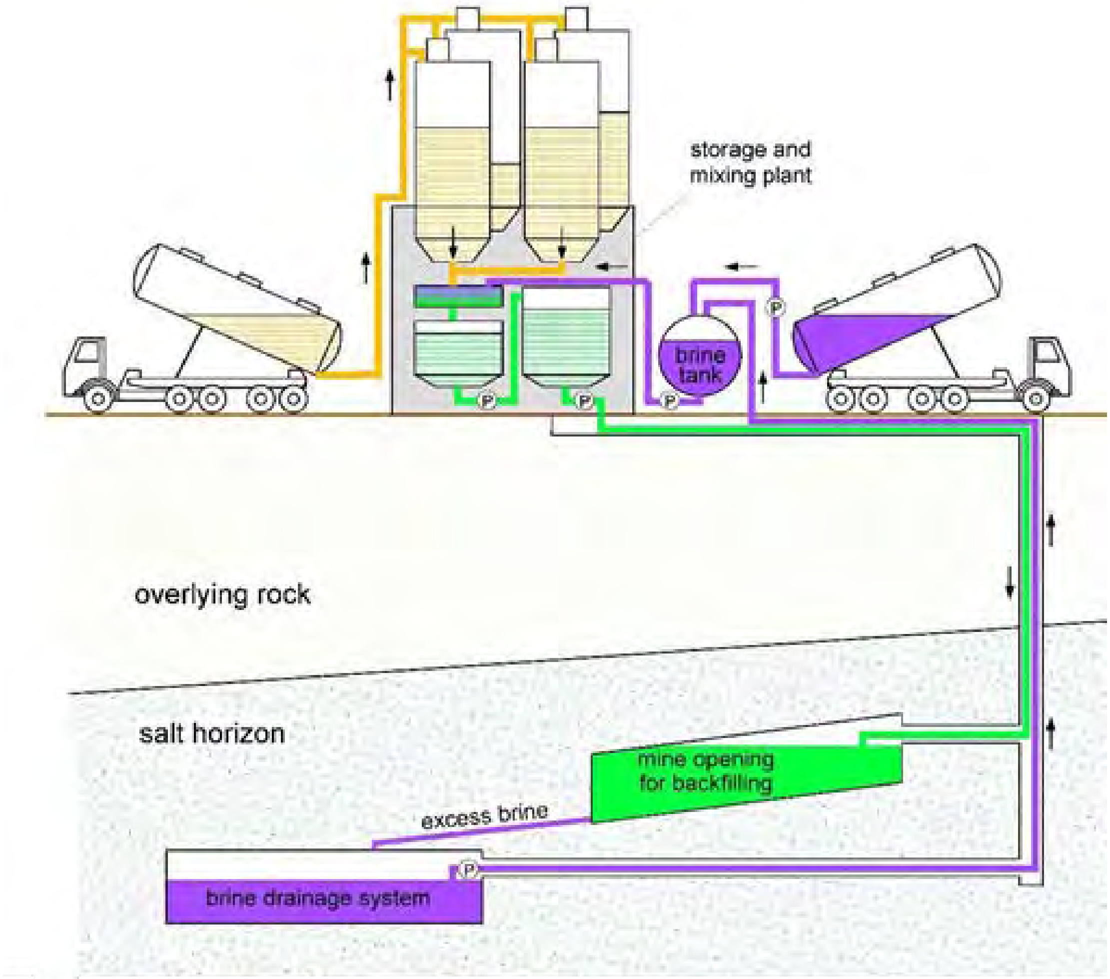
Note: "P" denotes a pump.

Figure 3-21 Process overview for viscous backfill

Flushing backfill

The flushing backfill contains more fluid than the viscous backfill and the fluid needs to be saturated for a geological repository in salt to avoid dissolution of the mine's host rock. The fluid is basically only used as a transport medium for the waste and drains from the emplaced backfill to be re-used again for the production of more flushing backfill mixture. Contrary to viscous backfill, the recipe for flushing backfill is less critical as setting/hardening of the mixture is not necessarily required.

Similar to viscous backfill, the actual mixture recipe(s) would constantly change reflecting the waste supply to the Chandler Facility over its lifetime. For the emplacement of flushing backfill, the particle size distribution is critical because the solid parts of the backfill mixture must settle in an appropriate timeframe so that the excess fluid can be drained. This drained fluid is collected and pumped back to the ground surface where it is used again to produce more flushing backfill mixture. A significant portion of the transport fluid is thus circulated and only the fluid volume remaining in the backfill body, i.e. which cannot be drained in a relevant timeframe, has to be added or "topped up" into the backfill mixture production process. The process overview for flushing backfill is presented in Figure 3-22.



Note: "P" denotes a pump.

Figure 3-22 Process overview for flushing backfill

Description of process, plant and infrastructure for hydraulic backfill

The process, plant and infrastructure required for viscous and flushing backfill are similar but not the same, i.e. an installation built for flushing backfill is unlikely to be suitable for the production of a viscous backfill without some modifications and additional equipment. The following information describes the process for the production of hydraulic backfill, commencing at the delivery of suitable waste materials at the proposed Chandler Facility.

Waste delivery and storage

Dry waste materials would be delivered in pneumatic tanker trucks, big-bags, or other modes of bulk transportation to the proposed Chandler Facility. They would be transferred to silos and/or bunkers by, for instance, pneumatic transport. In order to minimise the number of silos required, the waste materials would be grouped (through laboratory investigations prior to delivery of wastes to the Chandler Facility) and stored in silos combining certain waste types. From experiences in Germany it could be expected that between four and eight different materials groups, and corresponding silos/bunkers would be necessary to allow most backfill mixtures to be produced. Apart from dry waste materials, one or more fluids, such as brines, could be used in the backfill mixture.

Hydraulic backfill production

Both viscous and flushing backfill would require a mixing unit, which would be fed via dosing units from the silos/bunkers to blend the backfill. A mixing unit could comprise a screw mixer feeding a mixing vessel with a high intensity agitator. Apart from mixing the dry components of a backfill mixture, the mixing unit would allow fluid to be added, thus forming a suspension. Due to the expected gas-formation potential of the waste materials once mixed with brine, e.g. due to the reaction of aluminium containing wastes with brine, a gas extraction infrastructure would be installed over the mixing unit. To aid further gas extraction and allow other chemical reactions to occur, a second agitated vessel would be fed from the mixing unit, the so-called homogenising vessel. Retention time in this vessel could be up to eight hours to sufficiently allow chemical reactions and/or de-gassing to occur which would be checked by a combination of sensors and laboratory proofing of samples taken from the mixture.

Pipeline transport of hydraulic backfill

After the backfill mixture has been homogenised and/or degassed it would be ready for transport to the storage and disposal rooms. The suspension would be pumped into a pipeline through the main vertical shaft in which gravity would be used for transport. The depth of the Chandler Facility (> 800 metres below ground level) would create a hydraulic head: backfill mixture gradient (approx. 0,16 bar/metre) times depth (approx. 850 metres) equals 136 bar static head.

Although some dynamic pressure loss would occur in the vertical shaft pipeline, the pipeline infrastructure would be laid out with a sufficient factor of safety and the corresponding pipeline pressure rating would be over 160 bars. This pressure rating largely determines the type and quality of the pipeline system to be used. In addition to the pressure requirements, the pipeline system would be resistant against abrasion and corrosion. In Europe, two-layer steel pipeline systems are often used in which the inner layer provides resistance against abrasion and thickness against corrosion while the outer layer ensures the pressure can be held regardless of the state of the inner layer.

The hydraulic head build up in the shaft pipeline would be used to “pump”, through its own pressure, the suspension through the mine’s (horizontal) roadways towards its final destination. Pressure reduction of the built-up hydraulic head would be performed by the dynamic friction loss within the horizontal pipelines in the mine. Careful design of the horizontal pipeline infrastructure would, therefore, be critical to tune the pipeline diameter to the friction properties of the backfill mixture. Apart from pressure reduction by dynamic friction losses in the pipeline, some form of additional pressure reduction may be necessary which could be a choke station and/or a choke valve. Once most of the hydraulic head is reduced the backfill mixture would be expelled from the pipeline into the mine storage or disposal room to be backfilled. Typical expel pressures would generally not surpass a few bars to minimise sonic emissions from the outflow.

Backfill emplacement and drainage

The process layouts for viscous compared to flushing backfill would differ significantly from this point onwards as the viscous backfill would remain completely in the mined rooms whilst the flushing backfill would need to be drained of the excess carrying fluid. The rooms designated for flushing backfill would, therefore, be equipped with a filter at its lowest point comprising, for example, sand and gravel combined with geotextiles or porous bricks. The filter would prevent waste materials from entering the drainage system and would allow a solid free drainage fluid to be collected within a roadway below the lowest point of the rooms to be backfilled.

The drained fluid would be centrally collected underground and pumped back to the ground surface to be re-used in the production of more flushing backfill. This would require a high-pressure pump to be installed underground to overcome the hydraulic head of the drainage fluid: Pressure gradient (approx. 0,12 bar/metre) times depth (approximately 850 metres) plus dynamic friction loss in vertical shaft pipeline equals > 120 bar required pump head. For this pressure, some type of piston pump would be best suited.

Auxiliary equipment and safety

The production of hydraulic backfill would be a batch process but the transport of the backfill mixture to the mine could be a semi-continuous operation when multiple homogenisation vessels are used in the surface plant. Regardless of continuous transport of backfill mixture to the mine, the need for a flushing and cleaning system of the overall plant and pipeline infrastructure exists and would be accounted for in the detailed design of the Proposal. This is of particular importance for viscous backfill as binding agents and/or wastes with binding properties might cause blockage/scaling of the vessels and pipelines when flushing is not performed regularly.

The flushing system could also comprise so-called “pigging” stations from which a pig (a foam ball or rubber plug) is send through the pipeline system from the surface plant to the storage or disposal room. Pigs could either be caught in a receiver station down in the mine or simply be expelled in the mine room to be backfilled and left there. Considering the average lifetime of a foam or rubber pig, the latter method would likely be most efficient.

Other auxiliary equipment required for hydraulic backfill would comprise the overall monitoring and control of the process. Pressure sensors, flow sensors, gas monitoring in the plant and in the storage or disposal rooms to be backfilled would be required to operate an efficient and safe hydraulic backfill process. Concerning gas monitoring in the mine rooms, it could not be ruled out that some gas formation would continue within the emplaced backfill. It would be important to allow for this in the design of the mine’s ventilation system and to limit the access to rooms being backfilled as gasses could potentially be flammable (hydrogen) and/or toxic (ammonia). In Europe, this is not considered a real challenge as ample experience with, gas monitoring, restricted access, etc. has been gained.

Mine room layout

The general layout of the mine rooms designated to be hydraulically backfilled is shown in Figure 3-23 and Figure 3-24. Rooms should be designed, planned and constructed in a way that a gradient is included to ease the filling of the rooms and maximise the emplaced quantity of hydraulic backfill.

The rooms designed for viscous backfill are best constructed using a single entrance from the highest level to avoid the need for a dam at the lower end of the room to hold the backfill in place during emplacement. For flushing backfill the rooms are also best constructed from a single entrance however they should be connected, e.g. through one or more borehole, with a fluid collection system in a second roadway below the lowest level of the rooms. As stated earlier these room are also equipped with a filter to avoid waste materials to enter the drainage system.

Types of wastes suitable for hydraulic backfill

Independently of the type of backfill used, i.e. flushing or viscous backfill, only detailed laboratory work, prior to and during the operation of the Chandler Facility, could determine the suitability of any waste type for hydraulic backfill and the specific backfill mixture recipe. Over time, the backfill mixture recipe would also likely change following changes in the supply of waste types for storage at the proposed Chandler Facility. In addition, it is very likely that multiple recipes would be used in parallel to maximise the quantities of wastes being backfilled hydraulically at the Chandler Facility.

Both viscous and flushing backfill would have similar requirements for the waste materials regarding their particle size, but in a viscous backfill smaller particles could be processed as settlement of the mixture in the mined rooms is not envisaged. Very fine particle sizes could not be processed in a flushing backfill because the settlement requirements set a limit, i.e. particle sizes must be large enough to allow settlement of particles within a timeframe relevant for the operation of the proposed Chandler Facility. The maximum waste particle size for both viscous and flushing backfill types would be limited due to blockage risks and flow properties in mixing/reaction vessels and pipelines. Furthermore, abrasion would be taken into account during selection of waste types for hydraulic backfill as the backfill mixture transport would take place in pipelines in a turbulent hydraulic regime.

In general, most waste materials which could be collected (at their source), transported, unloaded and stored as a bulk material and fulfil the particle size distribution criteria could be emplaced using the hydraulic backfilling method. Restrictions on the type of waste materials suitable for hydraulic backfill would most likely be chemical, i.e. their reaction behaviour in combination with other waste materials and/or brine. In addition, physical phenomena might exclude a waste from being suitable, e.g. hydrophobic behaviour, which would lead to separation of particles in the mixing and transport infrastructure as well as in the room to be backfilled.

Waste materials which do not fulfil the particle size distribution criteria could be made suitable by particle size reduction. This would, however, necessitate an additional process step prior to intermediate storage in silos/bunkers. Since particle size reduction would be an energy intensive process, a case-by-case weighing of advantages, cost and disadvantages (e.g. dust hazard) would be undertaken for each waste type supplied to the proposed Chandler Facility.

Based on the preliminary inventory of wastes available for long-term storage at the proposed Chandler Facility, a preliminary assessment of their suitability for hydraulic backfill was undertaken (refer to Appendix I). The results of this assessment are presented in Table 3-16.

