TALISON LITHIUM

Talison Lithium Australia Pty Ltd

Greenbushes Lithium Mine Expansion

Environmental Referral Supporting Report

July 2018

GHD

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

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Acronyms

AHD	Australian Height Datum
AH Act	Aboriginal Heritage Act
AMA	Active Mining Area
AMD	Acid and Metalliferous Drainage
ANZECC	Australian and New Zealand Environment and Conservation Council
ASS	Acid Sulfate Soils
BAM Act	*Biosecurity and Agricultural Management Act 2007*
BBG	Blackwood Basin Group
bgl	below ground level
BMB	Balingup Metamorphic Belt
BoM	Bureau of Meteorology
CENRM	Centre of Excellence in Natural Resource Management
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
dB(A)	A-weighted decibels
DER	Department of Environment Regulation (former)
DoEE	Department of the Environment and Energy
DMIRS	Department of Mines, Industry Regulation and Safety
DPLH	Department of Planning, Lands and Heritage
DRF	Declared Rare Flora
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Envirnmentally Sensitive Area
GAMG	Global Advanced Metals Greenbushes Pty Ltd
Ha	hectare
IBRA	Interim Biogeographic Regionalisation of Australia
ILUA	Indigenous Land Use Agreement
IUCn	International Union for Conservation of Nature
Mbcm	Million bank cubic metres
MDE	Mine Development Envelope (Proposal area)

Mining Act	*Mining Act 1978*
MNES	Matters of National Environmental Significance
Mtpa	Million tonne per annum
PASS	Potential Acid Sulfate Soils
PAF	Potentially Acid Forming
PEC	Priority Ecological Community
NAF	Non Acid Forming
PDWSA	Public Drinking Water Source Area
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in diameter
PM_{10}	Particulate matter less than or equal to 10 microns in diameter
RL	Reduced Level
SWALSC	South West Aboriginal Land and Sea Council
SWMP	Surface Water Management Plan
TEC	Threatened Ecological Community
Talison	Talison Lithium Australia Pty Ltd
TSF	Tailings Storage Facility
tpa	tonnes per annum
UWA	University of Western Australia
WA	Western Australia
WC Act	*Wildlife Conservation Act 1950*
WoNS	Weeds of National Significance
WRL	Waste Rock Landform
WRP	Western Ringtail Possum

Executive summary

Talison Lithium Australia Pty Ltd (**Talison**) is proposing to expand the existing Greenbushes Lithium Mine (**the Mine**), to increase the production of spodumene ore and lithium mineral concentrate from the operation (**the Proposal**). The mine is located immediately south of the town of Greenbushes, approximately 250 km south east of Perth, Western Australia (**WA**).

The Greenbushes region is recognised as the longest continuously operated mining area in WA, with mining of tin having commenced in 1888. Tin, tantalum and lithium mining have all occurred throughout the history of mining activity in the area. Modern day hard rock, open cut mining of the Greenbushes deposit commenced in 1983 for tantalum and lithium. From the 1980's to the early 2000's tantalum mining and processing has been the primary activity, however changing market conditions have led to tantalum production being limited, and lithium mining and production being the key activities at the Mine since the early 2000's (Talison 2016).

The existing mining operation is located predominately within the Greenbushes State Forest (**State Forest 20**) with the surrounding region comprising the State Forest, agricultural properties, tree plantations, water storage and urban environment (Greenbushes townsite). The proposed expansion will involve the merging of the existing open pits to develop an expanded open pit, extension of the Floyds Waste Rock Landform (**WRL**) footprint, establishment of a new tailings storage facility (**TSF**) adjacent to existing facilities, and construction and operation of new infrastructure including a new Mine Services Area (**MSA**), explosive storage facilities, a new crushing circuit and two new spodumene processing plants.

The mining rate will increase to approximately 16 million bank cubic metres (**Mbcm**) as a result of the expansion producing an anticipated 9.5 million tonnes per annum (**tpa**) of spodumene ore. Processing of the ore will produce up to 2.3 million tonnes of lithium mineral concentrate. Lithium mineral concentrates from the operation will continue to be transported to the Ports of Bunbury and Fremantle (limited volumes) for export as per current arrangements, and will also supply the Tianqi Lithium Process Plant under construction in Kwinana, and the Albemarle Lithium Process Plant proposed for construction in the Kemerton Strategic Industrial Area north of Bunbury.

The Proposal will create approximately 300 jobs during the construction phase, and will increase the number of employees for the operational phase from the current 220 people to approximately 650 when full production is reached. Talison will seek to employ locally, where possible, for the Mine. Staff are predominantly expected to be drawn from the nearby towns of Greenbushes, Balingup, Bridgetown and Donnybrook. Talison has an active presence in the community and has commenced consultation with stakeholders in relation to the expansion plans.

The current Active Mine Area boundary (authorised under *Mining Act 1978* approvals) will expand from the 1,591 hectare (**ha**) approved area to a 1,989 ha Mine Development Envelope (**MDE**) (398 ha or 25% increase). Approximately 66% of the MDE has already been disturbed as a result of the extensive history of mining within the area, as well as forestry, water storage and supply, surrounding agriculture activities and edge effects from the town of Greenbushes. The expansion activities require native vegetation clearing of up to 350 ha within the surrounding State Forest 20 on mining tenure. The native vegetation is predominantly Jarrah-Marri forest and Jarrah-Marri forest with banksia understory and is well represented within the conservation estate at a local and regional level. No threatened flora or vegetation communities occur within the MDE. Some areas of the MDE and surrounding State Forest 20 are affected by dieback and weeds due to the extensive history of disturbance in the region.

Native vegetation clearing will impact on the habitat of Matters of National Environmental Significance (**MNES**) including Baudin's, Carnaby's and Forest Red-tailed Black Cockatoos, Chuditch, and possibly the Western Ringtail Possum (**WRP**). The expansion has been referred to

the Federal Department of the Environment and Energy (**DoEE**) for consideration due to the impact on MNES. Other conservation significant fauna known to occur within the native vegetation habitat within the MDE include Wambenger Brush-tailed Phascogale, Quenda and the Western Brush Wallaby.

Groundwater supply in the area is limited, therefore the operation relies primarily on surface water supplies from within the MDE. Water conservation and management is consequently a key priority for the operation and is managed in accordance with a Surface Water Management Plan (**SWMP**).

A number of material characterisation studies have been undertaken on the ore, waste and tailings materials produced by the existing Mine, which have identified a small amount (~1%) of potentially acid forming (**PAF**) waste rock. A further study is underway to characterise materials from the expanded open pit. Talison has an established management procedure for encapsulating the waste within the waste rock landform to prevent acid and metalliferous drainage from occurring. Mining and waste rock storage using the established method has been occurring for over 30 years. Monitoring of seepage from the waste rock landform shows no evidence of acid and metalliferous drainage impacts occurring.

The nearest sensitive receptors to the Mine are within the town of Greenbushes approximately 100 m from the MDE northern boundary. The proposed expansion will increase the scale and impact of the mining operation. This will potentially result in impacts of noise, dust and visual amenity being experienced by surrounding landholders to the south and east, who have not previously experienced these impacts.

The environmental impacts of the Mine have historically been managed through operating licences and clearing permits granted in accordance with Part V of the *Environmental Protection Act 1986,* and tenement conditions and approvals granted in accordance with the *Mining Act 1978*. Recent vegetation clearing which impacted on the habitat of threatened black cockatoos (MNES) has also been undertaken in accordance with the requirements of an Approval of a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999*. The Mine expansion could potentially be managed under this existing regulatory regime.

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1. Introduction

1.1 Purpose of this document

The Greenbushes Lithium Mine (**the Mine**) is an existing mining operation owned and operated by Talison Lithium Australia Pty Ltd (**Talison**, or **the Proponent**). Talison currently undertakes mining and processing of spodumene ore at the Greenbushes Lithium Mine to produce a lithium mineral concentrate of approximately 6% Lithium Oxide (**Li_2O**). Talison proposes to undertake an expansion of the existing Greenbushes Lithium Mine to increase the production of spodumene ore and lithium mineral concentrate from the Greenbushes deposit (**the Proposal**). The expansion will occur at the existing operation, which is located immediately south of the Greenbushes townsite, approximately 250 km south of Perth, and 80 km south east of Bunbury in Western Australia (**WA**) (Figure 1).

Talison is referring this Proposal under section 38 of the *Environmental Protection Act 1986* (WA; **EP Act**) as a proposal which may have a significant effect on some of the Environmental Factors defined by the WA Environmental Protection Authority (**EPA**). This document has been prepared to support the formal referral for the Proposal under section 38 of the EP Act. It provides information on the Proposal activities, potential environmental impacts and proposed mitigation measures associated with the expansion of the Mine. This document has been prepared in accordance with *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016* (WA).

1.2 The Proponent

The Proponent for this Proposal is Talison Lithium Australia Pty Ltd, ABN 39 139 401 308, a wholly owned subsidiary of Windfield Holdings Pty. Windfield Holdings Pty Ltd is ultimately owned by Tianqi Lithium Industries Inc (China, 51%) and Albemarle Corporation (USA, 49%).

The contact for Talison in relation to this Proposal is:

Stephen Green

Manager – Workplace Health, Safety, Training and Environment

Telephone: +61 8 9782 5700

Email:steve.green@talisonlithium.com

1.3 Environmental Impact Assessment Process

Talison is referring this Proposal under section 38 of the EP Act as a proposal which may have a significant environmental impact on environmental factors including:

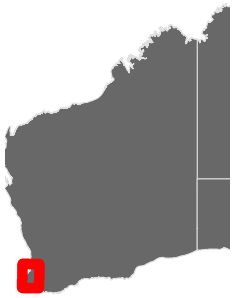
- Flora and Vegetation;
- Terrestrial Fauna;
- Terrestrial Environmental Quality;
- Hydrological Process;
- Inlands Waters Environmental Quality;
- Air Quality; and
- Social Surroundings.

Greenbushes Lithium Mine

Regional Location Plan

Legend

- Project Area
- Primary Roads
- Railways
- Rivers



GEOGRAPHE BAY

BUNBURY

BUSSELTON

GREENBUSHES

PROJECT AREA

BRIDGETOWN

OLD COAST ROAD

SOUTH WESTERN HIGHWAY

MURRAY RIVER

BRUNSWICK RIVER

COLLIE RIVER

COALFIELDS ROAD

FERGUSON RIVER

PRESTON RIVER

DONNYBROOK BOYUP BROOK ROAD

BUSSELL HIGHWAY

SUES ROAD

BROCKMAN HIGHWAY

BLACKWOOD RIVER

VASSE HIGHWAY

DONNELLY RIVER

STEWART HIGHWAY

MUIRS HIGHWAY

WARREN RIVER

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Date:	12/07/2018
Status:	Final
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1.4 Other Approvals and Regulation

The Mine is located predominately within the Greenbushes State Forest (**State Forest 20**). The surrounding area outside State Forest 20 includes agricultural properties, tree plantations and urban environment (Greenbushes townsite) (Talison 2011). Expansion of the Mine will extend the operation outside of State Forest 20 and into the agricultural area. Talison hold Mining and General Purpose Lease tenure over the extent of the Mine Development Envelope (**MDE**) for this Proposal. The tenure within the MDE is summarised below and illustrated in Figure 2.

- M01/3
- M01/6
- M01/7
- M01/8
- M01/9
- M01/16
- G01/1
- G01/2

Modern hard rock mining of the Greenbushes deposit commenced in 1983 with the first lithium processing plant commissioned in 1985 (Talison 2011). The mine has been subject to various regulatory requirements since this time. The potential environmental impacts of the existing Mine are currently regulated primarily through authorisations under the *Mining Act 1978* (WA; **Mining Act**), EP Act and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth; **EPBC Act**). A summary of current approvals which apply to the Mine is included in Table 1.

The approvals relate to mining and processing of lithium and tantalum, as there are currently two companies operating within the mining tenure. A tantalum business owned by Global Advanced Metals Greenbushes Pty Ltd (**GAMG**) (ABN 56 125 585 284) is operating within the same tenements, under a shared services agreement between the two parties. Further explanation regarding the two operations is included in sections 2.1 and 2.4.

Table 1 Approved Mining Activity at Greenbushes Lithium Mine

Element	***Mining Act 1978*** **Mining Proposal and Closure Plan**	***Environmental Protection Act 1986*** **Category 5 prescribed premises** (processing or beneficiation of metallic ore or non-metallic ore)	***Environmental Protection Act 1986*** **Category 5 prescribed premises- Category 44: prescribed premises-** (metal smelting or refining)
Recent approvals	MP ID 45382 – 2013 Continuation of Hardrock Mining III MP ID 56542 – 2015 Expansion of TSF2 MP ID 63657 – 2016 Lithium Plant Upgrade, CGP2 MP ID 70390 – 2017 Talison Crusher 1, Water Treatment Plant and Clear Water Dam MP ID 60857– 2016 Mine Closure Plan	L4247/1991/13 (Amended July 2016 to expand TSF2) Amendment Notice 1 (Surface water management) Amendment Notice 2 (CGP2 and Talison Crusher 2) Amendment Notice 3 (Talison Crusher 1, WTP and CWD)	L8501/2010/2 Amendment Notice 1 (Licence extension)
Life Of Project/Expiry	2035	Licence Expiry 2026	Licence Expiry 2026
Tonnes of Ore per Annum	8.7 Mt	4.7 Mtpa	4.0 Mtpa
Process Plant(s) and Crusher[1]	<u>Talison Infrastructure</u> TGP 0.4 Mt CGP1 1.9 Mt CGP2 2.4 Mt Talison Crusher 1 2.4 Mt Talison Crusher 2 2.4 Mt Total capacity 4.7 Mtpa <u>GAMG Infrastructure</u> Primary Tantalum Plant 4.0 Mt Secondary Tantalum Plant GAMG Crusher 4.0 Mt Total capacity 4.0 Mtpa	TGP 0.4 Mt CGP1 1.9 Mt CGP2 2.4 Mt Talison Crusher 1 2.4 Mt Talison Crusher 2 2.4 Mt Total capacity – 4.7 Mtpa	Primary Tantalum Plant 4.0 Mt Secondary Tantalum Plant GAMG Crusher 4.0 Mt Total capacity – 4.0 Mtpa, 7,000 tonnes of product roasted
Average tonnes of waste mined	7.26 Mtpa	NA	NA
Waste to Ore ratio	2.2 :1 (Li only) 1.2:1 (Li&Ta combined)	NA	NA
Total Volume of Pit	77 Mbcm (22 yrs) Incl Li & Ta pits	NA	NA
Depth of Pit	1020 m RL 310m deep	NA	NA
Waste Dumps	45-50 Mbcm (total)	NA	NA

Element	*Mining Act 1978* **Mining Proposal and Closure Plan**	*Environmental Protection Act 1986* **Category 5 prescribed premises** (processing or beneficiation of metallic ore or non-metallic ore)	*Environmental Protection Act 1986* **Category 5 prescribed premises- Category 44: prescribed premises-** (metal smelting or refining)
	Floyd's WRL height limit mine RL 1330 m (equal to 330 m AHD)		
Tailings Storage	75 Mt (total) TSF 1 (approved to height 282 mRL) and TSF 2 (approved raises to height 280 mRL) TSF 3 – under rehabilitation	5 Mtpa deposited to TSF 2 (TSF 1 is authorised for emergency deposition) Approval for 5 m raises of TSF2 to 280 mAHD	Discharge volume not specified. Tailings discharge to Talison managed TSF in accordance with operating licence L4247/1991/13
Water Infrastructure	NA	Clear Water Pond Clear Water Dam (under construction) Water Treatment Plant (under construction) Austins Dam Southampton Dam Cowan Brook Dam (infrastructure management in accordance with the Site Surface Water Management Plan)	Use of Talison infrastructure under agreement (infrastructure management in accordance with the Site Surface Water Management Plan)
Area of disturbance	1016.20 ha total Open pit - 229 ha (*Cornwall pit and decline, Cornwall North and C1-C3, approved to combine into a single open pit*) WRL - 272 ha (*IP WRL, Floyds WRL*) Tailings storage - 298 ha (*TSF1-3*) Water circuit - 161 ha (*Austin's, Southampton and Cowan Brook Dams, CWP and CWD*)	NA	NA
Mine Closure Plan	Revised 2016 (next revision due 2019)	NA	NA

*Note 1 – Technical grade plant (**TGP**) produces high grade lithium, a low impurity product for use in production of glass and ceramics. Chemical Grade Plant (**CGP**) produces lower grade product which is transported offsite for further processing to lithium chemicals for use in batteries and lubricants*

Note 2 – TSF – Tailings storage facility, WRL – Waste rock landform, TGP – Technical Grade Plant, CGP – Chemical Grade Plant, CWP – Clear Water Pond, CWD – Clear Water Dam, Mtpa – Million tonne per annum

Clearing for the current (approved) mining activities is undertaken under a Permit to Clear Native Vegetation purpose permit (CPS 5056/2) issued under section 51M of the EP Act. The permit authorises clearing of no more than 120 ha across M01/3, M01/6, M01/7, M01/16, G01/1 and G01/2. A second purpose permit (CPS 5057/1), is held which authorises up to 10 ha of clearing

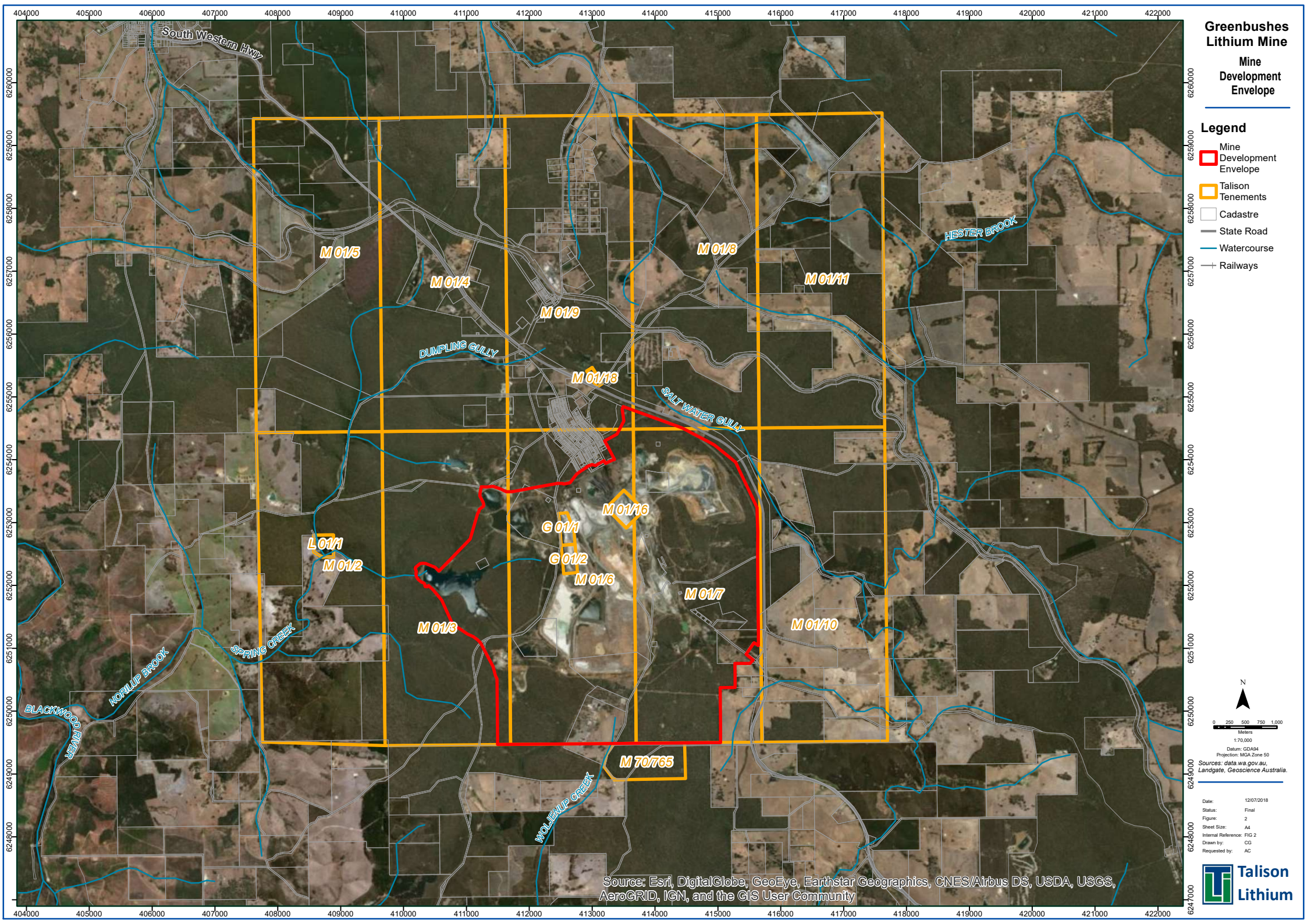
for rehabilitation purposes. Clearing for expansion of the Floyds Waste Rock Landform (**WRL**) was referred to the Department of the Environment and Energy (**DoEE**) (EPBC 2013/6904) in 2013 due to potential impact of the clearing on Matters of National Environmental Significance (**MNES**) (Black Cockatoo Habitat). The clearing was deemed a controlled action and in 2016 approval was granted to clear up to 75.7 ha of black cockatoo habitat for the WRL expansion subject to conditions and offsets.

It is anticipated that the regulatory regime currently applicable to the Mine can be extended to encompass the proposed expansion activities if the Proposal is not formally assessed by the Environmental Protection Authority (**EPA**). A summary of the additional approvals required for the expansion is included in Table 2. All approvals listed in the table (except the Native Vegetation Clearing Permit) are required for the expansion irrespective of whether the Proposal is assessed under Part IV of the EP Act.

Table 2 Summary of regulatory approval requirements for the Greenbushes Lithium Mine Expansion Proposal

Activity	Location	Approval Type	Legislation regulating the activity
Clearing Clearing of native vegetation (which includes impact on habitat of Black Cockatoos, Chuditch, Wambenger Brush-tailed Phascogale, Quenda, Western Brush Wallaby and also likely Western Ringtail Possum.)	M01/3, M01/6, M01/7	Native Vegetation Clearing Permit[1]	s51E of the EP Act
		Controlled Action – Assessment approach to be determined	EPBC Act
Processing Construction and operation of CGP3, CGP4, Talison Crusher 3 and a conveyor	M01/6,	Mining Proposal	Mining Act
		Works approval (construct) and licence amendment (operate)	Part V Div 3 of the EP Act
Mining Expansion of the Talison CR2 ROM Expansion of the open pit Expansion of Floyds WRL	M01/6, M01/7	Mining Proposal	Mining Act
Tailings storage New tailings storage facility, TSF4	M01/3, M01/6, M01/7	Mining Proposal	Mining Act
		Works approval (construct) and licence amendment (operate)	EP Act 1986, Part V Div 3
Supporting infrastructure New mine services workshop area New batching plant and explosive magazine Miscellaneous linear infrastructure (roads, pipelines, power supply)	M01/3, M01/6, M01/7	Mining Proposal	Mining Act
		Building permits	*Building Act 2011* (WA)
		Permit to install an apparatus for the treatment of sewage	*Health Act 1911* (WA)
Storage of Dangerous Goods	M01/3, M01/6, M01/7	Dangerous Goods Storage Licence	*Dangerous Goods Safety Act 2004* (WA) *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007* (WA)
Closure and Rehabilitation	All	Updated Mine Closure Plan	Mining Act

Note 1 – A Clearing Permit will not be required in the event this Proposal is assessed by the EPA under Part IV, EP Act


Greenbushes Lithium Mine
Mine Development Envelope
Legend
Mine Development Envelope
Talison Tenements
Cadastre
State Road
Watercourse
Railways
South Western Hwy
M 01/5
M 01/4
M 01/9
M 01/8
M 01/11
HESTER BROOK
DUMPLING GULLY
M 01/18
SALT WATER GULLY
M 01/16
G 01/1
G 01/2
M 01/6
L 01/1
M 01/2
M 01/3
M 01/7
M 01/10
SPRING CREEK
NORILUP BROOK
BLACKWOOD RIVER
M 70/765
WOLLENUP CREEK
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Requested by: AC
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2. The Proposal

2.1 Background

The Greenbushes region is recognised as the longest continuously operated mining area in WA, with the discovery of tin occurring in 1886, and subsequent mining commencing in 1888 (Talison 2011). Mining of tin, tantalum and lithium have all occurred throughout the history of mining activity in the area. Open cut mining of tantalum commenced in the 1940's when World War II stimulated demand. Mining was initially focussed on the weathered regolith resource. Hard rock processing facilities for tantalum ore were commissioned in 1992 (Talison 2016). Open cut hard rock mining of spodumene (lithium bearing mineral) commenced at the Mine in 1983. From the 1980's to the early 2000's tantalum mining and processing has been the primary activity undertaken.

Between 1999 and 2003, there was a major change in the markets for both tantalum and lithium products. The tantalum market was depressed, resulting in tantalum mining and primary processing operations at the Mine being placed on care and maintenance in 2006. Limited secondary processing of tantalum concentrates sourced from external sources, secondary process tailings, and as a by-product of lithium production continued. From 2006, the lithium market experienced substantial growth, resulting in the progressive expansion of the Lithium operations. In 2010 the ownership of the lithium assets and the tantalum and other minerals assets were separated (the Mine was previously owned and operated by a single entity).

The tantalum and other minerals assets (primary and secondary tantalum processing plants and crusher) and mining rights are currently owned and operated by GAMG. The lithium assets (remainder of the operational infrastructure and waste landforms) and mining rights are owned and operated by Talison. GAMG's tantalum operations (with the exception of the secondary process plant) are currently under care and maintenance. GAMG's secondary processing inputs are anticipated to increase based on supply from Talison's primary processing and potential third party supply from other tantalum operations in WA. The scale of the tantalum operation is not expected to reach current approved levels. Contractual arrangements are in place between the two companies for Talison to provide essential services and access to GAMG including environmental services, tailings storage and water management.

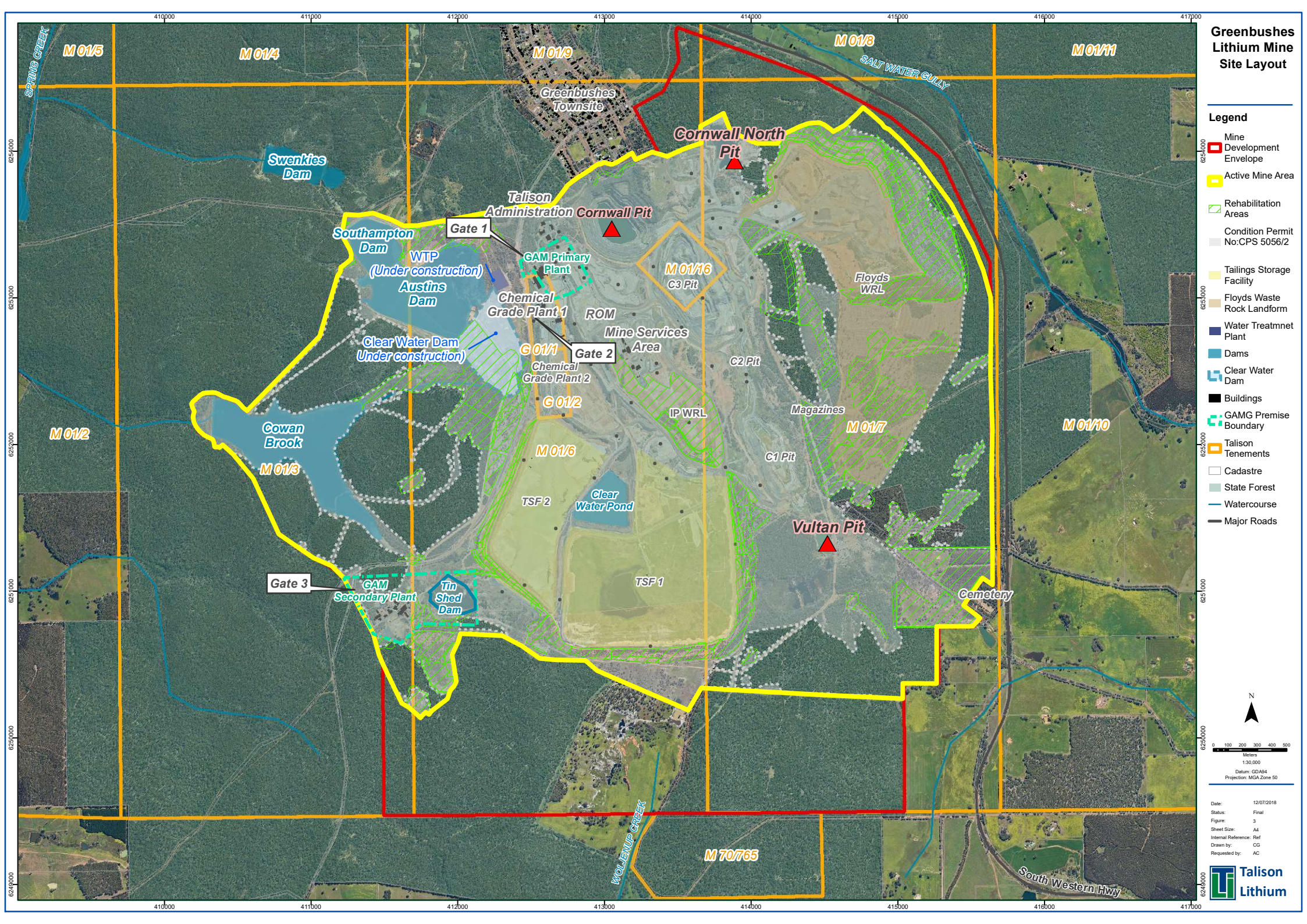
The current Mine is concentrated to the east of Maranup Ford Road, west of South West Highway, and south of the town of Greenbushes. It is predominantly within State Forest 20, and located on top of part of the southern section of the Darling Scarp. The main ore body is orientated north-northwest to south-southeast and lies along a ridgeline that rises to approximately 320 m Australian Height Datum (**AHD**). The method of extraction is open-pit using drill and blast, and load and haul to remove the hard rock which is then subsequently crushed and processed. Extracted ore is processed through either a technical grade (**TG**) or chemical grade (**CG**) plant to produce a lithium mineral concentrate via predominantly gravity processing methods. Tailings from mineral processing are discharged into an above ground TSF.

A summary of infrastructure comprising the existing Mine and GAMG Tantalum Operation is listed in Table 3. The existing, approved mine layout is illustrated in Figure 3.

Table 3 Summary of existing infrastructure at the Greenbushes Operation

Mining Infrastructure	Processing Infrastructure	Supporting Infrastructure
Greenbushes Lithium Mine Infrastructure (Talison)		
Lithium Pits C1-C3	Talison TGP1(0.4 Mtpa)	Austin's Southampton Water Circuit (dams)
Floyds WRL	Talison CGP1 (1.9 Mtpa)	Cowan Brook Water Supply Dam
IP WRL	Talison CGP2 (2.4 Mtpa) under construction	Administration Area
Explosives magazine	Talison Crusher 1 and 2 and ROM under construction	Warehouse
Miscellaneous haul roads and tracks	TSF 1 (inactive)	Mine Services Area
Rehabilitated historic disturbance areas	TSF 2 (active)	Miscellaneous linear infrastructure including pipelines, powerlines and access tracks
	Clear Water Pond	
	Clear Water Dam and Water Treatment Plant (under construction)	
	Rehabilitated historic TSFs (TSF 3)	
Greenbushes Tantalum Operation Infrastructure (GAMG)		
Cornwall Open Pit and underground (tantalum mining, inactive used for water storage)	GAMG Primary Process Plant and Crusher	*Use of Talison supporting infrastructure under agreement*
	GAMG Secondary Process Plant	Tin Shed Dam

Note 2 – TSF – Tailings storage facility, WRL – Waste rock landform, TGP – Technical Grade Plant, CGP – Chemical Grade Plant, GAMG – Global Advanced Metals


Greenbushes Lithium Mine Site Layout
Legend
Mine Development Envelope
Active Mine Area
Rehabilitation Areas
Condition Permit No:CPS 5056/2
Tailings Storage Facility
Floyds Waste Rock Landform
Water Treatmnet Plant
Dams
Clear Water Dam
Buildings
GAMG Premise Boundary
Talison Tenements
Cadastre
State Forest
Watercourse
Major Roads
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Requested by: AC
Talison Lithium
SPRING CREEK
M 01/5
M 01/4
M 01/9
M 01/8
SALT WATER GULLY
M 01/11
Greenbushes Townsite
Cornwall North Pit
Swenkies Dam
Talison Administration
Cornwall Pit
Southampton Dam
Gate 1
WTP (Under construction)
GAM Primary Plant
M 01/16
C3 Pit
Floyds WRL
Austins Dam
Chemical Grade Plant 1
ROM
Mine Services Area
Clear Water Dam (Under construction)
G 01/1
Gate 2
Chemical Grade Plant 2
C2 Pit
G 01/2
IP WRL
Magazines
M 01/7
M 01/10
M 01/2
Cowan Brook
M 01/3
M 01/6
C1 Pit
TSF 2
Clear Water Pond
Vultan Pit
Gate 3
GAM Secondary Plant
Tin Shed Dam
TSF 1
Cemetery
WOLLENUP CREEK
M 70/765
South Western Hwy
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412000
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6252000
6251000
6250000
6249000

2.2 Justification

Mining has occurred in the Greenbushes region since 1888 via a variety of mining methods (shafts, alluvial mining and dredging). Hard rock open cut mining of lithium (and tantalum) ores has been undertaken at the Mine since 1983.

The mine is globally recognised as a high grade deposit and is the world's largest hard rock lithium reserve. There is currently a global surge in the demand for lithium products and it is expected that annual demand for lithium will continue to rise significantly as a result of the increased usage of lithium for battery applications. Primary drivers of lithium demand are expected to come from hybrid and electric cars, electrical grid storage, power tools, mobile phones and computers.

Talison is a global leader in the production of lithium mineral concentrate and produces two categories at the Mine. Technical-grade lithium mineral concentrate with low iron content, primarily for feedstock for glass and ceramic industries, and high yielding chemical grade concentrate used to produce lithium chemicals for lithium-ion batteries and lithium based greases. Talison is well placed to realise the economic benefits of the growing demand for lithium products through the proposed expansion of the existing Mine.

No feasible alternatives to the proposed expansion of the Mine have been identified.

Talison has considered a 'no development alternative' for the Mine expansion. The resource at the Mine has been defined to extend beyond the current developed area of the mine and approved extents. Not proceeding with the expansion would mean a loss of the associated economic, social and employment opportunities developing the additional resource will bring to the South West and WA. The current climate of increased demand for lithium products may reduce in the future therefore not proceeding with the expansion of the Mine now could mean the loss of the economic opportunity to develop the expanded resource. Increased production from the mine will also enable more efficient extraction of the ore body, therefore not proceeding with the expansion will limit production to current levels and restrict the opportunity to improve the efficiency of the operation to maximise resource recovery.

Currently lithium mineral concentrate from the Mine is exported overseas for further refinement. The two owners of Talison's parent company, Tianqi Lithium Industries Inc (**Tianqi**) and Albemarle Corporation (**Albemarle**), are both developing or proposing to develop downstream processing operations, at Kwinana and Kemerton (WA) (these Projects are not directly linked to this Proposal and are undergoing separate approval processes). The proposed lithium processing plants will undertake refining of lithium mineral concentrate produced from the Mine. The expansion of the Mine will provide sufficient feed for the two processing plants and existing supply commitments. Current production levels only supply approximately half the anticipated demand of the two plants. As previously stated, global lithium demand is increasing, therefore in the event the lithium processing plants are not developed, lithium mineral concentrate produced from the Mine as a result of this Proposal will be exported as per current arrangements.

The Proposal to expand the Mine will promote economic activity and growth in the South West Region as it will support the development of two new lithium processing plants in the region. The expansion will provide economic benefit to the South West Region through increased direct and indirect employment opportunities at the Mine, and support of local suppliers, distributors and services during construction and operation phases. Direct employment at the mine is expected to increase from current numbers of approximately 220 mining staff to 650 mining staff for operation of the expanded Mine.

The expansion area has been selected as it is located predominantly immediately south of the current mining areas. The majority of the expansion footprint occurs within the existing approved Active Mining Area boundary for the operation with only the TSF4 and Mine Services Area (**MSA**) planned to be located outside the existing boundary. The MDE has been subject to impacts from

mining activity over an extended period of time (130 years). The surrounding State Forest 20 has also previously been subject to forestry activities (logging and plantation areas) which have impacted on the vegetation and habitats present. Where feasible, the expansion footprint is planned to occur in areas which have previously been subject to some degree of mining or agricultural disturbance.

Alternative strategies for waste rock and tailings storage involving use of the existing pits are currently not available. This option is currently not able to be considered for the Mine as the lithium resource is open at depth. The ore body is known to extend to over 500 m deep and is still open at this depth. The expanded pit only extends to 450 m depth.

The Mine has an excellent history of environmental performance. The Mine operates in accordance with the conditions and requirements of existing approvals, licenses and permits, and maintains positive relationships with regulatory and community stakeholders. The Mine has been operating since 1983 with no significant impacts to the environment having occurred as a result of activities at the Mine during this time. Talison has also improved the surrounding environment throughout the history of the operation of the Mine through an ongoing program of rehabilitation of historic mining areas such as shafts, alluvial mining and dredging operations which remained from late 19th, and early 20th century mining activity. The progressive rehabilitation program undertaken by Talison has reduced the area of disturbance associated within the mining operation over time from its original extent.

Talison strives to attain a high level of environmental performance through the implementation and maintenance of an integrated management system which is certified to International Standards ISO 9001:2015 Quality Management System requirements by Bureau Veritas. Part of the integrated management system is the site Environmental Management System (**EMS**) which is also certified, to ISO 14001:2015 EMS requirements. Talison undertakes regular review of the EMS and implements any improvements identified to reduce the impact of the mining operation on the surrounding environment and neighbouring communities.

2.3 Proposal Description

Talison proposes to undertake an expansion of the Mine to increase the production of lithium mineral concentrate from the Greenbushes deposit to meet the increasing global demand for lithium products. The expansion will increase production at the Mine from the current 4.7 million tonne per annum (**Mtpa**) to 9.5 Mtpa of spodumene ore to produce up to 2.3 Mtpa of lithium mineral concentrate.

The expansion will require the current approved operational boundary (Active Mining Area) to be extended to the south, with a smaller extension to the north, increasing the current (approved) area of 1,591 hectare (**ha**) to a 1,989 ha MDE. This represents a 398 ha (25%) increase to the current approved extent of the Mine. The MDE will include additional areas of State Forest 20 and agricultural land. Up to 350 ha of native vegetation clearing (outside existing CPS 5056/2 approved areas) is required within the MDE for the expansion.

The Key Characteristics of the Proposal are summarised in Table 4 and discussed in further detail in the following sections. The approximate layout of the expanded Mine is illustrated in Figure 4.

Table 4 Greenbushes Lithium Mine Expansion Key Characteristics

Proposal title	Greenbushes Lithium Mine Expansion		
Proponent name	Talison Lithium Australia Pty Ltd		
Proposal Activities	The Proposal is to undertake Stage 3 and Stage 4 expansion of the existing Greenbushes Lithium Mine in the Shire of Bridgetown - Greenbushes, WA. The Proposal includes the following: • Developing an expanded open pit; • Establishment of two additional chemical grade processing plants, a crusher and centralised ROM; • Establishment of a new Mine Services Area and explosives storage and handling infrastructure; • Expansion of the existing Floyds WRL; • Construction of an additional TSF4; and • Establishment of additional linear infrastructure corridors (Bypass Road, powerline, pipeline and road corridors).		
Element	**Location**	**Previous Approved Extent (Mining Proposal &/or Part V Operating Licence)**	**Proposed Extent**
Physical			
Mine Development Envelope (MDE)	Figure 4 M01/3, M01/6, M01/7, M01/8, M01/9, M01/16, G01/1, G01/2	The approved Active Mining Area for the Greenbushes Lithium Mine is 1,591 ha. A Clearing Permit (CPS 5056/2) has been previously approved authorising up to 120 ha of native vegetation clearing within the Permit boundary which occurs within the Active Mining Area	The MDE for the Greenbushes Lithium Mine Expansion is 1,989 ha. The total area of native vegetation clearing required (outside current approved areas) within the MDE is 350 ha.
Expanded Open Pit	Figure 4 M01/6, M01/7, M01/16	Existing approval authorises three existing open pits C1, C2 and C3 to be combined and extended to a single pit approximately 2.8 km long by 750 m wide and 310 m deep.	An expanded open pit will be developed which is approximately 2.8 km long, 1.0 km wide and up to 450 m deep (footprint of approximately 180 ha). The expanded open pit is predominately within already disturbed areas. The mining rate will increase to approximately 16 million bank cubic metres (**Mbcm**) producing an anticipated 9.5 Mtpa of spodeumene ore.
Expanded ROM	Figure 4 M01/6,	Existing approved ROM	Expand the existing Talison CGP2 ROM to approximately 21 ha within the existing disturbance footprint.
Processing Infrastructure	Figure 4 M01/6	TGP 0.4 Mt CGP1 1.9 Mt CGP2 2.4 Mt Talison Crusher 2 2.4 Mt Talison Crusher 1 2.4 Mt Total processing capacity 4.7 Mtpa All existing processing infrastructure is to the east of the Maranup Ford Road.	Establish two new Chemical Grade Processing Plants (CGP3 and CGP4) to the west of Maranup Ford Road. A three stage crusher (Talison Crusher 3) will be established to the east of Maranup Ford Road at the expanded ROM with a conveyor established linking the crusher to CGP3 and CGP4. Each plant will

Proposal title	Greenbushes Lithium Mine Expansion		
			have a design throughput capacity of 2.4 Mtpa and an expected combined production capacity of up to 1.0 Mtpa lithium mineral concentrate. The Plants will be established within a partially disturbed area and therefore will require some native vegetation clearing outside the existing CPS 5056/2 boundary. The footprint of CGP3 and CGP4 will be approximately 45 ha.
Mine Services Area (MSA)	Figure 4 M01/6 M01/7	Mine Services area located on the IP WRL.	Establishment of a MSA approximately 32 ha. The facility will require native vegetation clearing outside the existing CPS 5056/2 boundary. Existing facility location will be consumed by the expanded pit.
Explosives Magazine and batching facility	Figure 4 M01/3,	Explosives Magazine between C3 open pit and Floyds WRL	Establishment of a new site magazine and batching facility to the west of Maranup Ford Road. The facilities will require native vegetation clearing outside the existing CPS 5056/2 boundary. Existing facility location will be consumed by the expanded pit.
Waste Rock Landform (WRL)	Figure 4 M01/7	Floyds WRL approved footprint is 119 ha and the approved height limit is a final height of 330 mAHD	Expand Floyd's WRL beyond the existing approved extent to a final footprint of approximately 355 ha and a final height of 330 mAHD. Clearing of rehabilitation and native vegetation outside previously approved areas is required for the expansion of the WRL.
Tailings Storage Facility	Figure 4 M01/3, M01/6, M01/7	TSF 1 (approved to height 282 mRL) and TSF 2 (approved raises to height 280 mRL) TSF 3 –decommissioned and under rehabilitation	New TSF4 to be constructed immediately south of the existing TSFs having a footprint of approximately 240 ha.
Linear supporting infrastructure	M01/3, M01/6, M01/7	Not specified, miscellanesous roads, tracks, pipelines and powerlines have been developed within the approved Active Mining Area.	Linear supporting infrastructure including access tracks, pipelines, power supply and a Bypass road is proposed. The infrastructure will preferentially be located within disturbed areas, where possible. However some native vegetation clearing outside the boundary of CPS 5056/2 will be required. The location of the Bypass road will be determined through consultation with Main Roads WA.
Operational			
Tailings Production	Figure 4 M01/3, M01/6, M01/7	5 Mtpa deposited to TSF 2	Increased production of tailings to approximately 8 million tpa and disposal to a new TSF4 to be constructed immediately south of

Proposal title	Greenbushes Lithium Mine Expansion		
			the existing TSF, as well as to existing TSF2. Approximately 107 million tonnes of tailings is expected to be produced over the life of the Project.
Ore Processing	Figure 4 M01/6	Approved processing capacity 4.7 Mtpa	Establishment of two additional process plants, CGP3 and CGP4 will increase processing capacity to 9.5 Mtpa to produce up to 2.3 Mtpa of lithium mineral concentrate.
Transport routes	NA	Not specified	Transport of lithium mineral concentrate from Greenbushes to: Transport of lithium mineral concentrate from Greenbushes to: –Port of Bunbury –Kemerton Strategic Industrial Area –Kwinana Industrial Area –Fremantle Port (limited amounts of technical grade product) The transport route between Greenbushes and Bunbury/Port of Fremantle is already in use for the existing operation but the number of truck movements will increase. Inclusive of supply trucks and product transport to and from the operation, there will be approximately 200 movements in total per day (100 movements each way) when the expanded mine reaches peak production.

Greenbushes Lithium Mine

Proposed Layout and Disturbance

409000 410000 411000 412000 413000 414000 415000 416000 417000

6255000 6254000 6253000 6252000 6251000 6250000 6249000

DUMPLING GULLY
SPRING CREEK
SOUTH WESTERN GULLY
HESTER BROOK
WOLLENUP CREEK

M 01/5
M 01/4
M 01/18
M 01/9
M 01/8
M 01/11
Mine Services Area
M 01/16
M 01/7
Pit
Pit
Pit
Pit
Pit
Explosives Batch Facility
Magazine
G 01/1
G 01/2
L 01/1
Chemical Grade Plant 3 & 4
M 01/2
M 01/3
M 01/6
Floyds Waste Rock Landform
M 01/10
Linear Infrastructure Corridor
Floyds Waste Rock Landform
Tailing Storage Facility 4
Linear Infrastructure Corridor
M 70/765

Legend

- Mine Development Envelope
- Current Active Mining Area
- Condition Permit No:CPS 5056/2

Proposed Disturbance

- Chemical Grade Plant 3 & 4
- Explosives Batch Facility
- Floyds Waste Rock Landform
- Linear Infrastructure Corridor
- Magazine
- Mine Services Area
- Pit
- Tailing Storage Facility 4
- Approved clearing (within CPS 5056/2
- Talison Tenements
- Watercourses
- Primary Roads
- Railways
- Cadastre

N

0 100 200 300 400 500
Meters
1:25,000

Datum: GDA94
Projection: MGA Zone 50

Date:	12/07/2018
Status:	Final
Figure:	4
Sheet Size:	A3
Internal Reference:	FIG 22
Drawn by:	CG
Requested by:	SG

Talison Lithium

Mining

The ore body will continue to be mined via conventional hard rock open cut methods of drill, and blast, load and haul (via truck and excavator). The existing lithium pits C1-C3 will be combined into a single pit as per the current approved plans for the Mine. The pit design has increased in depth and width from the current approved pit parameters (MP ID 45382) and will be up to 2.8 km long by 1 km wide and will extend to up to 450 m in depth. The mining rate will increase to approximately 16 Mbcm as a result of the expansion producing an anticipated 9.5 Mtpa of spodumene ore. The mining rate will be progressively increased in line with increasing processing capacity. The required mining fleet is anticipated to increase from three excavators (110 tonne) and 12 trucks (90 tonne) to four excavators (260 tonne) and 28 trucks (140 tonne). Blasting is expected to occur daily.

