SORBY HILLS PROJECT

FAUNA, HABITAT AND OFFSET MANAGEMENT PLAN

Tenements: M80/196, M80/197, M80/286
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Report

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Document Control

Rev No	Date	Author(s)	Approved by	Summary of changes
A	10/12/2024	R. Houlihan	S. Noon	
B	10/02/2025	R. Houlihan	S. Noon	
C	5/09/2025	R. Houlihan	S. Noon	Incorporated EPBC conditions

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed Simon Noon .....

Full name (please print) Simon Noon .....

Organisation (please print) Boab Metals Limited.....

Date …9……/…12……../……2025…..

EXECUTIVE SUMMARY

Sorby Management Propriety Limited (SMPL) proposes to develop a new Silver Lead Zinc (Ag Pb Zn) mine at Sorby Hills (the Project), 50 km north of Kununurra in the East Kimberley Region of Western Australia (WA) (Figure 1-1).

Sorby Hills is a major Ag Pb Zn deposit; the primary lead mineral is galena (lead sulphide). The Sorby Hills mining tenements (M80/196, M80/197, M80/285, M80/286, and M80/287) cover a total area of 12,612.40 ha. Within these tenements, a total of 13 individual mineralised pods have been delineated by exploration. The ore pods form a linear belt (trending north–south) over an 8 km strike length and up to 1 km wide extent on the eastern margin of the Pincombe Inlier.

This Fauna, Habitat and Offsets Management Plan (FHOMP, the Plan) forms part of the Sorby Hills Environmental Management System (EMS). The Plan should be read in conjunction with the overarching Sorby Hills Environmental Management Plan (CORP-EN-PLN-1001). The purpose of this FHOMP is to document the management framework that will be used during Project implementation to avoid and mitigate impacts on native fauna (especially threatened fauna) and their habitats. The Plan is intended as a guide to help Project personnel (including contractors) to understand:

- how Project activities could harm vegetation and fauna and fauna habitats
- the actions required to avoid or mitigate harm to fauna and their habitats and to comply with statutory approval conditions
- what observations and monitoring will be used to assess the effectiveness of management actions
- how incidents involving harm to fauna or habitats are to be managed and reported.

The plan also describes SMPL's biodiversity offset strategy. The offset strategy recognises that it may not be possible to eliminate all adverse impacts on protected fauna and/or their habitats. In cases where management and avoidance actions cannot prevent residual significant impacts, offsets are required to compensate for harm to fauna or their habitats so that no net loss results from project implementation. The Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) will take a lead role in implementing offset actions funded by SMPL.

Table E1: Conditions of approval reference table (EPBC 2023/09576) – action management plans

EPBC condition reference	Requirement	Plan reference	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirement
4)	The approval holder must submit to the **department** for approval by the **Minister**, a Fauna, Habitat and Offset Management Plan (FHOMP). The FHOMP must:	This document	
4) a)	be prepared by a suitably qualified environmental professional	Page iii (Document control)	This plan was prepared by Rhys Houlihan (Green Values Australia). Mr Houlihan has over15 years of experience in the design and implementation of management activities for protected matters. He has demonstrated his capability in achieving specified environmental outcomes for protected matters and habitat quality improvement in both operational and independent advisory roles.
4) b)	be consistent with the Environmental Offsets Policy and the Environmental Management Plan Guidelines,	Section 1 (Introduction; Section 8 (Biodiversity Offset Strategy); Section 11 (References); Appendix 3 (Offset calcutions)	The Fauna, Habitat and Offset Management Plan (FHOMP) has been developed to align with Commonwealth offsets policy and associated guidelines.
4) c)	include commitments, environmental outcomes, management measures, corrective actions, trigger values and performance indicators that are SMART and are based on referenced or included evidence of effectiveness,	Section 6.5 (Performance objectives and targets); Section 8.7 (Offset performance objectives and monitoring)	Tables 6-9 and 8-3 provide details of outcomes, management measures and performance indicators.
4 d)	The FHOMP must include measures to avoid and mitigate harm as a result of the Action on protected matters, including, but not limited to:		
4 d) i)	detailed baseline information on protected matter habitat and habitat quality in the development envelope,	Section 6.1 (Threats to MNES)	Tables 6-1 and 6-2 provide concise contextual information about protected fauna species and habitats within the project development envelope.

EPBC condition reference	Requirement	Plan reference	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirement
4 d) ii)	a summary of the potential impacts of the Action on protected matters, including an assessment of associated risks,	Sections 6.2 (Potential impacts) and 6.3 (Risk assessment)	A systematic analysis of potential project impacts on threatened fauna and their habitats is provided in Table 6-7.
4 d) iii)	a detailed specification of environmental performance objectives and targets applicable to protected matters,	Section 6.5 (Performance Objectives and Targets)	Table 6-9 summarises SMPL's performance objectives and targets for protected matters addressed in this plan.
4 d) iv)	avoidance and mitigation measures that will be implemented by the approval holder to minimise the impact of the Action on protected matters, taking into account threatening processes,	Sections 6.4 (Environmental Management Strategies) and 7 (MNES specific avoidance and mitigation measures)	Section 7 provides information on the specific measures that will be implemented during the construction and active mining phases of the project to avoid and mitigate adverse impacts on Gouldian Finches, Australian Painted Snipes, Northern Crested Shrike-tits and their respective habitats. Section 7.4 briefly describes mitigation actions that will be incorporated in the mine closure plan design.
4 d) v)	a specification of how the effectiveness of the avoidance, mitigation and management measures will be monitored, including the methodology, frequency and duration of monitoring activities,	Section 5.5 (Environmental management system – checking); Section 8.7 (Offset performance objectives and monitoring)	Details of proposed monitoring are provided in Section 5.5.1. Monitoring methods are not included in this plan: methodological details are provided in standard operating procedures developed as part of the SMPL environmental management system.
4 d) vi)	a framework for annual reporting to the department on the effectiveness of implementation of the FHOMP.	Sections 5.6.2 (Incident reporting); 5.9 (Communication and reporting); 8.3 (Offset delivery and governance); 9 (Plan review and reporting)	SMPL commits to delivering annual reports on the implementation status and effectiveness of the FHOMP in Sections 5.9 and 8.3.

EPBC condition reference	Requirement	Plan reference	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirement
4 e)	The FHOMP must include a strategy and measures to compensate for the residual significant impacts of the Action on the **Gouldian Finch**, **Australian Painted Snipe** and **Crested Shrike-tit (northern)**, including but not limited to		
4 e) i)	detailed information on the residual impacts to protected matters that will be compensated for by the offset, including all areas of habitat, and the habitat quality, for protected matters at all locations impacted by the Action which the offset is to address,	Section 6.2 (Potential impacts); Appendix 3 (Offset calculations)	Table 8.1 summarises the areas subject to Threat Abatement Programs for each MNES
4 e) ii)	the relevant protected matters and a reference to the EPBC Act approval conditions to which the FHOMP refers	This table, Section 4.1 (Scope); Section 6.1 (Threats to Matters Protected under the EPBC Act)	This table provides a detailed cross reference to the EPBC Act approval conditions and where they are addressed in the FHOMP.
4 e) iii)	detailed information and a shapefile specifying the location, area and boundaries of each offset site,	Appendix 4	
4 e) iv)	detailed baseline information on the areas of the habitat, and the habitat quality for protected matters at each offset site,	Section 7 (MNES specific avoidance and mitigation measures); Section 8 (Biodiversity offset strategy)	Table 8.2 provides a concise summary of baseline information about the threatened species for which offsets are required.
4 e) v)	achievable offset outcomes, relevant to the conservation of the Gouldian Finch, Australian Painted Snipe and Crested Shrike-tit (northern), for each offset site and the timeframes in which they will be achieved,	Section 8 (Biodiversity offset strategy)	Table 8.3 describes offset performance objectives and targets: offset actions to address threatening factors. Where the current state of knowledge permits, timeframes for attainment of outcomes are provided.
4 e) vi)	a table summarising all commitments to achieve the offset outcomes for protected matters at each offset site and a reference to where each commitment is detailed in the FHOMP,	Section 8 (Biodiversity offset strategy)	Commitments relating to direct offsets are presented in Section 8.5. Commitments relating to indirect offsets are presented in Sectio 8.6.
4 e) vii)	reporting and review mechanisms to inform the department annually regarding compliance with the implementation of management measures and the attainment and maintenance of the offset outcomes,	Section 5.9.2 (External communication); Section 5.9.3	Performance and compliance reports will be submitted annually to DCCEEW, as described in Section 5.9 and Section 9.

EPBC condition reference	Requirement	Plan reference	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirement
		(Compliance reporting); Section 9 (Plan review and reporting)	
4 e) viiii)	an assessment of risks to achieving each offset outcome and what risk management measures and/or strategies will be applied to address these,	Section 6.3	A risk assessment has been developed that includes performance objectives and targets
4 e) ix)	a monitoring program, which must specify:		
	A) measurable performance indicators and the timeframes for their achievement to gauge attainment of each offset outcome for the protected matters,	Section 8.7, Table 8.3	To be confirmed following consultation with DBCA and Traditional Owners
	B) trigger values for corrective actions, and	Table 8.3	
	C) the proposed timing (including season/time of day/frequency) methods and effort, and an explanation of how these will be effective for this purpose, of monitoring to detect trigger values, changes in the performance indicators and to gather evidence that effectively demonstrates actual progress towards, attainment of and maintenance of all offset outcomes for the protected matters,	Section 8.7.2	
4 e) x)	corrective actions to be implemented to ensure all offset outcomes for the protected matters are achieved or maintained if trigger values are reached or performance indicators not achieved in the specified timeframes,	Section 8.7.3	Monitoring has been included aligned to the offset outcomes.
4 e) xi)	references to related plans and conditions of approval (including state/territory approval conditions), and	Table 3.1; Section 5.4 (Management system documents)	Statutory conditions for the protection of fauna and fauna habitats contained in approvals granted under the WA *Environmental Protection Act 1986* and the *Biodiversity Conservation Act 2016* are summarised in Table 3.1.
4 e) xii)	how each offset site will be protected, including securement, and all offset outcomes maintained or improved, at least until the expiry of the approval.	Section 8.3 (Offset delivery and governance)	The land on which offsets will be implemented will ultimately form part of freehold land held by the Miriuwung-Gajerrong Trustees Pty Ltd and leased

EPBC condition reference	Requirement	Plan reference	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirement
			to the State for joint management by MG Corporation and DBCA.
5)	Within 5 business days of commencing implementation of the approved FHOMP, the approval holder must notify the department of the date on which implementation of the FHOMP commenced.	This table	SMPL notes this requirement by including it in this table
6)	The approval holder must:		
6) a)	achieve all environmental performance objectives applicable to protected matters that are specified in the approved FHOMP, and	Section 5.6.1	The requirement to achieve environmental performance objectives and outcomes for protected matters forms part of the definition of compliance.
6) b)	achieve all offset outcomes for each offset site specified in the approved FHOMP by the time specified in the FHOMP. Once achieved, the approval holder must maintain or exceed the offset outcomes at least until the expiry date of this approval.	Section 5.6.1	

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ABBREVIATIONS and ACRONYMS

Term	Description
AER	Annual Environmental Report
Ag Pb Zn	Silver Lead Zinc
AS/NZS	Australian Standard/ New Zealand Standard
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EMS	Environmental Management Strategy
EPA	Environmental Protection Authority
FHOMP	Fauna, Habitat and Offset Management Plan
NT	Northern Territory
OEMP	Operational Environmental Management Plan
ORIA	Ord River Irrigation Area
PEC	Priority Ecological Community
PER	Public Environmental Review
PMLU	Post Mining Land Use
RoM	Run-of-Mine
SHECMS	Safety, Health and Environmental and Community Management System
SMPL	Sorby Management Proprietary Limited
TSF	Tailings Storage Facility
the Project	Sorby Hills Silver Lead Zinc Project
WA	Western Australia

GLOSSARY

Term	Definition
Buffer	An area surrounding significant environmental values designed to protect the values and limit impacts by maintaining ecological processes and functions in the habitat.
Clearing	Clearing of vegetation means – a) the killing or destruction of; b) the removal of; c) the severing or ringbarking of trunks or stems of; or d) the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock or any other act or activity, that causes – e) the killing or destruction of; f) the severing of trunks or stems of; or g) any other substantial damage to, some or all of the native vegetation in an area
Critical habitat	Habitat critical to the survival of a listed threatened species: can include (but may not be limited to) one or more of the following reasons: • habitat is used to meet essential life cycle requirements (for example, foraging, breeding, nesting, roosting, social behaviour patterns). • habitat is used by important fauna populations. • habitat is necessary to maintain genetic diversity and long-term evolutionary development of a species. • habitat is necessary for use as corridors to allow fauna species to move freely between sites used to meet essential life cycle requirements. • habitat is necessary to ensure the long-term future of the species through reintroduction or re-colonisation.
Critically endangered	Threatened species considered to be “facing an extremely high risk of extinction in the wild in the immediate future”.
Direct impact	An event or situation that is a direct consequence of implementing a controlled action.
Endangered	Threatened species considered to be “facing a very high risk of extinction in the wild in the near future”,
Exclusion area	An area within the project development envelope for which environmental assessments were carried out, but within which no clearing or other operational activities are permitted.
Habitat	The biophysical medium or media: a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms and into which organisms of that kind have the potential to be reintroduced.
Important population	A population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range.

Term	Definition
Incident	An unplanned event that causes environmental impacts or harm, including harm or damage to threatened fauna or their habitats.
Indirect impact	An impact that is an indirect consequence of an action.
Likely impact	An impact that has a real or not remote chance or possibility of occurring: may include events or impacts having a probability of occurrence of less than 50%.
Matter of National Environmental Significance	Includes, but is not limited to, threatened species, threatened ecological communities and migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999*.
Migratory	Fauna that periodically or occasionally visit Australia or an external Territory or the Australian exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth of Australia.
Mitigation measures	Action taken to effectively reduce any significant adverse impact of Project implementation on a protected matter.
Noncompliance	Failure to adhere to a statutory condition, for example a condition set out in the Project's EPBC approval.
Nonconformance	Deviation from a requirement of this management plan.
Offset	An environmental offset is an action or actions to compensate residual significant environmental impacts of a development or activity.
Priority fauna	Animal species that are either under consideration by the Department of Biodiversity Conservation and Attractions as threatened fauna but are in need of further survey to adequately determine their status, are adequately known but require ongoing monitoring to ensure their security does not decline or are conservation dependent and require active management to maintain their status. • Priority 1, 2 and 3 fauna include possibly threatened species that do not meet survey criteria, or are otherwise data deficient. • Priority 4 fauna include species that are adequately known and are rare but not threatened or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons.
Threatened fauna	Animals that are listed as critically endangered, endangered or vulnerable threatened species.
Roosting habitat	A place where winged animals like birds and bats rest or sleep. This can be, but isn't always, the same as nesting habitat. It can occur anywhere through the animal's range. A nesting habitat is important for reproduction and raising young, while a roosting habitat is for sleep and rest.
Significant habitat	Habitat that provides resources (breeding, resting and feeding), connectivity or habitat area for a species or community that is important for its survival.
Significant impact	An impact which is important, notable or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
Vulnerable	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future".

1 INTRODUCTION

Sorby Management Propriety Limited (SMPL), a subsidiary of Boab Metals Ltd (BML) proposes to develop a new Silver Lead Zinc (Ag Pb Zn) mine at Sorby Hills (the Project), 50 km north of Kununurra in the East Kimberley Region of Western Australia (WA) (Figure 1-1).

Sorby Hills is a major Ag Pb Zn deposit; the primary lead mineral is galena (lead sulphide). The Sorby Hills mining tenements (M80/196, M80/197, M80/285, M80/286, and M80/287) cover a total area of 12,612.40 ha. Within these tenements, a total of 13 individual mineralised pods have been delineated by exploration. The ore pods form a linear belt (trending north–south) over an 8 km strike length and up to 1 km wide extent on the eastern margin of the Pincombe Inlier.

This Fauna, Habitat, and Offset Management Plan (FHOMP, the Plan) is integrated with the Sorby Hills Environmental Management System (EMS). The Plan should be read in conjunction with the overarching Sorby Hills Environmental Management Plan (CORP-EN-PLN-1001). The purpose of this FHOMP is to document the management framework that will be used during Project implementation to avoid and mitigate impacts on native fauna (especially threatened fauna) and their habitats. The Plan is intended as a guide to help Project personnel (including contractors) to understand:

- how Project activities could harm flora and fauna and fauna habitats
- the actions required to avoid or mitigate harm to fauna and their habitats and to comply with statutory approval conditions
- what observations and monitoring will be used to assess the effectiveness of management actions
- how incidents involving harm to fauna or habitats are to be managed and reported

This Plan has been prepared in accordance with Commonwealth Environmental Management Plan Guidelines (Commonwealth of Australia, 2024). Offset provisions described in Section 8 of the plan are consistent with the requirements of the federal Environmental Offsets Policy (Commonwealth of Australia, 2012). The quantum of compensatory measures required to offset potential project impacts on Matters of National Environmental Significance was determined using the Offsets Assessment Guide developed by the Commonwealth. This Plan does not include species-specific procedures (for example, monitoring procedures). Relevant procedures, forms and other related documentation are referenced in Section 5.4.

This FHOMP:

1. Identifies key fauna and habitat values that may be adversely affected by Project implementation.
2. Identifies the threatening factors and Project aspects that must be managed in order to limit harm to fauna and habitat.
3. Defines the legislative requirements and non-statutory commitments with which SMPL must comply in order to protect biodiversity values in the Project area.
4. Describes the management controls that will be implemented in order to avoid or mitigate adverse impacts on fauna and fauna habitats as a result of Project activities.
5. Describes and quantifies the offset actions that will be implemented to compensate for unavoidable residual significant impacts of the Project on Matters of National Environmental Significance, so as to improve or maintain the viability threatened fauna covered under this Plan.
6. Describes the key roles and responsibilities for the implementation, communication and review of this Plan.
7. Explains how incidents and non-compliance matters are to be investigated and reported.

This FHOMP applies to activities conducted at the Sorby Hills Silver Lead Zinc mine and its associated processing facility and related support facilities on tenements M80/197 and M80/286. Activities conducted outside the mining tenements, for example transport and shipping of product are not addressed in this Plan.

This Plan focuses on actions required to protect threatened and priority fauna and the habitats that supports threatened and priority fauna.

The requirements set out in this Plan apply during all phases of Project implementation, including exploration, construction, commissioning, operations, decommissioning and closure.

Compliance with this Plan is mandatory for all SMPL personnel, contractors and suppliers whilst performing works onsite or any work on behalf of the Project.

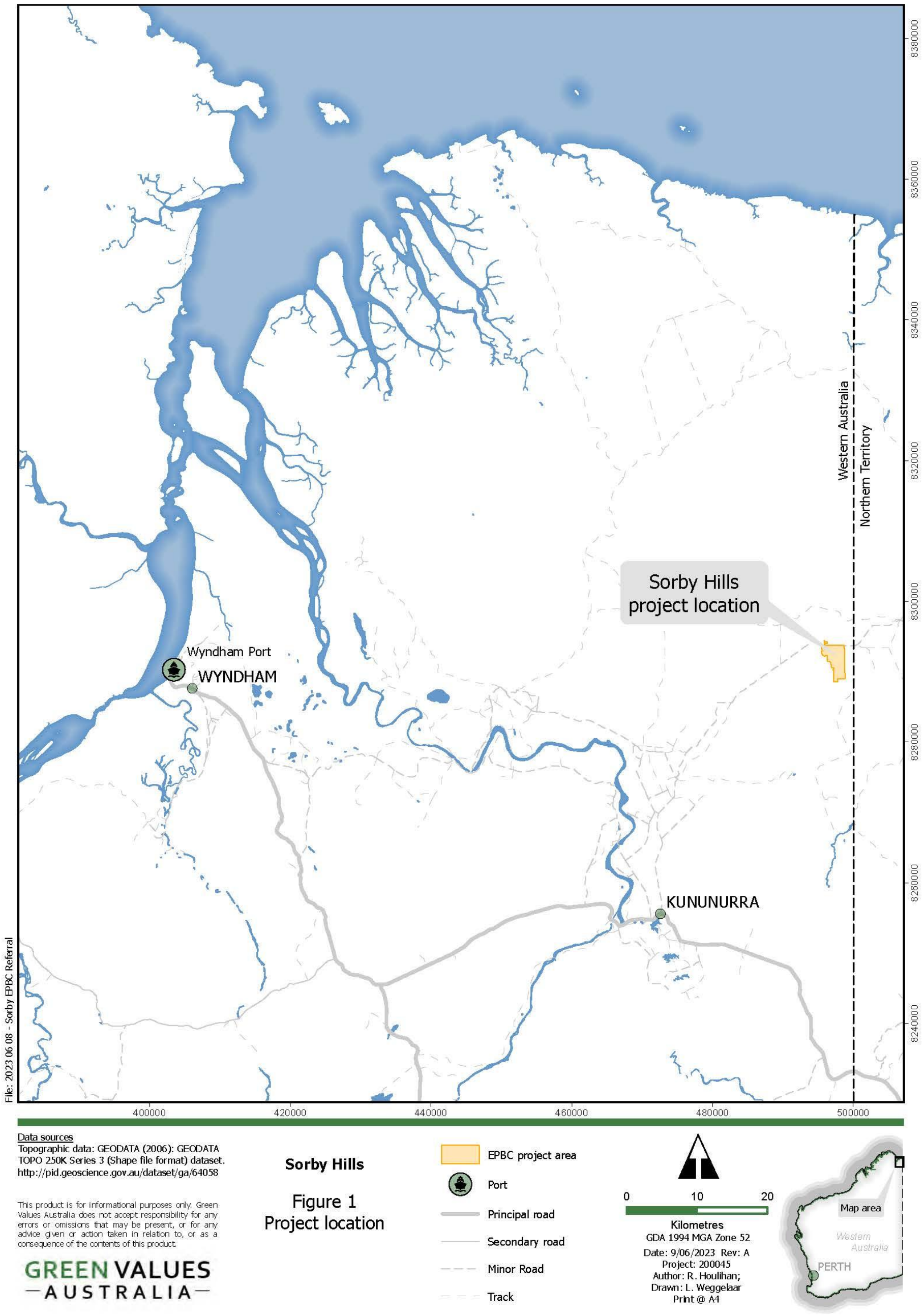

Figure 1-1: Project location

2 PROJECT DESCRIPTION

2.1 Mining Area

Sorby Hills is situated in the north-east Kimberley region of WA close to the Northern Territory (NT) border. The Sorby Hills Mine Site is located approximately 50 km by road north-east of the regional centre of Kununurra and lies to the south-east of the proposed Ord River Irrigation Area – Weaber Plains Development Project (ORIA – Weaber Plains Project). The nearest developed agricultural land and the closest residence to the Project site lie 21 km and 25 km to the south-west, respectively. A Project location map is provided as Figure 1-1.

Entry to the Project site is via an existing access road from the Weaber Plain Road.

A site layout plan for the Project site is provided as Figure 2-1.

2.2 Mined Products

The current resource for the Sorby Hills mining tenements totals 16.662 Mt at a grade of 4.5% Pb, 0.7% Zn and 52 g/t Ag at a 2.5% Pb cut-off.

Ore will be processed by flotation to produce a concentrate, which will be exported through the Port of Wyndham. Between 400,000 and 600,000 tpa of ore will be excavated from the open pits and processed through the facility to produce 45,000 tpa of concentrate for export. Concentrate will be transported to Wyndham Port via an existing road network, utilising road trains. SMPL is planning to utilise existing Wyndham Port facilities and ship once a month for 11 months each year. Shipping consignments will contain approximately 4,000 t of concentrate. The expected Project life is approximately 14 years, with 10 years anticipated for production and the additional 4 years accounting for the construction and closure phases.

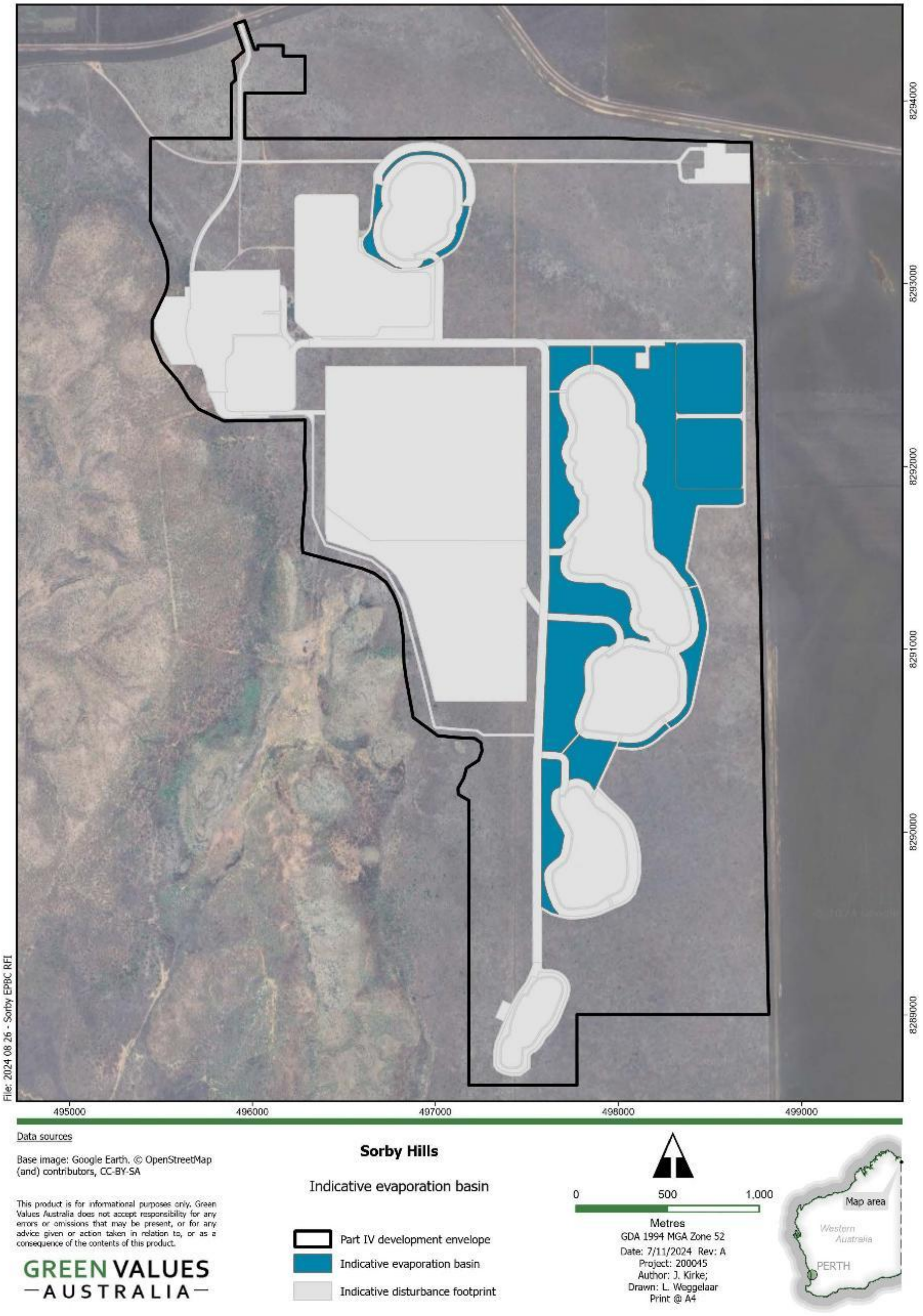

Figure 2-1: Project layout (general arrangement)

2.3 Supporting Infrastructure

The infrastructure to support mining and ore processing operations of the Project includes:

- Run-of-mine (ROM) pad, haul and access roads, a mill and concentrator and laboratory
- a Tailings Storage Facility (TSF), as part of an Integrated Waste Landform (IWL)
- an evaporation pond for containment of surplus groundwater from mine dewatering
- a road train loading area, access road to Kununurra (being Weaber Plain Road) and minor internal access roads
- workshop and site office
- accommodation village and associated waste management infrastructure (sewage treatment plant, landfill).

3 STATUTORY REQUIREMENTS: APPROVAL CONDITIONS

A summary of EPBC approval conditions relevant to the protection of threatened fauna and their habitats is provided in Table E1 (in the executive summary of this Plan). Conditions relevant to fauna and fauna habitats in other environmental approvals and binding commitments made by SMPL in its Environmental Review Document (2013) are summarised in Table 3-1.

Table 3-1: Conditions of approval reference table (EPBC 2023/09576)

Reference	Condition Requirement	Demonstration of how the plan addresses condition requirements and commitments made in the plan to address condition requirements
Ministerial Statement 964 under the *Environmental Protection Act 1986*		
Table 2	Development envelope is as detailed in Schedule (1057 ha).	Development envelope details are provided in Appendix 4 of this plan.
	Maximum clearing extent of 585 ha within a 1057 ha development envelope	Ground disturbance procedure CORP-EN-PRO-1004, referenced in Table 5.2 of this Plan.
Environmental Review Document fauna and habitat commitments (SMPL, 2013)		
Page iv	An exclusion area will be established to maintain biological diversity, ecological function and the most valuable habitats for threatened species such as the Gouldian Finch.	Exclusion area is shown in Figure 8-1 of this Plan.
	An internal clearing procedure will be implemented	Ground disturbance procedure CORP-EN-PRO-1004, referenced in Table 5.2 of this Plan.
	Cleared areas will be rehabilitated as soon as practicable. This will include replacing vegetation as this provides refuge for fauna and the construction of Gouldian Finch artificial nest boxes, these strategies will help offset the impacts of clearing	Closure details are included in Mine Closure Plan approved under the *Mining Act 1978*
	SMPL will destock of the Project Area	Destocking of the Project area started in 2023, and undertaken in accordance with the Sorby Deed of Agreement, administered between SMPL and the State of WA.
	SMPL will implement feral animal management controls	Key procedure is CORP-EN-WI-1005 (Cane toad monitoring and control work instruction), referenced in Table 5.2 of this Plan.
Page v	Speed limits will be established within the project area to reduce potential for impacts to fauna on site roads	Covered in site induction.
	Site personnel will be discouraged from feeding wildlife	Covered in site induction and in procedure CORP-EN-REG-1002 (referenced in Table 5.2 of this Plan)
	A self-imposed Development Exclusion Boundary will be established to provide a buffer zone between the Goomig Conservation Park and the area to be directly impacted by the Project.	Exclusion area is shown in Figure 8-1 of this Plan.
Appendix 4, Volume 2	SMPL will develop and implement a Gouldian Finch Management Plan	A Gouldian finch management plan has been developed for the Project in 2013. The commitments within this document have been incorporated into this FHOMP.

SMPL will comply with all relevant federal, state and local government environmental requirements. Copies of relevant licences, approvals and permits will be maintained. A summary of the relevant environmental legislation pertaining to the Project is maintained in the Environmental Legal and Other

Obligations Register (CORP-EN-LST-1003) and is available on the SMPL OneDrive. The register also summarises all conditions and commitments from approvals and licences. The Environmental Obligations Register is filed on SMPL's Filesite system.

The Senior Environmental Advisor is accountable for maintaining the register.

4 SCOPE AND OBJECTIVES

4.1 Scope

This FHOMP applies to potentially significant direct and indirect impacts of the implementation of the Sorby Hills Project on terrestrial vertebrate fauna (including water birds and migratory birds) and to the habitats that support them in and near the Project area. The Plan specifically relates to the avoidance and management of adverse impacts on fauna protected under Sections 18, 18A, 20 and 20A of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and under the WA *Biodiversity Conservation Act 2016* (BC Act).

This Plan outlines management actions to avoid or mitigate adverse impacts on Matters of National Environmental Significance that may occur in the vicinity of the Project; in particular the Gouldian Finch (*Erythrura gouldiae*), Australian Painted Snipe (*Rostratula australis)* and Northern Crested Shrike-Tit (*Falcunculus frontatus whitei*); and their habitats. These species were selected from the following fauna list following expert assessment by fauna specialists and direction from DCCEEW:

- Eastern Curlew (*Numenius madagascariensis*) – Critically endangered
- Curlew Sandpiper (*Calidris ferruginea*) - Critically endangered, migratory
- Gouldian Finch (*Erythrura gouldiae*) – Endangered
- Red Goshawk (*Erythrotriorchis radiatus*) – Endangered
- Australian Painted Snipe (*Rostratula australis)* – Endangered
- Northern Quoll (*Dasyurus hallucatus*) – Endangered
- Northern Crested Shrike-tit (*Falcunculus frontatus whitei*) – Vulnerable
- Grey Falcon (*Falco hypoleucos*) – Vulnerable
- Ghost Bat (*Macroderma gigas*) – Vulnerable
- Bare-Rumped Sheath-Tailed Bat (*Saccolaimus saccolaimus nudicluniatus*) – Vulnerable
- Fork-tailed Swift (*Apus pacificus*) – Migratory
- Yellow Wagtail (*Motacilla flava*) – Migratory

Invertebrate and subterranean fauna and their habitats are not addressed in this plan.

4.3 Objectives

The objectives of this Plan are to:

- Identify the key Project aspects that have the potential to directly or indirectly impact terrestrial vertebrate fauna.
- Describe what SMPL will do to avoid or mitigate adverse impacts on threatened fauna and their habitats.
- Describe the environmental outcomes that would adequately protect fauna and their habitats.
- Define a set of indicators and associated criteria that will be used to test the attainment of environmental outcomes.
- Describe how evidence will be collected – through monitoring and other means – to enable assessment of the effectiveness of the actions required under this plan.

5 ENVIRONMENTAL MANAGEMENT SYSTEM

Conformance with environmental legal obligations, industry best practice and regulatory guidelines is recognised by SMPL as a critical component of its operations. SMPL is committed to implementing the highest standards of environmental management and will ensure continual improvement in environmental performance over the life of the mine. The SMPL Environmental Management System (EMS) is aligned with the requirements of AS/NZS ISO14001:2016 (*Environmental management systems - Requirements with guidance for use*). The system is designed to ensure that all relevant legal and other requirements are met and that opportunities for continuous improvement are identified, assessed, and (where appropriate) implemented.

The EMS is made up of high-level policy statements and is supported by plans, procedures, registers, lists and other management tools. Implementation of the EMS provides a framework to prevent pollution and manage and minimise environmental impacts (including impacts on biodiversity).

This FHOMP is one of a suite of plans addressing management and monitoring requirements for specified environmental factors.

5.1 Environmental Policy

SMPL maintains a documented Environmental Policy PML-SM-HSE-POL-0002 (the 'Policy'). The Policy applies to all aspects of the Project and applies to all contractors and employees. The Policy is endorsed by SMPL's Managing Director (MD) and is reviewed biennially to ensure it remains relevant to the business. A copy of the current Environmental Policy is provided in Appendix A.

The Policy is communicated and made available to all stakeholders as part of the SMPL Site Induction. Copies of the Policy will also be displayed in prominent locations at the Sorby Hills Mine Site.

5.2 Environmental Management Roles and Responsibilities

5.2.1 SMPL Management Accountabilities

Overall responsibility for the implementation of the SMPL EMS rests with the SMPL MD. Management actions specified in the Project's Environment Management Plan (EMP) and subordinate plans and procedures may be delegated by the MD to specific Project personnel and/or contractors.

Key Project personnel, including the managers, superintendents and supervisors, are required to ensure that all personnel are aware of their responsibilities with respect to environmental matters and that all management actions are undertaken consistently and to a satisfactory standard. A general outline of roles and responsibilities for environmental management is provided in Table 5-1, below.

Table 5-1: Sorby Environmental Management System – Roles and Responsibilities

Role	Responsibility
SMPL MD	• Overall accountability for the environmental management of the Project. • Implementation of the SMPL Environmental Policy.
Site Senior Executive (Site General Manager)	• Support SMPL and contractor personnel in the implementation of the Sorby environmental management system.. • Actively promote environmental excellence and visibly demonstrate the implementation of Sorby environmental management system and related policies.
General Manager Operations	• Ensure that adequate resources including competent personnel are available and processes are in place for the achievement of environmental objectives. • Actively promote environmental excellence and visibly demonstrate the implementation of Sorby environmental management system and related policies.
Manager – Environment and Communities	• Allocate resources and assign responsibilities for the implementation, operation and ongoing improvement of the SMPL environmental management processes. • Overall responsibility to ensure that SMPL meets legal environmental requirements and obligations. • Overall responsibility to ensure that SMPL can meet its environmental objectives and targets. • Overall responsibility to ensure that SMPL manages operations in a manner that reduces environmental risks. • Ensure that environmental accountabilities are included in role descriptions. • Ensure contracts contain relevant and effective environmental provisions. • Ensure that adequate resources including competent personnel are provided and processes are in place for the achievement of environmental objectives. • Ensure that appropriate communications systems are in place so that Project personnel and other stakeholders understand Project environmental requirements. • Actively promote environmental excellence and visibly demonstrate the implementation of the Sorby environmental management system. • Monitor, review and report on environmental performance as required, to the SMPL senior management.
SMPL Senior Environmental Advisor	• Overall responsibility for development, maintenance and compliance with the SMPL EMS, the Sorby EMP and this FHOMP. • Report to Senior Management on matters of environmental compliance and performance. • Provide advice and support to the Area Managers and Contractor Managers to ensure compliance with legal requirements, achievement of environmental objectives, and improving environmental performance. • Review effectiveness and implementation of the SMPL EMS and this management plan. • Ensure SMPL Health Safety and Environment risk management processes are effectively implemented so that environmental risks and opportunities are identified and managed. • Facilitate and/or coordinate environmental auditing and compliance monitoring as required.
SMPL Environment and Communities Department	• Coordinate the delivery of environment and community training to key personnel. • Provide environment and community advice and assistance to personnel as required. • Liaise with Supervisors and Managers to identify and rectify operational environmental issues. • Implement the environmental monitoring, inspection and audit program and oversee the closeout of associated reporting and corrective and preventative actions. • Undertake environmental compliance activities and performance assessments.