Table 3-16 Waste types and examples potentially suitable for hydraulic backfill

NEPM code	Waste description	Waste examples
N205	Residues from industrial waste treatment/ disposal operations	Spent activated carbon
		Ion-exchange column residues
		Industrial waste treatment sludges and residues
		Residues from pollution control operations
		Includes sewerage sludge & residues (including biosolids, where contaminated with substances contained in this list above guideline levels
N120	Soils contaminated with a controlled waste	Soils contaminated with residues of substances contained in this list
		Dredging spoil similarly contaminated
N150	Fly ash	Fly ash from coal combustion
		Fly ash from incineration or EfW processes
D220	Lead, lead compound	Leaded glass (CRT glass, small particles & glass dust)
		Grit blast waste
		Lead and zinc refining slags
		Mine tailings
		Baghouse dust
C100	Basic solutions or bases in solid form	Wastes with pH > 10
		Wastes from cleaning fuels with bases
		Ammonium hydroxide
		Calcium hydroxide
		Sodium hydroxide, potassium hydroxide
		Pickling bases
		Red mud from alumina refining
D110	Inorganic fluorine compounds excluding calcium fluoride	Spent Pot Liner (SPL) waste from aluminium smelting
		Simple fluoride salts such as sodium fluoride and potassium fluoride
D230	Zinc compounds	Zinc ash/dust

NEPM code	Waste description	Waste examples
		Galvaniser's ash
		Smelting slag
		Spent filter cartridges (from electroplating/ galvanising)
D300	Non-toxic salts	Coal seam gas industry brine and salt wastes
		Aluminium dross
		Aluminium industry salt slag
		Simple inorganic chlorides
B100	Acidic solutions or acids in solid form	Waste acids
		Pickle liquors (acids)

Note: Colour coding is as follows:

Principally suited for hydraulic backfill without pre-treatment. (green)

Possibly suited for hydraulic backfill after pre-treatment (e.g. particle size reduction). (orange)

Transport and emplacement of waste materials using hydraulic backfill

For both types of hydraulic backfill, the advantages over dry/containerised wastes would be very similar and mainly connected to the ease of handling, transport and emplacement in the underground mined rooms.

Following the path of the waste from the source to the final deposition in the storage or disposal rooms, the advantages of hydraulic backfill would be as follows:

- Waste materials could be collected at the source as bulk material – packing and/or containerising would not be necessary and even undesirable (e.g. unpacking of waste materials at the disposal site could be labour intensive, could impose the need for additional process steps and would thereby be costly and introduce potential additional worker exposure during chemical waste handling).
- The transport of waste materials as a bulk material could be performed in a clean and contained manner when using the right loading, hauling and unloading equipment. For powder waste materials (ashes, salts, etc.) the loading, hauling and unloading could be done by pneumatic systems whereby interaction with humans and the environment would be principally absent. Liquid waste materials could be pumped into tankers and unloaded at the disposal site into tanks, i.e. also fully contained. Coarser materials such as slags and filter cakes could be loaded and hauled in (covered) dump trucks/trains, however, would require, after unloading and possibly intermediate storage, a size reduction step before application in a hydraulic backfill is possible.

- The different waste materials to be used in a hydraulic backfill mixture could be temporarily stored at the disposal site in tanks, silos/bunkers or (covered) areas until they are mixed into a hydraulic backfill. The size of this temporary storage would differ between a viscous and flushing backfill operation as the viscous backfill is based on a specific and stringent recipe whilst the flushing backfill has a more flexible recipe. This means that the different waste materials could be mixed into a flushing backfill more quickly decreasing the size of intermediate storage at the disposal site. Since the recipe of the viscous backfill is usually rather stringent, more intermediate storage would be needed to allow for the supply of waste materials to meet the recipe(s). Most wastes could be stored fully contained in silos or tanks thereby eliminating impact on humans and the environment.
- Once the waste materials are required in a hydraulic backfill mixture they could be taken from their respective silos/bunkers and/or tanks and transported to the backfill production facility by pneumatic or pipeline transport, again fully contained, thus clean, efficient and safe.
- After production of the backfill mixture, it could be transported through pipelines to the storage or disposal rooms in the mine:
    - For a flushing backfill the shaft pipeline itself would act as a "pump" as the gravitational force on the mixture builds pressure in the vertical shaft pipeline eliminating the need for significant pump effort to transport the mixture from the shaft to the underground rooms. Drainage fluid being re-circulated in this case would need to be pumped to the ground surface requiring energy.
    - The consistency of viscous backfill would be such that gravity alone most likely would not suffice for transport to the storage and disposal rooms and a pump would be needed. On the other hand, no drainage fluid would need to be pumped to the surface making the total pump effort comparable with the flushing backfill.
    - Transport of dry/containerised waste would require heavy plant to drive down and then back up the mine access decline or use the vertical shaft. The energetic efficiency of transport by heavy equipment/vehicles is generally considered to be significantly lower than pipeline transport, compare long distance transport of oil and gas.

Emissions from hydraulic backfill

As described above, the transport of the wastes used in a hydraulic backfill mixture could be performed in a relatively contained manner and, thereby, would be efficient and clean. Using the proper techniques and equipment, a safe, emission-free and energy efficient transport, storage and production process could be designed. However, considering emissions, the following should be noted for the storage and transport of wastes within the overall process of production, transport and emplacement of hydraulic backfill:

- Storage and transport of dry wastes would require fit for purpose design of (pneumatic) equipment such as compressors, silos and pipelines. Important themes during the design of this equipment would be material choice (abrasion), moisture control (compressed air must be dry to avoid clumping) and filters (waste powders should not enter the atmosphere through inadequate solids/air separation). Furthermore, all equipment would require regular maintenance to ensure a sustained emission-free storage and transport process.

- Storage and transport of liquid wastes and/or brines would require fit for purpose design of equipment such as pumps, tanks and pipelines. Important themes for the design of this equipment would be material choice (abrasion and corrosion) and pressure class (blockage could lead to high pressures in e.g. pipeline and tanks). Again, a rigorous maintenance schedule would eliminate unplanned and desired emissions.
- Handling of coarse wastes such as slags and filter cakes would require size reduction, i.e. crushing and/or milling, as an additional process step before they can be used in hydraulic backfill. This size reduction step could be a source for emissions: in the case of wet crushing/milling (using brine) gas emissions could occur if the wastes contain aluminium and in the case of dry crushing/milling dust control would be necessary. Proper design of the crushing/milling equipment would mitigate emissions and eliminate environmental impact.

Apart from transport, hydraulic backfill would be produced in a mixing plant where dry and liquid wastes are mixed (with brine) to a specific recipe and to a predetermined density. Considering emissions during the mixing phase of the process, the following should be noted:

- Hydrogen could be formed during mixing of wastes containing aluminium resulting from the reaction of aluminium with water (brine). Hydrogen is not per se a toxic or harmful gas for the environment but is flammable and explosive under the right conditions. The air above the mixing tank would need to be extracted and the corresponding electric equipment would need to be ATEX certified.
- During mixing of viscous hydraulic backfill where the pH could not be kept near 7 (generally recipes for viscous backfills create a pH of around 10 to 11) ammonia gas could form as a result from the reaction of flue-gas-cleansing-salts (cleansing flue gas from in particular NO_x). Ammonia is a harmful gas and the concentration of ammonia in the air expelled to the atmosphere would need to be controlled by either a scrubber (removing the ammonia) or by dilution with large quantities of clean air. Similar reactions could take place when wastes contain, for instance, phosphorus (phosphine) or arsenic (arsine).
- In order to avoid large quantities of gas being formed underground after the hydraulic backfill has been deposited in the storage and disposal rooms, the backfill mixture would need to be conditioned in a homogenisation tank for up to eight hours. During this time, most of the gas forming reactions would have completed and gas formation diminishes.
- It is likely that some gas formation would continue after deposition in the storage and disposal rooms. The layout of the rooms and the mine ventilation system would need to be designed to accommodate the proper extraction and dilution of any gases formed underground. Rooms in which hydraulic backfill is deposited would also need to be classified for some time as ATEX zones and continuous multi-gas monitoring would need to take place.

- Some gas formation from the emplaced hydraulic wastes in the storage and disposal rooms would be normal and could be managed safely by:
  - Monitoring of gas formation during backfill preparation.
  - Adjusting retaining time in the homogenisation tank accordingly.
  - Ample ventilation of the waste emplacement rooms in the mine.
- Underground waste storage facilities in Germany have shown that gas formation can be managed safely on a routine basis without forming a hazard to workers, the environment, the mine’s stability or jeopardising the long-term isolation of wastes from the biosphere.

Risks associated with backfill composition

The composition of hydraulic backfill would be crucially important for viscous backfill but far less critical for flushing backfill. The reasons for this are as follows:

- For flushing backfill, the brine with which the wastes are mixed, would merely be used as a transport medium and the actual mixture could constantly change reflecting the actual waste supply. Thus, for flushing backfill the emplacement of the waste materials in the rooms and concurrent drainage of the brine would constitute a semi-solid backfill body in the rooms being backfilled. This means that the strength of the backfill, after emplacement, would not rely on chemical (binding) reactions to occur per-se. Strength would mainly be developed by the deposition and subsequent consolidation of particles in the flushing backfill within the storage and disposal rooms. Some strength could develop from chemical binding and crystallisation as well, similar to viscous backfill (see next item in this list). Therefore, real risks associated with the backfill mixture not reaching the required composition would not be expected. Care should, however, be taken that the particle size distribution of the backfill mixture is such that sedimentation of the solids in the backfill mixture within the rooms in the mine could take place within a relevant time scale. To illustrate, when all the solid particles in a flushing backfill mixture are fine silt or clay sized, the sedimentation may take years (decades) and the drainage would thus take a very long time. As a result, large quantities of free liquid (brine) could remain in the mine post-closure which is undesirable from a long-term safety point-of- view.
- For viscous backfill, the risks associated with the backfill mixture not reaching the required composition would be more significant because the fluid, i.e. brine added to the dry waste materials would not merely be a transport medium but also a chemical reactant enabling the backfill mixture to set (harden) similar to the setting of a cement mixture. As with the setting of a cement mixture, when the mixture does not have the correct composition, the viscous backfill may either set too quickly, resulting in e.g. clogged pipelines, or not set at all resulting in the mine openings to be filled with a liquid mass instead of a solid mass. This risk could be considerable when thinking of the possible variations of wastes’ compositions. Thorough analysis of incoming wastes would be necessary to sufficiently and effectively reduce this risk.

- Despite the risks described in the previous two bullet-points the risks associated with the hydraulic backfill mixture not reaching the required composition (e.g. excess fluid in viscous backfill) could be fully mitigated by the overall design and construction of the storage and disposal rooms within the proposed Chandler Facility. This risk could be avoided by certifying the following:
    - The rooms of the mine would be designed such that their stability is not dependent on the hydraulic backfill properties after deposition in the rooms. In other words, no load carrying capacity could be assigned to the backfill for at least the operational period of the facility.
    - The mine layout and ventilation design would be such that it allows any gas formed in the mine to be properly diluted, extracted and expelled into the atmosphere taking into account gas concentrations and absolute gas quantities. When the latter are considered too great, the residence period in the homogenisation tank should be lengthened.
    - The rooms could be closed-off after being filled with the backfill mixture in such a manner that no fluids could escape from the rooms during or after the operation of the facility. The room seals could be designed and constructed in such a way that the convergence of the salt would neither be hampered by the seal nor the seal integrity deteriorates due to the convergence. In Germany, significant experience with seals. As examples, the extensive research and practical implementation of drift seals in the salt mines of Sondershausen and Teutschenthal are relevant.
    - The (vertical) position of the mine within the strata (horizons) could be chosen such that any fluids contained in the rooms post-closure could not enter the biosphere. Good practice would be to allow for sufficient salt roof thickness to contain any fluids being pressed out of the room as a result of creep, i.e. room convergence.

Considerations associated with groundwater contamination due to backfilling and possible preventative steps

The contamination of groundwater, irrespectively in which stratum, would be primarily prevented by the design of the proposed Chandler Facility, i.e. the position of the mining horizon within the geology. It is stated in German Law that the saline host rock functions as the only barrier rock and the long-term safety documentation in principle has to be provided for the saline rock as a barrier rock. Additional geological barriers may provide extra safety; however, they are not mandatory. The aim of the facility should be to completely and permanently seal the wastes from the biosphere and all requirements on wastes, mined voids, geotechnical barriers and all other technical devices and/or operational measures are geared towards that objective.

For the use of hydraulic backfill as a transport and emplacement method for the long-term storage of waste materials this means that the facility's design should fulfil this premise regardless of the composition of the backfill itself while considering the following requirements:

- Hydraulic backfill must not impair the barrier function of the host rock by e.g. dissolution.

- Gas formation or other chemical reactions should not diminish the long-term safety of the facility.

When the composition of hydraulic backfill fulfils these requirements and, in combination with a proper design of the facility that can pass the long-term safety evaluation for dry wastes, this evaluation will also be valid for hydraulically backfilled wastes achieving complete and permanent isolation from the biosphere, i.e. no contamination to any groundwater.

How does hydraulic backfill ensure a low permeability seal to prevent leakage of liquid waste material from the salt cavern?

The hydraulic transport and emplacement of waste materials itself does not in itself ensure a low permeability seal preventing leakage of liquid waste material. The complete and permanent isolation of waste materials, regardless if they are solid or liquid, must be ensured by the design and construction of the proposed Chandler Facility.

The hydraulic emplacement of wastes, and in particular, the setting of hydraulically emplaced waste would not necessarily have a negative effect on the facility's seals. On the contrary, it could even be beneficial to the complete and permanent isolation of waste materials from the biosphere because:

- Through nearly complete filling of the rooms (better void utilisation than packaged waste backfilling), convergence and consequent strain in the host rock mass would be reduced. The potential for development of cracks or connected porosity that could form a pathway for fluids, would thereby be minimised.
- The majority of fluid contained in the hydraulic backfill would either largely be drained or chemically bound.
- The permeability of the backfill mass after emplacement in the mined rooms would usually be very low thereby physically containing any fluids.
- The backfill mass could potentially have significant geotechnical strength whereby it could resist the salt's convergence and thus avoid pressing out of fluids containing contaminations such as heavy metals.
- Since fluids contained in the backfill should be saturated for a geological repository in a salt host rock, they would be unable to dissolve the host rock and therefore the development of hydraulic pathways through the saline host rock, by dissolution, would be avoided.

In order for any wastes and/or fluids which have been hydraulically emplaced in the storage and disposal rooms to permanently stay in these rooms, the rooms would need to be closed off from the rest of the facility by dams (seals). The construction and material choice for these dams would be instrumental in the isolation of the hydraulically emplaced wastes.

Dam design and construction should, therefore, be well thought through and performed by specialists. After the operational period of the facility the accesses, i.e. vertical shafts and mine access decline, should be properly sealed to further ensure the complete and permanent isolation of wastes from the biosphere.

Lessons learnt from other jurisdictions (e.g. Europe and the United States)

Lessons learnt regarding long-term waste storage in the United Stated of America have been primarily gained during the development and operation of the Waste Isolation Pilot Plant (WIPP) in New Mexico. The WIPP however has been developed for the storage of mainly radioactive wastes, and whilst the lessons learnt during the development of this facility can be useful for the Proposal, they will not surpass lessons learnt in the European underground waste storage and disposal industry.