Spodumene ore will be hauled via truck to one of three crushers for processing, and waste rock will be hauled to the existing Floyds WRL located between the open pit and the South Western Highway. Floyds WRL is currently approved for construction to a design height of 330 m AHD. It has been progressively built up from its lowest level of 230 m AHD in 10 m and 20 m lifts. A lateral expansion of Floyds WRL is proposed to increase the footprint of the dump from the approved 119 ha to approximately 355 ha, to accommodate the additional waste rock produced from the mining operation. Sterilisation drilling of the WRL footprint will occur prior to use for waste rock storage.

Additional water capture dams are also proposed to be established at the foot of Floyds WRL to capture surface water for supply to the mining operation.

Processing

Two new CG processing plants (CGP3 and CGP4) will be established to the west of the Maranup Ford Road. A two stage crushing circuit, Talison Crusher 3, will also be established to the east of the road (adjacent to the CGP2 ROM) to supply the plants. Each plant will have a design capacity of up to 2.4 Mtpa and produce a combined total of up to 1.0 Mtpa of lithium mineral concentrate at approximately 6% Lithium Oxide (Li_2O). The plants will be a near identical replication of CGP2 which is currently under construction (approved through MP ID 63657). A conveyor will be established between the Talison Crusher 3 and the two process plants across the Maranup Ford Road. The existing CGP2 ROM will be expanded to accommodate additional ore for CGP3 and CGP4. When both new plants are operational the Mine will produce up to 2.3 Mtpa of lithium mineral concentrate.

Tailings Storage

The volume of tailings produced from the Mine will increase from the current rate of 3.1 Mtpa to approximately 8 Mtpa. An additional TSF is required to accommodate the predicted 107 Mt of tailings which will be produced over the life of the project. TSF4 will be constructed to the south of the existing tailings storages (TSF 1-2) to accommodate the additional tailings. Additional linear infrastructure (tracks and pipelines) will also be established for transport of tailings to the new facility. It is also proposed to undertake recovery and reprocessing of tantalum tailings currently stored in TSF 1. The lithium content was not recovered when the material was processed to recover tantalum therefore a recoverable concentration of lithium remains in the tailings.

Supporting Infrastructure – Mine Services Area (MSA)

The existing MSA is not sufficiently sized for the increased mining fleet and is currently located within the proposed open pit expansion footprint. A new MSA is required as part of this Proposal. Talison proposes to construct the new facility to the north of the expanded Floyd's WRL. The MSA will comprise the following infrastructure:

- Heavy haulage workshop;
- Stores building;
- Heavy vehicle refuelling and hydrocarbon storage area. The hydrocarbon storage area will include diesel storage tanks with a capacity of 2 million litres and lubricant storage;
- Haulage contractors building;
- Drill and blast contractors building;
- Drill and blast workshop;
- Light vehicle workshop;
- Core shed;
- Exploration contractor building;
- Technical services building; and
- Mining technical services shed.

Supporting Infrastructure – Explosive Batching Facility and Magazine

The existing explosive magazine and batching facility is within the footprint of the proposed pit expansion. Therefore, the Proposal includes new facilities that need to be established prior to the existing facilities being mined out. The magazine will be established approximately 400 m west of CGP3/4 and the batching facility established approximately 750 km west of CGP3/4. The facilities have been appropriately located to meet separation requirements and will be security fenced to prevent unauthorised access.

Access roads will be established to each facility from the CGP3/4.

Supporting Infrastructure – Sewage Collection and Treatment infrastructure

Additional sewage treatment is required for new buildings being established at the MSA, CGP3, CGP4 and the Explosive Batching Facility. A graded PVC pipe gravity sewage system will be established within each area. The gravity sewage system for each of these three areas will drain to separate septic tanks connected to leach drains. The sewage treatment infrastructure will be established within the disturbance footprint for each area.

Supporting Infrastructure – Linear Infrastructure Corridors

The Mine expansion will require additional linear infrastructure including roads, power supply and pipelines. Corridors will be developed for the establishment of the required linear infrastructure. These will be established within existing disturbed areas, where possible.

Road train movements carting lithium mineral concentrate and supplies will increase with the increased production from the Mine. Trucks travelling to and from the mine are currently required to travel through the town of Greenbushes to access the Mite. To reduce the number of truck movements through the town of Greenbushes, this Proposal includes development of a Bypass Road. Consultation is in progress with Main Roads WA and the Shire of Bridgetown-Greenbushes in regards to a suitable route for a Bypass Road between the Mine access points and the South Western Highway.

Transport

The lithium mineral concentrate (**Li_2O**) produced by the process plant will be transported via truck to one of two lithium hydroxide production plants currently planned (Kemerton) or under construction (Kwinana), or to the Bunbury or Fremantle port for export as per current arrangements. The existing transport route to Bunbury will be maintained and from Bunbury

trucks will be diverted to one of the four destinations listed. Inclusive of supplies and lithium mineral concentrate transport, it is anticipated that truck movements from the Mine will increase from 60 movements per day (30 trucks to and from site) to approximately 200 per day total (100 trucks each way to and from the Mine) when the expansion reaches peak production.

Project Timing

An approximate timeframe for the described activities is included in Table 5.

Table 5 Greenbushes Lithium Mine Expansion Timeline

Expansion activity	Anticipated timing
CGP3/Talison Crusher 3/Conveyor construction	Planned commencement late 2018
Construction of new TSF4	Planned commencement late 2018
Mining fleet increase	Planned increases from mid 2019
Establish new batching facility and magazine	Planned for completion by mid 2019
Establish new MSA	Planned for completion by mid 2020
Floyds WRL expansion	Planned to commence in late 2020
CGP4 construction	Planned to commence in late 2020

2.4 Local and regional context

The Mine is located in the South West of WA, in the Shire of Bridgetown – Greenbushes, immediately south of the town of Greenbushes. The MDE predominantly occurs within State Forest 20 with some areas of Crown land. State Forest 20 is a Class A State Forest managed by the Department of Biodiversity, Conservation and Attractions (**DBCA**), and vested with the Conservation Commission of WA, that covers approximately 6088 ha. State Forest 20 is managed by the DBCA for timber production, recreation and biodiversity conservation.

The MDE occurs within the Southern Jarrah Forest (JF2) sub-region of the Jarrah Forest biogeographic region as defined in the Interim Biogeographical Regionalisation for Australia (**IBRA**). The landscape of the MDE is highly modified. The area includes areas of native vegetation interspersed with historical and current mining operations, townsites, farmland, water storages, plantations, power infrastructure and roads. Native vegetation within the Greenbushes region has been heavily logged in the past and has instances of Phytophthora Dieback disease (caused by the pathogen *Phytophthora cinnamomi)*.

The Greenbushes deposit has historically been mined for tin, tantalum and lithium. Tantalum was mined via open cut (Cornwall Pit) and an underground decline from pit, while Lithium has been mined from the open pits. The Cornwall Pit was completed in 2003 and is now flooded and included as a water storage facility in the mine's water circuit.

The two minerals were historically mined by a single company and were therefore part of a single operation. However, in 2010 the lithium operation and tantalum operation were separated. The lithium assets are now owned and operated by Talison and the tantalum assets are now owned and operated by GAMG. The tantalum assets include a crusher, primary process plant and secondary process plant. Market conditions for tantalum have been suppressed during the last decade resulting in GAMG's mining operations at the Mine being placed on care and maintenance, although the company is operating the secondary process plant on an ad hoc basis to process some tin and tantalum. Although the operations are run separately, an agreement has been reached between the two companies in relation to use of shared services. Talison provide environmental services to the GAMG operation as well as access to the TSF for storage of tailings and the Mine water circuit for water supply and discharge.

3. Stakeholder Consultation

3.1 Key stakeholders

The key stakeholders for the Proposal are considered to include:

- Bridgetown-Greenbushes Shire;
- Greenbushes and North Greenbushes Communities ;
- Grow Greenbushes (Rate Payers and Residents Association);
- Neighbouring rural landholders;
- Bridgetown Community;
- Balingup Community;
- South west towns along the key transport route;
- South West Boojarah and Wagyl Kaip Native Title Groups via the South West Aboriginal Land and Sea Council;
- Department of Biodiversity Conservation and Attractions;
- Department of Mines, Industry Regulation and Safety (**DMIRS**);
- Department of Water and Environmental Regulation (EPA Services, Regulatory Services,) (**DWER**);
- Department of the Environment and Energy (Federal); and
- Blackwood Basin Group (**BBG**).

3.2 Stakeholder engagement process

The Mine is an existing project and has an established stakeholder engagement program. Relevant stakeholders are consulted in relation to plans and changes at the operation as required. The surrounding communities are kept informed of activities at the operation through regular presentations at Grow Greenbushes meetings (formerly known as the Greenbushes Rate Payers and Residents Association) and contributions to local publications including the Warren Blackwood Times, Donnybrook-Balingup Post and the Greenbushes-Balingup Newsletter. Talison present an update to Grow Greenbushes at monthly meetings. This forum is also used to advise the community of the proposed changes at the Mine and obtain feedback on any issues or concerns that the community may have.

Talison also maintains an open communication channel with key government stakeholders. Annual reports inform and update agencies on activities and compliance at the operation. Talison also organise a joint regulatory agency site visit with representative from DWER, DMIRS and DBCA invited to attend. Talison presents the company's environmental performance and plans for the coming year at this event. Typically this event is organised annually although may be held less frequently if Talison has been in regular contact with the involved government Departments over the preceding year.

Talison maintains an active community presence through support of, and attendance at local events, a biennial open day, and employee participation in community organisations such as the Volunteer Fire Brigade, St John's Ambulance, the Tidy Towns Committee and the BBG. Talison recognise that an ongoing program of stakeholder engagement relating to the proposed expansion activities will be required to ensure key stakeholders are kept informed of the proposed expansion plans for the Mine.

Talison's proposed stakeholder engagement strategy for the expansion plans is outlined in Table 6.

Table 6 Greenbushes Lithium Mine Stakeholder Engagement Strategy

Stakeholder	Engagement Method	Frequency
Shire of Bridgetown-Greenbushes	Greenbushes Expansion Update Meetings	Quarterly through 2018/2019
Greenbushes and North Greenbushes Community	Grow Greenbushes	Monthly
	Newspaper/Newsletter Contributions	Bi-monthly through 2018/2019
	Mine Open Day	Biennially
Bridgetown and Balingup Community	Newspaper/Newsletter Contributions	Monthly through 2018/2019
	Bridgetown Show Exhibit	Annually
	Balingup Small Farm Field Day Exhibit	Annually
	Mine Open Day	Biennially
Neighbouring rural landholders	Individual meetings with landholders directly impacted by the proposed expansion.	As required
	Mine Open Day	Biennially
DBCA	Meetings to discuss expansion plans within the State Forest	As required
	Annual Report and Site Update Visit	Annually
DMIRS	Scoping meeting and follow up meetings to discuss expansion plans and approval requirements	As required pre and post approval submission
	Annual Report and Site Update Visit	Annually
DWER	Scoping meeting and follow up meetings to discuss expansion plans and approval requirements	As required pre and post approval submission
	Annual Report and Site Update Visit	Annually
DoEE	Scoping meeting and follow up meetings to discuss expansion plans and approval requirements	As required pre and post approval submission
	Annual Report (if required)	Annually
South West Boojarah Native Title Group via the South West Aboriginal Land and Sea Council	Site survey of expansion areas (including discussion of expansion plans)	Once off, in conjunction with Aboriginal Heritage Survey

3.3 Stakeholder consultation

Talison has commenced stakeholder engagement in relation to the proposed expansion of the Mine. A summary of consultation undertaken to date is provided in Table 7. To date consultation has been focussed on key regulatory authorities and surrounding land holders. Continued consultation will occur throughout the expansion project. Talison has engaged a Stakeholder Engagement Officer to plan and manage the stakeholder consultation for the expansion.

A Mine Open Day was held on 8th July 2018. Over 400 people attended the event which included a bus tour of the Mine and current CGP2 construction project area, and a video and plans of the proposed mine expansion. Staff were in attendance to answer questions from the

public in regards to the expansion and the associated impacts. Other activities undertaken on the day included:

- A presentation from Per Christiansen from the Blackwood Basin Group about the group's four year waterbird project at Schwenke's Dam, north of the Mine;
- A "Welcome to Country" conducted by Josh Whiteland from Koomal Dreaming who also provided guided walks through the forest around the Schwenke's Dam to highlight bush tucker and medicines;
- Recruitment officers from contractors associated with current projects at Talison were on hand to discuss employment opportunities;
- Geologists were available to discuss the mine geology and provide rock samples; and
- A showcase of drill and blast equipment and explanation of blasting procedures.

Table 7 Greenbushes Lithium Mine stakeholder consultation summary

Stakeholder	Date/Time	Consultation type	Purpose of consultation	Stakeholder comments/issues
DBCA	7/07/2017	Meeting	Site Closure & Final Land Use - Options for final land use and closure discussed	Continue discussions regarding closure and final land use.
Grow Greenbushes	5/10/2017	Meeting	General Site Update	Minutes of Grow Greenbushes Incorporated General Meeting 5 October 2017.
Grow Greenbushes	2/11/2017	Meeting	General Site Update	Minutes of Grow Greenbushes Incorporated General Meeting 2 November 2017
Multiple state government agencies	7/11/2017	Presentation	Discussion on change of tenure in the Active Mining Area with multiple government agencies	Continue to progress with discussions with relevant agencies.
DWER - EPA Services	7/11/2017	Meeting	Expansion plans to include Chemical Grade Plant 3 (CGP3)	Discussed options for CGP3 approvals pathway
Greenbushes Community	4/12/2017	Community Meeting / Presentation	Community meeting to discuss CGP2 construction and operation and changes at the mine	No specific issues raised
DBCA	12/12/2017	Site Visit / Meeting	DBCA Site visit.	Exploration drilling inspected & discussed the Working Arrangements document
Landholder 1	22/12/2017 - Current	Meeting / Phone Call / Email	General Site Update and Talison Lithium Expansion	Discussion to reduce clearing footprint by way utilising previously disturbed land.

Stakeholder	Date/Time	Consultation type	Purpose of consultation	Stakeholder comments/issues
				Consultation continuing.
Landholder 2	24/1/18 - Current	Meeting / Phone Call / Email	General Site Update and Talison Lithium Expansion	Discussion to reduce clearing footprint by way utilising previously disturbed land. Consultation continuing.
DMIRS	15/01/2018	Meeting	Discussed approval requirements for the planned expansion under the Mining Act 1978 - Mining Proposal & Mine Closure Plan	Mining Proposal required for whole of expanded mine in accordance with 2016 guidance. Updated Mine Closure Plan required for submission with the Mining Proposal.
BBG	17/01/2018	Meeting	Meeting to discuss TLA/BBG direction for 2018	Option for 2018 partnership and Working arrangement
Landholder 3	31/1/18 - Current	Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Grow Greenbushes	1/02/2018	Meeting	General Site Update	Minutes of Grow Greenbushes Incorporated General Meeting 1 February 2018.
DBCA	7/02/2018	Meeting	Meeting with DBCA to discuss change of land tenure	Progressed discussion relating to the proposed land tenure changes
Main Roads WA	19/02/2018	Meeting	Talison Lithium Expansion (including Bypass proposal)	Consultation continuing
Landholder 4	21/2/2018 - Current	Meeting / Phone Call/ Letter / Email	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 5	05/2/2018 - Current	Meeting / Phone Call/ Letter / Email	General Site Update and Talison Lithium Expansion	Consultation continuing
Grow Greenbushes	1/03/2018	Meeting	General Site Update	Minutes of Grow Greenbushes Incorporated General Meeting 1 March 2018.
DWER - EPA Services	14/03/2018	Meeting	Overview of full expansion plans and required clearing footprint	Discussed approvals pathway.

Stakeholder	Date/Time	Consultation type	Purpose of consultation	Stakeholder comments/issues
Community Meeting / Bridgetown-Greenbushes Tourism Association	21/03/2018	Community Meeting / Presentation	Community meeting at Shamrock hotel regarding the Talison Lithium Expansion Project	None
Landholder 6	05/2/2018 - Current	Meeting / Phone Call/ Letter / Email	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 7	15/3/2018	Meeting	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 8	30/1/2018	Meeting / Phone Call/ Letter / Email	General Site Update and Talison Lithium Expansion	Consultation continuing
Balingup Small Farm Field Day	21/04/2018	Presentation	Talison Lithium Expansion Presentation To BSFF Patrons - Presentation to Community and Wider Public	No specific issues raised. High level of interest in associated job opportunities.
DoEE	10/05/2018	Presentation	Overview of the mine expansion and the impact assessment undertaken for potentially impacted MNES	No specific issues raised.
DMIRS	11/05/2018	Meeting	Update DMIRS on the status of approvals for the proposed mine expansion. Confirm information requirements/design details for the Mining Propoal and Mine Closure Plan	Risk assessment requires more detail for the Mining Proposal. Meet again when risk assessment and outcomes are complete (will be after completion of studies)
DWER (Regulatory Services and EPA Services	11/05/2018	Meeting	Overview of the planned mine expansion and the approvals pathway for the expansion	Recommended joint meeting with DMIRS and DWER (Regulatory services) when approval applications for TSF are near completion
DWER (Regulatory Services and EPA Services	31/05/2018	Site Visit	Overview of the planned mine expansion, tour of existing mine and proposed expansion area and the approvals pathway for the expansion	Recommendation to complete impact studies underway and include them with the referral

Stakeholder	Date/Time	Consultation type	Purpose of consultation	Stakeholder comments/issues
Landholder 9	20/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 10	15/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 11	2/5/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 12	14/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 13	15/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 14	21/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Landholder 15	21/6/2018	Meeting / Phone Call	General Site Update and Talison Lithium Expansion	Consultation continuing
Local community	8/07/2018	Mine Open Day	Conduct tours of the mine and present details of the proposed expansion to the local community	General support for the Project with questions regarding the impacts to the local community and employment.

4. Environmental Principles and Factors

4.1 Principles

Section 4A of the EP Act establishes the object and principles of the Act. In accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2016), Table 8 describes how each of the five principles of the EP Act has been applied to the Proposal.

Table 8 EP Act Principles

Principle	Consideration of Principle in the Proposal
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decision should be guided by: a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b. an assessment of the risk-weighted consequences of various options.	Numerous technical and scientific investigations have been undertaken through the life of the Mine. Specific studies for flora, fauna, water, noise, dust and material characterisation are suitable to provide accurate and comprehensive data to Talison on the receiving environment in the surrounds of the Mine. This information has supported the carrying out of the impact assessment in this referral. Where further studies are underway or planned this has been noted and reported. Where the potential for serious or irreversible damage has been identified mitigation measures are proposed.
The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Talison considers that the Proposal is unlikely to result in any significant environmental impacts that would pose a threat to the health, diversity and productivity of the environment. The Proposal will have a direct impact on conservation significant fauna which Talison proposes to counterbalance through implementing a direct offset through acquisition of suitable land for conservation. The Proposal provides increased employment for the South West region resulting in enhancement of the local economy and a more sustainable future for local communities. It also supports an additional two related lithium projects which are either in construction or waiting approval to construct. Talison has an existing Mine Closure Plan for the Mine which will be updated for the planned expansion as part of approvals under the Mining Act. The Mine Closure Plan aims to rehabilitate and close the mine in a manner that will ensure that the health, diversity and productivity of the environment is maintained for future generations.
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Extensive biological studies of the Mine and the surrounding local area were undertaken in 2011 to understand the environment in which the Mine is located. Further detailed investigation of proposed clearing areas within the MDE was undertaken in 2018 to enable the potential impacts of the proposed clearing to be understood.

Principle	Consideration of Principle in the Proposal
	These studies have informed this referral to determine potential impacts to biological diversity. Where the potential for serious or irreversible damage has been identified mitigation measures are proposed. Talison will conserve biological diversity and ecological integrity by preferentially using existing disturbed areas for the expansion where practical. Talison will rehabilitate disturbed areas associated with the Proposal to return a functioning system. Talison will also conserve biological diversity and ecological integrity through acquisition of suitable land for conservation (and/or rehabilitation and conservation) as direct offset to the impact of the Proposal on conservation significant fauna. Talison considers that the Proposal will not significantly impact biological diversity or ecological integrity.
Principles relating to the improved valuation, pricing and incentive mechanisms a. Environmental factors should be included in the valuation of assets and services. b. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. c. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. d. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	Environmental factors have been considered throughout the development of this proposal. Talison recognises the polluter pays principle and the need to provide sufficient funding to ensure environmental management measures are implemented throughout the life of the mine, and the costs associated with closure, rehabilitation and decommissioning form part of the Closure Cost.
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	The nature of mining is such that it is optimised to maximise ore production and minimise associated waste rock and tailings production wherever possible. Waste rock and tailings are stored within engineered landforms which are designed to minimise the likelihood of discharges both over time and in a catastrophic failure. Water has historically been discharged regularly from the mine due to excess water. Changes have been introduced to the Mine water circuit to minimise the likelihood of a discharge needing to occur.

4.2 Identification of Key Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a Proposal. The EPA has 14 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

The environmental factors and the EPA's objectives are provided in Table 9. The relevance of each factor to the Proposal is summarised and the Key Environmental Factors that require further consideration are identified.

Table 9 Identification of Key Environmental Factors

Factor	Objective	Relevance to Proposal	Key Environmental Factor
Sea			
Benthic Communities and Habitat	To protect benthic communities and habitat so that biological diversity and ecological integrity are maintained.	No impacts to benthic habitats.	No
Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	No impacts to coastal processes.	No
Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	No impacts to marine environmental quality.	No
Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	No impacts to marine fauna.	No
Land			
Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Expansion of the Mine will require native vegetation clearing.	Yes
Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Expansion of the Mine will result in habitat clearing of conservation significant fauna and other terrestrial fauna.	Yes
Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	Given the location of the MDE (South West Australia) conservation significant subterranean fauna are considered unlikely to be present.	No
Landforms	To maintain the variety and integrity of significant physical landforms so that	Significant landforms are not present. The area has had a history of mining since 1888.	No

Factor	Objective	Relevance to Proposal	Key Environmental Factor
	environmental values are protected.		
Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Storage of tailings and waste rock which has elevated metal concentrations (in particular Arsenic and Lithium). Low volumes of potentially acid forming material may be present.	Yes
Water			
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	Surface water flows may be altered by new and expanded landforms and open pits.	Yes
Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water so that environmental values are protected.	Inland waters occur, including groundwater and surface water which could potentially be contaminated. The Mine is within the Blackwood River catchment.	Yes
Air			
Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Air emissions, including greenhouse gases, combustion products and dust are expected to increase as a result of the expansion of the Mine.	Yes
People			
Social Surroundings	To protect social surroundings from significant harm.	The Mine is immediately south of the town of Greenbushes. Expansion of an existing operation may potentially increase impacts for existing sensitive receptors or impact on new sensitive receptors not previously exposed to the Mine.	Yes
Human Health	To protect human health from significant harm.	No human health impacts expected. No radiation emissions.	No

4.3 Key Environmental Factor - Flora and vegetation

4.3.1 EPA objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

4.3.2 Policy and guidance

- Environmental Factor Guideline Flora and Vegetation (EPA 2016b).
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016h).
- Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004)
- *Environmental Protection Act 1986* (EP Act).
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations).
- *Wildlife Conservation Act 1950* (WC Act).
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- *Biosecurity and Agricultural Management Act 2007* (BAM Act).
- *Conservation and Land Management Act 1984* (CALM Act).

4.3.3 Receiving environment

Five flora and vegetation surveys have been undertaken within the Greenbushes Mine leases:

- Trudgen and Morgan (1991) A Flora and Vegetation Survey of part of the Greenbushes Leases;
- Onshore Environmental Consultants (2006) Flora and Vegetation Survey Greenbushes Lithium Mine Site: Vegetation surrounding south east corner of the TSF;
- AECOM Australia Pty Ltd (2010) Bridgetown RWSS Pipelines Millstream Dam to Greenbushes Link Biological Survey;
- Onshore Environmental Consultants (2012) Flora and Vegetation Survey Greenbushes Mining Leases. (Appendix A); and
- Onshore Environmental Consultants (2018a) Greenbushes Mining Operations Detailed Flora and Vegetation Survey (Appendix A).

The Onshore Environmental Consultants 2012 study was a Level 2 flora and vegetation study (now referred to as a detailed flora and vegetation survey) undertaken in Spring 2011 across all of the Greenbushes Mine leases covering a total area of 10,059.82 ha (referred to as the Greenbushes Study Area). This vegetation study was the first broad scale assessment of all the Greenbushes Mine leases and has been referred to by Talison as a baseline for environmental approvals, impact assessment and closure planning. The study included a review of previous survey work completed within, and immediately adjacent to the Greenbushes Study Area, along with a comprehensive detailed flora and vegetation survey including description and mapping of vegetation communities and condition, targeted searches for significant flora, and identification of introduced (weed) species present within the area (Onshore Environmental 2012).

The survey was undertaken by three botanists between the 13th and 21st October 2011. It included assessment of a total of 26 quadrats and a number of relevé plots providing good

coverage over the Greenbushes Study Area. It is acknowledged that the Greenbushes Study Area is large, however good coverage of the vegetation associations was made and the dominant associations were consistently represented across the larger Greenbushes Study Area. The field survey involved systematic sampling using quadrats and transects which generally linked the quadrats. The study sites were generally 10 m by 10 m, or an equivalent area (100 m^2) along narrow associations such as minor drainage lines (Onshore Environmental 2012).

A review of the survey was undertaken in February 2018 (Onshore Environmental 2018b, Appendix A) to assess its adherence to the most recent technical guidelines for flora and vegetation surveys (EPA 2016h), and address any updates required in relation to nomenclature, conservation significance and disturbance mapping. The review identified that the proposed areas of disturbance for the Proposal had not been surveyed as intensively as other areas during the 2011 survey. As a result, Onshore Environmental Consultants was engaged to undertake a single season detailed flora and vegetation survey of the MDE. The survey area included areas outside the existing approved clearing permit boundary (CPS 5056/2) (referred to as the Proposal Study Area).

The survey was undertaken in autumn 2018 by three botanists working over four days. The survey involved systematic sampling using quadrats. Relevé vegetation descriptions were made to increase the accuracy of vegetation mapping and targeted searches were completed in habitats where it was anticipated significant flora might occur (Onshore Environmental 2018a).

The study sites were 10 m by 10 m in dimension, or an equivalent area (100 m^2) along narrow associations such as minor drainage lines fringing lake units. The area sampled for each study site is standard for the Jarrah Forest bioregion. The number of study sites sampled was determined by the size and heterogeneity of the study area, with 40 quadrats formally assessed. Additionally, 72 relevé sites were assessed providing excellent coverage of the study area and a high proportion of the total flora present in February/March 2018 being recorded. However, it is recognised that this represents an early autumn assessment meaning that many annual and ephemeral plant taxa were not present (Onshore Environmental 2018a).

Regional biogeography

The Mine is located in the Southern Jarrah Forrest subregion (JF2) within the Jarrah Forrest Bioregion as described by the Interim Biogeographic Regionalisation for Australia (**IBRA**) (Thackway & Cresswell 1995). The Southern Jarrah Forest sub-region is described as, “Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Marri-Wandoo woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean” (Hearn et al 2002).

The vegetation of the Southern Jarrah Forest sub-region is described as, “Extensive areas of swamp vegetation in the south-east, dominated by Paperbarks and Swamp Yate. The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions” (Hearn et al 2002).

The MDE supports State Forest, plantation, cleared/disturbed areas for farmland and mining, water catchments and rehabilitated mining areas. A summary of land uses within the MDE is included in Table 10.

Table 10 Land Uses within the Greenbushes Lithium Mine Expansion MDE

Land Use	Area (ha)
Native Vegetation (State Forest)	671.3 (33.8%)
Plantation	8.9 (0.4%)
Rehabilitation	129.4 (6.5%)
Mining	1,052.7 (52.9%)
Water Catchment/Storage	74.8 (3.8%)
Agriculture	52.1 (2.6%)
Total	1,989

Note – areas are based on results of Onshore Environmental 2018b review of previous (Onshore Environmental 2012) flora and vegetation survey results and update to account for disturbance since the survey

Regional Vegetation Description

The MDE occurs in the Menzies Subdistrict of the Darling Botanical District, in the South-West Botanical Province (Beard 1981). The Menzies Subdistrict (southern jarrah forest) covers a total area of 26,103 km^2, of which 18,060 km^2 (67.86%) originally supported jarrah and jarrah-marri forest (GoWA 2018). The MDE is mapped as Beard Vegetation Association 3 – Medium Forest; Jarrah-Marri. At this broad level of mapping (sub-district) almost 60% of the pre-European extent remains intact (GoWA 2018) (Table 11).

Table 11 Extent of Beard Vegetation Association 3 - Medium Forest, Jarrah-Marri (GoWA 2018)

Scale	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Remaining within DBCA Managed Lands (%)
State: WA	2,661,404.6	1,806,035.9	67.86	81.36
Bioregion: Jarrah Forest	2,390,591.5	1,606,736.8	67.21	80.85
Sub-region: Southern (JAF02)	1,482,491.9	883,557.8	59.6	78.25
LGA: Shire of Bridgetown - Greenbushes	121,152.7	68,440.4	56.49	86.65

Vegetation complexes of the southern jarrah forest have most recently been defined by Mattiske and Havel (1998) and updated by Webb *et al* (2016). Vegetation complexes mapped within the MDE are listed in Table 12. The current extent of all vegetation complexes occurring within the MDE is more than 50% of the calculated pre-European extent within the South West Forest Region. All but the Grimwade complex have more than 50% of their current extent within DBCA managed lands (GoWA 2018) (Section 4.3.5, Table 17 and Table 18).

Table 12 Vegetation complexes within the Greenbushes Lithium Mine Expansion MDE

Vegetation Complex
Uplands
Dwellingup 1 (D1) Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.
Hester (HR) Tall open forest to open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla* on lateritic uplands in perhumid and humid zones.
Depressions and Swamps on Uplands
Goonaping Complex (G) Mosaic of open forest of *Eucalyptus marginata subsp. marginata* (humid zones) and *Eucalyptus marginata subsp. thalassica* (semiarid to perarid zones) on the sandy-gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to perarid zones) with some *Banksia menziesii* (northern arid and perarid zones) and low open woodland of *Melaleuca preissiana-Banksia littoralis* on the moister sandy soils (humid to perarid zones).
Valleys
Catterick (CC1) Open forest of *Eucalyptus marginata* subsp*. marginata-Corymbia calophylla* mixed with *Eucalyptus patens* on slopes, *Eucalyptus rudis* and *Banksia littoralis* on valley floors in the humid zone.
Grimwade (GR) Tall open forest to open forest of *Corymbia calophylla-Eucalyptus marginata* subsp*. marginata* with *Eucalyptus patens* on slopes and *Eucalyptus rudis* over some *Agonis flexuosa* on lower slopes in the humid zone.

Site Vegetation Description

Onshore Environmental (2012) mapped and described the vegetation types of the Greenbushes Study Area. Seven natural vegetation types were described and mapped within the Study Area, of which three were mapped within the MDE. The vegetation types and their extent are described in Table 13 and illustrated in Figure 5.

Onshore Environmental (2018a) mapped and described nine natural vegetation types within the Proposal Study Area. The vegetation types have been classified into seven broad floristic formations according to dominant vegetation strata. The vegetation types and their extent are described in Table 14 and illustrated in Figure 6.

Conservation significant vegetation

Searches of the EPBC Act Protected Matters database and the DBCA NatureMap confirmed that there are no Federal or State listed Threatened Ecological Communities (**TEC**) and no State listed Priority Ecological Communities (**PEC**) within or adjacent to the MDE. The Onshore Environmental (2012 and 2018a) field surveys did not identify any TEC or PEC within the MDE or the Greenbushes Study Area.

Other significant vegetation

Onshore Environmental (2012) identified a winter-wet dampland supporting a population of Threatened/Declared Rare Flora (**DRF**) *Caladenia harringtoniae* within mining lease M01/3. The area is classified as an Environmentally Sensitive Area (**ESA**).This is approximately 560 m west of the south-west boundary of the MDE (outside of the MDE).

Table 13 Vegetation types within the MDE (Onshore Environmental 2012, 2018b)

Broad Floristic Formation	Code	Description	Extent within the Greenbushes Study Area[1]	Extent within the MDE (ha, (Biologic 2018b)	Vegetation Condition	Representative Photograph
Eucalyptus Dense Forest	1a	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Dense Forest over *Banksia grandis, Bossiaea linophylla* and *Persoonia longifolia* Open Scrub over *Pteridium esculentum, Macrozamia riedlei* and *Leucopogon verticillatus* Open Low Scrub B (with *Leucopogon capitellatus* and *Bossiaea ornata* Open Dwarf Scrub D) in brown sandy loam on upper hill slopes and plateaux	1021.29	71.9	Very Good to Good	
	1b	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Dense Forest over *Bossiaea ornata, Hibbertia hypericoides* and *Leucopogon capitellatus* Dwarf Scrub D in brown sandy loam over undulating hill slopes and plateaux	3985.18	403.9	Very Good	

Broad Floristic Formation	Code	Description	Extent within the Greenbushes Study Area[1]	Extent within the MDE (ha, (Biologic 2018b)	Vegetation Condition	Representative Photograph
Eucalyptus Forest	2a	*Eucalyptus marginata* subsp. *marginata, Corymbia calophylla* Forest (to Dense Forest) over *Banksia grandis, E. marginata* subsp. *marginata, C. calophylla* Low Forest A over *Pteridium esculentum, Leucopogon capitellatus* and *Bossiaea ornata* Dwarf Scrub C in brown loamy sand on upper hill slopes and plateaux	364.11	195.4	Very Good to Good	

Note 1: Extent within the Greenbushes Study area has been updated from the results reported in Onshore Environmental 2012 based on updated disturbance footprint from Onshore Environmental 2018b.

Table 14 Vegetation types within the MDE (Onshore Environmental 2018a)

Broad Floristic Formation	Code	Description	Vegetation Condition	Extent within the Proposal Study area (ha)	Representative Photograph
Eucalyptus Forest	Hs Bo	Forest of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Low Heath D of *Bossiaea ornata* and *Leucopogon capitellatus* on grey/brown loamy sand on hillslopes.	Very Good	555.1	

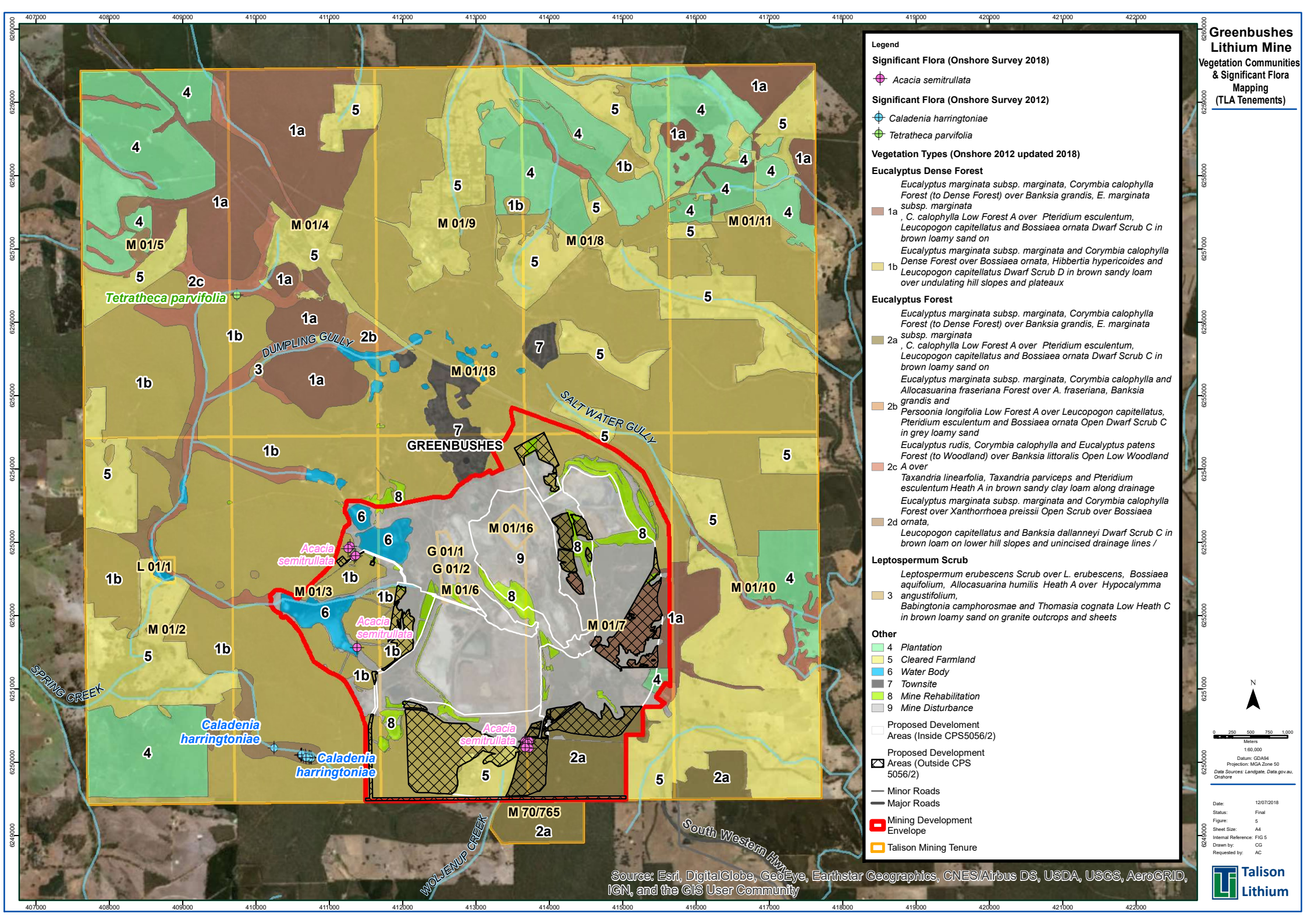
Broad Floristic Formation	Code	Description	Vegetation Condition	Extent within the Proposal Study area (ha)	Representative Photograph
	DL Er	Forest of *Eucalyptus rudis* subsp. *rudis* (sometimes mixed species) over Scrub of *Trymalium odoratissimum* subsp. *odoratissimum*, *Taxandria linearifolia* and/or *Hakea prostrata* over Open Tall Sedges of *Lepidosperma tetraquetrum* or *Chorizandra enodis* on brown sandy clay loam on minor drainage lines	Good to Degraded	1.2	
Eucalyptus Woodland	DL EpCc Tp	Woodland (to Forest) of *Eucalyptus patens* and *Corymbia calophylla* (sometimes with *Banksia seminuda* or *Banksia littoralis*) over Thicket of *Taxandria parviceps* (sometimes with *Bossiaea linophylla*, *Acacia extensa* and *Pteridium esculentum*) over Open Dwarf Scrub D of *Dasypogon bromeliifolius* and *Conospermum capitatum* on grey sand on drainage lines	Very Good	17.9	

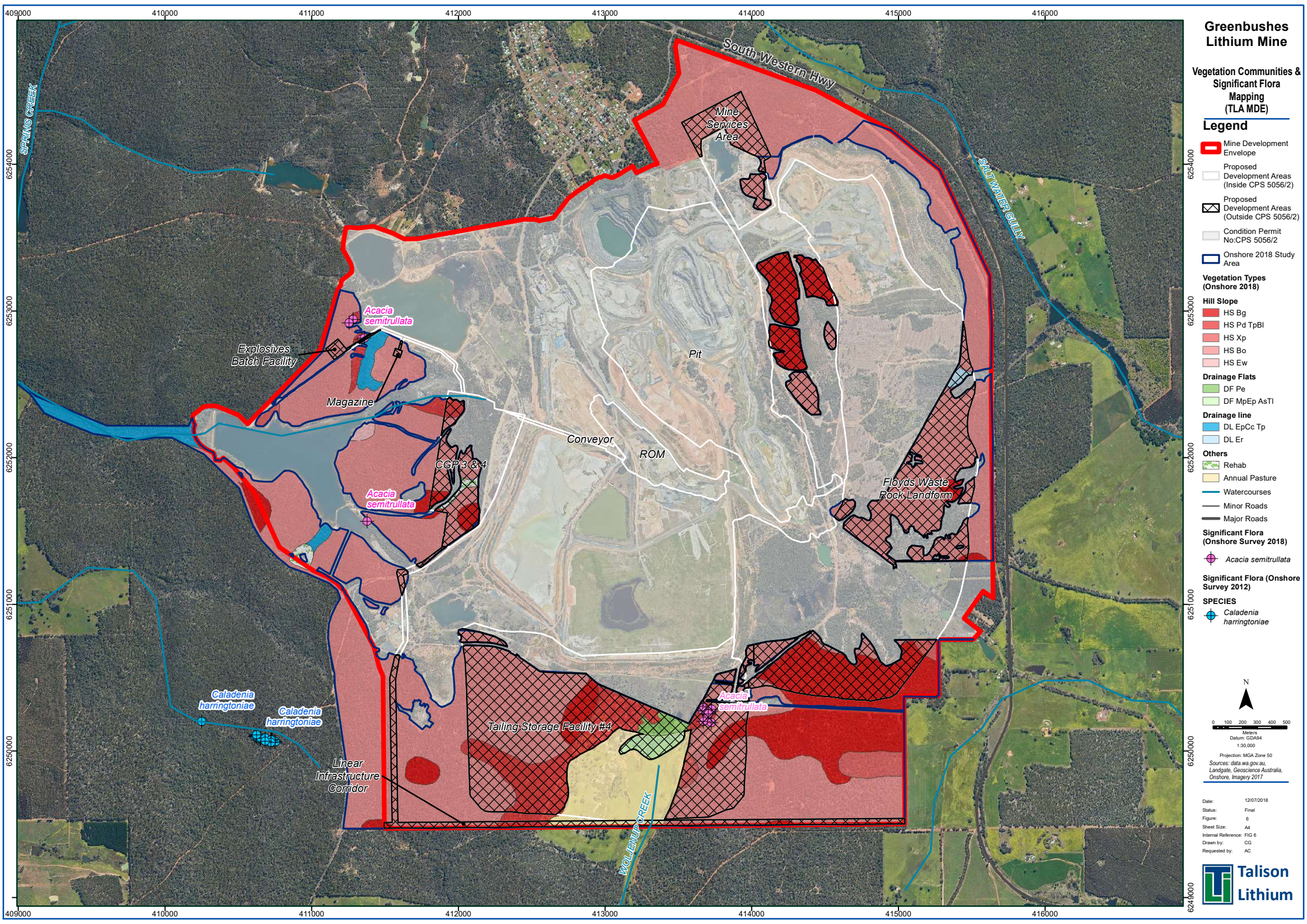
Broad Floristic Formation	Code	Description	Vegetation Condition	Extent within the Proposal Study area (ha)	Representative Photograph
Corymbia Forest	HS Bg	Forest of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* over Low Woodland A of *Banksia grandis*, *Persoonia longifolia*, *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub A of *Pteridium esculentum* and *Macrozamia riedlei* over Low Heath D of *Bossiaea ornata* and/or *Leucopogon capitellatus* on brown sandy loam on upper hillslopes	Very Good	119.3	
	HS Xp	Forest of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* over Scrub of *Xanthorrhoea preissii* (*Bossiaea linophylla*) over Dwarf Scrub C of *Xanthorrhoea gracilis* and *Phyllanthus calycinus* on brown sandy loam on hillslopes	Good	12.3	

Broad Floristic Formation	Code	Description	Vegetation Condition	Extent within the Proposal Study area (ha)	Representative Photograph
Podocarpus Heath A	HS Pd TpBl	Heath A of *Podocarpus drouynianus* (*Pultenaea ocheata*) with Woodland (to Forest) of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Scrub of *Taxandria parviceps* (*Bossiaea linophylla*) over Dwarf Scrub C/D of *Dasypogon bromeliifolius*, *Adenanthos obovatus* and *Leucopogon oxycedrus* on grey sand on lower hillslopes	Very Good	43	
Hypocalymma Low Heath C	HS Ew	Low Heath C of *Hypocalymma angustifolium*, *Babingtonia camphorosmae* and *Banksia dallanneyi* (*Xanthorrhoea gracilis* and *Bossiaea ornata*) with Low Woodland A of *Eucalyptus wandoo* (*Corymbia calophylla*) over Open Low Scrub B of *Xanthorrhoea preissii*, *Acacia celastrifolia* and *Corymbia calophylla* on grey clay loam soil on lower hillslopes	Very Good	1.3	

Broad Floristic Formation	Code	Description	Vegetation Condition	Extent within the Proposal Study area (ha)	Representative Photograph
Melaleuca Forest	DF MpEp AsTl	Forest of *Melaleuca preissiana* and *Eucalyptus patens* over Scrub of *Astartea scoparia* and *Taxandria linearifolia* over Low Scrub B of *Aotus gracillima* and *Pteridium esculentum* over Open Low Grass of **Anthoxanthum odoratum* and **Vulpia* sp. indet over Very Open Tall Sedges of *Isolepis cyperoides* and *Juncus pallidus* on black sandy clay loam on seasonally wet drainage flats	Good	4.9	
Pteridium Dense Heath A	DF Pe	Dense Heath B of *Pteridium esculentum* on grey sand on seasonally wet drainage flats	Degraded	3.6	

Note: The Proposal Study Area included areas outside of the MDE. Refer to Figure 5.