Role	Responsibility
	• Facilitate environmental monitoring. • Assist with investigation of environmental incidents and coordination of corrective actions, as required. • Facilitate environmental data provision by line managers/supervisors for environmental compliance reporting. • Maintain all documentation (hard copy files and/or electronic files) for auditing purposes. • Compile environmental data for internal and external reporting. • Undertake all external reporting requirements.
SMPL Communities Advisor	• Administer and manage the stakeholder engagement program. • Manage expectations among communities and other stakeholders and mediate conflict resolution. • Document stakeholder communications.
SMPL GIS Coordinator	• Receive spatial coordinates for all data required to be maintained as part of this plan and associated procedures on the SMPL GIS Database. • Periodically review and update the SMPL GIS Database to ensure it is up-to-date and accurate.
SMPL Area Managers	• Ensure all personnel are inducted, made aware of the requirements of this plan and related procedures prior to commencement of work and are provided with support. • Ensure that relevant requirements of this management plan are communicated and implemented within their area. • Ensure that employees and contractors comply with applicable management actions and procedures.
Contractors	• Overall responsibility for the implementation of the Contractor's EMP and associated procedures. • Ensure key personnel are appointed for the proper performance of the services under their contractual obligations. • Ensure that employees, agents and subcontractors comply with all environmental laws which apply to its services. • Ensure compliance with all environmental guidelines, rules and procedures relevant to SMPL sites. • Report Monthly to the SMPL Environment and Community Department inclusive of data collection requirements and environmental performance. • Conduct environmental training to contractor personnel and ensure that all components of the EMP are understood and adhered to. • Undertake environmental inspections and audits of the workplace. • Investigate environmental incidents and coordinate corrective actions in consultation with the SMPL Environment Department.
SMPL Employees and Contractor Staff	• Comply with the requirements of the EMP and related plans and procedures. • Report all environmental incidents as they occur. • Participation in environmental training, meetings or audits as required.

5.2.2 Contractor accountabilities

All contractors must comply with the requirements of the Sorby EMP and this FHOMP and related procedures and documents. Contractors may develop their own EMP (or integrated HSE Plan) that

addresses environmental risks specifically related to their scope of work. These contractor documents will, as a minimum, align with the requirements of the Sorby EMP (including this FHOMP).

A copy of the Contractor's EMP (or integrated HSE Plan) will be submitted to the SMPL Environmental and Community Department for review and approval prior to the contractor mobilising to site.

Should any conflict or inconsistency be identified between the Contractor's EMP and other Project related documents or requirements, it will be addressed by the relevant SMPL Area Manager in consultation with the SMPL Manager Environment and Communities.

Contractors are expected to be experienced and aware of the environmental issues that specifically relate to their work area and are required to have a working knowledge of the Contractor EMP (or integrated HSE Plan) and this EMP, and associated procedures. Contractor companies will ensure their managers, supervisors, and other relevant staff have had applicable training in the Contractor EMP (or integrated HSE Plan) and this EMP and related procedures.

The contractor will ensure a competent person is always on site to manage environmental issues whilst work is in progress.

Contractors and suppliers are required to confirm goods and services conform to environmental legislation, accepted standards, relevant codes of practice, the Sorby EMP and related procedures.

All spatial environmental data will be provided to SMPL in accordance with the Index of Biodiversity Standards Australia standards.

5.3 Competence, Awareness and Training

5.3.1 Induction

All SMPL staff and contractors working on the Sorby Hills site whose work has the potential to impact fauna or fauna habitats must attend an induction covering the basic requirements of this Plan. The training is to incorporate the following:

- Information to provide a basic understanding of this Plan and site-specific environmental issues.
- Information on threatening factors and activities that could harm fauna or fauna habitats and the need to carry out activities with as little impact as possible.
- An explanation of environmental reporting protocols, complaint procedures and actions required in the event of an incident.
- Information about known environmental hazards relevant to fauna and habitat protection and site emergency preparedness and response plans.
- Explanation of the fauna and habitat protection measures described in Section 6.4.

5.3.2 Training

SMPL maintains a training matrix for both the Safety and Environment training requirements; this matrix is filed on OneDrive. This matrix lists all training required for each position and lists status of competency against each requirement.

The Sorby Hills Mine Manager maintains a register of inducted personnel. The register is to include, as a minimum: date of induction, the name of the person inducted, and elements of the induction delivered. Copies of induction and training records are retained for audit purposes.

Environmental training on site includes conducting awareness training, environmental toolbox meetings and ground disturbance training. Records of environmental training are maintained by the Environment and Community Site Team and filed on OneDrive.

5.4 Management System Documents: Fauna and Habitats

This FHOMP is supported by a range of procedures, registers and forms (Table 5-2).

Table 5-2: Supporting documentation – fauna and habitats

Document reference	Title	Purpose
CORP-EN-PRO-1004	Environmental Procedure - Approval Request and Ground Disturbance	Describes actions to be completed before carrying out any ground disturbing works including, but not limited to, clearing of vegetation.
CORP-EN-REG-1002	Fauna observation/interaction register	A recording system for documenting planned observations and planned or unplanned interactions with fauna, including (for example), observations of fauna at water storage structures and vehicle interactions with fauna.
CORP-EN-PRO-1005	Injured fauna procedure	Explains what to do if an injured animal is encountered.
CORP-EN-PRO-1006	Biosecurity procedure	Describes actions required to limit introduction and spread of pest species.
CORP-EN-WI-1005	Cane toad monitoring and control work instruction	Describes routine monitoring of cane toads and measures to combat cane toad proliferation.
CORP-EN-PRO-1009	Fauna monitoring procedure	Standard procedures for monitoring habitat condition and extent and for collecting information on fauna presence/absence and abundance.
CORP-HS-FRM-1010	Training record form	Captures induction and training records.
CORP-HS-PRO-1005	Incident classification and reporting procedure	Documents incidents (including 'near-miss' events) involving fauna interactions, unplanned impacts on habitat.
CORP-EN-PRO-1010	Waste management procedure	Describes how putrescible and other non-process wastes are to be managed to prevent pollution and harm to animals.

Records arising from the implementation of this Plan may include:

- permits, approvals
- training records
- consultation/meeting records
- completed checklists

- monitoring program results
- inspection and audit reports
- environmental incident / non-conformance reports
- corrective and preventative actions
- equipment maintenance and calibration records
- statutory compliance and performance reports

Records must be legible, identifiable and traceable to the activity to which they relate. All records are protected and can only be accessed by authorised personnel.

SMPL uses OneDrive to maintain records of obligations, audits, stakeholder consultation, corrective actions, incidents and investigations.

Spatial data are stored and updated using ArcGIS. Records such as monitoring and survey results, area cleared, and area rehabilitated must be sent to the SMPL GIS Coordinator for upload into ArcGIS in accordance with the SMPL Environmental Procedure – Environmental and Heritage Data Management CORP-EN-PRO-1045, and the SMPL Environmental Procedure – Approval Requests and Ground Disturbance CORP-EN-PRO-1004.

SMPL Departments and Contractors are required to forward all ground disturbance records generated to the SMPL Environment and Community Department on a monthly basis via email.

Copies of all records, reports and correspondence will be kept on site and made available to any authorised regulatory authority upon request.

5.5 Checking

5.5.1 Routine monitoring

The Sorby Hills Environment Manager is required to ensure that monitoring required to inform and support fauna and habitat protection is carried out in accordance with this Plan. Monitoring and testing activities will be undertaken by the nominated SMPL staff or specialist environmental agencies/consultants.

All instruments and devices used for the measurement or monitoring of any parameter under any condition of this Plan must be calibrated in accordance with relevant standards and appropriately operated and maintained. Table 5-3 details monitoring activities related to the protection of threatened fauna and habitats

Table 5-3: Fauna and habitat monitoring activities

Activity	Frequency	Procedure
Dust Monitoring	Monthly	Dust Monitoring Procedure
Ground Disturbance	Monthly	Ground Disturbance Procedure
Weed Inspection	Annual	EMP
Rehabilitation Monitoring	Annual	EMP
Surface Water Monitoring	Following flood events	Surface Water Procedure
Feral Animal Activity	Ongoing	EMP
Threatened fauna register	Ongoing	EMP
Inspection of Water Infrastructure	Annual	Surface Water Procedure
Groundwater Monitoring	As per GWOS	Groundwater Operating Strategy (GWOS)
Heavy metal analysis (Bird Feathers)	Quarterly	Fauna Management Procedure
Soil and Sediment Monitoring	Quarterly	Heavy Metals Survey and Management Procedure
Planned observations of presence/absence of birds and/or other fauna at TSF	Daily	TSF Daily Inspections
Monitoring of TSF supernatant water quality	Monthly	TSF Operating Manual

The monitoring schedule is maintained within the SMPL Environmental Operations Workload Plan filed on OneDrive. All monitoring data are entered into associated electronic data registers and retained within the SMPL EMS management system on OneDrive.

5.5.2 Audit and Compliance

SMPL is required to demonstrate that it has evaluated compliance with both external requirements, such as conditions of Ministerial Statements, licences and permits, as well as internal requirements, such as conformance with SMPL procedures. The Manager - Environment and Communities will ensure that evaluation of compliance is undertaken as required.

5.5.2.1 Internal Audits and Inspections

Compliance audits of the Project, including contractor activities, will be conducted by the SMPL Environment and Community Department.

Project audits and inspections are conducted according to SMPL Environment and Community Department inspection and audit schedules (OneDrive). The audit and inspection schedules are maintained by the SMPL Environment and Communities Department and include details of proposed dates for the audits and inspections at required work sites across the Project and the personnel

involved in the audits and inspections. The audit and inspections schedules will be risk-based: higher risk activities will be the subject of increased audit and inspection.

Environmental audits and inspections will include:

- area and task specific inspections – these will typically be documented using inspection checklists
- SMPL EMS audits – these will be documented in audit reports
- audits against legal obligations to ensure compliance
- contractor EMS audits (for major contractors only) – these will be documented in audit reports
- ad hoc audits requested by SMPL or the SMPL contractor – these will be documented as best fits to suit the scope and intended outcomes of the audit

The findings of compliance and performance audits will be recorded in OneDrive and will include the allocation of actions to responsible persons and agreed timeframes for the implementation of corrective actions. Actions will be tracked to close out via OneDrive.

5.5.2.2 Contractor Inspections

Contractors must conduct environmental (or combined health, safety and environmental) inspections at regular intervals. The intervals at which inspections must be completed are described in the Contractors EMP. Records of contractor inspections will be maintained onsite.

Contractors must submit copies of completed inspection forms to the SMPL Environment and Communities Department.

5.5.2.3 External Audits

External audits will be undertaken as required to review the effectiveness and efficiency of this Plan. For such audits, a representative from SMPL's Environment and Community Department will accompany the auditors at all times. External audits/inspections may include compliance audits or inspections requested by – or conducted by – state or federal regulators.

The findings and recommendations arising from external audits will be recorded in InControl and managed to close out actions in agreed timeframes.

5.6 Incidents, Non-compliance and Non-conformance

5.6.1 Terminology

An environmental incident is defined as an unplanned event that causes (or could have caused) environmental impacts or harm.

A non-compliance means a failure to adhere to statutory conditions set out in Project approval documents, including EPBC 2023/09576. Failure to achieve environmental performance measures and/or offset outcomes described in the Plan is a non-compliance of Conditions 6a and 6b of EPBC approval 2023/09576.

A non-conformance means a deviation from commitments or actions described in this plan but not explicitly required under statutory approvals.

5.6.2 Incident Reporting and Investigation

The purpose of incident reporting and investigation is to identify the root cause of the event and implement controls to prevent the recurrence of the incident.

When an environmental incident/complaint is detected, appropriate action shall be taken immediately by the person who observes the incident to mitigate impact before reporting the incident to their supervisor. The supervisor will inform the Mine Manager or her/his delegate, who will, in turn, ensure that the incident is properly investigated, necessary actions to prevent impact and recurrence are completed, and all statutory and internal reporting is completed.

All environmental incidents/complaints must be reported by relevant personnel to their supervisor as soon as possible. Environmental incidents are to be reported by the Registered Manager to the relevant authorities in accordance with the "*Guidance Note on Environmental Non-compliance and Incident Reporting*" (DMIRS, 2018a) using the Environmental & Reportable Incident/Non-compliance Reporting Form (DMIRS, 2018b). A flow diagram of SMPL's environmental incident management process is shown in Figure 5-1.

Any non-conformances to the procedures of this Plan are to be recorded in accordance with the SMPL's Incident Investigation Form. Records of incidents/events are documented in the 'InControl' system.

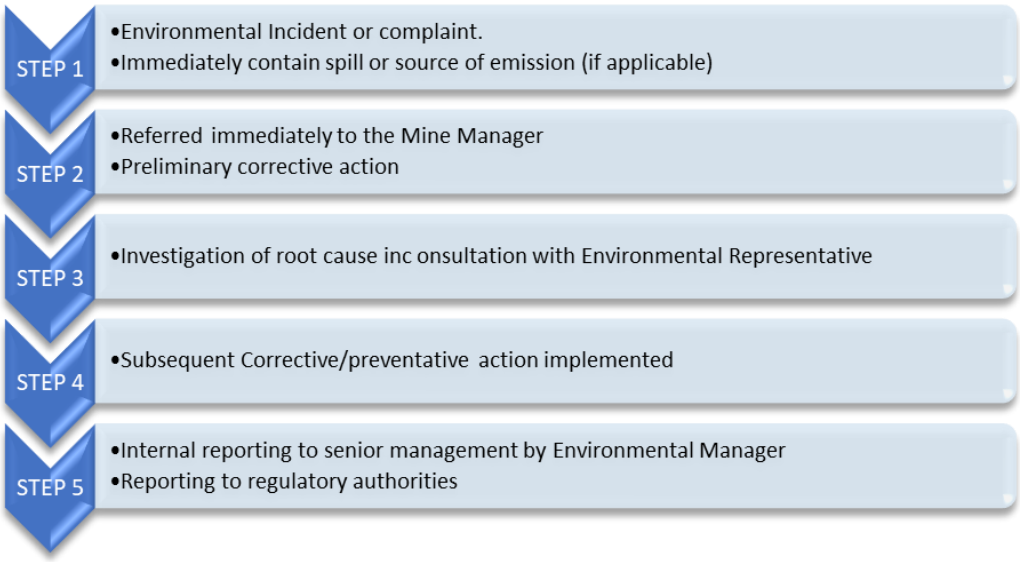

Figure 5-1: Environmental incident management process

Incidents and non-compliances must be reported to relevant administering authorities. Approval conditions under the EPBC Act require SMPL to notify incidents and non-compliance matters to DCCEEW as soon as practicable, and no later than 5 business days after becoming aware of the incident or non-compliance. Notifications must be in writing and must include:

- details of which statutory condition (if any) may be in breach
- a short description of the incident and/or non-compliance
- the location (including coordinates), date and time of the incident or non-compliance event.

Further details of the incident or noncompliance event must be provided to DCCEEW no later than 21 business days after becoming aware of the incident or non-compliance. The follow-up report must include information about:

- any proposed or completed corrective action or investigation
- the potential impacts of the incident or non-compliance
- the method and timing of proposed remedial actions (if any).

5.7 Continuous Improvement

Continuous improvement is an important aspect of the SMPL's EMS. As part of its efforts to continuously improve its environmental performance, SMPL requires management plans – including

this plan – to be reviewed at least every two years. Changes to this FHOMP may be required if monitoring and review activities find that the plan:

- needs to be modified to continue to meet conditions of statutory approval
- is not achieving the required standards of environmental protection
- no longer represents the current and/or appropriate practice

Amendments and updates to the EMS for the Sorby Hills Mine Site will be a key mechanism in promoting continuous improvement and ensuring the site remains a safe and effective working environment with minimal environmental impact. If changes to this plan are proposed, SMPL's approval under the EPBC Act requires the company to apply to the Minister for a variation to the approved plan.

5.8 Emergency Planning, Preparedness and Response

The response procedures required in the case of an environmental emergency are described in the following documents:

- SMPL Health and Safety Plan - Emergency Response Plan CORP-HS-PLN-1003
- SMPL Health and Safety Plan - Crisis Management and Recovery Plan CORP-HS-PLN-1004
- SMPL Health and Safety List – Emergency Contact List CORP-HS-FRM-1095

These documents outline

- relevant roles and responsibilities
- response and recovery procedures
- communication procedures including emergency on-site and off-site contact numbers

SMPL maintains appropriate emergency response equipment and materials onsite, which are periodically inspected and tested to ensure that they are maintained in a working order.

5.9 Communication and Reporting

5.9.1 Internal Communication

Internal communication of environmental information and discussion of environmental issues including actions required to protected threatened fauna and their habitats will be effected through:

- senior leadership meetings
- monthly and quarterly performance reporting

- contractor toolbox meetings
- environmental incident reporting
- site bulletins
- environmental training packages
- site notice boards

Progress on the implementation of this FHOMP will be communicated via monthly environmental reporting and in SMPL Environment/Compliance meetings.

5.9.2 External Communication

Communication of environmental information between key stakeholder groups is undertaken in accordance with the SMPL Stakeholder Engagement Plan. Key stakeholder groups include regulators, employees, local communities, landowners (including holders of Native Title), contractors, service providers, shareholders and industry. Feedback will be sought from stakeholders on a regular basis and considered in environmental management. The Stakeholder Engagement Plan details accountabilities for external communication.

5.9.3 Compliance Reporting

5.9.3.1 Internal Compliance Reporting

The SMPL Environment and Community Department undertakes a monthly review of SMPL's compliance and performance. The monthly review includes, as a minimum, a review of:

- monitoring – compliance with monitoring requirements and results of monitoring
- performance against objectives and targets
- incident reports
- overdue actions

Compliance/performance updates are included in the monthly operations report to senior management.

5.9.3.2 External Compliance Reporting

Compliance reporting under the Project's EPBC approval (2023/09576) is required for each 12-month period following Project commencement. For each reporting period, SMPL will:

- publish the compliance report on its website within 60 business days following the end of the 12-month reporting period; and
- notify DCCEEW by email that a compliance report has been published on the SMPL website and provide a weblink for the compliance report within five business days of the date of publication.

All EPBC approval compliance reports will be kept publicly available on SMPL's website until Project completion. Sensitive ecological information (if any) will be redacted from the publicly available reports. In the event that reports are redacted to protect sensitive information, SMPL will, within 5 business days of publication, notify the DCCEEW that the report has been redacted and provide an unredacted version of the compliance report to DCCEEW.

Reporting to WA regulatory authorities will be undertaken annually in the Annual Environmental Report (AER) under the Mining Act, and the Compliance Assessment Plan developed under Condition 4-2 of Ministerial Statement 964.

6 POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

6.1 Threats to Matters Protected Under the EPBC Act

SMPL has reviewed relevant literature and compiled a summary of threatening factors that could impact protected fauna that may occur – or whose habitat may be present – in the Project area (Table 6-1 and Table 6-2).

The key threatening factors (many of which are not caused by Project activities) identified through the process included, but were not limited to:

- loss or fragmentation of foraging or breeding habitat through direct impacts (ground disturbance)
- loss or decline in quality of habitat due to inappropriate fire regimes
- habitat impairment due to pastoral grazing
- introduction and spreading of weeds
- changes in hydrology (including through drainage and the diversion of water for agriculture or other purposes and construction of large dams)
- disturbance of / inference with breeding, roosting or feeding areas by humans or dogs
- ingestion of cane toad toxins
- predation by introduced carnivores.

Maps showing the regional extents of habitat assessed as being potentially suitable breeding or non-breeding habitat are presented for the following species:

- Gouldian Finch (Figure 6-1), and Australian Living Atlas details in Figure 6-6;
- Red Goshawk (Figure 6-2);
- Northern Quoll (Figure 6-3);
- Australian Painted Snipe (Figure 6-4), and Australian Living Atlas details in Figure 6-7;
- Northern Crested Shrike-tit (Figure 6-5), and Australian Living Atlas details in Figure 6-8;

No regional maps showing the extent of occurrence of habitat for the following species are provided for the below listed species, as no habitat suitable for these species has been mapped within the Project development envelope:

- Curlew Sandpiper
- Eastern Curlew

- Grey Falcon
- Ghost Bat
- Fork-tailed Swift
- Yellow Wagtail
- Bare-rumped Sheath-tailed Bat

Figures showing the nearest records of occurrence of each of the threatened species considered in this FHOMP are provided in Appendix 2.

Table 6-1: Summary of threatening factors – critically endangered and endangered species

Threats	Eastern Curlew *(Numenius madagascariensis)*	Curlew Sandpiper *(Calidris ferruginea)*	Gouldian Finch (*Erythrura gouldiae*)	Red Goshawk (*Erythrotriorchis radiatus*)-	Australian Painted Snipe (*Rostratula australis*) -	Northern Quoll (*Dasyurus hallucatus*)
	Critically endangered, migratory	Critically endangered, migratory	Endangered	Endangered	Endangered	Endangered
Contextual information	Nearest nationally important habitat lies ~60km NNE of Project area. Roosting trees normally occur within ~30 km of coastal feeding areas. Nearest internationally important habitat lies ~732 km SW of Project area. Non-breeding season is mostly spent in Australia, but birds are rarely seen inland and mostly stay in coastal areas (intertidal mudflats and sandflats, estuaries, mangrove swamps, bays, harbours and lagoons). Mostly feed on molluscs and crabs.	Have mostly been recorded in most coastal areas. Key locations in WA include the Eyre Bird Observatory, Port Headland Saltworks, Eighty Mile Beach, Roebuck Bay and Lake MacLeod. The species is widespread around the coastal and subcoastal plains of Western Australia. Nearest nationally important habitat lies ~60km NNE of Project area. Nearest internationally important habitat lies ~732 km SW of Project area. Birds generally forage within mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm deep. Feeding habitat includes exposed sandy or soft mud substrates on intertidal flats and beaches and may also occur at inland wetlands when conditions are suitable. Diet consists of polychaete worms, molluscs, crustaceans (such as amphipods, brine shrimps and copepods), and occasionally insects and seeds.	Known breeding habitat for Gouldian Finches in the NT and WA is characterised by rocky hills with hollow-bearing smooth-barked gums (*Eucalyptus brevifolia* or E. *tintinnans*) within 2 to 4 kilometres of small waterholes or springs that persist throughout the dry season. An understorey of suitable foraging grasses is typically an important component of breeding habitat. Dry season feeding habitat is dominated by annual spear grasses or native sorghum (Sarga species), and in the wet season birds shift to feeding from scattered patches of cockatoo grass, golden beard grass or spinifex-dominated communities. Other important wet season grasses include giant spear grass white grass, rice grass and kangaroo grass	Favoured areas for feeding contain permanent water, as they are relatively fertile and biologically rich, and support large populations of bird prey species. Wetlands also constitute important foraging habitat, particularly during the winter months. The species has a home range of approximately 200km2. Red goshawks typically breed in trees >20 m tall (range 14 –40.5 m) with an open limb and canopy structure, within ~1 km of permanent water. These trees commonly occur in proximity to, or along, a watercourse or wetland. The species rarely breeds in fragmented area. In northern Australia breeding typically occurs in the dry season (from May to October).	Typically inhabits shallow freshwater and brackish wetlands, especially where inundation is temporary, but also permanent wetlands with shallow zones. In the inland areas gilgai wetland surfaces and shallow wetlands with areas of bare wet mud and mixed heights of low vegetation. are favoured, especially for nest sites. Eats plant material, seeds, insects, worms and molluscs, crustaceans and other invertebrates. Foraging habitat requirements are not well understood. Flooded Bauhinia wetlands may provide suitable habitat in some years.	Preferred habitat usually consists of rocky areas where there is abundant shelter, but also occurs in wooded areas where there are tree hollows or occasionally termite mounds. Quolls are predominantly nocturnal and consume a wide range of prey including insects, small vertebrates, including snakes, bats, rodents, frogs and cane toads. They also eat fruit, nectar, eggs, carrion and human refuse. Females maintain territories of about 35 hectares, with males estimated to range over 150 hectares. Quolls have not been recorded in the Project area and apparently not recorded in the region around Kununurra but are abundant in some other parts of the Kimberley.
Relevance to Sorby Hills Project	The Sorby Hills Project is outside of the suitable habitat for coastal feeding or roosting. Closest recording from the Atlas of Living Australia (ALA) is over 100km from the site, with all records associated with coastal landscapes.	Roosting mainly occurs around intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons and also around non-tidal swamps, lakes and lagoons near the coast. Roosting habitat consists primarily of large intertidal sandflats, spits and banks. Less frequently, roosting occurs within mudflats, estuaries, coastal lagoons and bays. These sites are often near beds of seagrass and sometimes near saltmarshes. Closest recording from the Atlas of Living Australia (ALA) is over 75km from the site, with all records associated with coastal landscapes.	There is a slight chance of nesting where the lower slopes of the Pincombe Range lie within the Project area and support eucalypts. An estimated 29 ha of potential breeding habitat lies within the Project development envelope. Foraging habitat is regionally extensive. The Sorby Project area is almost certainly foraging habitat for the species both during and outside the breeding season. The Gouldian Finch is known to occur in the Goomig reserve, directly adjacent to the Project, and the Keep River National Park (ALA, 2024).	There are no areas of suitable breeding habitat within the Project development envelope, but some to the south and large areas of suitable habitat to the north. These are areas of tall woodland compared with the low woodland of the Project area and adjacent Pincombe Range. The closest Red Goshawk record is located over 110km from the site (ALA, 2024)	Australian Painted Snipe have not been recorded in the Project development envelope, but may be present in small numbers in some years when water levels provide suitable habitat across the Bauhinia woodlands. Nearest record of Painted Snipe is from the Lake Argyle area about 80 km to the south of the Project area (ALA, 2024).	Potentially suitable habitat has been mapped to the north of the Project area, with a small patch of possibly suitable habitat on the western edge of the Project area. High abundance of cane toads in Project area may have impacted quolls. The is no records within the vicinity of the Project (ALA, 2024), with the closest records of the species being the Parry Lagoons Nature Reserve (150km west) and the Bradshaw Field training Area (250km east).
Loss of feeding habitat (intertidal flats) due to shoreline development (including aquaculture, residential and commercial development, port development).*	✓ No direct or indirect impacts from the Project related to this threat. No suitable habitat occurs associated with this threat.	✓ No direct or indirect impacts from the Project related to this threat. No suitable habitat occurs associated with this threat.				
Loss of feeding habitat due to infrastructure and/or mining development			✓ Feeding habitat likely occurs within the Project area, however, would only form a small amount of the total habitat within the region. Recent monitoring completed on behalf of DPIRD have not identified any of the species occurring in the local area.			

Threats	Eastern Curlew (*Numenius madagascariensis*)	Curlew Sandpiper (*Calidris ferruginea*)	Gouldian Finch (*Erythrura gouldiae*)	Red Goshawk (*Erythrotriorchis radiatus*)-	Australian Painted Snipe (*Rostratula australis*) -	Northern Quoll (*Dasyurus hallucatus*)
	Critically endangered, migratory	Critically endangered, migratory	Endangered	Endangered	Endangered	Endangered
Loss of nesting / denning habitat due to fire.			✓ Indirect impact to habitat may occur from accidental fires from mining activities.	✓ Unlikely to occur as the roosting habitat associated with this species is not located adjacent or within ~4km of the Project.		✓ Indirect impact to habitat may occur from accidental fires from mining activities.
Loss or fragmentation of nesting / denning / roosting habitat (tree hollows, rocky habitats, caves) due to clearing for agriculture, infrastructure, mining	✓ No disturbance or fragmentation of roosting or nesting habitat is to occur.	✓ No disturbance or fragmentation of roosting or nesting habitat is to occur.	✓ Direct clearing of 16.1 ha habitat occurs within the development envelope, however, no birds were identified within the roosting or survey area.	✓ Unlikely to occur as the roosting habitat associated with this species is not located adjacent or within ~4km of the Project.		✓ 1.05ha of habitat occurs within the development envelope, however, this area shall be avoided. No disturbance or fragmentation of habitat is to occur.
Declining food resources due to unfavourable fire regimes.			✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.		
Declining food resources or reduction in habitat condition due to grazing pressure.			✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.
Declining food resources or reduction in habitat condition due to weed incursion.					✓ Indirect impact to habitat may occur from accidental weed incursion from mining activities.	✓ Indirect impact to habitat may occur from accidental weed incursion from mining activities.
Invasion of mudflats / coastal salt marshes by cordgrass, mangroves of other invasive species.	✓ No direct or indirect impacts from the Project related to this threat. No suitable habitat occurs associated with this threat.	✓ No direct or indirect impacts from the Project related to this threat. No suitable habitat occurs associated with this threat.				
Changes in hydrology (including through drainage and the diversion of water for agriculture, construction of large dams and sealevel rise*), loss of wetland habitat due to agriculture	✓ The Project is located on floodplain, however, is not designed to restrict or divert hydrology further than the impacts from agriculture.	✓ The Project is located on floodplain, however, is not designed to restrict or divert hydrology further than the impacts from agriculture.		✓ The Project is located on floodplain, however, is not designed to restrict or divert hydrology further than the impacts from agriculture.	✓ The Project is located on floodplain, however, is not designed to restrict or divert hydrology further than the impacts from agriculture.	
Disturbance at feeding and roosting sites (by dogs or humans, for example).	✓ There are no roosting or feeding sites within the Project footprint.	✓ There are no roosting or feeding sites within the Project footprint.				
The increased frequency and length of droughts		✓ The Project is unlikely to impact on frequency or length of droughts.				
Chronic or acute pollution						

Threats	Eastern Curlew (*Numenius madagascariensis*)	Curlew Sandpiper (*Calidris ferruginea*)	Gouldian Finch (*Erythrura gouldiae*)	Red Goshawk (*Erythrotriorchis radiatus*)-	Australian Painted Snipe (*Rostratula australis*) -	Northern Quoll (*Dasyurus hallucatus*)
	Critically endangered, migratory	Critically endangered, migratory	Endangered	Endangered	Endangered	Endangered
Poisoning by pesticides				✓ The Project does not require the use of pesticides and there is no foraging habitat mapped within the Project area.		
Lethal ingestion of Cane Toad toxin						✓ Cane toads are proliferating in the region; waste management and landfill activities may increase the cane toad numbers locally.
Predation by introduced species (cats, foxes)						
Collision with vehicles						✓ The Project will increase the number of vehicles locally; however, none of the roads directly intersect quoll habitat.
Collision with powerlines or fences						
Disruption by noise / vibration						
Light impacts on foraging behaviour						
Competition for tree hollows (from bees, for example)						

Note: grey cells are not confirmed threatening factors based on available conservation advice and relevant published technical studies. A tick mark (✓) signifies that the threatening factor has been identified as applicable to the species in relevant literature (for example in a current Recovery Plan) but may not be applicable at the Sorby Hills site.

Table 6-2: Summary of threatening factors – vulnerable and migratory species

Threats	Northern Crested Shrike-tit (*Falcunculus frontatus whitei*)	Grey Falcon (*Falco hypoleucos*)	Ghost Bat (*Macroderma gigas*)	Bare-Rumped Sheath-Tailed Bat (*Saccolaimus saccolaimus nudicluniatus*)	Fork-tailed Swift (*Apus pacificus*)	Yellow Wagtail (*Motacilla flava*)
	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Migratory	Migratory
Contextual information	Populations occur at very low density, with groups of two to five individuals occurring over widely spaced intervals (up to 20 km apart). Each group probably occupies a large home range (in the order of 20 ha). Thought to forage for invertebrates, mostly in foliage, branches and the trunk and bark across a range of eucalypt and other tree species. Flakey-barked bloodwoods (Corymbia spp.) are favoured, particularly in areas subject to seasonal inundation. Seasonally inundated Paperbark Woodlands may also provide suitable habitat. Extensive suitable and potentially suitable habitat (in the order of 259,000ha) occurs in the north Kimberley region.	Species is mainly found where annual rainfall is less than 500 mm and is essentially confined to the arid and semi-arid zones. Frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. Normally nests in tall trees along watercourses, particularly River Red Gum and Coolibah, but can also nest in telecommunication towers. Prey species include doves, pigeons, small parrots and cockatoos, finches and other bird species. May also eat small mammals.	Ghost bats are widespread and common in the Kimberley but may have decline in abundance due to impact of cane toads. Roost sites include caves, rock crevices and disused mine adits. The species typically roosts in large deep caves that provide stable conditions of temperature and humidity. Foraging typically occurs within 10 to 15 km of roosting site. Species is known to forage in productive areas including around waterholes and riparian zones but direct evidence of visits for drinking are rare. It is reported that bats are unlikely to drink saline water (salinity over 3000 mg/L to 6000 mg/L).	In Australia, all confirmed roosting records are from deep tree hollows in Eucalyptus trees. The species is mainly predicted to occur within 40 km of the coast (where habitat is suitable). Outside Australia, the species has been reported to roost in structures, such as the eaves of houses; between boulders; and in caves. Bare-rumped sheathtail bats are insectivorous and forage aerially.	Does not breed in Australia. Found across a range of habitats, from inland open plains to wooded areas. Almost entirely aerial species when in Australia. Forages on insects within a few metres to several hundred metres above the ground. Threatening factors have not been defined.	Widespread, but very uncommon, insectivorous bird associated with near wetland habitats (marshland, grassy and muddy lakeshores). Does not breed in Australia. Roosts in mangroves and other dense vegetation. Nearby agricultural land (e.g. Weaber Plains) may attract small numbers of birds due to available habitat such as open reticulated grassland. Species is much less likely in the Project area where suitable habitat is limited.
Relevance to Sorby Hills Project	No habitat considered by Shedley (2012) to be suitable occurs within the Project area. Most of the trees in the Project development envelope are smooth-barked eucalypts and bloodwoods rather than flakey-barked Corymbia, and there were few if any paperbarks present. Therefore, the habitat in the Project area is considered of low suitability. The closest ALA record is in the Bradshaw Field Training Area, approximately 250km east of the Project area in 1977, with more recent results (2021 and 2022) located almost 400km away.	Grey falcons have not been recorded in the Project area and habitat may not be suitable: rainfall in the Project area is probably too high and vegetation structure not suited to the species. A Grey Falcon has been identified on the southern edge of the Goomig Reserve (50km southeast) in areas of larger vegetation. All other sightings are along river systems in vegetation / habitat that doesn't occur within the Project footprint.	There is no roosting habitat in the Project area and the Ghost Bat has not been recorded in surveys within the Project area. However, it was detected nearby within a few kilometres to the north and to the south of the Project development envelope in 2005. Species may be an irregular foraging visitor to the Project area but does not roost there. The most recent recording is in 2019 50km north-east of the Project (ALA, 2024).	The species has not been recorded within the Project area or nearby. No confirmed records are known from Western Australia. The closest records are new Darwin, over 600km from the site (ALA, 2024).	As this species is almost entirely aerial in Australia, no habitat has been described by DCCEEW of this species. As this Project does not include aerial impacts, there is unlikely to be any impact on this species from the development, and no habitat exists. The species has been observed locally, with one recording from 2022 approximately 10km from site. However, the record notes "Kununurra Airport" which is a further 40km south-east of the Project.	Flooded edges of tracks in the Bauhinia woodlands may be suitable temporary habitat that might very occasionally attract small numbers of birds. The species has been observed locally, with one recording from 2022 approximately 10km from site. However, the record notes "Kununurra Airport" which is a further 40km south-east of the Project.
Loss of feeding habitat (intertidal flats) due to shoreline development (including aquaculture, residential and commercial development, port development).						
Loss of feeding habitat due to infrastructure and/or mining development						
Loss of nesting / denning habitat due to fire.	✓ Indirect impact to habitat may occur from accidental fires from mining activities.					
Loss or fragmentation of nesting / denning / roosting habitat (tree hollows, rocky habitats, caves) due to clearing for agriculture, infrastructure, mining	✓ Direct clearing of 12.5 ha habitat occurs within the development envelope, however, no birds were identified within the roosting or survey area.		✓ No disturbance or fragmentation of roosting or nesting habitat is to occur.	✓ No disturbance or fragmentation of roosting or nesting habitat is to occur.		

Threats	Northern Crested Shrike-tit (*Falcunculus frontatus whitei*)	Grey Falcon (*Falco hypoleucos*)	Ghost Bat (*Macroderma gigas*)	Bare-Rumped Sheath-Tailed Bat (*Saccolaimus saccolaimus nudicluniatus*)	Fork-tailed Swift (*Apus pacificus*)	Yellow Wagtail (*Motacilla flava*)
	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Migratory	Migratory
Declining food resources due to unfavourable fire regimes.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.					
Declining food resources or reduction in habitat condition due to grazing pressure.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.	✓ Limited fire regimes have occurred historically, due to the area being used for cattle grazing. As such, the site is considered heavily degraded with limited food resources.		
Declining food resources or reduction in habitat condition due to weed incursion.	✓ Indirect impact to habitat may occur from accidental weed incursion from mining activities.					
Invasion of mudflats / coastal salt marshes by cordgrass, mangroves of other invasive species.						
Changes in hydrology (including through drainage and the diversion of water for agriculture, construction of large dams and sealevel rise), loss of wetland habitat due to agriculture						✓ The Project is located on floodplain, however, is not designed to restrict or divert hydrology further than the impacts from agriculture.
Disturbance at feeding and roosting sites (by dogs or humans, for example).			✓ There are no roosting or feeding sites within the Project footprint.			
The increased frequency and length of droughts						✓ The Project is unlikely to impact on frequency or length of droughts.
Chronic or acute pollution			✓ No chronic or acute pollution is to occur.			✓ No chronic or acute pollution is to occur.
Poisoning by pesticides						
Lethal ingestion of Cane Toad toxin			✓ Cane toads are proliferating in the region; waste management and landfill activities may increase the cane toad numbers locally.			
Predation by introduced species (cats, foxes)		✓ The Project is likely to increase the abundance of feral animals due to clearing and landfilling activities.				