Some general lessons taken from the operation of European underground waste storage facilities are:

- If possible try to designate a single regulator to oversee and coordinate all other regulators to ensure efficiency, avoid duplication and create a clear and transparent authority and responsibility framework. The most eligible regulator in Europe is usually the mining authority as they will have significant in-house expertise with regards to the critical aspects of underground storage such as geology, geotechnical stability and risk assessment methodologies suitable for assessing and proving long-term safety.
- Gain sufficient real-life experience within the planned facility, through the (initial) development of gateways, drifts and rooms, before actual waste emplacement takes place. Proper exploration followed by analytical calculations and numerical simulations can yield tremendous insights in the mechanisms responsible for impairing the barrier function of the salt rock. Subsequent actual physical development of the facility, combined with in-situ testing, can confirm the assumptions used in the project's earlier development phases to further improve an already well supported safety case.
- Separate responsibilities such as the facility's operation, its regulatory oversight and the (scientific) review of safety supporting documentation to sustain a transparent decision-making structure before, during and after operation of the facility.
- Cooperate internationally and exchange information with specialists, operators and regulators in other countries operating underground waste storage facilities such as the United Kingdom, Germany and France.
- Involve the general public in the early stages of a project in order to "educate" and enable incorporation of public feedback in the overall safety case.

The lessons learnt regarding long-term waste storage in underground storage facilities in Europe, has been largely incorporated into European Directives and respective Member State Law. German law contains a very detailed description of all aspects concerning the safe and efficient long-term storage of wastes. A summary is presented of the relevant themes from German experiences.

Site specific safety assessment

The acceptance criteria for underground storage can only be derived by referring to local conditions, i.e. by assessing the risks related to containment accounting for the overall system of wastes emplaced, engineered structures, mined voids and the host rock for the actual planned site. The risk assessment should identify the following, pertaining to the actual site of the planned facility:

- The hazard, i.e. the emplaced wastes including e.g. their potential behaviour over time, interaction with the host rock and interaction with each other.
- The impact of wastes or their derivatives when they may reach the biosphere.
- The receptors within the biosphere that may be influenced by the wastes or their derivatives.
- The pathways through which the wastes or their derivatives can reach the biosphere.

Baseline information

The assessment process should be initiated by collecting the baseline information required in all subsequent phases. In order to properly build the supporting baseline information database, baseline data collection should be based on the actual site, including the foreseen mine layout. Baseline information to be gathered includes the following:

- **Geological conditions**: barriers, exploration data, resource estimations, host rock structure, tectonic history and strain, historic and present seismic data etc.
- **Mine layout details**: dimensions, depth, gateway cross-sections, ramps, slopes, (blind-) shafts, levels and sub-levels, cause, origin and composition of expected influxes, presence of hydrocarbons, safety pillars, existing drillings, etc.
- **Hydrological conditions**: stratigraphy, petrography, storage potential of host rock, neighbouring rocks and overburden, aquifers, aquitards, aquicludes, permeabilities, pore fluid composition, salinity, utilisation of groundwater, surface water, etc.
- **Waste emplacement**: waste types, emplacement methods, geotechnical behaviour of emplaced wastes, solubility behaviour, gas generation, host rock interaction, etc.

Overall safety concept

Using all the information collected during the baseline information gathering, an overall safety concept should be developed before a final risk assessment is prepared. This concept should yield a first opinion on whether complete and permanent isolation of wastes can be achieved and sustained over the long-term while considering the site-specific conditions. The development of an overall safety concept will show the necessity for additional and/or complementary research into baseline information.

Safety assessment components

Based on the baseline information and the overall safety concept, the final risk assessment would include the following components:

- Geological assessment (local, regional) (refer to Section 3.2.1).
- Geo-technical/geo-mechanical assessments (testing/analytical/numerical/validation) (refer to Appendix K).
- Hydrological assessment (numerical/validation/monitoring for groundwater and pore fluids) (refer to Chapter 8 and Appendix R).
- Geochemical assessment (groundwater quality, waste – host rock interaction) (refer to Chapter 8 and Appendix P).
- Biosphere impact assessment (identification and evaluation of receptors) (refer to baseline assessment in Chapters 7 to 17).
- Assessment of risks related to or present during the operational phase (refer to Chapter 6 and Chapters 7 to 18).
- Assessment of long-term risks (refer to Chapters 7 to 18).
- Assessment of risks related to the surface facilities at the planned site (refer to Chapter 6 and Chapters 7 to 18).
- Assessment of other risks (mining/waste emplacement and their strict separation) (refer to Appendix C).

The geo-mechanical/geo-technical assessment forms the basis for any successful safety concept (refer to Appendix K for more information on the geo-technical properties of the salt horizon to be used for permanent waste isolation).

German law on underground waste disposal/storage states that if the mechanical stability of the host rock is sufficiently proven, by testing and modelling, under any current or future circumstances, thereby proving complete and permanent isolation of the wastes from the biosphere, further assessments of the eventual dispersing of contaminants through the overburden is not mandatory.

Geo-mechanical/geo-technical (stability) assessment

The requirements with regards to the facility's stability which should ensure complete and permanent isolation of wastes from the biosphere are:

1. No deformations of the rooms and ground surface are to be expected, during and after operation of the mine, which could impair the mine's functional capacity, i.e. the ability to:
    a. extract salt and;
    b. seal the wastes from the biosphere.
2. The bearing capacity of the host rock (salt) should sufficiently prevent collapse of the mined rooms that could have a negative effect on the long-term safety of the waste storage facility.

3. The stored wastes should contribute to the mine's stability in the long-term.

4. After closure of the mine the host rock's ability to creep, which is a particular property of salt, has to provide full enclosure of the wastes.

During the (continuous) assessment, the following subjects should be sufficiently elaborated over the course of several phases before and during operation of the facility:

- Relevance of geological/tectonic and hydrological information to the expected mechanical situation in the underground facility.
- Dimensioning of the mine voids preferably supported by experiences from initial mine development and/or in-situ testing.
- Comprehensive analysis of expected mechanical behaviour of the rock mass (host rock, overburden) and emplaced waste materials based on laboratory experiments and numerical prognoses. The numerical models to be developed and maintained/improved during the operation of the facility should focus on the stability and convergence of the mined voids, consequent surface subsidence and the long-term effectiveness of the geological barriers, i.e. through a coupled hydro-mechanical assessment.
- Explanation of potential hazards to geo-mechanical stability arising from numerical prognoses and design of mitigating measures to minimise or eliminate their impact on long-term safety.
- Design of a permanent monitoring system to prove mechanical stability and assess long-term safety and integrity of the host rock. Data yielded by the system can be used for the continuous improvement of the arithmetical proof of long-term safety of the facility.
- In-situ measurements of the stress state during the facility's development and when considered relevant in-situ measurement of permeabilities.
- Development of stability and integrity enhancing measures to be applied during and after operation of the facility.

Proof of long-term safety

Using the baseline information collected, the safety concept and the several different assessments performed, in particular the geo-mechanical/geo-technical assessment, proof of long-term safety can be established. This comprehensive and all-embracing long-term safety analysis of the complete waste/underground construction/host rock system should comprise the following individual systems and evaluate them on the basis of the multiple barrier system:

- Assessment of natural barriers (halite and aquatards).
- Assessment of impacts on natural barriers caused by human intervention (e.g. shafts).
- Assessment of technical barriers.

- Assessment of events that might impair the complete and permanent isolation of the wastes and cause mobilisation of contaminants (natural events and human induced events) (refer to Appendix H to understand what levels of assessment have already been undertaken).
- Comprehensive evaluation of the complete system accounting for all safety-relevant aspects.

Arrange waste into compatible zones

Once waste is accepted and moved underground, waste would be organised according to a strict zoning scheme (refer to the WZG in Appendix C). The zoning scheme would ensure:

- Separation of waste with incompatible hazardous characteristics.
- Separation of acidic and alkaline wastes.
- Separation of waste with other potentially reactive properties.

Waste in containers would be unloaded and arranged in double-barrier containers such as double-lined bulk bags or PVC bags stored within barrels. Bulk bags placed in an excavated room are depicted in Figure 3-25. Hydraulic backfill would be pumped directly as depicted in Plate 3-5.

Waste storage, disposal and permanent isolation rooms

The emplacement room dimensions have been determined based on the geotechnical requirements with consideration of waste package emplacement requirements. An optimal emplacement room length of 250 metres was selected by considering the following factors:

- Health and safety considerations, i.e., egress time from rooms,
- Geotechnical considerations.
- Capital cost.
- Operating cost.

Backfilling and room closure

As discussed above, once a decision has been taken to permanently isolate waste, fine salt would be placed around the waste packages using a salt backfill sprayer (snow blower-type machine) to fill any voids present (refer to Plate 3-6). After loose salt backfilling has been completed an engineered seal or wall would be constructed at the entrance to the disposal room to permanently isolate the waste. The salt would deform over time and fill remaining gaps between the waste containers in a process known as salt creep (refer to Figure 3-23). A schematic showing the proposed sealing strategy is shown in Figure 3-24.

Initial State Phase 1 – Mining

Storage room excavated with continuous miner

Room and pillar dimensions established by geotechnical design

Initial State Phase 2 – Waste placement

Waste packages transported and placed in room

Stacked as close to roof and sides as possible

Initial State Phase 3 – Backfilling with fine salt

Space around waste packages filled with fine salt

Reduces free void and establishes contact with roof and sides

Creep stage 1 – after a few 10's of years

Room sealed and creep starts to take full effect

Creep moves waste and fine salt into void spaces

Creep stage 2 – after a few decades

Storage room creep in equilibrium with waste and backfill

Creep decreases to zero – waste permanently isolated

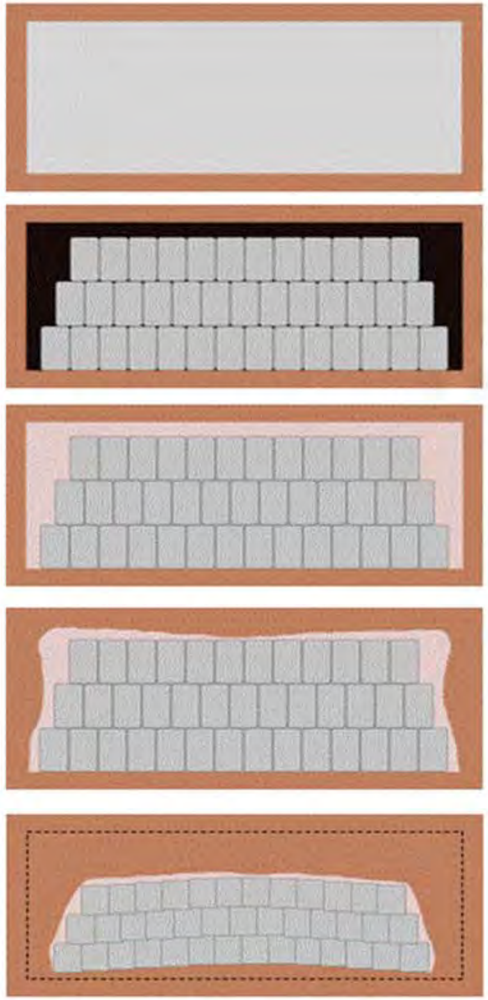


Figure 3-23 Salt creep in excavated room

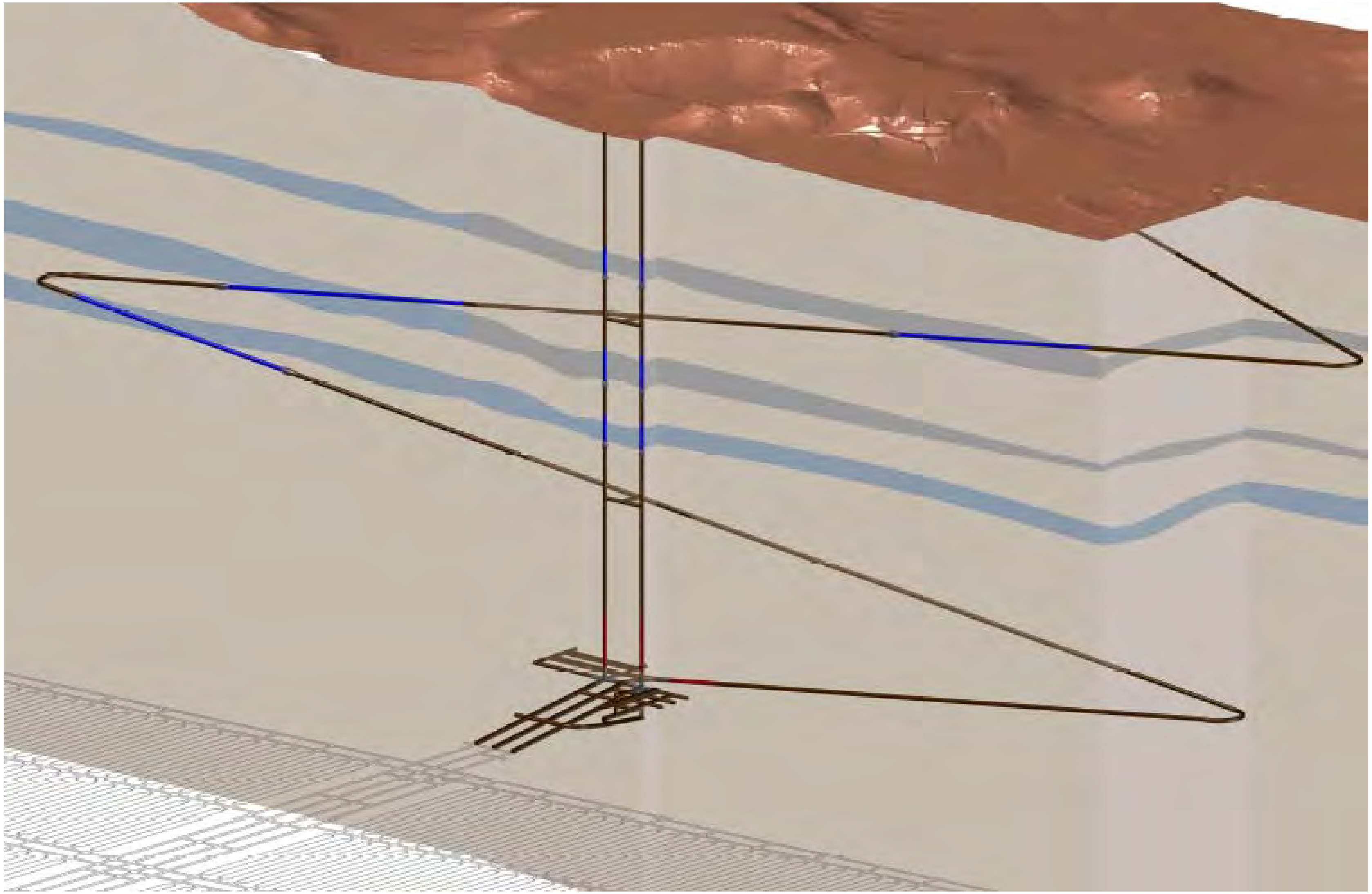


Figure 3-24 Schematic of proposed sealing strategy

Return of containers to surface

Unloaded ISO 20-foot shipping containers would be returned to the surface via the mine access decline. These containers would be stored at the surface to dispatch product salt, as required (refer to Section 3.5.4).