Greenbushes Lithium Mine
Vegetation Communities & Significant Flora Mapping (TLA Tenements)
Legend
Significant Flora (Onshore Survey 2018)
Acacia semitrullata
Significant Flora (Onshore Survey 2012)
Caladenia harringtoniae
Tetratheca parvifolia
Vegetation Types (Onshore 2012 updated 2018)
Eucalyptus Dense Forest
1a Eucalyptus marginata subsp. marginata, Corymbia calophylla Forest (to Dense Forest) over Banksia grandis, E. marginata subsp. marginata, C. calophylla Low Forest A over Pteridium esculentum, Leucopogon capitellatus and Bossiaea ornata Dwarf Scrub C in brown loamy sand on
1b Eucalyptus marginata subsp. marginata and Corymbia calophylla Dense Forest over Bossiaea ornata, Hibbertia hypericoides and Leucopogon capitellatus Dwarf Scrub D in brown sandy loam over undulating hill slopes and plateaux
Eucalyptus Forest
2a Eucalyptus marginata subsp. marginata, Corymbia calophylla Forest (to Dense Forest) over Banksia grandis, E. marginata subsp. marginata, C. calophylla Low Forest A over Pteridium esculentum, Leucopogon capitellatus and Bossiaea ornata Dwarf Scrub C in brown loamy sand on
2b Eucalyptus marginata subsp. marginata, Corymbia calophylla and Allocasuarina fraseriana Forest over A. fraseriana, Banksia grandis and Persoonia longifolia Low Forest A over Leucopogon capitellatus, Pteridium esculentum and Bossiaea ornata Open Dwarf Scrub C in grey loamy sand
2c Eucalyptus rudis, Corymbia calophylla and Eucalyptus patens Forest (to Woodland) over Banksia littoralis Open Low Woodland A over Taxandria linearfolia, Taxandria parviceps and Pteridium esculentum Heath A in brown sandy clay loam along drainage
2d Eucalyptus marginata subsp. marginata and Corymbia calophylla Forest over Xanthorrhoea preissii Open Scrub over Bossiaea ornata, Leucopogon capitellatus and Banksia dallanneyi Dwarf Scrub C in brown loam on lower hill slopes and unincised drainage lines /
Leptospermum Scrub
3 Leptospermum erubescens Scrub over L. erubescens, Bossiaea aquifolium, Allocasuarina humilis Heath A over Hypocalymma angustifolium, Babingtonia camphorosmae and Thomasia cognata Low Heath C in brown loamy sand on granite outcrops and sheets
Other
4 Plantation
5 Cleared Farmland
6 Water Body
7 Townsite
8 Mine Rehabilitation
9 Mine Disturbance
Proposed Develoment Areas (Inside CPS5056/2)
Proposed Development Areas (Outside CPS 5056/2)
Minor Roads
Major Roads
Mining Development Envelope
Talison Mining Tenure
GREENBUSHES
M 01/4
M 01/5
M 01/9
M 01/8
M 01/11
M 01/18
M 01/16
M 01/10
M 01/7
M 01/6
M 01/3
M 01/2
L 01/1
G 01/1
G 01/2
M 70/765
DUMPLING GULLY
SALT WATER GULLY
SPRING CREEK
WOLJENUP CREEK
South Western Hwy
Tetratheca parvifolia
Acacia semitrullata
Caladenia harringtoniae
N
0 250 500 750 1,000
Meters
1:60,000
Datum: GDA94
Projection: MGA Zone 50
Data Sources: Landgate, Data.gov.au, Onshore
Date: 12/07/2018
Status: Final
Figure: 5
Sheet Size: A4
Internal Reference: FIG 5
Drawn by: CG
Requested by: AC
Talison Lithium
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


409000
410000
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6254000
6253000
6252000
6251000
6250000
6249000
SPRING CREEK
South Western Hwy
SALTWATER GULLY
Mine Services Area
Pit
ROM
Conveyor
Explosives Batch Facility
Magazine
CGP 3 &4
Floyds Waste Rock Landform
Tailing Storage Facility #4
Linear Infrastructure Corridor
WOLLENUP CREEK
Acacia semitrullata
Caladenia harringtoniae
Greenbushes Lithium Mine
Vegetation Communities & Significant Flora Mapping (TLA MDE)
Legend
Mine Development Envelope
Proposed Development Areas (Inside CPS 5056/2)
Proposed Development Areas (Outside CPS 5056/2)
Condition Permit No:CPS 5056/2
Onshore 2018 Study Area
Vegetation Types (Onshore 2018)
Hill Slope
HS Bg
HS Pd TpBl
HS Xp
HS Bo
HS Ew
Drainage Flats
DF Pe
DF MpEp AsTl
Drainage line
DL EpCc Tp
DL Er
Others
Rehab
Annual Pasture
Watercourses
Minor Roads
Major Roads
Significant Flora (Onshore Survey 2018)
Acacia semitrullata
Significant Flora (Onshore Survey 2012)
SPECIES
Caladenia harringtoniae
N
0 100 200 300 400 500
Meters
Datum: GDA94
1:30,000
Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia, Onshore, Imagery 2017
Date: 12/07/2018
Status: Final
Figure: 6
Sheet Size: A4
Internal Reference: FIG 6
Drawn by: CG
Requested by: AC
Talison Lithium

Vegetation condition

Vegetation condition within the Greenbushes region has been impacted by past activities including logging, access tracks, historical mine activities including excavation of costeans and shafts, construction of powerline and rail corridors, clearing for farmland and plantation timber, edge effects around the Greenbushes townsite and illegal dumping of domestic rubbish in addition to more recent mining and exploration activity in the area (Onshore Environmental 2012). Dieback and macropod grazing also impact on vegetation condition within the Greenbushes region.

Assessment of vegetation condition was undertaken within the Proposal Study Area (Onshore Environmental 2018a) using a recognised rating scale based on the method detailed in Keighery 1994. The majority of the Proposal Study Area (more than 90%) was rated as Very Good or Good condition (Onshore Environmental 2018a).

A summary of vegetation condition within the Proposal Study Area is included in Table 15.

Table 15 Vegetation Condition mapped within the Proposal Study Area

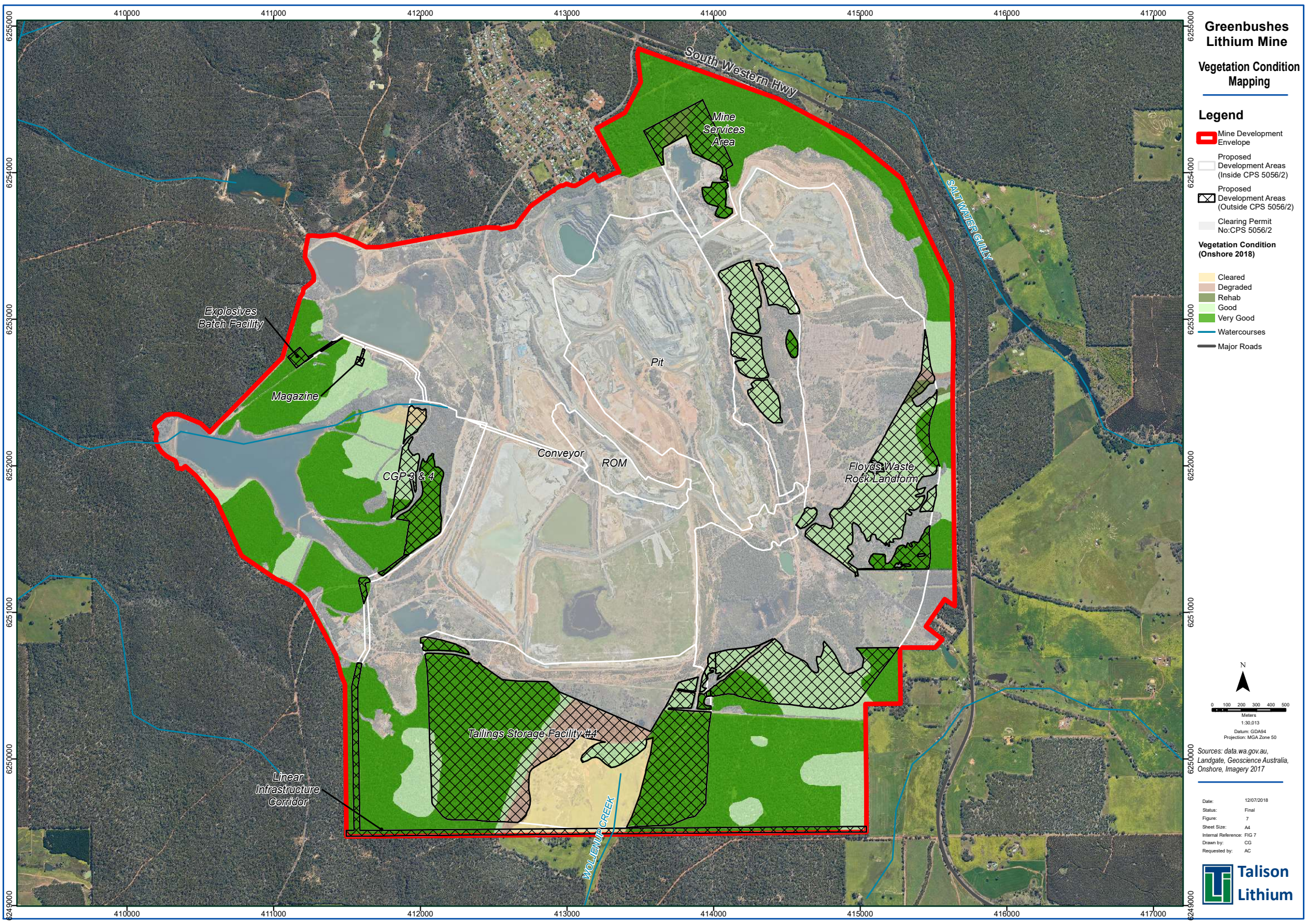
Vegetation condition	Area within the Proposal Study Area (ha)	% of the Proposal Study Area
Very Good	547.46	68.1
Good	207.74	25.9
Degraded	1.28	0.2
Rehab	1.82	0.2
Cleared	44.90	5.6
Total	803.2	100%

Note: The Proposal Study Area included areas outside of the MDE. Refer to Figure 5.

Flora diversity

The 2011 Spring survey recorded 368 plant taxa from 73 families and 208 genera within the Greenbushes Study Area. Species representation was greatest among the Fabaceae, Poaceae, Myrtaceae, Malvaceae, Asteraceae, Orchidaceae, Cyperaceae, Proteaceae and Stylidiaceae families. The most speciose genus was Acacia (18 taxa), followed by Stylidium (10 taxa), Caladenia (7 taxa), Lepidosperma (6 taxa), Lomandra (6 taxa) and Hakea (6 taxa) (Onshore Environmental 2012).

The 2018 Autumn survey recorded 231 plant taxa (including varieties and subspecies) from 56 families and 138 genera within the Proposal Study Area. Species representation was greatest among the Fabaceae, Cyperaceae, Proteaceae, Myrtaceae and Poaceae families. The most speciose genus was *Acacia* (18 taxa), followed by *Leucopogon, Hibbertia* and *Lomandra* (6 taxa each) (Onshore Environmental 2018a). The 2018 survey represents an early autumn assessment meaning that many annual and ephemeral plant taxa were not present and therefore species numbers were lower than the 2011 Spring survey. Additionally the 2011 survey was undertaken across a broader survey area which included vegetation types not represented within the MDE.



Greenbushes Lithium Mine

Vegetation Condition Mapping

Legend

- Mine Development Envelope
- Proposed Development Areas (Inside CPS 5056/2)
- Proposed Development Areas (Outside CPS 5056/2)
- Clearing Permit No:CPS 5056/2

Vegetation Condition (Onshore 2018)

- Cleared
- Degraded
- Rehab
- Good
- Very Good
- Watercourses
- Major Roads

N

0 100 200 300 400 500
Meters
1:30,013

Datum: GDA94
Projection: MGA Zone 50

Sources: data.wa.gov.au, Landgate, Geoscience Australia, Onshore, Imagery 2017

Date:	12/07/2018
Status:	Final
Figure:	7
Sheet Size:	A4
Internal Reference:	FIG 7
Drawn by:	CG
Requested by:	AC

Talison Lithium

Conservation significant flora

Searches of the following were undertaken to identify the potential presence of conservation significant flora within the MDE (Onshore Environmental 2012, 2018a):

- DBCA NatureMap Database;
- DBCA Threatened and Priority Flora Database;
- DoEE Protected Matters Database; and
- International Union for Conservation of Nature (**IUCN**) Database.

Conservation significant species occurring within a 20 km or 50 km radius of the relevant Study area were identified and a likelihood of occurrence assessment was undertaken (Onshore Environmental 2012, 2018a). A summary of conservation significant flora species considered likely to occur within the MDE based on this assessment is included in Table 16. The table also identifies those species listed that have been identified within the Greenbushes Study Area, and the Proposal Study Area.

No threatened flora listed under the EPBC Act or DRF listed under the *Wildlife Conservation Act 1950* (**WC Act**) have been recorded within the MDE. One priority species recognised by the DBCA (*Acacia semitrullata,* Priority 4) was recorded within the MDE.

One occurrence of the EPBC Act and the WC Act listed, *Caladenia harringtoniae* (Vulnerable) was recorded within the Greenbushes Study Area approximately 560 m from the south-west boundary of the MDE. Despite targeted searches of the MDE no other occurrences of this species have been recorded.

Table 16 Conservation significant flora summary

Species	Likelihood or location recorded	EPBC Act/WC Act listing	DBCA listing	Occurrence	Distance from the MDE
Acacia semitrullata	Recorded M01/3, M01/06, M1/07	NA	P4	160 plants from 14 point locations, representing 2 populations	Within the north west and central-southern sector
Caladenia harringtoniae	Recorded M01/3	Vulnerable	NA	26 plants located in an unincised drainage line/dampland	560 m west of the south-west boundary
Caladenia hoffmanii	Species or habitat considered likely to occur within 20 km of the MDE	Endangered	NA	Not identified during survey	
Dampiera heteroptera		NA	P3		
Diuris micrantha		Vulnerable	NA		
Goodenia arthrotricha		Endangered	NA		
Grevillea ripicola		NA	P4		
Melaleuca viminalis		NA	P2		
Tetratheca parvifolia	Recorded M01/5	NA	P3	Two locations, one of scattered plants at an estimated density of 5 plants/ 10 m^2 and the other a single plant.	~3 km north west

Introduced and invasive species

A total of 86 introduced flora species were recorded within the Greenbushes Study Area during the Onshore Environmental 2011 survey. Three of those recorded are Declared Plants under the *Biosecurity and Agricultural Management Act 2007* (**BAM Act**).

- *Asparagus asparagoides* (Bridal Creeper);
- *Galium aparine* (Goosegrass); and
- *Rubus ulmifolius* (Blackberry).

A total of 32 introduced flora species were recorded within the Proposal Study Area during the Onshore Environmental 2018 survey, of which three taxa are Declared Plants under the BAM Act:

- *Asparagus asparagoides* (Bridal Creeper);
- *Rubus anglocandicans* (Blackberry); and
- *Rumex acetosella* (Sorrell).

The relatively high diversity of weeds within the MDE and surrounding mining leases reflects the long mining history of the Greenbushes area and close proximity to surrounding agricultural land (Onshore Environmental 2018a). Many of the weed species recorded are likely to have been introduced during early exploration and mining, becoming established on disturbed ground and extending into adjacent areas. High moisture habitats are particularly vulnerable to colonisation by weeds, however infestations recorded during the 2018 survey were generally localised (Onshore Environmental 2018a). Farmland in the southern sector of the MDE is another source of introduced species, with 'edge effects' typically evident around the boundary of cleared annual pasture areas. The annual pasture and verge species are represented within intact native vegetation as a minor component of the understorey. Disturbed areas such as tracks and historical rehabilitation are more susceptible to invasion by these taxa, which are generally not vigorous and do not impact on native vegetation structure (Onshore Environmental 2018a).

Dieback

Phytophthora cinnamomi is a soil fungus which kills susceptible plants by attacking their root systems preventing the plant from absorbing water and nutrients. Dieback is the term commonly used when referring to this fungus due to its effect on vegetation. The fungus is found throughout the southern extent of Western Australia in areas with susceptible plant species that receive rainfall in excess of 400 mm/year (Dieback Working Group 2008). Project Dieback (2017) data shows that the Greenbushes area is within an area at risk of *Phytophthora cinnamomi*. Vegetation within the area is highly susceptible to the fungus and it has been identified within the MDE. Dieback mapping has been undertaken by the DBCA within part of the MDE. The mapping outcomes show that dieback occurs in some areas of the MDE. Some areas have been mapped as unprotectable due to surrounding land use and nearby presence of dieback infested areas. There are also areas which remain dieback free where controls are necessary to prevent infestation occurring. Further mapping of areas of proposed disturbance which have not yet been assessed is planned and updated mapping of areas is undertaken where needed as the status of areas can change over time.

4.3.4 Potential impacts

The Proposal will result in the direct loss of up to 350 ha of native vegetation (State Forest 20) outside of the existing approved disturbance area (CPS 5056/2).

The Proposal could also result in the following indirect impacts to vegetation and flora:

- Fragmentation of native vegetation (discussed in section 4.4.5);
- Possible introduction and/or spread of invasive pathogens causing vegetation deterioration or death;
- Possible introduction and/or spread of invasive plant species (weeds) causing increased competition with native vegetation in undisturbed and rehabilitated areas;
- Changes to vegetation structure and floristic composition in surrounding areas as a result of changes to surface water drainage patterns and flows (discussed in section 4.6.5);
- Reduced vegetation health as a result of smothering by dust generated from the operational activities; and
- Damage to, and loss of surrounding vegetation through accidental generation of a bushfire.

4.3.5 Assessment of impacts

Vegetation clearing

Talison proposes to clear up to 350 ha of native vegetation within the MDE for the purpose of lithium mining and processing. Vegetation clearing will reduce the local and regional extent of the vegetation communities represented within the MDE. The clearing footprint may result in the loss of up to 160 plants of Priority 4 species *Acacia semitrullata* dependant on the final footprint of infrastructure and landforms.

The impact of vegetation clearing has been considered in terms of vegetation complexes and site-vegetation types. Vegetation complexes have been used to assess the impact of clearing at both regional and local scales and site-vegetation types have been used to assess the impact of clearing at the local scale.

Vegetation complexes

Proposed clearing within the MDE will primarily occur within the Dwellingup complex (Figure 8). Over 85% of the pre-European extent of this complex is remaining, of which over 80% is within DBCA managed lands within the South West Forest Region. Table 17 and Table 18 show the current extents of all vegetation complexes mapped within the MDE, and the extent of proposed clearing within each complex at the South West Forest Region of Western Australia (regional), and the Shire of Bridgetown - Greenbushes (local) scales.

There is less than 0.3% of the current extents of all vegetation complexes within the proposed clearing footprint at a regional scale (South West Forest Region) (Table 17), and less than 3.5 % of the current extents of all vegetation complexes within the proposed clearing footprint at a local scale (Shire of Bridgetown-Greenbushes) (Table 18).

The proposal is therefore not expected to significantly reduce the extent of any vegetation complexes at the regional or local scale.

Vegetation types

Native vegetation covers approximately 671 ha (33.8%) of the MDE with Jarrah-Marri forest being the dominant vegetation association (Onshore Environmental 2018b). Proposed clearing will impact on three of the vegetation types mapped by Onshore Environmental (2012), and eight of the vegetation types mapped by Onshore Environmental (2018a). The estimated impact of clearing on the mapped extent of Onshore Environmental 2012 vegetation types within the Greenbushes Study Area is detailed in Table 19 and on the mapped extent of Onshore Environmental 2018 vegetation types within the Proposal Study area is detailed in Table 20. The vegetation proposed to be cleared is predominantly in Good or Very Good condition. None of the vegetation types within the MDE are considered to be locally or regionally significant.

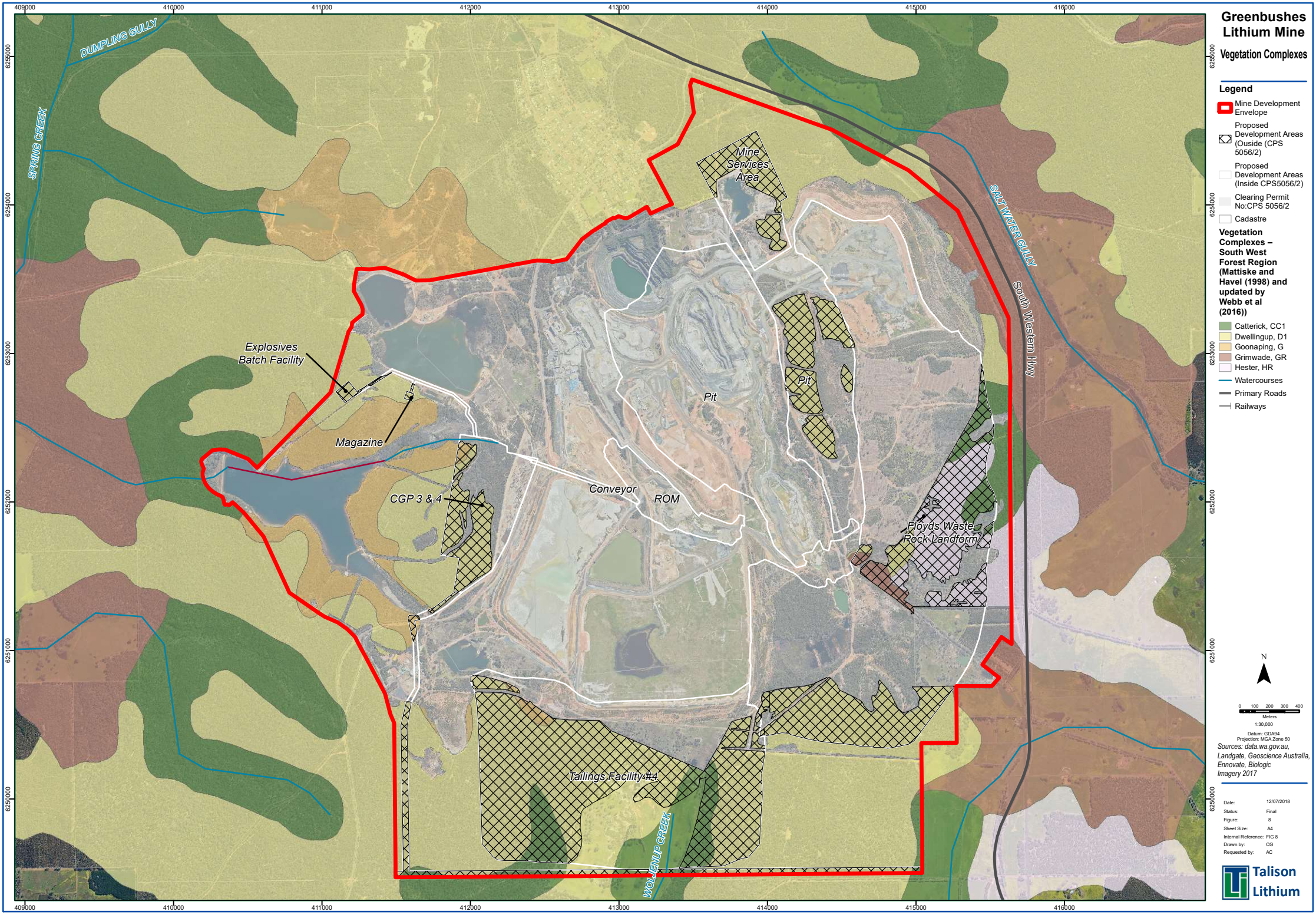
Clearing of some rehabilitated mining areas and plantation vegetation (*Pinus sp*.) will also occur within the MDE.

The proposed clearing of native vegetation is not considered to represent a significant impact to flora and vegetation on the basis that:

- Vegetation types to be cleared are well represented at a regional and local scale and are not considered to be regionally or locally significant; and
- No Threatened or Priority ecological communities occur within the MDE or surrounding mining leases.

Conservation significant flora

No Threatened or Declared Rare Flora occurs within the MDE with the closest record (*Caladenia harringtoniae*) being approximately 560 m from the MDE south-west boundary. Mapping of the surface water catchments within the area surrounding the recorded location indicates that run-off from the activities and landforms within the MDE will not impact on the sub-catchment within which the *Caladenia harringtoniae* occurs. It is therefore not expected that the recorded population of this species will be directly or indirectly affected by the Mine expansion. An illustration of predicted surface water flow and catchments in relation to the identified *Caladenia harringtoniae* location is included in Figure 9.



Greenbushes Lithium Mine

Vegetation Complexes

Legend

- Mine Development Envelope
- Proposed Development Areas (Ouside (CPS 5056/2)
- Proposed Development Areas (Inside CPS5056/2)
- Clearing Permit No:CPS 5056/2
- Cadastre

Vegetation Complexes – South West Forest Region (Mattiske and Havel (1998) and updated by Webb et al (2016))

- Catterick, CC1
- Dwellingup, D1
- Goonaping, G
- Grimwade, GR
- Hester, HR
- Watercourses
- Primary Roads
- Railways

N

0 100 200 300 400
Meters
1:30,000

Datum: GDA94
Projection: MGA Zone 50

Sources: data.wa.gov.au, Landgate, Geoscience Australia, Ennovate, Biologic Imagery 2017

Date:	12/07/2018
Status:	Final
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Sheet Size:	A4
Internal Reference:	FIG 8
Drawn by:	CG
Requested by:	AC

Talison Lithium

Table 17 Extent of vegetation complexes mapped within the MDE for South West Forest Region of WA (GoWA 2018)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	% pre-European extent remaining	Current extent remaining within all DBCA managed land (%)	Estimated extent to be cleared within the MDE (ha)	% of current extent within SWFR to be cleared (ha)
Dwellingup Complex D1	208,490.90	180,683.44	86.66	82.11	269	0.15
Goonaping Complex G	27,467.04	21,836.72	79.50	70.45	4	0.02
Catterick Complex CC1	27,385.55	16,745.40	61.15	55.54	37	0.22
Grimwade Complex GR	22,046.59	11,092.40	50.31	43.35	5	0.05
Hester Complex HR	32,249.57	23,763.74	73.69	67.12	35	0.15

Table 18 Extent of vegetation complexes mapped within the MDE for Shire of Bridgetown - Greenbushes (GoWA 2018)

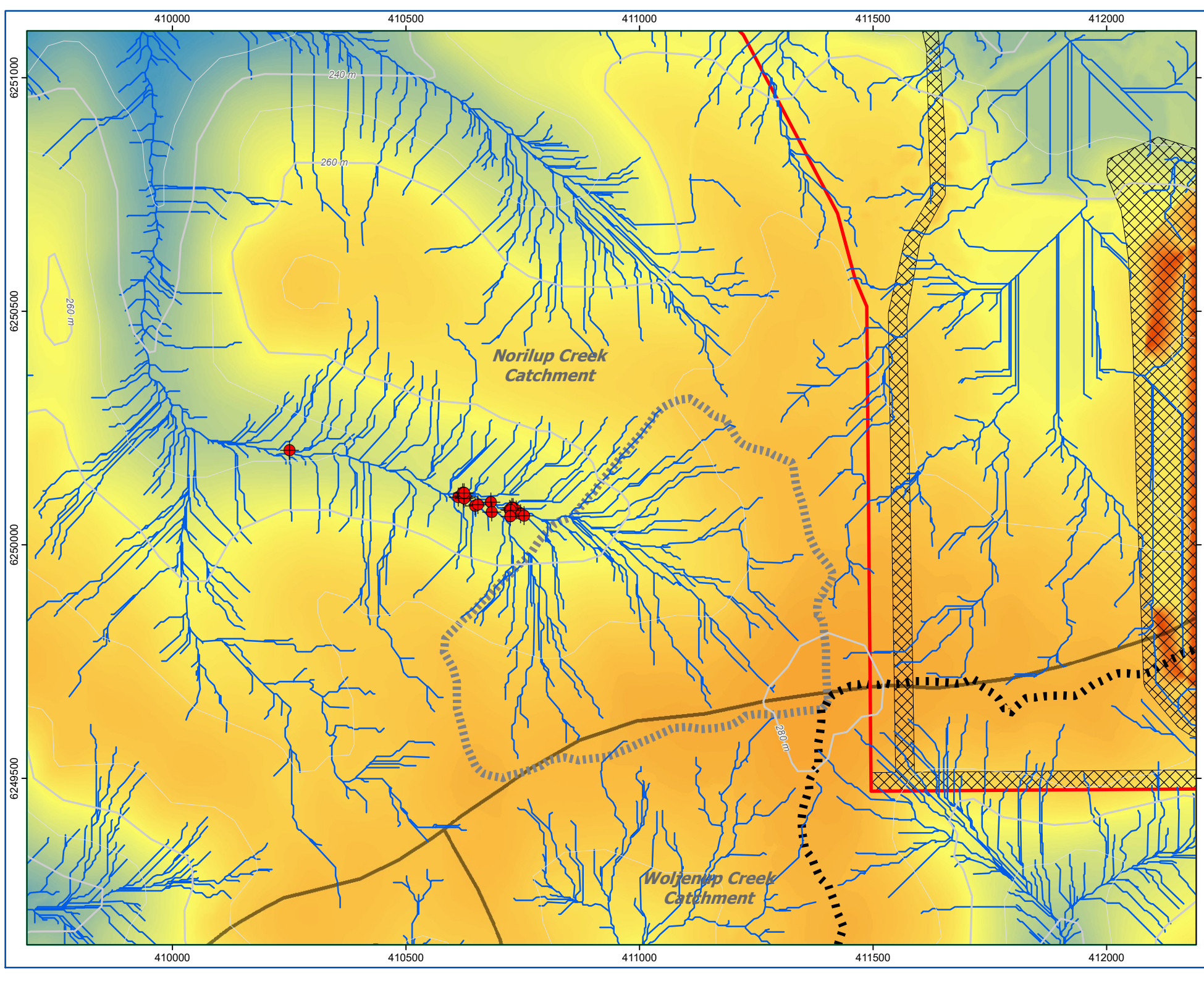
Vegetation complex	Pre-European extent (ha)	Current extent (ha)	% pre-European extent remaining	Proportion of the vegetation complex within the LGA (%)	Estimated extent to be cleared within the MDE (ha)	% of current extent to be cleared (ha)
Dwellingup Complex	13,704.69	8,482.20	61.89	6.57	269	3.17
Goonaping Complex	523.27	212.20	40.56	1.91	4	1.89
Catterick Complex	11,732.17	4,533.08	38.64	42.84	37	0.82
Grimwade Complex	5,272.19	1,662.71	31.54	23.91	5	0.3
Hester Complex	4,212.47	1,621.18	38.49	13.06	35	2.16

Table 19 Extent of clearing impact on Onshore Environmental 2012 vegetation associations within the MDE

Vegetation Association	Vegetation Condition	Extent mapped within Greenbushes Study area (ha)	Extent mapped within MDE (ha)	Proposed clearing area (ha)	% Mapped extent proposed to be cleared	% mapped within MDE proposed to be cleared
1a	Very Good to Good	1021.29	71.9	55	5.39	76.5
1b	Very Good	3985.18	403.9	180	4.52	44.6
2a	Very Good to Good	364.11	195.4	115	31.58	58.9

Table 20 Extent of clearing impact on Onshore Environmental 2018 vegetation types within the MDE

Vegetation type	Vegetation Condition	Extent mapped within the Proposal Study area (ha)	Extent mapped within MDE (ha)	Extent of Proposed clearing (ha)	% Mapped Extent Proposed to be cleared	% mapped within MDE proposed to be cleared
Hs Bo	Very Good	555.1	507	222.8	40.1	43.9
DL Er	Good to Degraded	1.2	1.2	1.2	100	100
DL EpCc Tp	Very Good	17.9	5.9	0.5	2.8	8.5
HS Bg	Very Good	119.3	115.9	75	62.9	64.7
HS Xp	Good	12.3	12.3	4	32.5	32.5
HS Pd TpBl	Very Good	43	43	38	88.4	88.4
HS Ew	Very Good	1.3	1.3	0	0.0	0.0
DF MpEp AsTl	Good	4.9	4.9	4.9	100	100
DF Pe	Degraded	3.6	3.6	3.6	100	100



Greenbushes Lithium Mine

Predictive Surface Modelling 2031

Legend

Caladenia harringtoniae

Elevation (m AHD)

Contours

5m

Index (20m)

2031 Indicative Surface Flow

Proposed Development Areas

Subcatchments

South West Catchments (GHD Hydrology study)

Name

West

WoljenupCreek SubCatchment

Predictive 2031 Surface Model

Value

High : 300 AHD

Low : 202 AHD

N

0 50 100 150 200

Meters

1:10,000

Datum: GDA94

Projection: MGA Zone 50

Date:	12/07/2018
Status:	Final
Figure:	9
Sheet Size:	A4
Internal Reference:	Pred2031
Drawn by:	CG
Requested by:	CG

Talison Lithium

Introduction and/or spread of invasive pathogens and weeds

The Proposal has the potential to introduce and/or spread invasive pathogens (*Phytophthora cinnamomi* or dieback), and invasive flora species (weeds) as a result of vehicle or heavy equipment movement throughout the MDE, land clearing, or movement of soil and plant materials. Dieback and weeds can also potentially be carried to downstream areas through the hydrological systems. *Phytophthora cinnamomi* can potentially result in widespread vegetation death in infested areas, and weeds can affect the health and survival of vegetation in rehabilitation areas and adjacent forested areas, potentially causing a reduction in species diversity and overall ecosystem health both within, and in the area surrounding, the MDE.

Given that weeds are widespread throughout the MDE, and known infestations of *Phytophthora cinnamomi* are also present, spread of these invasive species and pathogen could potentially occur as a result of the Mine expansion. Vegetation within the MDE is also known to be susceptible to dieback. Spread is mostly likely to occur as a result of poor hygiene practices when vehicles and mine equipment enter or depart the MDE or when they move around the MDE, particularly from areas known to be infested to areas which aren't. Collection and use of topsoil for rehabilitation is also a potential factor in the spread of weeds and pathogens if infested soils are stored or used in areas which have not been impacted.

Talison has established vehicle hygiene and ground disturbance procedures as well as a weed control program, which have been implemented to prevent the spread and introduction of invasive pathogens and weeds. Although topsoil is a valuable rehabilitation material, soil which is known to be heavily infested with weeds or *Phytophthora cinnamomi* is disposed of through burial and an alternative growth medium (oxidised clay) is used for rehabilitation. There have been no signs of significant deterioration of the surrounding vegetation indicating the effectiveness of these measures.

Dust causing reduced vegetation health

Dust can potentially impact on the health and condition of vegetation. If dust particles settle and accumulate on the surface of the leaves of vegetation it can block stomata causing reduced transpiration and photosynthesis and an associated decline in plant health. Mining activities (blasting and ore/waste handling), ore processing, land clearing and open areas such as stockpiles, WRL and TSF are likely to generate dust. Opportunities for dust emissions are expected to increase as a result of the Mine expansion due to increased mining activity, open areas, land clearing and vehicle movements however Talison has established practices to control emissions.

Dust can potentially travel long distances depending on particle characteristics, weather conditions and topography (Turner 2013). There is therefore potential for dust impacts to vegetation outside of the MDE, however this is considered unlikely to occur with implementation of effective dust mitigation practices which limit the generation of dust. Talison currently implement a range of effective dust mitigation measures (further discussed in section 4.8.6) and vegetation within the surrounds of the Mine does not currently show signs of decline as a result of dust impacts indicating the effectiveness of these measures.

Vegetation loss due to bushfire

There is a low risk of accidental fires being ignited as a result of mining activities within the MDE. Approximately half of the MDE is currently comprised of cleared area for mining activity and water storage, and is unlikely to support a fire. The cleared area will increase as the Mine is expanded further reducing fuel levels. As mining activities are predominantly undertaken within cleared areas it is unlikely that a fire will become established in the operational area and spread to the surrounding vegetation. In the unlikely event a fire occurs that spreads beyond the active

mining area, widespread damage and loss of vegetation within the surrounding State Forest 20 areas could occur.

Native vegetation clearing is the activity most likely to potentially cause a bushfire as it is undertaken in vegetated areas where there are fuel loads which could potentially support a bushfire. Effective management of clearing activities will prevent the incidence of bushfire as result of clearing activity. There is no record of bushfires resulting from the Mine throughout the past 30 years of open pit mining activity and the risk of one being generated as a consequence of the Mine expansion is considered to be very low.

4.3.6 Mitigation

The Proposal is an expansion of an existing mining operation that has been operated for over 30 years. Mineral resource developments are limited in the extent they can be moved from the location where the resource has been identified. Therefore, due to the nature of the Proposal being an expansion of an existing mineral resource development, the location of infrastructure and landforms is restricted by existing infrastructure and landforms, as well as the location of the ore body. Key constraints when planning the location of infrastructure and landforms for the expansion include:

- South West Highway to the immediate east of the proposed Floyd's WRL footprint;
- Greenbushes townsite immediate north of the existing open pits;
- Water storage dams to the west of the mining and processing area; and
- The location of the ore body which could potentially be sterilised through placement of infrastructure and landforms.

The proposed clearing required for the Proposal cannot be avoided as it is required to enable the Mine expansion to occur.

Mitigation and management measures for impacts to flora and vegetation which are currently implemented, or will be undertaken as part of the Proposal include:

Avoidance

- Talison's ISO 14001 certified EMS includes a Clearing/Disturbance procedure and associated permit to prevent clearing outside approved boundaries. The Procedure requires:
  - Internal permits must be granted before clearing can occur;
  - All clearing areas must be demarcated prior to clearing; and
  - All clearing areas must be surveyed after clearing to confirm the area cleared.
- Talison will consider the location of identified *Acacia semitrullata* populations when planning final infrastructure/landform locations and avoid them where practical to do so.
- Talison has preferentially located landforms and infrastructure in existing cleared areas where possible to avoid unnecessary vegetation clearing.

Minimisation

- Clearing is limited to only the footprint required with existing disturbance areas (or rehabilitated areas) used where possible to establish or expand infrastructure and landforms. In particular, Talison aims to use existing areas of disturbance to establish roads and infrastructure corridors wherever possible.
- Talison's ISO 14001 certified EMS includes the following procedures and management plans which detail measures which are implemented to prevent and minimise impacts on native flora and vegetation:

- Dieback Management Plan;
- Weed Control Management Plan;
- Vehicle Hygiene procedure for vehicles and equipment coming on to or returning to the site for earthmoving;
- Dust Management Plan; and
- Native Fauna and Flora Protection Procedure.

- Talison employ a full time environmental officer to manage weeds on site. Regular weed monitoring and weed control programs are undertaken, and a contractor is employed to hand weed during spring and/or autumn. Weed management techniques include spraying with herbicides (undertaken in late winter or early spring), hand pulling and cutting. Seeding with native species at the earliest opportunity is a key undertaking to control weed infestation within disturbed areas, even if these areas may require disturbance again in the future.
- Further dieback mapping will be undertaken within the proposed disturbance areas to determine the presence or absence of dieback prior to clearing activity.
- Implementation of the Talison Greenbushes Operations Hot Work Permit System, and Emergency Management Procedures, to minimise the risk of bushfires.
- Clearing activities will not be undertaken when the Fire Danger Rating is severe or higher.

Rehabilitation

- Progressive rehabilitation of disturbed areas where possible, as per the approved Mine Closure Plan. Areas active for the duration of mining activity will be rehabilitated at the end of life.
- The objective of rehabilitation is to establish a self-sustaining heath community with selected attributes compatible with surrounding Jarrah/Marri forest, and landforms that blend with the Mine's undulating scarp location.
- Growth medium is applied to rehabilitation areas to improve the likelihood of suitable vegetation establishing. Growth medium can comprise topsoil (if available), or weathered regolith material that has proven suitable for rehabilitation of current mining landforms.
- Rehabilitation areas are planted with seedlings, including *Corymbia calophylla* (Marri), *Eucalyptus marginata* (Jarrah), *Eucalyptus patens* (Blackbutt) and *Eucalyptus rudis* (Flooded Gum). The rehabilitation areas are direct sown with provenance seed by hand which is typically sourced from within 50 km of Greenbushes.
- Seed mixes are reviewed and modified dependant on the type of landform being rehabilitated, recommendations of annual rehabilitation monitoring, and availability of seed.
- Update of the Greenbushes Operations Closure Plan 2016 (as required under the Mining Act and in accordance with the DMIRS Guidelines for Preparing Mine Closure Plans, May 2015) which will include closure objectives and completion criteria related to rehabilitation. The updated plan will be submitted to DMIRS together with a Mining Proposal application for the expansion.
- Ongoing weed management is undertaken, particularly in rehabilitation areas with treatment during the first three growing seasons to minimise weeds and promote native vegetation growth. Weed spraying is undertaken in late winter or early spring.

4.3.7 Predicted Outcomes

The Greenbushes area has been extensively disturbed over a long history of mining within the region, farming and logging activity. The Mine is located within State Forest 20 and therefore impacts to flora and vegetation associated with the Mine expansion will reduce the area of protected vegetation within the South West Region, albeit on a relatively small scale. Talison considers that the impacts on flora and vegetation associated with the proposed Mine expansion do not significantly impact on the biological diversity and ecological integrity on a local or regional level.

Therefore, it is expected that the Proposal can meet the EPA objective for this factor.

Native vegetation clearing at the Mine has previously been regulated through Clearing Permits, issued in accordance with the requirements of Part V of the EP Act, and the associated Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations). Talison anticipate that the potential impacts to Flora and Vegetation, which result from the proposed Mine Expansion, could continue to be appropriately managed through the Clearing Permit process.

4.4 Key Environmental Factor - Terrestrial fauna

4.4.1 EPA objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.4.2 Policy and guidance

- Environmental Factor Guideline Terrestrial Fauna (EPA 2016g).
- Technical Guidance Sampling methods for terrestrial vertebrate fauna (EPA 2016i).
- Technical Guidance Terrestrial Fauna Surveys (EPA 2016j).
- Technical Guidance: Sampling of Short-range Endemic Invertebrate Fauna (EPA 2016k).
- Technical Guidance: Subterranean Fauna Survey (EPA 2016l).
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011).
- *Wildlife Conservation Act 1950.*
- *Biodiversity Conservation Act 2016.*
- *Environment Protection and Biodiversity Conservation Act 1999*

4.4.3 Receiving environment

The following fauna studies have been undertaken within Talison's Greenbushes mining leases which have informed this assessment:

- Biologic (2011) Greenbushes Level 1 Fauna Survey (Appendix B);
- Biologic (2018a) Greenbushes Targeted Vertebrate and SRE Invertebrate Fauna Survey (Appendix B);
- Biologic (2018b) Greenbushes Vertebrate, SRE and Subterranean Fauna Desktop Assessment (Appendix B);
- Kirkby (2018) Black Cockatoo Survey, Talison Mining, Greenbushes (Appendix C);
- Ennovate (2018) Black Cockatoo Habitat Quality Assessment - 2018 Expanded Mine Development Area (Appendix C);

- Harewood (2018a) Greenbushes Black Cockatoo Tree Hollow Review, Talison Lithium Pty Ltd (Appendix C); and
- Harewood (2018b) Greenbushes - Preliminary Western Ringtail Possum Surveys – June 2018 (Appendix D).

The Biologic 2011 study was a Level 1 Fauna survey (as defined by EPA Technical Guidance Terrestrial Fauna Surveys (EPA, 2016j) undertaken in Spring 2011 across all of the Talison Greenbushes mining leases covering a total area of 10,059.82 ha (referred to as the **Greenbushes Study Area**). This fauna study was the first broad scale assessment of all Talison's Greenbushes mining leases and is regarded as a baseline survey for environmental approvals, impact assessment and closure planning. The study included a desktop assessment of previous fauna surveys and records within the Greenbushes Study Area, a field survey to map and describe fauna habitats and species present, and targeted surveys for fauna of conservation significance including habitat tree assessments for the three threated black cockatoo species (Biologic 2011). The assessment included nocturnal surveys, bat recording, motion camera recording and opportunistic surveys of tracks, scats, other traces of fauna, and incidental recordings.

A review of the Biologic 2011 survey was undertaken in early 2018 with the primary objective of the review being to update information from the assessment and assess the likelihood of occurrence of conservation significant fauna, Short Range Endemic (**SRE**) and subterranean fauna within the MDE. A targeted survey for vertebrate fauna of conservation significance and SRE invertebrates was also undertaken within the MDE which included all areas outside the existing approved disturbance boundary of the mine (CPS 5056/2) (referred to as the **Proposal Study Area**). The survey was undertaken in February 2018 (Biologic 2018a) and included motion camera recording, targeted searches, opportunistic records and nocturnal surveys, as well as active foraging and leaf litter and soil sifting for SRE's. The Biologic 2018 targeted vertebrate fauna survey was unable to confirm or otherwise the presence, or use of habitat within the MDE, by the Critically Endangered Western Ringtail Possum. Therefore, a further targeted survey for the species was conducted by Greg Harewood in June 2018 (Harewood 2018a).

A ground based targeted black cockatoo survey was undertaken by recognised black cockatoo Researcher Tony Kirkby in early 2018. The survey was undertaken within blocks of vegetation within the MDE to assess the suitability for foraging and breeding by the three black cockatoo species known from the Greenbushes area. Following this survey, Talison recognised that due to the age of the Biologic (2011) black cockatoo habitat tree assessments, the status of the trees identified during the survey was unconfirmed. Additionally there are limitations to the assessment of suitable tree hollows from ground level. To address these issues in June 2018 Greg Harewood was engaged to undertake an aerial (drone) survey of recorded trees with hollows suitable for black cockatoo breeding (within and in proximity to the MDE). The purpose of the survey was to confirm the presence of trees with suitable breeding hollows from the earlier 2011 survey, and assess the characteristics of confirmed hollows from the Biologic 2011 and Kirkby 2018 surveys for their potential to represent actual or possible black cockatoo breeding hollows (Harewood 2018b).