Threats	Northern Crested Shrike-tit (*Falcunculus frontatus whitei*)	Grey Falcon (*Falco hypoleucos*)	Ghost Bat (*Macroderma gigas*)	Bare-Rumped Sheath-Tailed Bat (*Saccolaimus saccolaimus nudicluniatus*)	Fork-tailed Swift (*Apus pacificus*)	Yellow Wagtail (*Motacilla flava*)
	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Migratory	Migratory
Collision with vehicles		✓ The Project will increase the number of vehicles locally; however, there is no roosting or foraging habitat within the Project footprint and surrounds.	✓ The Project will increase the number of vehicles locally; however, there is no roosting or foraging habitat within the Project footprint and surrounds.			
Collision with powerlines or fences		✓ The Project will include the installation of powerlines; however, there is no roosting or foraging habitat within the Project footprint and surrounds.	✓ The Project will include the installation of powerlines; however, there is no roosting or foraging habitat within the Project footprint and surrounds.			
Disruption by noise / vibration			✓ The Project will increase the amount of noise and vibrations in the immediate area; however, there is no roosting or foraging habitat within the Project footprint and surrounds.			
Light impacts on foraging behaviour			✓ The Project will increase the amount of light in the immediate area; however, there is no roosting or foraging habitat within the Project footprint and surrounds.			
Competition for tree hollows (from bees, for example)				✓ There is no suitable habitat within the Project		

Note: grey cells are not confirmed threatening factors based on available conservation advice and relevant published technical studies. A tick mark (✓) signifies that the threatening factor has been identified as applicable to the species in relevant literature (for example in a current Recovery Plan) but may not be applicable at the Sorby Hills site.

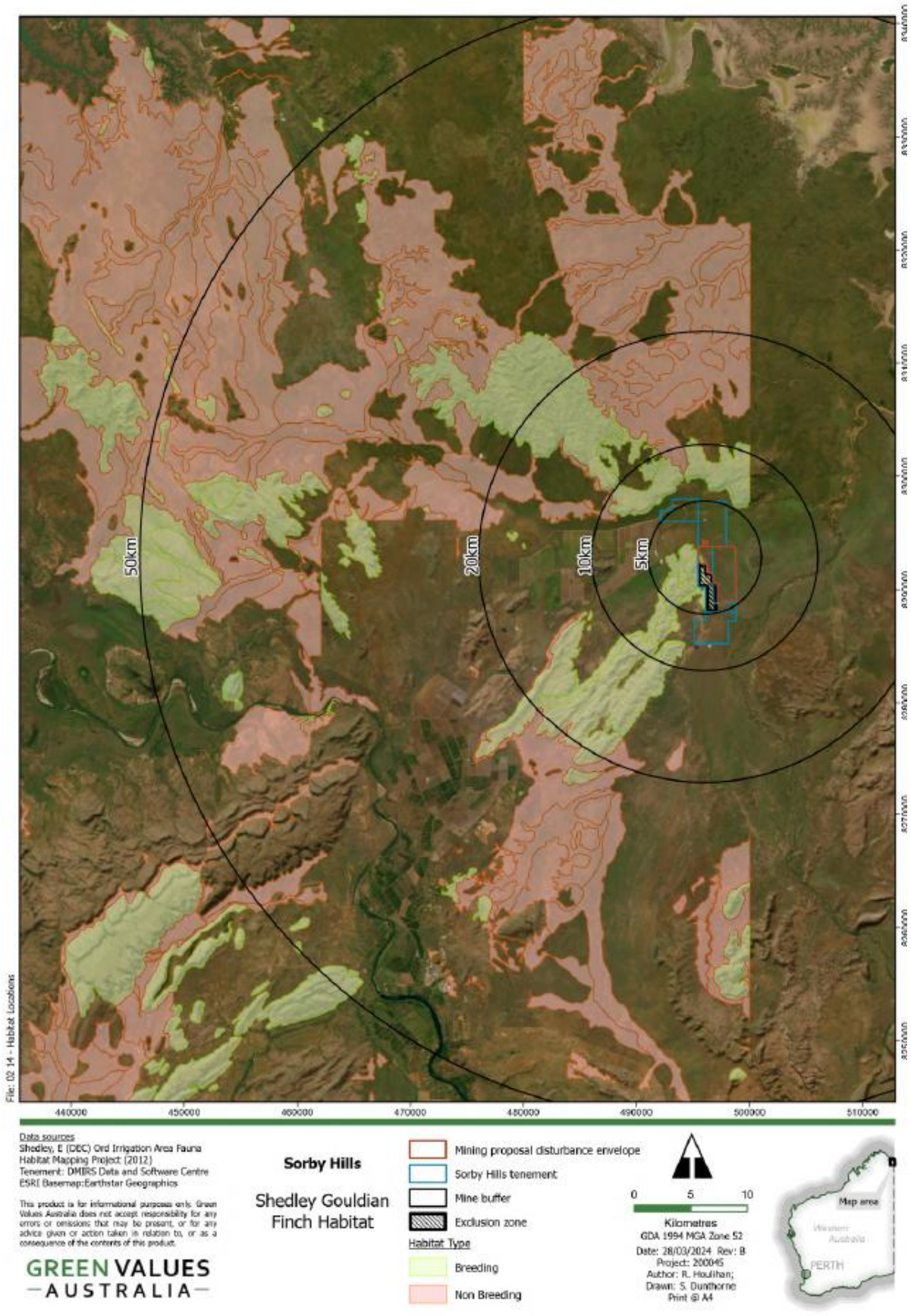

Figure 6-1: Regional habitats – Gouldian Finch Data source: Shedley, E (2012)

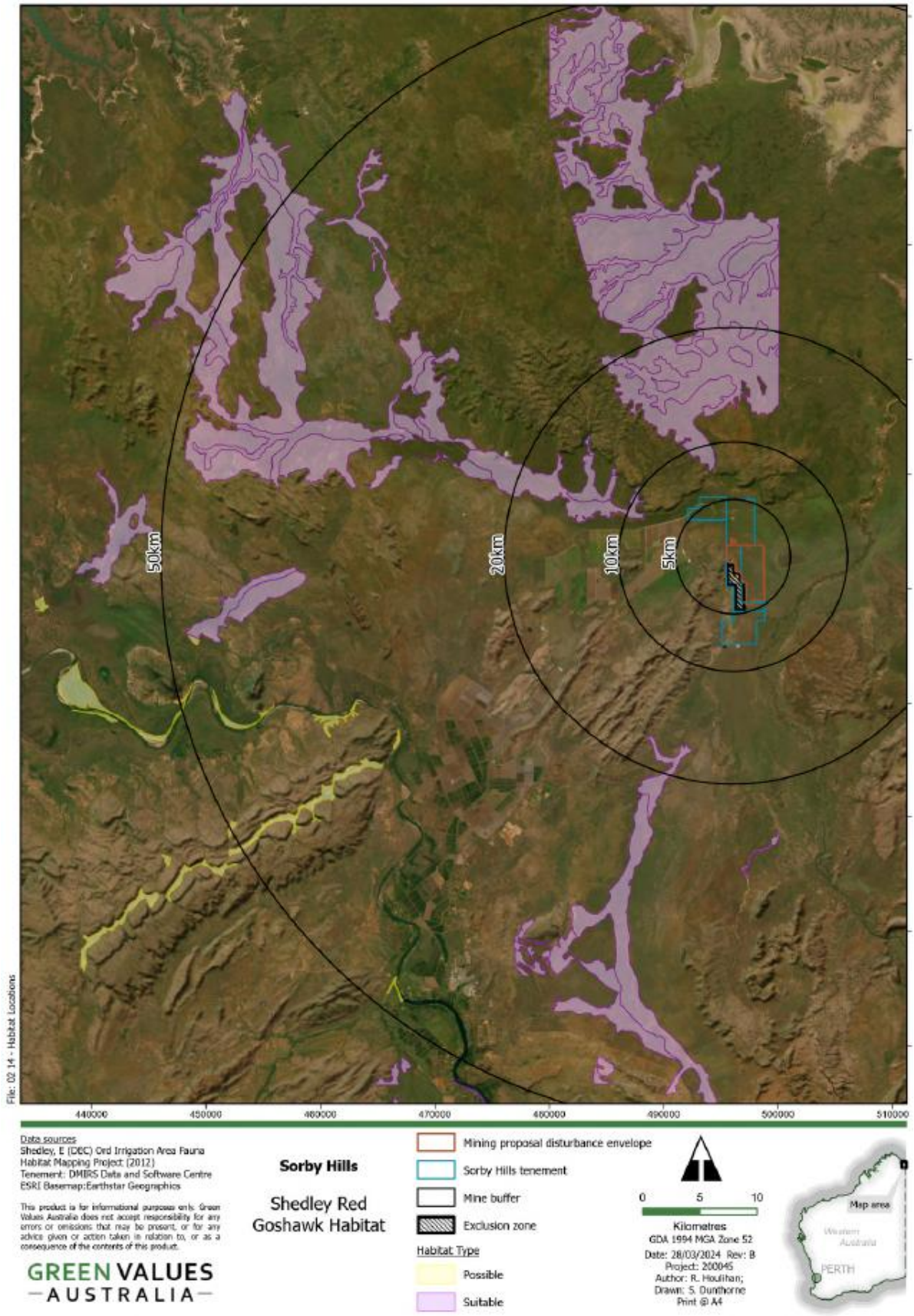

Figure 6-2: Regional habitats – Red Goshawk - Data source: Shedley, E (2012)

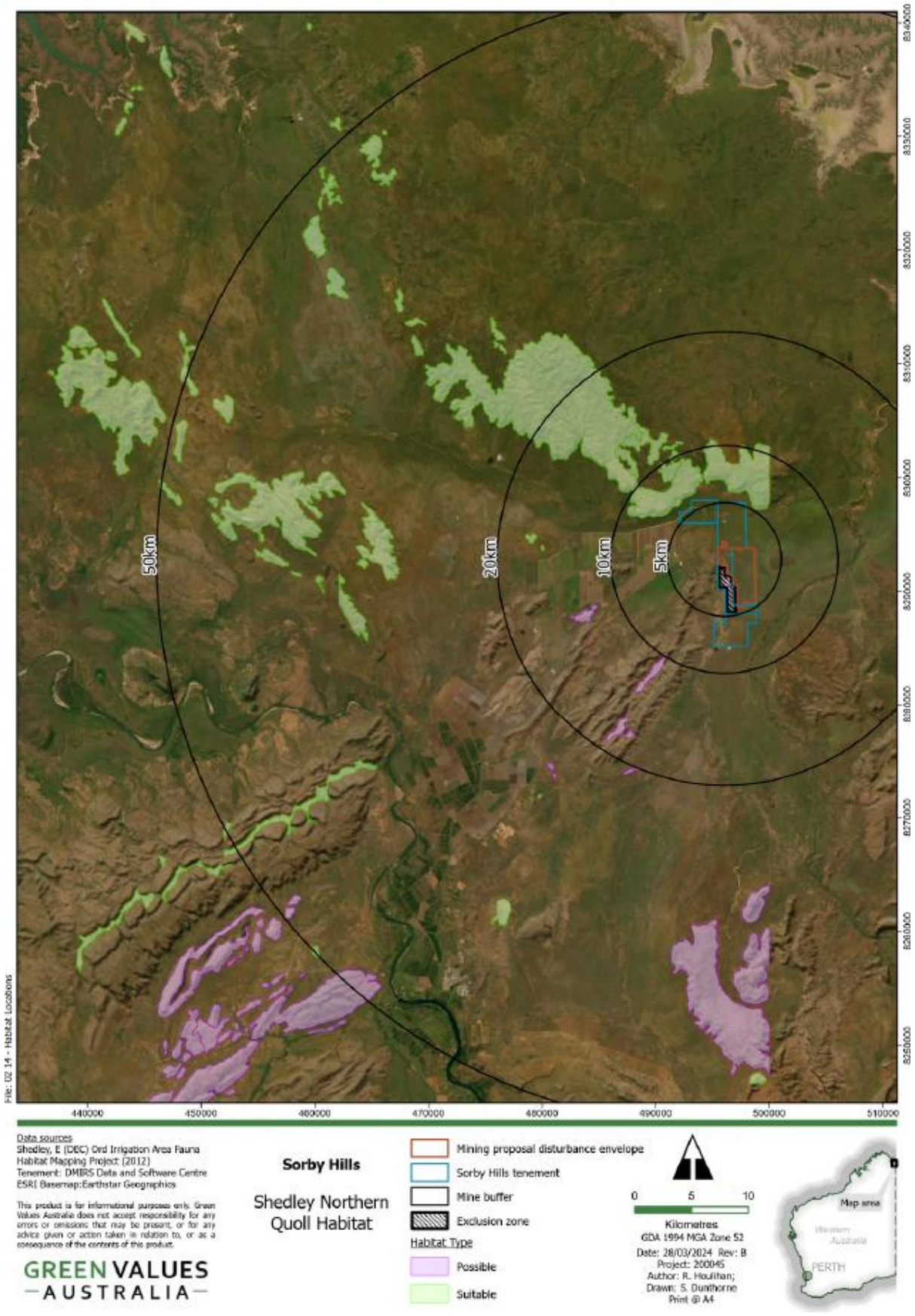

Figure 6-3: Regional habitats – Northern Quoll - Data source: Shedley, E (2012)

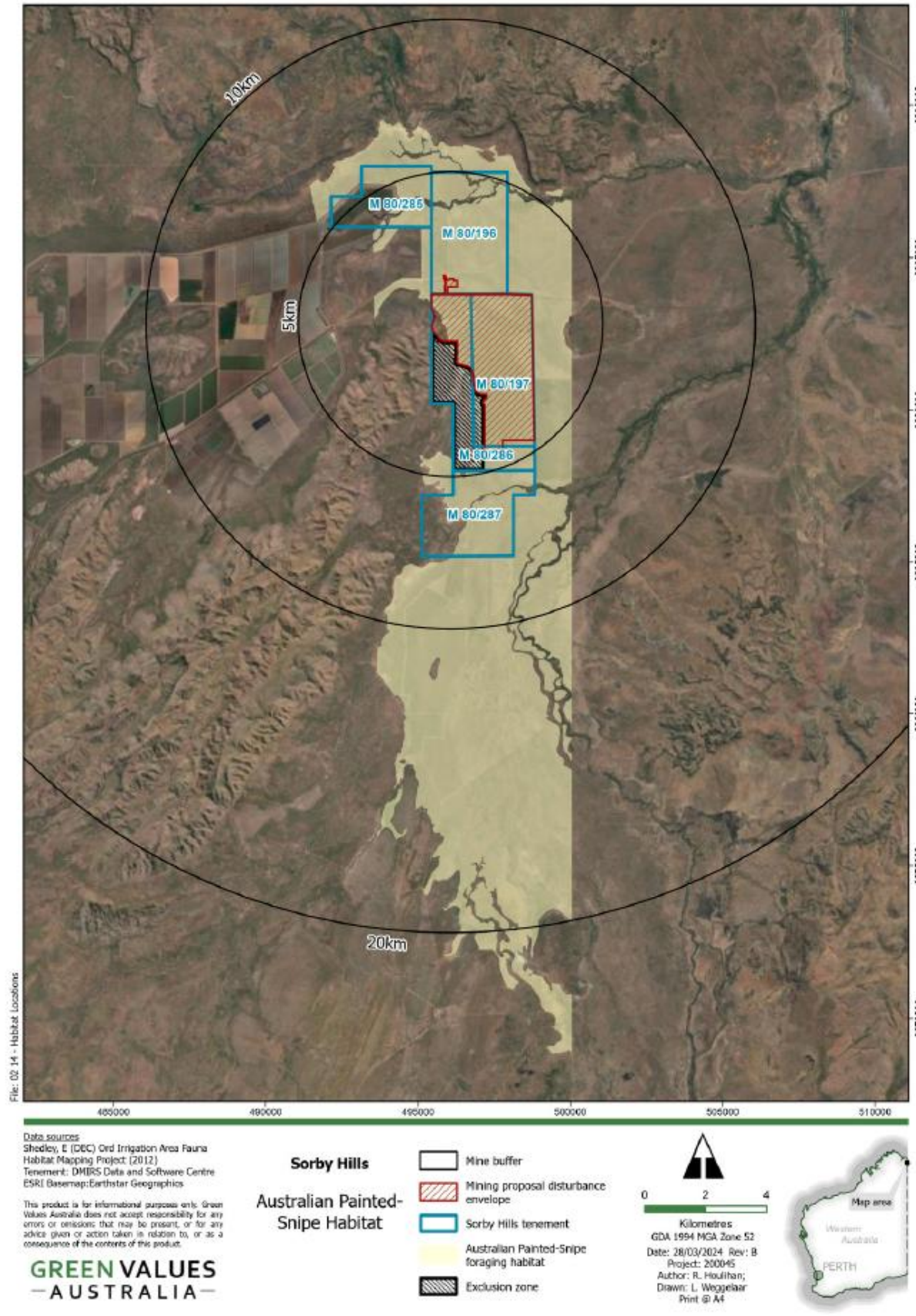

Figure 6-4: Regional habitats – Australian Painted Snipe – Data source Umwelt (2021)

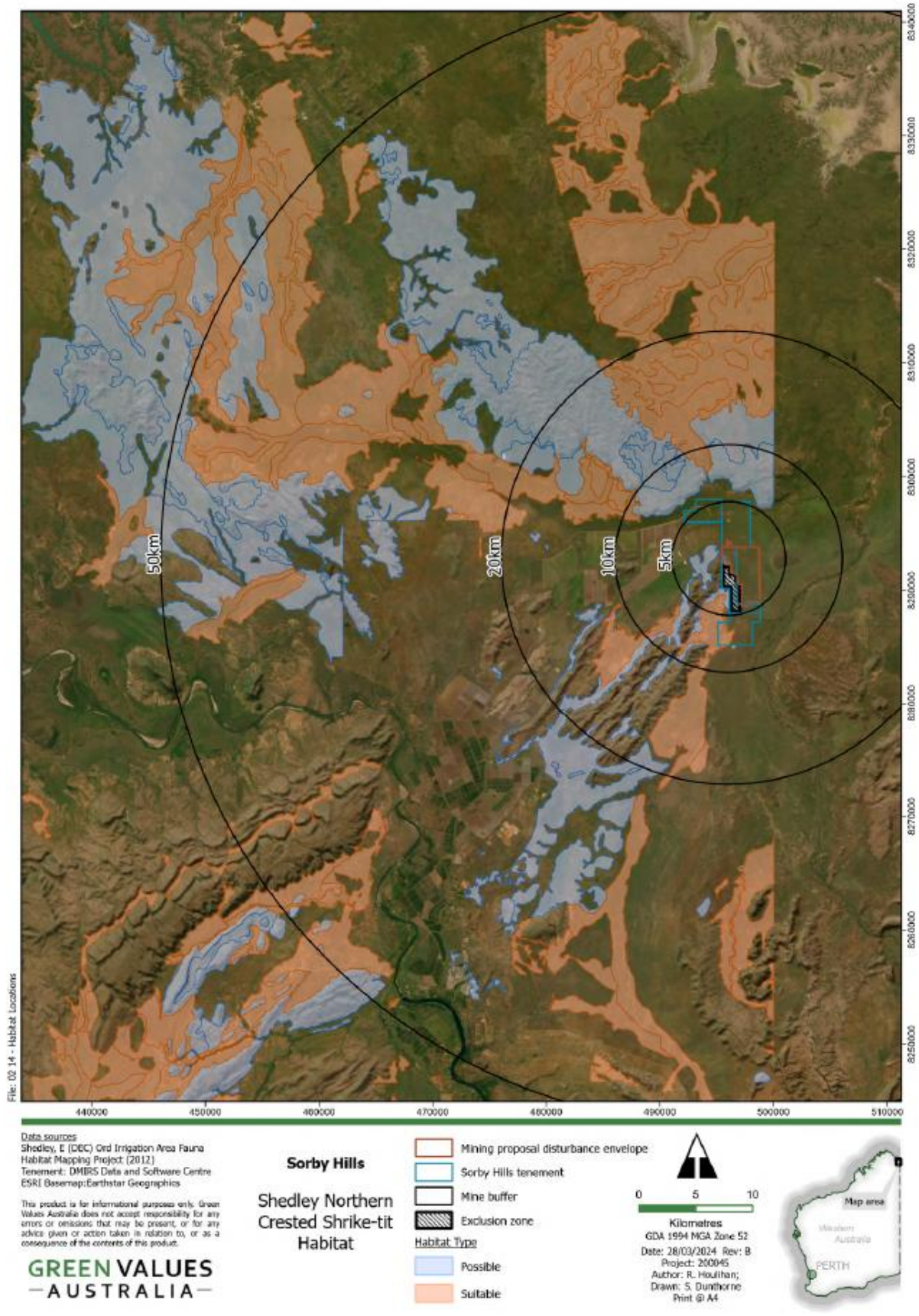

Figure 6-5: Regional habitats – Northern Crested Shrike-tit - Data source: Shedley, E (2012)

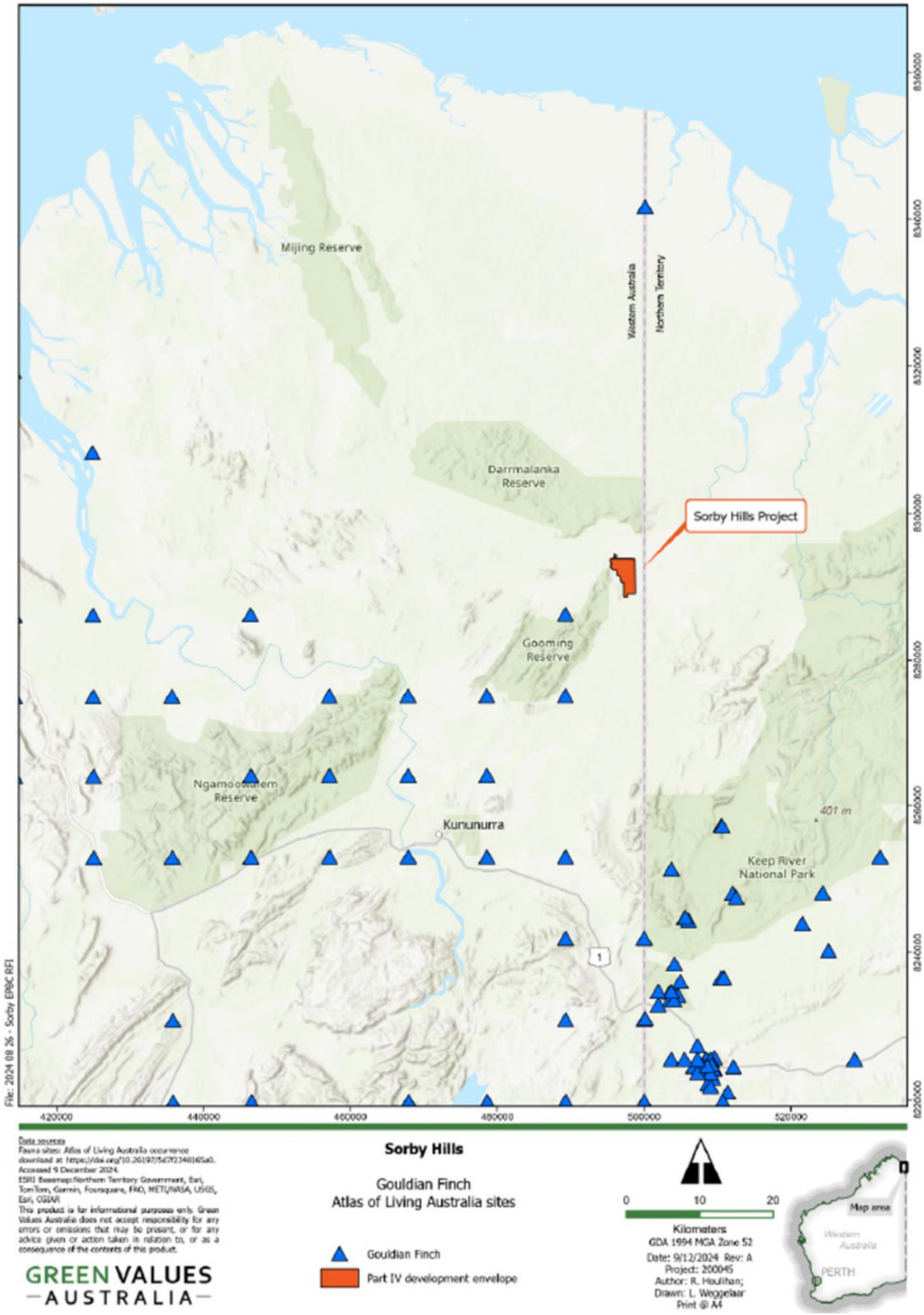

Figure 6-6: Atlas of Living Australia records of the Gouldian Finch relative to the Sorby Hills Project

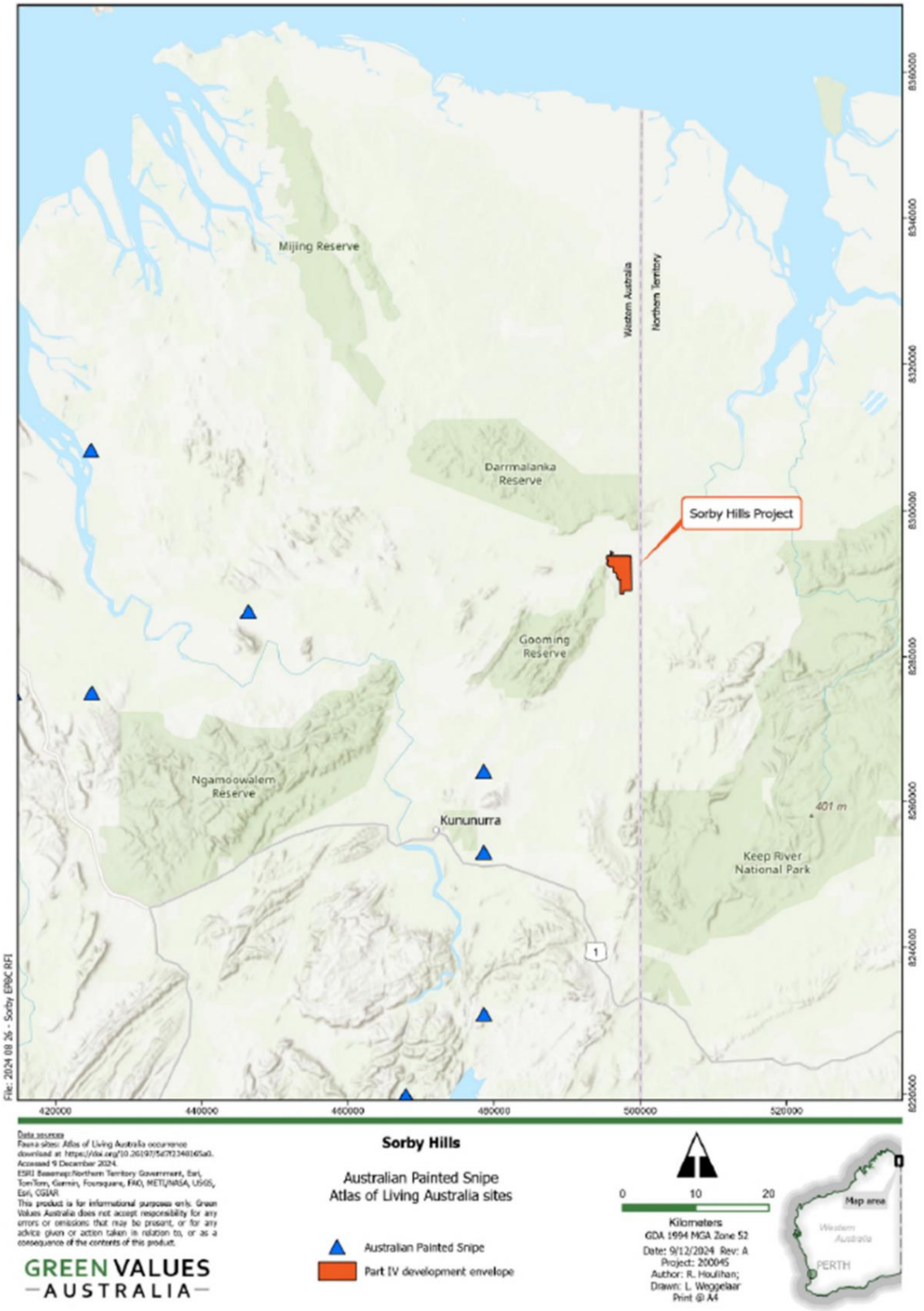

Figure 6-7: Atlas of Living Australia records of the Australian Painted Snipe, relative to the Sorby Hills Project

Figure 6-8: Atlas of Living Australia records of the Northern Crested Shrike-tit, relative to the Sorby Hills Project

6.2 Potential Impacts

Potential direct and indirect impacts on threatened fauna or their habitats were identified systematically through a risk assessment (Section 6.3). These include impacts resulting from:

- land disturbance/clearing of vegetation
- introduction of weeds
- altered hydrology
- storage/impoundment of mine-affected waters in dams or mine voids
- fauna entrapment in mine voids, trenches or dams including the tsf
- increased herbivory around water storage structures
- obstruction of fauna movement by pipelines
- release of mine-affected waters to the environment
- dust impacts on vegetation/habitat
- vehicle interactions with fauna
- incorrect disposal of putrescible and other non-process wastes
- fire initiated by project activities
- light emissions from project operations areas
- noise or vibration from project activities
- increased number or spread of non-native species (especially cane toads) facilitated by Project development

The estimated extents of direct impacts (vegetation clearing, ground disturbance) of Project implementation on species whose habitats occur within or near the Project development envelope are shown for the following species:

- Gouldian Finch (Figure 6-9)
- Red Goshawk (Figure 6-10)
- Northern Quoll (Figure 6-11)
- Australian Painted Snipe (Figure 6-12)
- Northern Crested Shrike-tit (Figure 6-13

The estimated extents of direct habitat disturbance are summarised in Table 6-3.

The following species have been excluded from Table 6-3 as no suitable habitat has been mapped for these species within the region and therefore direct disturbance cannot be estimated:

- Eastern Curlew
- Curlew Sandpiper
- Grey Falcon
- Ghost Bat
- Bare-rumped Sheath-tailed bat
- Fork-Tailed Swift
- Yellow Wagtail

The nearest locations at which these species have been recorded based on data available from the Atlas of Living Australia database (https://www.ala.org.au/) are shown in figures provided in Appendix 2.

Studies conducted for the Project indicate there is the potential for these species to use some of the habitat types identified within the Project area, despite none of the species being observed during fauna surveys (APM, 2011, 2012a, 2012b, 2012c; Bamford, 2024). This has been accounted for in the risk assessment and environment management strategies by including avoidance and mitigation measures for potential impacts from habitat loss for these species.

Table 6-3: Habitat extents and direct impact extents

Species	Estimated regional extent of habitat, ha	Estimated habitat within Project development envelope, ha Note 1	Estimated extent of direct disturbance of habitat, ha Note 2
Gouldian finch	290,112	29.0	16.1
Red Goshawk	88,249	0	0
Australian Painted Snipe	97,962	1,122.5	562.4
Northern Quoll	55,343	1.05Note 3	0
Northern Crested Shrike-tit	259,251	23.0	12.5

Note 1: The ‘Development envelope’ is an approved perimeter within which disturbance may occur. Not all of the land within the development envelope will be disturbed.

Note 2: ‘Direct disturbance’ means the footprint within which vegetation clearing or other ground disturbance would occur during Project implementation. The disturbance footprint lies wholly within the development envelope and entirely outside any avoidance or exclusion areas.

Note 3: this habitat has been excluded from the development envelope as now mapped as “Quoll exclusion zone”.