Containers would be visually inspected for damage and signs of contamination. Where contamination is identified the container would be cleaned using an appropriate technique. This would likely be carried out by simple sweeping out to collect any dry materials identified followed by washing or steam cleaning. Workers undertaking this operation would be equipped with appropriate personal protective equipment.

Any wash out would be carried out on a suitable pad with collecting sump to avoid any loss of contaminated water to the environment. The collecting sump would be monitored and excess water removed for appropriate disposal. Depending on the destination and use of the salt to be dispatched, the container may be fitted with an inner disposable lining for bulk transport as bagged salt would already be suitably protected from contact with the container inner surface.

3.6.6 Traffic and transportation

Heavy and light vehicle movements would be generated by salt and waste operations at the proposed Chandler Facility. These operations would not generate large volumes of traffic on the external road network. Salt exports and inbound waste would be transported primarily via the Central Australian Railway (although waste would be able to be received via road at the proposed Apirnta Facility). Between the Apirnta Facility and the Chandler Facility, salt and waste would be transported via the proposed Chandler Haul Road.

The movement of the workforce, equipment, materials, waste, utilities and services would also generate a number of heavy and light vehicle movements during operation of the proposed Chandler Facility. The main routes for these vehicle movements would be the Stuart Highway and Maryvale Road.

Workers who fly-in-fly-out from Alice Springs would utilise commercial services to Alice Springs Airport from the proposed Chandler Facility. It is anticipated that workers would be transported by coach on a weekly basis, staying the proposed accommodation village located to the north of the Chandler Facility.

Materials required for operation would be delivered as required via the Maryvale Road in the initial years of operation. During operation, materials would be delivered to site via the Henbury Access Road. Vehicle movements would not be significant given that the more voluminous materials required would be sourced on-site, for example, water from the proposed borefield, and fill from the mine access decline and vertical shafts or from borrow pits located along Maryvale Road and along the proposed alignments of the proposed Chandler Haul Road and Henbury Access Road.

Waste generated during operation would require periodic collection by appropriately licensed waste contractors. Vehicle movements associated with waste collection would not be significant and would likely occur on a weekly basis. Traffic and transportation impacts and mitigation (including the implementation of a Traffic Management Plan) are discussed further in Chapter 18.

3.6.7 Communications

Communications systems

The communications system includes infrastructure required for both aboveground and underground components including:

- Telephones.
- Wireless radios.
- Business network.
- Process control network.

The communications infrastructure would likely be a fibre optic network with cable supplied in the main shaft. This equipment would be used for local switching and as an overall link to the main network.

Ethernet-based telephone (i.e. Voice over Internet Protocol (VoIP)) technology would be used for both aboveground and underground telephone service. It would be connected via fibre optic link, for access to external lines and the mine infrastructure area internal phone network. Hard-wired emergency phones would be installed at the aboveground main control room, at the main shaft and secondary ventilation shaft stations, and at each underground refuge station.

The emergency phone system would be connected by twisted pair cable which would be installed in a ring between each phone. These phones would be for emergency communications in the event of failure of the other voice communications systems (VoIP phones and radio) and because the system would use separate and isolated infrastructure, it would provide additional redundancy to emergency communications and would not be affected by loss of electrical power.

Wireless voice coverage would be provided for the underground repository, main and secondary ventilation shafts, and the aboveground main control room using “leaky feeder” technology. Leaky feeder is a simple and robust analogue system that, for example, utilises a coaxial antenna cable. This cable would be hung throughout the underground tunnels using hangers and can easily be removed from emplacement rooms as they are filled with waste.

A separate channel would be provided for in-shaft work, as this would be required to ensure uninterrupted communications between shaft workers and the hoist control operator, particularly during maintenance and shaft inspections.

Although alerts of fire or other emergency conditions would be made via the radio system, the primary system of notification to the underground would be via another system, for example a stench gas system.

The leaky feeder radio system would also be used to carry monitoring signals from remotely installed instrumentation. The leaky feeder would carry cable modem terminal services connectivity to support ethernet data communications requirements in remote areas of the underground installation.

The business network would provide access for business computers to e-mail, internet and other network services at all appropriate locations both aboveground and underground. The process control network would carry all signals for monitoring and controlling systems at the mine infrastructure area both aboveground and underground. This network would be provided in key locations where connectivity between instrument and equipment is required. Main process network switches would be installed in the main control room.

Control and monitoring systems

Mine infrastructure area operators would be able to view custom-configured control screens that display equipment and system status and allow inputs to be executed through a mouse/keyboard interface. The operator could also monitor key areas through the use of closed circuit video monitors.

In the off-shift hours, selected main control room functions would be transferred to the underground control room, which would be continually staffed, allowing an operator to monitor underground operations and respond to any alarms.

Shaft hoisting operations would be controlled from the respective control terminals. Hoisting operations could be automated or controlled manually. A certified hoist operator would be on-site at all times that the hoist is in operation.

The following underground equipment would be monitored and controlled from the main control room:

- Sump and dewatering pumps.
- Power distribution facilities including motor starters and some switchgear.
- Ventilation fans and refrigeration units.

The following equipment would only be monitored in the main control room because this equipment either would not require control or would be controlled locally:

- Fire detection and suppression systems.
- Uninterruptible power supplies (status monitoring).
- Water quality monitoring, as required.

- Air quality monitoring, as required.
- Ground support monitoring, as required.
- Hoist system monitoring.

The fire detection and suppression system would report into the main control room but would be monitored and controlled by a separate and isolated infrastructure.

The control and monitoring system would allow for connection and activation of alarm devices to notify personnel of abnormal or unsafe conditions. Alarm notification devices would be used within the main control room and, as necessary, underground.

Video monitoring systems would be installed throughout the aboveground facilities. Closed circuit cameras would be used and the video data carried over the business network to the main control room where the operator would monitor these areas through the use of multiple screens. There would also be closed circuit cameras specific to the hoisting system that would feed to the respective hoist control for monitoring.

3.6.8 Worker accommodation

As discussed above, an accommodation village would be established approximately two kilometres north-east of the proposed Chandler Facility. The accommodation village would likely include:

- Semi-detached dwellings (180 rooms).
- Ablutions.
- Laundry facilities.
- Car parking.
- Dry mess, wet mess, kitchen and cold room.
- Games room including an internet connection.
- Tennis court and gymnasium.
- Sewage treatment plant.
- Fire water protection.
- Administration offices.

A concept layout of the proposed accommodation village is presented in Figure 3-25.

The location of the accommodation village was selected to facilitate ease of access to the operation and crew rotations to and from the Chandler Facility and Apirnta Facility. The proposed accommodation village is considered to be at a reasonable distance to minimise potential exposure to noise or dust emissions during both construction and operation of the Proposal.

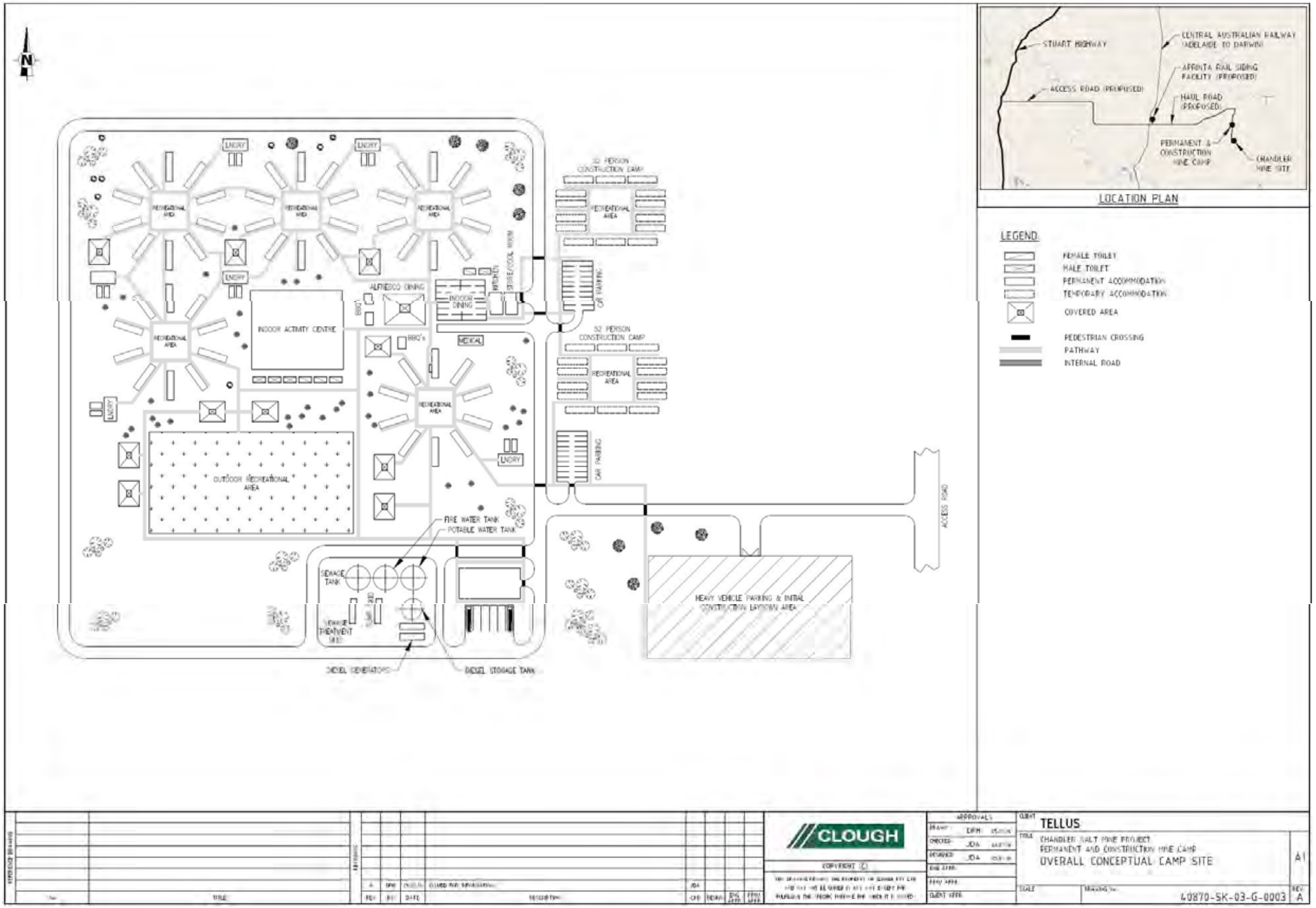


Figure 3-25 Concept layout of the accommodation village

3.6.9 Operational waste

This section discusses waste generated during operation of the proposed Chandler Facility. Also discussed are hazardous materials storage and waste management strategies during operation of the Chandler Facility.

Operational waste generated

Waste generated during operation would include maintenance waste, domestic waste, wastewater and reject salt. Non-mining waste that would be produced during operation would typically include:

- Tyres, oil, grease, detergent, solvents, paint.
- Scrap metal, wood, paper, cardboard, plastic and glass.
- General waste such as food waste, food containers and packaging.

Maintenance waste and domestic waste would be collected, separated and stored in appropriate containers according to their potential for reuse, recycling, recovery, treatment and/or disposal. Waste would be kept in dedicated areas for collection by appropriately licensed waste contractors. There is also potential for some of this waste to be stored underground within the storage and disposal rooms of the Chandler Facility.

Wastewater generated during operation would include:

- Raw water recaptured as process water after industrial use.
- Treated water recaptured as grey water after domestic use.
- Potable water recaptured as sewage after human consumption.

Wastewater would be beneficially reused or otherwise reinjected or released off-site. Opportunities for beneficial reuse include dust suppression, industrial use or domestic use. Irrigation of treated sewage may occur providing potential for permaculture at the accommodation village.

Reinjection or release of wastewater would be carried out in accordance with an environmental protection license under the NT *Waste Management and Pollution Control* Act and would be subject to meeting environmental water quality objectives.

The volume of water to be reused, treated, reinjected or released would be subject to the demand for reuse, the quality of the wastewater and the state of the receiving environment.

Some run of mine salt fed through the salt processing plant would be rejected due to the presence of other materials such as quartz, sandstone, siltstones and to a lesser extent anhydrite and gypsum. This reject material would be stockpiled separately to the run of mine salt and product salt and would be preferentially managed through reuse as backfill in the underground mine.

Potential release of treated water is explained further in Chapter 8, while general management of waste generated at the Chandler Facility is explained further in Appendix G.

Hazardous materials storage

Waste hydrocarbons would be stored in a tank within a bunded area. All hazardous and chemical wastes would be located to ensure they are:

- Clearly marked.
- Have secondary containment that is of sufficient capacity to contain 110 % of the maximum contents of the waste source volume.
- Located away from sensitive receptors (i.e. watercourses).
- Not at risk of theft of vandalism.
- Not damaged through exposure to the elements.
- Easily accessible.
- Unlikely to be damaged.

The quantity of chemicals and hazardous substances would be determined during detailed design of the Proposal. The management of hazardous wastes is discussed further in Chapter 11.

Waste management strategies

During operation, waste management would follow the principles of the waste hierarchy, as illustrated in Figure 3-26. A draft Waste Management Plan has been prepared for the Proposal (refer to Appendix G). The Waste Management Plan would be finalised following completion of the detailed design of the Proposal.

Waste management would begin with resource efficiency with a focus on:

- Ordering the correct amount of materials to be delivered when needed.
- Ensuring materials are not delivered to site damaged and unusable.
- Reducing the amount of packaging used by suppliers.
- Ensuring wastes are handled and stored correctly.
- Segregation of difficult types of waste.
- Maintaining a monthly record of waste types and volumes that are generated.

Waste types with the potential for reuse or to be recycled on site include:

- Concrete.
- Excavation spoil.
- Topsoil.
- Timber.
- Metals.
- Clay, concrete pipes, blocks and bricks.
- Packaging and plastics.

Hazardous waste generated during construction and operation would be temporarily stored at the Apirnta Facility until it could be permanently isolated at the Chandler Facility. All other non-hazardous waste would be taken off-site to landfill in Alice Springs.