Fauna habitats

Fauna habitat types were initially mapped by Biologic (2011) within the Greenbushes Study Area. Four natural and seven anthropogenic habitat types were mapped. The habitat types identified are directly correlated to the vegetation communities mapped within the area by Onshore Environmental 2012. Of the habitat types mapped, two natural and five anthropogenic habitats are present within the MDE (Biologic 2018b). A description of fauna habitat types, correlated vegetation communities, and their extent within the MDE is provided in Table 21. The

extent of the habitat types within the Greenbushes Study Area and the MDE are illustrated in Figure 10 and Figure 11 respectively. The fauna habitats defined by Biologic are not considered to be restricted or unique in the region.

Ecological linkages

Ecological linkages can be described as 'a series of (both contiguous and non-contiguous) patches of vegetation which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape' (Molloy *et al* 2009). Axis lines defined in Molloy *et al* 2009 identify patches of remnant vegetation within the South West Region with high connectivity or linkage value.

The MDE is linked to extensive areas of un-fragmented forest to the south west (State Forest 20) and north east (Wilga State Forest). The MDE is located to the east of a north-south aligned South West Regional Ecological Linkage (**SWREL**) Axis Line and south of an east-west aligned SWREL Axis Line (Map 4: Bunbury Wellington Region, Molloy *et al* 2009). Remnant vegetation within the MDE is classified as 1a (vegetation is touching or <100m from a SWREL) and 1b (vegetation is touching or <100m from an area classified as 1a) in association with the SWREL axis lines meaning the area forms part of the ecological linkage. The Proposal is not expected to significantly impact on ecological linkages as fauna will still be able to move around the MDE through vegetation cover.

Fauna diversity

Desktop assessments of vertebrate fauna potentially occurring within the MDE were undertaken by Biologic (2011, 2018b). The assessments were based on review of available literature and searches within a 25 km radius of the following:

- DBCA Naturemap Database;
- DBCA Threatened and Priority Fauna Database;
- Birdlife Australia Birdata Bird Atlas; and
- DoEE Protected Matters Database.

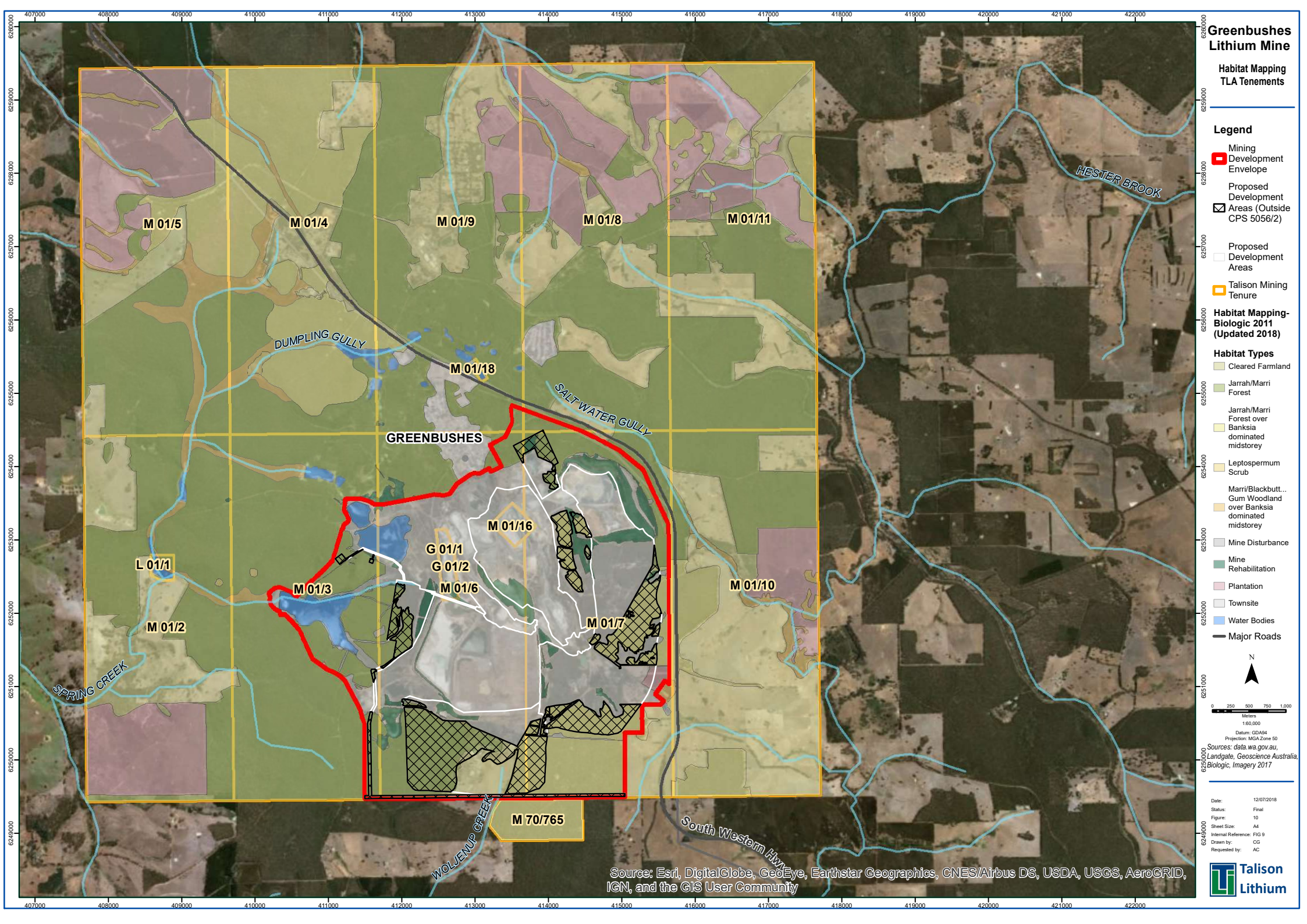
The desktop assessment by Biologic (2011) identified 196 vertebrate fauna species with the potential to occur within the Greenbushes Study Area. Eighty two of these species were recorded as occurring within the Greenbushes Study Area during the field assessment. The fauna assemblage recorded comprised eight native mammal species, six introduced mammal species, 59 bird species, four reptile species and five amphibian species. The number of reptile species was low due to the cool conditions during the time of the survey (Biologic 2011)

The desktop assessment completed by Biologic (2018b) identified a total of 291 species of vertebrate fauna which have previously been recorded and/or have the potential to occur within the MDE. This comprised 31 native mammals, 10 non-native mammals, 169 native birds, six non-native birds, 45 reptiles, 19 amphibians and 11 fish species. Fifty three vertebrate fauna species were recorded during the Biologic (2018a) survey directly and/or via secondary evidence, comprising 14 mammals (including six introduced species), 30 birds, seven reptiles and two amphibians.

Table 21 Fauna habitats within the Greenbushes Lithium Mine Expansion MDE (Biologic 2011, 2018a, 2018b)

Habitat	Extent within the Greenbushes Study Area (ha)	Extent within the MDE (ha)	Description	Significant vegetation species associated with habitat	Vegetation type (Onshore 2012)
Jarrah (*E. marginata*)/Marri (*C. calophylla*) forest over Banksia dominated midstorey	1,240.9	267.4	*E. marginata/C. calophylla* forest over *Banksia grandis/Persoonia longifolia* dominated scrub on upper hill slopes and plateaux	*C. calophylla* *E. Marginata* *B. grandis* *P. longifolia*	1a, 2a, 2b
Jarrah/Marri forest	3,946	403.9	*E. marginata/C. calophylla* forest over scrub on undulating hill slopes and drainage lines.		1b, 2d
Water bodies	117	74.8	Comprises large open water bodies of the study area, appear to be man-made structures	NA	6
Plantation	1,211.4	8.9	Artificial pine plantations with the MDE	Pinus spp	4
Rehabilitation	140.8	129.4	Areas which have been rehabilitated within the MDE	NA	8
Cleared Farmland	1931.3	52.1	Open paddocks, sometimes containing remnant trees	NA	5
Mine Disturbance	1054.7	1052.7	Areas impacted by mining activity	Pinus spp.	9

Note – Habitats identified in the Greenbushes Study Area (Biologic 2011) not occurring within the MDE are not included in the table.


Greenbushes Lithium Mine
Habitat Mapping TLA Tenements
Legend
Mining Development Envelope
Proposed Development Areas (Outside CPS 5056/2)
Proposed Development Areas
Talison Mining Tenure
Habitat Mapping-Biologic 2011 (Updated 2018)
Habitat Types
Cleared Farmland
Jarrah/Marri Forest
Jarrah/Marri Forest over Banksia dominated midstorey
Leptospermum Scrub
Marri/Blackbutt... Gum Woodland over Banksia dominated midstorey
Mine Disturbance
Mine Rehabilitation
Plantation
Townsite
Water Bodies
Major Roads
N
0 250 500 750 1,000
Meters
1:60,000
Datum: GDA94
Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia, Biologic, Imagery 2017
Date: 12/07/2018
Status: Final
Figure: 10
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Internal Reference: FIG 9
Drawn by: CG
Requested by: AC
Talison Lithium
M 01/5
M 01/4
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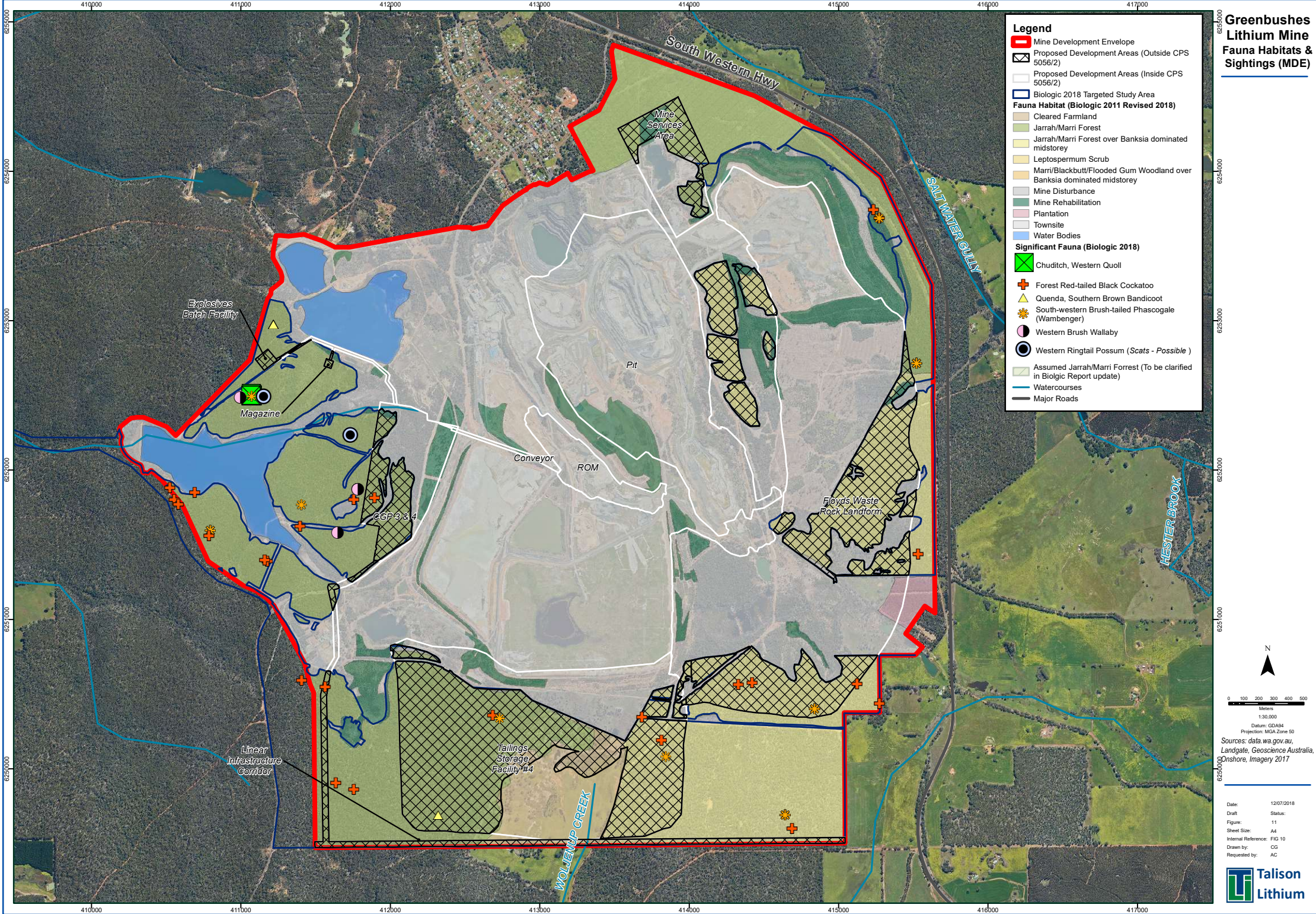
M 01/11
M 01/18
GREENBUSHES
M 01/16
G 01/1
G 01/2
M 01/6
M 01/3
L 01/1
M 01/2
M 01/10
M 01/7
M 70/765
DUMPLING GULLY
SALT WATER GULLY
HESTER BROOK
SPRING CREEK
WOLJENUP CREEK
South Western Hwy
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Greenbushes Lithium Mine
Fauna Habitats & Sightings (MDE)
Legend
Mine Development Envelope
Proposed Development Areas (Outside CPS 5056/2)
Proposed Development Areas (Inside CPS 5056/2)
Biologic 2018 Targeted Study Area
Fauna Habitat (Biologic 2011 Revised 2018)
Cleared Farmland
Jarrah/Marri Forest
Jarrah/Marri Forest over Banksia dominated midstorey
Leptospermum Scrub
Marri/Blackbutt/Flooded Gum Woodland over Banksia dominated midstorey
Mine Disturbance
Mine Rehabilitation
Plantation
Townsite
Water Bodies
Significant Fauna (Biologic 2018)
Chuditch, Western Quoll
Forest Red-tailed Black Cockatoo
Quenda, Southern Brown Bandicoot
South-western Brush-tailed Phascogale (Wambenger)
Western Brush Wallaby
Western Ringtail Possum (Scats - Possible)
Assumed Jarrah/Marri Forrest (To be clarified in Biolgic Report update)
Watercourses
Major Roads
South Western Hwy
Mine Services Area
SALT WATER GULLY
Explosives Batch Facility
Magazine
Pit
Conveyor
ROM
CGP 3 & 4
Floyds Waste Rock Landform
HESTER BROOK
Linear Infrastructure Corridor
Tailings Storage Facility #4
WOLLEMUP CREEK
410000
411000
412000
413000
414000
415000
416000
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6255000
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Internal Reference: FIG 10
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Talison Lithium

Conservation significant fauna

Biologic (2018b) undertook database searches and literature reviews in order to identify conservation significant fauna species potentially occurring within the MDE. Based on the results of the database searches and literature review, 44 conservation significant fauna species were identified as having the potential to occur within the MDE. Fauna surveys have confirmed the presence of seven conservation significant species (Biologic 2018b). The sighting locations are illustrated in Figure 11. Based on the species distribution, previous records and the habitats present, one further species is deemed highly likely, two likely, six possible, and 27 rarely, unlikely or highly unlikely to occur. The 18 conservation significant fauna identified within the MDE or considered highly likely, likely or possible to occur are detailed in Table 22.

A further species, Western Ringtail Possum (**WRP**), has possibly been recorded within the MDE. Scats potentially belonging to WRP (or the Common Brushtail Possum) were identified during the Biologic survey of the MDE (Biologic 2018a). As the presence of WRPs was not confirmed by the Biologic survey, Greg Harewood was engaged to undertake further targeted survey for WRPs and suitable habitat within the MDE, and at the nearby Schwenke's Dam (outside the MDE). The survey identified three old and unmaintained WRP dreys in paperbark trees near the Schwenke's Dam (outside the MDE) (Harewood 2018b). The dreys are in close proximity to two records of WRP made on motion camera's by the Blackwood Basin Group in 2014 (Pers Christensen pers. comms.). No other evidence of WRP was found during the survey work in and around the MDE. Harewood also concluded that "much of the vegetation observed seems to represent poor or marginal habit for WRPs at best". The conclusion was based on the fact that much of the area has been historically logged and lacks a coherent midstorey component, a structural unit most often favoured by WRPs though it is not possible to totally discount their presence in some areas (subject to suitable habitat being present) (HArewood 2018b). Based on the paucity of WRP records shown in NatureMap for the wider area it appears that even if WRPs are present in the general area, densities are likely to be very low (Harewood 2018b).

Records of conservation significant fauna within the MDE are from the Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats. The greatest density of conservation significant fauna records are from the northwest sector of the MDE. This area is linked to the Schwenke's wetland area to the immediate north of the MDE, which is also likely to be a preferred habitat of the species due to the abundance of prey likely to occur in the area. The Schwenke's area is a historic mining void which has been converted into an artificial wetland area by the Blackwood Basin Group and Talison with the aim of attracting wetland species, primarily birds, to the area (Christensen 2016).

Table 22 Conservation significant fauna species summary for the MDE

Species	EPBC Act listing	WC Act or DBCA Listing	Likelihood of Occurrence within the MDE (Biologic 2018b)
Mammals			
Western Quoll/Chuditch (*Dasyurus geoffroii*)	Vulnerable	Vulnerable	Confirmed present. Recorded within a single transect in the Jarrah/Marri forest habitat in the northwest of the MDE (Biologic 2018a).
Wambenger Brush-tailed Phascogale (*Phascogale tapaotafa wambenger)*	NA	Conservation Dependant	Confirmed present. Recorded from one location in the southeast of the MDE during the Biologic 2011 survey and 15 locations in the northwest, southeast and northeast of the MDE during the Biologic 2018a survey. The recordings were within Jarrah/Marri forest, Jarrah/Marri forest over Banksia and to a lesser extent rehabilitated areas habitats. The rehabilitated areas are not considered core habitat as they lack suitable hollow-bearing trees for nesting.
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	NA	P4	Confirmed present. Recorded from two locations in the northwest and south of the MDE during the Biologic 2018a survey within Jarrah/Marri forest habitat.
Western Brush Wallaby (*Notamacropus irma*)	NA	P4	Confirmed present. Recorded from six motion cameras in the northwest of the MDE during the Biologic 2018a survey within Jarrah/Marri forest habitat.
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Critically Endangered	Critically Endangered	Possibly recorded - Secondary evidence, scats, potentially belonging to the WRP were recorded in the Jarrah/Marri forest habitat within the northwest of the MDE during Biologic 2018a survey and there are two confirmed records from approximately 320 m north of the MDE. The scats cannot be confirmed as from the WRP due to the similarity with scats of the Common Brushtail Possum which also occurs within the MDE. Further survey effort by Harewood (2018b) did not find any further evidence of WRP within the MDE.
Quokka (*Setonix brachyurus*)	Vulnerable	Vulnerable	Possible - recent surveys have identified a population in the Nannup State Forest which is connected to the Greenbushes

Species	EPBC Act listing	WC Act or DBCA Listing	Likelihood of Occurrence within the MDE (Biologic 2018b)
			State Forest in which the MDE is located.
Numbat (*Myrmecobius fasciatus*)	Endangered	Endangered	Possible – species has been recently (2006) recorded within approximately 5 km of the MDE, suitable habitat is present and the MDE is within the species known distribution.
Western Falsistrelle (*Falsistrellus mackenziei*)	NA	P4	Likely – species has a large nightly range and has been recorded within the vicinity of the MDE within similar habitats to what occurs
Water Rat (*Hydromys chrysogaster*)	NA	P4	Possible – the broader Greenbushes area has been assessed as containing suitable habitat (Biologic 2011).. Habitats contained within the MDE are less suitable for the species
Birds			
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Endangered	Endangered	Confirmed present. Feeding signs observed within Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats during Biologic 2011 and Kirkby 2018 surveys.
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Endangered	Confirmed present. Feeding signs observed within Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats during Biologic 2011 and Kirkby 2018 surveys.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Vulnerable	Vulnerable	Confirmed present. Recorded throughout Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats during Biologic 2011, 2018a, and Kirkby 2018 surveys.
Black Bittern (*Ixobrychus flavicollis australis*)	NA	P2	Possible - no recent records of this species in the surrounding area but it possibly occurs as it is within the known distribution and the broader Greenbushes area has been assessed as containing suitable habitat (Biologic 2011).
Barking Owl (southwest population) (*Ninox connivens connivens*)	NA	P3	Possible - no recent records of this species in the surrounding area but it possibly occurs as it is within the known distribution and the broader Greenbushes area has been assessed as containing suitable habitat (Biologic 2011).

Species	EPBC Act listing	WC Act or DBCA Listing	Likelihood of Occurrence within the MDE (Biologic 2018b)
Masked Owl (southwest population) (*Tyto novaehollandiae novaehollandiae*)	NA	P3	Highly Likely – new database search has revealed the locality of several recent records including two within 1 km of the MDE. The MDE contains suitable habitat.
Blue billed duck (*Oxyura australis*)	NA	P4	Likely - suitable habitat (deep freshwater lakes) is present within the MDE and it is within the known distribution for the species.
Reptiles			
Dell's Skink (*Ctenotus delli*)	NA	P4	Possible – previously recorded within 8 km of the MDE which contains suitable habitat for the species.

Black Cockatoos

The MDE is within the modelled distribution for all three species of black cockatoo (Carnaby's, Forest Red Tailed and Baudin's) (DoEE 2017a). The vegetation within the MDE is dominated by known suitable foraging and breeding habitat species for black cockatoos including Marri, Jarrah, and *Banksia* spp (foraging only).

An assessment of foraging and breeding habitat within the Greenbushes Study Area was undertaken by Biologic as part of the 2011 fauna survey. A field survey of foraging and breeding habitat within the MDE, expansion areas was undertaken by recognised black cockatoo researcher Tony Kirkby in early 2018. Further assessment of habitat quality (based on Kirkby 2018 survey) was undertaken by Ennovate (2018) and an aerial survey to confirm the presence of, and assess the suitability of identified hollows for breeding was undertaken by Harewood (2018).

Based on the outcomes of these assessments the MDE contains suitable habitat for breeding, foraging and roosting by black cockatoos. The habitat value within the MDE has been reduced as a result of past mining and timber harvesting activities which have resulted in many of the larger trees suitable for breeding (Diameter at Breast Height (DBH) >500 mm) being removed from the MDE (Biologic 2011).

Biologic (2011) defined most areas of remnant native Jarrah-Marri forest within the Greenbushes Study Area (and within the MDE) as suitable foraging and breeding habitat for black cockatoos based on tree density assessments. The canopy layer in the native vegetation is entirely comprised of Jarrah and Marri and the midstorey is dominated by *Banksia grandis* trees, all of which are known feeding resources for black cockatoos. Jarrah and Marri are also known to support suitable breeding hollows for black cockatoos. Evidence of foraging by all three species of black cockatoo has been recorded within the MDE (as well as the surrounding State Forest 20), as evidenced by chewed Marri nuts and Banksia cones. The most evidence of feeding signs within the MDE was from the Forest Red-tailed Black Cockatoo, and this is the only species of black cockatoo to be directly observed within the MDE (Biologic 2011, Biologic 2018a, Kirkby 2018).

Based upon the Kirkby 2018 survey of black cockatoo habitat within the MDE, and further assessment of the quality of the habitat by Ennovate (2018), 677.86 ha of suitable black cockatoo foraging and breeding habitat has been assessed, of which 605.8 ha occurs within the MDE (~70 ha of vegetation within the MDE was not assessed by Kirkby but is also considered

to support black cockatoo foraging and breeding, based on Biologic's 2011 black cockatoo habitat assessment of the Greenbushes Mine leases). Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats in the MDE support black cockatoo foraging and breeding.

Two roost sites were recorded within the MDE by Biologic 2018a, one near Cowan Brook Dam and the other at the southeast boundary of the MDE. Both roost sites are near permanent water sources and are outside the proposed development footprint for the Mine expansion and will therefore be avoided. Feeding residues from Forest Red-tailed Black Cockatoos ranged from fresh through to old and grey indicating the site is used throughout the year by this species. Feeding residues from Baudin's Black Cockatoo were older and indicate that they may only be present in the non-breeding season. Very few feeding residues from Carnaby's Black Cockatoo were observed within the MDE (Kirkby 2018). The species using hollows within the MDE has not been confirmed but it is highly likely to be the Forest Red-tailed Black Cockatoo based on the presence of numerous examples of fresh foraging debris in the area at the time of the February survey (Kirkby 2018).

A total of 75 potential breeding trees with hollows were identified within the Greenbushes Study Area during ground based habitat tree assessments undertaken by Biologic (2011). In 2018 Kirkby undertook a targeted ground search for potential black cockatoo breeding trees within the majority of the MDE, expansion areas. The search located 50 potential breeding trees with suitable size hollows (49 Marri and 1 Jarrah) within the MDE (Kirkby 2018). Twenty-four of the hollows had chew marks indicating potential use by black cockatoos, although none were active at the time of the survey (February). Only one had signs of recent chewing (Kirkby 2018). Hollows within the remaining 26 trees identified were not observed to have any signs of use.

Due to limitations on ground level assessment of the suitability of hollows for breeding, and potential for trees to have been lost in the intervening period since the Biologic 2011 survey (as a result of logging, dieback, storm impact and fire), Talison engaged Greg Harewood to conduct an aerial (drone) survey of the recorded hollow locations. The survey covered 83 previously identified potential black cockatoo breeding trees with hollows within a 1 km buffer of the MDE. The result of the survey, for hollows within the MDE are summarised in Table 23. Further detail is included in the survey report in Appendix C

Table 23 Assessment of hollow suitability of identified potential breeding trees within 1 km of the MDE (Harewood 2018)

Hollow Status	Location recorded within the MDE	Located recorded outside the MDE (within 1 km buffer)
Actual/Potentially Suitable Hollow - Chew Marks	14	0
Potentially Suitable Hollow - No Chew Marks	16	0
Hollow Appears Unsuitable	22	8
No Hollow Seen	8	2
Status Unknown	1	12

Short Range Endemic Invertebrates

An assessment of the potential presence of SRE's was undertaken by Biologic (2018a). Due to the high habitat complexity in leaf litter, woody debris and scattered rock formations, and the prevalence of shade offered by the dense vegetation, the fauna habitat types featuring Jarrah/ Marri forest and Marri/Blackbutt/Flooded Gum Woodland are considered to have a moderate potential to host SRE fauna. Areas disturbed by mining, farming or plantation forestry are considered to have a low suitability for SRE fauna due to the disturbance of the natural vegetation and soil (Biologic 2018b). Based on the moderate potential for SRE to occur, 12 locations with the Jarrah/Marri forest habitats of the MDE were sampled for SRE's (Biologic

2018a). At each site active foraging, leaf litter sifting and soil sifting, and targeted searches for spider and scorpion burrows were undertaken.

Twenty specimens belonging to SRE groups were collected during the survey (Biologic 2018a). This comprised specimens from four broad taxonomic groups: Two Mygalomorph spiders, two isopods, four scorpions, and twelve millipedes (Biologic 2018a). Three of the taxa collected (representing five specimens) have been identified as 'Potential SRE' as they could not be identified to a species level due to the absence of diagnostic features which are only present on mature male specimens (Biologic 2018a). The 'Potential SRE' collected included:

- Mygalomorph Spider, *Nemesiidae* sp. indet. - two specimens collected from the Jarrah/Marri forest habitat type;
- Millipede, *Paradoxosomatidae* sp. indet. – two specimens collected from the Jarrah/Marri forest over Banksia habitat type; and
- Millipede, *Siphonotidae* sp. indet. - - single specimen collected from the Jarrah/Marri forest habitat type.

Owing to the poor state of taxonomy for the species collected, assessment of the local and regional significance of the fauna collected is somewhat limited. The taxa regarded as 'indet.' (*Nemesiidae, Paradoxosomatidae, Siphonotidae*) cannot be fully assessed for SRE status until significant knowledge gaps are resolved at various taxonomic levels. Although limited, the current information for these taxa indicates that there is a reasonable likelihood that they may be range restricted, therefore they are considered Potential SREs as a precaution. In each instance, genetic analysis would be required to determine the species and/or if the specimens are unique to what has previously been recorded within the region.

In the absence of firm taxonomic identifications, it is reasonable to use habitats as a surrogate to assess the potential impact of the Proposal to Potential SRE species (Biologic 2018a). Each of the moderately suitable SRE habitat zones (Jarrah/Marri forest and Jarrah/Marri forest over Banksia) are well represented beyond the MDE. Areas immediately beyond the MDE have not yet been sampled for SRE fauna, although based on the similar habitats present, it would be reasonable to assume that the Potential SRE fauna present within the MDE may also occur within the surrounding area (Biologic 2018a).

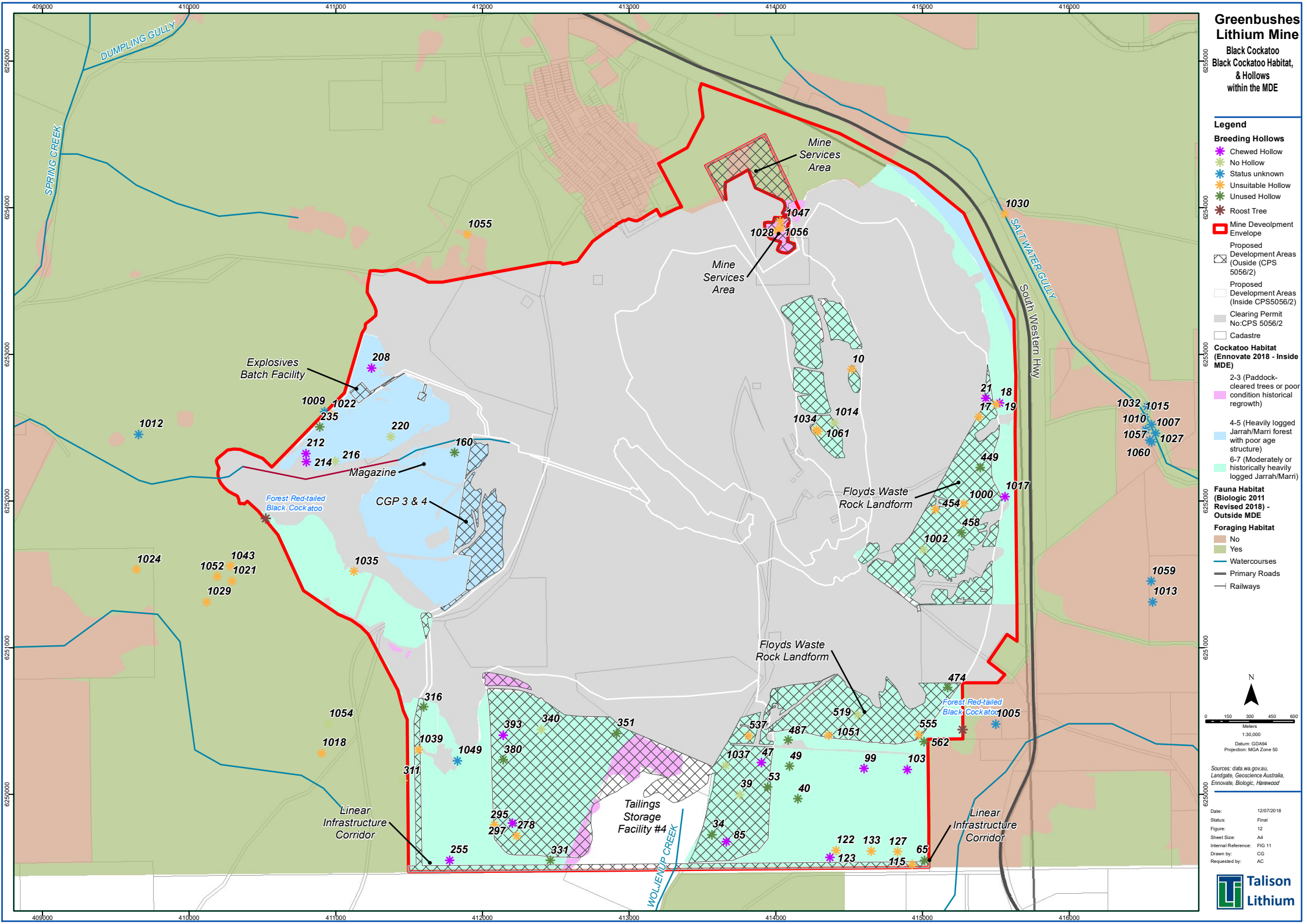
Introduced Fauna

Biologic (2018a) recorded six introduced mammals within the MDE:

- Pig (*Sus scrofa*);
- Cat (*Felis catus*);
- Rabbit (*Oryctolagus cuniculus*);
- Fox (*Vulpes vulpes*);
- House Mouse (*Mus musculus*); and
- Black Rat (*Rattus rattus*).

In addition to those listed above a further two introduced mammals have been recorded within the surrounding Greenbushes mining leases (Biologic 2011)

- European Cattle (*Bos taurus*); and
- Horse (*Equus caballus*).


Greenbushes Lithium Mine
Black Cockatoo Black Cockatoo Habitat, & Hollows within the MDE
Legend
Breeding Hollows
Chewed Hollow
No Hollow
Status unknown
Unsuitable Hollow
Unused Hollow
Roost Tree
Mine Deveolpment Envelope
Proposed Development Areas (Ouside (CPS 5056/2)
Proposed Development Areas (Inside CPS5056/2)
Clearing Permit No:CPS 5056/2
Cadastre
Cockatoo Habitat (Ennovate 2018 - Inside MDE)
2-3 (Paddock-cleared trees or poor condition historical regrowth)
4-5 (Heavily logged Jarrah/Marri forest with poor age structure)
6-7 (Moderately or historically heavily logged Jarrah/Marri)
Fauna Habitat (Biologic 2011 Revised 2018) - Outside MDE
Foraging Habitat
No
Yes
Watercourses
Primary Roads
Railways
DUMPLING GULLY
SPRING CREEK
SALTWATER GULLY
South Western Hwy
WOLJENUP CREEK
Mine Services Area
Explosives Batch Facility
Magazine
CGP 3 & 4
Floyds Waste Rock Landform
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Sheet Size: A4
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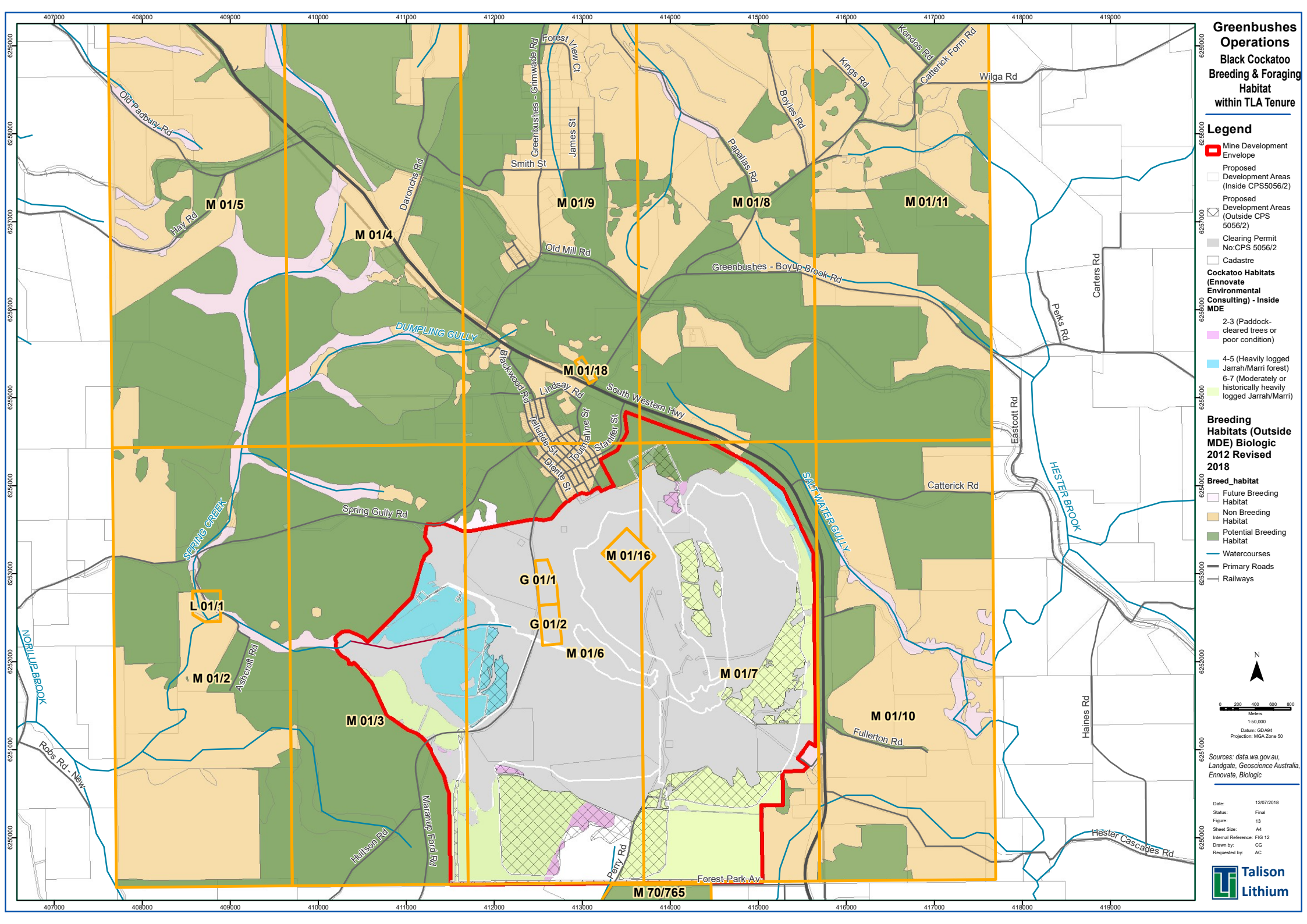
Talison Lithium


Greenbushes Operations
Black Cockatoo Breeding & Foraging Habitat within TLA Tenure
Legend
Mine Development Envelope
Proposed Development Areas (Inside CPS5056/2)
Proposed Development Areas (Outside CPS 5056/2)
Clearing Permit No:CPS 5056/2
Cadastre
Cockatoo Habitats (Ennovate Environmental Consulting) - Inside MDE
2-3 (Paddock-cleared trees or poor condition)
4-5 (Heavily logged Jarrah/Marri forest)
6-7 (Moderately or historically heavily logged Jarrah/Marri)
Breeding Habitats (Outside MDE) Biologic 2012 Revised 2018
Breed_habitat
Future Breeding Habitat
Non Breeding Habitat
Potential Breeding Habitat
Watercourses
Primary Roads
Railways
M 01/5
M 01/4
M 01/9
M 01/8
M 01/11
M 01/18
M 01/16
G 01/1
G 01/2
M 01/6
M 01/7
M 01/10
L 01/1
M 01/2
M 01/3
M 70/765
Old Padbury Rd
Hay Rd
Daronchs Rd
Greenbushes - Grimwade Rd
Forest View Ct
James St
Smith St
Old Mill Rd
Kondos Rd
Catterick Form Rd
Wilga Rd
Kings Rd
Boyles Rd
Papalias Rd
Greenbushes - Boyup Brook Rd
Carters Rd
Petks Rd
DUMPLING GULLY
Blackwood Rd
Lindsay Rd
South Western Hwy
Jarrahdale St
Stanifer St
Telluride St
Diente St
Eastcott Rd
HESTER BROOK
SALTWATER GULLY
Catterick Rd
Spring Gully Rd
SPRING CREEK
NORILUP BROOK
Ashcroft Rd
Robs Rd - New
Hutson Rd
Maranup Ford Rd
Perry Rd
Forest Park Av
Fullerton Rd
Haines Rd
Hester Cascades Rd
N
0 200 400 600 800
Meters
1:50,000
Datum: GDA94
Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia, Ennovate, Biologic
Date: 12/07/2018
Status: Final
Figure: 13
Sheet Size: A4
Internal Reference: FIG 12
Drawn by: CG
Requested by: AC
Talison Lithium

4.4.4 Potential impacts

Expansion of the Mine will result in direct impact to terrestrial fauna through the loss of fauna habitat as a result of clearing up to 350 ha of native vegetation for the Mine expansion. The fauna habitat area within this clearing footprint is suitable for foraging, breeding and roosting by three species of black cockatoos and provides habitat for other conservation significant fauna species including the Chuditch, Wambenger Brush-tailed Phascogale, Quenda, Western Brush Wallaby and also possibly the WRP. Vegetation clearing can also potentially lead to fragmentation of fauna habitats.

In addition to the loss of fauna habitat, other potential impacts to terrestrial fauna associated with the Proposal include:

- Death, injury or displacement of native fauna species due to vehicle interaction or entrapment associated with the mining operation;
- Increased competition or predation by introduced species;
- Disruption or disturbance to fauna as a result of noise, vibration, light and dust emissions from the mining operation; and
- Bushfire.

4.4.5 Assessment of impacts

Fauna Habitat Loss and Fragmentation

The MDE contains an estimated 671.2 ha of Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats. These habitats are suitable for a range of conservation significant fauna species including Black Cockatoos, Chuditch, Wambenger Brush-tailed Phascogale, Quenda, and Western Brush Wallaby which have been recorded from the MDE, and also possibly WRP. There is no confirmed evidence of WRP occurring within the MDE (two records of scats potentially belonging to either the WRP or Common Brushtail Possum) and habitat within the area is considered to represent poor or marginal habit for WRP due to the lack of a coherent midstorey component, a structural unit most often favoured by WRPs. This does not discount their presence in the area however owing to this, and the scarcity of records of WRP in NatureMap for the wider area, if present they are only likely to occur at low density (Harewood 2018b). It is considered that they are likely to prefer habitat around the Schwenke's Dam area to the north-west of the MDE (where they have previously been recorded, and three dreys have been identified) owing the area having more of the species' preferred habitat present .

The Proposal will result in the direct loss of 350 ha of habitats comprising an estimated 157 ha of Jarrah/Marri forest, and 193 ha of Jarrah/Marri forest over Banksia. The mapped extent of these habitats within the broader Greenbushes Study Area is 3,946 ha of Jarrah/Marri forest and 1,241 ha of Jarrah/Marri forest over Banksia (Biologic 2011, 2018b). Based on these areas, an estimated 4.0% and 15.6% of these habitat types will be cleared from the Greenbushes region for the Proposal.

Approximately 85% of the vegetation within the MDE mapped as Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitat types (Biologic 2018a) corresponds to the Dwellingup D1 and Catterick CC1 vegetation complexes of Mattiske & Havel (1998) as updated by Webb *et al*. (2016). The current extent of these complexes remaining within the Shire of Bridgetown-Greenbushes is 4,533 ha and 8,482 ha respectively, totalling 13,015 ha (refer to Table 18). The proposed clearing of up to 350 ha of this vegetation equates to maximums of approximately 2.7% of the current extent within the Shire and 0.2% of the current extent remaining with the Darling Plateau subregion of the South West Forests (GoWA, 2018b).

The Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats are also suitable foraging and potential breeding habitat for Carnaby's, Baudin's and Forest Red-Tailed Black Cockatoos. Based on the mapped extent of these habitats, and the additional 1,211 ha of plantations mapped within the Greenbushes Study Area (Biologic 2011, 2018b,) there is an estimated 6,398 ha of suitable black cockatoo foraging habitat and 5,187 ha potential breeding habitat within the immediate Greenbushes region. Clearing for the Proposal will reduce the available foraging habitat and potential breeding habitat for the black cockatoos by an estimated 5.5% and 6.7% respectively at this scale.

The extent of suitable habitat available for black cockatoos can be estimated based on the extent of representative vegetation. The vegetation (habitat) within the MDE is representative of Beard (1979) Vegetation Association 3 – Medium Forest; Jarrah-Marri, of which there is currently 67.86% of the Pre-European Extent remaining in WA (GoWA 2018) (Table 11). The current extent of this vegetation association within the Shire of Bridgetown-Greenbushes is 68,440 ha, which is 56.49% of its pre-European extent. Of this, 87% is in DBCA-managed land. Clearing of 350 ha of this vegetation association is expected to reduce the overall Medium Forest; Jarrah-Marri habitat area (and therefore available black cockatoo foraging and potential breeding habitat) within the Shire by 0.5%.

Ennovate (2018) undertook an assessment of the availability of black cockatoo Jarrah/Marri forest habitat within State Forests and nature reserves in proximity to the MDE. There are 20,950 ha of government-owned black cockatoo habitat within 10 km and over 50,000 ha within 15 km (Ennovate 2018). Considering that flocks are known to travel up to 13 km a day, the proposed clearing of up to 350 ha of habitat within the MDE will result in a reduction of available habitat, but is unlikely to reduce the area of occupancy of black cockatoos.

A total of 52 potential breeding trees with hollows have been identified within the MDE (Biologic 2011, Kirkby 2018). Through an aerial (drone) survey of the identified hollows it was concluded that only thirty of these potential breeding trees contained hollows assessed as being suitable for breeding (14 identified with chew marks, 16 without evidence of use) (Harewood 2018a). The hollows within the remaining 22 trees were assessed (based on aerial drone images) as unlikely to be suitable for black cockatoo breeding generally due to the entrance appearing to be too small or because the actual hollow appears to be too shallow and/or too small (Harwood 2018a).

Based on the current proposed development footprint for the Mine expansion it is expected that the Proposal will result in the removal of 12 trees which have been identified as having hollows suitable for black cockatoo breeding (a further 16 trees with identified hollows occur within the proposed development footprint however these were assessed as being unsuitable for black cockatoo breeding (Harewood 2018a)). Five of the potential breeding trees with suitable hollows appear to have evidence of past use in the form of chew marks and the remaining seven don't appear to have been used. The location of the MSA was not included within the Kirkby (2018) black cockatoo breeding habitat survey therefore the proposed development area will require survey prior to clearing to confirm whether any trees containing suitable black cockatoo breeding hollows are present, and whether these can be avoided. Planning for the final layout of the Mine expansion will take into account known potential breeding tree locations and will avoid them where possible (i.e. for linear infrastructure or smaller infrastructure such as the MSA and explosives infrastructure). The MDE appears to be predominantly used by Forest-Red tailed Black Cockatoo and this species is considered the most likely to utilise potential breeding trees with hollows within the MDE.

Two roost sites recorded within the MDE will not be impacted by the Proposal as they occur outside the proposed development footprint.