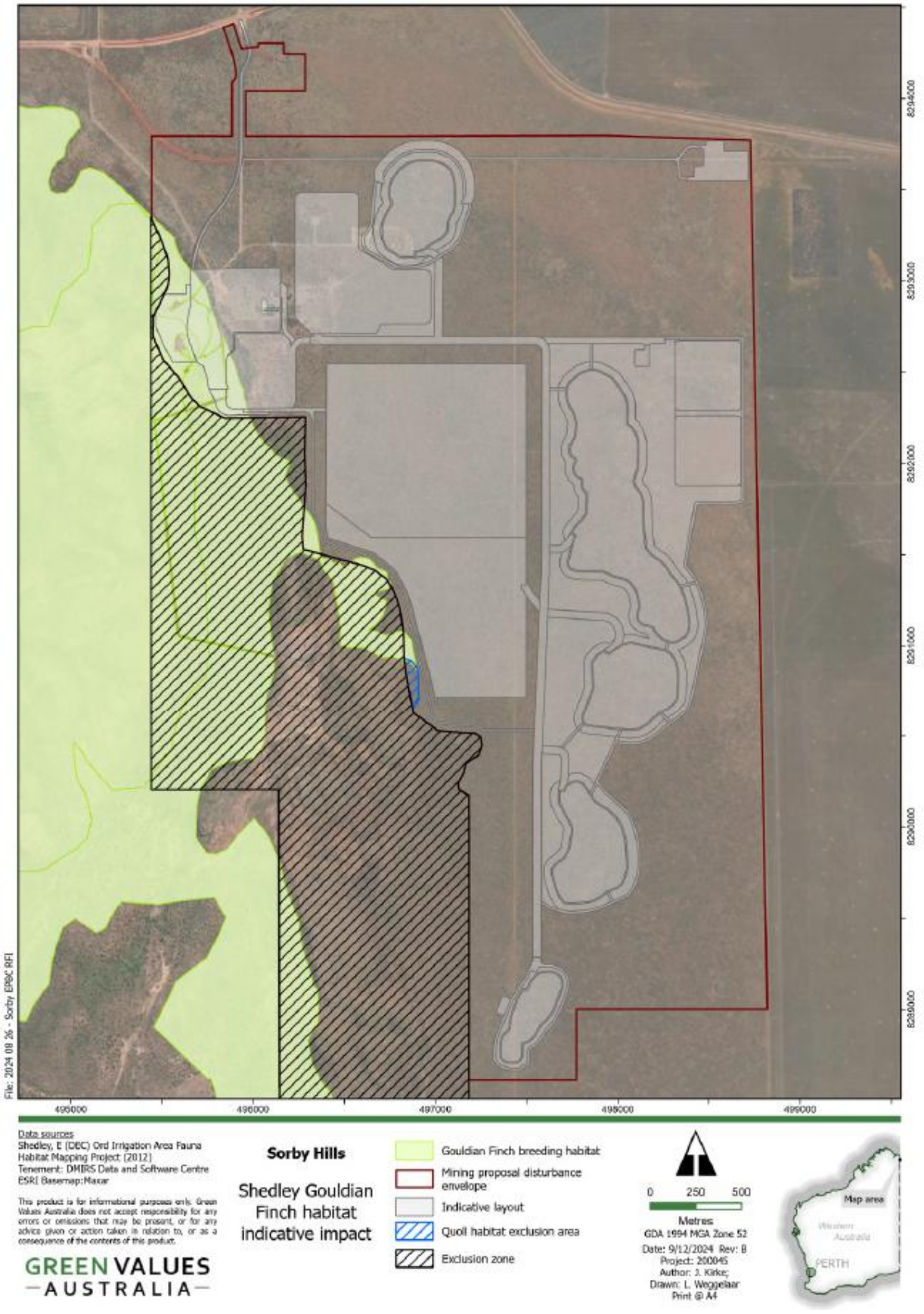

Figure 6-9: Direct impact extent – Gouldian Finch habitat

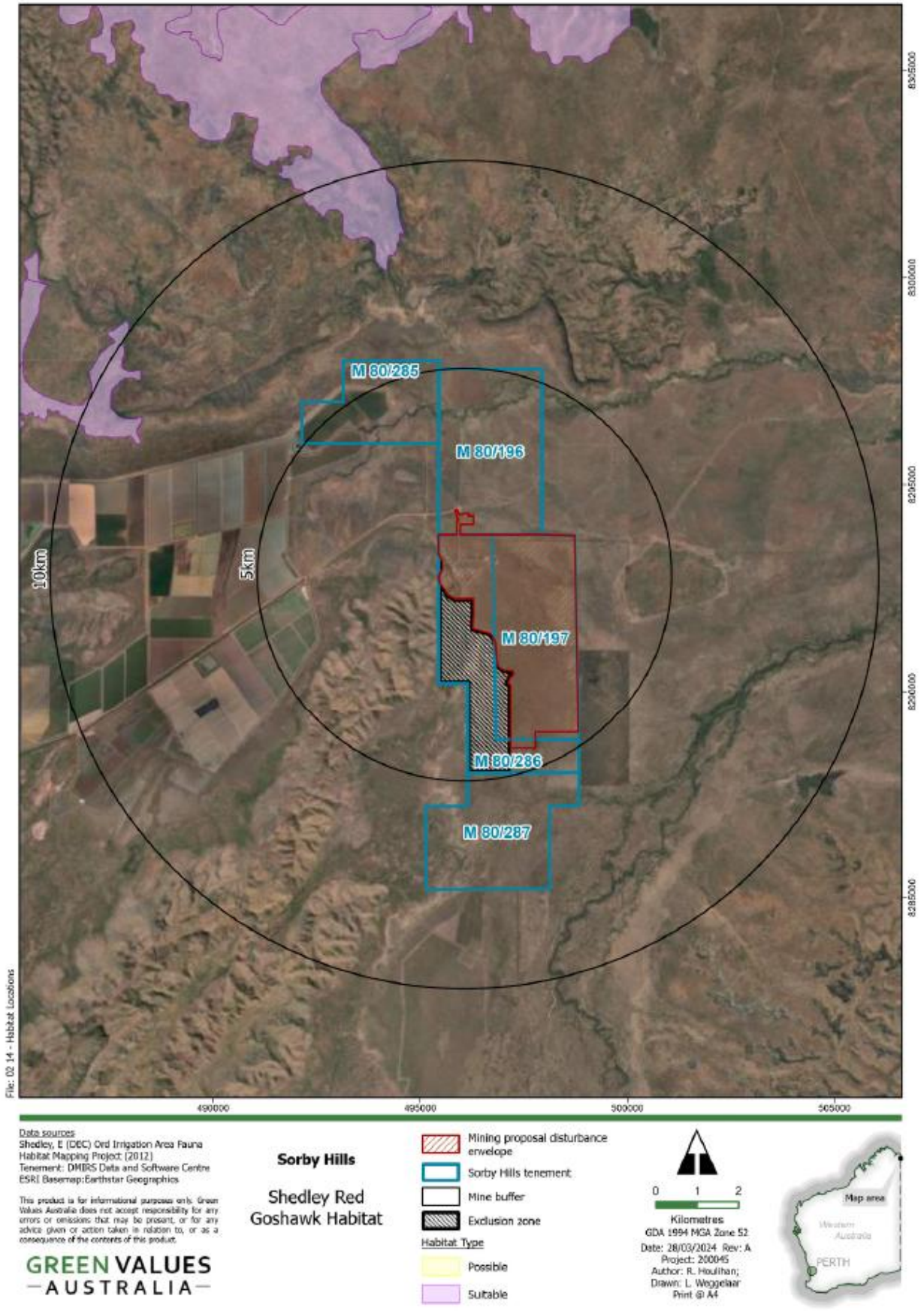

Figure 6-10: Direct impact extent – Red Goshawk habitat

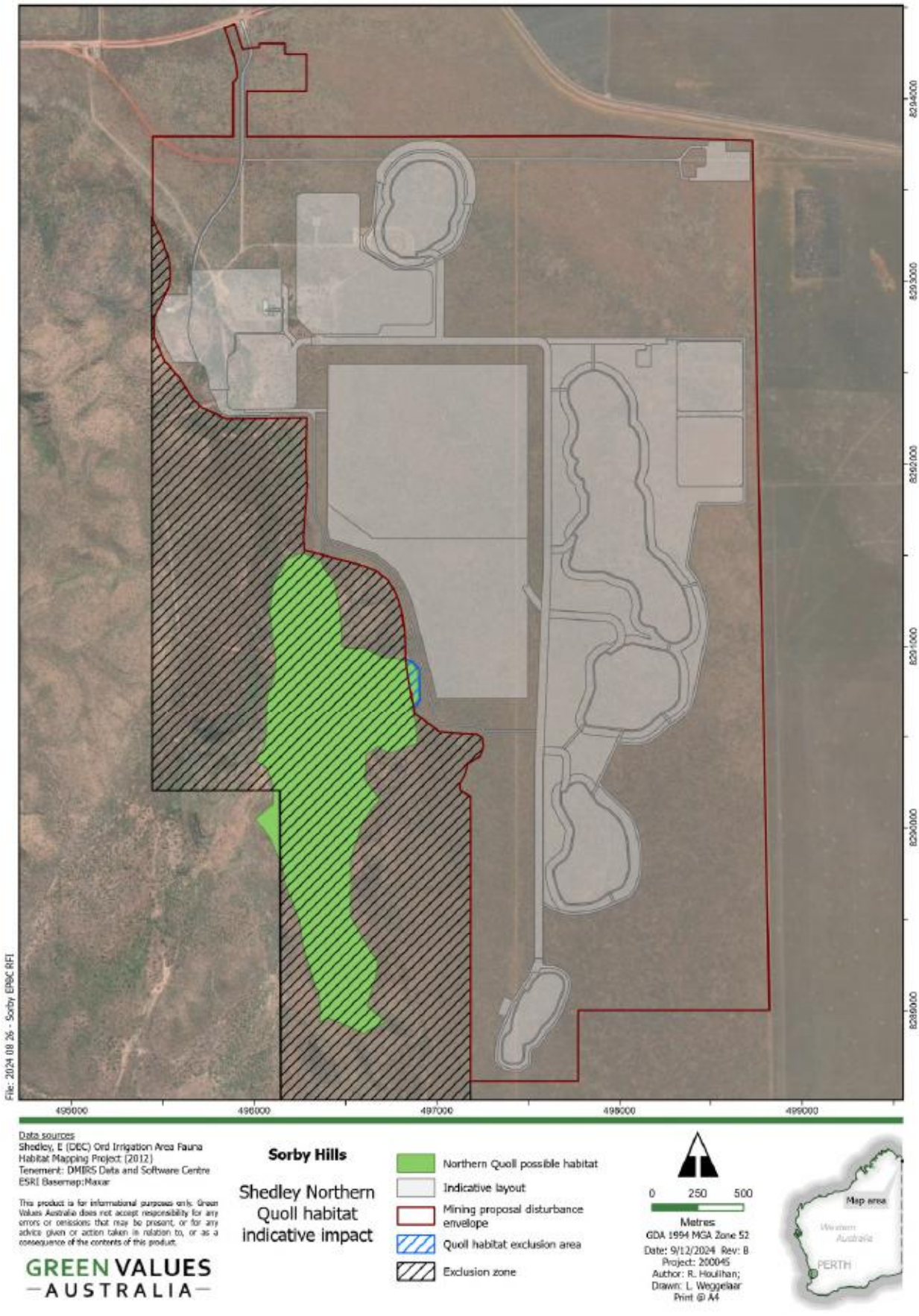

Figure 6-11: Direct impact extent – Northern Quoll habitat

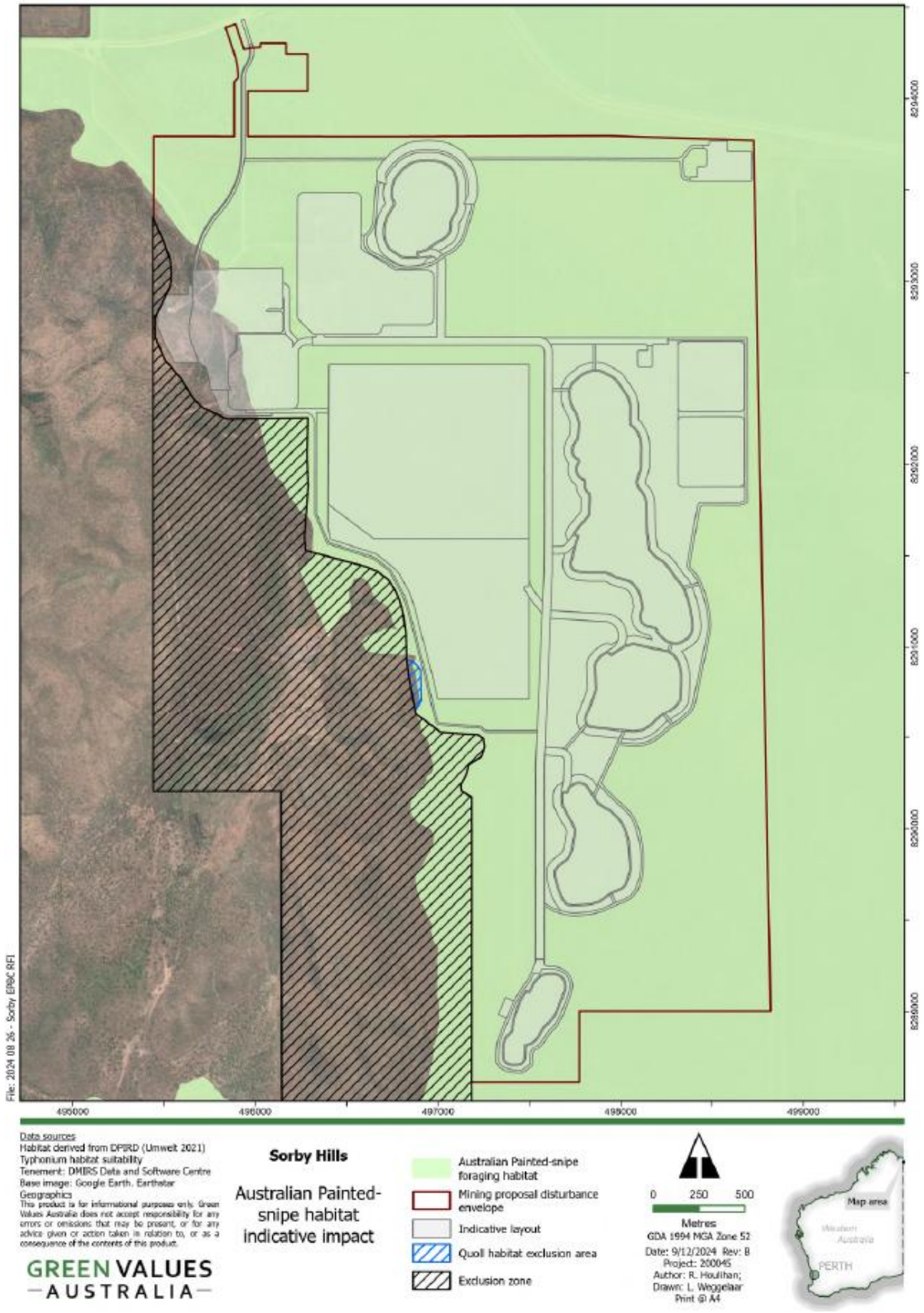

Figure 6-12: Direct impact extent – Australian Painted Snipe habitat

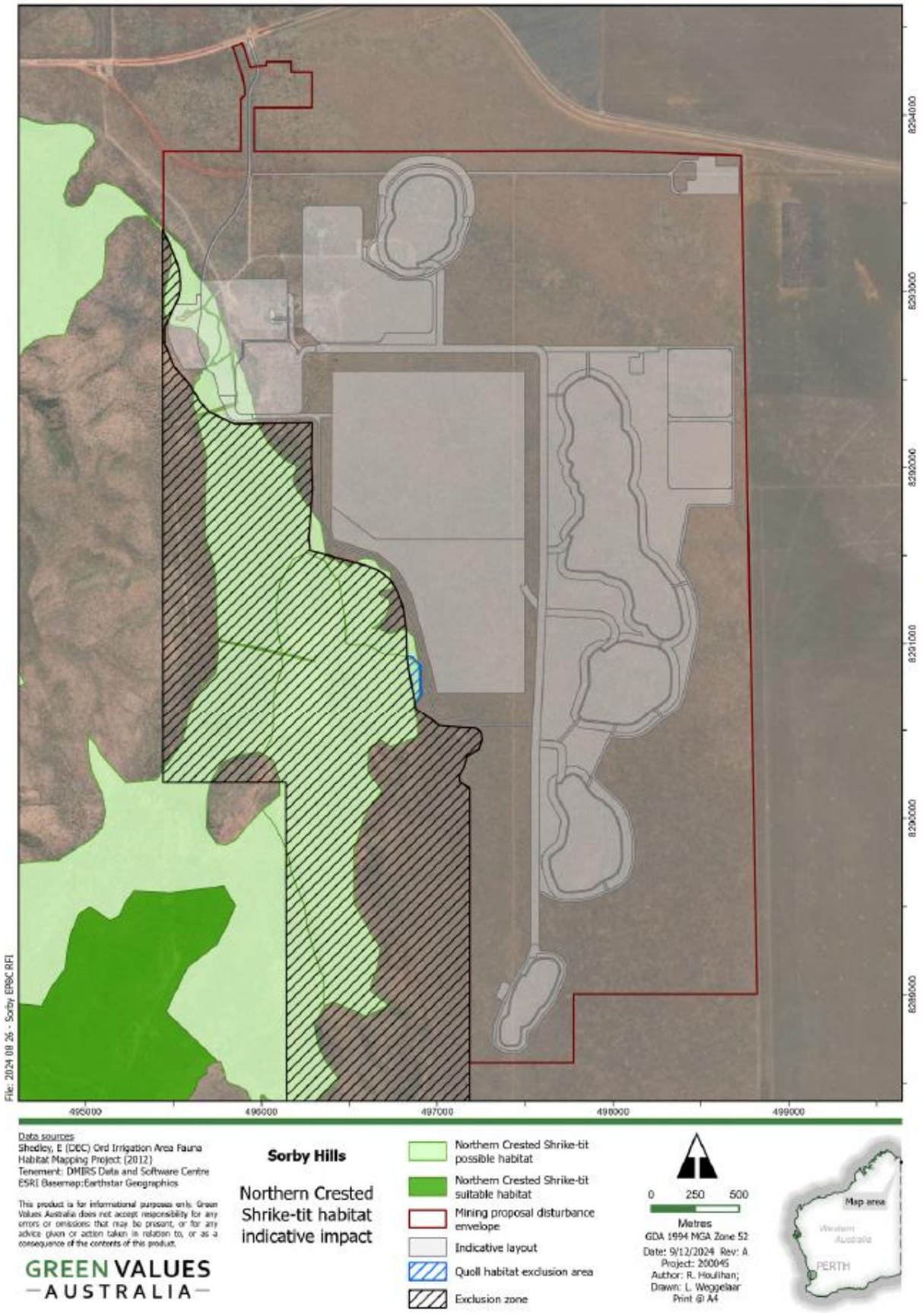

Figure 6-13: Direct impact extent – Northern Crested Shrike-tit habitat

6.3 Risk Assessment

SMPL carried out a systematic review of the risks to threatened fauna and their habitats potentially arising from Project activities. The risk assessment considered activities during all Project phases from construction through to closure. Likelihood and consequence definitions used in the risk assessment were based on definitions currently recommended by the WA Department of Water and Environmental Regulation (DWER) and the Department of Mines, Petroleum and Exploration (DMPE) and are shown in Table 6-4 and Table 6-5, respectively. Risk categories were assigned using the risk matrix recommended by DWER and DMPE (Figure 6-11). The risk assessment is provided in Table 6-6.

In all, twenty risk events were identified. Of these, none were classified as presenting inherently 'extreme' risk to threatened fauna or their habitats. One risk event (relating to increase in numbers of cane toads) was assigned a high inherent risk rating. Twelve events were considered to have medium inherent risk (in the absence of mitigating controls) and seven were classified as low risk.

Table 6-4: Likelihood definitions

Descriptor (DEMIRS 2024)	Frequency	Description
Almost certain	Once or more per year	The risk event is expected to occur in most circumstances. High number of known incidents across industry.
Likely	Once in 5 years	The risk event is expected to occur in some common circumstances. Regular incidents known across industry.
Possible	Once in 10 years	The risk event might occur in some circumstances. Incidents known across industry.
Unlikely	Once in 25 years	The risk event could occur in some uncommon circumstances, as this is known to occur at comparable sites. Some occurrences known across industry.
Rare	Once in 100 years	Highly unlikely, but the risk event may occur in exceptional circumstances, as may have occurred at comparable sites. Very few or no known occurrences across industry.

Table 6-5: Consequence definitions (biodiversity)

Consequence rating	Environmental Aspect / Indicator			
	Ecosystem function	Flora and vegetation	Fauna	Environmental threats: weeds, pathogens, introduced fauna
Insignificant	Alteration to an isolated area within the activity envelope with no effect on habitat or ecosystem.	No direct loss of vegetation within the activity envelope although increased stress may be incurred through indirect or induced pressures.	Localised and short-term (< 5 years) decrease in fauna habitat and or/fauna abundance occurring within the activity envelope.	Manageable, localised infestation / spread within the activity envelope that does not result in competition / impact with native species.
Minor	Localised alteration or disturbance to a habitat or ecosystem resulting in a recoverable impact within 5 years.	Localised and short-term (<5 years) loss of vegetation which is widely distributed outside of the activity envelope.	Localised and medium- term (5-10 years) decrease in fauna habitat and/or fauna abundance occurring within the activity envelope.	Manageable, localised infestation / spread that results in minor competition / impact with native species.
Moderate	Alteration or disturbance to a habitat or ecosystem resulting in a recoverable impact within 10 years.	Localised medium-term (5-10 years) loss of vegetation which is widely distributed outside of the activity envelope. Project places minimal pressure on continued survival of conservation significant vegetation on a local scale.	Localised and irreversible or widespread and long-term (>10 years) decrease in fauna habitat and / or fauna abundance within the activity envelope.	Localised infestation / spread that results in competition / impact with native species requiring considerable management / control measures.
Major	Alteration or disturbance to a habitat or ecosystem resulting in a recoverable impact within 25 years.	Localised and long-term (> 10 years) loss of vegetation, a large portion of which is confined to the activity envelope. Project places significant pressure on continued survival of conservation significant vegetation on a regional scale.	Significant, widespread, and persistent regional decreasee in fauna habitat and / or fauna abundance.	Regional infestation / spread that results in competition / impact with native species requiring extensive management / control measures.
Severe	Alteration or disturbance to a habitat or ecosystem resulting in a potentially non-recoverable impact.	Permanent loss of vegetation outside of the activity envelope, causing significant pressure or extinction of conservation significant vegetation on a regional scale.	Permanent regional loss of fauna habitat and/or loss of conservation significant fauna habitat and/or conservation significant fauna population.	Uncontrollable regional infestation / spread that results in competition / impact with native species and regional loss of vegetation communities or flora.

Table 6-6: Risk Matrix

Risk rating	Rare	Unlikely	Possible	Likely	Almost certain
Insignificant	Low	Low	Low	Medium	Medium
Minor	Low	Low	Medium	Medium	High
Moderate	Medium	Medium	Medium	High	High
Major	Medium	High	High	Extreme	Extreme
Severe	High	High	Extreme	Extreme	Extreme

Table 6-7: Risk assessment – fauna and fauna habitats

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
1	Clearing results in loss of significant fauna habitat	Unauthorised clearing and earthworks	Decline in conservation significant fauna breeding, roosting and/or foraging habitat	Construction & operations	Possible	Moderate	Medium		Site layout designed to avoid conservation significant fauna habitats. Establish and maintain exclusion zone within Development envelope over transitional habitat. Implement Ground Disturbance procedure and maintain GIS database. Communicate environmental protection requirements through inductions. Conduct targeted environmental awareness training. Implement fauna monitoring programs.	Unlikely	Moderate	Medium
2	Alteration of surface hydrology due to the construction of the Project	Placement of Project infrastructure within the landscape	Changes to local flooding extent, and/or duration impacting migratory bird species	Operations, decommissioning and post-closure	Possible	Moderate	Medium		Provide bunding and diversion structures to direct surface flows around Project footprint Provide culverts to maintain surface water movement and prevent backwater effects Limit dry season disposal of water to evaporation basin (to avoid creating permanent wetland). Review flood modelling annually to assess effectiveness of diversion structures.	Unlikely	Minor	Low
3	Inadequate hydrological design results in release of metals contaminated water or sediment into the surrounding environment (failure or overtopping of process water ponds; discharge from plant drainage systems)	Materials handling and storage	Uncontrolled discharge to downstream receiving environment resulting in contamination surface water	Operations	Unlikely	Minor	Low		Engineer water storages to provide adequate storage capacity to accommodate flows from 1%AEP events Provide separate 'clean water' and 'dirty water' storage systems Conduct pre-wet season inspections to ensure storages do not hold excess water at start of wet season. Monitor water quality in surface water storages.	Rare	Minor	Low
4	Fauna ingest metals from water stored in TSF and TSF evaporation pond, bioaccumulation of metals within the food chain	Storage of water containing elevated metals concentrations	Fauna mortality or morbidity, regional impact on species of conservation significance, in particular migratory species	Operations	Possible	Minor	Medium	Impact assessment of the TSF on waterbirds within the Project area was completed by Bennelongia in 2022. Bennelongia concluded: • Visits to the TSF by waterbirds attracted to shallow water are likely to be short inspections before the birds move elsewhere to better conditions and significant ingestion of sediment or water is unlikely. • Some terrestrial bird species may occasionally drink from the TSF but it is expected that current sources of drinking water will be used preferentially. • Has possible occurrence and low consequences. • TSF will be constructed from locally soured clays that are engineered to reduce risk of seepage. • Seepage analysis has been completed as part of the TSF engineering design report.	Operate TSF so as to minimise extent of decant pond. Preferentially use reclaimed water and dewatering water for operational purposes. Placement of predatory bird decoys, cannon blasts and other tactics to deter avifauna. Routine and opportunistic observations and monitoring of fauna at water storages: - Collection of bird feathers around tailings dam quarterly for metals analysis - Quarterly and opportunistic bird counts (species and numbers)	Unlikely	Minor	Low

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
5	Avifauna ingest metals in water stored at evaporation basin	Storage of water containing elevated metals concentrations	Fauna mortalilty or morbidity regional impact on species of conservation significance, in particular migratory species	Operations	Unlikely	Moderate	Medium	Water discharged to the evaporation basin will be excess groundwater from pit dewatering. A H3 hydrogeological study was completed by GHD in 2022 and groundwater quality was assessed against ANZECC guideline values for freshwater ecosystems at a 99% species protection level. Results indicated elevated levels of arsenic, lead, zinc and cadmium.	Placement of predatory bird decoys, cannon blasts and other tactics to deter avifauna. Routine and opportunistic observations and monitoring of fauna at water storages. Limit dry season disposal of water to evaporation basin (to avoid creating permanent wetland).	Unlikely	Minor	Low
6	Fauna ingestion of process waters or aquatic/terrestrial plants containing elevated metals concentrations: bioaccumulation of metals within the food chain	Storage of water containing elevated metals concentrations	Regional impact on species of conservation significance, in particular migratory species	Operations	Unlikely	Minor	Low		Preferentially use reclaimed water for operational purposes (thereby minimising water held in open storage). Conduct routine observations of fauna occurrence at water storages: if required, use predatory bird decoys, cannon blasts and other tactics to deter avifauna. Fence process water storages to exclude livestock (if site not entirely de-stocked). Low permeability liners installed to minimise seepage from water storages. At Project completion, cap tailings storage with non-reactive, non-mineralised waste and plant growth medium.	Unlikely	Minor	Low

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
7	The formation of a pit lake attracts fauna/feral animals, resulting in increased herbivory and/or entrapment of fauna	Decommissioning & Closure	Potential fauna injury/deaths. Proliferation of feral animals. Poor rehabilitation performance from grazing.	Decommissioning & closure	Unlikely	Minor	Low	Bennelongia (2022) Waterbird Report states: • "the likelihood of toxic effects from birds utilising the lakes is low, with most animals tolerating substantially higher concentrations of metals than occur in Project groundwater (unless mining will substantially elevate metals levels in groundwater)." • "Both migratory shorebirds and large wading species are unlikely to find habitat suitable for feeding. As such, migratory shorebirds and wading species are likely to make very little use of these waterbodies, with the possible exception of the Common Sandpiper and some small resident (i.e. not listed) shorebirds. Water quality is not expected to affect these birds and there is little likelihood of any adverse consequence of using the pit lakes, which represent created habitat. The risk score for most shorebirds and wading birds using the lake is calculated as 3 (Table 1, possible occurrence x very low consequence). For the Common Sandpiper, which may make more use of the lakes, the risk score is 4." • "The pit lakes that are created pits will remain as permanent features in the landscape. Due to the source of the recharge being from the local groundwater aquifer, the water quality will reflect the local groundwater quality. Sampling in bores throughout the region has revealed naturally high levels of lead in groundwater. It is also anticipated that salt concentrations will increase over time in the pit lakes, although this process will be slowed by the influx of fresh rainwater during the tropical wet season experienced at the Project." • "The pit lakes comprise a small fraction of the available wetlands in the region. There are large wetlands at Lake Argyle, Lake Kununurra, Parry Lagoons, and extensive smaller waterbodies in the wet season along the Ord River and Keep River and on the Victoria-Bonaparte mudflats. It is not expected that the TSF or pit lakes will be regularly used and form an integral part of the habitat of any species." Closure model simulations run by GHD (2022) indicate that the pit lakes are likely to be groundwater sinks and therefore it is unlikely that pit lake water will infiltrate the aquifer and pose a further risk to identified migratory bird species in the area. SWC (2013) made the following statements with respect to pit lake water: • As and Pb concentrations in the lake are predicted to be low due to high sorption of these solutes to the surface of the iron oxyhydroxide minerals. • Ni and Zn concentrations are predicted to reach saturation at 450 and 200 years, respectively, but remain below the drinking water and long-term irrigation guidelines.		Unlikely	Minor	Low
8	Fauna entrapment in site infrastructure	Infrastructure	Fauna death, including impact to local cattle	Construction and operations	Possible	Minor	Medium	Fauna surveys completed for the Project (APM 2011, 2012a, 2012b, 2012c; Bamford 2024) have identified conservation significant species and/or their habitat within the Project development envelope. The majority of conservation significant species identified within the Project development envelope are avifauna and are unlikely to be significantly impacted by Project infrastructure. Possible Northern Quoll habitat has been mapped on the eastern edge of the development envelope (1.05ha), however, it does not intersect the Project disturbance footprint.	Construct egress points at trenches and ponds. Provide fencing around major water storage structures. Install cattle fencing around Project footprint to restrict livestock access. Conduct twice daily inspections of open trenches. Conduct regular inspections of fenced water storage structures.	Unlikely	Minor	Low

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
9	Permanent water storages attract fauna to storage location	Establishment and use of water storages	Modified fauna behaviour	Operations, decommissioning and post-closure	Possible	Minor	Medium	Bennelongia (2022) Waterbird Report states: • "Both migratory shorebirds and large wading species are unlikely to find habitat suitable for feeding. As such, migratory shorebirds and wading species are likely to make very little use of these waterbodies, with the possible exception of the Common Sandpiper and some small resident (i.e. not listed) shorebirds. Water quality is not expected to affect these birds and there is little likelihood of any adverse consequence of using the pit lakes, which represent created habitat. The risk score for most shorebirds and wading birds using the lake is calculated as 3 (Table 1, possible occurrence x very low consequence). For the Common Sandpiper, which may make more use of the lakes, the risk score is 4." • "The pit lakes comprise a small fraction of the available wetlands in the region. There are large wetlands at Lake Argyle, Lake Kununurra, Parry Lagoons, and extensive smaller waterbodies in the wet season along the Ord River and Keep River and on the Victoria-Bonaparte mudflats. It is not expected that the TSF or pit lakes will be regularly used and form an integral part of the habitat of any species."	Use of evaporative water sprays in preference to evaporation ponds where practicable. Use of sound cannons to deter fauna Install and maintain fencing to exclude livestock from premises. Routine monitoring to check for fauna occurrences at / near water storages.	Unlikely	Minor	Low
10	Obstruction of fauna movement by water pipelines	Establishment of water pipelines	Habitat fragmentation; interference with flow of genetic material	Operations	Unlikely	Minor	Low	Fauna surveys completed for the Project(APM 2011, 2012a, 2012b, 2012c; Bamford 2024) have identified conservation significant species and/or their habitat within the Project development envelope. The majority of conservation significant species identified within the Project development envelope are avifauna and are unlikely to be significantly impacted by Project infrastructure. Possible Northern Quoll habitat has been mapped on the eastern edge of the development envelope (1.05ha), however, it does not intersect the Project disturbance footprint. Project layout has been designed to minimise habitat fragmentation as far as reasonably practicable.	Pipelines will be located within road reserves and existing disturbed areas.	Rare	Minor	Low
11	Contaminated water from processing plant is discharged to the environment	Materials handling and storage	Impact to fauna outside of development envelope	Operations	Unlikely	Minor	Low	Process plant inward draining, with all stormwater collected to be treated and reused within the processing plant. Surface water assessment by GHD (2022) included flood modelling which has been used to direct Project layout and location of diversion and drainage structures.	Drainage system in place around processing plant and ROM to direct flows and return to process water circuit. Bunding of plant infrastructure and bulk storage areas. Plant drainage system will be designed and constructed to contain at least the 5% AEP event. Sediment ponds will be established and maintained to capture sediment entrained in plant run-off Conduct pre-wet season inspections to check condition of plant drainage infrastructure.	Rare	Minor	Low

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
12	Dust emitted from mining or processing operations	Materials handling and storage	Fauna ingestion of lead or other metals via dust deposition on plants or ingestion of plants which have taken up metals via soil substrate	Operations	Possible	Minor	Medium	Dust monitoring locations have been established at the Project and baseline data was collected in 2011 and 2012.	Moisture levels in concentrate above7% to prevent dusting. Foggers at transfer points. Good scraper systems on conveyors to prevent carry-back and spillage. High wind protocols Surveillance and real time monitoring in combination with Trigger Action Response Plans. Concentrate storage / handling will be managed within shed equipped with suitable dust management measures. Rotabox containers (or equivalent) will be used for transport and storage (at site and port). Routine maintenance and scheduled inspections / audits of dust control equipment. Dust suppression on roads and pit. Dust monitoring and dust monitoring plan.	Unlikely	Insignificant	Low
13	Wheel generated dust from vehicle / machinery movement	Movement of machinery and materials	Dust generation impacts native vegetation health and damages habitat condition through smothering	Construction and operations	Possible	Minor	Medium		Use of water for dust suppression on roads and in pit. Conduct routine dust monitoring and annual vegetation health assessments.	Unlikely	Insignificant	Low
14	Material handled during construction or operational activities releases sediment during flood events	Mechanical disturbance of dispersive soils	Sedimentation of surrounding landscape adversely impacts on threatened flora and habitat	Construction and operations	Possible	Minor	Medium	Physical and chemical analysis of soils at the Project was completed by SWC (2011) and O'Kane (2021). Both studies concluded that Project soils have the potential to be dispersive. For the construction of most of the Project infrastructure, topsoil and subsoil will not be removed as the Project footprint will be built upwards to be above the wet season inundation level. Construction materials are intended to be sourced from a borrow pit identified within the Project development envelope. Hydrology model completed for the whole Project by GHD (2022).	Carry out geotechnical investigations to characterise construction materials: adopt selective use / placement of potentially dispersive materials. If required, stabilise dispersive materials by treating with lime or gypsum. Conduct hydrological modelling to identify areas at risk of inundation. Providing bunds and channels to direct surface water flows. Conduct inspections following significant flow events (>10% AEP) to check whether remedial works required.	Unlikely	Insignificant	Low
15	Vehicle interactions with conservation significant fauna	Vehicle movements across site	Death or injury of conservation significant fauna	All	Likely	Minor	Medium	Fauna surveys completed (APM 2011, 2012a, 2012b, 2012c; Bamford 2024) and supporting literature reviewed to map potential habitats for conservation significant fauna within the Project area.	Establish and maintain exclusion zone within mining tenements to restrict access to conservation significant fauna habitat. Enforce speed restrictions where roads traverse significant fauna habitat. Communicate fauna protection information through inductions and targeted training. Monitor and report fauna injury / death. Provide fencing around operational areas to exclude livestock.	Unlikely	Minor	Low

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
16	Improper / unauthorised waste disposal	Waste storage and disposal	Attracting wildlife and vermin	Construction and operations	Possible	Insignificant	Low		Provide bins / skips with well fitting covers. Separation of waste at source. Inductions/toolbox training. Restrict access to active landfill area. Cover putrescible waste at regular intervals. Conduct monthly housekeeping inspections of landfill and other operational and accommodation areas.	Unlikely	Insignificant	Low
17	Light emissions in plant area disrupt fauna and visual amenity	Light emissions	Light spill into surrounding areas attracting insects and distrupting fauna	Construction & operations	Unlikely	Minor	Low	Fauna surveys completed (APM 2011, 2012a, 2012b, 2012c; Bamford 2024). Survey results indicate no nocturnal conservation significant species, or their habitat identified within the Project disturbance footprint.	Lights to be aimed down and into work area. Encourage the use of Bug Yellow fluorescent lighting (or similar) to limit attraction of flying insects to permanently lit areas. Procurement specification (lighting)"	Unlikely	Insignificant	Low
18	Hot work or other Project activities initiate fire	Fire	Uncontrolled burning of native vegetation / habitat	Construction & operations	Possible	Moderate	Medium	Fauna surveys conducted for the Project (APM 2011, 2012a, 2012b, 2012c; Bamford 2024) identified conservation significant species and/or their habitat within the development envelope. Conservation advice provided by DCCEEW lists fire as a key threatening process for some of these species identified.	Establish firebreaks and carry out strategic burnings around processing area. Establish and maintain firefighting infrastructure within plant areas. Fire extinguishers to be placed strategically around plant. Hot works permit system in place. Welding screens to be used. Spark arresters on welding gear and any mobile plant required to operate off designated, cleared surfaces. Conduct scheduled fire safety inspections and audits. Implement and maintain a Fire & Emergency response procedure. Take advice from DBCA, Traditional Owners and other experienced stakeholders on implementing controlled burns in uncleared areas.	Unlikely	Moderate	Medium
19	Movement of vehicles or imported materials results in introduction / spread of weeds	Movement of machinery and materials	Impacts to native vegetation; reduction in habitat quality	Construction & operations	Possible	Moderate	Medium	Fauna surveys conducted for the Project (APM 2011, 2012a, 2012b, 2012c; Bamford 2024) identified conservation significant species and/or their habitat within the development envelope. Conservation advice provided by DCCEEW lists increased fire risk from weed invasion a key threatening process for some of these species identified.	All earthmoving and construction equipment or machinery that could potentially have collected weed seeds or matter will be cleaned of soil and vegetation matter and be inspected prior to mobilisation for works. All vehicles arriving onsite to be inspected for cleanliness and washed if dirty. All vehicles and equipment will be restricted to designated footprints. Weed and seed forms completed and submitted to HSE Advisor prior to mobilisation of equipment to site Implement annual weed monitoring and control programs	Possible	Minor	Medium

Risk ID	Description of unwanted event	Risk pathway / causal factors	Description of impact	Phase	Inherent Risk			Contextual Information	Proposed risk treatment	Mitigated Risk		
					Likelihood	Credible consequence	Risk rating			Likelihood	Credible Consequence	Risk rating
20	Increase in cane toad numbers due to clearing and Project development	Operational disturbance	Impacts to native fauna populations	Construction & operations	Likely	Moderate	High	Fauna surveys conducted for the Project (APM 2011, 2012a, 2012b, 2012c; Bamford 2024) identified conservation significant species and/or their habitat within the development envelope. Conservation advice provided by DCCEEW lists impacts from cane toads as a key threatening process for some of these species identified. Bamford (2024) noted that the lack of Northern Quolls observed within the Project development envelope and proximal region is likely due to the abundance of cane toads.	Induction and training on cane toads. Monitoring of cane toad numbers in the feral animal site register. Development of a cane toad handling and disposal procedure. Collection and disposal of cane toads by suitably-trained staff, in consultation with local DBCA cane toad officer. Trapping of tadpoles in dams.	Possible	Moderate	Medium

6.4 Environmental Management Strategies

SMPL's strategies for protecting fauna and their habitats are aligned with the environmental 'hierarchy of controls'. Examples of proposed controls are listed in Table 6-7. Of necessity, some controls will be implemented adaptively, that is by adopting a management approach that systematically and iteratively adjusts control methods. This could apply, for example, in the case of measures used to combat the establishment or spread of cane toad populations, which are a significant threat to many protected species addressed in this plan. Adaptive management may also be required in relation to threatened species, such as the Bare-Rumped Sheath-Tailed Bat or the Fork-Tailed Swift, whose ecology and habitat requirements are not well established.

Table 6-8: Hierarchy of control (illustrative examples)

Control type	Proposed controls (examples)	Impacts to be controlled (examples)
Avoidance / elimination	Establish exclusion zone over higher value habitat.	Habitat loss due to establishment of infrastructure. Fauna mortality/morbidity due to vehicle interaction.
Substitute	Reclaim process water to minimise water storage and discharge requirements for impacted water. Use of evaporative water sprays in preference to evaporation ponds where practicable.	Impacts arising from livestock or native fauna accessing water storages.
Engineering controls	Establish and maintain bunds, culverts and other drainage features to minimise changes to surface water flows throughout Project area. Provide down-facing lighting to minimise light spill beyond active work areas.	Impacts on wetland habitats and vegetation susceptible to changing hydrological conditions. Impacts on nocturnal fauna, including bats.
Administrative controls	Establish ground disturbance permitting system Implement hot work permitting system.	Habitat loss due to unauthorised clearing. Habitat loss due to fire initiated by Project activities.
Protective / deterrent equipment	Provide decoys or other bird deterrents at water impoundments.	Impacts arising from avifauna accessing water storages.

6.5 Performance Objectives and Targets

SMPL has documented its overall environmental objectives, targets, measures and responsibilities for the Project within the SMPL Environmental Report – Environmental Objectives and Targets CORP-EN-REP-1005. Performance against environmental objectives and targets is reviewed monthly, quarterly or annually (as specified in CORP-EN-REP-1005). The objectives and targets of

this FHOMP will be reviewed at least three-yearly. The need for updated objectives or targets will be considered in the context of factors such as company performance, changes in legislation and technological improvements.

Performance objectives and targets specific to the protection of threatened fauna and their habitats are summarised in Table 6-9, along with the management measures proposed to be used to deliver the target outcomes.