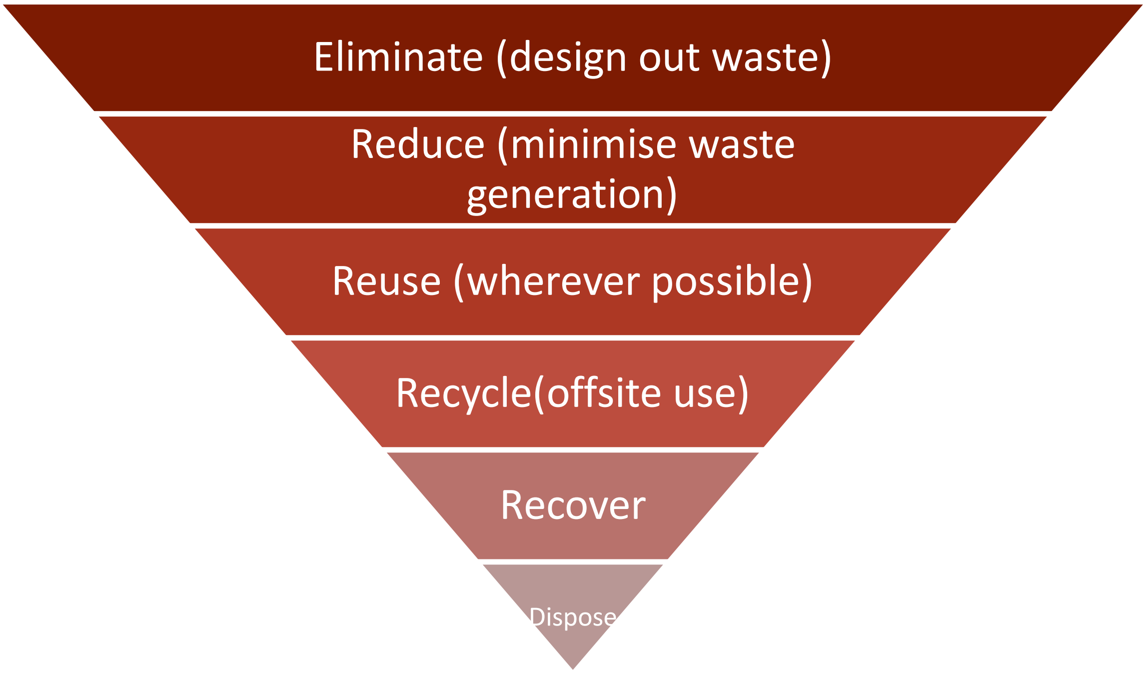


Figure 3-26 The waste hierarchy

3.6.10 Health, safety and environment

Management systems

The proponent operates integrated management systems in line with industry standards including:

- AS 4801 Occupational health and safety management systems.
- ISO 14001 Environmental management systems.
- ISO 9001 Quality management systems.

The management systems include a range of policies with associated objectives in areas of:

- Health and safety.
- Environmental management.
- Community relations.
- Fitness for work.
- Fire prevention.
- Workplace rehabilitation.
- Sustainable development.

These policies and objectives would be implemented through a range of issue-specific management plans (including the safety case) that would be developed for the Proposal.

The management systems and subordinate policies and plans would be periodically reviewed and improved as the proponent transitions into future stages of development of the Proposal.

Health and safety plans

The health and safety of workers would be managed in accordance with a Health and Safety Management Plan. The management plan would include a risk assessment including controls to reduce risk.

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. The Safety Case would include a risk assessment of major incidents involving hazardous materials and would include controls to reduce risk at the proposed Chandler Facility.

A draft Emergency Response Management Plan has been prepared and is included in Appendix T. The plan would guide the response of workers in the event of an emergency such as a fire, explosion, collapse or gas leak. The Emergency Response Management Plan would be finalised prior to construction of the Proposal.

Health, safety, environment and quality monitoring

A number of systems would be installed to monitor the Chandler Facility and the surrounding environment. These systems would include:

- Leak detection.
- Fire detection.
- Radiation monitoring.
- Structural monitoring.
- Air quality monitoring.
- Groundwater monitoring.
- Surface water monitoring.
- Waste sampling and testing.
- Salt product sampling and testing.

3.7 Overview of the Apirnta Facility

This section presents an overview of the proposed Apirnta Facility. Details regarding the construction of the Apirnta Facility are presented in Section 3.7 and details regarding the operation of the Apirnta Facility are presented in Section 3.8.

3.7.1 Description of the Apirnta Facility

The proposed Apirnta Facility would occupy an area of approximately 30 hectares and provide for the temporary storage of up to 400,000 tonnes of waste material prior to its permanent storage, recovery and isolation at the Chandler Facility.

The key infrastructure at the proposed Apirnta Facility would include:

- Rail siding.
- Loading bays.
- Waste inspection bays.
- Vehicle weighbridge.
- Storage warehouse.
- Open storage yard.
- Liquid waste tank.
- Quarantine zone.
- Laboratory.
- Office buildings.
- Maintenance shed.
- Access road.

The Apirnta Facility would be appropriately secured with security fences, gates and cameras. Only authorised persons would be granted access. Identification protocols would be developed to ensure security.

The Apirnta Facility would also be appropriately designed with stormwater drainage and would be connected to essential services including electricity, water and sewerage.

The Apirnta Facility would be designed in accordance with the NT Planning Scheme and the *Land Development Corporation Development Guidelines Version 2 – June 2012* (LDC 2012). A number of sustainability measures would also be incorporated into the design of the Apirnta Facility, as discussed below.

3.7.2 Storage areas for dry and solid waste materials

Two storage areas (a warehouse and an open storage yard) would be constructed to store dry and solid waste materials.

Warehouse

A warehouse would be constructed to temporarily store waste materials before being transported for permanent isolation and storage at the proposed Chandler Facility. The warehouse would be approximately 6,600 square metres in area. It would be a single storey, steel-framed building (refer to Figure 3-27)

Waste materials to be stored in the warehouse would be sealed in appropriate waste packages on wooden pallets then stacked in high-bays, similar to what is shown in Plate 3-10. The waste would be segregated as necessary in designated areas in accordance with appropriate Australian standards, codes and guidelines, particularly the Dangerous Goods Code as detailed in the WZG

Figure 3-27 Conceptual design of the Apirnta Facility looking east

(refer to Appendix C). The warehouse would be fitted out with safety equipment such as emergency showers, an eye wash station and spill kits (refer to Plate 3-11 and Plate 3-12). Attached to the warehouse would be a laboratory and an office building (refer to Section 3.5.6). Rainwater tanks would be installed adjacent to the warehouse for various purposes such as for vehicle wash down and dust suppression during construction (refer to Section 3.5.7).

Installation of solar panels on the warehouse roof will be assessed as part of the detailed power study and engineering phase of the Proposal.

Source: Sperrin Metal Storage Solution
Plate 3-10 Example high-bay stacking of wood pallets

Source: GibbGroup
Plate 3-11 Example of emergency shower and eye wash station

Source: GibbGroup
Plate 3-12 Example of spill kit

Storage yard

An open storage yard would be constructed to store 20-foot shipping containers that would be stacked four high. This activity would involve preparing a suitable sub-base and appropriately engineered surface. The yard would be used for the temporary storage of waste that would be sealed in the shipping containers.

At capacity, the storage yard would be approximately 198,000 square metres in size and would occupy the majority of the site. The storage yard would be capable of housing about 20,600 shipping containers (up to 400,000 tonnes of waste, for which approval is being sort).

The shipping containers would be segregated into 'like for like' waste categories and in accordance with the appropriate Australian standards, codes and guidelines including Dangerous Goods Code as detailed in the WZG (refer to Appendix C).

An internal road network would be constructed within the storage yard. The road network would be strictly one-way and would be used by authorised personnel operating forklifts. The road network is discussed further in Section 3.5.7.

3.7.3 Liquid waste storage tank

One liquid storage tank with a capacity of 40,000 litres would be installed at the proposed Apirnta Facility. The liquid storage tank would be used to store a variety of liquid wastes as listed in Appendix F. The perimeter of the liquid storage tank area would be completely bunded to contain any potential spillages and leaks.

3.7.4 Road and rail interchange areas and rail spur

Two interchange areas would be constructed where waste would be transferred from trucks and trains to the site for temporary storage (either in the warehouse or in the storage yard). A rail spur would also be constructed off the Central Australian Railway.

Road interchange

The road interchange area would be approximately 3,575 square metres in area and located in the southern portion of the site. The road interchange area would have designated truck grids (parking bays). Truck driver amenities would also be located in this area (refer to Section 3.5.7).

Rail siding and interchange

A rail siding at the Apirnta Facility, approximately two kilometres in length, would connect to the Central Australian Railway. A sealed interchange area would be established beside the rail siding to allow for the transfer of product salt and waste material to and from the railway, respectively. The siding would act as a transhipment point for outgoing salt and incoming waste.

Incoming materials would be transported in sealed shipping containers and off loaded from rail wagons at the rail siding and transferred to the proposed Apirnta Facility for temporary storage. From there, materials would be transported by road train vehicles for onward transport to the proposed Chandler Facility.

Outgoing salt which would have been brought from the mine site by road train would be loaded onto the empty rail wagons for onward transport to customers via Adelaide Port.

3.7.5 Quarantine zone

A quarantine zone would be constructed where waste materials that is transferred from trains would be stored prior to inspection and testing at the laboratory. Once tested, the waste would be moved and appropriately stored within the site (either in the warehouse or in the storage yard).

Similar to the storage yard, an internal road network would be constructed within the pre-inspection area. It would be strictly one-way and used by authorised personnel operating forklifts. A fence would also be installed around the boundary of the pre-inspection area. The internal fence line would be approximately 1.8 metres in height, increasing to 2.6 metres at the boundary of the site.

3.7.6 Laboratory, office and maintenance and storage shed

Laboratory and office

A laboratory and office would be provided within the warehouse. The laboratory would be used to test and verify received waste materials. The laboratory would house laboratory equipment including a fume hood to vent any potential gases that may be emitted during the waste inspection and testing. All chemicals and reagents would be stored in appropriate and suitable chemical storage cabinets, compliant with the relevant NT WorkSafe standards. The Apirnta Facility would be accredited for a range of chemical test methods by the National Association of Testing Authorities.

The office building would be used by staff and for security administration purposes. It would house office space, first aid rooms, store rooms and amenities (including a locker area, lunch room, toilets and showers). The office would be strategically located to oversee internal warehouse operations.

Maintenance and storage shed

A maintenance and storage shed would be constructed. The maintenance and storage shed would be approximately 405 square meters in area, and the yard would be approximately 4,518 square metres in area. Similar to the warehouse, it would be a single storey, steel-framed building used for both the maintenance and storage of plant and equipment.

3.7.7 Infrastructure

The following infrastructure would also be installed at the site.

Internal roads

A road network would be constructed within the site. The road network would be predominantly one-way with traffic management controls, as appropriate. As discussed above, an internal road network would be constructed within the storage yard and pre-inspection area and would be used by authorised personnel operating forklifts.

The road network in the operational area would be used by employees, contractors, visitors and by truck drivers delivering waste to the site.

Car parking

Two car parks would be constructed on-site. The main car park would be located to the south of the warehouse. It would occupy an area of approximately 1,450 square meters and would accommodate up to 25 car parking spaces.

The car park would cater for employees, contractors and visitors. The number of car parking spaces would be sufficient for all employees at the site during operation. The car parks would be designed to comply with NT Planning Scheme requirements and the Australian Standard (AS) *AS 2890.1-1993 Parking facilities – Off-street car parking*.

Loading bay

One loading bay would be installed adjacent to the laboratory, the dimensions of which would be approximately 7.5 metres by 3.5 metres.

Weighbridge and vehicle wash down facility

A weighbridge would be installed to weigh trucks and their contents as they enter the site (loaded). A wash down facility would also be installed adjacent to the road interchange area.

Truck driver amenities

Truck driver amenities would be provided adjacent to the road interchange area. The amenities would include bathroom facilities and an undercover waiting area.

Security gates, fencing and cameras

Four security gates would be installed at the site. One security gate (and accompanying gatehouse) would be installed at the entrance to the site. Another security gate would be installed at the exit. Two additional security gates would be installed to the west of the rail interchange area to allow forklift movement between this area and the storage areas.

A perimeter fence would be erected around the site. It would be approximately 2.6 metres high to preclude intruders as well as animals. As discussed above, internal fencing would be installed around the perimeter of the pre-inspection area to preclude pedestrians and other vehicles from entering this area. The internal fencing would be similar to the perimeter fencing but would be approximately 1.8 metres in height.

Twenty-four hour surveillance via closed circuit television cameras would also be installed at various locations within the site and along the perimeter fence.

Lighting

Lights would be installed at the site for safety and security purposes. Perimeter light poles would be approximately 10 metres high with luminaires pointing inwards, towards the site. Light poles within the site would be approximately 15 metres high with up to 10 luminaires per light pole.

Energy efficient lighting would be used at the site. Lighting would be at the minimum level of illumination necessary and would comply with Australian/New Zealand Standard (AS/NZS) *AS/NZS 1680.5:2012 Interior and workplace lighting, AS/NZS 1158.3.1:2005 Lighting for roads and public spaces – Pedestrian area* and *AS 4282-1997 Control of obtrusive effects of outdoor lighting*.

Bunding and stormwater drainage

Stormwater drainage would be installed at the site. All surface water would be contained on-site via a bunded drainage system that would include one or multiple water/oil separators. An underground gravity fed pipe system would direct stormwater towards the warehouse, laboratory, office and maintenance and storage shed.

After on-site treatment has taken place, the water would be used for ablutions, at the wash down facility and in the rainwater tanks (refer to Plate 3-13 and Plate 3-14). The capacity of the stormwater drainage system would accommodate a 1-in-100 year rainfall event over a 24-hour period. No stormwater would be discharged off-site.

Electricity, telecommunications, water and sewerage services

Connections to existing electricity, telecommunications and water would be required. Solar energy, located on the warehouse roof, would also be investigated as an alternative means to power the site. A septic tank system would be installed to manage sewerage at the site.

Source: Northline

Plate 3-13 Example of rainwater tank

Source: Northline

Plate 3-14 Example of vehicle wash down facility

3.8 Construction of the Apirnta Facility

This section provides details regarding the construction of the proposed Apirnta Facility. An indicative construction schedule is provided along with the proposed workforce and working hours. Information regarding the typical equipment, machinery and vehicles that would be used during construction is provided along with a description of the different phases of construction (enabling works, construction of aboveground infrastructure, and testing and commissioning).