The MDE forms part of a South West regional ecological linkage as defined in Molloy *et al* 2009. The proposed vegetation clearing footprint within the MDE will not result in complete fragmentation with fauna will still be able to travel through and around the MDE within the remaining vegetation and surrounds. The evidence of use of the habitat in the immediate surrounding area of the existing active mining operation by at least seven different conservation significant fauna species indicates the fauna are still utilising areas which have been impacted by an extensive history of mining and logging activity. Habitat fragmentation is therefore not considered to be a significant impact.

Death, Injury or Displacement

Fauna within the MDE are at risk of death, injury or displacement due to interaction with heavy and light vehicles undertaking vegetation clearing, transportation or mining activity associated with the Proposal. Fauna may also potentially become entrapped within mining infrastructure such as water storages or excavations. This impact is not new as mining activity is already occurring within the area, and has been for over 30 years. The likelihood of the impact occurring is expected to increase as a result of the expansion as there will be an increase in the number of mining vehicles and equipment operating on the site, and clearing of native vegetation (fauna habitat) is required.

Interaction between vehicles/machinery and fauna species, is most likely to occur during vegetation clearing activities as resident fauna could potentially be struck by vehicles undertaking the activity. Due to the Proposal's location within State Forest 20 there is suitable similar native vegetation for fauna to take refuge/find habitat within and outside the MDE when clearing activities occur provided they are allowed the opportunity to escape. Suitable management practices during planning and undertaking vegetation clearing will reduce the likelihood of death or injury to native fauna occurring as a result of this activity.

Fauna interaction with vehicles may also occur along transport routes within the MDE although the risk is considered to be low, given fauna are more likely to inhabit areas away from mining activity and transport routes due to the associated noise, vibration and dust impacts.

Noise, Vibration, Light and Dust

Mining activity results in the generation of noise, vibration, light and dust emissions which can disturb or displace fauna, causing them to avoid using habitat in impacted areas. This impact effectively reduces the habitat available in the local area due to fauna avoiding areas affected by these impacts. The proposed expansion occurs within an area which has been subject to mining activity since the late 19th Century. The current open cut mining operations have been undertaken for over 30 years therefore fauna residing in the local area are already accustomed to noise, vibration, light and dust impacts associated with the operation, or already avoid the mining area as a result of these impacts. As the boundary of mining activity will increase from the current area of 1,591 ha to a MDE of 1,919 ha there will be an increase to the area of fauna habitat subject to these impacts potentially causing some fauna to move to new habitat further from the operation. There are large areas of habitat area available in the surrounding State Forest 20 which fauna displaced by these impacts can move into.

Increased competition or predation by introduced species

Mining activity can potentially lead to an increase in the presence of introduced fauna species within an area primarily due to the ready availability of access to food and water supplies. Introduced fauna compete with native fauna for food and shelter, and also predate native fauna, particularly smaller mammals, reptiles and birds. As previously mentioned, the MDE has been subject to an extended period of mining activity, as well as tree harvesting, and is adjacent to the Greenbushes townsite which has resulted in introduced fauna species already being

present and established within the local area. Talison has an established program of feral animal control activities which are implemented each year to prevent introduced species from increasing their spread or density. Continued implementation of the feral animal control program is anticipated to prevent increases in introduced fauna as a result of the Proposal, and will potentially result in an overall reduction in feral animal numbers in the local area.

Fauna displacement and death due to bushfire

The impact and likelihood of fire caused by the Proposal is discussed in section 4.3.5.

4.4.6 Mitigation

As per discussion in section 4.3.6, the location of the Proposal is restricted therefore the proposed clearing of 350 ha of fauna habitat for the Proposal cannot be avoided as it is required to enable the mine expansion to occur.

Mitigation and management measures for impacts to terrestrial fauna which are currently implemented or will be undertaken as part of the Mine expansion include:

Avoid

- Talison has preferentially located landforms and infrastructure in existing cleared areas where possible to avoid unnecessary habitat removal.
- The initial location planned for the MSA was to the east of TSF 4. Due to the presence of potential breeding trees with hollows in this location a decision was made to move the facility to the North of the mine. There are less hollows in the new location. Planning for the development of the MSA will consider the location of these trees and avoid them if possible.
- Avoid unauthorised clearing of fauna habitat though implementation of Talison's ISO 14001 certified EMS which includes a Clearing/Disturbance procedure and associated permit. The Procedure requires:
  - Internal permits must be granted before clearing can occur;
  - All clearing areas must be demarcated prior to clearing; and
  - All clearing areas must be surveyed after clearing to confirm the area cleared.
- Talison will maintain a spatial record of all identified potential breeding trees with hollows which will be considered during the design and planning of infrastructure and landform footprints. Where practical to do so, modifications to the footprint of developments will be made to avoid identified potential breeding trees with hollows. This is not likely to be practical for large landforms such as the TSF 4 and Floyd's WRL, but may be able to be undertaken for minor developments such as linear infrastructure corridors, the Mine Services Area and Explosives Infrastructure.

Minimise

- Talison's ISO 14001 certified EMS includes the following procedures and management plans which detail measures which are implemented to prevent and minimise impacts on native flora and vegetation to minimise habitat degradation within areas surrounding the Mine:
  - Dieback Management Plan;
  - Weed Control Management Plan;
  - Vehicle Hygiene procedure for vehicles and equipment coming on to or returning to the site for earthmoving; and
  - Dust Management Plan.

- The site induction includes information on conservation significant fauna which may be encountered at the operation. It includes descriptions of the fauna, specific management measures intended to protect them, and responsibilities for reporting sightings and incidents involving threated fauna.
- A database of conservation significant fauna species sightings will be maintained.
- Continued implementation of the Talison feral animal control program on an annual and ad hoc basis as required. The program involves annual baiting for foxes and rabbits and feral cat trapping.
- All native fauna injuries or mortalities will be recorded and reported internally and to appropriate regulatory agencies, where required, in accordance with Talison's Native Flora and Fauna Protection Procedure.
- Signage will be installed along roads passing through areas identified as key fauna habitat for conservation significant fauna highlighting their potential presence.
- All ponds will have appropriate fauna egress to prevent native fauna becoming trapped.
- Where trenches are established (i.e for pipelines or services), which native fauna are unable to escape from, they will be inspected by a "fauna spotter" on a regular basis (i.e. dawn, midday and prior to sunset). Any entrapped fauna will be removed and relocated to surrounding vegetation. If trenches are left open overnight, ramps will be established to permit native fauna to escape.
- Implementation of traffic management rules to minimise the likelihood of fauna injury or mortality due to interaction with vehicles. Rules include prohibition of off-road driving unless authorised for a specific purpose (i.e. exploration and land clearing) and reduced speed limits on internal roads.
- Putrescible waste will be stored within lidded bins which prevent fauna entry to prevent attracting feral animals.
- A suitably qualified environmental professional (fauna spotter) will be present during all land clearing. The person will hold a permit to handle and move significant fauna under Regulation 15 of the WC Act, and have access to a care facility that can be used to rehabilitate injured fauna.
- Clearing will be timed outside the black cockatoo breeding season wherever possible.
- Due to the proposed MSA being outside the area surveyed for potential black cockatoo breeding trees, a detailed survey of the proposed clearing area for this infrastructure will be undertaken by a suitably qualified consultant prior to clearing to confirm if any suitable black cockatoo breeding hollows occur in the area.
- In addition to checking of hollows, prior to the commencement of clearing, ground searches of clearing areas will be undertaken, and any native fauna found will be relocated, or encouraged to move to neighbouring vegetation.
- Prior to clearing potential breeding trees with hollows suitable for breeding, a suitably qualified environmental professional (fauna spotter) will identify and check all hollows suitable for (Black Cockatoos, Western Ring Tail Possum or Wambenger Brush-tailed Phascogale). Where nesting animals are identified the tree will be marked and excluded from clearing until the resident animals have moved from the hollow.
- Wherever practical land clearing will be undertaken on one front only in a direction which provides an opportunity for fauna to escape the clearing area to surrounding vegetation.

- Implementation of Talison's Hot Work Permit System, and Emergency Management Procedures, to minimise the risk of bushfires.
- Clearing activities will not be undertaken when the Fire Danger Rating is severe or higher.

Rehabilitate

- Progressive rehabilitation will be undertaken in accordance with the Mine Closure Plan in order to over time, return habitat which is lost as a result of disturbance. The Mine Closure Plan will be updated and submitted to DMIRS together with a Mining Proposal application for the expansion.
- Completion criteria will incorporate fauna and habitat restoration objectives.
- Fauna habitat structures (logs, wood debris and rocky outcrops) are incorporated into rehabilitated areas to encourage the early return of native fauna such as reptiles and small mammals.

4.4.7 Predicted Outcomes

The proposed expansion of the Mine will directly impact terrestrial fauna primarily as a result of habitat loss. The Proposal will result in the direct loss of up to 350 ha of Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats. This will result in a reduction in the extent of available fauna habitat at a local scale. However, the habitats present within the MDE are considered to be well represented in the surrounding region, in particular in the neighbouring Greenbushes, Wilga and Nannup State Forests. The loss of fauna habitat is therefore unlikely to have a significant impact on the extent of fauna habitat at a regional scale. In addition, Talison conduct an ongoing rehabilitation program for mining disturbance which will result in replacement of the cleared habitat over time.

The Proposal will result in the loss of habitat for conservation significant fauna, including foraging and breeding habitat for black cockatoos. Evidence of foraging within the MDE is primarily from Forest Red-tailed Black Cockatoos and these are likely to be the only species using breeding habitat within the MDE. Baudin's and Carnaby's Black Cockatoos are likely to only use the area for foraging. Fauna habitat which will be cleared is also suitable for Chuditch, Wambenger Brush-tailed Phascogale, Quenda, Western Brush Wallaby and also possibly WRP although there is no confirmed evidence of the WRP occurring in the MDE. Direct impacts to fauna (in particular conservation significant fauna) as a result of habitat loss associated with the mine expansion are unable to be avoided and a suitable area is proposed to be offset in accordance with principles of the WA Environmental Offsets Policy (2011) and the EPBC Act Environmental Offsets Policy (2012) (see Section 6) to counter balance this impact.

The Proposal is in relation to an existing mining operation therefore secondary impacts associated with noise, dust, and vibration to terrestrial fauna are not likely to be significant as they are not new therefore fauna in the local area have likely already adapted to these. Similarly, fauna injury or death due to interaction with the mining activities is not expected to have a significant occurrence as fauna are accustomed to the mining operation. This impact can be minimised through appropriate traffic controls and management measures.

With the exception of habitat loss, residual impacts to terrestrial fauna are considered to be equivalent to those resulting from the existing Mine. Talison considers that the Project is able to meet the EPA's objective to protect terrestrial fauna so that biological diversity and ecological integrity are maintained through offsets and adequate management practices.

Native vegetation clearing (and the associated habitat loss) at the Mine has previously been regulated through Clearing Permits (issued in accordance with the requirements of Part V of the EP Act, and the associated Clearing Regulations) and as a Controlled Action under the EPBC

Act in relation to impacts on Threatened Fauna. Talison anticipate that the potential impacts to Terrestrial Fauna, which result from the proposed Mine expansion, could continue to be appropriately managed through the Clearing Permit and EPBC Act Controlled Action process.

4.5 Key Environmental Factor - Terrestrial environmental quality

4.5.1 EPA objective

To maintain the quality of land and soils so that environmental values are protected.

4.5.2 Policy and guidance

- Environmental Factor Guideline Terrestrial Environmental Quality (EPA 2016f).
- *Dangerous Goods Safety Act 2004* and associated Regulations 2007.
- *Contaminated Sites Act 2003.*
- *Contaminated Sites Regulations 2006.*
- *Environmental Protection (Controlled Waste) Regulations 2004.*
- *Soil and Land Conservation Act 1945.*
- *Environmental Protection (Unauthorised Discharges) Regulations 2004 .*
- Identification and investigation of acid sulfate soils and acidic landscapes (DER 2015a).
- Treatment and management of soil and water in the acid sulfate soil landscapes (DER 2015b) .

4.5.3 Receiving environment

Geology

The geology of the Greenbushes area is recorded as being mafic and ultramafic volcanics of Archaean age, i.e. granofelsic and amphibolitic greenstones. The Greenbushes ore body lies within the Balingup Metamorphic Belt (**BMB**) which forms the southern portion of the Western Gneiss Province, one of four divisions of the Archaean Yilgarn Craton. The Greenbushes deposit intrudes rocks of the BMB and lies within a 15-20 km wide, north to north-west trending lineament called the Donnybrook-Bridgetown Shear Zone (GHD 2013).

The ore body is made up of a series of pegmatite dykes trending northwest over a length between 3 - 7 km, which is cross-cut with later dolerite and pegmatite dykes. The rocks are locally faulted and sheared. West of the ore body and beneath TSF2 the Archaean basement rocks comprise generally amphibolitic greenstones and are either extensively lateritised or overlain by the Alluvial Greenbushes Formation. This alluvial deposit contains tin and has been extensively disturbed by historic mining operations (GHD 2013).

The primary ore minerals are found in specific mineralogical zones or assemblages. The Lithium Zone is enriched in the lithium bearing silicate spodumene.

Soil types and landscapes

The MDE occurs within the Yilgarn Plateau Province and intersects the Darling Plateau system. The system is described as a lateritic plateau with duplex sandy gravels, loamy gravels and wet soils, and a Jarrah marri wandoo forest and woodland.

Soil landscape mapping of the south west of WA was reviewed to determine the landscapes present within the MDE (DAFWA 2007).The soil landscapes which occur within the MDE are described in Table 24.

The open cut mine occurs within the Hester Subsystem and consists of undulating ridges and hill crests formed on laterite and gneiss which typically slope downwards off the main plateau into the surrounding Lowden Valleys System. The soils are mostly loamy gravels, sandy gravels and loamy earths.

The soil types present within the MDE include (IT Environmental 1999):

- Greenbushes alluvium formation;
- Colluvium deposit;
- Laterite – weathered zone;
- Laterite – iron rich zone ; and
- Laterite – pallid clay, saprolitic zone.

In some areas, the surface topsoil has been degraded as a result of weed infestation and dieback. These soils have limited value as a resource for rehabilitation or other purposes.

Alluvial cassiterite deposits (tin) have been mined in the Greenbushes Lithium Mineral field since 1888. The MDE contains many alluvial workings, tailings disposal areas and dredge pits as a result of mining activity which has occurred since this time. Soils have been impacted by these historical mining practices, in particular in the area to the west of the open pits where the Greenbushes Formation is present.

A 1999 study by IT Environmental of the metal attenuation capacity of soils around the Mine found that the soils in the area have a high capacity to attenuate Arsenic and Uranium in groundwater under oxidising/aerobic conditions. The soils can act as a sink, however Arsenic and Uranium attenuated by soil may be released in reducing or acidic conditions.

Table 24 Soil landscape mapping unit of the MDE (Tille *et al* 1994)

Soil Landscape Mapping Unit	Description	Extent within the MDE (ha)
Dwellingup subsystem		
255DpDW	Divides, lower to upper slopes and hillcrests. Duplex sandy gravels and loamy gravels with minor areas of shallow gravels, deep sandy gravels, yellow deep sands and yellow and pale deep sands, often gravelly.	587 (29.5%)
Yarragil Subsystem		
255DpYGd Yarragil downstream valleys Phase	Shallow, narrow valleys. Relief 20-40 m slopes 3-10%. Valley floor is narrower than upstream phase. Soil parent materials are laterite, granite and gneiss. Soils are loamy gravels, loamy earths and deep sandy gravels.	210 (10.5%)
255DpYGu Yarragil upstream valleys Phase	Relief 5-20 m slopes 3-10%. Valley floor is broader than downstream phase. Soil parent material is mainly laterite. Soils are gravels and sands.	69 (3.5%)
Hester subsystem		
255DpHR	Ridges and hill crests on laterite and gneiss, relief 5-40 m, slopes 5-15%. Soils are sandy gravels, loamy gravels and loamy earths.	66 (3.3%)
Mornington Hill subsystem		
255DpMH	Low hills on laterite overlying granite, relief 40-80 m, slope 5-20%. Soils are sandy and loamy gravels with some deep sands and loamy earths.	49 (2.5%)
Darling Plateau disturbed land, mine Phase		
DpXMINE	Mine. Disturbed land.	1008 (50.7%)

Acid Sulfate Soils

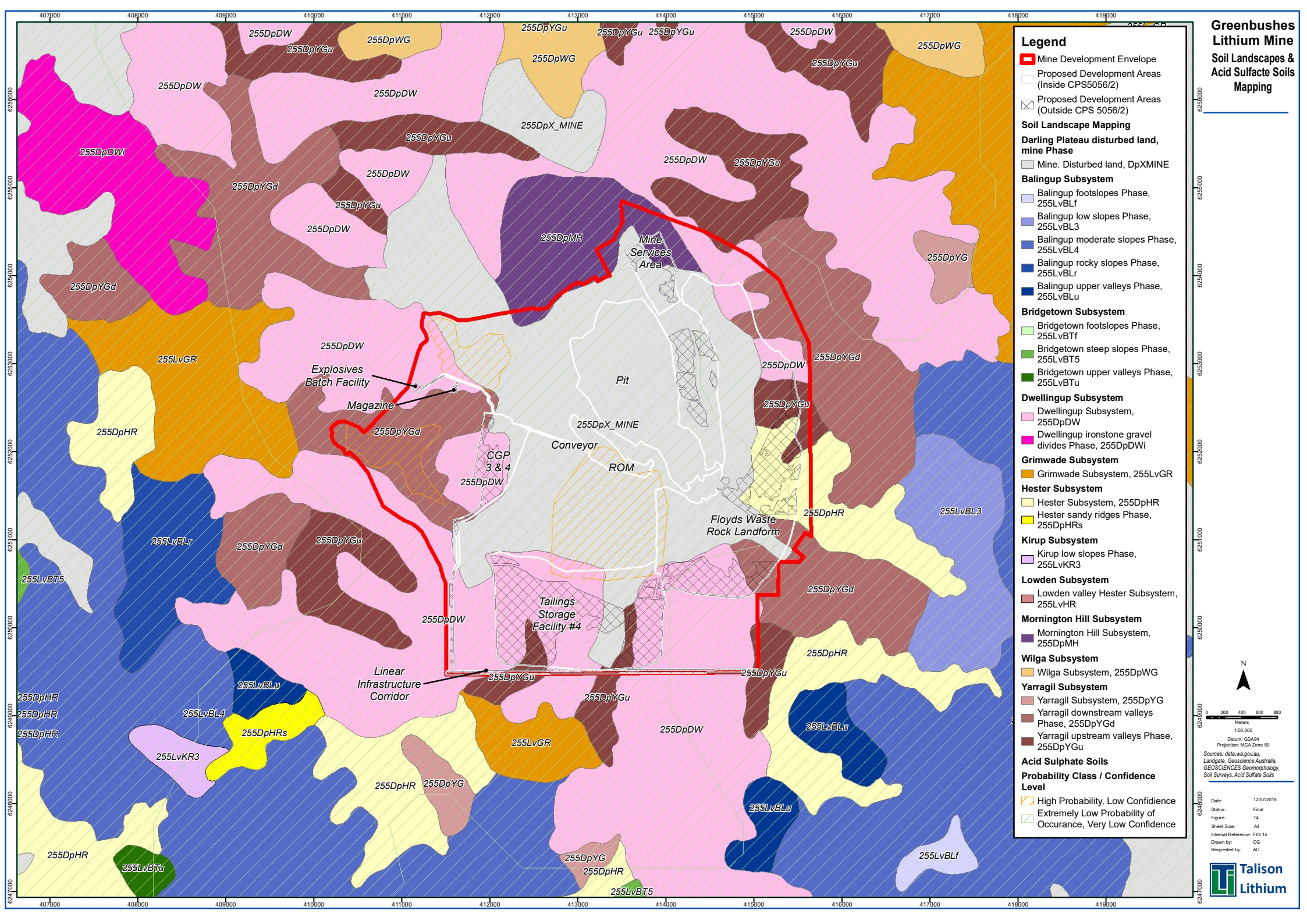
A review of the Australian Soil Resource Information System (ASRIS) (ASRIS 2011) indicates that there is 'Extremely low probability of occurrence' of acid sulphate soils (**ASS**) in the majority of the MDE. A small number of areas have been classified as 'High Probability of Occurrence' (ASRIS 2011), however these are located at the existing TSFs and water storage areas.

Material characterisation

A range of waste rock and tailings characterisation studies have been undertaken throughout the operation of the Mine to understand the potential for generation of Acid and Metalliferous Drainage (**AMD**) from the mining operation and develop suitable management processes to prevent AMD from occurring. The studies undertaken relevant to the lithium mining operation are listed in Table 25. A summary of the findings of these investigations is in the following sections.

Table 25 Material Characterisation Studies Undertaken at the Greenbushes Lithium Mine

Report	Author
Characterisation of Fresh Wastes Produced from the Tantalum and Spodumene Open Pits 1992	AGC Woodward-Clyde
Greenbushes Operations Acid-Formation Potential of Waste Rock Samples, Static Testwork Programme Phase I – Implications for Waste-Rock Management 2000	Graeme Campbell & Associates Pty Ltd
Greenbushes Operations Multi-element Composition of Waste-rock and Soil Samples Static Testwork Programme Phase II – Implications for Waste-Rock Management 2000	Graeme Campbell & Associates Pty Ltd
Greenbushes Operations Weathering and Solubility Behaviour of Waste-Rock Samples from Cornwall Pit (Kinetic – Testwork) – Implications for Waste Rock Management 2002	Graeme Campbell & Associates Pty Ltd
Appraisal of Drainage-water Quality from Floyd's Dump and Implications for Future Mine-waste Management 2014	Graeme Campbell & Associates Pty Ltd (Appendix E)
An extended kinetic study on the drainage of Floyd's waste dump to determine sulphur oxidation rates on representative samples of trace sulphide lithotypes 2015	Suzanne E Maree
Characterisation of Acid Metalliferous Drainage potential from Tailings Storage Facility 2 2016	GHD (Appendix E)


Greenbushes Lithium Mine
Soil Landscapes & Acid Sulfacte Soils Mapping
Legend
Mine Development Envelope
Proposed Development Areas (Inside CPS5056/2)
Proposed Development Areas (Outside CPS 5056/2)
Soil Landscape Mapping
Darling Plateau disturbed land, mine Phase
Mine. Disturbed land, DpXMINE
Balingup Subsystem
Balingup footslopes Phase, 255LvBLf
Balingup low slopes Phase, 255LvBL3
Balingup moderate slopes Phase, 255LvBL4
Balingup rocky slopes Phase, 255LvBLr
Balingup upper valleys Phase, 255LvBLu
Bridgetown Subsystem
Bridgetown footslopes Phase, 255LvBTf
Bridgetown steep slopes Phase, 255LvBT5
Bridgetown upper valleys Phase, 255LvBTu
Dwellingup Subsystem
Dwellingup Subsystem, 255DpDW
Dwellingup ironstone gravel divides Phase, 255DpDWi
Grimwade Subsystem
Grimwade Subsystem, 255LvGR
Hester Subsystem
Hester Subsystem, 255DpHR
Hester sandy ridges Phase, 255DpHRs
Kirup Subsystem
Kirup low slopes Phase, 255LvKR3
Lowden Subsystem
Lowden valley Hester Subsystem, 255LvHR
Mornington Hill Subsystem
Mornington Hill Subsystem, 255DpMH
Wilga Subsystem
Wilga Subsystem, 255DpWG
Yarragil Subsystem
Yarragil Subsystem, 255DpYG
Yarragil downstream valleys Phase, 255DpYGd
Yarragil upstream valleys Phase, 255DpYGu
Acid Sulphate Soils
Probability Class / Confidence Level
High Probability, Low Confidence
Extremely Low Probability of Occurance, Very Low Confidence
Mine Services Area
Pit
Explosives Batch Facility
Magazine
Conveyor
ROM
CGP 3 & 4
Floyds Waste Rock Landform
Tailings Storage Facility #4
Linear Infrastructure Corridor
255DpDW
255DpYGu
255DpWG
255DpX_MINE
255DpDWi
255DpYGd
255DpMH
255DpYG
255LvGR
255DpHR
255LvBLr
255LvBT5
255LvBL3
255LvBLu
255LvBL4
255DpHRs
255LvKR3
255LvBTu
255LvBLf
N
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1:50,000
Datum: GDA94
Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia, GEOSCIENCES Geomorphology, Soil Surveys, Acid Sulfate Soils
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Talison Lithium

Ore and Waste

The ore and waste from the deposit is not known to be dispersive. Waste rock mineralogy consists primarily of hard rock amphibolite, granofels and lesser amounts of dolerite.

Analysis of waste rock and soil samples undertaken by Campbell (2000b) found that the concentrations of environmentally significant elements were either below or close to those recorded for unmineralised soils and rocks with the exception of arsenic (**As**), antinomy (**Sb**) and lithium (**Li**). Waste rock samples generally had As and Sb concentrations less than 500 mg/L and 50 mg/L respectively. Lithium concentrations were generally less than 1,000 mg/L. These results range up to 100 times higher than the concentrations measured in surficial soil materials which range from 3-58 mg/L (As), 0.27-3.5 mg/L (Sb) and 33-75 mg/L (Li). The pegmatite ore also contains uranium and lesser amounts of thorium (approximately 24 mg/kg and 6.2 mg/kg respectively) (IT Environmental 1999).

Occurrences of sulphide minerals in the waste zone at Greenbushes are sporadic in distribution and occur as trace components with Sulphide-S values typically <0.2-0.3% (Campbell 2014). The volumes of High-Sulphide lithotypes is estimated to constitute less than 1% of the waste rock (Campbell 2014). Low volumes of potentially acid forming (**PAF**) materials may therefore be present in the open pit in association with the pegmatite ore body along some areas of the footwall contact zones, hanging wall and in inliers of waste rock. Waste rock also contains amphibolite with calcite veining, and calcite has an acid neutralising capacity therefore PAF materials are able to be neutralised within in the WRL.

There are two existing WRL at Greenbushes, Floyds WRL and IP WRL. The IP WRL is no longer active and all waste rock is sent to Floyds WRL. Floyd's WRL will be expanded to the south to accommodate the waste rock from the mine expansion.

Continuous water drainage occurs at the eastern toe of Floyds WRL, and has done for a significant period of time (>20 years). The drainage provides a first hand assessment of the integrated dynamics of weathering on a whole-dump-scale (Campbell 2014). Drainage water has consistently been neutral to alkaline and is well-buffered by carbonate species due to dissolution of calcite in the amphibolites (Campbell 2014). The drainage water produced by Floyds WRL has consistently been characterised by arsenic concentrations 0.01-0.02 mg/L and lithium concentrations 1-2 mg/L. The electrical-conductivity has a seasonal range of 2,500-3,500 µS/cm (Campbell 2014).

Tailings

A preliminary AMD assessment of the leaching potential from ore and tailings was undertaken by GHD in 2016 (Appendix E)). The outcomes of the study are described below.

Tailings and the ore body has a low acid producing potential with low concentrations of sulphides (and sulphur), and a theoretical maximum acid producing potential of 0.12 kg (H_2SO_4) per tonne for tailings, and 0.04 kg (H_2SO_4) per tonne for ore. Given the very low sulphur values (close to zero), the classification of the ore and tailings is considered reflective of "Non-Acid Forming" (**NAF**) despite the absence of buffering capacity (carbonates not identified) (GHD 2016).

Ore assay and elemental statistical analysis results indicate, a total of 10 metals (As, Al, Bi Co, Cs, Hf, Li, Nb, Pb, Rb, Sb, Sn, Ta, Th, Ti, U and W) were relatively enriched compared to the benchmark of average crustal abundance. Five of these metals also exceeded the available regulatory trigger values (As, Cs, Cr, Ni and Sn). The tailings assay, and elemental statistical analysis results indicate that of the 14 elements analysed a total of five metals were relatively enriched when compared to the average crustal abundance (As, Cs, Li, Rb, and W). Arsenic was also detected at concentrations that exceeded the regulatory trigger values (GHD 2016).

It is noted, that two metals of concern (Co and W) are likely derived from the ore grinding media (GHD 2016). Talison has commissioned an additional study to characterise the leaching potential of tailings and waste rock from the expanded open pit. The results of the assessment will be included with the Mining Proposal application to DMIRS for the Mine expansion.

4.5.4 Potential impacts

Activities associated with the Mine expansion that have the potential to impact terrestrial environmental quality include land clearing, mining and placement of waste rock, tailings storage, and storage and handling of environmentally hazardous materials.

The potential impacts that may occur to terrestrial environmental quality as a consequence of the Proposal are:

- Loss of topsoil and soil function due to land clearing; and
- Potential contamination of land and soils as a result of:
  - Accidental release of environmentally hazardous materials (chemicals) from storage or handling areas;
  - Contaminated stormwater or process water discharge to the environment (see section 4.7.5 for assessment of this impact);
  - AMD from waste rock and tailings storage;
  - Disturbance of Potentially Acid Sulfate Soils (**PASS**);
  - Seepage from tailings storage (see section 4.7.5 for assessment of this impact); and
  - Erosion from waste storage landforms (Floyds WRL and TSF4).

4.5.5 Assessment of impacts

Loss of topsoil and reduced soil function

Land clearing within the MDE to expand the Mine, WRL and establish associated infrastructure will disturb and expose soils. This can lead to loss of topsoil through erosion by wind or water, and subsequent transfer of sediments to surrounding areas. Collection of topsoil as soon as possible after clearing will minimise the loss of topsoil due to erosion. Inappropriate removal methods such as handling wet topsoil may directly damage soil structure and composition.

Talison aim to remove up to 300 mm of topsoil from cleared areas for stockpiling and use in progressive rehabilitation. The availability of topsoil within the MDE is however known to be limited due to weed and dieback impacts and the extent of previous disturbance areas. Collection of an oxidised clay material known as “orange softrock”, is undertaken, when mining areas this material occurs in. The material is stored for later use. The material is used as an alternate growth medium in rehabilitation activities. Due to limited topsoil availability at the current operation, Talison has been successfully using this “orange softrock” as a growth medium for rehabilitation programs over a number of years.

Topsoil which is impacted by weeds or dieback is collected separately to prevent spread, and is buried with waste rock rather than collected for use in rehabilitation. There will therefore be some net loss of topsoil where this occurs however this will be replaced by ‘orange softrock’ for rehabilitation.

Stockpiling of topsoil for later use in progressive rehabilitation and revegetation activities can also lead to reduced soil function and erosion impacts. Inappropriate stockpiling methods such as large stockpiles (> 2 m in height) or stockpiling wet topsoil can increase the potential for erosion through wind and stormwater runoff, and lead to compaction, reduced microbial activity and reduced water infiltration. Talison aim to use topsoil progressively where feasible to reduce

the timeframe for storage. Where the dieback status of area has been assessed as uninterpretable Talison intend to undertake further sampling and analysis of soil in order to make a determination whether to use the soil for rehabilitation or bury it.

Contamination of land as a result of environmentally hazardous material release (chemicals) from storage or handling areas

Direct contamination of soils and land could occur as a result of releases of environmentally hazardous materials (such as hydrocarbons and reagents) from storage or handling areas. The Proposal requires establishment of a new MSA including a new bulk hydrocarbon storage and refuelling area for the mining fleet (around 2 million litres diesel plus other oils and greases), and bulk reagent storage areas within the new process plants CGP3 and CGP4. Failure of these containment areas or malfunction of mining equipment can potentially lead to a release of these environmentally hazardous materials into the environment.

Direct contamination of soils (and potentially surface water or groundwater in proximity to the release) could occur in the event of such a release. Due to the large volume of storage required at the site, large areas of soil could potentially be affected. The depth of localised contamination could increase beyond the soil surface and impact upon the alluvial aquifer if a significant release occurs, which is not rectified in a timely manner. Talison has a suite of established hydrocarbon and emergency management procedures to respond to environmentally hazardous material releases as part of the site's ISO certified EMS. Talison operate a bioremediation area which soils affected by hydrocarbon spillages are removed to for treatment.

Storage and handling of all process reagents and hydrocarbons will be undertaken within appropriately sized secondary containment (110% capacity) therefore large direct release to soils or land from storage infrastructure is considered unlikely to occur. None of the reagents or hydrocarbons stored are classified as Dangerous Good in accordance with the *Dangerous Goods Safety Act 2004* and associated Regulations.

Contamination of land as a result of AMD from waste rock and tailings storage

AMD is caused by exposure of PAF materials to air and water. The resulting leachate may be very acidic (low pH) and contain elevated concentrations of metals, metalloids and major ions and low concentrations of dissolved oxygen. Hence, it can present a major risk to aquatic life, vegetation and human uses of the water resource for many kilometres downstream from where it enters a waterway (DFAT 2016).

Talison has undertaken material characterisation studies for the Greenbushes deposit to determine the potential risk of the operations activities causing AMD. Material characterisation studies undertaken to date indicate that ore and waste rock contain arsenic, lithium, sulphide minerals, and other enriched metals which can potentially be released from the material by acidic conditions caused by PAF material. Characterisation of the waste rock has found that there are low volumes of PAF materials present in the Greenbushes deposit. It is currently estimated that approximately 1% of waste material is PAF and requires co-disposal with acid neutralising waste rock to prevent AMD from occurring.

Waste rock with percentage total Sulphide greater than 0.25% or arsenic greater than 1,000 ppm has been defined by Talison as potentially able to cause AMD and requiring management to prevent this from occurring. Geochemical testing of the waste rock to determine short and long-term weathering effects on trace-sulphides has supported the use of this cut-off for management of Sulphides. All waste is monitored for the presence of PAF sulphides which could generate acid and liberate metals. Waste found to contain sulfides greater than 0.25% is selectively handled and co-located with calcite veined Amphibolite, which has an acid neutralising capacity, within internal areas of Floyds WRL to prevent the formation of AMD. To date approximately 2% of the waste in the waste dump is considered PAF (Talison 2016).

GHD's AMD assessment of Greenbushes tailings (2016) found that acid producing potential of tailings (and ore) appeared negligible. However, the study identified a large number of elevated metals within the tailings and elevated metals have been observed within tailings drainage waters. Therefore, further laboratory analysis is warranted to assess the metal leaching potential. Talison has commissioned an additional AMD study to characterise the leaching potential (e.g: acid generation and leaching) of tailings and waste rock with respect to future excavated pit material. The findings of the additional AMD investigation will be submitted to DMIRS with the Mining Proposal application for the mine expansion.

Based on mining activity having been conducted at the present Mine for over 30 years, there being no impacts or evidence of AMD effects, the sound understanding of material characterisation and the management practices to prevent AMD currently implemented by Talison, it is considered unlikely that AMD impacts will occur as a result of the Mine expansion.

Contamination of land as a result of disturbance of potentially acid sulphate soils

Potentially Acid Sulfate Soils are naturally occurring soils containing iron sulphides, which are harmless when left in an undisturbed state. When exposed to air through excavation or dewatering, the contained iron sulphides can oxidise to produce sulfuric acid and iron compounds. The acid can leach metals contained in the soils to the surrounding environment (DER 2015a). Excavation works within areas containing PASS can expose PASS to air and lead to a release of acid, iron compounds and metals which can contaminate surrounding land and waters.

Disturbance of PASS is not likely to occur during the expansion of the Mine as the majority of the MDE has been classed as having an 'extremely low' probability of ASS and those areas which have been classed as having a high probability of ASS occurring are existing landforms (TSF 1 and 2) and water storages (Austin's Dam and Cowan Dam) and therefore are not proposed to be disturbed.

Contamination of land as a result of erosion from waste storage landforms

Erosion of material from the surface of constructed waste storage landforms can potentially cause contamination of soils and sedimentation within the surrounding area as well as loss of growth medium from the landform. Waste rock and tailings are known to have elevated metals arsenic, antinomy and lithium. The Floyds WRL will be 10 m higher than the current maximum built height, over 3.5 km long and approximately 355 ha in area. TSF4 will potentially be up to 30 m in height, over 2 km wide and up to 240 ha in area. The landform sizes are large and as such erosion from the landforms can potentially impact on an extensive areas of land within State Forest 20 and private agricultural properties.

Control of landform design, construction and rehabilitation is therefore key to minimising erosion and the risk of associated contamination. Talison have developed a landform design criteria of 18° batter slopes, 10 m wide berms every 20 m height, which has been successfully implemented at waste storage landforms at the operation. Slopes are contour ripped and applied with 300 mm of clay growth medium or topsoil prior to revegetation with native species.

4.5.6 Mitigation

Mitigation and management measures for impacts to terrestrial environmental quality which are currently implemented or will be undertaken as part of the mine expansion include:

Avoid

- Topsoil affected by dieback or heavily weed infested will be collected separately and buried within WRL to avoid spread to rehabilitation areas.

Minimise

- Collection of topsoil is undertaken as soon as practical following vegetation clearing.
- Topsoil will be used for progressive rehabilitation in preference to stockpiling. Where stockpiling is required the piles will be no more than 2 m in height.
- Topsoil collection and stockpiling will be avoided when the soil is wet.
- Continued implementation of Talison's ISO certified EMS procedures relating to hydrocarbon management and spill response.
- New hydrocarbon and reagent storage facilities at the MSA and CGP3 and CGP4 are designed to meet AS 1940 and AS 1692.
- Implementation of Talison Waste Rock Management Plan and Environmentally Hazardous Waste Rock Management Plan to identify and manage waste rock which is PAF.
- Use of truck monitoring software to manage and control mining movements to accurately determine volumes of PAF material that is deposited at the Floyds dump and more precise locations of deposition.
- Completion of an AMD study to characterise the leaching potential (e.g: acid generation and leaching) of tailings and waste rock with respect to future excavated pit material. Implement the recommendations of the study.

Rehabilitate

- Progressive rehabilitation of Floyds WRL and TSF4 embankments to minimise stormwater flows from the embankments.
- Floyd's WRL and TSF4 will be designed and constructed for long term stability in accordance with the latest standards and guidance.
- Contouring of landforms during rehabilitation will be undertaken via contour ripping and inclusion of logs and rocks to prevent sheet flow from landforms.
- Revegetation mixes will include a fast growing Acacia species component to provide a fast growing species to aid in preventing runoff.

4.5.7 Predicted Outcomes

The Mine expansion has the potential to impact on Terrestrial Environmental Quality. The potential for impact to Terrestrial Environmental Quality can be mitigated through appropriate management and mitigation as outlined above. The most significant risk is associated with the management of waste storage landforms (Floyds WRL and TSF4) to prevent erosion. Talison has developed and applied a Waste Rock Management Plan and Environmentally Hazardous Waste Rock Management Plan as part of the operation's ISO certified EMS for the existing mine which have effectively managed this risk.

Design and management of waste storage landforms is currently regulated through the site operating licence (TSF only) (L4247/1991/13), various mining proposals and the mine closure plan. Talison anticipate that the potential impacts to Terrestrial Environmental Quality can continue to be effectively regulated under the same regulatory regime through application for a works approval and licence amendment to the DWER under Part V of the EP Act, and submission an updated whole of mine Mining Proposal and Closure Plan to DMIRS under the Mining Act.

4.6 Key Environmental Factor – Hydrological processes

4.6.1 EPA objective

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

4.6.2 Policy and guidance

- Environmental Factor Guideline Hydrological Processes (EPA 2016c).
- *Waterways Conservation Act 1976.*
- *Water Agencies (Powers) Act 1984.*
- *Metropolitan Water Supply, Sewage and Drainage Act 1909.*
- *Country Areas Water Supply Act 1947.*
- *Rights in Water and Irrigation (RIWI) Act 1914.*

4.6.3 Receiving environment

A desktop search of the DWER Geographic Data Atlas was undertaken to determine the proximity to areas proclaimed under the *Rights in Water and Irrigation Act 1914 (***RIWI Act**). The MDE only coincides with one proclaimed Public Drinking Water Source Area (**PDWSA**) (Greenbushes) although mining activity will not occur within the intersect area.

Table 26 DoW geographic data atlas queries within the MDE

Aspect	Details	Greenbushes Lithium Mine Expansion MDE
Groundwater Areas	Groundwater areas proclaimed under the *Rights in Water and Irrigation (RIWI) Act 1914*	None Present
Surface Water Areas	Surface water areas proclaimed under the RIWI Act	None present within the MDE. Dumpling Gully Surface Water Area is located 600 m north of the MDE
Irrigation District	Irrigation Districts proclaimed under the RIWI Act	None present
Rivers	Rivers proclaimed under the Rights in RIWI Act	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947.*	Greenbushes – located to the north of the MDE. Approximately 100 m at the southern tip coincides with the MDE, north of the Cornwall pit.
Waterways Management Areas	Areas proclaimed under the *Waterways Conservation Act 1976*.	None present

Surface water hydrology

The majority of the MDE is located within the Middle Blackwood Surface Water Area, within the Norilup Brook sub-area, the upper reaches of the Hester Brook sub-area and the upper reaches of the Woljenup Creek sub-area. These areas are not proclaimed under the RIWI Act. Watercourses within the areas are all tributaries of the Blackwood River. The Blackwood River Catchment is the largest in the South West of WA. It covers an area of approximately

22,500 km^2, arising some 300 km inland of the estuary, which discharges into the ocean at Augusta (Talison 2015).

The Norilup Brook sub-catchment area is some 68 km² at its confluence with the Blackwood River. The Norilup Brook originates in Greenbushes as the Dumpling Gully, which drains westward through Dumpling Gully Dams 1 and 2 and changes name to the Norilup Brook at its confluence with the Boronia Gully. The watercourse continues downstream in a southerly direction to Mt Jones Dam, which is located below the confluence with Spring Gully. Mt Jones Dam discharges to Norilup Dam at the confluence of the Norilup and Cowan Brooks. The Norilup Brook continues through public and private landholdings before it discharges into the Blackwood River (Talison 2015).

The Hester Brook watercourse originates north of Bridgetown (east of Greenbushes) and drains in a south-westerly direction, intersecting with Salt Water Gully approximately halfway along its course to the Blackwood River. The Brook has over a dozen tributaries (Talison 2015).The Woljenup Creek watercourse originates within the proposed TSF4 footprint within the MDE and drains in a southerly direction. It discharges to the Blackwood River approximately 5 km downstream of the MDE.

The Mine open pits are located along a ridgeline (topographic divide) which runs from the Greenbushes Township (~310 m AHD) towards the southeast (~270 m AHD). Surface and groundwater flows are directed to the east and west from the divide. Floyds WRL is located on the east facing hill slope and surface flows from this area drain into the Saltwater Gully. The drainage path to the Hester Brook for surface flows from Floyds WRL is Floyds Gully and Bunbury Gully via Salt Water Gully (Talison 2015).

The administration, process plants, TSFs and constructed reservoirs and dams associated with the operation are located on the west facing hill slope which descends to 245 m AHD. This area drains into the Norilup Brook via Spring Gully and Cowan Brook. Discharges from the Site can be regulated at the Cowan Brook and Southampton Dams, located on the Cowan Brook and Spring Gully respectively. Discharges are not currently authorised under the operating licence L4247/1991/13 but DWER will reassess this position pending commissioning of a new Reverse Osmosis water treatment plant which is intended to remove Li and improve the water quality of the Mine water circuit (Talison 2015).

Surface water flows are currently collected in constructed reservoirs/dams and TSFs within the MDE for use in the Mine water circuit. The Mine water circuit water storage infrastructure has a total capacity of approximately 5,800 ML (excluding open pits). Additional water containment dams are proposed to be established at the base of Floyds WRL to capture seepage and surface runoff as part of the expansion. The key elements of the existing Mine water circuit are described below:

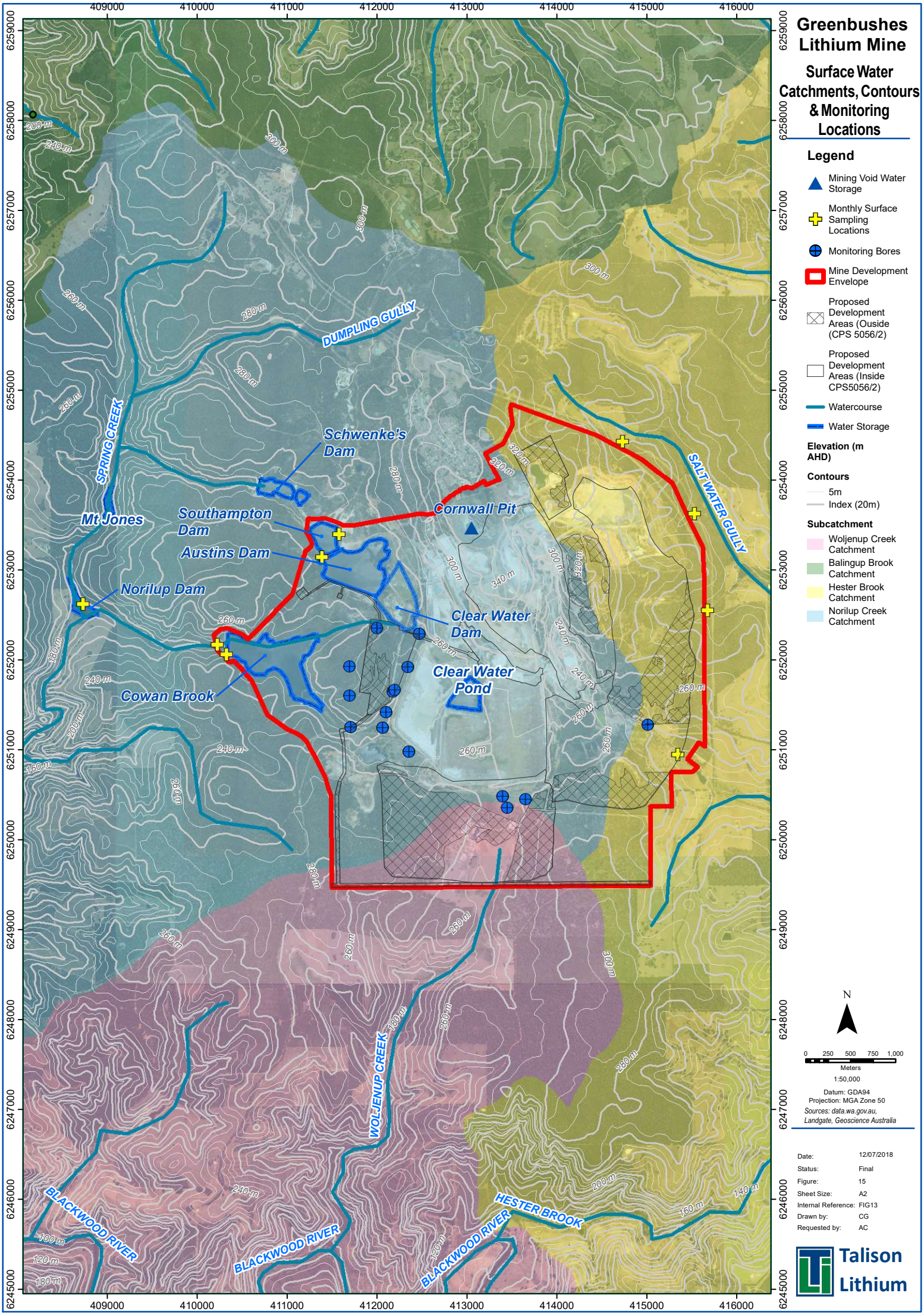
- Clear Water Pond (**CWP**)- The pond is the main supply for the process plants. The pond collects decant water from the TSF and pit dewater via historic Vultan's pit. Overflows from CWP are transferred via pipeline to Austin's Dam.
- Clear Water Dam (**CWD**) – currently under construction. The CWD will replace CWP once constructed and commissioned. All water (as far as practicable) from the TSFs will be pumped to the CWD for reuse in mineral processing. Clear Water Dam will also be the receptor for storm water flows from the processing areas. In addition to reuse for mineral processing, water from CWD will be treated via a Water Treatment Plant (**WTP**) and discharged to the Mine water circuit to aid in reducing Li levels within the circuit.
- Water Treatment Plant - A Reverse Osmosis (**RO**) WTP is currently under construction which will treat water from CWD to remove Li which is expected to result in an overall reduction in the amount of Li within the Mine water circuit. The plant is designed to treat

1,000,000 m^3/year of mine process water to less than 0.5 mg/L lithium concentration. Treated water will be reinjected back into the Mine water circuit to assist with diluting/reducing overall lithium concentrations.