Table 6-9: Performance objectives and targets: threatened fauna and habitats

Potential impact	Proposed control measures	Environmental objective	Performance indicator	Performance target
Loss of breeding/foraging habitat due to clearing -Gouldian Finch	Establish and maintain exclusion area over better quality habitat.	Minimise loss of suitable habitat Avoid habitat fragmentation.	Extent of habitat clearing Location of clearing, relative to important habitat patches	Limit clearing to no more than 16.1 ha of suitable habitat. Clearing to occur at edge of mapped suitable habitat to avoid fragmentation.
Loss of breeding/foraging habitat -Northern Crested Shrike-tit				Limit clearing to no more than 12.5 ha of suitable habitat. Clearing to occur at edge of mapped suitable habitat to avoid fragmentation.
Loss of breeding/foraging habitat due to clearing -Australian Painted Snipe				Limit clearing to no more than 562.4 ha of suitable habitat.
Loss of foraging habitat due to impacts to water quality – Australian Painted Snipe	Surface water quality monitoring. Retention of excess water within Project disturbance footprint.	Minimise impacts to surface water quality (foraging habitat).	Surface water quality.	No significant changes to surface water quality from baseline levels.
Loss of nesting/denning habitat due to fire and declining food resources due to unfavourable fire regimes – Red Goshawk	Establish fire prevention and fire response systems Collaborate with DBCA and Traditional Owners in implementation of controlled burning in vegetated area.	Minimise loss of habitat due to fire.	Frequency of Project-initiated fires Hectares protected by mosaic burns	No Project-initiated fires 70 ha/year of mosaic burns within Project development envelope
Loss of nesting/denning habitat due to fire and declining food resources due to unfavourable fire regimes – Northern Crested Shrike-tit				
Loss of denning habitat - Northern Quoll	Avoid clearing of denning areas 50 m buffer applied to any denning habitats.	Minimise impacts to suitable habitat.	Extent of habitat clearing.	No impacts to denning areas.
Injury or death due to lethal ingestion of cane toad toxin or vehicle collision	Implement cane toad control measures in accordance with DBCA and local management programs. Speed limit restrictions within 1 km radius of NQ denning habitat. Reporting of fauna deaths.	Minimise impacts to threatened species due to Cane Toads. Minimise deaths/injury to species from vehicle collision.	Cane toad numbers Fauna death numbers	Any increase in cane toad numbers in local area is not attributable to Project activities. No death of MNES species attributable to project operations
Injury or death due to vehicle collision				

Potential impact	Proposed control measures	Environmental objective	Performance indicator	Performance target
Changes in hydrology due to diversion of water for infrastructure – Eastern Curlew	Site layout designed to minimise impacts on hydrology regimes. Excess water retained within Project footprint.	Minimise impacts to hydrology regimes.	Flood modelling	Flood modelling indicates no significant impacts to hydrology regimes.
Changes in hydrology due to diversion of water for infrastructure – Curlew Sandpiper				
Changes in hydrology due to diversion of water for infrastructure – Red Goshawk				
Changes in hydrology due to diversion of water for infrastructure – Aus Painted Snipe				
Changes in hydrology due to diversion of water for infrastructure – Yellow wagtail				

7 MNES Specific Avoidance and Mitigation Measures

This section provides specific management measures for MNES species with specific habitat impact. A summary of SMPL's proposed management controls for avoiding and mitigating Project impacts on threatened fauna and their habitats is provided in Table 7-1.

7.1 Gouldian Finch

Management, mitigation and avoidance actions proposed to address direct and indirect impacts of Project implementation on the Gouldian Finch include, but are not limited to:

- Minimise clearing or other disturbance of the mapped Gouldian Finch habitat as far as practicable and, in particular, any White Gum nesting trees.
- Establish and maintain an exclusion zone between the Pincombe Range and the Project development envelope to separate potential habitat and the Project development.
- Destock cattle within the Project development envelope.
- Implement fire management regimes within the Project tenure (including consultation with other private and public land managers on improving native grass habitat management).
- Implement weed management measures.
- Minimise clearing of the potential habitat trees during the breeding season.
- Undertake feral cat trapping and baiting activities around Project operations.
- Observe waterholes and freshwater ponds within the Project tenure early in the dry season for the presence of Gouldian Finches.
- Conduct routine monitoring of water quality in process water dams, including the TSF.
- Progressively undertake rehabilitation activities with full rehabilitation at closure. Rehabilitation activities will include establishing vegetation types that support breeding and foraging habitats for the species.
- Support regional cane toad control activities in alignment with DBCA's programs and the Cane Toad strategy for WA 2021-2026 (DBCA, 2021).

7.2 Australian Painted Snipe

Management, mitigation and avoidance actions proposed to address direct and indirect impacts of Project implementation on the Australian Painted Snipe include, but are not limited to:

- Minimise clearing or other disturbance of the mapped Australian Painted Snipe habitat as far as practicable.
- Destock cattle within the Project development envelope.
- Implement fire management regimes within the Project tenure (including consultation with other private and public land managers on improving native grass habitat management).
- Implement weed management measures.
- Develop and implement surface water monitoring program, including water quality monitoring and flood mapping.
- Minimise alterations to surface water regimes as far as practicable by implementing appropriate drainage design to maintain pre-development site hydrology.
- Progressively undertake rehabilitation activities with full rehabilitation at closure. Rehabilitation activities will include establishing vegetation types that support breeding and foraging habitats for the species.

7.3 Northern Crested Shrike-tit

Management, mitigation and avoidance actions proposed to address direct and indirect impacts of Project implementation on the Northern Crested Shrike-tit include, but are not limited to:

- Minimise clearing or other disturbance of the mapped Northern Crested Shrike-tit habitat as far as practicable.
- Implement fire management regimes within the Project tenure (including consultation with other private and public land managers on improving native grass habitat management).
- Implement weed management measures.
- Progressively undertake rehabilitation activities with full rehabilitation at closure. Rehabilitation activities will include establishing vegetation types that support breeding and foraging habitats for the species.

7.4 Mine Closure

At the cessation of mining activities, the Project will be rehabilitated in accordance with the Post Mining Land Use (PMLU) criteria set out in the Mine Closure Plan. With respect to MNES, the following key closure outcomes will be incorporated into the closure design:

- The Integrated Waste Landform (IWL) final landform will be reprofiled to approximately 18 degrees and capped with competent rock material. The IWL will be revegetated with species commonly found within the Pincombe ranges, in particular hollow-bearing smooth-barked gums that provide suitable breeding habitat for species such as the Gouldian Finch and Northern Crested Shrike-tit.
- Where possible, oversize rocky material will be stockpiled and placed within the final landform as suitable for Northern Quoll.
- On the floodplain areas of the site, establishment of native grasses to support the diet of species such as the Gouldian Finch.
- Ongoing seed collection and rehabilitation trials will occur during the operational phase of the Project.
- Ongoing consultation with regulators and key stakeholders will occur through the operational phase of mining.

Table 7-1: Key management strategies – threatened fauna and habitats

Threatened Fauna and Habitat Management			
Aim	• Maintain the abundance, diversity, geographic extent and viability of threatened fauna populations and their habitats through the avoidance or management of adverse impacts and improvement in knowledge. • Minimise harm to native fauna and their habitats by controlling clearing activities. • Alleviate existing threatening factors by managing fire, reducing grazing pressures and routinely monitoring for and humanely destroying harmful pest species, including cane toads.		
Threatening Processes	Ground disturbance Fire	Grazing by livestock Invasive flora and fauna species	Hydrological change, including changes arising from climate change
Key Management Practices – Planning and Design	• No disturbance occurs within the development exclusion zone. • Ensure all required licences and permits are obtained prior to clearing activities commencing. • As far as practicable, fauna and habitat surveys are to be carried out over an area larger than the disturbance footprint to enable an informed assessment of potential impacts. • Working within the constraints of engineering and economic feasibility, ensure the development is designed to avoid direct impact to important habitat and to maximise use of pre-cleared/disturbed areas, thereby minimising clearing requirements. • Integrated Waste Landform to be designed consistent with the adjoining Pincombe Range and planted using vegetation to support extension of habitat for Gouldian Finch, Northern Quoll and Northern Crested Shrike-tit.		
Key Management Practices - Staff Management, Training and Awareness	• Ensure all staff are appropriately inducted and trained in the environmental aspects relevant to their positions, for example, clearing and habitat preservation, fauna identification, fire prevention and control. • All personnel who participate in training are to update their Training Register Form and the induction supervisor must ensure a Training Record of Attendance Form is completed. • Establish and maintain a ground disturbance register to monitor compliance with environmental requirements.		
Key Management Practices - Operational controls	• Undertake ground disturbance only in accordance with a valid ground disturbance permit. • All approved disturbance activities to be clearly delineated on ground and communicated to the relevant contractor. • Routine observations of fauna presence at or near water storage structure to be reviewed at least monthly to check effectiveness of deterrent devices and update need for additional controls.		

Threatened Fauna and Habitat Management	
Key Management Practices - Post-Clearing	• Previously disturbed areas that are no longer required shall be rehabilitated as soon as practicable. • Progressive rehabilitation shall be conducted throughout the Project life and revegetation continued after cessation of mining. • All temporary construction infrastructure and facilities are to be removed prior to rehabilitation.
Key Management Practices - Weed and Pest Animal Control	• All machinery, vehicles and plant which arrive on site are to be inspected and confirmed as free of soil and vegetative matter or cleaned as necessary. • Clean vehicles and equipment regularly in the wash down facility, to remove built up soil and vegetative matter. • Ensure domestic waste is disposed of in the correct manner. • During operations, inspect and map weeds and maintain a weed inventory. Implement weed control through construction and operations. • Implement cane toad monitoring and control program. • All vehicles are to remain on designated tracks to avoid disturbance and seed or soil transfer. • Undertake post rehabilitation monitoring for weed or pest animal invasion. Implement weed / pest animal control if required.
Key Management Practices - Fire Prevention and Control	• Procedure and permitting process for all hot work. • Hot work is not to be conducted in fire risk areas or on days deemed to have a high fire risk. • Ensure facilities comply with Local Government fire prevention requirements. • Ensure correct storage and isolation of flammable substances. • Implement safe smoking practices and appropriate disposal of cigarette butts. • Implement management practices to minimise fuel load, including fire breaks and burning. • Ensure appropriate fire response equipment is located onsite. • Collaborate with DBCA and Traditional Owners in controlled mosaic burns in vegetated, non-operational areas.

Threatened Fauna and Habitat Management			
Relevant Documents	• EPBC approval 2023/09576 • Ministerial Statement 1097 • Sorby Hills Silver Lead Zinc Project Public Environmental Review and EPA report number 1491 • Sorby Hills Silver Lead Zinc Project Mining Proposal (DMIRS Approval) • Works Approval (Department of Environment and Conservation (DWER) Approval)	• Ground clearing procedure • Fauna observation / interaction register • Injured fauna procedure • Biosecurity procedure • Cane toad monitoring and control program	• Information sheets: threatened fauna • Fauna monitoring procedures • Training record form • Incident classification and reporting procedure • Waste management procedure
Monitoring	• Ground disturbance is mapped monthly. • Areas progressively rehabilitated mapped annually. • Maintaining records of fauna observed at TSF and water storage structures. • Fauna injury / mortality records. • Cane toad monitoring and control records. • Quarterly heavy metal analysis (Bird Feathers) found around TSF facility • Quarterly monitoring of evaporation basin water quality	• Annual reconciliation of extent of habitat disturbance for each threatened fauna habitat suitability category. • Fires and fire management activities mapped after works completed. • Monitoring of water levels adjacent to the Project disturbance during the wet season to validate hydrological modelling. • Annual inspection of exclusion area to document habitat condition, check for presence of threatened species and verify that exclusion rules have been adhered to.	
Reporting	• Map extent of ground disturbance and report in annual performance / compliance reports. • Annual performance and compliance reporting to DCCEEW, DEMIRS and DWER. • Delineate areas rehabilitated on the Site Plan and report in the AER. • All fires in and around the Project are to be reported immediately to the Registered Manager. • Incidents and non-compliance events to be notified in accordance with statutory requirements.		
Corrective Actions	• All non-compliances are recorded as Environmental incidents. • Appropriate actions are issued and managed in the incident management system.		

Threatened Fauna and Habitat Management	
Key Performance Indicators	• No unauthorised clearing. • No unauthorised impacts to vegetation, priority species or priority ecological communities. • No death of vegetation from dust. • No preventable unplanned fires. Natural fires controlled appropriately. • Containment of weed infestations. Successful rehabilitation of cleared areas.

8 BIODIVERSITY OFFSET STRATEGY

This section describes the compensatory measures proposed by SMPL to address those significant impacts to fauna or fauna habitats that cannot be eliminated by the diligent implementation of mitigation and avoidance actions described in the previous section.

In developing its offset strategy, SMPL has been mindful of the eight offset principles promulgated by the Australian government (*Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy, October 2012). The offsets proposed by SMPL are designed to:

1. 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.
2. emphasise direct offsets, while including other compensatory measures where appropriate.
3. be in proportion to the level of statutory protection and environmental threat that applies to each species or its habitat.
4. be of a size and scale proportionate to the residual impacts on the protected matter.
5. effectively account for and manage the risks of the offset not succeeding.
6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.
7. be efficient, effective, timely, transparent, scientifically robust and reasonable.
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced

8.1 Legislative and policy context

The Sorby offsets strategy has been prepared to meet Condition 4 of the project approval for the Sorby Hills Silver-Lead-Zinc Project (2023/09576) issued on 29 August 2025 under sections 130(1) and 133(1) of the Environment Protection and Biodiversity Conservation Act 1999. The offset actions set out in the strategy seek to compensate the unavoidable residual significant impacts of implementing the Sorby Hills Lead-Silver-Zinc Project on the following threatened species and their habitats:

- Australian Painted Snipe (*Rostratula australis* – Endangered, Marine)
- Crested Shrike-tit (northern) (*Falcunculus frontatus whitei* - Vulnerable)
- Gouldian Finch (*Erythrura gouldiae* - Endangered)

The overarching objective of the offset strategy is to deliver a net benefit to the conservation status of the three species targeted by the strategy (Offset Principle #1).

SMPL's approach to biodiversity offsets has been developed to meet the requirements of the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (Commonwealth of Australia, 2012). In preparing this offset strategy, SMPL has sought to reflect recommendations and priorities set out in the following documents:

- Commonwealth of Australia, 2022. *National Recovery Plan for the Australian Painted Snipe (Rostratula australis).*
- O'Malley, C, 2006a. *National Recovery Plan for the Gouldian Finch (Erythrura gouldiae)*, WWF-Australia, Sydney and Parks and Wildlife NT, Department of Natural Resources, Environment and the Arts, NT Government, Palmerston.
- Threatened Species Scientific Committee, 2000. *Conservation Advice: Falcunculus frontatus whitei - crested shrike-tit (northern)*, 16 July 2000.

Figures showing the nearest records of occurrence of each of the threatened species considered in the Sorby offset strategy are provided in Figure 6-6, Figure 6-7 and Figure 6-8. Maps showing the regional extents of habitat assessed as being potentially suitable breeding or non-breeding habitat are presented in the following figures:

- Gouldian Finch (Figure 6-1)
- Australian Painted Snipe (Figure 6-4) and
- Northern Crested Shrike-tit (Figure 6-5)

Figures showing the local mapped extent of potentially suitable habitat for each of the three species are presented in Figure 6-9, 6-12 and 6-13.

8.2 Strategic considerations and alignment with offset principles

In assessing potential strategies for compensating for possible residual significant impacts on MNES values, SMPL has adopted the following criteria:

- The scale and character of offset actions must be consistent with Commonwealth offset policies (Offset Principle #4).
- Offsets should be consistent with priority actions in published recovery plans / conservation advice (Offset Principles #3, #4 and #6)
- Offset actions should preferably be actionable in the short term, in order to deliver conservation benefits during the life of the project (Offset Principle #7)

- Offset actions should, where practicable, lend themselves to participation by Traditional Owners and be aligned with management approaches described in conservation park management plans developed by them (Conservation Commission of WA, 2011) (Offset Principles #2, #6 and #8).
- Offset actions should take into account lessons from relevant conservation programs in the region. (Offset Principles #5 and #7)

SMPL does not propose 'averted loss' in its offset strategy, except to the extent that it has established exclusion areas in which mining activities are prohibited as part of its environmental management program. The mining exclusion area is shown in Figure 6-9, Figure 6-12 and Figure 6-13. Potential habitat for all three MNES species addressed in this offset strategy has been mapped in the proposed exclusion area.

There are limited opportunities in the project locality for delivering positive outcomes through the active restoration of habitat, as the area is remote and substantially undisturbed, apart from the effects of historic and contemporary cattle grazing. However, destocking of areas previously and currently used for cattle grazing will contribute to habitat recovery. Destocking of land within the project development envelope is included as a management action in SMPL's fauna and habitat management plan and does not form part of the offset strategy.

SMPL's proposed offset approach focuses on the implementation of on-ground management actions to combat threatening factors, as described in the following sections.

8.3 Offset delivery and governance

As a key part of its offset strategy, SMPL proposes to fund the development and implementation of threat abatement programs for the Gouldian Finch, Australian Painted Snipe and Northern Crested Shrike-tit. The threat abatement programs will aim to reduce key threatening processes to the species' survival within areas identified as suitable habitats for the species, thereby providing a direct offset. Table 8-1 provides the area of suitable habitat for each MNES that will be subject to the threat abatement programs implemented by SMPL. These areas have been calculated using the EPBC Offset Calculator. Copies of the offset calculations are provided in Appendix 3.

Table 8-1: Area subject to Threat Abatement Programs for each MNES

MNES Species	Area of Impact (ha)	Habitat Subject to Threat Abatement Program (ha)
Gouldian Finch (*Erythrura gouldiae*)	16.1	175
Australian Painted Snipe (*Rostratula australis*)	562.4	2000
Northern Crested Shrike-tit (*Falcunculus frontatus whitei*)	12.5	22

SMPL will fully fund the offset actions proposed under this Plan, including on-ground management measures/actions and research activities to support the environmental values addressed by this plan.

The details relating to the value and timeframe for the provision of the funding for research and/or management actions to combat threatening factors will be detailed prior to or post commencement of the Proposal, pending advice from DCCEEW and DBCA.

SMPL intends to engage and coordinate with DBCA, which will be the recipient of the threat abatement funding and responsible for developing and implementing the programs and defining the program outcomes. Direct offset actions will generally occur adjacent to the 14,165 ha parcel of land proposed for gazettal as the Goomig Conservation Park and shown as the exclusion zone ass shown in Figure 8-1.

The land will be jointly vested in the Western Australian Conservation Commission and the Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation (MG Corporation), as provided for under Section 8AA of the CALM Act. The reserve will be established for the purpose of 'Conservation and Traditional Aboriginal Uses'.

Once the reserve has been formally gazetted, freehold land title will be transferred to the Miriuwung-Gajerrong Trustees Pty Ltd and leased to the State for joint management by MG Corporation and DBCA. After the title for the land has been transferred, the Conservation Commission's statutory role for these areas will be in accordance with the provisions of a binding management agreement.

Subject to consultation with the Yoorrooyang Dawang Regional Park Council, it is possible that some of the offset funding provided by SMPL will be used for combatting threatening factors in other parts of the Regional Park of which the Goomig Park is one component (Figure 8-1). Specific offset activities and schedules will be developed in consultation with DBCA, SMPL and the MG Corporation.

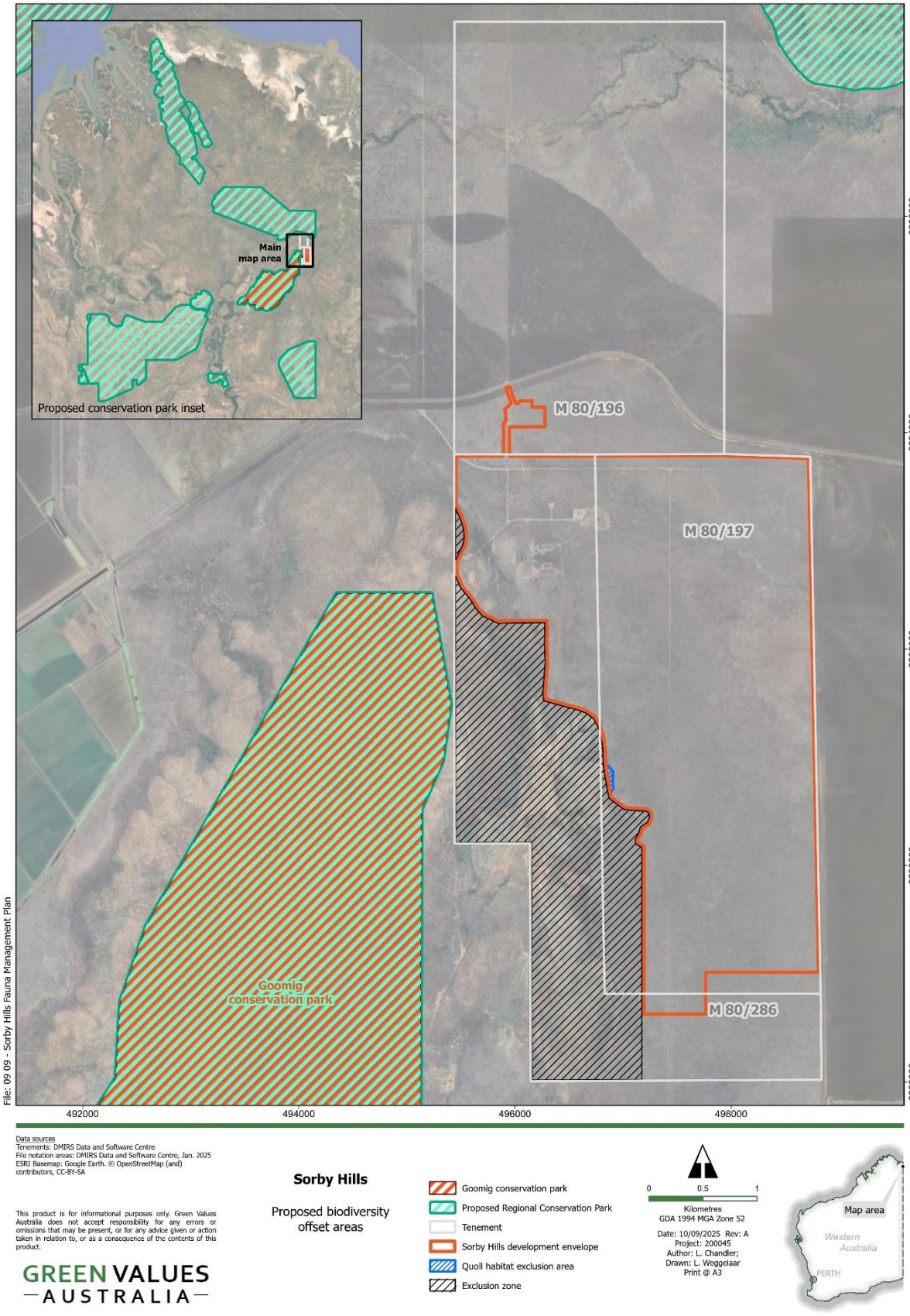

Figure 8-1: Location of Goomig Conservation Park

Monitoring the management of the Goomig Conservation Park is a function of the Yoorrooyang Dawang Regional Park Council. DBCA will have specific responsibility for establishing the monitoring requirements of the threat abatement programs and performance criteria to be used to evaluate the success of the implemented programs. Performance criteria will be aligned with National Recovery Plans, where relevant. Adaptive management practices will be built into the threat abatement programs developed by DBCA.

DBCA will provide annual reports to the Park Council on the implementation and operation of the management plan. This information will enable the evaluation of the park's management, including in relation to the implementation of offset actions. The offset evaluation would include periodic (at least triennial) assessments of how the strategies of the plan have achieved the stated objectives and whether new or modified strategies are required to deliver net positive biodiversity outcomes. DBCA will be required to provide an annual report detailing the results of offset activities for inclusion in SMPL 's annual Compliance Assessment Report.

8.4 Threat Abatement Programs

Key threatening processes to the survival of the Australian Painted Snipe and Gouldian Finch have been identified in their respective National Recovery Plans. SMPL has also reviewed the existing scientific literature on the processes threatening these species and the Northern Crested Shrike-tit and the effectiveness of various abatement programs that have been implemented across Australia.

Based on current recovery plans, government conservation advice and relevant peer-reviewed literature, the most important threatening factors affecting the species addressed in this offset strategy are as follows:

- **Gouldian finch**: impacts of inappropriate fire regimes and grazing on feeding habitat (and possibly nesting habitat, in the case of fire)
- **Australian Painted Snipe**: altered hydrology in wetlands; changes to wetland vegetation as a result of grazing, altered fire regimes and/or clearing of vegetation for cropping. Possible impacts from predation by introduced mammals.
- **Northern Shrike-tit**: high intensity fires / altered fire regimes; grazing and spread of invasive plant species

Additional analysis of threatening factors is provided in Table 8-2.

Table 8-2: Summary of threatening factors (MNES fauna and habitats)

Threatening factor	Gouldian Finch (*Erythrura gouldiae*) (Endangered)	Australian Painted Snipe (*Rostratula australis*) (Endangered)-	Northern Crested Shrike-tit (Falcunculus frontatus whitei) (Vulnerable)
Loss or fragmentation of habitat due to infrastructure and/or mining development	Background information appended to the National Recovery Plan for the Gouldian Finch (O'Malley 2006) says that "*The loss of critical habitat due to infrastructure development, such as in the case of the creation of Lake Argyle in the Kimberley region, may have played a role in regional Gouldian Finch population declines…and it is possible that some local populations may currently be being affected by mining activity or infrastructure development*..". Feeding habitat likely occurs within the Project area, however, the extent of feeding habitat lying within the development envelope represents a very small amount of the total habitat within the region. Direct clearing of up to 16.1 ha habitat is proposed within the project development envelope,	Large scale fragmentation of wetlands may cause Painted Snipe to have to travel larger distances between wetlands (thereby expending more energy) in order to access adequate food or shelter. Direct clearing of 562.4 ha of foraging habitat is proposed within the development envelope.	Published conservation advice for the Northern Crested Shrike-tit says that the northern subspecies occupies a large home range and may be particularly susceptible to habitat fragmentation and may not survive in small habitat remnants. Populations of shrike-tits are reported to be widely spaced (~ 20 km apart) and individual groups may have territories extending over approximately 20 ha (Threatened Species Scientific Committee, 2016). Mapping by Shedley (2012) suggests that areas within the Project development envelope may represent marginal or possible habitat for this species, rather than 'suitable' habitat. Areas of suitable habitat have been recorded southwest of the development envelope (**Error! Reference source not found.**). Direct clearing of 12.5 ha of 'possible' habitat is proposed within the development envelope.
Loss of nesting habitat due to fire.	Gouldian Finches are reported to avoid hollows that have been burnt (O'Malley, 2006). There may be a link between Gouldian Finch population persistence and the maintenance of heterogeneous fire patterns in landscapes (O'Malley, 2006).	The impacts of fire on Painted Snipe habitat are unknown. Too frequent or excessively hot fires may have a negative impact on wetland vegetation structure.	Conservation advice for the Northern Crested Shrike-tit says that nesting habitat may be harmed by high Intensity fires in the late dry season, but that low intensity fires are unlikely to cause adverse effects.
Declining food resources due to unfavourable fire regimes.	Inappropriate fire regimes may adversely affect Gouldian Finches by affecting seasonal seed availability (O'Malley, 2006).	The impacts of fire on Painted Snipe habitat are unknown. There is no documented evidence that fire reduces food availability.	The northern subspecies of the Shrike-tit is thought to forage for invertebrates, mostly in foliage, branches, and the trunk and bark across a range of eucalypt and other tree species. Feeding habitat may be harmed by high intensity fires.
Declining food resources or reduction in habitat	Parts of the project development envelope have been used in the past for cattle grazing.	Grazing and trampling of wetland vegetation, disturbance to wetland substrates and nutrient enrichment may adversely affect habitat where	Limited fire regimes have occurred historically, due to the area being used for cattle grazing. The site is considered heavily degraded with limited food resources.

Threatening factor	Gouldian Finch (*Erythrura gouldiae*) (Endangered)	Australian Painted Snipe (*Rostratula australis*) (Endangered)-	Northern Crested Shrike-tit (Falcunculus frontatus whitei) (Vulnerable)
condition due to grazing pressure.	The site is considered heavily degraded with limited food resources.	grazing occurs near wetlands (Commonwealth of Australia, 2022).	
Declining food resources or reduction in habitat condition due to weed incursion.	Weed incursion is not explicitly mentioned as a threatening factor in the Recovery Plan for this species, however the Recovery Plan notes that changing composition of grass species may favour species that are less palatable to the Gouldian Finch.	Changes to vegetation structure may reduce the amount of protective cover available for Painted Snipe or otherwise make wetlands less hospitable for the species.	The conservation advice for the Northern Crested Shrike-tit recommends implementing weed management to identify, control and reduce the spread of exotic grasses in the subspecies' key habitat.
Changes in hydrology (including through drainage and the diversion of water for agriculture, construction of large dams), loss of wetland habitat due to agriculture	Breeding habitat for Gouldian Finches is normally within 2 to 4 km of small, persistent waterholes and springs. Although altered hydrology is not mentioned as a threatening factor in the Recovery Plan for the species, the Recover Plan comments that changes in the availability of surface water in the dry season could affect persistence of the species.	The main threat to Painted Snipe identified in the National Recovery Plan for Australian Painted Snipe (Commonwealth of Australia, 2022) is the loss and degradation of wetlands, through drainage and the diversion of water for agriculture and reservoirs.	Altered hydrology is not mentioned as a threatening factor for this species.
Predation by introduced species	Predation is not mentioned as a threatening factor in the recovery for this species, except in relation to possible effects of increased herbivory by feral herbivores and/or habitat destruction by feral pigs.	There is no direct evidence that predation by introduced mammals (for example, cats or foxes) is a significant threatening factor for Painted Snipe.	Predation is not mentioned as a threatening factor in the published conservation advice for this species, except in relation to possible effects of increased herbivory by feral herbivores.

8.5 Direct offsets

8.5.1 Fire management

Inappropriate fire regimes have been identified as a key threatening factor for the viability of the Gouldian Finch and Northern Crested Shrike-tit (O'Malley, C, 2006; Threatened Species Scientific Committee, 2000). SMPL will resource the implementation of a prescribed burning program within the Goomig Conservation Park, drawing on Dawawang fire knowledge. The resourcing provided will be sufficient to allow a 3-year low-intensity burning cycle to be implemented over a nominal 2000 ha area of the conservation park. SMPL will also fund DBCA and the Miriuwung Gajerrong Rangers to monitor and report on the effectiveness of the prescribed burning program. Once established, the fire management program may serve as an opportunity for on-country training of rangers for other parts of the broader Yoorrooyang Dawang regional conservation parks.

8.5.2 Weed and pest management

Displacement of native vegetation by invasive introduced species has been identified as a potential threatening factor for habitat used by the Painted Snipe (Commonwealth of Australia, 2022). Weeds may also adversely affect the quality of foraging material available to granivorous species such as the Gouldian Finch. A range of weeds, including buffel grass (*Cenchrus ciliaris*), common lantana (*Lantana camara*) and kapok bush (*Aerva javanica*) occur in the proposed Goomig conservation park. SMPL will resource annual weed assessments and control in susceptible areas within the proposed Goomig conservation park. If requested by the Yoorrooyang Dawang Regional Park Council, SMPL will resource 2-yearly on-country training of rangers in weed identification and control.

8.6 Indirect offsets

Priorities for offset contributions to address important knowledge gaps affecting the conservation of the protected fauna targeted in SMPL's offset strategy will need to be agreed in consultation with DCCEEW, DBCA and Traditional Owners. There may be opportunities for building on recent research by Charles Darwin University (Collett *et al,* 2023) into the effects of low-intensity burning on the occurrence of Gouldian Finches in the East Kimberley.

Additionally, or alternatively, conservation advice published for the Northern Crested Shrike-tit (Threatened Species Scientific Committee, 2000) makes it clear that currently understanding of this species' habitat requirements is inadequate: resourcing of research in the Goomig conservation park (much of which has been mapped as 'suitable habitat' for the species) may help address this knowledge gap.

8.7 Offset Funding Allocation

The funding required to support meaningful benefits from indirect offsets will be determined in consultation with a range of stakeholders and service providers. SMPL has provisionally assumed that the allocation of funding of offset actions will be approximately 90% for direct offset actions and 10% for indirect offsets. An indicative breakdown of the funding allocation is as follows:

Offset	Proposed Control Program	Proportion of Funding
Fire management	Design and Implement controlled burning program	45%
Weed and pest management	Conduct annual weed surveys and weed control in susceptible areas of Goomig Conservation Park	45%
Indirect offsets	Develop programs to acknowledge knowledge gaps in consultation with key stakeholders (DCCEEW, DBCA and Traditional Owners)	10%

8.8 Offset performance objectives and monitoring

8.8.1 Performance objectives, indicators and criteria

Provisional performance criteria for offset actions aimed at reducing inappropriate fire regimes and weed occurrence are summarised in Table 8-3. SMPL will define target outcomes for the extent of weed management activities following consultation with the DBCA and Traditional Owners.

Table 8-3: Performance objectives and targets: offset actions to address threatening factors

Threatening factor	Proposed control measures	Environmental objective	Performance indicators	Performance target (provisional)
Inappropriate fire regimes	Design and Implement controlled burning program	Reduce frequency and extent of high intensity, late dry season fires in areas providing suitable habitat for MNES fauna covered by this plan.	Extent of area over which controlled burns completed each year.	Offset area (~2000 ha) to be burned at least once in three years (average of ~700 ha /year, subject to seasonal conditions)
			Extent of high intensity wildfires within Goomig Conservation Park and project development envelope.	Extent of high intensity wildfires to be no greater in offset areas and project development envelope than in equivalent sized reference area.
			Grass seed availability in controlled burn areas, compared to reference sites	Within 6 years of commencement of offset action, grass seed availability in managed areas to be significantly greater than reference site seed availability
			Grass seed composition in controlled burn areas, compared to reference sites	Within 6 years of commencement of offset action, grass seed quality in managed areas is significantly better than – reference site seed quality (metrics may include species heterogeneity, energy value, palatability)
			Number of unburnt nesting trees (Gouldian Finch) in managed offset areas, compared to reference sites.	Frequency of burnt hollow-bearing trees (hollows / ha) in managed areas is less than number of burnt hollow-bearing trees in reference areas.
			Number of Gouldian Finches and Northern Crested Shrike-tits observed in offset managed areas, compared to reference sites.	Within 6 years of commencement of offset action, occurrence of Gouldian Finches and / or Northern Crested Shrike-tis in managed areas is significantly greater than occurrence in reference sites.
Weed invasion	Conduct annual weed surveys and weed control in susceptible areas of Goomig Conservation Park	Preserve vegetation assemblages required by MNES fauna covered by this plan.	Extent of area surveyed and treated for weeds each year	TBA
			Weed frequency (percent cover) in offset areas prior to treatment and 2 years after treatment, compared to reference sites.	Weed frequency in treated areas 2 years post-treatment is no more than 10% higher than in reference sites.
			Number of weed species in offset areas prior to treatment and 2 years after treatment, compared to reference sites.	Number of weed species in treated areas 2 years post-treatment is no greater than in reference sites.

8.8.2 Monitoring

The objectives of the proposed monitoring program are to:

- Document the implementation status of proposed offset actions
- Check the effectiveness of direct offset actions in reducing the posed by threatening factors
- Record changes in habitat quality in offset areas, compared to reference sites
- Make observations about the occurrence of threatened species in offset areas and their use of offset areas.

Offset implementation

The implementation status of offset actions will be tracked by recording

- Extent of land over which low-intensity burns, weed management and (if applicable) destocking has occurred (ha/year)
- Compiling maps of 'time since last burnt' over offset area

Habitat quality

Habitat quality monitoring will be carried out prior to the start of the threat abatement program and then annually following the start of the offset actions. Monitoring will occur in treated offset sites and in reference sites agreed with the offset area managers (DBCA and MG Corporation). Habitat quality will be described in terms of:

- Vegetation condition and structure, compared to reference site conditions
- Grass seed abundance and composition
- Numbers and frequency (trees/ha) of unburnt habitat trees (hollow-bearing trees)
- Weed abundance (cover) and types of weeds

Habitat quality in offset areas will be compared against attributes of reference sites following each monitoring event and any trends in habitat quality indicators will be assessed over the life of the project.

Threatened species occurrence

8.8.3 Targeted surveys for the presence / absence of Gouldian Finches and Northern Crested Shrike-tits will be carried out in offset areas before the commencement of the threatening factor abatement program and then annually for the first five years of offset implementation.If results from the first five years of monitoring show objective evidence of ecological benefits, then the frequency of monitoring may be reduced to once every 2 years. If monitoring results do not show objective evidence of ecological benefits (results are ambiguous or negative), then a modified offset approach will be discussed with relevant stakeholders (DCCEEW, DBCA, Traditional Owners and EPA) and annual monitoring will continue to assess the modified offset actions.Evaluation, Reporting and Contingency Actions

Monitoring results will be reviewed at least annually and will be included in annual performance and compliance reports submitted to DCCEEW, DBCA, EPA and DMPE.

If the extent of low intensity burns does not reach scheduled targets in a given year (for example due to unsuitable weather conditions or unavailability of Traditional Owner rangers), the work will be carried over to the following year.

If there is evidence that any habitat quality indicator is declining – either in absolute terms or relative to the reference sites – a review of offset activities will be completed in consultation with DBCA, Traditional Owners and subject matter experts at least 4 months before the scheduled start of the next season of offset activities. It may take up to five years before trends are apparent.