3.8.1 Construction schedule

Subject to obtaining approval, it is anticipated that construction would commence in the middle of 2018. Construction would occur over a six month period, ending in late 2018. About three months would be required for testing and commissioning, ending in early to mid 2019. An indicative construction schedule is provided in Table 3-17.

Table 3-17 Indicative construction schedule (Apirnta Facility)

Activity	Indicative construction period	
	Start	Finish
Planning approval and environmental licences obtained	February 2017	February 2018
Enabling works	March 2018	June 2018
Construction of aboveground infrastructure	July 2018	December 2018
Testing and commissioning	January 2019	March 2019

3.8.2 Construction workforce and working hours

Construction of the proposed Apirnta Facility is expected to require approximately 50 full-time equivalent jobs.

Hours of construction would be 12 hours a day, seven days per week. It is not anticipated that night shift work would be required for the construction of the proposed Apirnta Facility, however, the proponent has identified this as a contingency option for specific and appropriate work tasks during the construction phase.

The proponent or its contractors would (where suitable) aim to source employees (construction staff) locally either from the community of Titjikala or from Alice Springs or other communities within the NT. Construction workers sourced from further afield than Titjikala would be housed within the accommodation village located to the north of the proposed Chandler Facility.

3.8.3 Construction equipment, machinery and vehicles

Enabling and construction works would likely require the following equipment and machinery:

- Light vehicles
- Bulldozer.
- Excavator.
- Grader.
- Backhoe.
- Earth removal trucks.
- Concrete trucks.
- Cranes.
- Tip trucks and trailers.
- Hand held tools.

3.8.4 Enabling works

Prior to commencement of construction works, the following enabling works would be required:

- Detailed site survey including services searches.
- Geotechnical investigations.
- Installation of temporary erosion and sediment controls.
- Installation of traffic management measures.
- Installation of fencing and signage to delineate work boundaries.
- Installation of any necessary drainage diversions.
- Installation of temporary construction facilities including a perimeter security fence and temporary site office and construction compound (described further below).
- Delineation of parking areas for construction vehicles.
- Vegetation removal.
- Earthworks (including topsoil stripping and stockpiling and earthworks).
- Installation of drainage.
- Rehabilitation of disturbed areas designated for landscaping (via topsoiling, seeding and planting).

Access would be restricted by the early installation of a perimeter fence around the site. A temporary, demountable site office would be erected. The office would be approximately 100 square metres and would be removed on completion of the construction works.

A construction compound would be established. It would be used for crew parking, deliveries, site sheds and for the storage of equipment and materials. A temporary amenities building would also be set up in the construction compound to ensure compliance with worker health and safety requirements.

Fences would be placed around construction areas and construction compounds to ensure safety during construction works.

3.8.5 Construction of the Apirnta Facility

Construction of the proposed Apirnta Facility would involve:

- Installation of suitably engineered hardstand areas.
- Construction of the warehouse (including laboratory and office) and maintenance and storage shed.

A description of the activities associated with the construction of the Apirnta Facility is provided below.

Installation of impervious hardstand areas and associated infrastructure

Following construction of footings, construction of the building and pit slabs would occur. Typical works required as part of the slab installation would include:

- Installation of formwork.
- Installation of conduits.
- Installation of services.
- Installation of a water barrier.
- Installation of steel reinforcement.
- Installation of sealed surface.
- Striping of formwork once sealed surface is complete.

Additional infrastructure that would be installed would include:

- Liquid storage tank.
- Weighbridges and vehicle wash down facility.
- Truck driver amenities.
- Security gates, fencing, cameras and lighting.
- Stormwater drainage.
- Electricity, water and sewerage services.
- Ablutions.

Construction of warehouse and maintenance and storage shed

Construction of the warehouse (including the laboratory and office) would involve erecting the structural frame of the warehouse including the installation of steel columns, wall bracing, roof sections and roof bracing. Following completion of the structural frame, the building cladding would be installed, including the following installations:

- Communications.
- Electrical wiring.
- Air conditioning.
- Insulation.
- Wall sheeting.
- Roof sheeting.
- Roof vents.
- Rollers doors, doors and windows.

Upon completing the structural works, fit out of the warehouse would commence. This would include the installation of lighting, plumbing, internal communications, fire services, laboratory equipment and furniture. No painting would likely be required.

The maintenance and storage shed would be constructed in much the same way as described above for the warehouse. All buildings would be constructed in accordance with the relevant provisions of the NT *Building Act*, NT Building Regulations and *Building Code of Australia*. An architect would be engaged to provide services in relation to the design of buildings.

3.8.6 Testing and commissioning

Once construction is complete, testing and commissioning of the proposed Apirnta Facility would commence. The purpose of this is to ensure that all systems and components are tested to verify if they function according to their design objectives or specifications.

3.8.7 Construction environmental management

A CEMP would be prepared to include specific work details and safeguards to be implemented during construction of the proposed Apirnta Facility to reduce identified risks to the environment.

3.9 Operation of the Apirnta Facility

This section describes the operation of the proposed Apirnta Facility. The volume and type of waste that would be delivered and stored at the site is provided. Traffic and access to the site, workforce and hours of operation are also provided.

3.9.1 Workforce and hours of operation

At a peak storage capacity event, it is estimated that approximately 25 people would be required on-site at any one time. The number of staff required during the initial years of operation is likely to be approximately 10-15 full-time employees and contractors.

The hours of operation would be the same as those for construction, namely 12 hours a day, seven days per week, day shift only for the Apirnta Facility in the initial years of operation. Transfer of containers from the Apirnta Facility to the Chandler Facility may also occur over a night shift depending on operational requirements.

3.9.2 Site operational process

The site would receive waste materials transported via road and rail utilising companies licenced to transport dangerous goods. The overall process is summarised below and is illustrated in Figure 3-28.

The waste would arrive to the site in sealed and labelled storage containers, including:

- Flexible intermediate sealed and labelled storage containers or bulka bags.
- Rigid intermediate sealed and labelled storage container or sealed and labelled drums, typically containing waste liquids.

The above would typically be received on wrapped pallets, or transported within sealed ISO 20-foot shipping containers (refer to Figure 3-30). Waste arriving via trucks would enter the site at the site gatehouse located off of the access road which would be connected to the Chandler Haul Road. Waste arriving via rail would do so via the rail siding off the Central Australian Railway. The site operational details for both road and rail are discussed below.

Figure 3-28 Waste storage container (ISO 20-foot shipping container)

The proponent would adopt a rigid Quality Assurance, Traceability, Notification and Certification System. This process is summarised in Figure 3-29 and is designed to complement tracking systems required by other legislation such as the *Australian Code for the Transport of Dangerous Goods by Road and Rail* and the *National Environmental Protection (Movement of Controlled Wastes between States and Territories) Measure.*

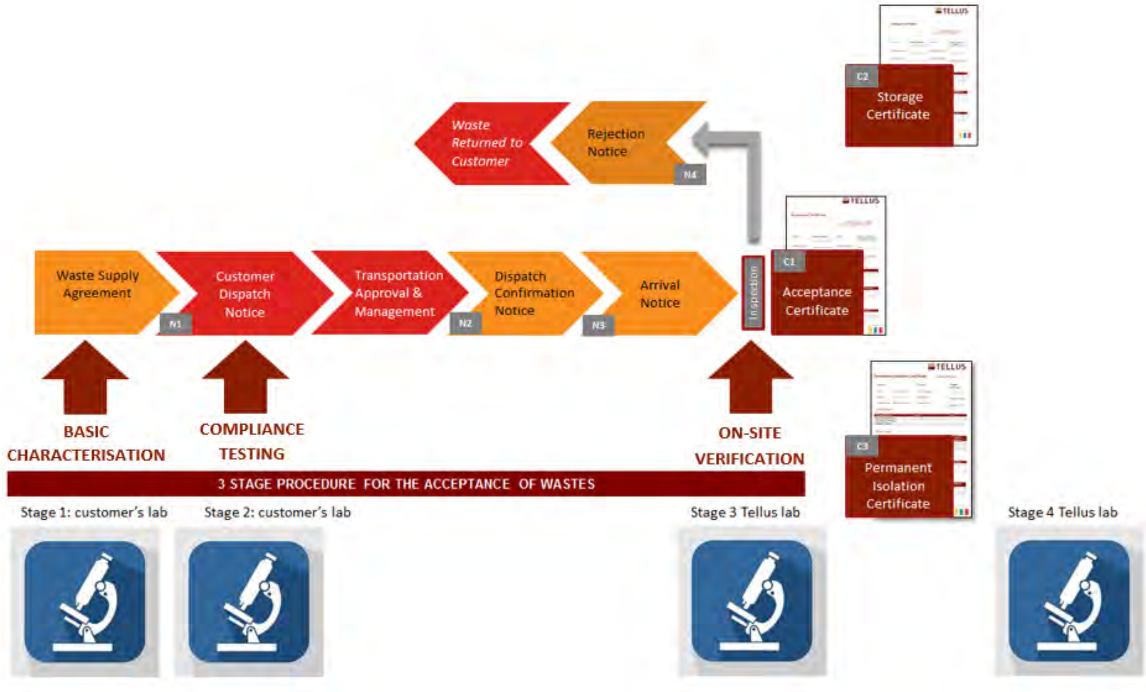


Figure 3-29 The proponent's traceability process

The proponent would implement a notification service for management of the waste that is delivered to the proposed Apirnta Facility. This would include:

- **N1 - Dispatch notice issued by customer**. Prior to dispatching waste to the Apirnta Facility, the customer must issue a Dispatch Notice to the proponent. The Dispatch Notice must be issued so that deliveries are in accordance with the Waste Delivery Plan. The Dispatch Notice will include information on the waste code, description, weight, volume, material safety data sheets, proposed date of delivery and Transport Plan.

  It is anticipated that following the issue of a Dispatch Notice the customer will secure all required approvals for transportation (e.g. NEPM approvals for movement of controlled substances and Dangerous Goods), arranging packing and accredited transporters.

- N2 - **Dispatch confirmation notice issued by the proponent**. The proponent will issue a Dispatch Confirmation Notice to the customer, either confirming that the dispatch may proceed; or may not proceed, including reasons (example: resources or space temporarily not available). This will normally be issued within five business days of the proponent receiving evidence from the customer of all required approvals for transportation. The proponent is not required to accept waste at the facility unless the proponent has issued a Dispatch Confirmation Notice.

- **N3 - Arrival notice issued by the proponent.** All deliveries of waste must be booked in at least 48 hours prior to the arrival of the delivery. This is to ensure that sufficient segregated storage is available for any particular waste stream. Un-booked deliveries may be subject to delays in unloading and/or may incur additional charges. The proponent will issue an Arrival Notice to the customer confirming arrival of the delivery at the Apirnta Facility (provided that the proponent has issued a Dispatch Confirmation Notice in relation to that delivery). The Arrival Notice will be generated at the weighbridge (in real time).

- **Inspection point.** Following the issue of an Arrival Notice, at the Apirnta Facility Delivery Point, the waste will be subjected to weighing, visual inspection of containers, and sampling. On-site laboratory testing (Level 3, on-site verification checks) will be performed by qualified persons to analyse the waste streams to determine if the WAC are satisfied and to ensure compliance with any site licence Conditions of Acceptance.

  If the waste is accepted, this is the point of risk transfer and an Acceptance Certificate is issued. If the waste is rejected, there is no transfer of risk, and a Rejection Notice is issued. A representative sample will be taken from each delivery batch and waste type. Details of third party analysis and a material safety data sheet will assist in the correct identification.

  The Conditions of Acceptance for the Nominated Facility will specify that the Customer must provide:

  - Prior to unloading, documentation supporting that waste was transported in accordance with all required approvals.
  - The weight card, which provides evidence of the gross weight of the delivery to be used as the basis for billing.
  - Documentation of waste volume, and waste codes.
  - Acceptable packaging.

  The waste must not comprise any unlawful material. The delivery must be consistent with the Dispatch Notice from the customer.

- **N4 - Rejection notice issued by proponent (if necessary).** If an Acceptance Certificate is not issued, the customer will be issued a Rejection Notice and will remain responsible for the delivery; and the rejected delivery will be managed in accordance with the Rejection Procedure. The Procedure will provide that, amongst other things, the proponent may procure the return of the delivery to the address in the Dispatch Notice (at the cost and risk of the customer).

  The proponent may (in its sole discretion) elect, by notice in writing, to accept the delivery in which case the proponent may treat and or repackage the waste at the cost of the customer. If the proponent makes this election, the waste will be deemed to be Acceptable Waste and an Acceptance Certificate will be issued.

3.9.3 Traffic and access

Trucks would enter the site at the site gatehouse located off the access road. The site would operate with a one-way traffic system with one entry and one exit point for safety reasons. Traffic on-site would be limited to a speed of 15 kilometres per hour. A fleet of 32-tonne container handling forklifts would operate within the site transferring waste materials from trucks and trains into the storage areas.

At a peak storage capacity event, the frequency of one-way truck movements would be approximately five per hour over a 10 hour working day. Train movements would be approximately one per day, which is based on storing 400,000 tonnes of waste.

Traffic and transportation impacts and mitigation (including the implementation of a Traffic Management Plan) are discussed further in Chapter 18.

3.9.4 Volume and type of waste delivered to site

The site would be designed and constructed to store a maximum of 400,000 tonnes of waste at any given time. The site would be capable of accepting a wide range of waste materials. Typical waste types accepted (and not accepted) at the site are listed in Table 3-7. A likely waste inventory is provided in Appendix F.

3.10 Road infrastructure

This section describes the proposed road infrastructure required for the Proposal. A summary of the roads proposed is presented in Table 3-18.

Table 3-18 Haulage and access road summary

Road name	Function	Length	Area (30 m wide zone)
Henbury Access Road	• Personnel • Construction materials • Waste materials for storage	60 km	180 ha
Chandler Haulage Road	• Personnel • Construction materials • Waste materials for storage • Salt	30 km	93 ha
Internal mine infrastructure roads	• Personnel • Visitors • Waste materials for storage • Salt	16 km	48 ha
TOTAL			**321 ha**

3.10.1 Henbury Access Road

The proposed Henbury Access Road would be approximately 60 kilometres long and would connect the Apirnta Facility to the Stuart Highway. It would provide for the movement of workers and delivery vehicles to and from the Stuart Highway to the Apirnta Facility and through to the Chandler Facility.