- TSF2 Recovery Sumps – Collect seepage from TSF2 and returns it to the TSF. When CWD is commissioned it will be piped to the Dam.
- Austin's and Southampton Dams – neighbouring dams. Austin's Dam is the regulating storage reservoir. A manual control valve regulates discharge from Austin's Dam to Southampton Dam which is kept at an almost constant water level. Water is pumped from Southampton Dam to the processing plants for use. If Austin's Dam reaches capacity it overflows to Cowan Dam via a spillway. Overflows from Southampton Dam are restricted to protect water quality in the downstream Schwenke's Dam. Water supply is pumped from Cowan Dam to Southampton Dam if water supply from Austins Dam is insufficient.
- Cowan Brook Dam – Cowan Brook dam can overflow via Cowan Brook to the Norilup Dam during winter due to rainfall. The Norilup Dam is therefore connected to the Mine water circuit. Overflows from Cowan Brook dam are not currently permitted through the EP Act Part V operating licence for the Mine. The new RO WTP is expected to improve quality of water within the circuit sufficiently for discharges to again be able to occur to the Norilup Dam.
- Tin Shed Dam – provides process water to the GAMG secondary plant.

Schwenke's Dam and Norilup Dam are outside of the MDE but can potentially receive water from the Mine water circuit as a result of overflows however this is avoided through careful water management in accordance with the site Surface Water Management Plan (**SWMP**). The SWMP is an approved document under the operating licence L4247/1991/13 and will be updated progressively as required associated with changes to surface water management resulting from the mine expansion.

Talison is currently undertaking a Surface Water Assessment to characterise the existing surface water environment and potential changes associated with the implementation of the Proposal. The Surface Water Assessment will be included with the Mining Proposal application, and works approval/licence applications for the Mine expansion activities.


Greenbushes Lithium Mine
Surface Water Catchments, Contours & Monitoring Locations
Legend
Mining Void Water Storage
Monthly Surface Sampling Locations
Monitoring Bores
Mine Development Envelope
Proposed Development Areas (Ouside (CPS 5056/2)
Proposed Development Areas (Inside CPS5056/2)
Watercourse
Water Storage
Elevation (m AHD)
Contours
5m
Index (20m)
Subcatchment
Woljenup Creek Catchment
Balingup Brook Catchment
Hester Brook Catchment
Norilup Creek Catchment
Schwenke's Dam
Southampton Dam
Austins Dam
Norilup Dam
Mt Jones
Cowan Brook
Cornwall Pit
Clear Water Dam
Clear Water Pond
DUMPLING GULLY
SPRING CREEK
SALT WATER GULLY
WOLJENUP CREEK
HESTER BROOK
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Talison Lithium

Wetlands

No Ramsar listed or Nationally Important wetlands occur within 5 km of the MDE. The closest Ramsar/ Nationally Important wetland is the Vasse-Wonnerup Wetland System, approximately 60 kilometres to the north-west of the Mine. Similarly, there are no conservation category or resource enhancement wetlands within 5 km of the Mine.

Groundwater and hydrogeology

The MDE for the expanded mining operation is located in the Karri subarea of the Karri Groundwater Area (Talison 2015). The Karri area is not a proclaimed groundwater area. The groundwater flow system in the area is classified as 'local flow systems in Precambrian rocks' (BoM 2017).

The Archaean host rocks of the region which underlie the Mine are generally considered as relatively low yielding groundwater sources. Localised faults and fractures can provide increased yields and isolated aquifers but there is no evidence of large-scale water movement in fractured rocks at Greenbushes. The dominant basement groundwater flows usually occur within the weathered host rock material, which can develop lateritic weathering profiles 20 to 50 m thick. These are comprised of leached clays and lateritic caprock near the current ground surface, and grade into oxidised and fresh bedrock at depth.

More recent sedimentary sequences have been deposited in former water sources, which are generally incised into the Archaean bedrock. These shallow alluvial deposits can form local aquifers that may be either permanent or seasonal depending on extent, thickness and connectivity. These alluvial deposits may or may not be in hydraulic connection with the underlying Archaean rocks but, where perched, can reflect the hydraulic separation and origin with differing water quality (GHD 2017). An inferred shallow aquifer has been defined to the south and west of TSF2. The aquifer is coincident with a former water course and historic mining dredge channel. The aquifer is inferred as hydraulically connected to surface water features to the west of the mining operation such as swamps/dams, Austins drain and toe drains around the tailings facilities where the groundwater discharges at the surface. A perched aquifer system tends to occur within 5 m of surface during the winter period and disappears in summer.

Regular groundwater monitoring has been undertaken since 1997 and water levels have remained relatively stable since. The results show seasonal fluctuations whereby water levels reach a maximum at the end of winter in October, then decline to the lowest point at the end of summer in April. The recorded groundwater levels indicate that groundwater flows are directed to the east and west from the previously described ridgeline (drainage divide). Flow from the area of the processing plant and TSFs discharges to a swamp/wetland area on the east side of Austin's Dam (now the CWD, under construction) and a drain running from the TSF to Austin's Dam (SES 2017) indicating the presence of a perched aquifer. Swampy areas between Maranup Ford Road and Austin's Dam indicate the area is also potentially a groundwater discharge area.

Groundwater from the eastern margin of the TSFs, open pits and Floyds WRL flows in an easterly direction. A spring originates at the toe of Floyds WRL which discharges groundwater to Hester Brook via Floyds Gully and Salt Water Gully.

Due to limited groundwater availability, dewatering of the open pit occurs via collection of groundwater inflows in a sump which are currently pumped to the Clear Water Pond via the Vultan pit.

Talison is currently undertaking a Hydrogeology Study to complement the current understanding of the hydrogeological conditions of the mining area. The study will build on the existing hydrogeological information for the Mine and will focus on areas with little or no hydrogeological

information. The Study will be included with future approval applications for the Mine expansion including a Mining Proposal application. A Dewatering study is also underway to assess any impacts which may be associated with dewatering within the expanded open pit. To date there has been no demonstrable impact from dewatering of the existing open pits, or Cornwall underground mine which extended below the planned pit depth for the expansion.

4.6.4 Potential impacts

Hydrological processes could potentially be impacted by vegetation clearing, and alteration of natural topography to establish new or expanded landforms including TSF4, Floyds WRL extension, expanded open pit and infrastructure. Draw down effects associated with dewatering from the open pit are not expected given open cut mining has already been occurring within the MDE for 30 years with no drawdown related impacts apparent. The groundwater resources also tend to be low yielding isolated aquifers not likely to experience drawdown.

The potential impacts that may occur to hydrological processes as a consequence of expanding the Mine are:

- Groundwater level rise in shallow/perched aquifers as a result of land clearing which causes reduced rates of evapotranspiration and increased rainfall infiltration and recharge;
- Groundwater mounding in the vicinity of the new or existing TSFs;
- Altered surface water flow regime as a result of alterations to existing drainage patterns caused by establishment of new landforms and infrastructure; and
- Erosion and sedimentation in surrounding areas, as a result of land clearing and the alteration of surface water drainage patterns.

4.6.5 Assessment of impacts

Groundwater level rise

Groundwater level rise has the potential to occur as result of removal of vegetation during land clearing, which reduces local evapotranspiration rates and increases infiltration. Changes in vegetation structure can result due to the increased availability of water and the potential for waterlogging.

However, given:

- The MDE has been subject to extensive clearing over the history of mining in the area without evidence of local groundwater level rise. The local area is likely to already experience reduced evapotranspiration and increased infiltration rates as a result of historic clearing for the Mine and surrounding agricultural properties east of the Mine.
- The MDE is surrounded by an expansive area (6,088 ha) of State Forest 20 which will buffer the effect of reduced local evapotranspiration rates and increased infiltration.
- Each infrastructure area / landform will be progressively cleared when required.
- Groundwater resources are restricted due to the nature of the underlying geology which has low permeability and porosity.

It is considered unlikely that groundwater level rise will occur as a result of vegetation clearing for the proposed Mine expansion.

Groundwater mounding in the vicinity of the new or existing TSFs

Establishment of a TSF involves impounding large volumes of wet slurry (ground ore, residual reagents and water) within a specially designed storage facility. Contained water is removed

from the TSF via decant structures. Groundwater mounding in the vicinity of a TSF can occur when retained water percolates through the foundations of the structure to the unsaturated zone beneath the infrastructure. Saturation of this zone causes groundwater to mound beneath the infrastructure. Mounding of groundwater can impact on the health of vegetation in the vicinity, particular if the water quality is poor.

Due to the nature of groundwater resources within the MDE it is considered unlikely that mounding will occur as underlying geology tends to have low permeability and porosity which is unlikely to support mounding.

Nevertheless, the design of the new TSF4 will be such that the likelihood of percolation through the foundations is minimised. Design details for the TSF with be included in the Mining Proposal and Works Approval applications for this facility.

Altered surface water flow regime

Establishment of new or expanded landforms and infrastructure can potentially alter drainage patterns on a local scale through alteration of the natural topography. It is noted that drainage patterns within the Greenbushes area have been subject to a long history of alteration as a consequence of continued mining activity in the area, by various mining techniques, since the late 19th century. The expanded open cut will increase the capture of rainfall and runoff, roads and new infrastructure may intercept surface water flows within the surface water catchments of the MDE, expanded and new landforms (Floyds WRL, TSF4) may intercept surface water flows and contribute additional flows from the constructed slopes.

Surface water flows and catchment in the MDE are managed in accordance with the Greenbushes Operations SWMP which is reviewed typically annually or when changes to site water management are required, such as in association with establishing new infrastructure or developing new mine plans. The plan ensures flows are maintained to watercourses throughout the year through controlled and monitored discharges. It also outlines the Mine water circuit.

Surface water flows within the MDE which are impacted through new infrastructure or landform establishment will be directed into the Mine water circuit to ensure collection of flows where possible to supply the processing circuit.

Erosion and sedimentation in surrounding areas

Surface runoff from cleared areas typically has an increased runoff rate due to removal of vegetation, which acts to slow the flow of water across an area, and contains collected sediments. Increased runoff rates from cleared areas can potentially result in erosion within the flow path and sedimentation. Clearing within the MDE will predominantly occur within topographically low areas (250 – 280 mRL) with slopes of <5% therefore runoff rates are not expected to significantly increase in the cleared areas. Clearing will occur progressively to avoid large cleared expanses. All new infrastructure areas will have appropriate water collection and controls included as part of the design.

Roads within the MDE can act as a barrier to surface water flow. In order to maintain surface water flow, culverts are included in the road design. Culverts concentrate water flows and therefore can potentially lead to localised erosion, sedimentation and scour both up and downstream of the culvert in not appropriately designed for the expected flows.

Recognising the drying climate and limited availability of water within the MDE, Talison aims to collect surface water through the Mine water circuit wherever possible to provide supply to the mining and processing operations. Surface water flows from cleared areas will either be captured and managed within the cleared area or directed into the Mine water circuit for use avoiding impacts on downstream receptors. Similarly flows from constructed land surfaces

(such as WRL or TSF slopes) will be captured and directed to the Mine water circuit. Additional water catchment dams will be constructed at Floyds WRL for this purpose.

4.6.6 Mitigation

Impacts to hydrological processes will primarily be managed and mitigated through implementation of Talison's SWMP. The Plan is an approved document under the operating licence L4247/1991/13. The plan will be updated as the expansion progresses to account for changes in surface water flows and management which will occur as a result of the expansion. Updated versions will be provided to DWER in accordance with licence requirements.

Additional mitigation and management measures for impacts to hydrological processes include:

Minimise

- Progressive clearing of new infrastructure and landform areas as they are required, limited to only the area needed.
- Maintenance of a site water balance.
- Diversion structures will be used where necessary to direct surface flows around constructed landforms and infrastructure to join natural drainage lines.
- Discharges from Mine water storages to downstream environments including Cowan Brook Dam will be monitored. Discharge from Cowan Brook Dam is not currently authorised under the site operating licence therefore discharge will not occur unless the licence is amended.
- TSF design and construction in accordance with ANCOLD Guidelines on tailings dams - Planning, design, construction, operation and closure (2012) and Department of Mines and Petroleum Code of Practice – Tailings Storage Facilities in Western Australia (2013).
- Road design and location will be cognizant of maintaining surface water flows and drainage.
- Continued implementation of the site water monitoring program with additional monitoring locations included relative to the expansion footprint. A Hydrogeological Study and Surface Water Study (both currently underway) will inform the location of new monitoring sites.

Rehabilitate

- Artificial waste landforms are designed and constructed in accordance with the latest standards and guidance and learnings from the past 20 years of construction and rehabilitation of these landforms at the Mine.
- Progressive rehabilitation of WRL and TSF embankments to minimise flows from the embankments.

4.6.7 Predicted Outcomes

Impacts to groundwater processes are not expected to occur as a result of the proposed expansion, predominantly due to the already altered state of groundwater and the limited groundwater resource.

Surface water flows within the MDE are already modified as a result of the area's history of mining. Talison's existing SWMP will be updated to include changes associated with the Proposal. This plan ensures supply of sufficient water to the Mine while maintaining flows in the surrounding areas. Surface water impacts from vegetation clearing and infrastructure / landforms are likely to be minor and localised. The Proposal is therefore expected to be able to meet the EPA's objective to maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

It is expected impacts to hydrological processes will be considered as part of the assessment of the application for works approval and licence amendment required for the expansion activities under Part V of the EP Act. The licence currently regulates monitoring and discharge of water from the Premises. Additionally, in the event the Proposal is not assessed by the EPA impacts to hydrological processes as a result of native vegetation clearing would be considered as part of the Clearing Permit assessment under Part V of the EP Act and the associated Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations).

4.7 Key Environmental Factor – Inland waters environmental quality

4.7.1 EPA objective

To maintain the quality of groundwater and surface water so that environmental values are protected.

4.7.2 Policy and guidance

- Environmental Factor Guideline Inland Waters Environmental Quality (EPA 2016d).
- Australian and New Zealand Environment and Conservation Council (**ANZECC**) water quality guideline (2000).

4.7.3 Receiving environment

Surface water

The potential receiving environments for surface water quality include the Norilup and Cowan Brooks (Norilup Brook Sub-catchment), the Hester Brook (Hester Brook sub-catchment), and the Woljenup Creek (Woljenup Creek Sub-catchment) which are tributaries within the Blackwood River Catchment. The majority of the MDE is located within the Norilup Brook Sub-catchment with the predominant land use within the catchment being State Forest and Crown Reserve. The western part of the sub-catchment, downstream of the MDE, is predominantly cleared for private rural allotments for agricultural uses including grazing, horticulture and rural residential.

The Hester Brook is located to the east of the MDE and runs in a southerly direction to the Blackwood River. The Floyds WRL occurs within the sub-catchment which is predominantly cleared for private rural allotments for agricultural use including grazing, horticulture and rural residential. Landholders with access to the Norilup Brook use the water predominantly for livestock. One landholder has been identified as also using water from the Norilup Brook for garden irrigation. Landholders with access to Hester Brook have not been surveyed but the elevated salinity of the Brook (1,000-5,000 µs/cm) suggests use is likely limited to livestock and potentially irrigation. Both watercourses are also used for recreational activities (Talison 2015). No further investigation of Bridgetown-Blackwood Sub-catchment has been undertaken to date but will be as part of the previously mentioned Surface Water Assessment currently being undertaken.

Talison has undertaken surface water quality monitoring since 1997. The results indicate that surface water quality is generally good with elevated levels of Li, As and Iron (Fe) attributable to the natural mineralogy and history of mining activity. Radioactive elements Thorium and Uranium are below limit of detection for all waters monitored, and radionuclide activity remains stable and below trigger values (SES 2017). Seasonal variation in water quality also occurs as a

result of evaporation in summer and additional rainfall in winter. A summary of surface water quality is included in Table 27.

Table 27 Surface Water Quality Summary (Talison 2015, SES 2017)

Monitoring Location	pH	TDS (mg/L)	Elevated elements (2016/2017 data) (mg/L)
Norilup Brook Sub-catchment			
Austins Dam	8-8.5	1,000-2,000	Li - 10-12.9 As – 0.067-0.18 Fe also elevated
Southampton Dam	7-9	1,000-2,000	Li - 9.8-11.9 As – 0.046-0.15 Fe also elevated
Cowan Brook Dam	8-8.5	700-1,000	Li – 6.4-7.3 As – 0.005
Norilup Dam	8	500-1,000	Li - <2.5 (ANZECC Guideline for irrigation) As – 0.001
Hester Brook Sub-catchment			
Saltwater Gully	7.5-8	1,000-2,500	
Hester Brook	7-8	1,200-2,700	

Mineralisation in the Greenbushes area is expected to result in water chemistry that differs from that in non-mineralised areas of south west WA. Surface water monitoring data shows elevated concentrations of lithium, arsenic and to a lesser extent iron, at several sites in the Mine water circuit. Elevated concentrations within the Mine water circuit occur as a result of the collection and return of process water from the TSF decant, which has elevated concentrations of these elements, to the circuit. The SO_4/Cl ratio is also higher at some locations than is normally found in south west WA. The major source of sulfates is expected to be from weathering of sulphide ores but sulfate is also added in the mineral process.

The Mine water circuit includes two arsenic treatment units which are located at the CWP. The units treat incoming flows to the pond. A third arsenic treatment unit treats water returned to the Mine water circuit from the GAMG secondary process plant. An RO WTP and CWD are approved and currently under construction at Austin's Dam. The WTP is intended to improve water quality in the Mine water circuit (approval for the infrastructure has been granted by DMIRS and DWER).

Groundwater

As described in section 4.6.3 low yielding, isolated groundwater resources occur in localised faults and fractures in the Archean bedrock. The aquifers are confined and tend to be brackish to saline. Permanent or seasonal aquifers can form in shallow alluvial deposits and lateritic material. An inferred shallow aquifer has been defined to the south and west of TSF2. The aquifer is coincident with a former water course and historic mining dredge channel. Historic mining of the alluvial deposit has disturbed the aquifer. The aquifer is inferred as hydraulically connected to surface water features to the west of the mining operation such as swamps/dams, Austins drain and toe drains around the tailings facilities where the groundwater discharges at the surface (SES 2017). A low salinity perched aquifer system tends to occur within 5 m of surface during the winter period and disappears in summer.

The Mine is developed in a mineralised area and consequently concentrations of various metals in groundwater are likely to be higher than normal levels in the natural environment. Groundwater monitoring has been undertaken within the MDE since 1997. Metal concentrations

exceed the Australian Drinking Water Guidelines (**ADWG**) and/or ANZECC Guidelines for Irrigation in some bores for Mn, Fe, Li, P, As, Ni, Co, and Cd. Results have however remained relatively stable over time with the exception of As, and Li in some bores, the cause of which has not been able to be definitively determined. Historic groundwater monitoring records are included in Appendix F.

Radioactive elements Thorium and Uranium are below detection limits in all monitoring bores and radionuclide activity concentration levels (Ra-226 and Ra-228) are below ANZECC trigger values for irrigation and livestock water (SES 2017).

4.7.4 Potential Impacts

The proposed Mine expansion has the potential to impact on inland waters as a result of land clearing, production and storage of tailings, production and storage of contaminated process water and processing activities.

The potential impacts that may occur to inland waters environmental quality as a consequence of the Mine expansion are:

- Erosion and sedimentation as a result of vegetation clearing and alteration of surface water drainage patterns (refer to section 4.6.5 for assessment of this impact);
- Contamination of surface water in downstream environments as a result of contaminated water runoff or discharge ;
- Contamination of groundwater and/or surface water as a consequence of tailings storage ;
- Contamination of ground and/or surface water due to release/spillage of environmentally hazardous materials (chemicals) or tailings (refer to section 4.5.5 for assessment of this impact); and
- Contamination of ground and/or surface water due to the potential mobilisation of metals from PASS or PAF material (refer to section 4.5.5 for assessment of this impact).

4.7.5 Assessment of impacts

Contamination of surface water in downstream environments as a consequence of contaminated water runoff or discharge

Surface water runoff, process water and wastewater can become contaminated through contact with environmentally hazardous materials (chemicals), collection of sediments and dust or extended contact with ore, waste rock or tailings. Runoff and wastewater/process water from the Mine will typically have elevated metals, in particular Li and As, and to a lesser degree Fe, as a consequence of the enrichment of these metals within the geology of the local area. Release of these waters into the environment can therefore potentially result in contamination of local surface water environments including the Cowan and Norilup Brooks and Dams and the Hester Brook and Woljenup Creek, as well as the Blackwood River further downstream. As described in the previous section Li, As and Fe concentrations have been increasing within surface water environments at the Mine in preceding years indicating surface water contamination has already occurred to some degree.

Talison has undertaken a range of activities in recent years, through implementation of the SWMP (which is updated on an as needs basis) and ongoing consultation with DWER (previously DER) in order to minimise impacts to surface water quality in the surrounding catchments. Since implementation of the SWMP the increasing Li and As trends in surface water environments have plateaued.

The overall strategy employed by Talison through the SWMP to maintain surface water quality within the downstream environment is to:

- Collect and reuse/recycle as much process, stormwater and pit inflows as possible;
- Minimise and manage water discharges from the operation to downstream surface water sources; and
- Improve water quality within the Mine water circuit.

The key downstream environments that Talison aims to minimise impact on are the Cowan and Norilup Brook Dams. The site water circuit is managed to minimise discharges to Cowan Brook Dam as far as is practicable. This is achieved through collection and reuse of wastewater, seepage from TSFs, pit inflows and potentially contaminated surface water runoff within the Mine water circuit. In addition, the Cornwall pit which is inactive and not part of the expansion plans provides a water storage facility for excess water from the Mine water circuit. This assists in reducing the need for water discharges as water can be stored in the pit during the winter, high rainfall period and used during the drier summer period.

Talison recognises that recycling of water within the Mine water circuit will result in concentration of key contaminants within the water in the circuit over time. In particular lithium and arsenic concentrations have increased within the Mine water circuit over time. The mining operation is currently not authorised under the licence to discharge water from the Mine water circuit. DWER has advised this can be reviewed once the new RO WTP is operational and water quality within the Mine water circuit has improved, or a guideline for Li concentration in discharge water is agreed. Approval has recently been granted to construct the new WTP adjacent to Austin's Dam. The WTP is designed to remove Li from water from the Dam and produce a permeate free from all impurities for use in the Mine water circuit. In addition to this, two arsenic treatment plants are in operation at CWP. The treatment plants are able to treat water entering and exiting the CWP. The water treatment systems will assist in improving the water quality of the Mine water circuit and reduce the associated risk of contamination of downstream surface water.

A secondary impact associated with contamination of downstream surface water environments is the potential death or health decline of aquatic fauna within the affected environment. Talison commissioned the Centre of Excellence in Natural Resource Management (**CENRM**) at the University of Western Australia (**UWA**) to conduct a number of studies (CENRM 2013 and CENRM 2014) into the impact of Li in aquatic environments. Annual ecological assessments of the Norilup Brook have also been undertaken (in accordance with operating licence conditions since 2016).

An ecotoxicology study was undertaken in 2012 to determine the effect of lithium on three local aquatic species. EC_{50} values were determined for each species based on an endpoint of immobilisation (CENRM 2013). The study was also used to determine water quality (Li) guidelines or triggers for water discharged from the Mine using the ANZECC Direct Toxicity Assessment methodology. The study results indicated the most sensitive species to lithium was Western Pygmy Perch (*Nannoperca vittata*) with a 96 hour LC_{50} value of 41.9 mg/L. Water boatman (*Diaprepocoris barycephalus)* was the least sensitive to lithium with a 96 hour LC_{50} value of 86.2 mg/L and freshwater crayfish (*Cherax preissi)* demonstrated an EC_{50} value of 77.6 mg/l after 96 hour exposure. Based on these results an interim trigger value of 0.42 mg/L lithium was determined (CENRM 2013).

Following this study an ecological and bioaccumulation study was undertaken to compare heavy metals in water, sediment and bioaccumulated in aquatic fauna flesh in upstream and downstream environments. Sample sites for the study were upstream, far downstream and immediately downstream of the Mine water circuit discharge point at Cowan Dam. The results of

the study indicated there is some degree of bioaccumulation in the flesh of crayfish and fish immediately downstream of the discharge point at Cowan Dam but no bioaccumulation further downstream or upstream (CENRM 2014). The majority of ecological indicators, including species diversity, the number of species, and the average species evenness at each sample location, showed no significant differences between locations (CENRM 2014).

The concentration of lithium at the study sample site immediately downstream of of the Mine water circuit discharge point at Cowan Dam reached a maximum of 6.0 mg/L which significantly exceeds the interim trigger value of 0.42 mg/L(CENRM 2014). However, even at the maximum concentrations immediately below Cowan Dam, there does not appear to have been significant ecological consequences and controlled discharge of water from the Mine is unlikely to cause deaths of the animals inhabiting the downstream environments or have any significant ecological consequences (CENRM 2014).

Annual monitoring of the upstream, downstream and discharge aquatic environment has found that substances (particularly As and Li) contained in the water previously discharged from the Mine, even at their maximum concentrations immediately below the Cowan Dam discharge point, have not had any significant ecological consequences. Minor differences in ecological indicators has been noted however there has been no clear trend where upstream sites differed significantly from downstream sites. Overall, these results suggest that water discharged from the mine has had no significant ecological impacts on the sites downstream from the mine (CENRM 2017a, 2017b).

Contamination of groundwater and/or surface water as a consequence of tailings storage

The proposed expansion of the Mine includes construction of a new TSF, TSF4. The existing TSF2 will also continue to be raised and will be combined with TSF1 to extend its operating life. The TSFs will store tailings produced from lithium processing activities. Tailings storage can potentially result in contamination of groundwater and/or surface water as a result of the following:

- Discharge of tailings to the environment due to accidental discharge from tailings transfer pipelines.
    - From time to time pipeline ruptures can occur due to general wear and tear on the infrastructure or blockages. Tailings are in slurry form so can potentially run overground to surface water or can be collected and transported by surface water if any flows occur. Tailings transfer pipelines are bunded, monitored and inspected regularly to ensure pipeline ruptures are prevented where possible or responded to in a timely manner when they occur. Timely response to a rupture ensures tailings are contained as much as practical in the immediate vicinity of the release to prevent significant impact to surface water or groundwater.
- Accidental release of tailings to the environment as a result of overtopping of the TSF or an embankment failure.
    - Accidental tailings releases and embankment failures rarely occur, particularly when a TSF is appropriately designed and tailings disposal is managed to ensure even placement in the TSF and maintenance of adequate freeboard. The new TSF will be constructed over the Woljenup Creek. Tailings could potentially end up in the creek if released from the TSF4.
- Seepage of tailings leachate from the TSF.

Tailings leachate typically contains elevated salts and metals and can potentially be acidic. If seepage from the TSF occurs contaminated leachate can impact on groundwater quality potentially causing elevated metals, salinity and increased acidity. Leachate seepage occurs at

both the existing TSF2 which is in use and the currently inactive TSF1. The seepage is actively managed through recovery drains and sumps and is returned to the Mine water circuit to minimise impact to groundwater quality. Carbonate addition to the tailings also aids in maintaining a higher pH and preventing acidic conditions from presenting. A subsurface drainage and recovery system has been installed at the existing TSF2 to capture seepage and prevent it impacting on groundwater. The new TSF will also be designed with a leachate recovery systems to intercept seepage before it impacts on groundwater. While there is a likelihood that some seepage from the new TSF4 may occur, an effective recovery system will minimise impact on groundwater. Talison will also establish groundwater monitoring locations prior to construction of the TSF to measure the baseline water quality and identify any potential changes to groundwater quality which indicate seepage may be occurring.

4.7.6 Mitigation

Impacts to inland waters environmental quality (surface waters) will primarily be managed and mitigated through implementation of the site SWMP which is an approved document under the site operating licence L4247/1991/13. The plan is updated as required and will be updated progressively to account for changes in surface water flows and management which will occur as a result of the expansion.

Mitigation and management measures for impacts to inland waters environmental quality which are outlined within the SWMP, and additional measures currently implemented or will be undertaken as part of the Mine expansion include:

Avoid

- All potentially contaminated surface waters are captured within the Mine water circuit for reuse, recycling and retreatment.

Minimise

- Operation of an RO WTP to remove lithium and improve water quality within the Mine water circuit (construction is underway and it is anticipated to be operational in early 2019).
- Talison aims to improve water quality with the Mine water circuit and Austin's Dam to a level suitable for the DWER to authorise discharge from the Mine water circuit if required. Discharges which do occur will be monitored for quality and volume and managed to prevent erosion, scouring and sedimentation.
- Continued weekly monitoring of water quality within the Mine water circuit.
- TSF design, construction and operation of TSF in accordance with ANCOLD Guidelines on tailings dams - Planning, design, construction, operation and closure *(*2012) and Department of Mines and Petroleum Code of Practice – Tailings Storage Facilities in Western Australia (2013).
- TSF4 design will include a leachate recovery system (a leachate recovery system has been established at existing TSF2).
- Progressively update the SWMP to include changes associated with the mine expansion and continue to implement the plan.

Monitor

- Annual hydrological review of the operation by a consultant hydrologist.
- Annual TSF Audits by a qualified geotechnical engineer.

- Annual ecological assessment within the Norilup Brook Sub-catchment inclusive of water and sediment quality, aquatic fauna and macroinvertebrate diversity and abundance, and aquatic fauna bioaccumulation as per operating licence requirements (L4247/1991/13).
- Continue to undertake groundwater, surface water and Mine water circuit monitoring in accordance with operating licence requirements (L4247/1991/13) and the SWMP.
- Establish groundwater monitoring bores at the site of Floyd's WRL expansion and TSF4 prior to construction for baseline and ongoing monitoring.
- A Hydrogeological Study and Surface Water Study (both currently underway) will inform the location of new monitoring sites.

4.7.7 Predicted Outcomes

The MDE is highly mineralised has been subject to mining activity since the late 19th Century resulting in groundwater and surface water which has already been impacted to some degree, in particular from elevated As and Li present in the deposit. There does not appear to be a significant impact on downstream environments and water uses as a result of this to date. Improvements to water and tailings management and treatment in recent years appear to have arrested increasing levels of As and Li, particularly in surface water environments. Further improvements are expected when the WTP is operational.

While the expansion of the Mine continues to present a risk of surface and groundwater contamination, in particular from As and Li, it is expected that this risk can be minimised through continued implementation of the site SWMP, water treatment, and the improvements to water and tailings management which have been made. Talison is not anticipating any decrease in surface or groundwater quality as a result of the expansion. Continued comprehensive surface and groundwater monitoring will identify any significant changes to surface or groundwater potentially attributable to the mining operation so they can be investigated and addressed in a timely manner.

Surface water and groundwater quality controls and monitoring are currently specified through Talison's operating licence (L4247/1991/13). It is expected that impacts to inland waters environmental quality will be considered as part of the assessment of the application for works approval and licence amendment required for the expansion activities under Part V of the EP Act.

4.8 Key Environmental Factor – Air quality

4.8.1 EPA objective

To maintain air quality and minimise emissions so that environmental values are protected.

4.8.2 Policy and guidance

- Environmental Factor Guideline Air Quality (EPA 2016a).
- Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses No. 3 (EPA 2015).
- National Environment Protection (Ambient Air Quality) Measure (NEPC 2016).
- Environmental Protection Bulletin No. 24 – Greenhouse Gas Emissions and Consideration of Projected Climate Change Impacts in the EIA Process.

4.8.3 Receiving environment

Climate

Greenbushes experiences a Mediterranean type climate characterised by warm dry summers and cool wet winters, with the majority of the rain falling in the winter. The nearest Bureau of Meteorology (**BoM**) climate station, which records wind speeds and directions, is Bridgetown (Site number: 9617). It is located approximately 9 km to the southeast of the Mine. A summary of the rainfall and temperature data collected since 1998 is shown in Figure 16. Rainfall data shown has been taken from the BoM Greenbushes rainfall station (Site number 9552). The average maximum temperatures (1998-2017) for Bridgetown range from 15.7°C in July to 30.0°C in January. The average minimum temperatures range from 4.5°C in July to 13.5°C in February (BoM 2017). The majority of rainfall (>85%) is received between April and October. Rainfall averages 928.7 mm/year and mean monthly rainfall varies from 15.7 mm in February to 167 mm in July.

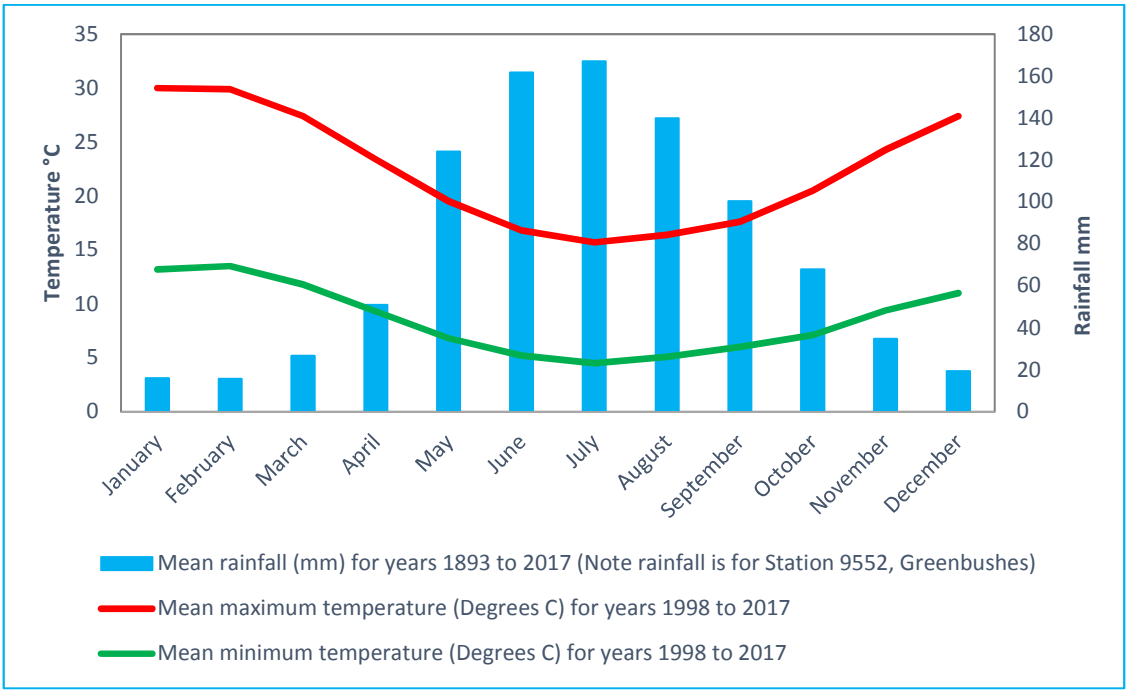


Figure 16 BoM Climate Statistics for Bridgetown (BoM 009617)

The average morning (9 am) wind speed reported during summer for Bridgetown BoM station is 13.0 km/h, prevailing predominately from the east and south east. The wind speed marginally increases in the afternoon (3 pm) with an average wind speed of 14.8 km/h reported which prevails from south east to south westerly direction. During winter months winds abate to an average of 5.6 km/h during the morning prevailing from the north and north west. Afternoon winds increase to an average of 12.5 km/hr and typically are from the north to north westerly direction (BoM 2017a). Storms during the winter period tend to approach from the north west.

Background air quality

The Mine is located within State Forest 20 with agricultural properties located at the outskirts of the State Forest. Local air quality is predominantly influenced by dust emissions from the Mine and to a lesser extent agricultural activities in the surrounding area. Regional dust sources in the local airshed include:

- Mechanical land disturbance from surrounding pastoral properties;
- Vehicle movement along unsealed roads;

- Burning and incineration (backyard burning, residential wood fired heaters, prescribed burns and wildfires); and
- Emissions from the existing Mine, including wind erosion from the TSF1, TSF2, Floyds WRL, existing pits, stockpiles and haul roads. Other dust sources to a lesser extent include blasting, crushing, conveyors and loading/unloading activities.

The nearest industrial premises to the Mine (besides the GAMG tantalum operation which as previously mentioned is within the MDE) is the Greenbushes sawmill which is 3 km north of the Mine. The sawmill is not expected to influence the local air quality in the vicinity of the Mine due to the distance from the mine.

Talison implements a program of dust monitoring at the mine which has been ongoing since 1999. The monitoring network comprises a Hi-Vol dust sampler and a Tapered Element Oscillating Microbalance (**TEOM**). The HiVol dust sampler records particulates less than or equal to 10 microns in diameter (**PM_{10}**) over a 24 hour period as per requirements of operating licence L4247/1991/13. The sampler is situated at the end of Diorite Street on the northern boundary between the town and the MDE. It is operated every alternate day from November to May and every sixth day outside of this period.

The TEOM provides real time detection of PM_{10} levels and which are monitored to detect and react to increasing dust levels. The ambient dust monitoring location is shown in Figure 18. The monthly average monitoring results recorded since 1999 have been referred to, to determine current background dust levels for the local area. The average maximum 24 hour PM_{10} concentration recorded since monitoring commenced is 26 µg/m^3. The annual average PM_{10} concentration recorded since monitoring commenced is 15 µg/m^3. Seasonal trends are evident in the monitoring results with the average maximum 24 hour PM_{10} concentration during the winter months being around 17 µg/m^3 and increasing to around 35 µg/m^3 during the summer months. A summary of dust monitoring results is included in Figure 17.

Seasonal trends are likely to affect natural dust suppression due to rainfall and reduced winds in the winter time. Additionally, the prevailing winds in the winter tend to be away from the Greenbushes townsite where as in summer, winds prevail from the east to south east.

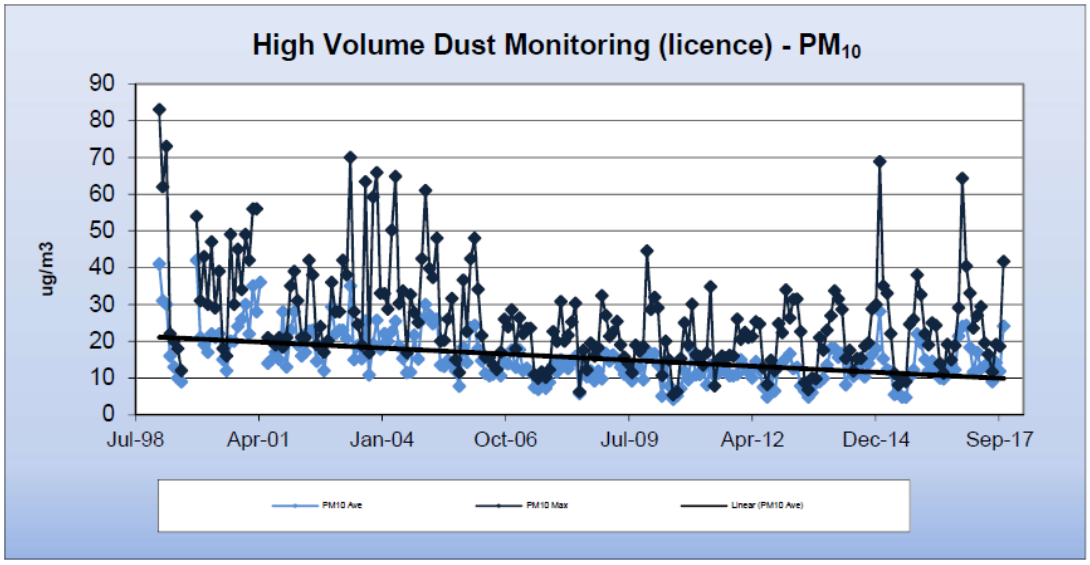


Figure 17 HiVol PM_{10} Monitoring Summary

Dust from mining and associated activities is subject to air quality standards as described by the *National Environment Protection (Ambient Air Quality) Measure* (**Air NEPM**) (NEPC 2016). The Air NEPM sets a criteria of 25 µg/m^3 for annual average and 50 µg/m^3 for 24-hour average PM_{10}. Dust emissions from the operation are currently regulated through the premises operating

licence L4247/1991/13 which specifies monitoring of PM_{10} through the period 1 November to 31 March and sets a limit of 90 µg/m^3 per 24 hour period at the HiVol monitoring location on Diorite Street in Greenbushes. Occasional exceedances of 50 µg/m^3 at this location have been recorded at the monitoring location but these have been associated with smoke resulting from fires in the region, or unrelated construction/earthworks activities occurring in proximity to the dust monitor. No exceedances of the operating licence limit of 90 µg/m^3 PM_{10} have occurred.

Sensitive receptors

Sensitive receptors who may be impacted by dust emissions attributed to the Mine include mine employees, Greenbushes residents, rural residents, surrounding vegetation and fauna.

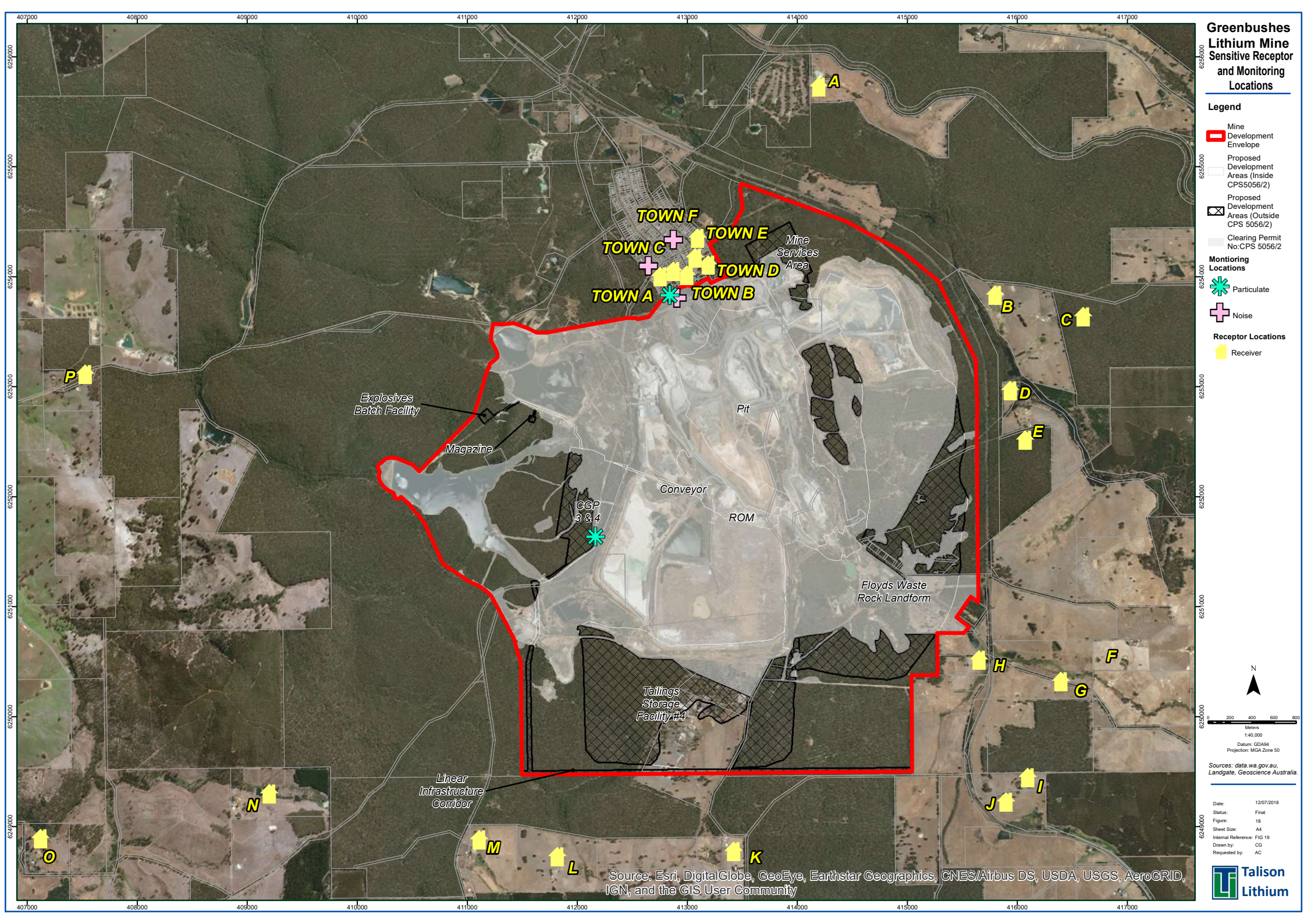
The Mine is located immediately south of the town of Greenbushes. All residences and businesses within the town are considered sensitive receptors due to the town's proximity to the Mine. The closest residence to the MDE is approximately 80 m from the boundary. Outside the town site an additional 16 receptors have been identified within approximately 2 km of the MDE. The receptors are predominantly to the south and east of the Mine. The minimum separation distance recommended in the Department of Environment Regulation (now DWER) Draft Separation Distances Guidance Statement (2015) for noise and dust for Category 5 prescribed premises is 2 km. The closest receptors outside the town of Greenbushes are approximately 250 m from the MDE boundary and approximately 450 m from the closest mining activity (waste dumping at Floyds WRL). The location of the Greenbushes town site and surrounding sensitive receptors is shown in Figure 18. Native vegetation and fauna are also considered sensitive receptors. Impacts to fauna and native vegetation are discussed in section 4.3.5 and 4.4.5.