At Year 5, a comprehensive review of the offset program by an independent expert will be commissioned in order to assess whether there is compelling evidence that offset actions are maintaining or improving habitats for the three species targeted under this Plan.

9 PLAN REVIEW AND REPORTING

9.1 Reporting and Timing

Details of the progress of the outcomes of this Plan will be included in the Compliance Assessment Report, which will be provided annually by SMPL to DCCEEW. The Compliance report will include, but not be limited to the following:

- evaluation of the monitoring results associated with threat abatement programs to identify progress in meeting the success criteria
- activities associated with this Plan undertaken in the previous 12 months
- activities associated with this Plan proposed for the coming 12 months
- summary of compliance with the approved Plan and associated conditions.

9.2 Review and Revision

This Plan will be reviewed and revised based on one or more of the following:

- change of environmental conditions for the Proposal under either the EP Act or the EPBC Act
- review is requested from DCCEEW and/or DWER
- revision of significant environmental impacts (if required)
- receipt of information addressing any data gaps (if required and where available)
- otherwise, every 3 years.

10 STAKEHOLDER CONSULTATION

SMPL's core engagement strategy principles adopted for the Project include early consultation and engagement, open and transparent communication, fostering collaboration and welcoming feedback and incorporating community and stakeholder considerations into the design and implementation of the Project.

Throughout the development of the Proposal, SMPL has worked with the Traditional Owners to identify exclusion areas with respect to the Project and has minimised the impact of these areas through project design. In addition, SMPL has committed to continue working with this country's Traditional Owners to ensure any impacts are minimised and approved through the correct mechanisms.

SMPL will continue to engage with relevant stakeholders on matters associated with the Project to ensure stakeholder concerns are addressed and potential impacts are managed. Key stakeholders identified for the purposes of the review, implementation and reporting for this Plan are DBCA and DCCEEW.

A summary of the consultation undertaken to date in relation to this Plan is provided in Table 10-1.

Table 10-1: Stakeholder Consultation Register

Stakeholder	Date(s)	Relevant issues/Topics raised	Proponent response/Outcome
DCCEEW	28/11/2024	Discussion on Fauna Management Plan and integration of offsets package.	Finalisation of report and inclusion of proposed offset approach into document.
DBCA	11/12/2024	Email to discuss regional management programs and opportunities for engagement.	
DBCA	16/12/2024	Meeting with Brad Johnson, regional manager, on offset strategies for both state and federal offset packages. Consultation on the proposed land management activities and how this would be incorporated into the current regional operations. DBCA has signed an ILUA with MG for the management and operations of the conservation parks (Pincombe Range) as part of the implementation of the Ord River agreement. MG persons will be employed and trained as rangers. Management activities as outlined by Boab for the fauna management and typhonium management could form part of this work (i.e. SMPL would provide a financial contribution to DBCA to support the works) – the works will be (not limited to) the following: - Feral animal management - Weed and fire control - Rehabilitation planting - Typhonium monitoring requirements	SMPL has developed a more detailed offset package for consultation with DBCA, with the intent to progress into a MoU for ongoing land management during operations. DBCA noted that there is availability for the ranger team to work with SMPL to undertake works onsite – such as water sampling, monitoring, weed/fire control, seed collection, rehabilitation, etc. Utilising this part-time support onsite would reduce headcount and support local employment.

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APPENDIX 1. MNES INFORMATION SHEETS (NT GOV)

Threatened species of the Northern Territory

Crested shrike-tit (northern)

Falcunculus frontatus whitei

Conservation status

Australia: Vulnerable
Environment Protection and Biodiversity Conservation Act 1999

Northern Territory: Near Threatened
Territory Parks and Wildlife Conservation Act 1976

Credit: M. Gardner

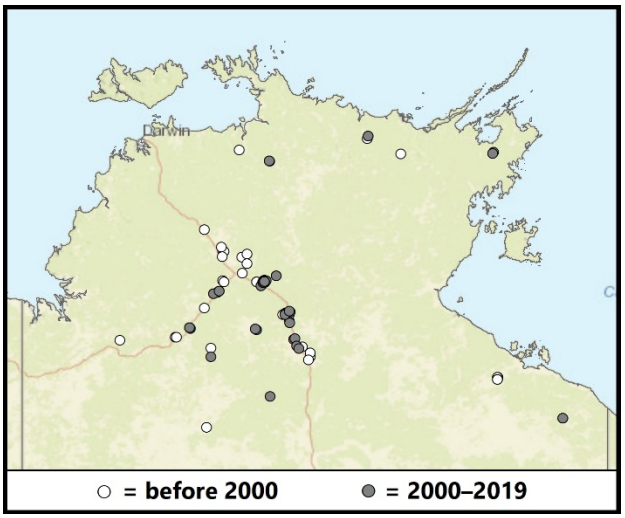
Description

The Crested Shrike-tit is an unmistakeable bird. It has a bold black and white head, short black crest, green back and wings, and yellow breast and belly. The chin and throat of males are black, while those of females are green. The bill is deep and hooked. Three subspecies of the Crested Shrike-tit are recognised. The brighter yellow underparts, large white markings on the head and proportionately short tail distinguish the Crested Shrike-tit (northern) from the other two subspecies. The taxonomy of this species is unresolved; some authors regard the three taxa as species.

Distribution

The Crested Shrike-tit has a disjunct distribution in Australia: *Falcunculus frontatus frontatus* occurs in south-eastern Australia and northern Queensland; *F. f. leucogaster* occurs in south-western Western Australia; and *F. f. whitei* occurs in the Kimberley region and Top End.

In the Northern Territory (NT), the Crested Shrike-tit (northern) has been recorded from widely scattered localities from near Timber Creek to the east Gulf Country, north to Kakadu National Park and in north-eastern Arnhem Land[1]. Although most records have been collected from within 100 km of both Katherine and Mataranka, this likely reflects biases in surveys for this subspecies. Large areas of the distribution remain poorly surveyed.



Caption: Known localities of the Crested Shrike-tit (northern) in the NT (nrmaps.nt.gov.au)

NT conservation reserves where reported: Kakadu National Park and Nitmiluk National Park.

Ecology and life-history

The Crested Shrike-tit (northern) typically occurs in open woodlands dominated by *Eucalyptus* and/or *Corymbia* species, though it has also been recorded in woodlands dominated by *Melaleuca* sp. or *Terminalia arostrata*[1]. Its distribution extends from relatively wet, though still strongly seasonal, areas to semi-arid regions. However, the subspecies is very patchily distributed throughout this range and occurs at low densities (e.g. 1.25 adults/km^2 in suitable habitat at Jawoyn lands south of Katherine[2]).

Crested Shrike-tits (northern) forage unobtrusively in the canopy of trees, feeding on a variety of invertebrates, including cicadas, katydids, tree crickets, spiders and beetle larvae. The massive strong bill is used to chisel and tear bark, branches and foliage to access invertebrate prey (especially larvae); though prey are also gleaned from leaves and branches.

The subspecies is monogamous, resident and territorial. Breeding occurs over the wet season, with nest building commencing in September or October[3]. Females lay one or more clutches of 2–3 eggs anytime between October and March. Breeding success is low and re-nesting after nest failure is irregular.

Threatening processes

The Crested Shrike-tit (northern) is thinly and patchily distributed over a large but it is unclear what factors influence habitat suitability. It is likely that different threats occur in different parts of its distribution.

The low density of the Crested Shrike-tit (northern) and its patchy distribution render the subspecies especially vulnerable to habitat loss, degradation and fragmentation.

Habitat quality may be negatively impacted by fire and/or grazing regimes, which can reduce the density of large trees, limit tree recruitment and affect the abundance of prey. Nonetheless, at least in the short-term, the subspecies can evidently persist in some areas that are grazed or burned annually. Invasive plants pose a threat due to the impacts they have on the fire regime, particularly through promoting more intense and widespread fires.

Conservation objectives and management

Research priorities for the Crested Shrike-tit (northern) are to: provide a more precise estimate of total population size and trends; investigate the ecology of the species, with particular attention to characteristics associated with habitat suitability; and assess the impacts of a range of fire regimes. An appropriate survey protocol has been developed for this subspecies[5].

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Threatened species of the Northern Territory

Curlew sandpiper

Calidris ferruginea

Conservation status

Australia: Critically Endangered
Environment Protection and Biodiversity Conservation Act 1999

Northern Territory: Critically Endangered
Territory Parks and Wildlife Conservation Act 1976

Credit: D. Portelli

Description

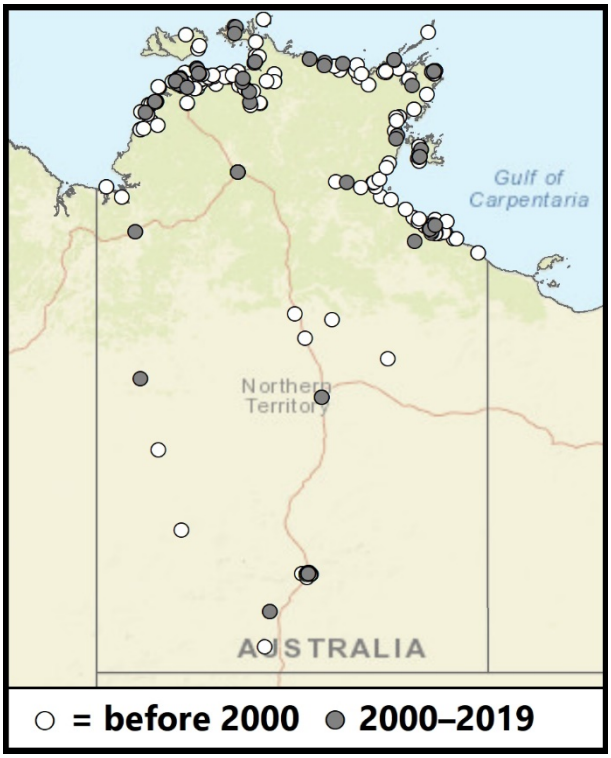
The Curlew Sandpiper is a small to medium-sized migratory shorebird with long legs, a long, fine-tipped, down-curved black bill, and a wingspan of 38–41 cm. In non-breeding plumage (typical of Australian visitors), the top and back of the head and the upperparts are grey-brown with little mottling or scalloping. The face has a distinct white eyebrow. The underparts are white with grey-brown streaking on the sides of the breast. A white rump and broad wingbar are visible in flight.

Distribution

Curlew Sandpipers breed in central and eastern Siberia and migrate annually along the East Asian-Australasian Flyway (EAAF) to overwinter in Africa, southern Asia and Australasia. They have a widespread distribution in Australia during the non-breeding season; most birds occupy coastal areas, but records of the species are scattered across most inland regions[1].

In the Northern Territory (NT), Curlew Sandpipers have been recorded from most coastal areas, which are important non-breeding and staging grounds.

The Fog Bay, Chambers Bay and Port McArthur areas are particularly important for the species in the NT[2]. Inland records include the Victoria River District, Barkly Tableland and Alice Springs region.



Caption: Known localities of the Curlew Sandpiper in the NT (nrmaps.nt.gov.au)

NT conservation reserves where reported: Barranyi National Park, Djukbinj National Park, Kakadu National Park, Keep River National Park and Limmen National Park.

Ecology and life-history

After breeding in the northern summer on tundras in the Russian Arctic and New Siberian Islands, Curlew Sandpipers that overwinter in Australia migrate southwards along the EAAF. These non-breeding birds occur on intertidal mudflats and sandflats, estuaries, coastal brackish lagoons, saltmarshes and occasionally on inland freshwater wetlands. They feed on invertebrates such as marine worms, molluscs and crustaceans, which they obtain from the surface of mud or sand or by probing deep into the substrate. Curlew Sandpipers have an estimated generation length of 7.6 years[3].

Threatening processes

The main acute cause of decline for Curlew Sandpipers migrating to Australia is habitat loss and degradation at migratory staging grounds in the Yellow Sea region[4,5]. Habitat degradation has also occurred gradually across most of its range.

Threats in Australia, particularly eastern and southern coastal areas, include habitat loss and degradation from pollution and coastal development, ongoing human disturbance, changes to hydrological processes and invasive plants[1].

Anthropogenic climate change is likely to have a long-term negative impact on the Curlew Sandpiper throughout its range, particularly through the potential loss of intertidal habitats due to sea-level rise[5].

Conservation objectives and management

In the NT, the primary conservation objective is to maintain a stable or increasing numbers of non-breeding Curlew Sandpipers by: retaining healthy intertidal mudflat habitats; improving protection of roosting sites; managing anthropogenic disturbance at important sites when Curlew Sandpipers are present; and incorporating requirements for the species into coastal planning and management.

Secondarily, the Australian Government should be supported in its international endeavours to promote conservation of shorebirds along the East Asian-Australasian Flyway.

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Threatened species of the Northern Territory

Gouldian finch

Erythrura gouldiae

Conservation status

Australia: Endangered
Environment Protection and Biodiversity Conservation Act 1999

Northern Territory: Vulnerable
Territory Parks and Wildlife Conservation Act 1976

Credit: S. Murphy

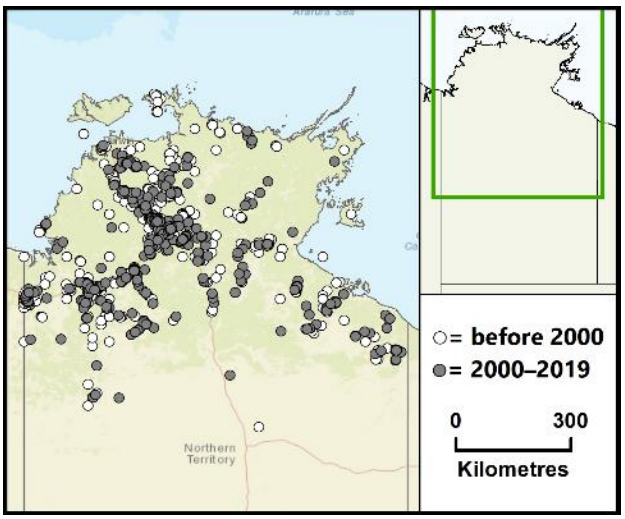
Description

The Gouldian Finch is an unmistakeable small bird. Adults have a purple breast, yellow belly, green back and wings, bright blue rump and a black tail with finely elongated streamers. Three colour morphs exist, which differ in the colour of the facial mask: black-faced individuals are the most common, followed by red-faced individuals, while the yellow-faced morph is very rare. Males are considerably more brightly coloured than females, and juveniles are entirely dull green.

Distribution

The Gouldian Finch was formerly distributed throughout the tropical savannas of northern Australia. However, it is now restricted to isolated areas, mostly within the Northern Territory (NT) and the Kimberley. The decline in its range has been most pronounced in the easternmost parts of its distribution[1]. The locality with the most known individuals is in the Yinberrie Hills, about 40 km north of Katherine.

NT conservation reserves where reported: Caranbirini Conservation Reserve, Judbarra/Gregory National Park (NP), Kakadu NP, Limmen NP and Nitmiluk NP.



Caption: Known localities of the Gouldian Finch in the NT (nrmaps.nt.gov.au)

Ecology and life-history

Gouldian Finches occupy two different regions of the landscape on an annual cycle[2]. Towards the end of the wet season and throughout the dry season, between February and October, they occupy wooded hills with hollow-bearing Snappy Gums *Eucalyptus brevifolia* and *E. leucophloia* or Salmon Gums *E. tintinans*. Hollows in these trees are used for nesting. During this period, they forage on the ground, feeding on shed seeds (mostly *Sorghum* spp.), and find water at small rocky waterholes. In the wet season, Gouldian

Finches move from the hills into lowland drainages to feed on seeds of a variety of perennial grasses—including Cockatoo Grass *Alloteropsis semialata*, Golden Beard Grass *Chrysopogon fallax* and Soft Spinifex *Triodia pungens*—that begin to set seed in mid-December[3].

Average clutch size is five eggs, but usually only one or two young fledge per clutch, and a pair may raise several clutches within a year[4]. Gouldian Finches are short-lived: generation length is estimated to be 2.7 years[5].

Threatening processes

The marked decline in the range of the Gouldian Finch is most likely due to reduced food availability caused by pastoralism and altered fire regimes, both of which influence the composition of vegetation communities. Large-scale fires late in the dry season reduce the amount of seed, particularly from species the Gouldian Finch relies upon early in the wet season[6–7]. Frequent fires can also reduce the availability of tree hollows that are suitable for breeding. The parasitic mite *Sternostoma tracheacolum* and illegal trapping for the aviculture trade have also been implicated in the decline of the species.

Conservation objectives and management

A national recovery plan for the Gouldian Finch was prepared in 20068. Management priorities for the species are to: i) maintain long-term monitoring in the late-dry season at selected sites across the range; ii) improve fire management by reducing the extent of late-dry-season fires and protecting wet-season foraging habitat; and iii) educate landholders about threats to the species and suitable management practices, including fire management, grazing management and feral herbivore control.

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Threatened species of the Northern Territory

Northern quoll

Dasyurus hallucatus

Conservation status

Australia: Endangered
Environment Protection and Biodiversity Conservation Act 1999

Northern Territory: Critically Endangered
Territory Parks and Wildlife Conservation Act 1976

Description

The Northern Quoll is a distinctive carnivorous marsupial. It is the size of a small cat (weight 300–1,100 g), with prominent white spots on a generally dark body and a long sparsely furred tail.

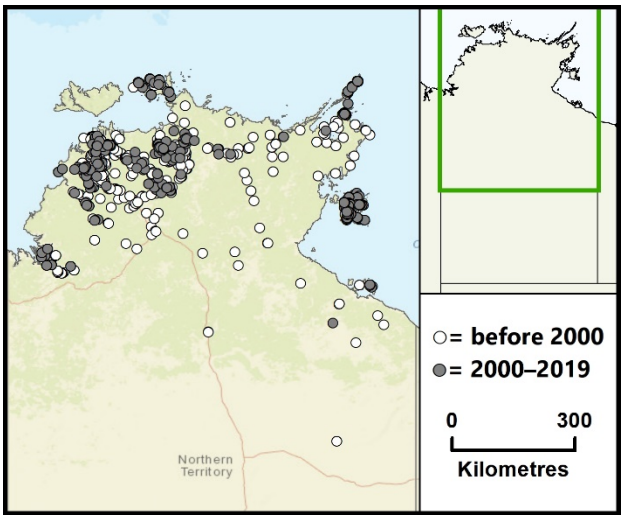
Distribution

The Northern Quoll occurs across much of northern Australia, from south-eastern Queensland to the south-west Kimberley, with a disjunct subpopulation in the Pilbara. However, it has declined across much of this range[1].

In the Northern Territory (NT), the Northern Quoll is restricted to the Top End. A 1905 record from Alexandria marks the southern limit of its known NT distribution, which is now a substantial distance from recent records. It has been recorded from Groote Eylandt and the nearby North-east and Winchelsea Islands, Marchinbar Island (in the Wessel group), Inglis Island (in the English Company Islands group) and Vanderlin Island (Sir Edward Pellew group). Additional island subpopulations have been established by translocating Northern Quolls to Astell and Pobassoo islands in the English Company island group.

Credit: M. Armstrong

NT conservation reserves where reported: Black Jungle Conservation Reserve (CR), Blackmore River CR, Channel Island CR, Charles Darwin National Park (NP), Fogg Dam CR, Garig Gunak Barlu NP, Kakadu NP, Leaning Tree Lagoon Nature Park, Limmen NP, Litchfield NP, Manton Dam Recreation Area, Mary River NP, Nitmiluk NP, Tjuwaliyn (Douglas) Hot Springs Park and Umbrawarra Gorge Nature Park.



Caption: Known localities of the Northern Quoll in the NT (nrmaps.nt.gov.au)

Ecology and life-history

The Northern Quoll occurs in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It was once common in many

eucalypt open forests. During the non-breeding season, home ranges cover about 35 ha, but this increases to about 100 ha for males in the breeding season[2]. Individuals use hollow logs, rock crevices, caves and tree hollows as den sites.

Northern Quolls are generalist predators, preying on a wide range of invertebrates and small vertebrates. Most foraging is done on the ground, but they are also adept climbers.

Like many small carnivorous marsupial species, male Northern Quolls typically live for only one year[3]. Mating is highly synchronised, occurring in late May to early June, after which time almost all males die. Young are born in the middle of the dry season (June), and reach independence in the early wet season (November).

Threatening processes

The Northern Quoll appears to have been declining in the NT for at least several decades[1,4], possibly because of impacts from feral Cats *Felis catus*, disease and/or changed fire regimes. However, the spread of Cane Toads *Rhinella marina* is a far more severe threat[5]. Quolls appear to be particularly susceptible to the poison of Cane Toads, and are killed when they attempt to kill or consume them. Nonetheless, Northern Quolls can persist in some areas after Cane Toads have established. It is important that these refuge localities are protected from other threats.

Conservation objectives and management

A national recovery plan for the Northern Quoll was prepared in 2010[8]. This plan describes research and management priorities for the species across its range. Priority actions for the NT are: i) protecting key localities from colonisation by Cane Toads and Cats (especially through quarantine of offshore islands); ii) fostering recovery at localities that have collapsed following Cane Toad arrival; and iii) identifying and managing other threats to remnant Northern Quoll localities. These actions can be achieved through research, raising awareness and effective land management (e.g. reducing high fuel loads through weed control).

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Australian Government
Department of Sustainability, Environment,
Water, Population and Communities




Threat abatement plan

for the biological effects, including lethal toxic ingestion, caused by cane toads

The contents of this document have been compiled using a range of source materials and is valid as at September 2010.

Photo credits

FRONT COVER IMAGES (left to right)
Toad aggregation (Ruchira Somaweera, University of Sydney), Calling male (David Nelson, University of Sydney), Cane toad (Damian McRae, DSEWPaC), Metamorph cane toad (David Nelson, University of Sydney)
BACK COVER IMAGES (left to right)
Calling male (David Nelson, University of Sydney), Metamorph cane toad (David Nelson, University of Sydney), Cane toad in leaf litter (Damian McRae, DSEWPaC), Slaty-grey snake with cane toad (Zig Madycki, DSEWPaC)

Australian Government
Department of Sustainability, Environment,
Water, Population and Communities




Threat abatement plan

for the biological effects, including lethal toxic ingestion, caused by cane toads

CONTENTS

SUMMARY

Rationale

Since the introduction of cane toads (*Bufo marinus*, now revised to *Rhinella marina*) to Australia in 1935, the ecological impact of this animal has aroused considerable concern. Cane toads use potent steroid-derived toxins as chemical defences. The active constituents of these differ from the toxins found in native frogs. All life stages of the cane toad (eggs, tadpoles, metamorphs and adults) are toxic, although toxin types and content change markedly during a toad's lifespan. Toxin levels (and thus, danger to native vertebrate predators) are high in eggs, decrease through tadpole life, are lowest at around the time of metamorphosis, and increase rapidly thereafter. It is difficult to tease apart the effects of cane toads from other threatening processes operating on native species and ecological communities (Shine 2009a). However, there is no scientific evidence that cane toads have caused species extinction. The direct pathway of lethal toxic ingestion of cane toads is the most important cane toad impact.

In 2005, the biological effect of the cane toad was listed as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (Threatened Species Scientific Committee 2005).

Since 1986, the Australian Government has directed at least $11 million dollars to development of a broad-scale means to control cane toads, without success. Community action to manually remove cane toads from the landscape has also been funded. Neither of these endeavours have prevented the continued spread of the pest or significantly limited its impact on Australia's biodiversity. Recognising that it is not currently possible to contain or eradicate cane toads across the nation, a new approach to dealing with their negative impacts is needed. This involves identifying and reducing impacts on key natural assets affected by cane toads, an approach that requires national coordination.

This threat abatement plan (TAP) provides a national strategy to guide investment and effort by the Australian Government, jurisdictions, research organisations and non-government organisations in abating the impacts of cane toads across their known and anticipated range. The TAP will be reviewed in five years.

Objectives for the threat abatement plan

This TAP has three objectives:

- to identify priority native species and ecological communities (including those that are protected matters under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) at risk from the impact of cane toads.
- to reduce the impact of cane toads on populations of priority native species and ecological communities.
- to communicate information about cane toads, their impacts and this TAP.

Implementation of the threat abatement plan

This TAP will be implemented by the Australian Government in conjunction with a broad range of stakeholders. Note that the time-frames listed in this TAP are: short-term, 1–3 years; medium-term, 3-5 years; and long-term, more than 5 years.

1. INTRODUCTION

This threat abatement plan (TAP) has been developed to address the listed key threatening process *The biological effects, including lethal toxic ingestion, caused by Cane Toads (Bufo marinus)* (see listing advice, Threatened Species Scientific Committee 2005) in a feasible, effective and efficient manner. The TAP binds the Australian Government and its agencies in Australia's response to the impact of cane toads and identifies the research, management and other actions needed to address the impacts of this species on Australia's biodiversity.

This plan should be read in conjunction with the two publications: *The ecological impact of invasive cane toads (Bufo marinus) in Australia* (Shine 2009a); and *Cane Toads in Communities - Executive Report* (Bureau of Rural Sciences 2009). These publications provide information on the scope of the cane toad threat and public perceptions of cane toads and their impacts across the known and anticipated range of the species.

1.1 Threat abatement plans

Under section 270 (A) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the Australian Government:

- develops TAPs
- implements the actions under TAPs that are its direct responsibility
- facilitates the implementation of actions where other groups (e.g. states and territories, industry) share the implementation responsibilities.

The EPBC Act prescribes the process, content and consultation required when making a TAP.

The EPBC Act requires the Australian Government to implement TAPs to the extent to which they apply in areas under Australian Government control and responsibility. In addition, Australian Government agencies must not take any actions that contravene a TAP. Where a TAP applies outside Australian Government areas in states or territories, the Australian Government must seek the cooperation of the affected jurisdictions, with a view to jointly implementing the TAP.

The EPBC Act provides for the protection of Matters of National Environmental Significance, including listed threatened species and ecological communities, listed migratory species, wetlands of international significance, World Heritage properties and National Heritage places (Commonwealth of Australia 2006). A TAP may address threats to these listed matters specifically, as well as more broadly to species and communities under threat from the listed threatening process. As some of these matters may be affected by a specific threat, appropriate Matters of National Environmental Significance may also be addressed in a TAP.

The Department of Sustainability, Environment, Water, Population and Communities prepares a five-year project plan for each TAP and assesses progress on the main strategic actions contained within the TAP on a yearly basis. After five years, each TAP is reviewed to ensure the objectives of the TAP have been achieved.

Mitigating the impact of invasive species is not simply a matter of developing and applying better technical solutions. It also involves the development of better biological and ecological information, as well as understanding and addressing the social and economic factors surrounding the species. The need to move away from attempts at broad-scale cane toad control and eradication to the protection of key biodiversity assets will require the transfer of knowledge on the management of cane toad impacts, as well as support for community effort to limit those impacts.

This new focus, on protection of key assets, is in response to the lack of a method for broad-scale biological control (see 1.2.2). A review of scientific research into the impacts of cane toads on native species informs the initial priority list of “key assets” within this TAP. Scientific findings will continue to inform the priority list and the TAP will also promote the development and use of scientifically proven control measures.

Communication of scientific evidence regarding which species are at risk will be the key factor in this new approach to protecting biodiversity from cane toad impacts.

1.2 Threat abatement plan for cane toads

1.2.1 The threat

History and spread

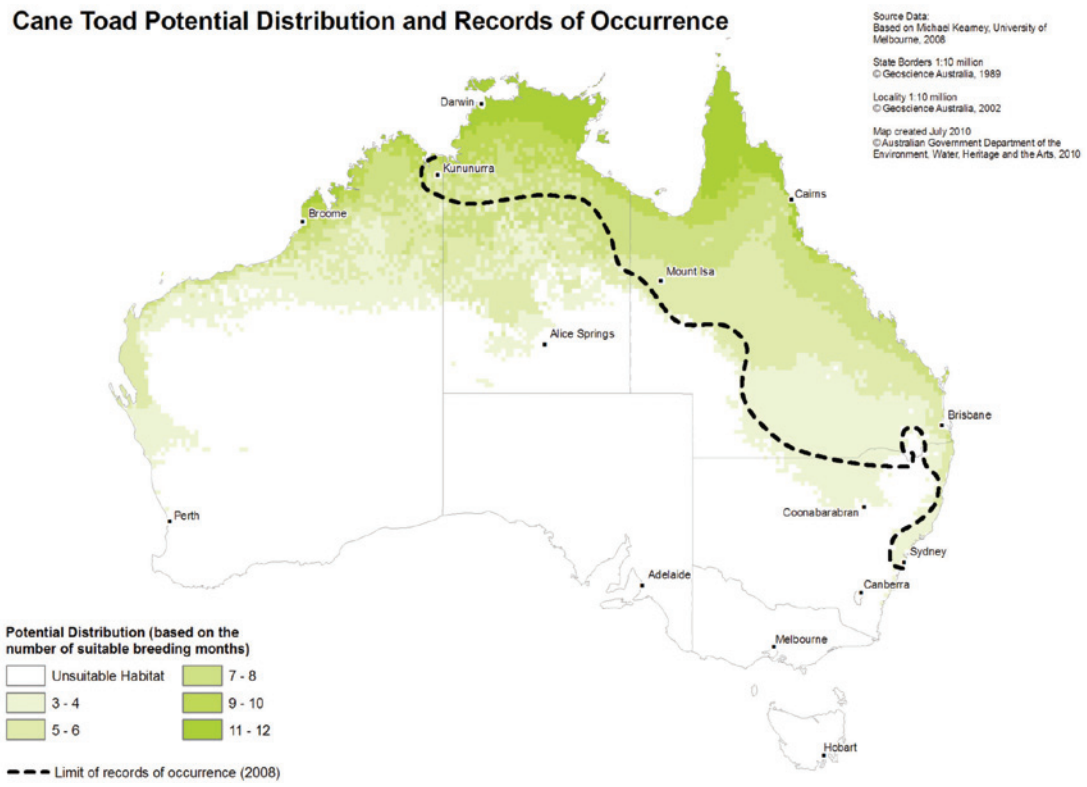
Cane toads were introduced to Australia in 1935 as a means of controlling pest beetles in the sugar cane industry. This is a process that was common to many sugar cane or other crop producing areas of the world (including Puerto Rico, Papua New Guinea and Fiji). At some locations, cane toads failed to establish (e.g. Egypt, where they were introduced in 1937). However, in many others locations cane toads survived and established to become pests. Attempts at cane toad management and control have been most extensive in Australia (Global Invasive Species Database 2009).

The success of cane toads in pest insect control in Australia was never determined, as the use of agricultural chemicals for this purpose became widespread soon after their release (Shine 2009b). Cane toads, however, did become very successful at invading the environments of Australia's north. Since 1935, they have dispersed over 2000 km west from their release site at Gordonvale, Queensland and many hundreds of kilometres to the north and south (Figure 1). Their southern dispersal includes areas considered to be marginal cane toad habitat in arid south-west Queensland and the cooler climates and higher altitudes of northern New South Wales. The black line in Figure 1 indicates records of cane toad occurrence. In south-west Queensland and northern New South Wales in particular, these records do not necessarily indicate established populations.

In the first few decades after cane toads were released in Queensland, they expanded their range at about 10 km per year (Shine 2009b). Since reaching the wet-dry tropics of the Northern Territory, the westward expansion of cane toads has been recorded at around 55 km each year (Phillips et al. 2007).

The New South Wales Key Threatening Process profile for cane toads (DECCW 2006) indicates that their current rate of spread in NSW is approximately 3-4 km per year. However, this may be punctuated by brief spreads of relatively rapid movement often assisted inadvertently by human movement e.g. by "hitch-hiking" with produce or landscaping material.

Figure 1: Map showing potential distribution (shaded areas) and limit of records of occurrence (black line) of cane toads in Australia (based on Kearney et al. 2008)



Ecological impacts

Across their range, cane toads have been implicated in a complex web of direct and indirect impacts on native species and potentially the ecological communities in which these species occur. Assessing cane toad impacts through scientific research is very difficult (Shine 2009a). However, available evidence identifies the direct pathway of lethal toxic ingestion of cane toads as the most important impact. Many native Australian predators have evolved in the absence of prey species with the chemical defences present in cane toads. Consequently, predators are vulnerable to being lethally poisoned when cane toads invade and establish in their areas. No species extinction has ever been attributed to the cane toad, however, research has identified vulnerable predator species and other ecological impacts.

Local population extinctions of the endangered marsupial predator, the northern quoll (*Dasyurus hallucatus*), have been observed following the arrival of cane toads in some areas (Oakwood 2003a, b). Lethal toxic poisoning through ingestion of the cane toad has been identified as the cause of these local extinctions. Several species of goannas, snakes and the blue tongued lizard (*Tiliqua scincoides)* have also been identified as highly vulnerable to lethal poisoning through ingestion of cane toads (Shine 2009a).

Other pathways of cane toad impact on native species have been identified (Shine 2009a) as:

- predation by cane toads (varies, predominantly a minor impact)
- larval competition with frog tadpoles or mosquitoes (minor impact)
- parasite transfer (minor impact)
- competition for terrestrial food (minor impact)
- competition for shelter sites (e.g. usurpation of burrows) (minor impact).

Historically, in the absence of scientific evidence about the complexities of direct and indirect impacts of cane toads, anecdotal information has served to provide guidance on impacts and priorities for managing them.

Cane toads have had an adverse impact on a number of matters of NES and those impacts are expected to continue as they expand their range. For example, cane toads have impacted:

- listed threatened species such as the northern quoll *Dasyurus hallucatus* – an EPBC Act listed endangered species
- Wetlands of International Importance listed under the terms of the Ramsar Convention, including iconic wetlands in Kakadu National Park
- World Heritage properties such as the Wet Tropics of Queensland and the Gondwana Rainforests of Australia.

1.2.2 Managing the threat

Since 1986, the Australian Government has directed approximately $11 million to development of a broad-scale means to control cane toads and a further $9 million to other cane toad research and management activities (details in Table 1).

Table 1: Australian Government funding on cane toad research and management 1986 to 2009

Area of expenditure	Funding allocated
Research on impacts	$5,212,518
Research control (long term/biological control)	$11,111,922
Research control (short/medium term control)	$1,303,235
Management	$1,162,117
Community groups	$1,283,234
Education	$44,468
TOTAL	**$20,117,494**

Over $11 million of the Australian Government cane toad funding has been provided for the search for a biological control agent in the toads' native habitat in South America, and research directed at modifying a virus in order to disrupt the development of infected cane toad tadpoles. In 2008, an independent review of the CSIRO's cane toad biological control research (Shannon and Bayliss 2008) resulted in funding for this project being discontinued. The review team found that:

> *'there are still major technical hurdles to be overcome in the development of a self-disseminating genetically modified cane toad control agent. The long term feasibility of the approach is also questionable on several counts including the availability of an acceptable viral vector, the difficulty of generating an appropriate immune response from virally expressed proteins, and the major hurdle of obtaining approval for release. The lack of a national and international risk assessment and management plan for the release of a virally vectored genetically modified organism regardless of exact product specification is also a major deficit and should be an essential part of any further program in this area'.*

To date no broad-scale or biological control has been identified and it is unlikely that such a control could be developed and approved for use before the cane toad will have reached its maximum extent (see Figure 1) and impact. The option for undertaking research into broad-scale biological control of cane toad is subject to there being a significant change to the technical

hurdles identified in the review of CSIRO's cane toad biological control research (Shannon and Bayliss 2008) or some other significant step in 'proof of concept'. This TAP has a five-year operating time-frame and based on currently available information it is not anticipated that such evidence could be provided during its operation.

Community action to manually remove cane toads from the landscape has also received Australian Government funding (approximately $1.3 million from 1986 to 2009). Government agencies in Queensland, New South Wales, Western Australia and the Northern Territory have contributed to cane toad control efforts. However, there is no evidence that these endeavours have prevented the continued spread of the pest or significantly limited its impact on Australia's biodiversity. Community action, while satisfying to local communities, does not have the capacity to make any significant changes to the rate of spread of cane toads or to the densities of cane toads beyond specific local areas. However, where community action is focused on cane toad management to protect assets at a local scale it could help maintain priority biodiversity assets.

A decade of effort around Port Macquarie may have resulted in local eradication from that area. However, the cane toad is likely to be towards the southern limits of its "natural" range in this region of northern New South Wales, and climatic factors may have assisted control efforts. An additional factor in the success of this effort is likely to have been the status of the Port Macquarie infestation as an isolated satellite population (Peacock 2007).

The biological effects, including lethal toxic ingestion, caused by Cane Toads *(Bufo marinus)* (Threatened Species Scientific Committee 2005) was listed as a key threatening process under the EPBC Act in 2005 in response, in particular, to concerns about the impact of cane toads on the northern quoll. At the time of this listing, the then Minister for the Environment and Heritage decided that the development of a TAP would not be an efficient way to abate the threat posed by cane toads.

In 2009, this decision was reviewed by the then Minister for the Environment, Heritage and the Arts. Consultation with colleagues in state and territory governments about the feasibility, effectiveness and efficiency of developing and implementing a TAP to abate the cane toad threat was undertaken, and national coordination emerged as a dominant theme in support of developing a TAP at this time.

This TAP provides a national strategy to guide investment and effort by the Australian Government, jurisdictions, research organisations and non-government organisations in abating the impact of cane toads across their known and anticipated range. This TAP identifies key assets (native species and ecological communities) to be protected, discusses protection methods, and identifies the need to develop humane control methods for cane toads.