The key features of the proposed Henbury Access Road would include:

- An unsealed surface.
- An approximately 30 metre wide road with a single lane in each direction

- Longitudinal drainage system for the management of surface water runoff including water quality basins and appropriate cross-drainage structures such as culverts at waterway crossings.
- Cross culverts and/or weirs at water course crossings, including the Finke River. Where significant drainage/creek crossings are required, culverts would be constructed.
- No road lighting apart from intersections with major roads (i.e. Stuart Highway) where appropriate safety measures would be incorporated.
- A light aircraft strip approximately 250 metres long. The light aircraft strip would provide for day and night emergency access to the Chandler Facility. The light aircraft strip would predominantly be used in unusual circumstances, such as evacuation for medical emergencies. When the road is used as an emergency landing strip road traffic would be restricted by traffic lights to prevent collision.
- An upgraded road crossing to provide adequate durability and safety for road users at the Central Australian Railway. The design of the upgraded crossing would be subject to consultation and agreement with the NT Department of Transport.
- Borrow pits for road construction and ongoing road maintenance activities.
- A road design in accordance with the NT Department of Transport and Department of Infrastructure requirements.

The following activities would be undertaken to prepare the surface of the Henbury Access Road:

- Vegetation clearing and topsoil stripping (topsoil would be stockpiled for use in future rehabilitation works).
- Surface rolling to identify soft spots.
- Removal of soft spots and backfilling with consolidated material to develop a stable sub-base.
- Surface preparation works including laying road material for the access road in three stages:
    - Road sub-base.
    - Road base.
    - Road surface.

Construction materials would be sourced from borrow pits discussed in Section 3.5.6. The construction methodology would be agreed with the proponent’s contractors during detailed design but would be conventional and in line with industry best practice.

3.10.2 Chandler Haul Road

The proposed Chandler Haul Road would be approximately 30 kilometres long and would connect the Chandler Facility to the Apirnta Facility. It would provide for the movement of salt from the Chandler Facility to the rail siding at the Apirnta Facility. It would also provide for the movement of waste temporarily stored at the Apirnta Facility to the Chandler Facility.

The key features of the proposed Chandler Haul Road would include:

- An unsealed surface.
- Approximately 30 metre wide road with a single lane in each direction
- Longitudinal drainage system for the management of surface water runoff including water quality basins.
- Cross culverts and/or weirs at watercourse crossings.
- No road lighting apart from intersections with major roads (i.e. Chamber Pillars Road) where appropriate safety measures would be incorporated.
- An upgraded road crossing to pride adequate durability and safety for road users at Chambers Pillar Road. The design of the upgraded crossing would be subject to consultation and agreement with the NT Department of Transport.
- Borrow pits for road construction and ongoing road maintenance activities.
- A road design in accordance with the NT Department of Transport and Department of Infrastructure requirements.

The following activities would be undertaken to prepare the surface of the haul road:

- Vegetation clearing and topsoil stripping (topsoil would be stockpiled for use in future rehabilitation works).
- Surface rolling to identify soft spots.
- Removal of soft spots and backfilling with consolidated material to develop a stable sub-base.
- Surface preparation works including laying road material for the haul road in three stages:
    - Road sub-base.
    - Road base.
    - Road surface.

Construction materials would be sourced from borrow pits discussed in Section 3.5.6. The construction methodology would be agreed with the proponent's contractors during detailed design but would be conventional and in line with industry best practice.

3.10.3 Other roads

In addition to the Henbury Access Road and Chandler Haul Road there would be a network of smaller internal access roads within the bounds of the proposed Chandler Facility. The access roads would be unsurfaced, unsealed and about 10 metres wide and would include longitudinal drainage and stormwater basins. The specification and geometry of all roads would be finalised following comprehensive geotechnical investigations, test work and detailed design of the Proposal.

3.11 Closure

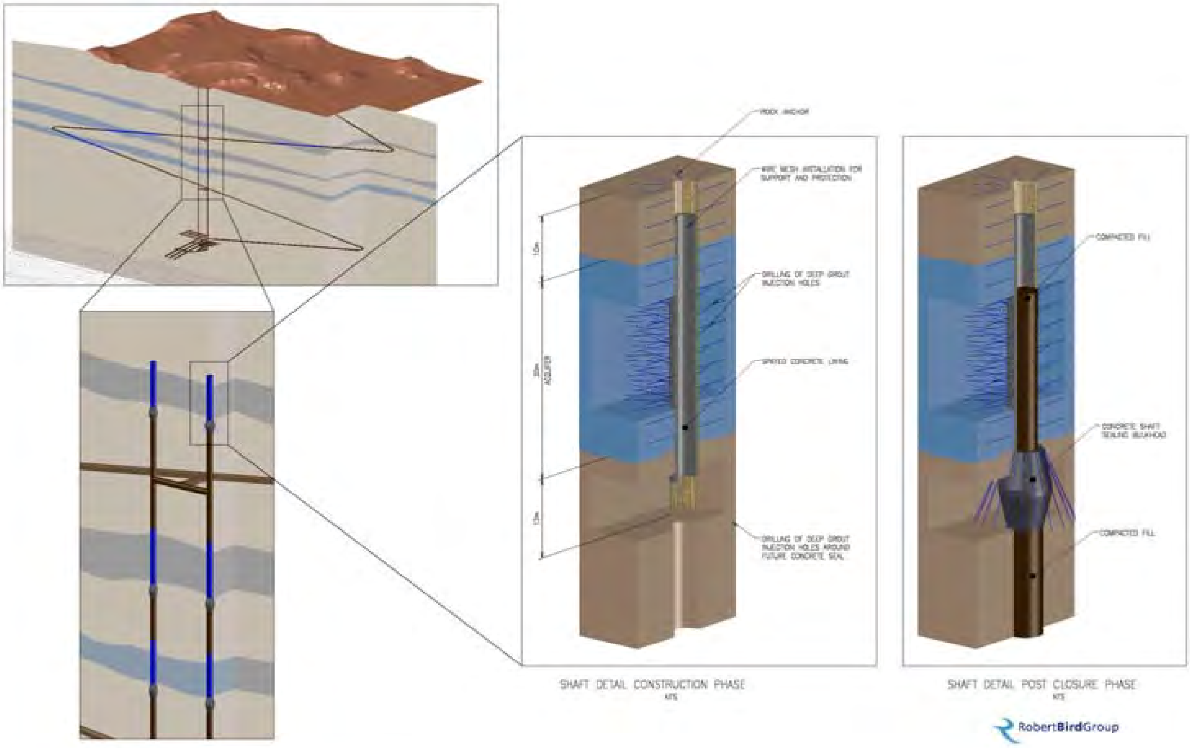
Closure would occur at the end of year 25 of operations (year 29 of the Proposal) and would involve:

- Finalisation of underground operations.
- Demobilisation of underground equipment.
- Backfilling of underground mine, access decline and vertical shafts.

Finalisation of underground would include backfilling of the remaining excavated rooms with waste material, finely crushed salt and engineered barriers as described in Section 3.5.5. Demobilisation of underground equipment would include the transfer of the equipment to the surface via the mine access decline or vertical shafts. Mine closure would also be funded through a financial security established under the *Mining Management Act 2001*.

Chapter 13 provides further discussion on closure and rehabilitation requirements, potential impacts and necessary mitigation and management measures. A draft Rehabilitation Closure Plan (RCP) has been prepared for the Proposal (refer to Appendix J).

Figure 3-30 Establishment of engineered barriers to underground mine



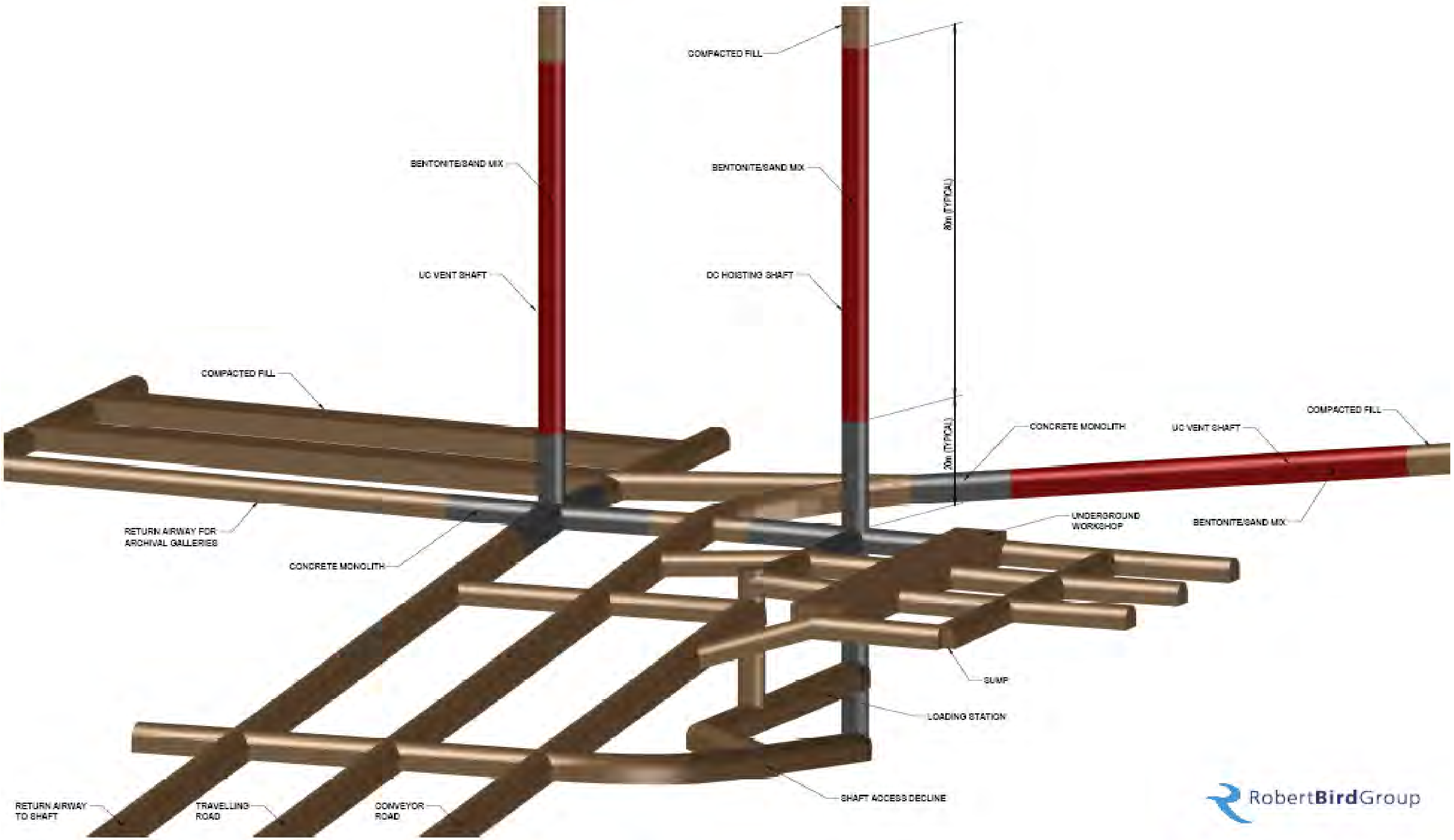


Figure 3-31 Backfilling of underground mine

3.12 Decommissioning

Decommissioning would occur at the end of the life of the Proposal. Decommissioning would include:

- Demobilisation of equipment.
- Demolition of buildings.
- Decommissioning and removal of utilities.
- Backfilling and sealing of underground mine.
- General site clean-up.

Demobilisation of equipment would include the transport of salt mining and waste storage equipment that is not required for closure or rehabilitation activities. The equipment would be demobilised to regional locations for reuse or scrapping and recycling or disposal.

Demolition of buildings would include the removal of surface infrastructure and underground infrastructure. Disconnection and removal of utilities would involve initial disconnection then progressive dismantling, cleaning and removal of infrastructure.

Decommissioning of utilities would firstly entail electrical isolation then disconnection of all connections to power, water, compressed air, etc. This would be followed by complete clean-down and drainage of all lubricating fluids and mechanical disassembly for recovery/reclamation/recycling, where possible.

Backfilling of the underground mine would include backfilling of remaining excavated rooms and development drives with bulk salt followed by the reinstatement of soil and rock material from overburden stockpiles to the mine access decline and vertical shafts.

General site clean-up would include removal of stockpiled waste, other waste such as litter and remediation of any identified contaminated areas such as areas where leaks or spills have occurred. Waste would be stockpiled separately according to reuse, recycling and recovery potential. Concrete footings would be crushed and stockpiled for recycling, for example.

There is potential for contamination of land, particularly within the mine infrastructure area as a result of operational activities associated with the proposed Chandler Facility. Possible contamination sources include fuel or oil leakage and concentrated sodium chloride discharges from the run of mine salt stockpile. Any contaminated sites would be registered and remediated using suitable methods throughout the mine life or during the decommissioning phase of the Proposal.

The site would generally be returned to its original condition as far as possible, and all topsoil returned to the landscape, where possible.

Decommissioning would be guided by a detailed RCP. The RCP would include measures to control potential impacts on the environment. Decommissioning would also be supported through a financial security established under the *Mining Management Act 2001*.

3.13 Rehabilitation

To ensure that the objectives of rehabilitation are achieved, a draft RCP has been developed for the Proposal (refer to Appendix J). .

Following decommissioning the site of the Chandler Facility and Apirnta Facility would be rehabilitated with the following objectives:

- Achievement of the same or similar land use capabilities as existed prior to the disturbance, unless other beneficial land uses are pre-determined and agreed.
- Creation of a stable landform – waste stockpiling areas and other disturbed land would be rehabilitated to a condition that is self-sustaining or to a condition where maintenance requirements are consistent with an agreed post-mining land use.
- Surface and groundwater that leave the lease should not be significantly degraded. Current and future water quality would be maintained in accordance with relevant water quality standards.

The creation of a stable landform would involve ripping, grading and redistribution of topsoil from topsoil stockpiles to mimic the natural landform around the site of the proposed Chandler Facility and Apirnta Facility.

The creation of a stable landform would also restore pre-existing land use capability but this would also require revegetation with native species and reinstatement of pre-existing drainage lines.

Maintenance of pre-existing surface water and groundwater quality would be achieved through the creation of a stable landform and restoration of pre-existing land use capabilities and would be subject to ongoing surface water and groundwater monitoring against water quality objectives.

Surface monuments would be installed after decommissioning and remediation of the Chandler Facility to identify the isolation/disposal area.