During the previous annual report period no complaints relating to dust emissions from the premises were reported.

4.8.4 Potential impacts

The potential impacts that may occur to air quality as a consequence of the proposed expansion of the Mine include:

- Reduced air quality due to dust emissions associated with:
  - vegetation clearing;
  - earthworks for infrastructure construction (CGP3, CGP4, MSA, TSF4, batching plant and magazine);
  - ore and waste haulage and other vehicle and equipment movements on unsealed roads;
  - extraction of ore and waste from the pit including drilling, blasting and material handling activities;
  - wind erosion from increased open areas including TSFs, WRL, haul roads, open pit and stockpiles; and
  - crushing, screening and transfer of ore within the processing circuit.
- amenity impacts to receptors as result of the nuisance and aesthetic impact of visible dust;
- health impacts on sensitive receptors and native fauna as a result of dust emissions;
- reduced air quality due to increased combustion emissions; and
- increase in greenhouse gas emissions associated with the increased mining fleet required for the expanded operation.


Greenbushes Lithium Mine
Sensitive Receptor and Monitoring Locations
Legend
Mine Development Envelope
Proposed Development Areas (Inside CPS5056/2)
Proposed Development Areas (Outside CPS 5056/2)
Clearing Permit No:CPS 5056/2
Montioring Locations
Particulate
Noise
Receptor Locations
Receiver
TOWN F
TOWN E
TOWN C
TOWN D
TOWN A
TOWN B
Mine Services Area
Explosives Batch Facility
Magazine
Pit
Conveyor
ROM
CGP 3 & 4
Floyds Waste Rock Landform
Tailings Storage Facility #4
Linear Infrastructure Corridor
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
N
0 200 400 600 800
Meters
1:40,000
Datum: GDA94
Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia.
Date: 12/07/2018
Status: Final
Figure: 18
Sheet Size: A4
Internal Reference: FIG 19
Drawn by: CG
Requested by: AC
Talison Lithium
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.8.5 Assessment of impacts

Reduced air quality, health and aesthetic impacts due to dust emissions

Dust emissions can reduce the air quality in the surrounding area, cause acute and chronic health effects, as well as impact on amenity as a result of reduced visibility and settling on surfaces causing soiling and staining (DEC 2011). The potential impact of dust is determined by particle size, chemical composition and concentration (DEC 2011).

The total suspended solid (**TSP**) fraction of dust is typically responsible for nuisance and amenity impacts whereas the smaller PM_{10} and $PM_{2.5}$ fractions are more commonly associated with the potential for health impacts due to their ability to penetrate the lungs (DEC 2011).

The vast majority of dust from mining activities consists of course particles (around 40%) and particles larger than PM_{10}, generated from activities such as mechanical disturbance of rock and soil materials by blasting and drilling, dozing, excavation, loading and dumping, and trucks on haul roads. A small amount of dust emissions can be associated with crushing and processing. Dust is also generated when wind blows over bare ground and different types of stockpiles (GHD 2018). Overall dust emissions associated with the Mine are expected to increase as a result of the expansion. Increased dust emissions from the Mine will occur as a result of:

- vegetation clearing, up to 350 ha of native vegetation clearing will be undertaken;
- earthworks for infrastructure construction (CGP3, CGP4, Crusher 3, MSA, TSF4, batching plant and magazine);
- increased ore and waste haulage and other vehicle and equipment movements on unsealed roads;
- increased extraction of ore and waste from the pit including drilling, blasting and material handling activities. The mining fleet is expected to more than double for the expanded Mine to meet the proposed production increase from 4.7 Mtpa to 9.5 Mtpa of ore with an associated increase in waste stripping. The current blasting frequency will increase to meet the increased production rate;
- wind erosion from increased open areas including TSFs, WRL, haul roads, open pit and stockpiles. The tailings surface and product stockpiles in particular are susceptible to dust generation due to the very fine particle size of the material; and
- increased crushing, screening and transfer of ore within the processing circuit associated with the production increase from approximately 4.7 Mtpa to 9.5 Mtpa of ore.

Air dispersion modelling was undertaken by GHD (2018) in order to assess the potential impact of dust emissions from the expanded Mine on surrounding sensitive receptors. The assessment considered both the incremental impact of dust emissions from the Mine, and the cumulative impact based on current PM_{10} monitoring results from the Mine. One modelling scenario was produced for the year 2028 which is considered to represent the maximum activity level for the expanded Mine. Full results of the air dispersion modelling are included in the Dust Impact Assessment Report in Appendix G (GHD 2018). A summary of the modelling and assessment is presented below.

The impact of dust emissions from the expanded Mine was assessed by comparing air dispersion modelling results to relevant criteria. The criteria referred to include:

- *National Environment Protection (Ambient Air Quality) Measure* (**Air NEPM**), National Environment Protection Council (NEPC);
- *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* (**Kwinana Policy**), WA EPA;

- *State Environment Protection Policy (Air Quality Management)* (**SEPP-AQM**), EPA Victoria (2002); and
- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW Approved Methods**), NSW EPA (2005).

Additionally the premises operating licence (L4247/1991/13) conditions establish a limit for monitored dust levels which is referred to as an additional criteria.

The Air NEPM was developed to provide benchmark standards for ambient air quality to ensure all Australians have protection from the potential health effects of air pollution. Air NEPM standards for particulate matter only are referred to in this assessment. The Air NEPM does not outline any 1-hour PM_{10} criteria, TSP or monthly deposition criteria. Accordingly, the SEPP-AQM, Kwinana Policy and NSW Approved Methods have been referred to as a criteria for this assessment. The criteria used to assess the impact of dust emission from the Mine are detailed in Table 28.

Table 28 Criteria for ambient air quality at sensitive receptors

Pollutant	Averaging period	Maximum allowable concentration	Guideline/Criteria
TSP	24-hour	90 µg/m^3	Kwinana Policy
	Annual	90 µg/m^3	NSW Approved Methods
PM_{10}	1-hour (99.9th percentile)	80 µg/m^3	SEPP-AQM
	24-hour	50 µg/m^3	Air NEPM
	Annual	25 µg/m^3	Air NEPM
Deposited dust	Maximum increase	2 g/m^2/month	NSW Approved Methods
	Maximum total	4 g/m^2/month	NSW Approved Methods

The maximum incremental and cumulative results for TSP, PM_{10} and deposited dust from predictive air dispersion modelling are summarised in Table 29, including comparison to the maximum allowable concentration for the relevant criteria. The incremental 1-hour 99.9th percentile criteria for PM_{10} is the most significant result with the maximum incremental concentration predicted to reach 129 µg/m^3 at Receptor J in worst case conditions which exceeds the criterion of 80 µg/m^3 by 61% . The criterion is also predicted to be exceeded at six additional receptors (Town A, Town B, D, E, G and I) during worst case conditions.

It is highlighted that the predicted results are based on a single modelling scenario using worst case meteorological conditions and the operational year predicted to have the highest dust emissions. Predicting air pollution is a complex application and there are limitations with advanced dispersion models used to undertake predictions, due to the variability and limited predictability of modelling inputs. Real air quality concentrations are likely to be highly variable depending on emission levels and the persistence of particular meteorological conditions. The predicted results are therefore not representative the typical level of impact which would be expected in the surrounding area, and rather are a conservative prediction of the maximum level of impact which could potentially occur.

Although the modelling has predicted an exceedance of the 1-hour 99.9th percentile maximum allowable concentration for PM_{10}, the 24-hour and annual average PM_{10} concentrations were all predicted to be below the respective criteria during worst case meteorological conditions. It is therefore expected that emission levels will remain within the criterion during typical mine operation and meteorological conditions. Implementation of additional monitoring and mitigation can and will be used to identify and respond to conditions which are more likely to result in

increased dust emissions which could potentially impact the air quality of nearby sensitive receptors.

Table 29 Predicted maximum dust concentration (worst-case conditions) comparison with relevant air quality criteria for Greenbushes Lithium Mine

Pollutant	Averaging period	Maximum allowable concentration	Maximum predicted incremental concentration at sensitive receptors from expanded Greenbushes Mine	Maximum predicted cumulative concentration at sensitive receptors (includes background)
TSP	24-hour	90 µg/m^3	75 ug/m^3 (Town B)	NA – no TSP background monitoring data available
	Annual	90 µg/m^3	19 ug/m^3(I)	
PM_{10}	1-hour (99.9th percentile)	80 µg/m^3	129 ug/m^3 (G)	NA – no background monitoring data available
	24-hour	50 µg/m^3	30 ug/m^3 (G)	48 µg/m^3 (G)
	Annual	25 µg/m^3	7 µg/m^3(I)	21 µg/m^3(I)
	24-hour (L4247/1991/13 licence limit at monitoring station)	90 µg/m^3	19 µg/m^3 (HiVol)	37 µg/m^3 (HiVol)
Deposited dust	Maximum total	4 g/m^2/month	0.12 g/m^2/month (G)	NA – no background monitoring data available

Reduced air quality due to blasting, and vehicle and heavy equipment combustion emissions

Air quality may also be reduced as a result of combustion emissions. Blasting and the operation of typically diesel powered vehicles and heavy equipment at the Mine generates combustion emissions. Combustion emissions from blasting include Carbon Monoxide (**CO**) and oxides of nitrogen (**NOx**), and from vehicles typically comprises NOx, Suphur dioxide (**SO_2**), PM_{10} and volatile organic compounds (**VOCs**). There will be an increase in combustion emissions as a result of the expansion as the mining fleet is expected to at least double to meet the proposed production rate for the expansion of up to 9.5 Mtpa of spodumene ore. Blasting is also expected to increase to daily from the current regime. Combustion and blasting emissions are typically short-lived and the majority will occur within the confines of the open pit therefore they will not cause a significant impact on the local air quality.

Reduced air quality due to emissions during transport

Increased production from the Mine will result in increased transport requirements for the operation. Dust emissions could potentially occur as a consequence of transporting the lithium mineral concentrate product from the site to customers. Lithium mineral concentrate dust emissions can potentially cause air quality impacts on a regional scale as the transport routes used are between the Mine, Bunbury Port, Kemerton Strategic Industrial Area and Fremantle Port. Dust emissions along transport routes can cause a nuisance impact for receptors in proximity to the route who may be affected by the emissions. Dust emissions are unlikely to occur however as trucks transporting the lithium mineral concentrate will be covered.

Reduced air quality due to bushfire

Mining activities have the potential to ignite bushfires through hot work and vehicle movements. Bushfires can cause a temporary reduction in the regional air quality, depending on the extent of the fire. Over half of the MDE has been disturbed through mining activity therefore does not support high fuel loads and is unlikely to support a fire. However, the surrounding State Forest 20 areas have higher fuel loads and are more susceptible to supporting a fire should one be generated. The risk of a fire being generated will not increase significantly as a result of the Mine expansion.

Increase in greenhouse gas emissions

The operation of typically diesel powered vehicles and heavy equipment at the Mine will result in generation of greenhouse gas emissions. Talison proposes to at least double the mining fleet which will result in a corresponding increase in greenhouse gas emissions from the premises. Talison currently reports greenhouse gas emissions in accordance with the requirements of the *National Greenhouse and Energy Reporting Act 2007* and will be required to continue to do so.

4.8.6 Mitigation

Dust monitoring is undertaken using a HiVol in accordance with the requirements of operating licence L4247/1991/13 to measure PM_{10} levels at the boundary between the operation and the nearest receptors in the town of Greenbushes. Additional monitoring is undertaken within the Mine using a TEOM dust monitor to measure dust levels in real time so that dust controls can be increased when results indicate the levels are rising. Talison also have an onsite meteorological station to record meteorological conditions. The operating licence specifies a limit for PM_{10} levels at the monitoring location to protect the air quality of the Greenbushes townsite. Talison will continue to implement the current monitoring program for the duration of the operation in accordance with these requirements.

Talison also proposes to establish additional dust monitoring in accordance with the recommendations of the Dust Impact Assessment (GHD 2018). The additional monitoring will include:

- Up to four dust deposition gauges to monitor cumulative dust emissions around the MDE boundary.
- Operate up to two TEOM dust monitors at locations identified as the most likely to be impacted by dust emissions. (Note: locations may not be permanent and may change seasonally. Monitoring locations will also depend on availability of power and a suitable location, free from interference by surrounding infrastructure or vegetation) .
- Configure meteorological and dust level alerts for select dust monitors

Further mitigation and management measures for impacts to air quality which are currently implemented or will be undertaken as part of the Mine expansion include:

Minimise

- Water carts are employed within the mining and haulage areas to wet down dust generating areas.
- Progressive clearing of areas, so there is limited opportunity for dust generation from open areas.
- Update and implementation Talison Dust Management Plan to include additional monitoring, dust level triggers and response actions.
- Watering occurs prior to blasting when weather conditions are dry and windy.

- Dust extraction units are included within the processing plants and crushers.
- Road sweeping is undertaken as needed on sealed roads, predominantly around the processing areas.
- Transport of product offsite using covered vehicles to prevent dust.
- Weather forecasting is used to predict extreme weather conditions likely to result in increased dust emissions so that Talison can attempt to minimise the impact through extra dust controls.
- Where possible consideration will be given to weather conditions when planning blasting to avoid conditions likely to increase the impact of dust (i.e. strong winds in the direction of receptors).
- TSF deposition is managed to maximise wet areas to suppress dust from the surface of the facility.
- Application of binding agents (Gluon) is used on the TSF surface, particularly during the dry summer period, to minimise wind generated dust emissions.
- Use of sprinklers on product and fine ore stockpiles to minimise dust emissions from these areas.
- Storage of product stockpiles in covered areas where available.
- Continued implementation of the Talison Hot Work Permit System and Emergency Management Procedures to minimise the risk of Bushfires and the associated impact on air quality.
- Consideration of energy efficiency when selecting mining equipment fleet and designing infrastructure to minimise greenhouse gas emissions.

Rehabilitate

- A vegetated cover is maintained on inactive areas of the TSF.
- Progressive rehabilitation of disturbed areas is undertaken to minimise wind erosion from open areas.

4.8.7 Predicted Outcomes

Expansion of the Mine will result in increased emissions of dust and combustion products which will impact on the local air quality. Dust emissions from the Mine may cause localised temporary exceedance of air quality criteria if worst case meteorological conditions occur.

The potential for reduced air quality (and exceedance of air quality criteria) as a result of the dust emissions from the expanded Mine can be mitigated through expanding the existing dust monitoring system, establishing meteorological and dust levels alerts, and implementing mitigation actions to reduce dust emissions when the alerts are triggered. Continued monitoring of air quality (PM_{10}) will inform Talison of the impact of dust emissions on surrounding sensitive receptors. There is not expected to be any permanent or significant impact on air quality resulting from the Mine expansion. Talison will continue to implement controls to ensure compliance with licence limits for PM_{10}

Air quality controls and monitoring are currently specified through Talison's operating licence. It is expected that impacts to air quality will be considered and reassessed as part of the assessment of the application for works approval and licence amendment required for the expansion activities under Part V of the EP Act.

4.9 Key Environmental Factor – Social surrounds

4.9.1 EPA objective

To protect social surroundings from significant harm.

4.9.2 Policy and guidance

- Environmental Factor Guideline Social Surroundings (EPA 2016e).
- Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41 (EPA 2004).
- *Environmental Protection (Noise) Regulations 1997*.
- *Aboriginal Heritage Act 1972.*

4.9.3 Receiving environment

Cultural heritage

European heritage

A database search was undertaken to determine whether the proposed Mine expansion will impact on any World or Commonwealth Heritage Sites. No sites on the Commonwealth or World Heritage lists occur within 5 km of the MDE. One site (Southampton Farm Homestead) on the Register of National Estate is located approximately 6.5 km from the MDE.

A search on the inHerit Western Australia database did not identify any registered sites within the MDE (Heritage Council 2017). The South Cornwall Pit, which is part of the operating mine, is listed as “Other Heritage Listings” on the municipal inventory. It is a Category 2 site of local significance due to the continuous history of mining activity at this location. The registered sites closest to the Mine, include:

- Numerous sites within the town of Greenbushes;
- Golden Valley Site approximately 8 km north east; and
- Southampton Homestead approximately 6.5 km west.

A locally recognised site of historical significance, the ‘Lost and Found’ mine is located between the open pit and existing Floyds WRL, within the current Active Mine Area. The location is known to be locally significant although does not occur on the heritage register. The site is not currently accessible to the public. Talison has committed to investigate options for retaining this site within the Mine’s current Mine Closure Plan.

Another site of historical significance which is not listed is the Greenbushes cemetery. The cemetery is located outside the MDE approximately 100 m east of the proposed expansion footprint for Floyds WRL. Talison contributes funding toward the upkeep and maintenance of this site.

Aboriginal heritage

The Project area occurs at the boundary of the South West Boojarah #2 Native Title Claim area (WC2006/004), and the Wagyl Kaip (WC1998/070) and Southern Noongar (WC1996/109) Native Title Claim areas. Talison has a Noongar Standard Heritage Agreement in place with the South West Boojarah #2, and Wagyl Kaip and Southern Noongar claimant groups. A search of the Aboriginal Heritage Inquiry System identified one ‘Registered’ Site of Aboriginal heritage significance, the Blackwood River (ID 20434), and no Sites lodged as ‘Other Heritage Places’ in proximity to the Mine (DPLH 2017). The Blackwood River is a site of mythological significance in

association with *Waugal* beliefs (Brad Goode & Associates 2016). The Blackwood River site occurs within mining tenements M01/2, M01/4, M01/5, M01/10 and L01/1 and is entirely outside the MDE for the Mine expansion. The site will not be directly affected by the Proposal (Figure 19).

An Aboriginal Heritage Survey within the existing active mining area boundary (M01/3, G01/1, G01/2, M01/6, M01/16 and M01/7) was conducted by Brad Goode & Associates in December 2015/ January 2016. The survey involved representatives of the Gnaala Karla Booja, South West Boojarah and Wagyl Kaip Native Title Groups (Brad Goode & Associates 2016). The survey included a desk top study, an archaeological inspection of the survey area, and ethnographic consultation with the nominated Noongar representatives. The survey did not identify any Aboriginal Sites of significance as defined under section 5 of the *Aboriginal Heritage Act 1972* (AH Act). Some areas of the expanded MDE for the Project were not covered by the 2015/2016 survey therefore an ethnographic and archaeological survey of areas not previously surveyed was undertaken involving representatives of the South West Boojarah Native Title Group in April 2018. The survey did not identify any Aboriginal heritage sites or places as defined by section 5 of the AH Act within the MDE.

Land use

The MDE is located within part of the State Forest 20 and private property (rural). A large proportion of the MDE is already cleared as a result of the history of mining in the area and current day mining of the Greenbushes deposit. The current primary land use within the MDE is for mining, agriculture, conservation and forestry (State Forest) and water catchment.

Transport of lithium mineral concentrate will occur by truck, via public roads rated to accept B-double trucks. The road reserves are owned and maintained by Main Roads WA.

Demography and economy

The Mine is located within the Shire of Bridgetown/Greenbushes immediately south of the town of Greenbushes, 10 km north-west of Bridgetown, and 10 km south east of Balingup. The Shire of Bridgetown/Greenbushes has a population of 4,661 (ABS, 2017). Industries with the highest number of employees include health care and social assistance (11.7%), Mining (10.7%) and Agriculture, Forestry and Fishing (10%). The wider Warren Blackwood region has a population of 39,813 (ABS, 2017). Top employing industries in the region include accommodation, agriculture, education and retail.

Visual amenity

The Mine is located at a high point of the Darling Plateau. The Plateau is characterised as an expansive undulating landscape with green forest vegetation and occasional rocky outcrops and peaks. The open pits are located along a ridgeline at approximately 300 mAHD which runs from the Greenbushes town site to the south east. Development of the pits will continue along the ridge line for the expansion of the Mine.

Floyds WRL is located on the east facing hill slope between the open pits and the South Western Highway. Vegetation on the hill slope, and the WRL act as a visual buffer to the lithium processing areas, TSFs and constructed reservoirs/dams which are located on the west facing hill slope, and the open pit along the ridge. The top of the existing Floyds WRL is currently visible from a section of South West Highway. The final height of the WRL will increase by approximately 10 m above its current level.

Elevated areas of the operation such as the WRL are also visible from high points in the surrounding area.

Noise and Vibration

The existing noise environment within the vicinity of the MDE is dominated by the following local noise sources:

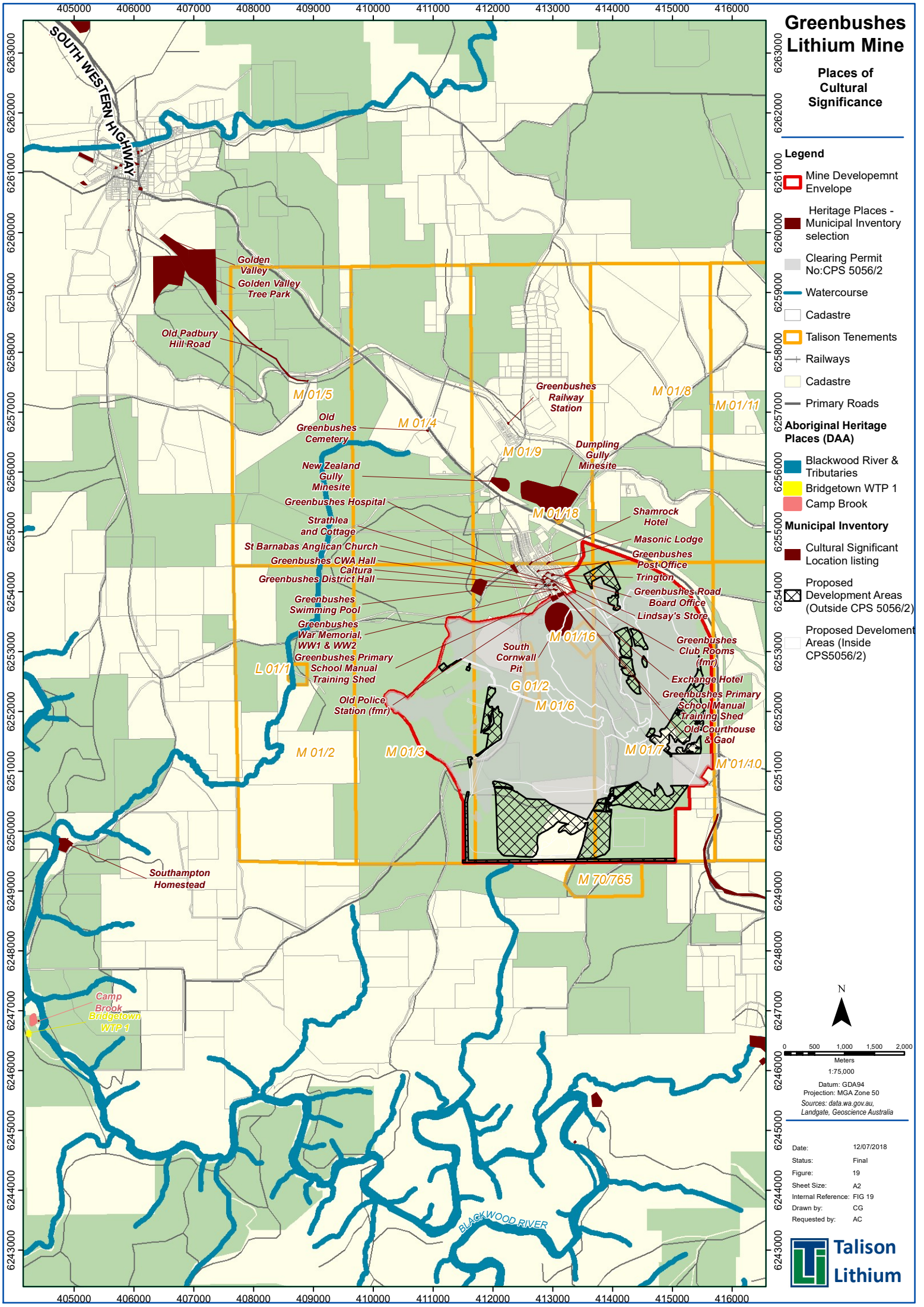
- Mining and processing (currently from the Talison Greenbushes Lithium Mine, but historically and potentially in future can include the GAMG Tantalum Operation which is co-located with the Talison operations within the MDE);
- Traffic associated with South West Highway, Maranup Ford Road and local Greenbushes townsite; and
- Natural (leaves rustling, wind in trees and bird and insect calls).

The closest other industry in the surrounding area is the GAMG tantalum operation which is located within the MDE (currently has reduced production from the secondary process plant only), and Greenbushes sawmill approximately 3 km north. The closest sensitive receptors are located within the town of Greenbushes immediately north of the mining operation. In addition to receptors within the Greenbushes townsite, seventeen sensitive receptors have been identified within approximately 2 km proximity of the MDE predominantly to the south and east. The closest of these is approximately 250 m from the MDE eastern boundary and approximately 450 m from the closest mining activity (waste dumping at Floyds WRL).

Due to the close proximity to sensitive receptors (and nature of activities undertaken), the Mine does not meet the noise limits specified by the *Environmental Protection (Noise) Regulations 1997* (**Noise Regulations**). Approval to exceed the specified limits was sought, and approval for increased noise limits was granted through *WA Government Gazette*, 27 February 2015, No. 31. *Environmental Protection (Talison Lithium Australia Greenbushes Operation Noise Emissions) Approval 2015* (referred to as **Talison Regulation 17 Approval**). GAMG tantalum operations also operate under an identical approval *Environmental Protection (Global Advanced Metals Greenbushes Operation Noise Emissions) Approval 2015*. As a result, when both companies are operating, the combined noise emissions can't exceed the limits specified in the Regulation 17 Approval. The approved noise levels for the mining operation are summarised in Table 30.

Continuous noise monitoring is undertaken at the 'Sound Wall' North of the Cornwall pit. The results of monitoring since 2001 are summarised in Figure 20.

The chart includes the Regulation 17 limits in addition to a 12dB attenuation factor to account for the predicted noise level at the nearest highly sensitive area based on the recorded noise level at the 'Sound Wall'. Noise levels have reduced since the early 2000's as a result of the cessation of tantalum mining and primary processing activities which were the closest activities to the townsite.


Greenbushes Lithium Mine
Places of Cultural Significance
Legend
Mine Developemnt Envelope
Heritage Places - Municipal Inventory selection
Clearing Permit No:CPS 5056/2
Watercourse
Cadastre
Talison Tenements
Railways
Cadastre
Primary Roads
Aboriginal Heritage Places (DAA)
Blackwood River & Tributaries
Bridgetown WTP 1
Camp Brook
Municipal Inventory
Cultural Significant Location listing
Proposed Development Areas (Outside CPS 5056/2)
Proposed Develoment Areas (Inside CPS5056/2)
SOUTH WESTERN HIGHWAY
Golden Valley
Golden Valley Tree Park
Old Padbury Hill Road
M 01/5
Old Greenbushes Cemetery
M 01/4
Greenbushes Railway Station
M 01/8
M 01/11
M 01/9
Dumpling Gully Minesite
New Zealand Gully Minesite
Greenbushes Hospital
Strathlea and Cottage
St Barnabas Anglican Church
Greenbushes CWA Hall
Caltura
Greenbushes District Hall
M 01/18
Shamrock Hotel
Masonic Lodge
Greenbushes Post Office
Trington
Greenbushes Road Board Office
Lindsay's Store
Greenbushes Swimming Pool
Greenbushes War Memorial, WW1 & WW2
Greenbushes Primary School Manual Training Shed
L 01/1
M 01/16
South Cornwall Pit
Greenbushes Club Rooms (fmr)
Exchange Hotel
G 01/2
M 01/6
Greenbushes Primary School Manual Training Shed
Old Courthouse & Gaol
Old Police Station (fmr)
M 01/2
M 01/3
M 01/7
M 01/10
M 70/765
Southampton Homestead
Camp Brook Bridgetown WTP 1
BLACKWOOD RIVER
N
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Projection: MGA Zone 50
Sources: data.wa.gov.au, Landgate, Geoscience Australia
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Status: Final
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Drawn by: CG
Requested by: AC
Talison Lithium

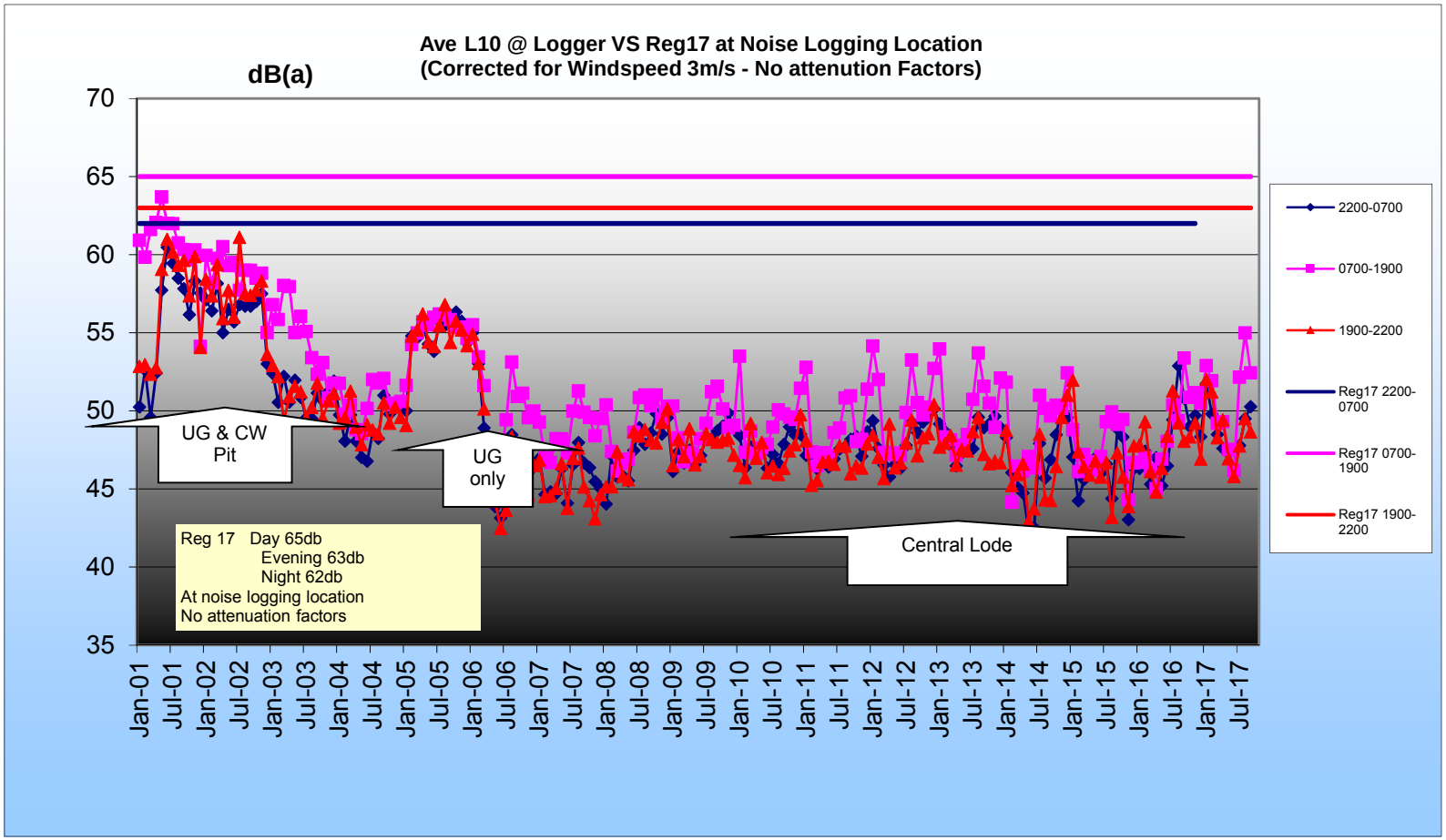

Figure 20 Summary of Noise Monitoring Results for the Greenbushes Operation in comparison with Regulation 17 limits

Table 30 Talison Regulation 17 Approved noise limits

Type of premises receiving noise	Time of day	LA 10 approved level (dB)	A max approved level (dB)
A highly sensitive area	700 to 1900 hours all days	53	71
	1900 to 2200 hours all days	51	69
	2200 to 0700 hours all days	50	68
A noise sensitive premises other than a highly sensitive area Commercial premises	All hours	60	80

4.9.4 Potential impacts

The potential impacts that may occur to social surroundings as a consequence of the proposed expansion of the Mine include:

- Unidentified Heritage Site disturbance during clearing and/or excavation works;
- Reduced visual amenity as a result of increased lighting at the operation;
- Reduced visual amenity from additional and increased mining footprint, specifically the open pits, WRL and TSF;
- Noise impacts to sensitive receptors through increased noise emissions;
- Amenity impact resulting from increased traffic on local networks (Greenbushes town and South West Highway);
- Vibration impacts associated with increased frequency of blasting; and
- Socio-economic benefits (positive impact).

4.9.5 Assessment of impacts

Cultural heritage

There are no known protected European or Aboriginal heritage places within the MDE. However, artefacts or burial locations of potential heritage significance could potentially be uncovered during earthworks and excavations. Ground disturbance permitting and procedures will be in place in the event of heritage discovery, however, given that that the area has been subject to recent archaeological and ethnographic surveys discovery of artefacts or buried locations is considered unlikely. Sites outside of, but within close proximity to the MDE such as the Greenbushes cemetery have been avoided during the design of the expansion and will be protected to ensure mining activities do not cause an impact.

Visual amenity

There is currently a limited view of the Mine from the immediate sounding area due to the screening effect of the surrounding State Forest 20 and topography. Floyd's WRL is elevated in the landscape and therefore can been seen from high points in the surrounding area. A small section of the existing Floyds WRL is currently visible on a local scale from the South Western Highway and from rural residences to the east of the existing landform. The visible section of Floyds WRL will increase as the height of the WRL increases to the final approved height of

330 m AHD and the landform extends to the south. The TSF landforms are also elevated and as they increase in height will become increasingly visible from surrounding areas.

There is greater visibility of the Mine from high points in the surrounding area, particularly to the south and east. Due to the increased footprint of the open pit, Floyds WRL and TSF it is expected that the Mine will become a more dominant feature in the landscape when viewed from these areas. The area does not however have a high perceived amenity due to the extensive history of mining and forestry activities at this location. Extensive rehabilitation of historic mining disturbance within the Greenbushes area throughout the operating life of the Mine has made an overall improvement to the visual amenity associated with the Mine and its surrounds. Progressive rehabilitation of Floyds WRL also assists in improving the visual amenity of the Mine by blending the landform into the surrounding landscape.

Lighting requirements, in particular for waste dumping at Floyds WRL, and construction of TSF 4 (if undertaken during night periods) may cause light overspill to surrounding receptors in close proximity. Talison has developed a light management plan to ensure activities are appropriately managed to limit light overspill. Light spillage from processing areas, and mining and haulage within the pit is expected to be minimal as these areas occur lower in the topographic profile and are shielded by the surrounding forest and other landforms.

Noise and Vibration

The primary noise sources which have been identified at the Mine include blasting, operation of mining equipment and vehicles, rock breaking on the ROM, crushing and processing activities. Blasting can also cause vibration impacts. Vibration impacts can be effectively managed through consideration during blast design. The expansion involves construction and operation of an additional crusher and processing plants, and an increase of the mining fleet. Blasting frequency will also increase to daily.

Accordingly it is anticipated that noise emissions associated with the operation will increase and vibration could potentially increase depending on blast sizes.

Construction noise associated with CGP3, CGP4, Talison CR3, the MSA and explosive infrastructure is not expected to impact on receptors as it is unlikely to be distinguishable from the existing background mining noise. Construction noise associated with TSF4 could potentially impact on receptors located to the south of this infrastructure.

Herring Storer Acoustics (HSA) developed the initial “SoundPlan” noise model for the Mine, which has been maintained over time. The model is updated when planning new activities at the Mine to predict the likely noise levels and assess the impact associated with proposed changes. An update to the noise model was undertaken by Herring Storer Acoustics to include the proposed Mine expansion and predict noise levels in the surrounding area as the expansion progresses (Appendix H). Comparison of the predicted levels with the Talison Regulation 17 Approval limits was undertaken (HSA 2018). As part of the assessment measurement of current noise levels was also undertaken April 2018 to confirm existing noise levels for inclusion in the model update (HSA 2018) and current compliance with the Talison Regulation 17 Approval. The results found the Mine currently applies with the criteria specified.

The modelling predicts that noise levels associated with the expanded Mine could potentially exceed the allowable night time noise level criteria by up to 5 dB(A) in worst case conditions dependent on the receiver location and stage of the mining operations (HSA 2018). The highest occurring noise levels are considered as being present seasonally, occurring under isolated wind directions (HSA 2018).The allowable noise level during the night period, under the Talison Regulation 17 Approval, is 50 dB(A). The modelling indicates up to six surrounding sensitive receptors could receive noise levels in exceedance of the Talison Regulation 17 Approval allowable night time noise level under worst case conditions. The receptors where this is

predicted to occur are situated to the east of the Floyds WRL, and within the town of Greenbushes. Mitigation measures and monitoring of noise levels should therefore be targeted to these areas. The noise modelling included operation of GAMG's primary crusher to account for the cumulative impact of the potential scenario of the tantalum primary processing operation recommencing.

Management of operations will be required during periods of high noise propagation conditions to reduce noise to the approved levels (HSA 2018). Monitoring and management of noise emissions is currently undertaken in accordance with a Noise Management Plan to prevent exceedance of the Regulation 17 Approval Limits.

Talison and GAMG implement the joint Noise Management Plan (Appendix I) to ensure compliance with the Regulation 17 Approval limits. The management plan includes trigger levels based on the Regulation 17 Approval limits which are summarised in Table 31. The triggers require implementation of a series of actions to reduce noise emissions to required levels. The plan also specifies continuous monitoring of noise is undertaken at the Sound Wall, which overlooks the open pit, in accordance with requirements of the site Noise Management Plan. The results of monitoring can also be used to confirm and refine the accuracy of the noise model. The current noise monitoring, trigger levels and mitigation actions included in the Noise Management Plan will require review and update to account for the increased impact of noise levels on a larger number of sensitive receptors as a result of the expansion.

Table 31 Talison Regulation 17 noise trigger levels

LA Max Trigger	Peak noise events at the noise monitoring station on the sound wall. These levels correspond to the Regulation 17 approved levels + 12dB Attenuation Factor. The LA Max triggers are as follows:	
	0700-1900 Hours	83 dB
	1900-2200 Hours	81 dB
	2200-0700 Hours	80 dB
Primary LA10 Trigger	The Primary response is triggered by noise levels at the noise monitoring station exceeding the Regulation 17 selected levels in greater than 20% of hours for that time period. i.e. 80% of hours will have levels less than the selected value. These levels correspond to a noise level 4dB below the approved levels + 12dB attenuation Factor	
	0700-1900 Hours	61 dB
	1900-2200 Hours	59 dB
	2200-0700 Hours	58 dB
Secondary LA 10 Trigger	Noise levels at the noise monitoring station exceeding the Regulation 17 selected levels in greater than 2% of that time period will trigger the secondary response. i.e. 98% of hours will have noise levels less than the selected level. These levels correspond to the approved levels + 12dB Attenuation Factor	
	0700-1900 Hours	65 dB
	1900-2200 Hours	63 dB
	2200-0700 Hours	62 dB

Attenuation Factor - An adjustment of 12 dB (A) applied to noise data recorded at the noise monitoring station to model the attenuated noise levels which would be recorded at the closest modelled location within the Greenbushes Town site.

An assessment of the impact of weather conditions and seasonality was also undertaken by HSA to predict noise levels under a variety of weather conditions for each of the identified

sensitive receptors, and the percentage of time predicted noise levels are likely to occur for. The assessment concluded that highest occurring noise levels from the mine are considered as being present seasonally, occurring under isolated wind directions. As the predictive noise modelling assumes the worst case weather conditions for all receivers, i.e. propagation from noise source to receiver, under the opposite conditions, predicted noise levels could be reduced in the order of around 5 to 9 dB(A) (HSA 2018).

Traffic

Traffic impacts will increase within the town of Greenbushes and other South West towns along the main transport routes for the Mine due to the increase in road train movements predicted for the expansion. Road train movements carting lithium mineral concentrate and supplies are anticipated to increase from 60 per day (30 trucks to and from site) to a maximum of 200 per day total (100 trucks each way to and from the mine) when the expansion reaches peak production. Talison proposes to establish a bypass road between South Western Highway and Maranup Ford Road to reduce the truck movements through the town and the associated noise. Talison is consulting with Main Roads WA to determine the optimal bypass route.

Socio-economic benefits

The proposal to expand the Mine will require the existing workforce of approximately 220 employees to increase to approximately 650 employees who will be sought from the local region wherever possible. A construction workforce of approximately 300 people will also be required for the CPG3/CGP4, Talison CR3, explosives infrastructure and MSA construction. The company also has a policy of supporting local business and will use local goods and services where possible throughout the expansion and operation of the mine. The expansion will supply feed to two new lithium hydroxide production plants which will be developed at Kemerton and Kwinana supporting the creation of jobs at these locations, having an overall economic benefit to the South West Region.

4.9.6 Mitigation

Impacts to social surroundings will be minimised through the mitigation and management measures discussed below.

Avoid

- Implement the Talison Clearing/Disturbance Procedure and Permit whereby permit conditions specify that works are stopped in the event of actual and/or suspected Aboriginal artefacts or bones being uncovered during earthworks. The relevant authority (DPLH) will be contacted immediately by Talison if this occurs.

Minimise

Noise is managed in accordance with the Talison Noise Management Plan developed in accordance with Clause 8 of the *2015 Environmental Protection (Talison Lithium Australia Greenbushes Operation Noise Emissions) Approval WA Government Gazette*, 27 February 2015, No. 31. The Noise Management Plan is included in Appendix I for reference. A review of the current Noise Management Plan will be undertaken based on the results of noise modelling (HSA 2018) to determine additional monitoring and management measures which can be included in the Noise Management Plan to minimise noise emissions as far as practicable. Noise mitigation measures already included in the Noise Management Plan which will continue to be implemented through the expansion include:

- Continuous monitoring of noise emissions at the Sound Wall;
- Noise attenuation methods will be considered for plant and equipment design;

- Selection of equipment and Plant items to limit noise emissions where feasible;
- Noise emissions will be a consideration when designing haul road and infrastructure locations;
- Maximum sound power levels are specified for Contractor equipment;
- Respond to community noise complaints and queries as per the Talison Incident Management Procedure;
- Rock breakers will only be used during day time periods;
- Consideration will be given to weather conditions when planning blasting to avoid conditions likely to increase the impact of noise (i.e. strong winds in the direction of receptors or very still conditions); and
- Airblast and ground vibration levels will be predicted when designing blasts with design adjusted where required to reduce predicted levels to within those specified within the Noise Regulations.

Additional noise mitigation measures which will be undertaken to minimise noise include:

- Consider alternate locations for the Rock Breaker which will reduce the impact of this noise source;
- Update of the noise model to account for any additional noise mitigation strategies undertaken;
- Establish an additional permanent noise monitoring station (potentially to the east of Floyd's WRL); and
- Review the Noise Management Plan for the expansion and consider the inclusion of restrictions on night dumping and review whether the triggers will require updating.

Talison will address other impacts to social surroundings through:

- Consultation with Main Roads WA and Shires along the transport route between Greenbushes and Bunbury in relation to haulage along the South Western Highway;
- Consultation with Main Roads WA and the Shire of Bridgetown-Greenbushes in relation to the planned bypass road for the Mine; and
- Participation in a study into the feasibility of recommissioning the Bunbury – Greenbushes rail line.
- Review, update and implement the Talison Light Management Plan as the expansion progresses and the receptors likely to be impacted by light change.

Rehabilitate

Achieving an optimum level of visual amenity is one of the key drivers of Talison's rehabilitation activities at the site. Talison will:

- Continue to liaise with relevant government agencies including DBCA, DMIRS and DWER in regards to Closure Planning and Rehabilitation of the Mine;
- Continue implementation of the Mine Closure Plan and rehabilitation strategies which include:
  - Progressive rehabilitation of Floyds WRL slopes and TSF batters will be undertaken as these features will be most visible from surrounding areas;

– Rehabilitation aims to blend the shape and vegetative cover of landforms with the surrounding landscape where possible through profiling of the landforms and use of a local provenance seed mix based on the surrounding vegetation community; and
– Seed mixes include a fast growing Acacia species component to provide a fast growing cover which senesces within five years and is then replaced by longer living, but slower establishing understorey species. Vegetated slopes have less visual impact than bare rock.

4.9.7 Predicted Outcomes

It is considered unlikely that the expansion will have an impact on cultural heritage given that there are no known protected European or Aboriginal heritage Sites within the MDE for the Proposal.

The proposed expansion of the Mine will increase the local noise levels potentially impacting on the amenity of surrounding residents and will also impact on visual amenity. Talison aims to operate within the limits specified in the Talison Regulation 17 Approval through continued management of noise emissions as per the site Noise Management Plan and review and update of the Plan to include additional monitoring and mitigation measures.

The expanded Mine will have increased impact on local visual amenity, in particular when viewed from high points in the surrounding landscape, as a result of the expansion of Floyds WRL, TSF4 and an expanded open pit footprint. The continued implementation of Talison's Mine Closure Plan and Rehabilitation Plans, which include consideration of visual amenity, aims to minimise the long term visual impact of the operation.