Eradication of cane toads is not currently possible. Neither the technologies nor the resources required to contain and eradicate cane toad numbers on a continental scale are available. The timescales required for the development and application of such technologies would mean that cane toads will have reached the extent of their continental impact regardless of the investment made.

Recognising the new information now available about cane toads and their impacts, as well as the failure of past attempts at broad-scale control, this TAP takes the approach of identifying and prioritising the native species and ecological communities under threat from cane toads, and targeting action to protect those assets which have been determined to be of the highest priority.

This approach will focus on achieving positive biodiversity outcomes for species or ecological communities vulnerable to the presence of cane toads. This approach has evolved as the efforts undertaken to date have neither provided a broad-scale control method such as a biological control, nor an effective answer to the expansion of the toads' range through manual removal. Both of these approaches have been proven to be an ineffective use of limited natural resource funds. This new approach will allow for a more effective and efficient use of conservation resources at the national, state, territory and local levels than is occurring under current strategies.

1.2.3 Involvement of stakeholders

The success of this TAP will depend on a high level of **cooperation between all key stakeholders**, including:

- the Australian Government and its agencies
- state and territory conservation and resource management agencies
- local government
- natural resource management agencies and private conservation land management bodies
- research institutes
- industry and entrepreneurs
- Indigenous communities
- other community groups.

The Invasive Animals CRC currently supports a Cane Toad Advisory Group (CTAG). This committee is comprised of Australian Government, state and territory representatives and provides strategic and practical advice on the planning, implementation and delivery of cane toad projects and their outcomes. The CTAG provides a mechanism to focus national and jurisdictional understanding of, and efforts to abate, cane toad impacts and via its links to the Vertebrate Pests Committee will serve as a major coordination point for actions undertaken under this TAP. Major outcomes will be communicated from this group to local government, natural resource management agencies, conservation groups, industry and entrepreneurs, conservation bodies and community groups in each jurisdiction.

Ongoing delivery of awareness and capacity building programs in natural resource management will be required at national, state and regional levels and will make a significant contribution to national implementation of this TAP.

Implementation of some of the objectives of this TAP (e.g. identification and prioritisation of native species and ecological communities) will require specific efforts from the Australian Government and jurisdictions. However, as information is collated, and priorities determined, other stakeholders will have strong locally focused responsibilities for ensuring actions are undertaken to protect biodiversity assets that are impacted by cane toads.

The *Cane Toads in Communities* study (Bureau of Rural Sciences 2009) consulted Indigenous groups and the Indigenous Advisory Committee has advised on suitable communication approaches for Indigenous stakeholders.

1.3 Definition of priority native species and ecological communities

For the purposes of this TAP, priority native species and ecological communities are those that have been determined through peer-reviewed research to be highly vulnerable at population level to negative impacts from the presence of cane toads.

At the national level, relevant Matters of National Environmental Significance and the National Reserve System will also be considered. For state and territory agencies, this TAP can guide investment based on state or regional conservation priorities. It will be important that managers assess the impacts of cane toads and allocate adequate resources to achieving effective management at all priority sites (national, jurisdictional, regional, local) and that outcomes are measured and assessed on an on-going basis.

Jurisdictional governments, natural resource management groups and community groups will need to determine more localised priority assets and the means by which they will undertake protection and management actions.

2. OBJECTIVES AND ACTIONS

This TAP has three objectives:

- identify priority native species and ecological communities at risk from the impact of cane toads.
- reduce the impacts of cane toads on populations of priority native species and ecological communities.
- communicate information about cane toads, their impacts and this TAP.

Supporting actions to implement these objectives are listed below.

Objective 1 – Identify priority native species and ecological communities at risk from the impact of cane toads

There are neither the resources nor an appropriate broad-scale control that can be applied to the management of cane toads in a way that would lead to containment and/or eradication of cane toads across their range. However, the Australian Government has a responsibility to manage cane toads on land under its control and where Matters of National Environmental Significance are being impacted by cane toads. Objective 1 addresses the identification of those species and ecological communities at risk from the impact of cane toads.

Ecological communities

There are eight threatened ecological communities listed under the EPBC Act that fall within the current geographic range of the cane toad (Table 2).

Table 2: EPBC Act listed threatened ecological communities within the current cane toad range

Ecological community	EPBC category	Recovery plan comment
Swamp Tea-tree *(Melaleuca irbyana)* Forest of South-east Queensland	Critically Endangered	
Mabi Forest (Complex Notophyll Vine Forest 5b)	Critically Endangered	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Endangered	
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	*"considered responsible for a recent abrupt decline in observations of the northern quoll Dasyurus hallucatus".* (McDonald 2010)
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	Endangered	*"under high population densities, such as those that occur with the hatching of a clutch of toadlets, may have a very deleterious effect on invertebrate populations".* (Fensham et al. 2010)
Weeping Myall Woodlands	Endangered	
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	

Currently, none of the listing advices for these communities indicate that cane toads are a threat to the community. Further, no other listed ecological communities fall within the predicted future range of cane toads (as shown in Figure 1 Kearney et al. 2008). However, elements of some of the listed communities are impacted, or may in future be impacted, by cane toads as they continue to spread. As shown in Table 2, two of the recovery plans in place for these ecological communities mention cane toads and their possible impacts.

Kearney et al. (2008) used the software package Ozclim (CSIRO, Australia) to derive predictions for changes in monthly maximum and minimum air temperature and relative humidity, as well as mean monthly rainfall by 2050. Under this anticipated climate change scenario for Australia, both expansions and contractions in the potential range of the cane toad and in the length of the toads' breeding season have been predicted for 2050. The southern border of cane toad distribution is predicted to move further south by approximately 100 km and be limited by the opposing influences of increasing air temperature and decreasing humidity on the core body temperature of cane toads. In this scenario, further ecological communities listed under the EPBC Act would fall within the range of cane toads.

Native species and ecological communities on off-shore islands may need to be protected from cane toads. Quarantine or emergency management measures to protect these islands may result in the preservation of endemic island species and ecological communities. Further, it may be possible, under particular circumstances, to protect populations of those species identified as highly impacted on the mainland (Table 3) by preserving populations already present on islands or relocating species from the mainland to islands. Islands known to be free of cane toads and which support populations of species highly impacted by cane toads on the mainland, have been identified (Appendices 1, 2 and 3).

Species

Although many individual animals may succumb to lethal toxic ingestion of cane toads, particularly when toads first appear in a new area, the number of species known to be negatively affected at a population level is small. It is this group that forms the highest priority for action under this TAP. Research is currently being undertaken by several groups (e.g. the University of Sydney, Australian National University) to clarify the impact of toads on certain species such as the northern quoll and goanna species. This research may provide insights into priority species for protection over the life of this TAP.

The ecological impact of invasive cane toads (Bufo marinus) in Australia (Shine 2009a) provides an extensive scientific assessment of the impacts of cane toads on native species. A summary of this assessment, listing those native species for which the level of negative population impact by cane toads is high or moderate is provided (Table 3). This provides an initial assessment of priority for species requiring population level protection. Research is continuing in this area, and the lists may need to be adapted as understanding improves.

Table 3: Current state of knowledge of identified high or moderate negative population level threats to Australian native fauna from the cane toad (modified from Shine 2009a). Lethal toxic ingestion is the most common pathway of impact

Species	Degree of impact	Authority	Pathway for impact
Proteocephalid Tapeworm*	High	Freeland 1993, 2004	Toads destabilise host / parasite equilibrium
Crocodiles			
Freshwater crocodile (in semi-arid landscapes) *Crocodylus johnstoni*	High (location dependent)	Letnic et al. 2008	Lethal toxic ingestion
Goannas			
Varanus spp.	High	Freeland 2004; Griffiths and McKay 2007; Doody et al. 2009; Ujvari and Madsen 2009	Lethal toxic ingestion
Skinks			
Tiliqua scincoides (including subspecies)	High	Price-Rees et al. 2010	Lethal toxic ingestion
Snakes			
Northern death adder *Acanthophis praelongus*	High	Hagman et al. 2009b, Phillips et. al. 2010	Lethal toxic ingestion
King brown snake *Pseudechis australis*	High	G.P. Brown et al. University of Sydney unpublished data	Lethal toxic ingestion
Marsupials			
Northern quoll *Dasyurus hallucatus*	High	Oakwood 2003a, Oakwood 2003b; O'Donnell 2009	Lethal toxic ingestion
Eutherian mammals			
Pale field-rat *Rattus tunneyi*	Moderate	Watson and Woinarski 2003a, Watson and Woinarski 2003b	Unknown

* **NB:** This tapeworm is a parasite of the spotted python *Antaresia maculosa* and has been described to family level only (Proteocephalidae).

The northern quoll is the only species listed in Table 3 (above) that is also listed under the EPBC Act (as Endangered). Significant actions have taken place to protect the northern quoll through the Northern Territory's *Island Arks* program, as a result of documented decline of the species with the arrival of cane toads (Rankmore et al. 2008). This program has provided 'insurance populations' of the species on two toad-free islands. While the program has been highly successful in establishing populations of northern quolls on the islands, it has not yet attempted to reintroduce any individual animals to their original habitats.

Species, for which there is suspicion, but not scientific certainty, of negative population level impacts, on a national scale, caused by cane toads, have also been identified (Table 4). The draft national recovery plan for the spotted-tailed quoll (*Dasyurus maculatus*) (Long and Nelson 2010) has identified the potential threat of cane toads on the northern subspecies of this species, although research is inconclusive. Research into possible impacts is recommended under this draft recovery plan. Any such research would inform the priority list under this TAP.

Table 4: Current state of knowledge on uncertain negative population-level threats to Australian native fauna from the cane toad (modified from Shine 2009a)

Species	Type of impact	Degree of impact	Authority
Dragons (Agamidae)			
Frilled lizard *Chlamydosaurus kingii*	Lethal toxic ingestion	Reports inconsistent	van Dam et al. 2002; T. Madsen pers. comm.
Birds			
Rainbow bee-eater *Merops ornatus*	Usurpation of burrows	unknown	Boland 2004

Future research may require other species to be added to this list, or the list at Table 3.

Recommended actions and priorities

Action	Priority
Action 1.1 Identify native species, ecological communities and off-shore islands currently known to be at high to moderate risk. (Largely completed).	High priority, short term because currently underway
Action 1.2 Identify the ways in which cane toads impact the native species and ecological communities listed in 1.1 (Largely completed).	High priority, short term because currently underway
Action 1.3 Where impact is unknown but may be high, establish and support research to further understand the impact of cane toads on the native species and ecological communities. Where appropriate, research ways to assist with the recovery of priority native species and ecological communities. (Has commenced).	Medium priority, medium term
Action 1.4 Develop a prioritisation tool to guide allocation of resources for protection of native species and communities. Apply it to native species and ecological communities identified: first from Action 1.1, then from Action 1.3.	Low priority, medium term

The criteria to be used in the prioritisation tool (Action 1.4) will include:

- protection of cane toad-free off-shore islands, particularly those that currently support populations of native species identified in Table 3 (Appendices 1, 2 and 3 contain a preliminary list of islands known to fall within this category)
- protection of those species identified in Table 3
- capacity to add species when evidence of impact becomes clear (e.g. species listed under Table 4)
- Matters of National Environmental Significance.

Performance indicators

- Lists showing off-shore islands and the EPBC Act listed ecological communities and species at risk from the impacts of cane toads developed by the Cane Toad Advisory Group (CTAG) and the Vertebrate Pest Committee (VPC), agreed by VPC and made available to all stakeholders within 12 months of the making of this TAP.
- Scientific evidence, endorsed by the CTAG and VPC, is gathered for those species for which high impact from cane toads is currently suspected, but not yet confirmed within 18 months of the making of this TAP.
- Research, which improves scientific understanding of impacts on native species and ecological communities; improves understanding of recovery measures; and which informs resourcing agreements between the Australian Government and affected jurisdictions is endorsed by the VPC as it becomes available.
- Prioritisation tool for allocation of resources to ecological communities/species developed and agreed by the CTAG and the VPC within 24 months of the making of this TAP.
- Prioritisation tool applied at a national level and application encouraged at jurisdictional, regional and local levels within 6 months of the prioritisation tool being agreed by the VPC.

Objective 2 – Reduce the impact on populations of native species and ecological communities

Under Objective 1, actions to determine the priorities for the application of resources to the management of cane toads and their impacts will be developed. Listings and mapping of threatened ecological communities and species will be undertaken. The Australian Government will address those ecological communities and species that are on land under its control or are Matters of National Environmental Significance, in cooperation with state and territories. These listings and maps will also enable stakeholders to determine state, regional and local priorities and apply appropriate resources to their protection.

The purpose of Objective 2 is to promote effective tools that can be used to reduce the impact of cane toads on native species. The tools will cover all aspects of cane toad management at the planning and response stages, and be broadly applicable.

Use of these tools and guidelines will be the responsibility of all stakeholders, in particular those with land and water management responsibilities in areas identified as being of priority for protection against cane toads. The Australian Government will be monitoring the uptake of management actions in each of the identified priority areas. Where the Australian Government and state/territory governments have mutual obligations (e.g. some Ramsar Wetlands) negotiation of appropriate actions and funding of management actions will be undertaken.

While the purpose of this TAP is not to develop specific cane toad control tools, such as poisons, research is underway that could result in a larger toolkit becoming available over the life of this TAP. These could include:

- development and registration of a humane lethal spray for toads
- use of a larval alarm pheromone to manage cane toad populations within water bodies (Hagman and Shine 2009c; Hagman et al. 2009a)
- use of a parasitic nematode of cane toads (*Rhabdias pseudosphaerocephala*) identified as present in established populations of Australian cane toads (Dubey and Shine 2008; Shine 2009b)
- development of better traps.

As such tools become available, information about them will be included on the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) cane toad webpage.

The Australian Government is a signatory to the Australian Pest Animal Strategy which includes as one of its principles that 'Where there is a choice of methods, there needs to be a balance between efficacy, humaneness, community perception, feasibility and emergency needs'.

Recommended actions and priorities

Action	Priority and timeframe
Action 2.1 Focus management of cane toad impacts by Australian Government agencies on designated high priority native species and ecological communities, and seek cooperative action on priorities by jurisdictions and other stakeholders**.**	High priority, short term
Action 2.1.1 Implement and monitor emergency management of canetoad impacts for **known** high priority native species and ecological communities (as designated in Table 3) using currently available tools and techniques (e.g. trapping, fencing of small areas, manual removal from designated sites)	High priority, short term
Action 2.1.2 As new species and communities are added to the list of priority native species and ecological communities via a peer reviewed process, implement or adjust management of cane toad impacts, using available tools and techniques. Additional tools and techniques will become available with the registration of toxins for euthanasia of captured toads and development of other impact management or cane toad control techniques. Codes of practice and standard operating procedures for cane toad control will provide guidance on these techniques.	Medium priority, medium term

Recommended actions and priorities (Continued)

Action 2.2 Prepare guidelines, including codes of practice and standard operating procedures, that can be applied to both emergency responses and on-going management for high priority native species and ecological communities for endorsement by the VPC.	Medium priority, medium term
Action 2.2.1 Australian Government to prepare and implement management plans, (including identifying and addressing gaps in management techniques and tools) for designated high priority species and ecological communities on land managed by Australian Government agencies.	Medium priority, medium term
Action 2.2.2 Provide the guidelines for emergency and on-going cane toad management to all stakeholders. Liaise with responsible jurisdictions/agencies to encourage the preparation and implementation of such plans in their areas of responsibility. Where mutual obligations exist the Australian Government will work cooperatively to prepare such plans.	Medium priority, medium term
Action 2.2.3 Australian Government to monitor the development and implementation of guidelines and cane toad management plans for designated high priority species and ecological communities.	Medium priority, medium to long term
Action 2.2.4 Australian Government to monitor the literature about the spread and impact of the cane toad and review/amend guidelines and develop new management plans as required.	Medium priority, medium to long term
Action 2.3 Establish guidelines for humane management actions to control cane toads for VPC and Animal Welfare Committee endorsement.	Medium priority, medium term
Action 2.3.1 Distribute guidelines to all Australian Government agencies with land management responsibilities.	Medium priority, medium term
Action 2.3.2 Australian Government to seek cooperative adoption of guidelines by states/territories including incorporation in state based regulations as appropriate.	Medium priority, medium term

Performance indicators

- Australian Government agencies advised of this TAP, the designation of high priority species and ecological communities, and their management responsibilities within six months of the TAP being made.
- Application of this TAP by Australian Government agencies is monitored by these agencies and DSEWPaC over the life of the TAP.
- Jurisdictions and stakeholders are advised of this TAP, the national high priority species and ecological communities and the jurisdictions'/stakeholders' management responsibilities within six months of the TAP being made.
- Management plans agreed with relevant stakeholders (state/territory governments) for each of those species impacted by cane toads at a population level within eighteen months of this TAP being made.
- Responses of jurisdictions and other stakeholders are monitored throughout the life of the TAP.
- Additional advice is provided to all stakeholders within six months of new species and ecological communities being identified and agreed or removed from the list of priority species.
- Guidelines for emergency and on-going management plans are developed and agreed by VPC within two years of the TAP being made.
- Guidelines are provided to all stakeholders within three months of being agreed by VPC.
- Preparation of plans across all land tenures for high priority species and ecosystems are monitored by the Australian Government on an on-going basis across the life of the TAP.
- Humane management actions (standard operating procedures and codes of practice for humane treatment of cane toads) are developed and agreed by the VPC within two years of the TAP being made.

Objective 3 – Communicate information about cane toads, their impacts and this TAP

Australians are concerned about the impact of cane toads on the environment. However, community concern is highest when cane toads incursion is recent or imminent and fades over time as the community adjusts to living with cane toads in the environment (Bureau of Rural Sciences 2009). The initial very high level of concern leads to high expectations that environmental agencies will take action to avert the impact of toads.

This TAP acknowledges:

- there are no “magic bullets” that the Australian Government can provide that will eradicate or reduce the cane toad population across Australia
- there are competing conservation requirements for limited conservation funding generating a need to prioritise any allocation of cane toad management funds to those efforts most likely to conserve biodiversity (over $20 million has been provided by the Australian Government to address the impact of cane toads since 1986 with limited success)
- it is clear that, in some cases, other established invasive species, or human activity, are the cause of native species extinctions
- actions to support priority species and threatened ecological communities from the impact of cane toads across Australia must be prioritised, with priority being given to those species that would be most affected at a national population level and ecosystems where multiple complex changes may occur
- there remains a need for tools to help all stakeholders at national, state/territory, regional and locals levels to effectively implement and manage cane toad impacts.

While the primary responsibility for managing established pests lies with the states and territories and landholders, all stakeholders can play significant roles in reducing the impacts of cane toads. However, to empower stakeholders to take actions that collectively reduce the worst impacts of cane toads it is necessary to communicate:

- the strategic approach detailed in this TAP
- the key priority species and ecosystems that need protection
- guidelines designed to enable action to be undertaken effectively
- standard operating procedures and codes of practice to ensure the humane treatment of cane toads.

State agencies and community groups have produced significant high quality communication materials relating to cane toads. These groups present this material to stakeholders and the general public through regular newsletters and media releases. A number of networks of conservation groups and researchers with an interest in cane toads already exist. These networks can form a link in a communications strategy for this TAP including communications in regard to developments in toad control methods.

Recommended actions and priorities

Actions	Priority and timeframe
Action 3.1 Implement a one-stop-shop webpage on the DSEWPaC website with links to jurisdictional and stakeholder information on cane toads and including information on: • the threat cane toads pose to biodiversity • management actions to limit this threat • guidelines for cane toad management • information to help identify cane toads from other amphibians • codes of practice and standard operating procedures • management plans (as they are developed) for areas designated as high priority.	Medium priority, ongoing
Action 3.2 Encourage monitoring, evaluation and reporting on cane toad management actions is maintained and communicated to stakeholders.	Medium priority, ongoing
Action 3.3 Ensure Australian Government fact sheets and other communications material on cane toads are current and reflect the strategy developed in this TAP.	Medium priority, ongoing

Performance indicators

- Webpage on the DSEWPaC website holds appropriate information and linkages within 12 months of the Minister making this TAP.
- All co-funded or Australian Government-funded cane toad projects include reporting of cane toad management actions, and monitoring of results, and are made available to the public within six months of the completion of the project.
- Cane toad fact sheets and other communications material are revised and made available to the public within 12 months of the Minister making this TAP.
- Threat abatement plan priorities are communicated directly to communities and stakeholders that have expressed concern and interest in cane toad control within three months of any request.

3. DURATION, IMPLEMENTATION AND EVALUATION OF THE PLAN

3.1 Duration of the plan

This TAP reflects the fact that threat abatement will be ongoing, as there is no prospect for national eradication of cane toads.

This TAP must be reviewed by the Minister at intervals of not longer than five years. The Minister's scientific advisory committee, the Threatened Species Scientific Committee, will be provided with annual updates of actions taken under this TAP.

3.2 Cost of the plan

Funding for TAP actions, along with a range of other responsibilities under the EPBC Act, to be undertaken by the Australian Government, is provided to the Department of Sustainability, Environment, Water, Population and Communities via the Australian Government budget each year. At the time of writing this TAP (2010-11 financial year), this funding sits under Outcome 1 of the Department's budget:

> *"The conservation and protection of Australia's terrestrial and marine biodiversity and ecosystems through supporting research, developing information, supporting natural resource management, regulating matters of national environmental significance and managing Commonwealth protected areas."*

This budget outcome is allocated to a wide variety of actions including biodiversity conservation, the *Caring for our Country* initiative, the *Australian Biological Resources Study Strategic Plan 2007–2011*, assessment of Commonwealth-managed and all export fisheries, protection of cetaceans as well as development and implementation of individual TAPs.

Over the financial years 2008/2009 and 2009/2010, $2 million of funding under *Caring for our Country* was allocated to both the development of this TAP and a set of projects designed to meet the *Caring for our Country* business plan targets on cane toads. This TAP sets a new approach to the management of cane toads that focuses on the protection of high priority areas and high priority species which will be more effective, efficient and feasible than the broad-scale approaches used in the past.

Where possible, actions under this TAP will be facilitated through existing internal budget allocations where an existing responsibility for biodiversity protection already exists (e.g. the National Reserve System). Departmental funding relating to the delivery of EPBC Act activities will be used to fund actions that fall outside these existing responsibilities (e.g. development and application of the prioritisation tool). It is not possible to assign costs to each element of the TAP at the time of writing this TAP.

Investment in many of the TAP actions will be determined by the stakeholders, in particular the states and territories. It is not possible to quantify either the uptake of actions or the funding that may be provided by each of the affected jurisdictions. This will be a matter of negotiation (e.g. one tool or resource, funded solely by one jurisdiction, may be shared with other jurisdictions in return for a discounted cost to use or access a different tool or resource).

In addition to funding provided directly by the Australian Government and the jurisdictions, TAP actions are often enacted via existing intergovernmental mechanisms such as the VPC. Funding for these mechanisms is incorporated in normal organisational administrative costs and is not able to be detailed on the basis of costs of an individual TAP.

The total cost of implementation of this TAP, therefore, cannot be quantified at the time of its writing. However, the Australian Government is committed to undertake all the actions listed within the five-year life of this TAP.

This TAP provides a framework for undertaking targeted priority actions. Budgetary and other constraints may affect the achievement of the objectives of this TAP and, as knowledge changes, proposed actions may be modified over the life of the TAP. Australian Government funds may be available to implement key national environmental priorities, such as relevant actions listed in this TAP and actions identified in regional natural resource management plans.

3.3 Implementing the plan

In order to successfully implement this TAP, DSEWPaC will:

- implement the TAP as it applies to Commonwealth land and act in accordance with the provisions of the TAP
- maintain its strong links with state and territory agencies and with local and regional bodies that are responsible for the management of cane toads
- seek stronger coordination of national action on cane toads under the auspices of the VPC and draw on expertise from CTAG, state and territory agencies and non-government organisations
- encourage involvement of key stakeholders and experts in cane toad related research and management.

In relation to Australian Government responsibilities, the EPBC Act requires the Director of National Parks to protect, conserve and manage biodiversity and heritage in Commonwealth reserves and conservation zones and to contribute to these factors in areas outside Commonwealth reserves and conservation zones. Collaboration between all stakeholders is required for the successful implementation of this TAP. Local governments assist in delivering state and territory priorities at a local and regional level and consequently may be involved in the management of specific assets as part of jurisdictional actions.

Research priorities for managing the impacts of cane toads should focus on: identification of priority biodiversity assets at risk from the impact of cane toads; mechanisms for the protection of those assets found to be of a high priority; and preparation of appropriate tools for stakeholders to use to mitigate the negative impacts of cane toads. All research and monitoring results will be provided to stakeholders via the DSEWPaC cane toad webpage within the timeframes set under Objective 3.

3.4 Evaluating and reviewing the plan

Section 279 of the EPBC Act provides for the review of this TAP at any time and requires that the TAP be reviewed at intervals of no longer than five years. If evidence is found that the objectives and actions recommended in the TAP need to be updated or modified to prevent species or ecological communities becoming threatened, or that the effectiveness of the TAP can be improved, it can be revised within five years of the release of this TAP. Annual reports on the implementation of the TAP will be provided to the Threatened Species Scientific Committee.

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APPENDICES

Appendix 1 Queensland Islands with no record of cane toads, but holding populations of those native species determined to be highly impacted (at the population scale) in the presence of cane toads (i.e. species listed in Table 3). Data collated in 2010.

	Acanthophis praelongus Northern death adder	Pseudechis australis King brown snake	Tiliqua scincoides intermedia Northern blue-tongue lizard	Varanus gouldii Gould's goanna	Varanus indicus Mangrove monitor	Varanus mertensi Merten's water monitor	Varanus panoptes Yellow-spotted monitor	Varanus semiremex Rusty monitor	Varanus scalaris Spotted tree monitor	Varanus tristis Black-headed monitor
BADU ISLAND	X				X				X	
BOIGU ISLAND					X					
CAP ISLET					X					
CARLISLE ISLAND							X			
CLIFF ISLAND NATIONAL PARK								X		
COMPIGNE ISLAND				X						
COONANGLEBAH (DUNK) ISLAND	X									
COQUET ISLAND										
DARNLEY ISLAND					X					
DAUAN ISLAND					X					
DENHAM ISLAND		X								
DOWAR ISLET					X					X
EBORAC ISLAND	X									
FLINDERS ISLAND				X			X			X

	Acanthophis prarelongus Northern death adder	Pseudechis australis King brown snake	Tiliqua scincoides intermedia Northern blue-tongue lizard	Varanus gouldii Gould's goanna	Varanus indicus Mangrove monitor	Varanus mertensi Merten's water monitor	Varanus panoptes Yellow-spotted monitor	Varanus semiremex Rusty monitor	Varanus scalaris Spotted tree monitor	Varanus tristis Black-headed monitor
FRIDAY ISLAND				X	X					
HOOK ISLAND				X						X
HORN ISLAND				X						X
INGRAM ISLAND								X		
KESWICK ISLAND							X			
LLOYD ISLAND								X		
MAER ISLAND					X					X
MOA ISLAND				X					X	
MORETON ISLAND				X						
MORNINGTON ISLAND	X	X	X	X					X	X
NORTH KEPPEL ISLAND				X						
PRINCE OF WALES ISLAND		X		X	X					X
RESTORATION ISLAND				X						
STANLEY ISLAND					X		X			X
ULUI ISLAND					X				X	X
WAEIR ISLET					X					
WARRABER ISLET									X	

Appendix 2 Islands in the Northern Territory with no record of cane toads with no record of cane toads, but holding populations of those native species determined to be highly impacted (at the population scale) in the presence of cane toads (i.e. species listed in Table 3). Data collated in 2010.

	Dasyurus hallucatus Northern Quoll	Acanthophis praelongus Northern death adder	Pseudechis australis King Brown	Tiliqua scincoides intermedia Northern blue-tongue lizard	Varanus acanthurus Ridge-tailed monitor	Varanus glebopalma Black-palmed monitor	Varanus gouldii Gould's goanna	Varanus indicus Mangrove monitor	Varanus mertensi Merten's water monitor	Varanus panoptes Yellow-spotted monitor	Varanus scalaris Spotted tree monitor	Varanus tristis Black-headed monitor
ASTELL ISLAND	X											
BATHURST ISLAND		X	X	X			X		X	X	X	X
BICKERTON ISLAND			X	X			X		X			X
BROMBY ISLET					X							
CHANNEL ISLAND	X											
COTTON ISLAND												X
CROKER ISLAND										X	X	
DARCH ISLAND										X		
DJEERGAREE ISLAND					X	X						
DORCHERTY ISLAND										X		
DRYSDALE ISLAND										X		
EAST VERNON ISLAND											X	
FIELD ISLAND (KARDANGARL)										X		
GRANT ISLAND											X	
GROOTE EYLANDT	X	X	X	X	X	X	X	X	X	X	X	X
GULUWURU ISLAND					X	X						

	Dasyurus hallucatus Northern Quoll	Acanthophis praelongus Northern death adder	Pseudechis australis King Brown	Tiliqua scincoides intermedia Northern blue-tongue lizard	Varanus acanthurus Ridge-tailed monitor	Varanus glebopalma Black-palmed monitor	Varanus gouldii Gould's goanna	Varanus indicus Mangrove monitor	Varanus mertensi Merten's water monitor	Varanus panoptes Yellow-spotted monitor	Varanus scalaris Spotted tree monitor	Varanus tristis Black-headed monitor
ILYAUGWAMAJA ISLAND	X											
INGLIS ISLAND	X				X			X				
JIRRGARI ISLAND			X		X		X					
LAWSON ISLAND										X	X	
MARCHINBAR ISLAND	X		X		X	X			X	X		
MCLUER ISLAND											X	X
MELVILLE ISLAND			X	X	X		X	X	X		X	X
MOOROONGGA ISLAND		X		X							X	
MUNGWARNDUMANANJA ISLAND	X											
NORTH EAST CROCODILE ISLAND												X
NORTH EAST ISLES	X											
NORTH WEST CROCODILE ISLAND											X	
PERON ISLAND NORTH										X		
POBASSOO ISLAND	X		X		X					X		
PROBABLE ISLAND			X								X	
RARAGALA ISLAND			X		X	X						
RAPUMA ISLAND											X	
VALENCIA ISLAND											X	
WIGRAM ISLAND			X			X						
WINCHELSEA ISLAND	X					X	X		X			
YABOOMA ISLAND								X		X	X	

Appendix 3 Islands in Western Australia with no record of cane toads, but holding populations of those native species determined to be highly impacted (at the population scale) in the presence of cane toads (i.e. species listed in Table 3). Data collated in 2010.

	Dasyurus hallucatus Northern Quoll	Acanthophis praelongus Northern death adder	Pseudechis australis King Brown	Varanus acanthurus Ridge-tailed monitor	Varanus glauerti Kimberly RocK Monitor	Varanus glebopalma Black-palmed monitor	Varanus gouldii Gould's goanna
ADOLPHUS ISLAND	X						
AUGUSTUS ISLAND	X			X	X		
BATHURST ISLAND						X	
BERTHIER ISLAND	X						
BIGGE ISLAND	X	X					
BOONGAREE ISLAND	X					X	X
BYAM MARTIN ISLAND					X	X	
CAFFARELLI ISLAND	X						
CAPSTAN ISLAND	X						
CARLIA ISLAND	X		X				
CHAMPAGNY ISLAND					X		
CORNEILLE ISLAND			X	X			
FENELON ISLAND			X				
GIBBINGS ISLAND					X	X	
HEYWOOD ISLAND					X		
HIDDEN ISLAND	X		X		X	X	
IRVINE ISLAND			X				
KATERS ISLAND						X	
KOOLAN ISLAND	X					X	

	Dasyurus hallucatus Northern Quoll	Acanthophis praelongus Northern death adder	Pseudechis australis King Brown	Varanus acanthurus Ridge-tailed monitor	Varanus glauerti Kimberly Rocl Monitor	Varanus glebopalma Black-palmed monitor	Varanus gouldii Gould's goanna
LACHLAN ISLAND				X		X	
LONG ISLAND			X		X		
MIDDLE OSBORNE ISLAND					X		
PASCO ISLAND					X		
PURRUNGUNGKU ISLAND	X						
SAINT ANDREW ISLAND					X		
SIR FREDERICK ISLAND	X				X		
SIR GRAHAM MOORE ISLAND			X	X	X		
SOUTH WEST OSBORNE ISLAND					X	X	
SUNDAY ISLAND			X		X		
UWINS ISLAND	X				X		
WOLLASTON ISLAND	X						

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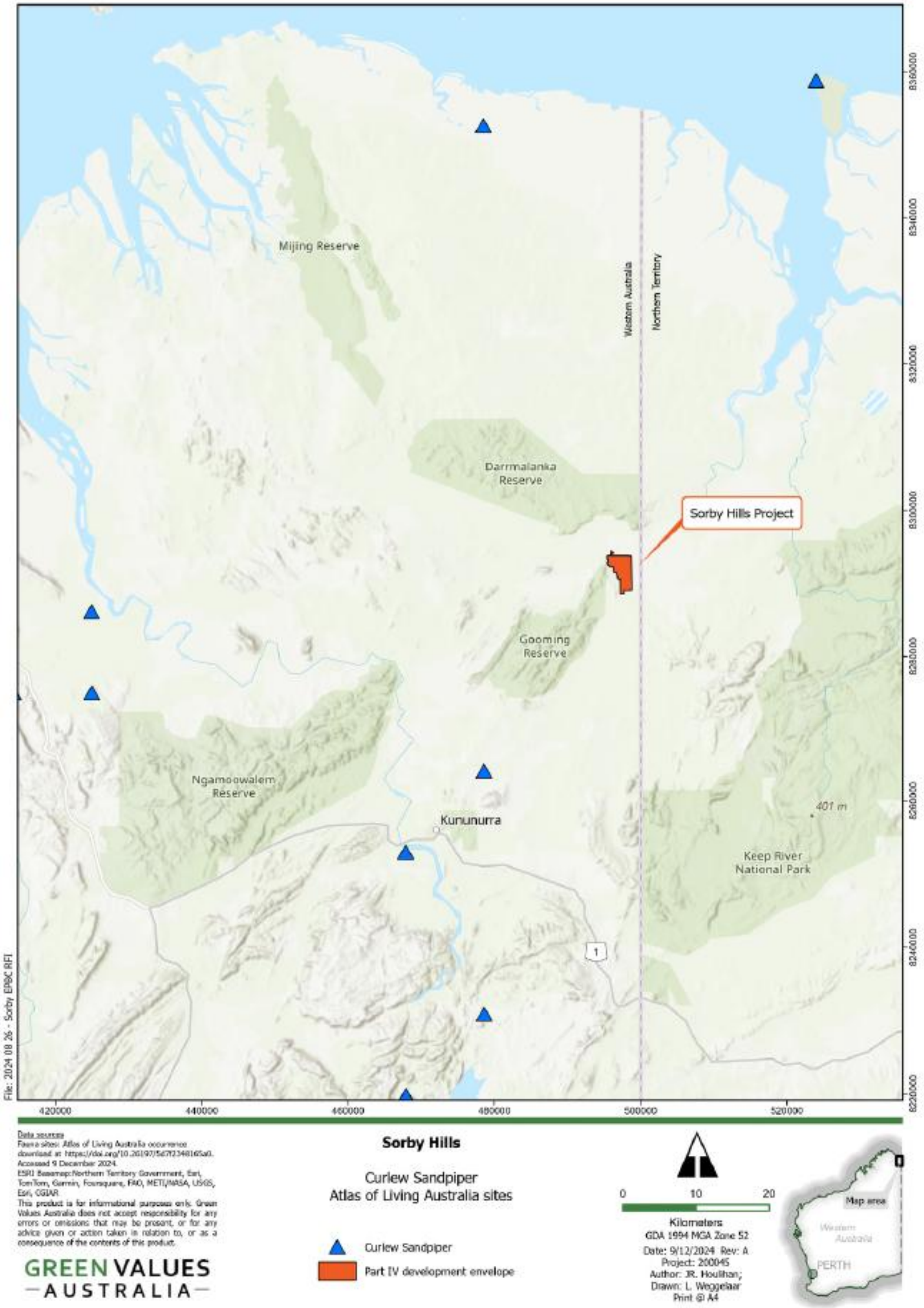
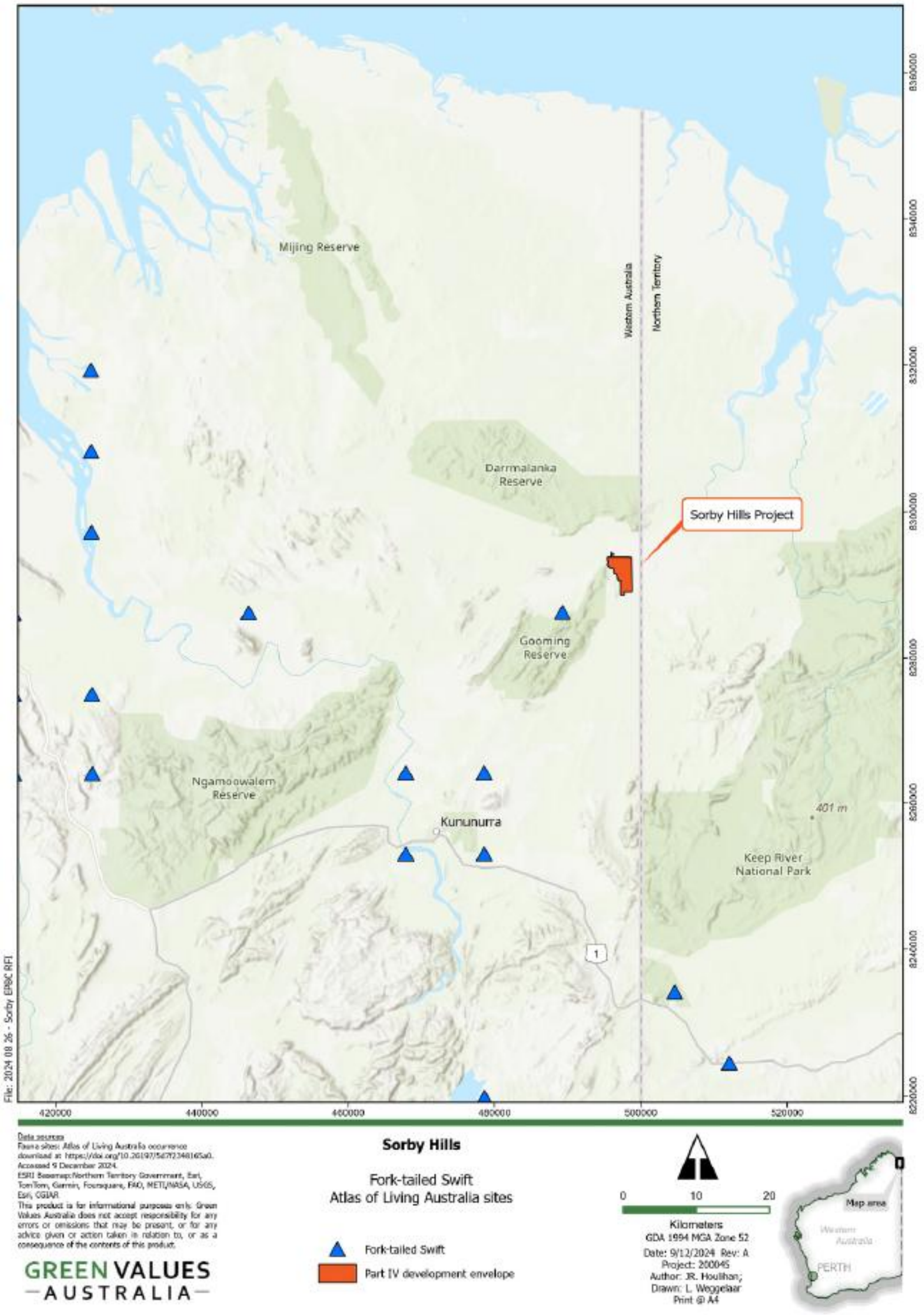
APPENDIX 2. ATLAS OF LIVING AUSTRALIA – RECORDS OF SIGNIFICANT FAUNA