3.14 Post closure

3.14.1 Overview

The safety philosophy for underground storage of hazardous waste requires the permanent isolation of the waste from the biosphere by a geological barrier. To ensure this, a site-specific risk assessment was undertaken and included the following elements:

- Post closure risk assessment (refer to Appendix H)
- Geological and geo-technical assessment (refer to Appendix K).
- Geo-mechanical assessment (refer to Appendix K).
- Hydrogeological assessment (refer to Appendix P)
- Assessment of the operational phase (refer to Appendix H).
- Environmental impact assessment (this EIS)

The long term assessment has determined that no credible pathways to the biosphere would be generated during the long-term post-operation of the underground storage. The barriers of the underground storage site (e.g. the waste quality, engineered structures, back filling and sealing of shafts and drillings), the performance of the host rock, the surrounding strata and the overburden would be quantitatively assessed over the long-term and evaluated on the basis of site-specific data or sufficiently conservative assumptions where site data does not exist.

The geochemical and geo-hydrological conditions such as groundwater flow, barrier efficiency, natural attenuation as well as potential leaching of the deposited wastes has to be taken into consideration.

The long-term safety of the underground storage has been demonstrated by a safety assessment comprising a description of the initial status at the time of closure followed by a scenario outlining important changes that are expected over geological time. The consequences of a release of substances from the underground storage has been assessed for different scenarios reflecting the possible long-term evolution of the biosphere, geosphere and the underground storage (refer to Appendix H).

The demonstration of long-term safety of underground disposal in a salt rock would principally be undertaken by designating the salt rock as the barrier rock. Salt rock fulfils the requirement of being impermeable to gases and liquids, of being able to encase the waste because of its convergent behaviour (creep) and of confining it entirely at the end of the transformation process.

The convergent behaviour of the salt rock does not contradict the requirement to have stable cavities in the operation phase. The stability is important, in order to guarantee the operational safety and in order to maintain the integrity of the geological barrier over unlimited time, so that there is continued protection of the biosphere.

3.14.2 Post closure monitoring

The principal focus of monitoring in the post closure phase would be on groundwater monitoring. In addition, the performance of revegetation programs would also be monitored.

Post closure monitoring objectives for the Proposal are contained within the Draft Water Management Plan contained in Appendix Q. Monitoring of groundwater and surface across the Proposal site has been in place since 2013 to determine baseline environmental conditions at and around the proposed Apirnta Facility and Chandler Facility.

Although the proposed Chandler Facility has been assessed to not result in any changes to existing groundwater conditions (refer to Chapter 8), the proponent would monitor groundwater during mine operations and after mine closure and report on the post-closure performance of the Proposal.

Monitoring results would be interpreted and analysed to identify either long-term trends or significant changes between sampling events. This is facilitated by a plot of analyte levels over time. If analytes change significantly between sampling events, a further sampling event would be conducted immediately to verify the result. If either a long-term trend is identified or a significant change between sampling events is verified, the NT EPA would be advised and the reason for the change investigated as a matter of priority.

For any perceived long-term trends to be true trends rather than normal fluctuations in environmental quality, they need to be based on a number of years of data.

The results of the monitoring program would be reported to NT EPA annually. Any anomalies would be reported within seven days of being identified

3.15 Water resources

This section provides an overview of the water resource requirements during construction and operation of the Proposal.

3.15.1 General water supply

Based on groundwater drilling research undertaken during 2014 and 2015, sufficient water could be supplied to meet calculated water demand from the Upper Langra Formation. Further information regarding water supply is provided in Chapter 8.

3.15.2 Accommodation village

During enabling works, potable water would be supplied to the accommodation village via truck that would travel to site using Maryvale Road. Following the completion of a borefield, potable water would be supplied to the accommodation village via reverse osmosis plant and pipeline.

During the peak construction period, potable water demand for a 270-person accommodation village would require a demand of approximately 16 mega litres of water. This volume is expected to fall during operation to a volume of approximately 12 mega litres for a 180-person accommodation village.

3.15.3 Construction and operation requirements

Raw water demand during construction and operation has been calculated at 54 mega litres per annum. The bulk of raw water demand would be for dust suppression and the remainder would be used in day to day operations within mine infrastructure area at the proposed Chandler Facility.

Underground hand washing stations would be similar to those used in typical underground mining operations, where the washing stand is integrated with a small reservoir, pump, and water heater.

Service water would primarily be required for the construction phase of the Proposal to supply water for drilling, dust suppression and equipment wash down. During operations, use of service water would be limited as it would be important to limit moisture at the repository to minimise the potential for condensation within the secondary ventilation shaft.

Service water would be supplied underground using a heavy-wall steel pipeline in the downcast shaft. The water main would be appropriately designed and include automatic shut-off valves in the event that the water column fails. At the base of the shaft, a pressure reducing valve would be used to reduce the static pressure to a safe working pressure. Steel pipes would distribute the water throughout the mine with down-pipes provided at regular intervals to provide access for hose connections.

3.15.4 Total water demand

Total water demand during construction has been estimated at 54 mega litres per annum. During operation, total water demand increases to 104 mega litres per annum.

3.15.5 Potable and service water

Potable water would be transferred underground in portable containers and provided to all personnel in the underground areas for both drinking and hand washing. Bottled water would be available at various locations including the underground lunch room.

3.15.6 Underground dewatering

Any seepage water from the mine access decline or vertical shafts would be collected in sumps at each of these locations and pumped to a dewatering sump.

If required, underground sump water could be used in hydraulic backfill processing. Water would be pumped to the surface via a positive displacement pump via the downcast shaft or via staged sumps up the decline.

To minimise potential contamination, the underground maintenance shop and the underground diesel fuel bay would be equipped with an isolated containment sump and bunded. These sumps would be suitable for containing any accidental fluid spills, such as fuel, oil, or engine coolant and any captured fluids would be pumped into a drum on the repository level and transferred in the main shaft cage to surface for appropriate treatment or use in hydraulic backfill processing.

The dewatering system would consist of a series of sumps. The combined storage capacity of the shaft bottom could be used for emergency and temporary water storage in the remote event of an unlikely major water in-rush.

3.15.7 Sewage

For sewage in the underground areas, toilets would be provided at the sanitary facilities. These 'mine toilets' are typical to underground mining applications and use compressed air to function as simple, small-scale sewage treatment plants. This allows the self-contained toilet/reservoir units to function for approximately 18 months before a fluid clean-out is required. These would be placed by forklift and taken to aboveground for clean-out work to be completed.

3.15.8 Stormwater management systems

All stormwater would be managed in accordance with the measures outlined in the draft Water Management Plan (refer to Appendix Q). In summary, all stormwater run-off from the mine infrastructure area, as well as any groundwater pumped to surface from underground sumps, would be directed via ditches to the stormwater management pond for treatment to remove suspended solids. The pond water could be used for dust suppression.

To control stormwater within this area, a stormwater management system would be designed to include a perimeter drainage ditch, oil/water separators and an intermediate settling pond.

Overland flow would be designed to drain directly to the perimeter drainage ditch. Sub-drains and catch basins would be used around the building areas to facilitate effective drainage, discharging to the perimeter ditch. Pumped water from the main shaft and the secondary ventilation shaft would be directed to an oil/water separator and then released into the perimeter ditch.

All of the stormwater collected by the surrounding drainage ditch would be released from a single outlet into the intermediate settling pond. The drainage water in the settling pond would be directed to a second oil/water separator and then released to the perimeter ditch which ultimately would discharge into the stormwater management pond.

Stormwater run-off from the waste rock/spoil mound area would be collected in a network of trapezoidal drainage ditches around the perimeter of this area. It would then be directed to a stormwater management pond.

Rainfall run-off volumes from the two aforementioned areas are summarised for the six hour, 25 millimetre and the 1:100 year events. The assumed run-off coefficients are also tabulated. As the surface facilities area is assumed to be predominantly paved, the run-off coefficient is correspondingly higher than for unpaved areas.

The primary function of any on-site stormwater management pond would be to control total suspended solids prior to discharge and, to contain any contaminated surface water and preventing any off-site discharge. A pond would consist of:

- A retention area for settling of particles (to a size of approximately 0.02 millimetres).
- An extended storage area for larger storm events (spill over basin).
- A low permeability base (e.g., composite or natural) with a protective cover (granular material).

The stormwater management system would be designed with capacity to:

- Retain the six hour, 25 millimetre storm for a period of 24 hours.
- Safely pass the 1 in 100 year storm event without overtopping of the embankments and erosion of the outlet system.

To prevent discharge from ponds in the unexpected event that contaminants in the discharge water exceed acceptable limits, or general discharge needs to be halted due to downstream issues, a gate would be installed on all outlets. Gates would be controlled manually and would normally remain in the open position. They would be closed in advance of storm fronts. Information on storm fronts would be obtained from the Automatic Weather Station located at the proposed Chandler Facility.

3.15.9 Erosion and sediment control

A draft Sedimentation and Erosion Management Plan has been prepared for the Proposal (refer to Appendix L). The purpose of the plan is to (a) identify risks and (b) inform the detailed design of the Proposal.

The draft Sedimentation and Erosion Management Plan outlines drainage control measures for areas within and surrounding the mine infrastructure area and spoil heaps, including the run of mine salt stockpile at the proposed Chandler Facility. The Sedimentation and Erosion Management Plan would be finalised following further topographic survey during the detailed design of the Proposal.

3.16 Utilities and services

Utilities and services would be needed throughout aboveground infrastructure and underground infrastructure at the proposed Chandler Facility and also at the proposed Apirnta Facility. Utilities and services would include:

- Air circulation.
- Water and reticulation.
- Power and reticulation.
- Gas and reticulation.
- Fuel delivery and storage.
- Communications infrastructure.
- Personal amenities.
- Waste management.
- Surface water controls.
- Groundwater controls.
- Lighting installation.
- Emergency services.

3.16.1 Air circulation

Air circulation would be provided to the underground mine through a system of fans and ducting installed throughout the mine. Fresh air fans would be installed in the mine access decline and the main shaft, booster fans would be installed throughout the mine, and exhaust fans would be installed in the secondary shaft.

3.16.2 Water and reticulation

A borefield, water storage and water treatment would be utilised for water supply during construction and operation of the Chandler Facility as described in Section 3.2.3.

Raw water would be reticulated to aboveground and underground areas through a network of balance tanks, booster pumps and piping (including down the vertical shaft). Potable water would likewise be reticulated aboveground but would be provided to underground workers in bottles.

The Apirnta Facility would also require its own raw water supply. The facility would also utilise rainwater and recaptured stormwater runoff, as appropriate.

3.16.3 Power and reticulation

Power for the proposed Chandler Facility would be generated at the hybrid solar/diesel power plant and reticulated across the site, including the aboveground and underground domains. The accommodation village and Aprinta Facility would require separate, standalone power supplies.

3.16.4 Gas and reticulation

Gas would be delivered to the Chandler Facility in tanks for use in construction and operation activities such as welding and some mining activities.

3.16.5 Fuel delivery and storage

Fuel would be delivered by appropriately licensed contractors who are able to demonstrate compliance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail*.

Fuel would be trucked to the hybrid solar/diesel power plant, as required. Fuel would also be stored at an emergency fuel storage facility at the power plant and the underground fuel storage bay.

Diesel fuel and lubrication oils would be provided by supply truck from Alice Springs to the Chandler Facility, as needed. Drums would be filled at the fuelling station and brought to the mine infrastructure area for transfer underground to the diesel fuel bay and for use by underground equipment.

The diesel fuel storage tank for the emergency diesel generators allows for 48 hours of operation of the diesel generators at 35 % loading. The storage tank would consist of an aboveground double-walled tank and would be connected directly to the generators.

Both aboveground and underground fuel storage areas would be provided with sufficient sump capacity to collect accidental spillage that could occur during fuel transfer or leakage from tanks or pipes. Berms would be constructed as needed to ensure that any spillage of fuel or lubricant is retained within the storage and refuelling areas. Space for only a single piece of mobile equipment would be provided in the underground diesel fuel bay to reduce the risk of a fire incident.

The following fuel demand is required during operation for the Proposal:

- The mobile fleet usage is as per the 1.4 million litres per annum the EPA has questioned.
- The larger component is power. A five megawatt and two megawatt solar power plant could use upwards of 8.8 million litres per annum.

3.16.6 Communications infrastructure

Communications at the Chandler Facility would be provided through a combination of fibre optics, Ethernet and wireless infrastructure established at the site – providing services such as email and VOIP technology.

3.16.7 Personal amenities

Personnel amenities would be provided at key locations around the Chandler Facility site including administration buildings, worker accommodation and a dedicated underground services area.

Sewage would be treated through modular sewage treatment plants while sludge residue would be routinely collected by appropriately licensed waste contractors for off-site management.

3.16.8 Waste management

Waste would be stored in appropriate containers such as industrial bins or drums in dedicated waste collection areas. Waste would be routinely collected by appropriately licensed waste contractors.

3.16.9 Surface water controls

Surface water controls at the Chandler Facility and Apirnta Facility would function to divert clean water away from surface infrastructure areas.

Stormwater at the Chandler Facility would include perimeter ditching along with a simple network of channels leading to stormwater ponds where runoff would collect and allow entrained sediment to settle at the bottom. Oil and water separators would be installed, where necessary.

The stormwater controls would be designed to withstand the 1 in 100 year average recurrence interval (ARI) event without releasing stormwater. Gates would be installed at stormwater ponds to enable controlled release of stormwater when water quality and downstream conditions are appropriate.

3.16.10 Groundwater controls

Groundwater in the underground area would be collected in a system of sumps and pumped to the surface for treatment and reuse, reinjection or off-site disposal. Water treatment facilities would be situated near the mine access decline and vertical shafts. The facilities would include storage and settlement tanks with appropriate treatment or amendment.

3.16.11 Lighting installation

Lighting would be installed where necessary to ensure a safe working environment. Areas to be lit include outdoor working areas, buildings and surface infrastructure and areas of the underground salt mine.

3.16.12 Emergency services

The closest emergency services that may be required for assistance in the event of an emergency situation are those located in Alice Springs. Emergency response facilities would, however, be established on-site to enable an appropriate, fast response in the event of an emergency such as a fire or hazardous spill.

These facilities would include emergency communication devices, firefighting equipment and spill clean-up equipment. An emergency phone system would also be established. The system would be independent of power and communications systems in order to remain functional in the unlikely event of a breakdown. The emergency response facilities would be situated at both at the proposed Chandler Facility and Apirnta Facility.

The Chandler Haul Road would also be appropriately designed to allow for light aircraft (operated by the Royal Flying Doctors Service) to land on-site in the event of a medical emergency. The section of road would be designed to relevant standards for remote airstrips, including those specified by the Royal Flying Doctors Service.