Noise controls and monitoring are currently specified through Talison's Regulation 17 Approval and are managed in accordance with the Talison/GAMG Noise Management Plan. It is expected that noise emissions will be considered as part of the assessment of the application for works approval and licence amendment required for the expansion activities under Part V of the EP Act to ensure compliance with the requirements of the Regulation 17 Approval.

Visual amenity considerations are included within the Mine Closure Plan for the Mine which has been approved by DMIRS. An updated Mine Closure Plan and new Mining Proposal will be submitted for the expanded Mine which will include consideration of visual amenity. Talison anticipate that the potential impacts to visual amenity associated with the Mine expansion, will be assessed through the Mining Proposal and Mine Closure Plan assessment.

5. Matters of National Environmental Significance

5.1 Policy and guidance

- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Environment Protection and Biodiversity Conservation Regulations 2000.*
- Significant impact guidelines 1.1 - Matters of National Environmental Significance. (Department of the Environment 2013).

Under the EPBC Act, Proposal's which have the potential to significantly impact Matters of National Environmental Significance (**MNES**) trigger the requirement for referral to the Commonwealth Department of the Environment and Energy (**DoEE**) for potential assessment as a 'controlled action'. Matters of National Environmental Significance which trigger the requirement for referral include:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (listed under the RAMSAR Convention);
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park;
- A water resource, in relation to coal seam gas or coal mining; and
- Nuclear actions (including uranium mines).

5.2 Controlled action provisions

The Proposal was referred to the DoEE and advertised for public comment on 11 May 2018 as a potential controlled action under the EPBC Act due to impacts on listed threatened species.

On 17 June 2018, the DoEE determined the Proposal to be a 'Controlled Action' requiring approval due to impacts on listed threatened species and communities (reference number 20178/8206). Specifically the DoEE determined that based on the information provided in the referral, the Project is likely to have a significant impact on the following matters of national environmental significance (MNES):

- Black Cockatoos: the vulnerable Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), the endangered Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the endangered Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
- Western Quoll/Chuditch (*Dasyurus geoffroii*) – Vulnerable;
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable;
- Pink Spider Orchid *(Caladenia harringtoniae)* – Vulnerable.

Talison proposes that the Proposal be assessed under an accredited process under the Bilateral Agreement between the Commonwealth of Australia and the State of Western Australia. If the EPA decide to assess the Proposal it is proposed that the EPA assessment process is used.

5.3 Summary of the existing environmental value(s) that relate to the MNES

Talison has undertaken a number of targeted surveys in order to assess the presence of EPBC Act listed species (MNES) within the MDE (the surveys are previously listed in sections 4.3.3 and 4.3.4).

Based on the outcomes of these surveys the following MNES could potentially be impacted by the Proposal:

- Threatened Black Cockatoo species:
  - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered;
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable; and
  - Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) – Endangered;
- Western Quoll/Chuditch (*Dasyurus geoffroii*) – Vulnerable;
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable;
- Quokka (*Setonix brachyurus*) – Vulnerable; and
- Pink Spider Orchid *(Caladenia harringtoniae)* – Vulnerable.

5.3.1 Black Cockatoo

The MDE is located within the modelled distribution for all three species of black cockatoo (DSEWPaC, 2012). It is located within the feeding and predicted breeding range of Baudin's Cockatoo and Forest Red-tailed Black Cockatoo, and the feeding and known breeding range of Carnaby's Cockatoo. All three species of black cockatoo have been recorded via sighting, calls or feeding residues within the MDE and surrounds (Kirkby 2011, 2018; Biologic, 2011, 2018a).

The majority of feeding residues within the MDE are from Forest Red-tailed Black Cockatoos. Residues from Baudin's and Carnaby's Cockatoos were older than those from Forest Red-tailed Black Cockatoos, which, due to the timing of the survey, indicates they likely only use the MDE for foraging in the non-breeding season (Kirkby 2018). Forest Red-tailed Black Cockatoo feeding residues ranged from fresh through to old and grey indicating the MDE is used throughout the year by this species and it is therefore the most likely of the species to utilise breeding habitat within the area.

Most feeding residues within the MDE were from the seeds of Marri. The survey area also has other small patches of foraging suitable for Baudin's and Carnaby's Cockatoos such as *Banksia grandis* and *Hakea prostrata* but none seem to have been utilised. Apart from a small amount of feeding by Carnaby's Cockatoos on pine seeds no other species were noted to have been taken (Kirkby 2018).

A total of 52 potential breeding trees with hollows have been identified within the MDE (Biologic 2011, Kirkby 2018). Through an aerial (drone) survey of the identified hollows it was concluded that only 30 of these potential breeding trees contained hollows assessed as being suitable for breeding (14 identified with chew marks, 16 without evidence of use) (Harewood 2018a). The hollows within the remaining 22 trees were assessed (based on aerial drone images) as unlikely to be suitable for black cockatoo breeding generally due to the entrance appearing to be too small or because the actual hollow appears to be too shallow and/or too small (Harwood 2018a).

Based on the current proposed development footprint for the Mine expansion it is expected that the Proposal will result in the removal of 12 trees which have been identified as having hollows suitable for black cockatoo breeding (a further 16 trees with identified hollows occur within the proposed development footprint however these were assessed as being unsuitable for black

cockatoo breeding (Harewood 2018a)). Five of the potential breeding trees with suitable hollows appear to have evidence of past use in the form of chew marks and the remaining seven don't appear to have been used. Planning for the final layout of the Mine expansion will take into account known potential breeding tree locations and will avoid them where possible (i.e. for linear infrastructure or smaller infrastructure such as the MSA and explosives infrastructure). The MDE appears to be predominantly used by Forest-Red tailed Black Cockatoo and this species is considered the most likely to utilise potential breeding trees with hollows within the MDE.

Two roost sites have been recorded within the MDE by (Biologic 2018a), one near Cowan Brook Dam and the other at the southeast boundary of the MDE. Both roost sites are near permanent water sources and are outside the proposed development footprint for the Proposal.

All of the vegetation required to be cleared (up to 350 ha) as part of the Proposal comprises black cockatoo foraging habitat and potential breeding habitat. It is comprised of both the Jarrah/Marri forest and Jarrah/Marri forest over Banksia broad fauna habitats described by Biologic (2011, 2018a). Although the quality of the habitat varies in regards to its value for black cockatoos, the majority is considered to be moderate quality (Ennovate 2018). The habitat which will be removed from the MDE consists of habitat described in the species recovery plan as critical for the survival of black cockatoos (DEC 2008; DPAW 2013) therefore the Proposal will have a significant impact on this species.

However, black cockatoo habitat is well represented locally. The estimated area of suitable foraging habitat available within the Shire of Bridgetown-Greenbushes (based on current extent of Beard Vegetation Association 3 – Medium Forest; Jarrah-Marri) is 68,440 ha (GoWA 2018). Of this, 87% is in DBCA-managed land. There are 20,950 ha of DBCA managed black cockatoo habitat within 10 km and over 50,000 ha within 15 km (Ennovate, 2018) of the MDE. Considering that flocks are known to travel up to 13 km a day, the proposed clearing of up to 350 ha of habitat within the MDE is considered unlikely to reduce the area of occupancy for the species.

5.3.2 Western Quoll/Chuditch

Now present in approximately 5% of their former range, most Chuditch are found in varying densities throughout the Jarrah Forest and South Coast of WA. They also occur at lower densities in the Goldfields and Wheatbelt, as well as in Kalbarri National Park (translocated) (DEC, 2012).

The MDE falls within the distribution of the Chuditch. Thirty-five records of the Chuditch have been recorded within the vicinity of the Mine (DBCA 2018). One, from 1987, is located approximately 570 m north of the MDE. The remaining 34 records are within approximately 21 km, with the majority from north of the Mine (DBCA, 2018).

Chuditch use a range of habitats including forest, mallee shrublands, woodland and desert. The most dense populations have been found in riparian Jarrah Forest (DEC, 2012). The MDE contains preferred habitats of the species and is located well within the species core-range.

During the recent survey by Biologic (2018a), 21 records of Chuditch were recorded on five motion cameras set in a single targeted transect in the northwest section of the MDE. Visually comparing spot patterning, it appears the captures may represent a single individual; however this has not been confirmed (Biologic 2018b). The survey was undertaken prior to the mating season (April to July), extinguishing the possibility that records represent transient or passing individuals. This is further supported by the number and frequency of the records obtained (Biologic 2018b).

Both the Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitat types within the MDE provide suitable habitat for the species. Given the species typically large home-range (3–15 km^2 for males and females respectively), it is possible that the species may occur throughout the MDE. However, it appears that within the MDE, the north-west portion, which adjoins several waterbodies (Cowan Dam, Southampton Dam and Austin's Dam) and a portion of undisturbed forest, provides preferred habitat for individuals. This area is also connected to the Schwenke's area (outside the MDE) which may be a preferred habitat of the species due to availability of prey. The Schwenke's area is a historic mining void which has been converted into an artificial wetland area by the Blackwood Basin Group with the aim of attracting wetland species, primarily birds, to the area (Christensen 2016).

The habitat within the northwest section of the MDE is considered habitat critical to the survival of the Chuditch, as defined by the Chuditch Recovery Plan (DEC 2013), as it is currently occupied by the species. Clearing within this section of the MDE will be for relatively passive infrastructure (explosive storage/handling infrastructure and access tracks) with a small development footprint to minimise the loss of this habitat. However, as it is critical habitat the Proposal is considered to have a significant impact on this species.

Remaining suitable habitat within the MDE may also be critical habitat as it may support undiscovered Chuditch populations. However, based on the significant survey effort expended in the 2018 survey (Biologic, 2018a) to locate the species, this is unlikely. Furthermore, Chuditch require habitats of suitable size which are relatively un-fragmented due to their large home ranges. Vegetation within the MDE is relatively fragmented, being made up of 10 or 11 main 'blocks' of vegetation between 30 ha and 159 ha (Kirkby, 2018).

While these are not fragmented at a local scale, in relation to the size of the Chuditch's home ranges of 1,500 ha for males and 300 ha for females (DEC 2012), they do not provide large enough areas to support an individual. Chuditch were only recorded from one 'block' of vegetation; the largest and the one that adjoins State Forest 20 outside the MDE (Biologic, 2018a). Therefore, considering these factors in combination with the location of the record from the 2018 survey, it is likely that the surrounding and adjoining extensive tracts of State Forest vegetation and that within the Talison Greenbushes mining lease area provide more significant habitat than that within the MDE.

5.3.3 Western Ringtail Possum

The MDE falls within the Southern Forest Management Zone of the known distribution of the WRP (DPaW, 2017). The WRP has a known preference for Jarrah, Wandoo and Marri forest in inland localities (Biologic, 2018a). It feeds on the leaves of Jarrah and Marri trees in inland areas where such vegetation predominates. The species shelters in tree hollows in inland areas, with hollows providing up to 70% of the refugia available to the species in the Jarrah forests (DPaW, 2017).

Six records of WRP have been recorded within the vicinity of the MDE (DBCA 2018). Two of these records are approximately 320 m north of the MDE from August and December 2014 (DBCA 2018) in proximity to Schwenke's Dam. During a survey of the MDE by Biologic (2018a) scats potentially belonging to WRP (owing to their size and shape) were found in two locations in the north-western portion. The scats could not be confirmed due to similarity with scats of the Common Brushtail Possum within this region of the State (Jarrah Forest vs. Peppermint Forest). The Common Brushtail Possum was abundant throughout the MDE (Biologic 2018a). Both potential WRP scat collections were from Jarrah/Marri forest habitat in the north-western portion of the MDE.

Despite an extensive amount of survey effort, using both motion cameras and spotlighting, no individuals of the species were recorded in the MDE (Biologic 2018a) therefore the presence and use of habitat by the species was unable to be confirmed or otherwise. Therefore, a further targeted survey for the species was conducted by Greg Harewood in June 2018 (Harewood 2018a).The survey identified three old and unmaintained WRP dreys in paperbark trees near the Schwenke's Dam (outside the MDE) (Harewood 2018b). The dreys are in close proximity to two records of WRP made on motion camera's by the Blackwood Basin Group in 2014 (Pers Christensen pers. comms.). No other evidence of WRP was found during the survey work in and around the MDE.

Both the Jarrah/Marri forest (of which there is an estimated 403.9 ha within the MDE) and Jarrah/Marri forest over Banksia (of which there is 267.3 ha within the MDE) habitat types could potentially provide suitable habitat for the species, most likely in the north-western section, which adjoins a large block of undisturbed native forest (Biologic 2018a). The Proposal will remove 350 ha of this habitat, comprised of approximately 157 ha of Jarrah/Marri forest and 193 ha of Jarrah/Marri forest over Banksia.

Critical habitat for the WRP in the Southern Forests Management Zone is described as 'forests with limited anthropogenic disturbance (unlogged or lightly logged, and a low intensity and low frequency fire history), that are intensively fox-baited and have low indices of fragmentation' (DPaW, 2017). Given the fire history, degree of disturbance from forestry and mining and low level of fox control (annual) within the MDE, despite suitable habitat being present, it is not considered to be critical habitat. A similar assessment was made by (Mike Braimbridge) "much of the vegetation observed seems to represent poor or marginal habit for WRPs at best". The conclusion was based on the fact that much of the area has been historically logged and lacks a coherent midstorey component, a structural unit most often favoured by WRPs though it is not possible to totally discount their presence in some areas (subject to suitable habitat being present) (Harewood 2018b). Based on the paucity of WRP records shown in NatureMap for the wider area it appears that even if WRPs are present in the general area, densities are likely to be very low (Harewood 2018b).

5.3.4 Quokka

The Quokka occurs on two offshore islands (Rottnest Island and Bald Island) and a number of mainland sites in South West WA, ranging from just south of Perth to the Hunter River (DoEE, 2018). The distribution of this species is severely fragmented and there is little to no migration between populations.

According to the species' Recovery Plan (DEC, 2013), the MDE is located within the Northern Forests distribution area for the species, which extends from immediately east and north-east of the Perth metropolitan area to Collie. Distribution appears to be discontinuous from Collie to Nannup despite continuous forest habitat (DEC 2013).

Habitat requirements vary between the populations. Critical habitat for the Northern Forests populations comprises *Taxandria linearifolia* swamps. Habitat critical to survival includes areas of natural vegetation where the understorey is sufficiently thick and complex to provide a predation refuge close to more open, recently burnt vegetation which is used as a food source (DEC 2013). While the main habitat for mainland populations constitutes dense riparian vegetation, Quokka also use heath and shrubland, Swamp Peppermint (*Taxandria linearifolia*) dominated swamps in Jarrah forest, swampy shrublands, swordgrass-dominated understorey, regrowth areas of the Karri forest, Bullich (*Eucalyptus megacarpa*) swamp forest and Paperbark (*Melaleuca spp.*) swamp.

Forty-three records of Quokka have been recorded within the vicinity of the MDE (DBCA 2018). The nearest records were captured approximately 10.5 km, 11.1 km, 11.8 km and 12.3 km

south-west of the MDE from December 2004, April 2005, February 2005 and April 2005, respectively (DBCA 2018).

The Quokka was not recorded within the MDE during the recent survey by Biologic (2018a). Nor was it recorded within the broader Greenbushes survey area in the 2011 survey (Biologic, 2011). All natural habitats with the MDE provide potential habitat for the species, however favoured habitats with a dense understorey, like that which occurs in natural wetlands, do not occur within the area. Other preferred habitat of woodlands and shrublands with a dense vegetated understorey is not overly abundant within the MDE. Therefore, it is unlikely that the species will reside within the MDE permanently, although may occasionally occur while dispersing through the landscape. The Proposal is therefore considered unlikely to have a significant impact on this species.

5.3.5 Pink Spider Orchid

Caladenia harringtoniae (Pink Spider Orchid) is a tuberous perennial herb visible above ground between August-November/December. The distinctive pink flowers are present from October to November (Brown *et al.,* 2006). Not all plants in a population will flower annually, with flowering influenced by environmental conditions including the presence or absence of summer fire and the amount of rainfall received during winter and spring (DotE 2013a). As such, it is possible that the species may be present in an area but not be found during single-year field surveys.

C. harringtoniae grows in sandy loam soils on winter wet flats, granite outcrops and along the margins of streams and lakes. It usually occurs in swampy areas that are inundated for parts of the year with Paperbark (*Melaleuca*) species and Flooded Gum (*Eucalyptus rudis*). It has also been located along creek lines in Jarrah (*Eucalyptus marginata*) and Karri (*Eucalyptus diversicolor*) forests (Hoffman and Brown 1992). It is restricted to 37 populations in the south-west of Western Australia occurring between Nannup and Albany within the Southern Jarrah Forest and Warren bioregions (DoEE 2008).

It appears to be relatively well conserved but is in need of ongoing monitoring in relation to habitat change (Hearn *et al*.,2006). Plants are killed by fire during their active growing period (May-November). However, flowering is known to be stimulated by summer fire (December-April), with most populations having only been seen in any numbers in the spring following a summer fire.

C. harringtoniae is restricted to a single location (26 individual plants) in State Forest approximately 560 m west of the southwest boundary of the MDE. This known population and the associated winter-wet dampland habitat in which it occurs is a designated Environmentally Sensitive Area (Onshore Environmental, 2012). Assessment of the predicted surface water flow and surface water catchments indicates that there will be no runoff from the mining operation to the habitat in which the *C. harringtoniae* is located (Figure 9).

Potential habitat for this species within the MDE would correspond to creek lines in Jarrah/Marri forest types that are present. Despite extensive ground truthing of the Greenbushes Study area, including within the MDE, and targeted searches of suitable habitat, no additional populations were recorded (Onshore Environmental 2012, 2018a). The MDE has also been subject to a long history of mining and forestry disturbance reducing the quality of this habitat and as such the likelihood of the species occurring within the area.

The Proposal is unlikely to result in direct or indirect impacts to this known location given its distance from the MDE. The Proposal is therefore considered unlikely to have a significant impact on this species.

5.4 Potential impacts on MNES

The potential impacts on the MNES listed have been previously described in Section 4.4.4 of the Environmental Factor – Terrestrial Fauna Chapter.

In summary potential impacts or threats to MNES as a result of the Proposal include:

- Loss of 350 ha native vegetation which the following MNES are known, to occur within, or potentially have been recorded within (WRP),:
    - Threatened Black Cockatoos;
    - Chuditch; and
    - Western Ringtail Possum.
- Possible additional loss of habitat in surrounding areas due to accidental clearing;
- Possible introduction and/or spread of invasive pathogens causing habitat decline;
- Possible introduction and/or spread of invasive plant species (weeds) causing habitat decline;
- Changes to surface water drainage patterns and flows, or sedimentation causing habitat decline;
- Habitat decline as a result of smothering by dust generated from the operational activities;
- Damage to, and loss of habitat or mortality of fauna through accidental generation of a bushfire;
- Death, injury or displacement of native fauna species due to vehicle interaction or entrapment associated with the mining operation;
- Increased competition or predation by introduced species; and
- Disruption or disturbance to fauna as a result of noise, vibration, light and dust emissions from the mining operation.

5.5 Mitigation measures

The following key management actions will be implemented for the Proposal in relation to MNES:

Talison will minimise the impact of the Proposal on MNES through the continued implementation of the Talison EMS, which is certified to International Standard ISO 14001:2015, and Quality Management System (**QMS**) certified to ISO 9001:2015. The QMS and EMS include management plans and procedures relating to mining activities which may impact on MNES. A summary of proposed measures which will be implemented to minimise the risk of significant impact to MNES are outlined below.

- Implementation of the Talison Clearing/Disturbance Procedure and associated Permit process to prevent clearing outside approved boundaries, and ensure only necessary clearing is undertaken. The Procedure requires:
    - Internal permits must be granted before clearing can occur;
    - All clearing areas must be demarcated prior to clearing; and
    - All clearing areas must be surveyed after clearing to confirm the area cleared.
- Implementation of the Talison Weed Control Management Plan which outlines the weeds present, controls to prevent weed spread and introduction, and weed control programs which have been undertaken to date. Annual monitoring of weeds within rehabilitation

areas is undertaken as part of rehabilitation monitoring. The outcomes inform targeted weed control program requirements.

- Talison employ a full time environmental officer to manage weeds on site. Regular weed monitoring and weed control programs are undertaken, and a contractor is employed to hand weed during spring and/or autumn. Weed management techniques include spraying with herbicides (undertaken in late winter or early spring), hand pulling and cutting. Seeding with native species at the earliest opportunity is a key undertaking to control weed infestation within disturbed areas, even if these areas may require disturbance again in the future.
- Implementation the overarching Talison Dieback Management Plan. In addition, individual, area specific Dieback management plans are developed for new areas of disturbance to be implemented during the clearing of areas. The Dieback Management Plan requires strict adhere to hygiene procedures when moving from areas where dieback is known to occur to areas that are dieback free or not interpretable.
- Dieback surveys are undertaken prior to undertaking disturbance in areas not previously surveyed.
- Implementation of the Talison Vehicle Hygiene Procedure intended to prevent the spread of weeds (and dieback). The Procedure requires:
  - Vehicles to be cleaned prior to coming onto site from other areas. Vehicles are inspected to confirm this requirement is met; and
  - Vehicles to be cleaned if they have been operating within a weed or dieback infested area before they move to other work areas. Washdown facilities are provided on the site.
- Implementation of the Talison Native Flora and Fauna Protection Procedure which identifies conservation significant fauna and flora, and outlines general protection measures for these species and reporting requirements when conservation significant species are sighted or activities at the Mine have resulted in injury or death of native fauna.
- The site induction includes information on MNES which may be encountered at the operation. It includes descriptions of the relevant flora and fauna, specific management measures intended to protect them, and responsibilities for reporting sightings and incidents involving threated fauna.
- A database of conservation significant fauna species sightings will be maintained.
- All native fauna injuries or mortalities will be recorded and reported internally, and to appropriate regulatory agencies where required.
- Implementation of the Talison feral animal control program on an annual and ad hoc basis as required. The program involves annual baiting for foxes and rabbits and feral cat trapping.
- Putrescible waste will be stored within lidded bins which prevent fauna entry to prevent attracting feral animals.
- Implementation of traffic management rules to minimise the likelihood of fauna injury or mortality due to interaction with vehicles. Rules include prohibition of off-road driving unless authorised for a specific purpose (i.e. exploration) and reduced speed limits on internal roads.
- Clearing will be timed outside the black cockatoo breeding season wherever possible.
- Prior to clearing, a suitably qualified environmental professional (fauna spotter) will identify and check known hollows for the presence of native fauna (Black Cockatoos or WRP).

Where nesting animals are identified the tree will be marked and excluded from clearing until the resident animals have moved from the hollow or if clearing is unable to be delayed the nesting animal will be relocated by a suitably trained professional fauna handler.

- In addition to checking of hollows, prior to the commencement of clearing, ground searches of clearing areas will be undertaken, and any native fauna found will be relocated, or encouraged to move to neighbouring vegetation.
- A suitably qualified environmental professional (fauna spotter) will be present during all land clearing. The person will hold a permit to handle and move significant fauna under Regulation 15 of the WC Act, and have access to a care facility that can be used to rehabilitate injured fauna.
- Wherever practical land clearing will be undertaken on one front only in a direction which provides an opportunity for fauna to escape the clearing area to surrounding vegetation.
- Where trenches are established (i.e. for pipelines or services), which native fauna are unable to escape from, they will be inspected by a "fauna spotter" on a regular basis (i.e. dawn, midday and prior to sunset). Any entrapped fauna will be removed and relocated to surrounding vegetation. If trenches are left open overnight, ramps will be established to permit native fauna to escape.
- Signage will be installed along roads passing through areas identified as key fauna habitat for MNES highlighting their potential presence.
- All ponds will have appropriate fauna egress to prevent native fauna becoming trapped.
- Implementation of the Talison Dust Management Plan to minimise dust emissions from the Mine
- Implementation of the Talison Surface Water Management Plan intended to prevent potential impact to surface waters.
- Drainage design and design of landforms will be implemented to contain any potentially sediment laden flows within the MDE.
- Implementation of the site Talison Hot Work Permit System, and Emergency Management Procedures, to minimise the risk of bushfires.
- Clearing activities will not be undertaken when the Fire Danger Rating is severe or higher.

The measures described are predominantly already implemented within Talison's existing activities and management. Existing management plans and procedures will be updated prior to commencing the Proposal to address changes associated with the expansion activities, and updated knowledge of MNES present. As an additional measure intended to minimise and prevent impacts to MNES, Talison will also develop a Conservation Significant Species Management Plan which will document all management measures and monitoring targeted to threatened and other specially protected flora and fauna species known to occur within, or in close proximity to, the MDE.

5.6 Proposed outcome

The proposed environmental outcomes for threatened fauna species (MNES) potentially impacted by the Proposal are:

- No mortality of threatened fauna species as a result of clearing activities associated with the Project;
- No detrimental impact on habitat of threatened fauna species outside the MDE as a result of weed or disease spread to adjacent areas, sedimentation from runoff, reduced

availability of surface or groundwater, or accidental clearing beyond the MDE which is associated with the implementation of the Proposal;

- No detrimental impact on habitat of the Pink Spider Orchid outside the MDE as a result of weed or disease spread to adjacent areas, sedimentation from runoff, reduced availability of surface or groundwater, or accidental clearing beyond the MDE which is associated with the implementation of the Proposal; and
- Counterbalance the loss of up to 350 ha of Jarrah/Marri forest and Jarrah/Marri forest over Banksia (fauna habitat suitable for MNES), inclusive of up to 35 trees with potential breeding hollows, through implementation of a suitable environmental offset which aligns with the Principles of the WA Environmental Offsets Policy (2011) and the EPBC Act Environmental Offsets Policy (2012).

6. Offsets

6.1 Significant Residual Impact

Environmental offsets are conservation actions which provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a Proposal (EPA 2014). Offsets differ to mitigation measures in that they are undertaken outside of a MDE. They are applicable where a Proposal has a significant residual impact after the hierarchy of mitigation measures (avoid, minimise and rehabilitate) has been applied. Offsets should directly correlate to the impacts of a Proposal.

Talison's mitigation measures intended to avoid, minimise and rehabilitate impacts to flora, vegetation and fauna have been described within section 4.3.6 and 4.4.6 of this document. After application of these measures, Talison believes the Proposal will have a significant residual impact due to direct impacts to MNES and other conservation significant fauna species through removal of up to 350 ha of native vegetation, which is considered suitable habitat for these species. Recorded MNES and other conservation significant fauna known to use the Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitats of the MDE include:

- Threatened Black Cockatoo species - Carnaby's Black Cockatoo (Endangered), Forest Red-tailed Black Cockatoo (Vulnerable) and Baudin's Black Cockatoo (Endangered);
- Western Ringtail Possum – Critically Endangered (unconfirmed as present but possibly occurs);
- Western Quoll/Chuditch - Vulnerable;
- Wambenger Brush-tailed Phascogale – Conservation Dependent (WC Act);
- Western Brush Wallaby – Priority 4 (DBCA Listing); and
- Southern Brown Bandicoot – Priority 4 (DBCA Listing)

Talison intends to counterbalance this residual impact through implementation of an environmental offset strategy that is relevant and proportionate to the significance of the environmental impact.

6.2 Offset calculation

The DoEE Offset Assessment Guide has been used to assess the quantum of residual impact associated with the Proposal and quantify offset requirements. The values input to the calculator are described in Table 32.

Completed offset assessment calculators are included in Appendix J. Based on the offset calculation, if an offset area of similar habitat quality to that cleared for the Mine expansion is identified Talison anticipates that an offset area of up to 1570 ha could be required to achieve a direct offset of 100% of the residual environmental impact associated with removal of the habitat for the Mine expansion. This is the largest offset area anticipated to be required. If an offset area with a lower habitat quality is identified, which can be rehabilitated to the quality of the impact area, a smaller offset area will be required. A larger area could be required dependant on how much of the habitat that will be impacted by the Proposal is considered to be suitable for WRP. Survey work by Harewood (2018b) suggests that much of the vegetation observed within the MDE represents poor or marginal habit for WRPs therefore an offset has been calculated based on black cockatoos rather than WRP. The chosen offset area will ideally have suitable Jarrah/Marri forest and Jarrah/Marri forest over Banksia habitat for the species listed in section 6.1. Talison is currently working with the DBCA and Blackwood Basin Group to identify a suitable offset area/s.

Table 32 Offset Calculator Input Values for the Talison Greenbushes Lithium Mine Expansion

Attribute	Value	Reasoning
Area of habitat impacted	350 ha	Loss of Jarrah/Marri forest and Jarrah/Marri forest over Banksia which is suitable habitat for Black Cockatoos (Baudin's, Carnaby's and Forested Red-tailed). Thirty potential breeding trees >500 mm DBH with hollows assessed as being suitable for black cockatoo breeding are within the MDE of which 12 are expected to be removed for the Proposal. The habitat is also suitable for Western Quoll/Chuditch, Wambenger Brush-tailed Phascogale, Western Brush Wallaby and Southern Brown Bandicoot and possibly WRP.
Vegetation quality of the impacted area	6	The habitat quality of the MDE has been assessed by Ennovate (2018, Appendix C). Based on this assessment the MDE is considered to have an average quality score of 6.
Start quality of the offset area	6	An offset site is yet to be identified. Talison intend to identify an offset area/s which is of similar or better quality to the impacted area. A value the same as the impact site has been used to determine the highest likely offset area Talison will be seeking. The final area of the offset will be dependent on the quality of suitable habitat at the offset site. Talison will also consider acquisition of land which is of lower quality than the MDE with the intention of rehabilitating the land to a suitable quality.
Future Quality without Offset	5	An offset site is yet to be identified therefore the threats to the site are not known to quantify the future quality of the offset. Typically if left unprotected and unmanaged, it could be expected that an offset site will deteriorate in quality, particularly if the eventual offset site is likely to comprise a remnant/ or remnants adjacent to other land uses.
Time Horizon Over which loss is averted	20 years	The offset area will be protected for 20 years as a minimum. To achieve this the offset area will either be vested with the DBCA for conservation purposes or a conservation covenant of 20 years will be placed on the offset site/s.
Time until ecological benefit	1 year	It is anticipated to take approximately 12 months to identify, acquire and suitably protect an offset site. If Talison identify a suitable offset site which requires rehabilitation the ecological benefit will occur over a longer period of time (nominally 20 years for rehabilitation)
Risk of loss without offset	20%	Without protection in place, the habitat within a proposed offset site is expected to degrade over time. The University of Queensland 'Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act' (2017) lists the average background vegetation loss for the Shire of Bridgetown-Greenbushes is ~8%. This has been increased to 20% as an offset location will be identified which is not currently included in the conservation estate and is therefore liable to be lost.

Attribute	Value	Reasoning
Risk of loss with offset	5%	Minimal risk as it is intended that the offset area will be vested with DBCA for inclusion in the conservation estate, or a conservation covenant established over the land, to avert the risk of loss for at least 20 years. There is still a slight chance of loss as a result of the potential for natural disaster impacts (bushfire, severe storm damage) within the area.
Confidence in result	90%	The likelihood of offset success (and therefore confidence in result) is considered to be high given that a land acquisition offset is proposed which would be transferred to the conservation estate (DBCA) for protection in perpetuity or alternatively a conservation covenant will be placed over the land. Talison is already engaged with the DBCA and the Blackwood Basin Group (who currently manage an existing Talison offset site within the Shire of Boyup Brook) in relation to finding a suitable offset site. Given the experience of the two land management agency/groups Talison is confident an offset area/s can be appropriately managed to maintain or improve the quality of the offset set.

6.3 Proposed offset strategy

Talison proposes to implement a direct offset through acquisition of suitable land, containing the required attributes to counterbalance the impact to MNES from the Proposal. Talison intends to vest the identified offset site/s to the DBCA conservation estate. Alternatively if DBCA are unable to manage the identified offset land, a 20 year conservation covenant will be placed on the land and an alternative landcare group will be identified to manage the offset. Talison proposes to use Blackwood Basin Group as an alternate land manager. This Group currently manage Talison's existing offset site within the Shire of Boyup Brook.

A potential offset location is yet to be identified. Talison is working with the DBCA and the Blackwood Basin Group to find a suitable area or areas, of sufficient size, with suitable habitat characteristics to offset the significant residual impacts of the Proposal to the conservation significant fauna species listed in section 6.1. A number of options are currently being considered as potentially suitable sites. Once identified a survey of the proposed offset site will be undertaken to determine the site's suitability as an offset for the significant residual impacts of the Proposal.

The proposed offset strategy has been developed in line with the Principles of the WA Environmental Offsets Policy (GoWA 2011) and the EPBC Act Environmental Offsets Policy (DSEWPaC 2012b). The application of the six principles of the WA Environmental Offsets Policy (DSEWPaC 2011) to the proposed strategy are summarised in Table 33 and the eight principles of the EPBC Act Environmental Offsets Policy (DSEWPaC 2012b) are summarised in Table 34.

Table 33 Application of the WA Offset Policy Principles to the proposed offset strategy

Principle	Application to the Talison Greenbushes Lithium Mine Expansion Proposal
Environmental offsets will only be considered after avoidance and mitigation options have been pursued.	Strategies which have been or will be implemented to avoid and mitigate environmental impacts are described in this document.
Environmental offsets are not appropriate for all projects.	The Mine has been in operation for over 30 years without evidence of any significant environmental impact. The company and its predecessors have actively worked to improve the State Forest surrounding the mine through progressive rehabilitation of legacy mining areas, gradually reducing the area of disturbance associated with the mine. Talison believe the expanded mining operation can continue to be operated in an environmentally responsible manner but the expansion will have a potentially significant residual impact associated with the loss of 350 ha of habitat suitable for MNES threatened fauna species. Offsets are considered an appropriate counterbalance to enable the Proposal to meet the EPA's objective for Flora and Vegetation, and Fauna. Talison is working with the DBCA and landcare group the BBG to identify suitable offsets which can be secured for the Mine expansion.
Environmental Offsets will be cost effective, as well as relevant and proportionate to the significance of the environmental value being impacted	Talison has undertaken a habitat quality assessment (Ennovate 2018) in order to quantify the habitat value of vegetation which will be cleared for the Proposal. The offset area requirements have been calculated using the offsets assessment guide and associated guidance. The rationale behind the input values to calculate the offset area are described in section 6.2. Talison is working with DBCA and BBG to identify areas which are potentially suitable for offset arrangements. Talison intends to use one or both of these experienced land managers (DBCA or BBG) to manage the offset site.
Environmental offsets will be based on sound environmental information and knowledge	An ecological assessment of the proposed offset site will be undertaken once identified to confirm it contains suitable environmental values to offset the impact of the mine expansion.
Environmental offsets will be applied within a framework of adaptive management.	It is intended that the land identified for offset to be acquired and vested with the WA conservation estate vested with DBCA. The land would be managed by DBCA in accordance with their land management practices. DBCA management of the conservation estate is undertaken and reported on in accordance with the requirements of the *Conservation and Land Management Act 1984.* Alternatively, if offset land will be managed by the BBG, an Environmental Management Plan will be developed and implemented by the BBG for the offset area.
Environmental offsets will be focussed on longer term strategic outcomes.	The offset proposal will add to the area of reserved vegetation within the South West Forest for a period of at least 20 years.

Table 34 Application of the EPBC Act Environmental Offsets Policy Principles to the proposed offset strategy

Principle	**Application to the Talison Greenbushes Lithium Mine Expansion Proposal**
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	Talison has undertaken a habitat quality assessment (Ennovate 2018) in order to quantify the habitat value of vegetation which will be cleared for the Proposal. The offset area requirements have been calculated using the offsets assessment guide and associated guidance. The rationale behind the input values to calculate the offset area are described in section 6.2.
Suitable offsets must be built around direct offsets but may include other compensatory measures	Talison proposes to acquire a suitable offset area/s (direct offset) which will be vested with the DBCA conservation estate or placed under conservation covenant. The identified area/s will achieve a direct offset of at least 90% of the residual environmental impacts associated with land clearing for the Mine expansion. Talison aims to achieve 100% offset but if this cannot be achieved, funding for the management of the offset area will make up the remaining 10%.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	Offsets for impacts on affected MNES have been calculated using the offsets assessment guide which includes IUCN data on the probability of annual extinction for different categories of threatened species as a multiplier in the offset calculations (DSEWPaC 2012). The higher the level of statutory protection and associated probability of annual extinction the greater the quantum of biodiversity offset required. Based on calculation using the offset guide it is expected that a maximum offset area of 1570 ha of Jarrah/Marri forest and Jarrah/Marri forest over Banksia could achieve a direct offset of 100% of the residual impact associated with the clearing of MNES threatened fauna habitats although this is dependent on the characteristics of the chosen offset site/s.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	A maximum offset area of 1570 ha (calculated via the offsets assessment guide) of Jarrah/Marri forest and Jarrah/Marri forest over Banksia is expected to achieve a direct offset of >100% of the residual impact associated with land clearing for the Mine expansion. A smaller area which contains suitable environmental values but requires rehabilitation to improve the quality of the habitat to the standard of the impact area could also be a suitable offset. The final area will be dependent on the characteristics of the identified site.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	Talison proposes to vest the acquired offset land to DBCA conservation estate in perpetuity (20 years). The area would be managed by DBCA in accordance with their land management practices which are intended to maintain or improve the conservation estate. Alternatively, if offset land will be managed by the BBG, an Environmental Management Plan will be developed and implemented by the BBG for the offset area.
Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The biodiversity offset proposed will be for the WA and Commonwealth environmental impact assessment of the Mine expansion and not the result of any other legal requirement that applies to the Proposal.

Principle	**Application to the Talison Greenbushes Lithium Mine Expansion Proposal**
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The offset area requirements have been calculated using the offsets assessment guide and associated guidance. The rationale behind the input values to calculate the offset area are described in section 6.2. Talison is working with DBCA and BBG to identify areas which are potentially suitable for offset arrangements. An ecological assessment of the proposed offset site will be undertaken once identified to confirm it contains suitable environmental values to offset the impact of the mine expansion.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	It is intended for the land identified for offset to be acquired and vested with the WA conservation estate vested with DBCA. The land would be managed by DBCA in accordance with their land management practices. DBCA management of the conservation estate is undertaken and reported on in accordance with the requirements of the *Conservation and Land Management Act 1984.* Alternatively, if offset land will be managed by the BBG, an Environmental Management Plan will be developed and implemented by the BBG for the offset area.

7. Conclusions

7.1 Flora and vegetation

Flora and vegetation will be directly impacted by the Mine expansion due to the requirement to clear up to 350 ha of native vegetation for the expanded Mine footprint. Vegetation within the MDE has previously been impacted by a long history of mining activity in the region and forestry practices. The loss of vegetation will not impact on any threatened vegetation communities or flora species as none occur within the MDE. Two main populations of Priority 4 species, *Acacia semitrullata* occur within the MDE which are likely to be impacted by clearing for the expansion, but will be avoided where possible. The native vegetation which is proposed to be cleared is representative of vegetation complexes which all have greater than 50% of their pre-European extent remaining within the South West Forest Region.

Dieback is known to occur within the MDE and the region has a high diversity of weed species due to the extensive history of disturbance. The proposed vegetation clearing will reduce the area of protected vegetation within the South West Region, albeit on a relatively small scale. As the vegetation which will be impacted by the expansion is widespread throughout the region, Talison considers that impacts on flora and vegetation associated with the proposed Mine expansion do not significantly impact on the biological diversity and ecological integrity on a local or regional scale.

7.2 Terrestrial fauna

The proposed expansion of the Mine will result in the direct loss of up to 350 ha of Jarrah/Marri forest and Jarrah/Marri forest over Banksia fauna habitats. The native vegetation which will be cleared is suitable foraging and potential breeding habitat for three species of conservation significant black cockatoo species, although feeding evidence within the MDE indicates it is primarily used by the Forest Red-Tailed Black Cockatoo. Thirty potential breeding trees with hollows suitable for breeding have been recorded in the MDE of which up to 12 are expected to require removal for the Mine expansion. Five of the 12 have been observed to have chew marking indicating they have potentially been used or investigated for breeding potential previously.

Other conservation significant fauna recorded from these habitats include Chuditch, Wambenger Brush-tailed Phascogale, Quenda, Western Brush Wallaby and also possibly WRP. While the available fauna habitat in the local area will be reduced as a consequence of the Proposal, the habitats present within the MDE are considered to be well represented in the surrounding region, in particular in the neighbouring Greenbushes, Nannup and Wilga State Forests. The loss of fauna habitat is therefore unlikely to have a significant impact on the extent of fauna habitat at a regional scale. The impact to fauna habitat is unable to be avoided and a suitable area is proposed to be offset in accordance with Commonwealth and WA Offset Guidelines.

7.3 Terrestrial environmental quality

The Mine expansion has the potential to impact on terrestrial environmental quality due to the presence of minor amounts of PAF within the Greenbushes deposit and potential for erosion from the large constructed landforms (TSF4 and Floyds WRL) which are part of the expansion. Talison has undertaken several studies throughout the operating life of the Mine in order to understand and quantify the presence of PAF within the deposit. Further study of materials from the expanded open pit is currently underway. An effective Waste Rock Management Plan and Environmentally Hazardous Waste Rock Management Plan are implemented to ensure PAF

material is identified and appropriately placed within the WRL, to prevent exposure to weathering and potential associated production of AMD. The mine has been operating at its current location for over 30 years with no evidence of AMD occurring therefore through continued identification and management of PAF potential impacts to terrestrial environmental quality can be avoided.

Talison aims to minimise erosion from large landforms through design and construction of landforms which are stable and compatible with the surrounding landscape. Landform designs will be developed for all large landforms (TSF and WRL) which account for landform stability. Through effective landform design it expected that erosion from mine landforms will not impact significantly on the surrounding terrestrial environmental quality.

7.4 Hydrological processes

The Proposal occurs in a hydrological setting that has been significantly modified as a result of the history of mining activity and agriculture within the surrounding area. Impacts to groundwater processes are not expected to occur as a result of the Mine expansion, predominantly due to the already altered state of groundwater, and the limited groundwater resource which is present.

Talison implement a SWMP to ensure supply of sufficient water to the mining operation while maintaining flows in the surrounding areas. The current plan will be updated to account for the Mine expansion to ensure mine supply and downstream flows are maintained. Further study of the surface water hydrology of the MDE is currently underway to characterise changes which will occur as a result of the expansion. The study will inform the update of the SWMP.

7.5 Inland waters environmental quality

The extensive history of mining activity in the Greenbushes region has resulted in surface and groundwater quality at the mine already being impacted to some extent. As, Li, and to a lesser extent Fe, occur at elevated levels within water storages which are part of the Mine water circuit, and some groundwater monitoring bores associated with the TSF. The elevated levels do not appear to be impacting downstream water users. Improvements to water and tailings management and treatment in recent years through implementation of a SWMP appear to be reducing this impact. A WTP is approved for construction at the Mine. Construction of the Plant is expected to be complete in 2019 and its operation is expected to further improve the quality of water in the Mine water circuit reducing the likelihood of continuing impact on water quality downstream.

With the continued implementation, and update when necessary, of the SWMP, and design and construction of new TSF4 in accordance with the relevant guidelines, Talison is not anticipating any significant new impacts to surface or groundwater quality to occur as a result of the expansion.

7.6 Air quality

The expansion of the Mine will increase the emissions of dust and combustion products from the Mine, which will impact on the local air quality. The increased emissions are not expected to cause a permanent or significant impact. Dust modelling indicates that short term 1-hour maximum dust concentrations during worst-case conditions could potentially exceed nominated criteria at sensitive receptors. The remaining air quality criteria are predicted to be met and dust is therefore not expected to cause a significant impact to amenity or air quality. Additional monitoring of dust levels and meteorological conditions, and implementation of additional dust controls or modified activities at set trigger levels, is proposed to be implemented to effectively reduce the likelihood of the dust emissions impacting on the surrounding receptors.

7.7 Social surrounds

The proposed expansion of the Mine will increase noise levels and impact on visual amenity within the local area. Noise modelling predicts potential exceedance of the current night time limits specified in the Talison Regulation 17 Noise Approval under worst case conditions. Additional noise mitigation and monitoring can be implemented to minimise the likelihood of the Talison Regulation 17 Noise Approval limits being exceeded. As the Mine expansion is occurring progressively monitoring, noise mitigation and updating of the noise model can be used to confirm whether an exceedance is likely and whether an amendment to the approval Talison Regulation 17 Noise Approval may be necessary.

The expansion involves an increase in the footprint of landforms (TSF4, Floyds WRL and the open pit) at the Mine which is expected to increase the visibility of the operation to residences in the surrounding agricultural area. Talison proposes to limit this impact through continued implementation of Talison's Mine Closure Plan which considers the visual impact of the operation. Progressive rehabilitation of visible areas is a key objective for Talison. An updated Mine Closure Plan is currently being developed for the expanded operation which will be submitted to the DMIRS in conjunction with a Mining Proposal for the expansion of the Mine.

Talison is currently undertaking a program of stakeholder engagement in relation to the expansion which will continue throughout the implementation of this Proposal.

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Appendices

Appendix A - Flora and Vegetation Studies (Onshore Environmental)

Appendix B – Fauna Studies (Biologic)

Appendix C – Black Cockatoo Habitat Studies (Tony Kirkby, Ennovate and Harewood)

Appendix D – Preliminary Western Ringtail Possum Surveys (Harewood 2018)

Appendix E Acid and Metalliferous Drainage Studies (GHD and Graeme Campbell and Associates Pty Ltd)

Appendix F - Greenbushes Lithium Mine TSF and Process Dam Areas – Water Monitoring Review 2016-17 (Significant Environmental Services)

Appendix G - Talison Greenbushes Dust Impact Assessment (GHD)

Appendix H - Acoustic Assessment Greenbushes (Herring Storer Acoustics)

Appendix I - Talison Lithium Australia / Global Advanced Metals Greenbushes Operations Noise Management Plan

Appendix J – Greenbushes Lithium Mine Expansion Offset Assessment Calculators

GHD
1st Floor
10 Victoria Street
T: 61 8 9721 0700 F: 61 8 9721 0777 E: bunmail@ghd.com

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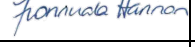
Rev B	A Callegari	M Toner		F Hannon		9/5/2018
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