Species	Common Name	Nearest record to Project development envelope (km)	Figure Reference
Dasyurus hallucatus	Northern Quoll	73	G
Apus pacificus	Fork-tailed Swift	8	C
Motacilla tschutschensis	Eastern Yellow Wagtail	8	L
Chloebia gouldiae	Gouldian Finch	8	E
Erythrotriorchis radiatus	Red Goshawk	49	I
Rostratula australis	Australian Painted Snipe	30	H
Macroderma gigas	Ghost Bat	18	D
Saccolaimus saccolaimus	Bare-rumped Sheath-tailed Bat	345	J
Falcunculus whitei	Northern Crested Shrike-tit	162	K
Falco hypoleucos	Grey Falcon	23	F
Numenius madagascariensis	Eastern Curlew	30	B
Calidris ferruginea	Curlew Sandpiper	30	A

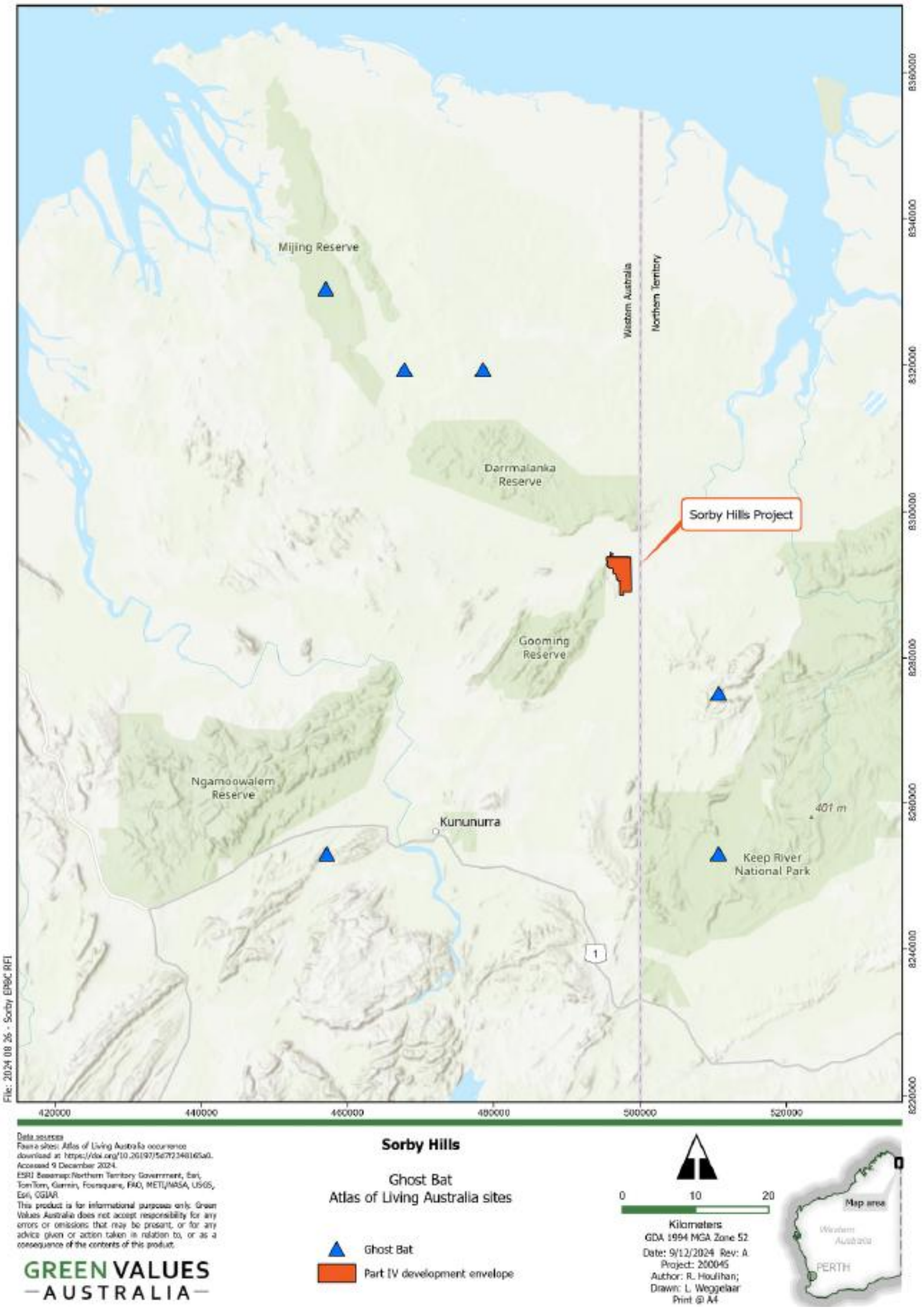


Appendix Figure A: Atlas of Living Australia records of the Curlew Sandpiper in relation to the Sorby Hills Project

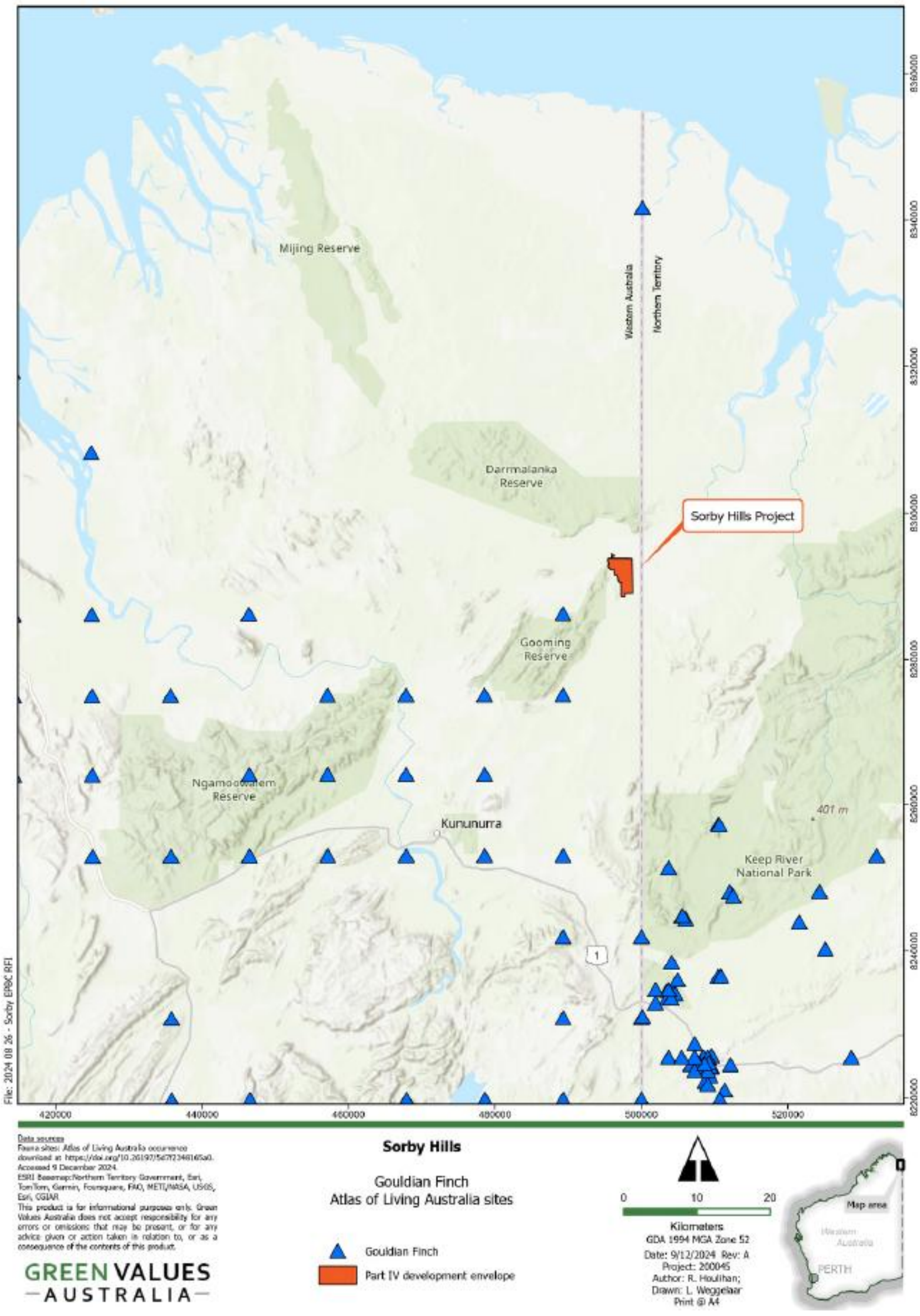
Appendix Figure B: Atlas of Living Australia records of the Eastern Curlew in relation to the Sorby Hills Project



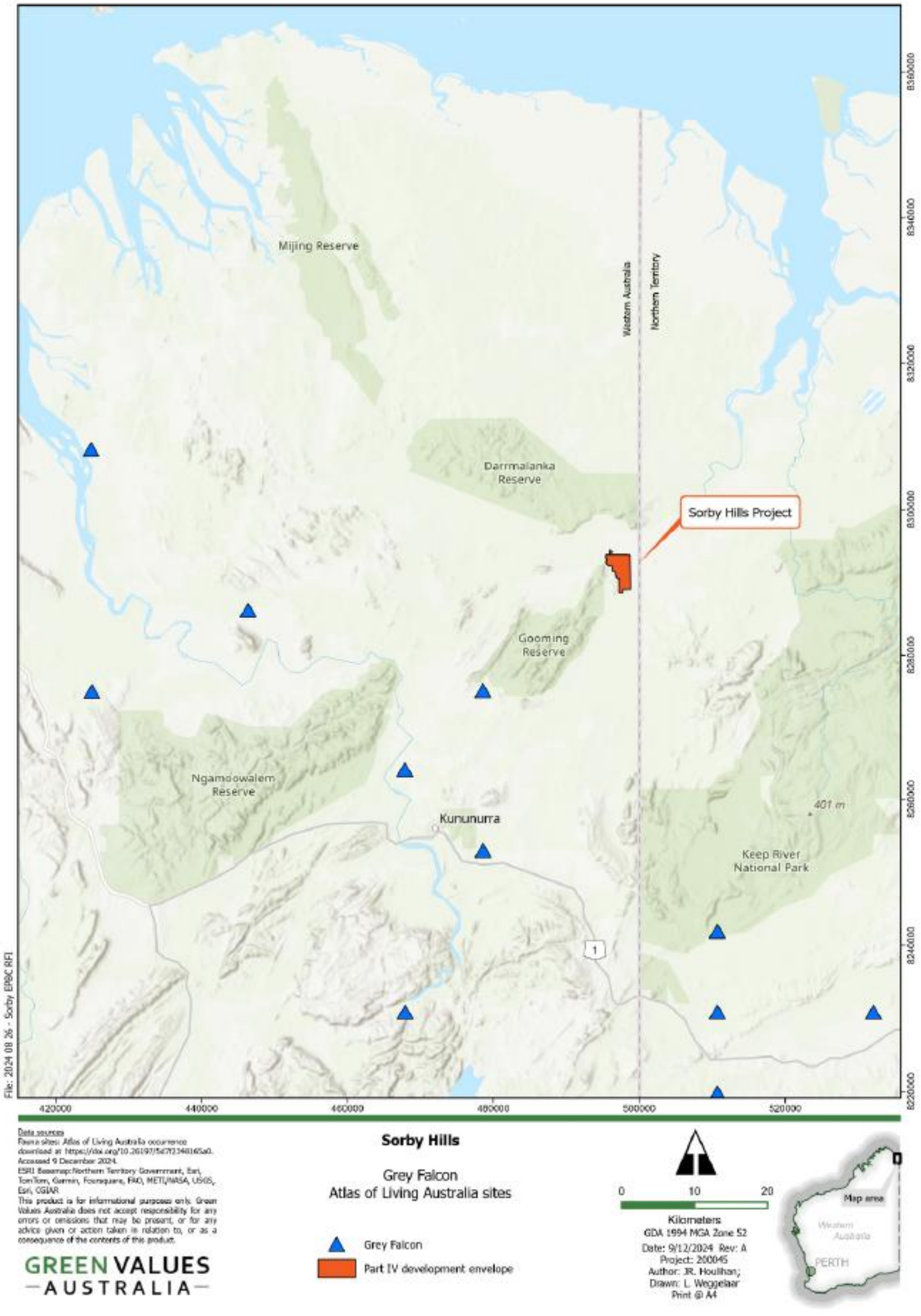
Appendix Figure C: Atlas of Living Australia records of the Fork-tailed Swift in relation to the Sorby Hills Project



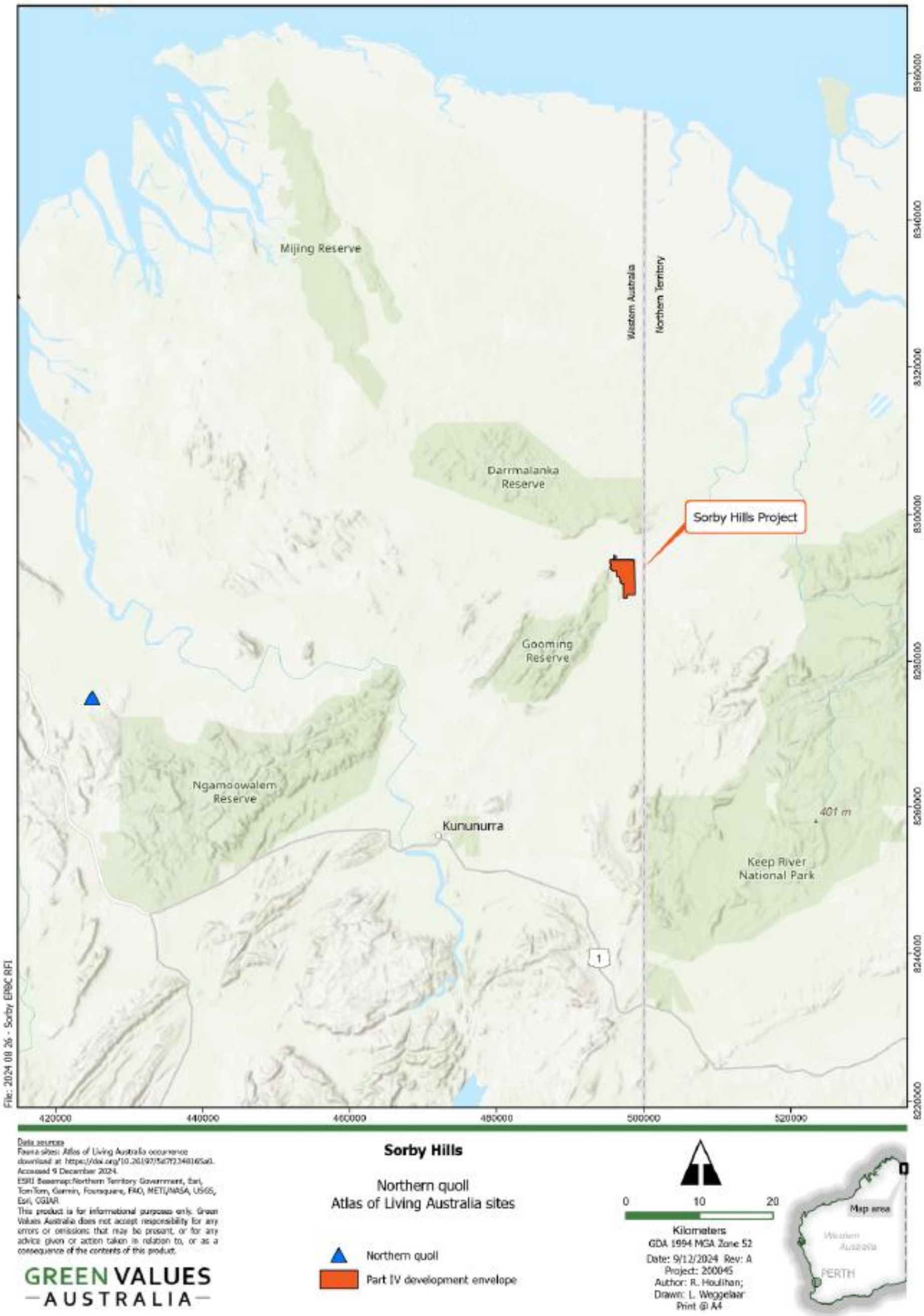
Appendix Figure D: Atlas of Living Australia records of the Ghost Bat in relation to the Sorby Hills Project



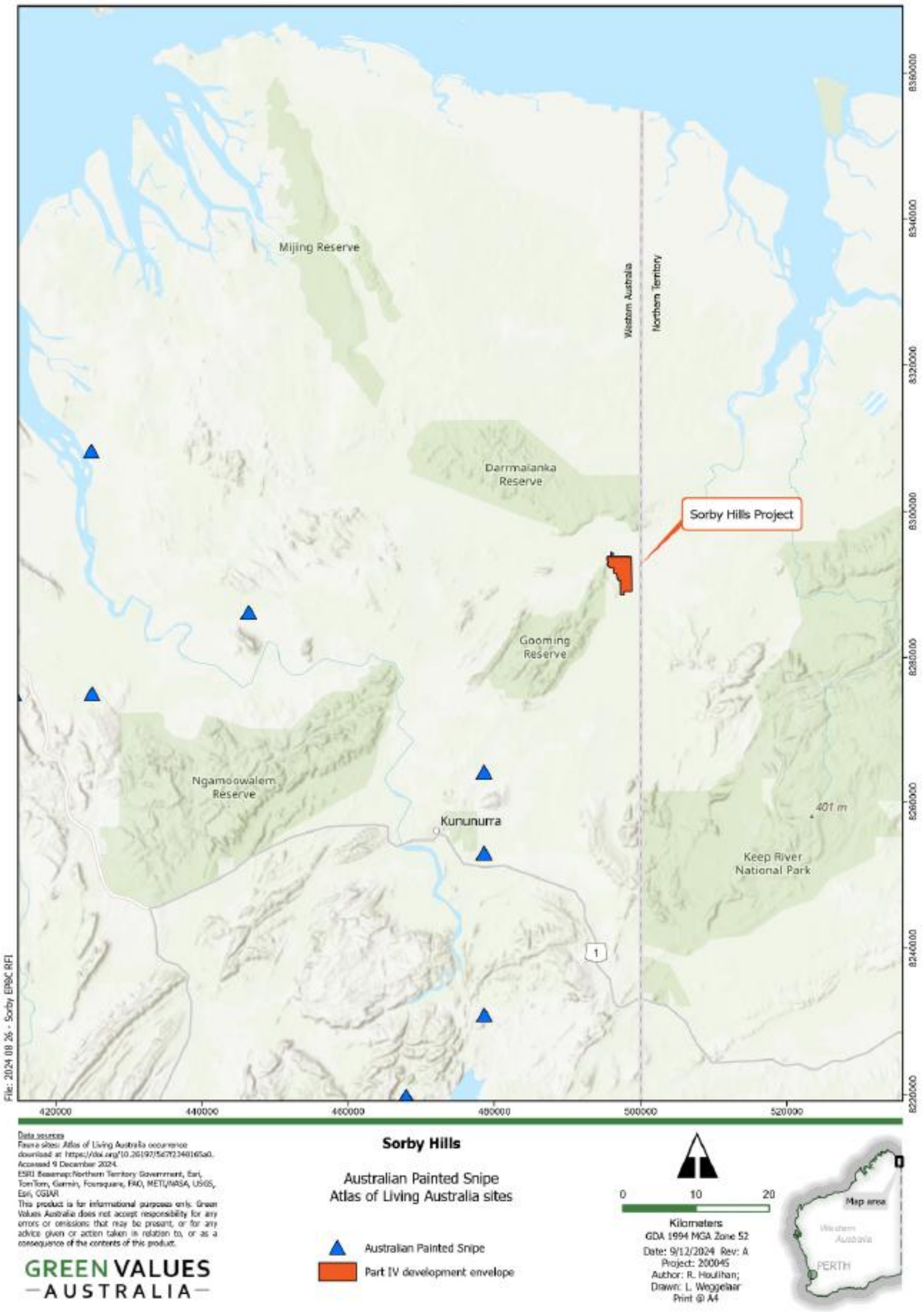
Appendix Figure E: Atlas of Living Australia records of the Gouldian Finch in relation to the Sorby Hills Project



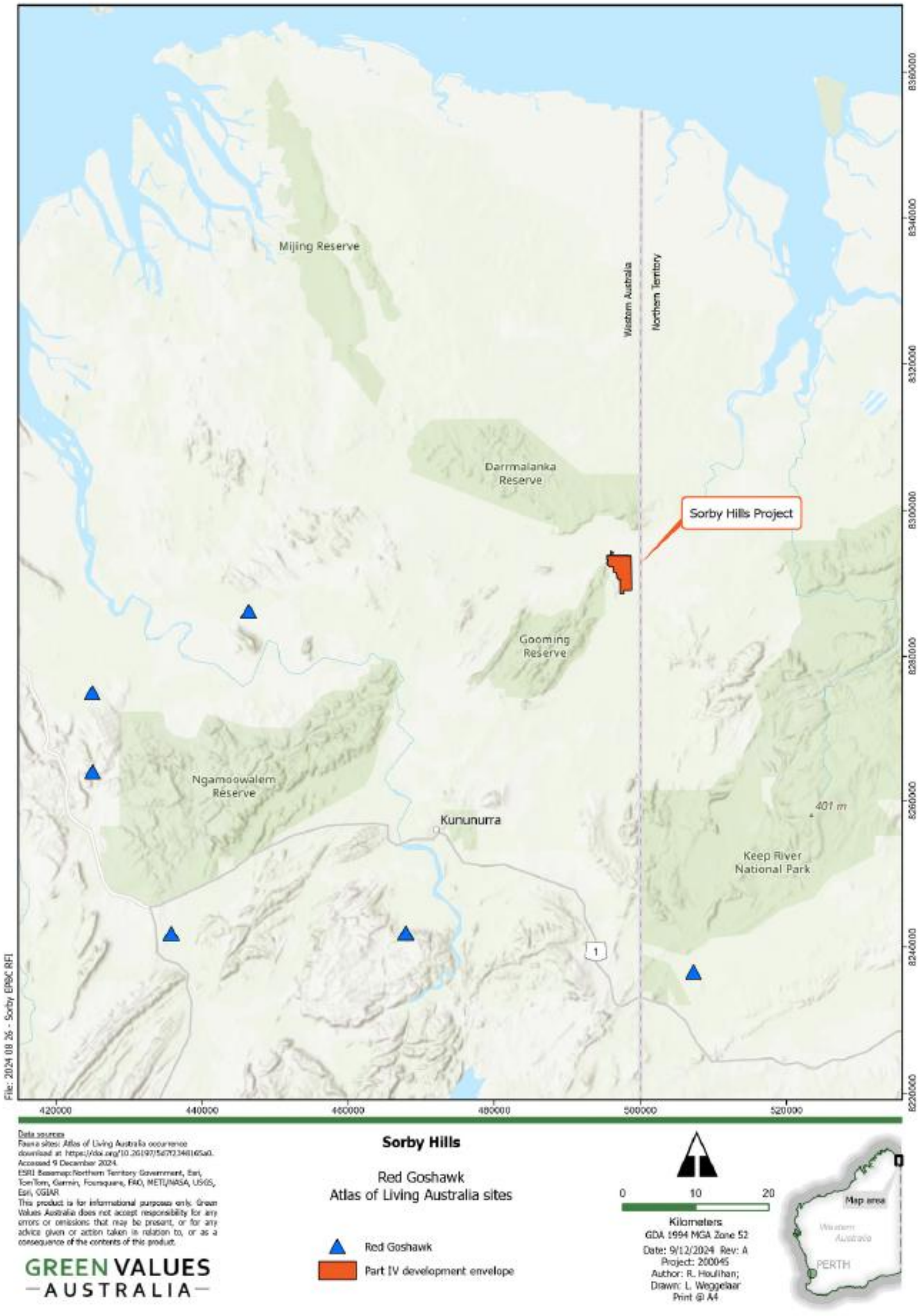
Appendix Figure F: Atlas of Living Australia records of the Grey Falcon in relation to the Sorby Hills Project



Appendix Figure G: Atlas of Living Australia records of the Northern Quoll in relation to the Sorby Hills Project



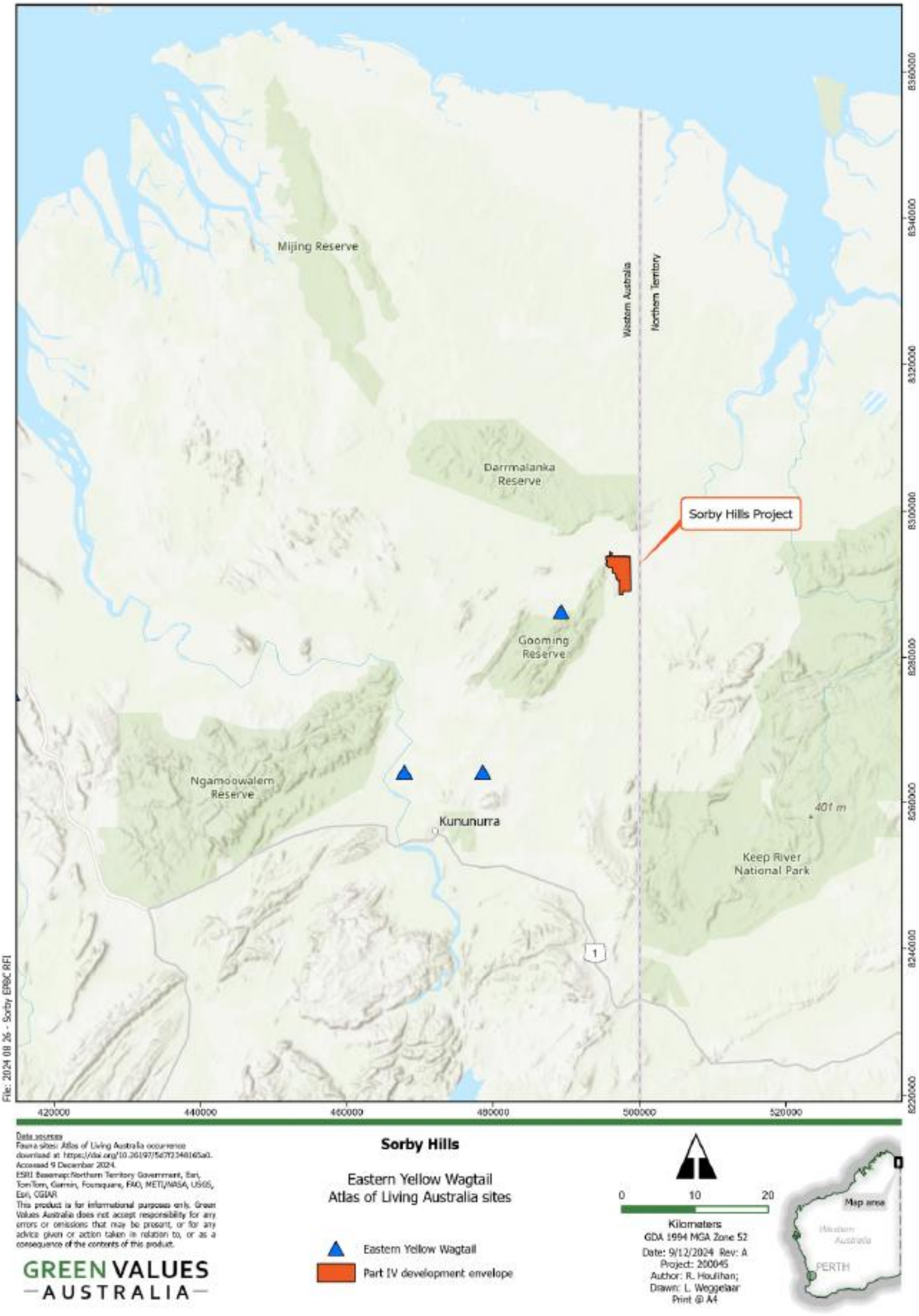
Appendix Figure H: Atlas of Living Australia records of the Australian Painted Snipe in relation to the Sorby Hills Project



Appendix Figure I: Atlas of Living Australia records of the Red Goshawk in relation to the Sorby Hills Project

Appendix Figure J: Atlas of Living Australia records of the Sheath-tailed Bat in relation to the Sorby Hills Project

Appendix Figure K: Atlas of Living Australia records of the Northern Crested Shrike-tit in relation to the Sorby Hills Project



Appendix Figure L: Atlas of Living Australia records of the Yellow Wagtail in relation to the Sorby Hills Project

APPENDIX 3. OFFSET CALCULATIONS

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Gouldian Finch
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Gouldian Finch Foraging Habitat	**Area**	16.1	Hectares	
			Quality	**7**	Scale 0-10	
			Total quantum of impact	11.27	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset** **Future area without offset (adjusted hectares)**		**Risk of loss (%) with offset** **Future area with offset (adjusted hectares)**									
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	11.27	Adjusted hectares	Fire management, weed management, destocking	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	175	**Risk of loss (%) without offset** **Future area without offset (adjusted hectares)**	0% 175.0	**Risk of loss (%) with offset** **Future area with offset (adjusted hectares)**	0% 175.0	0.00	0%	0.00	0.00 12.43	110.26%	Yes		
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**7**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	80%	0.80	0.71				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	11.27	12.43	110.26%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Shrike tit
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Northern Crested Shrike tit	**Area**	12.5	Hectares	
			Quality	**2**	Scale 0-10	
			Total quantum of impact	2.50	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	2.50	Adjusted hectares	Fire management, weed management	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	22	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	0.00	60%	0.00	0.00	2.59	103.51%	Yes	
									Future area without offset (adjusted hectares)	22.0	**Future area with offset (adjusted hectares)**	22.0								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**2**	**Future quality without offset (scale of 0-10)**	**1**	**Future quality with offset (scale of 0-10)**	**3**	2.00	60%	1.20	1.18				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Painted snipe
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Australian painted snipe	**Area**	562.4	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	224.96	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	224.96	Adjusted hectares	Destocking, fire management, weed management, feral animal control	**Time over which loss is averted (max. 20 years)**	10	**Start area (hectares)**	2000	**Risk of loss (%) without offset**	0%	**Risk of loss (%) with offset**	0%	0.00	60%	0.00	0.00	213.01	94.69%	Yes	
									Future area without offset (adjusted hectares)	2000.0	**Future area with offset (adjusted hectares)**	2000.0								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**3**	**Future quality with offset (scale of 0-10)**	**5**	2.00	60%	1.20	1.07				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

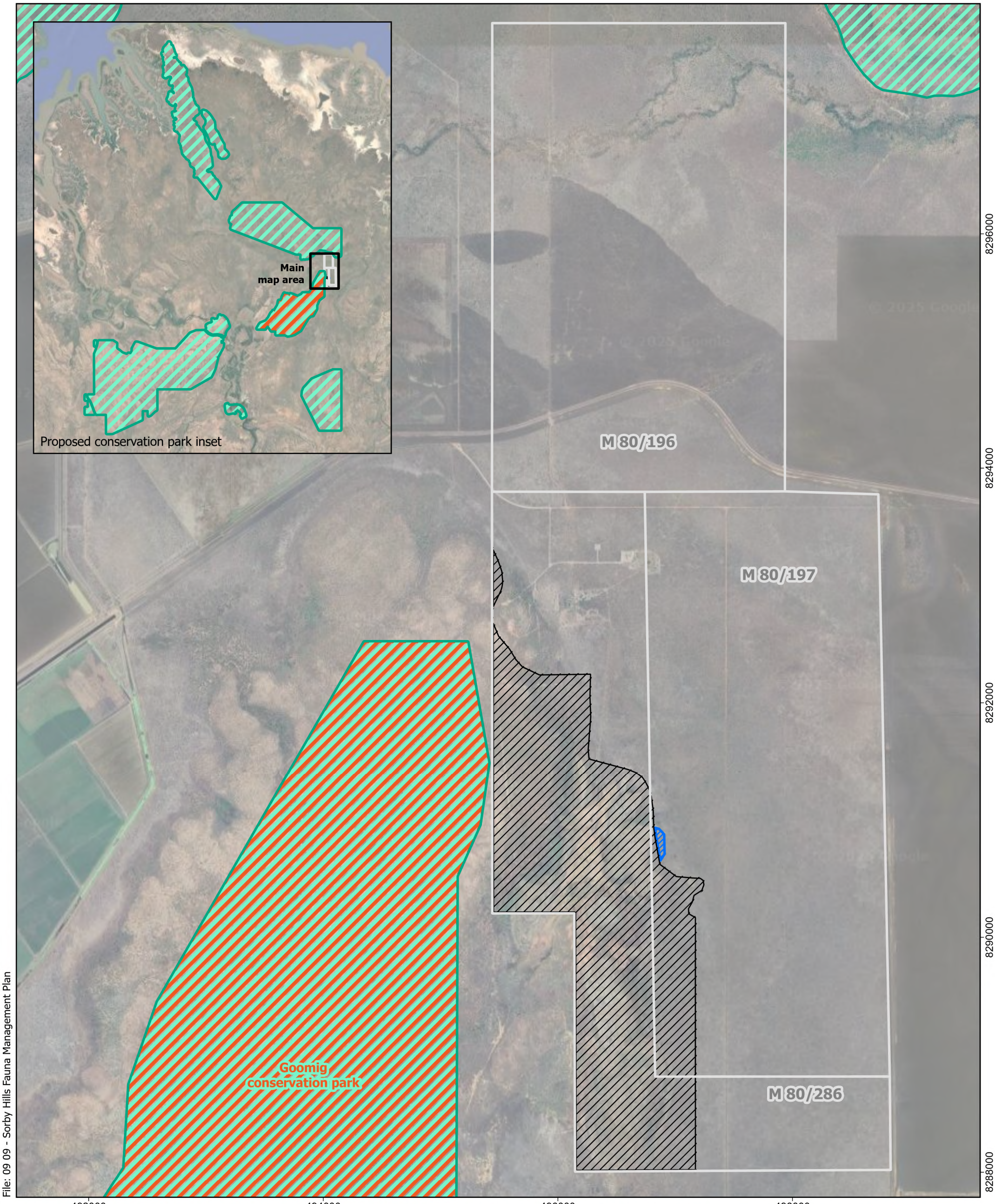
Summary

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	224.96	213.01	94.69%	**Yes**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

APPENDIX 4. SPATIAL DATASETS

[Note: Placeholder for electronic dataset, however data represented in the following pages for context]



File: 09 09 - Sorby Hills Fauna Management Plan

Data sources
Tenements: DMIRS Data and Software Centre
File notation areas: DMIRS Data and Software Centre, Jan. 2025
ESRI Basemap: Google Earth. © OpenStreetMap (and) contributors, CC-BY-SA

GREEN VALUES AUSTRALIA

Sorby Hills

Proposed biodiversity offset areas

- Goomig conservation park
- Proposed Regional Conservation Park
- Tenement
- Quoll habitat exclusion area
- Exclusion zone

0 0.5 1
Kilometres
GDA 1994 MGA Zone 52

Date: 9/09/2025 Rev: A
Project: 200045
Author: L. Chandler;
Drawn: L. Weggelaar
Print @ A3